Appendix 1
Detention Basin Design Criteria and Review Submittal Guidelines for Developers

General Guidelines

1. Designs should satisfy Oregon Drainage Law. ODOT will accept the runoff that drains naturally prior to development. ODOT generally will not accept runoff that does not naturally drain to the highway. Once runoff is collected in a system it is no longer considered natural drainage.
2. ODOT's Hydraulics Manual explains our hydraulic design criteria and procedures. The manual is available from the ODOT Hydraulics Unit. Contact the Hydraulics Managing Engineer at 986-3400.
3. Detention may be required when any of the following criterion are met:
   - History of drainage deficiencies in the area is known.
   - The total runoff from the site after the proposed development without flow control is 0.014 m3/s (0.5 ft3/s) or greater.
   - The total impervious surface after the proposed development is 1,000 m2 (0.25 acre) or greater.
4. Detention may not be required when:
   - The total runoff from the site after the proposed development without flow control is less than 0.014 m3/s (0.5 ft3/s).
   - The total contributing area after the proposed development is less than 1,000 m2 (0.25 acre).
   - It is demonstrated the downstream ODOT drainage facilities are sufficiently sized. The analysis must evaluate the entire contributing basin to the downstream ODOT facilities and assume full development runoff coefficients based on current zoning.
   - It is demonstrated the affects of the changed site conditions do not increase the peak runoff due to time lag and sub basin location. A complete hydrogragh analysis, using multiple sub basins, is required for this method.
   - When the ODOT drainage facility being impacted is a bridge, large box, or large pipe. A large facility must span 4 m or larger.
   - All regulatory agencies, watershed councils, and the ODOT Hydraulics Unit agree that detention is not in the best interest for the specific watershed at this location.
5. A site plan and construction drawings drawn to scale and drainage calculations must be submitted for ODOT's review and approval. Enough

information should be submitted so the design can be independently verified.

Drainage Calculations

1. The detention basin's outlet structure must limit the maximum outflow to the peak flow that drains to the highway prior to the proposed development. When calculating the maximum outflow, use the same recurrence interval as the design recurrence interval for the detention basin.
2. The design recurrence interval for detention basins shall be as follows:
   - For detention basins which serve 2 hectares (5 acres) or less and discharge directly to and are physically connected to storm sewers or which discharge to ditches which do not lead directly to cross culverts or inlets:

     ☐ 10-year.
   - For detention basins which serve 2 hectares (5 acres) or less and do not discharge directly to storm sewers (This includes systems that utilize ditches and lead directly to cross culverts or inlets.) use one of the following: (Note: DHV=0.15ADT)

     ☐ 25-year when the design hourly volume (DHV) of the highway is less than 100.

     ☐ 50-year when the design hourly volume (DHV) is 100 or greater.
   - For detention basins which serve an area of development of greater than 2 hectares (5 acres):

     ☐ 10-year, 25-year, and 50-year.

   A recurrence interval differing from described above is only allowed if required by a local or regional agency or the ODOT District Manager and approved by the ODOT Hydraulics Unit.
3. The drainage calculations should include the following information:
   - Provide a narrative describing the characteristics of the contributing drainage basin prior to proposed development including but not limited to slope, shape, soil type, vegetation, storage, and runoff coefficients. A description of the changes to this information due to proposed development should also be included.
   - Show drainage basin area(s) for contributing flows from on-site and off-site, if applicable.
   - Calculations for the time of concentration. Show flow paths, points of concentration and lengths for each flow component.

- Show all runoff coefficients and include the rainfall intensity-duration-frequency-curve used for the calculations.
- Peak runoff from the site prior to proposed development during the design storm.
- Peak runoff from the site after proposed development during the design storm.
- Calculations that show the outlet structure will limit the peak outflow to the allowable outflow. Note: Orifice calculations are based on the center of the orifice (not the invert).
- Storage and volume calculations for the detention system. Note: Water quality storage volumes should not be considered available for detention storage unless a thorough hydrogragh and stage-storage analysis is submitted which includes variable outflow rates.
- Calculations that show the required detention storage volume is available on the proposed project.
- Auxiliary outlet or overflow capacity must be provided to allow overflow during storm events that exceed the design storm or to allow overflow if the outlet structure is obstructed. The purpose of this overflow outlet is to provide protection to the embankments of the storage facility to avoid catastrophic failure. The overflow outlet cannot be connected directly to a storm drain system that may be at capacity during the 100-yr rainfall event. A typical auxiliary outlet may consist of a rip rapped lined weir and outlet channel.
- Units: Calculations should be prepared in the same units used for the plans.
- ODOT's procedure manual that is dated 1978 and entitled "Application of Detention Storage for Limiting Runoff" presents a procedure for designing detention systems. The procedure described is one of many currently being used. Methods utilizing hydrogragh analysis are described in the ODOT Hydraulics Manual. Any method that provides reasonable detention volumes is acceptable.

Site Plan / Construction Drawings

1. The site plan should include but not be limited to the following information:

   - Buildings, landscaped areas, and impervious areas such as parking lots and sidewalks.
   - Contours of site prior to proposed development
   - Contours of site after proposed development

- Details of proposed and existing drainage systems including the flow line elevations, size, material, length, and available headwater for all pipes and ditches. Also identify the location and rim elevation of all inlets and manholes.
- Details of the proposed detention system that includes the dimensions and bottom elevation of all detention ponds. Details of the outlet and overflow structure should also be shown. If an orifice is used, include the size, type and elevation of the orifice.
- Units: Plans should be prepared in either English or metric units as directed by the District Manager.

2. The need for screening or other debris control designs should be considered and may be required for outlet structures that have orifices smaller than 13 mm (6-inches) in diameter.

Detention Basin Review Submittal Checklist

❑ DRAINAGE CALCULATIONS

- ❑ Narrative (Existing and Proposed)
  - ❑ Slope of drainage basin(s)
  - ❑ Shape of drainage basin(s)
  - ❑ Soil type(s)
  - ❑ Ground cover
  - ❑ Storage
  - ❑ Other
- ❑ Drainage Basin Areas (Existing and Proposed)
- ❑ Time of Concentration (Existing and Proposed)
  - ❑ Show Location of Flow Paths
  - ❑ Lengths of flow paths
  - ❑ Slopes of flow paths
  - ❑ Flow Regimes
  - ❑ Points of Concentration
- ❑ Runoff Coefficients
- ❑ Rainfall Data (I-D-F curves, isopluvial maps, etc)
- ❑ Peak runoff (Before and After)
- ❑ Outlet control structure release rates (orifices, weirs, etc)
- ❑ Storage and volume for detention (required and available)
- ❑ Auxiliary overflow capacity (100-yr)
- ❑ Units: Prepare calculations in the same units that the construction drawings are prepared.

❑ SITE PLAN / CONSTRUCTION DRAWINGS

- ❑ Buildings
- ❑ Landscaped Area
- ❑ Impervious Areas
- ❑ Contours – Existing
- ❑ Contours – After Development
- ❑ Drainage Systems – Existing
- ❑ Drainage Systems Plans and Details – After Development
- ❑ Detention System Plans and Details
- ❑ Auxiliary Outlet or Overflow
- ❑ Screening provided to protect orifices

❑ Back-Check Calculations, Plans, and Details for Consistency

Water Quality Facility Design Criteria – Draft

Prepared by Paul R. Wirfs, PE, ODOT Urban Hydraulic Engineer, July 24, 2002

Water Quality

- The water quality volume calculation is applied to the net new impervious surface area. (New impervious surface area) – (Removed impervious surface area) = Net new impervious surface area.
- Design Storm
    - West of the Cascades = 1/3 of the 2-yr, 24-hr storm.
    - East of the Cascades = 2/3 of the 2-yr, 24-hr storm.
    - Apply multiplier (1/3 or 2/3) to rainfall value from NOAA isopluvial map. The resulting rainfall value shall not exceed 1” and not be less than 0.5”.
    - The King County SBUH software may be used to determine the peak runoff flow rate and total effective volume of the design storm.
- POND: Use the Total Effective Runoff Volume of the design storm.
- SWALE: Use the Peak Runoff flow rate of the design storm.
- WATER QUALITY STRUCTURE: Use the Peak Runoff flow rate of the Design Storm.

Water Quality Facilities

- The facilities listed below are the most common types of facilities used on ODOT projects and are acceptable methods for treating stormwater prior to discharge to ODOT R/W. Additional stormwater treatment measures may also be required (i.e. oil/water separators, etc.) to pre-treat stormwater from sites with high pollutant loadings. Other methods of treating stormwater runoff may be proposed but must be evaluated on a project-by-project basis to determine if the proposed treatment methods are adequate.
- Provide maintenance access to all facilities.
- Facilities treating stormwater from outside ODOT R/W must be placed outside ODOT R/W.
- Facilities treating stormwater from ODOT R/W may be placed in ODOT R/W.
- Provide Operation and Maintenance Manual for all facilities to be maintained by ODOT.

Extended Dry Pond

- Design Outflow Rate = Necessary to release Design Volume in 48 hrs. Q = V/[(48)(60)(60)] = Maximum Allowable Water Quality Outflow Rate.
- Use the water surface elevation at the top of the storage volume to determine orifice sizing.
- Contact ODOT Hydraulics Unit for sample details for outlet control structure.
- Preferred Side Slope: 1V:4H or 1V:3H
- The water quality design volume is in addition to any detention storage volume required in combined use facilities. The water quality volume is in the lower portion of the pond and the detention volume is in the upper portion of the pond.
- If soil percolation rates are determined as part of the geotechnical investigation then the pond sizing can be reduced taking into account the residual affect of storm water percolating into the pond sides and bottom even though this would not be the primary outlet source for the storm water.
- Also refer to the GENERAL POND DESIGN CRITERIA.

Vegetated Swale

- Minimum Hydraulic Residence Time: 9 min
- Maximum Water Design Depth: 150 mm (0.5 ft)
- Minimum Freeboard: 150 mm (0.5 ft) (for facilities not protected from high flows)
- Manning “n” Value: 0.24
- Maximum Velocity: 0.61 m/s (2 ft/s) (or check shear stress on channel bottom) based on the 25-yr flow.
- Minimum Length: 30 m (100 ft)
- Minimum Slope: 0.5%
- Minimum Bottom Width: 1.2 m (4 ft)
- Maximum Side Slope: 1V:4H (within treatment depth)
- Include porous paving system on bottom of swale to provide stability for large mowing equipment.
- Include flow spreader where pipe enters swale.

- Include flow spreaders at 15 m (50 ft) intervals if porous paving system is not included.
- For swales that do not provide a split flow manhole upstream and must convey the water quality design storm in addition to the 25-yr conveyance storm, provide calculations to show adequate capacity and channel bottom stability for the 25-yr storm.

Water Quality Structure

A self-activating structure, with no moving mechanical parts or external power sources, which removes pollutants from stormwater flow and retains them in the structure. Pollutants to be removed and retained include, but are not limited to, sediments, floatables, and petroleum products and by-products. Supply water quality structures from a manufacturer who is regularly engaged in designing and building stormwater-treatment structures and appurtenances and who has provided similar structures for a minimum of five years of continuous, successful operation.

Water Quality Structures approved for use on ODOT projects are listed on the ODOT Qualified Products (Conditional Use) List.

General Pond Design Criteria

This criteria applies to all ponds.

- Provide maintenance access road and sediment de-watering area.
- Side slopes 1V:3H or flatter. Slopes of 1V:4: are preferred. The access point into the pond should be sloped 1:6 or flatter.
- Freeboard
    - Design Storm WS elevation to auxiliary outlet rim = 0.3 m to 0.6 m.
    - Check Storm WS elevation to top of embankment = 0.3 m
- Design water surface elevations should be below roadbed subgrade. If this is not possible then an impermeable liner should be used to protect roadbed material.
- Maximum design water surface elevation in the pond should be below the upstream invert of the pond inlet pipe (i.e. Backwater from pond should not adversely impact the operation of the upstream storm drain system). If this is not possible then a detailed backwater analysis of the storm drain system is required to assure the system E.G.L. is below all grate and rim elevations.
- Set Backs

  - Check flood high water elevation to Embankment slopes> 10% side slope = 60 m
  - Check flood high water elevation to Well = 30 m
  - Toe of Berm to Property Line = 1/2 berm height or 1.5 m min.

- Safety
  - Fences are not preferred but are sometimes necessary.
  - Limit pond depths to 1m or less. If this is not possible then a protective fence is required around the pond perimeter.
  - Maintain side slopes to 1:3 or flatter. If this is not possible then a protective fence may be required around the pond perimeter.
  - Ponds in clear zones may be hazard to vehicles. Placing ponds near roadways that are protected by curb, guardrail or concrete barrier is acceptable.