Flood Risk Review
Meeting Minutes

FEMA Region X
Contract No. HSFEHQ-09-D-0370
Task No. RX FV13-00001
Ketchikan Gateway Borough, Alaska

Prepared for:
FEMA Region X
Bothell, Washington

August 2016

Community Name:	Ketchikan Gateway Borough and Incorporated Areas
Meeting Date:	08/042016
Meeting Time:	9:00 AM Alaska Time
Meeting Location:	Ketchikan Gateway Borough Conference Room C 199 First Avenue Ketchikan, Alaska
Attendees:	**Ketchikan Gateway Borough** Richard Harney, Principal Planner Sara Fouse, Planning/Zoning Clerk **Village of Saxman** Lee Wallace President **State of Alaska** Sally Cox, State of Alaska Risk MAP Coordinator **FEMA** Ted Perkins, Regional Engineer, FEMA Region X Amanda Siok, Risk Analyst, FEMA Region X Karen Wood-McGuiness, NFIP Specialist **STARR** Tiffany Coleman, Project Manager, STARR Ali Marjani, Coastal Engineer, STARR Ginger Evans, Senior GIS Analyst, STARR

Meeting Notes:

1. Meeting Introduction
    - The purpose of the meeting is provide a preview of the Ketchikan Gateway Borough flood maps. There may be changes when the maps are released as preliminary.

2. Presentation Part 1 – Ted Perkins with FEMA gave an overview of Risk MAP & Regulatory and Non-Regulatory Products. He also described the vertical datum shift, the work map symbology, the floodplain and floodway, and key dates in the Ketchikan mapping process.
    - The effective maps are referenced to Mean Lower Low Water (MLLW). The updated map for Ketchikan Gateway Borough are in the National Vertical Datum of 1988 (NAVD 88). To convert elevations in MLLW to NAVD 88 subtract 3.7 feet.
    - Currently the coastal area in Ketchikan is being regulated to 22 feet MLLW. This converts to 18.3 feet in NAVD88. Richard Harney had computed a different conversion

on the Alaska DGGS website. It was determined that the elevations had to be entered as meters and converted to feet. When this was done, the website produced a number that matched the information presented by Ted. Ted Perkins stated that he would follow up with others at FEMA to determine if the conversion should be constant or vary within the study limits.

3. Presentation Part 2 – Tiffany Coleman with STARR gave an overview of the study scope and the riverine hydraulic analysis.
    - The scope of work included LiDAR collection, field survey, hydrology and hydraulic analysis for three riverine streams, redelineation of Carlanna Creek, coastal analysis of the Tongass Narrows coast line, and development of Risk MAP Products.
    - Preliminary maps are only being developed for areas on Revillagigedo Island. Coastal flood hazard and elevations that were determined for other islands can be used as the best available data. Richard Harney noted that the community prefers this approach.
    - The three riverine streams that were restudied were Ketchikan Creek, Hoadley Creek, and Shoenbar Creek.
    - Richard Harney mentioned that Ketchikan Gateway Borough had requested that the USACE Whipple Creek study be included. Tiffany Coleman noted that it was not included and asked for a copy of the study to review. Ted Perkins noted that may still be incorporated at this point in the map update process.
    - Hydrology for Hoadley, Ketchikan, and Shoenbar Creek was performed using updated regression equations released in 2003. A rain-fall runoff model for Ketchikan Lakes was incorporated into the study for Ketchikan Creek.
    - Flows increases were noted for Hoadley and Shoenbar Creek due to updates in the regression equations. The Base Flood Elevations (BFEs) in the draft study are higher than the effective for Hoadley and Shoenbar Creek. Ketchikan Creek has both increases and decreases in the BFEs of the draft study compared to the effective study.

4. Presentation Part 3- Ali Marjani with STARR described the coastal modeling used to generate the elevations and flood zones along the Tongass Narrows.
    - The coastal study reflects updates to study methodology that were developed for the Pacific Northwest coastline in 2004-2005.
    - The new approach uses measured wind data and a 2-Dimensinal Modeling approach.
    - The coastal analysis included model runs for 106 storm events based on 43 years of record.
    - Ali described how the Total Water Level is a combination of the Still Water Elevation, wave set-up and wave-run up. The wave run-up is higher on steep slopes than it is on mild-slope areas.
    - 36 coastal transects were selected initially and 12 transects were used in the draft mapping. The total water level at each transect was rounded to the nearest foot.
    - Ali described the coastal mapping zones included in the draft maps. The areas with 3 ft.

waves are designated as VE and other areas are AE. Ted Perkins noted the scientific data has a shown that a 3-ft breaking wave has enough energy to break a slab on grade structure from its foundation.

5. Presentation Part 4- Amanda Siok with FEMA described the Risk MAP products that were developed.

   - The non-regulatory products were developed as a way to identify and reduce risk. These products include Changes Since Last FIRM (CSLF), depth grids, BFE+1, 2, 3 for coastal areas, and multi-hazard risk assessments.

   1. The Changes Since Last FIRM (CSLF) dataset compares the effective mapping to the draft mapping and shows increases and decreases. This data can be intersected with parcel data to identify properties affected by floodplain changes.
   2. Richard Harney stated that the parcel data has already been provided to STARR. Tiffany Coleman with STARR will confirm that Eric Coughlin has received parcel data from Ketchikan Gateway Borough.

   - The BFE+1, +2, +3 grids show the coastal floodplain with 1, 2, or 3 feet added to the computed elevation. Ted Perkins indicated that this data could be used to provide more confidence in locating key facilities outside of the floodplain since there is uncertainty. This is not meant to indicate a prediction of sea level rise.
   - Data for different hazards within the study area was discussed. Amanda Siok requested that Ketchikan Gateway Borough provide information on any dam breach studies that have been performed. Amanda noted the information related to dam breach studies is sensitive.
   - Richard Harney inquired on whether rock slide is included in landslide. Amanda noted that it is included.
   - Richard Harney and Lee Wallace stated that they do not have data on wildfire risk areas.
   - Lee Wallace mentioned concern about how earthquake/landslide/tsunami could affect the hospital. Amanda noted that the computed tsunami height is only 1 meter based on a distance source but could be higher based on a tsunami generated from a local event.
   - Richard Harney would like to include LEPC in the Resilience Meeting.
   - Lee Wallace mentioned that tsunami maps show where to evacuate.
   - The non-regulatory products will be submitted in a flood risk database/multi-hazard risk database. The Risk Report will include an analysis of the hazard mitigation plan.
   - Richard Harney inquired about whether the non-regulatory analysis could be updated in 3 to 5 years. Ted Perkins stated that FEMA will continue to be available to provide information. Amanda Siok added that FEMA can allot Ketchikan funds as a CTP to run hazus and update the risk assessment.

6. Presentation Part 5 – Discussion of Future Work and Open House Meeting
   - The schedule of the preliminary map release was discussed. The preliminary map

release could be in December 2016. A delay in schedule could occur due to review of the Whipple Creek study and possible incorporation in to the mapping updates.

- The schedule of the Open House meeting was discussed. Richard Harney noted that it may be preferred to hold the Open House meeting in March/April instead of January since many of the residents travel out of town in January. Ted Perkins stated that the public meeting may be held just before the appeals period begins.
- The schedule of the Resilience Meeting was discussed. Richard Harney stated the December would be good. Amanda Siok explained that it could be held anytime as convenient for the community.
- Updates to the ordinances were discussed. Karen Wood-McGuiness explained that she can review the ordinance and is available to answer questions.
- The communities have the opportunity to comment on the draft maps and will have the opportunity to provide comments and appeal the preliminary maps. The comments should be submitted by local officials. Each community has the opportunity to provide their own comments. STARR has set up a website to make it easier for comments to be submitted. STARR provided the website in the last quarterly update and will email a link to meeting attendees to be sure the communities have access to the website.

7. Follow-up Discussion
    - Richard Harney asked if data for the 36 coastal transects is available. Ted Perkins stated that all data produced is available for the community.
    - Richard Harney asked for clarification on when a floodplain permit is required. Karen Wood-McGuiness stated that it is required when the building itself is in the floodplain.
    - Lee Wallace with the Village of Saxman is concerned with the risk from the 300,000 gallon water tank in the community. He wondered if there was any risk analysis that could be performed. Amanda Siok noted that FEMA does not analyze risk from water tank failures.
    - Ginger Evans ran a GIS showcase of the data. The first area reviewed was located in the northwest area of the Ketchikan Gateway Borough at the end of the road. Richard Harney requested that the floodplains in that area be included in the preliminary panels. STARR noted that it may be possible to add a panel in that area.
    - At the request of Lee Wallace, Ginger scrolled along the shoreline to review the coastal floodplains in Saxman.
    - Flood zones for areas outside of the coastal and riverine floodplains were discussed. STARR is currently showing these areas as unshaded Zone X. Zone D areas may need to be delineated near the streams.
8. The meeting adjourned until the afternoon meeting at 1 PM.

STARR	Meeting Minutes	Doc #: *20160804FRR_afternoon*
Title: FRR Afternoon Meeting- August 4, 2016,– Ketchikan Gateway Borough, AK		Page 1 of 3

Community Name:	Ketchikan Gateway Borough and Incorporated Areas
Meeting Date:	08/042016
Meeting Time:	1:00 PM Alaska Time
Meeting Location:	Ketchikan Gateway Borough Conference Room C 199 First Avenue Ketchikan, Alaska
Attendees:	**Ketchikan Gateway Borough** Richard Harney, Principal Planner **City of Ketchikan** Seth Brakke, Assistant Public Works Directory **Engineers and Surveyors** Scott Menzies, Scott Menzies Engineering Fred Monrean, MEA Inc John Person, Land Surveyor, R&M **State of Alaska** Sally Cox, State of Alaska Risk MAP Coordinator **FEMA** Ted Perkins, Regional Engineer, FEMA Region X Karen Wood-McGuiness, NFIP Specialist **STARR** Tiffany Coleman, Project Manager, STARR Ali Marjani, Coastal Engineer, STARR Ginger Evans, GIS Specialist, STARR

Meeting Notes:
Meeting Notes:

1. Meeting Introduction
    - The purpose of the meeting is provide a preview of the Ketchikan Gateway Borough flood maps. There may be changes when the maps are released as preliminary. The community had requested this meeting to provide information to engineers and surveyors in advance of the preliminary release.
    - Richard Harney from Ketchikan Gateway Borough had attended the morning meeting and attended portions of this meeting. Seth Brakke from the City of Ketchikan was

unable to attend the morning meeting but attended the afternoon meeting. Engineers and surveyors from the community also attended the meeting.

2. Presentation– Ted Perkins gave a shortened version of the presentation from the morning Flood Risk Review meeting.
    - The vertical datum was discussed. The effective maps are referenced to Mean Lower Low Water (MLLW). The updated map for Ketchikan Gateway Borough are in the National Vertical Datum of 1988 (NAVD 88). To convert elevations in MLLW to NAVD 88 subtract 3.7 feet.
    - A field surveyor at the meeting mentioned that he computed a vertical datum shift that was different by tenths of a foot. He stated he would submit the information he obtained.
    - Ted Perkins discussed the slides showing the scope of work briefly.
    - Ted described how the coastal study was based on improved methodology developed in 2005 by top coastal engineers in the Pacific Northwest.

3. Discussion
    - Richard Harney from the Ketchikan Gateway Borough noted there may be a need for 500 elevation certificates in the area when the maps are released. Information shared with the surveyors early on should help with planning on the effort needed to verify the structure elevations. Karen Wood-McGuiness noted that property owners have 45 days from when they receive a letter from the insurance company to provide an elevation certificate for the property.
    - Richard Harney requested information from FEMA on when the vertical datum switches from MLLW to NAVD88.
    - Karen Wood-McGuiness stated that structures can still be rated according to grandfather rules if insurance is purchases before a new map is release. She is available to discuss this process and how it affects property owners.
    - Flood damage claims in Ketchikan were discussed. It was noted that $99,000 in claims have been processed since Ketchikan entered the NFIP. Richard Harney noted that most insurance claims have been related to stormwater damage.
    - Representative from FEMA and the State of Alaska had to leave due to time limitations. Representative from STARR reviewed areas of concern that were brought up by those at the meeting.
    - The draft floodplains at the Totem Heritage Center was discussed. Seth Brakke noted that much of the building is mapped into the draft floodplain. Tiffany Coleman with STARR stated that the delineation could be reviewed. She also pointed out that it is possible the grade adjacent to the center is higher than surrounding areas. She recommended that the elevation at the Center be compared to computed water surface elevations. Ginger Evans with STARR pulled up the mapping for the area on the large

screen. Tiffany Coleman with STARR provided the 1-percent annual chance elevation at the nearest cross section to Seth. Tiffany noted that STARR can also provide the overbank velocity from the model.

- The draft floodplains at the Hospital Culvert on Hoadley Creek were discussed. Both of these areas show increases in the floodplain extents. A portion of the Hospital Emergency Room is within the 1-percent annual chance floodplain. Seth Brakke noted concerns for emergency response due to the inundation of the emergency room and possible loss of access due to overtopping of the roadway. He noted a need to replace the culvert to mitigate the flood risk.
- The draft floodplains at the Baranoff Avenue Culvert on Hoadley Creek were reviewed. Tiffany Coleman with STARR explained that the modeling showed that some of the 1-percent annual chance flood flow bypassed the culvert and crossed the road at a low area. This was modeled using multiple conveyance areas in HEC-RAS. Seth Brakke noted that he believed that flow in this manner is possible but that he expected the flow to go south along Carlanna Road instead of return to Hoadley Creek due to the height of the curb.
- Seth Brakke with the City of Ketchikan inquired on roadways that were overtopped and depths associated with those areas. Tiffany Coleman with STARR reviewed each road crossing in the HEC-RAS model along Shoenbar and Hoadley Creek. At Seth's request, STARR added the draft HEC-RAS models to the data provided to the communities but asked that the not be distributed since the data is not final. STARR also offered to provide draft flood profiles to Seth. Seth Brakke also requested a copy of the draft depth grids.
- The coastal flood zones at the Thomas Basin was discussed. Seth Brakke noted an 18 ft. NAVD88 BFE at the cruise ship breakwater. He inquired as to why this was a high velocity zone (VE). Ali noted that the computed wave height was greater than 3 feet. Seth noted that some erosion had occurred along the breakwater. He was interested in whether the port structures in that area needed to be designed for larger waves.
- Richard Harney with Ketchikan Gateway Borough noted a hard copy of the Whipple Creek study, which was mentioned during the morning meeting, would be copied and provided to STARR after the meeting.

4. The meeting adjourned at approximately 3 PM.
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Date: 8/11/2016

Attachment 1

Morning Sign-In Sheet

August 4, 2016

Ketchikan Co. Flood Risk Review Meeting (Morning)

Sign-In Sheet

RiskMAP

	Name	Title	Phone	E-Mail	Attended Meeting
1	Amanda Siok	Risk Analyst	425-487-4626	Amanda.Siok@fema.dhs.gov	A Siok
2	Ann Gravier	Hazard Mitigation Officer		ann.gravier@alaska.gov	
3	Becca Fricke-Croft	Training/Communication	425-329-3699	Becca.Croft@starr-team.com	
4	Betty Svensson	Deputy Director		betty@akml.org	
5	Braden Allen	Hazard Mitigation Specialist		Braden.Allen@fema.dhs.gov	
6	Brett Holt	Mitigation Planner	425-487-4553	Brett.Holt@fema.dhs.gov	
7	Crane Johnson	Senior Hydrologist		Benjamin.Johnson@noaa.gov	
8	David Landis	Mayor - Ketchikan Gateway Borough		davidl@kgbak.us	
9	De Anne Stevens	Geologist		Deanne.Stevens@alaska.gov	
10	Ginger Evans	GIS Specialist	859-422-3082	Ginger.Evans@stantec.com	Ginger Evans
11	Jamie Mooney	Communication Specialist	206-643-5641	Jamie.Mooney@mbakerintl.com	
12	Jeff Markham	HMA Specialist	425-487-4798	Jeffrey.Markham@fema.dhs.gov	
13	Jimmy Smith	NFIP Coordinator		jimmy.smith@alaska.gov	
14	Karen Wood-McGuiness	NFIP Specialist	425-487-4675	Karen.Wood-McGuiness@fema.dhs.gov	
15	Lee Wallace	Tribal President - Saxman		lwallace2@ccthita.org	

August 4, 2016

Ketchikan Co. Flood Risk Review Meeting (Morning)

Sign-In Sheet

RiskMAP

	Name	Title	Phone	E-Mail	Attended Meeting
16	Lew Williams	Mayor - City of Ketchikan		mayor@city.ketchikan.ak.us	
17	Marshall Rivers	Project Manager		marshall.rivers@mbakerintl.com	
18	Michael West	Seismologist		mewest@alaska.edu	
19	Nabi Allahdadi	Flood Mapping Engineer	919-851-1919	Nabi.Allahdadi@stantec.com	
20	Rachael Norris	Government Affairs		rachael.norris@fema.dhs.gov	
21	Richard Henry	Principal Planner	907 228 6634	richardh@kgbak.us	[signature]
22	Sally Cox	Alaska State RiskMAP Coordinator	907.269.4588	sally.cox@alaska.gov	[signature]
23	Seth Brakke	Assistant Public Works Director		sethb@city.ketchikan.ak.us	
24	Steve Masterman	Geologist		Steve.masterman@alaska.gov	
25	Tamra Biasco	Risk Analyst Branch Chief		Tamra.Biasco@fema.dhs.gov	
26	Ted Perkins	Regional Engineer	425-487-4684	dwight.perkins@fema.dhs.gov	[signature]
27	Tiffany Coleman	Mapping Study Manager	859-422-3024	Tiffany.Coleman@stantec.com	[signature]
28	Tom Donnelly	Recovery Specialist	425-487-4578	Thomas.Donnelly@fema.dhs.gov	
29	Wendy Shaw	USACE - Alaska		Wendy.l.shaw@usace.army.mil	
30				iragovt@kpunet.net	

	August 4, 2016 Ketchikan Co. Flood Risk Review Meeting (Morning)	Sign-In Sheet	RiskMAP

	Name	Title	Phone	E-Mail	Attended Meeting
31		Region X Service Center		RSCX@starr-team.com	
32	Ali Marjani	Coastal Eng. - STARR		ali.marjani@stantec.com	[illegible]
33	SARA FOUSE	PLATTING/ZONING CLERK		SARAF@KGBAK.US	[illegible]
34	LEE WALLACE	SALMAN/ I.R.A.		iragout@kpunet.net	[illegible]
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Attachment 2

Afternoon Sign-in Sheet

August 4, 2016

Ketchikan Co. Flood Risk Review Meeting (Afternoon)

Sign-In Sheet

RiskMAP

	Name	Title	Phone	E-Mail	Attended Meeting
1	Amanda Siok	Risk Analyst	425-487-4626	Amanda.Siok@fema.dhs.gov	
2	Ann Gravier	Hazard Mitigation Officer		ann.gravier@alaska.gov	
3	Becca Fricke-Croft	Training/Communication	425-329-3699	Becca.Croft@starr-team.com	
4	Betty Svensson	Deputy Director		betty@akml.org	
5	Braden Allen	Hazard Mitigation Specialist		Braden.Allen@fema.dhs.gov	
6	Brett Holt	Mitigation Planner	425-487-4553	Brett.Holt@fema.dhs.gov	
7	Crane Johnson	Senior Hydrologist		Benjamin.Johnson@noaa.gov	
8	David Landis	Mayor - Ketchikan Gateway Borough		davidl@kgbak.us	
9	De Anne Stevens	Geologist		Deanne.Stevens@alaska.gov	
10	Ginger Evans	GIS Specialist	859-422-3082	Ginger.Evans@stantec.com	Ginger Evans
11	Jamie Mooney	Communication Specialist	206-643-5641	Jamie.Mooney@mbakerintl.com	
12	Jeff Markham	HMA Specialist	425-487-4798	Jeffrey.Markham@fema.dhs.gov	
13	Jimmy Smith	NFIP Coordinator		jimmy.smith@alaska.gov	
14	Karen Wood-McGuiness	NFIP Specialist	425-487-4675	Karen.Wood-McGuiness@fema.dhs.gov	Karen Wood-McGuiness
15	Lee Wallace	Tribal President - Saxman		lwallace2@ccthita.org	

August 4, 2016

Ketchikan Co. Flood Risk Review Meeting (Afternoon)

Sign-In Sheet

RiskMAP

	Name	Title	Phone	E-Mail	Attended Meeting
16	Lew Williams	Mayor - City of Ketchikan		mayor@city.ketchikan.ak.us	
17	Marshall Rivers	Project Manager		marshall.rivers@mbakerintl.com	
18	Michael West	Seismologist		mewest@alaska.edu	
19	Nabi Allahdadi	Flood Mapping Engineer	919-851-1919	Nabi.Allahdadi@stantec.com	
20	Rachael Norris	Government Affairs		rachael.norris@fema.dhs.gov	
21	Richard Henry	Principal Planner		richardh@kgbak.us	
22	Sally Cox	State of Alaska Risk MAP Coordinator		sally.cox@alaska.gov	[illegible]
23	Seth Brakke	Assistant Public Works Director		sethb@city.ketchikan.ak.us	
24	Steve Masterman	Geologist		Steve.masterman@alaska.gov	
25	Tamra Biasco	Risk Analyst Branch Chief		Tamra.Biasco@fema.dhs.gov	
26	Ted Perkins	Regional Engineer	425-487-4684	dwight.perkins@fema.dhs.gov	[illegible]
27	Tiffany Coleman	Mapping Study Manager	859-422-3024	Tiffany.Coleman@stantec.com	[illegible]
28	Tom Donnelly	Recovery Specialist	425-487-4578	Thomas.Donnelly@fema.dhs.gov	
29	Wendy Shaw	USACE - Alaska		Wendy.l.shaw@usace.army.mil	
30				iragovt@kpunet.net	

August 4, 2016

Ketchikan Co. Flood Risk Review Meeting (Afternoon)

Sign-In Sheet

RiskMAP

	Name	Title	Phone	E-Mail	Attended Meeting
31		Region X Service Center		RSCX@starr-team.com	
32	Scot Menzies	Menzies Engineering	907-220-9424	scot@megalaska.com	yes
33	Seth Brakke	Asst. Public Works Director City of Ketchikan	228-4725	sethb@city.ketchikan.ak.us	yes
34	Fred Monrean	MEA Inc	247-5920	fmonrean@kpunet.net	"
35	John Pearson	Land Surveyor R&M	225-7917 ext. 102	johnpearson@rmketchikan.com	✓
36	Ali Marjani	Coastal Eng. STARR		ali.marjani@stantec.com	Ali Marjani
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Attachment 3

PowerPoint Presentation

KETCHIKAN GATEWAY BOROUGH, AK
Flood Risk Review Meeting

August 4, 2016

FEMA

Agenda

Flood Risk Review

- Background
- Flood Study Methodologies
- Risk Assessment Work
- RiskMAP Process
- Flood Study Process
- FEMA and State Contacts
- Review of Data/Changes from Existing Maps

RiskMAP, the NFIP and Hazard Mitigation Planning

RiskMAP
Increasing Resilience Together

Goals

Deliver High-Quality Risk Data → Increase Awareness of Flood Risk → Promote Community Mitigation Actions



Products

Deliver High-Quality Risk Data
- Intuitive Flood Maps
- Credible data- reliable, accurate, watershed-based
- Illustrations of Flood Depths
- Valuable Flood Risk Assessments

Increase Awareness of Flood Risk
- Tools to understand how flood risk has changed
- Continuous engagement with communities
- Enable communities to communicate flood risk to constituents

Promote Community Mitigation Actions

Support that allows communities to identify and risks and promote:
- Community resiliency
- Sustainability
- Reduced need for federal disaster assistance

Processes

← MITIGATION PLANNING →

Enhance delivery of Risk MAP Products

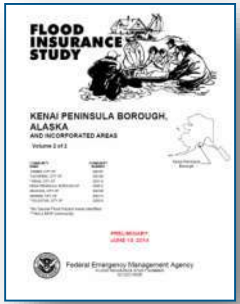
Collaborate across all levels of government

→ **Reduce Risk to Lives and Property**

Regulatory & Non-Regulatory RiskMAP Products

Regulatory Products

- **Flood Insurance Study (FIS)**



- **Flood Insurance Rate Maps (FIRM)**

Non-Regulatory Products

- **Changes Since Last FIRM**

- **Flood Depth Grids**

- **HAZUS Risk Assessment**

- **Risk Report**

- **Risk Database**

How the National Flood Insurance Program (NFIP) Works

Three disciplines of the NFIP:

- Mapping – Flood Studies
- Regulations
- Insurance

Project Team

- FEMA Region X
- State of Alaska
- FEMA Contractor -STARR
- Ketchikan Gateway Borough Alaska
- City of Ketchikan
- City of Saxman

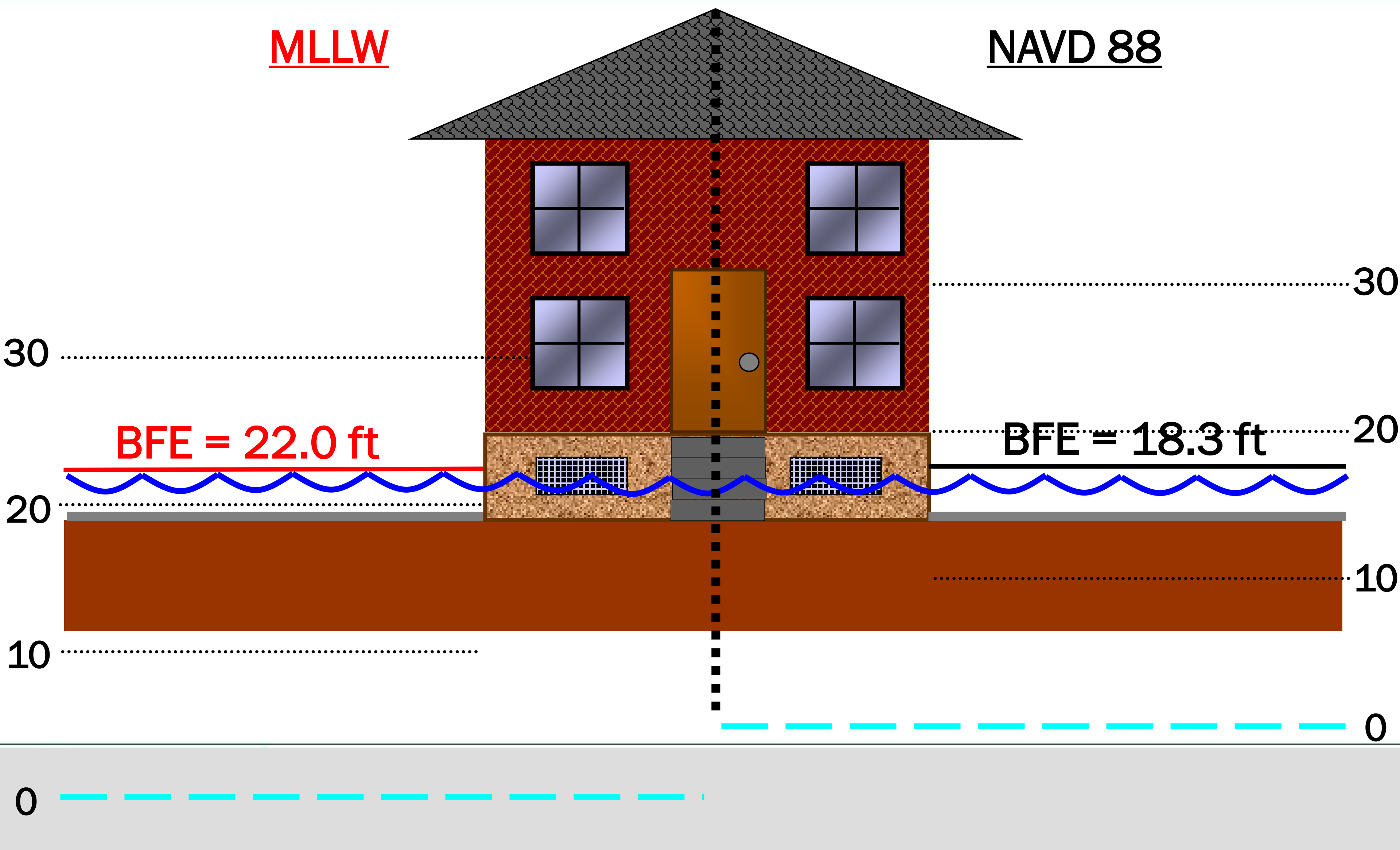
What's new

Vertical Datum Change

- **MLLW**
  - Mean Lower Low Water - The average of the lower low water height of each tidal day observed over the National Tidal Datum Epoch
- **NAVD 88**
  - Based on the density of the Earth instead of varying values of sea heights
  - More accurate
- **Conversion for Ketchikan, AK**
  - MLLW -3.7' = NAVD 88

Digital Flood Insurance Rate Maps

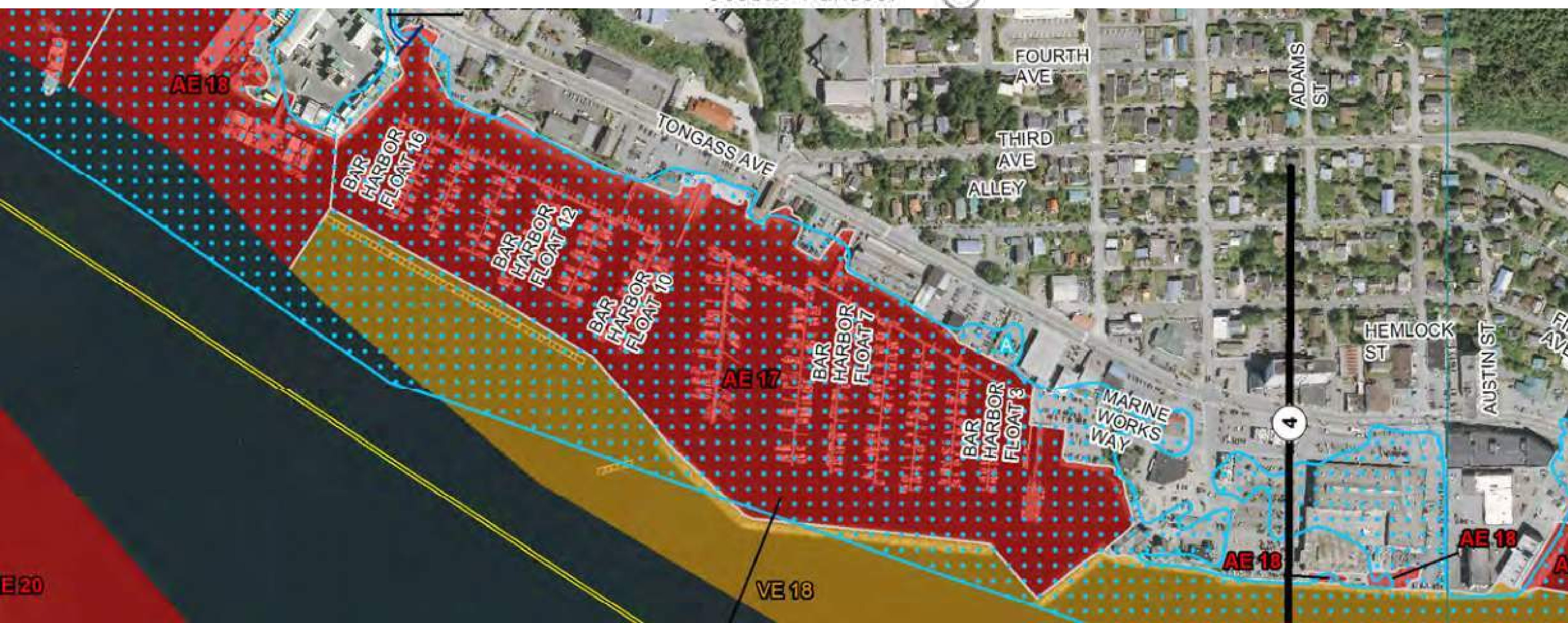
Vertical Datum and FIRMs (e.g. uses -3.7’ conversion)



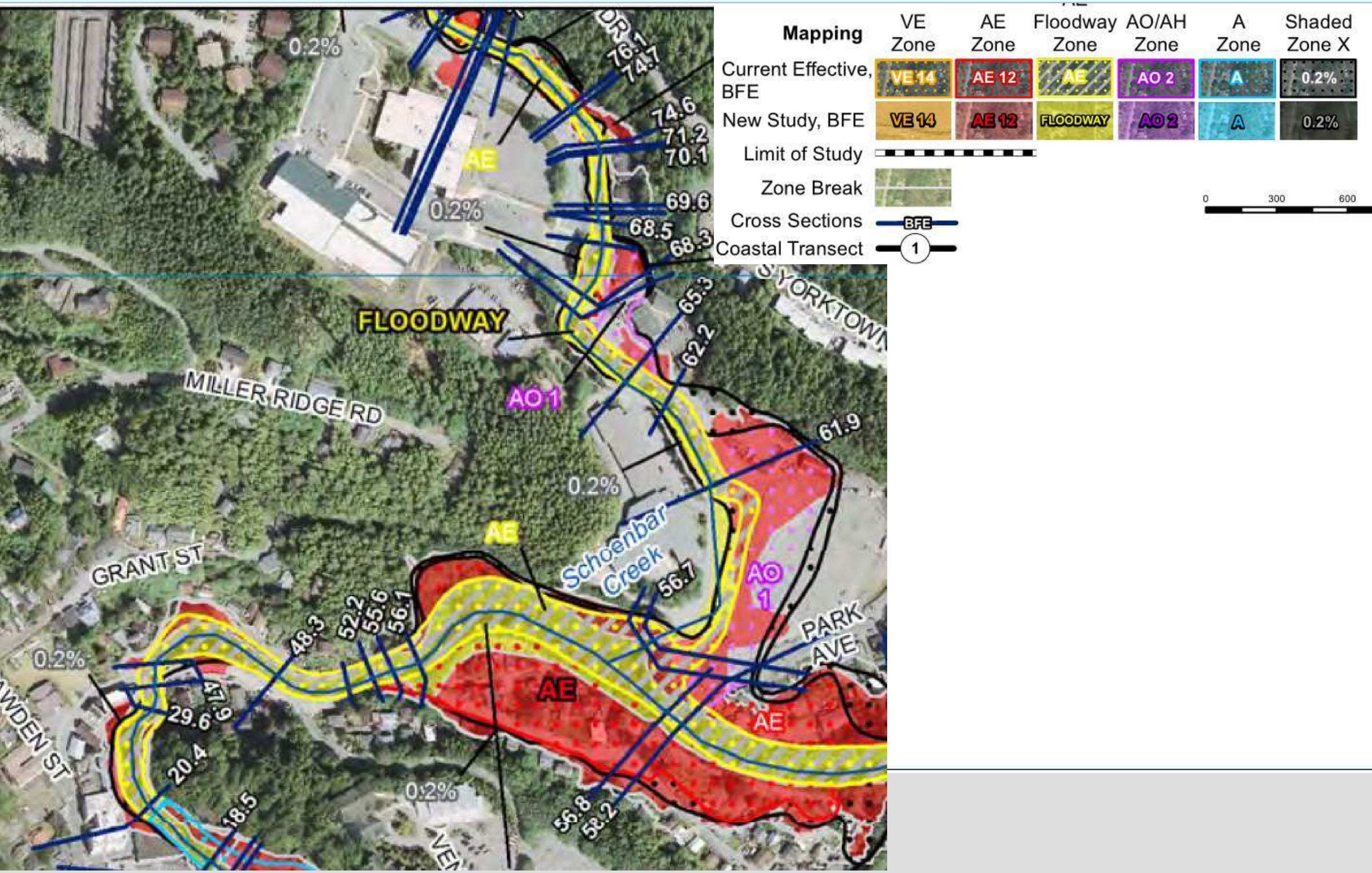
Draft Map Labeling Coastal

Mapping	VE Zone	AE Zone	Floodway Zone	AO/AH Zone	A Zone	Shaded Zone X
Current Effective, BFE	VE 14	AE 12	AE	AO 2	A	0.2%
New Study, BFE	VE 14	AE 12	FLOODWAY	AO 2	A	0.2%
Limit of Study						
Zone Break						
Cross Sections	BFE					
Coastal Transect	1					

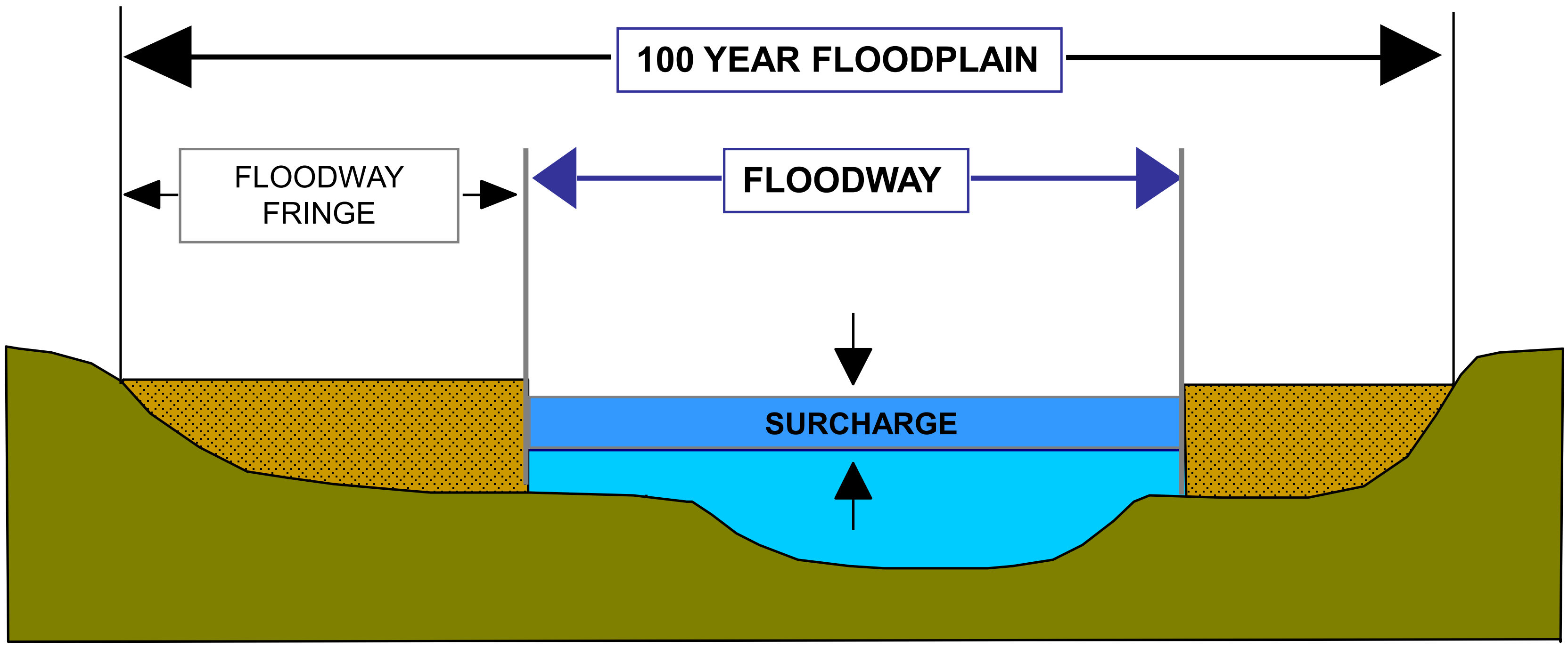
0 300 600



Draft Map Labeling
RIVERINE



Floodway Schematic



FLOODWAY + FLOODWAY FRINGE = 100 YEAR FLOODPLAIN
SURCHARGE NOT TO EXCEED 1.0 FEET

Ketchikan Mapping Process

Ketchikan Discovery Meeting – August 7, 2013

Partnership Agreement – August 12, 2014

Draft Maps Provided – March 7, 2016

Flood Risk Review– August 4, 2016

SCOPE OF WORK

- LiDAR
- Field Survey
- Coastal

  60 miles of coastal analysis (12 transects)

- Riverine

  Updated Detailed Studies (Hydrology and Hydraulics)

  0.8 miles of Hoadley Creek

  1.3 miles of Ketchikan Creek

  1.1 miles of Schoenbar Creek

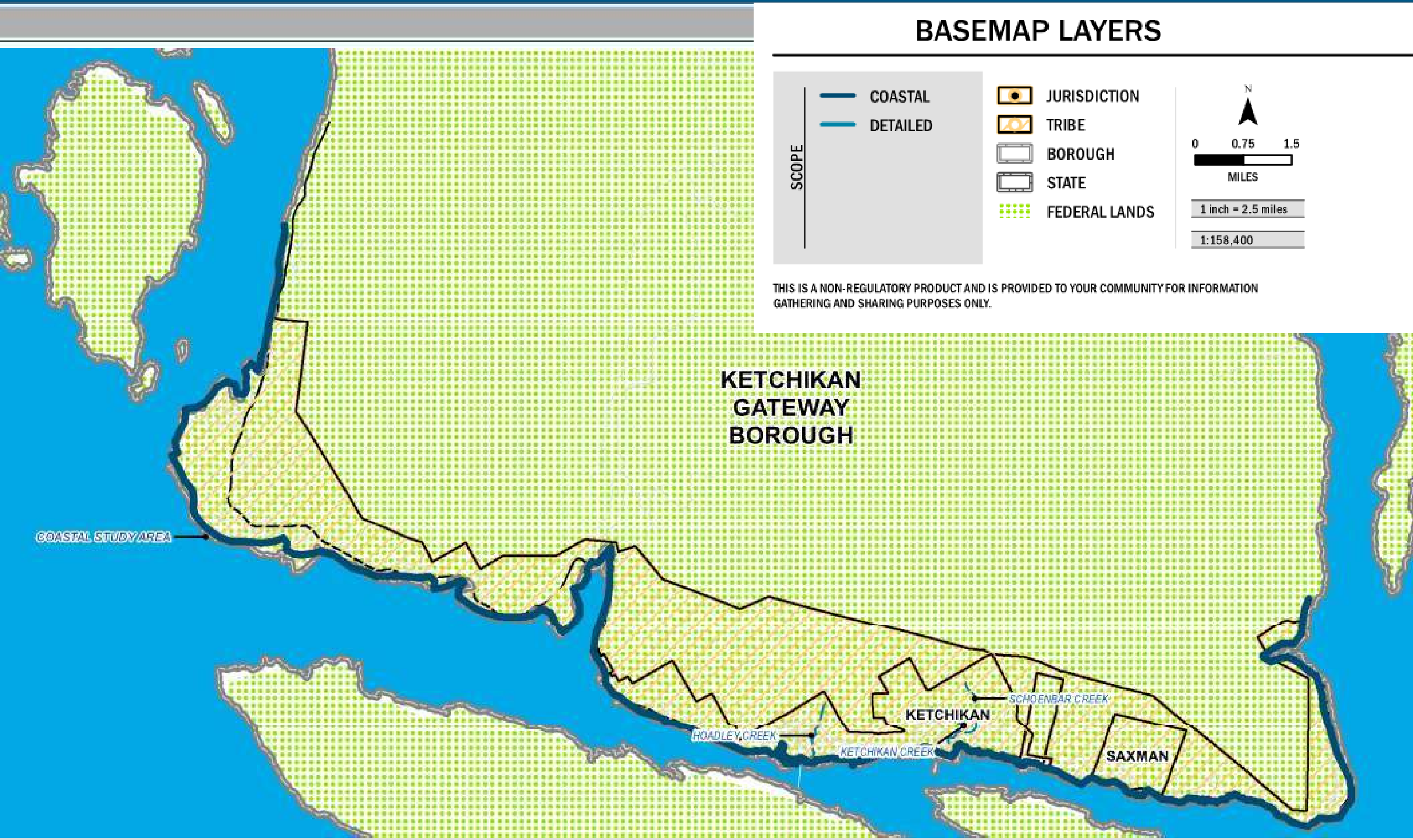
  Redelineation of Detailed Study

  0.1 miles of Carlanna Creek

- Risk MAP Products

  Depth grids, Analysis Grids, Multi-hazard Risk Assessment, CSLF, BFE+1,2,3 Risk Report, Risk Database

SCOPE OF WORK



Field Survey Collection

- Collected by Atkins in August 2014
- Structures and cross sections were surveyed on the AE study reaches of the Hoadley Creek, Ketchikan Creek, and Schoenbar Creek
- Deliverables included field survey points, sketches, and photographs

RIVERINE STUDIES - HYDROLOGY

- Rainfall-Runoff model - Ketchikan Lake Dam based on 2009 WESCORP study
- Regression calculations based on 4 inputs
- Discharges computed for 0.2%, 1%, 2%, 4%, 10%, and 1% plus annual chance events

Comparison to effective Discharge

Hoadley Creek at Mouth

Event	Proposed Discharge (cfs)	Effective Discharge (cfs)	% Change
10%	580	390	+49%
2%	760	515	+48%
1%	**820**	**570**	**+44%**
0.2%	990	690	+43%

Comparison to effective Discharge

Ketchikan Creek at Mouth

Event	Proposed Discharge (cfs)	Effective Discharge (cfs)	% Change
10%	4,460	4,200	+6%
2%	5,800	5,950	-3%
1%	**6,380**	**6,800**	**-6%**
0.2%	7,810	8,200	-4%

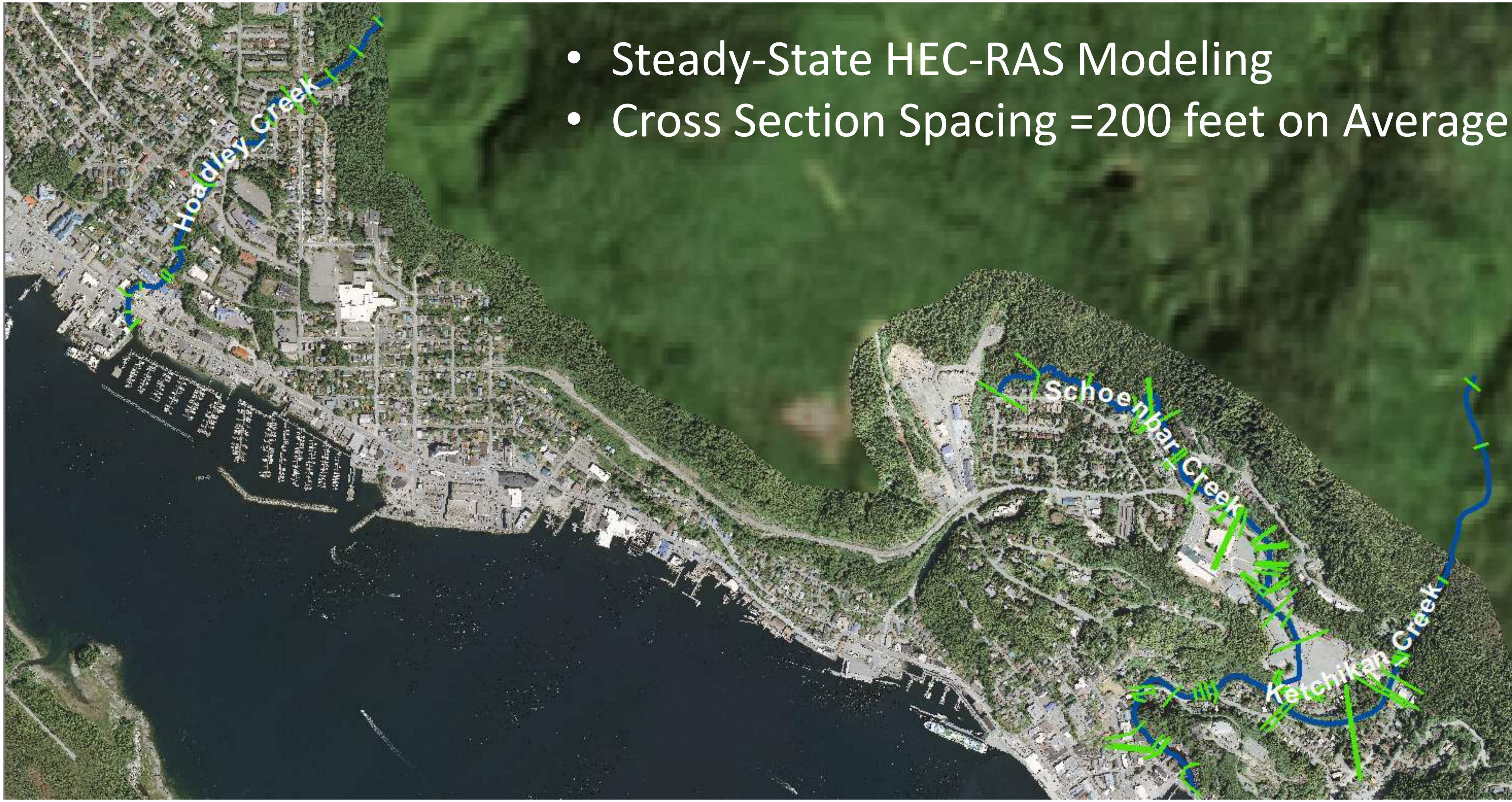
Comparison to effective Discharge

Schoenbar Creek at Mouth

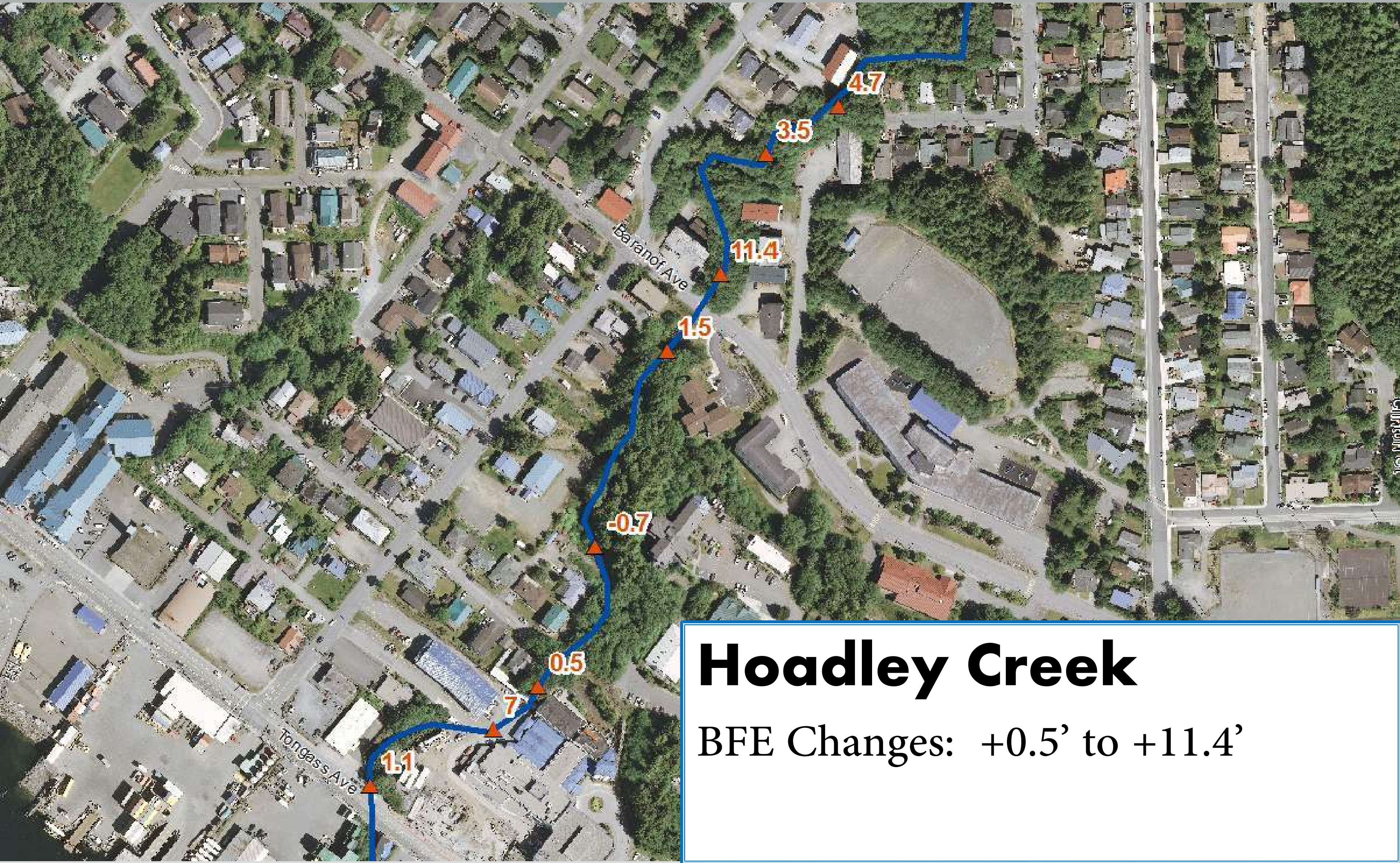
Event	Proposed Discharge (cfs)	Effective Discharge (cfs)	% Change
10%	850	620	+37%
2%	1,100	795	+38%
1%	**1,200**	**880**	**+36%**
0.2%	1,430	1,130	+27%

RIVERINE HYDRAULICS

- Steady-State HEC-RAS Modeling
- Cross Section Spacing =200 feet on Average



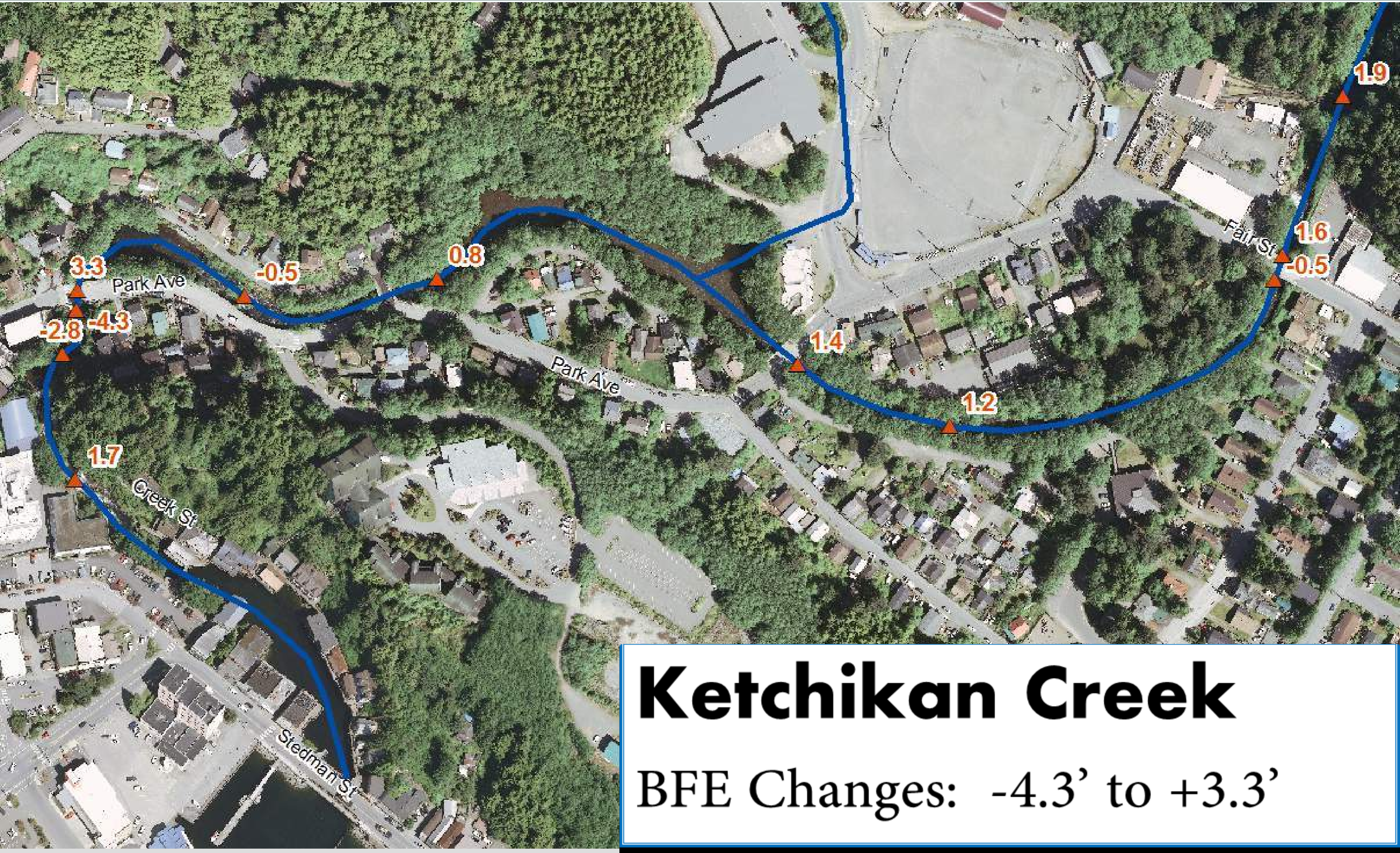
Changes in Riverine BFE's



Hoadley Creek

BFE Changes: +0.5' to +11.4'

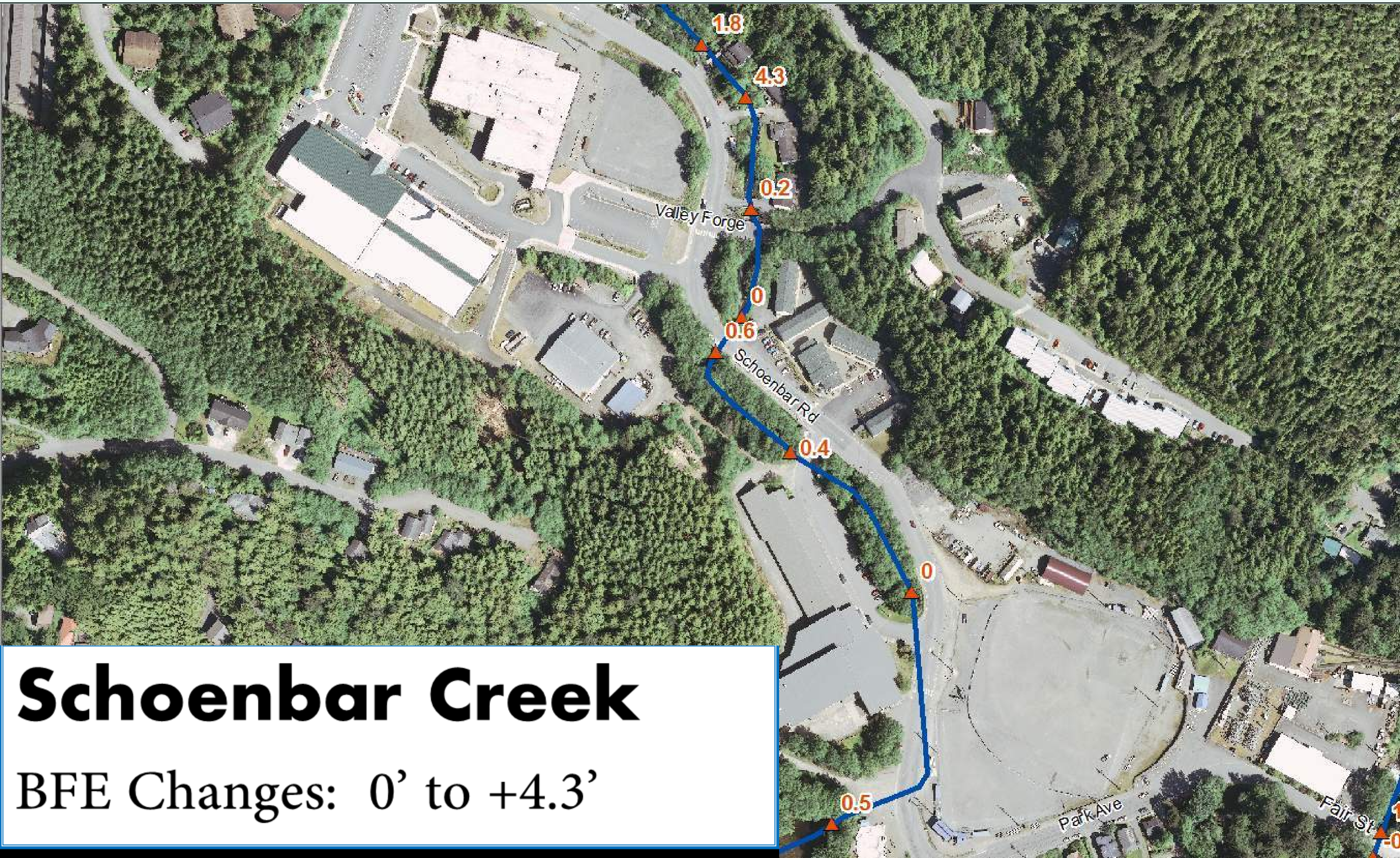
Changes in Riverine BFE's



Ketchikan Creek

BFE Changes: -4.3' to +3.3'

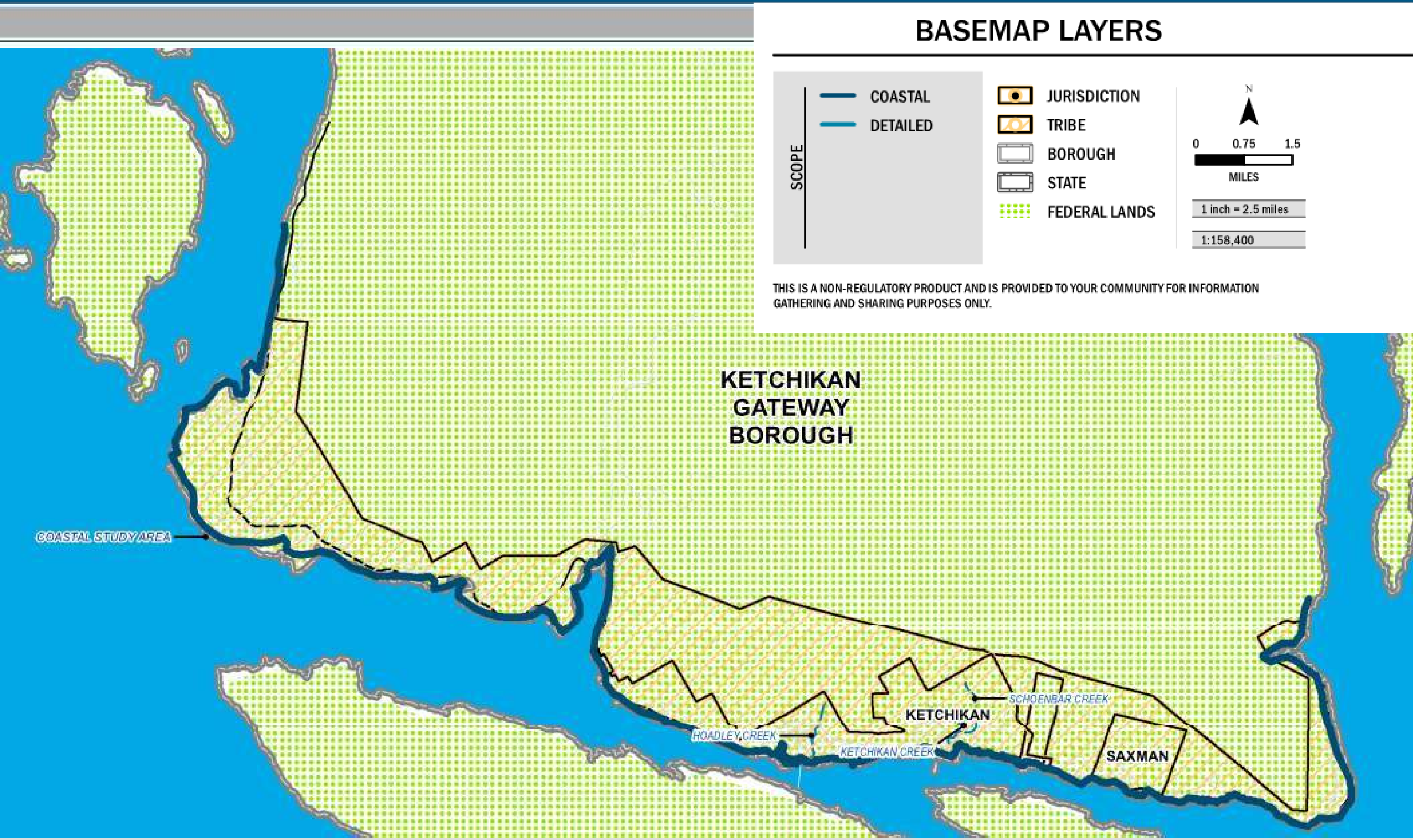
Changes in Riverine BFE's



Schoenbar Creek

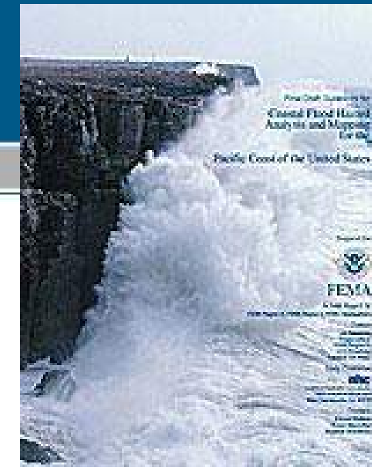
BFE Changes: 0' to +4.3'

COASTAL MODELING



Coastal Analysis Modeling Comparison

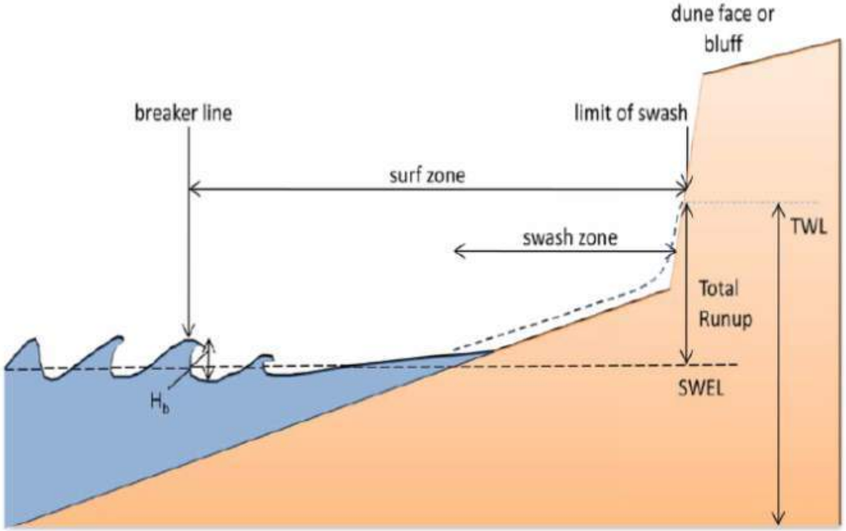
Guidelines for Coastal Flood Hazard Mapping and Analysis for Pacific Coast of the United States January 2005



	Old Approach	New Approach
Methodology	USACE Shore Protection Manual	FEMA Pacific Coast Guidelines
Wind data	Synthetic wind data	Measured wind data
Water Level Model	Water Level Gauge Data	Updated Historic Tide Gauge Data
Wave Model	1-Dimensional	2-Dimensional
Study Resolution	Calculations generalized over broad regions	Calculations using enhanced grid resolution
Topography	USGS Contour Maps	2014 LiDAR data

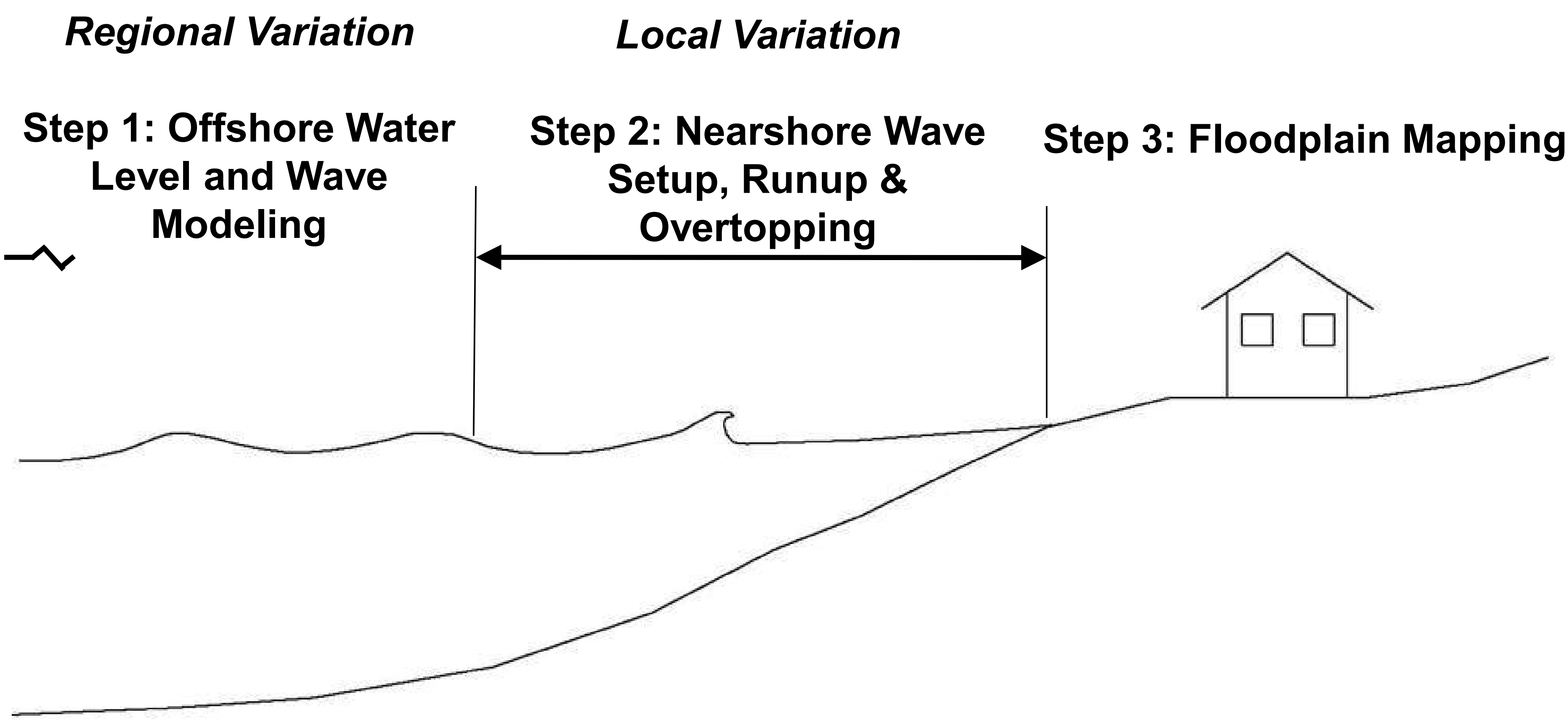
Coastal Flooding Overview

Regional Variation → ***Local Variation***

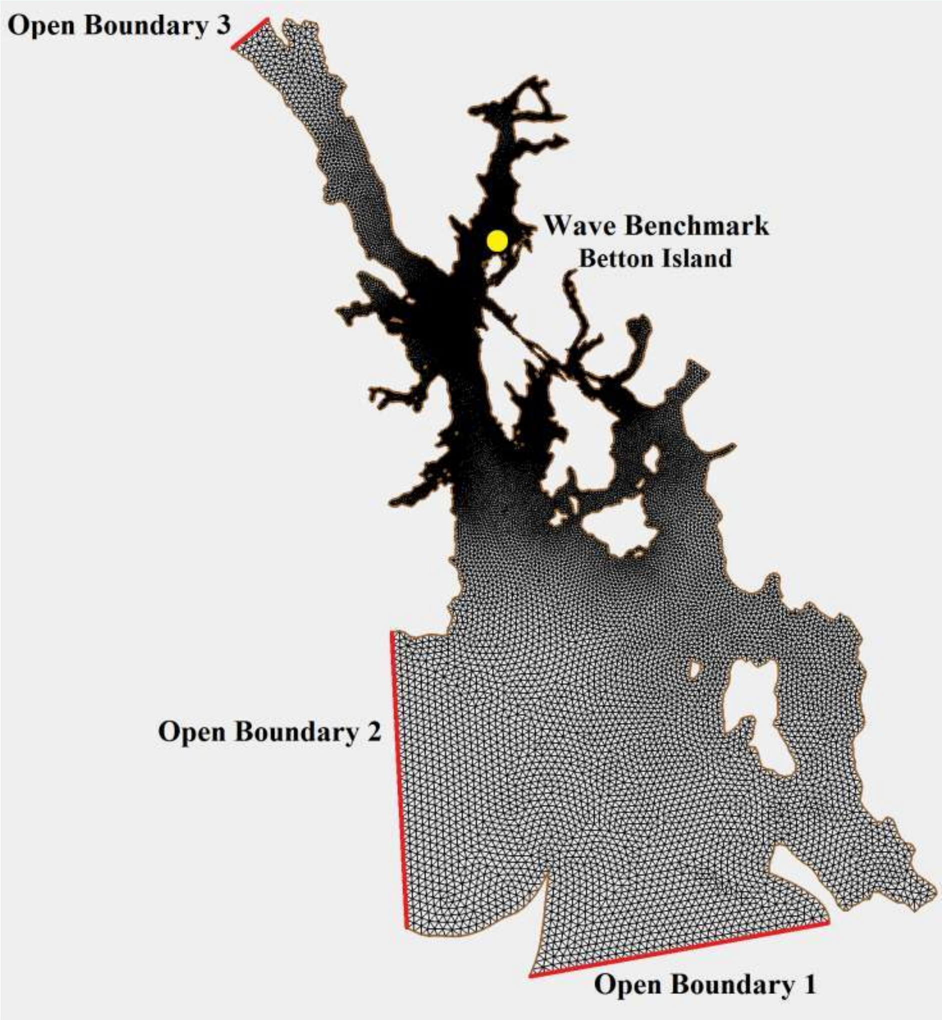


Tides, Storm Surge, El Niño → Wave Setup, Wave Runup

Modeling Process

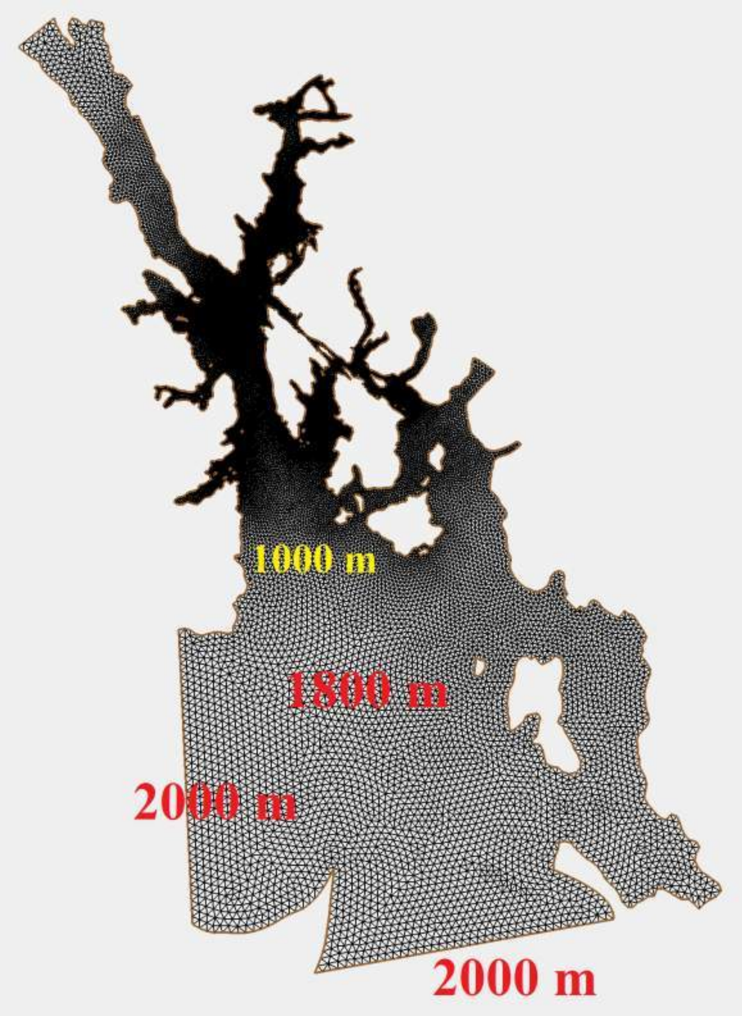


STEP 1: WAVE MODELING



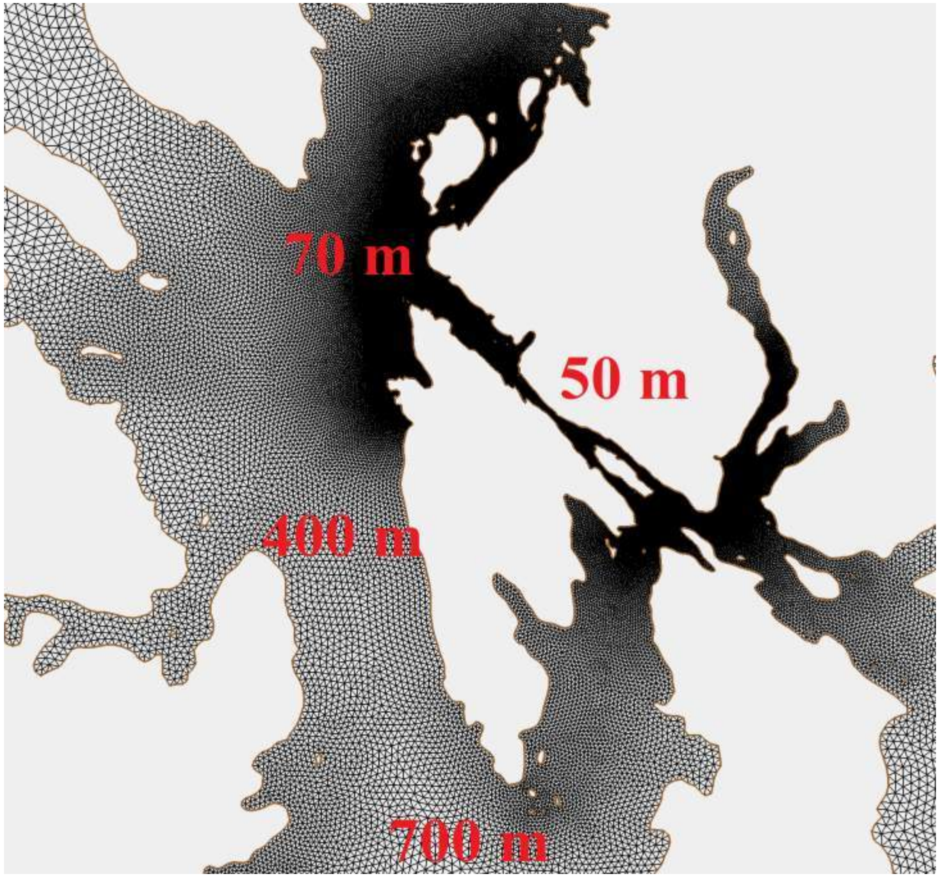
- SWAN (3rd Generation Wave Model)
- Wave Height, and Period, and Direction for 106 Storm Events (1973-2015, 43 Years)

Computational Mesh



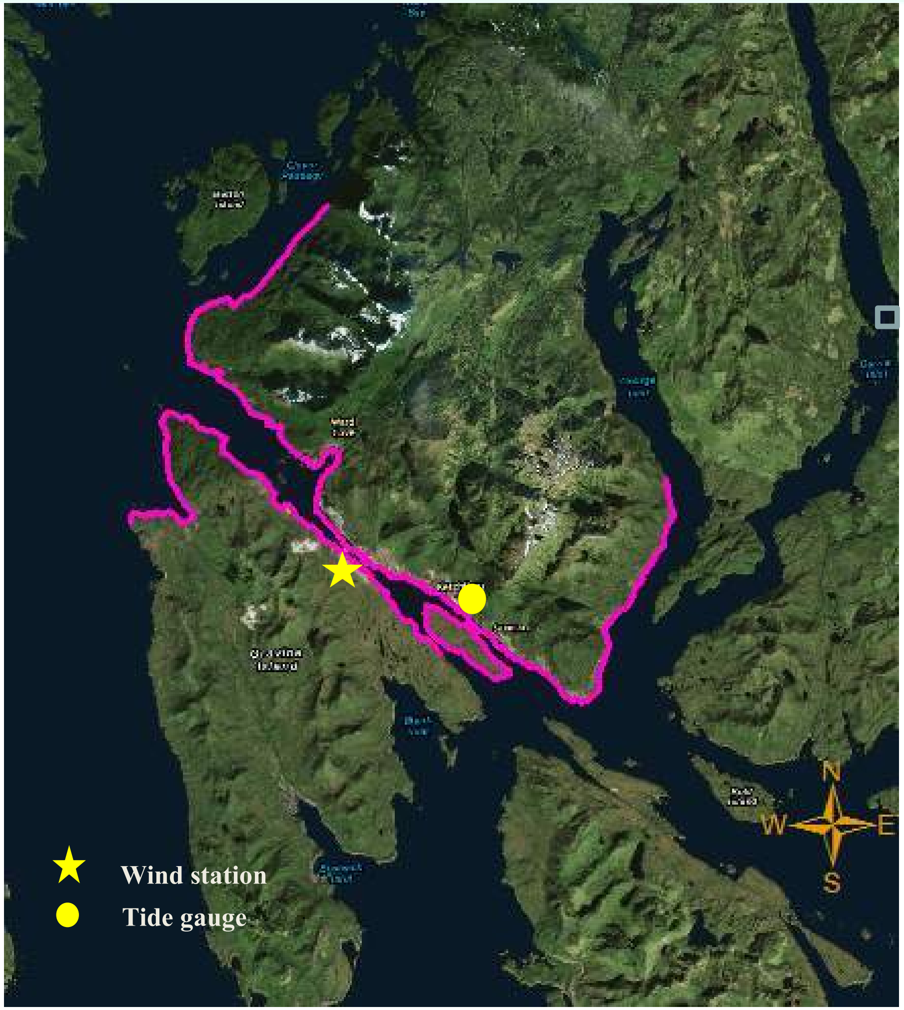
- Mesh Resolution Adequate to resolve wave generation, propagation, and all nearshore processes (Shoaling, Refraction, …)

Computational Mesh

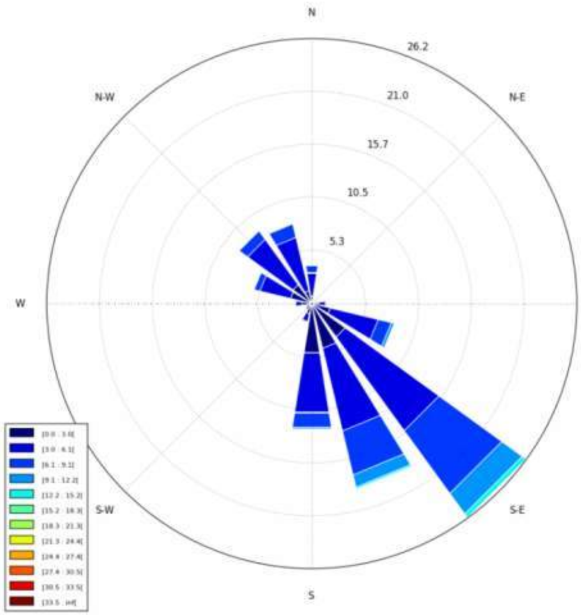


- Mesh Resolution Adequate to resolve wave generation, propagation, and all nearshore processes (Shoaling, Refraction, …)

Wave Modeling – Input Data

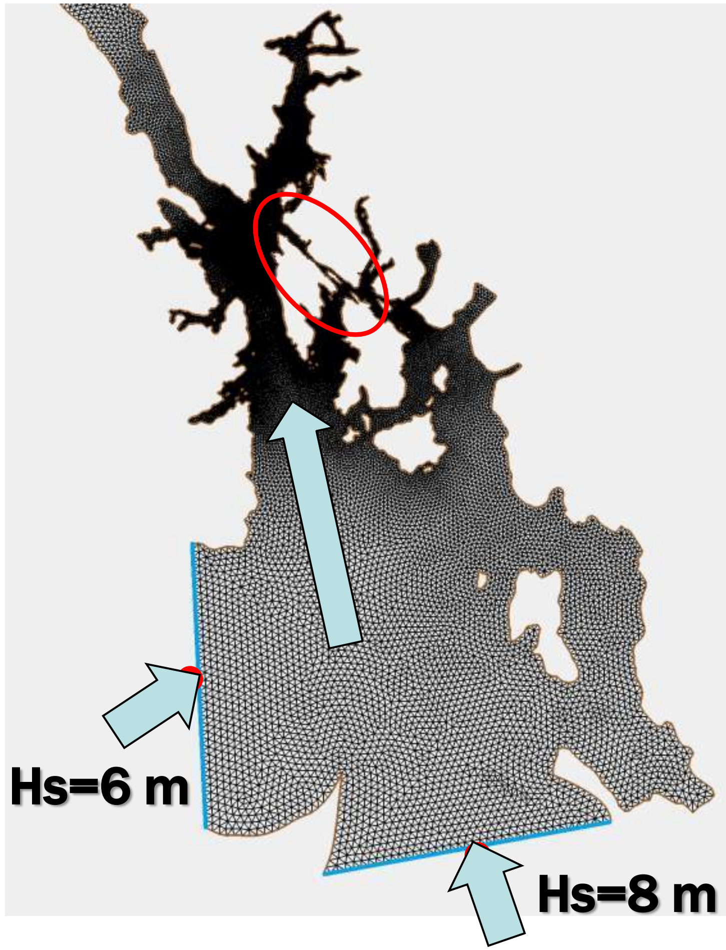


- Water Level (NOAA Tide Gauge)
- Wind (Ketchikan Airport)



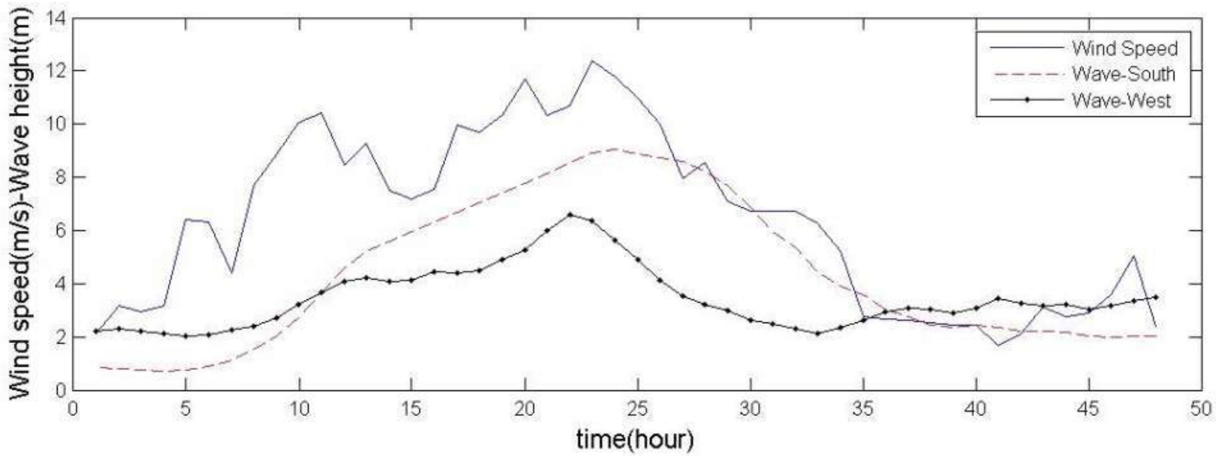
Wind Rose

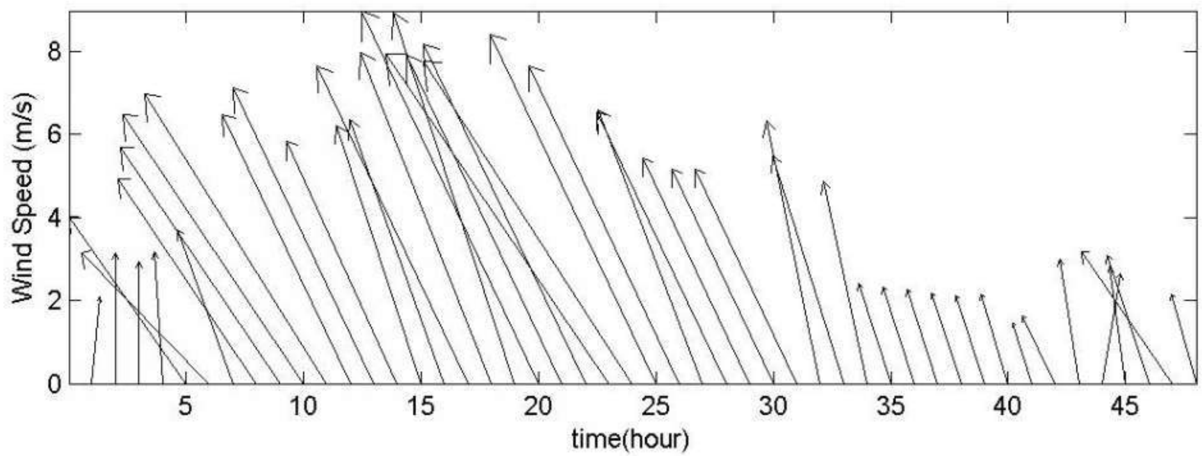
Wave Modeling – Input Data



- Water Level (NOAA Tide Gauge)
- Wind (NCDC)
- Offshore Wave (Buoy)

Wave Modeling – Offshore Wave

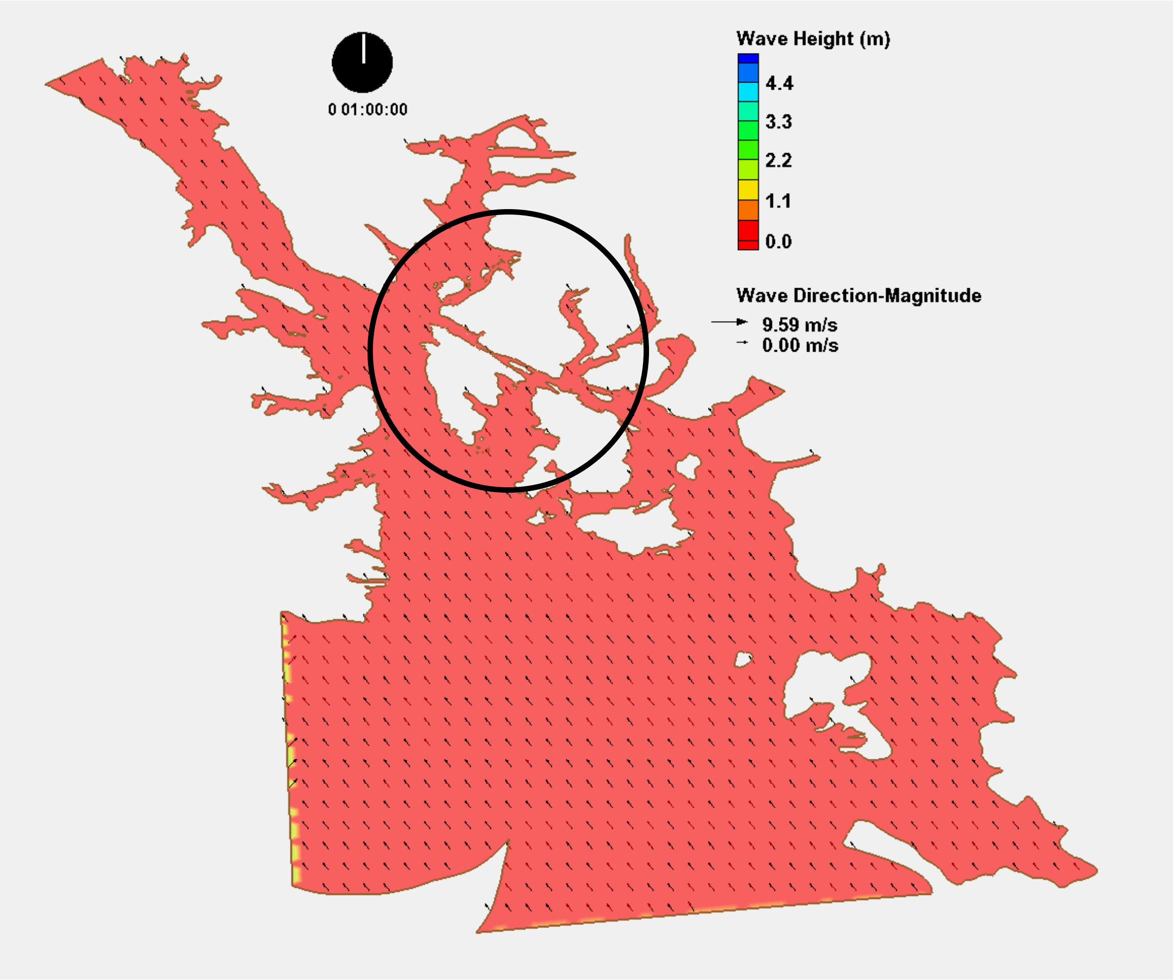




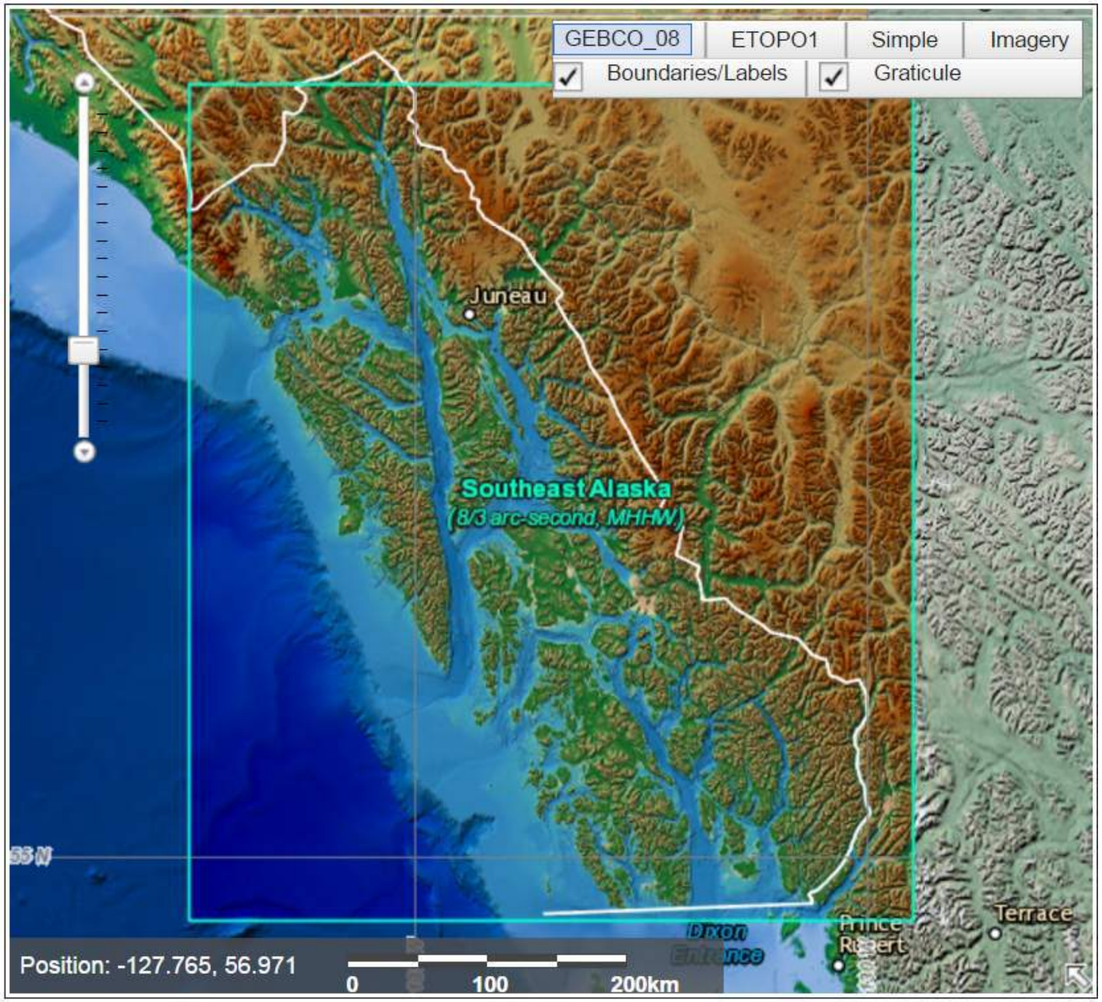
Wave Modeling – Offshore Wave

Only Wave at Boundary

No Wind Force



Wave Modeling – Input Data

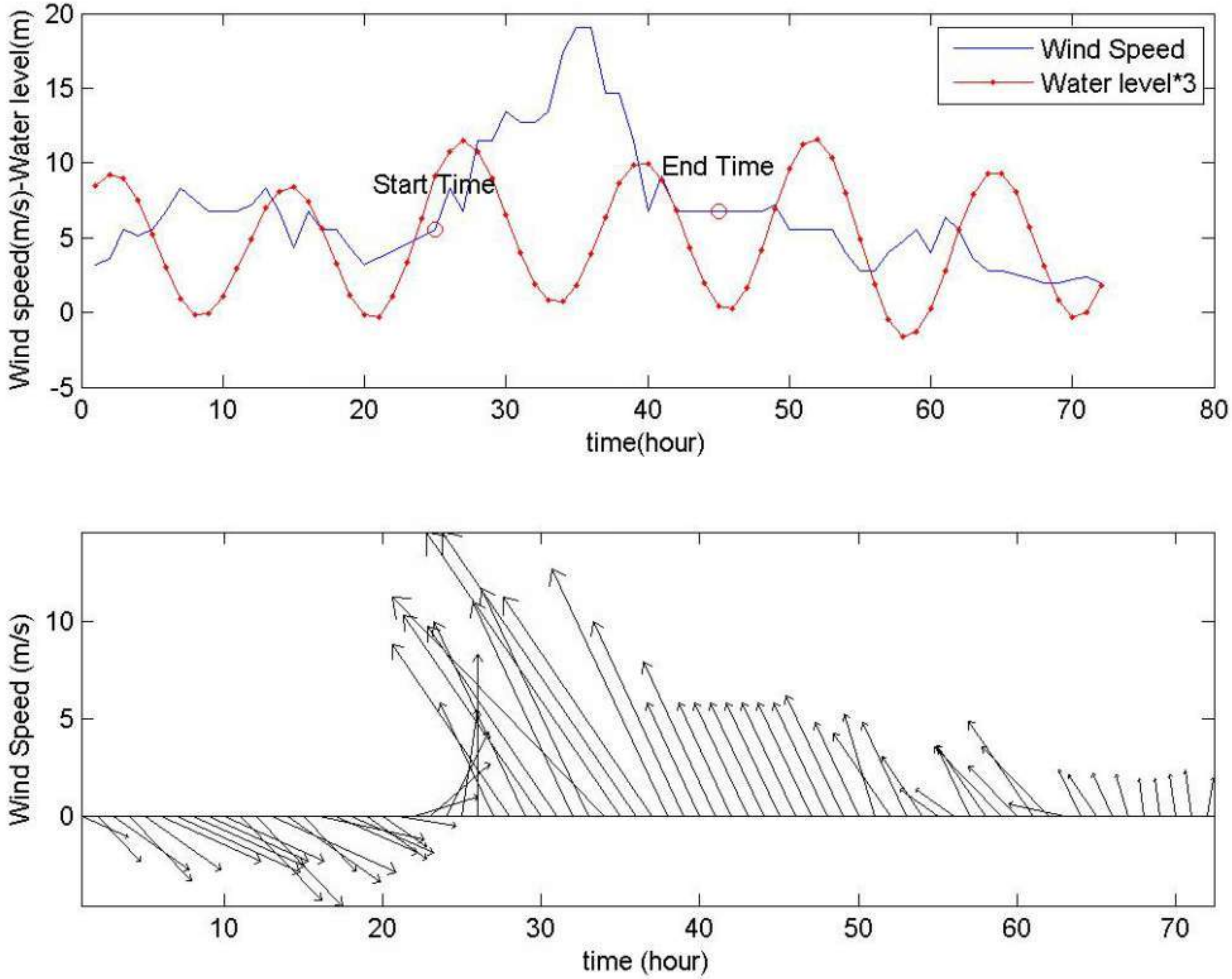


- Water Level (NOAA Tide Gauge)
- Wind (NCDC)
- Bathymetry (NGDC)

Wave Modeling - Sample Event

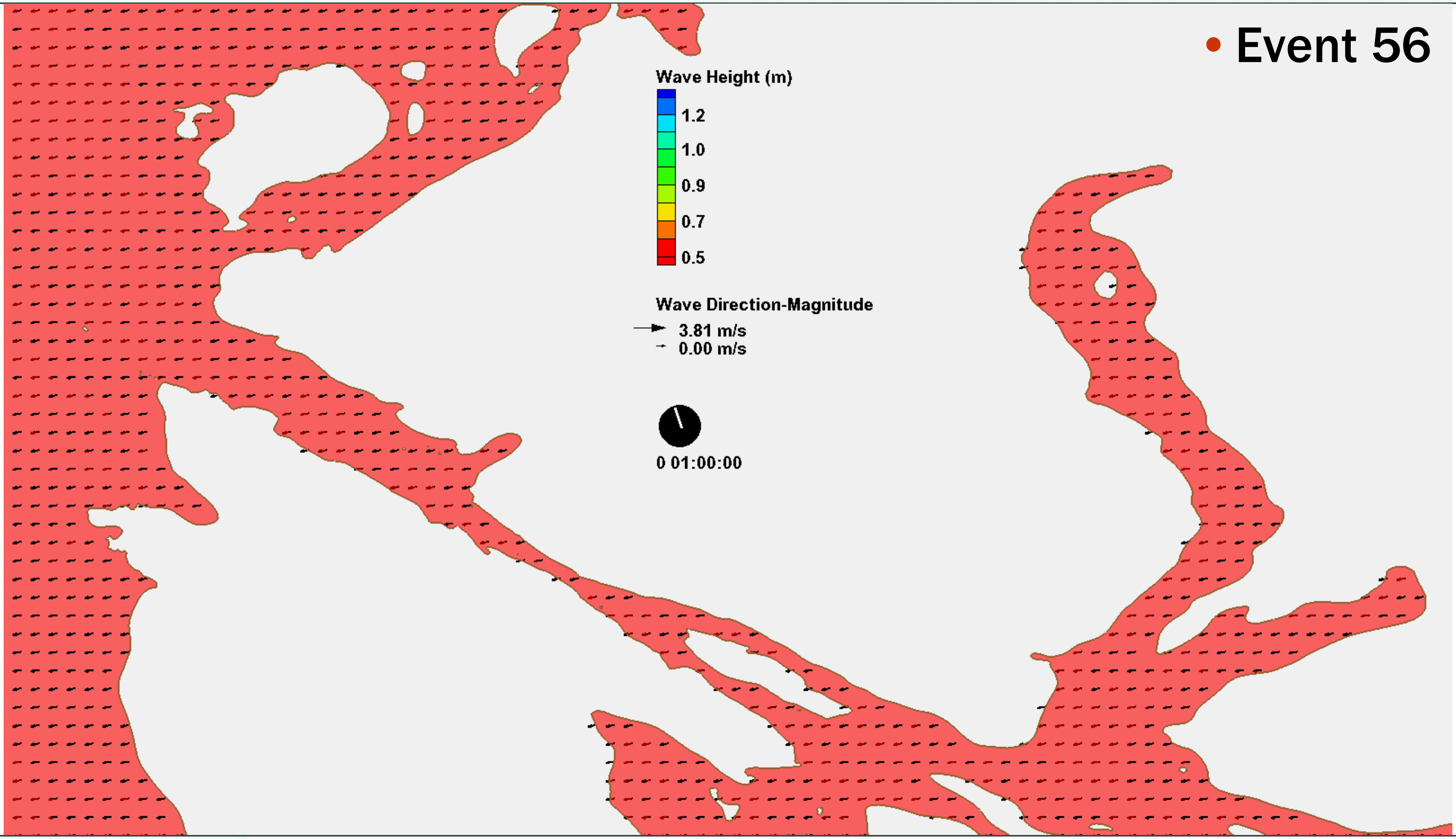
- Event 56

  South East



Wave Modeling - Sample Result

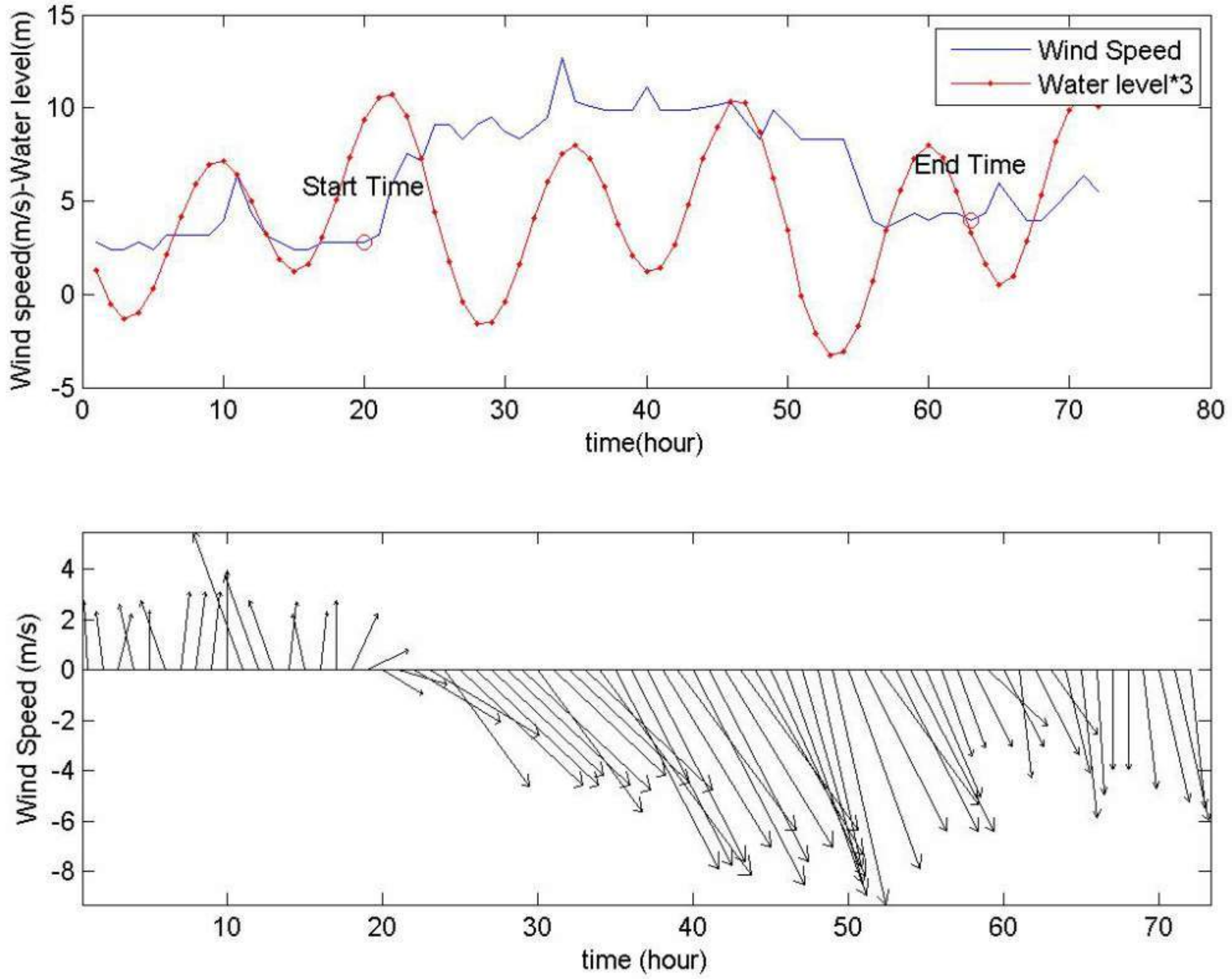
- Event 56



WAVE MODELING - SAMPLE EVENT

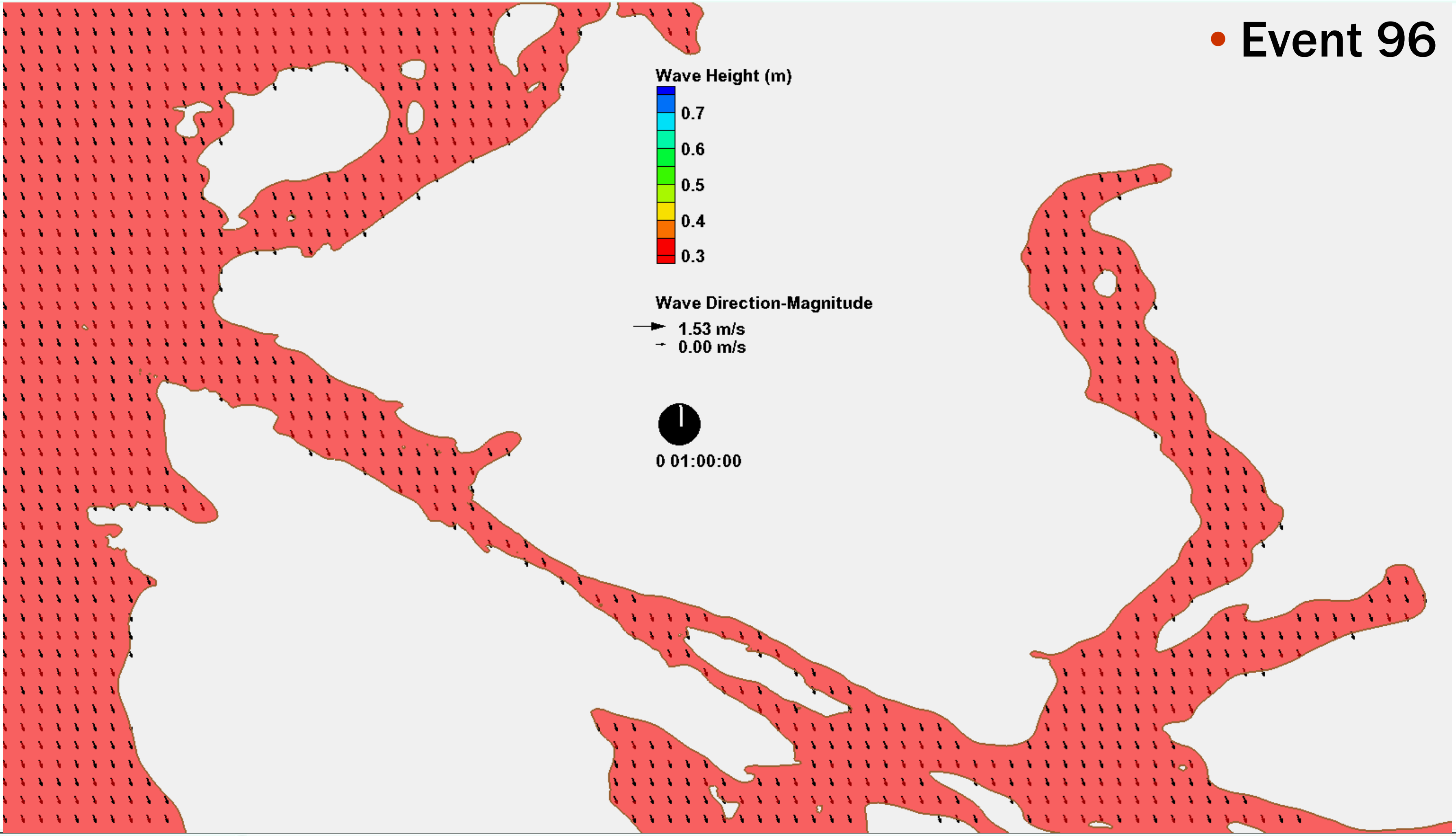
- Event 96

  North West



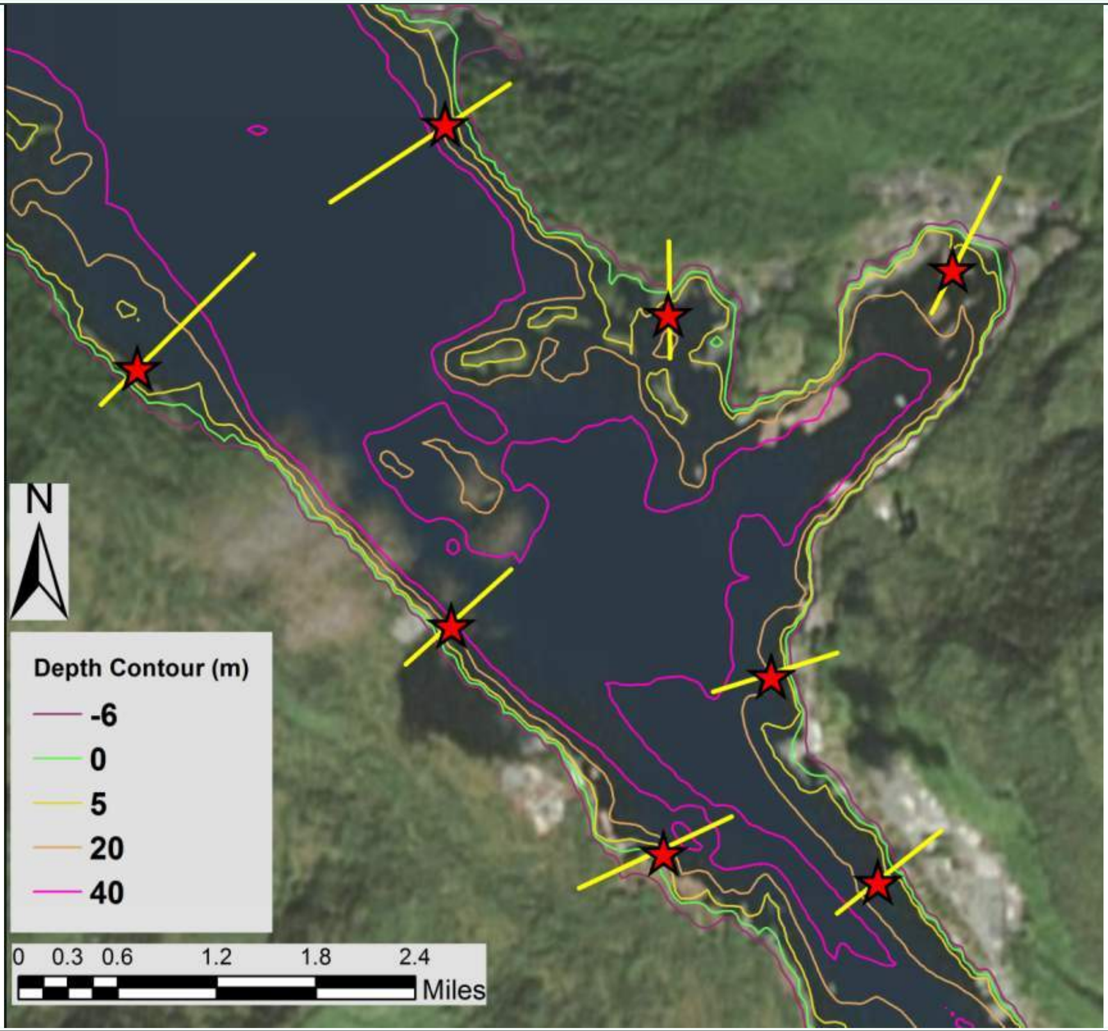
Wave Modeling - Sample Result

- Event 96

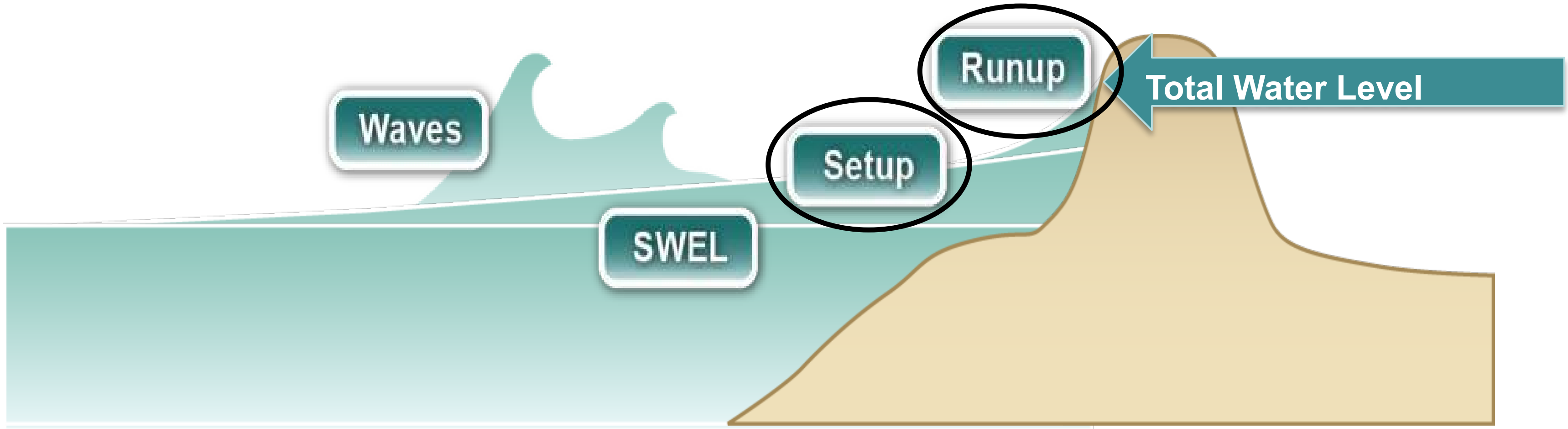


Wave Modeling - Outputs

- Wave information selected at the breaker line (***Outside the surfzone***)



Step 2: Wave Setup and Runup (Transect Analysis)

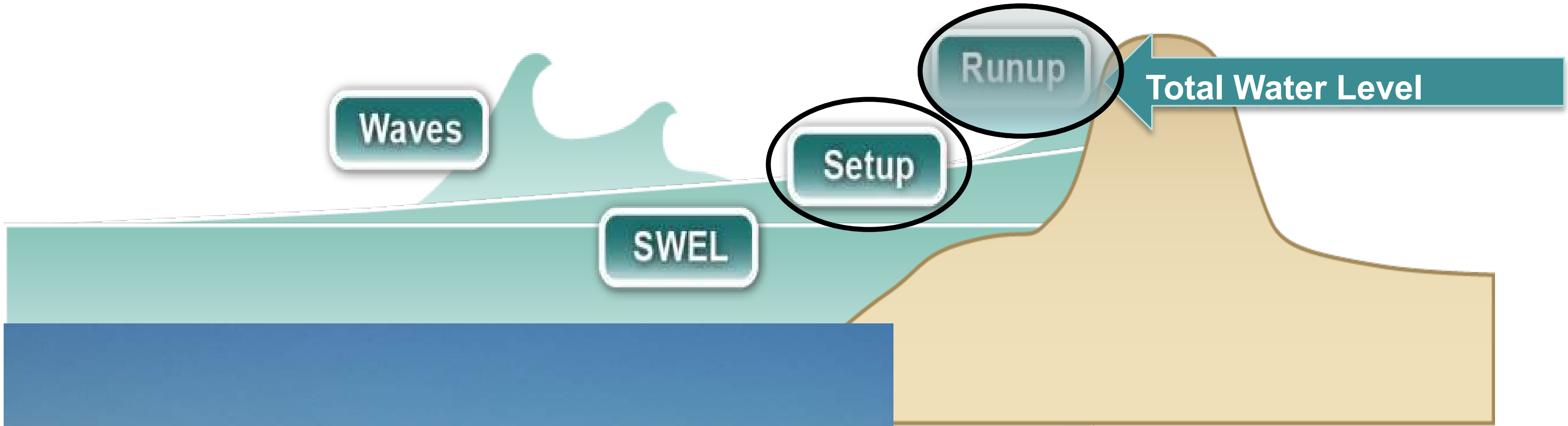


Wave Height
Wave Period
SWEL
Profile Slope

→

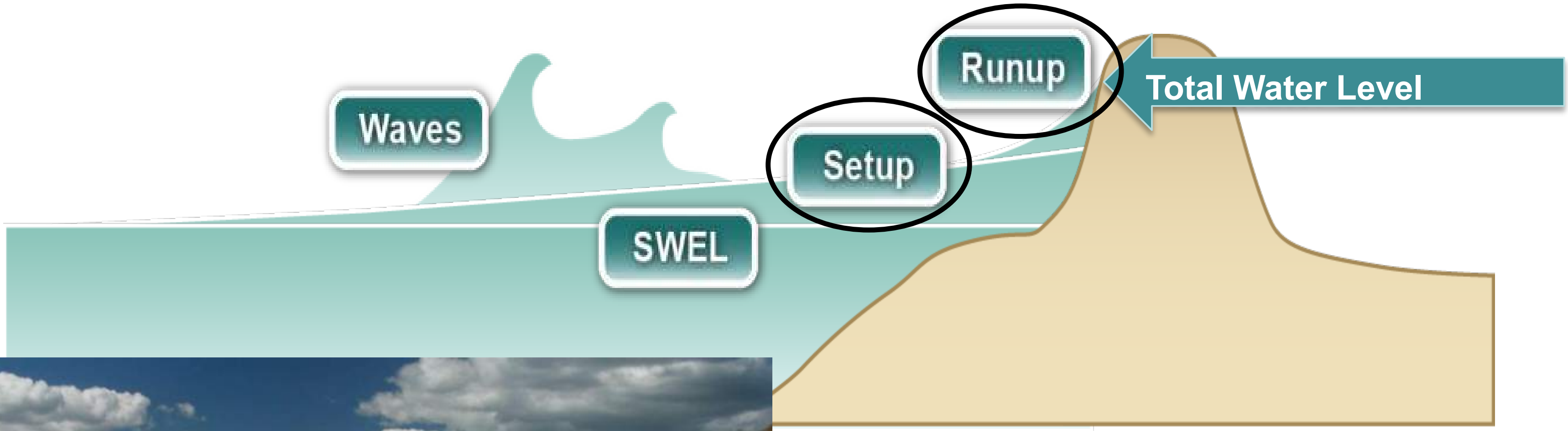
Wave Setup
Wave Runup

Step 2: Wave Setup and Runup (Transect Analysis)



Mild Slopes (Beaches)

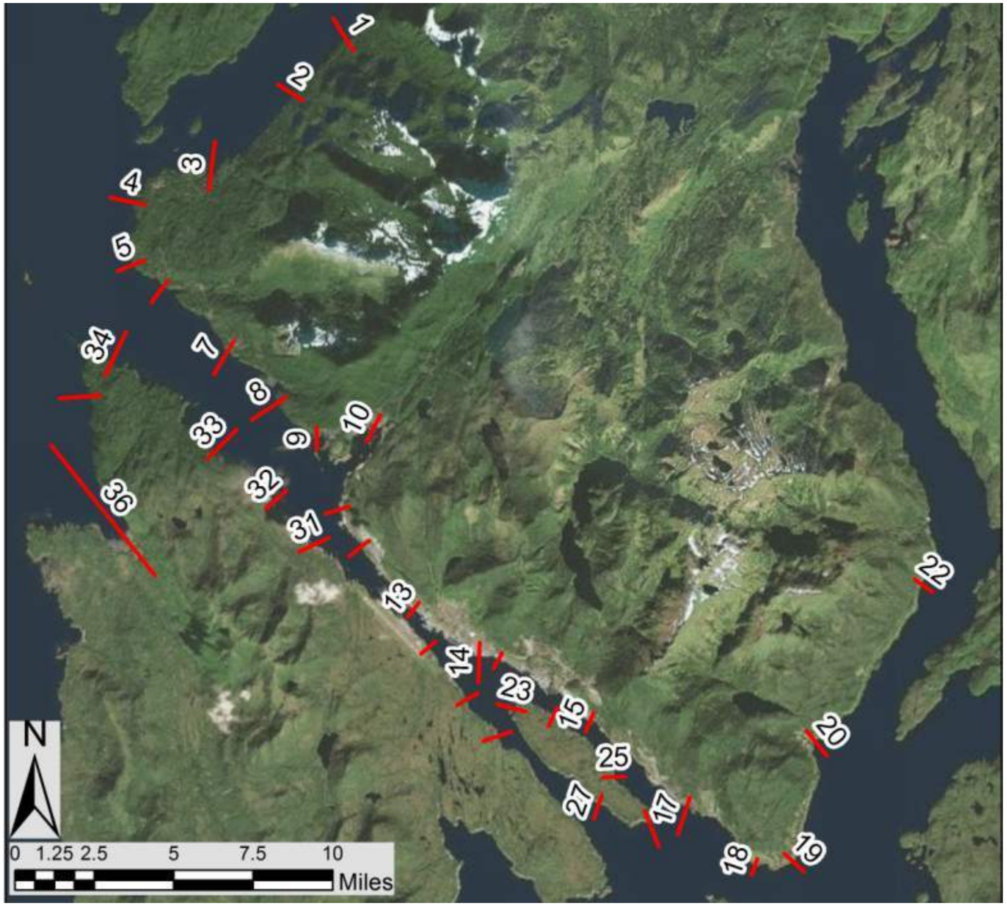
Step 2: Wave Setup and Runup (Transect Analysis)



Steep Slope (Bluffs/Bulkheads)

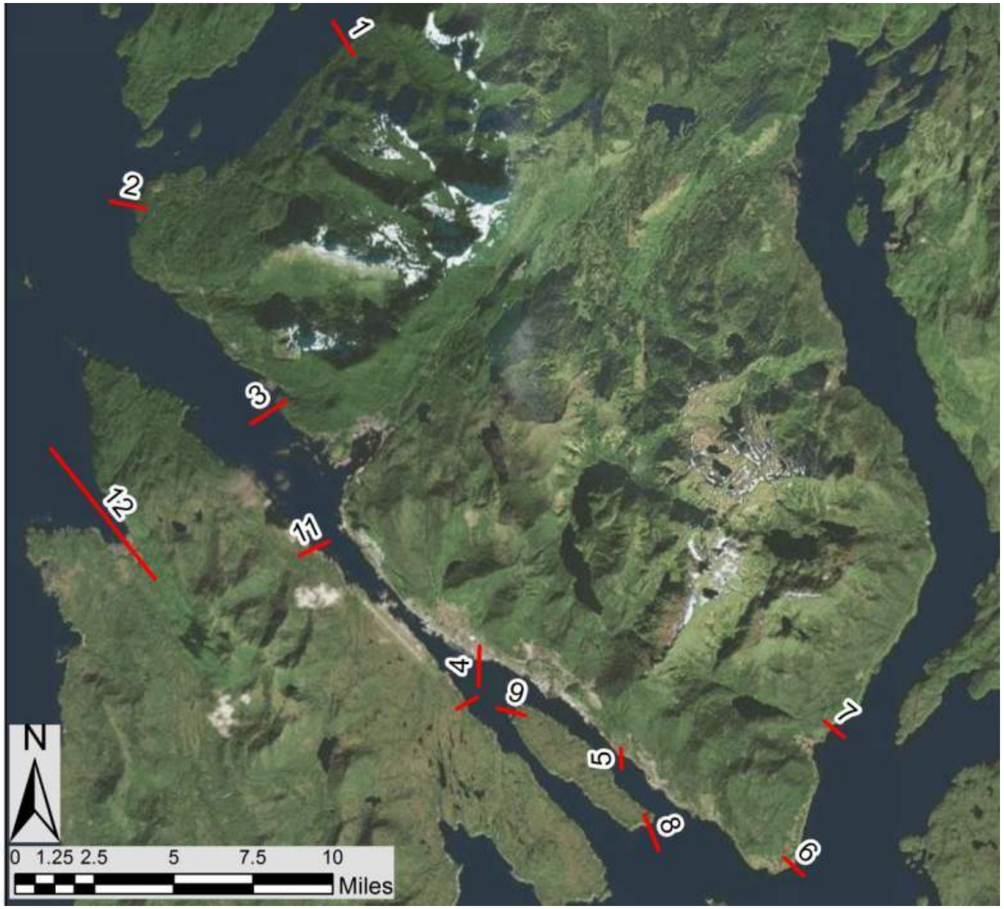
Step 2: Wave Setup and Runup (Transect Analysis)

36 Transects Initially, 12 Transects Presented

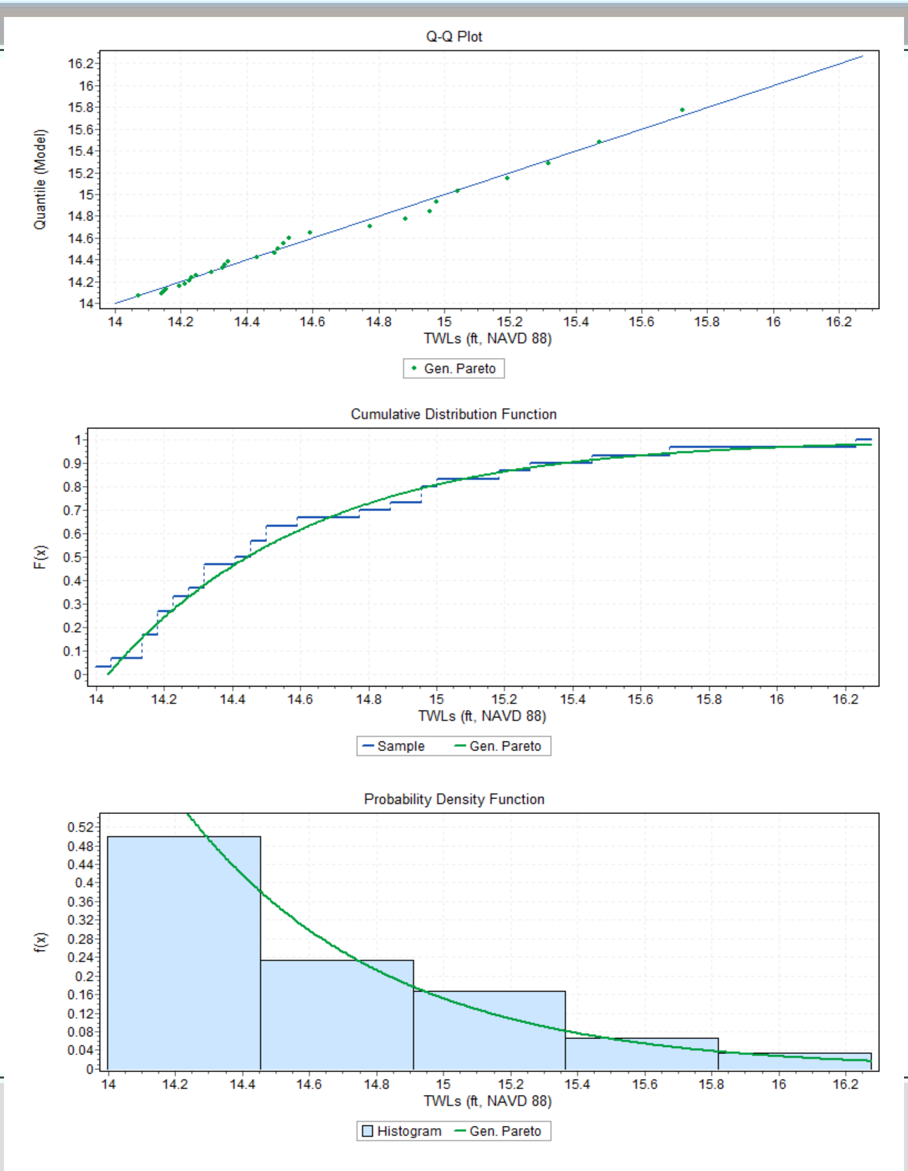


Step 2: Wave Setup and Runup (Transect Analysis)

36 Transects Initially, 12 Transects Presented



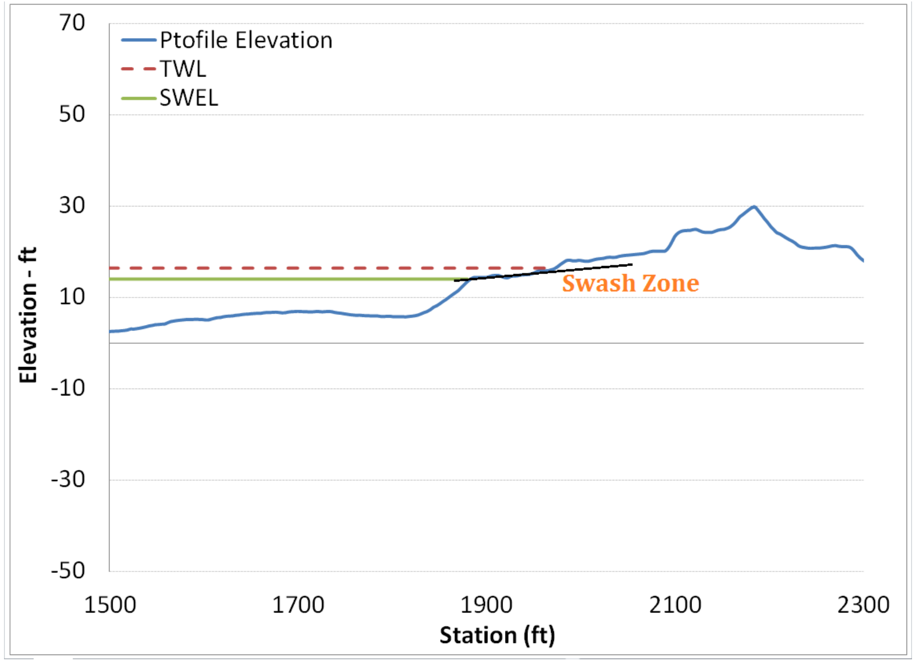
100 YEAR TWL



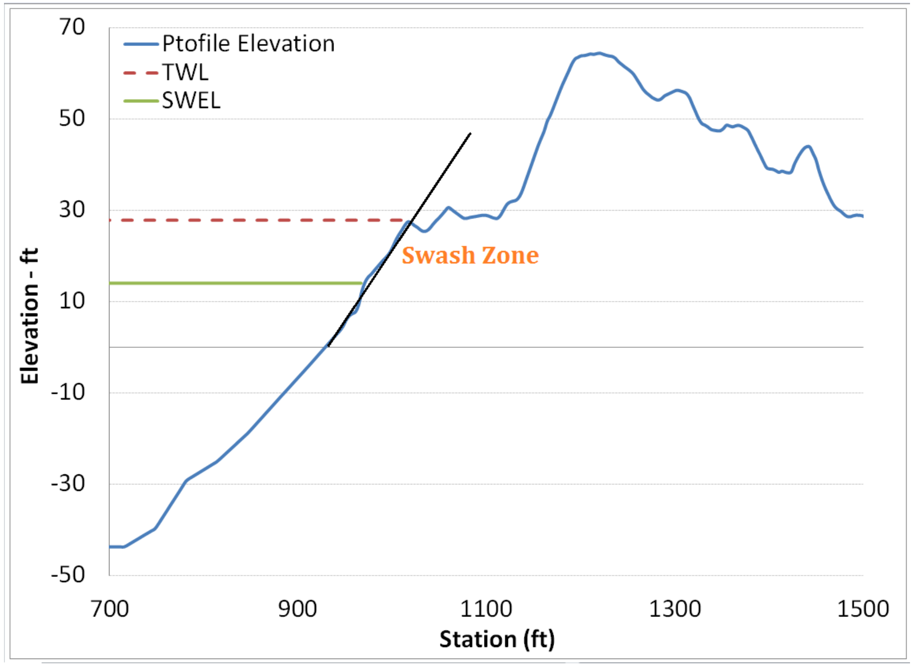
- 43-year record of flood elevations at each transect
- Fit probability distributions to the data at each transect
- Read 0.2%, 1%, 2%, etc. annual chance flood elevations at each transect from distributions

100 YEAR TWL

Mild Slope Shore - Low BFE



Steep Slope Shore - high BFE

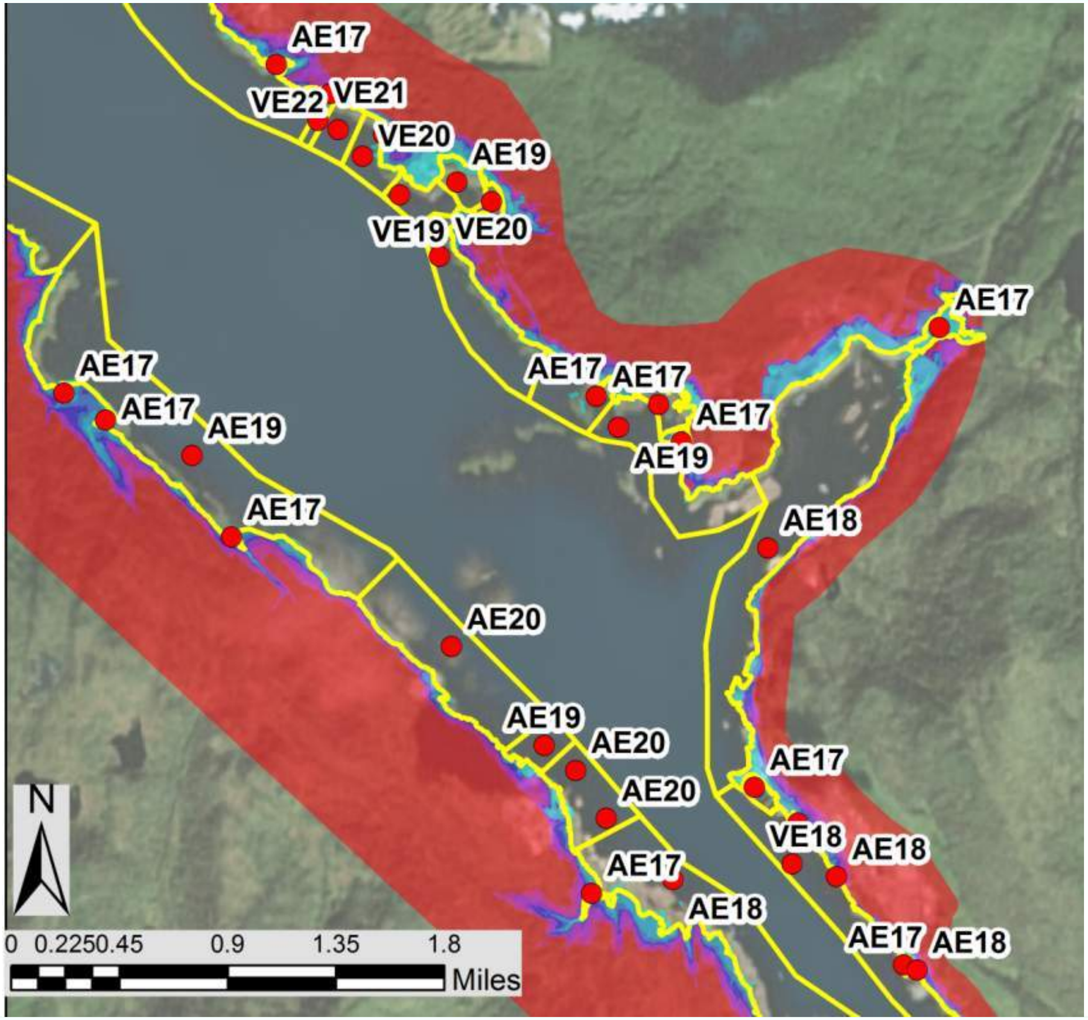


Step 3: General Mapping

ZONE	BFE
AE if TWL < SWL + 3’ VE if TWL ≥ SWL + 3’	TWL Rounded to Nearest Foot

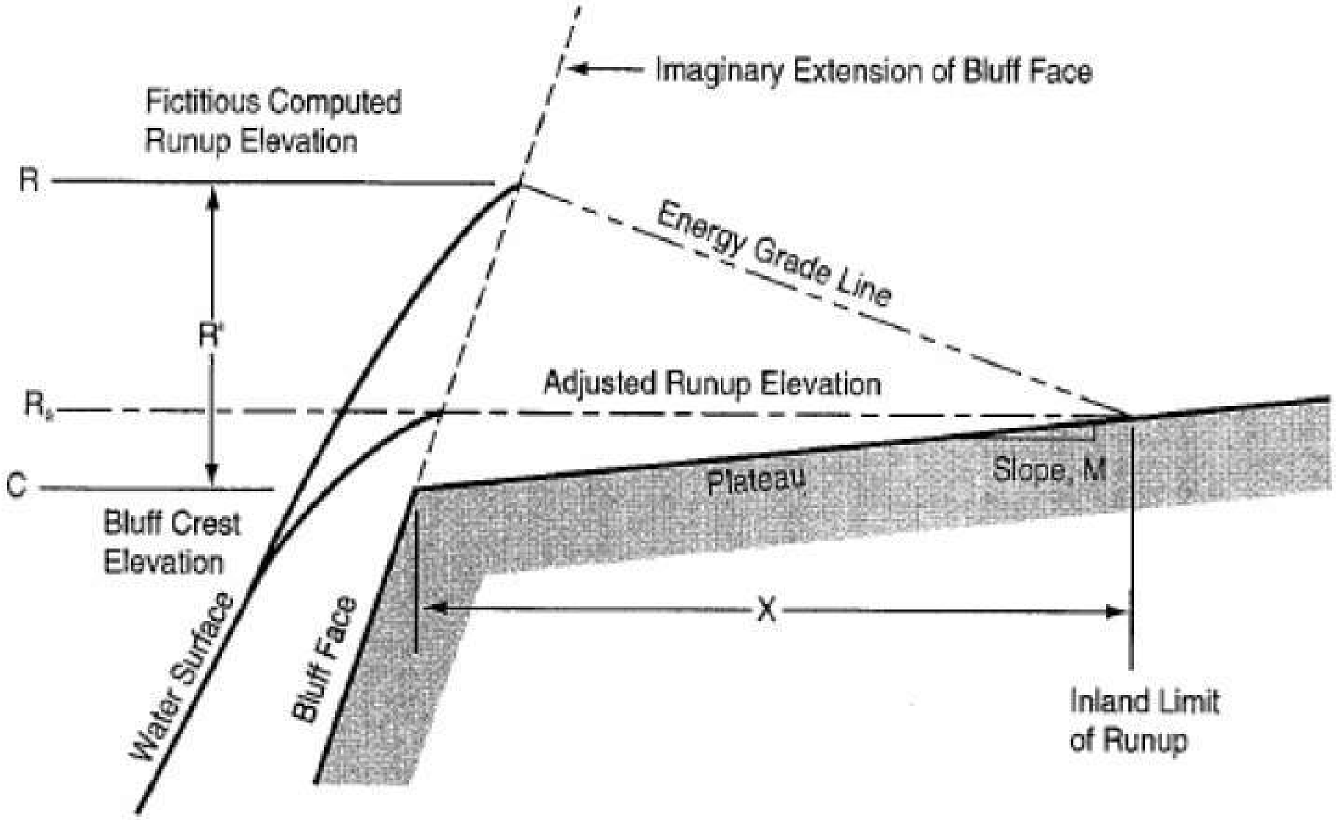
Delineation	Zone Breaks
Follow Contour of TWL	Break along the Coast Where Shoreline Characteristics

Step 3: General Mapping – Delineation and Zone Breaks



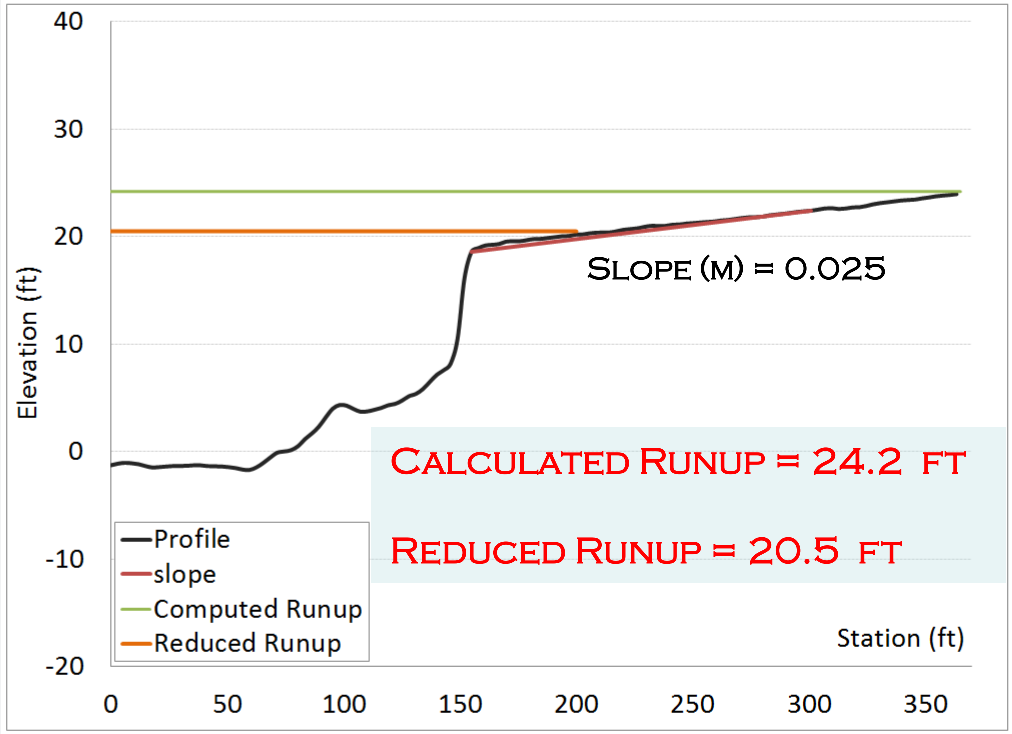
Step 3: Identifying Special Mapping Areas - Plateaus

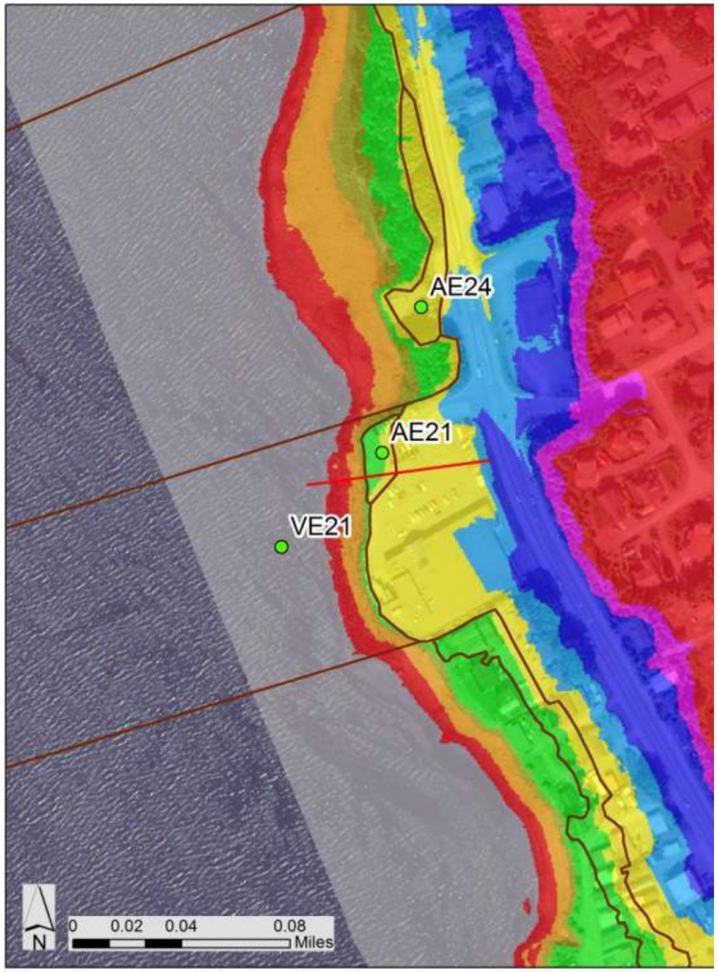
Runup Reduction of Plateau



Step 3: Identifying Special Mapping Areas - Plateaus

Runup Reduction of Plateau



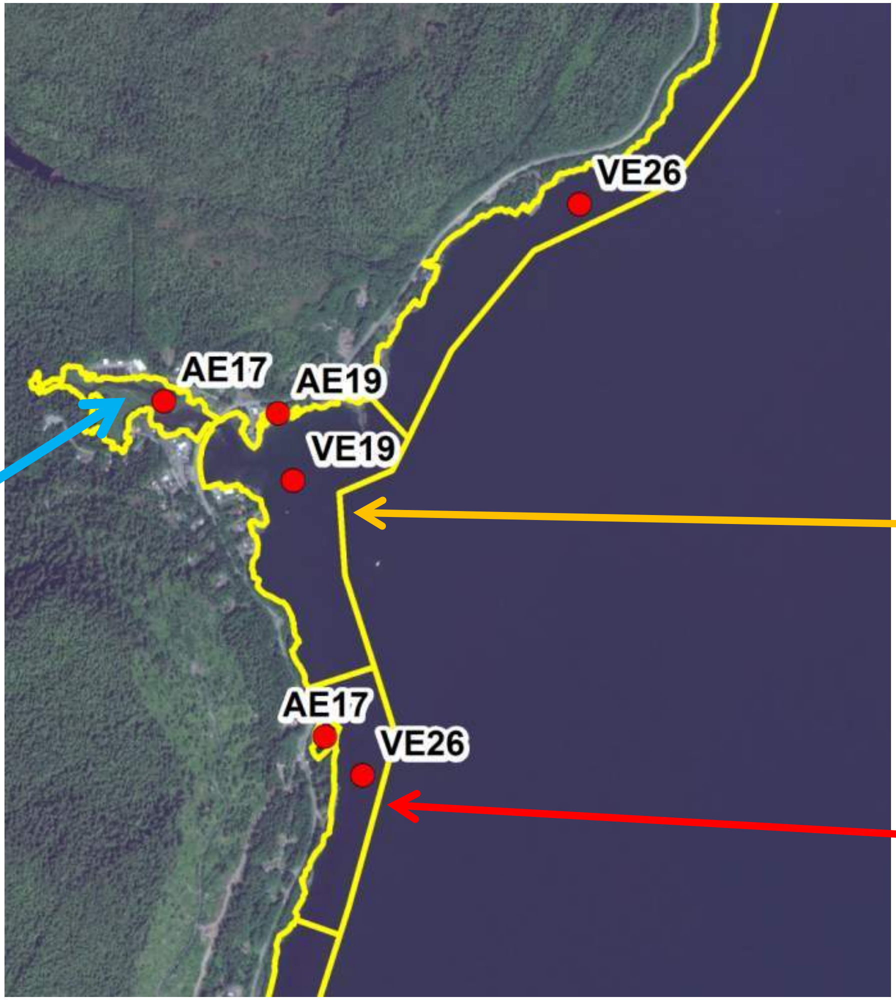


FAQ – Variation in BFE's Along the Coast

Main Factor:

- Geometry
- Change in Slope
- Wave Properties

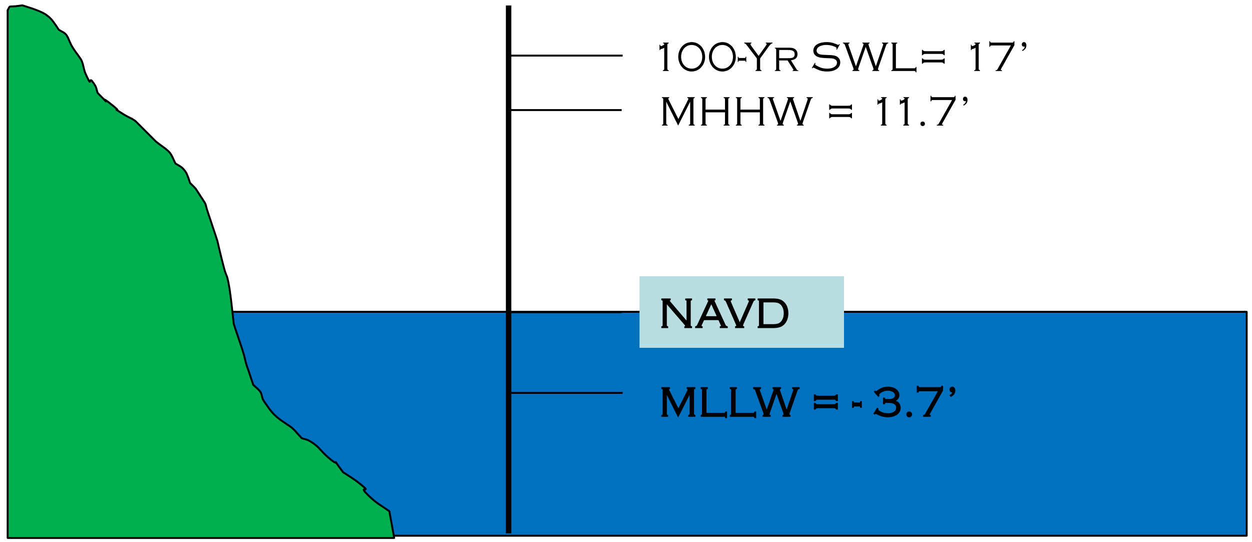
Sheltered Area



Mild

Steep

FAQ – Datums



Non-Regulatory Products

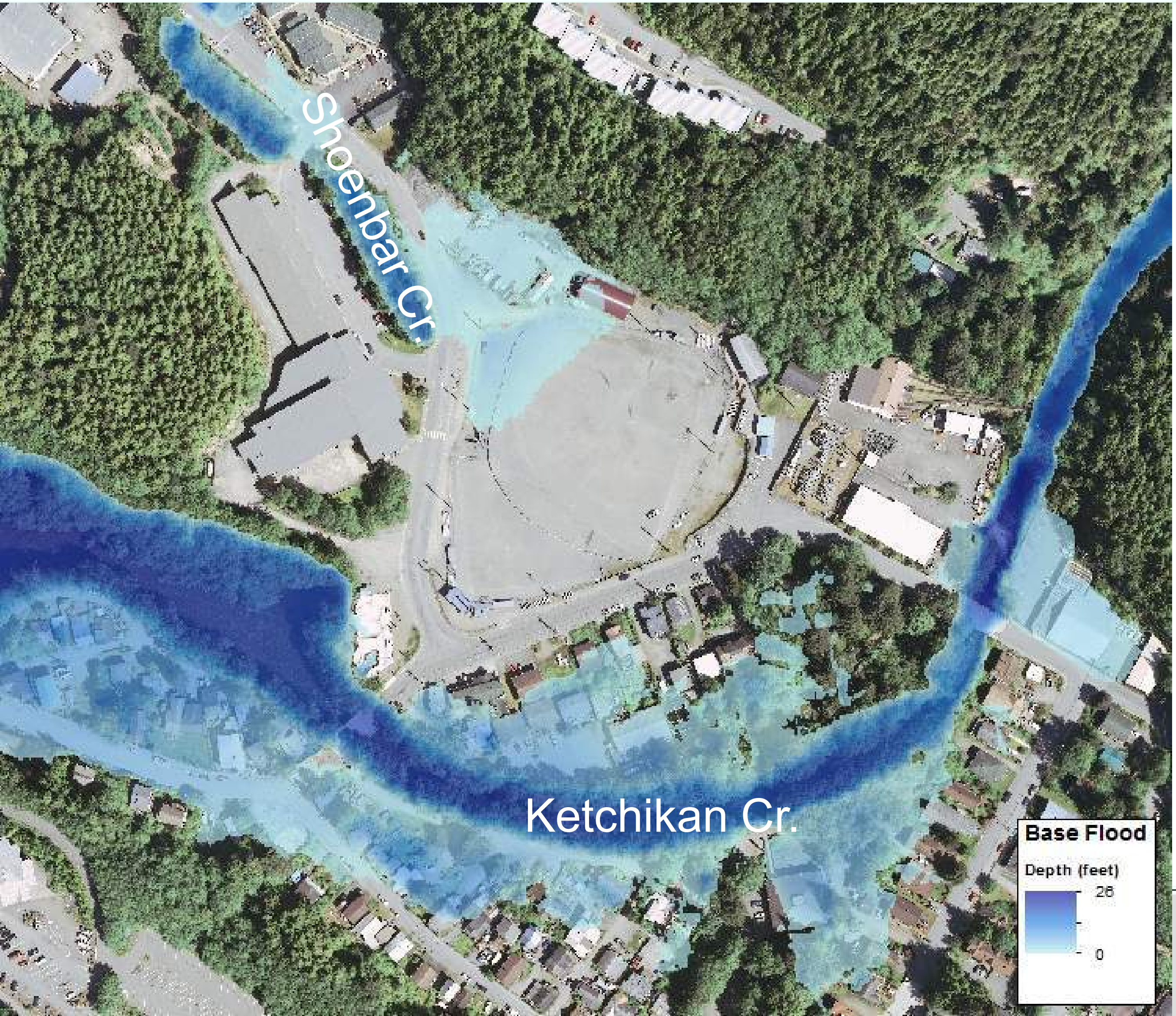
- Changes Since Last FIRM
- Depth Grids
- BFE+ Grid
- Multi-hazard Risk Assessment
  - Hazus Risk Assessment
  - Vulnerability Assessment
- Risk Report
- Risk Database

Use of Risk MAP Products

- Supplement regulatory products (FIRM/FIS)
- Provide data to inform Hazard Mitigation Plans
- Can guide land use and development plans
- Can inform incident response plans


Changes Since Last FIRM
Shoenbar Cr.
Unchanged
SFHA Increase
SFHA Decrease
SFHA Increase
SFHA Increase
Ketchikan Cr.
SFHA Increase
Unchanged

Flood Depth Grids

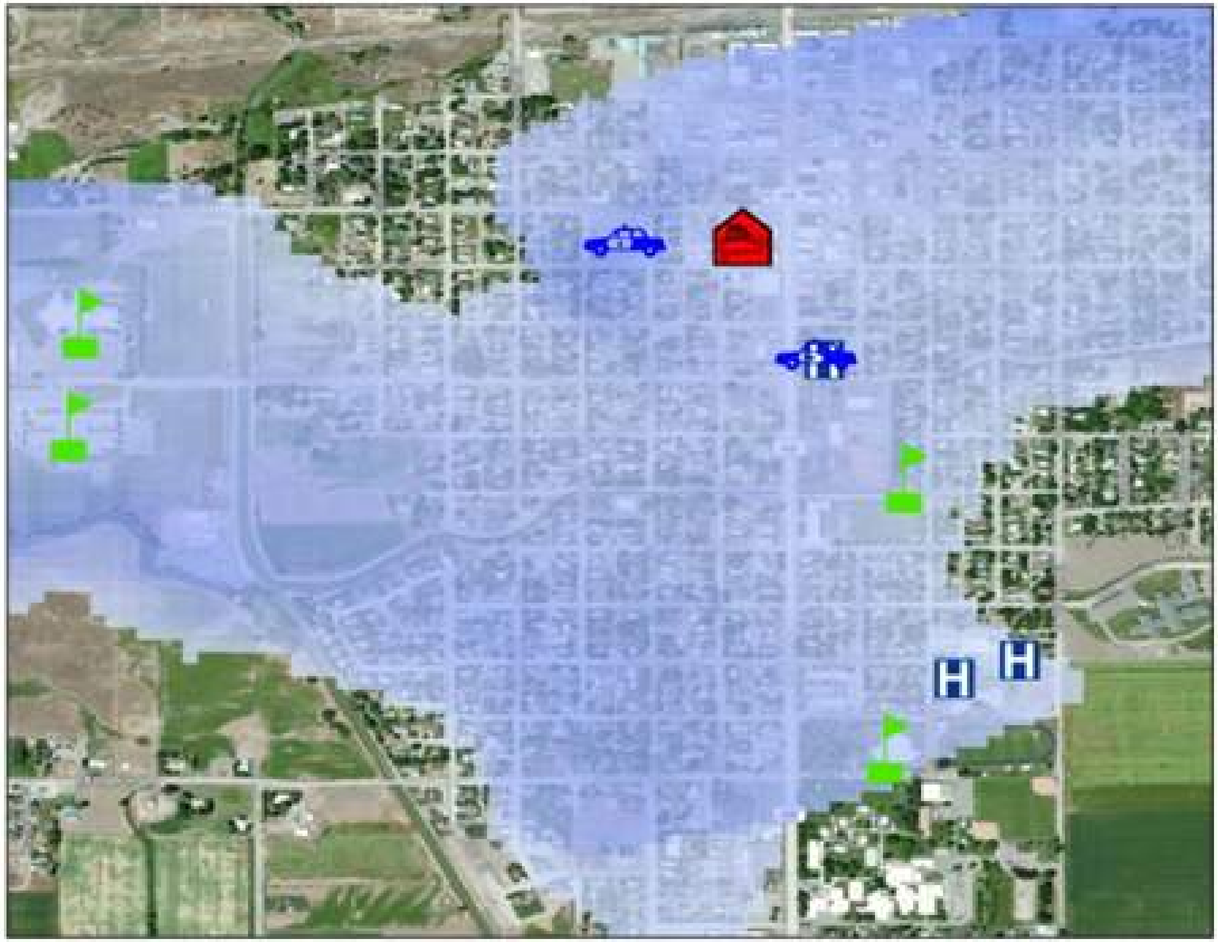


- Riverine: 10%, 4%, 2%, 1%, 1%+& 0.2% Annual Chance Floods (Hoadley Creek, Shoenbar Creek, and Schoenbar Creek)
- Coastal: 1% Flood

Flood Depth Grids

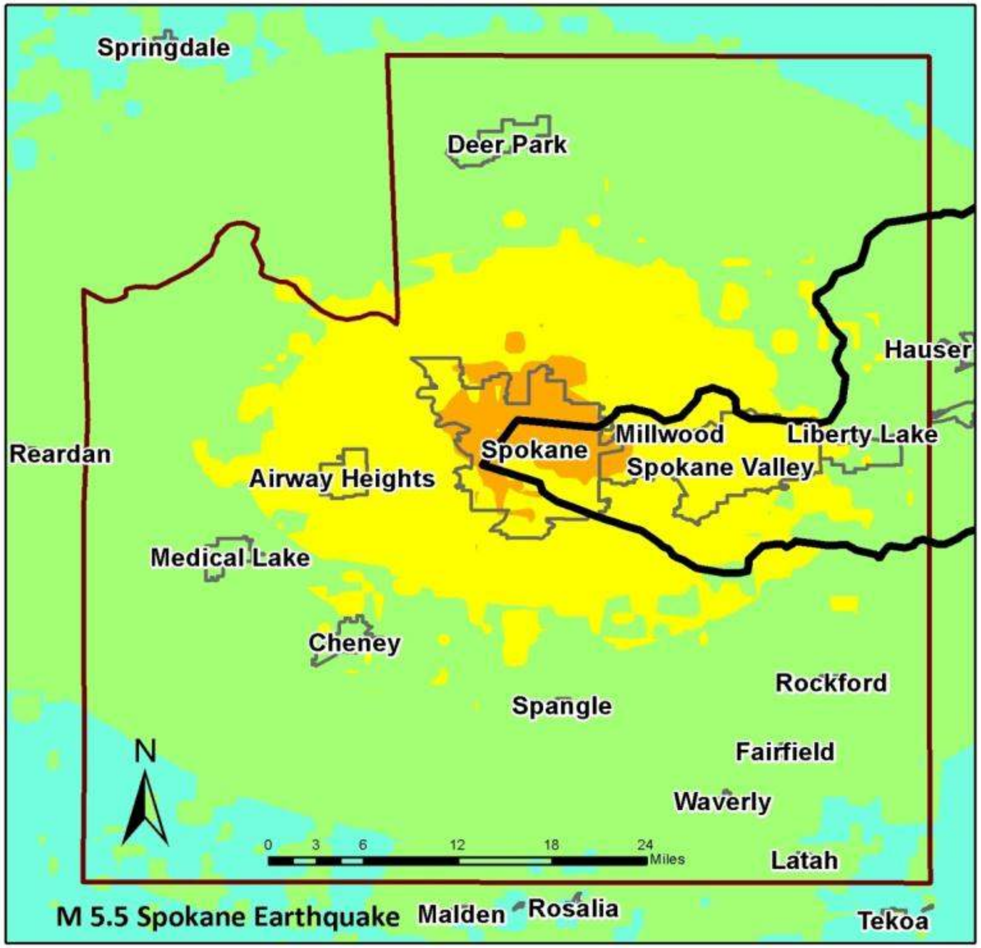
- **BFE+ Grid** **+1', +2', +3' feet to be used in planning for sea level rise impacts**

Hazus-MH Risk Assessments



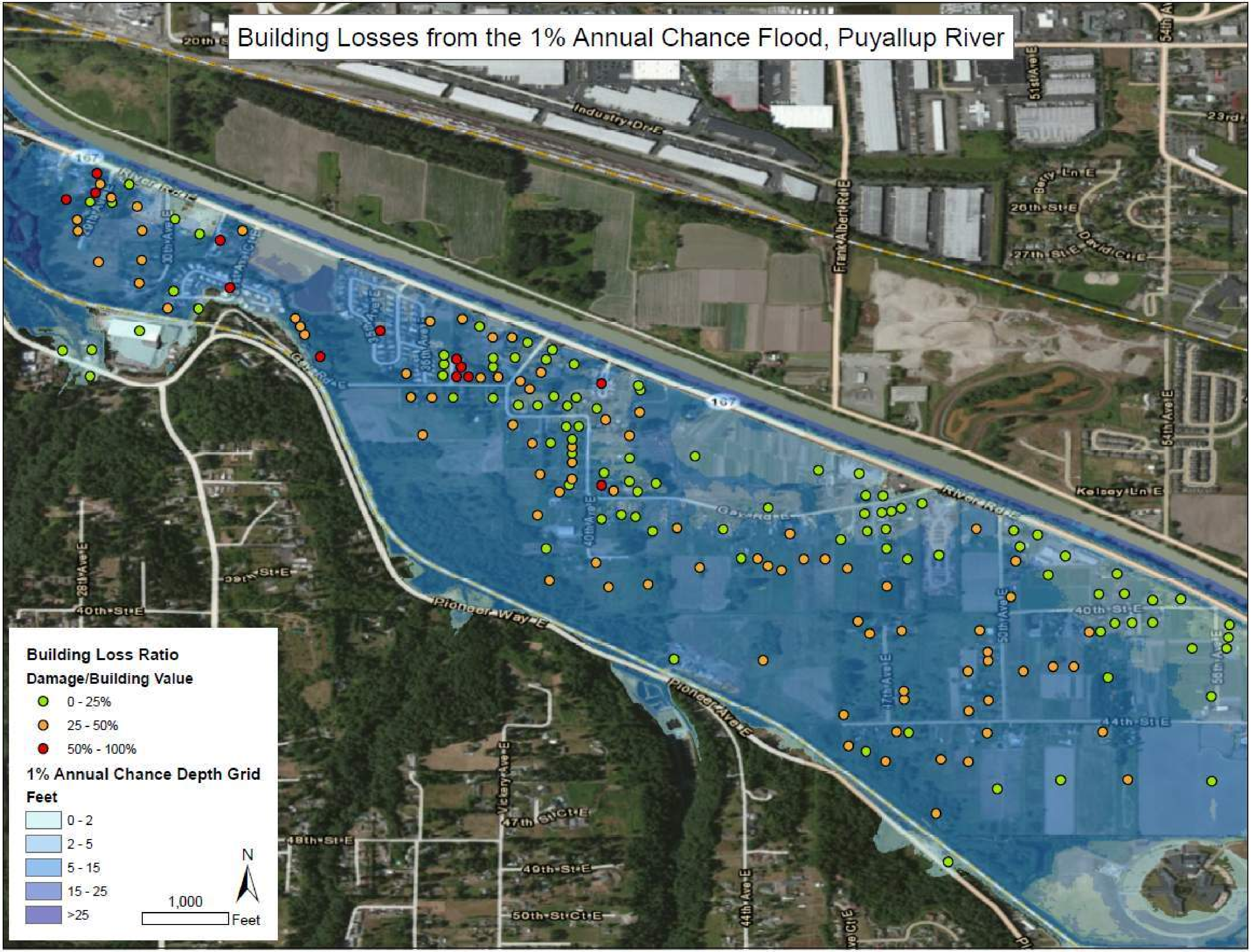
- Multiple Scenario flood and earthquake events
- Estimated Potential Losses
- Population, Debris, and Essential Facility Impacts

Multi-Hazard Assessments



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

- Flood
- Earthquake
- Tsunami
- Dam failure


Building Losses from the 1% Annual Chance Flood, Puyallup River
Building Loss Ratio
Damage/Building Value
0 - 25%
25 - 50%
50% - 100%
1% Annual Chance Depth Grid
Feet
0 - 2
2 - 5
5 - 15
15 - 25
>25
1,000
Feet
N
Industry Dr E
River Rd E
Gay Rd E
Pioneer Way E
Pioneer Ave E
Frank Albert Rd E
40th Ave E
50th Ave E
54th Ave E
40th St E
44th St E
47th St Ct E
48th St E
49th St E
50th St Ct E
Vickery Ave E
26th St E
27th St E
Berry Ln E
David Ct E
Kelsey Ln E
51st Ave E
23rd
20th
167

Output

Address	Building Value	Occupancy Type	Building Loss	Loss Ratio
2802 RIVER RD E	$7,100	Mobile Home	$5,500	**78%**
2623 31ST AV E	$174,800	Mobile Home	$132,000	**75%**
3707 GAY RD E	$15,000	Mobile Home	$10,000	**68%**
3107 36TH AVCT E	$10,300	Mobile Home	$6,800	**66%**
2411 28TH AV E	$52,400	Mobile Home	$34,000	**65%**
4109 GAY DR E	$6,600	Mobile Home	$4,200	**64%**
3705 GAY RD E	$23,100	Mobile Home	$13,900	**61%**
2518 29TH AV E	$18,200	Mobile Home	$10,400	**58%**
XXX 28TH STCT E	$1,430,6000	Mobile Home	$819,300	**57%**
4034 RIVER RD	$363,200	Mobile Home	$198,400	**55%**
3103 36TH AVCT E	$3,500	Mobile Home	$1,800	**52%**

Outreach Inserts

FEMA

Severe Storms

LOCAL HISTORY

All areas of Spokane County are vulnerable to sever
annually. Affects can range from minor disruptions in
major structural damage and business closures. The best
before, *during*, and *after* severe stroms occur. As a reside
recognize the risks associated with your area and to star
around your own home and local community. This ha
simple steps you can take today as well as offer multip
overall risk from severe winter weather and storms.

UNDERSTANDING YOUR RISK

In recent years, Spokane County has experienced severe
occur frequently with sustained gusts of up to 50 mph. Fu
heavy rain and wind. Drifting often results from blizzard
of snow in compact areas. Ice and hail storms can dam
both private and public infrastructure throughout the are

DATE	April 1972	Nov. 1981	Dec. 1995	April 1996	Nov. 1996	Dec. 1996	Dec. 1996	Dec .1996	May 1997
TYPE OF STORM	Tornado	Wind	Rain, Flood, & Wind	Rain, Flood, & Wind	Ice Storm	Winter storm, Ice, Wind, & Gale Warning	Winter storm, Ice, Wind, Gale, Landslide & Avalanche	Tornado and Thunder-storm	

REDUCING YOUR RISK

BEFORE

- Design and landscape your home with wildfire safety in mind. Select materials and plants that help contain fire rather than fuel it.
- Plant fire resistant shrubs and trees; Hardwood trees are *less* flammable than evergreen, pine, eucalyptus or fir trees.
- Regularly clean gutters and roof.
- Have your chimney cleaned and inspected at least twice a year, contact your local fire department for exact specifications regarding spark arrester installations.
- Use 1/8-inch mesh screens beneath porches, decks, floor areas and the home itself. Screen opening to floors, roof, and attic so that burning embers cannot accumulate.

DURING

- If advised to evacuate your home, do so immediately. Be sure to take your disaster supply kit, lock your home, and choose a route that travels away from the fire hazard.
- If you haven't received evacuation orders, FEMA recommend following precautions:
  - Gather fire tools such as rake, axe, handsaw/chainsaw, and
  - Close outside attic, eaves and basement vents, windows doors. Remove flammable drapes and curtains.
  - Shut off any natural gas or fuel supplies at the source.
  - Close all doors inside the house to prevent draft. Open the fireplace, but close the fireplace screen.

Floods

SPOKANE COUNTY

ORY

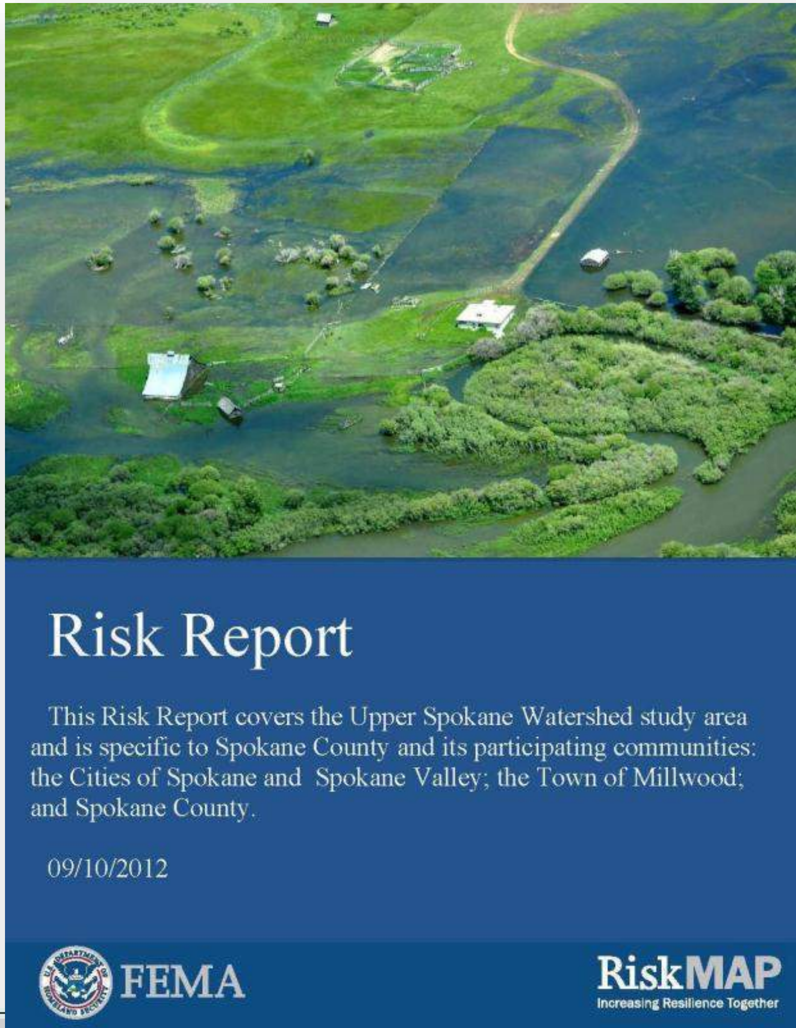
mon natural disaster in Spokane County, some even resulting in local and federal
ons in recent years. Several bodies of water in the County flood every two to five
the Spokane and Little Spokane Rivers, and Latah Creek, causing concern for
both inside and out of the floodplain. Floods have the potential to contaminate
upplies, foul septic systems, inundate electrical and heating systems, and even
er to rise and seep into basements or low-lying structures. If floodwaters
enough level, they may restrict access to certain roads or neighborhoods,
gency responders from reaching residents in times of crisis. The following
help you identify a variety of simple steps you can take today as well as offer
n approaches to reducing the overall risk from flooding.

Preparing your Home for Wildfire

In order to make your home as defensible as possible against wildfire risk, there are a host of measures that can be taken. This list is not exhaustive, but does provide a number of safety measures to better protect your property during fire season. It is recommended that you create a 30 to 100 foot safety zone around your home. Within this area, you can take steps to reduce potential exposure to flames and radiant heat. Homes built within pine forests should have a *minimum* safety zone of 100 feet. If your home sits on a steep slope, additional safety precautions should be taken. Contact your local fire department or forestry service for additional information.

- ✓ Rake leaves, dead limbs and twigs. Clear all flammable vegetation.
- ✓ Remove leaves and rubbish from under structures.
- ✓ Thin a 15-foot space between tree crowns, and remove limbs within 15 feet of the ground.
- ✓ Remove dead branches that extend over the roof.
- ✓ Prune tree branches and shrubs within 15 feet of a stovepipe or chimney outlet.
- ✓ Ask the power company to clear branches from powerlines.
- ✓ Remove vines from the walls of the home.

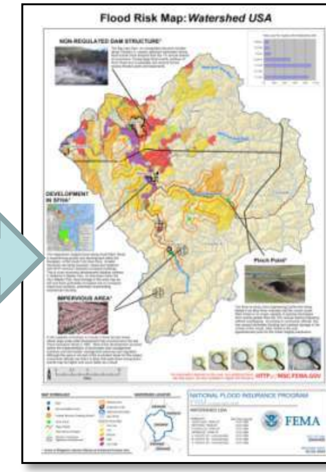
Deliverables


Risk Report

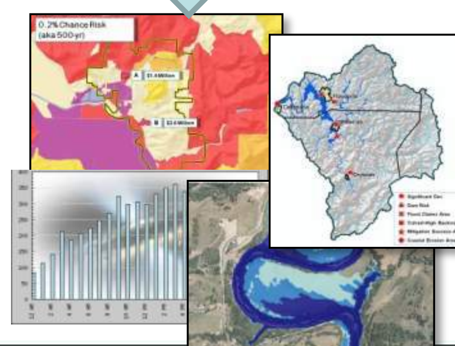
This Risk Report covers the Upper Spokane Watershed study area and is specific to Spokane County and its participating communities: the Cities of Spokane and Spokane Valley; the Town of Millwood; and Spokane County.

09/10/2012

Flood Risk Database



Flood Risk Map



Ad-Hoc Flood Risk Analyses

Proposed Project Schedule
Timeline of events

- **Flood Risk Review Meeting for Community Staff …....................................August 4, 2016**
- **Preliminary maps issued ………...~December 2016**
- **CCO Meeting/Open House Meeting……... ~January 2017**
- **Appeal Period and Draft Multi-Hazard Risk Report……………………………….~March 2017**
- **End of Appeal Period ……………………………………………………..……….…..~June 2017**
- **FEMA issues "Letter of Final Determination (LFD)" ……...……………………...September 2017?**

  to communities and publishes the BFEs in the Federal Register

  Communities have 6 months to adopt the study before the data becomes "effective". *Failure to adopt results in suspension from NFIP*
- **Risk MAP Resilience Workshop and Delivery of Final Flood Risk Report and Risk Assessment Database ……………………………………………………December 2017?**
- **Effective date ………………………………………………………………March 2018?**

Appeals & Comments

- Submit to your community officials
- Community bundles all the comments and forwards them to Region 10 Support Center

FEMA Region X Service Center

20700 44th Ave. W., Suite 110

Lynnwood, WA 98036

- Forms are available here at the open house

Letters of Map Change (LOMC) (ways to appeal at any time)

- **Letter Of Map Amendment (LOMA) -** for property owners who believe a property was incorrectly included in a floodplain, primarily through showing that the lowest elevation of the structure is above the 1% flood elevation.
- **Letter of Map Revision (LOMR) –** for communities to submit better technical information to change a floodplain or to reflect physical changes made to the floodplain.

(LOMA) Hotline - 1-877-FEMA-MAP

FEMA Coastal Outreach Website

www.fema.gov/coastal-flood-risks

Plan, Prepare & Mitigate › Protecting Homes › Flood Hazard Mapping ›
Coastal Flood Risks: Achieving Resilience Together

Follow FEMA:

- Safer, Stronger, Protected Homes & Communities
- Protecting Homes
  - Flood Insurance
  - Flood Hazard Mapping
    - Change my Flood Zone Designation
    - Letter of Map Amendment Information
    - User Groups
    - Risk MAP
    - Cooperating Technical Partners
    - Living with Levees
    - Status of Map Changes
    - Forms, Documents, and ...

Coastal Flood Risks: Achieving Resilience Together

Share/Email This Page

Related Links

- Coastal Flood Risk Study Process
- Coastal Flood Risk Resources
- Coastal Frequently Asked Questions
- National Flood Insurance Program (NFIP)

Information Tables

Flood Insurance	Flood Study / Engineering	Property Identification & Digital Mapping
State Table	City Table	Floodplain Regulations

Property Identification and Digital Mapping Table

- Determining if one is in a Flood Zone
- If yes, what type of flood zone is one in (AE, A, AO, AH, V, VE, Shaded X, unshaded X)
- Ability to add layers to help better locate a property (orthophotos, parcel data)
- Print a map of your property and the flood zone
- Where one should go next for more information (Insurance, Floodplain Regulations)

Flood Insurance Table

- When is flood insurance required?
- What is the flood insurance rate structure for the zone one is in (AE, A, AO, AH, V, VE, Shaded X, unshaded X)?
- What are my best options to get the lowest rate?

Floodplain Regulations Table

- What are the building requirements/restrictions for the zone one is in (AE, A, AO, AH, V, VE, Shaded X, unshaded X)
- What are the building requirements/restrictions for a floodway?

Community Table

- City Floodplain Regulations
- Emergency Management Capabilities
- Locally Available Hazard Mitigation Plans

State Table

- State Flood Mapping Priorities
- Risk Reducing Strategies
- State Floodplain Regulations

Flood Study/Engineering Table

- How does one determine the 1% flood?
- What areas were updated?
- What information was used (topography, bathymetry, models, assumptions)?
- What is the process to appeal the information and/or provide better information?

Questions & Comments

FEMA:

Flood Study Engineer:	**Ted Perkins**	**(425) 487-4684**
Risk Analyst/GIS Specialist:	**Amanda Siok**	**(425) 487-4626**
NFIP Insurance Specialist:	**Deb Gauthier**	**(425) 487-2023**
Floodplain Management Spec.:	**Karen Wood-McGuiness**	**(425) 487-4675**
Mitigation Planner:	**Brett Holt**	**(425) 487-4553**

State of Alaska Contacts:

State RiskMAP Coordinator	**Sally Cox**	**(907) 269-4588**
State Hazard Mitigation Officer	**Ann Gravier**	**(907) 428-7045**
State NFIP Coordinator	**Jimmy Smith**	**(907)-269-4132**

STARR PM:	**Tiffany Coleman**	**(859) 422-3024**

Flood Insurance Information: **www.floodsmart.gov**

Attachment 4

Whipple Creek Floodplain Report

June 1974

FLOOD PLAIN INFORMATION

WHIPPLE CREEK

KETCHIKAN, ALASKA

PREPARED FOR THE KETCHIKAN GATEWAY BOROUGH BY THE DEPT. OF ARMY, ALASKA DISTRICT, CORPS OF ENGINEERS, ANCHORAGE, ALASKA

JUNE 1974

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U.S. Corps of Engineers. Alaska District.

1. Floodplains

2. Whipple Creek - Floods.

3. Ketchikan, Alaska - Floods.

I. Title

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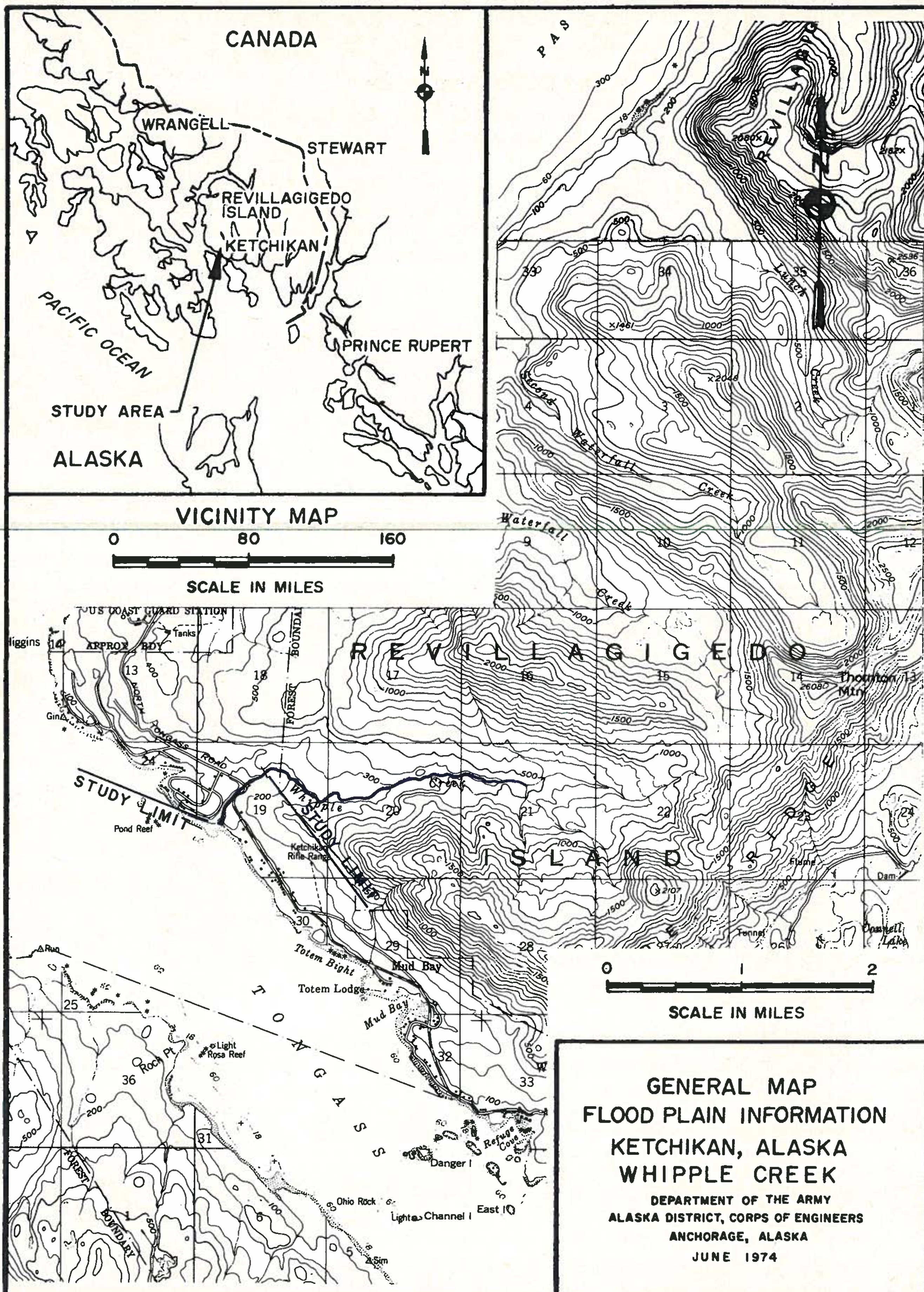


GENERAL MAP
FLOOD PLAIN INFORMATION
KETCHIKAN, ALASKA
WHIPPLE CREEK

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA
JUNE 1974

PLATE I

PREFACE

The portion of the Ketchikan Gateway Borough covered by this report is subject to flooding from Whipple Creek. The properties along this stream are primarily residential and have not been damaged by past floods. Although large floods have occurred in the past, studies indicate that even larger floods are possible. The open spaces along the stream which are available for future development are extensive.

This report has been prepared because a knowledge of flood potential and flood hazards is important in land use planning and for management decisions concerning flood plain utilization. It includes a history of flooding along Whipple Creek and identifies those areas that are subject to possible future floods. Special emphasis is given to these floods through maps, photographs, profiles and cross sections. The report does not provide solutions to flood problems; however, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development and thereby prevent intensification of loss and damage. It will also aid in the identification of other flood damage reduction techniques, such as works to modify flooding and adjustments, including flood proofing, which might be embodied in an overall Flood Plain Management (FPM) program. Other FPM program studies--those of environmental attributes and the current future land use role of the flood plain as part of its surroundings--would also profit from this information.

At the request of the Ketchikan Gateway Borough and with the endorsement of the State of Alaska, Department of Natural Resources, this report was prepared by the Alaska District, Corps of Engineers, under continuing authority provided in Section 206 of the 1960 Flood Control Act, as amended.

Assistance and cooperation of the National Weather Service, U. S. Geological Survey, Alaska Disaster Office, the "Ketchikan Daily News," and private citizens in supplying useful data and photographs for the preparation of this report are appreciated.

Additional copies of this report can be obtained from the Ketchikan Gateway Borough. The Alaska District, Corps of Engineers, upon request, will provide technical assistance to planning agencies, as well as guidance and further assistance, including the development of additional technical information.

BACKGROUND INFORMATION

Settlement

The Ketchikan Gateway Borough, consisting of approximately 12,000 square miles, with a population of over 12,000, is one of the more populated areas in the State of Alaska. The borough was formed in 1963 to provide a regional government for the Ketchikan area including Revillagigedo Island and some of the smaller offshore islands. The English explorer, Captain George Vancouver, is credited with the discovery of Revillagigedo Island in 1793, which he named after a Spanish viceroy.

A. W. Berry, who sailed into Tongass Narrows in 1882 in search of a fisheries site, is believed to have established the first white settlement on the island at the mouth of Ketchikan Creek. This spot, which teemed with spawning salmon and which is now the city center of the present-day Ketchikan, had for centuries been the home of Tlingit Indians. Berry's settlement was short-lived, ending when fire destroyed most of the fisheries plant. The following year, M. E. Martin, financed by Portland, Oregon interests, purchased the remains of the cannery, as well as land from the Indians. Several other canneries were established in the area and eventually the U. S. Customs station was transferred from Mary Island to Ketchikan. Thus, the city became a port of entry for all ships plying the waters of Alaska, an important factor in its growth and development. The city also began to prosper with the gold rush of 1898 when miners found opportunity in prospecting the mountains and valleys of the area. Gold, silver, copper, platinum and other minerals were discovered within the present city limits and elsewhere on

Revillagigedo and nearby islands. Ketchikan was incorporated as a city in 1900 as a booming mining town with a population of 800.

Commercial fishing took over as the leading industry with the decline of mining early in the century. As the fishing industry developed, Ketchikan increased in population and activity until it had gained the distinction of being known as the "Canned Salmon Capitol of the World."

Dwindling salmon stocks brought about a decline in the fishing industry in the 1950's. After the decline in mining and fishing, a big boost to Ketchikan's economy came in the form of construction and operation of the Ketchikan Pulp Company - a 55 million dollar plant at nearby Ward Cove.

Today, Ketchikan, Alaska's third largest city, has a diversified economic base with industries in fishing, timber and pulp, and in tourism. Modern buildings of all kinds afford contrast to the many interesting totem poles, reminders of the great Indian tribes and clans which once inhabited the area.

The Stream and Its Valley

Whipple Creek, with a drainage area of 5.30 square miles, originates in the mountains north of Wacker and lies entirely outside the city limits of Ketchikan. The heavily timbered watershed lies northwest of Slide Ridge with elevations ranging from sea level to over 2100 feet. The stream flows generally westward to the salt waters of Tongass Narrows, entering the narrows opposite the north end of Gravina Island. Only a little more than one-half mile of the stream lies outside the boundary of the Tongass National Forest. This is the portion of Whipple Creek included in the study area as shown on the General Map, Plate 1.

The section of the stream bed west of the North Tongass Highway is characterized by waterfalls and cataracts and has a steep gradient. Above the highway bridge, however, the stream bed is mostly sand and gravel, sloping gently upward to the forest boundary. Runoff generally reaches the creek through small tributaries or enters directly from the surrounding slopes. Drainage areas contributing to the runoff in or near the study area are shown in Table 1.

TABLE I

DRAINAGE AREAS

Location	River Mile	Drainage Area Sq. Mile
Whipple Creek at Nat'l Forest boundary	0.60	5.16
Whipple Creek at USGS Gage	0.35	5.29
Whipple Creek at Mouth	0.0	5.30

The city of Ketchikan lies just below the 56th parallel in the southeasternmost part of the state. The entire southeast region of Alaska is typified by large amounts of rainfall and experiences a maritime climate, due to its proximity to the Pacific Ocean. Ketchikan has a mean annual precipitation of 154 inches with the major portion occurring in the fall. Temperatures are relatively mild and the daily variations minimal. Seasonal variations are also minimal, with normal temperatures ranging from 35°F in January to 58°F in August. The mean annual temperature of the area is approximately 46°F.

FIGURE 1 - Looking at Tongass Narrows from the mouth of Whipple Creek.

FIGURE 2 - The new North Tongass Highway Bridge spanning Whipple Creek.

FIGURE 3 - Upstream view of Whipple Creek just above the Old Highway Bridge.

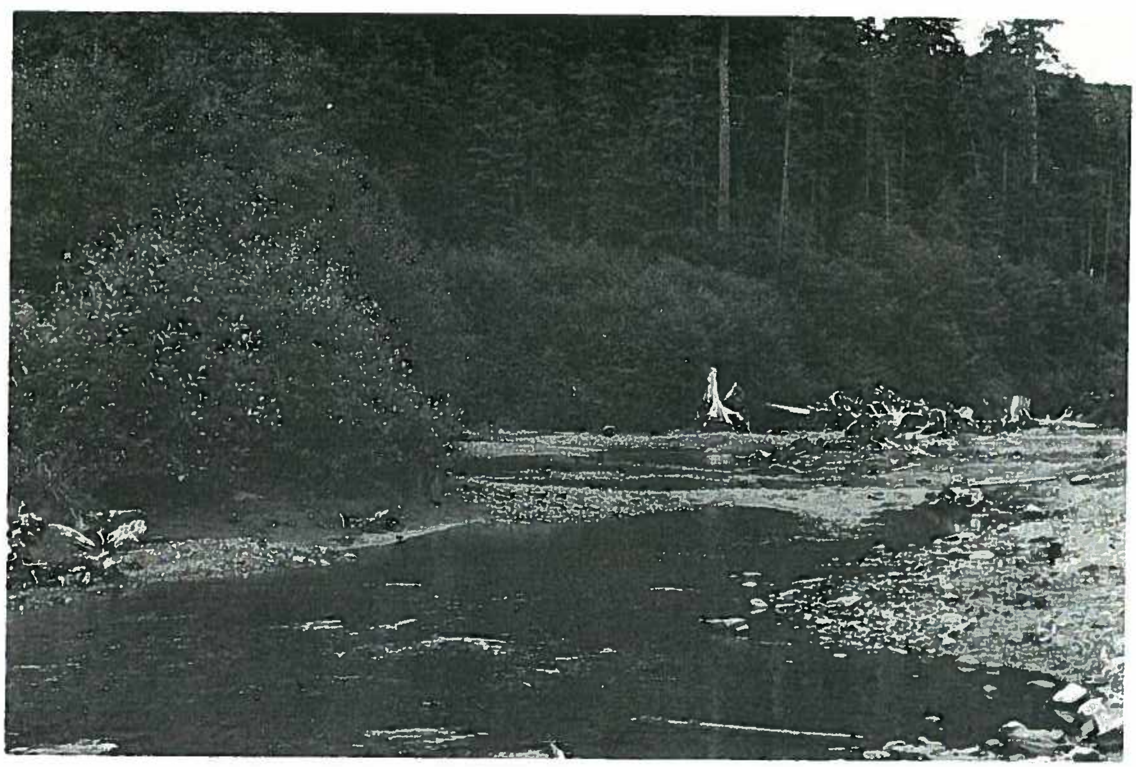


FIGURE 4 - Upstream view of Whipple Creek in the vicinity of the upper study limit.

Developments in the Flood Plain

As previously mentioned, the portion of Whipple Creek included in the study extends from the salt waters of the Tongass Narrows upstream for a little over one-half mile to a point just outside the boundary of the Tongass National Forest. There is some nearby residential development along the lower reach of the stream, west of the North Tongass Highway. Present development, though, is minor and because of the steep gully through which the stream passes in this area, is not located within the flood plain.

There are only two stream crossings in the study area, each utilizing bridges. One of these is the new North Tongass Highway bridge and the other is the old highway bridge which is presently abandoned. Fallen timber, boulders and debris are present and serve to obstruct the stream to some extent.

FLOOD SITUATION

Source of Data and Records

The U. S. Geological Survey has collected stream gaging records on Whipple Creek from 1968 to the present. To supplement the records of the gaging station, newspaper files, historical documents and records were searched for information concerning past floods. From these investigations and from the studies of possible future floods on Whipple Creek, the local flood situation, both past and future, has been developed.

Maps used for this report were prepared, utilizing photogrammetric methods, from aerial photographs taken in 1973. Stream cross sections and data on bridge crossings were obtained by field surveys in 1973.

Flood Season and Flood Characteristics

High flows occur primarily as a result of intense precipitation which may occur anytime during the fall and winter months. The greatest rainfall potential occurs in the fall. During winter months, rapid snowmelt can contribute heavily to high flows. The maximum recorded peak discharge of 2830 cfs occurred on November 19, 1968. Two other peak discharges, greater than 1000 cfs, have been recorded in the seven years of records. They are 1800 cfs on November 2, 1969 and 1640 cfs recorded on August 19, 1971.

River stages can rise from normal levels to extreme flood peaks in a relatively short period of time. Floods are generally of short duration and characteristically have high velocities in the main channel and lower velocities in overbank areas.

Basically, there are two types of flooding that can occur on Whipple Creek. The first is the result of storm-related runoff, as exemplified by the Intermediate Regional and Standard Project Flood projections. Such flooding could occur at any time, due to the abundant rainfall in the Ketchikan area. The second form of flooding is the result of timber and debris jams occurring at random locations along the stream. Although the volume of flow in the stream might be substantially less than the aforementioned flood predictions, the resulting level of flooding can be higher.

Factors Affecting Flooding and their Impact

Obstructions to Floodflows - Natural obstructions to floodflows include trees, brush and other vegetation growing along the stream banks in flood plain area. Man-made encroachments on or over the stream, such as the roads and bridges, can also create more extensive flooding than would otherwise occur.

During floods, trees, brush and other vegetation growing in the flood plain impede floodflows, thus creating backwater and increased flood heights. Trees and other debris may be washed away and carried downstream to collect at bridge piers or other obstructions. As floodflows increase, masses of debris could break loose and surge downstream until another obstruction is encountered.

In general, obstructions restrict floodflows and result in overbank flows, unpredictable areas of flooding, possible destruction of bridges and pile-supported structures and an increased velocity of flow immediately downstream. It is impossible to predict the degree or location of the accumulation of debris; therefore, for the purposes of this report, it was necessary to assume that there would be no accumulation of debris along the stream or at any of the bridges in the development of the flood profiles.

Flood Damage Reduction Measures - There are no existing flood control structures on Whipple Creek. Neither is there an existing borough ordinance, building code or other regulating measure specifically for the reduction of flood damage. This study has been requested so that it may be used as a basis for the development of Flood Plain Management planning measures by the Ketchikan Gateway Borough.

Other Factors and Their Impact - Due to its steep slope and high velocity flow and the fact that much of the stream is contained within a steep gully, Whipple Creek has a narrow flood plain. With the high velocities, though, erosion can become a major problem during flooding. Flooding and threats of flooding promote action by local officials and individuals in flood warning and flood fighting activities. Due to the size and nature of the development along Whipple Creek, there is no significant problem with floatable materials being stored in the flood plain, which could cause additional damage.

Flood Warning and Forecasting - The National Weather Service, Alaska River Forecast Center (RFC), located in Anchorage, is responsible for issuing flood forecasts and flash flood warnings for the Ketchikan area including Whipple Creek. These forecasts and warnings are based on current and forecast precipitation and are disseminated to the public by commercial radio and television stations. Weather warnings and forecasts are also issued by the National Weather Service using the same communication facilities.

Flood Fighting and Emergency Evacuation Plans - Although there are no formal flood fighting or emergency evacuation plans for the Ketchikan area, provisions for alerting area residents in time of emergency are accomplished by the Alaska Disaster Office through the Ketchikan Gateway Borough. This office maintains communication with the National Weather Service at its control center, establishing a "flood watch" during the early stages of flood threat. Residents along the stream are warned by radio and telephone of approaching flood conditions and advised to evacuate the area. Subsequent flood fighting, evacuation and rescue activities are coordinated on a borough-wide basis with borough officials.

Material Storage on the Flood Plain - As previously stated, due to the size and nature of the development along Whipple Creek, there are no significant quantities of floatable materials stored in the flood plain. If they were present, they could be carried away by flood flows, causing damage to any structures downstream.

PAST FLOODS

Summary of Historical Floods

Very little information is available concerning historical floods on Whipple Creek, since records of past floods are very meager and, in most cases, non-existent. Flooding which has occurred has generally been confined to slight overbank flooding and erosion. Field investigations and office computations supplemented what data were available and were used to develop the flood profiles of this report.

Flood Records

Local records regarding past floods and damages are non-existent or are lacking in detail. City and borough officials and other residents were interviewed in an effort to obtain any available information on past floods.

Flood Descriptions

Due to the lack of development adjacent to Whipple Creek, records and information are limited and no description of past floods is available.

FUTURE FLOODS

Floods of the same or larger magnitude as those that have occurred in the past will occur in the future. Larger floods have been experienced in the past on streams with similar geographical and physiographical characteristics as those found in the study area. Similar combinations of rainfall and runoff which caused these floods could occur in the Whipple Creek area. Therefore, to determine the flooding potential of the study area, it was necessary to consider storms and floods that have occurred in regions of like topography, watershed cover, and physical characteristics. Discussion of the future floods in this report is limited to those that have been designated as the Intermediate Regional Flood and the Standard Project Flood. The Standard Project Flood represents a reasonable upper limit of expected flooding in the study area. The Intermediate Regional Flood may reasonably be expected to occur more frequently, although it will not be as severe as the infrequent Standard Project Flood.

Intermediate Regional Flood

The Intermediate Regional Flood (IRF) is defined as one that could occur once in 100 years, on the average, although it could occur in any year. The peak flow of this flood was developed from a statistical analysis of streamflow and precipitation records and a study of runoff characteristics; however, limitations in Whipple Creek basin data required analysis on a regional rather than a watershed basis. In determining the Intermediate Regional Flood for Whipple

Creek, statistical studies were made using flood data from U. S. Geological Survey gaging stations and precipitation data from National Weather Service climatological stations in the vicinity of Ketchikan, Alaska. The peak flow developed for the Intermediate Regional Flood in the study area is 3,800 cubic feet per second.

Standard Project Flood

The Standard Project Flood (SPF) is defined as a major flood that can be expected to occur from a severe combination of meteorological and hydrologic conditions that is considered reasonably characteristic of the geographical area in which the study area is located, excluding extremely rare combinations. The Corps of Engineers, in cooperation with the NOAA Weather Service, has made comprehensive studies and investigations based on the past records of experienced storms and floods and has developed generalized procedures for estimating the flood potential of streams. The peak discharge for the Standard Project Flood on Whipple Creek is 5630 cfs. A discharge hydrograph for the Standard Project Flood on Whipple Creek is shown on Plate 9. Table 2, on the following page, shows a flood elevation comparison between the Intermediate Regional and the Standard Project Floods at the North Tongass Highway Bridge.

TABLE 2

FLOOD ELEVATION

Whipple Creek at North Tongass Highway

Flood	Elevation (a)
Standard Project	103.5
Intermediate Regional	101.1

(a) Feet, Mean Lower Low Water Datum

Frequency

A frequency curve of peak flows was constructed based on an analysis of past flooding on Whipple Creek and other streams in the area. The frequency curve thus derived, which is available upon request, reflects the judgment of the engineers who have studied the area and are familiar with the region; however, it must be regarded as approximate and should be used with caution in connection with any planning of flood plain use. Floods larger than the Standard Project Flood are possible but the combination of factors necessary to produce such a large would be extremely rare.

Hazards of Large Floods

The extent of damage caused by any flood depends on the topography of the area flooded, depth and duration of flooding, velocity of flow, rate of rise, developments in the flood plain and the effectiveness of flood fighting efforts. Floodwaters flowing at high velocity and carrying floating debris would create conditions hazardous to persons and vehicles attempting to cross flooded areas. In general, floodwaters three feet deep or more and flowing at a velocity of three feet per second or more could easily sweep an adult person off his feet, thus creating definite danger of injury or drowning. Wells could be flooded and water lines could be ruptured by deposits of debris and the force of the floodwaters, thus creating the possibility of contaminated domestic water supplies. Isolation of areas by floodwater could create hazards in terms of medical, fire or law enforcement emergencies.

Flooded Areas and Flood Damage - The areas along Whipple Creek that would be flooded by the Intermediate Regional and Standard Project Floods are shown on Plates 2 and 3. The actual limits of overflow may vary somewhat from those shown on the map because the five-foot contour intervals and the scale of the maps do not permit precise plotting of the flooded area boundaries. As may be seen from the flooded area maps, the flood plain of Whipple Creek is narrow. Just upstream from the mouth, the banks of Whipple Creek are steeply sloped and easily contain the projected flood volumes. Cascades and waterfalls are encountered at intervals between the beach and the North Tongass Highway. Little out-of-bank flooding, if any, is anticipated in this area. The reaches of the stream just upstream and downstream from the Tongass Highway are not likely to flood out of banks. There is a possibility of a debris jam around the support pier of the bridge but any backwater will be contained within the high banks.

Upstream of the highway, flow is maintained within the channel banks to the old highway bridge. Further upstream, some stream bank overtopping will occur, but no serious damage is anticipated because of the absence of development. Flooding in the upper reaches of Whipple Creek will be contained within a relatively small area and all floodwater is expected to drain back into the channel at a point immediately downstream.

Plates 4, 5 and 6 show water surface profiles for the Intermediate Regional and the Standard Project Floods. These profiles can be used to determine elevations the flood would attain at any location and the depth of flow. Typical cross sections of the flood plain at selected locations, together with the water surface elevation and extent of the IRF and SPF are shown on Plates 7 and 8.

Obstructions - During floods, debris collecting around the bridges could decrease their carrying capacity and cause greater water depths (backwater effect) upstream of these structures. Since the occurrence and amount of debris are indeterminate factors, only the physical characteristics of the bridges were considered.

Velocities of Flow - Water velocities during floods depend on the size and shape of the stream and the bed slope, all of which vary on different streams and at different locations on the same stream. During the Intermediate Regional Flood, velocities of main channel flow above tidal influence would range from 6 to 15 feet per second. Velocities of this magnitude are sufficient to cause severe erosion to streambanks and the fill around bridge abutments, move structures off their foundations, transport vehicles, and cause similar damages. Overbank flow would average about two feet per second. The velocity of flow would be slightly higher during the Standard Project Flood.

Rates of Rise and Duration of Flooding - Intense rainfalls that accompany severe storm fronts usually produce the floods occurring on Whipple Creek. There is a short time lag before flooding actually begins. Floods generally rise rapidly to their peak discharge and then recede almost as fast.

Photographs, Future Flood Heights - The levels that the Intermediate Regional and Standard Project Floods are expected to reach at various locations in the study area are indicated on the photographs shown on the following pages.

FIGURE 5 - Future flood heights at upstream side of the new North Tongass Highway Bridge.

FIGURE 6 - FUTURE FLOOD HEIGHTS AT UPSTREAM SIDE OF THE OLD HIGHWAY BRIDGE.

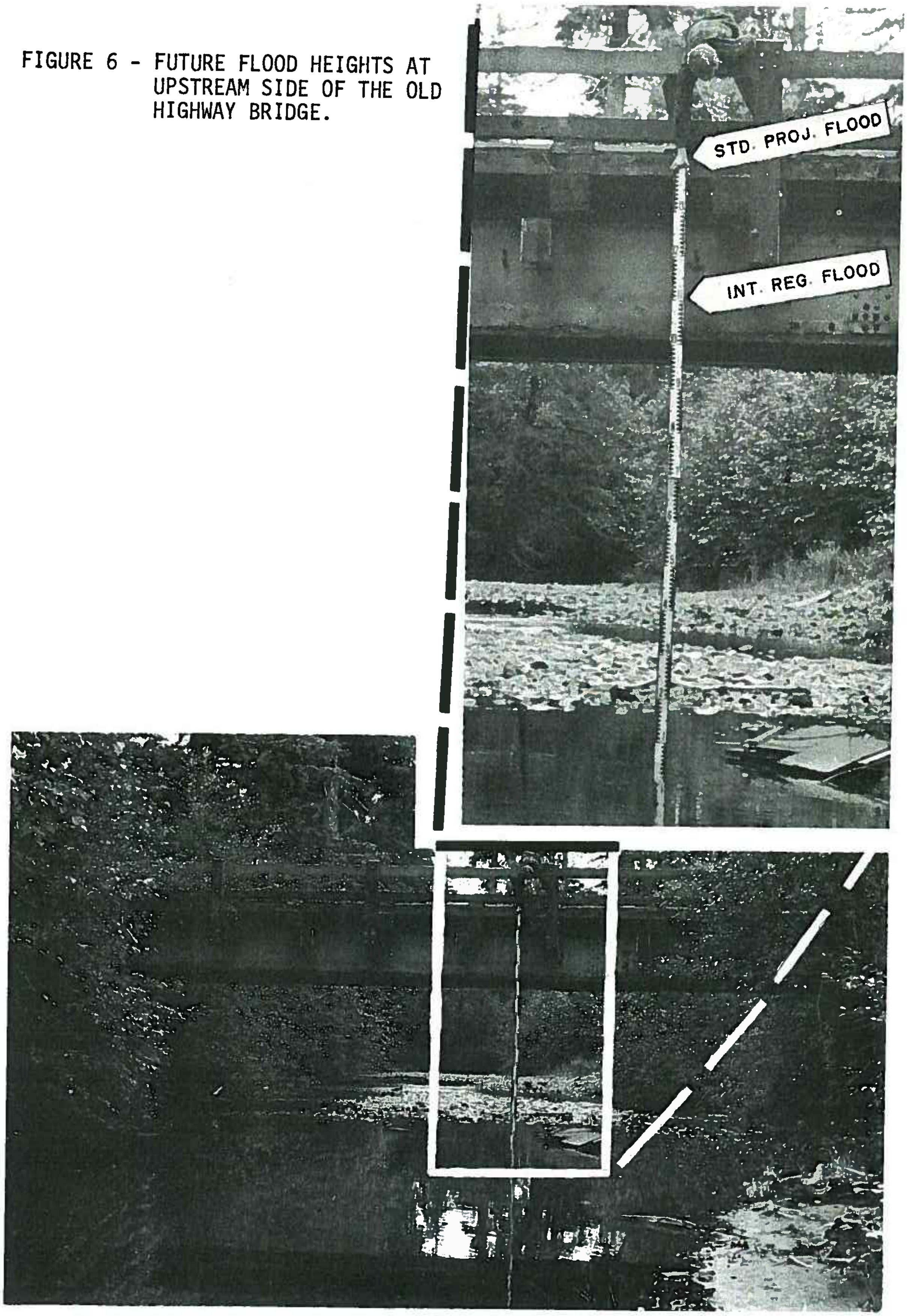
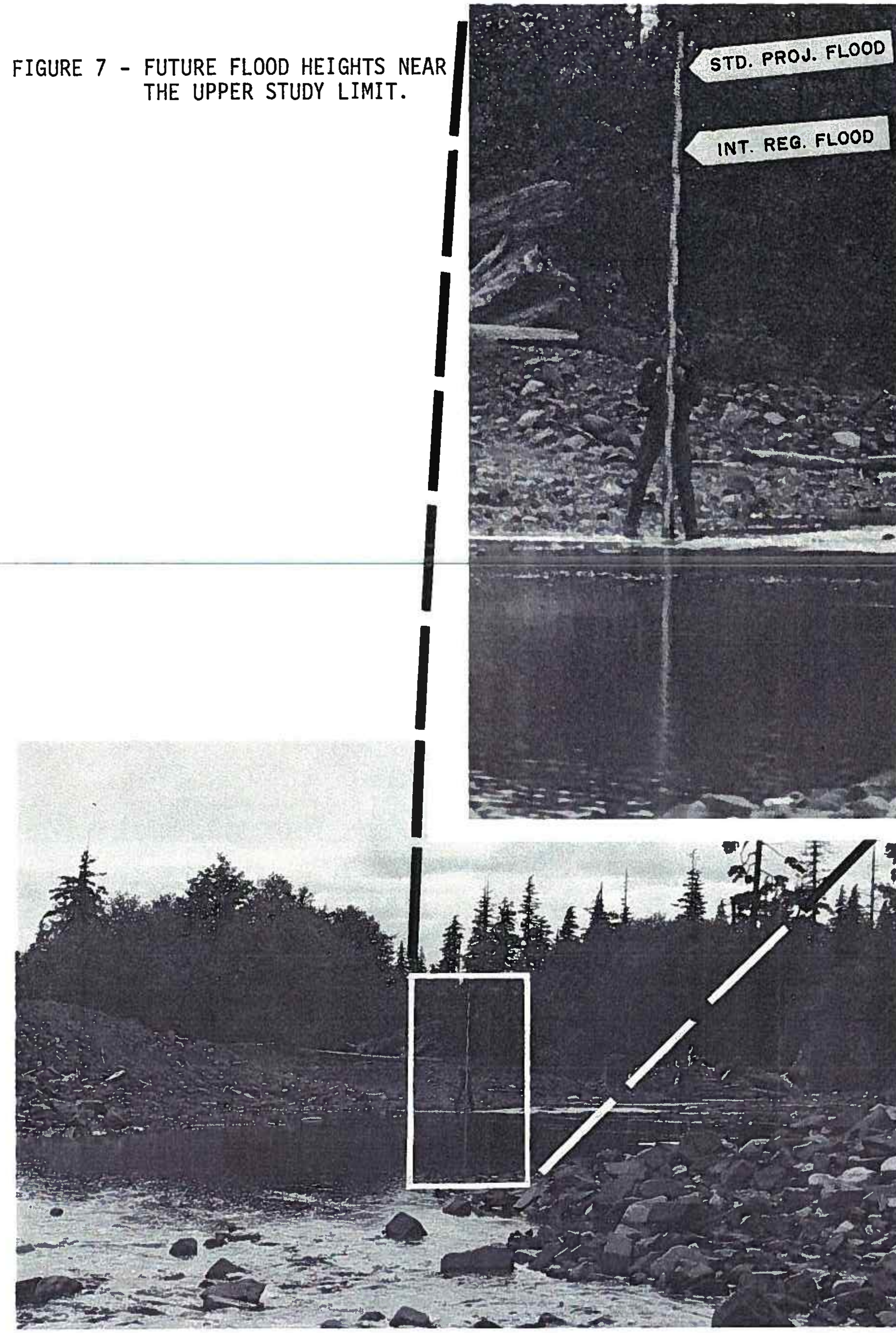


FIGURE 7 - FUTURE FLOOD HEIGHTS NEAR THE UPPER STUDY LIMIT.



GLOSSARY

Backwater. The resulting high water surface in a given stream due to a downstream obstruction or high stages in an intersecting stream.

Flood. An overflow of lands not normally covered by water that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Peak. The maximum instantaneous discharge of a flood at a given location. It usually occurs at or near the time of the flood crest.

Flood Plain. The areas adjoining a river, stream, watercourse, ocean, lake, or other body of standing water that have been or may be covered by floodwater.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Hydrograph. A graph showing flow values against time at a given point, usually measured in cubic feet per second. The area under the curve indicates total volume of flow.

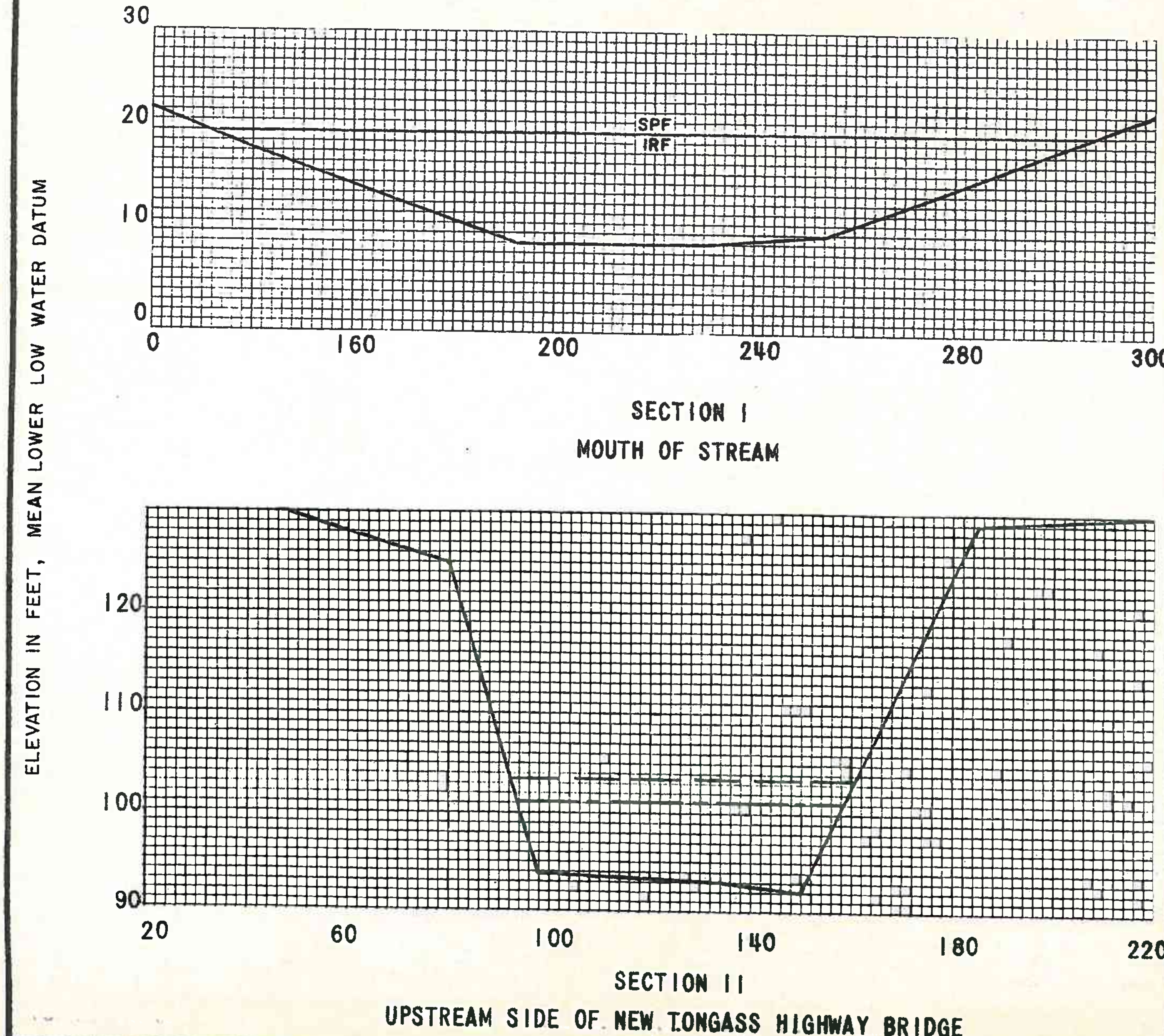
Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the general region of the watershed.

Left Bank. The bank on the left side of a river, stream or watercourse, looking downstream.

Right Bank. The bank on the right side of a river, stream, or watercourse, looking downstream.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40-60 percent of the Probable Maximum Floods for the same basins. As used by the Corps of Engineers, Standard Project Floods are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Underclearance Elevation. The lowest point of a bridge or other structure over or across a river, stream, or watercourse that limits the opening through which water flows. This is referred to as "low steel" in some regions.



LEGEND

— — — STANDARD PROJECT FLOOD

— — — INTERMEDIATE REGIONAL FLOOD

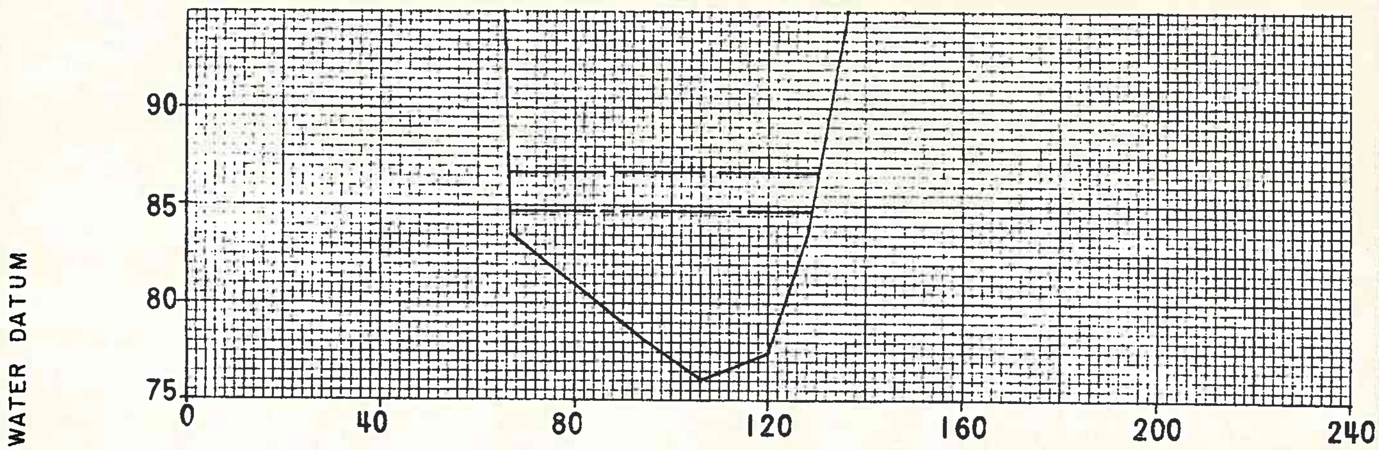
NOTE

SECTIONS TAKEN LOOKING DOWNSTREAM. ADDITIONAL SECTIONS NOT SHOWN BUT AVAILABLE AT DISTRICT OFFICE.

SELECTED CROSS SECTIONS
FLOOD PLAIN INFORMATION
WHIPPLE CREEK
KETCHIKAN, ALASKA

PREPARED BY THE
DEPARTMENT OF THE ARMY
ALASKA DISTRICT, CORPS OF ENGINEERS
ANCHORAGE, ALASKA
JUNE 1974

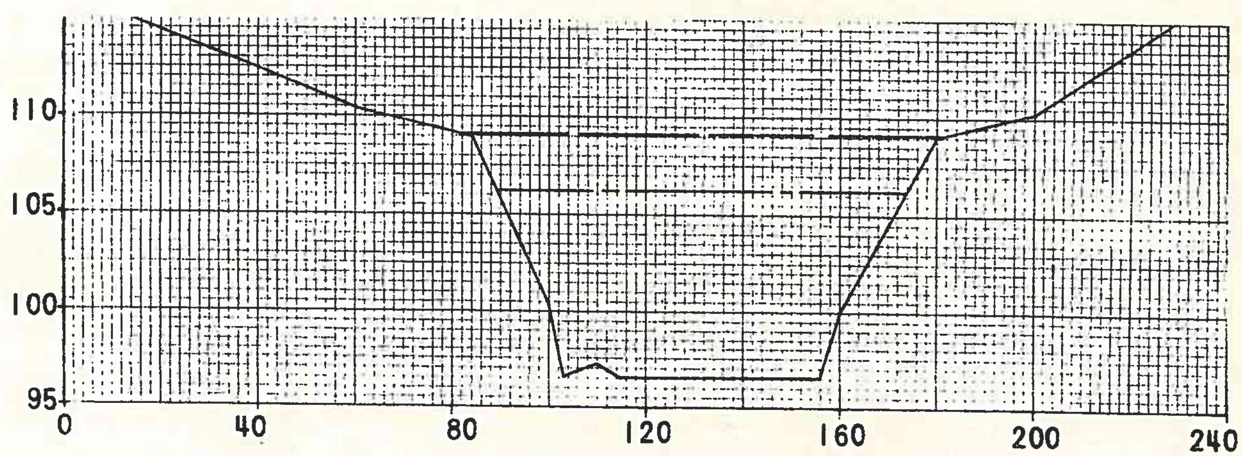
PLATE 7



DISTANCE IN FEET

CROSS SECTION 6

UPSTREAM SIDE OF OLD TONGASS HIGHWAY BRIDGE



DISTANCE IN FEET

CROSS SECTION 13.2

UPSTREAM SIDE OF OLD TONGASS HIGHWAY BRIDGE

LEGEND

— — — STANDARD PROJECT FLOOD

—— — — INTERMEDIATE REGIONAL FLOOD

NOTE

SECTIONS TAKEN LOOKING DOWNSTREAM. ADDITIONAL SECTIONS NOT SHOWN BUT AVAILABLE AT DISTRICT OFFICE.

SELECTED CROSS SECTIONS
FLOOD PLAIN INFORMATION
WHIPPLE CREEK
KETCHIKAN, ALASKA

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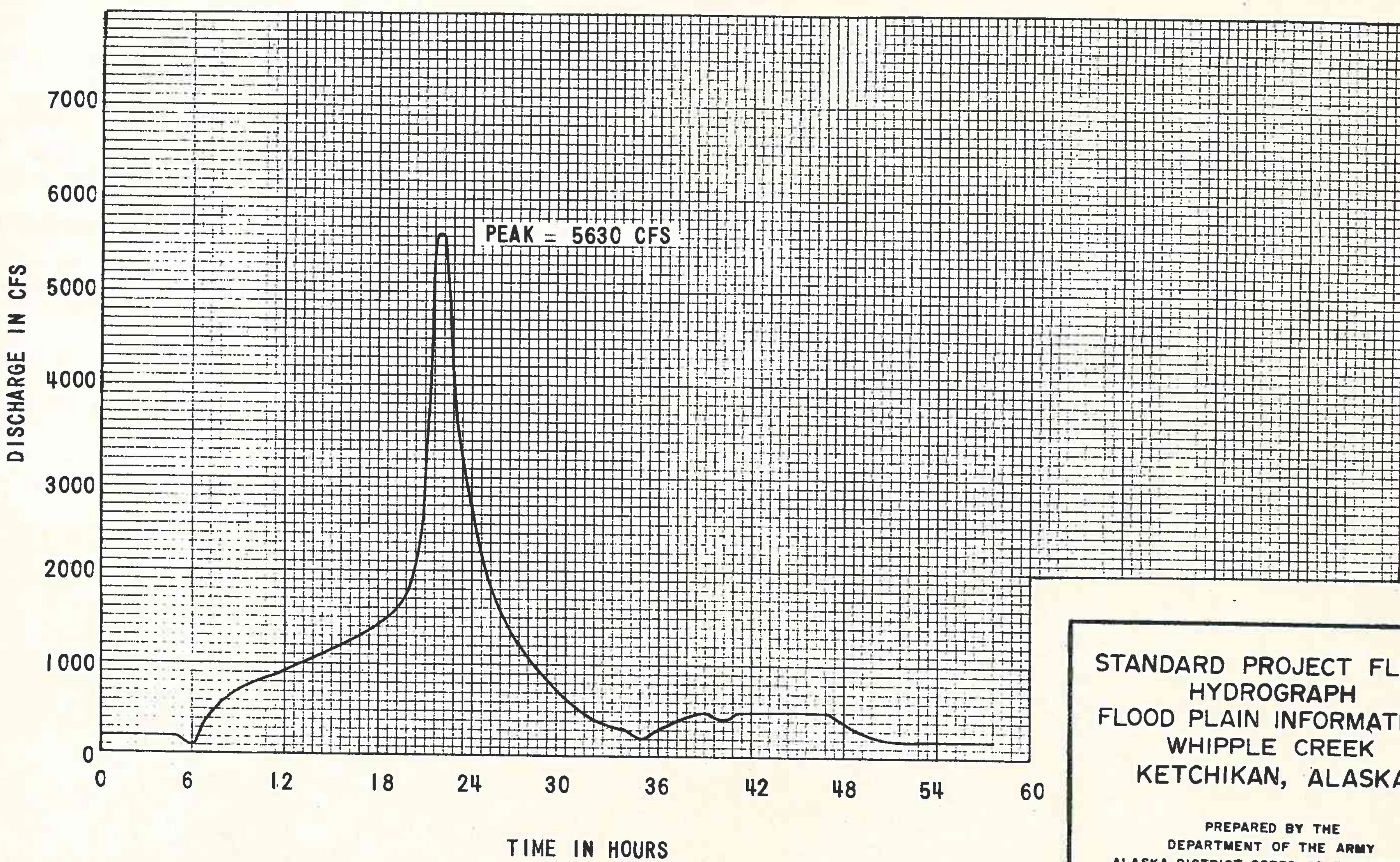
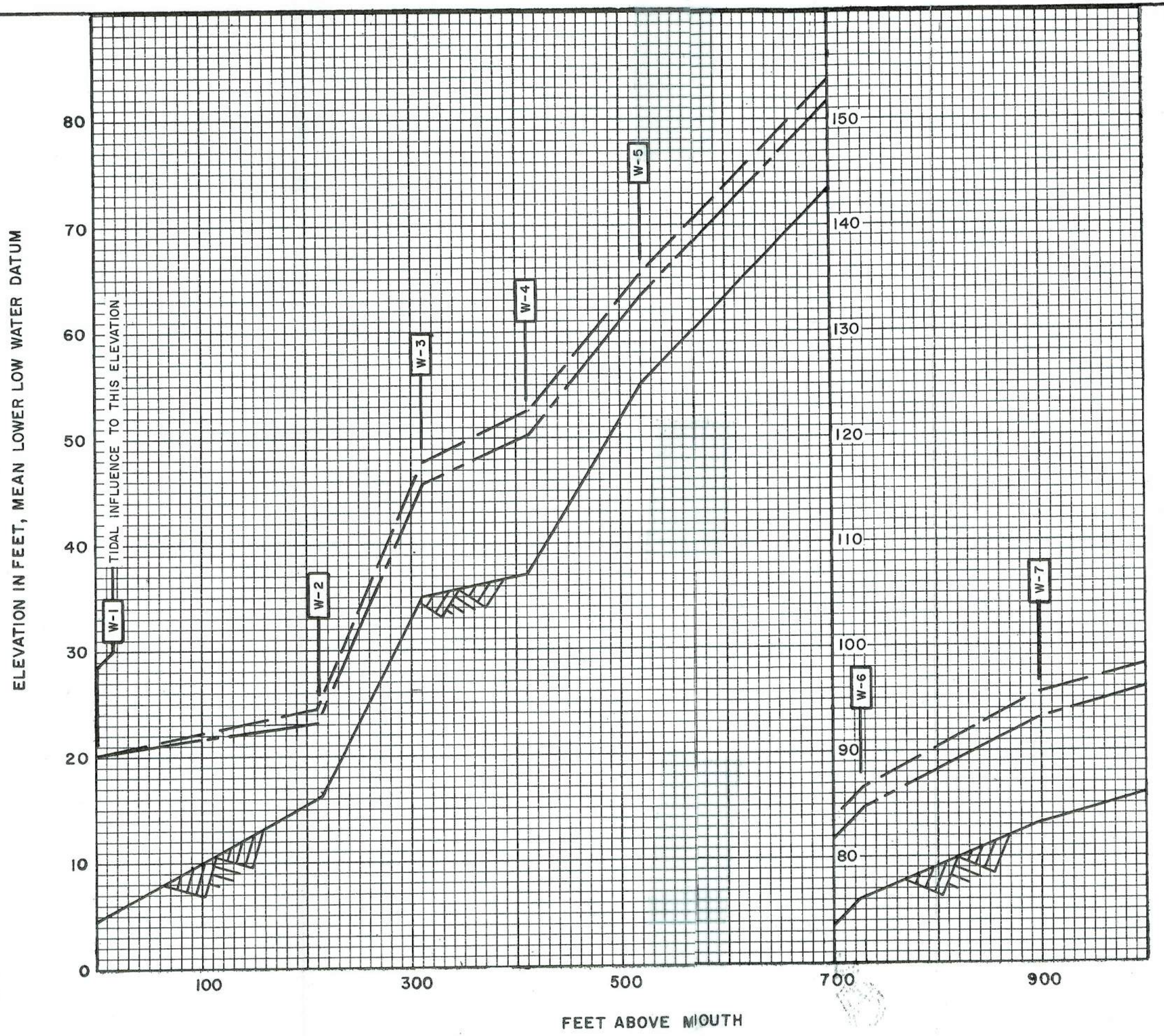
ANCHORAGE, ALASKA
JUNE 1974



STANDARD PROJECT FLOOD HYDROGRAPH
FLOOD PLAIN INFORMATION
WHIPPLE CREEK
KETCHIKAN, ALASKA

PREPARED BY THE
DEPARTMENT OF THE ARMY
ALASKA DISTRICT CORPS OF ENGINEERS
ANCHORAGE, ALASKA
JUNE 1974



LEGEND

STANDARD PROJECT FLOOD

INTERMEDIATE REGIONAL FLOOD

STREAM BED

W-2 CROSS SECTION

HIGH WATER PROFILES
FLOOD PLAIN INFORMATION
WHIPPLE CREEK
KETCHIKAN, ALASKA

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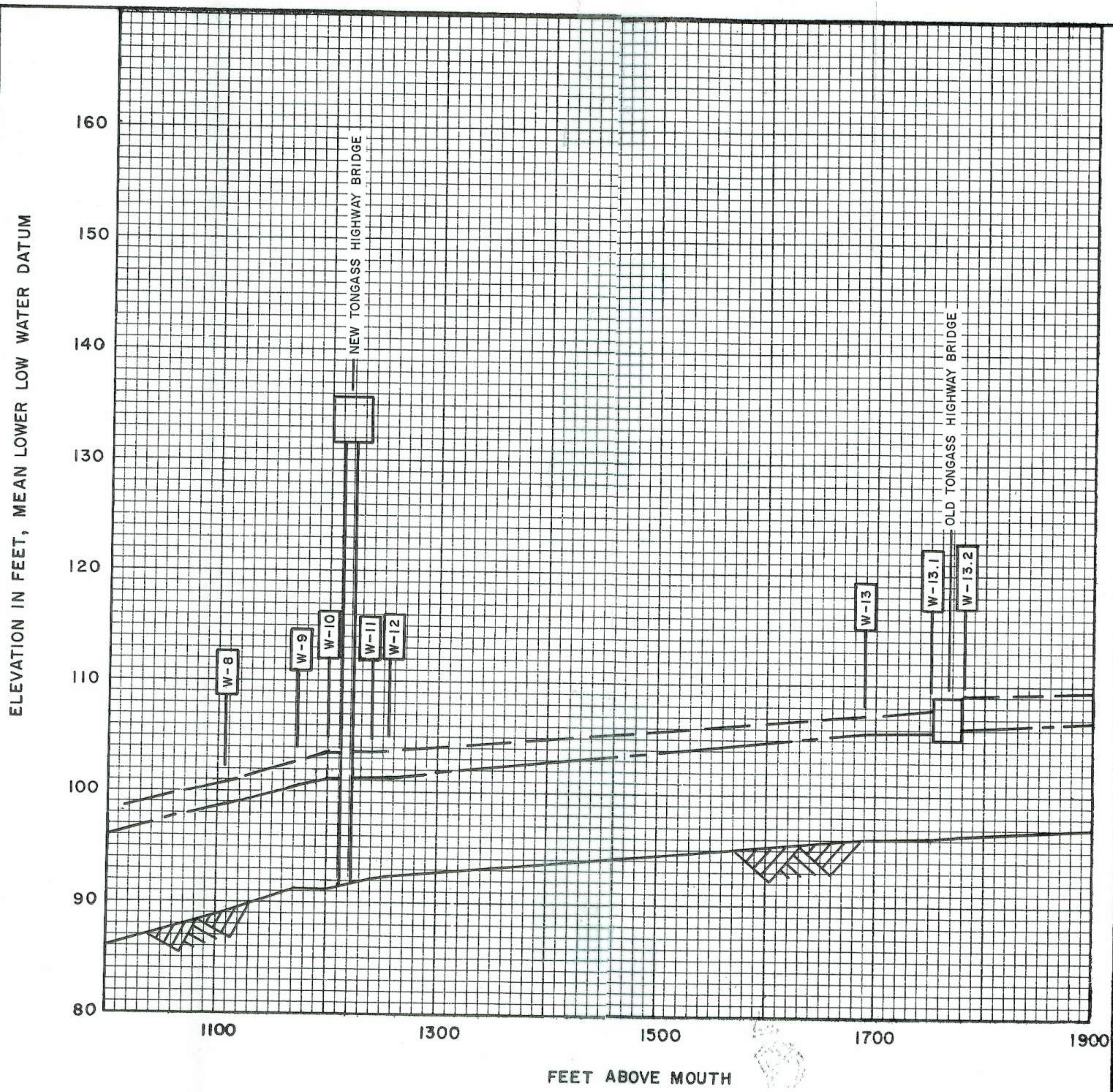
PLATE 4



LEGEND

STANDARD PROJECT FLOOD

INTERMEDIATE REGIONAL FLOOD

STREAM BED

W-2 CROSS SECTION

HIGH WATER PROFILES
FLOOD PLAIN INFORMATION
WHIPPLE CREEK
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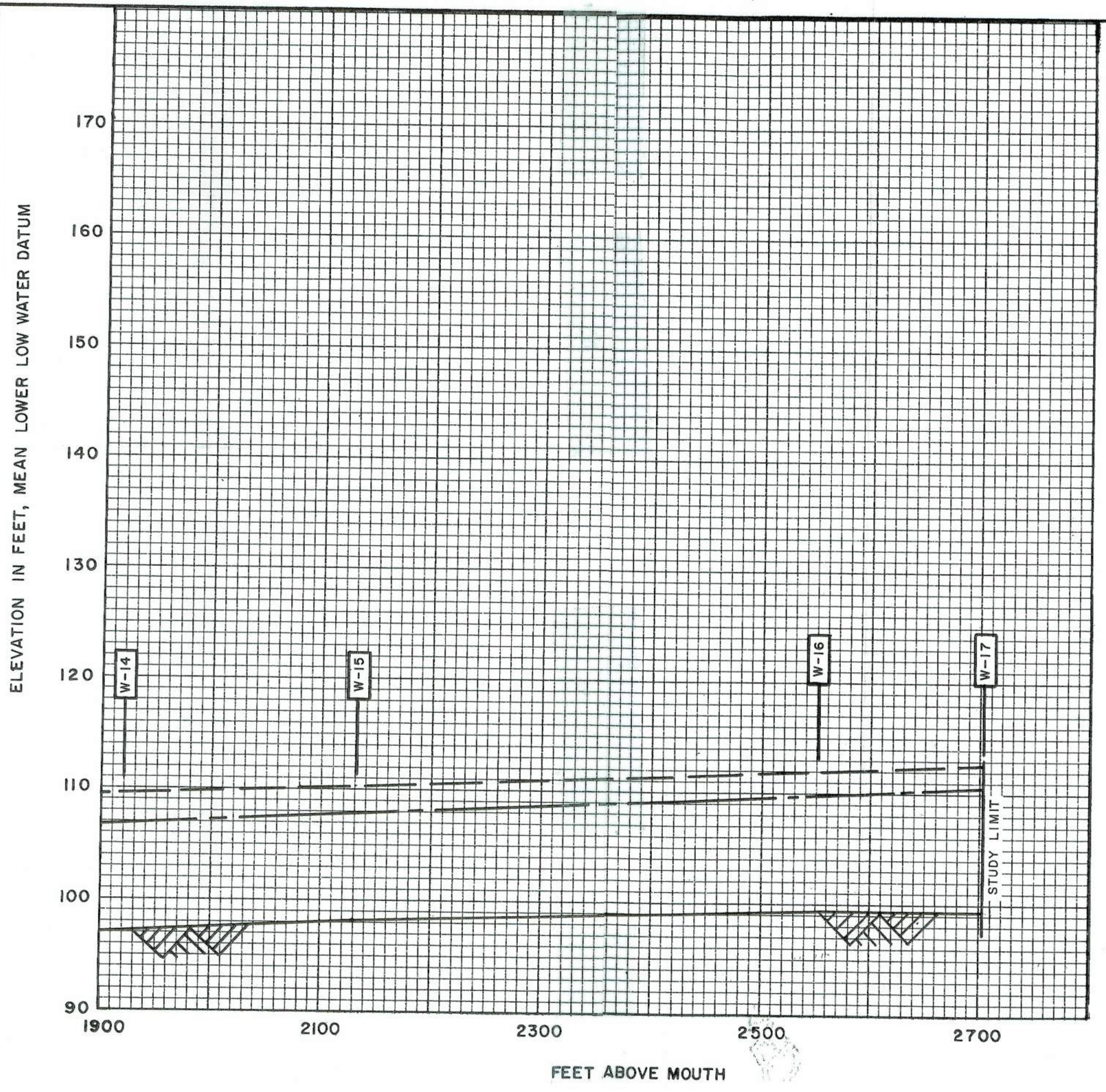
JUNE 1974

PLATE 5



LEGEND

- STANDARD PROJECT FLOOD
- INTERMEDIATE REGIONAL FLOOD
- STREAM BED
- W-2 CROSS SECTION

HIGH WATER PROFILES
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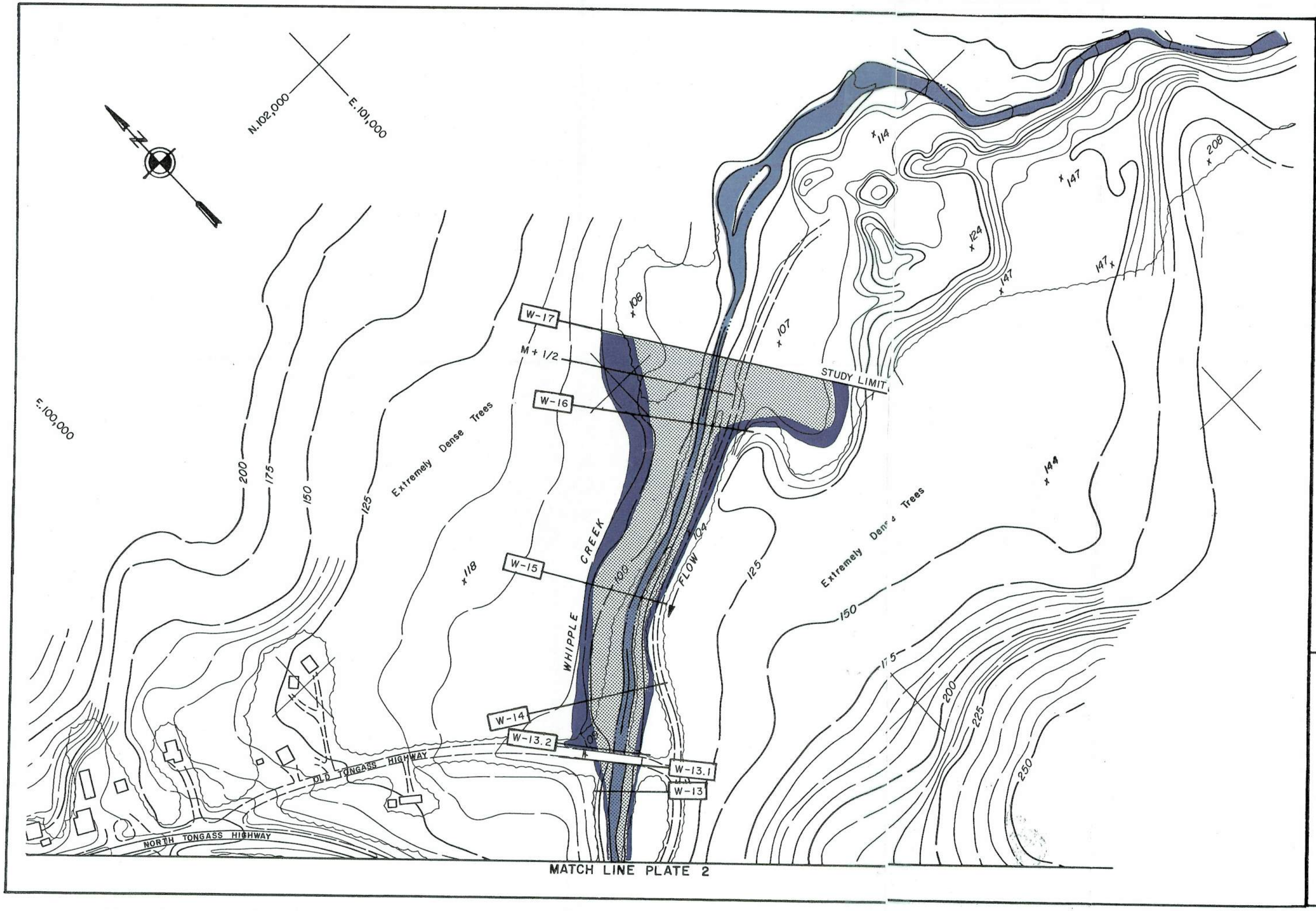

LEGEND

OVERFLOW LIMITS

STREAM CHANNEL — INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+4 — MILES ABOVE MOUTH

W-3 — CROSS SECTION

250 — GROUND ELEVATION IN FEET MEAN LOWER LOW WATER DATUM.

NOTES

1. MAP BASED ON 1965 CITY OF KETCHIKAN MAP.
2. LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.
3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. CONTOURS BELOW 200' AT 5' INTERVALS, ABOVE 200' AT 10' INTERVALS.

0 200 400

SCALE IN FEET

FLOODED AREA MAP
FLOOD PLAIN INFORMATION
WHIPPLE CREEK
KETCHIKAN, ALASKA

PREPARED BY THE
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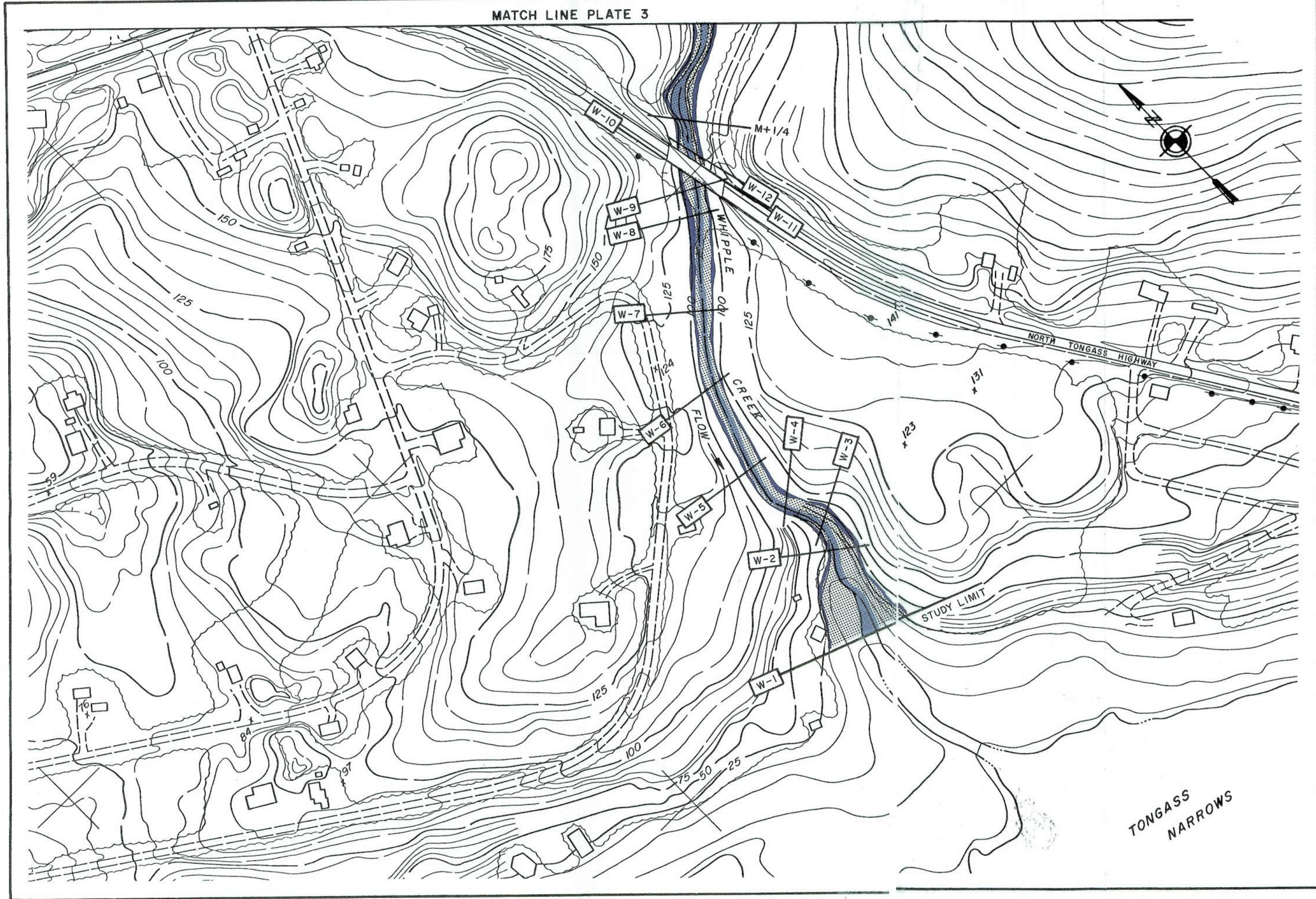

LEGEND

OVERFLOW LIMITS

STREAM CHANNEL — INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

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JUNE 1974

FLOODS

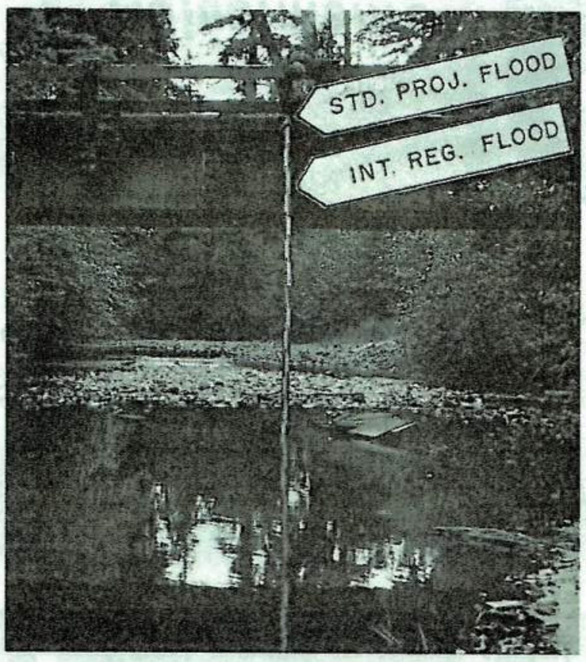
on

WHIPPLE CREEK

s folder is an announcement of and supplement to "Flood Plain Information (FPI) Report, Whipple ek, Ketchikan, Alaska." The purpose of the report o present the facts on flood potential and flood ards which will provide a sound basis for land use ning and for management decisions concerning d plain utilization.

development increases along Whipple Creek, the ential for flood damages will also increase. ough the flood plain is narrow, the high velocities ciated with flood flows make floods particularly rdous. Although property adjacent to Whipple k has not suffered damage from floods in the , studies indicate that larger floods can occur in future. Emphasis is given to future floods in the Report. Maps, profiles and cross sections have n included to illustrate the possible extent and rity of future floods.

uded in this folder are photographs showing re flood heights at selected locations. The flood ht shown for a large flood, the Intermediate ional Flood (IRF) has a chance of being equalled xceeded once in about 100 years, on the average, ough this flood could occur in any year. Also cated is the flood height that would be reached if ry large flood, the Standard Project Flood (SPF) ld occur.



Future flood heights at old highway bridge

Future flood heights near upper study limit.

Inside the folder are sketches illustrat horizontal and vertical relationship of flood and also a flooded area map from the report the extent of the Standard Project Flood.

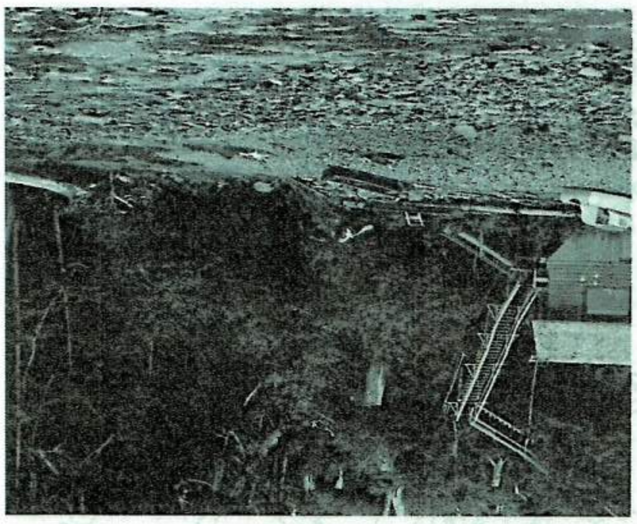
Future flood heights upstream of new North Tongass highwa

FLOODS

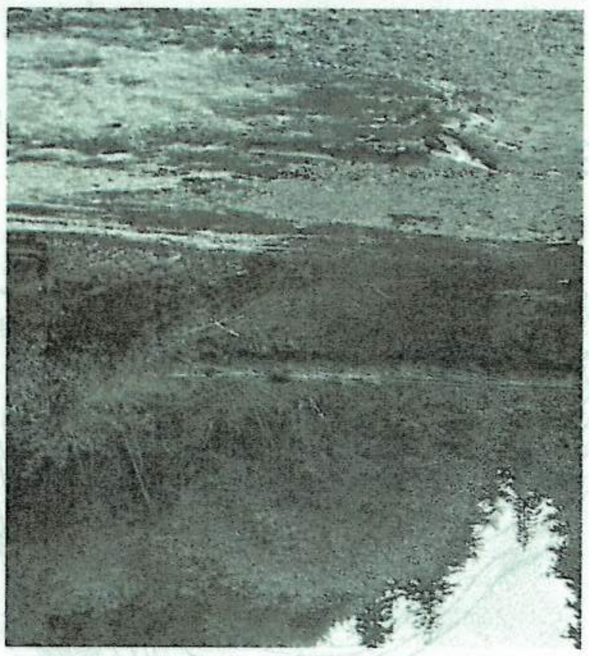
on

WHIPPLE CREE

KETCHIKAN, ALASKA




View of Whipple Creek, upstream of old highway bridge.


View of Whipple Creek near upper study limit.

CTION is needed

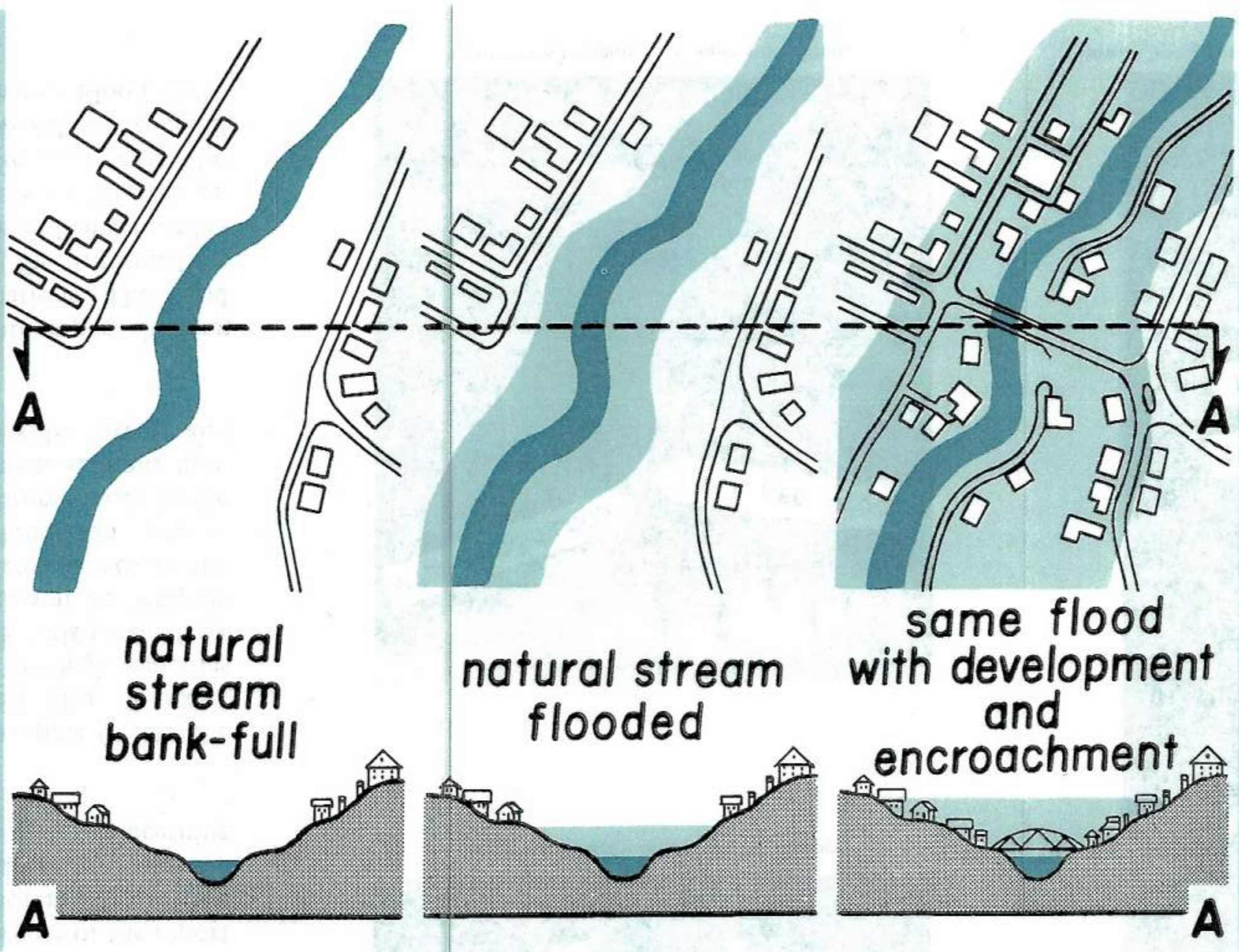
has not been much new development along e Creek in recent years and lands adjacent to ream in the study area remain only lightly ped. With any growth that might be expected e areas, there will be an increase in the amount age caused by floods, unless action is taken.

tive regulatory measures such as zoning nces and building codes can be designed to help t increased flood damages. Flood proofing can e potential damages to properties already to flooding, and additional works to modify g and erosion damage can also be a part of the nge solution.

ikan is not the only area with flooding ms. Flood plain information has already been ed for many of several thousand flood-plagued unities. Nearly 750 of those having FPI Reports end of 1973 have adopted or strengthened ions, while 780 others have them under study. ditional 1100 communities have used the FPI s to establish interim land use controls.

folder has been prepared for the Ketchikan way Borough by the U. S. Army Corps of neers from data in the report "Flood Plain ormation, Whipple Creek, Ketchikan, ka." Copies of the report and this folder are able upon request from the Ketchikan way Borough, 344 Front Street, Ketchikan, ka 99901.

BUILDING in the FLOOD PLAIN can make FLOODS WIDER and DEEPER



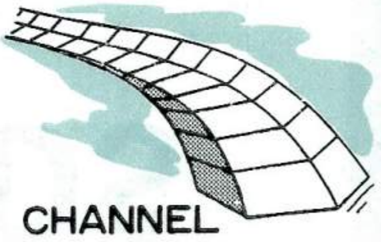
***this* ENCROACHMENT can change a Small Flood into a MAJOR FLOOD**

TOOLS of FLOOD PLAIN MANAGEMENT for the reduction of Flood Damage and Human Suffering

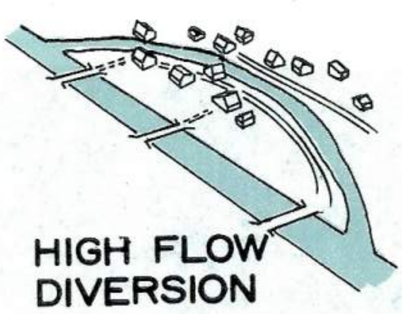
MEASURES TO MODIFY FLOODS

are often required to alleviate existing problems and sometimes to forestall future problems · · ·

DAMS & RESERVOIRS



CHANNEL ENLARGEMENT



HIGH FLOW DIVERSION

LEVEES

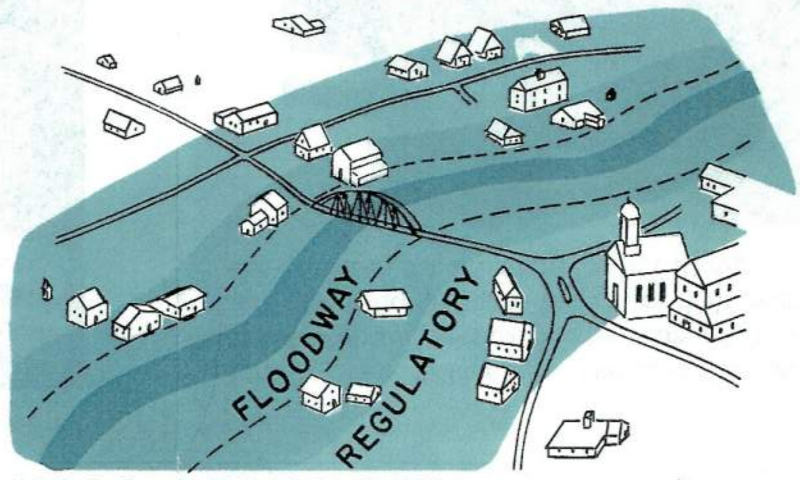
OTHER MEASURES

aid the Flood Plain occupant in coping with floods · · ·

Tax Adjustments

Flood Insurance

Warning & Emergency Plans

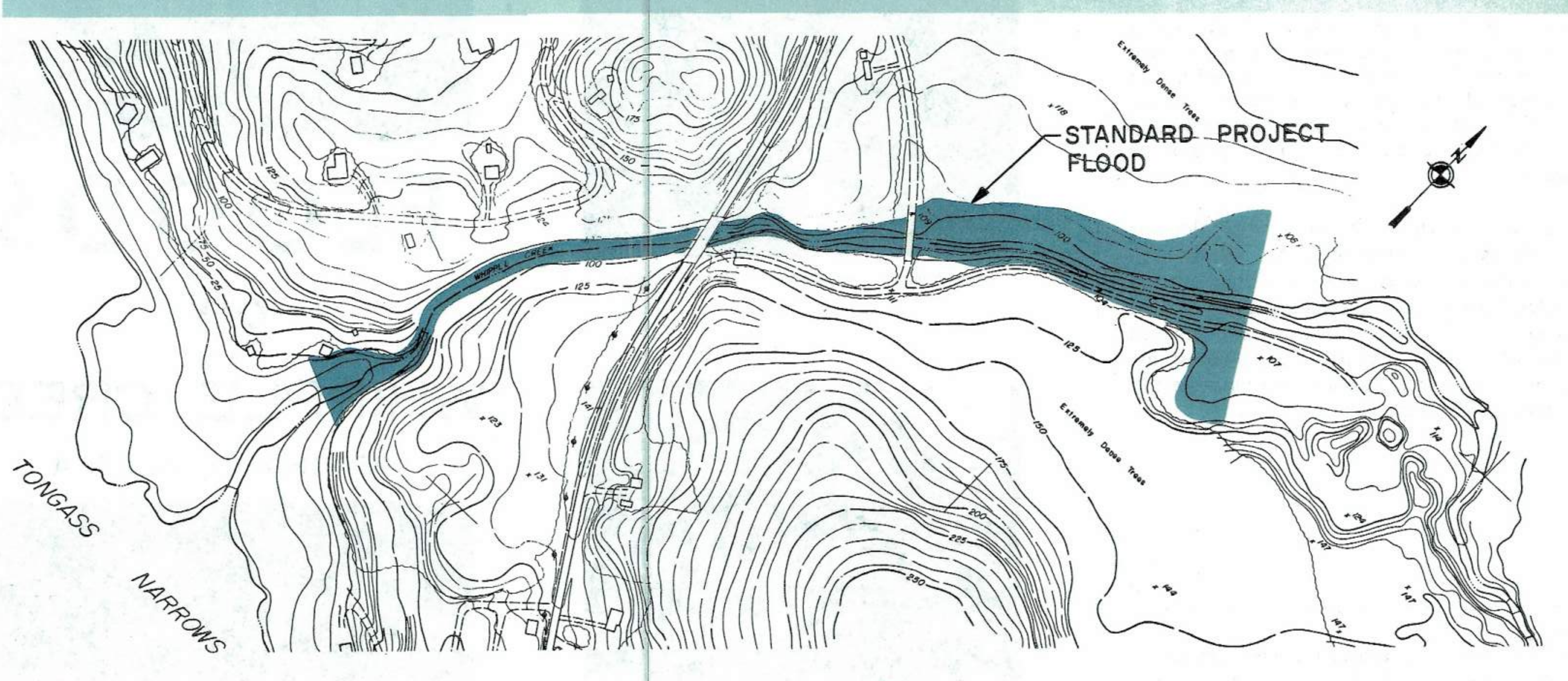


MEASURES TO REDUCE *VULNERABILITY*

TO FLOODS provide for a future with more freedom from flood damage, often at minor cost and with little adverse effect on the environment · · · · · ·

REGULATIONS — ZONING, BUILDING CODES, URBAN RENEWAL, SUBDIVISION

FLOOD PROOFING · RELOCATIONS



PROFILES in the *Flood Plain Information Report* show elevations of the IRF and SPF floods for the entire study area.

WHIPPLE CREEK FLOODED AREAS

KETCHIKAN, ALASKA

0 400 800

APPROXIMATE SCALE IN FEET