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## 800.01 General

This chapter is intended to serve as a guide to highway designers so they can identify and consider hydraulic-related factors that impact design. Detailed criteria and methods that govern highway hydraulic design are in the Washington State Department of Transportation (WSDOT) *Hydraulics Manual* and *Highway Runoff Manual*.

Some drainage, flood, and water quality problems can be easily recognized and resolved; others might require extensive investigation before a solution is developed. The Project Engineer's Office (PEO) should use good engineering judgment and be mindful of WSDOT's legal and ethical obligations concerning hydraulic issues. The Hydraulics Manual explains WSDOT policy regarding hydraulic design and hydraulic reports; this chapter also includes roles and responsibilities and required documentation for hydraulic reports.

Below is a summary of roles and responsibilities:

- PEO – responsible for the preparation of correct and adequate stormwater and drainage design. The work may be performed by WSDOT or a private consultant engineer but is overseen by the PEO. The PEO is also responsible for initiating the application for required hydraulic-related permits.
- Region Hydraulic Engineer (RHE) provide technical assistance to Scoping teams, Pre-Design teams, PEOs, WSDOT consultants, Maintenance, Developer Services and Local Programs. The roles and responsibilities of the RHE and HQ Hydraulics Section are outlined in the Hydraulics Manual.
- WSDOT Headquarters (HQ) Hydraulics Section – responsible for the preparation or oversight of all hydraulics Specialty reports as described in the Hydraulics Manual. While the PEO is responsible for preparation of reports, plans, specs, and estimate for all drainage facilities except bridges, assistance from the RHE and the HQ Hydraulics Section may be requested for any drainage facility design.
- Geotechnical – responsible for understanding the characteristics of the soil and rock materials that support or are adjacent to a transportation facility so that, when designed, constructed, and maintained, the facility will be adequate to safely carry the estimated traffic and to support hydraulic structures for stormwater and stream crossing designs, as set forth in the Geotechnical Design Manual.
- Bridge – responsible for delivering or coordinating bridge design calculation and plans per WSDOT Bridge Design Procedure and the Bridge Design Manual; review consultant and contractor designed structures; acts as the subject matter expert for structural issues; assure that the most cost-effective and appropriate structure type is selected for a particular bridge site.
- Pre-Design Team – consists of engineering, environmental, utilities, real estate, geotechnical, bridge and structures staff for coordination prior to beginning preliminary design. The Pre-Design Guidance for Fish Passage Projects document contains helpful links and provides guidance for pre-design.
- Design Team – the team of designers, checkers, engineers, and architects responsible for design and preparation of the contract documents for construction.

## 800.02 Coordination with Other Specialty Groups

For the design and construction of structures, walls, and roadway embankments in the vicinity of waterbodies, early and often coordination with specialty groups, along with coordination at key check-in points throughout the project delivery process is critical for the efficient delivery of a project. In [Exhibit 800-1](#) through [Exhibit 800-3](#), the pre-design team/project engineering office (PEO) includes, environmental, survey, utilities, right of way and other groups to support the project. The coordination for the design and construction of structures, walls, and roadway embankments in the vicinity of waterbodies is only one component of many that the delivery team needs to consider within the entire PS&E process. [Exhibit 800-1](#) through [Exhibit 800-3](#) provide a series of flow charts to illustrate the process and timing throughout the project delivery process (e.g., pre-design through construction) for the minimum level of coordination between the following groups: pre-design team, design team, bridge, geotechnical, hydraulics, WSDOT maintenance office, and the WSDOT construction office.

[Exhibit 800-1](#) is a flow chart for specialty group coordination during pre-design, resulting in a structure free zone (SFZ) determined collaboratively by the pre-design team, hydraulics, geotechnical, and bridge. This SFZ shall be used for the next steps in design or development of design-build documentation. To determine the SFZ, early coordination between the pre-design team, geotechnical, and hydraulics for identifying potential risks such as total scour, seismic conditions, and unstable slopes is important to reduce the potential for unaccounted costs later in design or construction. Coordination between the geotechnical and hydraulic engineers is necessary to obtain data as part of the geotechnical scoping memo/package for determining total scour and the need for scour countermeasures, which may affect the SFZ at the pre-design phase. For design-build, the information determined during the pre-design phase is used to assist in preparing the design-build documentation. For a design-bid-build, the design team determines if the structure and walls will be contractor supplied design ([Exhibit 800-2](#)) or designed by a bridge and geotechnical engineer as part of the PS&E ([Exhibit 800-3](#)).

[Exhibit 800-2](#) is a flow chart when the design team determines the crossing structure will be designed through a contractor supplied design method. The starting point for [Exhibit 800-2](#) is after the SFZ is determined during pre-design. Since the structure will be designed by the contractor, the design team shall provide preliminary structures plans. The geotechnical engineer completes the geotechnical data required for the substructure design and coordinates with the hydraulic engineer to make sure there will be sufficient geotechnical data to assess preliminary total scour. After completion of the geotechnical substructure design, the design team, geotechnical engineer, and hydraulic engineer coordinate to determine if the preliminary structure span and substructure types are feasible for the calculated scour depths. If the structure span is feasible, a final geotechnical report and final hydraulic design report (FHD) are completed. If the structure span is not feasible, additional structure types and sizes are evaluated. Coordination continues through PS&E to make sure the contract is in compliance with the design. Once a contract is awarded, the Region construction office coordinates with the design team, geotechnical engineer, and hydraulic engineer for review of Type 3E working drawings and other various submittals. The Region construction office shall coordinate with the HQ Hydraulics office for all stream and restoration construction components of the design.

[Exhibit 800-3](#) is a flow chart is for the structure design process. The starting point for [Exhibit 800-3](#) is after the SFZ is determined during pre-design. The design team coordinates with the bridge engineer, geotechnical engineer, and hydraulic engineer to complete the various Bridge Design Manual (BDM) forms for site data, stream crossing, and other various geotechnical and hydraulics information. This information will be part of the bridge site data packet. After structure preliminary plans are completed, the geotechnical engineer completes the geotechnical data required for the substructure design and coordinates with the hydraulic engineer to make sure there will be sufficient geotechnical data to assess preliminary total scour.

After completion of the geotechnical substructure design, the design team, bridge engineer, geotechnical engineer, and hydraulic engineer coordinate to determine if the preliminary structure span and substructure types are feasible. If feasible, a final geotechnical report and final hydraulic design (FHD) are completed. If not feasible, alternative structure types are evaluated. Coordination continues through PS&E to make sure the contract is compliant with the design. The Region construction office coordinates with the PEO, HQ Geotechnical office, HQ Hydraulics office, and the HQ Bridge and Structures office for review of various submittals. The Region construction office shall coordinate with the HQ Hydraulics office for all stream construction and restoration.

### 800.03 Hydraulic Design Process

The overall Hydraulic Design Process includes Scoping, Pre-Design, and Design. To allow the most efficient hydraulic report review and assessment, PEOs shall follow the hydraulic review process outlined in Section 1-5 and Figure 1-1 of the Hydraulics Manual. Figure 1-1 has been revised for this Design Manual Chapter and is shown here in [Exhibit 800-4](#).

All projects are required to complete a hydraulic assessment.

During the Scoping phase, all WSDOT projects shall complete a stormwater and hydraulic assessment. Scoping instructions can be found online under [Tools, Templates, and Links on the HQ Hydraulics website](#). This assessment's goal is to discuss the following:

- Does the project have existing stormwater and hydraulic deficiencies within the project limits? If so, assess and discuss the risk of the project not addressing these deficiencies.
- Does the project's impacts or modifications make existing stormwater and hydraulic conditions worse?
- Does the project's impacts or modifications create new stormwater and hydraulic issues that need to be addressed?
- Are there any stormwater retrofit opportunities within the project limits?

In many cases, the stormwater assessment may lead the project to create a hydraulic report. On certain types of projects, the stormwater and hydraulic assessment may be very brief if the impacts are minor, there are not any existing stormwater and hydraulic deficiencies within the project limits, and there are not any stormwater retrofit opportunities within the project limits. For example, a "paver" project may have a very brief stormwater and hydraulic assessment since the work is typically limited to just replacing the existing pavement. The Region Hydraulics Engineer shall review each stormwater and hydraulic assessment to determine the appropriate action and documentation necessary to support the project.

There are three types of Hydraulic Reports: Specialty Report, Hydraulic Report Type A, and Hydraulic Report Type B. All reports developed for WSDOT must be reviewed and receive concurrence; Specialty Reports and Type A Hydraulic Reports require concurrence by the HQ Hydraulics Section, while a Type B Hydraulic Report only requires concurrence by the RHE. For some regions, HQ Hydraulics has delegated concurrence authority for Type A Hydraulic Report to the RHE. For design-bid-build projects, concurrence is required prior to the project advertisement date. For design-build projects, the identified concurring RHE or HQ Hydraulics Section engineer shall be involved in developing the scope and the Request for Proposal and reviewing conceptual hydraulics reports. The Hydraulics Manual discusses Hydraulic Reports, including a definition of the report types, descriptions, and respective concurrence requirements by RHE and/or HQ Hydraulics Section. PEOs shall contact the RHE to determine the hydraulic report review process. For more info regarding milestones and scheduling, see the Hydraulics Manual.

## 800.04 Floodplain Management

Encroachment of a highway or highway facility into a floodplain might present significant problems and requires an investigation for further action. A thorough investigation includes the following:

- The effect of the design flood on the highway or highway facility and the required protective measures.
- The effect of the highway or highway facility on the upstream and downstream reaches of the stream and the adjacent property.
- Compliance with hydraulic-related environmental concerns and hydraulic aspects of permits from other governmental agencies per [Chapter 225](#) of the Design Manual.
- Addressing requirements in Chapter 432 of the Environmental Manual.
- Compliance with floodplain requirements for non water-crossing projects per the Hydraulics Manual.

A Flood Risk Assessment (FRA) is required for all water crossing projects. WSDOT has developed a template for completing an FRA which serves as communication tool for identifying potential risks of meeting (1) FEMA, (2) local jurisdiction, and (3) public health and safety in the preliminary stages of design. The FRA helps to identify subsequent deliverables that may be needed for the permitting process.

Once the Preliminary Hydraulic Design (PHD) is complete (or near completion) an FRA shall be completed and reviewed by HQ Hydraulics Section. The FRA is then provided to the PEO to be used to communicate with local communities and Washington Department of Fish and Wildlife (WDFW) about potential flood risks associated with the proposed project. The FRA will also help determine the likelihood of needing to complete a conditional letter of map revision (CLOMR) based on the selected alternative documented in the PHD. The FRA is intended to help determine if the project may require a CLOMR, easements, right-of-way acquisition (or other critical path tasks) early in the project delivery process; these critical path items can have large impacts on the project schedule and should thus be coordinated early in the process. It is also intended that the FRA, along with the PHD, be used as reference documents for design build.

The FRA is further discussed in the Hydraulics Manual. Projects proposed within a Special Flood Hazard Area (SFHA) and other floodplain management additional requirements are found in Chapter 432 of the Environmental Manual.

## 800.05 Water Crossings

Chapter 7 of the Hydraulics Manual covers the design requirements for water crossings on state highways. All fish-bearing water crossings within Washington State must meet the requirements of WAC's Hydraulic Code Rules and the requirements of the Hydraulics Manual. WSDOT and WDFW have cooperated in a Fish Passage Barrier Removal program since 1991. To determine if a water crossing is within a fish bearing stream, PEOs can check the [WSDOT fish barrier database](#) or contact the HQ Environmental Services Office to determine if there are fish barriers within the limits of the proposed project. New water crossings (e.g., bridges and culverts) must be designed to meet current fish passage standards and WAC to ensure they do not hinder fish use or migration.

HQ Hydraulics oversees the preparation of Preliminary and Final Hydraulic Design (PHD and FHD) for fish passage projects. Refer to [Exhibit 800-5](#) for a flow chart describing the PHD Stream Design Process.

## 800.06 Safety Considerations

Locate culvert ends outside the Design Clear Zone when feasible. (See Section [1600.03\(2\)\(c\)](#) for roadside safety and hydraulic considerations with the design clear zone.)

For detention ponds and wetland mitigation sites, see [Chapter 560](#) regarding fencing.

## 800.07 Documentation

For the list of documents required to be preserved in the Design Documentation Package and the Project File, see the Design Documentation Checklist: <https://wsdot.wa.gov/engineering-standards/design-topics/design-tools-and-support>

## 800.08 References

*Bridge Design Manual*, M 23-50.20, WSDOT

*Design-Build Manual*, M 3126.08, WSDOT

*Environmental Manual*, M 31-11.25, WSDOT

*Geotechnical Design Manual*, M 46-03.16, WSDOT

*Highway Runoff Manual*, M 31-16, WSDOT

*Hydraulics Manual*, M 23-03, WSDOT

*Plans Preparation Manual*, M 22-31.08, WSDOT

*Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans)*, M 21-01, WSDOT

*Standard Specifications for Road, Bridge, and Municipal Construction (Standard Specifications)*, (Amendments and General Special Provisions), M 41-10, WSDOT

*Utilities Manual*, M 22-87, WSDOT

# Exhibit 800-1 Specialty Group Coordination: Pre-Design

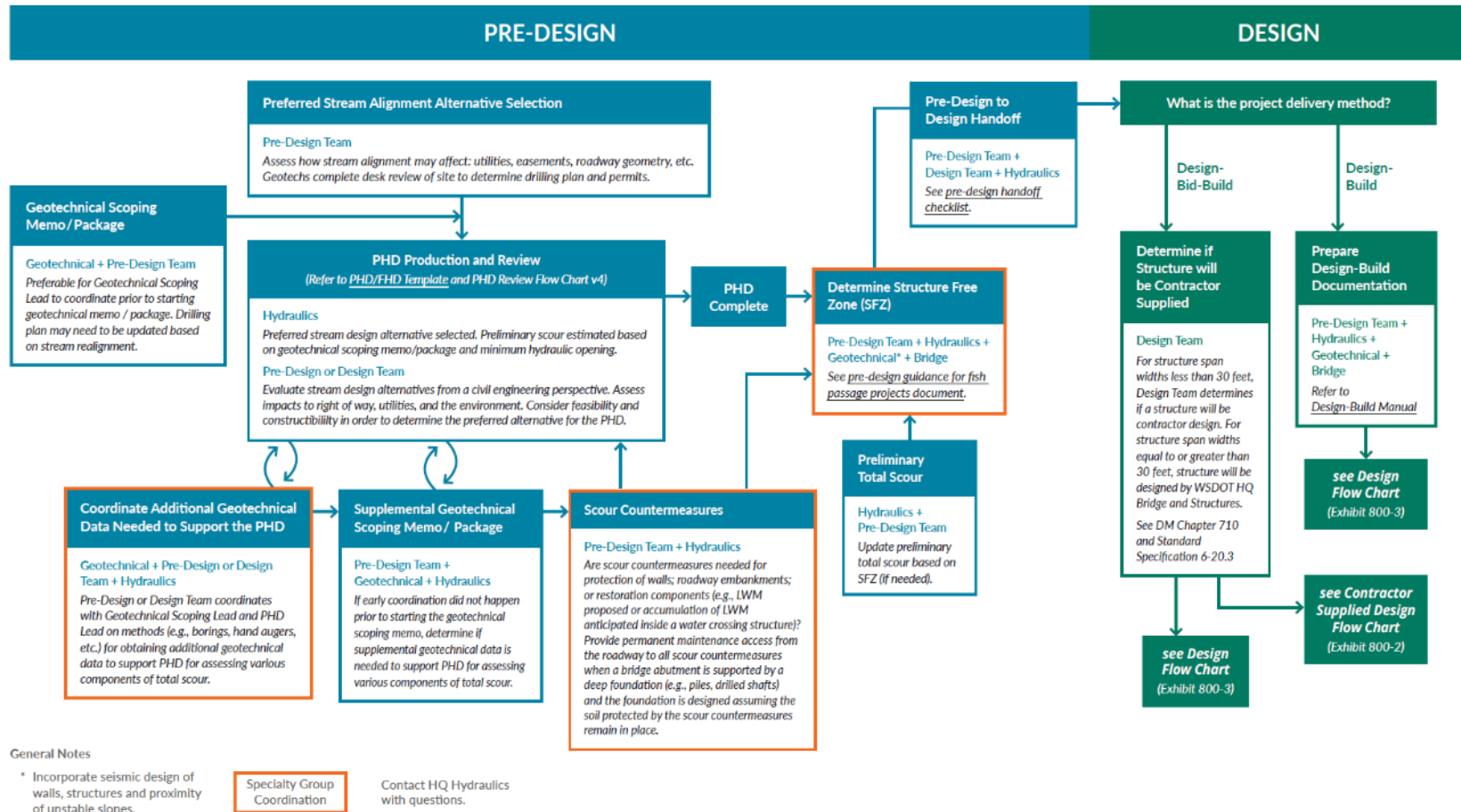
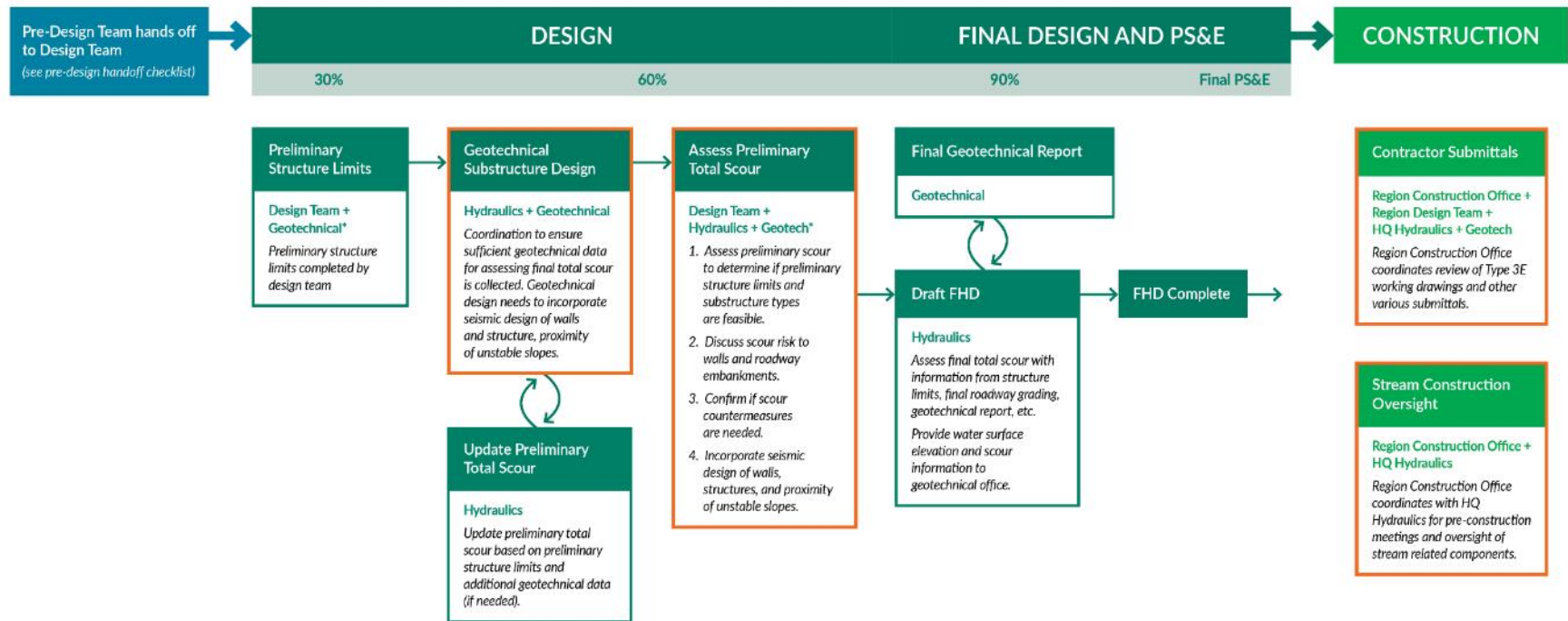


Exhibit 800-2 Specialty Group Coordination: Contractor Supplied Design\*\*



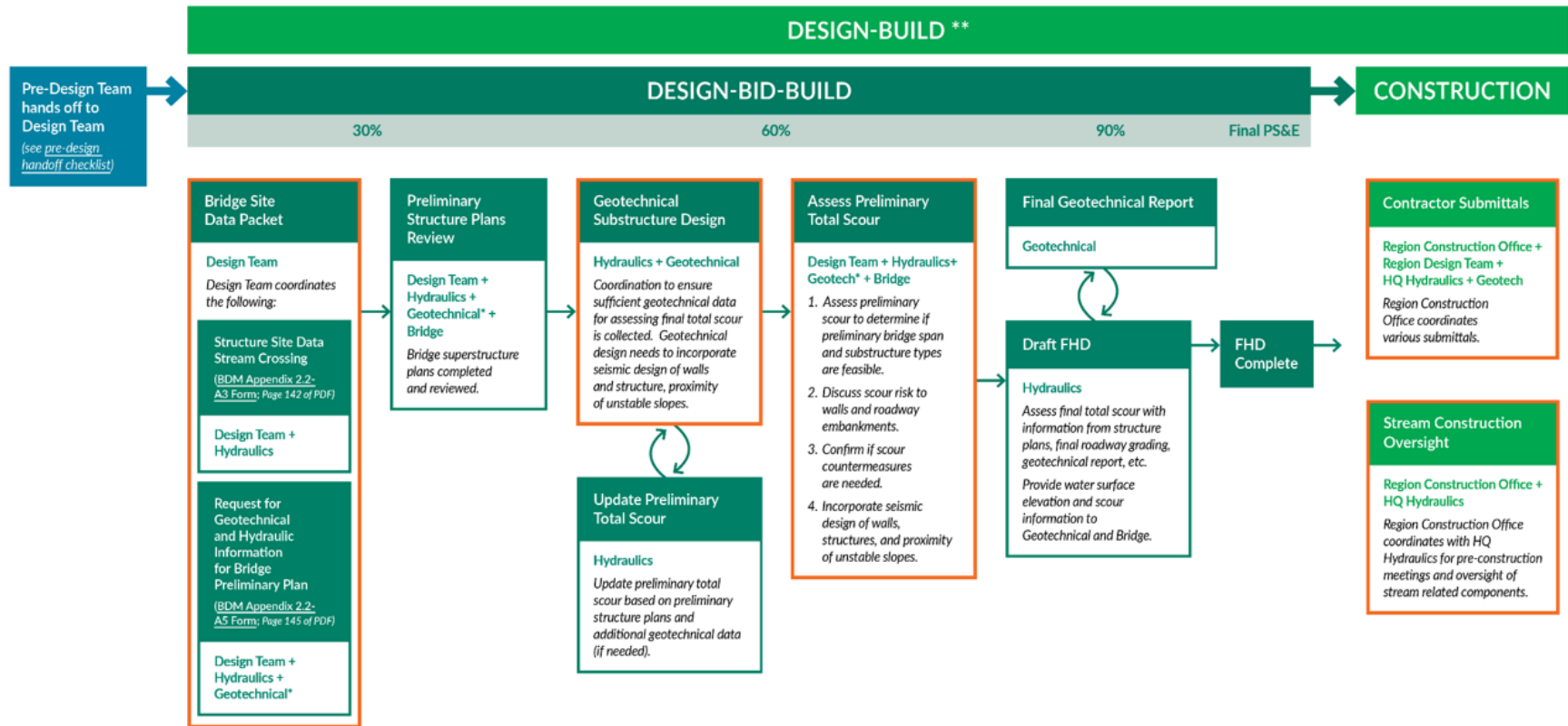
General Notes

- \* 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.

Exhibit 800-3 Specialty Group Coordination: Design



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.



Exhibit 800-4 Hydraulic Design Process

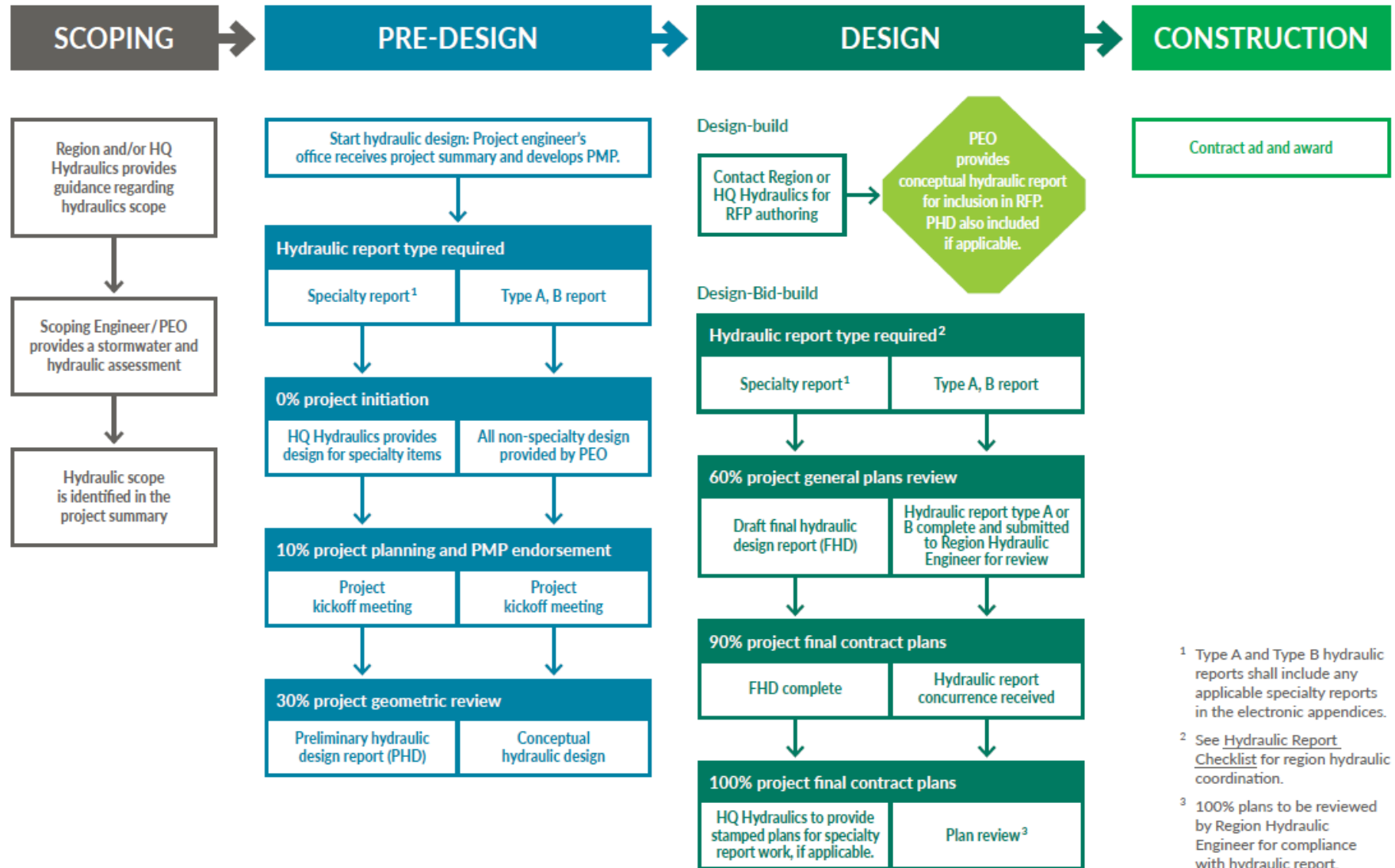
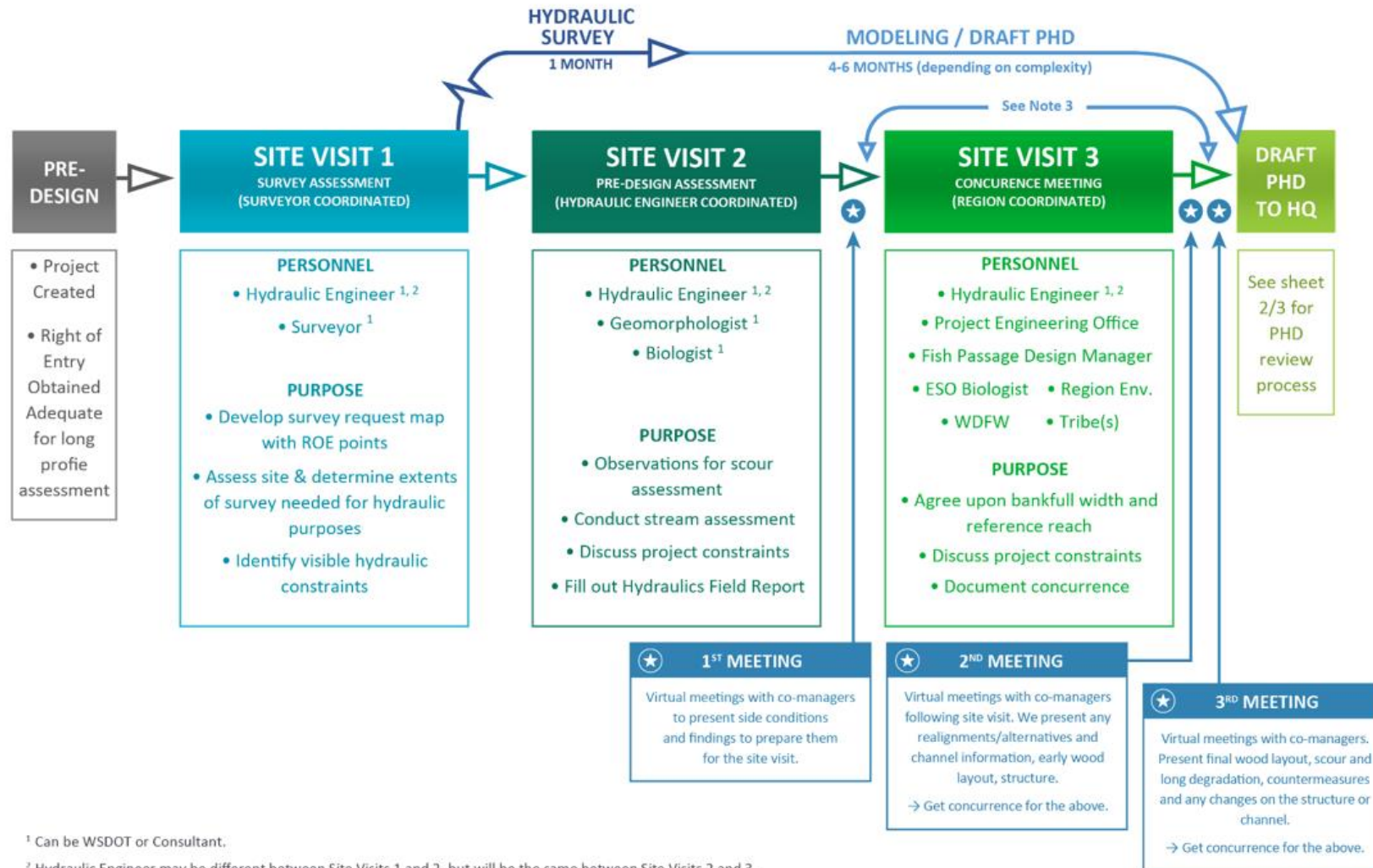


Exhibit 800-5 Preliminary Hydraulic Design: Stream Design Process



<sup>1</sup> Can be WSDOT or Consultant.

<sup>2</sup> Hydraulic Engineer may be different between Site Visits 1 and 2, but will be the same between Site Visits 2 and 3.

<sup>3</sup> For complex sites additional meetings, coordination, and site visits may be necessary to discuss design updates and other challenges.