ECB 2014-10: Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects

Project Implementation: Beaver Island HREP

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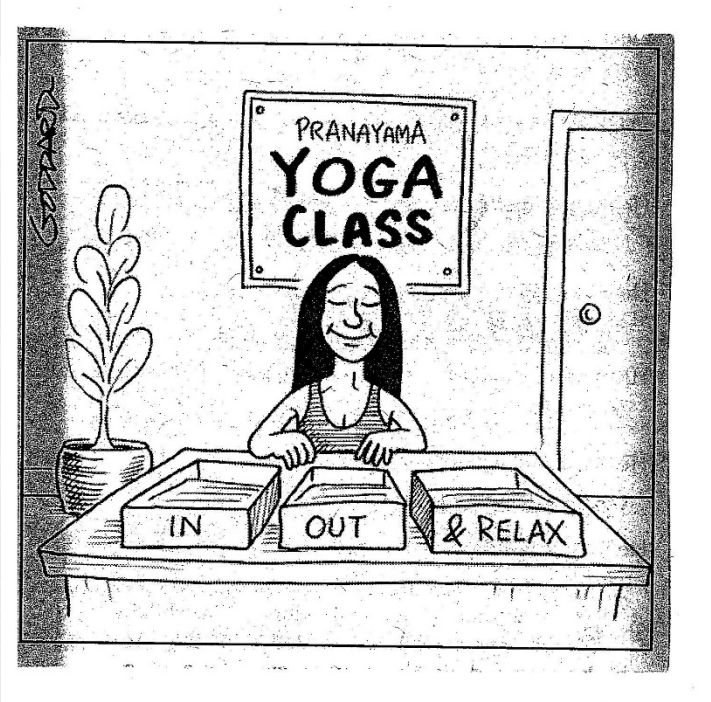
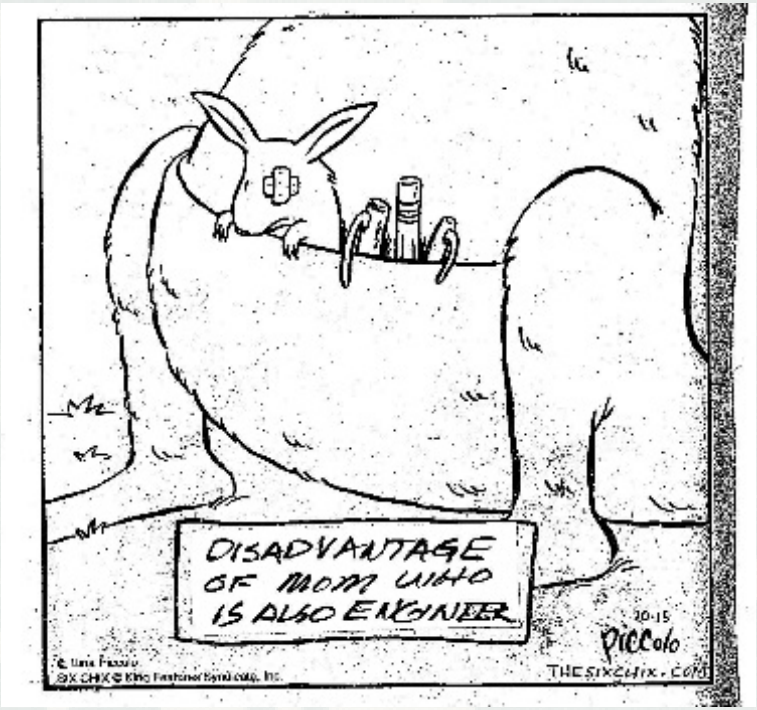
Outline

- ECB 2014-10 and Applicability
- Identify 3 Focuses of ECB
- 2-Phase Qualitative Analysis
- Application to Beaver Island HREP Topographic Diversity Objective
- UPDATE ECB 2016-25 released 9-20-16
- Concluding Points

Intent & Implementation





BLUF: USACE policy requires consideration of climate change in all current and future studies to reduce vulnerabilities and enhance the resilience of our water-resource infrastructure.

Initial Guidance: ECB 2014-10

- Issued 2 May 2014
- As of 20 Sep 16 replaced by ECB 2016-25

ECB 2016-25

Applies to ALL hydrologic studies for inland watersheds (including operational hydrologic studies for water management or to dam safety AND any completed projects where Federal funds are being used to rehabilitate project)

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ENGINEERING AND CONSTRUCTION BULLETIN

No. 2014-10 **Issuing Office:** CECW-CE **Issued:** 2 May 2014 **Expires:** 2 May 2016

Subject: Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects

Applicability: Guidance.

References: Required and related references are provided in Appendix A.

1. Purpose. This ECB provides USACE with initial guidance for incorporating climate change information in hydrologic analyses in accordance with the USACE overarching climate change adaptation policy. USACE policy requires consideration of climate change in all current and future studies to reduce vulnerabilities and enhance the resilience of our water-resource infrastructure. The guidance in this ECB is also in accordance with the President's Climate Action Plan released in June 2013 and with Executive Order 13653.

2. Objective. The objective of this ECB is to support incorporation of new science and engineering products and other relevant information about specific climate change and associated impacts in hydrologic analyses for new and existing USACE projects to enhance USACE climate preparedness and resilience.

a. This ECB is effective immediately and applies to all hydrologic analyses supporting planning and engineering decisions having an extended decision time frame. However, this guidance does not apply to operational hydrologic studies for water management or to dam safety.

b. Changes other than climate threats that affect inland hydrology will continue to be evaluated in the manner described in current USACE guidance (e.g., Chapter 18, Evaluating Change in EM 1110-2-1417, *Flood-Runoff Analysis*; and EM 1110-2-1413, *Hydrologic Analysis of Interior Areas*).

troduction. USACE projects, programs, missions, and operations have generally proven to be st enough to accommodate the range of natural climate variability over their operating life s. Recent scientific evidence shows, however, that in some places and for some impacts ant to USACE operations, climate change is shifting the climatological baseline about which natural climate variability occurs, and may be changing the range of that variability as well. is relevant to USACE because the assumptions of stationary climatic baselines and a fixed e of natural variability as captured in the historical hydrologic record may no longer be opriate for long-term projections of the climatologic parameters, which are important in ologic assessments for inland watersheds. However, projections of the specific climate ges and associated impacts to local-scale project hydrology that may occur far in the future due anging baselines and ranges of variability as reported in the recent literature are uncertain gh to require guidance on their interpretation and use. This ECB helps support the pretation and use of climate change information for hydrologic analyses supporting planning ngineering decisions in three specific areas:

ECB 2014-10 focuses on 3 areas:

I. **Guidance** on conducting a **qualitative assessment** of potential climate change threats and impacts potentially relevant to the particular USACE hydrologic analysis being performed.

II. Providing **resources** to support the **qualitative assessment** of climate threats and impacts specific to those analyses.

III. Providing an **overview of future planned guidance** for additional **quantitative assessments** of potential climate change threats and impacts for use in future hydrologic analyses.

****** The qualitative analysis is the only approach required for hydrologic studies for inland watersheds at this time. ******

Qualitative only requirement consistent for ECB 2016-25

Qualitative Analysis Requirements

GOAL: to describe the observed present and possible future climate threats, vulnerabilities, and impacts specific to the study goals or engineering designs.

• Includes consideration of both past **(observed)** changes as well as potential future **(projected)** changes to relevant hydrologic inputs.

• The qualitative approach will not produce binding numerical outputs, but can **identify the direction of change** where change is detected in climate variables relevant to the specific study.

• The qualitative analysis is intended to answer a linked series of questions related to **2 key decision components**:

(1) Is climate change relevant to the project?

(2) If yes, what is the direction of the potential climate change in the variables that may affect the hydrology of the project, and potentially impact project goals and designs?

Qualitative Analysis: Two Phases

Phase 1 – Screening level analysis to **identify whether climate change is relevant** to the project goals or design in accordance with SMART planning (i.e., are important hydrologic variables altered by climate change?).

Examples:

- Hydrologic and/or climatic parameters used to size, locate, or otherwise used to design project features

- Hydrologic and/or climatic parameters used to evaluate performance or quantify benefits of an alternative

Qualitative Analysis: Two Phases

Phase 2 – If Climate Change is relevant to the project goals and designs:

- Evaluate **potential impacts** to the important hydrologic/climatic variables
- Identify opportunities to reduce potential vulnerabilities and **increase resilience** as a part of the project's authorized operations

Information should be presented in a risk register* or separately in a manner consistent with risk characterization in planning and design studies.

**A Risk Register is a Risk Management tool commonly used in Project Management and organizational risk assessments. It acts as a central repository for all risks identified by the project or organization and, for each risk, includes information such as risk probability, impact, counter-measures, and so on.*

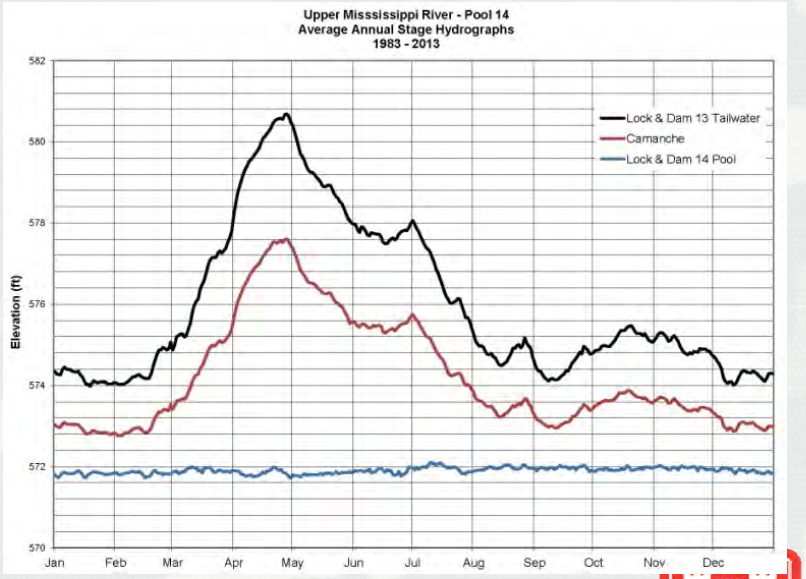
Beaver Island HREP

- Authority: UMRR (EMP)
- Sponsors: IADNR & USFWS
- Location
  - Upper third Pool 14 (RM 512.8 to 517.8)
  - Across from Clinton, IA (ADM)
  - ~2,000 ac. (1,600 ac. project)
  - Camanche Gage @ RM 511.8

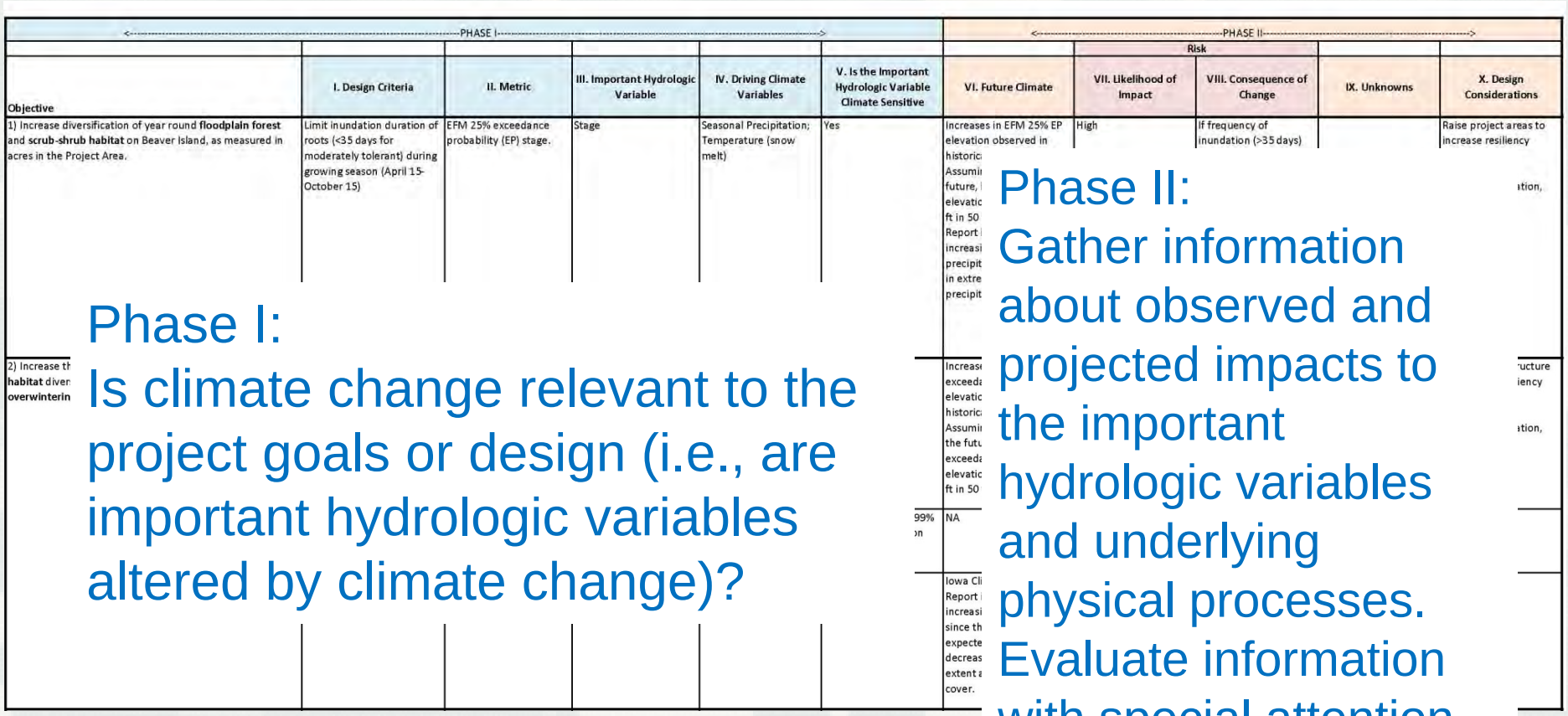
  (USGS Clinton Gage #05420500)

  D.A. 85,600 sq. miles

  POR: 1873-present



Risk Matrix



Objective	I. Design Criteria	II. Metric	III. Important Hydrologic Variable	IV. Driving Climate Variables	V. Is the Important Hydrologic Variable Climate Sensitive	VI. Future Climate	Risk: VII. Likelihood of Impact	Risk: VIII. Consequence of Change	IX. Unknowns	X. Design Considerations
1) Increase diversification of year round **floodplain forest** and **scrub-shrub habitat** on Beaver Island, as measured in acres in the Project Area.	Limit inundation duration of roots (<35 days for moderately tolerant) during growing season (April 15-October 15)	EFM 25% exceedance probability (EP) stage.	Stage	Seasonal Precipitation; Temperature (snow melt)	Yes	Increases in EFM 25% EP elevation observed in historic… Assumi… future, … elevatic… ft in 50… Report … increasi… precipit… in extre… precipit…	High	If frequency of inundation (>35 days)		Raise project areas to increase resiliency
2) Increase th… **habitat** diver… **overwinterin**…						Increas… exceeda… elevatic… historic… Assumi… the futu… exceeda… elevatic… ft in 50…				
						99% …	NA			
						Iowa Cli… Report … increasi… since th… expecte… decreas… extent a… cover.				

Phase I:
Is climate change relevant to the project goals or design (i.e., are important hydrologic variables altered by climate change)?

Phase II:
Gather information about observed and projected impacts to the important hydrologic variables and underlying physical processes. Evaluate information with special attention to similarities and differences.

Risk Matrix

<----------PHASE I---------->					
Objective	I. Design Criteria	II. Metric	III. Important Hydrologic Variable	IV. Driving Climate Variables	V. Is the Important Hydrologic Variable Climate Sensitive
1) Increase diversification of year round **floodplain forest** and **scrub-shrub habitat** on Beaver Island, as measured in acres in the Project Area.	Limit inundation duration of roots (<35 days for moderately tolerant) during growing season (April 15-October 15)	EFM 25% exceedance probability (EP) stage.	Stage	Seasonal Precipitation; Temperature (snow melt)	Yes
	Depth > 4ft	99% exceedance duration stage during overwintering	Stage	NA - Stage during low flow conditions controlled by Dam 14.	No, (Dam 14 limits 99% exceedance duration elevation)
	DO > 5 mg/L	> 5 mg/L during overwintering	Residence Time (volume, dredge depth, stage)	Temperature, Seasonal Precipitation	Yes

Objective 1:

Increase diversification of year round **floodplain forest** and **scrub-shrub habitat** on Beaver Island, as measured in acres.

Risk Matrix

Objective	<----------PHASE II---------->				
		Risk			
	VI. Future Climate	VII. Likelihood of Impact	VIII. Consequence of Change	IX. Unknowns	X. Design Considerations
1) Increase diversification of year round **floodplain forest** and **scrub-shrub habitat** on Beaver Island, as measured in acres in the Project Area.	Increases in EFM 25% EP elevation observed in historical record (0.9 ft). Assuming similar rate into future, EFM 25% EP elevation will increase 1.5 ft in 50 yrs. IA Climate Report indicates increasing averge annual precipitation and increase in extreme heavy precipitation in summer.	High	If frequency of inundation (>35 days) increases, objective would not be met and we would see increased mortality		Raise project areas to increase resiliency (coping range) CONSTRAINTS: Wetland delineation, Floodplain
			met (loss of overwintering habitat)	change on future sedimentation rates.	
	Iowa Climate Change Report indicates increasing winter temps since the 1970's are expected to continue, decreasing duration, extent and thickness of ice cover.	Low - near-freezing water temps will not change DO-Temp relationship	Low DO can impact fish survival.	Impacts of temperature on snowpack and ice clarity-photosynthesis-DO	No change

Objective 1:

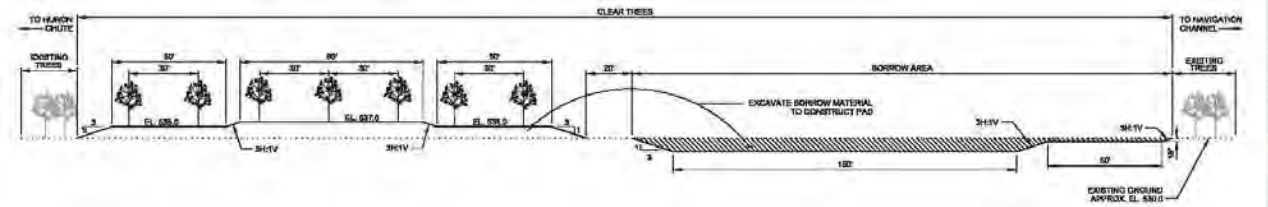
Increase diversification of year round **floodplain forest** and **scrub-shrub habitat** on Beaver Island, as measured in acres.

Objective 1:

Increase diversification of year round **floodplain forest** and **scrub-shrub habitat** on Beaver Island, as measured in acres.

PHASE I

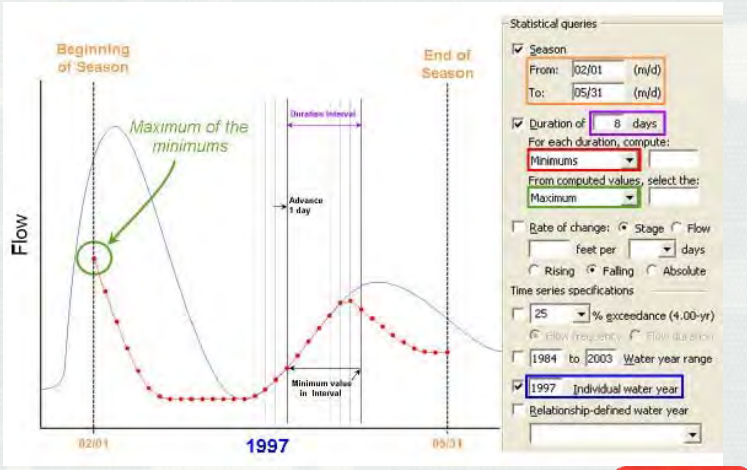
I. Design Criteria



Limit inundation duration to **25 days** (minimally tolerant tree species) during the growing season (April 15-October 15)

II. Metric

-**HEC-EFM** returns the elevation that has a 25% probability of being inundated for 25-days or more during the growing season



*Objective 1: **floodplain forest** and **scrub-shrub habitat***

PHASE I

III. Important Hydrologic Variable

-Stage

IV. Driving Climate Variables

-Seasonal precipitation; Temperature (snowmelt)

V. Is the Important Hydrologic Variable Climate Sensitive? Yes

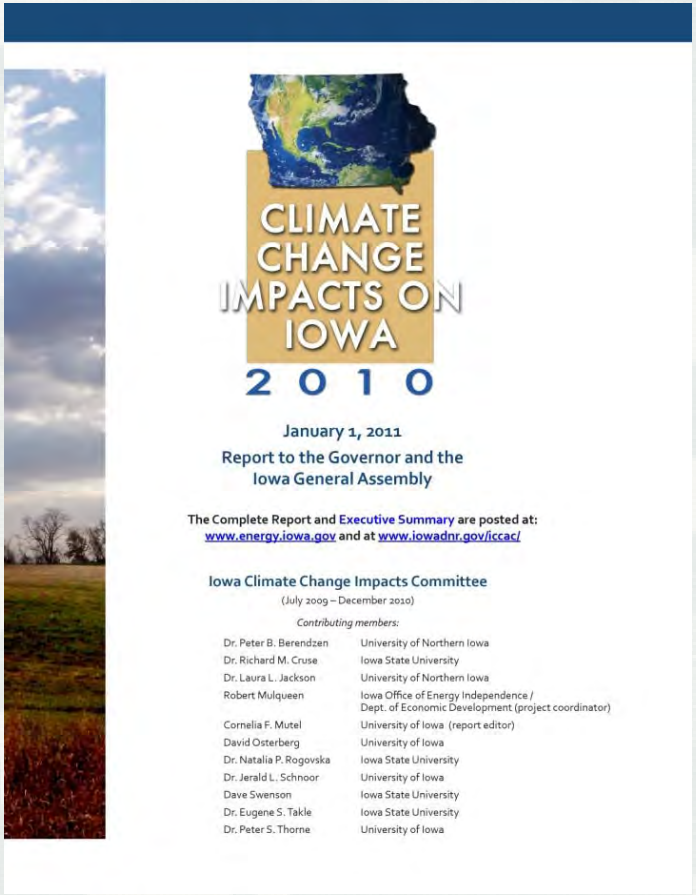
Objective 1: floodplain forest and scrub-shrub habitat

PHASE II

VI. Future Climate

-Historical: EFM 25% EP for (1984-2013) is 0.9 ft greater than that for (1954-1983); assuming a similar rate into 50 yrs, +1.5’ to current design

-IA Climate Change Report:
Increasing avg. annual precipitation and increase in extreme heavy precipitation in summer



Objective 1: floodplain forest and scrub-shrub habitat

PHASE II

RISK

VII. Likelihood of Impact- High

VIII. Consequence of Change

If trees are inundated >25 days, more frequently than ¼ yrs, increased mortality

IX. Unknowns NA

X. Design Considerations

Raise project areas to increase resiliency (provide coping range)

CONSTRAINTS: Wetland delineation, Floodplain impacts

Concluding Points

- Until we have quantitative guidance, PDT judgement will be required in making decisions on how best to build resilience into design based on results of qualitative assessment
- ECB 2016-25

  -No substantial changes made (exemptions for operational water management and dam safety studies removed)

  -At least 1 member of ATR Team must be qualified to review for compliance with ECB 2016-25

  -Tools developed for evaluating trends in historic data are mentioned and in some cases are now required for use in qualitative analysis
- MVD HH&C CoP is standing up a Climate Change Adaptation Sub-CoP with appointed District POCs to provide support and promote knowledge sharing across MVD

Questions?

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Acknowledgements

- Kevin Landwehr, P.E., D.WRE, Chief Hydrology and Hydraulics Branch, MVR

Climate Hydrology Assessment Tool

https://maps.crrel.usace.army.mil/projects/rcc/portal.html

- Used to identify historic trends in instantaneous peak flows at the gage(s) nearest the study area

Nonstationarity Detection Tool (NSD)

https://maps.crrel.usace.army.mil/projects/rcc/portal.html

- Used to assess abrupt or slowly varying changes in observed peak flow data.

Watershed Vulnerability Assessment Tool (WVA)

https://maps.crrel.usace.army.mil/projects/rcc/portal.html

- Can provide information on the relative vulnerability of a given watershed to climate change using a wider variety of flow variables

Objective 2:

Increase the structure and function of year-round **aquatic habitat** diversity, as measured by acres and native fish use of **overwintering** habitat in the Project Area.

PHASE I

I. Design Criteria

***Velocity** < 0.5 cm/s during overwintering (November-February)

II. Metric

-**95% non-exceedance duration** stage during overwintering (closure structure overtopping/gate/stoplog design)

III. Important Hydrologic Variable

-Flow

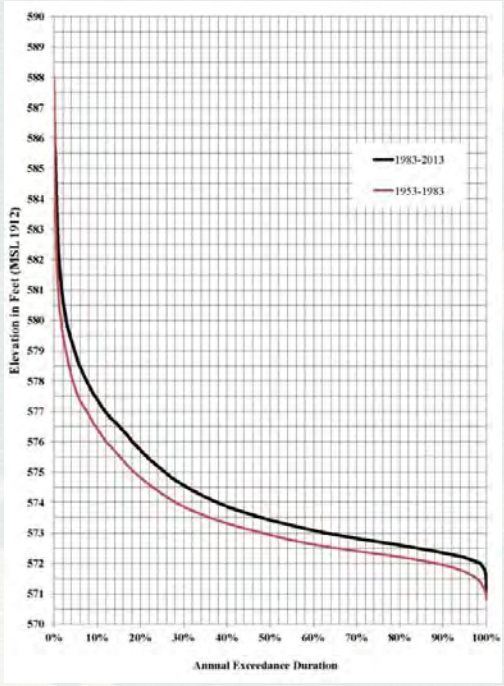
*Objective 2: aquatic overwintering habitat -*velocity*

PHASE I

IV. Driving Climate Variables

-Seasonal precipitation; Temperature (snow fall vs. rain)

V. Is the Important Hydrologic Variable Climate Sensitive? Yes



PHASE II

VI. Future Climate

-Historical: 95% non-exceedance (overwintering) duration (1983-2013) 0.3 ft greater than that for (1953-1983); assuming similar rate into 50 yrs, +0.5' to current design

-IA Climate Change Report: Increasing daily min. & max. winter temps (rain vs. snow)

*Objective 2: aquatic overwintering habitat -*velocity*

PHASE II

RISK

- **VII. Likelihood of Impacts** High
- **VIII. Consequence of Change** No creation overwintering habitat
- **IX. Unknowns** NA
- **X. Design Considerations**

  Raise closure structure to increase resiliency (provide coping range)

  CONSTRAINTS: Wetland delineation, Floodplain impacts

Objective 2:

Increase the structure and function of year-round **aquatic habitat** diversity, as measured by acres and native fish use of **overwintering** habitat in the Project Area.

PHASE I

I. Design Criteria

***Depth** < 4ft during overwintering (November-February)

II. Metric

-**99% exceedance duration** stage during overwintering (min. stage)

III. Important Hydrologic Variable

-Stage

*Objective 2: aquatic habitat overwintering -*depth*

PHASE I

IV. Driving Climate Variables

NA- Stage during low flow is controlled by Dam 14

V. Is the Important Hydrologic Variable Climate Sensitive?

No, Dam 14 limits 99% exceedance duration

PHASE II

VI. Future Climate NA

RISK

VII. Likelihood of Impact Low

VIII. Consequence of Change Loss of overwintering habitat

IX. Unknowns Impact of climate change- future sedimentation rates

X. Design Considerations NA

Objective 2:

Increase the structure and function of year-round **aquatic habitat** diversity, as measured by acres and native fish use of **overwintering** habitat in the Project Area.

PHASE I

I. Design Criteria

***DO** > 5 mg/L during overwintering (November-February)

II. Metric

***DO** > 5 mg/L during overwintering (November-February)

III. Important Hydrologic Variable

-Residence Time (volume/dredge depth/stage)

*Objective 2: aquatic habitat overwintering -*DO*

PHASE I

IV. Driving Climate Variables

-Temperature; Seasonal Precipitation

V. Is the Important Hydrologic Variable Climate Sensitive? Yes

PHASE II

VI. Future Climate

-IA Climate Change Report: Increasing daily min. & max. winter temps, decreasing the duration, extent and thickness of ice cover

*Objective 2: aquatic habitat overwintering -*DO*

PHASE II

RISK

VII. Likelihood of Impact Low – warming air temps will likely decrease ice cover, but near freezing water temps will not change DO concentration

VIII. Consequence of Change DO < 5mg/L impacts fish survival

IX. Unknowns Impacts of temperature on snowpack and ice clarity-impacts photosynthesis & DO, sedimentation rates

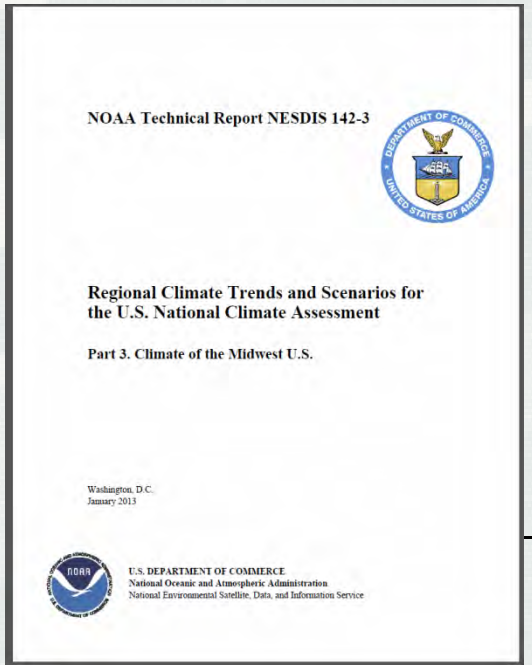
X. Design Considerations NA

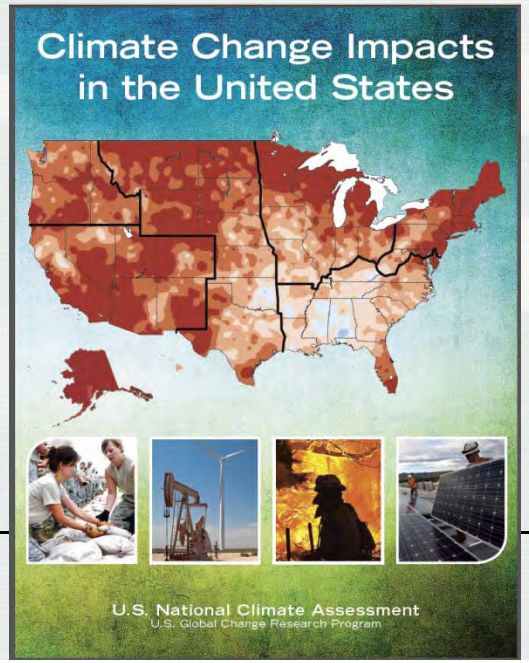
Sources of Information

NOTE: The certainty and applicability of the available science on climate change and hydrology that is ready for consideration in decisions varies strongly with location and spatial scale. It is important to select information for the qualitative analysis at the appropriate scale of the study.

Information to support the Qualitative Assessment should be compiled from available, established, rebuttable, scientific and engineering research literature.

Library started at: T:\ec-hh\Literature to Support qualitative analysis of Climate Change impacts





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Sources of Information (cont.)

USACE is currently developing regional climate change literature syntheses at the two-digit Hydrologic Unit Code (HUC2) scale, as well as developing screening-level watershed-scale vulnerability assessments at the HUC-4 scale.

Applicability to projects already initiated

ECB applies **except** for the following cases:

- Feasibility Phase – The Tentatively Selected Plan milestone was completed prior to 2 May 2014.

- Preconstruction Engineering and Design (PED) – The required hydrology and hydraulics components of the PED phase were more than 50% complete as of 2 May 2014.

ECB 2016-25 presents a slightly revised Qualitative Analysis Framework

Phase I – Literature review outlining the broad trends of observed and projected changes to climate that might impact watershed hydrology and project purpose.

Phase II – Analysis focusing on the projected changes in the study area and watershed of interest

-

II. Providing **resources** to support the **qualitative assessment** of climate threats and impacts specific to those analyses.

III. Providing an **overview of future planned guidance** for additional **quantitative assessments** of potential climate change threats and impacts for use in future hydrologic analyses.

Qualitative only requirement consistent for ECB 2016-25

****** ... quired for hydrologic studies for inland watersheds at this time. ******