2022 Fish Passage and Stream Restoration Design Training

Module 4: Hydraulic Design Process

Presenter: Heather Pittman, PE Fish Passage Design Manager—Olympic Region

December 19, 2022

Heather Pittman

- Fish Passage Design Manager-Olympic Region
- Olympia, Wa
- WSDOT

- **Current Duties:** Oversee fish passage design in Olympic Region, help with policy updates and training, stream construction support

- **Background & Experience:** 14 years of WSDOT experience, including 5 years in the Mount Baker Area Project Offices and 9 years at Headquarters Hydraulics

- **Education:** BS Civil Engineering—Michigan State University

- **Personal Interests:** Knitting and other crafts, videogames, gardening, being outside and in/around water, and small child wrangling

Agenda

- PHD Roles and Responsibilities
- PHD Process
- Design Methodologies
- Structure Free Zone/Type, Size, and Location
- Design Delivery Methods
- Scour Process
- FHD Process
- Post FHD Process

SR 9 Lake Creek, Built 2022

Learning Objectives

- Understand the process of:
  - PHD
  - FHD under different design delivery methods
  - Post FHD work
- Know the roles and responsibilities of all involved people
- Know the role of the stream design team
- Understand the terminology used throughout the process

SR 302 Minter Creek, Built 2021

Abbreviations

- SR = State Route
- MP = Mile Post
- WDFW = Washington Department of Fish and Wildlife
- PHD = Preliminary Hydraulic Design
- FHD = Final Hydraulic Design
- PEO = Project Engineering Office
- ESO = Environmental Services Office
- HQ = Headquarters
- LWM = Large Woody Material
- SFZ = Structure Free Zone
- TSL = Type, Size, and Location
- MHO = Minimum Hydraulic Opening

PHD Process - Purpose

Determine and Document:

- Bankfull width
- Minimum Hydraulic Opening
- Preliminary Channel Alignment
- Preliminary Channel Geometry
- Preliminary LWM Layout
- Sediment Sizing
- Preliminary Scour (MHO)

SR 99 WF Hylebos Creek, Built 2015

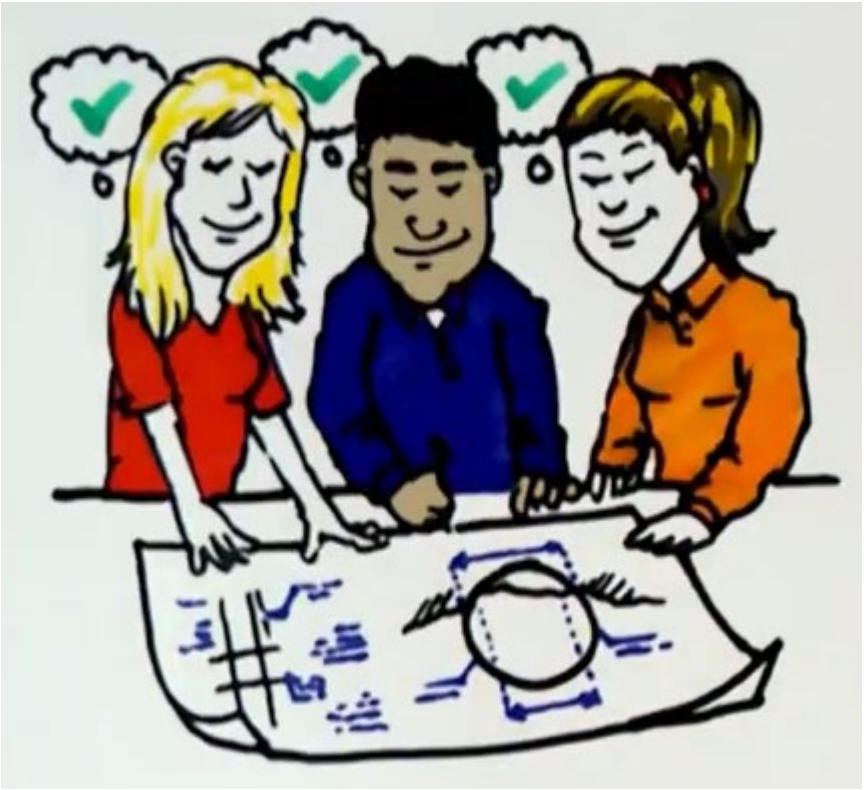
PHD Process - Purpose

- Determine and Document:
  - **Bankfull width**
  - **Minimum Hydraulic Opening**
  - **Preliminary Channel Alignment**
  - Preliminary Channel Geometry
  - Preliminary LWM Layout
  - Sediment Sizing
  - **Preliminary Scour (MHO)**

SR 112 Jansen Creek, Built 2016

PHD Involved Parties

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)



PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Fish passage design policy
- Management of the hydraulic design & internal review process
- Coordinate with region/external partners on design elements
- Fill the role of the hydraulic designer when consultant not on board (Site Visit 1)

PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Either HQ Hydraulics/ESO staff or Consultants
- Gather all field information (Site Visit 2)
- Author Field Report Form
- Author PHD
- Facilitate on site meeting (Site Visit 3)
- Respond to comments

PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Either a region or a consultant
- Responsible for
  - Establish Control
  - Existing Surface (including bathymetry)
  - Coordinate with Hydraulic Engineer to define critical features and survey limits

PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Establishes Program Priorities
- Answers barrier/biological questions
- PHD Author (if internal)
- Part of review process

PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Subsurface material exploration

PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Assist with comanager coordination
- Look for project permit red flags
- Part of review process

PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Identifies roadway constraints
- Facilitates communication between groups
- Organizes coordination meetings
- Looks at project constructability
- Takes the project through the design phase if internal

PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- PEO
- Bridge and Structures
- Geotech
- Region Environmental
- Region Landscape Architects
- Assistant State Design Engineer
- HQ ESO
- HQ Hydraulics

PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

- Provides concurrence on bankfull width and reference reach
- Reviews PHD from a regulatory perspective
- Early involvement helps prevent issues receiving HPA at later phases of a project

PHD Roles & Responsibilities

- HQ Hydraulics
- Hydraulic Design Team
- Survey Team
- HQ Environmental Services Office (ESO)
- HQ Geotechnical
- WSDOT Region Environmental
- WSDOT PEO
- WSDOT Review Team
- WDFW
- Tribe(s)

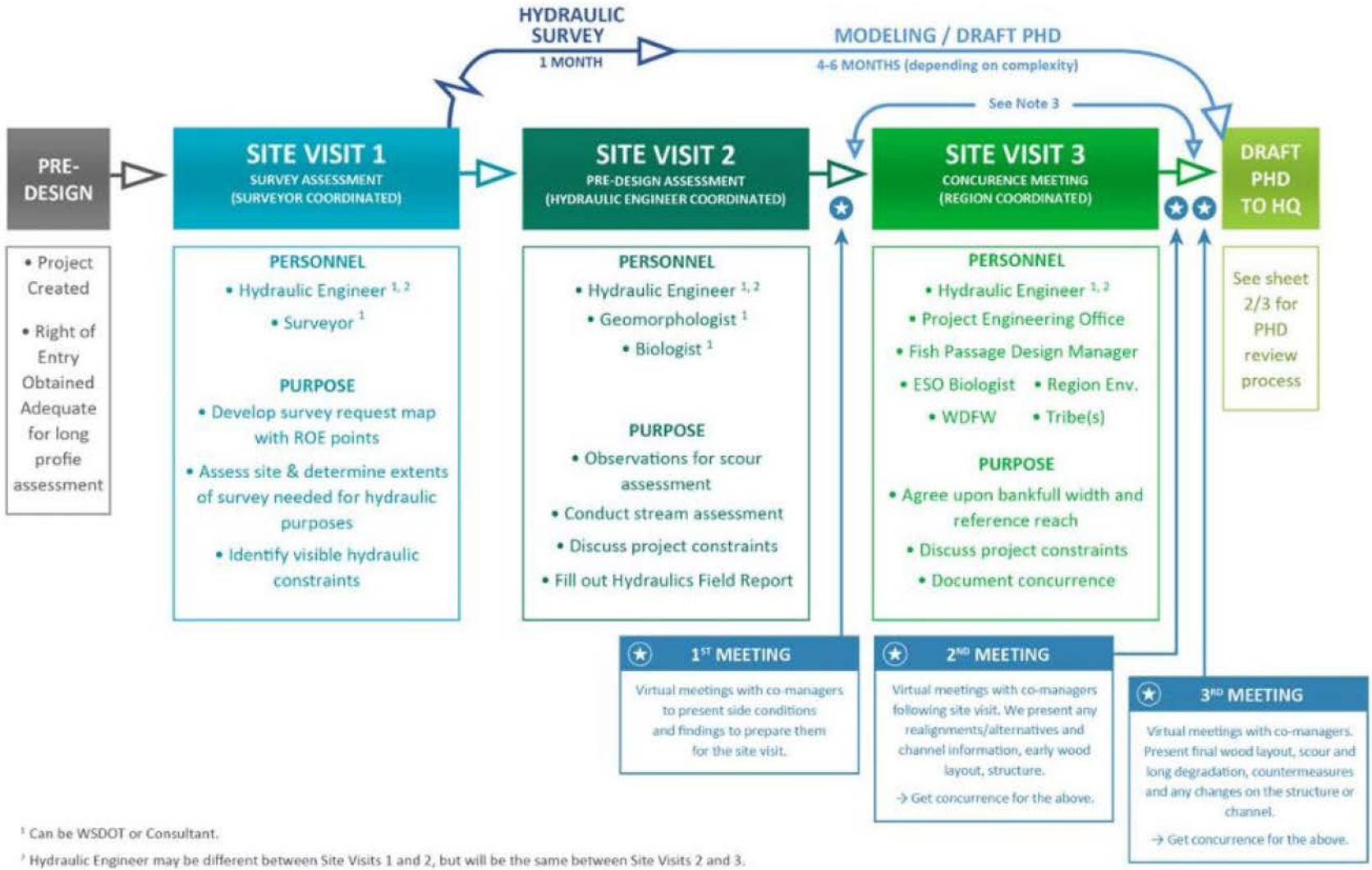
- Provides agreement on bankfull width and reference reach
- Reviews PHD and provides feedback

Importance of Teamwork

- Great number of team players
- Early coordination and communication
- Open and honest communication
- Need to build trust for future projects

PHD Process Flow Chart

Exhibit 800-5 Preliminary Hydraulic Design: Stream Design Process



[1] Can be WSDOT or Consultant.

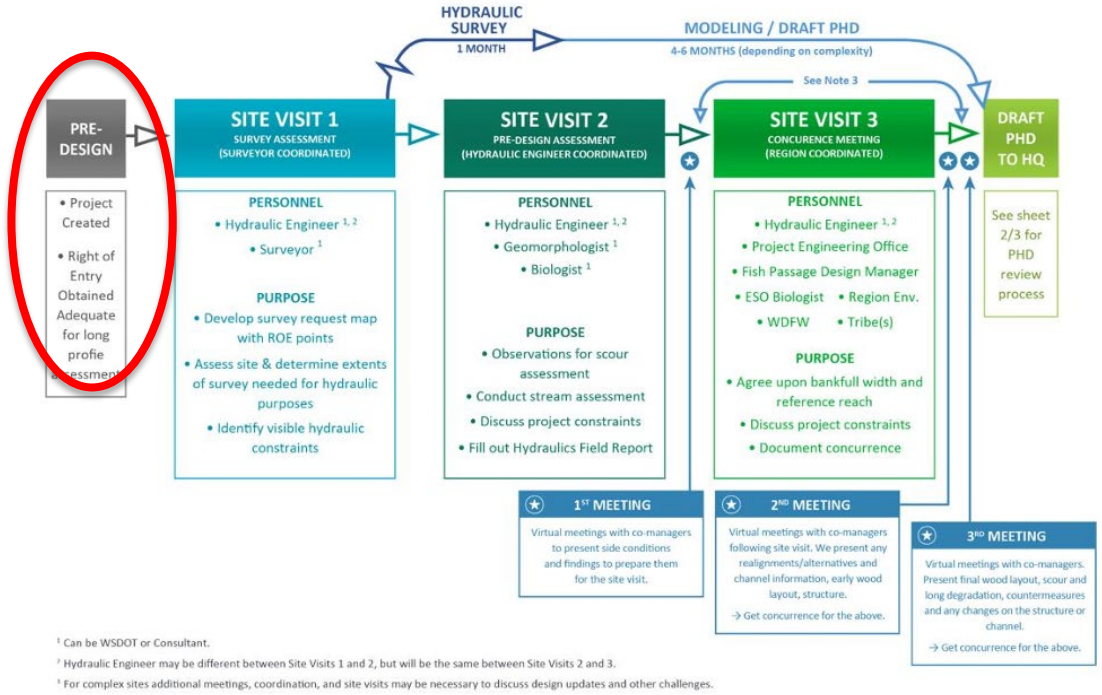
[2] Hydraulic Engineer may be different between Site Visits 1 and 2, but will be the same between Site Visits 2 and 3.

[3] For complex sites additional meetings, coordination, and site visits may be necessary to discuss design updates and other challenges.

Pre-Design

- Project Prioritization
- Project Creation
- Rights of Entry

Exhibit 800-5 Preliminary Hydraulic Design: Stream Design Process



[1] Can be WSDOT or Consultant.

[2] Hydraulic Engineer may be different between Site Visits 1 and 2, but will be the same between Site Visits 2 and 3.

[3] For complex sites additional meetings, coordination, and site visits may be necessary to discuss design updates and other challenges.

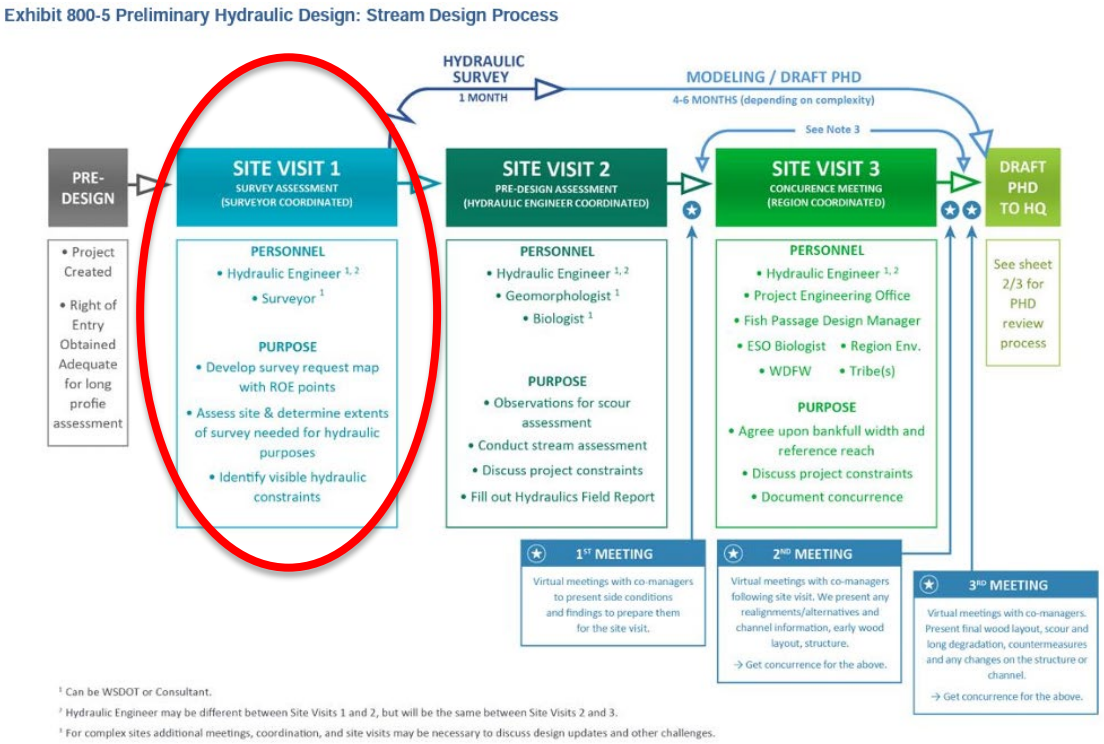
Site Visit 1

Who:

- Hydraulic Engineer
- Survey

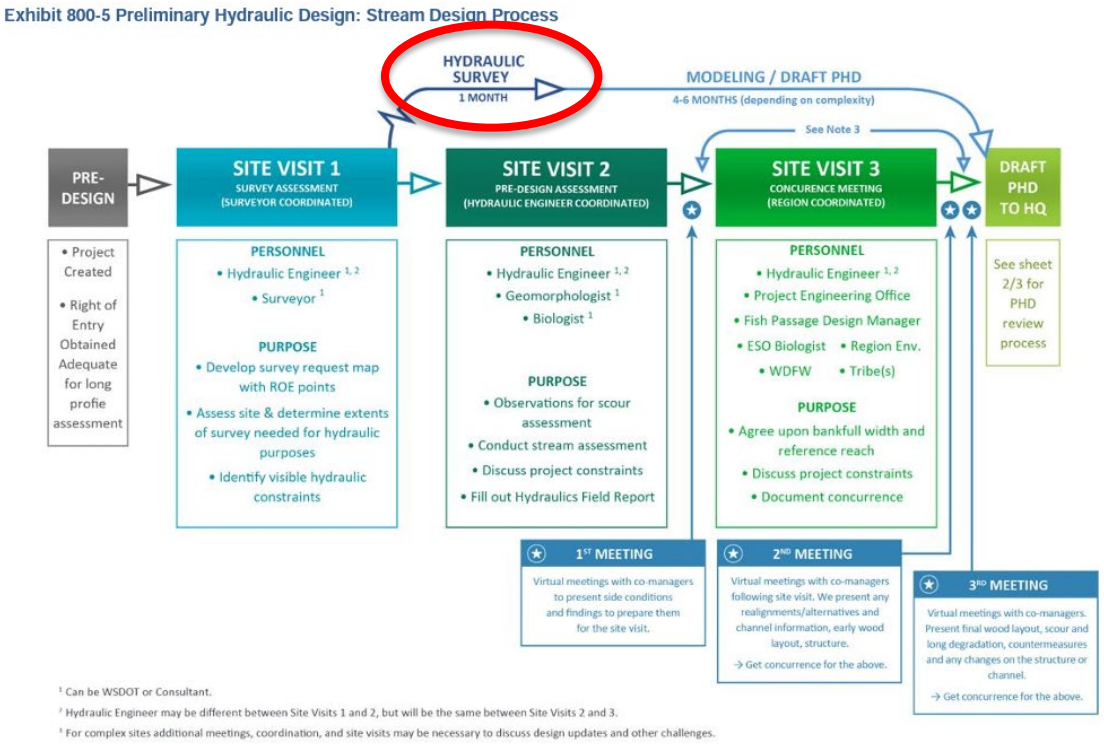
Purpose:

- Determine survey extents
- Identify obvious constraints



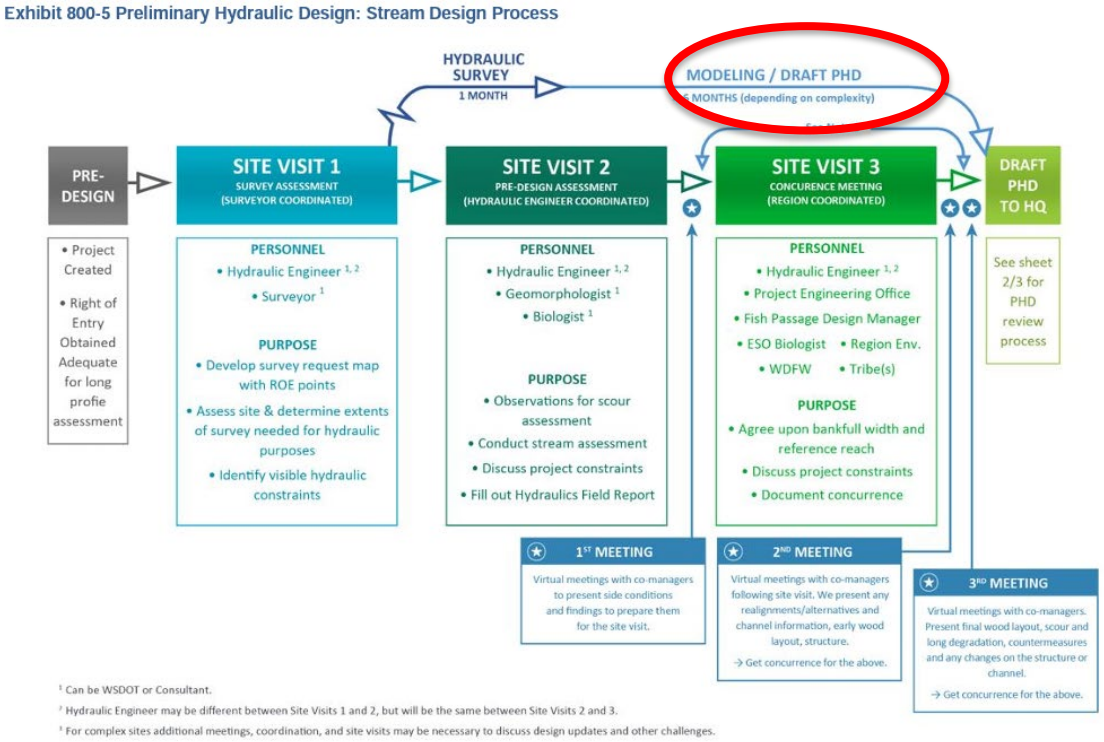
Hydraulic Survey

- Establish Control
- Existing Surface (including bathymetry)
- Process data into InRoads Surface
- Notify Fish Passage Design Manager of completion
- Hydraulic Designer tc confirm survey



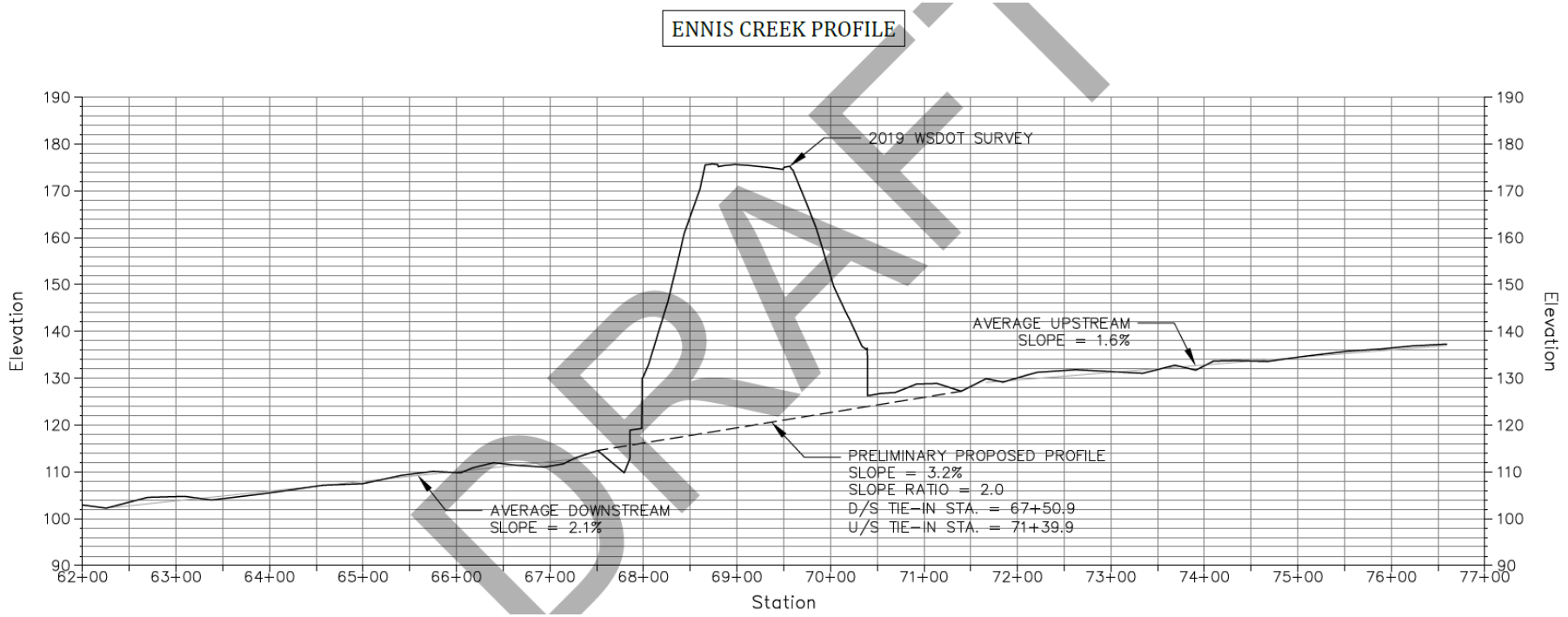
Modeling/PHD Draft

- PHD Template to be followed
- Design decisions to be documented
- Constraints to be brought up with HQ Hydraulics
- Plans need to follow Plans Prep/Checklist



Design Constraints

- Slope Ratio
- Velocity Ratio
- Discontinuity between upstream and downstream reaches
- Freeboard Concerns
- Geometric Constraints
- Sediment Size
- Infrastructure



DRAFT

Design Methodologies

- Stream Simulation
- Unconfined Bridge
- Confined Bridge

SR 20 Lorezan Creek, Built 2021

Design Methodologies

Stream Simulation

- FUR less than 3.0 (confined)
- Bankfull less than 15ft
- Structure width less than 20ft
- Slope within 125% of upstream reach
- 1ft or less of channel regrade
- Channel is mostly stable

Confined Bridge

- FUR less than 3.0 (confined)
- Bankfull width greater than 15ft
- MHO greater than 20ft
- Slope greater than 125% of upstream reach
- 1ft or more of channel regrade

Unconfined Bridge

- FUR greater than 3.0

Equivalent or Better

- Designs that don't fit in the other "boxes" but are agreed upon by WSDOT and Comangers to be the appropriate solution to the site. Sometimes also called "alternate designs"

“Meets Stream Simulation”

- Slope within 125% of upstream reach
- Structure length under 10 times the width or additional width added for geomorphic processes
- Channel morphology matches expected
- Channel shape matches expected
- MHO is a minimum of Equation 3.2
- Required freeboard is provided*
- D50 of the proposed sediment is within 20% of reference reach*
- Invert appropriately countersunk

* Unless otherwise approved

SR 9 Norway Park Creek, Built 2022

Site Visit 2

Who:

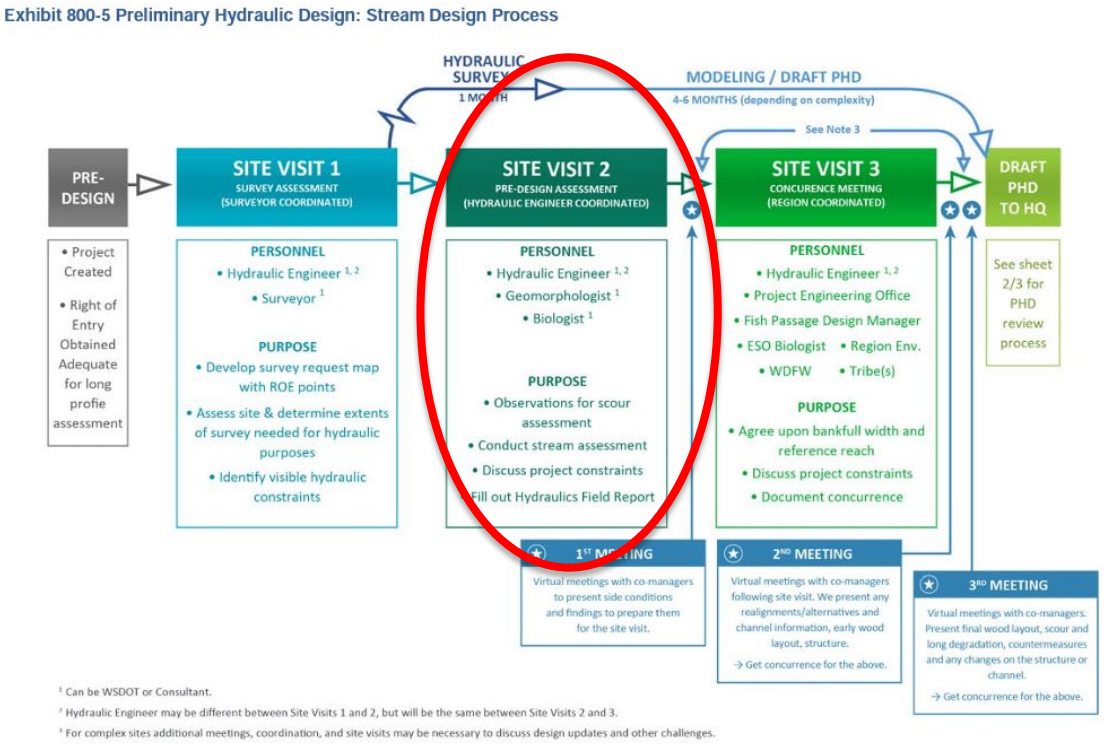
- Hydraulic Design Team

Purpose:

- Conduct stream assessment
- Determine project constraints

Deliverable:

- Field Report



Site Visit 2

Do:

- Allow enough time
- Gather detailed info
- Prepare in advance
- Check weather/conditions
- Bring appropriate people

Do not:

- Rush
- Risk your safety

Field Report Form

- All fields filled out in detail
- Include photos
- Review Process
  - HQ Hydraulics
  - PEO
  - WDFW
  - Tribes

WSDOT Hydraulics Section	Site Visit 2 Field Report	Project Number:
	Project Name:	Date:
	Project Office:	Time of Arrival:
	Stream Name:	Time of Departure:
WDFW ID Number:	Tributary to:	Weather:
State Route/MP:	Township/Range/Section/ ¼ Section:	Prepared By:
County:	Purpose of Site Visit:	WRIA:

Meeting Location:

Attendance List:

Name	Organization	Role

Observations:
Describe measurements, locations, known history, summarize on site discussion.

Reference Reach:
Describe location, known history, summarize on site discussion, appropriateness, bankfull measurement, geomorphic pattern, slope.

Bankfull Width & Bankfull Depth:
Describe who was involved, extents collection occurred within.

Data Collection:
Describe site conditions, channel geomorphology (shape, spacing of features, etc), habitat type and location, flow splits, LWM location and quantity, etc. Provide a sketch showing location of data collected.

Pebble Counts:
Describe location of pebble counts if available.

Photos:
Any relevant photographs placed here with descriptions.

Samples:
Work within the wetted perimeter may only occur during the time periods authorized in the APP ID 21036 entitled "Allowable Freshwater Work Times May 2018". Work outside of the wetted perimeter may occur year-round. APPS website:
https://www.govonlinesaas.com/WA/WDFW/Public/Client/WA_WDFW/Shared/Pages/Main/Login.aspx

Were any sample(s) collected from below the OHWM?	*No ☐ If no, then stop here.*
	Yes ☐ If yes, then fill out the proceeding section for each sample; as well as log the sample for GHPA annual reporting in the 202x Fish Passage Streambed Sediment Sample Log spreadsheet located on ProjectWise Field Resources folder.

Sample #:	Work Start:	Work End:	Latitude:	Longitude:

Summary/description of location:
Summarize/describe the sample location.

Description of work below the OHWL:
Describe the work below the OHWL, including equipment used and quantity of sediment sampled.

Description of problems encountered:
Describe any problems encountered, such as provision violations, notification, corrective action, and impacts to fish life

Field Report Form

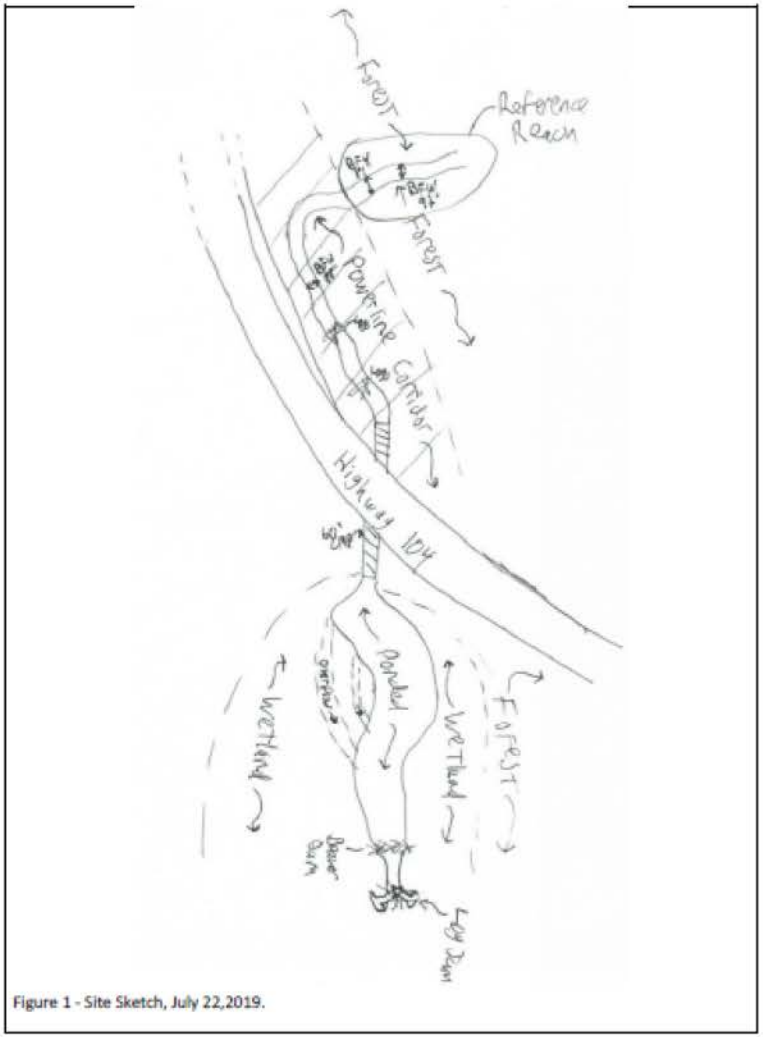


Figure 1 - Site Sketch, July 22,2019.

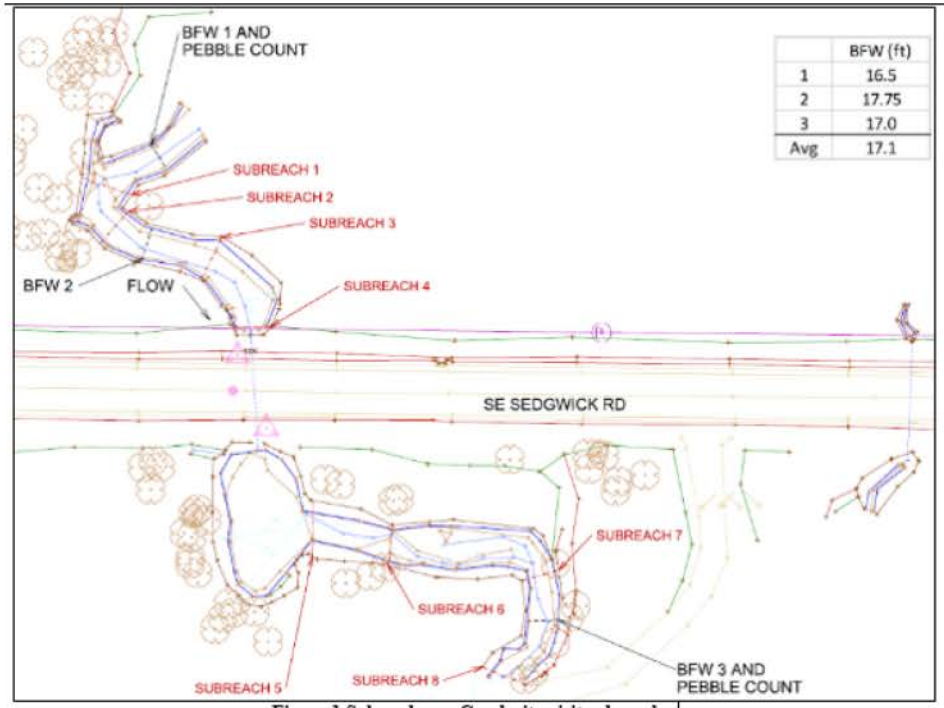
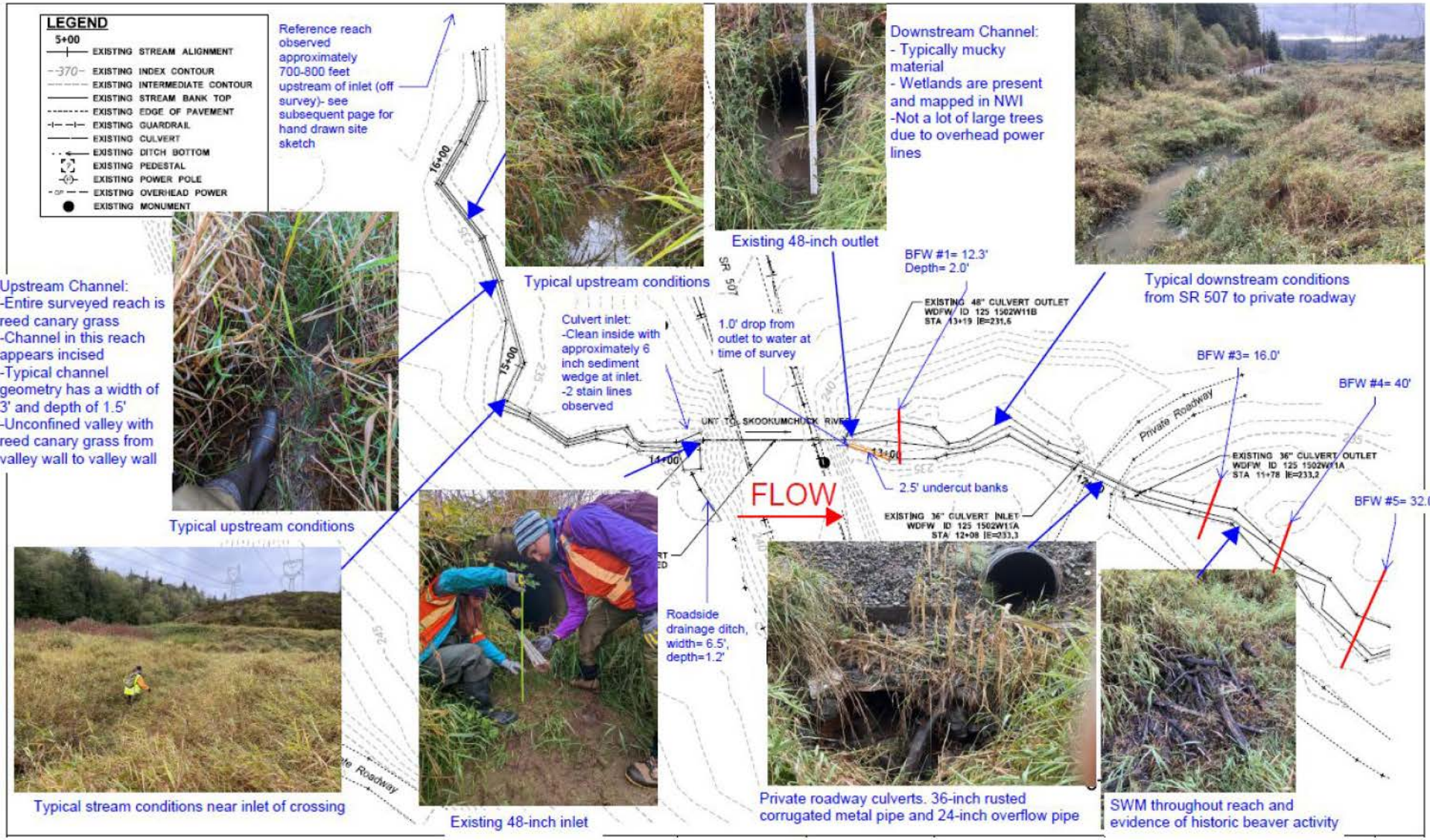


Figure 1 Salmonberry Creek site visit subreaches

Field Report Form



Field Report Form

Figure 3 Cohesive clayey bank material (left), channel substrate (right)

Figure 4 Looking downstream at the 180 degree turn of subreach 2 (left), and looking upstream (right)

Figure 5 Erosion on right bank at 180 degree turn (left), groundwater seep (right)

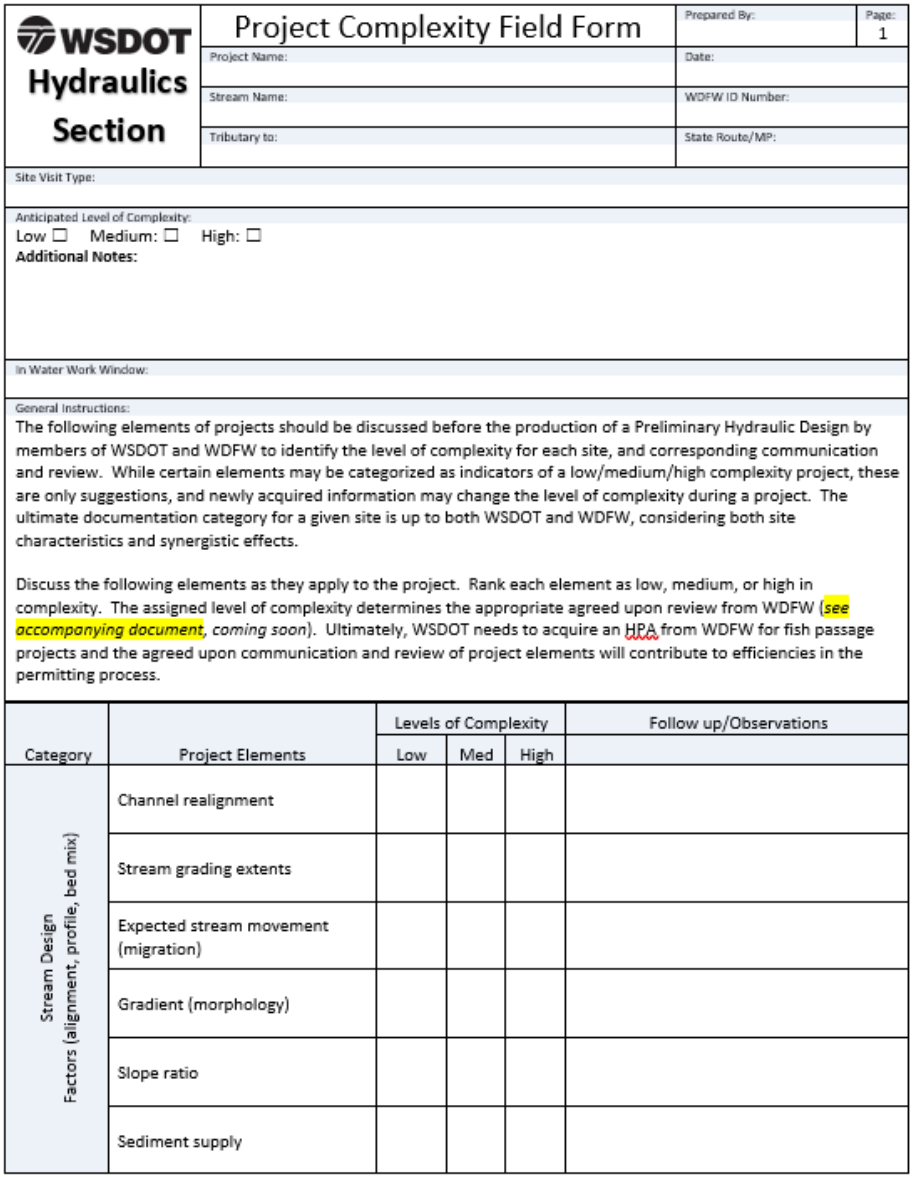
Figure 8 Culvert inlet looking downstream

Figure 9 Culvert outlet (left), inside view of culvert (right)

Figure 10 Scour pool above culvert outlet (left), scour pool from left bank (right)

Project Complexity Form

- All fields filled out
- Comments on why elements selected
- Future conditions
- Living document
- Review Process
  - HQ Hydraulics
  - PEO
  - WDFW
  - Tribes



WSDOT Hydraulics Section

Project Complexity Field Form

Prepared By: | Page: 1

Project Name: | Date:

Stream Name: | WDFW ID Number:

Tributary to: | State Route/MP:

Site Visit Type:

Anticipated Level of Complexity:
Low ☐ Medium: ☐ High: ☐
Additional Notes:

In Water Work Window:

General Instructions:
The following elements of projects should be discussed before the production of a Preliminary Hydraulic Design by members of WSDOT and WDFW to identify the level of complexity for each site, and corresponding communication and review. While certain elements may be categorized as indicators of a low/medium/high complexity project, these are only suggestions, and newly acquired information may change the level of complexity during a project. The ultimate documentation category for a given site is up to both WSDOT and WDFW, considering both site characteristics and synergistic effects.

Discuss the following elements as they apply to the project. Rank each element as low, medium, or high in complexity. The assigned level of complexity determines the appropriate agreed upon review from WDFW (*see accompanying document, coming soon*). Ultimately, WSDOT needs to acquire an HPA from WDFW for fish passage projects and the agreed upon communication and review of project elements will contribute to efficiencies in the permitting process.

Category	Project Elements	Levels of Complexity			Follow up/Observations
		Low	Med	High	
Stream Design Factors (alignment, profile, bed mix)	Channel realignment				
	Stream grading extents				
	Expected stream movement (migration)				
	Gradient (morphology)				
	Slope ratio				
	Sediment supply				

Project Complexity Form

Category	Project Elements	Levels of Complexity			Follow up/Observations
		Low	Med	High	
Stream Design Factors (alignment, profile, bed mix)	Channel realignment				
	Stream grading extents				
	Expected stream movement (migration)				
	Gradient (morphology)				
	Slope ratio				
	Sediment supply				

Category	Project Elements	Levels of Complexity			Follow up/Observations
		Low	Med	High	
Structure Factors	Stream size and bankfull width				
	Meeting requirements for freeboard				
	Fill depth above barrier				
	Risk of degradation/aggradation				
	Long culvert criteria/openness ratio				
	Channel confinement & Floodplain Utilization Ratio (FUR)				
	Meeting Stream Simulation				
	Tidal influence				
	Alluvial fan				
	Presence of other barriers nearby				
	Potential for backwater impacts				
	Presence of infrastructure nearby				
	Need for bank protection				
	Geotech or seismic considerations				

Project Complexity Form

Complexity Field Forms Instructions to Hydraulics Lead

Project Element Definitions:

If elements are not applicable, write N/A under Follow up/observations

Stream Design Factors

- Channel Realignment: Is there a horizontal channel realignment anticipated? (High = significant; Medium = Moderate; Low = Remain in place)
- Stream grading extents: How far upstream and downstream is grading expected? (High = significant; Medium = Moderate; Low = Minor Grading)
- Expected Stream Movement (Migration): How much movement is expected by the creek both in relation to the stream overall and the potential structure. (High = Channel lateral migration is expected; Medium = Some movement expected, particularly in newly exposed roadway fill slopes; Low = No movement expected, and geotechnical data is available to back up this assessment)
- Gradient: What type of morphology is expected as a result of gradient? (High = Step-pool or greater; Medium = upper end of plane bed trending toward step-pool; Low = Plane bed/pool riffle)
- Slope ratio: Is it possible to meet the slope ratio (High = No; Medium = Probably/Maybe; Low = Yes)
- Sediment supply: Are there any risks to the project overall due to sediment supply or will sediment supply impact any of the design elements for the project, for example, a high sediment supply or upstream sediment trap (High = Yes; Medium = Probably/Maybe; Low = No)

Structure Factors

- Stream size and bankfull width: How large is the stream? (High = 30' +; Medium = 15'-30' Low = 2'-15')
- Meeting freeboard requirements: Can freeboard above the 100-year be met? (High = No, not without a significant roadway raise; Medium = minor roadway raise may be necessary; Low = Yes)
- Fill depth above barrier: Will the depth of fill above the crossing make things complicated? (High = Yes, either high fill or low fill; Medium = moderately low or high, may cause complications but won't know until further analysis is done; Low = No)
- Risk of degradation/aggradation: Is there a risk for the stream to aggrade or degrade? (High = Yes; Medium = Probably/Maybe; Low = No)
- Channel confinement & Floodplain Utilization Ratio (FUR): (High = unconfined; Medium = borderline of confined/unconfined; Low = confined)
- Meeting Stream Simulation: Can stream simulation be met? Look at the other design factors that have been identified already and rate. If systems is tidal this is N/A. (High = unlikely to meet stream sim; Medium = some elements of risk have been identified and more evaluation is necessary; Low = stream simulation can be met)
- Tidal Influence: (High = below head of tide; medium = above head of tide; low = non-tidal).
- Alluvial Fan: (High = on alluvial fan; medium = possibly on fan or fan not expected to impact design; low = no fan)
- Presence of other barriers nearby: Are there other barriers nearby that could impact the design of the crossing in question. (High = yes; medium = maybe; low = no)
- Potential for backwater impacts: Is there a risk for backwater impacts either by the WSDOT crossing onto other properties (High = yes; medium = maybe; low = no)
- Presence of infrastructure nearby: Are there design constraints at this location that limit the design and possibly the compliance with stream simulation? Note them in the notes if there are. (High = yes; medium = maybe; low = no)
- Need for bank protection: Is bank protection expected. If in deep fill the answer is yes unless geotechnical data supports otherwise. (High = yes; medium = maybe; low = no)
- Geotech and/or seismic considerations: Are there geotechnical concerns at this site either through the already received Geotech or perceived as part of the site visit? (High = yes; medium = maybe; low = no)

Complexity Field Forms Instructions to Hydraulics Lead Cont.

Prior to Site Visits:

- ☐ Fill in headings of Complexity Field Form
- ☐ Do desktop assessment of the elements in the list
- ☐ Understand Project Element Definitions. Please reach out to HQH if unsure of what Project Element Covers.

Site Visit 2:

- ☐ Fill out field form in the field and/or adjust any project elements that were assessed during the desktop assessment. Recommend bringing the Project Elements Definitions on site as reference.
- ☐ Update electronic version of form and attach to Site Visit 2 Field Report Form for review/distribution.
- ☐ Estimate the anticipated level of complexity using the field report elements.

Site Visit 3:

- ☐ Prior to Site Visit 3, update any elements that have changed as a result of additional information
- ☐ Bring the Project Elements Definitions on site as reference.
- ☐ Go over each element of complexity in the field and obtain concurrence. Note any additional information, concerning factors, or other notes on each element. If there are additional notes in general, add those to the additional notes under anticipated level of complexity.
- ☐ Obtain concurrence on anticipated level of complexity.

1st Meeting with Comanagers

Who:

- Project Team
- Comanagers

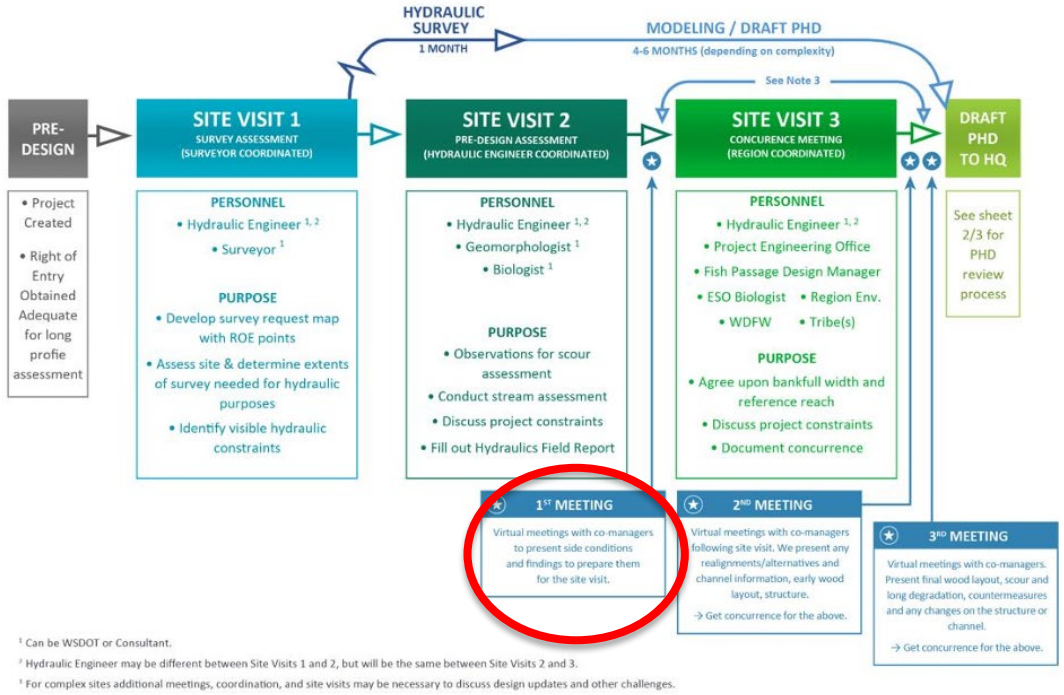
Purpose:

- Highlight important Site Visit 3 elements

Deliverable:

- Any information requests from comanagers

Exhibit 800-5 Preliminary Hydraulic Design: Stream Design Process



Site Visit 3

Who:

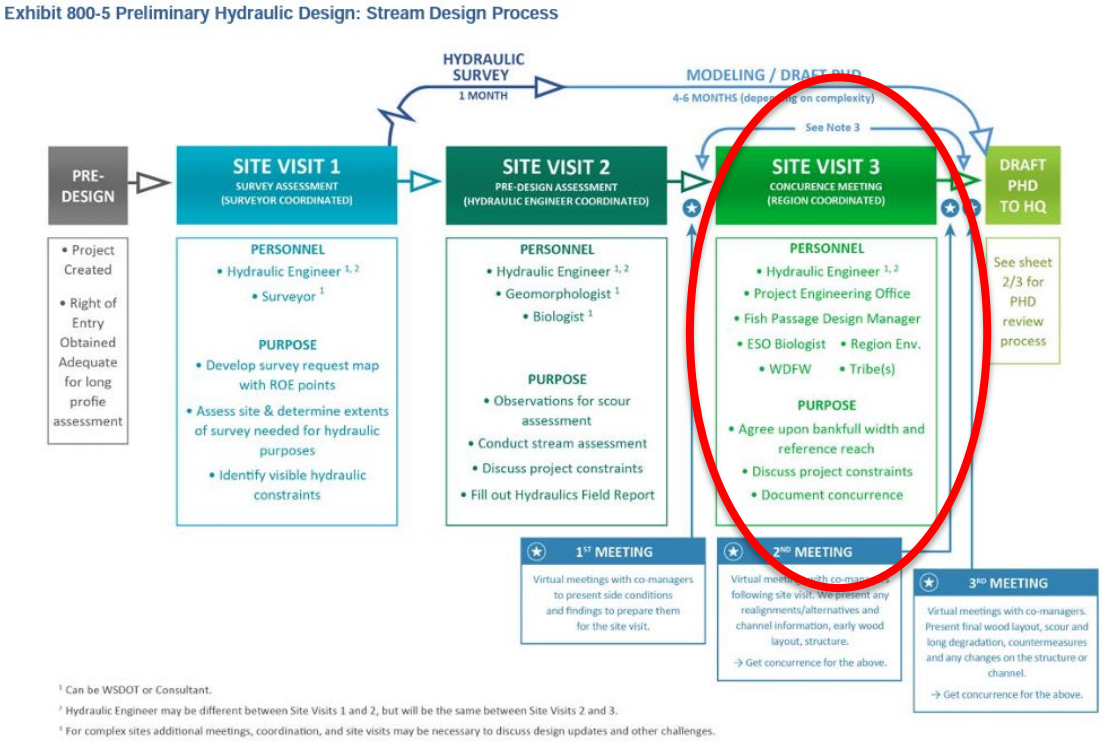
- Project Team

Purpose:

- Agreement on bankfull width & reference reach
- Discuss project constraints

Deliverable:

- Field Report Update or PHD Update



Site Visit 3

Do:

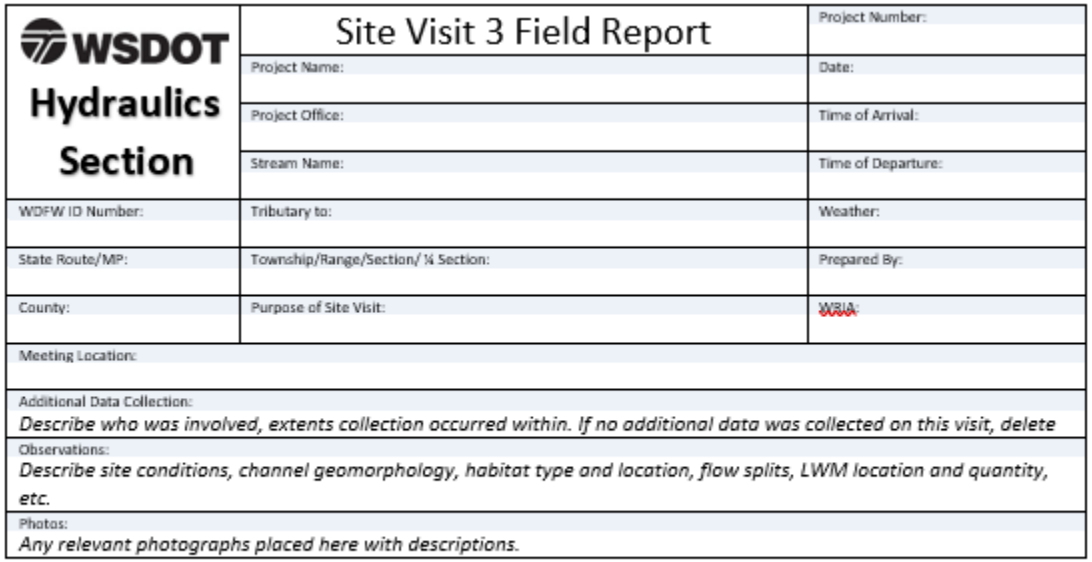
- Discuss project constraints
- Fill out the concurrence form
- Talk about any comanager concerns
- Discuss next steps
- Revisit Site Visit 2 notes to make sure additional data isn’t necessary

Do not:

- Concur on a structure size without analysis
- Miss getting concurrence form initialed

Field Report Form

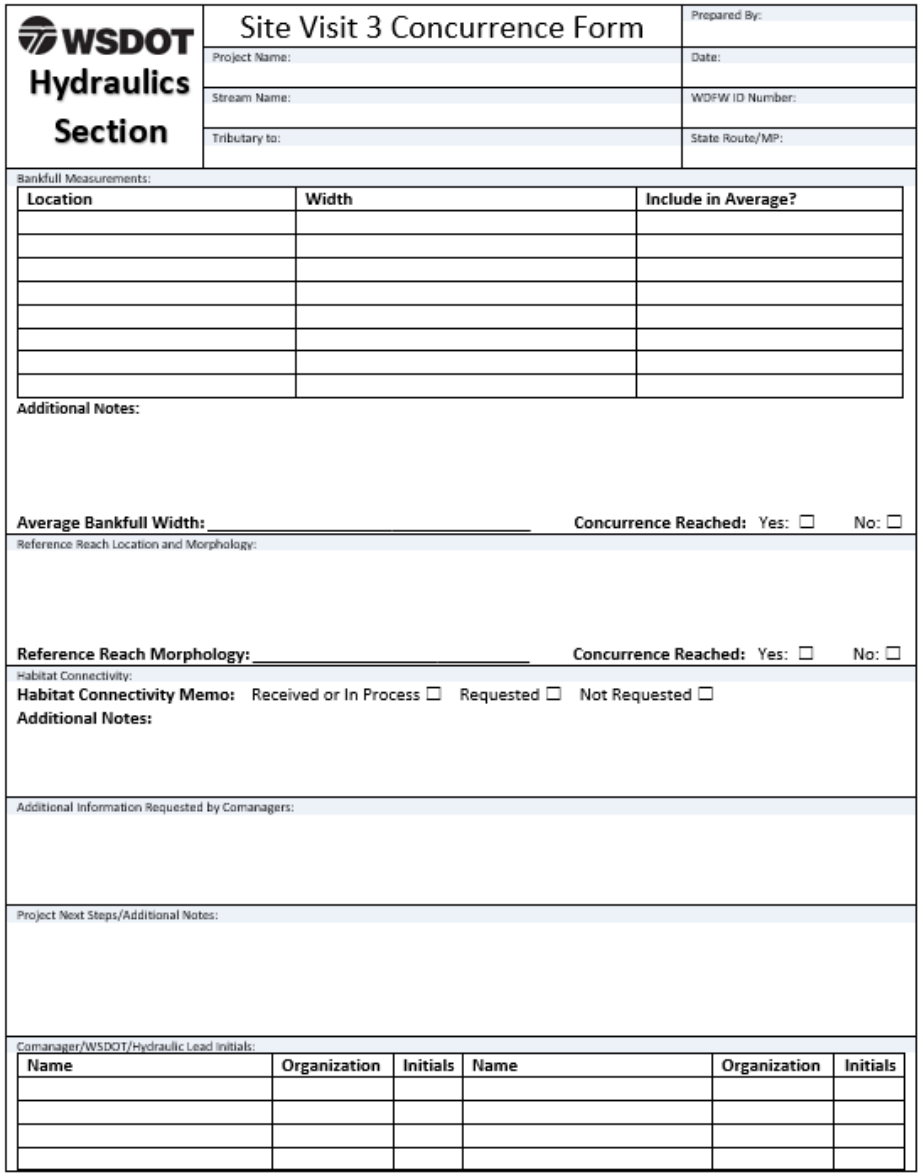
- All fields filled out in detail
- Include photos
- Any additional gathered information
- Review Process
  - HQ Hydraulics
  - PEO
  - WDFW
  - Tribes



WSDOT Hydraulics Section	Site Visit 3 Field Report	Project Number:
	Project Name:	Date:
	Project Office:	Time of Arrival:
	Stream Name:	Time of Departure:
WDFW ID Number:	Tributary to:	Weather:
State Route/MP:	Township/Range/Section/ ¼ Section:	Prepared By:
County:	Purpose of Site Visit:	WRIA:
Meeting Location:		
Additional Data Collection: *Describe who was involved, extents collection occurred within. If no additional data was collected on this visit, delete*		
Observations: *Describe site conditions, channel geomorphology, habitat type and location, flow splits, LWM location and quantity, etc.*		
Photos: *Any relevant photographs placed here with descriptions.*		

Concurrence Form

- All fields filled out in detail
- Make sure everyone is in agreement
- Note missing parties
- Get initials from listed parties
- When compiling Field Report Package, a scanned version of this is required



WSDOT Hydraulics Section

Site Visit 3 Concurrence Form

Prepared By:

Project Name: | Date:

Stream Name: | WDFW ID Number:

Tributary to: | State Route/MP:

Bankfull Measurements:

Location	Width	Include in Average?

Additional Notes:

Average Bankfull Width: _____ Concurrence Reached: Yes: ☐ No: ☐

Reference Reach Location and Morphology:

Reference Reach Morphology: _____ Concurrence Reached: Yes: ☐ No: ☐

Habitat Connectivity:

Habitat Connectivity Memo: Received or In Process ☐ Requested ☐ Not Requested ☐

Additional Notes:

Additional Information Requested by Comanagers:

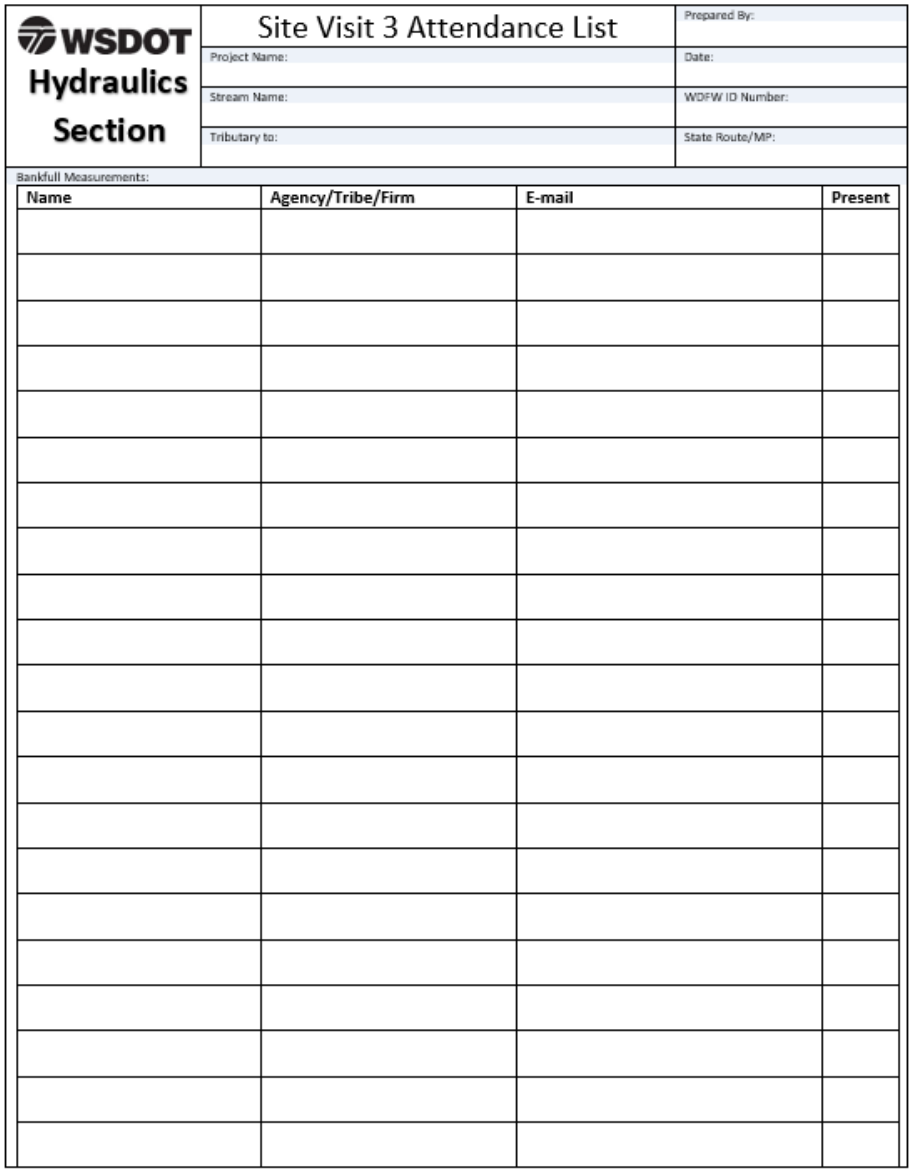
Project Next Steps/Additional Notes:

Comanager/WSDOT/Hydraulic Lead Initials:

Name	Organization	Initials	Name	Organization	Initials

Attendance Form

- Fill out to best of ability prior to site visit 3 using invitee list
- Add additional names as necessary



WSDOT Hydraulics Section

Site Visit 3 Attendance List

Prepared By:

Project Name:

Date:

Stream Name:

WDFW ID Number:

Tributary to:

State Route/MP:

Bankfull Measurements:

Name	Agency/Tribe/Firm	E-mail	Present

Site Visit 3 Instructions

Site Visit 3 Forms Instructions to Hydraulics Lead

Prior to Site Visit:

- ☐ Fill in headings of Site Visit 3 Field Report, Site Visit 3 Concurrence Form, Site Visit 3 Attendance List, and Site Visit 3 Complexity Form
- ☐ Determine whether a habitat connectivity memo is expected on the project. If yes, check the received or in process box on Site Visit 3 Concurrence Form
- ☐ Determine who the representatives from WDFW, Tribes, HQ Hydraulics, and Hydraulics Lead will be, fill in names/organizations under Comanager/WSDOT Initials
- ☐ Obtain attendance list from WSDOT PEO or Scoping Team. Fill in Site Visit 3 Attendance List. Make sure to leave extra space in case there are unexpected people. Leave "present" blank.
- ☐ Bring survey print out or other long profile information and know the slope of the reference reach AND approximate design slope.
- ☐ Determine what the approximate bankfull flow depth is.
- ☐ If available, have rough idea of what the structure size might be (is it stream sim or will it be larger?)

During Site Visit:

- ☐ Complete the Site Visit 3 Complexity Form. See Site Visit 3 Complexity Form instructions for further information.
- ☐ Note where bankfull widths were taken and what the measurements are. Make sure comanagers are present and agree with the measurements as they are being pulled. Make sure measurement pulled are accurate and in accordance with the WAC/WCDG. Consult HQH Representative in the field if there are concerns. If additional width should be accounted for in the final Minimum Hydraulic Opening Width due to uncertainties in planform, wood, etc., note that here. Note whether or not concurrence was reached. If concurrence is not reached it must be noted as to why it is not and whether additional steps need to be taken.
- ☐ Discuss and note reference location, any features that are expected to be replicated, the reference reach morphology, and any other defining details. Ensure comanager concurrence on these details.
- ☐ Discuss whether a habitat connectivity memo is expected on the site. Note whether one is requested by the team and if it is requested, note any reasoning behind this. (noted critter utilization of existing crossing, green belts, other evidence, etc.) If request is due to smaller creatures, discuss whether the group thinks the proposed structure would automatically accommodate those.
- ☐ Note any additional information that the comanagers want
- ☐ Discuss any additional steps or any additional site notes.

After Site Visit:

- ☐ Scan Site Visit 3 Concurrence Form and Attendance List
- ☐ Update Site Visit 3 Complexity form by either scanning field copy or electronically updating
- ☐ Add any additional data collection, observations, or photographs to the Site Visit 3 Field Report
- ☐ Compile Site Visit 3 Field Report Form, Complexity Form, Concurrence Form, and Attendance List into single document and provide to WSDOT through project specified channels for review

2nd & 3rd Comanager Meetings

Who:

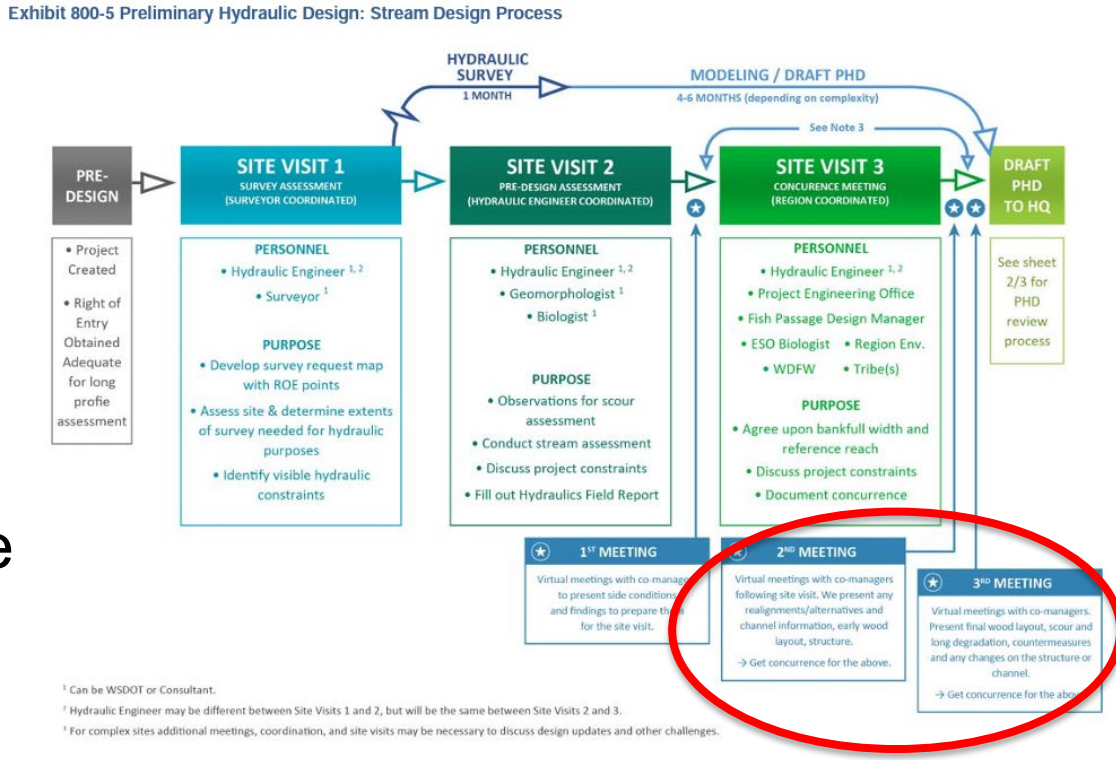
- Project Team
- Comanagers

Purpose:

- Review/preliminary concurrence on alignment alternatives, early wood layout, structure

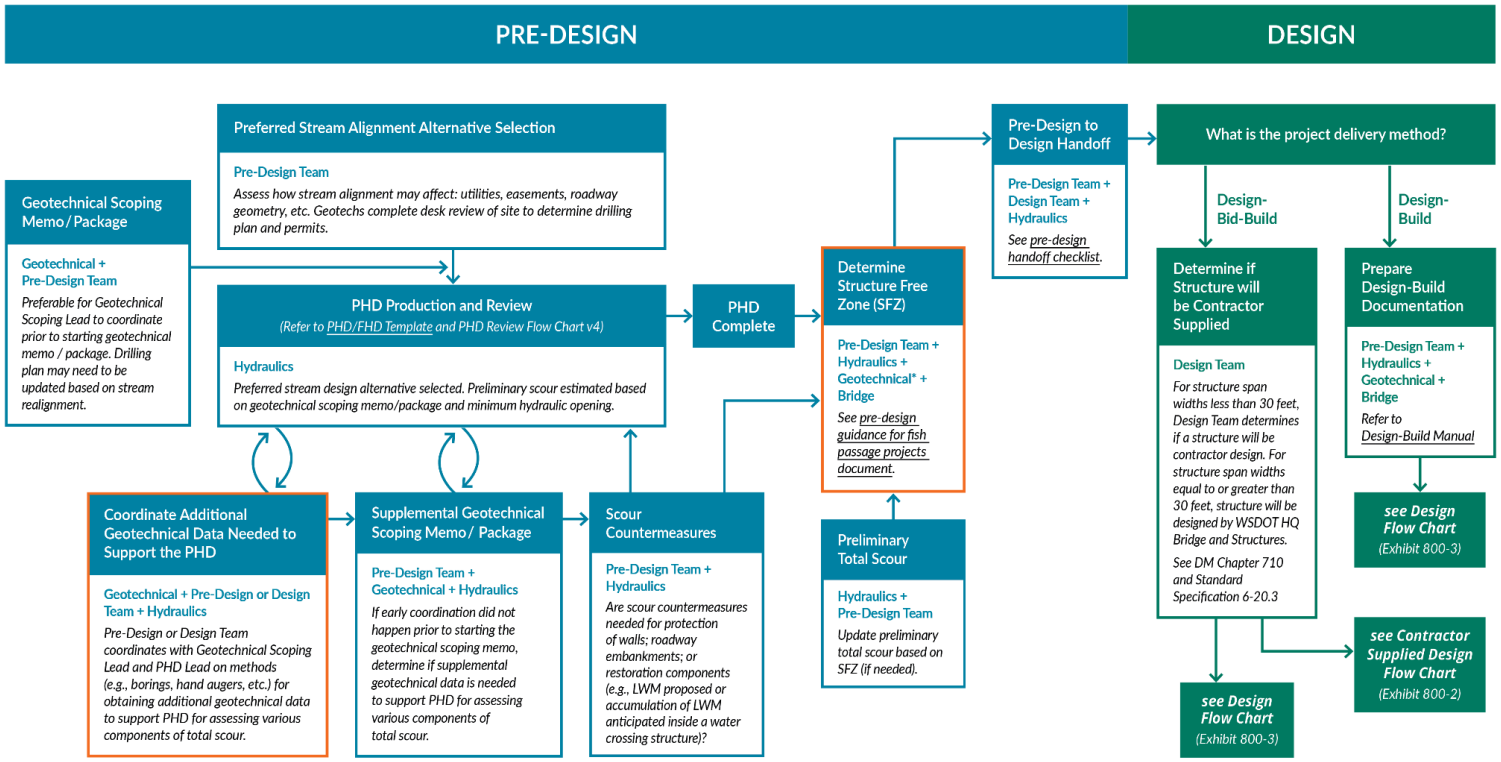
Deliverable:

- PHD Updates



Specialty Group Coordination – Pre-Design

SPECIALTY GROUP COORDINATION | PRE-DESIGN
EXHIBIT 800-1



General Notes

* Incorporate seismic design of walls, structures and proximity of unstable slopes.

Specialty Group Coordination

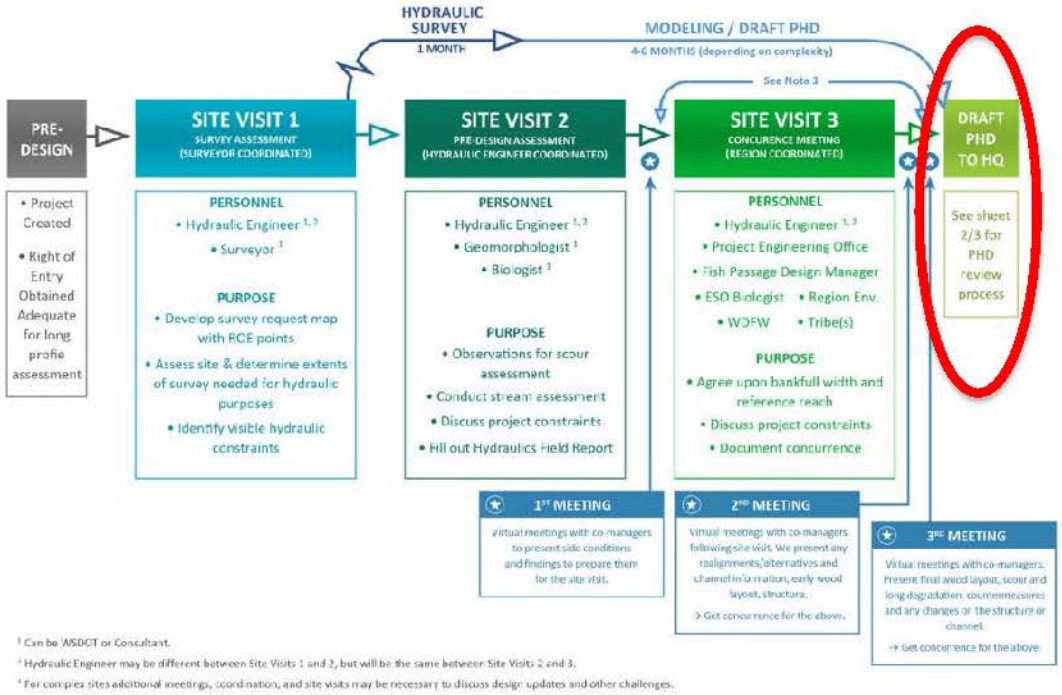
Contact HQ Hydraulics with questions.

Draft PHD

Washington State Department of Transportation

US 12 MP 19.17 Unnamed Tributary to Vance Creek: Preliminary Hydraulic Design Report

…ibit 800-5 Preliminary Hydraulic Design: Stream Design Process

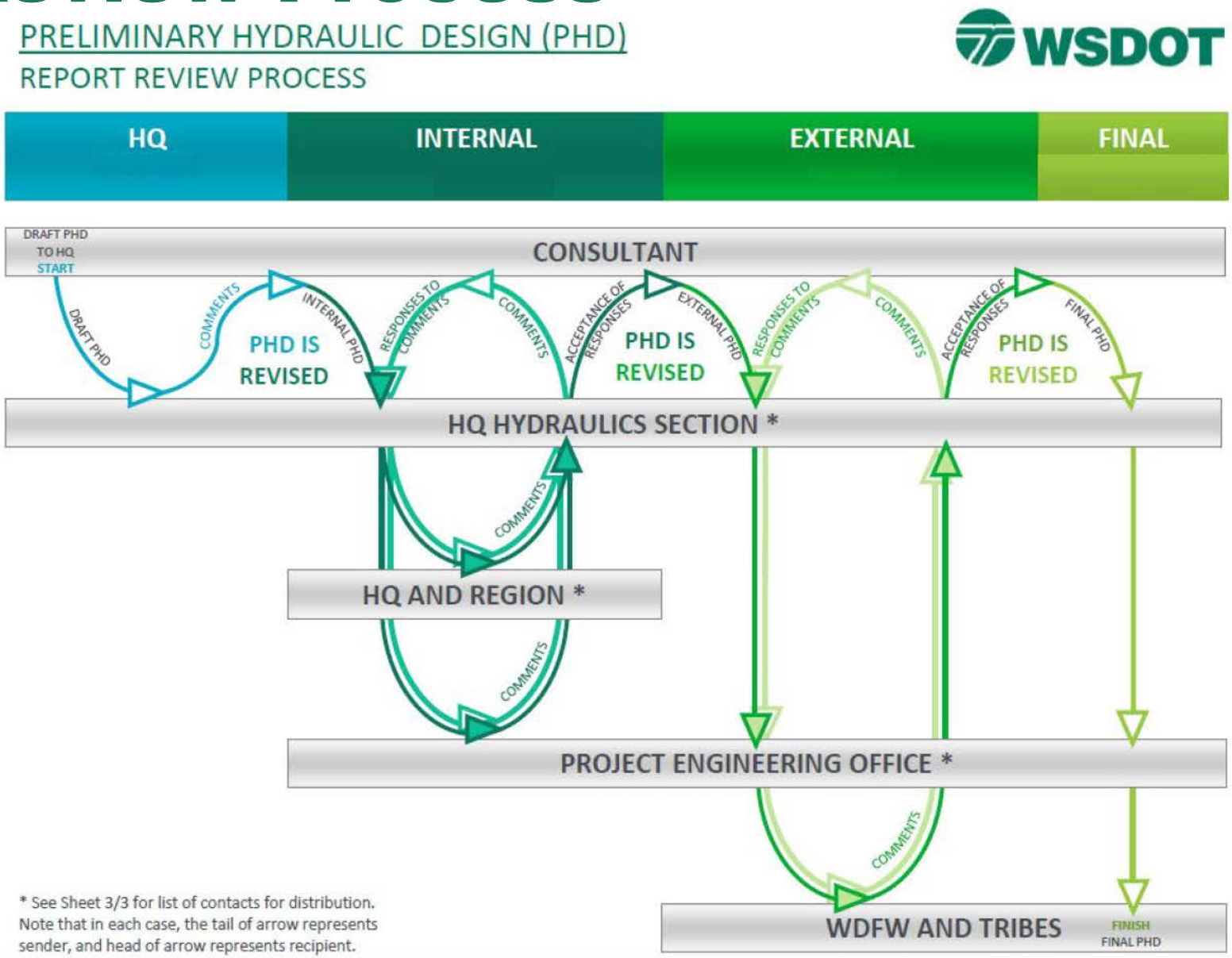


[1] Can be WSDOT or Consultant.

[2] Hydraulic Engineer may be different between Site Visits 1 and 2, but will be the same between Site Visits 2 and 3.

[3] For complex sites additional meetings, coordination, and site visits may be necessary to discuss design updates and other challenges.

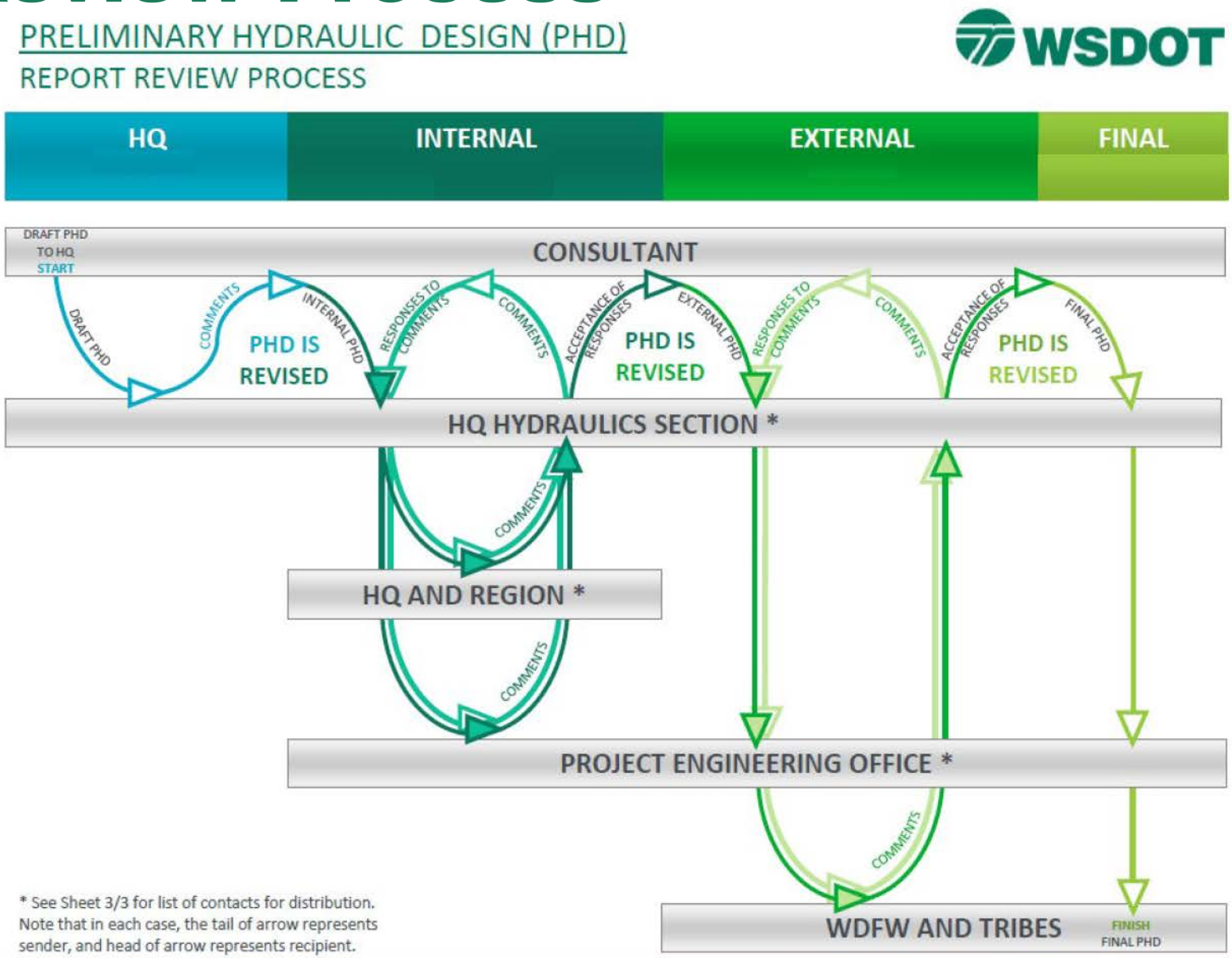
Review Process



PHD QC/QA Process

- If you don't feel good about your name on it, don't hand it in
- Clearly tell your story, remembering your audience
- Template is followed
- Chapter 7 of HM followed
- Model QCed, stable, and makes sense
- Design makes sense

Review Process



Comment Form

COPY AND PASTE THE TEXT BELOW AS THE NAME OF THIS DOCUMENT:

SR42_MP42.42_ArthurDentCreek_994242_IntReviewCommentForm

State Route	42
Mile Post	42.42
Stream Name	ArthurDentCreek
WDFW ID	994242
Review Level	IntReview
Due Date	10/4/2023
PHD Organization	Galaxy Engineering
PHD Contact	Douglas Adams
PHD Contact Phone	360-420-4242
Region	OR
WSDOT Project Office - Engineer	
WSDOT Project Contact	
WSDOT Contact Phone	

HQ/Internal Comment Form

PHD **INTERNAL REVIEW** COMMENT FORM

WDFW NUMBER(S):	STREAM CROSSING:	COMMENTS DUE DATE
994242	SR42_MP42.42_ArthurDentCreek	Wednesday, October 4, 2023
WSDOT PROJECT CONTACT:	**WSDOT CONTACT PHONE:**	**WSDOT PROJECT OFFICE - ENGINEER:**
PHD AUTHOR CONTACT:	**PHD AUTHOR CONTACT PHONE:**	**PHD AUTHOR ORGANIZATION:**
Douglas Adams	360-420-4242	Galaxy Engineering
REVIEWER NAME:	**REVIEWER PHONE:**	**REVIEWER ORGANIZATION:**

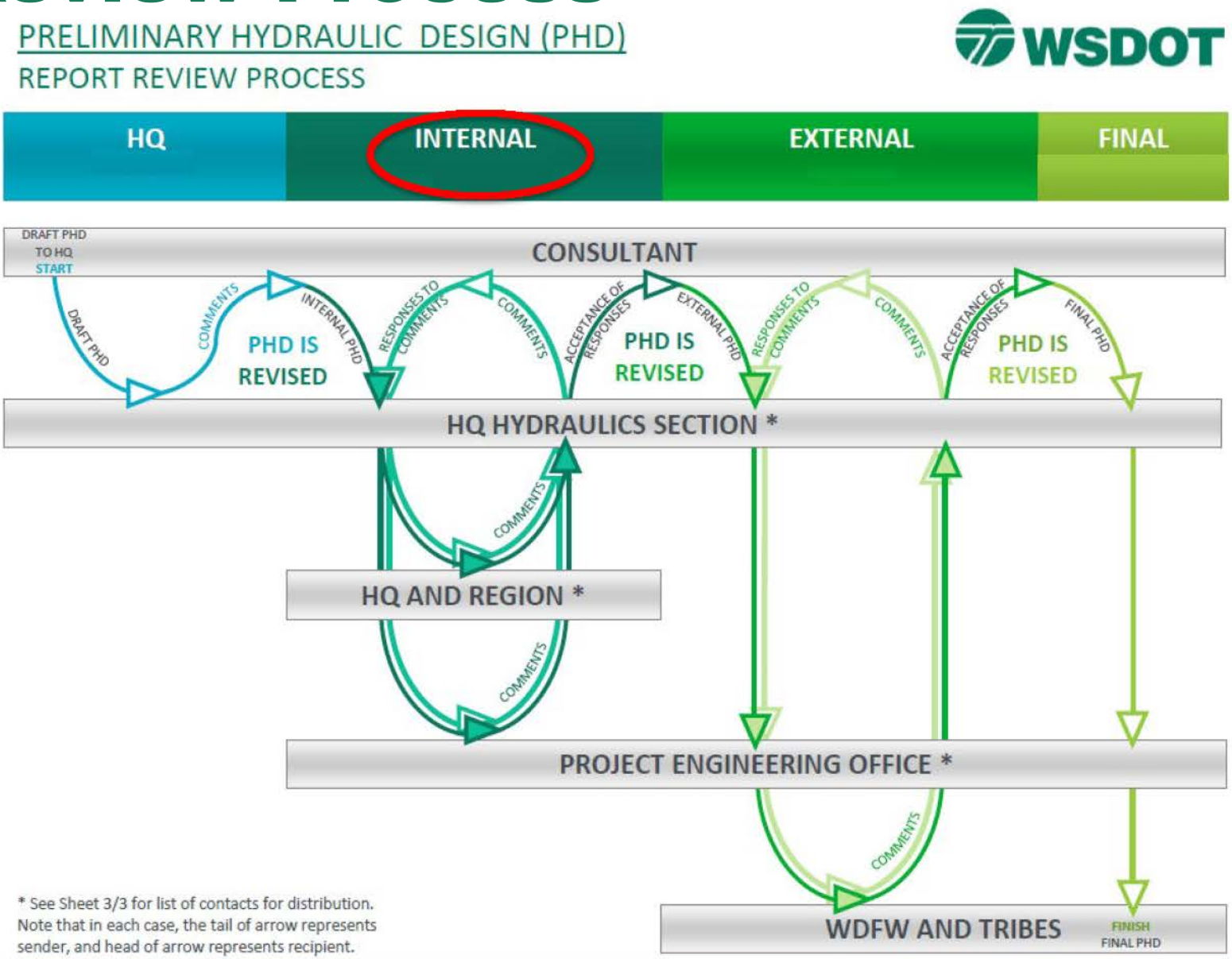
2013 WCDG | Hydraulics Manual Ch 7 | WAC 220-660 | WDFW - Washington State Fish Passage | WSDOT - Fish Passage Inventory

COMMENT #	HEADING / PARAGRAPH	SEVERITY OF COMMENT	REVIEWER'S COMMENT	RESOLVED?	DESIGNER'S RESPONSE
		[1] Fatal Flaw			
		[2] Clarity Needed			
		[3] Desired Element			

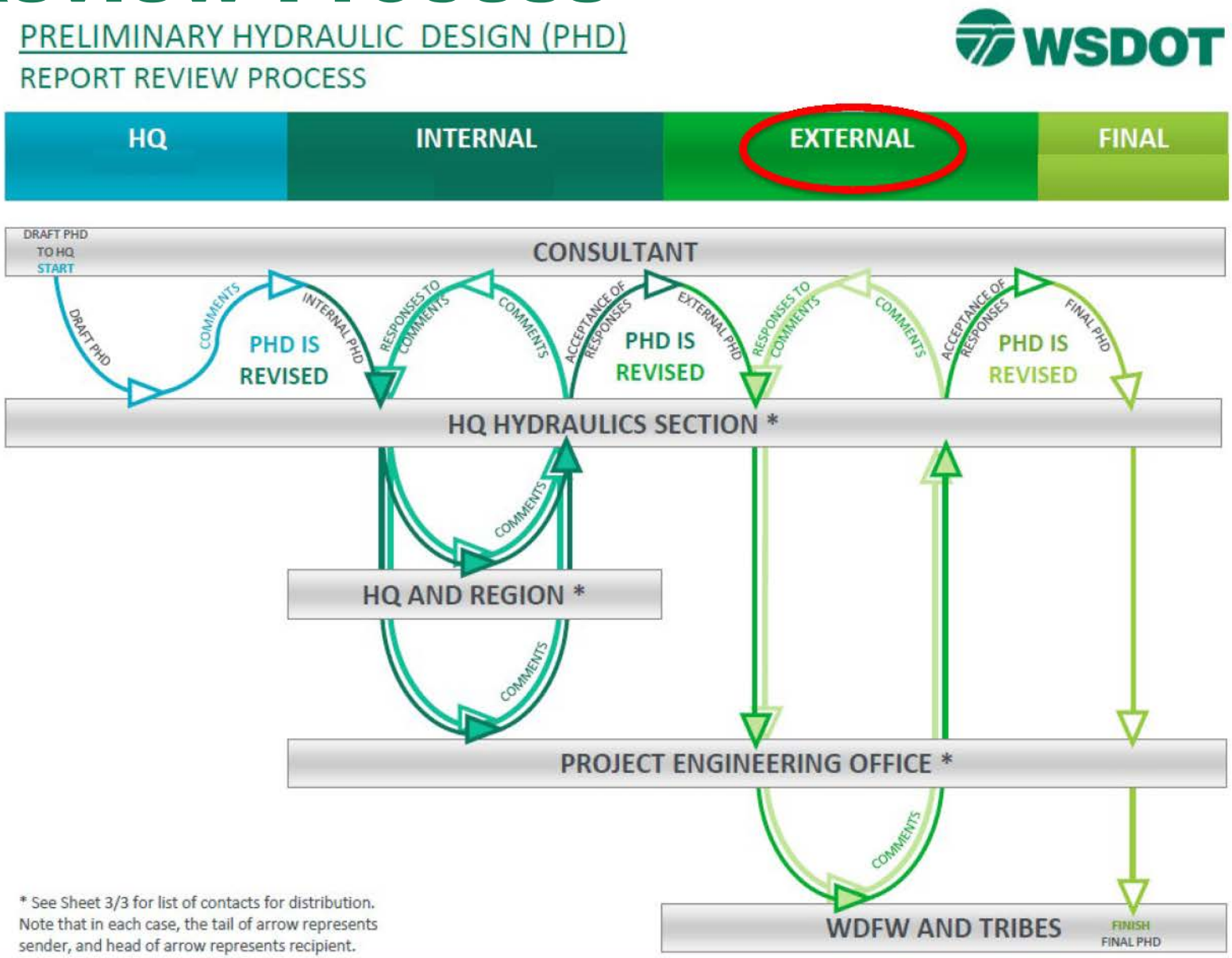
[1] Fatal Flaw: Does not meet design criteria
[2] Clarity Needed: Needs discussion; insufficient information.
[3] Desired Element: Suggestion for design

[1] Fatal Flaw: Does not meet design criteria
[2] Clarity Needed: Needs discussion; insufficient information, misunderstanding of design criteria
[3] Desired Element: Suggestion for design, future consideration

Review Process



Review Process



Low Complexity Stream Summary

- Document summarizes how the design meets WCDG
- Stand alone
- Cover all elements laid out

WSDOT Hydraulics Section	Low Complexity Stream Summary	Date:
	Project Name:	WDFW ID Number:
	Project Office:	County:
	Stream Name:	State Route/MP:

Brief Project Summary

The Washington State Department of Transportation (WSDOT) is proposing a project to provide fish passage at the State Route (SR) X crossing of NAME Creek at milepost (MP) XX.XX within WSDOT's Olympic/Northwest/Southwest/North Central/South Central/Eastern region. The existing structure at that location has been identified as a fish barrier by the Washington Department of Fish and Wildlife (WDFW) and WSDOT Environmental Services Office (ESO) (site identifier [ID] SITE NUMBER), and has an estimated XX linear feet (LF) of habitat gain.

NAME Creek exhibits a GEOMORPHOLOGY TYPE planform and has a bankfull width of X feet as identified during Site Visit 3 (see attached field notes).

The proposed project will replace the existing STRUCTURE TYPE, LENGTH, DIAMETER/WIDTH with a structure designed to accommodate a minimum hydraulic width of X feet. The proposed structure will be approximately X feet long and the project is proposed to include approximately X feet of channel grading (including the structure length). The proposed structure is designed to meet the requirements of the federal injunction using the DESIGN METHODOLOGY *(confined/unconfined bridge or stream simulation design criteria)* as described in the 2013 WDFW *Water Crossing Design Guidelines* (WCDG) (Barnard et al. 2013). This design also meets the requirements of the WSDOT *Hydraulics Manual* (WSDOT 2022a). The crossing location can be seen in the Vicinity Map below.

Add Figure 1 from PHD Template. If there are any design exceptions/deviations, they need to be summarized here too; however, if there are any exceptions/deviations they must be reviewed with the Comanagers and there must be agreement that the project is still Low Complexity.

Design Elements

Floodplain Utilization Ratio	FUR: *Value* ☐>3.0 (Unconfined) ☐<3.0 (Confined)
Design Methodology	☐Stream Simulation ☐ Bridge
Structure Length	*Value* ft Long Structure? ☐ Yes ☐ No
Preliminary Scour	*Value* ft (100-year) *Value* ft (500-year)
Migration Risk	☐Low ☐ Not Low Scour Countermeasures? ☐ Yes ☐ Possibly ☐ No
Gradient	Value % Downstream Value% Upstream Value % Reference Reach

Element	Requirement	Proposed
Channel Morphology		
Minimum Hydraulic Width		
Slope	*Gradient (0.75% to 125% of Ref Reach)*	*Gradient and Ratio*
Freeboard above the 100-year		

Medium Complexity PHD Light

- Summary form filled out just like low complexity
- All medium or high complexity elements added per instructions
- All other information removed from PHD
- Redact information if only a partial page is needed

Instructions

This document is meant to be utilized to summarize a PHD for a medium complexity site (per the Project Complexity Field Form) and as agreed upon by WSDOT and Co-Managers.

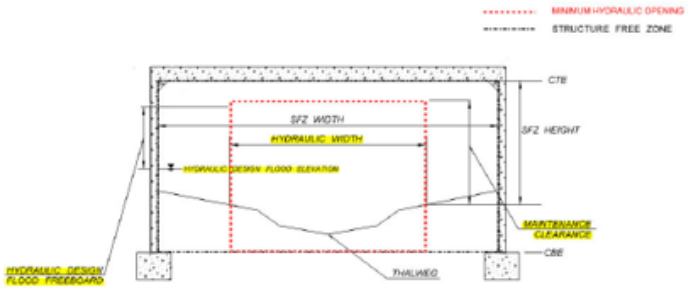
The intent of this document would be to provide how the design meets the WAC, Water Crossing Design Guidelines, and Hydraulics Manual. This document and the PHD "Light" would be attached to a summary memo from region to WDFW and Tribes (if Tribes elect to use this method of review rather than the full PHD). The PHD is still required to be written for all crossings.

PHD "Light" to simply be the full PHD with PDF pages removed per the guidelines below. This will allow PDF pages to be added back in upon request from the co-managers and updates to be made in the original Word document to carry through both the full PHD and PHD "Light". If sections that are to be deleted are on the same PDF page as sections to remain, place a box over the deleted sections and flatten the PDF prior to saving or use the Redact Tool (see below).

[redacted]

4.2 Minimum Hydraulic Opening

The minimum hydraulic opening is defined horizontally by the hydraulic width and the total height is determined by vertical clearance and scour elevation. This section describes the minimum hydraulic width and vertical clearance; for discussion on the scour elevation see Section 7. See Figure 14 for an illustration of the minimum hydraulic opening, hydraulic width, freeboard, and maintenance clearance terminology.



Medium Complexity PHD Light

PHD Content to Always Be Removed Full PHD to Produce "PHD Light"

Sections that can always be removed unless concerns have been brought up relating to them include:

- 2.1 Site Description
- 2.2 Watershed and Land Cover
- 2.4 Fish Presence in the Project Area
- 2.5 Wildlife Connectivity
- 2.6.3 Fish Habitat Character and Quality
- 4.2.1 Design Methodology (unless unconfined bridge)
- 4.2.5 Future Corridor Plans
- 4.3.2 Channel Complexity
- 5.1
- 6 Floodplain Evaluation (unless in a FEMA SFHA or there is concerns for human health and safety)
- References
- Appendix A: FEMA Floodplain Map (unless in a FEMA SFHA)
- Appendix F: Large Woody Material Calculations
- Appendix G: Future Projections
- Appendix I: Model Stability
- Appendix J: Reach Assessment
- Appendix K: Scour Calculations
- Appendix L: Floodplain Analysis (FHD ONLY)
- Appendix M: Scour Countermeasure Calculations: If blank or not required below
- See table below for further sections removal based on low level of complexity items

Category	Project Elements	Sections to Remove if Complexity Form Indicates Low Complexity
Stream Design Factors (alignment, profile, bed mix)	Channel realignment	4.1.2
	Stream grading extents	
	Expected stream movement (migration)	2.7.5
	Gradient (morphology)	2.6.4
	Slope ratio	4.1.3
	Sediment supply	2.3 and not needed for Geotech considerations
Structure Factors	Stream size and bankfull width	
	Meeting requirements for freeboard	4.2.3 and not needed for fill depth above barrier
	Fill depth above barrier	4.2.3 and not needed for meeting freeboard requirements
	Risk of degradation/aggradation	7
	Long culvert criteria/openness ratio	4.2.4
	Channel confinement & Floodplain Utilization Ratio (FUR)	2.7.2.1, Entire Section 5, Appendix E, Appendix H, Appendix I
	Meeting Stream Simulation	
	Tidal influence	
	Alluvial fan	
	Presence of other barriers nearby	
	Potential for backwater impacts	
	Presence of infrastructure nearby	2.6.2 Existing Conditions
	Need for bank protection	8, Appendix M
	Geotech or seismic considerations	2.3 and not needed for sediment supply

External Comment Form

PHD **EXTERNAL REVIEW** COMMENT FORM

WDFW NUMBER(S):	STREAM CROSSING:	COMMENTS DUE DATE
994242	SR42_MP42.42_ArthurDentCreek	**Wednesday, October 4, 2023**
WSDOT PROJECT CONTACT:	**WSDOT CONTACT PHONE:**	**WSDOT PROJECT OFFICE - ENGINEER:**
PHD AUTHOR CONTACT:	**PHD AUTHOR CONTACT PHONE:**	**PHD AUTHOR ORGANIZATION:**
Douglas Adams	360-420-4242	Galaxy Engineering
REVIEWER NAME:	**REVIEWER PHONE:**	**REVIEWER ORGANIZATION:**

Please cite the following criteria during your review: (1) **2013 WCDGs**, (2) **Stream Design Checklist**, or (3) **Relevant WAC**. Also, please answer the questions at the bottom of the page.

2013 WCDG | Hydraulics Manual Ch 7 | WAC 220-660 | WDFW - Washington State Fish Passage | WSDOT - Fish Passage Inventory

COMMENT #	HEADING / PARAGRAPH	SEVERITY OF COMMENT	REVIEWER'S COMMENT	RESOLVED?	DESIGNER'S RESPONSE
		[1] Fatal Flaw		Future refinement	
		[2] Clarity Needed			
		[3] Desired Element			

[1] Fatal Flaw: Does not meet design criteria
[2] Clarity Needed: Needs discussion; insufficient information, misunderstandin of design criteria
[3] Desired Element: Suggesti for design, future consideratic

[1] Fatal Flaw: Does not meet design criteria
[2] Clarity Needed: Needs discussion; insufficient information, misunderstanding of design criteria
[3] Desired Element: Suggestion for design, future consideration

External Comment Form

In addition to your comments above, **please respond to the following questions**, even if the response may duplicate comments previously entered in the table.

1. Based on the information available and on previous discussions, does the design of this project (considering its draft level of completeness), meet / exceed WDFW's Water Crossing Design Guidelines?

(●) Yes ( ) No

2. Does the PHD **bankfull width** match the expected value based on site visits, prior measurements, or derived from other described methods?

(●) Yes ( ) No

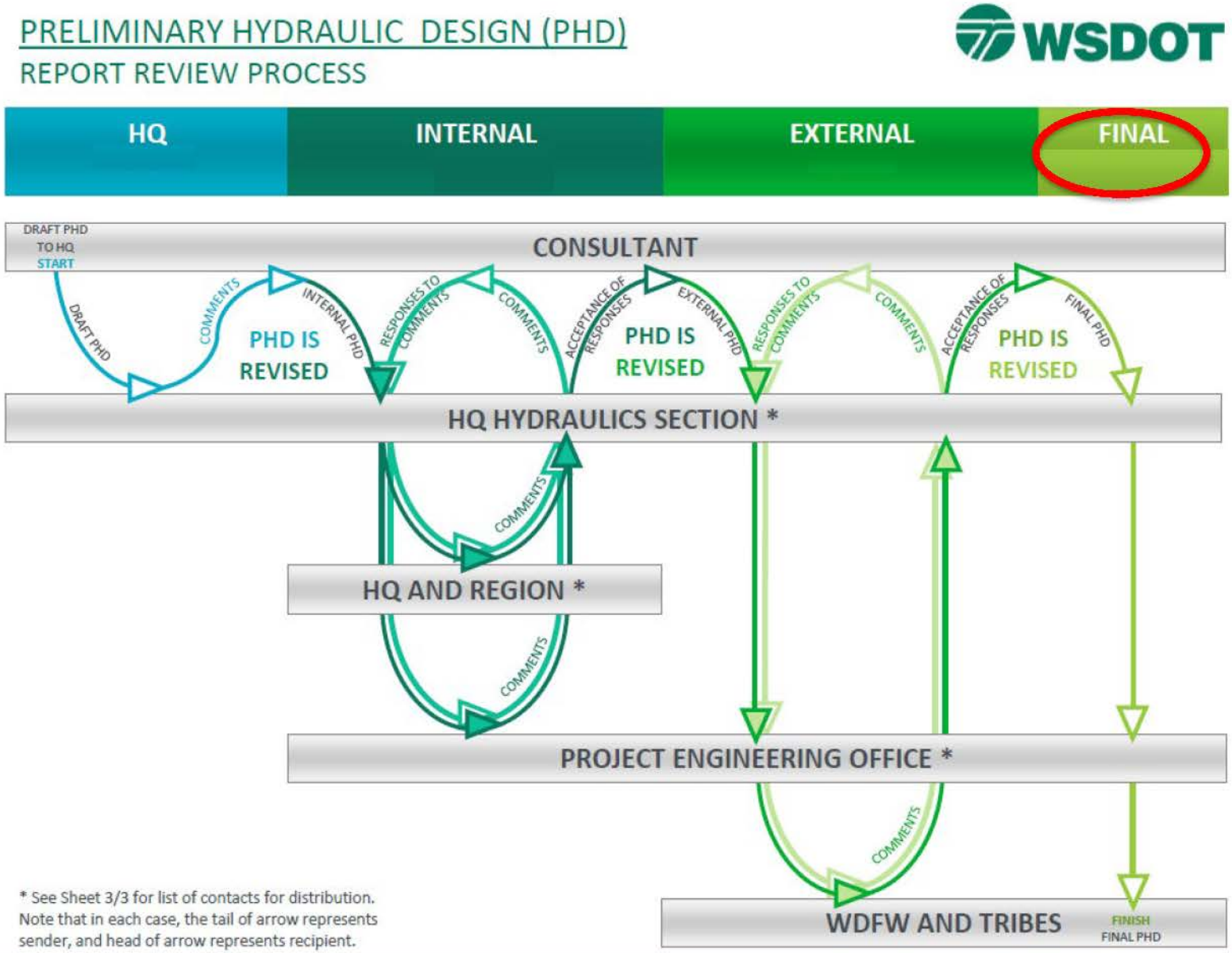
3. Does the PHD **reference reach** match the expected value based on site visits, prior measurements, or derived from other described methods?

(●) Yes ( ) No

4. Does the minimum hydraulic opening (width / height) match / exceed the minimum value expected by the reviewer?

(●) Yes ( ) No

Review Process



Structure Free Zone

What is it? And purpose.

Structure Free Zone (SFZ) – An imaginary, rectangular prism of infinite length both upstream and downstream, that is horizontally centered on the Bearing of Stream, is parallel to the Bearing of Stream, and which represents the minimum boundary within which no part of the fish passage structure, including footings, shall be allowed unless meeting the criteria for an allowable exception in this paragraph. It is bounded on top and bottom by the CTE and the CBE respectively, with minimum interior width equal to the minimum SFZ Width specified in Table 2.30-B.Width. Allowable exceptions are as follows: Fillets may be inside the SFZ provided both of the following are true: (1) the sum of all fillet areas in a given cross section is less than the 2% of the area calculated as the SFZ Width multiplied by the SFZ Height, and (2) all fillet areas are entirely above the elevation of the Hydraulic Design Flood plus Hydraulic Design Flood Freeboard.

A defined, 3-dimensional shape, that no portion of the crossing structure can encroach.

Structure Free Zone

How it's determined

Start with PHD requirements

Washington State Department of Transportation

SR 20 MP 105.42 Olson Creek: Preliminary Hydraulic Design Report

Julie Heilman PE
State Hydraulic Engineer
WSDOT Headquarters Hydraulics Office

Raymond Walton, PhD, PE, D.WRE, Project Manager
WEST Consultants, Inc.

Corinne Horner, EIT, Staff Hydraulic Engineer
WEST Consultants, Inc.

SR 20 Olson Creek to Skagit River – Remove Fish Barrier
MP 105.42 Olson Creek
Preliminary Hydraulic Design Report
April 2020

Washington State Department of Transportation

SR 20 MP 94.82 Unnamed Tributary to Skagit River: Preliminary Hydraulic Design Report

Julie Heilman PE
State Hydraulic Engineer
WSDOT Headquarters Hydraulics Office

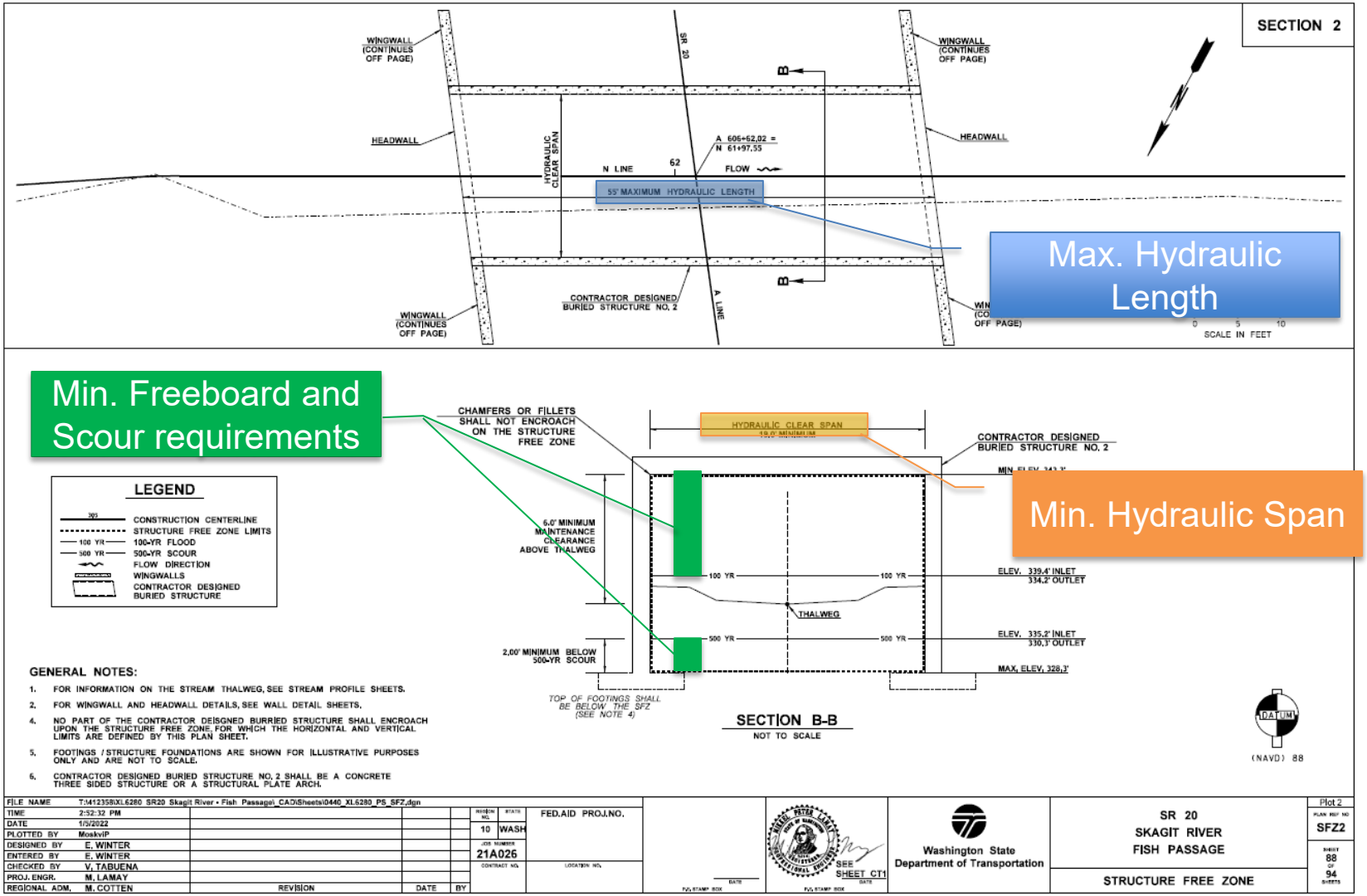
Raymond Walton, PhD, PE, Project Manager
WEST Consultants, Inc.

Alec Robertson, P.E., Senior Engineer
WEST Consultants, Inc.

SR 20 Unnamed to Skagit River – Remove Fish Barrier
MP 94.82 Unnamed Tributary
Preliminary Hydraulic Design Report
February 2020

Structure Free Zone

How it's determined



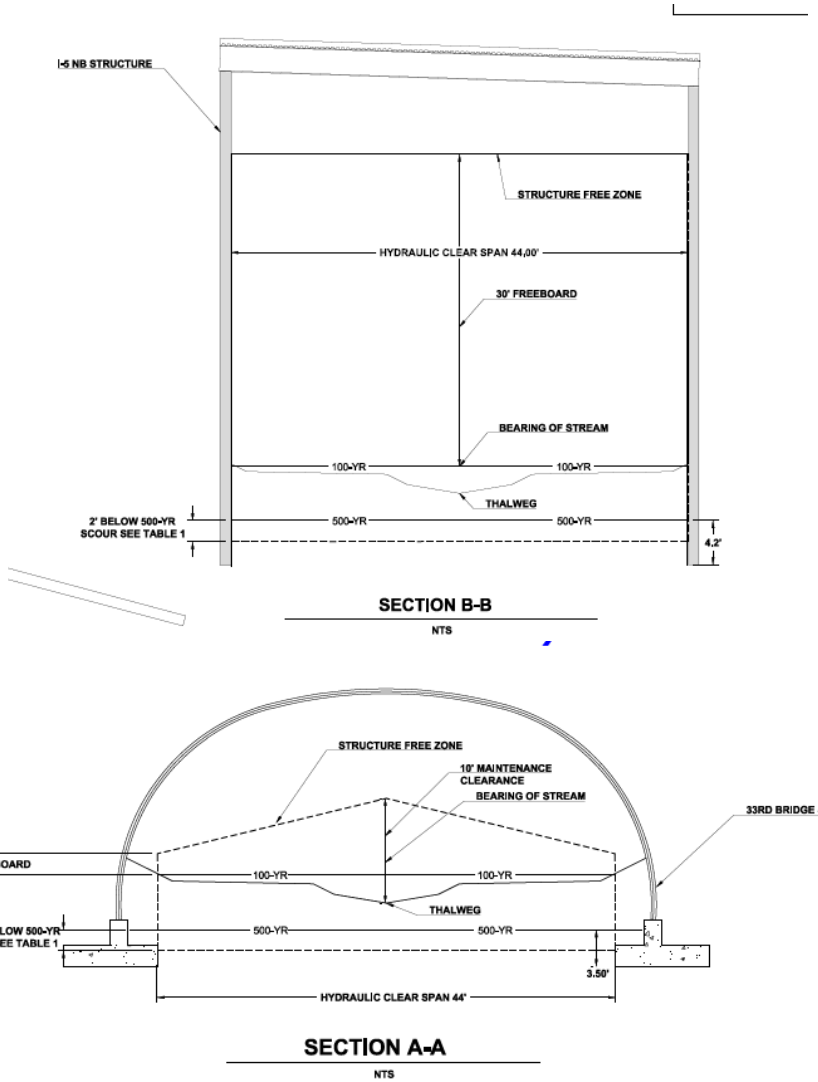
Structure Free Zone

Potential Modifications

Revise SFZ based on project specific constraints and risks.

Examples:

- Increased height for long culverts to ensure maintainability.
- Increased depth for scour risk.
- Increased width to accommodate design of features within the structure.
- Increased depth due to geotechnical characteristics.



What is a Bridge?

FHWA Highway Bridge Definition: A public vehicular structure more than 6.1 meters (20 feet) in length that spans an obstruction or depression.

SR 532 Church Creek, Built 2017

SR 112 Olsen Creek, Built 2018

SR 542 High Creek, Built 2016

What is a Bridge?

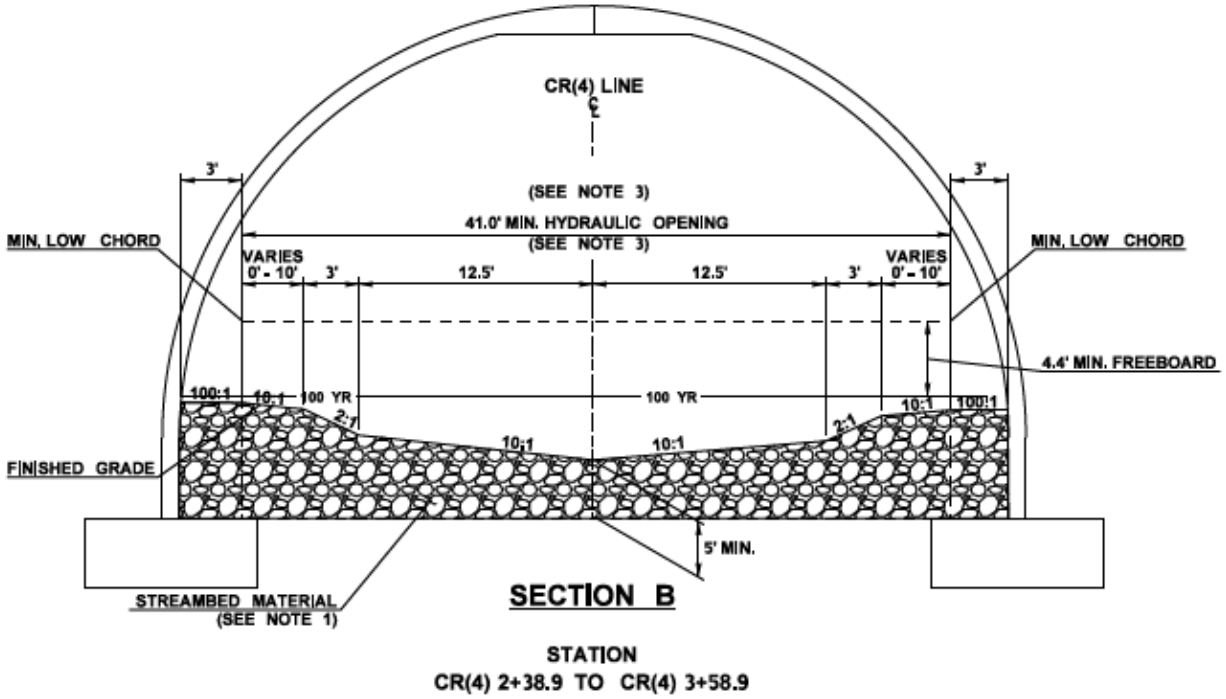
US 101 Siebert Creek, built 2020-2021

SR 542 Hedrick Creek, built 2018

SR 542 Anderson Creek, built 2015

Type, Size, Location (TSL)

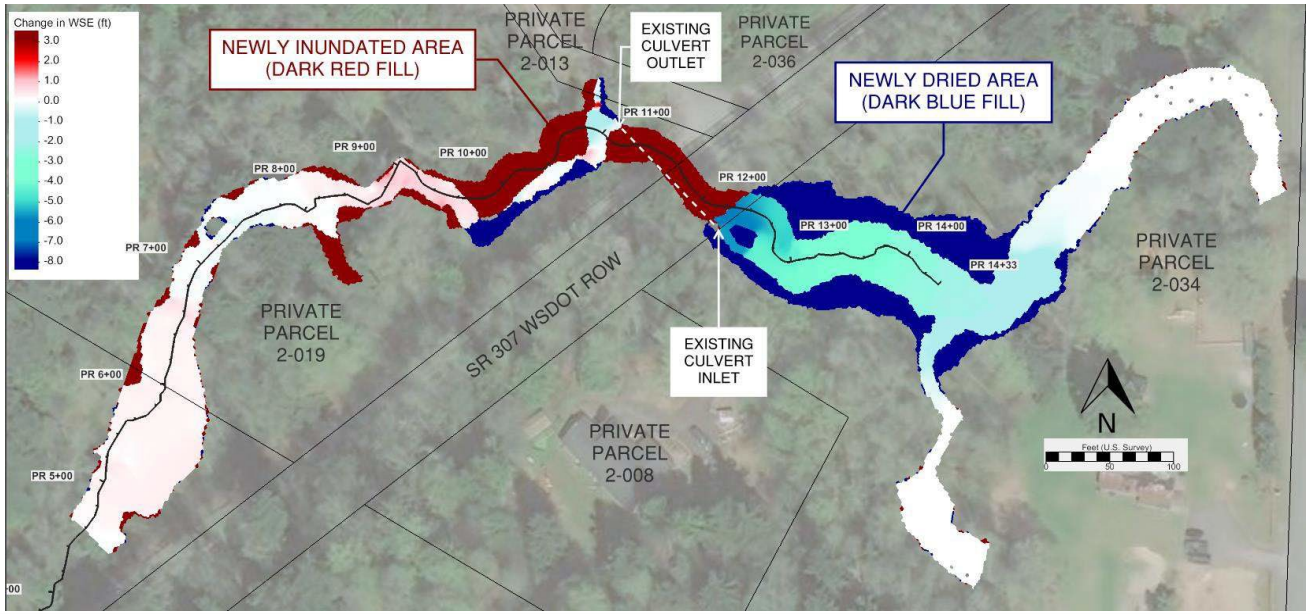
Structure that fits around the Structure Free Zone. Can be chosen either by WSDOT or in DB by the design builder (contract depending)



Flood Risk Assessment

WSDOT Environmental Manual Exhibit 432-2

- Define FEMA Zones
- Informs on flood risks
- Is not an official document for permitting
- Informs on if a no-rise is needed
- See Module 16



No-Rise Assessment

2. For projects within FEMA regulatory floodways based on FEMA's effective flood maps (e.g., Floodway Zone AE):
   a. HQ Hydraulics conducts no-rise analysis based on FEMA's standards.[1]
   b. If there is no rise in Base Flood Elevation (BFE):
      i. Region requests that the local review and approve the no-rise certification.
      ii. Region submits floodplain development permit application to the local (if required per local code).
   c. If there is a reduction in BFE OR changes to the extent of the floodway:
      i. Region submits floodplain development permit application to the local.
      ii. HQ Hydraulics submits Letter of Map Revision (LOMR) to FEMA through the local after construction is completed based on as-built conditions.[2]
   d. If there is a rise in BFE:
      i. Region submits floodplain development permit application to the local and HQ Hydraulics submits Conditional Letter of Map Revision (CLOMR) application to FEMA through the local.[3]
      ii. HQ Hydraulics submits LOMR to FEMA through the local after construction is completed based on as-built conditions.[2]

Design Delivery Methods

Design-Build

- 2.30 of RFP (HQ Hyd Author)
- Use minimums from PHD as requirements in RFP
- PHD updated by Design-Builder to reflect changes

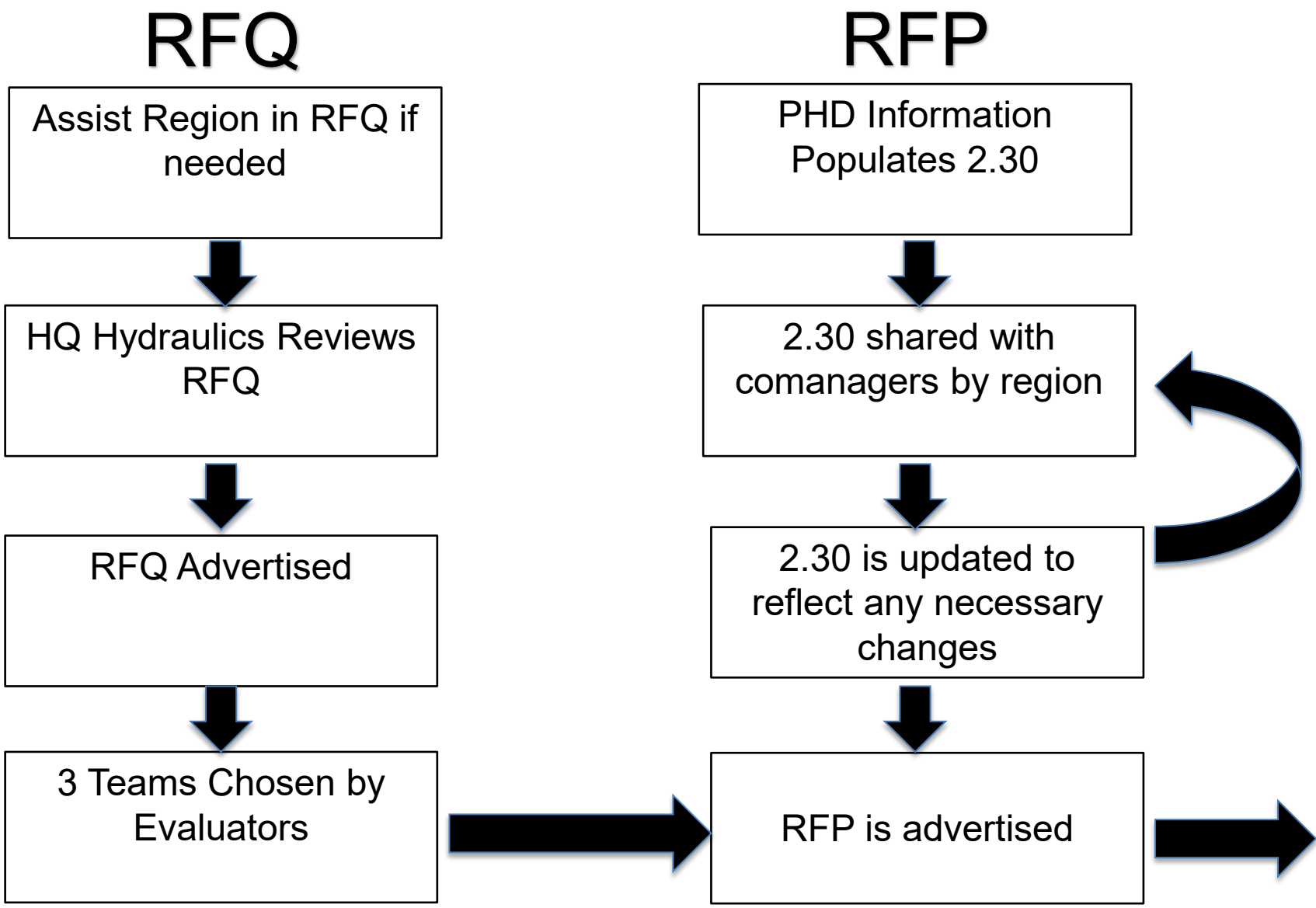
Design-Bid-Build

- PEO begins working toward 30% design or continues working on design with Hydraulic Design Team

Progressive Design-Build

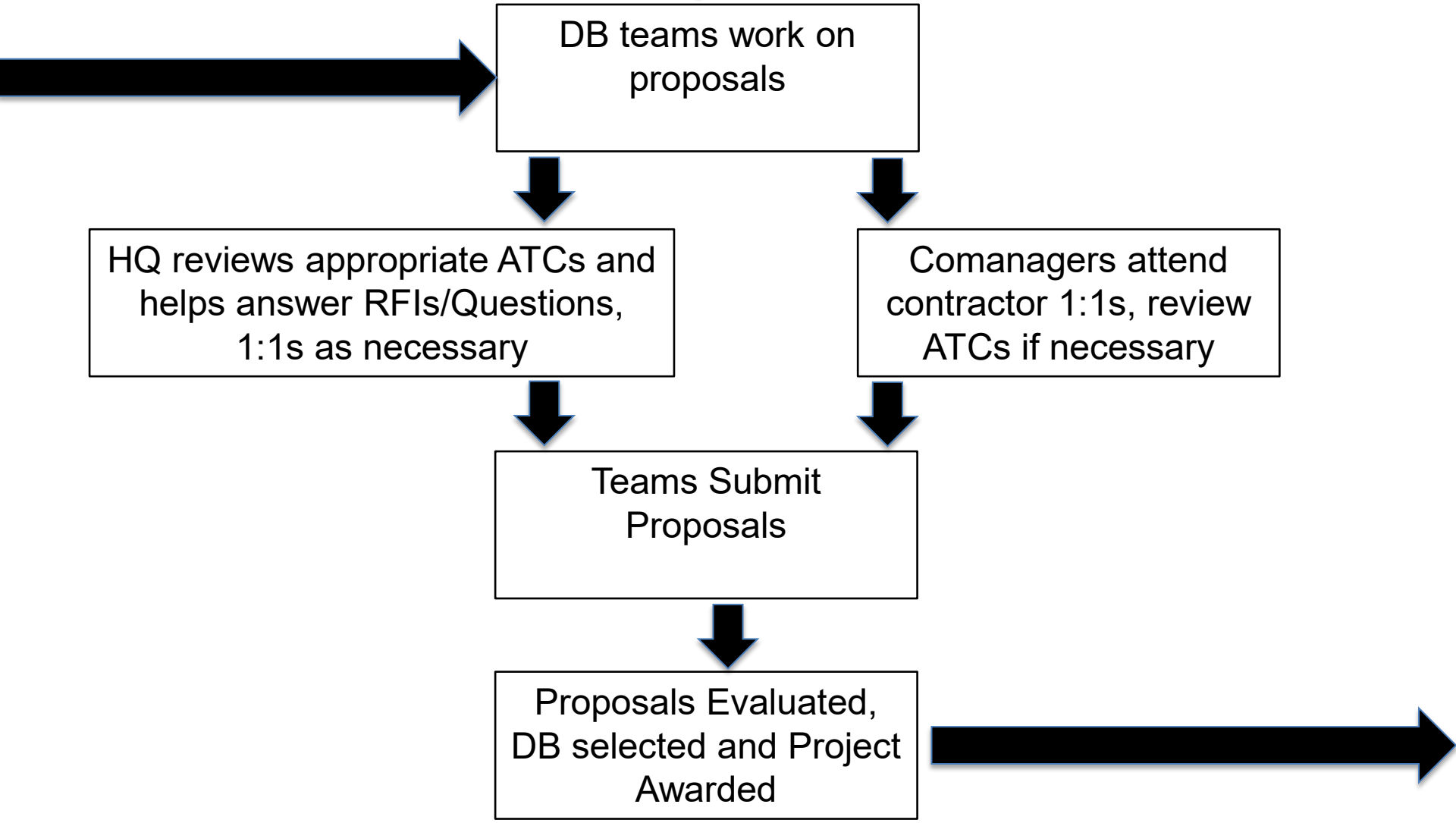
- PDB Team selected
- PDB Team begins working toward 30% design or continues working on design with Hydraulic Design Team

Design Build



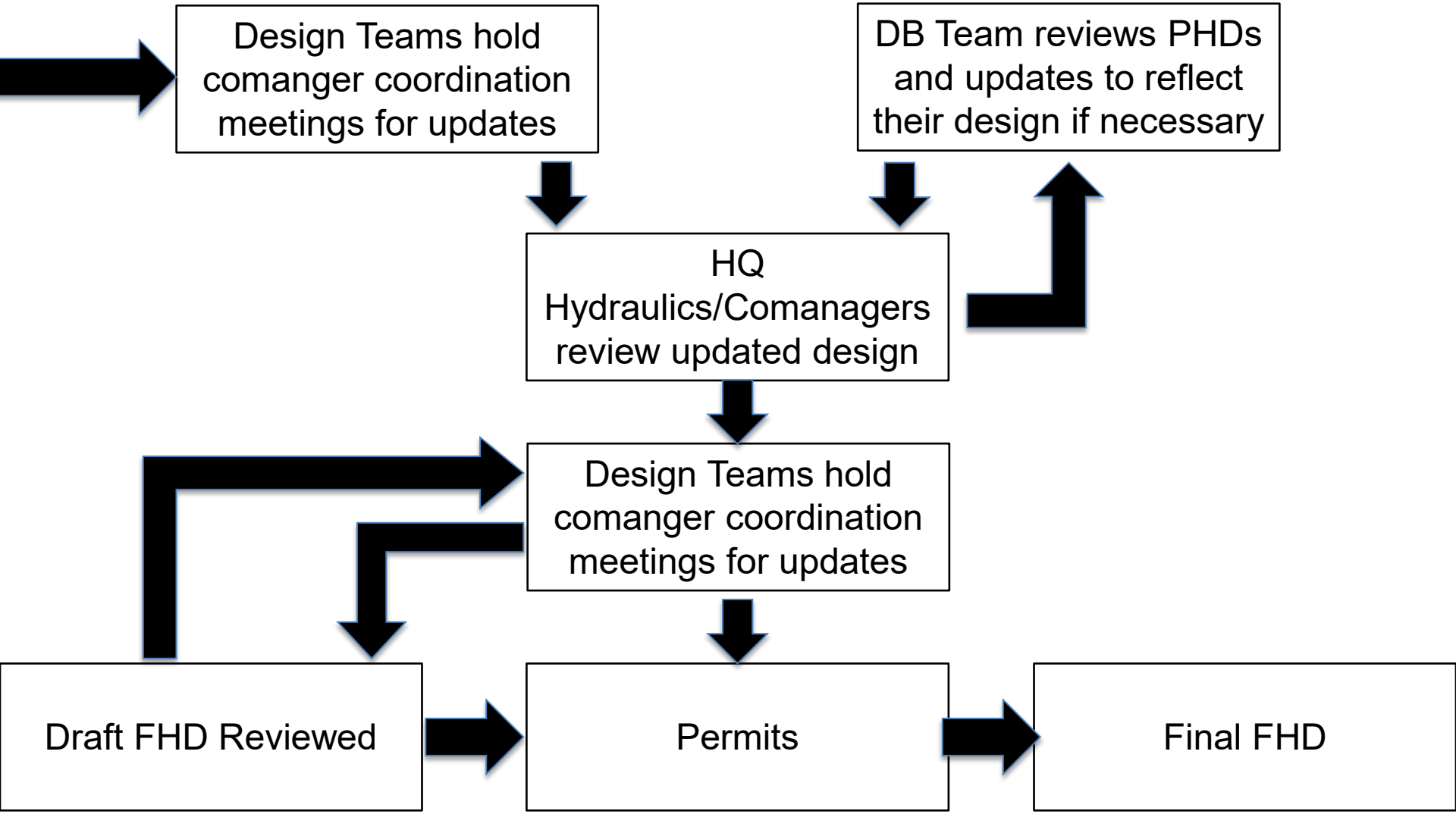
Design Build

Proposals



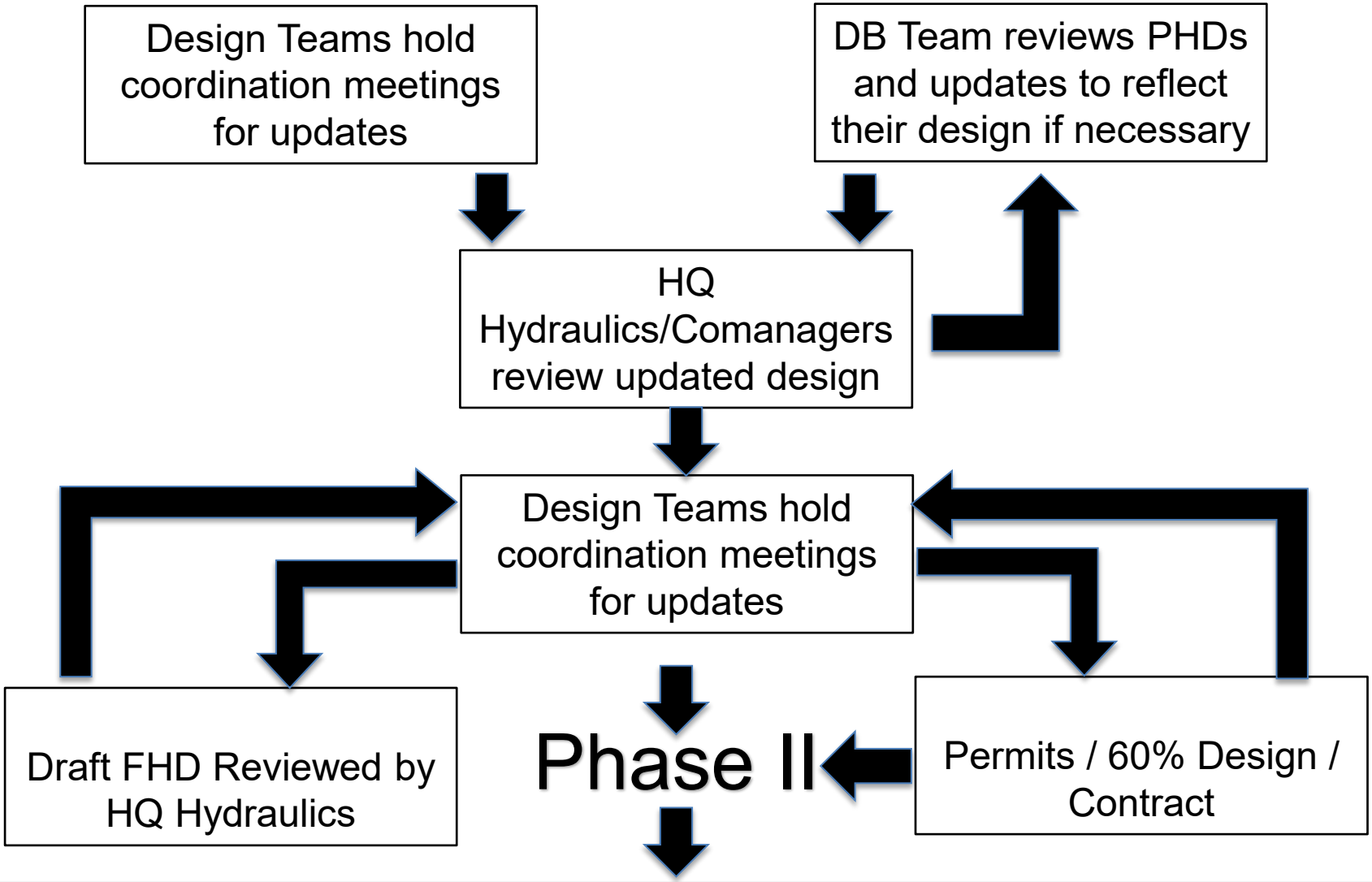
Design Build

Design



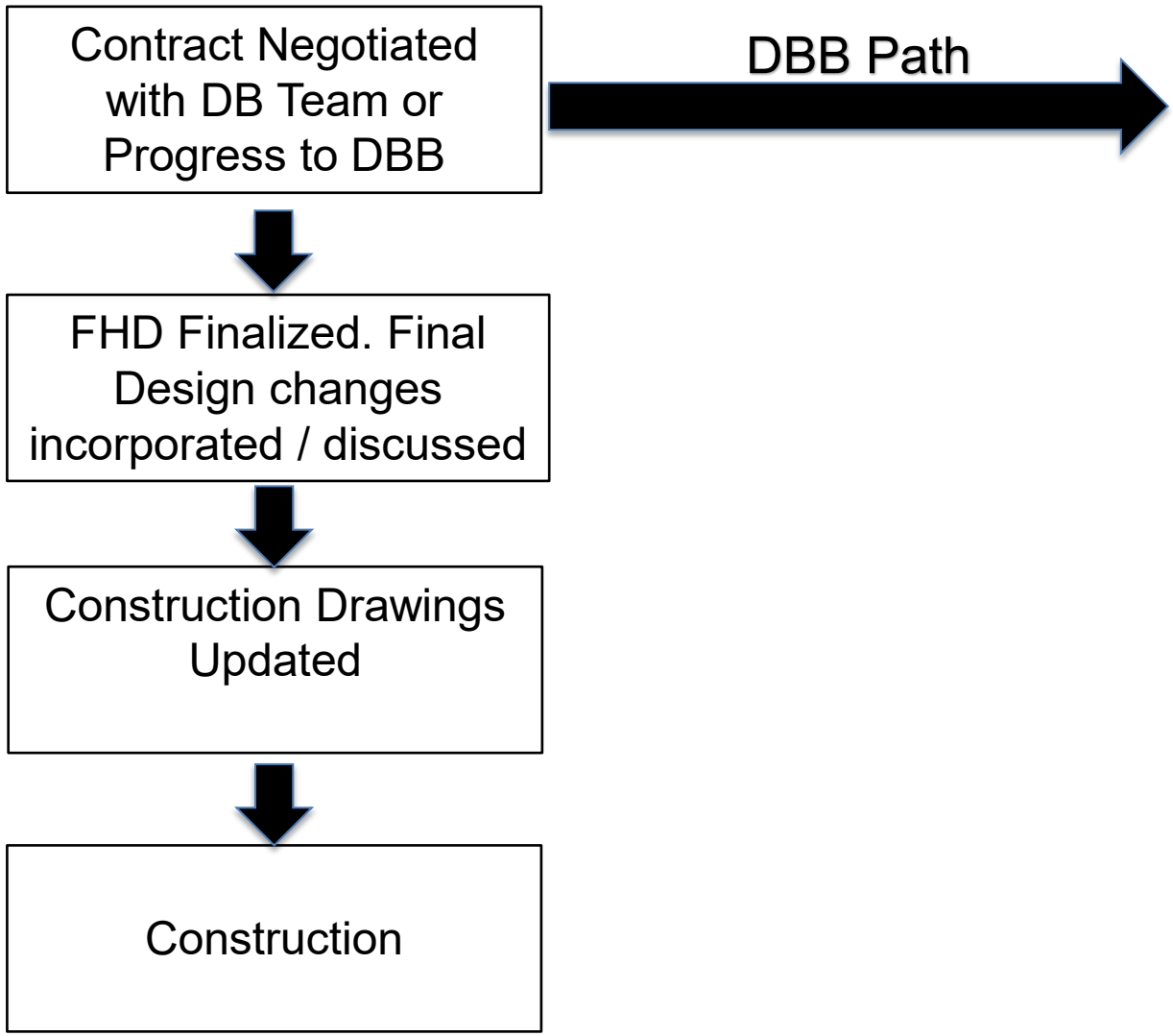
Progressive Design Build

Phase I



Progressive Design Build

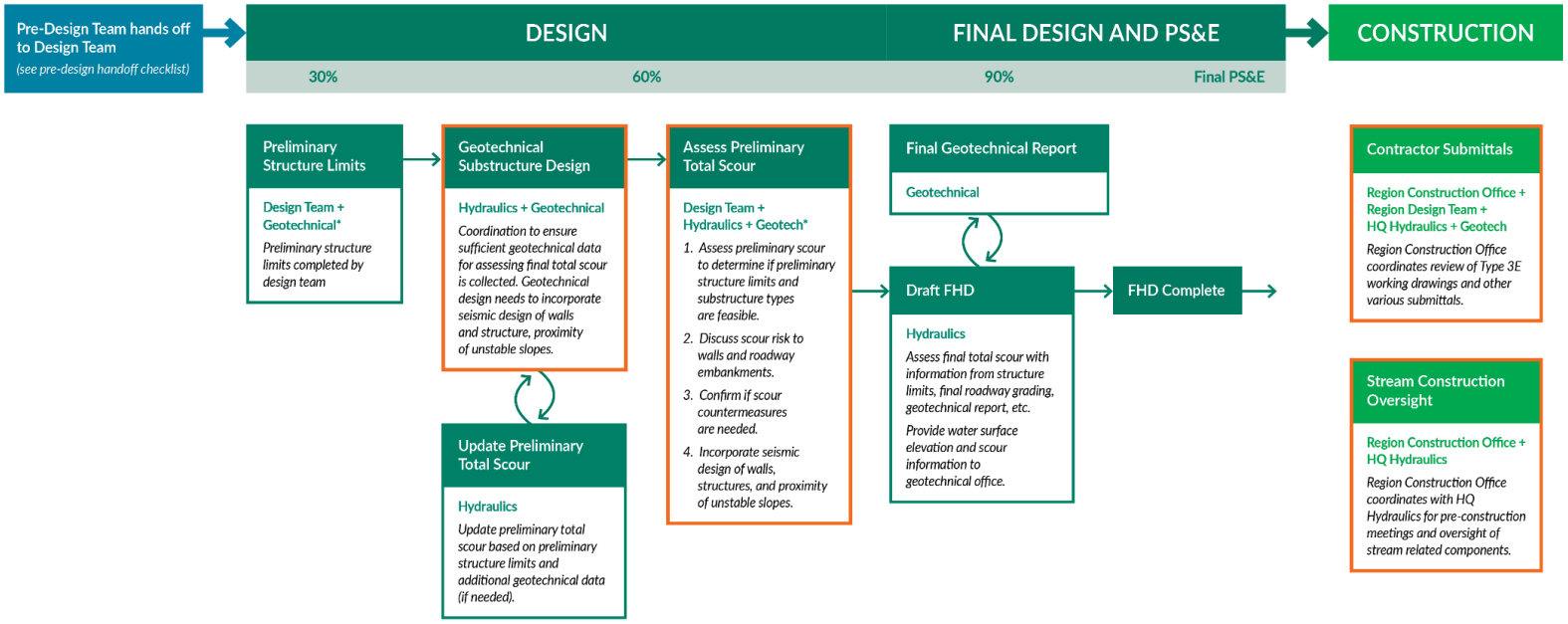
Phase II



Specialty Group Coordination – Contractor Supplied Design

SPECIALTY GROUP COORDINATION | CONTRACTOR SUPPLIED DESIGN**

EXHIBIT 800-2



General Notes

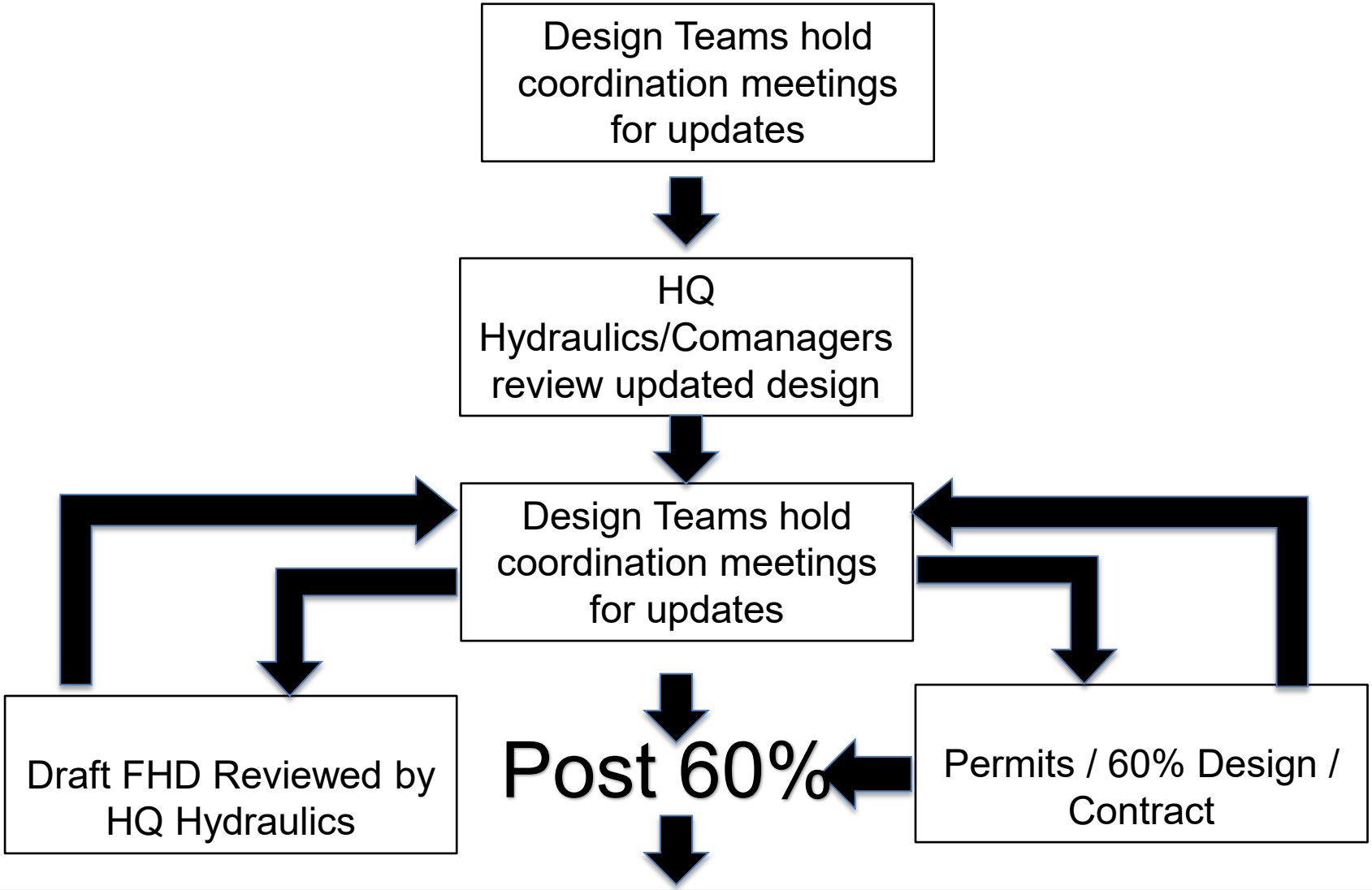
* Incorporate seismic design of walls, structures and proximity of unstable slopes.

** See DM Chapter 710 and Standard Specification 6-20.3.

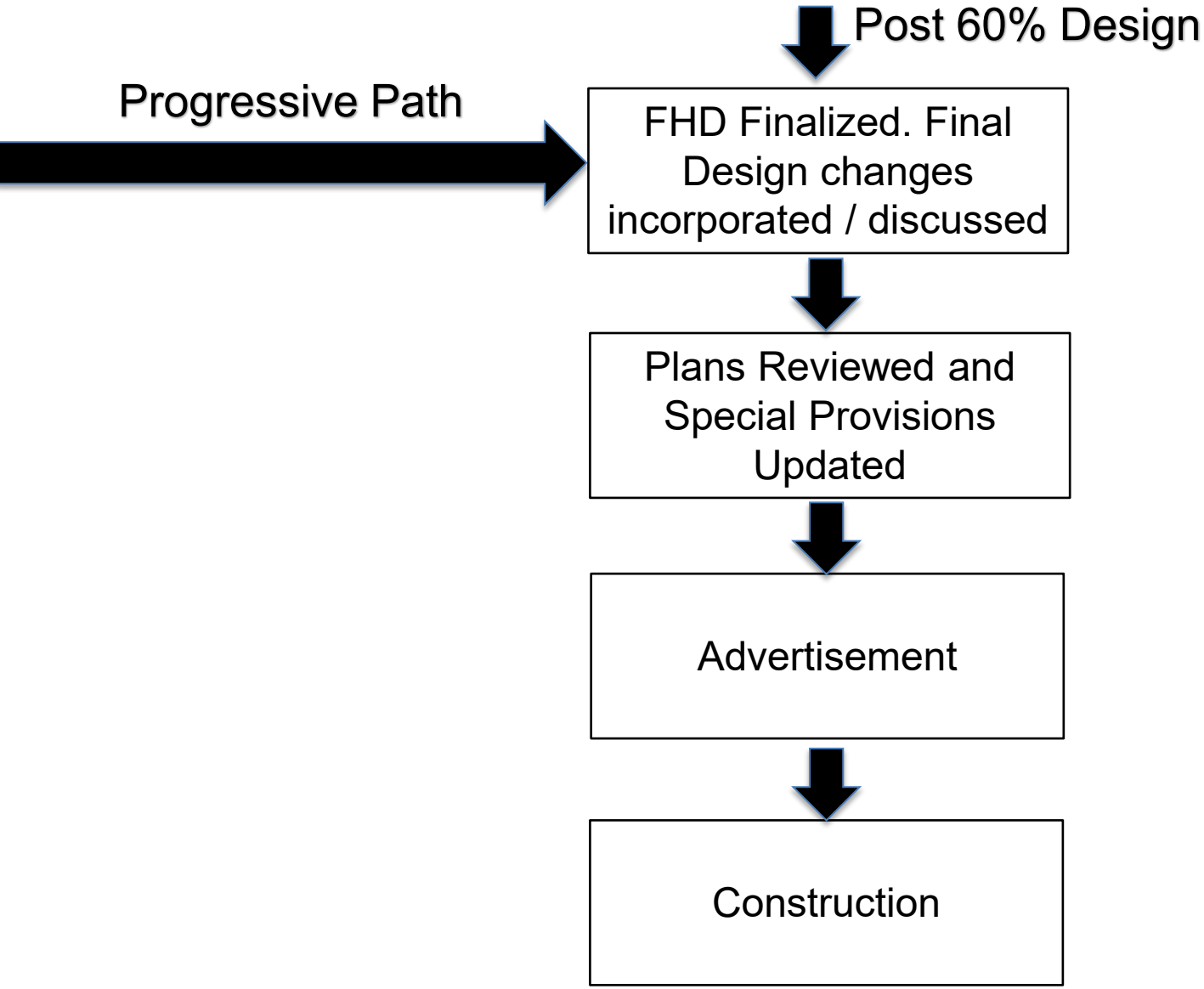
Specialty Group Coordination

Contact HQ Hydraulics with questions.

Design Bid Build

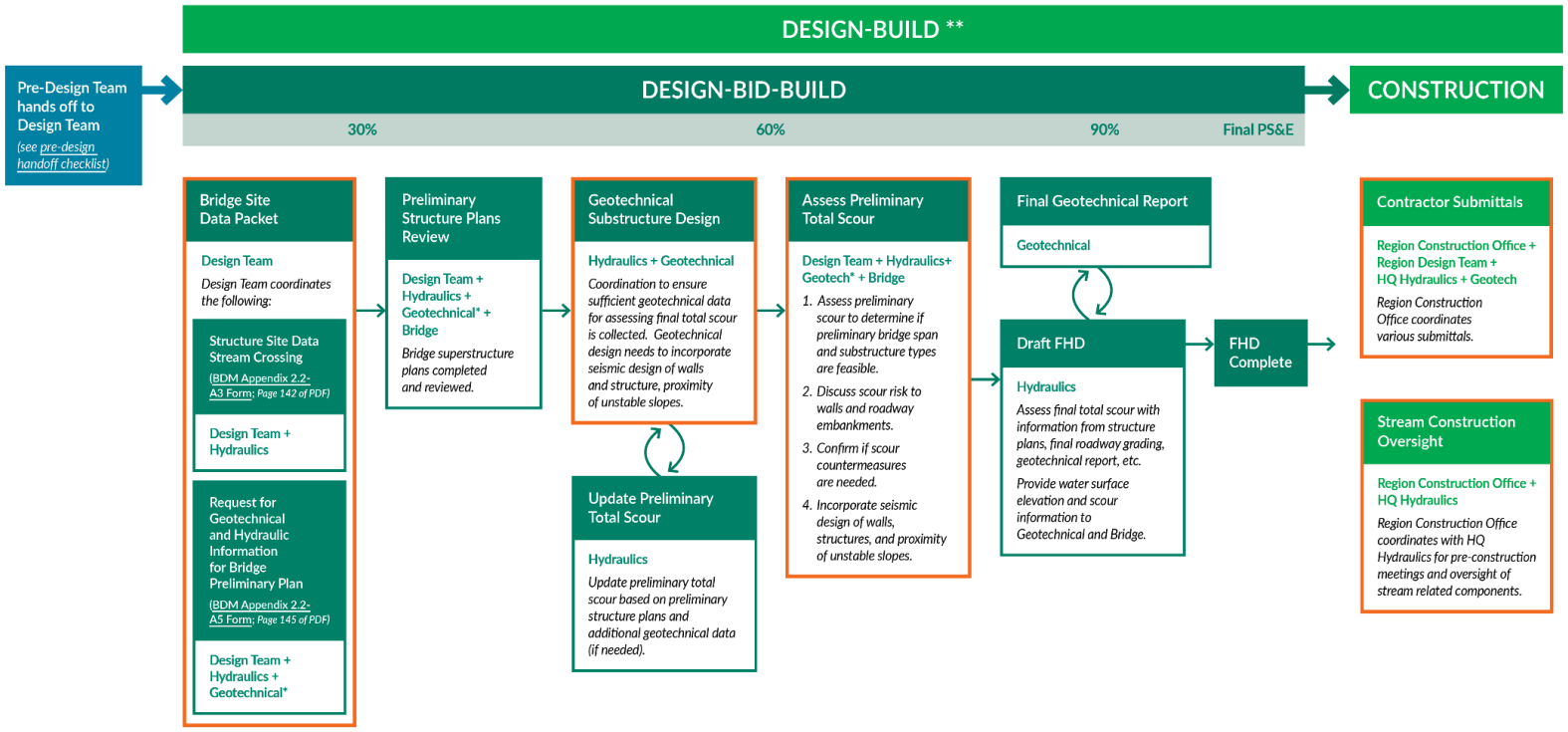


Design Bid Build



Specialty Group Coordination – Design

SPECIALTY GROUP COORDINATION | DESIGN
EXHIBIT 800-3



General Notes

* Incorporate seismic design of walls, structures and proximity of unstable slopes.

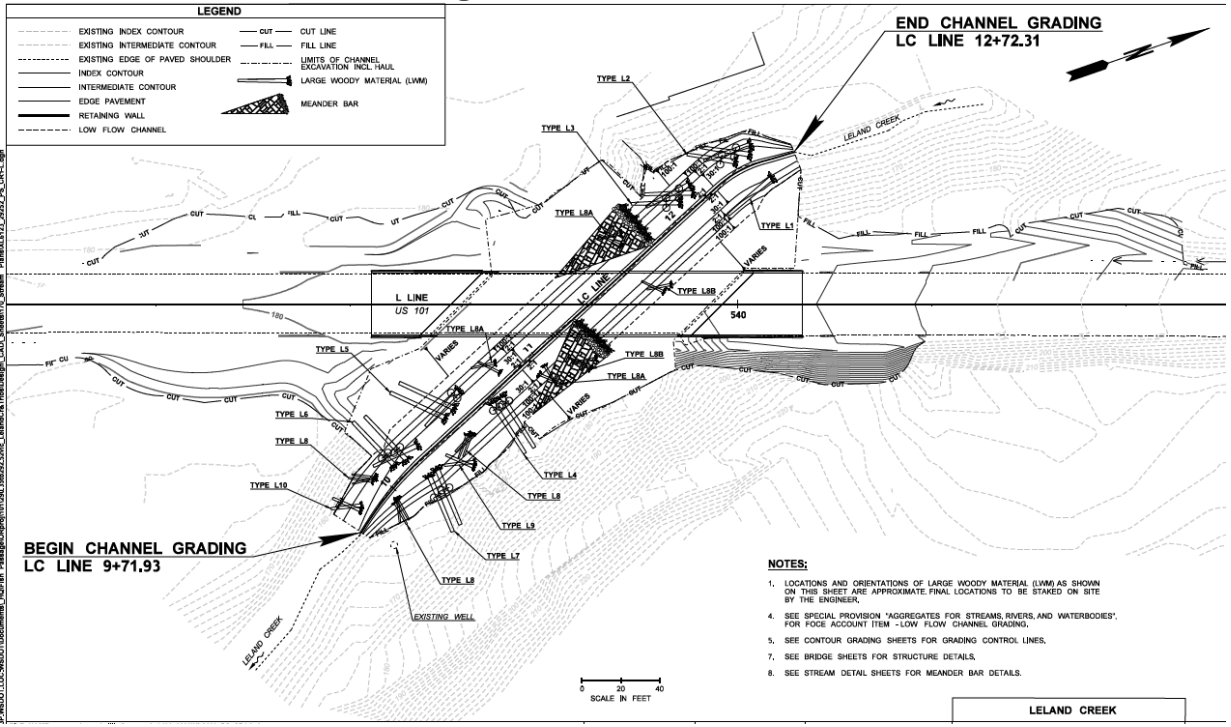
** This process is not intended for all deliverables.

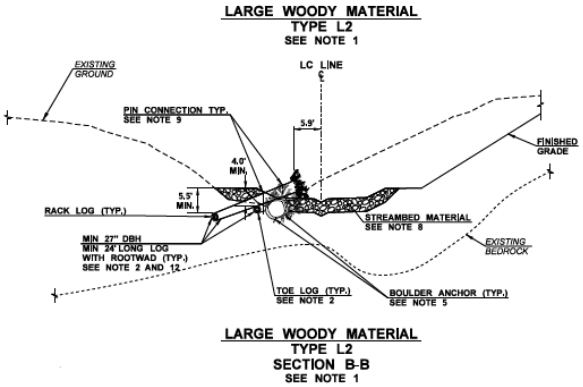
Specialty Group Coordination

Contact HQ Hydraulics with questions.

FHD Updates

- Updated InRoads Surface
- Update hydraulics model
- Work with WDFW/Tribes on LWM design
- Complete Wood Layout and Calculations
- Final habitat components determined





PHD & FHD Differences

FHD covers everything in PHD plus:

- Any design changes
- Final hydraulic model
- Final LWM layout
- Final total scour calculations
- Updated plans

Deliverables (unless otherwise specified:

- FHD
- Hydraulic Model

SR 112 Olsen Creek, Built 2018

Seasonal Flow Analysis

- Either MGS Flood Seasonal Flow Statistics or Gage Data (if available)
- Flow Requirements (Minimum)
  - Design Flow: 50% Exceedance Flow
  - Contingency Flow: 10% Exceedance Flow

7-06.3(2)B Stream Flows

Minimum Stream Flows

At all times of operation the Contractor's temporary stream diversion shall be designed to convey the following minimum flow rate of water in cubic feet per second:

***

HARLOW CREEK
95 cfs

FISHER CREEK
51 cfs

STEAMBOAT CREEK
26 cfs

***

During all phases of the bypass installation and decommissioning, the Contractor shall maintain flows downstream of the project site.

A Contingency System is required for this Project. The capacity of the combined temporary stream diversion system and the Contingency System shall be designed to convey the following minimum flow rate of water in cubic feet per second:

***

HARLOW CREEK
208 cfs

FISHER CREEK
161 cfs

STEAMBOAT CREEK
126 cfs

***

After FHD

- Update Special Provisions
- Review updated Plans
- Address any Region review comments


Design Complete!
Questions?