CHAPTER 11 SAMPLE STORMWATER ORDINANCE ANALYSIS

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The Rational Method

The Rational Method is recommended to estimate stormwater discharge for proposed developments. The Manning equation is recommended for determining culvert, collection pipe and open channel capacity. For closed conduits flowing full, the Hazen-Williams formula is recommended.

Experience has shown that when applied properly, the Rational Method provides satisfactory estimates for peak discharges on small catchments where storage effects are insignificant. The rational method is not recommended for drainage areas much larger than 100-200 acres, for any catchment where ponding of stormwater in the catchment might affect peak discharge, or where the design and operation of large (and hence more costly) drainage facilities is to be undertaken, particularly if they involve storage.

The Rational Method is also recommended for use in calculating required storage volumes for detention facilities that serve small areas.

General Requirements for Stormwater Management

1.1 Purpose

The purpose of these requirements is to define minimum standards and procedures for the design, permitting, construction and maintenance of drainage facilities. They also provide standard procedures for estimating flow and establishing allowable runoff criteria for developed property.
These requirements present minimum storm water standards that apply to physical development within the City. Compliance with these standards does not relieve the Engineer of the responsibility to use sound professional judgment. These standards are intended to assist, but not to substitute for, design by a registered Professional Engineer licensed in the State of Idaho.

1.2 Purpose of a drainage facility

- Limit peak post-development stormwater flows
- Treat storm water to improve water quality
- Mitigate the impacts of increased runoff due to urbanization
- Maximize infiltration and minimize runoff from developed property
- Facilitate groundwater recharge
- Protect groundwater quality

State or Federal law may preempt these standards and require more stringent or additional requirements. Alternatives to standard plans, specifications, and design details found in these design requirements may be accepted if they meet or exceed the performance of the standards.

1.3 Regulatory Authority

The City shall approve all designs, plans, and construction requirements.

1.4 Required Elements for Stormwater Management Plans

Stormwater management plans shall be submitted for all commercial, industrial, residential, and subdivision developments. Stormwater management plans shall contain:

- Topographic survey of the development showing existing drainage and conveyance systems
- Topographic map showing delineation of all basins tributary to the area affected by the proposed development
- Peak flow rate calculations for all outlets and drainage works (pre-and post development, as applicable)
- Runoff volume calculations for all proposed and existing storage facilities (pre-and post-development, as applicable)
- Plan of new or modified drainage systems, including dimensions and volume calculations
- Grades of all impervious surfaces
- Flood routing, flow and volume computations for the 100-year flood through the site (includes all contributing areas)

- Drainage report which includes basis for design, narration for the design, and operation of the drainage system. For multi-phase developments, the drainage report must include pertinent data from all phases.
- Copies of any easements, permits, or discharge agreements
- Landscape plan
- Operation and maintenance plan, with the name of the responsible contact, as well as company specifications and recommended maintenance for equipment or systems used in the drainage system.
- All calculations are to be computed in a tabular format acceptable to the City. The computations shall be submitted in paper and electronic formats

1.5 Stormwater Management Design Criteria

Water Quantity Design Storm Criteria for Surface Water Management

The Rational Method for determining peak flow rates and volumes should be used for developments affecting areas not greater than 100 acres. For larger developments (greater than 100 acres), the Natural Resources Conservation Service (NRCS) method, TR-55 should be used. Other hydrologic methods may be acceptable for determining runoff rate and volumes, however, if an alternate hydrologic method is selected, the design professional shall obtain written approval from the City prior to beginning hydrology studies.

The post-development runoff flow rate from any proposed land development shall be less than the calculated pre-development runoff rate for any storm up to the 10-year event. Pre-and post-development rates shall be calculated for the 10-and 100-year events.

Outlets from detention facilities must be adjustable and designed to replicate predevelopment discharge conditions for up to 10-year storm events. Overflows must pass the 100-year event without failing.

Minor conveyance systems (subsurface pipe networks, inlets, etc.) shall be designed to accommodate the peak flow of the 100-year event. Major conveyance systems (streets, channels, etc.) shall be designed to accommodate the peak flow of the 100-year event.

The stormwater runoff from the proposed development cannot be diverted and released to any downstream property that, prior to the proposed development, would not have received any runoff unless the downstream property owner provides:

1) Easement
2) On-site detention meeting the criteria presented in this document
3) Written approval from the city engineer and street department certifying the capacity of receiving infrastructure.

1.5.2 Water Quality Design Storm Criteria

Different standards apply to surface and subsurface management of stormwater. For all controls, it is presumed that these standards are met when:

1) Applicable nonstructural practices for source control and pollution prevention are implemented. Source controls prevent pollutants from entering stonn water runoff and may include practices such as parking lot sweeping and spill prevention;
2) Storm water best management practices, BMPs, are sized to capture and treat runoff
3) Stormwater management BMPs are maintained as designed.

1.5.3 Subsurface Management of Stormwater

Storm water runoff can also be disposed of underground by using seepage beds, infiltration basins, and infiltration swales. Infiltration practices shall be designed to exfiltrate the entire water volume for a 10-year event and pass the 100-year event. Source controls should be in place to protect ground water in case of accidental hazardous material or waste spills.

1.5.4 Water Quality Design Criteria during Construction

For new development projects, water quality BMPs shall be implemented on all disturbed areas. Storm water BMPs shall be designed to remove the average annual load of total suspended solids (TSS). The removal rate for TSS during construction and until the site is stabilized, is *70%.* Hazardous materials cannot leave the site nor may they be allowed to impact groundwater. The design storm to meet these water quality criteria is the 2-year event. The total volume of the 2-year event must be retained and treated.

1.5.5 Water Quality Design Criteria for Post-Development

For new development projects, water quality BMPs shall be implemented on all impervious and disturbed areas. All other pervious areas must be stabilized to protect against erosion. Storm water BMPs shall be designed to remove TSS at the more stringent of the removal rates shown in the following table or current NPDES requirements:

TABLE 1.5.5.1 Required Removal Rates for Total Suspended Solids (TSS)

% of parcel area that is impervious	% TSS removal efficiency required
0-49	60
50-74	75
75-100	80

1.5.6 Water Quality Design for High-Risk Land Uses

Projects that fall into certain land use categories may generate higher than allowable pollutant concentrations. These land use categories are considered to be potential significant sources of pollutants and include the following:

- Industrial facilities that are required to obtain a NPDES industrial stormwater permit
- Vehicle salvage yards (including auto recycler facilities)
- Vehicle fueling facilities
- Vehicle parts stores
- Fleet storage areas (cars, buses, trucks)
- Vehicle service, maintenance and equipment cleaning areas
- Road salt storage and loading areas (if exposed to rainfall)
- Commercial nurseries
- Outdoor storage and loading/unloading areas of hazardous substances
- Bulk material sales (landscape, rock/sand products)
- Stormwater discharges from land uses with higher potential pollutant loads require the following:
- Source reduction (pollution prevention) BMPs
- Pretreatment systems for the expected pollutants (besides sediment) such as catch basin inserts, oil/water separators, drainage channels, bio-filtration swales, and/or deep sump catch basins.
- Proposed site activities should be evaluated for the potential to contribute pollutants to storm water. Applicable BMPs shall be identified in the facility's Operation and Maintenance Plan.

1.6 Redevelopment Standards

A redevelopment project is a project that requires a building permit and proposes to add, replace and/or alter impervious surface (other than routine maintenance, resurfacing, or repair). The following requirements apply to redevelopment projects:

1.6.1 Water Quantity

The applicant shall evaluate the existing stormwater system to determine if the system has sufficient capacity for additional runoff from the proposed redevelopment project. A plan shall be submitted for a redevelopment project when there is an increase in impervious surface greater than 100 ft^2 or greater than 10% of the existing impervious area (whichever is greater) to the tributary area of the storm water facility. A plan is also required when an existing drainage system is modified in any way.

1.6.2 Water Quality

For all projects requiring a building permit, an Operation and Maintenance (O & M) Plan for the drainage system will be required. The O & M Plan shall include source controls for all onsite activities that can contribute pollutants to stormwater runoff. Tenant improvements that do not affect drainage, single-family house projects, and residential subdivisions with 4 or fewer living units are exempted from this requirement.

If the redevelopment project is less than or equal to 5000 ft^2, and involves a land use with potential higher pollutant loads, the system shall be retrofitted to manage the particular pollutants associated with the land use.

If the redevelopment project is greater than 5000 ft^2, then the applicable % TSS removal rate from section 1.5.5 is required. The TSS removal rate applies to surface discharge of storm water only. Subsurface disposal is prohibited unless the applicant can demonstrate that its implementation meets applicable and current Idaho DEQ groundwater protection requirements. If the land use has a potential for higher pollutant loads, additional pretreatment may be required.

If it is not practicable to meet the applicable redevelopment standards, the applicant must request a variance and new retrofitted or expanded stormwater management systems must be designed to improve existing conditions.

1.7 Determining Peak Discharge, Peak Volume, and the Water Quality Volume

1.7.1 Water Quantity

The following is a list of the basic steps to be taken in order to calculate the peak discharge rates from pre- and post-development conditions and the volume of stormwater that must be retained onsite to control peak discharge rates from specified storms. The Rational Method is presented. NRCS TR-SS is also permitted. Other hydrologic methods may be accepted for determination of runoff rate and volume; however the design professional shall obtain written approval from the City Engineer prior to beginning hydrologic studies for the project if an alternate hydrologic method is used.

The Rational Method must be used for basins less than 100 acres. Alternate methods may be permitted for basins greater than 100 acres.

Calculations should be presented in an easily tabular format and submitted on paper and on disk. For TR-SS, HEC-l , and other computer modeling techniques that may be approved by the City, the Engineer shall supply the City with the base data, assumptions and input and output files in electronic and paper format.

1.8 Steps for Determining Peak Discharge (Rational Method)

$$Q_p = CiA = ft^3/sec = cfs = Acre\text{-}in/hr$$

Where:

Qp = peak discharge (cfs)
C = dimensionless runoff coefficient
i = average rainfall intensity (in./hr) for a duration equal to the time of concentration and for the recurrence interval chosen for design storm (2-year treatment, 10-year conveyance, and 100-year overflow)
A= basin area (acres)

1) **Calculate the site area (A):**
   - Use USGS topographic maps, surveys, and other available information.
   - Show delineated basin boundaries on maps or drawings submitted to the City for review and approval.

2) **Determine the pre and post development composite runoff coefficient (C) for each basin:**
   - This value is obtained from the Runoff Coefficient table for pre-development and post development conditions. Composite C values shall be computed from Table 1.8.2, and fall within the ranges given in Table 1.8.1 for the pre and post development land use. For mixed surfaces, determine a weighted coefficient using the following formula:

$$C = \frac{[(C_1 \times A_1) + (C_2 \times A_2) \ldots + (C_n \times A_n)]}{A_{total}}$$

TABLE 1.8.1 Accepted Range of Composite Runoff Coefficients

Description of Area	Runoff Coefficients
Business	
Downtown areas	0.70-0.95
Neighborhood areas	0.50-0.70
Residential	
Single-family areas	0.30-0.50
Multi-units, detached	0.40-0.60
Multi-units, attached	0.60-0.75
Residential (suburban)	0.25-0.40
Apartment dwelling areas	0.50-0.70
Industrial	
Light areas	0.50-0.80
Heavy areas	0.60-0.90
Parks, cemeteries	0.25
Playgrounds	0.35
Railroad yard areas	0.40

TABLE 1.8.2 Runoff Coefficients for Use in Computing Composite

Description of Area	Runoff Coefficient
Unimproved areas	0.25
Streets Asphaltic	0.95
Concrete	0.95
Brick	0.85
Drives and walks	0.85
Roofs	0.95
Lawns; Sandy Soil:	
Flat,	2% 0.10
Average,	2-7% 0.15
Steep,	7% 0.20
Lawns; Heavy Soil:	
Flat,	2% 0.17
Average,	2-7% 0.22
Steep,	7% 0.35

3) Calculate the time of concentration in minutes (t_c)

The time of concentration (in. /hr) over a duration equal to the time of concentration for the contributing area can be estimated using Kirpich's Equation as follows:

$$t_c = 0.0078\ (L^{0.77}/S^{0.385})$$

The minimum t_c required for 100-year spillway flows is 30 minutes (i = 3.76 in/hr)
The minimum t_c required for all other design flows is 10 minutes (i = 3.67 in/hr)

Where: t_c = time of concentration (min)
L = length of travel (ft)
S = slope (ft/ft)

4) Determine the average rainfall intensity (i):

This value is obtained from the intensity-duration-frequency curves for Pocatello, Idaho. Use t_c and the design storm to determine intensity. If $t_c \leq 10$ minutes for designs requiring a 10 year storm, use t_c = 10 minutes (i = 3.67 in/hr). If $t_c \leq 30$ minutes for designs requiring a 100 year storm, use t_c =30 minutes (i =3.76 in/hr).

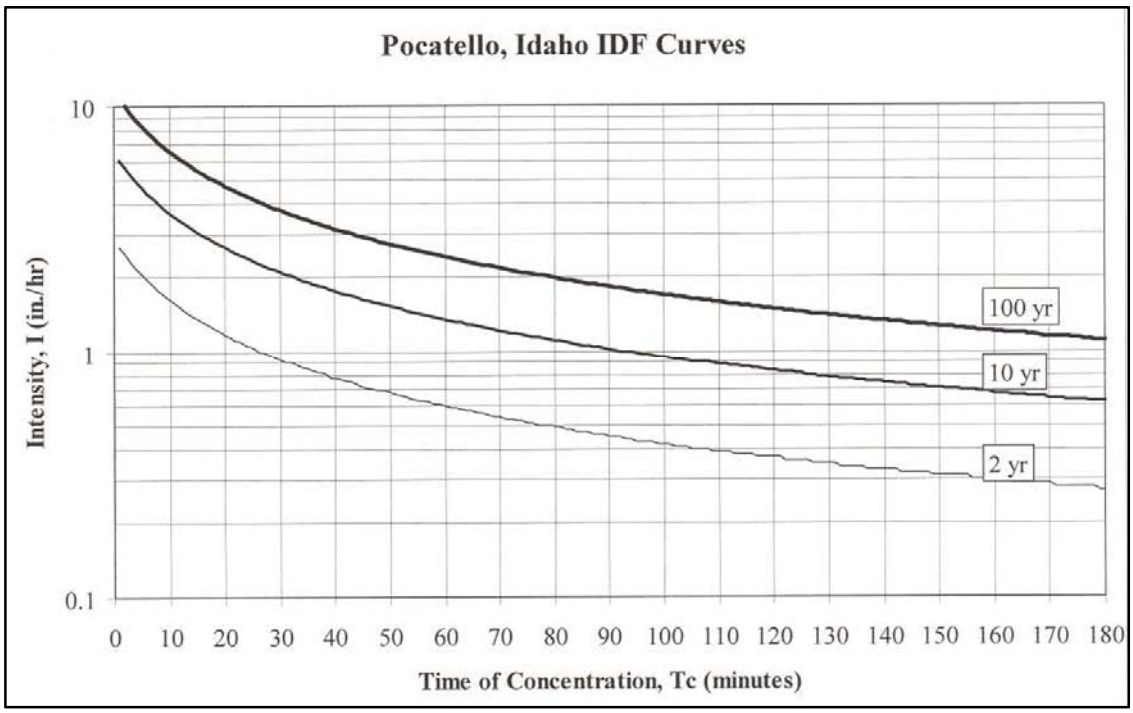

Figure 11-1: Pocatello IDF Curves

5) **Calculate the peak discharge (Q_p) for each basin outlet**
   a. $Q_p = C^* I * A$
   b. Calculate pre-development Q_p
   c. Calculate post-development Q_p

1.9 Steps to Calculate Onsite Storage volumes for Control of Peak Discharge Rates

$$V_r = C \times (i/12) \times A \times T$$

Where:

V_r = Volume of runoff (ft^3)
C = Dimensionless runoff coefficient
A= Contributing area to storage site (ft^2)
T = Duration of storm (hr)

1) Calculate the contributing drainage area (A)

Use value from I) above.

2) Determine the average rainfall intensity (i)

Use the IO-year 3 hour event for detention (i = 0.62)
Use the 2-year 3 hour event of retention (i = 0.27)

3) Determine the storm duration (T)

For volume computations, T = 3 hours

4) Determine the runoff coefficient (C)

Use value from step 2 above.
Compute an overall composite C if more than one basin contributes to the storage facility.

5) Calculate the total volume of runoff (V) to be detained

$$V_{total} = (C_{post\text{-}develop} - C_{pre\text{-}develop}) \times (0.62/12) \times A \times 3$$

6) Calculate the volume of retention required for treatment:

$$V_{2\,yr} = (C_{post\text{-}develop}) \times (0.27/12) \times A \times 3$$

Design Calculations

Show design calculations to justify the size of subsurface piping, storm sewer inlets and downstream capacity if the proposed drainage works reroute the pre-development flow path. Appurtenances shall be designed to the following criteria:

Facility	Design Storm
On-site retention	2-year
On-site detention	10-year
Storm sewer piping & inlet	10-year
Constrictions at RR tracts	100-year
Bridges, streets, and open channels	100-year

Storm drains shall be designed to provide the required capacity without surcharging the line. Storm drain outlets shall be designed to function as a part of the build out drainage system. Where major trunk lines are not available, a temporary outlet and a future connection to the proposed trunk storm drain shall be provided. This is to permit effective drainage until the development and construction of a completed storm drain system.

Storm sewers shall not be designed with a velocity of less than 2 fps. When a pipe size has been established, it shall not be reduced downstream. Maximum manhole spacing is 400 feet. Manholes will also be required at changes in grade, pipe size, or alignment. Curved pipe will not be permitted for 36-inch pipe or less. Inlets shall be designed to intercept 100% of the total runoff delivered to the inlet in the 10- year storm event. Dry well inlets shall be designed to receive all of the stormwater that runs to the inlet. Manholes shall be required at the upstream terminus of all storm sewer lines.

1.10 Additional Criteria

1) Storage deeper than 1.0 feet shall require an outlet mechanism that will facilitate full discharge within 24 hours.

2) Spillway height shall not exceed 6.0 feet for any facility.

3) All portions of central storage basins must drain towards outlet.

4) Private detention facilities:

(a) Minimum bottom grade = 1% maximum with side slope = 4: 1 and drained to the outlet.

(b) City Parks: graded to drain to outlet; 10: 1 side slopes for mowing access.

5) Provide minimum of 1-foot freeboard above high water design elevation on all sides of the detention area, including lowest development gutter flow line.

6) The outlet pipe must be sized to pass the constant flow rate necessary to drain the pond in 24 hours, and be connected to the same storm water outfall that the basin drained to before development unless approved otherwise. The outlet pipe and the emergency spill way together shall be designed to pass the 100-year event for the entire drainage tributary to the facility.

7) Discharge requirements:

(a) Detention volume must be disposed of within 24 hours.

(b) If pumps are used, provide automatic switch control with vertical float control mechanisms. Pumps shall be accessible when lagoon is full. Screen pump inlet with ¾ inch stainless steel mesh.

8) Dry wells will be permitted for disposal of water provided that they are wider than they are deep; however, no percolation rate will be considered for reduction of retention volume. All dry wells shall be approved and permitted by the Idaho Department of Environmental Quality.

9) Storage facility outlets shall be located above the elevation of the storage required to retain and treat for the 2-year event. Maximum outlet invert height shall be 12 inches.

10) All disturbed soils shall be stabilized by seeding and irrigation until such vegetation is established.

1.12 References:

Stormwater Master Plan. Prepared by Schiess and Associates, Consulting Engineers. Prepared for the City of Pocatello, March 2000.

State of Idaho Catalog of Storm Water Best Management Practices For Idaho Cities and Counties. Prepared by Storm Water Program, Watershed and Aquifer Protection Bureau, Idaho Department of Environmental Quality.