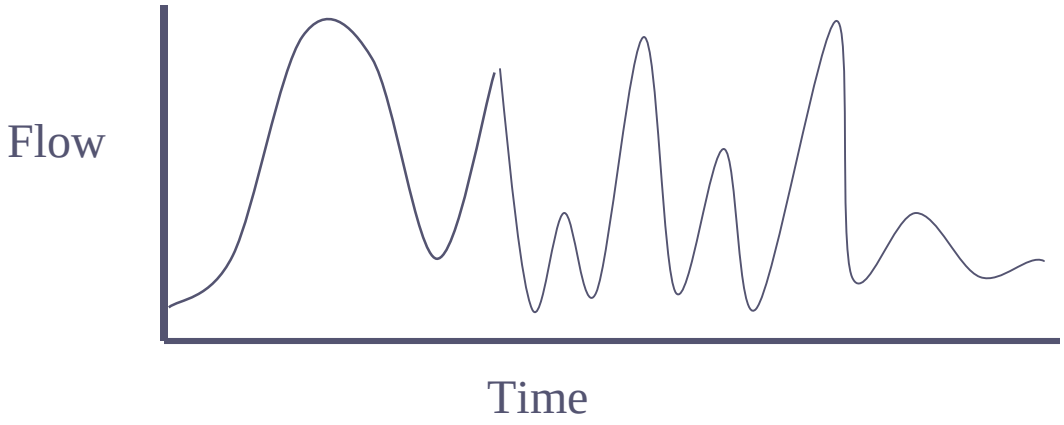
Section 4a

Hydrologic Methods (continued)

DEFINITIONS

- HSPF-Hydrologic Simulation Program - Fortran is a U.S. EPA program for simulation of watershed hydrology and runoff for pervious and impervious land areas.
- Continuous Simulation Hydrograph- A graph of runoff rate past a specific point in time generated from multi-year inputs of hourly precipitation and evaporation.



Benefits of Continuous Flow Model

- Simulates hourly runoff for 50 to 150 years (depending on precipitation / evaporation record).
- Allows for pond performance to be evaluated using a wide range of storms and antecedent conditions,
- Rainfall-Runoff algorithms in HSPF are more detailed than SCS, produces much better estimates of runoff.
- Allows for Calculation of *Flow Duration Statistics*, which are used to design ponds for Channel Stability.

Continuous Simulation Model Requirements

- Precipitation- Two methods of transposing precipitation timeseries are available in the continuous simulation model: Extended Precipitation Timeseries Selection and Precipitation Station Selection.

- Threshold Discharge Areas- Basins sizes for this method shall be limited to 320 acres, and be below an elevation of approximately 1500 feet.

- Soil Characteristics- Determination of soils types and land cover values.

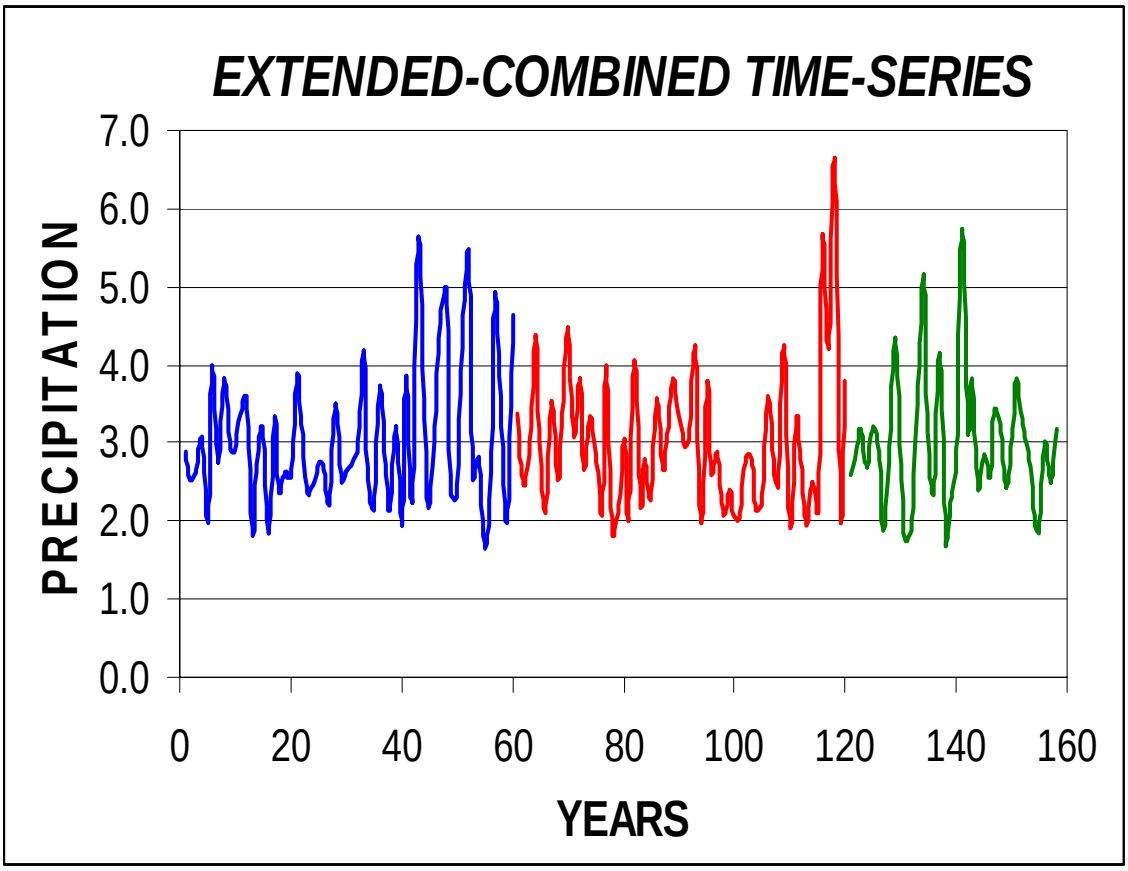
Precipitation

- Extended Precipitation Timeseries Selection

  ~developed by combining and scaling precipitation records from widely separated stations resulting in record lengths in excess of 100-years,

  ~used only for projects with a mean annual precipitation ranging from 32-inches to 60-inches.

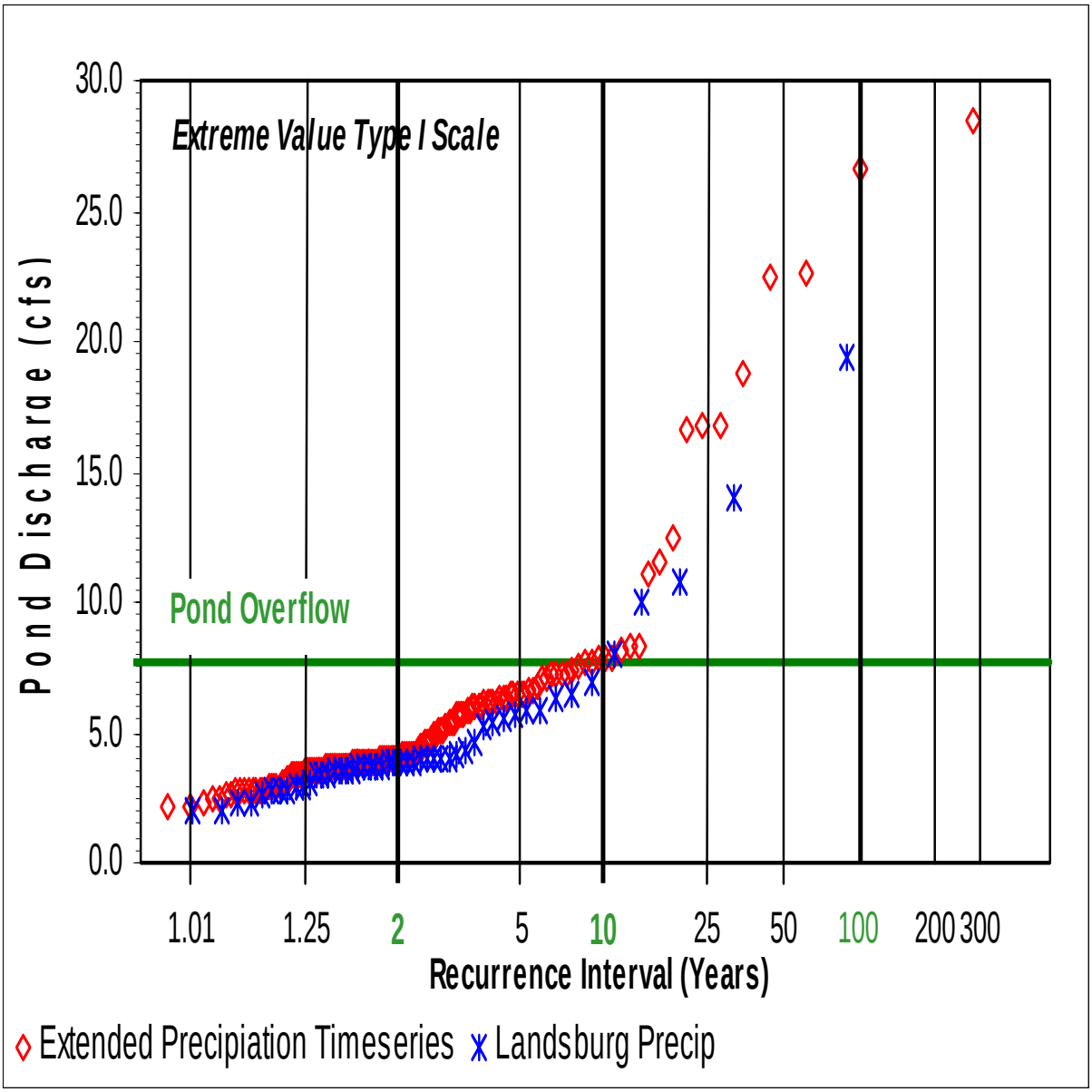
Precipitation



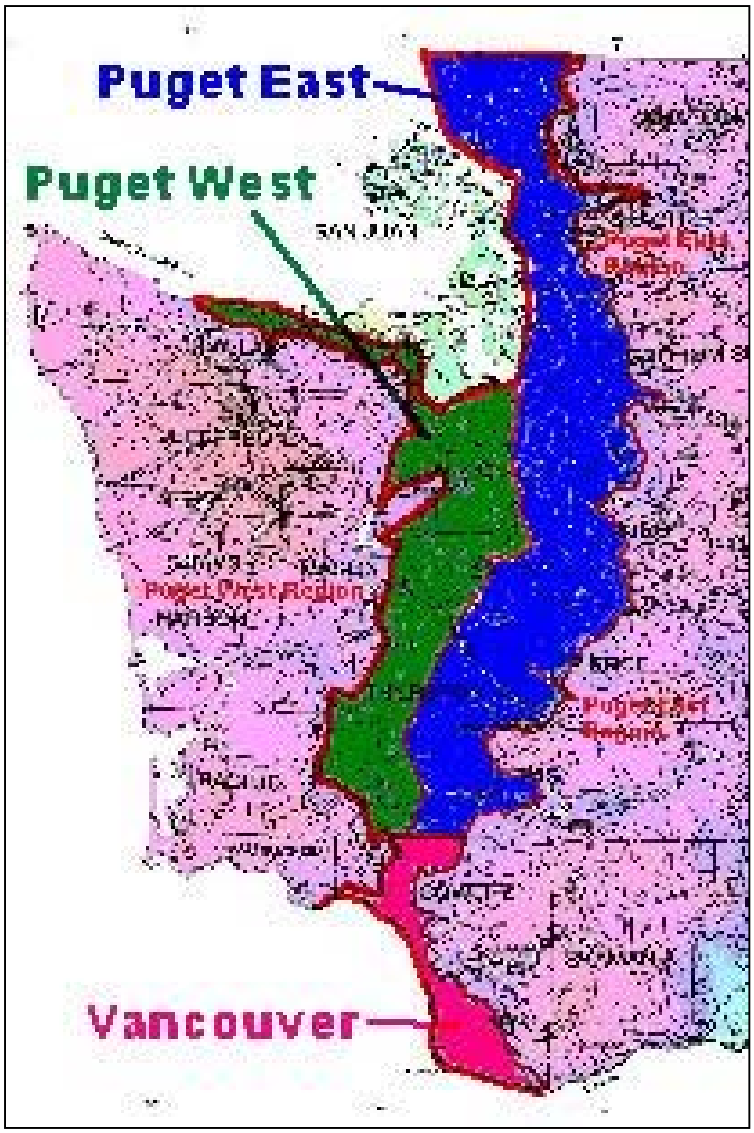
Extended Precipitation Timeseries

Peak Flow Comparison

158-Year Record and 45-Year Gage Record



Precipitation



Extended Precipitation Timeseries Regions

Precipitation

- Precipitation Station Selection

  ~for projects outside of extended timeseries region,

  ~a source gage is selected and a single scaling factor is applied to transpose the hourly record from the source gage to the site of interest (target site).

  ~Scaling Factor is ratio of 25-year 24-hour precipitation at Site of Interest relative to source gage.

Precipitation

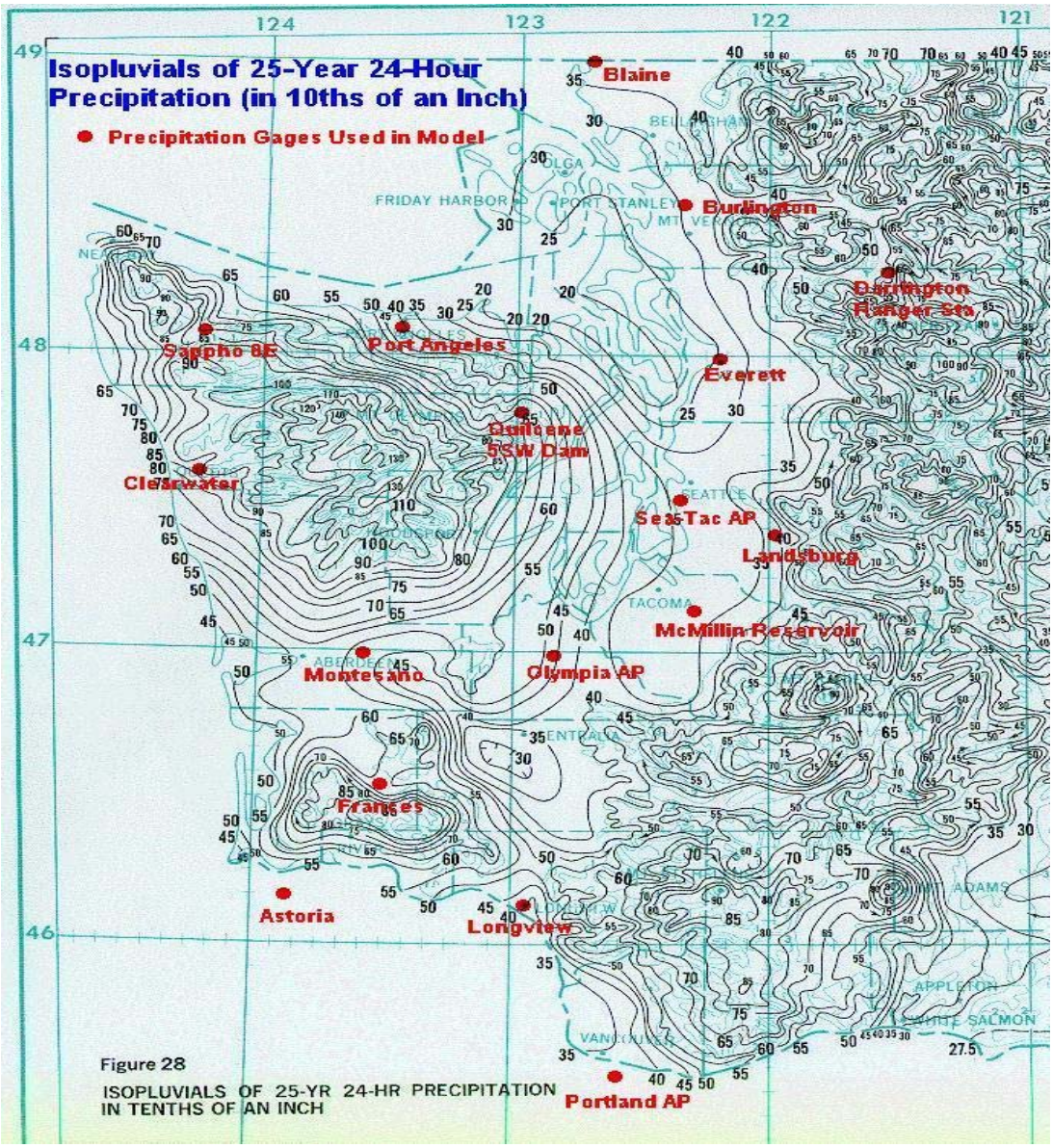


Figure 28
ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

Precipitation Station Selection

Shortcomings of Precipitation Station Selection

- Nearest Gage May Not have "Representative Record"

  ~ Record may be an "active record" with one or more extreme storm events (outliers)

  ~ Record may be a "benign record" with absence of many noteworthy storms

  ~ Record may be of poor quality with missing data and machine malfunctions.

Shortcomings of Precipitation Station Selection

- Storm Characteristics Vary by Duration and Season

  ~ Not Possible to Rescale Time-Series with Single Scaling Factor and Obtain correct storm characteristics at all durations at the site of interest.

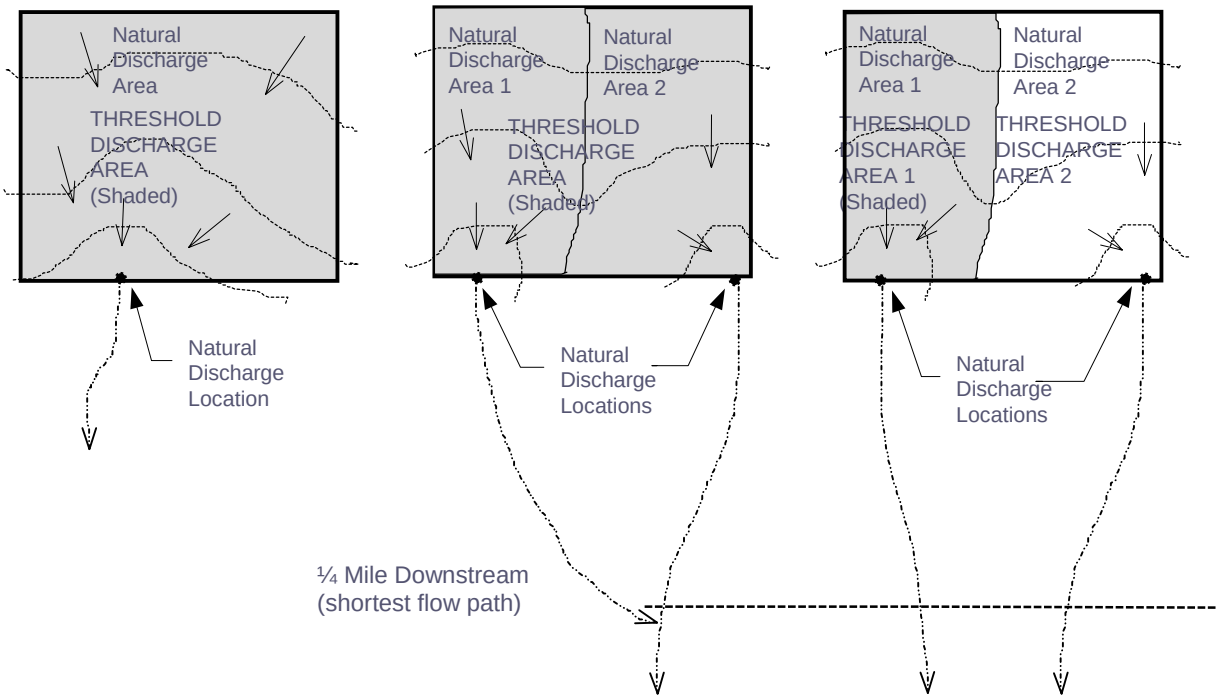
  ~ Different scaling factors needed for range of durations: 2-hr, 6-hr, 24-hr, 3-day, Annual

Threshold Discharge Areas

Example of a Project Site with a Single Natural Discharge and a Single Threshold Discharge Area

Example of a Project Site with Multiple Natural Discharges and a Single Threshold Discharge Area

Example of a Project Site with Multiple Natural Discharges and Multiple Threshold Discharge Areas



Soil Characteristics

- USGS Soil Categories

*Outwash - Soils having high infiltration rates, even when thoroughly wetted, and consisting of deep well to excessively drained sands or gravels. These soils have a high rate of water transmission.

Examples: Everett Soils
Winthrop Soils
Spanaway Soils

*Till - Soils having slow infiltration rates when thoroughly wetted and consisting of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures. These soils have a slow rate of water transmission

Examples: Montesano Soils
Sumas Soils

Soil Characteristics

- USGS Soil Categories

*Saturated Soil - Soils having very slow infiltration rates when thoroughly wetted and consisting of clay soils with high swelling potentials, soils with a permanent high water table, soils with a hardpan or clay layer at or near the surface and shallow soils over nearly impervious materials. These soils have very slow rate of water transmission.

Examples: Colville Soils
Wapato Soils

NRCS	USGS Categories
A	Outwash
B	Till or Outwash
C	Till
D	Wetland

Soil Characteristics

- Default HSPF Parameters

  * Define interception, infiltration, and movement of moisture through the soil.

  * Pervious areas have been grouped into three land cover categories; forest, pasture, and lawn and three soil/geologic categories; till, outwash, and saturated/wetland soil

Soil Characteristics

- Default HSPF Parameters

  * Combinations of soil type and land cover are called *pervious land segments* or *PERLNDS*.

Pervious Land Soil Type / Cover Combinations
1. Till/Forest
2. Till/Pasture
3. Till/Lawn
4. Outwash/Forest
5. Outwash/Pasture
6. Outwash/Lawn
7. Saturated Soil/All Cover Groups

Runoff Timeseries Generation

- Precipitation and evaporation for the selected climate region are read, and runoff is computed for predevelopment and postdevelopment conditions. The continuous simulation model stores this information as a runoff time series.

- Runoff computations are performed on a *water year* basis, that is, they begin on October 1 and end on September 30. This is done because the soils are typically driest at the beginning of fall and a single set of antecedent conditions can be used for all regions of western Washington. A time period shorter than the full record can be used for the runoff computations, however the full period of record should be used in facility design to provide the most accurate streamflow computations.

MGS Flood Public Domain Version

Features:

- Meets Ecology's Stormwater Guidelines
- Uses HSPF Computational Algorithm
- Optionally Include Groundwater Discharge
- Multiple Subbasin Capability
- Can Design Facilities for "Re-development" Conditions
- Includes Extended Precipitation timeseries for
  Most of western Washington
- Contains Statistics and Graphics Routines
- Can be Calibrated if Desired

MGS Flood Proprietary Version

Features in Addition to those in Public Domain Version:

- Ability to specify Pond Geometry
- Includes a Variety of Hydraulic Structures;
  Orifice, Orifice w/ Backwater, Weirs, Risers,
  Sand Filters, Rectangular and V Notch Weirs
- Optimization Routine for Automatically Designing Ponds to Ecology Standard

For More Information: http//:www.MGSengr.com