Introduction To Hydraulic Design

In this introduction you will learn:

- Hydraulic design process - from how hydraulic issues are identified to final report approval.

- Who to coordinate design with and where to get help.

- Technical manuals needed for hydraulic design.

- Training opportunities.

- Additional resources available.
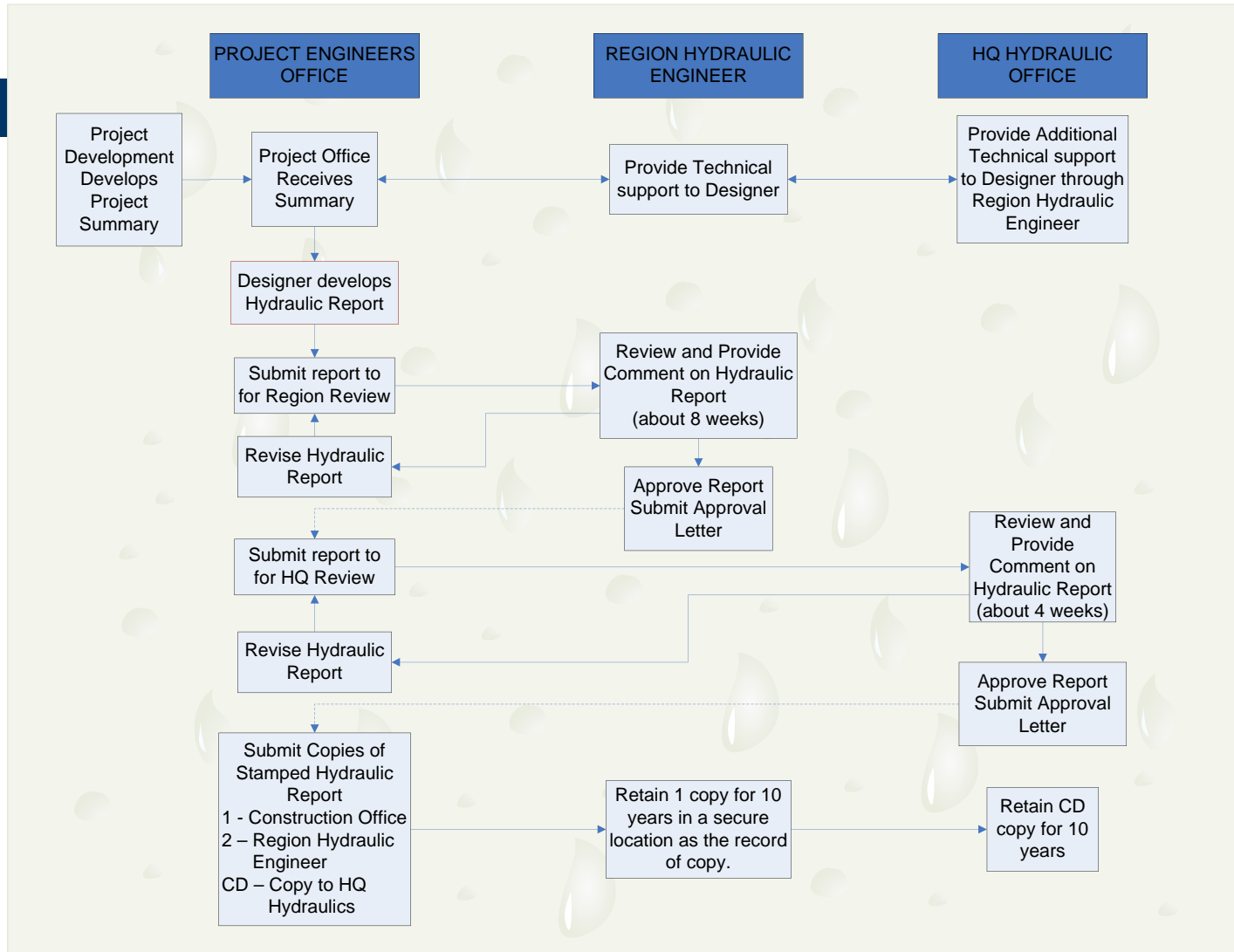
Who Determines Hydraulic Issues?

Project Development

- Develops Project Summary with input from Hydraulic Engineer and Maintenance.

Project Office

- During the project design, the design team may identify hydraulic deficiencies.

Overview of Hydraulic Design Process

Where to Start

Just been tasked with Hydraulic Design?

Congratulations!

Now what?

- Review Project Summary.

- Coordinate with project designers.

- Meet with Region Hydraulic Engineer.

- Maintenance

Technical Manuals

Two manuals provide technical requirements for Design:

1. **<u>Hydraulic Manual</u>** – provides most all necessary information to complete the hydrologic and hydraulic analysis to get stormwater off and away from roadway. Goal is to provide a safe driving and protect roadway. Based on FHWA guidelines.

2. **<u>Highway Runoff Manual (HRM)</u>** – developed to direct the planning, design, and maintenance of stormwater management facilities for highways. Goal is to protect environment and starts after runoff leaves the roadway. Based on DOE requirements.

Need a copy of these manuals?

WSDOT Engineering Publications has copies of the latest versions of each:

http://www.wsdot.wa.gov/publications/manuals/index.htm

Hydraulic Report Outline

Developed to assist designers in writing the final report and help with review process.

- Located in Appendix 1-3 of the Hydraulics Manual.
- Check with Region Hydraulic Engineer, so regions have customized outlines to meet region needs.

Training

HQ Hydraulics offers the following courses:

1. **Highway Runoff Manual Training (2 days)** Covers: Stormwater Planning and Design Integration (Chapter 2), Minimum Requirements (Chapter 3), and Best Management Practices (Chapter 5).

2. **Hydraulics & Hydrology Drainage (2 days)** Hydraulics Manual training.

3. **StormSHED 3G Beginner (1 day)** Hands-on training includes program overview, developing basins, ditches, and networks (conveyance design).

Training Continued

3. **MGSFlood Training (1 day)** – WWA only. Hands-on training includes BMP design guidance from Chapter 5 of the HRM using the most utilized WWA BMP's.

4. **StormSHED 3G Intermediate (1 day)** – EWA only. Continuation of beginners course. Class includes BMP design guidance from Chapter 5 of the HRM using the most utilized EWA BMP's.

Washington State Department of Transportation

Need More Info on Training?

- Live classes are offered about every other year in each region or as requested.

- For "just in time training needs" each class has training material online and some classes have DVD's available for check out through the Region Hydraulic Engineers.

- For more information on each class, including training material, see the HQ Hydraulics Training web page:

http://www.wsdot.wa.gov/Design/Hydraulics/Training.htm

Software for Hydraulic Design

- **MGS Flood** – model BMP's using continuous simulation (WWA only)
- **HEC-RAS** – models flow through rivers and natural channels
- **HY-8** – culvert design
- **ArcView GIS** – basin mapping, stream gauge locations, and precipitation data.
- **StormSHED 3G**

Washington State
Department of Transportation

What is StormSHED used for?

StormSHED 3G is used for:

- The design of conveyance systems statewide (storm drains and ditches).

- <u>EWA Only</u> – Most runoff treatment and flow control BMP's including bioinfiltration swales, natural dispersion, vegetative filter strips, infiltration and detention ponds, etc.

Where does StormSHED 3G fit into the process?

1. **Basin Calculations** – determine all areas contributing runoff to the conveyance and stormwater systems.
2. **Inlet Analysis** – for roadways with curb and gutter, need to locate inlets along the project.
3. **Sag Analysis** - where inlets are located in a sag, need to perform a sag analysis.
4. **Design Storm and Precipitation** – need to determine which design storm(s) and precipitation values apply at the project location.
5. **StormSHED 3G** – Finally, after collecting the data from steps 1-4 are, then a designer is ready to start using StormShed 3G.

Basin Calculations

The size of the drainage basin is one of the most important parameters in a hydraulic analysis. To determine the basin area contributing to a point of interest, designer should select the best available maps from one or more sources including those noted below:

- Topo maps
- GIS maps
- InRoads*
- Plan sheets*

**Remember areas outside the project limits may also be contributing runoff.

Basin calculations should be included in the hydraulic report with a noted scale that allows reviewers to verify the calculations. Additionally, each basin should show flow direction arrows and be clearly labeled.

Inlet Spreadsheet

INLET SPACING - CURB AND GUTTER SPREADSHEET (ENGLISH UNITS)

$Tc =$	5.00
$C =$	0.90
$I =$	2.39
$m =$	5.62
$n =$	0.53

Project Name:
Project #:
S.R.:
Designed By:
Date:
Instructions: Red Text is automatically calculated. Black Text should be input by designer
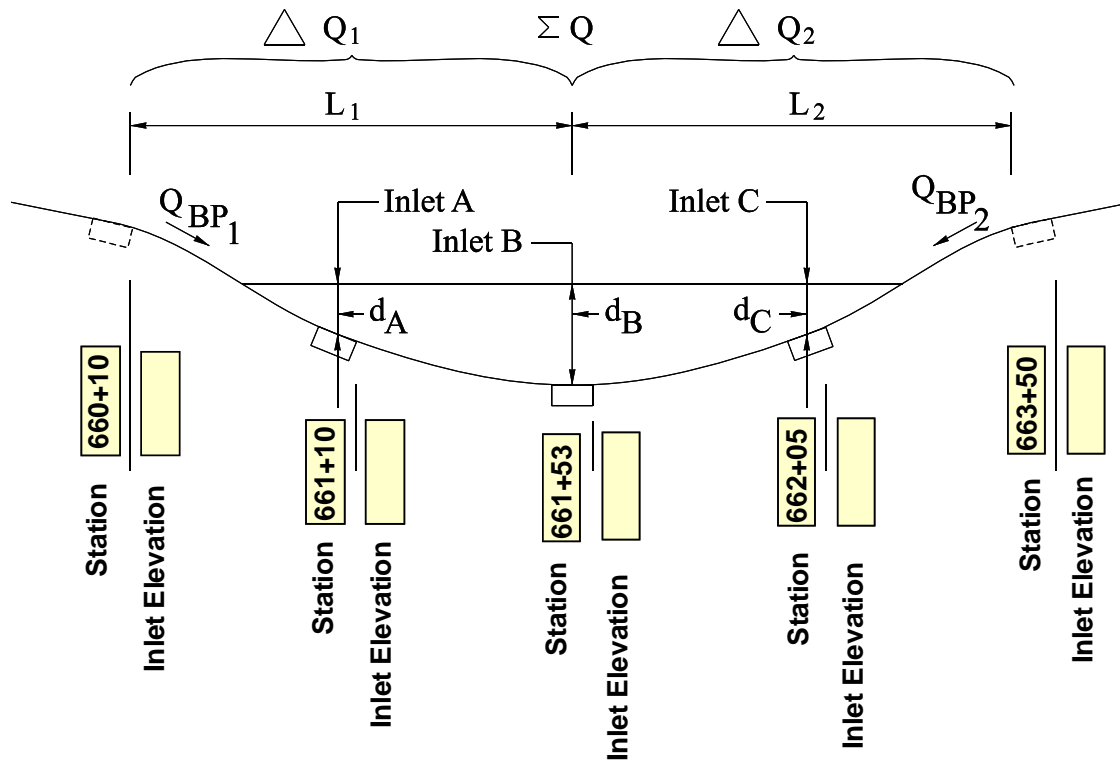
Is this roadway an interstate highway?   NO

Station	Distance	Width	ΔQ	ΣQ	Slope L	Super T	G.W.	G.L.	d	Z_d	$Q_{pp}**$	Vcontinuous**	Vside**
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Rational Method –Chapter 2 of Hydraulics Manual

http://www.wsdot.wa.gov/Design/Hydraulics/ProgramDownloads.htm

Sag Analysis

SAG INLET DESIGN WORKSHEET

Combination inlet at low point

http://www.wsdot.wa.gov/Design/Hydraulics/ProgramDownloads.htm

Design Storm and Precipitation

WWA

Type 1A storm for both conveyance and BMP design.

EWA

• Short Duration storm - conveyance & flow based BMP's

• Long Duration storm (Type 1A) - volume based BMP's

Precipitation Values:

Isopluvial Maps or ArcGIS for precipitation values

StormSHED 3G

Ready to Start StormSHED 3G

During design remember to:

- Coordinate hydraulic design with project designer including any project design changes that could affect the hydraulic design.

- Periodic reviews with Region Hydraulic Engineer.

- Contact Maintenance about region practices.

- Ask for help. Both Region Hydraulics and HQ Hydraulics are available to provide assistance.