CITY OF CALDWELL
ENGINEERING DEPARTMENT

CALDWELL MUNICIPAL STORMWATER MANAGEMENT MANUAL

July 2009

Table of Contents

100 STORMWATER MANAGEMENT

100.1 GENERAL OVERVIEW

Storm water management (SWM) involves a coordinated effort to control the size and severity of floods, the impacts of water pollution events, and erosion and sedimentation problems. Previous local SWM programs have focused on FLOOD CONTROL. Idaho State and Federal EPA regulations will require a more comprehensive management program in the future.

The Idaho Legislature enacted the Ground Water Quality Protection Act of 1989. The act called for creation of a Ground Water Quality Council that is responsible for developing a Ground Water Quality Plan as well as a Ground Water Monitoring Plan. The Water Quality plan has identified urban runoff as a possible major non-point source of ground water contamination.

In 1987 a new subsection was added to the National Pollutant Discharge Elimination System (NPDES) of the Clean Water Act and EPA published implementing regulations in 1990. These regulations require control of pollutants in urban storm water discharge to surface waters, and mandate an extensive permitting process for municipal storm sewer systems. This applies to communities with populations over 100,000, such as Boise, and will apply to smaller communities such as Caldwell beginning in 2006.

For surface waters of particular concern (“water quality limited”), the State of Idaho has promulgated an “anti-degradation” policy for certain pollutants. The lower Boise River, which receives runoff from the City of Caldwell, is a “water quality limited” stream segment and is subject to the “anti-degradation” policy.

A storm water management program is needed to meet the stated objectives of State and Federal regulations. This Manual outlines the City's storm water management program, which is intended to accomplish these objectives and set up the “Best Management Practices” (BMP) for managing storm water discharge from new developments. It is expected that this manual will require modification as State and Federal regulations change.

100.2 MANAGEMENT GOALS

This storm water management plan addresses three distinct system goals: flow controls, water quality protection, and erosion and sedimentation control. These goals must be addressed for the construction phase of a development, as well as for the completed development. Existing storm drainage systems are addressed in Section 101.1.1

100.2.1 Flow Controls

Management of storm water flows involves the design and implementation of a control system to achieve the following objectives:

1. Mitigate downstream impacts from storm water flows resulting from land development activities.

2. Accommodate storm water and other flows from upstream lands and developments by providing adequate conveyance facilities through development sites.

3. Preserve use of existing drainage ways and their carrying capacity, and prevent encroachment into historic drainage ways.

100.2.2 Water Quality Protection

Management of surface water and groundwater quality involves the design and implementation of a control system to achieve the following objectives:

1. Mitigate the impacts to surface water and groundwater from contaminants in storm runoff caused by land development activities.

2. Control the quantity of water contaminants through construction of facilities that treat storm runoff.

3. Comply with the “anti-degradation” policy of the Idaho Department of Environmental Quality for pollutants of concern in the Boise River.

100.2.3 Erosion and Sedimentation Control

The management of erosion from new developments and resulting sediment load in receiving waters involves the design and implementation of a control system. The sources of sediment may be controlled through the use of diversions, ground cover, lined channels, sediment basins, sediment control structures, filtering and screening membranes, street sweeping, the elimination of dirt tracking from construction sites, or other approved methods.

100.3 LEGISLATIVE AUTHORITY

The City of Caldwell does not have exclusive responsibility for drainage in the corporate limits and impact area of the City. It does have the responsibility and authority to manage storm water in the City and its impact area that is associated with streets and roads, subdivisions, planned unit developments and new construction. The following laws apply:

100.3.1 Idaho Constitution

The City has constitutional authority as a municipal corporation to promulgate regulations governing the discharge of storm water onto the public right-of-way or into the City's storm water system.

100.3.2 Jurisdiction and Ownership

The City has authority to control discharges into the public right-of-way or into any storm sewers or drainage facilities within the public right-of-way through its ownership of the right-of-way. (See Title 50, Idaho Code, Section 1330)

100.3.3 Flood Prevention

Title 50, Idaho Code, Section 333 gives the City authority to prevent or minimize flooding.

100.3.4 Land Use Planning Act

Title 67, Idaho Code, Section 6518 authorizes the City to adopt standards for storm drainage systems.

100.3.5 Other

This is not a comprehensive listing of all legal authority. There are other legal authorities, which the City may assert from time to time.

100.4 URBAN HYDROLOGY

As rain falls on an undeveloped watershed, some precipitation may be intercepted by trees, grass, or other vegetation. Precipitation that reaches the ground starts to fill depressions (depression storage) and infiltrates into the ground to replenish soil moisture and groundwater reservoirs. If rainfall is intense and/or of long duration, the storage and absorptive capacity of the soil is exceeded and surface runoff occurs.

As land is developed, the surfaces are graded and covered with non-porous materials. The reduced interception and depression storage causes the amount and rate of runoff from developed area to be greater than from undeveloped area. During rainfall events, the runoff may move more quickly through the drainage system due to unnatural routing of the flows and increased flow rates. Minor or major flooding may result.

It is the intent of this manual that downstream drainage systems and water quality not be adversely affected by upstream development.

100.5 REQUIRED SUBMISSION TO THE CITY FOR DRAINAGE REVIEW

Note: *Review and approval of the Drainage Report by the City of Caldwell does not constitute an engineering review of the entire project plans and calculations. The review is for the purpose of ensuring general conformance to City policies and requirements. The submitting design engineer is solely responsible for the design. All submissions to the City shall be stamped and signed by a Professional Engineer registered in the State of Idaho.*

The Drainage Report includes the basis of the design and operation of the drainage system. The report is intended to be a stand alone document. All necessary information for Drainage Report review shall be included in the report. If possible, the report should be submitted prior to the development plan submittal. For any multi-phase developments, the drainage report must include all pertinent stormwater data from other phases that drain to or accept drainage from the newer phase, including contributing drainage basins, stormwater facilities constructed previously, temporary facilities, points and routes where irrigation or drainage ways enter and leave the parcel, users of any irrigation facilities, etc. The City intends that facilities detain stormwater and discharge at the rate of one miner's inch (1/50 cfs) per acre of the drainage basin. Any proposed non-discharging retention facility is not allowed unless specifically approved by the City Engineer. The following items shall also be addressed or included in the Drainage Report:

1. Topographic survey of the development site and 100 feet beyond showing existing drainage and irrigation water conveyance systems within the site on a 24" X 36" drainage basin map. Proposed drainage basins shall be clearly defined and correlated with the calculations. Roadway grade breaks and other delineations, as needed, shall define each basin. The total parcel shall be delineated into basins, including any contributing areas upstream of the development. Existing and proposed contours (minimum of 2 foot intervals) shall be shown for the development site and shall extend 100 feet beyond the site. The following items shall be shown on the map:

   a) All existing and proposed drainage and gravity irrigation facilities (e.g., detention and retention facilities, storm sewers, swales, outlet structures, irrigation facilities, culverts, drains, etc);

   b) Any relevant floodplain boundary based on the most current information as defined by FEMA;

   c) Legend defining map symbols, North arrow, and scale bar;

   d) Locations of all soil borings or explorations.

2. Peak flow rate and runoff volume calculations shall be shown for each defined basin. Hydraulic calculations shall be included for gutter flow, inlet capacities, pipe capacities, sand and grease trap flows and any other treatment device or conveyance.

3. Runoff volume calculations, as described above, shall be calculated for each defined basin. The entire acreage of the development plus any contributing areas shall be included in the calculations. Volume calculations and accompanying discussions shall address method of calculations as described in section 101, volumes for any storage facilities, infiltration rates where applicable, discharge flow rates where applicable and any other calculations needed to show ultimate storage, infiltration, and discharge volumes. Commercial or industrial development shall be calculated on a lot-by-lot basis at the time of building permit application except that the subdivider shall provide handling of stormwater from public street frontages which shall be handled in a common lot, or easement(s) confined within lot lines or by written maintenance agreement between affected lot owners if across lot lines. Individual commercial or industrial lot owners shall be responsible for the handling of all storm water generated upon their own lot consistent with the provisions of this Chapter. The Developer of a subdivision shall be responsible to provide infrastructure for handing of all public street storm drainage and infrastructure accessible to lot owners for the continuation of site historic drainage unless Non-discharging retention facilities have been specifically approved by the City Engineer pursuant to section 100.5 of this Chapter.

4. Plan, profile, and calculations of new or modified drainage and irrigation water systems, including all conveyance facilities, pipework, treatment devices, infiltration and percolation facilities, and any storage basins, inclusive, from inlet to overflow or outlet.

5. Infiltration rates where applicable. All infiltration rates shall be established at the actual location of the infiltration facility. Soil classification or percolation testing shall be utilized to establish infiltration rates. (See Section 104).

6. Seasonal high ground water table where applicable.

7. Flood routing computations for the 100-year flood through existing drainage conveyance systems and routing of the 100-year storm to the ultimate drain, storage facility, or infiltration location.

8. Copies of any associated permits and discharge agreements.

101 DESIGN OVERVIEW

101.1 GENERAL RULES

It is the presumption of this manual that a storm drainage system established for any new or modified development must conform to the capabilities and capacities of the existing downstream drainage system. It is also presumed that all upstream drainage rights shall be maintained and downstream drainage privileges shall be preserved. In addition, the following rules shall apply:

101.1.1 Grandfather Clause

The regulations contained in this manual shall not be applied retroactively. Any development (and the impervious area associated therewith) in place as of the date of enactment of this manual, and discharging to an existing storm drainage system, may continue to discharge. The addition of any impervious area greater than 1,000 square feet, subsequent to the enactment of this manual, shall be subject to the provisions of this manual. The modification of any existing drainage system or the addition of impervious areas that tends to increase quantity or decrease quality of discharge shall constitute "development" and render the existing system subject to the provisions of this manual. The setting of storm drainage practices for City sponsored street projects within the confines of City owned right-of-way may be directed by the City Engineer.

101.1.2 Downstream Rule

It is the intent of this manual that downstream drainage systems be preserved and the system and adjacent property not be adversely affected by upstream development. It is the developer's responsibility to ensure that the runoff, storm and domestic, from a development not increase pollutant load for pollutants of concern and discharge rates not exceed a development's "reasonable" share of downstream system capacity. The City Engineer may promulgate such requirements and procedures needed to achieve this requirement.

101.1.3 Continuance of Existing Systems

Existing storm water, irrigation or drainage conveyances for upstream or downstream properties shall be continued across the development. The conveyance may be relocated within the development, but the original or relocated facility must meet the applicable requirements set forth in this manual and the requirements of any other jurisdictional entity. In no case shall a conveyance facility be reduced in size from the pre-developed condition. The City Engineer may promulgate such requirements and procedures needed to achieve this requirement.

101.1.4 Irrigation Rule

Irrigation facilities shall meet the criteria of the irrigation entity with jurisdiction over the facility. It shall be the general requirement that irrigation delivery systems not be combined with stormwater drains and that stormwater storage not be combined with irrigation return water. The design and location of irrigation facilities within public right-of-way shall be subject to the review and approval of the City Engineer.

101.1.5 <u>Discharge Rule</u>

Any development proposing new or increased discharge off-site, in compliance with this manual, shall notify in writing the owner of the canal, ditch, drain or pond into which discharge shall occur. In addition, the design of new discharging facilities shall be subject to the review of the entity operating or maintaining the canal, ditch, drain or pond. Any development proposing to increase the rate or reduce the quality of discharge from a site may be denied permission to discharge.

101.1.6 <u>Engineer's Rule</u>

The design of any drainage system shall be under the responsible direction and control of an engineer having requisite training and experience in stormwater system design. All drawings and reports shall be certified by the Engineer in responsible charge.

A drainage facility which fails to function as designed, and in conformance with this manual, shall be redesigned, reworked and/or reconstructed at the expense of the developer and the design engineer until the original design intent is met.

101.1.7 <u>Acceptable Risk Rule</u>

The presumption in this manual is that runoff from storms larger than the design storm is not fully accounted for. It is presumed that storms larger than the design storm may cause property damage, injury or loss of life. This manual is not intended to remove all risk.

101.2 DESIGN STORMS

The following storm conditions shall be assumed in the design of storm drainage system components:

Table I

Design Storm Frequencies	
System	**Return Frequencies**
Primary Conveyance	25 Year
Secondary Conveyance	100 Year
Upstream Drainage	100 year
Retention Storage	100 Year
Detention Storage	100 Year (25 Year)*

***** In circumstances where overflow from detention facilities can be transported through a secondary conveyance system to a point of disposal, without danger to persons or property, for the 100-year storm, the detention facility can be sized for the 25-year return frequency storm.101.3 RUNOFF RATE

Determination of runoff rate for various storm conditions is important in the design of an acceptable storm drainage system. Accurate modeling of tributary area to a drainage way can be a complicated, time-consuming process. This section introduces simplified modeling methods acceptable for design. The use of the simplified modeling methods contained herein does not remove the obligation from the developer and design engineer to meet the design intent of this manual. (See 101.1.6).

101.3.1 Calculation Methodology

The peak rate of flow after development shall be determined for use in designing conveyance components (channels, pipelines and gutters) of the drainage system. The computation of peak flows for each system shall be included in a Drainage Report. Design storm frequencies for determining peak rates are shown in Table I. See Section 102.4 for primary and secondary system definitions of the drainage system capacity.

The rate of discharge shall be calculated using the proper methodology. The peak rate for areas up to eighty acres shall be calculated using the Rational Method or approved derivatives. The Soil Conservation Service (SCS) method TR No. 55 shall be used for areas larger than eighty acres.

101.3.2 Rational Method Equation

The equation for the rational method follows:

Q = CIA (peak flow rates in cfs)

C = non-dimensional runoff coefficient

I = average rainfall intensity in inches per hour (in/hr.), over a duration equal to the time of concentration t_c for the contributing area.

t_c = time of concentration in minutes (min)

A = size of the contributing area (acres)

(1) Typical C values are shown in Table 2

Table 2

Recommended "C" Coefficients for "Rational Method Equation"

Peak Rate of Discharge **Description of Run-Off Area Runoff Coefficients "C"**

Business	
Downtown areas	0.95
Urban neighborhood areas	0.70
Residential	
Single-family	0.50
Multi-family	0.75
Residential (rural)	0.40
Apartment dwelling areas	0.70

Industrial and Commercial

Light areas	0.80
Heavy areas	0.90
Parks, cemeteries	0.10
Playgrounds	0.20
Railroad yard areas	0.20
Unimproved areas	0.10

Streets

Asphalt	0.95
Concrete	0.95
Brick	0.85
Gravel	0.40
Drives and walks	0.85
Roofs	0.95

Adapted from ASCE (1972

(1) For large areas with mixed surfaces, a weighted coefficient shall be used. Multi-lot single family residential developments shall use a coefficient of 0.50 for the entire basin area unless a higher coefficient is needed to account for a higher percentage of impervious area. Right-of-Way plus 20 feet, ROW plus 2000 square feet per lot, etc. shall not be used in calculations. Any contributing areas shall use the appropriate coefficient for foreseeable future land uses.

(2) The time of concentration (t_c) is defined as the time required for runoff to travel from the most distant point in the basin to the point of measurement. For the design storm return frequency, it is the storm duration producing the peak runoff rate. It is related to the slope and runoff coefficient and may be estimated by various methods. For overland travel distances greater than 1,000 feet, the Izzard (1946), Kirpich (1940), SCS lag equation or velocity charts (1975) may be used.

(3) Rainfall intensity shall be based upon the intensity-duration-frequency information in Table 3. It is not necessary to consider times of concentration less than 10 minutes.

Table 3

	Frequency (years)					
Duration	2	5	10	25	50	100
(Minutes)	**Intensity in Inches per Hour**					
10	1.21	1.67	1.96	2.37	2.73	3.11
15	1.02	1.41	1.66	2.00	2.30	2.62
30	0.71	0.98	1.15	1.39	1.59	1.82
60 (1 hr)	0.45	0.62	0.73	0.88	1.01	1.15
120 (2)	0.27	0.36	0.42	0.50	0.58	0.66

180 (3)	0.20	0.27	0.32	0.37	0.43	0.48
360 (6)	0.13	0.17	0.20	0.23	0.27	0.30
720 (12)	0.08	0.11	0.13	0.15	0.18	0.19
1440 (24)	0.05	0.07	0.08	0.09	0.11	0.12

Source: NOAA Atlas 2

(4) The size of the drainage area shall include all on-site areas and any off-site lands tributary to the design point.

101.3.3 SCS TR55 Method

See SCS TR55 for application and calculation method.

(1) The time of concentration shall use the methodologies described above in Section 101.3.2. Runoff curve numbers shall be pre-approved by the City Engineer.

(2) Computer software adaptations of this method are acceptable provided their data and graphical printout are submitted for review.

101.3.4 Other Methods

Other methods of determining peak rate of flow and discharges based on sound engineering principles and with proven results may be used only if pre-approved by the City Engineer.

101.4 RUNOFF VOLUME

Runoff volumes shall be calculated for use in determining storage requirements for retention and detention facilities. Volumes shall be calculated based upon return frequencies listed in Table I.

101.4.1 Criteria for Calculating Runoff Volumes

The storm duration used for volume design shall be the duration that results in the largest storage volume requirement in a 24-hour period. Storm duration's from t_c to 24 hours shall be checked. The beneficial and reasonable contributions of offsite discharge, infiltration and percolation may be included when determining peak storage volume requirements. Volumes shall be included on the plans. Volumes and design methodology shall be shown in the Drainage Report.

101.4.2 Minimum Runoff Volume

Regardless of the method used in computing runoff, the runoff volume used for design of residential subdivisions and commercial developments shall not be less than the volume from 1-inch of runoff times the area of the road right-of-way plus any contributing impervious surfaces.

102 CONVEYANCE SYSTEM DESIGN

102.1 GENERAL OVERVIEW

A stormwater conveyance system includes any pipeline, ditch, swale, canal, borrow pit, channel, gutter, drain, creek or river having as one of its purposes the transporting of stormwater runoff. This section is devoted primarily to design of pipelines, gutters and channels and relies on the storm criteria and calculation methodologies outlined in Section 101.3.

102.2 LOCATION

Stormwater conveyance components may be located in public right-of way or on private property in easements subject to the following conditions:

102.2.1 Public Right-of-Way

Only pipelines and gutters may be located in public right-of-way. The positioning of a pipeline or gutter in right-of-way is subject to the review and approval of the City Engineer, and in all instances pipelines must maintain Idaho State mandated separations from potable water lines (10 feet-horizontal, 18 inches – vertical). Manhole rings and covers should be positioned to minimize contact with wheeled traffic and to avoid interference with sanitary sewer lines.

102.2.2 Easements

Pipelines and open channels may be located on private property if easements of adequate width for construction, maintenance and operation of the pipeline or channel are provided. The easement shall specifically exclude encroachments and obstructions (including trees and shrubs) which affect maintenance or replacement of the pipe. Required easement widths shall vary between fifteen and twenty-five feet depending on pipe depth and at the discretion of the City Engineer or as indicated in “Exhibit B. Easements running along property lines shall be situated such that the centerline of the pipe is offset at least 2.5 pipe diameters from the property line.

102.3 PIPE STANDARDS

102.3.1 Size

Pipe size shall be dictated by peak flow and hydraulic capacity. (See Sections 101.3 and 102.6.1) Minimum pipe diameter shall be twelve (12) inches. Hydraulic capacity must exceed 110% of the design peak flow.

102.3.2 Depth of Bury

The pipeline shall have a required depth of bury of at least twelve (12) inches. Additional depth may be required when traffic loading dictates the need.

102.3.3 Material

The pipeline shall be constructed of at least Class III reinforced concrete pipe or SDR 35 PVC, both with watertight joints. Higher pressure rating will be required on PVC pipe when depth of bury is less than thirty (30) inches. Other pipe materials may be acceptable with prior approval of the City Engineer and when supplied with watertight joints.

102.4 SYSTEM SIZING

102.4.1 Primary Conveyance System

The primary conveyance system shall be designed to accommodate peak flow of the design storm return frequency in Table 1. The primary system consists of catch basins, drop inlets, streets, street gutters and conduit systems. In general, the primary conveyance system should convey the design storm to the receiving waters with the maximum treatment and the minimum impact or inconvenience to the public.

102.4.2 Secondary Conveyance System

The secondary conveyance system shall be designed to accommodate the peak flow of the design storm frequency in Table 1. The secondary system conveys storm water to the receiving waters after capacity of the primary system has been exceeded. In general, the secondary conveyance system will convey the design storm to the receiving waters with some impacts and inconvenience to the public. The secondary conveyance system must be a defined, designed system that includes easements and restrictions that protect the water conveyance system in perpetuity. If these conditions are not met, the primary system must be designed to accommodate both primary and secondary flows.

102.5 MULTIPLE USE FACILITIES

Stormwater conveyances shall be designed to convey stormwater runoff from upstream areas, using both the primary and secondary systems and the design storm indicated in Table 1. The intent of this manual is to minimize the combining of stormwater and irrigation water (live or return) except in major drains, but where separation is not feasible, the conveyance facility must be sized for both flows.

102.6 CLOSED CONDUIT

102.6.1 Hydraulic Capacity

Hydraulic capacity may be calculated by various acceptable methods for closed conduits such as Hazen-Williams Formula, Darcy-Weisbach Equation and Manning Equation.

102.6.2 Velocities

Velocities in closed conduits flowing full shall not be more than eight (8) feet per second, unless the conduit is designed for higher rates, nor less than two (2) feet per second.

102.6.3 Energy Dissipaters

Energy dissipaters shall be provided at outfalls as needed to prevent scouring of the downstream system.

102.6.4 Catch Basins

Catch basin inlets shall be designed to accommodate the design flow.

102.6.5 Siphons and Surcharged Systems

Storm drain piping (primary system) shall have free surface flow and not be surcharged up to the design storm without prior approval of the City Engineer. The storm drain system shall be free draining except for cross drain siphons.

When valley gutter cross drains are not desirable**,** cross drain siphons may be used, provided the ”equivalent hydraulic slope” will maintain a flow in the pipe flowing full of at least three feet per second. The “equivalent hydraulic slope” is defined as the difference in elevation between gutter flow lines divided by the length of siphon.

102.7 OPEN CHANNEL

102.7.1 Hydraulic Capacity

Hydraulic capacity may be calculated by various acceptable methods for open channels such as Darcy-Weisbach Equation and Manning Equation.

102.7.2 Velocities

Velocities in open channels at design flow shall not be greater than the velocity, determined from channel conditions, to erode or scour the channel lining (generally 5 fps for an unlined channel). Super-critical velocities should be avoided. Borrow ditch conveyance facilities (if permitted) shall not be allowed on road sections where the ditch invert exceeds 3% slope without provisions for reducing velocities, such as check dams, or lining the ditch.

102.8 GUTTER CAPACITY

Street gutters may provide storm water conveyance up to their hydraulic capacity. Beyond that limit, subsurface piping or flow routing will be required to facilitate proper drainage. The minimum gutter grade shall be 0.4%. In limited circumstances, where no reasonable option exists, the City Engineer may allow a minimum gutter grade of 0.3%. Gutter flow shall be intercepted by an underground conveyance or storage system at a maximum spacing determined by gutter hydraulic capacity.

102.8.1 Hydraulic Capacity

The hydraulic capacity of irregular channels can be calculated using Manning's Equation and appropriate coefficients. Channel depth is limited in accordance with the provisions of Section 102.8.2.

102.8.2 Water Depth in Street Sections

The street section may be utilized for water conveyance as outlined below. The street section may not be utilized for storm water storage.

Primary System

For Storm events less than or equal to the design storm (see Table 1) for the primary system, the street and gutter section may be used to convey water to catchments with the following restrictions:

(1) Local Streets
Design storm flow cannot encroach into private property, or exceed 2-inch depth at the crown.

(2) Collector Streets
Design storm flow cannot overtop the curb and at least one 10-foot lane must be free of water.

(3) Arterial Streets
Design storm flow cannot overtop the curb and at least one 12-foot lane in each direction must be free of water.

Secondary System

During storm events with return frequencies for the secondary system (see Table 1), the street and gutter section may be used to convey water to a catchments with the following restrictions:

(1) Local and Collector Streets
Buildings shall not be inundated. The depth of water over the gutter flow line shall not exceed 12-inches, and shall not exceed 6-inches at the roadway crown.

(2) Arterial Streets
Buildings shall not be inundated. The depth of water at the roadway crown shall not exceed 3-inches.

102.8.3 <u>Valley Gutters</u>

Cross drain valley gutters are not allowed across collector and arterial streets.

102.8.4 <u>Street Grades</u>

Water flowing down steep grades at high velocity can be dangerous to small children. Where flow depths exceed 6-inches, mean velocities in the gutter at peak flows shall not exceed 8-feet per second. Excessive depth and velocity shall be corrected through diversion of runoff, drop inlet structures or redesign of the street.

103 DETENTION/RETENTION FACILITIES

103.1 GENERAL DESCRIPTION

Detention or Retention facilities temporarily store stormwater runoff to minimize the potential for flooding and to partially remove sediments and pollutants from the water. Retention facilities store the runoff until it percolates, infiltrates or evaporates away. Detention facilities are similar except that a controlled discharge to an existing drainage way is also included. Detention facilities discharge any volumes larger than the water quality event. Both retention and detention facilities may have overflows through a secondary conveyance to a discharge location.

The elements of detention or retention may be incorporated into basins, swales or underground facilities such as seepage beds or french drains. The criteria for design are itemized below. Table 4 compares requirements for retention and detention facilities:

Table 4

Comparison of Retention and Detention Facility Requirements

PARAMETER	RETENTION	DETENTION
Required storm frequency Section 101.2	100 yr	100 yr or 25 year with overflow
General requirement 103.1, 103.2.1, 103.6	Only allowed if approved by City Engineer	Discharge rate one miner's inch per acre
Sand and grease traps 103.3.1	Required	Required
Other Requirements 103.6, 103.7.1	Increased volume to account for nuisance water	Rock filled trench to convey nuisance water to outlet
Emptying requirement 103.6, 103.7.6	48 hours for 2 year storm, 120 hours for design storm	120 hours
Infiltration/Percolation 103.8, 104	20 foot boring below bottom of facility	10 foot boring below bottom of facility
Infiltration facilities not allowed 104.2	Bedrock or impervious soils within 20 feet	Bedrock or impervious soils within 10 feet
Infiltration rate 104.3	67% of perc test or 50% of Soil Classification	67% of perc test or 67% of Soil Classification

Design calculation rate 104.6	Most impermeable remaining strata rate	Most impermeable remaining strata rate

103.2 GENERAL CRITERIA

103.2.1 Site Runoff

The maximum off-site discharge rate for the design storm (post development) shall be limited to 1 miner's inch (one fiftieth of a cubic foot per second) per acre provided the downstream system has proven adequate capacity and there was historic discharge from the property.

103.2.2 Storm Return Frequency

Detention and retention facilities shall be designed for the return frequencies listed in Table I.

103.2.3 Storm Duration

For the design storm return frequency, the storm duration which produces the peak storage requirement, shall be used for design. Storm durations between the time of concentration and 24-hours shall be investigated.

103.2.4 Location of Storage Facilities

Stormwater retention and detention facilities and associated inlet piping, outlet piping and traps shall be located outside of existing or master planned right-of-way. Said stormwater facilities shall be located on private property within a perpetual operation and maintenance easement for single-lot developments. For multi-lot residential developments, facilities shall be located in a common lot. Exception to the common lot requirement may be allowed for multi-lot residential developments, less than two (2) acres in area with the approval, of the City Engineer provided that all retention or detention facilities are located within the confines of an adequately sized perpetual operation and maintenance easement, the lot on which the easement is located meets all minimum lot requirements exclusive of the easement (s); storage depth is not more than two feet; and side slopes are 5:1 or flatter. Any proposed exception to this manual shall, in all respects, meet or exceed the function and ease of maintenance of a stormwater retention or detention facility constructed without such exception.

For commercial or industrial development, stormwater retention and detention facilities and associated inlet piping, outlet piping and traps shall be located outside of existing or master planned right-of-way and shall be located, at the discretion of the developer, in either a common lot or a perpetual operation and maintenance easement. Facilities shall be contained in easements for needed conveyance to lots or to historic drainage conveyance.

Regardless of location of a stormwater retention or detention facility in any type of private residential, industrial or commercial development, maintenance of the facility shall not be the responsibility of the City unless maintenance is expressly assumed, in writing, by the City.

103.2.5 <u>Storm Drainage From Offsite</u>

Single lot developments may not accept additional off-site drainage for retention or detention unless there are legal recorded documents setting forth the conditions of use and assignment of responsibility for future maintenance.

103.2.6 <u>Multi-Use Facilities</u>

Retention or detention facilities as approved by the City Engineer may be designed as open surface facilities for multi-use such as parks or open space as long as a public nuisance or safety hazard is not created.

103.2.7 <u>Idaho State Code Requirements</u>

Retention and detention facilities which incorporate absorption trenches, french drains, or any subsurface infiltration element for storm water management shall conform to Title 42, Chapter 39, Idaho Code, and to the Idaho Department of Water Resources Rules (IDWR) for Waste Disposal and Injection Wells (IDAPA 37.03.03) if required.

103.2.8 <u>Infiltration Surface</u>

The infiltration surface for ponds is the area of the horizontal projection of the water surface at the design storm depth. The infiltration surface for seepage trenches is the vertical projection of the trench wall surface at design storm depth. The infiltration surface area must be reduced to the area of any infiltration windows if such are constructed.

103.3 SEDIMENT CONTROL

103.3.1 <u>Sand and Grease Traps</u>

Runoff into retention and detention facilities shall flow through a sand and grease trap with a throat velocity less than or equal to 0.5 feet per second for the design flow. Minimum trap detention time upstream of the throat shall be 40 seconds at peak flow for the design storm. An array of traps may be utilized to meet this criterion including the use of alternative methods for the treatment of storm water and removal of sediment as approved by the City Engineer. Any proposed alternate method(s) shall, in all respects, meet or exceed the function and ease of maintenance of a stormwater retention or detention facility constructed with standard sand and grease traps.

103.3.2 <u>Sediment Storage</u>

The design volume of underground facilities such as french drains and seepage beds shall be increased by 15% to accommodate sediment storage.

103.4 OPERATIONAL RESPONSIBILITY

The responsibility for operation and maintenance of retention or detention facilities must be clearly defined and noted on development plans. The City is not to have drainage system or landscaping operation and maintenance responsibility for any private development located on private property or in common lots.

103.5 DAMS AND EMBANKMENTS

The following criteria shall apply in the design of storage basins:

103.5.1 Freeboard

Facilities shall be designed to accommodate the runoff from a design storm with the return frequency shown on Table 1. Open basin facilities shall be designed with freeboard above the maximum design water elevation in accordance with Table 5.

TABLE 5 – FREEBOARD REQUIREMENTS	
Water Depth	Freeboard
0-12 inches	4 inches
12-24 inches	6 inches
24 + inches	12 inches

103.5.2 Side Slopes

Open retention or detention facility side slopes shall not exceed 4:1 unless the facility is fenced. A fenced facility may have side slopes no steeper than 2:1. Side slopes on facilities located in easements shall not exceed 5:1and shall meet other requirements of Section 103.2.4 or within an industrial development or unless the facility will also be acting as a man-made decorative or recreational water feature, meaning an amenity containing water year round or throughout the irrigation season, in which case, slopes shall not be greater than 2:1 five feet into the water feature from the bank. Determination of what constitutes a decorative or recreational water feature shall be at the discretion of the City Engineer upon finding the foregoing.

103.5.3 Embankment Top Width

The minimum top widths of all dams and embankments are listed in Table 6.

TABLE 6 – MINIMUM TOP WIDTHS

Height (feet)	Top Width (feet)
0 – 3	6
3 – 6	8
6 – 10	10
10 – 15	12

103.5.4 Embankment Height

The design top elevation of all dams and embankments, after all settlement has taken place, shall equal or exceed the maximum water surface elevation, plus the required freeboard height. The design height of the dam or embankment is defined as the vertical distance from the top down to the bottom of the deepest cut.

103.5.5 Embankment Material

All earth fill shall be free from brush, roots, and organic material that might decompose and shall be compacted to 95% of Maximum Standard Proctor Density.

103.5.6 Safety Ledges

Safety ledges shall be constructed on the side slopes of all retention or wet detention basins having a permanent pool of water and deeper than 5-feet. The ledges shall be 4 to 6 feet in width and located about 2-1/2 to 3 feet below and 1 to 1-1/2 feet above the permanent water surface.

103.5.7 Idaho State Review

Embankments over 6-feet shall be reviewed by the Idaho Department of Water Resources.

103.6 SPECIAL CRITERIA – RETENTION

Retention facilities shall be designed to accommodate the runoff volume from the design storm with allowances for sediment and freeboard as indicated in Sections 103.3.2 and 103.5.1, respectively. For residential developments, additional volume equal to 30% of the design storm run-off volume shall be included in the facility design volume to account for carryover from precedent storms, irrigation over-spray, and other nuisance water, i.e. car washing, etc. The facility shall be designed to empty within 48-hours for the 2-year storm, and 120-hours for the design storm. Particular detail and attention shall address nuisance water from over-irrigation, plugging of pond bottoms, or any other condition which may cause standing water in the facility over the required 120-hour drain time. For multi-lot residential developments, retention facilities are only acceptable if approved by the City Engineer.

103.6.1 Nuisance Water

Retention facility size shall be increased by 10% above the peak volume computed for the design storm to accommodate nuisance water such as sprinkler overspray. Except where a high water table does not permit it, nuisance water shall be stored in a rock trench to avoid the creation of mosquito breeding areas.

103.6.2 Carry-Over Storm

Retention facility size shall be increased 20% above the peak volume computed for the design storm to accommodate retained volume from a storm proximate in time to the design storm.

103.6.3 Retention Time

The infiltration surface shall be sized, relative to pond or trench volume, for the retention facility to empty within 120 hours for the design storm. The depth of ponds or the width of seepage trenches are limited by this requirement. The minimum top widths of all dams and embankments are listed in Table 6.

103.6.4 Overflow Drain

For property having established historical drainage rights, the retention facility shall include an overflow drainage line from the retention facility to a point of historical discharge. Pipe sizing shall be a minimum of 12 inch diameter or have capacity of two miner's inches per acre of the drainage basin, whichever is larger.

103.6.5 Proof Test.

Each constructed retention facility shall be filled to the retained depth for the design storm, soaked for four hours, refilled to retained depth and timed to completely drain. The criterion of Paragraph 103.6.3 shall be met or the pond shall be rejected. The Engineering Department shall be informed a minimum of two days in advance of proof testing and will make the final determination of approval or rejection. The preference of the City of Caldwell is that non-potable water be utilized for this test when it is reasonably available.

103.6.6 City Engineer Approval

Retention facilities in residential developments are strongly discouraged, and are only acceptable with a showing of compelling public interest and only with the approval of the City Engineer.

103.7 SPECIAL CRITERIA – DETENTION

The design of any detention facility requires consideration of several factors, such as size of the basin; minimum free board depth; maximum allowable depth of temporary ponding; recurrence interval of the storm being considered; storm duration; timing of the inflow; allowable outflow rate; and the length of time water is allowed to remain in the facility. The design goal is to leave downstream areas with the same hydrology that existed before development. Balancing the requirements is done through the preparation of three items: an inflow Hydrograph, a depth-storage relationship, and a depth-outflow relationship. These items are combined in a routing routine to determine the outflow rate, depth of stored water, and volume of storage at any specific time, as the runoff passes through the detention facility. Particular detail and attention shall address nuisance water from over-irrigation, plugging of pond bottoms, or any other condition which may cause standing water in the facility. Outlets shall be controlled through the use of an orifice inside a manhole or other approved structure. Other design considerations are discussed in the following sections.

103.7.1 Outlets

Outlet pipes shall be at least 12-inches in diameter. Orifice plates shall be used with trash racks or equivalent to prevent clogging. Facility bottoms shall be sloped to outlets. A rock filled trench shall convey nuisance water caused by over-irrigation from inlets to outlets. The pore capacity of the outlet trench shall equal the volume of storage required to contain the water quality event (103.7.6).

103.7.2 Cut-off Walls

Anti-seep cut-off walls or other seepage control methods are to be installed along outlet pipes as necessary.

103.7.3 Scour Protection

Suitable slope protection as approved by the City Engineer, shall be placed upstream and downstream of principal outlets as necessary to prevent scour and erosion. High velocity discharges require energy dissipaters.

103.7.4 Orifice Plates

Orifice plates or other flow restriction devices shall be provided to limit discharge in accordance with Section 103.2.1. The orifice opening shall be drilled into an end cap placed on the outlet pipe such that the cap can be rotated to contain water quality events with the orifice rotated to the top. With the orifice rotated to the bottom, the basin shall have the ability to be totally drained for maintenance.

103.7.5 Emergency Spillways

Emergency spillways shall be provided to protect embankments and suitably lined to prevent scour and erosion. Emergency overflows shall not be allowed into live-water irrigation facilities without prior written permission from the owner and/or operator of the irrigation system and applicable regulatory agencies unless an historical right to drain exists.

103.7.6 Water Quality

For the purpose of protecting water quality in the receiving water, detention basins shall retain the "first-flush" of storms. At a minimum, at least 0.2" of runoff from impervious area shall be retained (not discharged off-site). In all cases, the facility should be designed to empty within 120 hours of the last storm. The retained storage depth shall not exceed one foot.

103.8 ABSORPTION DESIGNS

Any detention or retention facility that allows water to infiltrate or percolate into the ground will be considered an absorption design and must meet the requirements of this Section and Section 104.

103.9 INNOVATIVE DESIGNS

A drainage facility utilizing technology that is new, innovative or different from facilities presumed in the scope of this manual may be accepted for review and approval at the sole discretion of the City Engineer. Any facility accepted for review under this paragraph shall be evaluated to meet the full intent of this manual. Nothing in this paragraph shall be construed to require City review of any particular new or innovative design.

104 INFILTRATION/PERCOLATION FACILITIES

104.1 DESIGN OF INFILTRATION BASINS

In general, infiltration basins, for the purposes of this manual, are above ground storage facilities, such as grassy swales or ponds, intended to contain design storm runoff without overflowing. These facilities may be combined with below ground percolation facilities. They may operate as either detention or retention facilities and must meet the applicable requirements of Section 103.

The maximum probable groundwater elevation shall be established and used for facility design. Proposed facility bottom elevations within three feet of seasonal high groundwater levels shall have a minimum 24 inch layer of well graded fine aggregate material placed such that the top surface of said fine aggregate is located at a minimum of one foot above the high water elevation. Aggregate shall meet the gradation requirements of ITD Standard Specification 703.02, "Fine Aggregate for Concrete". A site assessment of the area immediately around the proposed facility shall be conducted by a licensed Hydrogeologist or by a Professional Engineer, registered in the State of Idaho and practicing in the field of geoscience. The site assessment shall include an evaluation of the soil strata to a depth of at least twenty feet for retention facilities and at least ten feet for detention facilities below the bottom of the proposed facility to determine if the probable maximum high groundwater elevation will encroach into the facility or if impervious layers exist. No storage credit may be taken for volumes below seasonal high groundwater elevation. The site assessment shall be included in the drainage report.

104.2 INFILTRATION FACILITIES NOT ALLOWED

There are several conditions that rule out a site as an infiltration facility.

1. Bedrock or impervious soils within twenty (20) feet (retention facilities) and ten (10) feet (detention facilities) of the infiltrating surface unless the material is removed and replaced with suitable drain materials. The horizontal area of any such backfilled window shall be used for design calculations;

2. Infiltrating surface on top of fill unless the fill is clean sand or gravel and no water quality degradation will occur;

3. Surface and underlying soil of SCS Hydrologic Group C, or the saturated infiltration rate less than 0.25 inches per hour;

4. Facility located within 100-feet or within the zone of contribution of existing water well.

5. Facility located within 25 feet of a potable water main.

104.3 INFILTRATION RATES

The design of an infiltration basin is dependent on the appropriate selection of an infiltration rate. This may be determined either directly through performance of a percolation test or indirectly based on classification of soil types. Borings shall extend through the proposed infiltration facility down to twenty (20) feet (retention facilities) and ten (10) feet (detention facilities) below the bottom of the infiltration facility.

104.3.1 Percolation Test

Infiltration rate may be established using the results of a percolation test performed in conformance with procedures outlined in Exhibit "C" and under the responsible charge of a registered Professional Engineer or licensed Hydrogeologist. The infiltration rate for design purposes is 67% of the percolation rate established in the test. Percolation tests shall be performed at the actual location and elevation of the most impermeable permanent (unexcavated) layer below the proposed facility. Percolation test results shall be included in the drainage report.

104.3.2 Soil Classification

Infiltration rate may be established using the results of soil classification of the infiltration surface. The infiltration rate for various soil types is listed in Table 4. Soil classification shall be done by a registered Professional Soils Engineer or licensed Hydrogeologist experienced in the field of geoscience. For design purposes, the infiltration rate shall be 50% (retention facilities) and

67% (detention facilities) of the listed rate in Table 7.

TABLE 7 - INFILTRATION RATES	
SCS Group and Type	**Infiltration Rate (Inches Per Hour)**
A. Sand	8
A. Loamy Sand	2
B. Sandy Loam	1
B. Loam	0.5
C. Silt Loam	0.25*
C. Sandy Clay Loam	0.15
D. Clay Loam & Silty Clay Loam	<0.09
D. Clays	<0.05
* Minimum rate, soils with lesser rates shall not be considered as candidates for infiltration facilities.	

104.4 DESIGN OF PERCOLATION FACILITIES

In general percolation facilities are below ground storage facilities such as french drains or seepage beds that may be designed to store the design storm runoff above and/or below ground. The water may be stored within structural cavities or in the pore space of granular fill before it percolates into the ground through a sand filter. The percolation facility must meet the applicable requirements of Section 103.

If there is not a positive outflow, or retention exceeds 25% of storage, percolation facilities shall be designed as a retention facility, including the criterion listed in Section 103.6.

The storage volume shall accommodate the design storm, plus comply with Section 103.3.2 regarding sedimentation, Section 103.6.1 regarding nuisance water, and Section 103.6.2 regarding carry-over storms. Infiltration rates are covered in Section 104.3. Accepted engineering design formulae shall be used in determining storage volumes and infiltration rates.

104.4.1 Sand Filter

A minimum 12-inch layer of fine aggregate material shall be placed below all percolation facilities and a minimum 24 inch layer of fine aggregate material shall be placed below all percolation facilities within three feet of the high water table. The top surface of said fine aggregate shall be located at a minimum of one foot above the high water elevation. The fine aggregate material shall meet the gradation requirements of ITD Standard Specification 703.2, “Fine Aggregate for Concrete”.

104.4.2 Filter Fabric

The facility shall have an approved filter fabric (4 oz/square yard) placed between the storage media and the surrounding soil. No filter fabric need be placed between the storage media and the sand filter.

104.5 PERCOLATION FACILITIES NOT ALLOWED

There are several conditions that rule out a site for a percolation facility. If any of the conditions described in Section 104.2 exist, disposal of storm water by percolation is not permitted.

104.6 SOIL STRATA CHARACTERISTICS

Soil borings or test pits shall be taken at the trench sites to classify soil types. When the soil strata has varying infiltration characteristics, the minimum or most impermeable rate for any remaining unexcavated soil strata shall be used for design calculations. The pond bottom or the area of any excavation window, whichever is less, shall be used for design calculations. The infiltration rates described in Table 4 shall apply. A percolation test may be used to define infiltration rates instead of Table 4.

104.7 MATERIALS

Table 8 indicates the effective void volume for typical materials used in seepage beds. The Design Engineer may determine void volumes for other materials by laboratory analysis and submit them to the City Engineer for review. The sand filter pore volume may not be used as storage volume for the facility. No storage may be allowed for pore volume below the water table.

TABLE 8
VOID VOLUME OF TYPICAL MATERIALS

Material	Volume (%)
Blasted Rock	30
Uniform sized gravel (1-1/2")	40
Graded gravel (3/4" minus)	30
Sand	25

Pit run gravel	20

105 MISCELLANEOUS SPECIFICATIONS

105.1 EROSION AND SEDIMENT CONTROL

Erosion and sediment discharged from the development site must be minimized or eliminated both during construction and after the development is complete. Properly designed developments utilize ground covers, lined ditches, riprap, and underground piping systems to eliminate erosion and control sediment.

Prior to the beginning of construction, where construction activities disturb more than one acre, the developer or his representative must have a Stormwater Pollution Prevention Plan (SWPPP) in place and must file a Notice of Intent (NOI) with the EPA, in accordance with NPDES (National Pollutant Discharge Elimination System) requirements. The SWPPP will include provisions for reducing sediment discharges from the construction site and tracking of mud onto roadways. A copy of this plan and the NOI shall be provided to the City prior to any site grading.

105.2 IRRIGATION AND DRAINAGE FACILITIES

Stormwater conveyance and storage facilities shall be separate and distinct from non-storm systems such as irrigation, irrigation return, underdrain, and sanitary sewer flows with the exception of landscape or irrigation overspray. Existing non-storm systems rerouted or piped through new developments (except sanitary sewers) shall not be located in the public right-of-way except at crossings. These systems should be located in individual easements. Systems routed through new developments shall not utilize development conveyance or other stormwater facilities upstream of any storage, detention, or retention. Systems routed through new developments may utilize conveyance downstream from any storage, detention, or retention facilities. Approved discharges of storm drain facilities into non-storm systems shall be at centralized, distinct locations. Stormwater system conveyance piping shall not be utilized for land drainage systems.

105.3 DESIGN SPECIFICATIONS

This section sets forth the minimum standards, specifications, standard details, etc. to be used for the design of storm water and drainage facilities. Except as modified herein, all work shall be in accordance with the current IDAHO STANDARDS FOR PUBLIC WORKS CONSTRUCTION (ISPWC).

105.3.1 Discharge Pipes

All discharge pipes shall end in a precast concrete or corrugated metal end section or a cast-in-place concrete headwall. Wingwalls and energy dissipaters shall be included when conditions require.

105.3.2 Testing

The City Engineer may require testing (such as the mandrel or air test) beyond the requirements of ISPWC as needed to ensure proper installation of pipe.

105.3.3 Manhole Design Standard

Manholes shall be designed according to the latest edition of ISPWC.

105.3.4 Manhole Spacing

Manholes shall be provided at all intersections of two or more pipe segments and at all locations where the pipe changes direction. Manhole spacing shall not exceed 400 feet.

105.3.5 Manhole Frames and Covers

Manhole frames and covers shall be cast iron conforming to specification ASTM A 48 Class 30. They shall be suitable for HS-25 loading capacity. All storm drain manhole covers shall have a cast-in-place concrete collar (SD-508A), and the words "STORM DRAIN" cast integrally in the top of the cover. Manhole covers shall be set within 1-foot of finished grade. The manhole cover shall be flush with the finished grade.

Concrete collars shall be placed after paving is complete.

105.3.6 Catch Basins

Catch basins located within street right-of-way shall be Type II or Type IV (per ISPWC SD-602B, SD-601, or SD-602D) with a 1-foot sump.

Catch basin grates and frames shall be welded steel, capable of an HS-25 loading.

Catch basins located outside of street right-of-way may be Type I, II, III, or IV.

All construction shall be in accordance with Section 606 of ISPWC.

106 INSPECTION and CERTIFICATION REQUIREMENTS

106.1 POST-CONSTRUCTION SUBMISSIONS

Prior to final acceptance of the development, record or as-built drawing in hard copy form must be submitted to the City.

EXHIBIT "A"

STANDARD PERCOLATION TEST

The use of the percolation test is to be used in conjunction with a site survey and soil profile analysis. It is not to be used as the sole determiner of a proposed disposal site's infiltrative capability. The following outlines a procedure for making a standard percolation test.

1. Dig or bore a hole with horizontal dimensions of six (6) to eight (8) inches and with vertical sides to a depth of at least eight (8) inches in the zone of anticipated soil absorption.

2. Carefully scarify the bottom and sides of the hole with a knife or other device to remove any smeared surfaces.

3. Place about one (1) inch of coarse sand in the bottom of the hole to prevent scouring and sediment. A small section of standard four-inch diameter perforated drainpipe is handy to prevent water splash on the hole sidewall.

4. Fill the hole with at least eight (8) inches of water and allow the soil to presoak at least twenty four (24) hours. If the soil contains greater than 27% clay the soak period shall be extended to 48 hours. The water must be clear, free of organics, clay or high sodium content.

5. Measurement procedure. In soils where:

   (a) Water remains in the hole after the presoak period; adjust the water depth to six (6) inches. Measure the drop in water level every thirty (30) minutes. Continue the test until the last reading is the same as the previous reading or four (4) hours, whichever occurs first.

   (b) No water remains in the hole after the presoak period, add water to bring the depth to six (6) inches. Measure the drop in (30) minute intervals, refilling the hole to the six (6) inch depth after each thirty (30) minute reading. Continue the test until the last reading is the same as the previous reading or four (4) hours, whichever occurs first.

   (c) The first six (6) inches of water soaks away in less than thirty (30) minutes, the time interval between measurements should be ten (10) minutes.

6. Calculations:

$$\text{Percolation Rate, Minutes/inch} = \frac{\text{Time, in Minutes}}{\text{Water Drop, in Inches}}$$

7. At least two percolation tests should be run on each site, one test at each end of the proposed facility, in the zone of the most impervious soil layer.

THIS PAGE INTENTIONALLY LEFT BLANK