ORCHARD RIDGE ESTATES

RUNOFF, AND EROSION CONTROL PLAN

2019

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7B ENGINEERING
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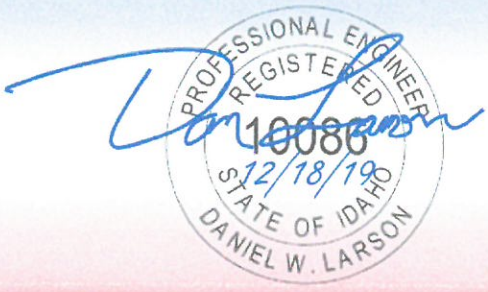

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DESIGN REPORT – RUNOFF & EROSION CONTROL PLAN
For Orchard Ridge Estates

RPD00000297200A aka Section 29, Township 57 North, Range 2 West,
Boise Meridian, Bonner County, Idaho

Figure 1: Project Vicinity Map

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Introduction

This report has been prepared to address design considerations relating to a subdivision on 7.06 acres in Dover, Idaho for the Kramer-Marienau Joint Venture. More specifically, this Runoff and Erosion Control Plan addresses site changes to construct a new roadway for access to 3 new residential lots created by the preliminary subdivision.

A 14,460 SF driveway/roadway is planned to be constructed. Stormwater runoff will be directed to a stormwater treatment and disposal facility located next to Syringa Heights Rd. This report, calculations, and drawings are for review by City of Dover as part of a Preliminary Engineering Plan for a proposed Subdivision. All other requirements for subdivision approval and any future building permits must be met by the Owner. This report addresses design decisions and calculations that will aid the City, the Contractor, and the Owner in the review of this proposal

Project Location

The site is located off of Syringa Heights Rd. approximately 0.5 miles off of US HWY 2.

Property Identification Numbers RPD00000297200A aka Section 29, Township 57North, Range 2 West, Boise Meridian, Bonner County, Idaho

Property owner:	**Location:**	**Size of Lot:**
Kramer-Marienau Joint Venture	Section 29, T75N, R2W	7.06 Acres

Geotechnical

The USDA NRCS Web Soil Survey was used to categorize the soil characteristics at this site. A site visit confirmed the findings of the NRCS and the soils appeared to be consistent with the Survey. The site consists of 4.3% Pend Orielle silt loams and 58.6% Dufort-Rock Outcrop, soils in Hydrologic group B. These soils have a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of well drained soils or silt. The parent material for these soils are volcanic ash and loess over outwash derived from granite, schist and or gneiss. This site also contains about 37.1% Mission Silt Loams, soils in Hydrologic group D. These soils have a low infiltration rates (High runoff potential) when thoroughly wet. The storm facility is located in the area of mission silt loams close to Syringa Heights Rd.

All required testing and inspections will be coordinated by the Owner and Contractor and/or his representative and will be submitted to the Engineer if required at the completion of construction.

Water System

Water is to be provided by the Syringa Heights Water District.

Sewer System

Sewer will be provided by the City of Dover.

Road Specifications

Syringa Heights Rd is maintained by the City of Dover.

Stormwater Facility Description and Calculations

To treat the impervious runoff from the proposed driveway only one grassed infiltration and detention area is proposed. The swale shown is sized to capture the first ½" of runoff from the site for treatment requirements.

The swale is located on the western side of the syringa heights and is designed as a grassed infiltration area to treat and convey runoff from the proposed Marienau Drive.

The GIA is sized for onsite treatment and to detain the 25-Year, 24-Hour peak storm event. Table 1 below summarizes the design calculations for the 25-Year peak runoff events using the SCS TR-20 method.

Table 1: Stormwater Basin Summary (25-Year, 24-Hour)

Stormwater Basin Summary				
Basin	Area (SF)	CN	25-Yr, 24-Hr Peak Flow (CFS)	Post Detention Flow Rate (CFS)
A (Existing)	115,151	65	0.92	-
A (Proposed)	115,151	69	-	0.63
B (Existing)	102,424	65	0.82	-
B (Proposed)	102,424	65	-	0.82
Total Runoff	217,575	65	1.74	1.45
			(Pre-Developed)	(Post-Developed)

All stormwater discharges from the property into the existing storm system along Syringa Heights Road.

Treatment Calculations

In general, more treatment volume is provided in the design than is required for the improvements shown. Table 2 below summarizes the treatment design calculations for the required first ½ inch of runoff from new impervious surface areas created by the project.

Table 2: Treatment Volume Summary

Treatment Summary		
Facility	Volume Required (CF)	Volume Proposed (CF)
(GIA 1)	602.5	624
Total	**602.5**	**624**

The treatment volumes were found using the following calculations:

- **Treatment Volume** was calculated with the following equation:

$$(V_{treatment}\ cf) = (A_{impervious}\ sf) \times \left[\left(\frac{1}{2} in \text{ of runoff}\right) \times \left(\frac{1ft}{12in}\right)\right]$$

- **Treatment Area** was calculated with the following equation:

$$(A_{treatment}\ sf) = (V_{swale}\ cf) \div [\text{Depth of Swale in } ft]$$

*Note: Maximum treatment depth is 6" from the bottom of Swale/Grassed Infiltration Area for residential and **8" for Commercial or Industrial**. However, Swales or GIAs may be deeper where additional detention is required.*

- **Infiltration Disposal Rate** was calculated with the following equation:

$$(Q_{infiltrate}\ CFS) = (A_{swale}\ sf) \times (f_{swale}\ \frac{in}{hr}) \times \left(\frac{1\ ft}{12\ in}\right) \times \left(\frac{1\ hr}{360\ sec}\right)$$

where f_{swale} is the Infiltration Rate assumed or proposed for a given soil.

- **Manning's Equations**:

$$Q = VA \qquad V = \frac{k}{n}\left(\frac{A}{P}\right)^{2/3} S^{1/2}$$

Where:

k is a unit conversion factor:
k=1.49 for English units (feet and seconds).
k=1.0 for SI units (meters and seconds).
A = Flow area of the pipe, culvert, or channel.
P = Wetted perimeter (the portion of the circumference that is in contact with water).
Q = Discharge (flow rate).
S = Downward (longitudinal) slope of the culvert, pipe, or channel.
V = Average velocity in the pipe, culvert, or channel.

GIA (Facility 1)

1. **Impervious Surfaces:** **<u>14,460 sf</u> (Total)**
   - **Proposed Driveway** **14,460 sf**

2. **Treatment Volume Required by City:**

$$(V_{treat}) = (14{,}460\ sf) \times \left[(0.5\ in) \times \left(\frac{1ft}{12in}\right)\right] = \mathbf{602.5\ cf}$$

3. **Treatment Volume and Proposed Swale:**

Table 3: Proposed Swale

Proposed Swale Calculations		
Elevation	Area (SF)	Cumulatvie Volume (CF)
2148.00	1200	0
2148.20	1560	276
2148.40	1920	624
2148.60	2280	1044
2148.80	2640	1536
2149.00	3000	2100

$$(V_{Treatement\ provided}) = 624\ cf\ at\ 4.8\ inches$$

4. **Underdrain Pipe Capacity Calculation:**

It is assumed that the topsoil layer of the facility will be properly modified for infiltration and plant growth as detailed in the plans. An infiltration rate of 1 to 3 inches is desirable. For this analysis, a rate of 2 in/hr is assumed and that there is no confining layer.

$$(A_{swale\ bottom}\ sf) = (1220 sf)$$

$$(Q_{infiltrate}\ cfs) = (1220\ sf) \times (2_{swale}\ \tfrac{in}{hr}) \times \left(\tfrac{1\ ft}{12\ in}\right) \times \left(\tfrac{1\ hr}{360\ sec}\right) = \mathbf{0.56\ cfs}$$

From commonly available nomographs for smooth interior pipe (Manning's "n" of 0.012), a 6" pipe at 8 % slope **has a capacity of 1.8 cfs at a velocity of 9.5 fps**. This capacity chart is included in the Appendices but is based on Manning's Equation.

Stormwater Facility Construction and Maintenance

The facilities shown on these plans are intended to be constructed as a bioinfiltration facility. There are two main versions of bioinfiltration that the Owner and Contractor should consider. Their differences are outlined below:

Constructions considerations

Grassed Infiltration Area (Common GIA – Preferred Option):

GIA's are commonly seen as depressed grassy areas or swales free of invasive weeds, shrubs, or trees. They use soils and a compact root zone (typically from grass) to remove stormwater pollutants. They require frequent mowing and light maintenance (see below).

1) Grass or sod may be used but should be a species adapted to permeable soils. Avoid grass intended for clay soils or sod grown on clay.
2) Soil should be less than 25% clay, 3 to 5% organic material, and at least 60% sand.
3) Apply compost at a depth of 3 inches over area and till to 8-inch depth.
4) Scarify facility subgrade to 12-inch depth before planting. DO NOT COMPACT.
5) Grass height should be kept at 3 inches to 9 inches and all grass clippings removed.
6) Sediment should be removed when it begins to inhibit the growth of grass.

Bioretention (Raingarden):

Bioretention facilities (or Raingardens) use soils and both woody and herbaceous plants to remove pollutants. They require little or no maintenance (unless obvious failure occurs) but are more expensive to construct. Raingardens are ½ to $^1/_3$ the area of a GIA.

1) Scarify native soil at subgrade and place 18-inches of sand at the bottom of the facility.
2) Topsoil should be less than 25% clay, 8-9% organic material, and at least 60% sand 2 ft to 4 ft thick.
3) Place a 3-inch layer of mulch over the topsoil to line the pond before planting.
4) A mixture of trees, shrubs, and grass is preferred.
5) Water-loving plantings should be chosen (Alder, Willow, Ash, Dogwood, Sedges, etc.) or ponding depth should be limited to 6 inches.
6) Infiltration rates should not exceed 9 inches per hour.
7) Undesirable ponding may occur on some native soils and underdrains may be required.

Maintenance Requirements

Inspect the chosen facility monthly and between large storm events for the first year. After the facility is established and working as designed, inspect in the spring and fall. Remove any dead or diseased vegetation and replant as needed. Mulch any bare spots at inspection and the entire facility every 2 to 3 years.

Water standing for more than 4 days after a storm when temperatures are above 50 degrees Fahrenheit may indicate a problem with the facility. Sediment removal and scarification of the topsoil or subgrade may be required. In extreme cases, soils may need to be replaced.

In addition to the treatment/detention/infiltration facility required to treat the driving surfaces, the treatment swale must be kept clean and clear to allow snow storage and stormwater oils.

Erosion and Sediment Control BMP's

To properly construct this project, approximately 30,715 SF will be disturbed, including:

- Tree and brush removal
- Road grading
- Placement of fill/cut
- Fine grading of landscape and stormwater facilities

All disturbed exposed areas will be covered with suitable topsoil, mulched, and either landscaped or re-vegetated on slopes 3:1 or less. Slopes steeper than 2:1 will be stabilized with stone mulch, riprap or boulders.

Temporary Erosion and Sediment Controls

All temporary erosion control features shall be installed and maintained as detailed and shall prevent stormwater runoff or sediment migration off-site. Barriers shall be placed perpendicular to the direction of flow and shall be deployed before construction begins. Leave all temporary stormwater and erosion control measures in place until vegetation has been re-established. Construct silt fence where overland flow may allow runoff to leave the construction site or enter the neighboring properties. Mulching of disturbed, final graded areas can be done with hay, straw, or grass clippings (8-10 pounds per 100 sf).

Timing of Construction

Construction activities for this site grading will proceed as follows:

Construction Schedule	Timing
Tree and stump removal	May-20
Excavation and grading	May-20
Utility Construction	May-20
Finish grade GIA and landscape areas	May-20
Reseed slopes and distrubed areas	Jun-20

By constructing in the dry season, the risk of sediment laden runoff is minimized and the sequence of construction will occur during optimal conditions. The Owner and Contractor shall continually monitor the site conditions and progress of the work, keeping erosion control measures in good repair.

Staging Areas

Equipment will be staged on the property and the county right-of-way that is undeveloped, ensuring any runoff from equipment or vehicles has adequate time for treatment. No dikes, berms or grading of staging areas is warranted or proposed.

Preservation of Existing Vegetation

Preserve all vegetation (trees and grass) not within the areas to be graded and minimize bare soil exposure. Grading activity areas shall be limited to those shown on the Plan.

Keep all construction equipment, materials, and waste within the areas designated on the Plan and out of areas to be preserved.

Clearing Limits

Minimize the total area of bare soil exposed to 1 acre and cover with straw or stone mulch within 14 days of disturbance. Mulch slopes and cover exposed driveway surfaces with rock as grading progresses to reduce dust and erosion potential. Do not disturb areas outside of the grading limits established by the Plan. At the end of construction, prepare all slopes and landscape areas for seeding or include seed in the erosion control mulch used.

Mulching

Apply straw, grass, grass hay, compost, wood chips, or wood fibers onto exposed soils leaving no more than 1 acre exposed for no more than 14 days. Driveway graded surfaces should be mulched or covered by aggregate as soon as practical to prevent erosion and reduce dust. Slopes steeper than 2:1 may require netting or tacking agents to hold mulch in place.

If wood chips or fibers are used, especially if obtained by chipping trees or stumps on the site, limit use to slopes under 6%. If vegetation is desired, treat chipped areas with a nitrogen fertilizer to aid plant germination and growth – otherwise wood chips tent to reduce growth of undesirable plants.

Use wood or stone mulches in areas that are not desirable to mowed or maintain. Bark chips in particular should not be used on sloped areas as they tend to be carried away by spring runoff.

Gravel or crushed rock placed as mulch should be placed at 10 tons / 0.10 acre (4,400 sf) at a depth of 3 inches (average). Use where subject to traffic or on slopes where maintenance of vegetation is not desired.

Hay or straw mulch should be free of unwanted seeds and applied at 2 or 3 bales per 1,100 sf of exposed soil at a depth of 2 to 3 inches in a uniform mat. No more than 40% of the original ground or exposed soils should be visible through the mat. Netting or tacking agents may be needed on slopes exposed to wind or steeper than 2:1.

Wood fiber mulches should be used where plant growth is to be inhibited, particularly on slopes steeper than 3:1 where mowing or maintenance of vegetation is not desired. If used in areas where growth is to be encouraged, nitrogen treatment will be needed. Apply to an average depth of 3 inches or about 25 lbs per 1,000 sf.

Compost used as mulching should be applied to the Grassed Infiltration Area and any other areas where growth (grasses) is desired. Apply compost at a depth of 3 inches over areas where seeding is to be done.

Inspect all mulched areas weekly and repair any damaged or exposed soils immediately. Mulching should cease once vegetation is re-established.

Silt Fence

Stretch silt fencing along the contour between supporting posts and use an extra-strength filter fabric or a wire mesh backing if not supplied with the silt fence material used. Anchor filter cloth a 4 in. by 4 in. trench with backfill. Where silt fence is joined, overlap, fold, and staple the connection to prevent sediment from bypassing. Join silt fence fabric only at a fence post with a minimum 6 inch overlap. Do not attach silt fence to trees

Fence posts should be 36 inches long. Wooden posts (if used) should be hardwood and at minimum 2x2's (minimum of 3 square inches of wood). T or U posts should not weigh less than 1 lb per lineal foot. Space posts 10 feet apart when fence is supported by a wire mesh, or 6.5 feet apart if using extra-strength filter fabric without a wire mesh. Posts should be driven 16 inches into the ground, leaving 20 inches exposed to support the silt fence.

Wire fence (if not supplied) should be a minimum 14.25 gauge with a maximum of 6 in. mesh openings. Fasten the support fence to the upslope side of the fence posts using heavy duty wire staples, tie wires, or hog rings. Extend the wire mesh support fence to the bottom of the trench and staple or wire the silt fence fabric to the wire support fence.

Inspect silt fence periodically for damage (tearing, sagging, etc) and for sediment accumulation. Remove sediment when it reaches ½ the height of the silt fence or when heavy rains are anticipated. Keep silt fence in place until permanent erosion control measures are stabilized.

Check Dams

Check dams made of straw bales, logs, brush, stone, straw wattles, or other similar materials should be placed at intervals in the ditches that are disturbed as shown on the plans. Check dams should be kept and place and maintained until vegetation is established or permanent stone mulch (or riprap) is in place. An excavated sump above each check dam improves sediment removal and aids in keeping the dam in place. Stake in place straw bales or other features susceptible to being easily moved by temporary stormwater flows.

Check dams should extend 2 feet outside of the banks of the ditches and be sloped such that the center of the dam forms a weir as an outfall. Suitable materials are stone (2 to 16 in. in diameter), logs (6 to 8 in. in diameter and driven into the ground or staked in place), sandbags (can be pea gravel or drain rock), brush (staked in place), straw bales (staked in place), straw wattles (staked in place), or silt fence (see below).

Inspect check dams regularly and after any storm. Make all repairs necessary and remove accumulated debris or sediments from behind the check dam when they reach a depth of ½ the original height of the dam. On fabric check dams, inspect for signs of fabric deterioration.

Permanent Erosion Controls

After construction is complete, all exposed soils shall be covered by a minimum of 3-inches topsoil or mulch. Areas to be vegetated will be seeded, planted, or landscaped. Slopes in

excess of 2:1 shall be armored with rip-rap or covered with topsoil, seeding, mulch, and matt.

Seeding and mulching shall not be applied to areas of standing water. Mulch shall be applied at a rate of 8-10 pounds per 100 square feet (2" – 3" thick when loose) with a maximum of 20% of original ground noticeable. Slopes in excess of 3:1 which are not rip-rapped shall be covered with Jute matting or hydro-seeded for stability of seed bed.

Plant List

Refer to Bonner County Code Title 12, Appendix B - North Idaho Native and Beneficial Plant List.

Operation and Maintenance Plan

Temporary and Permanent Erosion and Stormwater control measures will be the responsibility of the Owner:

Inspection Schedule & Maintenance Activities

As described above, both temporary and permanent erosion and sediment control measures should be inspected by the Owner and/or Contractor. Below is an inspection schedule table for convenience.

Stormwater Feature or Erosion Control Measure	Inspection Frequency	Maintenance Activities
Mulching	Weekly & following major rain event	Mulch exposed soil
Check Dams	Weekly & following major rain event	Repair and remove sediment
Silt Fence	Weekly & following major rain event	Repair and remove sediment
Treatment and Detention Facility	Monthly the first year and bi-annually thereafter	Mulch exposed soil and mulch cell every 2 to 3 years

In conclusion, I find that the proposed permanent improvements if properly constructed and maintained as described herein and shown on the Plans, will treat and detain the additional runoff to be generated with the future construction of the roadway and buildings on this property.

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Soil Map—Bonner County Area, Idaho, Parts of Bonner and Boundary Counties

Map Scale: 1:2,030 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
11	Dufort-Rock outcrop complex, 5 to 45 percent slopes	5.4	58.6%
31	Mission silt loam, 0 to 2 percent slopes	3.4	37.1%
35	Pend Oreille silt loam, 5 to 45 percent slopes	0.4	4.3%
Totals for Area of Interest		**9.3**	**100.0%**

Bonner County Area, Idaho, Parts of Bonner and Boundary Counties

31—Mission silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 5462
Elevation: 2,000 to 2,800 feet
Mean annual precipitation: 25 to 38 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 90 to 120 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Mission and similar soils: 75 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mission

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Volcanic ash and loess over silty glaciolacustrine deposits

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 3 inches: silt loam
Bw - 3 to 12 inches: silt loam
2Btx - 12 to 21 inches: silt loam
2E - 21 to 33 inches: silt
2Bt - 33 to 48 inches: silt loam
3C - 48 to 67 inches: fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 10 to 20 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): 6e

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Other vegetative classification: western redcedar/queencup beadlily (CN530)
Hydric soil rating: No

Minor Components

Hoodoo

Percent of map unit: 3 percent
Landform: Flood plains, drainageways
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: Yes

Odenson

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Bonner County Area, Idaho, Parts of Bonner and Boundary Counties
Survey Area Data: Version 14, Sep 13, 2018

Bonner County Area, Idaho, Parts of Bonner and Boundary Counties

35—Pend Oreille silt loam, 5 to 45 percent slopes

Map Unit Setting

National map unit symbol: 5466
Elevation: 2,000 to 3,600 feet
Mean annual precipitation: 25 to 38 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 70 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Pend oreille and similar soils: 70 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pend Oreille

Setting

Landform: Mountains
Landform position (two-dimensional): Footslope, backslope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Volcanic ash and/or loess over till derived from granite and/or metamorphic rock

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 6 inches: ashy silt loam
Bw - 6 to 19 inches: gravelly loam
2Bt - 19 to 43 inches: gravelly sandy loam
2C - 43 to 60 inches: very cobbly sandy loam

Properties and qualities

Slope: 5 to 45 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B

Other vegetative classification: western hemlock/queencup beadlily (CN570)
Hydric soil rating: No

Minor Components

Hoodoo
Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Bonner County Area, Idaho, Parts of Bonner and Boundary Counties
Survey Area Data: Version 14, Sep 13, 2018

Bonner County Area, Idaho, Parts of Bonner and Boundary Counties

11—Dufort-Rock outcrop complex, 5 to 45 percent slopes

Map Unit Setting

National map unit symbol: 545c
Elevation: 2,100 to 3,600 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 43 to 45 degrees F
Frost-free period: 90 to 110 days
Farmland classification: Not prime farmland

Map Unit Composition

Dufort and similar soils: 45 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dufort

Setting

Landform: Mountain slopes, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank, side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Volcanic ash and/or loess over till derived from granite and/or gneiss and/or schist

Typical profile

A - 0 to 13 inches: ashy silt loam
Bt - 13 to 24 inches: gravelly silt loam
2C - 24 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 5 to 45 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Other vegetative classification: grand fir/ninebark (CN506)
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: bedrock

Properties and qualities

Slope: 5 to 45 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Data Source Information

Soil Survey Area: Bonner County Area, Idaho, Parts of Bonner and Boundary Counties
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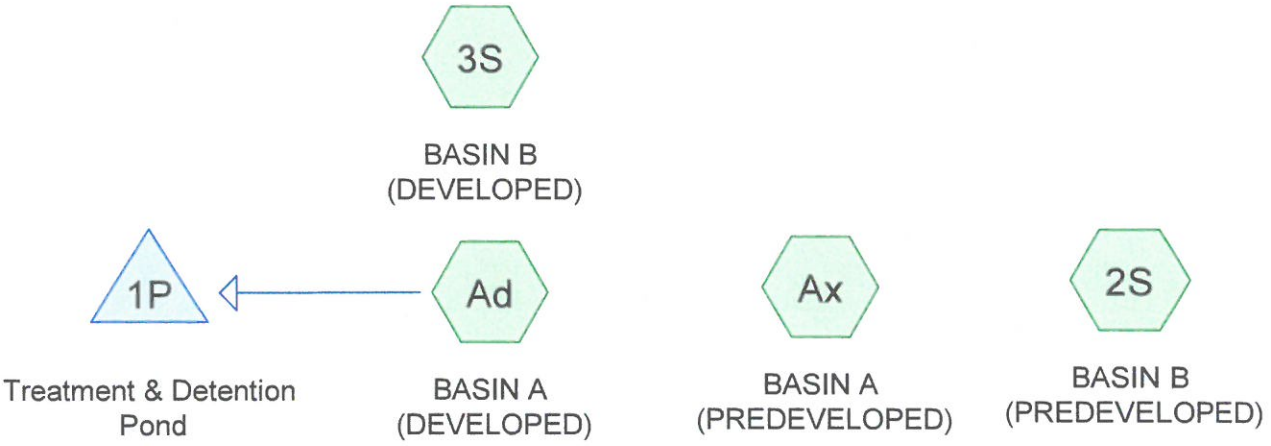


Subcat Reach Pond Link

Routing Diagram for Predeveloped

Prepared by {enter your company name here}, Printed 12/18/2019

HydroCAD® 10.00-25 s/n 10419 © 2019 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.658	65	2 acre lots, 12% imp, HSG B (2S, 3S, Ad, Ax)
0.332	98	Paved parking, HSG D (Ad)
9.990	**66**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
9.658	HSG B	2S, 3S, Ad, Ax
0.000	HSG C	
0.332	HSG D	Ad
0.000	Other	
9.990		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	9.658	0.000	0.000	0.000	9.658	2 acre lots, 12% imp	2S, 3S, Ad, Ax
0.000	0.000	0.000	0.332	0.000	0.332	Paved parking	Ad
0.000	**9.658**	**0.000**	**0.332**	**0.000**	**9.990**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1P	2,148.00	2,144.00	50.0	0.0800	0.010	6.0	0.0	0.0

Time span=5.00-30.00 hrs, dt=0.01 hrs, 2501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2S: BASIN B Runoff Area=102,424 sf 12.00% Impervious Runoff Depth=0.51"
Flow Length=200' Slope=0.1000 '/' Tc=26.2 min CN=65 Runoff=0.82 cfs 0.099 af

Subcatchment 3S: BASIN B (DEVELOPED) Runoff Area=102,424 sf 12.00% Impervious Runoff Depth=0.51"
Flow Length=200' Slope=0.1000 '/' Tc=26.2 min CN=65 Runoff=0.82 cfs 0.099 af

Subcatchment Ad: BASIN A Runoff Area=115,151 sf 23.05% Impervious Runoff Depth=0.67"
Flow Length=200' Slope=0.1000 '/' Tc=26.2 min CN=69 Runoff=1.40 cfs 0.148 af

Subcatchment Ax: BASIN A Runoff Area=115,151 sf 12.00% Impervious Runoff Depth=0.51"
Flow Length=200' Slope=0.1000 '/' Tc=26.2 min CN=65 Runoff=0.92 cfs 0.111 af

Pond 1P: Treatment & Detention Pond Peak Elev=2,148.77' Storage=1,461 cf Inflow=1.40 cfs 0.148 af
Outflow=0.63 cfs 0.147 af

Total Runoff Area = 9.990 ac Runoff Volume = 0.457 af Average Runoff Depth = 0.55"
85.08% Pervious = 8.499 ac 14.92% Impervious = 1.491 ac

Summary for Subcatchment 2S: BASIN B (PREDEVELOPED)

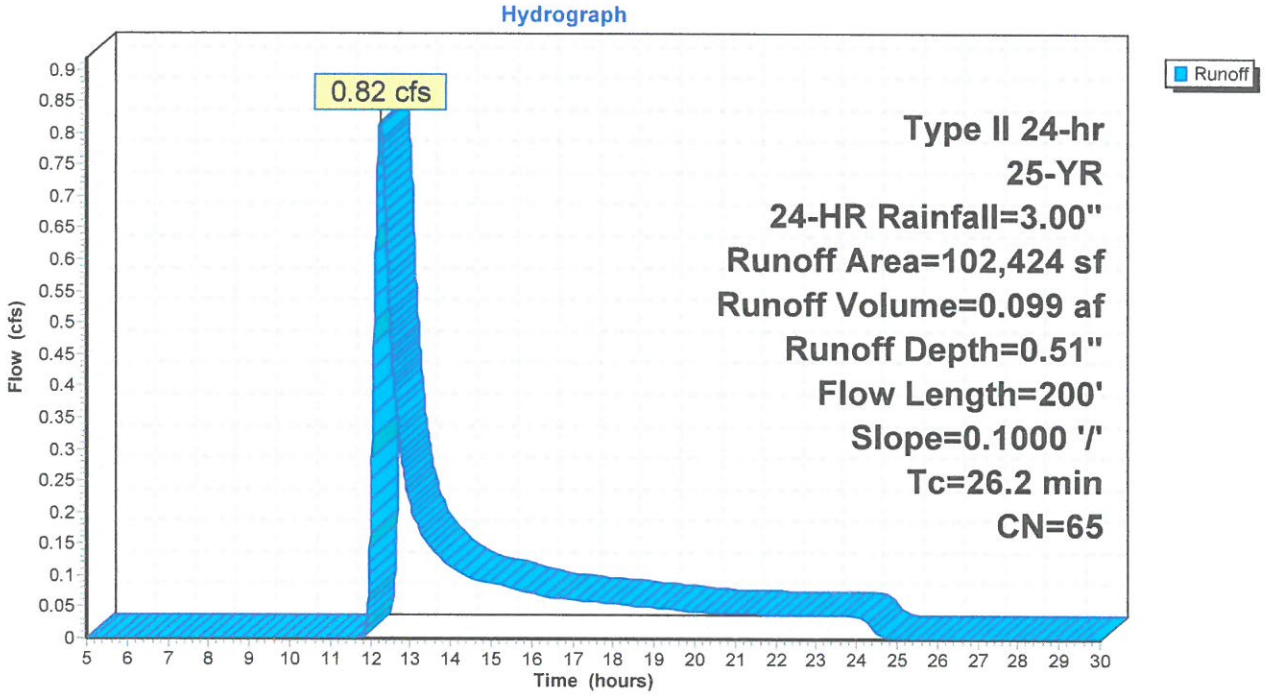
Runoff = 0.82 cfs @ 12.25 hrs, Volume= 0.099 af, Depth= 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-YR, 24-HR Rainfall=3.00"

Area (sf)	CN	Description
102,424	65	2 acre lots, 12% imp, HSG B
90,133		88.00% Pervious Area
12,291		12.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.2	200	0.1000	0.13		**Sheet Flow, NATIVE SHEET FLOW** Woods: Light underbrush n= 0.400 P2= 1.80"

Subcatchment 2S: BASIN B (PREDEVELOPED)



Hydrograph for Subcatchment 2S: BASIN B (PREDEVELOPED)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.19	0.00	0.00
5.50	0.21	0.00	0.00
6.00	0.24	0.00	0.00
6.50	0.27	0.00	0.00
7.00	0.30	0.00	0.00
7.50	0.33	0.00	0.00
8.00	0.36	0.00	0.00
8.50	0.40	0.00	0.00
9.00	0.44	0.00	0.00
9.50	0.49	0.00	0.00
10.00	0.54	0.00	0.00
10.50	0.61	0.00	0.00
11.00	0.71	0.00	0.00
11.50	0.85	0.00	0.00
12.00	1.99	0.13	**0.17**
12.50	2.20	0.20	**0.50**
13.00	2.32	0.23	0.21
13.50	2.40	0.26	0.14
14.00	2.46	0.28	0.12
14.50	2.51	0.30	0.10
15.00	2.56	0.32	0.09
15.50	2.60	0.34	0.08
16.00	2.64	0.35	0.07
16.50	2.67	0.37	0.07
17.00	2.71	0.38	0.06
17.50	2.74	0.39	0.06
18.00	2.76	0.40	0.06
18.50	2.79	0.41	0.05
19.00	2.81	0.42	0.05
19.50	2.84	0.43	0.05
20.00	2.86	0.44	0.04
20.50	2.88	0.45	0.04
21.00	2.89	0.46	0.04
21.50	2.91	0.47	0.04
22.00	2.93	0.47	0.04
22.50	2.95	0.48	0.04
23.00	2.97	0.49	0.04
23.50	2.98	0.50	0.04
24.00	**3.00**	**0.51**	0.04
24.50	3.00	0.51	0.01
25.00	3.00	0.51	0.00
25.50	3.00	0.51	0.00
26.00	3.00	0.51	0.00
26.50	3.00	0.51	0.00
27.00	3.00	0.51	0.00
27.50	3.00	0.51	0.00
28.00	3.00	0.51	0.00
28.50	3.00	0.51	0.00
29.00	3.00	0.51	0.00
29.50	3.00	0.51	0.00
30.00	3.00	0.51	0.00

Summary for Subcatchment 3S: BASIN B (DEVELOPED)

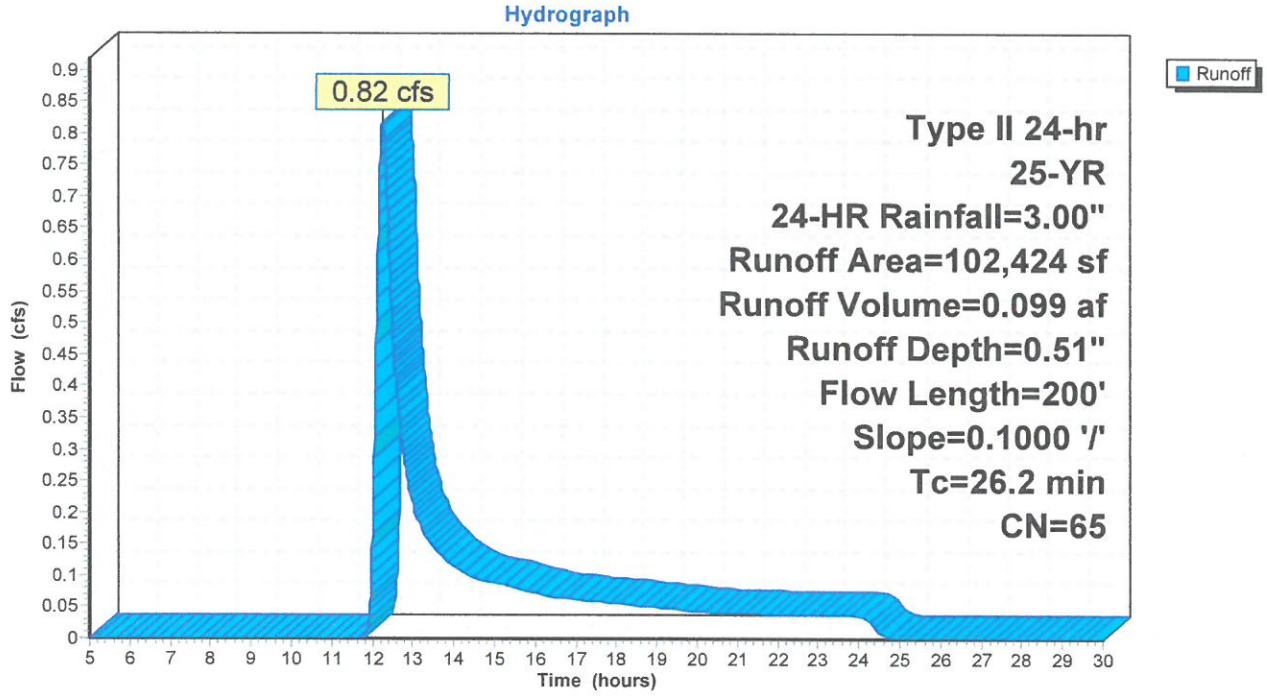
Runoff = 0.82 cfs @ 12.25 hrs, Volume= 0.099 af, Depth= 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-YR, 24-HR Rainfall=3.00"

Area (sf)	CN	Description
102,424	65	2 acre lots, 12% imp, HSG B
90,133		88.00% Pervious Area
12,291		12.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.2	200	0.1000	0.13		**Sheet Flow, Developed SHEET FLOW** Woods: Light underbrush n= 0.400 P2= 1.80"

Subcatchment 3S: BASIN B (DEVELOPED)



Hydrograph for Subcatchment 3S: BASIN B (DEVELOPED)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.19	0.00	0.00
5.50	0.21	0.00	0.00
6.00	0.24	0.00	0.00
6.50	0.27	0.00	0.00
7.00	0.30	0.00	0.00
7.50	0.33	0.00	0.00
8.00	0.36	0.00	0.00
8.50	0.40	0.00	0.00
9.00	0.44	0.00	0.00
9.50	0.49	0.00	0.00
10.00	0.54	0.00	0.00
10.50	0.61	0.00	0.00
11.00	0.71	0.00	0.00
11.50	0.85	0.00	0.00
12.00	1.99	0.13	**0.17**
12.50	2.20	0.20	**0.50**
13.00	2.32	0.23	0.21
13.50	2.40	0.26	0.14
14.00	2.46	0.28	0.12
14.50	2.51	0.30	0.10
15.00	2.56	0.32	0.09
15.50	2.60	0.34	0.08
16.00	2.64	0.35	0.07
16.50	2.67	0.37	0.07
17.00	2.71	0.38	0.06
17.50	2.74	0.39	0.06
18.00	2.76	0.40	0.06
18.50	2.79	0.41	0.05
19.00	2.81	0.42	0.05
19.50	2.84	0.43	0.05
20.00	2.86	0.44	0.04
20.50	2.88	0.45	0.04
21.00	2.89	0.46	0.04
21.50	2.91	0.47	0.04
22.00	2.93	0.47	0.04
22.50	2.95	0.48	0.04
23.00	2.97	0.49	0.04
23.50	2.98	0.50	0.04
24.00	**3.00**	**0.51**	0.04
24.50	3.00	0.51	0.01
25.00	3.00	0.51	0.00
25.50	3.00	0.51	0.00
26.00	3.00	0.51	0.00
26.50	3.00	0.51	0.00
27.00	3.00	0.51	0.00
27.50	3.00	0.51	0.00
28.00	3.00	0.51	0.00
28.50	3.00	0.51	0.00
29.00	3.00	0.51	0.00
29.50	3.00	0.51	0.00
30.00	3.00	0.51	0.00

Summary for Subcatchment Ad: BASIN A (DEVELOPED)

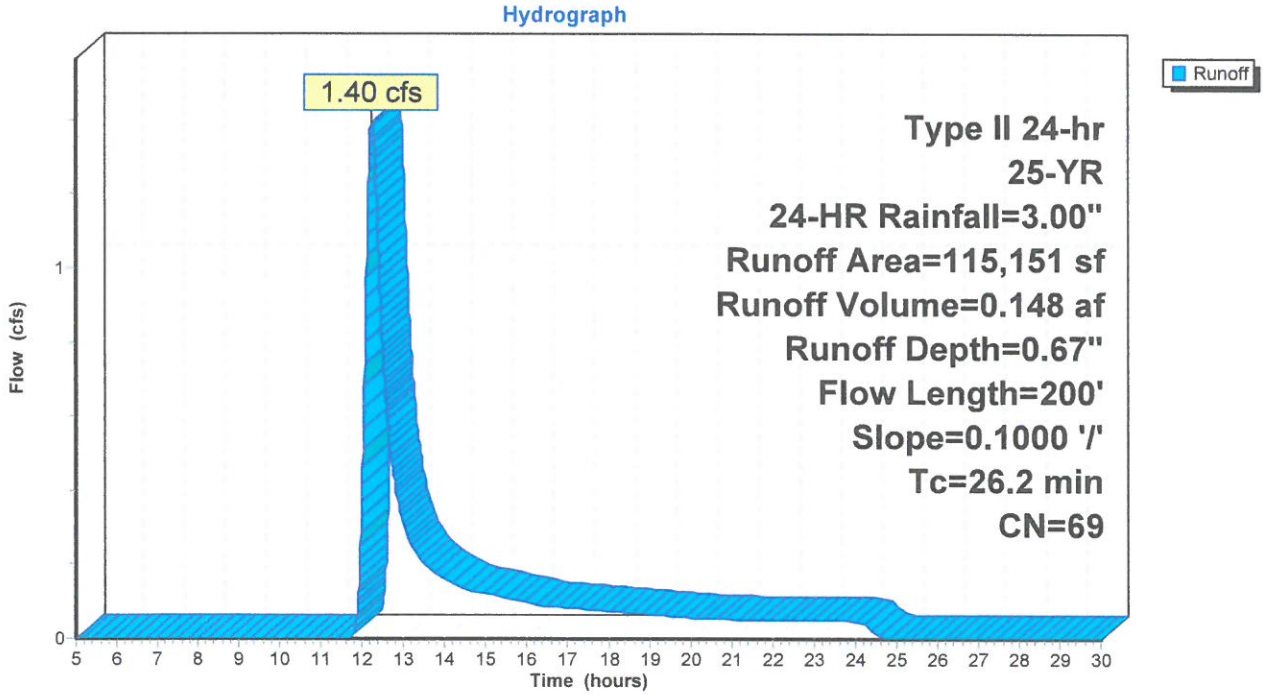
Runoff = 1.40 cfs @ 12.23 hrs, Volume= 0.148 af, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-YR, 24-HR Rainfall=3.00"

Area (sf)	CN	Description
100,691	65	2 acre lots, 12% imp, HSG B
14,460	98	Paved parking, HSG D
115,151	69	Weighted Average
88,608		76.95% Pervious Area
26,543		23.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.2	200	0.1000	0.13		**Sheet Flow, Developed SHEET FLOW** Woods: Light underbrush n= 0.400 P2= 1.80"

Subcatchment Ad: BASIN A (DEVELOPED)



Hydrograph for Subcatchment Ad: BASIN A (DEVELOPED)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.19	0.00	0.00
5.50	0.21	0.00	0.00
6.00	0.24	0.00	0.00
6.50	0.27	0.00	0.00
7.00	0.30	0.00	0.00
7.50	0.33	0.00	0.00
8.00	0.36	0.00	0.00
8.50	0.40	0.00	0.00
9.00	0.44	0.00	0.00
9.50	0.49	0.00	0.00
10.00	0.54	0.00	0.00
10.50	0.61	0.00	0.00
11.00	0.71	0.00	0.00
11.50	0.85	0.00	0.00
12.00	1.99	0.21	**0.42**
12.50	2.20	0.29	**0.77**
13.00	2.32	0.34	0.30
13.50	2.40	0.37	0.20
14.00	2.46	0.40	0.16
14.50	2.51	0.43	0.13
15.00	2.56	0.45	0.12
15.50	2.60	0.47	0.11
16.00	2.64	0.49	0.10
16.50	2.67	0.50	0.09
17.00	2.71	0.52	0.08
17.50	2.74	0.53	0.08
18.00	2.76	0.55	0.08
18.50	2.79	0.56	0.07
19.00	2.81	0.57	0.07
19.50	2.84	0.58	0.06
20.00	2.86	0.59	0.06
20.50	2.88	0.60	0.05
21.00	2.89	0.61	0.05
21.50	2.91	0.62	0.05
22.00	2.93	0.63	0.05
22.50	2.95	0.64	0.05
23.00	2.97	0.65	0.05
23.50	2.98	0.66	0.05
24.00	**3.00**	**0.67**	0.05
24.50	3.00	0.67	0.01
25.00	3.00	0.67	0.00
25.50	3.00	0.67	0.00
26.00	3.00	0.67	0.00
26.50	3.00	0.67	0.00
27.00	3.00	0.67	0.00
27.50	3.00	0.67	0.00
28.00	3.00	0.67	0.00
28.50	3.00	0.67	0.00
29.00	3.00	0.67	0.00
29.50	3.00	0.67	0.00
30.00	3.00	0.67	0.00

Summary for Subcatchment Ax: BASIN A (PREDEVELOPED)

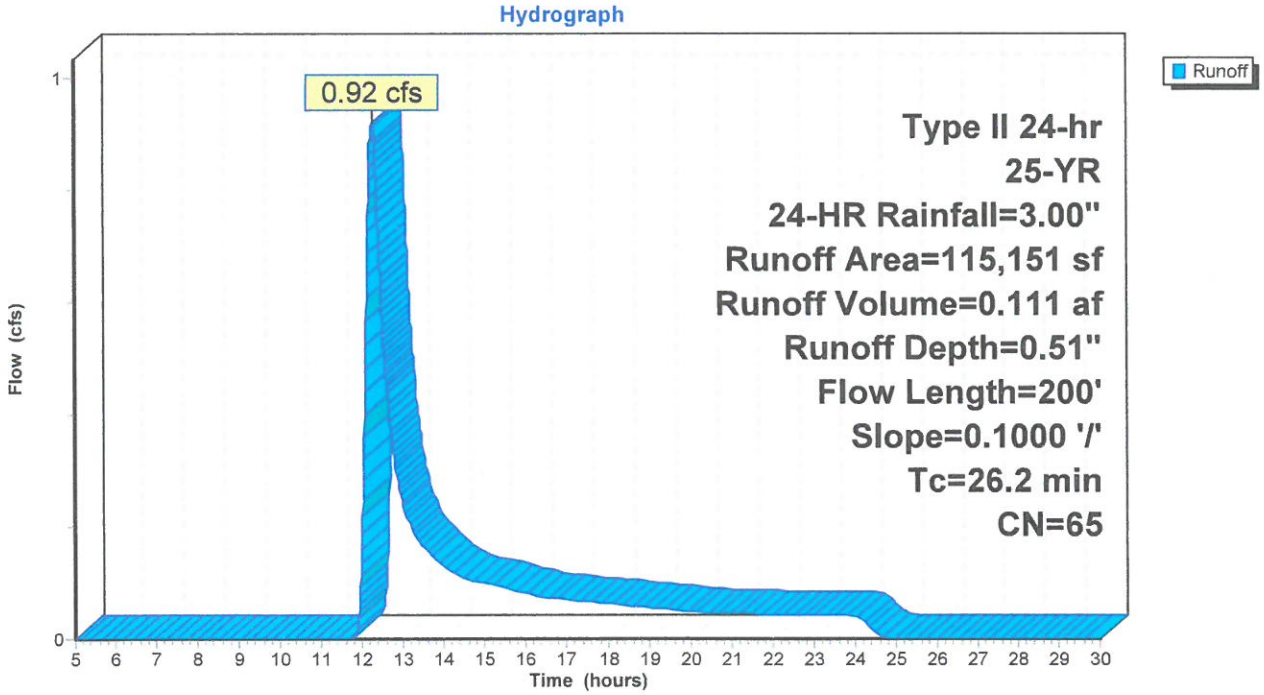
Runoff = 0.92 cfs @ 12.25 hrs, Volume= 0.111 af, Depth= 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-YR, 24-HR Rainfall=3.00"

Area (sf)	CN	Description
115,151	65	2 acre lots, 12% imp, HSG B
101,333		88.00% Pervious Area
13,818		12.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.2	200	0.1000	0.13		**Sheet Flow, NATIVE SHEET FLOW** Woods: Light underbrush n= 0.400 P2= 1.80"

Subcatchment Ax: BASIN A (PREDEVELOPED)



Hydrograph for Subcatchment Ax: BASIN A (PREDEVELOPED)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.19	0.00	0.00
5.50	0.21	0.00	0.00
6.00	0.24	0.00	0.00
6.50	0.27	0.00	0.00
7.00	0.30	0.00	0.00
7.50	0.33	0.00	0.00
8.00	0.36	0.00	0.00
8.50	0.40	0.00	0.00
9.00	0.44	0.00	0.00
9.50	0.49	0.00	0.00
10.00	0.54	0.00	0.00
10.50	0.61	0.00	0.00
11.00	0.71	0.00	0.00
11.50	0.85	0.00	0.00
12.00	1.99	0.13	**0.19**
12.50	2.20	0.20	**0.56**
13.00	2.32	0.23	0.24
13.50	2.40	0.26	0.16
14.00	2.46	0.28	0.13
14.50	2.51	0.30	0.11
15.00	2.56	0.32	0.10
15.50	2.60	0.34	0.09
16.00	2.64	0.35	0.08
16.50	2.67	0.37	0.07
17.00	2.71	0.38	0.07
17.50	2.74	0.39	0.07
18.00	2.76	0.40	0.06
18.50	2.79	0.41	0.06
19.00	2.81	0.42	0.06
19.50	2.84	0.43	0.05
20.00	2.86	0.44	0.05
20.50	2.88	0.45	0.05
21.00	2.89	0.46	0.04
21.50	2.91	0.47	0.04
22.00	2.93	0.47	0.04
22.50	2.95	0.48	0.04
23.00	2.97	0.49	0.04
23.50	2.98	0.50	0.04
24.00	**3.00**	**0.51**	0.04
24.50	3.00	0.51	0.01
25.00	3.00	0.51	0.00
25.50	3.00	0.51	0.00
26.00	3.00	0.51	0.00
26.50	3.00	0.51	0.00
27.00	3.00	0.51	0.00
27.50	3.00	0.51	0.00
28.00	3.00	0.51	0.00
28.50	3.00	0.51	0.00
29.00	3.00	0.51	0.00
29.50	3.00	0.51	0.00
30.00	3.00	0.51	0.00

Summary for Pond 1P: Treatment & Detention Pond

Inflow Area = 2.644 ac, 23.05% Impervious, Inflow Depth = 0.67" for 25-YR, 24-HR event
Inflow = 1.40 cfs @ 12.23 hrs, Volume= 0.148 af
Outflow = 0.63 cfs @ 12.58 hrs, Volume= 0.147 af, Atten= 55%, Lag= 21.1 min
Primary = 0.63 cfs @ 12.58 hrs, Volume= 0.147 af

Routing by Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 2,148.77' @ 12.58 hrs Surf.Area= 2,588 sf Storage= 1,461 cf

Plug-Flow detention time= 68.5 min calculated for 0.147 af (100% of inflow)
Center-of-Mass det. time= 66.7 min (967.3 - 900.6)

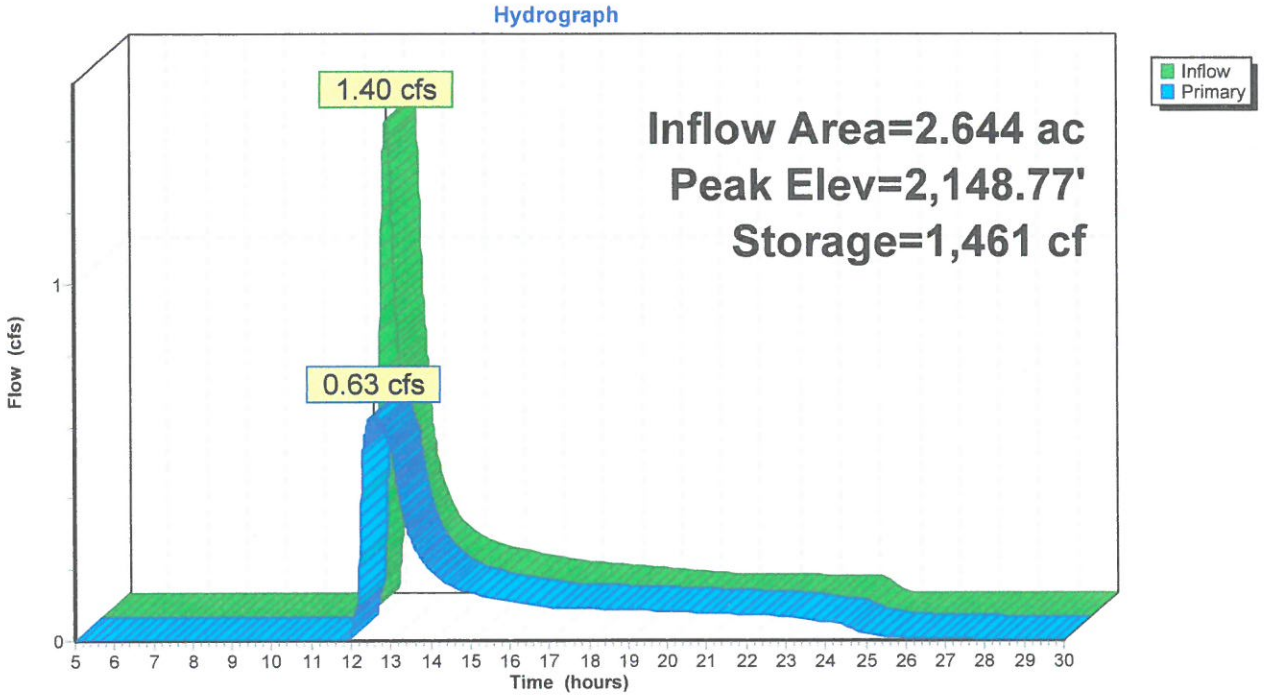
Volume	Invert	Avail.Storage	Storage Description
#1	2,148.00'	3,725 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
2,148.00	1,200	0	0
2,148.50	2,100	825	825
2,149.00	3,000	1,275	2,100
2,149.50	3,500	1,625	3,725

Device	Routing	Invert	Outlet Devices
#1	Primary	2,148.00'	**6.0" Round Culvert** L= 50.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 2,148.00' / 2,144.00' S= 0.0800 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Device 1	2,148.40'	**8.0" Horiz. Orifice/Grate X 0.50** C= 0.600 Limited to weir flow at low heads
#3	Device 1	2,148.00'	**2.000 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 2,121.50'
#4	Primary	2,149.00'	**70.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.63 cfs @ 12.58 hrs HW=2,148.77' (Free Discharge)
- **1=Culvert** (Passes 0.63 cfs of 0.68 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.51 cfs @ 1.47 fps)
  - **3=Exfiltration** (Controls 0.12 cfs)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Treatment & Detention Pond



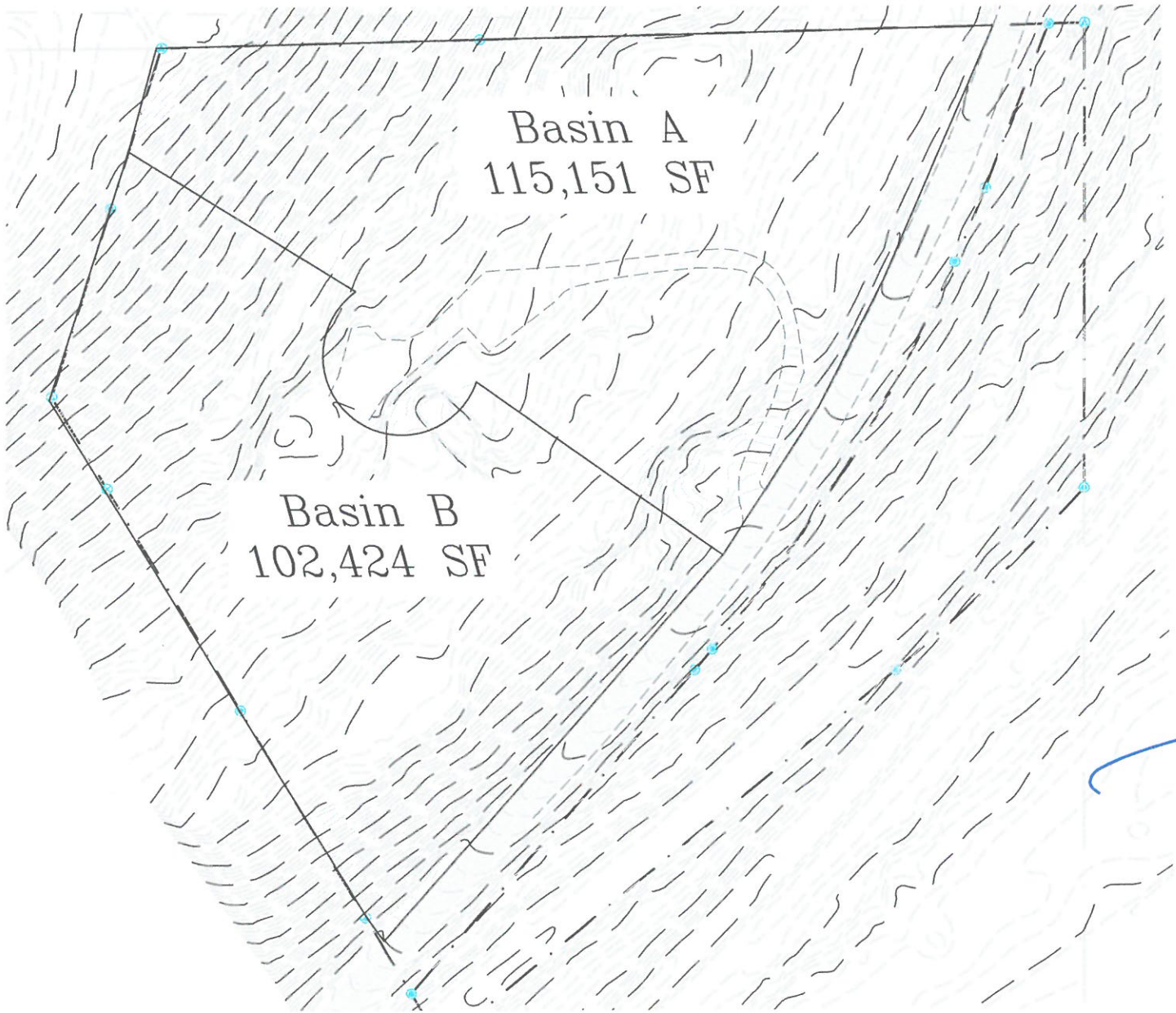
Hydrograph for Pond 1P: Treatment & Detention Pond

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	2,148.00	0.00
5.50	0.00	0	2,148.00	0.00
6.00	0.00	0	2,148.00	0.00
6.50	0.00	0	2,148.00	0.00
7.00	0.00	0	2,148.00	0.00
7.50	0.00	0	2,148.00	0.00
8.00	0.00	0	2,148.00	0.00
8.50	0.00	0	2,148.00	0.00
9.00	0.00	0	2,148.00	0.00
9.50	0.00	0	2,148.00	0.00
10.00	0.00	0	2,148.00	0.00
10.50	0.00	0	2,148.00	0.00
11.00	0.00	0	2,148.00	0.00
11.50	0.00	0	2,148.00	0.00
12.00	**0.42**	102	2,148.08	0.02
12.50	**0.77**	**1,440**	**2,148.76**	**0.63**
13.00	0.30	**1,203**	**2,148.67**	**0.55**
13.50	0.20	917	2,148.54	0.29
14.00	0.16	815	2,148.50	0.20
14.50	0.13	759	2,148.47	0.16
15.00	0.12	726	2,148.45	0.14
15.50	0.11	703	2,148.44	0.12
16.00	0.10	682	2,148.43	0.11
16.50	0.09	660	2,148.42	0.10
17.00	0.08	640	2,148.41	0.09
17.50	0.08	623	2,148.40	0.09
18.00	0.08	601	2,148.39	0.09
18.50	0.07	574	2,148.37	0.09
19.00	0.07	542	2,148.36	0.09
19.50	0.06	504	2,148.34	0.08
20.00	0.06	462	2,148.31	0.08
20.50	0.05	415	2,148.29	0.08
21.00	0.05	369	2,148.26	0.08
21.50	0.05	325	2,148.23	0.08
22.00	0.05	284	2,148.21	0.07
22.50	0.05	246	2,148.18	0.07
23.00	0.05	210	2,148.16	0.07
23.50	0.05	186	2,148.14	0.06
24.00	0.05	175	2,148.13	0.05
24.50	0.01	151	2,148.12	0.04
25.00	0.00	105	2,148.08	0.02
25.50	0.00	77	2,148.06	0.01
26.00	0.00	60	2,148.05	0.01
26.50	0.00	49	2,148.04	0.01
27.00	0.00	41	2,148.03	0.00
27.50	0.00	36	2,148.03	0.00
28.00	0.00	31	2,148.03	0.00
28.50	0.00	28	2,148.02	0.00
29.00	0.00	25	2,148.02	0.00
29.50	0.00	22	2,148.02	0.00
30.00	0.00	20	2,148.02	0.00

PRELIMINARY STORMWATER BASIN MAP FOR

ORCHARD RIDGE ESTATES

A SUBDIVISION IN THE CITY OF DOVER
RPD00000297200A AKA 1072 SYRINGA HEIGHTS RD
DOVER, IDAHO 83864



STORMWATER BASIN MAP

KRAMER-MARIENAU

ORCHARD RIDGE ESTATES
DOVER, IDAHO

PROFESSIONAL ENGINEER
REGISTERED
STATE OF IDAHO
DANIEL W. LARSON
10986
12/18/18

PRELIMINARY
FOR REVIEW ONLY
NOT FOR CONSTRUCTION

PROJECT NO:	1944
DRAWN BY:	ICE
CHECKED BY:	DWL
SCALE:	1"=100' (8.5"X11" ONLY)

SHEET 1 OF 1

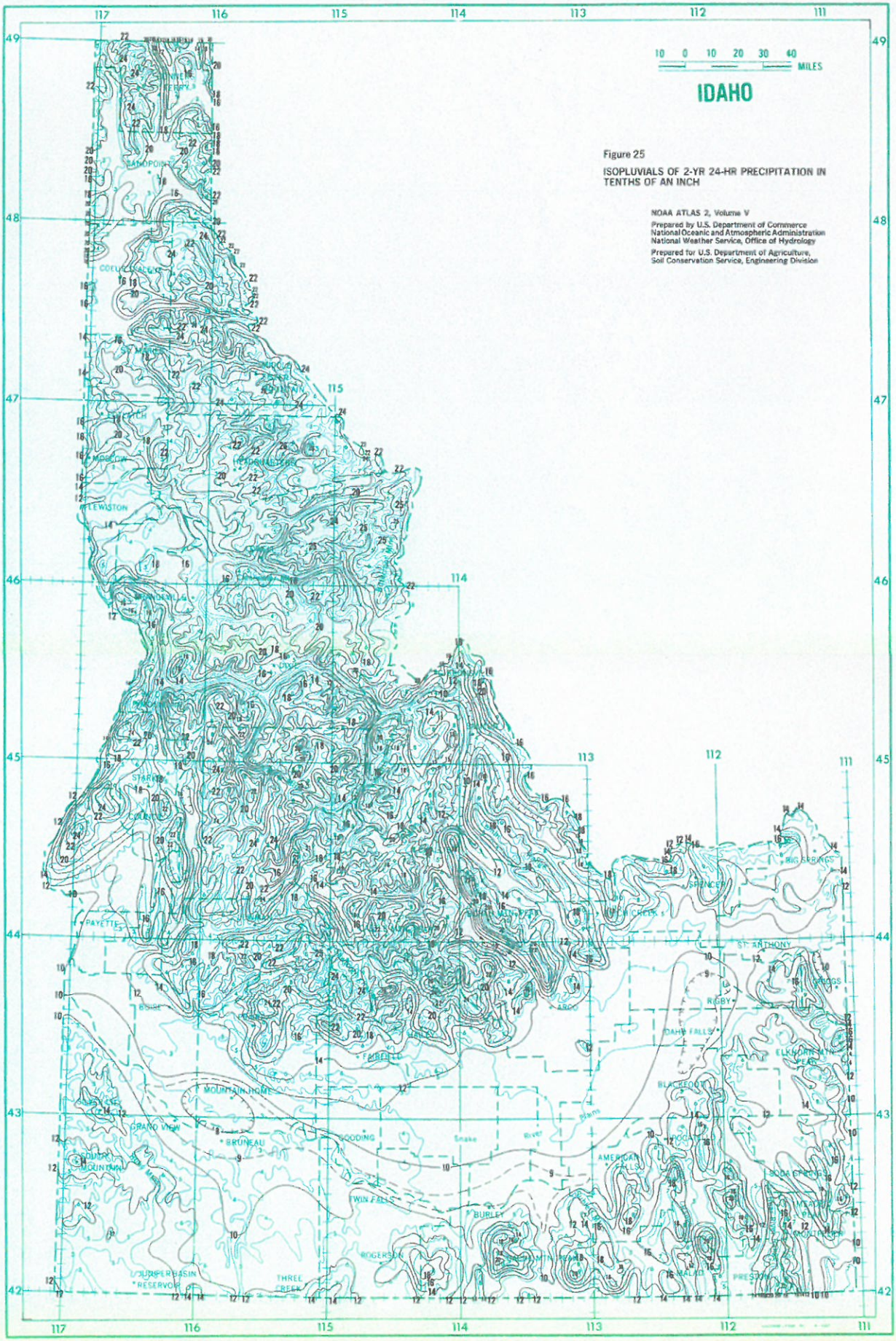


Figure 25

ISOPLUVIALS OF 2-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume V

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

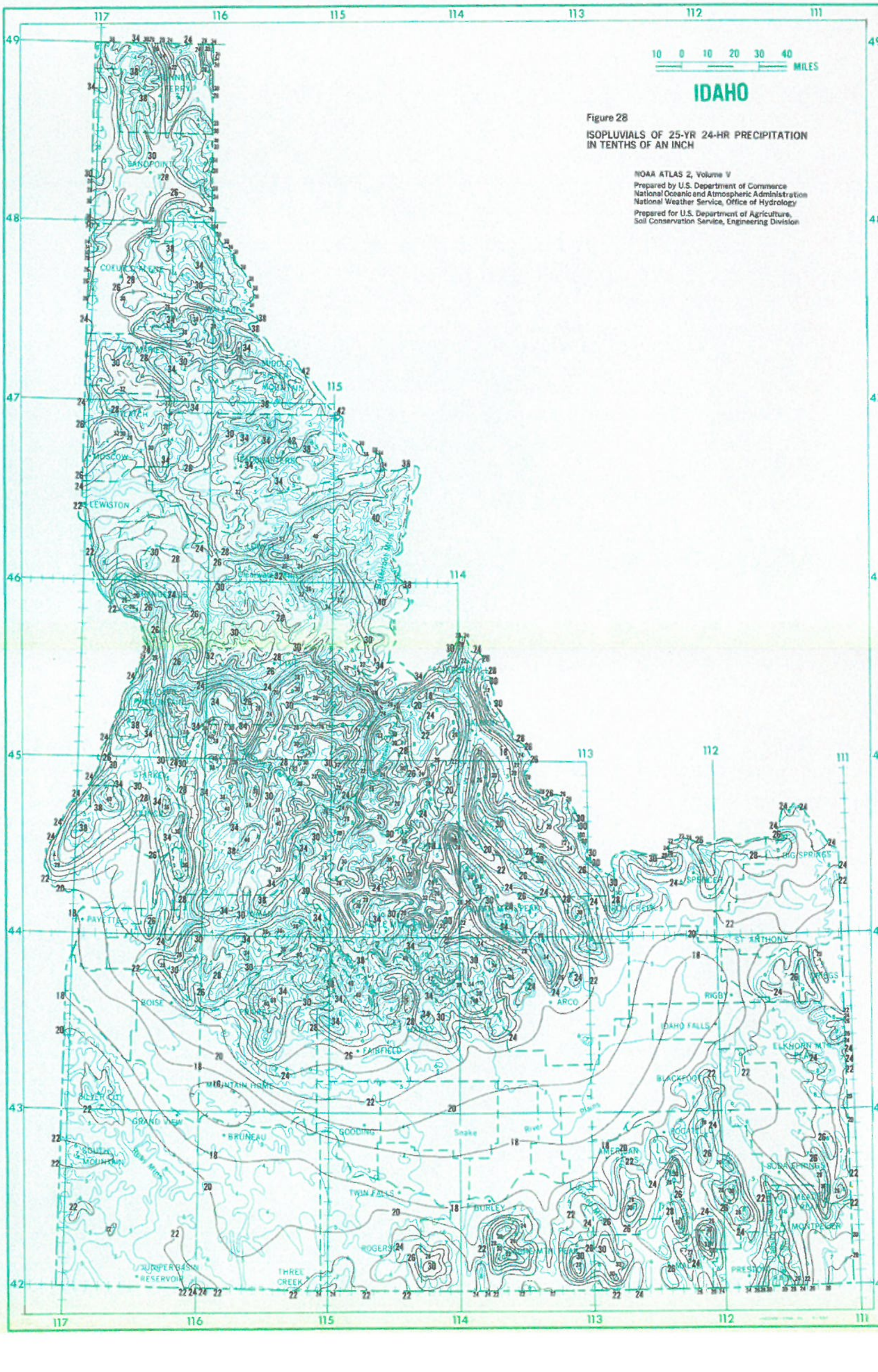


Figure 28

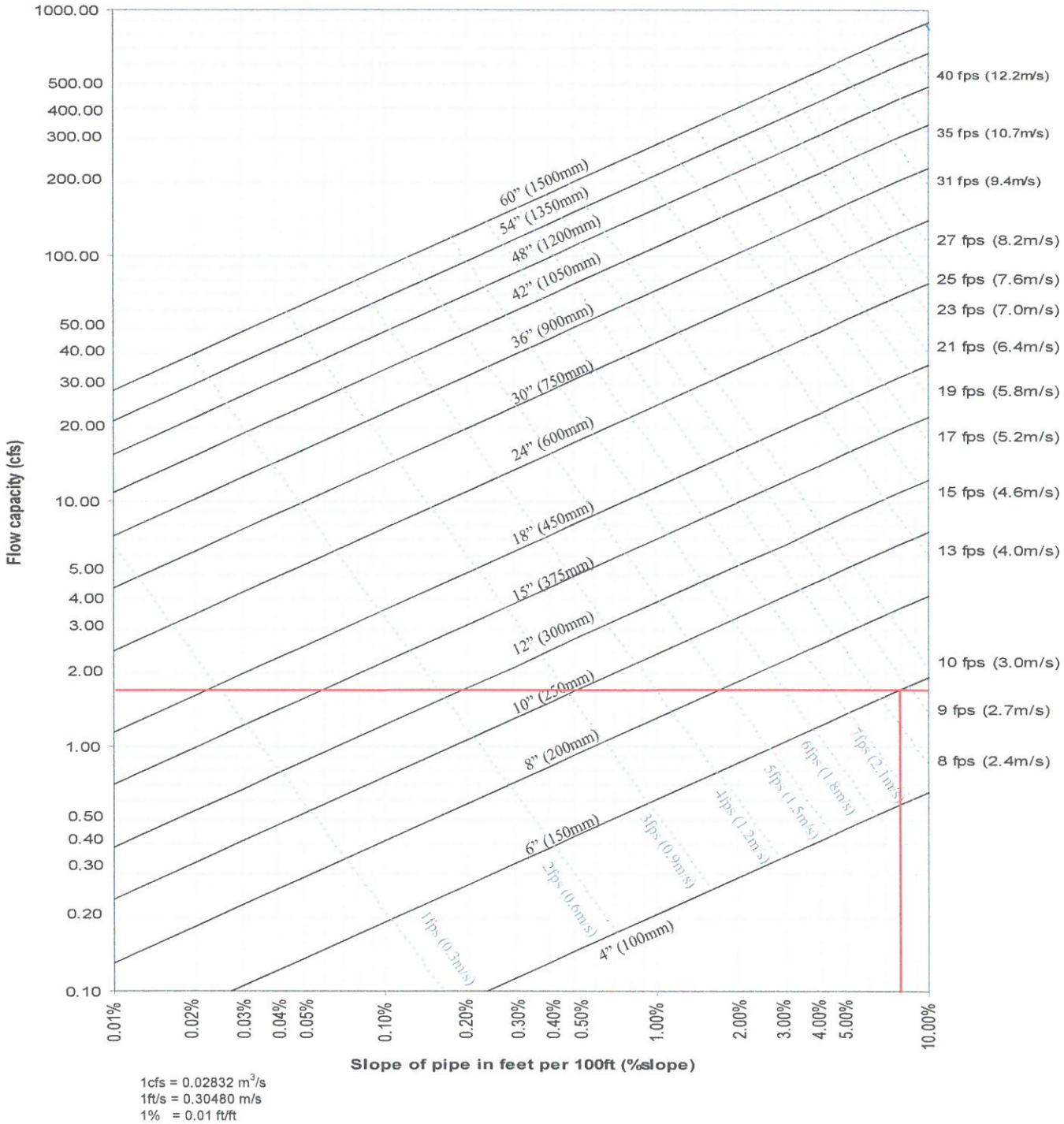
ISOPLUVIALS OF 25-YR 24-HR PRECIPITATION IN TENTHS OF AN INCH

NOAA ATLAS 2, Volume V

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 3-1
Discharge Rates for ADS Corrugated Pipe with Smooth Interior Liner[1]



1cfs = 0.02832 m^3/s
1ft/s = 0.30480 m/s
1% = 0.01 ft/ft

1. Applicable products: N-12®, MEGA GREEN®, N-12 STIB, N-12 WTIB, HP STORM, SaniTIte®, SaniTite HP, N-12 Low Head

Note: Based on a design Manning's "n" of 0.012.
Solid lines indicate pipe diameters. Dashed lines indicate approximate flow velocity.
Redeveloped from FHWA HDS 3 – Design Charts for Open-Channel Flow[2]

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