Chehalis Basin Strategy Local Actions Program Technical Advisory Group Meeting #1

October 27, 2020

Meeting Purpose

- Obtain technical input on the analyses and recommendations for potential inclusion in a Local Actions Program
  - Climate Change Modeling Recommendations
  - Potential Options for Delineating Erosion and Channel Migration Hazards

Agenda

- Welcome and Purpose of Meeting
- Introductions
- Schedule for Technical Group Topics and How the Work Will be Used
- Current Use of Climate Change Modeling and Potential Options
- Potential Options for Delineating Erosion and Channel Migration Hazards
- Next Steps and Closing

Introductions

- Breakout rooms of three members
- Introduce yourself (one minute each)
- Name and affiliation
- If you have been involved in basin flood issues
- Fun fact about yourself

Tech Group Schedule

- Schedule for meetings and issues
- How your work will be used

Tech Advisory Group Schedule

Meeting #2: November 9, 2020

- Discuss H&H model predictions for future flooding and potential increases in flood depths and extent of future floodplain
- Determine if additional modeling or other analyses would be practical and useful before March 2021 or in future

Tech Advisory Group Schedule

Meeting #3: November 13, 2020

Initial presentations and discussion:

- Potential to increase flood storage either through restoration or removing infrastructure
- Approaches to protect transportation routes and critical infrastructure
- Options for identifying floodplain extent from climate change and identifying at risk structures
- Potential local flood protection structural/non-structural actions
- Strategies to address erosion damage

Tech Advisory Group Schedule

Meeting #4: December 14, 2020

- Discussion and follow-up from meetings #1-3

Meeting #5: January 8, 2021

- Discussion and follow-up from meetings #1-4

Meeting #6: January 13, 2021

- Discussion and follow-up from meetings #1-5

Meeting #7: February 8, 2021

- Discussion and follow-up from meetings #1-6

Techniques for Meeting Engagement

- Chat room
- Jamboard
- Survey
- Discussion

Chehalis Basin Strategy Local Actions Program

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Climate Change – Board Desired

- Plan for the 100-year flood conditions that are predicted for 2080 when considering outcomes and actions.
- This planning assumption provides the foundation for all of the outcome measures agreed to by the Chehalis Basin Board.
- This will also focus their initial evaluation on what kinds of actions can most feasibly reduce risks associated with this expanded

Climate Change Projections

Overview of Methods used

in the Draft SEPA EIS

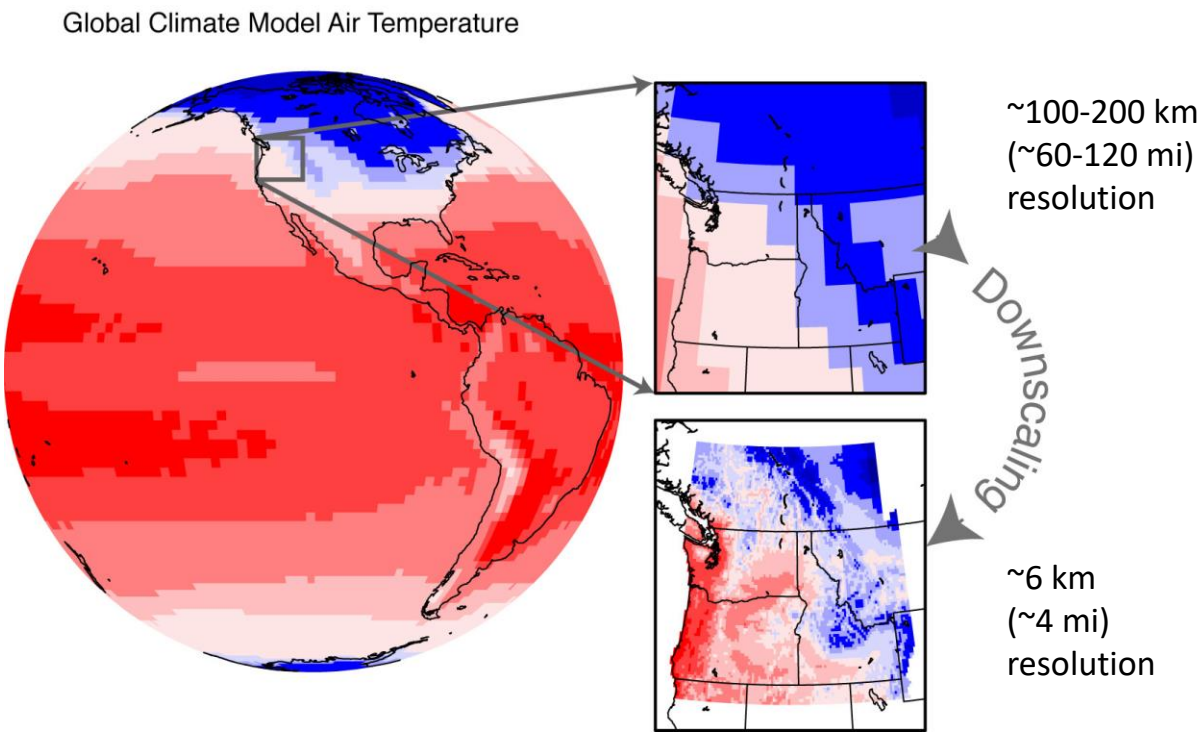
Guillaume Mauger, UW CIG

GCMs and Downscaling

"GCM" =

Global Climate Model

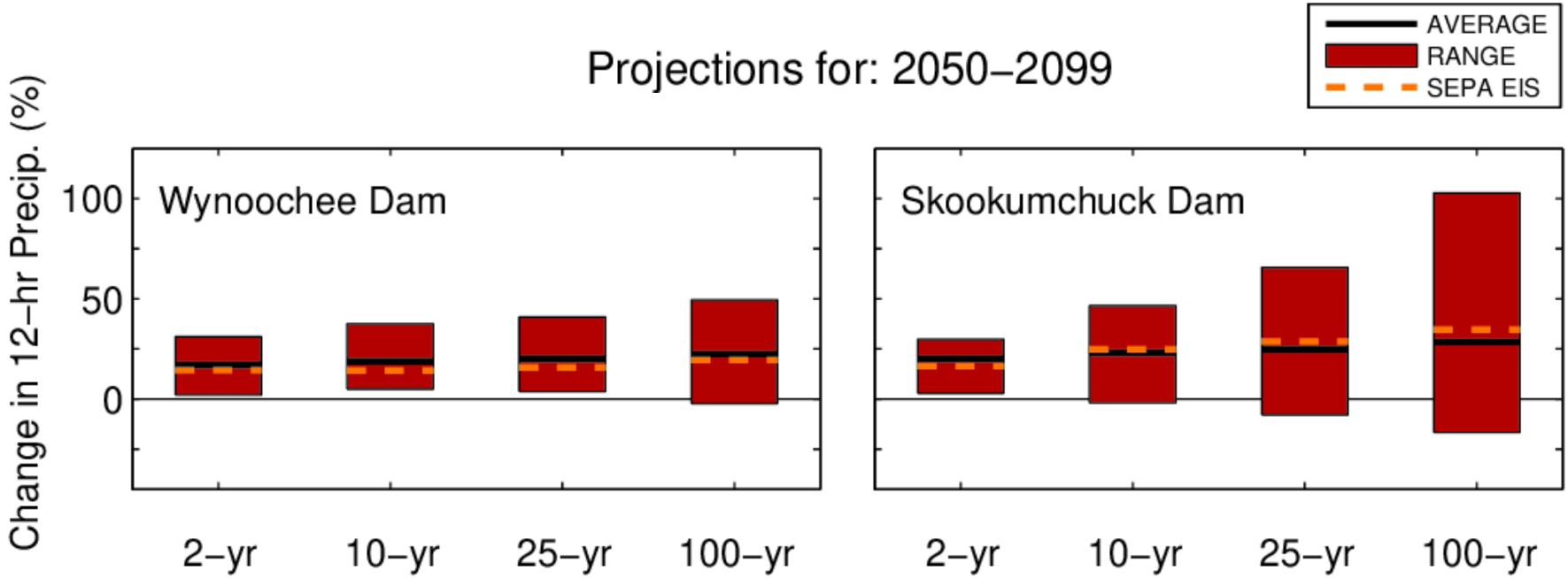
"Downscaling":



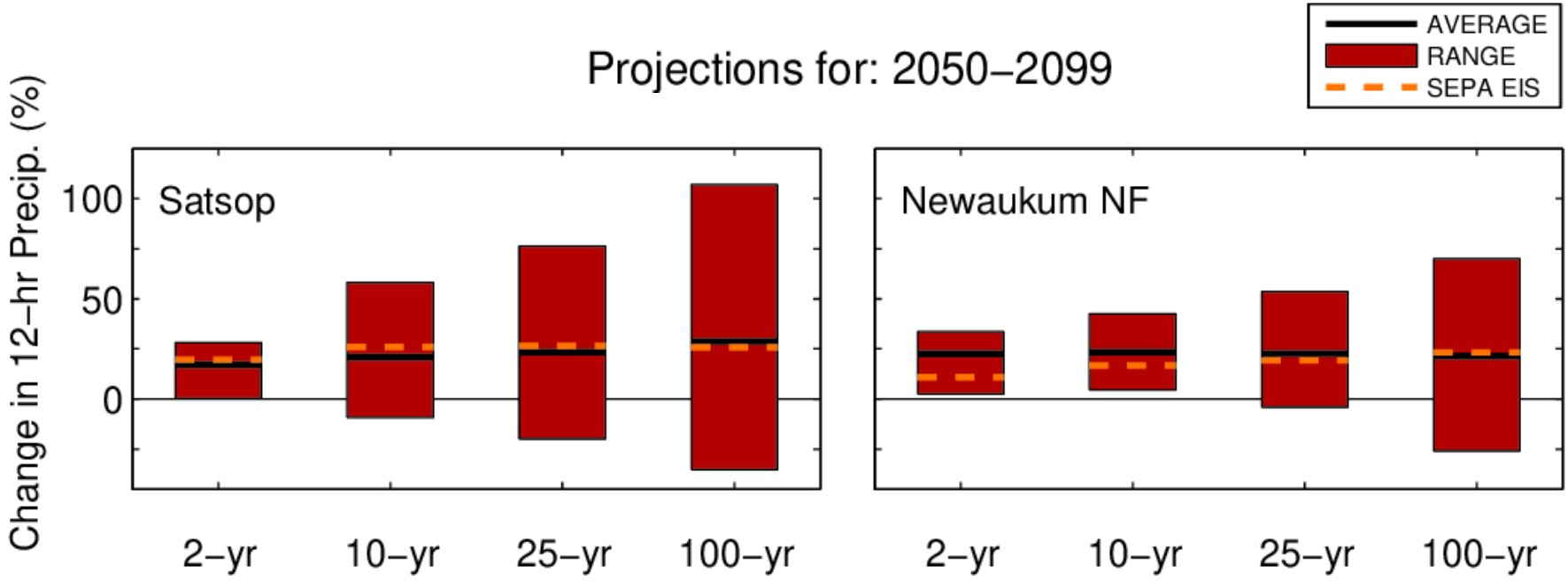
Projections in Draft SEPA DEIS

- We used projections from two GCMs:
  - ACCESS 1.0, RCP 4.5 (low-end GCM, low greenhouse gas scenario)
  - GFDL CM3, RCP 8.5 (high-end GCM, high greenhouse gas scenario)
- These GCM projections were "dynamically downscaled" using a Regional Climate Model ("WRF"), because research indicates *this approach is better than statistical downscaling at capturing changes in precipitation extremes*.
- **ONLY TWO PROJECTIONS WERE AVAILABLE AT THE TIME**

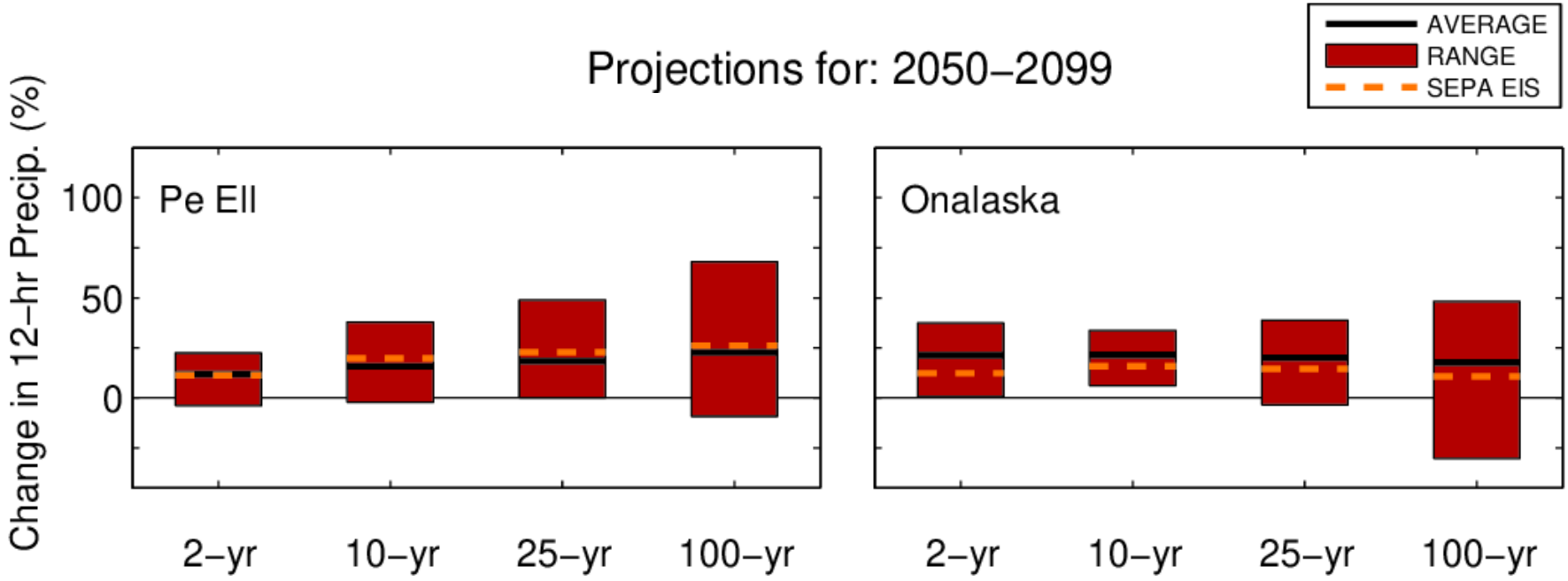
Full Range of Projections x GFDL



Full Range of Projections x GFDL



Full Range of Projections x GFDL

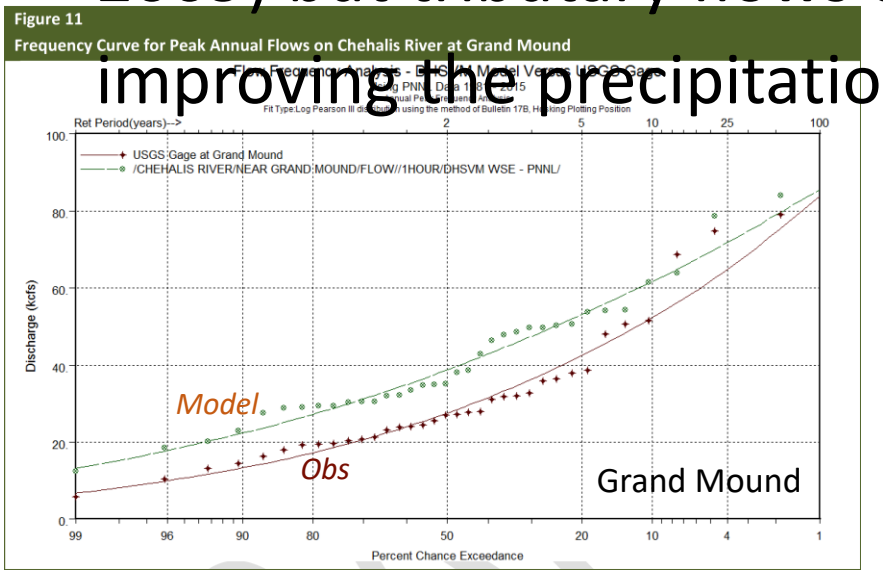


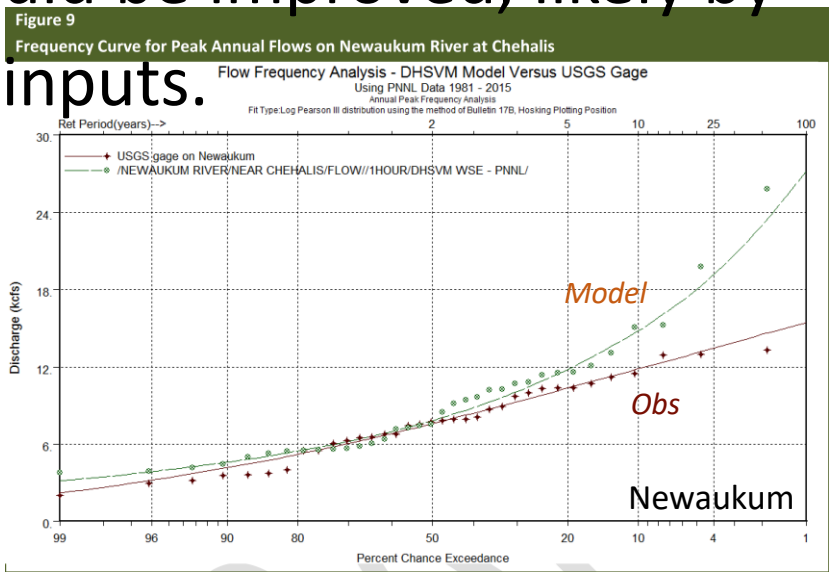
Error Found in Dynamic

- Subsequent to most of the EIS analyses, CIG found an error in the GFDL downscaling
- Corrected GFDL projection was modeled in DHSVM and results were reprocessed
- *Result:* Corrected GFDL data showed a 50% increase in peak flows for late century
- Identification of error by CIG came too late for SEPA EIS analysis

Hydrologic Modeling

- Calibration was acceptable (NSE>0.85 for WY 2006 - 2009) but tributary flows could be improved, likely by improving the precipitation inputs.





Future Flood vs. Flood of Record

- Flood of Record (Dec 2007) is larger at Doty but late century catastrophic flood is larger at all other locations on Chehalis
- Late century catastrophic flood is larger on upstream tributaries
- Extreme floods on Satsop and Wynoochee don't generally coincide with mainstem floods

Comparison of Historical and Modeled Flows in Chehalis River Basin

LOCATION	LATE CENTURY 100-YEAR FLOOD	FLOOD OF RECORD (CFS)	FLOOD OF RECORD DATE
Chehalis River near Doty	45,100	52,600[1]	12/3/2007
Chehalis River near Grand Mound	102,200	79,100	12/4/2007
Chehalis River at Porter	120,700	86,500	12/5/2007
SF Chehalis River near Wildwood[2]	N.A.	12,200	12/3/2007
SF Chehalis River at Boistfort[2]	26,700	5,700	2/7/1945
Newaukum River near Chehalis	18,500	13,300	2/8/1996
Skookumchuck River near Bucoda	19,500	11,300	2/8/1996
Satsop River near Satsop	26,600	63,600	3/19/1997
Wynoochee River above Black Creek	18,100	25,600	3/19/1997

[1] WSE estimated value (2014), the USGS estimated that this event had a peak flow of 63,100 cfs
[2] The hydraulic model only extends to Boistfort so late century catastrophic flood data is not available at Wildwood. The USGS gauge at Boistfort stopped operating in 1965 and the gaginggauging near Wildwood began in 1995. The basin area to Boistfort is approximately double the basin area at Wildwood so the December 2007 flow at Boistfort might be approximated as about double the flow at Wildwood.

Climate Change Projections

Options for Updating Climate Projections for use in Local Actions Project

WATERSHED SCIENCE & ENGINEERING

Larry Karpack, WSE

Climate Change Modeling Options for Near Term Analyses

- Need to do – use same scalar as used in SEPA EIS
  - 26% scalar used to estimate change from historical to late century
  - Allows *"apples to apples"* comparisons to SEPA EIS modeling
  - 26% increase likely represents about the median increase from ensemble
- Optional – use additional, larger scalar to capture high end scenario
  - Corrected GFDL modeling showed ~50% increase
  - GFDL generally a "high end" scenario in terms of heavy precipitation
  - Alternatively – CIG could review data from similar studies and give estimate of the high end of the range
  - High end of range allows "worst case" floodplain to be delineated

Climate Change Modeling Options for Long Term Analyses

- Option 1 – Explore range in climate projections by evaluating additional GCM projections in existing DHSVM model
  - 12 Total GCMs have now been downscaled, 1 has been run to date
  - Existing model can be rerun with or without modification
  - Run time – approximately 3 weeks per GCM
  - Runs can be made in parallel but limited by available computers
  - Data post-processing (frequency analysis) takes about 1 day per GCM
  - Can be implemented independent of Options 2 & 3

Climate Change Modeling Options for Long Term Analyses

- Option 2 – Improve DHSVM model accuracy and calibration
  - Review of precipitation biases in WRF modeling
  - Adjustment of inputs as appropriate
  - Recalibrate DHSVM to improve peak flow performance across basin
  - Run all 12 GCMs with recalibrated DHSVM model
  - Post process of all outputs
  - Same caveats on time and effort as Option 1
  - Can be implemented independent of Options 1 & 3

Climate Change Modeling Options for Long Term Analyses

- Option 3 – Re-evaluate the approach to developing flow scalars
  - Compute frequency analyses for 15 sites used in SEPA EIS for all GCMs
  - Conduct additional frequency analyses at other locations if desired
  - Evaluate:
    - If the spatial pattern of projected changes follows a consistent pattern
    - If the projected changes by quantile (i.e., 10-year, 100-year) follow a consistent pattern
    - If the uncertainty in the extreme statistics can be improved by using "bootstrapping"
  - Compute scalar(s) and range
  - Develop recommendations for future use
  - Best if done in conjunction with Option 1, Option 2, or both.

Discussion

Questions

- What questions do you have about the approach used in the SEPA analysis?
- What are the pros and cons of each option that should be considered by the Chehalis Basin Board?
- Are there other options that should be considered for the near or long term?
- What option would you recommend the Board consider implementing in the short

Chehalis Basin Strategy Local Actions Program

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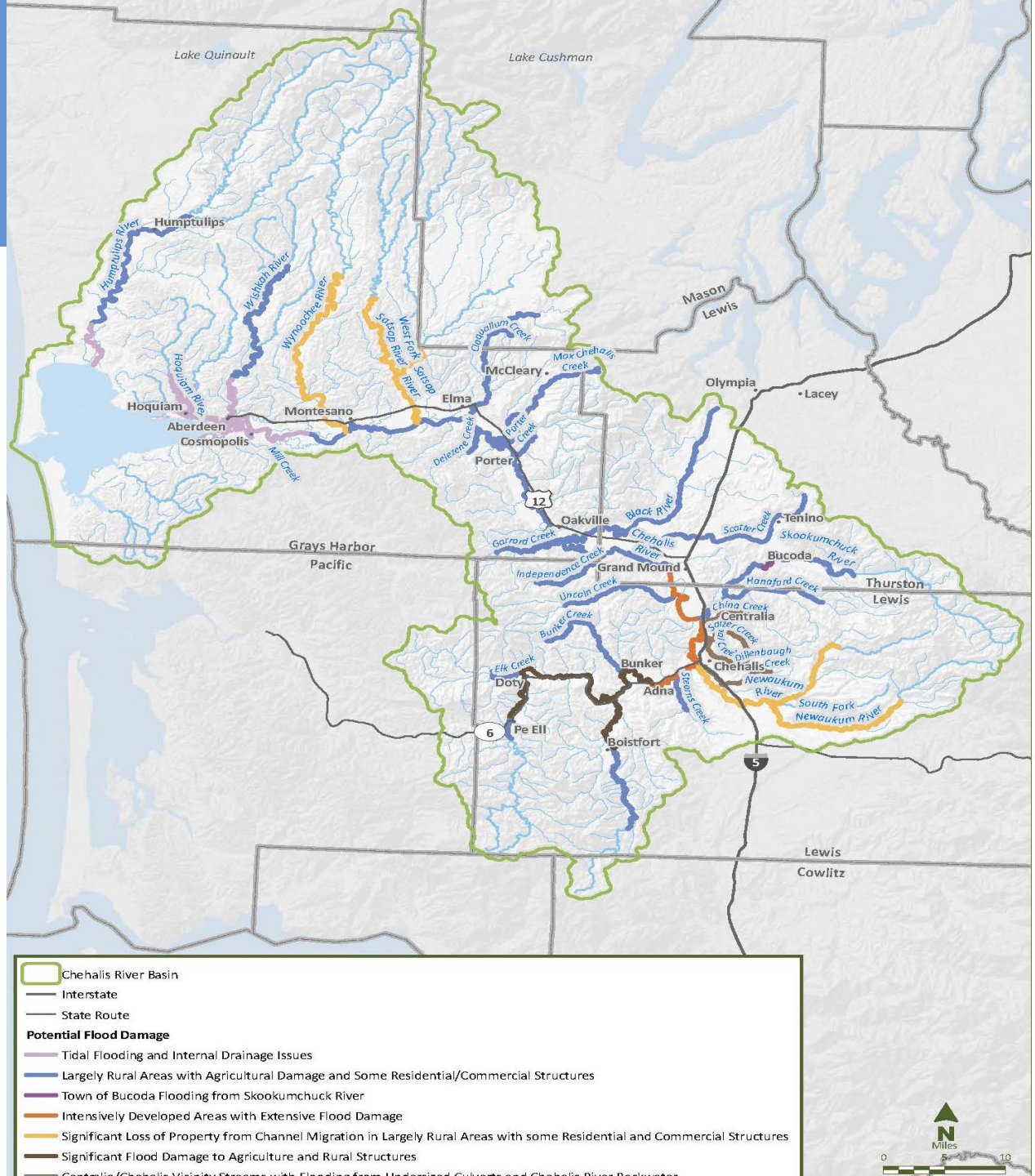
Erosion Hazards – Board Desired Outcomes

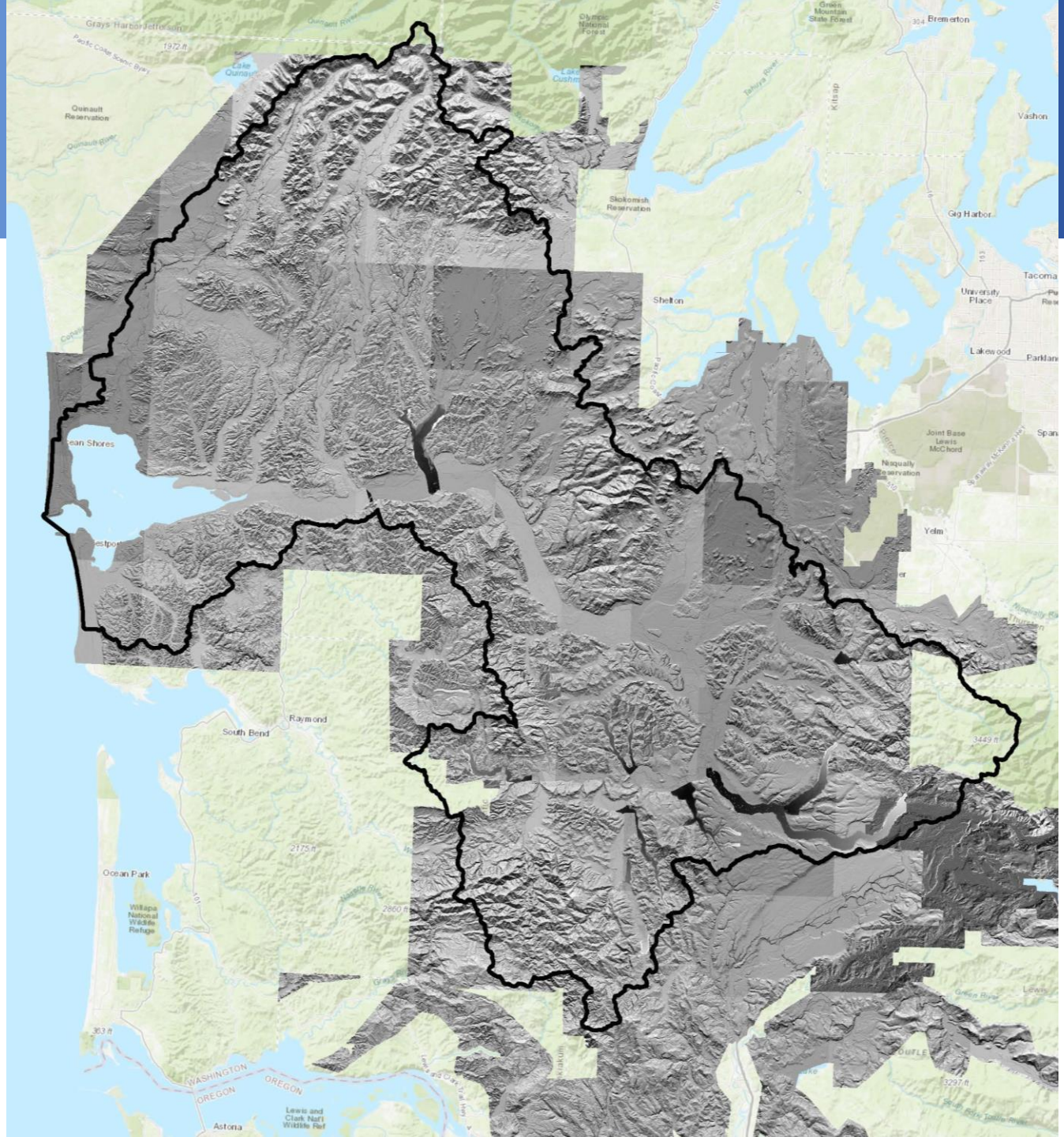
- **Reduce number of locations where migrating river channels and bank erosion pose a high risk of near-term damage** to valuable structures or loss of economically productive land uses by an average of X per year over up to 30 years, while protecting ecological processes (Outcome 4A "Farmland and Rural Structures Protected).

- **No new structures would have been developed that are vulnerable to channel erosion or mainstem or tributary flooding from 2080 predicted 100-year flood levels**… (Outcome 8: Prevent New At-Risk Development).

Options for Consideration

- Option 1. Focused Modern Valley Bottom and Avulsion Hazard Mapping
- Option 2. Comprehensive Modern Valley Bottom and Avulsion Hazard Mapping
- Option 3. Focused Planning-Level CMZ Delineation
- Option 4. Comprehensive Planning-Level CMZ Delineation
- Option 5. Focused CMZ Delineation
- Option 6. Comprehensive CMZ Delineation


Lake Quinault
Lake Cushman
Humptulips
Humptulips River
Wishkah River
Wynoochee River
Satsop River
West Fork Satsop River
Clearwater Creek
Max Chehalis Creek
McCleary
Elma
Montesano
Hoquiam
Hoquiam River
Aberdeen
Cosmopolis
Mill Creek
Delezene Creek
Porter Creek
Porter
12
Oakville
Black River
Garrard Creek
Chehalis River
Independence Creek
Grand Mound
Lincoln Creek
Bunker Creek
Scatter Creek
Tenino
Skookumchuck River
Bucoda
Hanaford Creek
Thurston
Lewis
China Creek
Centralia
Salzer Creek
Jackson Creek
Dillenbaugh Creek
Chehalis
Newaukum River
South Fork Newaukum River
Stearns Creek
Bunker
Adna
Elk Creek
Doty
Pe Ell
6
Boistfort
5
Olympia
Lacey
Mason
Lewis
Grays Harbor
Pacific
Lewis
Cowlitz
Chehalis River Basin
Interstate
State Route
Potential Flood Damage
Tidal Flooding and Internal Drainage Issues
Largely Rural Areas with Agricultural Damage and Some Residential/Commercial Structures
Town of Bucoda Flooding from Skookumchuck River
Intensively Developed Areas with Extensive Flood Damage
Significant Loss of Property from Channel Migration in Largely Rural Areas with some Residential and Commercial Structures
Significant Flood Damage to Agriculture and Rural Structures
N
Miles
0
5
10


Grays Harbor
Jefferson
Olympic National Forest
Green Mountain State Forest
Bremerton
Quinault Reservation
Vashon
Skokomish Reservation
Gig Harbor
Tacoma
University Place
Shelton
Lakewood
Joint Base Lewis McChord
Nisqually Reservation
Yelm
Raymond
South Bend
Ocean Park
Willapa National Wildlife Refuge
WASHINGTON
OREGON
Astoria
Lewis and Clark Nat'l Wildlife Ref

Preliminary Input on Erosion Areas of Concern

- Lower Satsop River
- Lower EF and WF Satsop rivers
- Lower Wynoochee River
- Mainstem Chehalis River in the vicinity of Satsop and Wynoochee confluences
- SF Newaukum River
- Localized areas (bridges, etc.) on Cloquallum, Salzer, China, McCormick creeks

Pros and Cons of Options

OPTION	PROS	CONS	TIMEFRAME
Option 1. Focused Area Mapping	• Focused on areas currently most at risk • Would not spend time and effort on areas with limited channel migration that have lesser risk • Can be rapidly completed in the near-term time frame	• May miss areas at longer-term risk for migration	NEAR-TERM Can be completed in ~100 days (3 months) ~$150,000 - $200,000
Option 2. Local Actions Program Study Area Mapping	• Provides comprehensive coverage based on GIS mapping	• May miss areas at longer-term risk for migration • Medium-term time frame to complete	LONG-TERM Can be completed in ~200 days (7 months) ~$500,000
Option 3. Focused Planning-Level CMZ Delineation	• Focused on areas currently most at risk • Provides longer-term certainty that risks in this area have been identified	• May miss areas at longer-term risk for migration • May overestimate CMZ without field assessment	LONG-TERM Can be completed in ~200 days (7 months) ~$200,000 - $300,000
Option 4. Local Actions Program Study Area Planning-Level CMZ Delineation	• Provides comprehensive coverage of all areas of interest and risk • Provides longer-term certainty that risks have been identified	• Long-term time frame to complete • May overestimate CMZ without field assessment	LONG-TERM Can be completed in ~1 year ~$650,000 - $750,000
Option 5: Focused CMZ Delineation	• Focused on areas most at risk • Most accurately delineates detailed CMZ	• Medium-term time frame to complete	LONG-TERM Can be completed in ~250 days (8–9 months) ~$300,000 -- $400,000
Option 6. Local Actions Program Study Area CMZ Delineation	• Provides comprehensive coverage of all areas of interest and risk • Most accurately delineates detailed CMZ	• Long-term time frame to complete	LONG-TERM Can be completed in ~18 months ~$850,000 -- $1 million

Why Consider Erosion Hazards Now?

- Depending on the option chosen for delineating erosion hazard areas, some work could be done in advance of a board decision in March that could inform the approach and magnitude of a program needed to significantly address erosion hazards in the basin.

Discussion

Questions

- Are there additional options that should be considered by the Board for the short or long term?
- Do you have additions or changes to the pros and cons of the options that should be considered by the Chehalis Basin Board?
- What options would you recommend the Board consider implementing in the short and long term?