DRAINAGE REPORT

Redmond Red Rock
Commercial Center – Final Phase 3
Redmond, Oregon

PREPARED FOR:
Dickerhoof Real Estate Group
P.O. Box 1583
Corvallis, OR 97339

REGISTERED PROFESSIONAL ENGINEER
55,506PE
Marcus D. Cross
OREGON
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MARCUS D. CROSS
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PRESENTED BY:

R-C RHINE-CROSS GROUP

CIVIL ENGINEERING ■ SURVEYING ■ PLANNING
112 N 5th ST – Suite 200 – P.O. BOX 909
KLAMATH FALLS, OR 97601
(541) 851-9405

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Final Stormwater Report – Final Phase 3
Redmond Red Rock Commercial Center

Project Description:

The applicant is proposing to construct the final Phase 3 of a commercial center along NW Oak Tree Lane in Redmond, Oregon including retail shops and associated paved parking and maneuvering areas. Phase 3 includes construction of a new Famous Footwear, Ulta Beauty, Marshall's, and a new retail shop with building square footage proposed at approximately 37,864 sq.ft.. The site contains existing retail stores totaling approximately 11,787 sq.ft. and another 2657 sq.ft SELCO credit union currently being applied for under a separate permit. The site is directly north of the Wal-Mart center, and is known as the Red Rock Commercial Development. Access to the site is via two driveway connections from NW Oak Tree Lane. The project is located on tax lot 509 of map 15-13-04DD situated in the SE1/4 of the SE1/4 of Section 4, T15S, R13 E, W.M., Deschutes County, Oregon.

The existing Phase 3 property is currently undeveloped, being part of the partially developed Redmond Red Rock commercial center. The onsite soil is classified as 32A (Deschutes Sandy Loam) by the SCS soil survey of Deschutes County, Oregon (Hydrologic Soil Group B). The onsite soil exhibits good infiltration characteristics; therefore, infiltration will be proposed as a means of stormwater disposal for this development.

The site is relatively flat, with a slight slope from northwest to southeast. The Red Rock Center had a comprehensive geotechnical evaluation done for the project; this evaluation will be used for design assumptions for the onsite infiltration facilities.

There are no natural streams, floodplains, or natural depressions on or near the site. The offsite roads are curbed with collection basins existing along the frontage of the site that direct stormwater runoff into drywells.

According to the Oregon Water Master Well Log Query, there are no groundwater wells on or near the property boundary. The nearest well is located west of the subject property at 1826 N. Hwy 97, drilled in 1996, and located more than 1/4 mile away.

Basic Requirements:

Basic Requirement #1 – Drainage Submittal

The project will require a commercial building permit and creates more than 5000 square feet of impervious surface and disturb more than one acre. This requirement **is applicable.**

Basic Requirement #2 – Geotechnical Site Characterization
The project will propose infiltration as a means of stormwater disposal, therefore a GSC is required to evaluate measured infiltration rates. The project is not located in a seasonally high groundwater area or in a special drainage area. This requirement **is applicable.**

Basic Requirement #3 – Water Quality Treatment
The project will create more than 5000 square feet of impervious surface and disturb more than one acre. This requirement **is applicable.**

Basic Requirement #4 – Flow Control
The project will require a commercial building permit and creates more than 5000 square feet of impervious surface and disturb more than one acre. This requirement **is applicable.**

Basic Requirement #5 – Natural and Constructed Conveyance Systems
There are no natural conveyance systems on or adjacent to the site. The onsite stormwater will be collected in catch basins and routed to the infiltration facility in underground storm piping, therefore this requirement **is applicable.**

Basic Requirement #6 – Erosion and Sediment Control (ESC)
Erosion and Sediment control applies to all projects; therefore, this requirement **is applicable.**

Basic Requirement #7 – Source Control
The project will create more than 5000 square feet of impervious surface and disturb more than one acre. This requirement **is applicable.**

Basic Requirement #8 – Source Control
The project will create more than 5000 square feet of impervious surface and disturb more than one acre and proposes drainage facilities and structures. This requirement **is applicable.**

Other Requirements:

- A DEQ 1200-C permit is not required for this project because no stormwater runoff will be allowed to leave the site.
- A DEQ UIC permit is not required for the infiltration facilities will be designed as open infiltration swales with no underground storm piping.

Geotechnical Information:

A full Geotechnical Site Investigation was prepared for the Red Rock Commercial Center project by Kleinfelder, Inc. The report is included in this Drainage Report under Appendix B. The onsite soils are typical sandy and rocky, with a very deep groundwater depth.

The stormwater runoff will be infiltrated into the ground. Due to this fact, Kleinfelder, Inc tested the infiltration rates at several locations throughout the development where the proposed infiltration facilities are located. Results of the test are shown in Appendix B. The proposed facility will use an infiltration rate of 1.4 inches/hour after applying the recommended factor of safety to the tested rate that was taken within the proposed stormwater facility footprint. Drywell #1 within the drainage calculations was installed in 2015 with the construction of the Maurice's store. This drywell was tested in 2015 at over 72 inches per hour, as a factor of safety, the drywell will be shown utilizing 24 inches per hour. The newly constructed facility will use a more conservative rate of 6 inched per hour for a drilled and shot drywell.

Downstream / Down Gradient Analysis:

This project does not propose to release runoff from the site. The infiltration facilities will be designed to completely infiltrate the runoff from the 50-yr storm. If the infiltration facilities were to overflow, the drainage would be directed to the street where multiple drywells exist fronting the property.

Hydrology:

As required by the Central Oregon Stormwater Manual (COSM), all stormwater run-off from the development will be collected and routed to an onsite infiltration facility. The infiltration facility will be designed as an open swale with a minimum of 18" of sandy loam material to provide filtration prior to disposal into the ground. The open infiltration facility will not need to be registered with Oregon DEQ as an Underground Injection Control (UIC) program facility. The closed loop drywell systems will be registered as a UIC with Oregon DEQ, however these roof drywell systems do not require monitoring.

Hydrology for the site will be calculated using the NRCS Curve Number Method, utilizing HydroCAD computer modelling software. The hydrograph used is the SCS urban hydrograph with level pool routing.

The design storms for this project are tabulated in by the NOAA Precipitation Frequency Atlas of the Western United States-Volume X (Oregon) and in Table 5-5 of the COSM. The design storms are tabulated as follows for the Redmond area.

Type I Storm Distribution:

6-month Storm:	0.7 inches/24 hour
50-year Storm:	2.0 inches/24 hour
100-year Storm:	2.2 inches/24 hour

The project will create impervious area in the form of roof area and pavement areas. The site will be modeled as a single catchment area since runoff from all onsite developed area will be routed to the facility. The catchment area is tabulated below, see Appendix C for Basin Map. The curve numbers assume Antecedal Moisture Condition (AMC) of II. A pre-developed condition analysis was not performed because the site is designed utilizing infiltration.

Basin 1S
Existing developed area from Phase 1 of the commercial center along Oak Tree Ln.
36,802 sq.ft. of Pavement & Sidewalk Area CN=98 (AMC II)
6,787 sq.ft. of Roof Area CN=98 (AMC II)
7,393 sq.ft. of Swale Area CN = 79 (AMC II)

Basin 2S
New developed area from Phase 3 of the commercial center along Oak Tree Ln.
41,516 sq.ft. of Pavement & Sidewalk Area CN=98 (AMC II)
7,610 sq.ft. of Swale Area CN = 79 (AMC II)

Basin 3S
Developed area around the SELCO Credit Union along Oak Tree Ln & Canal Blvd.
41,367 sq.ft. of Pavement & Sidewalk Area CN=98 (AMC II)
2,657 sq.ft. of Roof Area CN=98 (AMC II)
17,061 sq.ft. of Swale Area CN = 79 (AMC II)

Basin 4S
New Developed area east of Marshall's along Canal Blvd.
13,631 sq.ft. of Pavement & Sidewalk Area CN=98 (AMC II)
1,648 sq.ft. of Swale Area CN = 79 (AMC II)

Basin 5S
New developed area north and east of Marshall's including Marshall's loading dock.
13,257 sq.ft. of Pavement & Sidewalk Area CN=98 (AMC II)
5,042 sq.ft. of Swale Area CN = 79 (AMC II)

Basin 6S
New developed area north of Ulta Beauty.
7,031 sq.ft. of Pavement & Sidewalk Area CN=98 (AMC II)
973 sq.ft. of Swale Area CN = 79 (AMC II)

Basin 7S
Existing developed area north and west of Maurice's.
22,443 sq.ft. of Pavement & Sidewalk Area CN=98 (AMC II)
3,033 sq.ft. of Swale Area CN = 79 (AMC II)

Basin 8S
Existing Roof for the Maurice's Building.
5,000 sq.ft. of Roof Area CN=98 (AMC II)

Basin 9S
New Roof for the Famous Footwear Building.
5,000 sq.ft. of Roof Area CN=98 (AMC II)

Basin 10S
New Roof for the Ulta Beauty and Marshall's Building.
31,064 sq.ft. of Roof Area CN=98 (AMC II)

Basin 11S
New Roof for the Retail Shop adjacent to Marshall's Building.
1,800 sq.ft. of Roof Area CN=98 (AMC II)

Stormwater Facility Analysis and Design:

The BMP's selected for this project will be open landscape planter infiltration swales and closed loop roof downspout drywell systems. Per City of Redmond requirements, runoff from the developed site must infiltrate the volume of the 50-year storm and provide overflow for the 100-year storm. The stormwater facility infiltration rate has been calculated for each facility by utilizing the recommended rate in the Kleinfelder Geotechnical Investigation and calculating the total outflow based on the area of the facility (See Calculations Appendix C). Additionally, the infiltration swales were designed to completely retain the 6-month runoff volume with no infiltration. The storm water calculations were modeled according to these guidelines, and the results are tabulated below:

6-Month Storm:

BASIN #	BASIN AREA	STORM EVENT	RUN-OFF RATE	RUN-OFF VOLUME
1S	50,982 sq.ft.	6-month (0.7")	0.28 cfs	1,350 ft^3
2S	49,126 sq.ft.	6-month (0.7")	0.27 cfs	1,307 ft^3
3S	61,085 sq.ft.	6-month (0.7")	0.23 cfs	1,175 ft^3
4S	15,279 sq.ft.	6-month (0.7")	0.10 cfs	475 ft^3
5S	18,299 sq.ft.	6-month (0.7")	0.07 cfs	345 ft^3
6S	8,004 sq.ft.	6-month (0.7")	0.05 cfs	255 ft^3
7S	25,476 sq.ft.	6-month (0.7")	0.17 cfs	770 ft^3
8S	5,000 sq.ft.	6-month (0.7")	0.05 cfs	209 ft^3
9S	5,000 sq.ft.	6-month (0.7")	0.05 cfs	209 ft^3
10S	31,064 sq.ft.	6-month (0.7")	0.29 cfs	1,291 ft^3
11S	1,800 sq.ft.	6-month (0.7")	0.02 cfs	85 ft^3

POND #	STORAGE REQUIRED	STORAGE PROVIDED	WATER HEIGHT	OVERFLOW HEGHT
1P	2625 ft^3	8,378 ft^3	2.02 ft	5.0 ft
2P	1,175 ft^3	10,615 ft^3	0.73 ft	5.0 ft
3P	820 ft^3	3,696 ft^3	1.48 ft	5.0 ft
4P	1,024 ft^3	2,585 ft^3	2.78 ft	5.0 ft
DW1	402 ft^3	452 ft^3	8.02 ft	12.0 ft
DW2	1,392 ft^3	3,064 ft^3	4.64 ft	15.0 ft

Infiltration swale can retain the 6-month storm volume with no infiltration outflow.

50-Year Storm:

BASIN #	BASIN AREA	STORM EVENT	RUN-OFF RATE	RUN-OFF VOLUME
1S	50,982 sq.ft.	50-yr (2.0")	1.42 cfs	6,273 ft^3
2S	49,126 sq.ft.	50-yr (2.0")	1.37 cfs	6,055 ft^3
3S	61,085 sq.ft.	50-yr (2.0")	1.51 cfs	6,665 ft^3
4S	15,279 sq.ft.	50-yr (2.0")	0.45 cfs	2,004 ft^3
5S	18,299 sq.ft.	50-yr (2.0")	0.45 cfs	2,004 ft^3
6S	8,004 sq.ft.	50-yr (2.0")	0.24 cfs	1,045 ft^3
7S	25,476 sq.ft.	50-yr (2.0")	0.75 cfs	3,354 ft^3
8S	5,000 sq.ft.	50-yr (2.0")	0.16 cfs	741 ft^3
9S	5,000 sq.ft.	50-yr (2.0")	0.16 cfs	741 ft^3
10S	31,064 sq.ft.	50-yr (2.0")	1.00 cfs	4,574 ft^3
11S	1,800 sq.ft.	50-yr (2.0")	0.06 cfs	261 ft^3

POND #	STORAGE REQUIRED	STORAGE PROVIDED	WATER HEIGHT	OVERFLOW HEGHT
1P	5,213 ft^3	8,378 ft^3	3.76 ft	5.0 ft
2P	1,727 ft^3	10,615 ft^3	1.07 ft	5.0 ft
3P	1,548 ft^3	3,696 ft^3	2.80 ft	5.0 ft
4P	2,021 ft^3	2,585 ft^3	4.35 ft	5.0 ft
DW1	405 ft^3	452 ft^3	8.21 ft	12.0 ft
DW2	2,368 ft^3	3,064 ft^3	7.89 ft	15.0 ft

Infiltration swale can retain the 50-year storm volume with infiltration outflow.

All storm-water facilities operate according to the guidelines of the Central Oregon Storm-water Manual (COSM). The 100-yr storm has also been calculated to ensure that the facility does not overflow during this storm. See Appendix D for detailed infiltration, pond volume, and Hydrocad routing calculations.

<u>Conveyance System:</u>

The conveyance system has been designed to provide free flow conditions during the 25-year storm event with no pipe or parking lot flooding. All onsite storm improvements will be privately owned & maintained by the property owner. All structures and pipes will meet the requirements the City of Redmond Standards.

ESC Analysis and Design:

The property is relatively flat with a slight slope from northwest to southeast across the site. Oak Tree Lane is paved with curb, gutter, and catch basins, including a public street system infiltration drywell system. The surrounding street system is higher in elevation that the undeveloped property. The developed site will be filled so that the finished floor of the proposed building is slightly higher than the surrounding street system.

The following site-specific erosion and sediment control measures will be used during construction:

- Gravel construction entrance
- Temporary drainage cut off ditches on the west and south property lines
- Inlet protection
- Concrete washout

A grading and erosion and sediment control plan is included in the civil engineering site construction drawings. See civil plans for site specific requirements.

The following is a discussion of the 16 elements listed in Section 9.4.3 of the COSM.

1. Project Management **Is Applicable**

- Hold a pre-construction meeting that includes the inspector to discuss erosion and sediment control measures and construction limits;
- The ESC plan must be kept onsite at all times when work is occurring;
- The ESC measures shown on this plan are minimum requirements for anticipated site conditions. During the construction period, the measures must be upgraded as needed to comply with all applicable local, state, and federal erosion and sediment control regulations;
- Erosion and sediment control measures shown on the plan must be installed in such a manner to ensure that sediment or sediment laden water does not leave the construction site or enter surface waters or the conveyance system; and
- Consult DEQ for review of any treatment system or operational plan that may be necessary to treat contaminated construction dewatering water or sediment and turbidity in stormwater runoff.

2. Construction Sequence **Is Applicable**

- Schedule major land disturbing activities during the dry months and allow time before the wet season begins to adequately stabilize the disturbed ground (see the Soil Stabilization step below).
- Phase and/or schedule construction to limit the amount of disturbed, un-stabilized soil exposed at any one time.

- The following construction sequence shall be followed in order to best minimize the potential for erosion and sedimentation control problems:
  a) Fence or flag areas to be protected or left undisturbed during construction;
  b) Install graveled or paved construction entrances, exits, and parking areas to reduce the tracking of sediment onto public or private roads;
  c) Clear and grub sufficiently for installation of temporary ESC BMPs;
  d) Install temporary ESC BMPs; constructing sediment trapping BMPs as one of the first steps prior to grading;
  e) Clear, grub and rough grade for roads and utility locations;
  f) Clear, grub and grade individual lots or groups of lots;
  g) Temporarily stabilize, through re-vegetation or other appropriate BMPS, lots or groups of lots in situations where substantial cut or fill slopes are a result of the site grading;
  h) Construct roads, buildings, permanent stormwater facilities (i.e. inlets, ponds, UIC facilities, etc.);
  i) Protect all permanent stormwater facilities utilizing the appropriate BMPs;
  j) Remove temporary ESC controls when permanent stormwater facilities have been installed, all land-disturbing activities have ceased, and vegetation has been established in the areas noted on the accepted ESC plan.

3. Clearing Limits **Is Applicable**

- Distinctly mark all clearing limits, both on the plans and in the field, taking precaution to visibly mark separately any sensitive or critical areas, and their buffers, and trees that are to be preserved, prior to beginning any land-disturbing activities, including clearing and grubbing;
- Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum extent and duration practical;
- Where clearing is required, limit the compaction of disturbed soil by laying mulch, chipped wood, or plywood sheets.
- If clearing and grubbing has occurred, there is a window of 10 calendar days during the dry season (July 1 through September 30) and 5 calendar days during the wet season (October 1 through June 30) in which construction activity must begin, otherwise the cleared area must be stabilized.
- Suggested BMPs:
  - EP-2 Preservation of Existing Vegetation

4. Construction Access Route **Is Applicable**

- Limit access for construction vehicles to one route whenever possible.
- Establish construction equipment paths throughout the site to limit compaction of proposed landscaping and stormwater facility areas. Whenever possible, establish equipment paths on the proposed street and paved parking locations.
- Stabilize the construction access route with a 3-6 inch rock or similar sized crushed aggregate construction entrance to minimize the tracking of sediment onto roadways;
- Inspect all roadways adjacent to the construction access route at the end of each day. Significant amounts of sediment that leaves the construction site must be cleaned up

within 24 hours and stabilized back on the site or properly disposed. The cause of sediment release must be identified and prevented from causing a recurrence of the discharge within the same 24 hours. Vacuuming or dry sweeping must be used to clean-up released sediment and sediment must not be intentionally washed into storm sewers, drainage ways, or water bodies.

- Locate wheel wash or tire baths onsite, if applicable, disposing of wastewater into a separate temporary onsite treatment facility, or note that washout will be done offsite.
- Cover and secure all dump truck loads leaving the construction site to minimize spillage on roads; and
- Restore construction access route equal to or better than the pre-construction condition.
- Suggested BMPs:
    - SC-10 Entrance/Exit Tracking Control
    - SC-11 Entrance/Exit Tire Wash

5. Sediment Controls **Is Applicable**

- Pass stormwater runoff from disturbed areas through a sediment pond prior to leaving a construction site or discharging to an infiltration facility.
- Limit compaction of the bottom area of both temporary and permanent stormwater control facilities.
- Keep sediment on the project site, to the maximum extent practical, in order to protect adjacent properties, water bodies, and/or roadways.
- Stabilize earthen structures such as dams, dikes, and diversions with either crushed aggregate, seed or mulch, erosion control blankets, turf reinforcing mats, or a combination thereof;
- Locate sediment facilities such that they will not interfere with natural drainage channels and/or streams; and
- Inspect sediment control BMPs weekly, at a minimum, and daily during a storm event, and after any discharge from the site (stormwater or non-stormwater). The inspection frequency may be reduced to once every two weeks if the site is stabilized and inactive. Keep records of inspections, results, and corrective actions.
- Suggested BMPs:
    - SC-1 Sediment Fence / Temporary Cut Off Ditches
    - SC-2 Sand Bag Barrier
    - SC-3 Gravel Bag Berm
    - SC-7 Fiber Rolls or Wattles
    - SC-9 Temporary Sediment Basin

6. Soil Stabilization **Is Applicable**

- Select appropriate BMPs that protect the soil from the erosive forces of raindrop impact, flowing water, and wind erosion, taking into account the expected construction season, site conditions and estimated duration of use.
- Control fugitive dust from construction activity. Note that dust control must be continuous, particularly during the dry season (i.e. not limited to the 5/10 calendar day limits listed below);

- Stabilize exposed unworked soils (including stockpiles), whether at final grade or not, within 10 calendar days during the regional dry season (July 1 through September 30) and within 5 calendar days during the regional wet season (October 1 through June 30). This time limit may be adjusted by DEQ if your site requires a 1200-C permit or by the local jurisdiction if local precipitation conditions justify a different standard. In addition to the above guidelines, contractors are expected to track weather conditions and forecasts and stabilize sites as needed to prevent erosion and meet the performance standards outlined in Section 9.5.1.
- Stockpile soil stabilization materials at the project site, particularly during the wet season; and
- Stabilization practices include, but are not limited to, temporary and permanent seeding, mulch, sod, matting, plastic covering, early application of gravel base on areas to be paved, and dust control.
- Suggested BMPs:
    - EP-5 Temporary Seeding and Planting
    - EP-8 Mulches
    - EP-10 Erosion Control Blankets and Mats
    - EP-13 Wind Erosion Control

<u>*7. Inlet Protection*</u> **Is Applicable**

- Protect inlets, drywells, catch basins and other stormwater management facilities from sediment, whether or not facilities are operable, so that sediment does not enter the conveyance system (both on and offsite).
- Inlet protection devices should be installed in such a matter as to allow filtered water to enter the facility and prevent localized flooding. As an alternative, a bypass can be provided to an alternate collection location.
- Keep roads adjacent to inlets clean; sediment and street wash water shall not be allowed to enter the conveyance system (both on and offsite) without prior treatment; and
- Inspect inlets weekly at a minimum and daily during storm events. Clean or remove and replace inlet protection devices before six inches of sediment can accumulate.
- Suggested BMP:
    - SC-8 Storm Drain Inlet Protection

<u>*8. Runoff Control*</u> **Is Applicable**

- Protect downstream properties, waterways, and stormwater facilities from possible impacts due to increased flow rates, volumes, and velocities of stormwater runoff from the project site that may temporarily occur during construction.
- Install sediment controls along the site perimeter on all down gradient sides of the construction site before commencing earth disturbing activities.
- Whenever possible, construct stormwater control facilities (detention/retention storage pond or swales) before grading begins. These facilities should be operational before the construction of impervious site improvements.
- Protect permanent infiltration ponds that are used for flow control during construction; and

- Suggested BMPs:
  - SC-1 Sediment Fence or Temporary Cut Off Ditches.
  - SC-6 Compost Berms or Socks
  - SC-7 Fiber Rolls or Wattles
  - SC-9 Temporary Sediment Basin
  - RC-11 Check Dams

9. Concrete Washout **Is Applicable**

- Designate the location of a slurry pit where concrete trucks and equipment can be washed out. Slurry pits are not to be located in, or upstream of, a swale, drainage area, stormwater facility, water body, or in an area where a stormwater facility exists or is proposed.
- Suggested BMPs:
  - SC-11 Entrance/Exit Tire Wash
  - NS-14 Concrete Management

10. Material Storage/Stockpile **Is Applicable**

- Identify location for storage/stockpile areas, within the proposed ESC plan boundaries, for any soil, earthen and landscape material that is used or will be used onsite.
- Stockpile materials (such as topsoil) onsite, keeping off of roadway and sidewalks; and
- Maintain onsite, as is feasible, items such as gravel and a roll of plastic, for emergency soil stabilization during a heavy rain event, or for emergency berm construction.
- Suggested BMPs:
  - NS-9 Stockpile Management

11. Cut and Fill Slopes **Is Applicable**

- Consider soil type and its erosive properties; • Reduce slope runoff velocities by reducing the continuous length of slope with terracing and diversion, and roughening the slope surface.
- Place check dams at regular intervals within ditches/trenches that are cut into a slope; and
- Stabilize soils on slopes.
- Suggested BMPs:
  - EP-5 Temporary Seeding and Planting
  - RC-2 Energy Dissipater
  - RC-11 Check Dams

12. Channel and Outlet Stabilization **Is Applicable**

- Design, construct and stabilize all temporary onsite conveyance channels to prevent erosion from the expected flow velocity of a 2 year, 24 hour frequency storm in the post-developed condition; and,
- Stabilize outlets of all conveyance systems adequately to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches.

- Suggested BMPs:
  - EP-10 Erosion Control Blankets and Mats
  - RC-2 Energy Dissipater
  - RC-11 Check Dams

13. Dewatering **Not Applicable**

- Discharge into a controlled system, prior to discharge into a sediment trap or sediment pond, any effluent of dewatering operations that has similar characteristics to stormwater runoff at the site, such as foundation, vault, and trench dewatering.
- Handle highly turbid or otherwise contaminated dewatering effluent, such as from a concrete pour, construction equipment operation, or work inside a coffer dam, separately from stormwater disposed of onsite.
- Consider other disposal options such as infiltration, transport offsite for legal disposal, and/or treat and dispose onsite with chemicals or other technologies.
- If the site requires dewatering, check to determine if there are any toxic pollutants in the soil or groundwater by checking for odors, discoloration, or an oily sheen. Also check site records for soil and groundwater test results for commercial projects. If toxic pollutants are suspected, the water should be tested by a certified lab and the results discussed with municipal and DEQ staff prior to any dewatering activity; and
- Applicable methods for dewatering include filter boxes, portable sediment tanks, and sump pits with perforated standpipes wrapped in filter packs and surrounded by stone.
- Suggested BMPs:
  - NS-1 Dewatering and Ponded Water Management

14. Control of Other Pollutants **Is Applicable**

- Control all onsite pollutants, such as waste materials and demolition debris, in a manner that does not cause contamination of stormwater or groundwater; woody debris may be chopped or mulched and spread onsite.
- Cover, contain and protect all chemicals, liquid products, petroleum products, other hazardous materials, and non-inert wastes present onsite from precipitation and/or vandalism. Maintain a supply of materials on hand to address and contain spills.
- Locate designated vehicle and equipment service areas, fuel, and materials away from drainage inlets, watercourses, and canals. Properly contain areas using berms, sandbags, or other barriers. Regularly inspect and maintain equipment, especially for damaged hoses and leaky gaskets.
- Conduct maintenance and repair of heavy equipment and vehicles (i.e. oil changes, fuel tank drain down, etc.) that may result in discharge or spillage of pollutants using spill prevention measures, such as drip pans. Clean all contaminated surfaces immediately following any discharge or spill incident. Perform repairs onsite using temporary plastic or oil absorbing blankets beneath the vehicle.
- Designate an area for cleaning painting equipment and tools. Never clean brushes or rinse containers into the street, gutter, drainage inlet, or waterway.
- Apply landscaping or agricultural chemicals, including fertilizers and pesticides, in such a manner, and at application rates, that inhibits the loss of chemicals into

stormwater runoff facilities. Use drop spreaders, rather than broadcast spreaders to help prevent chemicals from being spread onto sidewalks, streets, or storm drainage systems. Guidelines on proper use and application of chemicals, including fertilizers and pesticides, can be found in the Pacific Northwest Weed Control Handbook, published by the Extension Services of Oregon State University, Washington State University, and the University of Idaho (revised annually).

- Locate pH-modifying sources, such as bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and cutting, exposed aggregate processes, and concrete pumping and mixer washout waters, away from any stormwater facilities or location of proposed stormwater facilities; and
- See Chapter 10 – Source Control for additional guidance.

15. Permanent Facilities **Is Applicable**

- Utilize permanent BMPs (i.e. stormwater ponds) in the ESC plan to ensure that successful transition from temporary BMPs to permanent BMPs occurs;
- During final site stabilization, inspect, maintain (i.e. remove sediment) and re-vegetate all permanent stormwater ponds that were used for sediment control;
- When possible, select vegetation designed to reduce the need for fertilizers or pesticides (i.e. native, pest resistant, xeriscaping); and
- Consider improving the stormwater retention capability of the site soils by amending with organics or mulch prior to vegetation installation.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contaminants from contacting stormwater runoff.

16. Maintenance of BMPs **Is Applicable**

- Inspect on a regular basis (at a minimum weekly, and daily during/after a runoff producing storm event) and maintain all erosion and sediment control BMPs to ensure successful performance of the BMPs.
- Conduct maintenance and repair in accordance with individual ESC BMPs outlined in this section. Recommended maintenance standards include:
    - Sediment must be removed from behind a Sediment Fence when it has reached a height of 1/3 of the fence height and also before fence removal,
    - Sediment must be removed from behind Bio Bags, Straw Wattles, and other barriers when it has reached a height of 2 inches and also before BMP removal, and
    - Sediment must be removed from a sediment basin, sediment trap, or catch basins when it has filled half (50%) of the facility storage capacity and also at the completion of the project.
- Remove temporary ESC BMPs within 30 days after the temporary BMPs are no longer needed. Permanently stabilize areas that are disturbed during the removal process. Properly dispose of or store for future use any ESC materials following removal; and
- In addition to the above guidelines, contractors are expected to track weather conditions and forecasts and stabilize sites as needed to prevent erosion and meet the performance standards outlined in Section 9.5.1.

Long Term Maintenance:

The SELCO credit union at Red Rock Center developed facility contains an onsite private stormwater system that drains the parking lot and roof areas of the site. It is the responsibility of the property owner to inspect, operate, and maintain the stormwater facilities, and storm lines described below. There will be no HOA or other group maintenance, therefore financial guarantees are not required.

The owner shall at all times maintain the following elements of the stormwater system:

- All onsite underground storm piping & catch basins
- The storm water infiltration/detention pond.

The following Operations and Maintenance requirements are intended to serve as a guide only. Each stormwater facility is different and may require maintenance different, less than, or above and beyond what is discussed in this manual.

Catch Basins and Inlets:
Catch basins trap sediment and some oils than can pollute water bodies. They need to be inspected and cleaned annually to remove accumulated sediment, fluids, and trash.

Inspection:
Inspect catch basins at least once per year. Periodically inspect the catch basin and surrounding areas for pollutants such as minor spills and oil dumping. Remove the pollutant source as soon as discovered.

Cleaning:
Clean catch basins when they become one third full to maintain sediment-trapping capacity. Catch basin and manhole cleaning should be performed in a manner that keeps removed sediment and water from being discharged back into the storm sewer. Clean putrid materials such as oils and trash from catch basins when discovered. Keep the inlet cleared of debris and litter.

Safety:
Work inside underground structures requires special OSHA required confined space equipment and procedures. The most practical option for catch basin maintenance may be to contract with a sewer cleaning contractor.

Materials Handling:
Dispose of waste from maintenance of drainage facilities shall be conducted in accordance with federal, state, and local regulations. Removed sediment must be disposed of in the garbage as solid waste. Water should be disposed of in a sanitary sewer after oils are removed using oil absorbent materials or other mechanical means. Used oil absorbents should be recycled or disposed of according to the manufacturer's instructions.

Repairs:
Repair any damages that prevent the catch basin from functioning as designed, such as broken or damaged grates, outlet elbows, or concrete surfaces.

Storm Pipe:
Storm sewer pipes convey stormwater, and consist of many different materials. Storm pipes are cleaned to remove sediment or blockages when problems are identified. Storm pipes must be clear of obstructions and breaks to prevent localized flooding.

Inspection:
Pipes are difficult to inspect, requiring special equipment and training. Usually, if a problem occurs, the owner needs to call a sewer or plumbing contractor to inspect, repair, or clean pipelines.

Cleaning:
Clean pipes when sediment depth is greater than 20 percent of the pipe diameter. When cleaning a pipe, minimize sediment and debris discharges from pipes to the downstream storm sewer. Install downstream debris traps (where applicable) before cleaning and then remove collected material. Generally, use mechanical methods to remove root obstructions from inside storm sewer pipes. Do not put root-dissolving chemicals into storm sewer pipes. If there is a problem, remove the vegetation over the line and use mechanical means to clean the pipe.

Safety:
Work inside underground structures requires special OSHA required confined space equipment and procedures. The most practical option for pipe maintenance may be to contract with a sewer cleaning contractor.

Materials Handling:
Dispose of waste from maintenance of drainage facilities shall be conducted in accordance with federal, state, and local regulations. Removed sediment must be disposed of in the garbage as solid waste.

Repairs:
Repair or replace pipes when a dent or break closes more than 20 percent of the pipe diameter. Repair or replace pipes damaged by rust or deterioration.

Infiltration Basins/Ponds:

Infiltration facilities dispose of water by holding it in an area where it can soak into the ground. These open facilities that may either drain rapidly and have grass or rock bases, or have perpetual ponds where water levels rise and fall with stormwater flows.

Infiltration facilities may be designed to handle all of the runoff from an area, or they may overflow and bypass larger storms.

Since the facility is designed to pass water into the ground, anything that can cause the base to clog will reduce performance and is a large concern. Generally, infiltration basins are managed like detention ponds but with greater emphasis on maintaining the capacity to infiltrate stormwater.

Inspection:
Check once per year after rainstorms to see if the facility is draining as intended. Inspect annually for all features. A thorough inspection of the observation points should be made if there is a decrease in retention basin capacity. Inspection points can include monitoring ports built into the base of the facility and water table depth monitoring wells.

Identify and remove pollutant sources to the facility. Inspect the facility for oil and other pollutants and remove any pollutants greater in volume than a surface sheen.

Cleaning:
Trash should be removed when it exceeds 1 cubic foot per 1000 square feet. Remove sediments when it accumulates 2 inches or if the facility does not drain between storms or meet 90% of design capabilities. Sediment may be removed by hand or by hiring a licensed earth moving contractor.

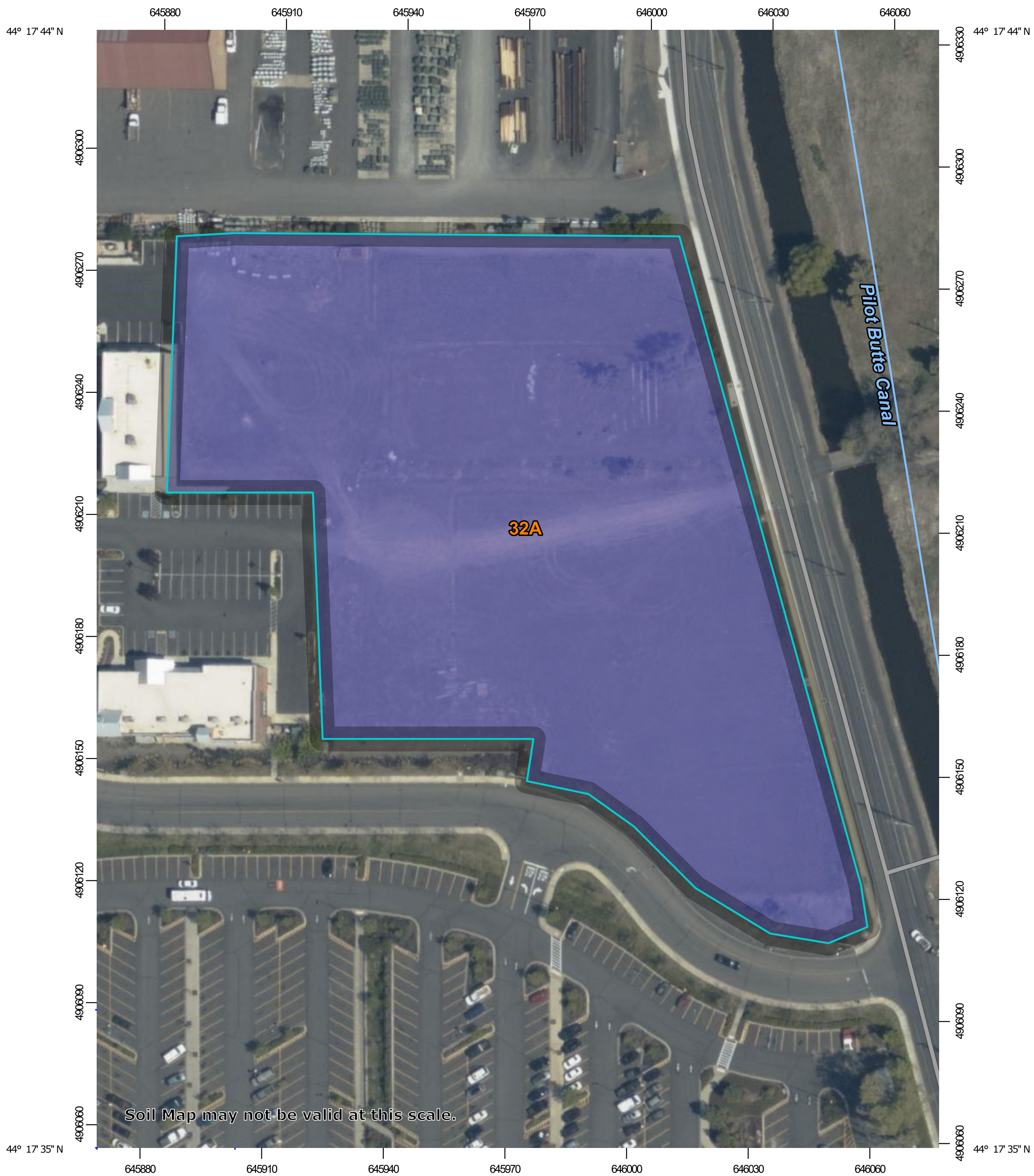
Materials Handling:
Dispose of waste from maintenance of drainage facilities shall be conducted in accordance with federal, state, and local regulations. Removed sediment must be disposed of in the garbage as solid waste.

Vegetation Management:
If existing, mow or control vegetation to match surrounding areas or sustain any other intended use of the facility. Pesticides and fertilizers should not be used because of the likelihood of the chemicals leaching into the ground. Use mechanical methods to control weeds. If rock-scape is used in the facility, maintain in good working order.

Repairs:
Repair and seed bare areas. Repair eroded slopes when rills form, where the cause of damage is present, or there is potential for future erosion. If the facility is overflowing for storms it was designed to infiltrate, it needs to be repaired. This requires removing accumulated sediment and cleaning or rebuilding the system so that it works according to design.

Appendix A

121° 10' 17" W
121° 10' 8" W



121° 10' 17" W
121° 10' 8" W

Map Scale: 1:1,340 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0, 15, 30, 60, 90

Feet: 0, 50, 100, 200, 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Upper Deschutes River Area, Oregon, Parts of Deschutes, Jefferson, and Klamath Counties
Survey Area Data: Version 17, Sep 14, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 7, 2020—Jun 2, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
32A	Deschutes sandy loam, dry, 0 to 3 percent slopes	B	4.5	100.0%
Totals for Area of Interest			**4.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix B

KLEINFELDER

GEOTECHNICAL EXPLORATION REPORT
PROPOSED REDROCK CENTER
NW OF 2ND STREET AND CANAL BLVD.
REDMOND, OREGON

November 29, 2006

Kleinfelder Project No. 76018 (A01)

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KLEINFELDER 62915 NE 18th Street, Suite 1 Bend, OR 97701 (541) 382-4707 (541) 383-8110 fax

KLEINFELDER

A Report Prepared For:

Mr. James Lewis
Desertscape, LLC
920 NW Bond Street, Suite 200
Bend, OR 97701

GEOTECHNICAL EXPLORATION REPORT
PROPOSED REDROCK CENTER
NW OF 2ND STREET AND CANAL BLVD.
REDMOND, OREGON

Kleinfelder Project Number 76018 (A01)

Prepared By:

Reviewed By:

REGISTERED PROFESSIONAL ENGINEER 14227 OREGON NOV. 29, 1988 MARK V. HERBERT EXPIRES 6/30/2007

Travis Farstvedt, E.I.T.
Staff Geotechnical Engineer

Mark V. Herbert, P.E.
Senior Geotechnical Engineer

KLEINFELDER, INC.
62915 NE 18th Street
Suite 1
Bend, OR 97701

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November 29, 2006

EXECUTIVE SUMMARY

Kleinfelder, Inc. (Kleinfelder) has completed a geotechnical engineering exploration of the site for the proposed Redrock Center. The site is approximately 8.5 acres in size and is located between Highway 97 and Canal Boulevard on the south side of the Central Electric Co-Op facility, in Redmond, Oregon. The project location is shown on Figure 1, Vicinity Map.

The project consists of 6 proposed buildings ranging from 3,100 square feet to 19,140 square feet in plan, paved drive and parking areas, grading, stormwater collection system, utilities, and landscaping. A site map depicting the proposed building locations is presented on Figure 2.

Based on this investigation, the site appears suitable for the proposed development from a geotechnical perspective. Key items are summarized below and are discussed in greater detail in the body of this report.

Soils/Bedrock: Our subsurface exploration encountered native soils to shallow to moderate depths, one foot to 14 feet, overlying basalt bedrock. The overburden soils were generally silty sand. These soils are believed to be ash-fall deposits, and are locally referred to as Mazama Ash. Isolated deposits of existing gravel and cinder fill, less than 1.5 feet thick, were also encountered. Beneath the soils and fill, basalt bedrock was generally encountered by the air track borings and test pits. The air track borings were drilled to a depth of 34 feet below ground surface (bgs). The test pits were excavated to a maximum depth of 4.5 feet bgs. See Section 4.2.

Groundwater: Groundwater was not encountered during exploration and is not expected to influence site development. The regional groundwater table in the area is estimated to occur at depths in excess of about 200 feet bgs. See Section 4.2.5.

Foundations: We recommend the proposed buildings be supported by spread footings. Footings founded upon re-compacted native silty sand, compacted structural fill or basalt bedrock should be designed for a maximum allowable bearing pressure of 3,000 pounds per square foot (psf). We recommend a minimum width of 16-inches for strip footings and 24-inches for isolated column footings. See Section 5.3.

Slabs: The native soils, basalt rock and compacted fill should provide acceptable support for floor slabs. Four inches of crushed gravel base course should be placed beneath floor slabs. A vapor retarder is not necessary beneath slabs, if floor coverings are not moisture-sensitive. The native silty sand soils exhibit a low potential for frost heave. See Section 5.5.

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Seismic: Based upon our knowledge of local geologic conditions and subsurface exploration at the site, subsidence, fault rupture, lateral spreading and liquefaction are not considered to be significant site hazards. Ground shaking from a seismic event would induce motions indicative of this site being underlain by shallow bedrock. We recommend International Building Code (IBC) Site Class B be used for structural design. See Section 5.2.

Structural Fills: Structural fill should consist of on-site silty-sand, removed from on-site borrow areas, or imported granular material. The native sand is relatively dry to damp, and will require moisture-conditioning to achieve proper compaction. Structural fill beneath footings, floor slabs and pavement should be compacted to 95 percent of ASTM D698. See Section 5.6.

Drainage Considerations: Based on the infiltration rates measured and granular nature of the soils, it is our opinion the soils exposed at the bottom of the proposed retention basin in the areas of P-01 through P-05 are capable of absorbing some storm water runoff. The soils are non-plastic (low clay content) and are relatively loose. During winter, frozen ground conditions inhibit infiltration, however, the rate of runoff from melting snow is slower. Shallow hardpan and basalt bedrock will also impede downward flow of water. It is likely that standing water will occasionally be present and require several weeks to dissipate. If this is not acceptable, we recommend the underlying bedrock be loosened by blasting. See Section 5.7.

Pavement Sections: A pavement section of 3-inches of asphaltic concrete (AC) overlying 8- inches of crushed aggregate base course (ABC) is recommended for service areas and driveways. For paved automobile parking areas, a pavement section of 2-inches of AC overlying 6-inches of ABC is recommended. See Section 5.8.

This summary is intended for introductory and reference purposes only. A thorough reading of the body of the report is necessary to fully understand the recommendations contained herein.

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Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

1.0 INTRODUCTION

1.1 General

Mr. Craig Glazier of Desertscape, LLC. authorized Kleinfelder on September 24, 2006 to perform a geotechnical exploration for the proposed Redrock Center. The site is located between Highway 97 and Canal Boulevard on the south side of the Central Electric Co-Op facility in Redmond, Oregon. It is approximately 8.5 acres in size. The project site and location is shown on Figure 1, Vicinity Map.

1.2 Project Description

The project includes six proposed buildings ranging from 3,100 square feet to 19,140 square feet in plan with slab-on-grade floors, paved drive and parking areas, grading, a stormwater collection system, utilities, and landscaping. A site map depicting the proposed building locations is presented on Figure 2, attached. Figure 2 was prepared based on the Site Plan provided by KJD Architecture. Access to the property will be from Highway 97 and Canal Boulevard.

1.3 Purpose and Scope of Services

The purpose of this exploration was to evaluate subsurface conditions beneath the proposed building footprints, surrounding pavement areas and stormwater disposal areas in order to provide recommendations for foundation design and other geotechnical aspects related to site development. Our scope of services included the following tasks.

- Explore soil and bedrock conditions by drilling 18 air track borings within the proposed building footprints;
- Explore shallow soil conditions by excavating 12 test pits in the planned building footprint, pavement areas, and three, potential stormwater retention areas;
- Perform infiltration tests at four proposed stormwater retention basin areas;
- Conduct laboratory tests to characterize soil characteristics throughout the site, encountered by the test pits;
- Perform engineering analysis to develop recommendations for foundations, floor slabs, site preparation, excavation and grading, drainage and pavement; and
- Prepare this geotechnical report summarizing our findings, conclusions and recommendations.

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2.0 FIELD EXPLORATION

Eighteen exploratory air track borings were drilled on October 19, 2006. The depths of the borings were 34 feet below ground surface (bgs). Air track borings are drilled using a rotary hammer bit and compressed air to remove the drill cuttings. The penetration rate is recorded as the drill bit advances. The penetration rate is empirically related to geologic material types. Air track borings are well suited to determine the stratigraphy and hardness of consolidated deposits; i.e. bedrock. Stratigraphic representations shown on the air track boring logs are based on the penetration rate data, our knowledge of the local/regional geology, and our experience with similar conditions. Samples recovered by air track drilling methods are of limited use, and were not retrieved. Subsurface soil conditions encountered are presented on air-track logs in Appendix A, Figures A-1 through A-18. An Air-Track Boring Log Legend is presented for reference on Figure A-19.

Twelve exploratory test pits were excavated on October 25, 2006. The depth of the pits ranged from one foot to 4.5 feet below ground surface (bgs). Test pits were excavated with a John Deere 410G, rubber-tired backhoe. The test pits were excavated to evaluate the characteristics and depths of the shallow soils and bedrock. At representative locations, penetration tests were performed on the shallow overburden sand soils with a manually-operated, dynamic cone penetrometer. This device utilizes a 15-lb. weight falling 18 inches to drive a 1½-inch diameter cone into the soils. The number of blows required to drive the cone 12 inches into the subsoils gives an indication of the relative density or stiffness of the granular or cohesive soils encountered. Results of the penetration tests are presented on exploratory test pit logs, in Appendix B. Eight soil samples were obtained from the test pits for subsequent laboratory testing. Subsurface soil conditions encountered are presented on test pit logs in Appendix B, Figures B-1 through B-12. A Test Pit Log Legend is presented for reference on Figure B-13.

Infiltration tests were performed to evaluate stormwater absorption rates for five proposed stormwater retention ponds. A six-inch diameter pipe was inserted into the exposed soils at the bottom of the test pit and the annular space around the pipe was sealed with granular bentonite to minimize upward seepage outside of the pipe during the tests. The pipe was filled with water to saturate the underlying soils prior to conducting the test. After the saturation period, the holes were re-filled and water depth measurements were taken at 30-minute intervals. Measurements were recorded for approximately four hours within the infiltration pipes, or until "perc" rates became relatively stable or ceased. See Table I for infiltration test data.

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A Kleinfelder geotechnical engineer monitored the explorations, logged the borings and test pits, visually classified the materials encountered and retrieved samples. The boring logs and test pit logs describe the materials encountered at each location explored. The soil and rock characteristics between and away from exploration locations will vary. The stratigraphic contacts indicated at each location represent the approximate boundaries between soil and rock types. Test pit locations were backfilled with the excavated materials in an uncontrolled manner and will not perform as structural fill. Test pit locations should be re-excavated and re-placed as structural fill.

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3.0 LABORATORY TESTING

Recovered soil samples were returned to our Bend laboratory where they were visually classified and prepared for laboratory analysis. Index testing was completed on representative soil samples and consisted of moisture content and grain size analysis. Laboratory test results are included in Appendix C.

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4.0 EXISTING SITE CONDITIONS

4.1 Surface

The site is situated between Highway 97 along its west boundary, Canal Boulevard along its east boundary and a Central Electric Co-Op facility along the north boundary. A Walmart Supercenter is being developed on the open space adjacent to its south boundary. The property is mostly grass covered, with isolated mature Juniper trees throughout the site. An existing irrigation canal flows south to north through the center of the property. We understand that the irrigation canal will be abandoned and re-located.

4.2 Subsurface

Our subsurface exploration encountered isolated deposits of existing fill and native soils to shallow to moderate depths overlying basalt bedrock. The overburden soils were generally silty sand. These soils are believed to be ash-fall deposits, and are locally referred to as Mazama Ash. Beneath the overburden soils, basalt bedrock was generally encountered by the air track borings. The soil and bedrock profile within the limits of our exploration is described below in the general stratigraphic sequence in which they were encountered.

4.2.1 Existing Fill

Existing fill was encountered at isolated locations throughout the site. Test Pit TP-01 and TP-07 encountered existing base rock fill to depths ranging between 0.5 to one-foot bgs. This existing fill was used as a driveway for the previous site activities. Test Pit P-01 and P-02 encountered existing red cinder fill between depths of 1.0 to 1.5 feet bgs. The origin of this existing fill is a parking lot for a previous car lot along Highway 97.

4.2.2 Silty Sand with Gravel

Native silty sand with gravel was encountered in all test pits to depths ranging between one foot to 3.5 feet bgs. Silty sand depths in the air-track borings ranged between 2 and 14 feet bgs. This silty sand is typically fine to medium grained, brown and damp where encountered. At some locations these soils contain subangular gravel up to 0.5 inch to 3 inches in diameter. Believed to have been deposited by volcanic ash-fall, this silty sand is locally referred to as Mazama Ash. The Mazama Ash was typically two to three feet deep when deposited approximately 7,000 years ago, but has been re-worked by wind and water, forming isolated, deeper deposits. Gradation tests indicate the native soils classify as silty-sand (SM) according to the Unified Soil Classification

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System and contain between 24.5 and 37.1 percent clay- and silt-sized particles. Moisture content of the native silty-sand ranges between 6.1 and 14.5 percent. All test pits excavated through the overburden silty sand were terminated due to refusal, generally at the top of the hardpan and basalt bedrock.

4.2.3 Hardpan

Cemented hardpan was encountered at eight test pit locations. The top of the cemented hardpan was encountered at depths ranging from two to 3.5 feet bgs. The hardpan encountered was generally medium dense to dense in the upper zone, and could be penetrated by the John Deere 410 backhoe. The hardpan generally became harder with increased depth to the termination of the test pits because of refusal. Local experience indicates that cemented hardpan can frequently be excavated using large trackhoes and ripped using large bulldozers.

4.2.4 Basalt Bedrock

Basalt bedrock was penetrated at all 18 air track boring locations. The top of the basalt was inferred in the air track borings by increased resistance at the overburden soil-bedrock contact, at depths ranging from two to fourteen feet bgs. The basalt encountered was generally medium hard to hard based on the penetration rates of the air track borings. The upper layer of this basalt is a consolidated deposit, known locally as Newberry Basalt, based on its origin as a lava flow from the Newberry volcano southeast of Bend, Oregon.

4.2.5 Groundwater

No groundwater was encountered in any of the borings, although the exploration methods employed were not specifically intended to explore for groundwater. The regional groundwater table in the area is estimated to occur at depths in excess of about 200 feet bgs. Groundwater is not expected to significantly impact site development. Limited subsurface seepage and surface drainage should be expected to follow the natural surface grades. Some seepage may occur adjacent to the irrigation canal, which is unlined and tends to saturate soils laterally for a few to dozens of feet.

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5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the field exploration, laboratory testing, engineering analysis and our local experience, it is our opinion that the site is suitable for the proposed development from a geotechnical perspective, provided the recommendations presented in this report are incorporated into design and construction.

5.1 Regional Geology

Redmond is located within the High Lava Plains Physiographic Province of central Oregon. This relatively young volcanic region is characterized by a multitude of volcanic cones and buttes, lava flows, and lava tubes. The region exhibits moderate topographic relief and is relatively smooth in nature. The region exhibits a poorly developed drainage network with few canyons and gullies as a result of central Oregon's locations in the rain shadow formed by the Western and High Cascade Mountains. Yearly precipitation averages between 10-15 inches. With exception of talus depositions, isolated lake-bottom sediments, and fluvial debris, most of the rocks in the province are volcanic, and thick accumulations of basaltic lava are common.

5.2 Seismic Hazards

Based upon our knowledge of local geologic conditions and subsurface exploration at the site, subsidence, fault rupture, lateral spreading and liquefaction are not considered to be significant site hazards. Ground shaking from a seismic event would induce motions indicative of this site being underlain by shallow, hard bedrock.

We recommend International Building Code (IBC) Site Class B be used for structural design, based on the results of our exploration and our local experience. A "seismic site hazard investigation" according to State of Oregon State Structural Specialty Code (2004) was not requested for this project and, thus, no further seismic design parameters are provided herein.

5.3 Foundations

We recommend the proposed buildings be founded on conventional, spread footings. The footings should bear on recompacted native soil, properly compacted structural fill, or competent basalt bedrock. Footings bearing on these materials should be designed for a maximum allowable bearing pressure

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of 3,000 psf. The following criteria should also be incorporated into project plans and specifications:

- Exterior footings should bear below frost depth. A foundation burial depth of 18 inches is recommended for exterior footings.
- Continuous strip footings should be at least 16 inches wide. Isolated pad footings should be at least 24 inches square. A structural engineer should determine footing dimensions.
- The total settlement under the recommended bearing pressure should not exceed ½-inch in native soil or compacted fill areas. Differential settlement across a 20-foot span should be less than ¼-inch in soil or fill areas. Settlement potential of basalt bedrock is negligible, therefore, differential settlement between soil and hard rock could approach ½-inch.
- The allowable bearing can be increased by 1/3 for temporary loads such as wind and seismic.
- Structural fill beneath footings should consist of on-site, silty-sand soils, ¾-inch minus crushed aggregate base or granular import approved by the geotechnical engineer. Acceptable, imported structural fill will be well-graded sand and gravel meeting the requirements of the Engineered Fill Specifications Summary, Table 5.9-1.
- Granular fill placed beneath footings should be compacted to 95 percent of standard Proctor density, ASTM D698.
- Placement and compaction of structural fill should be observed and/or tested on a daily basis by a qualified Kleinfelder technician working under the direction of a professional geologist or geotechnical engineer.

5.4 Retaining Walls

Lateral pressures on retaining walls depend upon the type of wall, hydrostatic pressure behind the wall, type of backfill material, and allowable wall movement. Where allowable wall movement is less than approximately ½-percent of the wall height or where wall movement is constrained, lateral earth pressures should be estimated for an "at rest" condition. Where allowable wall movement is greater than ½-percent of the wall height, lateral earth pressures should be estimated for an "active" condition. Walls backfilled with on-site silty-sand material or similar import should be designed for an equivalent fluid lateral earth pressure of 50 pounds per cubic foot (pcf) for the "at rest" condition and 35 pcf for the "active" condition. These values are for a level backfill. In general, walls that are attached to a structure should be designed for the "at rest" condition and unattached walls may be designed for the "active" condition.

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We recommend a coefficient of sliding resistance between the concrete and bearing materials of 0.60 be used in the analysis. If passive earth resistance is needed, such as for keyways, a value of 350 pcf equivalent fluid pressure, should be used for the native sand or compacted fill. These values do not include a safety factor. Keyways cut into competent basalt bedrock should be designed using a uniform horizontal bearing pressure of 2,000 psf. For retaining walls not attached to a structure, hydrostatic pressures should be reduced by placing a series of weep holes at the wall base.

5.5 Floor Slabs and Exterior Concrete Flatwork

The recompacted, proof-rolled native soils, compacted structural fill, and competent, basalt bedrock should provide adequate support for floor slabs, sidewalks, and exterior concrete flat work. Based on our understanding of the project, it is likely that most of the slab-on-grade floors will bear on native silty sand and compacted structural fill. The native silty sand soils exposed below slabs should be proof-rolled with a fully-loaded, 10 cubic yard dump truck. Any deflections observed while proof rolling should be corrected before placing structural fill or base aggregate. Correction may consist of further compaction, including moisture conditioning as necessary. If the subgrade is wet and pumping, correction should consist of over-excavation to unyielding soil or bedrock, and replacement with granular structural fill. Structural fill should be compacted to 95 percent of standard Proctor density (ASTM D698).

We recommend six inches of crushed aggregate leveling course be placed beneath slabs-on-grade. The leveling course should be compacted to 95 percent of standard Proctor density, ASTM D698. If more than six inches of material is needed to establish bottom-of-slab level, either additional leveling course or structural fill, compacted to 95 percent of standard Proctor density, can be used to raise the subgrade level.

Exterior concrete flatwork, such as entryway slabs and sidewalks, should be underlain by a minimum of four inches of crushed aggregate leveling course. Structural fill beneath sidewalks should be placed in lifts not exceeding eight inches thick and compacted to 95 percent of standard Proctor density. If organic matter or other unsuitable material is exposed at slab or sidewalk subgrade elevations, it should be removed to firm, unyielding soil or bedrock, and replaced with structural fill.

We recommend floor slabs, sidewalks and entry-way slabs be reinforced. Concrete containing fibrous material would be an acceptable alternative to mesh or rebar, however, it should be noted that reinforcing fibers in concrete are intended to improve crack control and reduce aggregate segregation, but do not appreciably increase flexural strength of concrete slabs. A modulus of subgrade reaction of 300 pounds per cubic inch should be used for slab thickness design. We anticipate the maximum differential settlement of the slabs will be 1/4-inch across a 20-foot span.

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Based on the soil and bedrock conditions encountered, placement of a vapor retarder beneath interior slab-on-grade floors is not recommended for this site. In addition, an increasing body of evidence suggests vapor retarders (vapor barriers) trap moisture between the slab and membrane, aggravating or promoting slab curling and other problems, i.e. loosened floor coverings and mold. Kleinfelder is not aware of under-slab mold problems in the Redmond area. Current industry standard, however, is to place a vapor barrier on top of the crushed rock layer.

If floor moisture is not a concern, then the under-slab base material should consist of a dense-graded crushed aggregate meeting the requirements of Table 5.9-1, Engineered Fill Specifications Summary.

If floor moisture is a consideration due to moisture-sensitive floor coverings, or storage of materials directly on the floor slab, we recommend one of the following alternatives be considered:

- Place a six-inch thick layer of ¾-inch minus, washed, crushed gravel beneath the slabs. The gravel should contain less than two percent passing a No. 4 sieve. The clean, crushed gravel will act as a capillary moisture break and should minimize moisture transfer through slabs. The recommended gradation is uniformly-graded crushed gravel between ¼ inch and ¾ inch, containing less than two percent passing the No. 4 sieve, similar to coarse, asphalt pavement aggregate.
- Place a vapor barrier beneath the slab, directly on top of the compacted dense-graded crushed aggregate base course layer. The sand layers normally placed above and below the membrane to protect it from punctures during construction should not be placed. We recommend a puncture-resistant product be specified. To maximize water tightness, the membrane must be installed in accordance with the manufacturer's recommendations.

Even with a capillary break or vapor barrier placed as outlined above, there is the possibility some floor moisture or dampness may occur because of inadequate perimeter drainage or other unforeseen conditions, i.e. plumbing leaks and broken water lines. These post-construction conditions should be addressed separately by qualified specialists with local knowledge of slab moisture protection systems, flooring design, and other components that may be influenced by moisture intrusion. Our investigation addresses present subgrade conditions for slab support only and does not evaluate future, potential moisture conditions unless specifically stated otherwise.

The native silty-sand has low frost heave potential in its present moisture condition. However, if a source of moisture would be present, the silty sand would have moderate frost heave potential. Exterior slabs could heave on the order of one-inch if the silty-sand or filled subgrade soils were saturated and sub-zero temperatures occurred. Exterior slabs should be depressed from doorway

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thresholds one-inch to accommodate frost heave. The most effective and economical method to control frost heave is typically provision for adequate drainage of surface runoff away from slabs and other foundation elements.

5.6 Excavations and Grading

The native silty-sand soil stratum can be excavated with conventional earth moving equipment such as backhoes, excavators and bulldozers. The silty-sand soils most closely resemble Type B materials when applying OSHA excavation guidelines. The very hard basalt rock is fractured, but will likely require drilling and blasting or hydraulic-hammer chipping to remove. Utility trench excavations will likely encounter bedrock. Basalt bedrock excavated with hydraulic hammers would be classified as "stable rock" when applying OSHA excavation guidelines. Basalt rock that is excessively disturbed by blasting may require classification as Type A material.

Grading plans were not available for the proposed Redrock Center site at the time this exploration was conducted, however, we anticipate building pads will include a combination of shallow cuts and fills. Rock excavation may be necessary, depending on proposed foundation depths. Building footprints and structural areas should be cleared of surficial organics and roots to a depth of four inches prior to placing new fill, concrete or pavement.

The existing irrigation canal bottoms predominately on basalt bedrock. The sidewalls and saturated soils most likely consist of organic soil and strippings built up over the life of the existing canal. The sidewalls of the canal should be removed to basalt bedrock and replaced as stated in Table 5.9-1. The existing materials removed from the existing canal sidewalls should be hauled off-site for disposal.

The properly cleared subgrade in soil areas should be moistened and re-compacted by applying three to four passes of a heavy-duty sheepsfoot roller or other suitable equipment prior to placing new fill. The native, silty-sand soils will make an acceptable structural fill when properly moisture conditioned and compacted. The existing moisture content of the shallow sand is below optimum, therefore, adding water to structural fill will be needed to reach optimum moisture content, which is estimated at 20 percent.

Other acceptable structural fill materials should consist of well-graded sand and gravel, or crushed rock, meeting the requirements of Table 5.9-1. Structural fill should be placed in eight-inch lifts, watered as necessary and compacted to 95 percent of standard Proctor (ASTM D698) for fill beneath footings, floor slabs, exterior dock slabs and pavement. Structural fill beneath sidewalks and other lightly loaded structures should be compacted to 92 percent of standard Proctor. See Table 5.9-1. Observation of fill placement and compaction testing of structural fill by a Kleinfelder representative is recommended.

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5.7 Drainage Considerations

The region exhibits a poorly developed drainage network with few canyons and gullies as a result of eastern Oregon's location in the rain shadow formed by the Western and High Cascade Mountains. Yearly precipitation averages between 10-15 inches.

Runoff generated from hard-surfaced areas on this site (roof, sidewalks and pavement) will be substantial. Surface runoff in the Redmond area has historically been discharged into drywells excavated into native, gravelly-sand soils and fractured bedrock. We understand surface runoff will be routed to an on-site stormwater collection system. Desertscape, LLC requested infiltration (percolation) test data for the project site for use in stormwater system design.

A percolation test is essentially a falling-head permeability test, performed to measure the hydraulic conductivity of soils. The "perc holes" (P-01, P-02, P-03, P-04 and P-05) were excavated to the estimated infiltration test depth, and six-inch diameter PVC pipe was inserted to the bottom of each excavation. The annular space around the pipe was sealed with granular bentonite to minimize upward seepage outside of the pipe during the tests.

The pipes were filled with approximately 12 inches of water to saturate the underlying soils prior to conducting the tests. After the saturation period, the holes were re-filled and water depth measurements were taken at 30-minute intervals. Measurements were recorded for approximately four hours at each location, until "perc" rates became relatively stable, or ceased. Percolation rates, in inches per hour, for each location are tabulated below.

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TABLE I

Location	Soil Profile	Infiltration Test Depth	4-Hr. Average Infiltration Rate	Final Infiltration Rate	Recommended Infiltration Rate
P-01	Silty Sand	3 feet	9.1 inch/hr	5.5 inch/hr	2.8 inch/hr
P-02	Silty Sand	3 feet	7.1 inch/hr	5.3 inch/hr	2.6 inch/hr
P-03	Basalt Bedrock	1 foot	1.3 inch/hr	0.8 inch/hr	0.4 inch/hr
P-04	Silty Sand	2 feet	4.3 inch/hr	2.75 inch/hr	1.4 inch/hr
P-05	Silty Sand	1.5 feet	5.8 inch/hr	3.5 inch/hr	1.8 inch/hr

Based on the infiltration tests, it appears the proposed retention areas evaluated are capable of absorbing some runoff. We recommend a Safety Factor of 2.0 be applied to the final rates listed above, for design. The area of P-03 appears to be relatively impervious because of shallow bedrock.

Cemented hardpan and basalt bedrock, however, is located 1 to 3 feet below all areas tested. Our experience in similar bedrock areas indicates the bedrock and hardpan is nearly impervious and may inhibit downward flow of water. This may result in periodic standing water, which could require several weeks to dissipate. During winter, the ground periodically freezes, inhibiting percolation. Ice formation in the bottom of swales should be expected during freezing weather.

If some periodic standing water is acceptable, then no artificial drainage improvement is necessary. If standing water is not acceptable, we recommend drainage be improved by drilling and blasting the basalt bedrock. A blasting depth of ten feet is recommended.

5.8 Pavement Recommendations

The re-compacted and proof-rolled native silty-sand and properly compacted structural fill should provide adequate subgrade support for paved parking and driveways associated with the proposed building construction. The basalt bedrock possesses very high subgrade strength and is essentially non-yielding.

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Structural fill in paved areas should consist of inorganic sand and gravel having 100 percent passing a three-inch sieve, 35 percent to 65 percent passing the No. 4 sieve, and less than 20 percent passing a No. 200 sieve. It should be placed in maximum 12-inch, moisture conditioned lifts, and compacted to at least 95 percent of the standard Proctor density, ASTM D698.

Most of the vehicular traffic is expected to be automobiles and light trucks, with occasional service and delivery trucks. For exterior driveway and service areas, we recommend a pavement section of 3-inches of Asphaltic Concrete (AC) underlain by 8-inches of crushed Aggregate Base Course (ABC). For paved automobile parking areas, a pavement section of 2-inches of AC overlying 6-inches of crushed ABC is recommended. The AC should be compacted to 95 percent of Marshall density (ASTM D1559) or 91 percent of the Rice theoretical maximum density. The asphalt aggregate should meet the requirements for Class B or C, per Oregon Department of Transportation (ODOT) specifications. The ABC should consist of ¾-inch minus crushed aggregate conforming to Section 2630 of ODOT's manual for highway construction. The ABC should be compacted to 98 percent of standard Proctor density, ASTM D698.

5.9 Engineered Fill Specifications Summary

The following table summarizes the specifications for potential uses of engineered fill for this project.

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Table 5.9-1
Engineered Fill Specifications Summary
Redrock Center

Material Type & Specifications	Placement Location	Placement Specifications
Leveling Course - Crushed Aggregate, ¾" minus, <8% passing #200 sieve	Leveling Course Beneath Footings on Native Soils, Structural Fill or Basalt Bedrock	Maximum 6" lifts; compacted to minimum 95% of standard Proctor density (ASTM D698)
	Leveling Course Beneath Slabs on Grade	Maximum 6" lifts; compacted to minimum 95% of standard Proctor density (ASTM D698)
	Base Course Beneath Paved Driveways and Parking Areas	Maximum 8" lifts; compacted to minimum 98% of standard Proctor density (ASTM D698), conforming to ODOT Section 2630
Structural Fill - Granular, Inorganic soils, 3" minus, 35% to 65% passing the #4 sieve, <20% passing #200 sieve	Beneath Footings	Maximum 12" lifts; compacted to minimum 95% of standard Proctor density (ASTM D698)
	Structural Fill Beneath Slabs on Grade	Maximum 12" lifts; compacted to minimum 95% of standard Proctor density (ASTM D698)
	Structural Fill Beneath Paved Driveways and Parking Areas	Maximum 12" lifts; compacted to minimum 95% of standard Proctor density (ASTM D698)
	Lightly Loaded Exterior Structures (e.g. sidewalks)	Maximum 12" lifts; compacted to minimum 92% of standard Proctor density (ASTM D698)
	Structural Fill to Replace Existing Irrigation Canal	Maximum 12" lifts; compacted to minimum 95% of standard Proctor density (ASTM D698)
Utility Trench Backfill – 3" minus sand & gravel, <10% retained on 1 ½ inch screen	Utility Trench Backfill	Maximum 12" lifts; compacted to minimum 95% of standard Proctor density (ASTM D698)
Granular Landscape Fill - Inorganic soils, 3" minus	Landscaped Areas	Fill depth greater than 4 feet, Maximum 24" lifts; compacted to minimum 85% of standard Proctor density (ASTM D698). Fill depth less than 4 feet, additional compaction not required

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6.0 ADDITIONAL SERVICES

6.1 Plans and Specifications Review

We recommend that Kleinfelder review the geotechnical, civil and structural aspects of the project design plans and specifications to confirm the applicability of our recommendations, and to make any appropriate recommended modifications.

In the event Kleinfelder is not, at a minimum, retained to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted, we will assume no responsibility for misinterpretation. Misinterpretation of these recommendations can result in costly delays and design changes.

6.2 Construction Observation and Testing

We recommend that all earthwork construction be monitored by a Kleinfelder representative, including site preparation, placement of engineered fill and trench backfill, and all foundation and slab excavations. The purpose of these services will be to verify our recommendations, that the structures and facilities will perform geotechnically as designed, and that the quality of the earthwork and foundation construction is adequate. If subsurface conditions encountered during construction differ from those explored by our test borings and test pits described herein, we should review our recommendations in light of these different conditions and, if appropriate, recommend changes in design or construction procedures.

Kleinfelder also provides comprehensive special inspection and testing services in accordance with City of Redmond and IBC requirements. We look forward to preparing an estimate for these services upon completion of the project plans and specifications.

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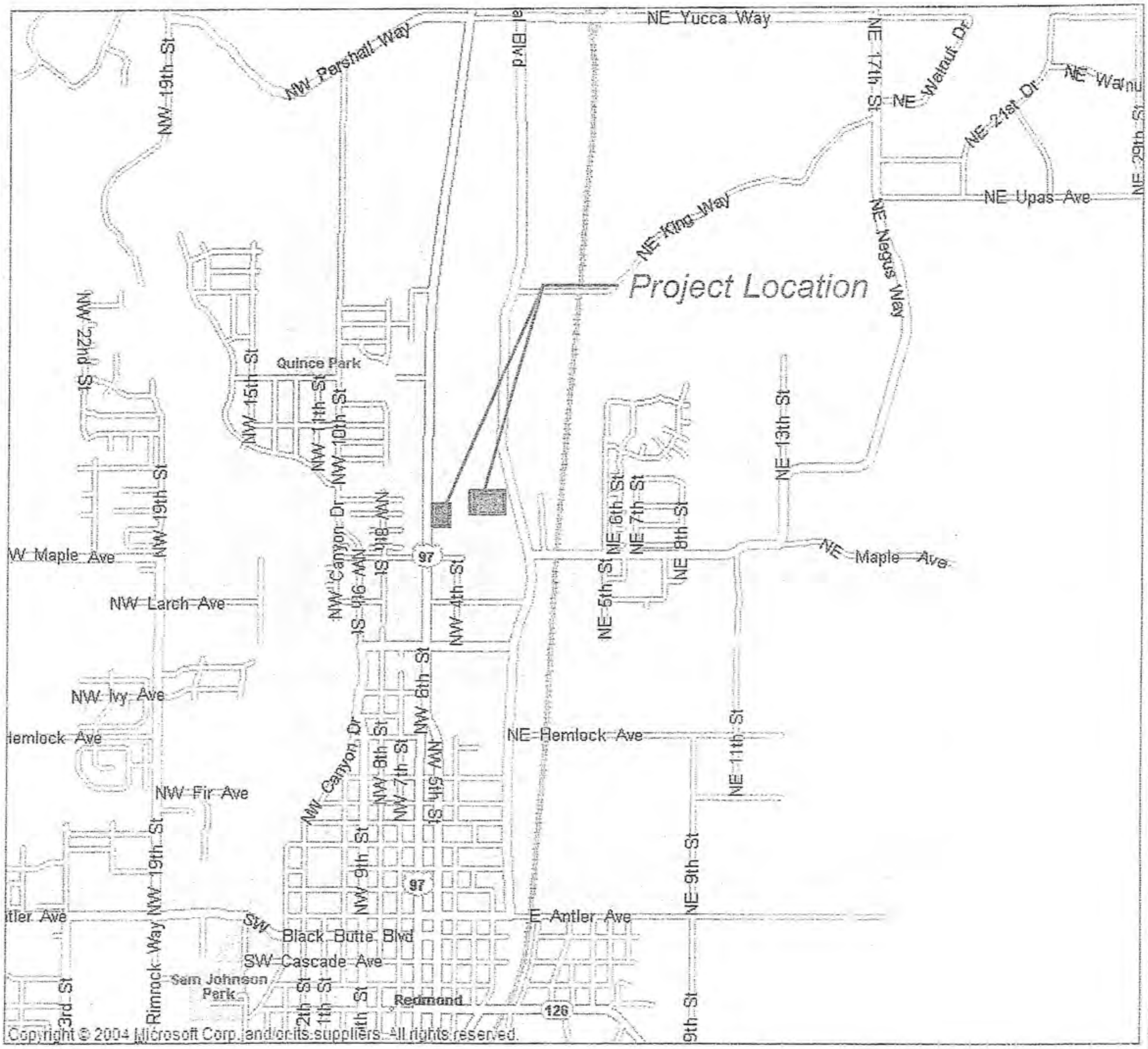

NOT TO SCALE

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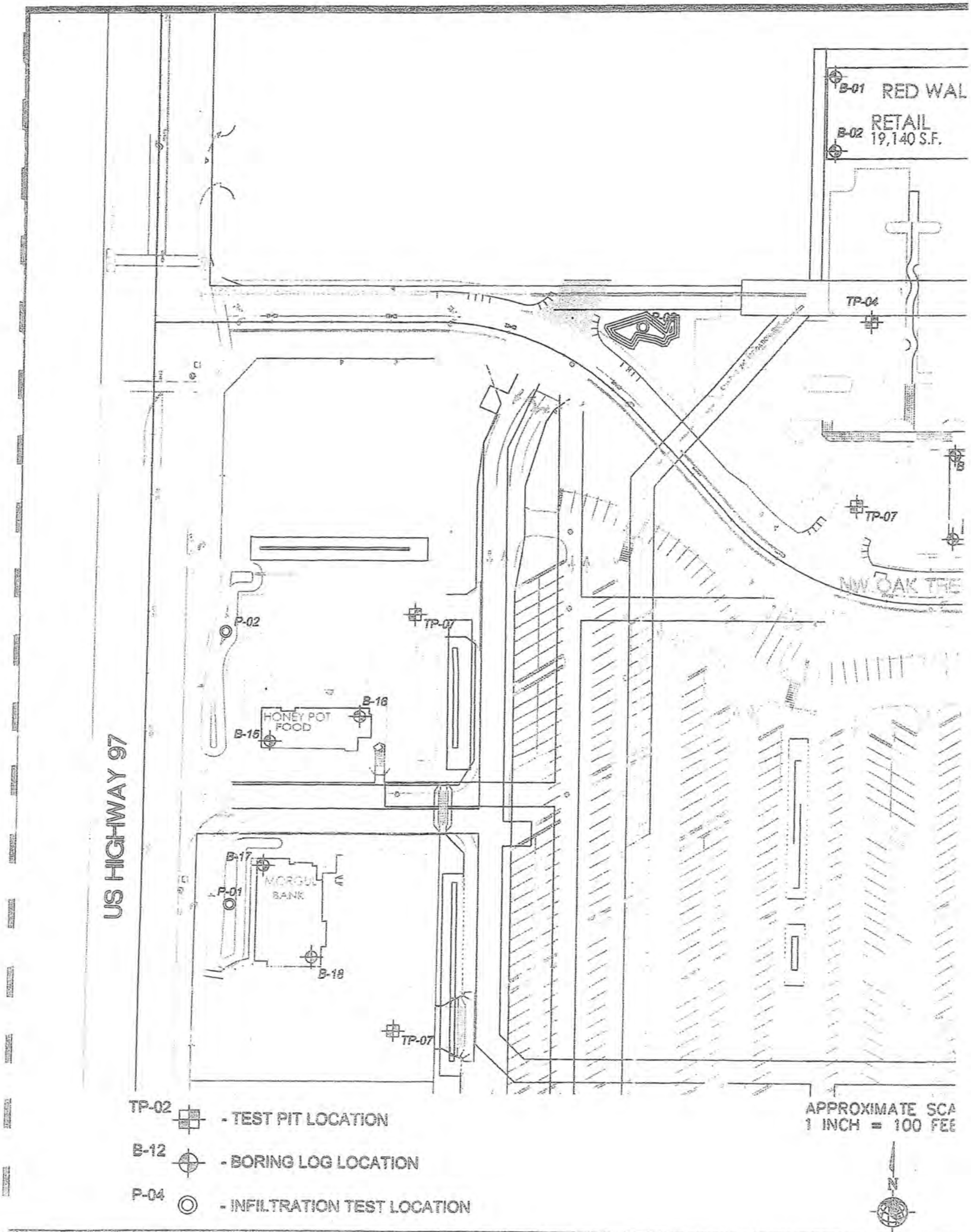
REDROCK CENTER
REDMOND, OREGON

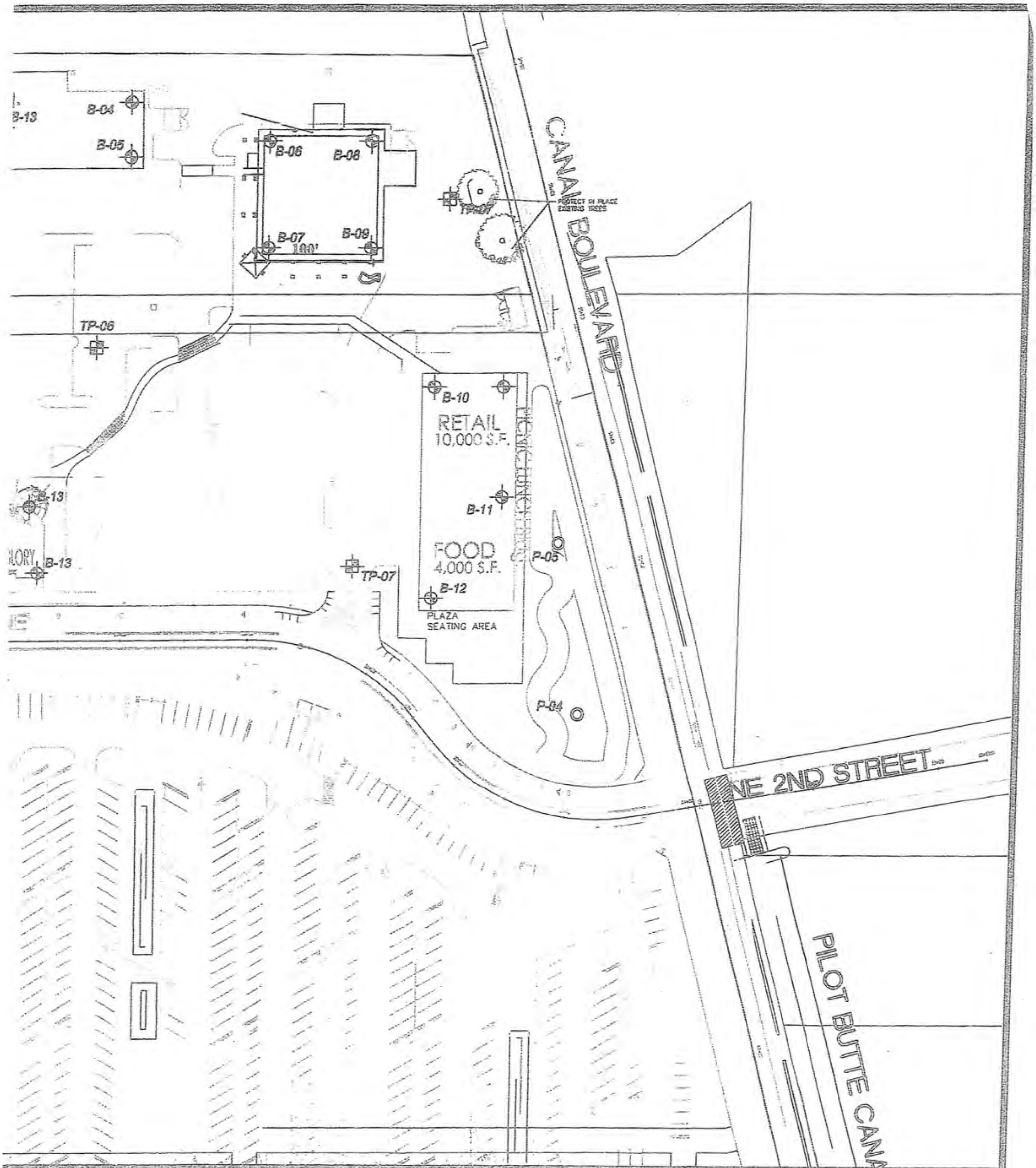
Project: #76018 A01 November 2006

Vicinity Map

L:2006/PROJECTS/BEN

FIGURE 1


US HIGHWAY 97
B-01
RED WAL
RETAIL
B-02
19,140 S.F.
TP-04
TP-07
NW OAK TRE
P-02
TP-07
B-16
HONEY POT
FOOD
B-15
B-17
MORGUL
BANK
P-01
B-18
TP-07
TP-02
- TEST PIT LOCATION
B-12
- BORING LOG LOCATION
P-04
- INFILTRATION TEST LOCATION
APPROXIMATE SCA
1 INCH = 100 FEE
N



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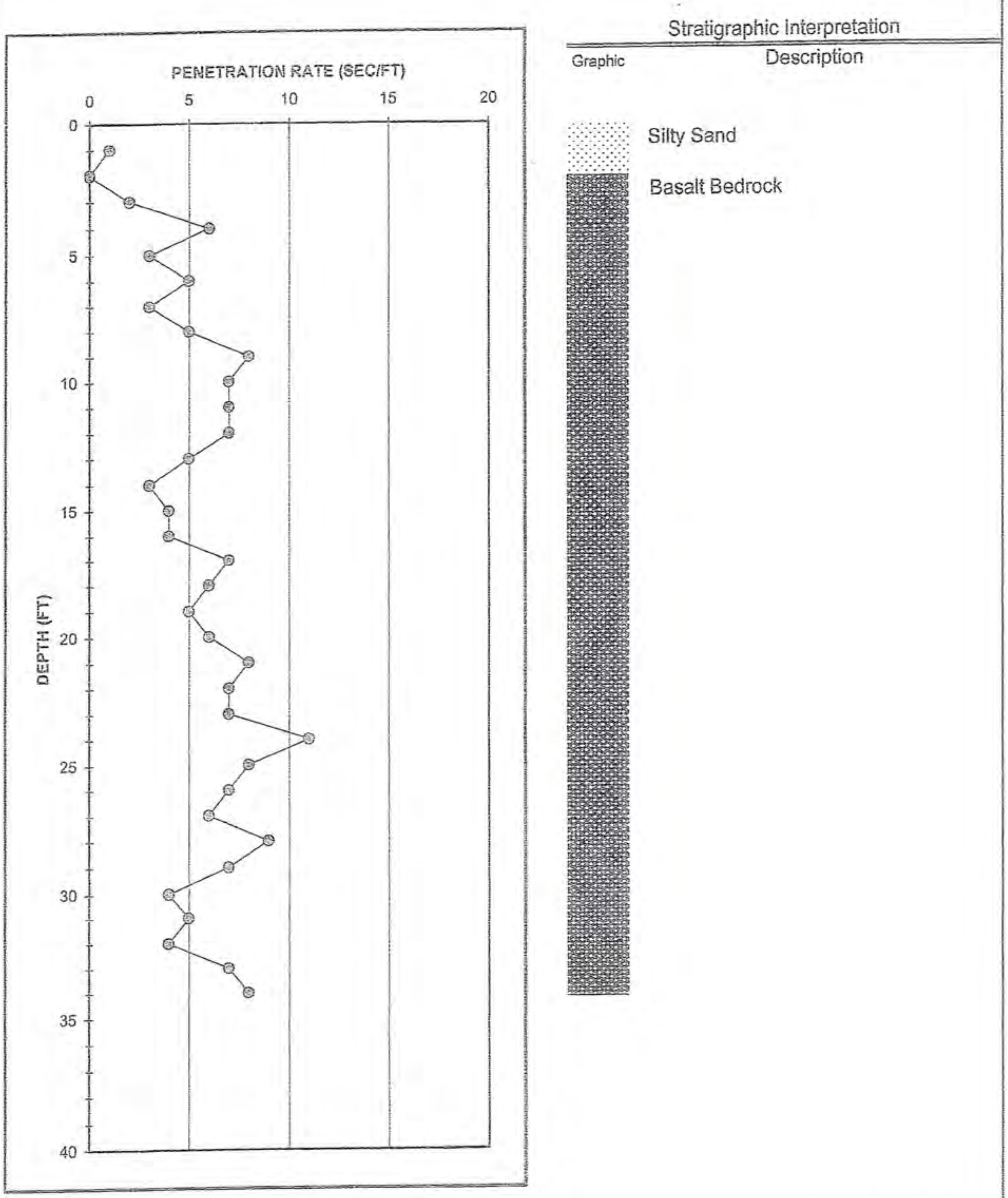
Geotechnical Location Map
Redrock Center
Redmond, Oregon

PROJECT # 76018 (A01)

FIGURE 2

LOG OF AIR TRACK BORING



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Logged By:	TRF	Total Depth (feet):	34	Driller: Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5	

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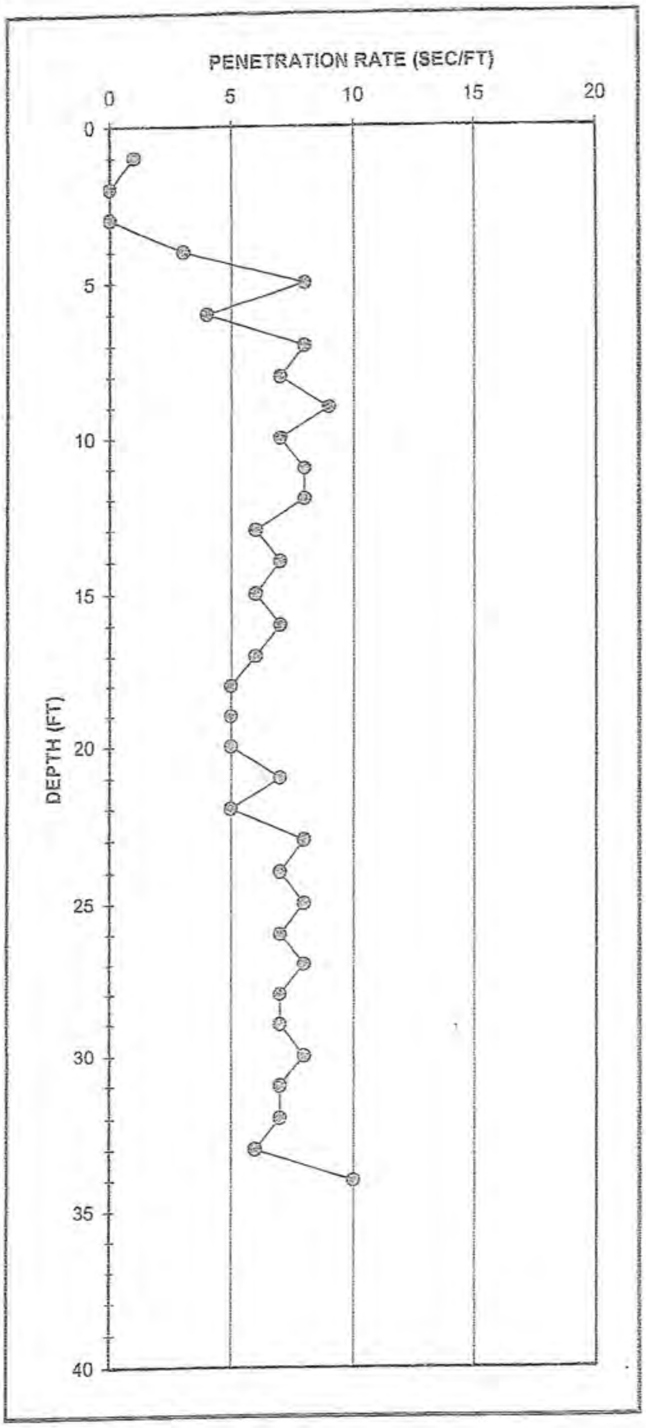
BORING B-01
Redrock Center
Redmond, Oregon

Project # 76018 (A01)

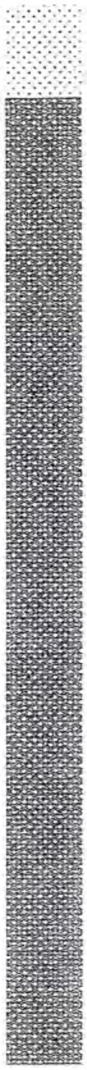
FIGURE A-1

LOG OF AIR TRACK BORING



Stratigraphic Interpretation

Graphic | Description



Date Drilled: 10/19/2006
Logged By: TRF
Reviewed By: MVH

Surface Elevation (fmsl): none
Total Depth (feet): 34
Boring Diameter (inch): 3.5

Drilling Method: Atlas Copco Rock D3
Driller: Quality Drilling & Blasting

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BORING B-02
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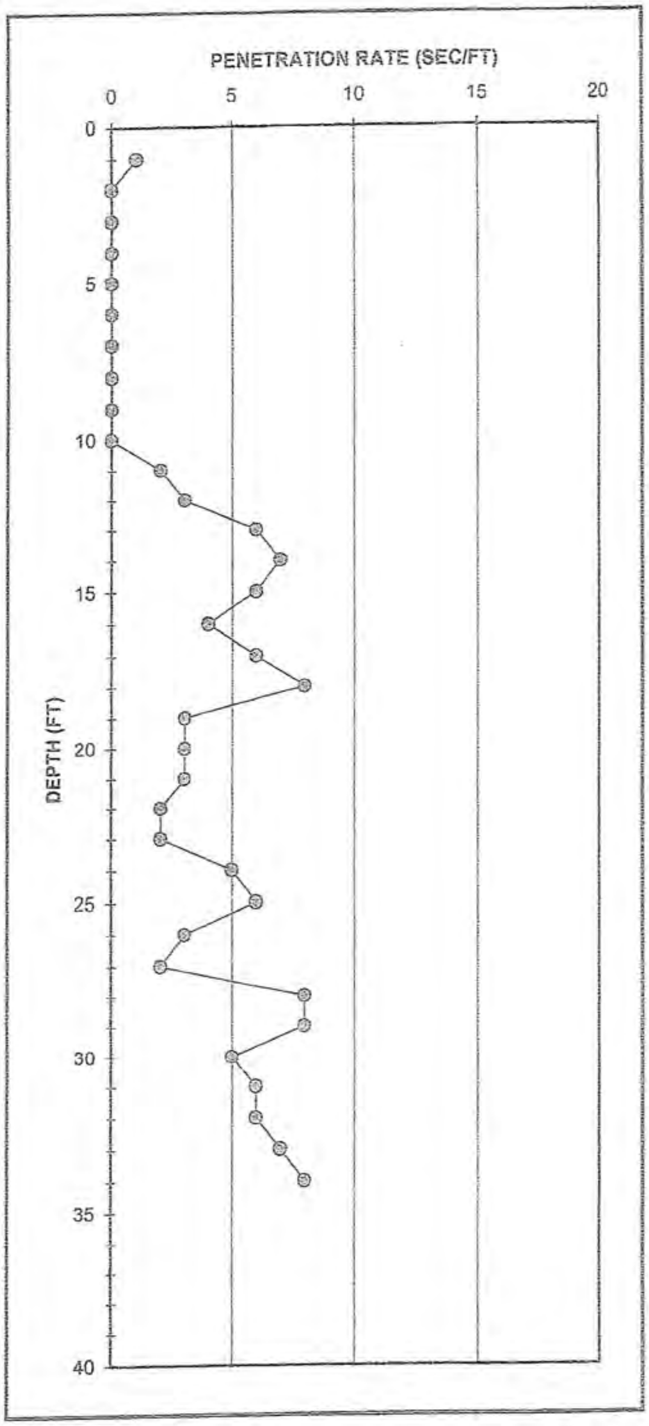
Redmond, Oregon

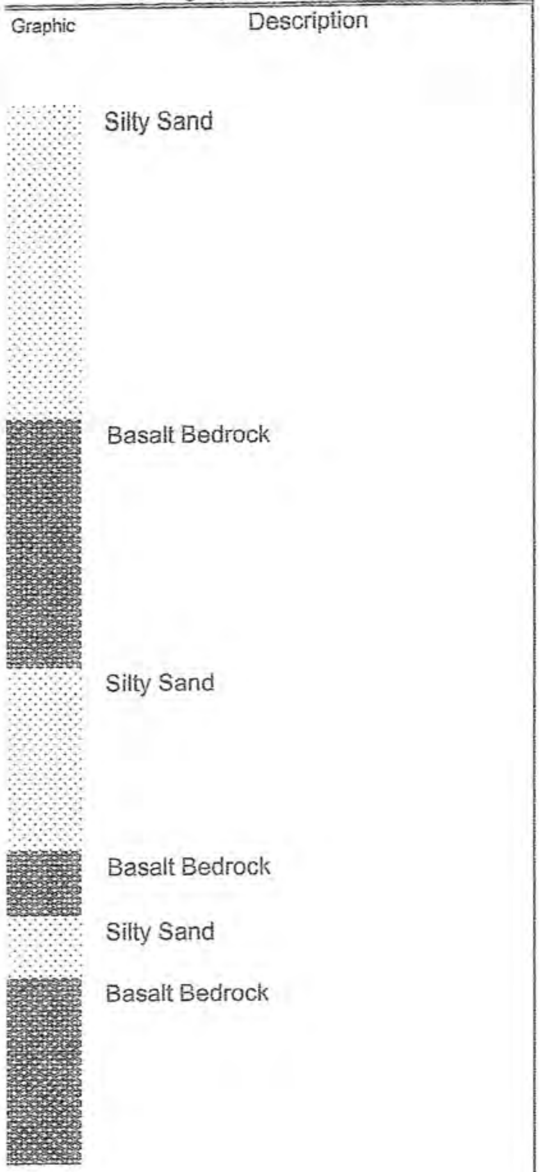
Project # 76018 (A01)

FIGURE A-2

LOG OF AIR TRACK BORING



Stratigraphic Interpretation



Date Drilled: 10/19/2006	Surface Elevation (fmsl):	none	Drilling Method:	Atlas Copco Rock D3
Logged By: TRF	Total Depth (feet):	34	Driller:	Quality Drilling & Blasting
Reviewed By: MVH	Boring Diameter (inch):	3.5		

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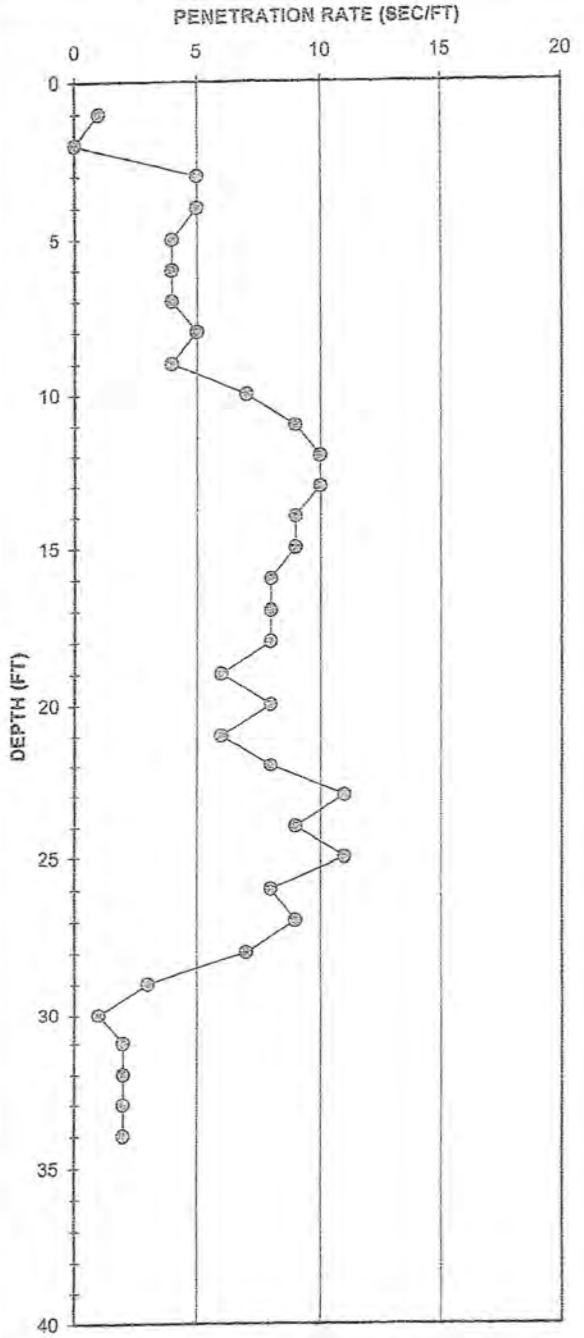
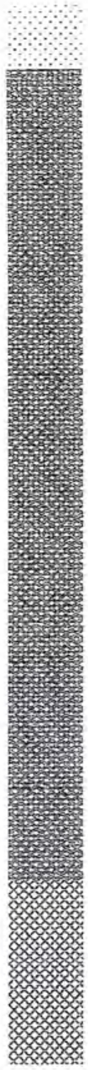
BORING B-03
Redrock Center
Redmond, Oregon

Project # 76018 (A01)	**FIGURE A-3**

LOG OF AIR TRACK BORING



Stratigraphic Interpretation

Graphic	Description
	Silty Sand Basalt Bedrock Red Cinders

Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none
Logged By:	TRF	Total Depth (feet):	34
Reviewed By:	MVH	Boring Diameter (inch):	3.5

Drilling Method: Atlas Copco Rock D3
Driller: Quality Drilling & Blasting

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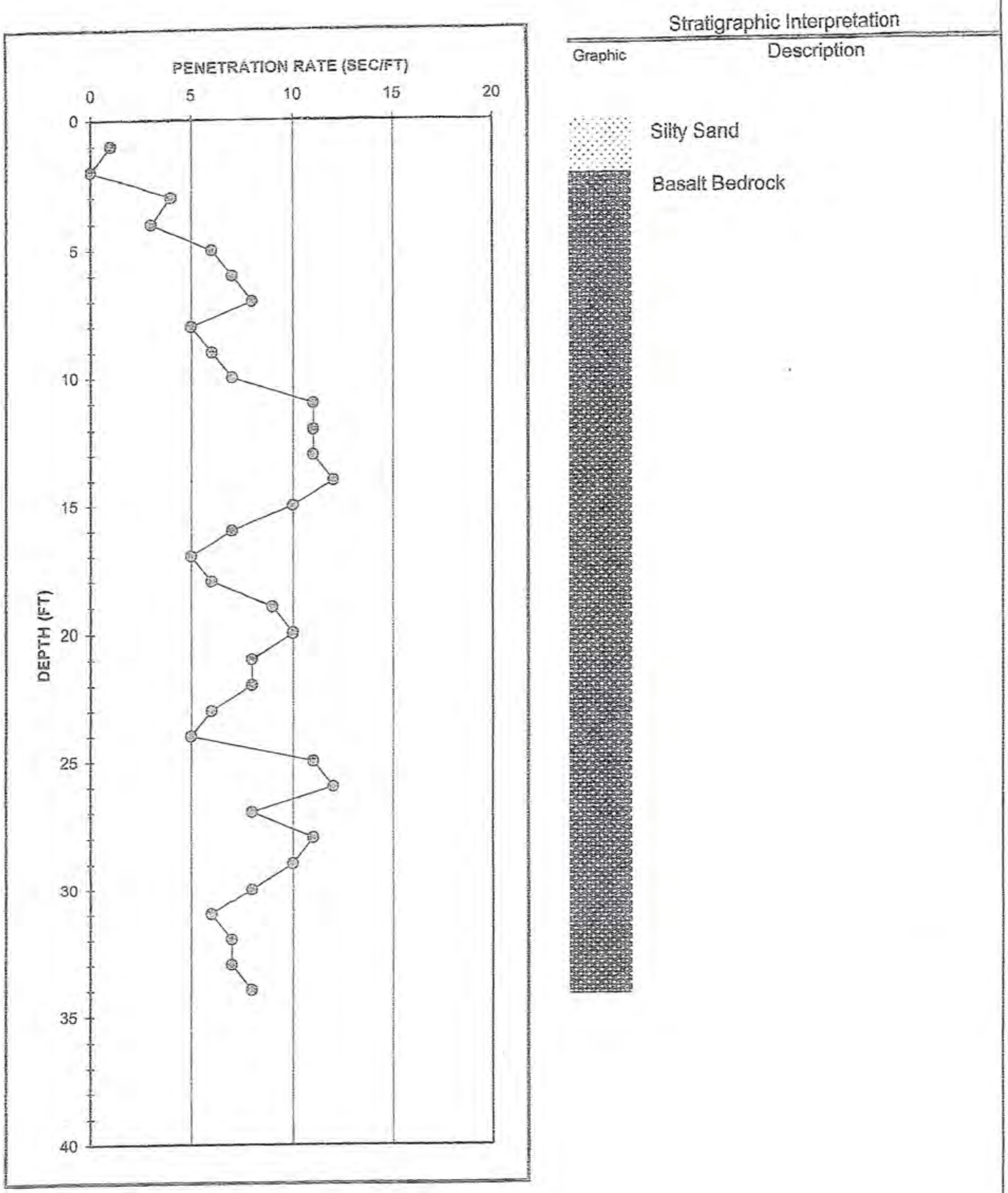
BORING B-04
Redrock Center
Redmond, Oregon

Project # 76018 (A01) | **FIGURE A-4**

LOG OF AIR TRACK BORING



Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none	Drilling Method: Atlas Copco Rock D3
Logged By:	TRF	Total Depth (feet):	34	Driller: Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5	

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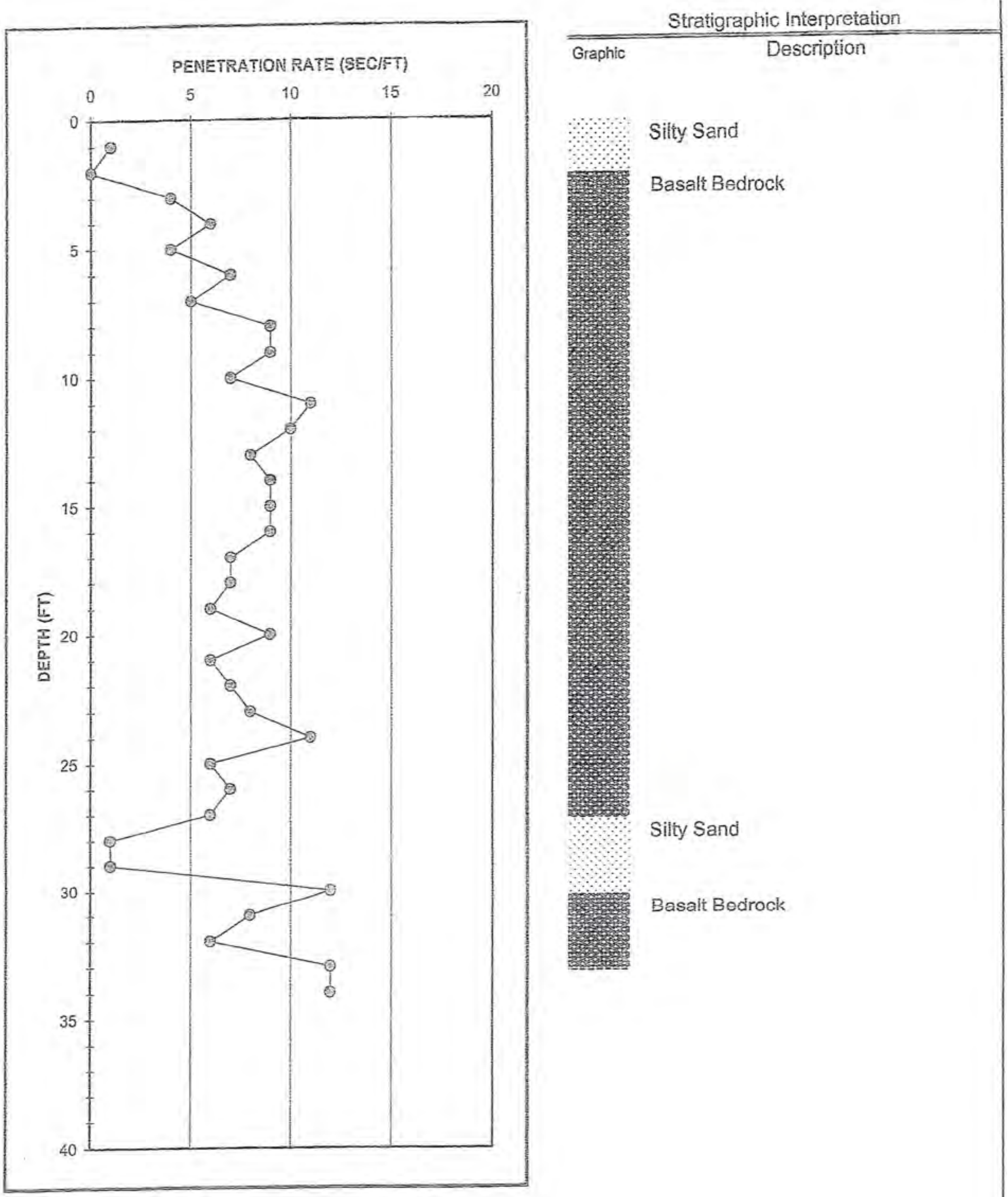
Redmond, Oregon

Project # 76018 (A01)

FIGURE A-5

LOG OF AIR TRACK BORING



Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none	Drilling Method:	Atlas Copco Rock D3
Logged By:	TRF	Total Depth (feet):	34	Driller:	Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5		

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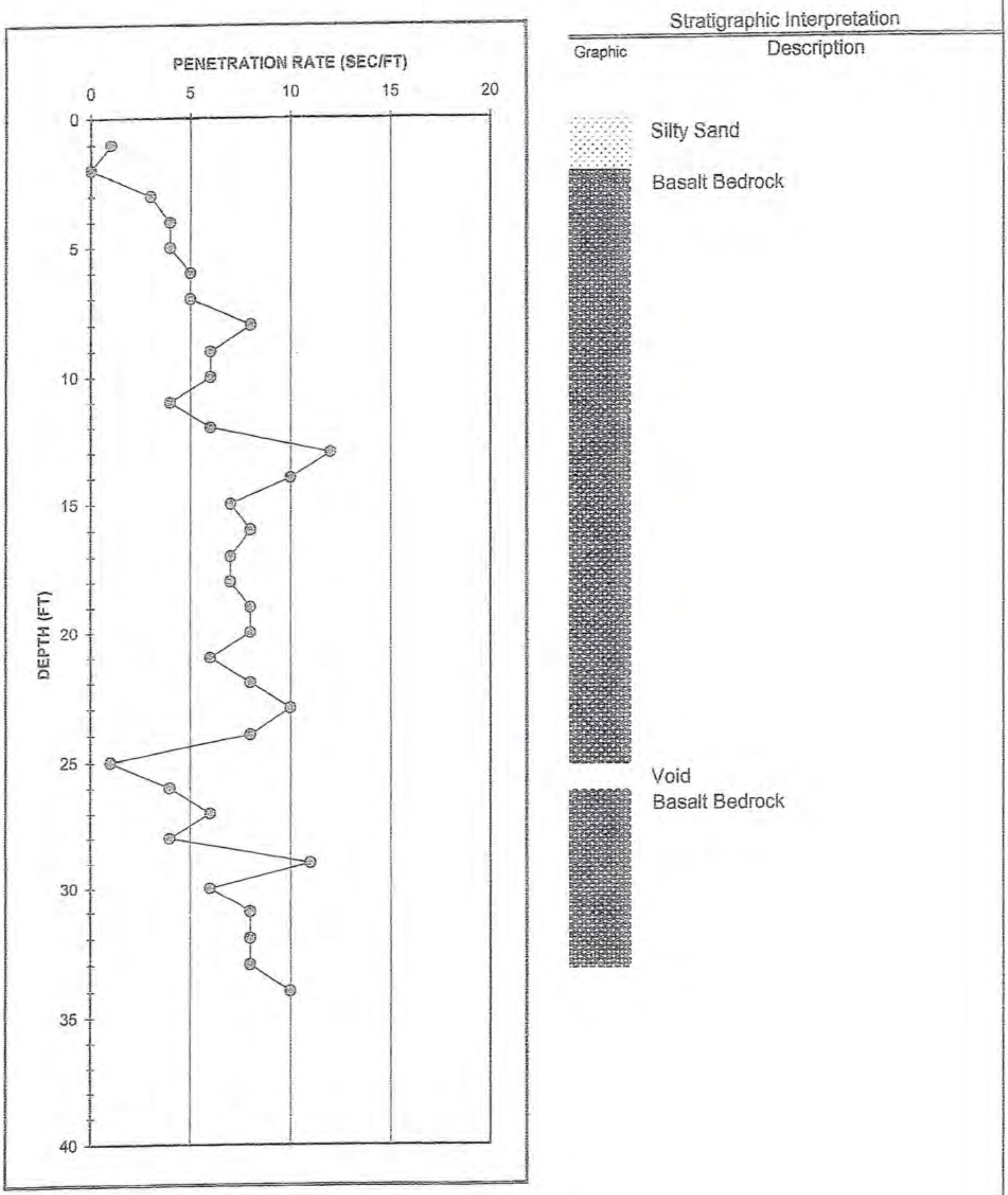
Redrock Center
Redmond, Oregon

Project # 76018 (A01)

FIGURE A-6

LOG OF AIR TRACK BORING



Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none	Drilling Method:	Atlas Copco Rock D3
Logged By:	TRF	Total Depth (feet):	34	Driller:	Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5		

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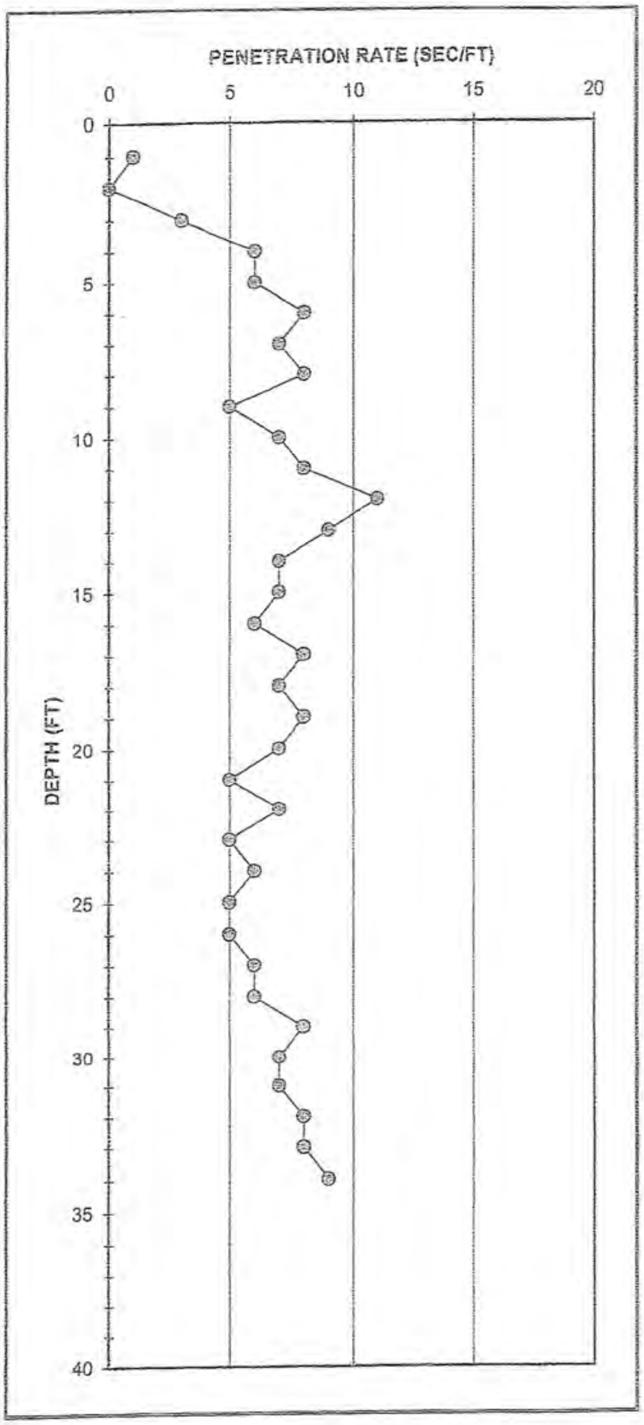
Redrock Center
Redmond, Oregon

Project # 76018 (A01)

FIGURE A-7

LOG OF AIR TRACK BORING



Stratigraphic Interpretation

Graphic	Description
	Silty Sand
	Basalt Bedrock

Date Drilled: 10/19/2006
Logged By: TRF
Reviewed By: MVH

Surface Elevation (fmsl): none
Total Depth (feet): 34
Boring Diameter (inch): 3.5

Drilling Method: Atlas Copco Rock D3
Driller: Quality Drilling & Blasting

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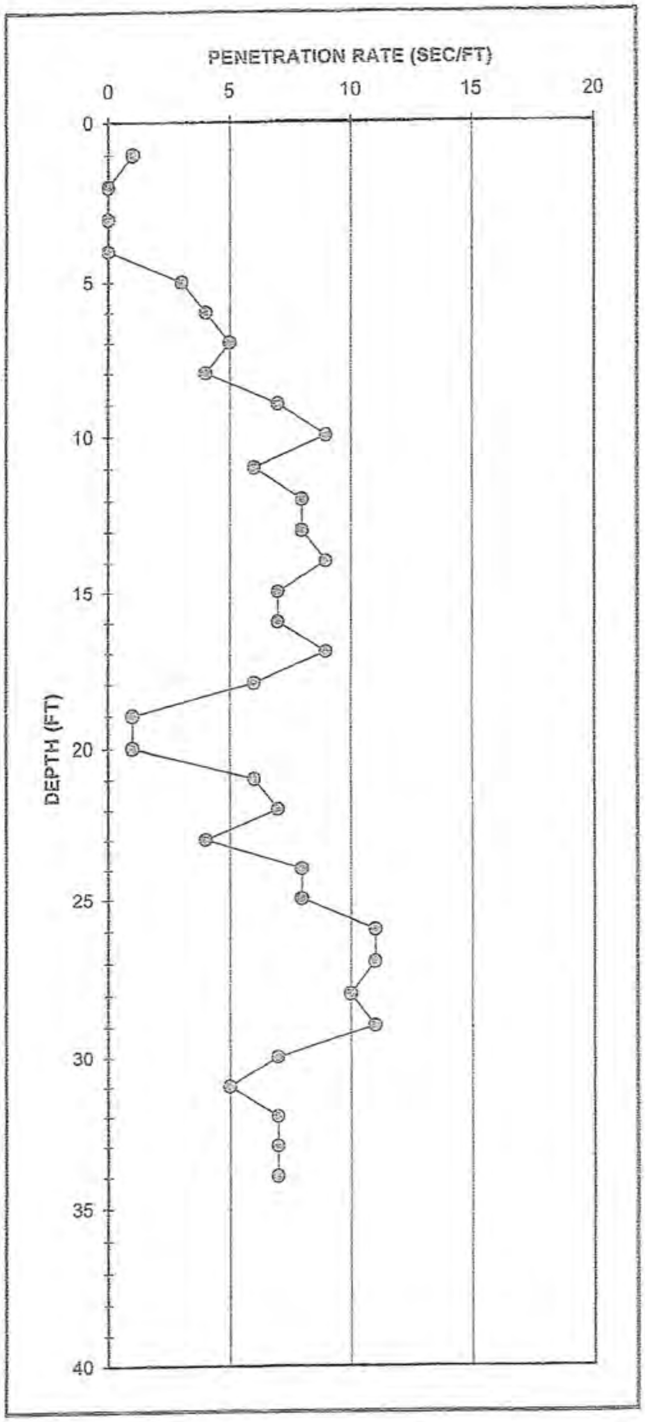
BORING B-08
Redrock Center
Redmond, Oregon

Project # 76018 (A01)	FIGURE A-8

LOG OF AIR TRACK BORING



Stratigraphic Interpretation

Graphic	Description
	Silty Sand
	Basalt Bedrock
	Silty Sand
	Basalt Bedrock

Date Drilled: 10/19/2006
Logged By: TRF
Reviewed By: MVH

Surface Elevation (fmsl): none
Total Depth (feet): 34
Boring Diameter (inch): 3.5

Drilling Method: Atlas Copco Rock D3
Driller: Quality Drilling & Blasting

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BORING B-09
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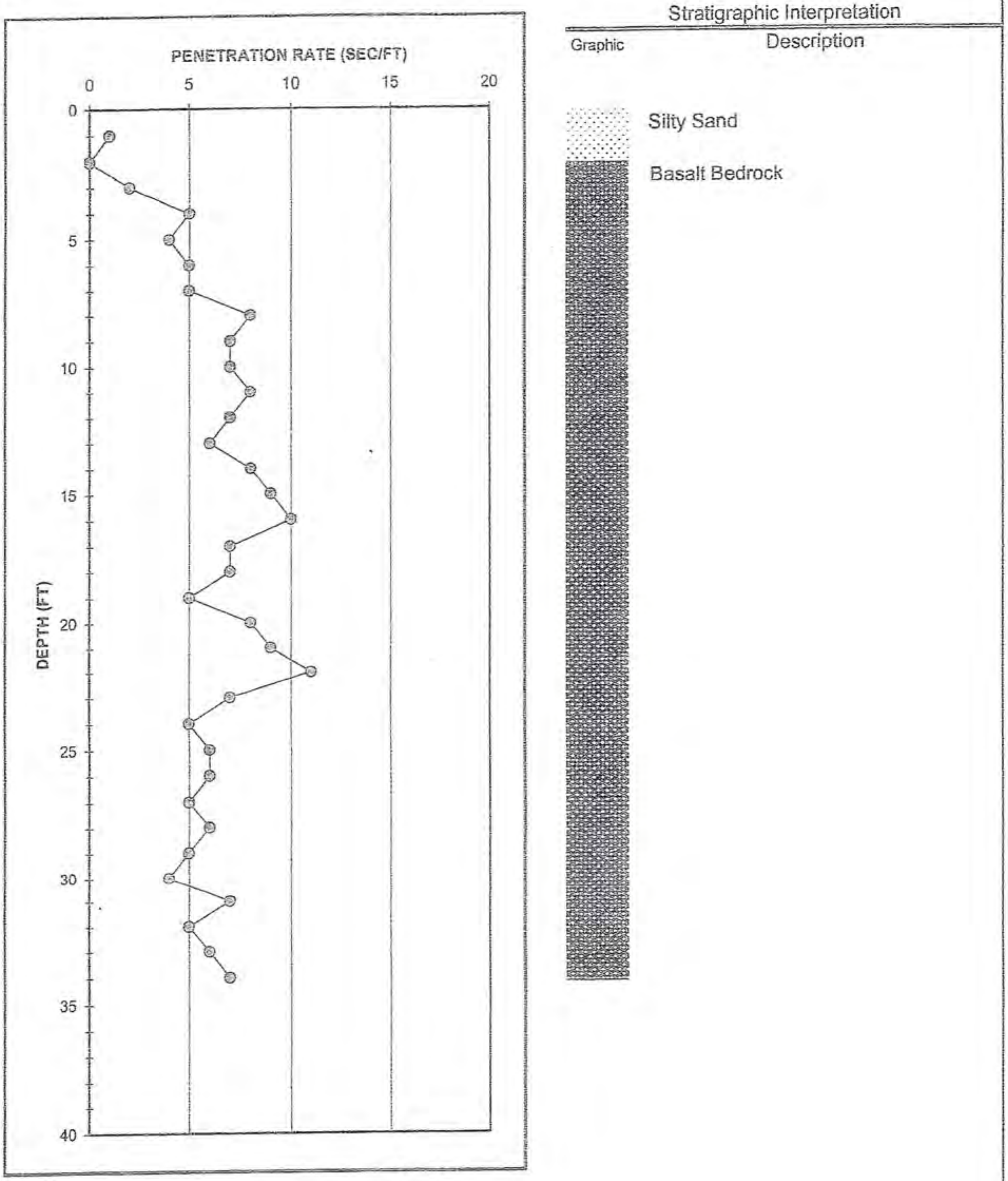
Redmond, Oregon

Project # 76018 (A01)

FIGURE A-9

LOG OF AIR TRACK BORING



Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none	Drilling Method:	Atlas Copco Rock D3
Logged By:	TRF	Total Depth (feet):	34	Driller:	Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5		

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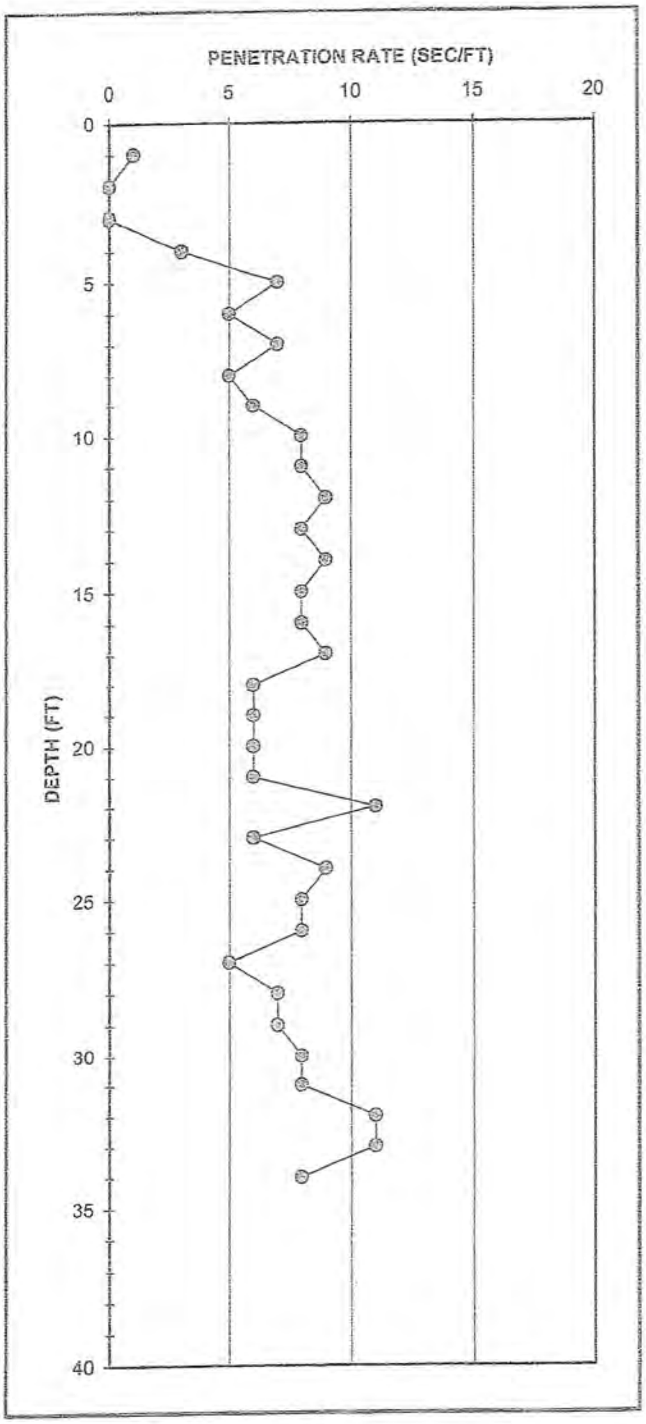
BORING B-10
Redrock Center
Redmond, Oregon

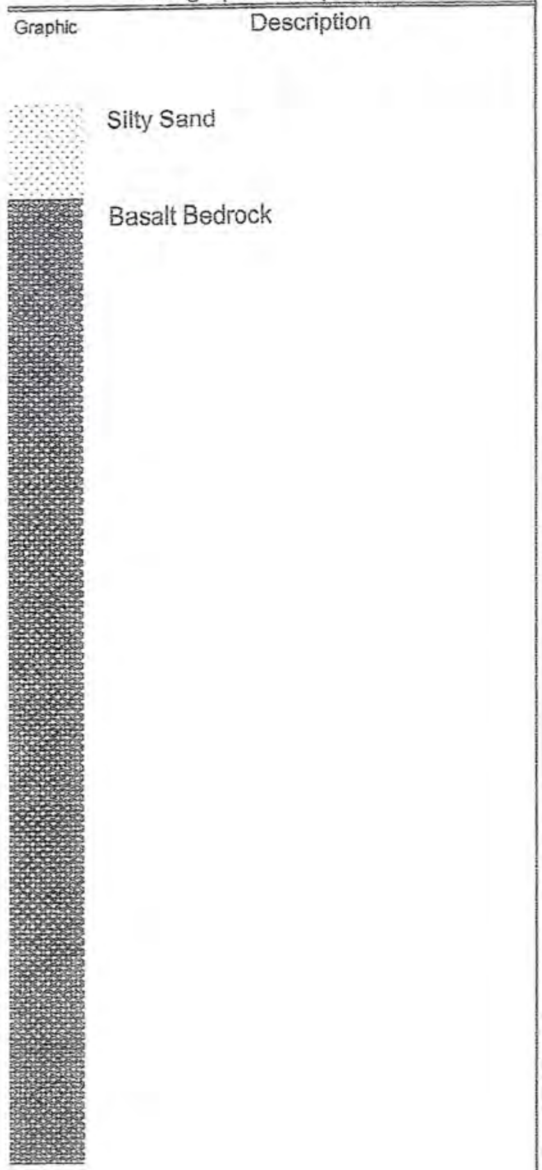
Project # 76018 (A01)

FIGURE A-10

LOG OF AIR TRACK BORING



Stratigraphic Interpretation



Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none	Drilling Method:	Atlas Copco Rock D3
Logged By:	TRF	Total Depth (feet):	34	Driller:	Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5		

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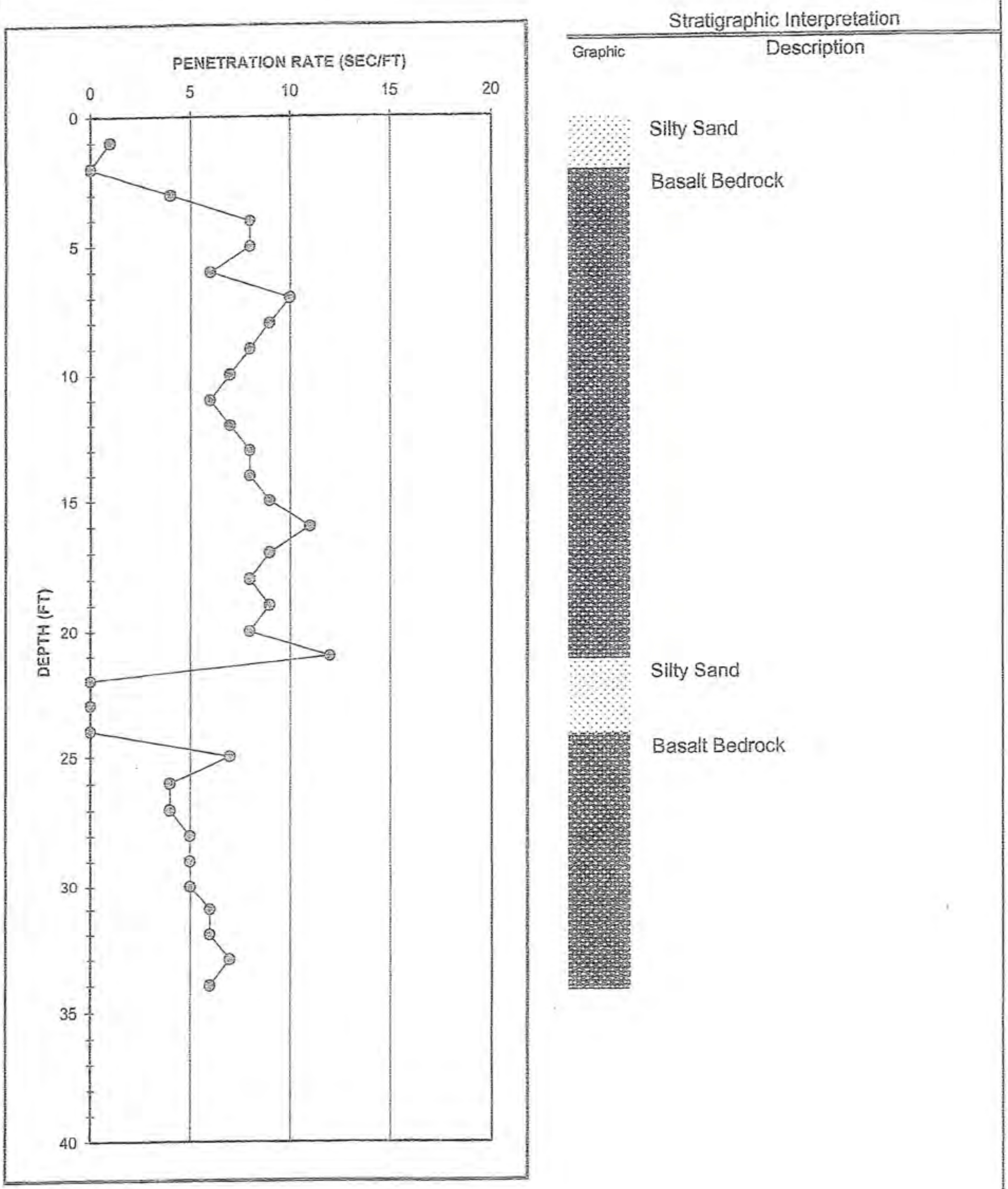
FIGURE A-11

LOG OF AIR TRACK BORING



Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none	Drilling Method: Atlas Copco Rock D3
Logged By:	TRF	Total Depth (feet):	34	Driller: Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5	

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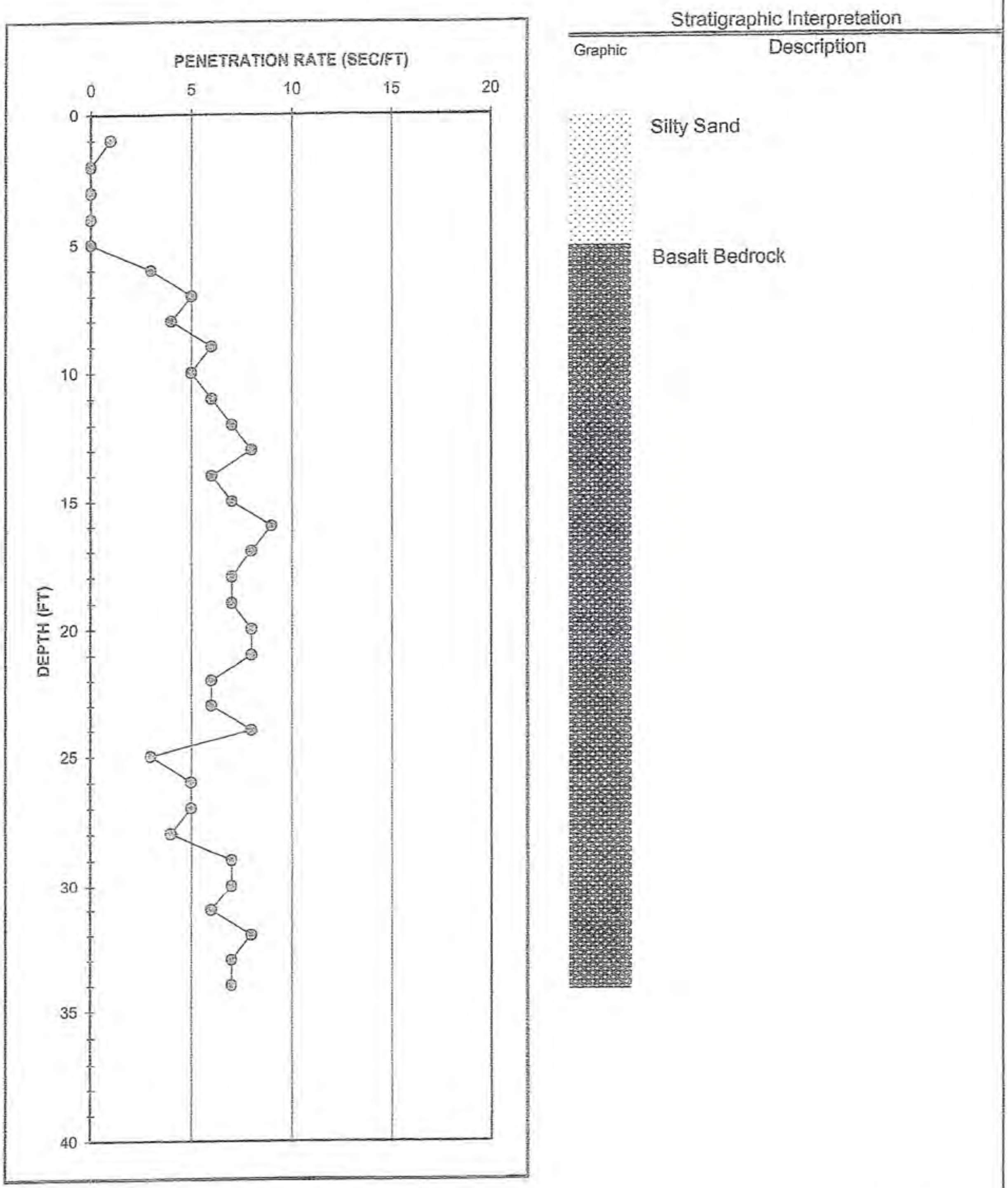
FIGURE A-12

LOG OF AIR TRACK BORING



Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none	Drilling Method: Atlas Copco Rock D3
Logged By:	TRF	Total Depth (feet):	34	Driller: Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5	

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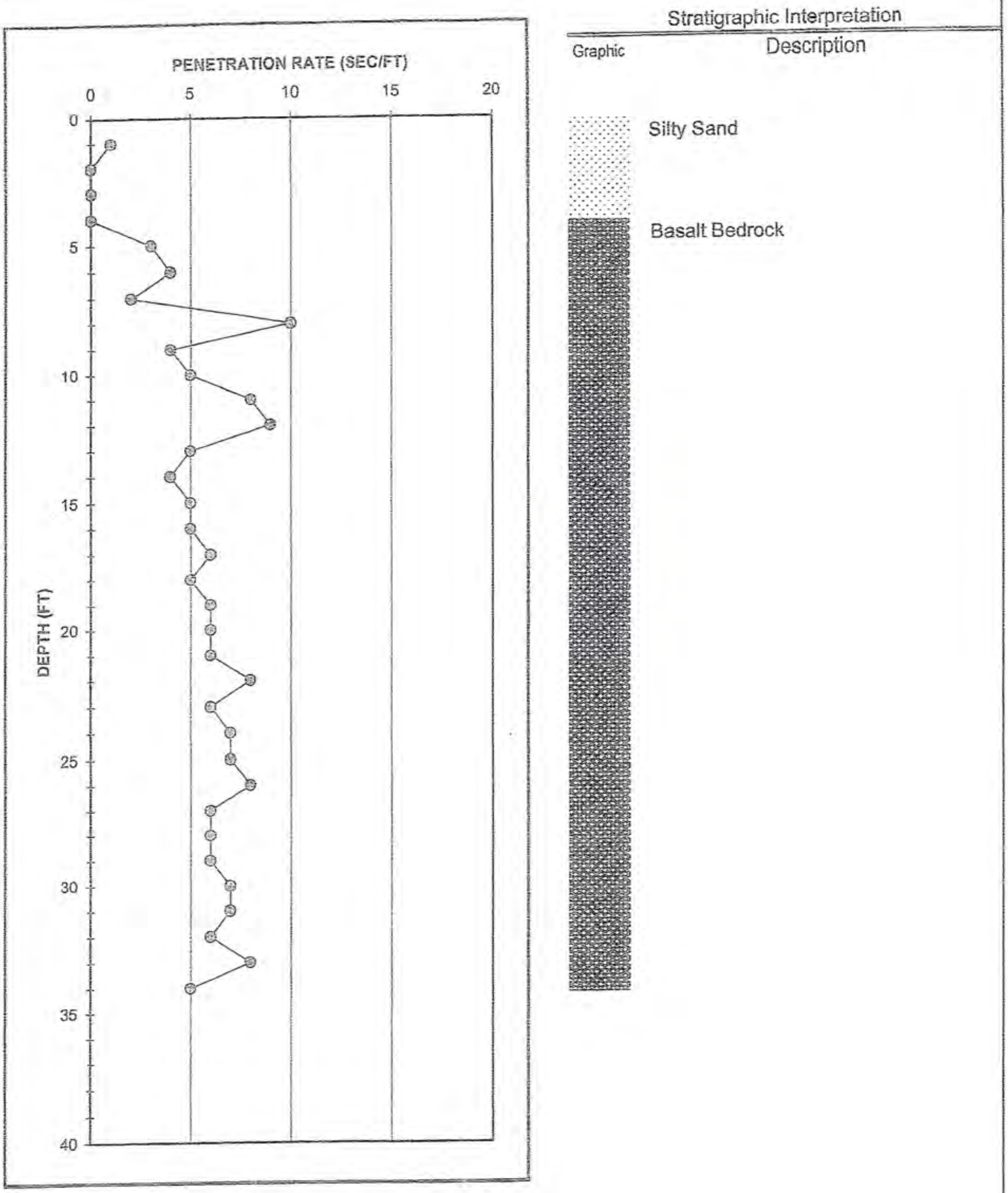
FIGURE A-13

LOG OF AIR TRACK BORING



Date Drilled: 10/19/2006
Logged By: TRF
Reviewed By: MVH

Surface Elevation (fmsl): none
Total Depth (feet): 34
Boring Diameter (inch): 3.5

Drilling Method: Atlas Copco Rock D3
Driller: Quality Drilling & Blasting

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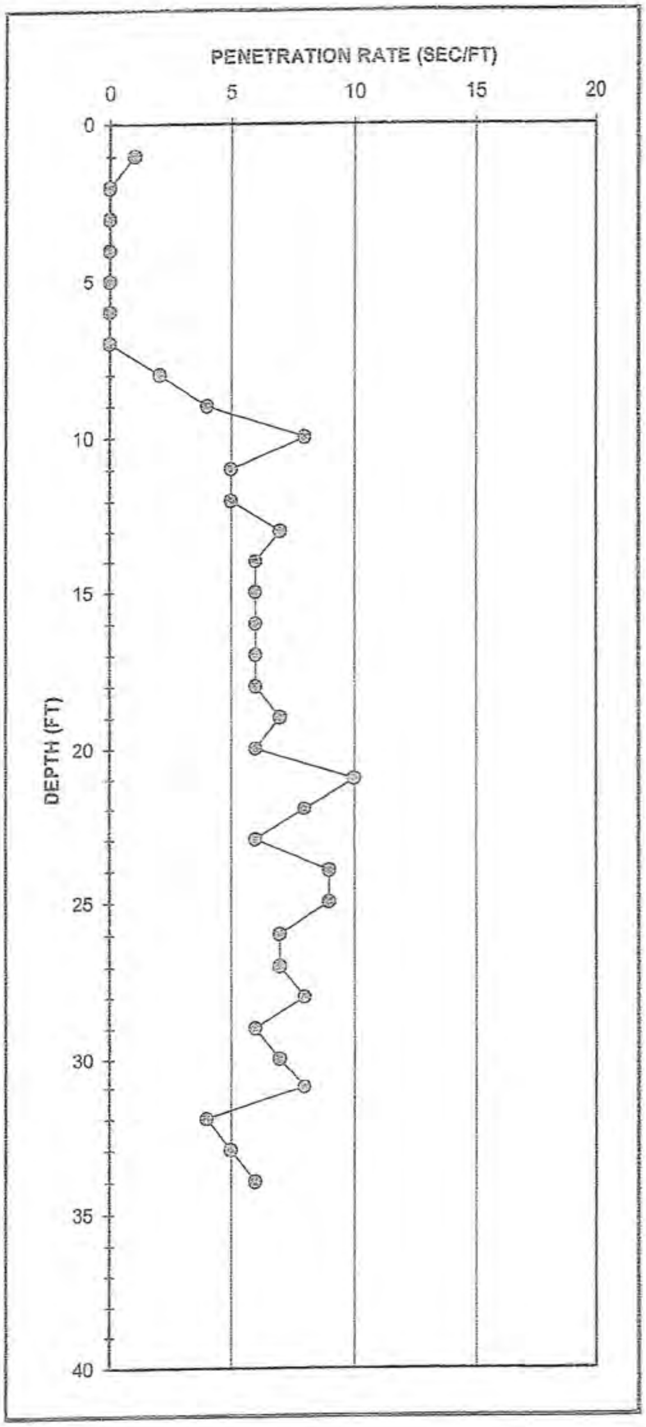
FIGURE A-14

LOG OF AIR TRACK BORING



Stratigraphic Interpretation

Graphic	Description
	Silty Sand
	Basalt Bedrock

Date Drilled: 10/19/2006
Logged By: TRF
Reviewed By: MVH

Surface Elevation (fmsl): none
Total Depth (feet): 34
Boring Diameter (inch): 3.5

Drilling Method: Atlas Copco Rock D3
Driller: Quality Drilling & Blasting

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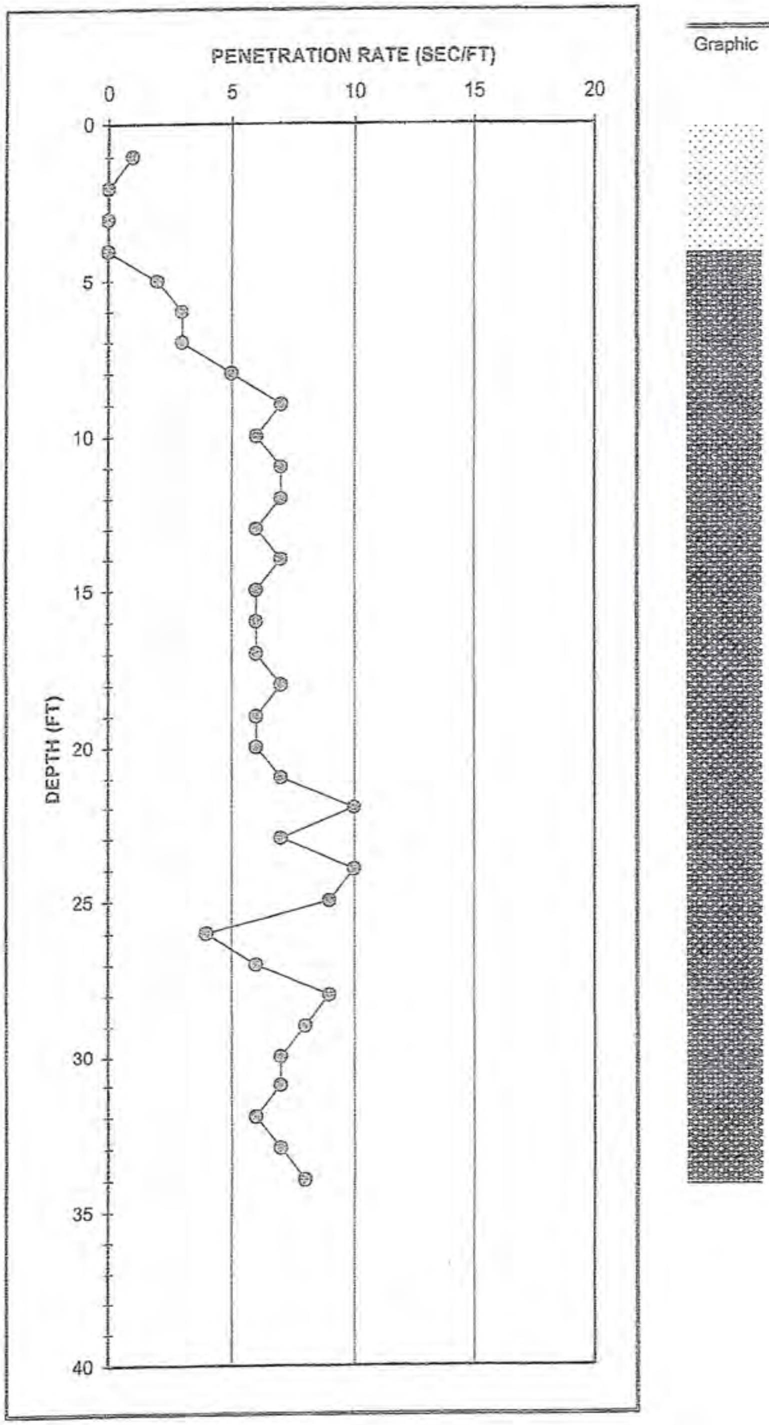
FIGURE A-15

LOG OF AIR TRACK BORING



Stratigraphic Interpretation

Graphic	Description
	Silty Sand
	Basalt Bedrock

Date Drilled: 10/19/2006	Surface Elevation (fmsl):	none	Drilling Method:	Atlas Copco Rock D3
Logged By: TRF	Total Depth (feet):	34	Driller:	Quality Drilling & Blasting
Reviewed By: MVH	Boring Diameter (inch):	3.5		

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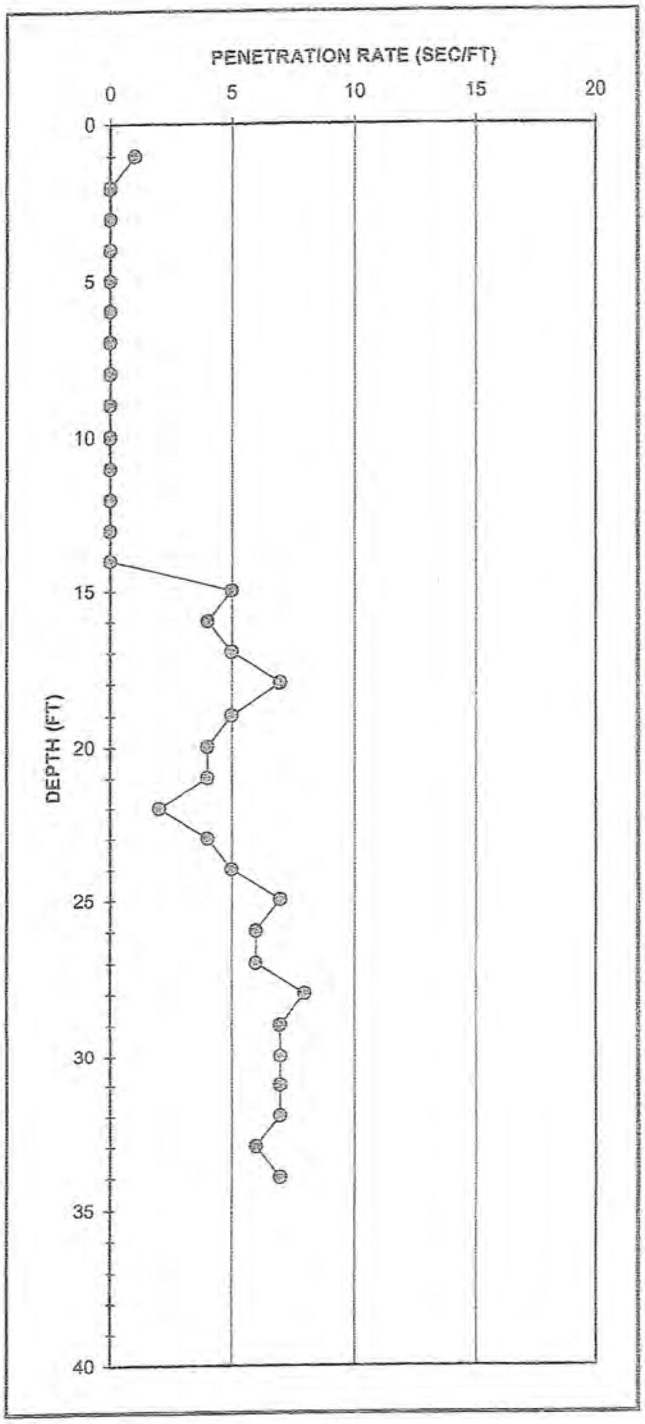
FIGURE A-16

LOG OF AIR TRACK BORING



Stratigraphic Interpretation

Graphic	Description
	Silty Sand
	Basalt Bedrock
	Silty Sand
	Basalt Bedrock

Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none	Drilling Method:	Atlas Copco Rock D3
Logged By:	TRF	Total Depth (feet):	34	Driller:	Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5		

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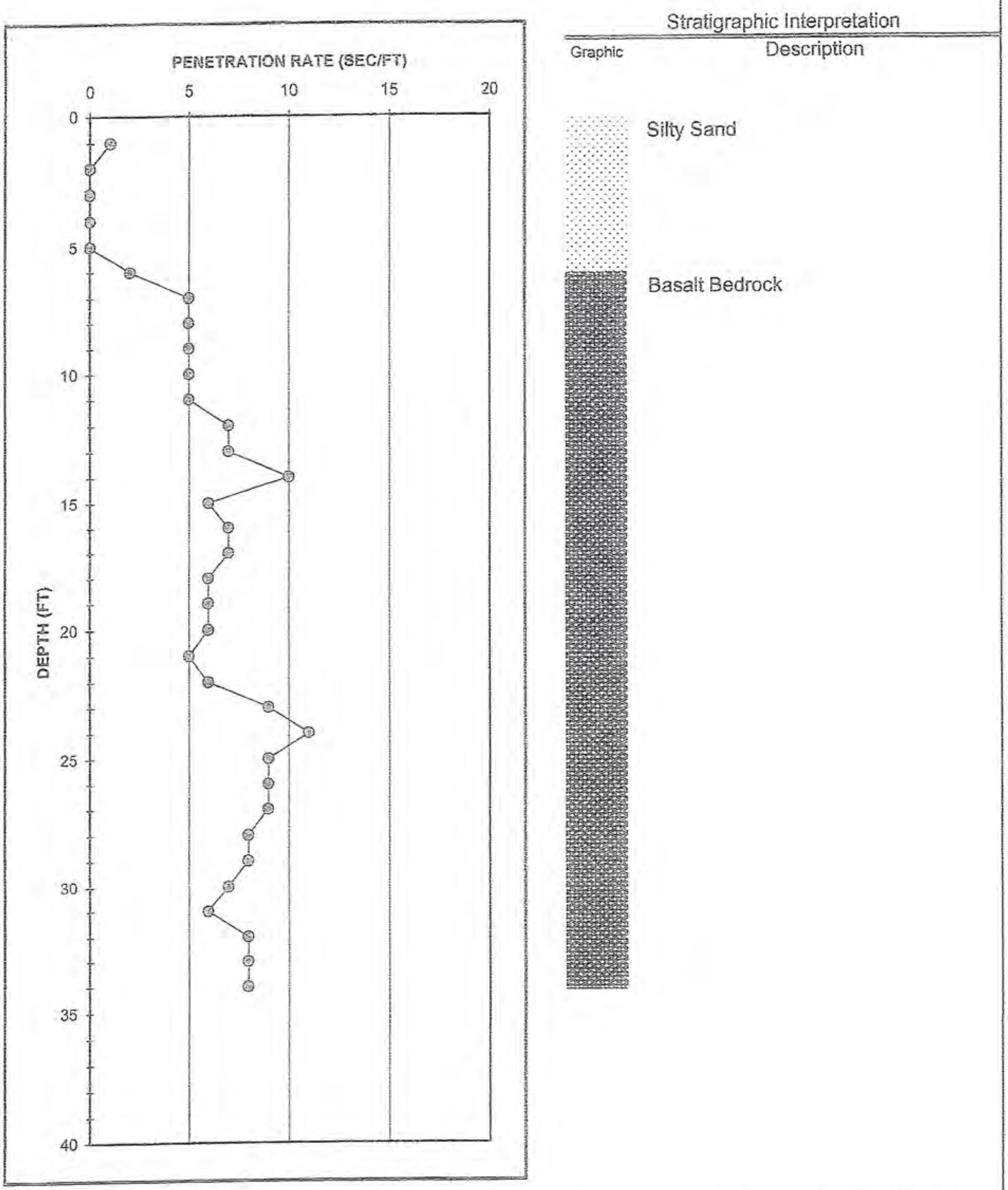
Project # 76018 (A01) **FIGURE A-17**

LOG OF AIR TRACK BORING



Date Drilled:	10/19/2006	Surface Elevation (fmsl):	none	Drilling Method:	Atlas Copco Rock D3
Logged By:	TRF	Total Depth (feet):	34	Driller:	Quality Drilling & Blasting
Reviewed By:	MVH	Boring Diameter (inch):	3.5		

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FIGURE A-18

SYMBOL DESCRIPTIONS

SILTY SAND, with gravel at some locations, occasional cobbles, fine to medium grained, brown, dry, loose to medium dense

WEAK ZONE; CINDERS?, presumed to be cinders, red-purple-black, dry, loose

BASALT BEDROCK, weathered to vesicular to massive, fractured to very hard, gray

NOTES

1. Air track borings were drilled on October 19, 2006.

2. Boring locations were staked before drilling by Kleinfelder using a rag tape and existing features as references.

3. Boring elevations were not determined.

4. Logs shown are representative of the locations explored. Subsurface conditions may vary between and away from borings.

5. Air track borings result in depth versus penetration rate data. Stratigraphic representations are based on this data, our knowledge of the local/regional geology, and our experience with similar conditions. No samples are recovered by air track drilling methods.

6. Logs shown are subject to the findings, conclusions, recommendations and limitations stated in the Geotechnical Exploration Report.

KLEINFELDER GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS SOILS AND MATERIALS TESTING	**AIR TRACK BORING LOG LEGEND** **Redrock Center** **Redmond, Oregon**	
	PROJECT NO. 76018 (A01)	**FIGURE A-19**

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DEPTH (feet) *ELEVATION (feet)*	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	AF		FILL: 3/4"-0 baserock with silty sand, fine to medium grained, angular gravel to 3/4", gray, dry				
	SM		Silty Sand, some gravel, brown, fine to medium grained, subangular gravel to 1", dry, large roots to 2"				
			Cemented hardpan, sand and gravel, light brown, dry				
3.00 Hole Bottom			Test Pit terminated at 3' bgs due to refusal. Groundwater not encountered during trenching. (GWNEDT)				

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

APPROV:

BY:

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: *Bulk* *Grab* *Shelby Tube*

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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TEST PIT LOG TP-01

FIGURE B - 1

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) *ELEVATION (feet)*	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	OL		TOPSOIL				
	SM		Silty Sand, fine to medium grained, some subangular gravel to 1", brown, dry - DCP 50/4"		S-1		
			Slightly Cemented Hardpan, light brown, dry				
	BA		Basalt Bedrock, hard, gray Test Pit terminated at 4.5' bgs due to refusal. GWNEDT				
4.50 Hole Bottom							

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: *Bulk* *Grab* *Shelby Tube*

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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FIGURE B - 2

PROJECT NO. *76018 (A01)*

TEST PIT LOG TP-02

APPROV:

BY:

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) *ELEVATION (feet)*	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	OL		TOPSOIL				
	SM		Silty Sand, some gravel, fine to medium grained, subangular gravel to 1", brown, dry		S-2		
			Cemented Hardpan, sand and gravel, light brown, dry				
	BA		Basalt Bedrock, hard, gray				
3.00 Hole Bottom			Test Pit terminated at 3.0' bgs due to refusal. GWNEDT				

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: *Bulk* *Grab* *Shelby Tube*

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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TEST PIT LOG TP-03

FIGURE

B - 3

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) *ELEVATION (feet)*	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	OL		TOPSOIL				
	SM		Silty Sand, some gravel, fine to medium grained, subangular gravel to 1", brown, dry				
				Grab	S-3		
			- DCP 50/3"				
			Cemented sand and gravel, light brown, dry				
	BA		Basalt Bedrock, hard, gray				
3.00 Hole Bottom			Test Pit terminated at 3' bgs due to refusal. GWNEDT				

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: Bulk Grab Shelby Tube

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve. A=Atterberg Limits*

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FIGURE
B - 4

PROJECT NO. *76018 (A01)*

TEST PIT LOG TP-04

DEPTH (feet) *ELEVATION (feet)*	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	OL		TOPSOIL				
	SM		Silty Sand, some gravel, fine to medium grained, subangular gravel to 1", brown, dry				
	BA		Basalt Bedrock, hard, gray				
2.50 Hole Bottom			Test Pit terminated at 2.5' bgs due to refusal. GWNEDT				

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: *Bulk* *Grab* *Shelby Tube*

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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TEST PIT LOG TP-05

FIGURE
B - 5

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) / ELEVATION (feet)	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	OL		TOPSOIL				
	SM		Silty Sand, some gravel, fine to medium grained, subangular gravel to 1.5", brown, dry				
			- DCP 31/6"		S-4		
			- DCP 50/6				
			Cemented Hardpan, sand and gravel, light brown, dry				
3.00 Hole Bottom			Test Pit terminated at 3' bgs due to refusal. GWNEDT				

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: *Bulk* *Grab* *Shelby Tube*

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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FIGURE
B - 6

PROJECT NO. *76018 (A01)*

TEST PIT LOG TP-06

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) / ELEVATION (feet)	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	AF		FILL: 3/4"-0 baserock				
	SM		Silty Sand, some gravel, fine to medium grained, subangular gravel, to 1", brown, dry		S-5		
			Cemented Hardpan, light brown sand and gravel, dry				
2.50 Hole Bottom			Test Pit terminated at 2.5' bgs due to refusal. GWNEDT				

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: Bulk Grab Shelby Tube

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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TEST PIT LOG TP-07

FIGURE
B - 7

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) / ELEVATION (feet)	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	AF		FILL: Red Cinders to 1", loose, dry				
	SM		Silty Sand, some gravel, fine to medium grained, subangular gravel to 3", isolated cobbles to 10", brown, damp		S-6		
			Cemented Hardpan, sand and gravel, light brown, dry				
4.00 Hole Bottom			Test Pit terminated at 4' bgs due to refusal. GWNEDT				

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: *Bulk* *Grab* *Shelby Tube*

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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TEST PIT LOG P-01

FIGURE B - 8

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) ELEVATION (feet)	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	OL		TOPSOIL (FILL)				
	AF		FILL: Red cinders to 2", dry				
	SM		Silty Sand, some gravel, fine to medium grained, subangular gravel to 3", cobble to 8", dry, brown		S-7		
3.00 Hole Bottom	BA		Basalt Bedrock, hard, gray Test Pit terminated at 3' bgs due to refusal. GWNEDT				

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: Bulk Grab Shelby Tube

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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FIGURE
B - 9

PROJECT NO. *76018 (A01)*

TEST PIT LOG P-02

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) *ELEVATION (feet)*	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	SM		Silty Sand, some gravel, fine to medium grained, subangular gravel to 1", brown, dry				
	BA		Basalt Bedrock, hard, gray				
1.00 Hole Bottom			Test Pit terminated at 1' bgs due to refusal. GWNEDT				

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: *Bulk* *Grab* *Shelby Tube*

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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FIGURE
B - 10

PROJECT NO. *76018 (A01)*

TEST PIT LOG P-03

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) / ELEVATION (feet)	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	OL		TOPSOIL				
	SM		Silty Sand, fine to medium grained, some subangular gravel to 1", brown, dry		S-8		
			Cemented Hardpan, sand and gravel, light brown, dry				
			Basalt Bedrock, hard, gray				
2.50 Hole Bottom			Test Pit terminated at 2.5' bgs due to refusal.				

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: *Bulk* *Grab* *Shelby Tube*

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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TEST PIT LOG P-04

FIGURE
B - 11

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

DEPTH (feet) *ELEVATION (feet)*	NAME	SYMBOL	SOIL DESCRIPTION	SAMPLE	SAMPLE NUMBER	MOISTURE CONTENT %	OTHER TESTS*
0	OL		TOPSOIL				
	SM		Silty Sand, some gravel, fine to medium grained, subangular gravel to 1", brown, dry				
	BA		Basalt Bedrock, hard, gray				
1.50 Hole Bottom			Test Pit terminated at 1.5' bgs due to refusal. GWNEDT				

DATE EXCAVATED: 10/25/2006
REVIEWED BY: MVH

LOGGED BY: TRF
EQUIPMENT: DEERE 410G

+SAMPLE TYPE: *Bulk* *Grab* *Shelby Tube*

*TESTS: *M=Moisture Content(%), D=Dry Density(pcf), Tv=Torvane, Pp=Pocket Penetrometer, G=Grain Size, G2=% Passing No. 200 Sieve, A=Atterberg Limits*

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TEST PIT LOG P-05

FIGURE
B - 12

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS
MATERIALS PLACED BY MAN				AF	FILL

NOTE: DUAL SYMBOLS ARE USED TO INDICATE INTERMEDIATE SOIL CLASSIFICATIONS

FIELD MEASUREMENTS

▽	Water level observed during drilling
▼	Water level observed after drilling
RQD	Rock Quality Designation

LABORATORY TESTS

GS	Grain Size Analysis Course or Fine Sieve
H	Grain Size Analysis Hydrometer
% Org.	Organic Content

LOG LEGEND

SOIL SAMPLES

- Cal. (3" OD) Split Spoon
- Core Sample
- SPT (2" OD) Split Spoon
- Shelby Tube
- Grab
- No Recovery

WELL CONSTRUCTION

- Blank casing
- Screened casing
- Cement grout
- Bentonite
- Sand pack or gravel pack
- Native material mixed with bentonite
- Native backfill or cavings
- Bentonite-cement grout

KLEINFELDER
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS
SOILS AND MATERIALS TESTING

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L:2006\BEN6R015\logleg

Test Pit Log Legend
Geotechnical Exploration
Redrock Center
Redmond, Oregon

PROJECT # 76018

FIGURE B-13

KLEINFELDER

An employee-owned company

SIEVE ANALYSIS

(ASTM C117 / C136)

Client:	DesertScape, LLC	**Project No.:**	76018 A01
Project Name:	RedRock Center	**Lab No.:**	B03307
Sample Description:	Silty Sand	**Date Sampled:**	10/25/06
Material Source:	Test Pit Sample	**Date Analyzed:**	11/7/2006
Sample Location:	TP-02 at 2.0-2.5ft bgs	**Moisture %:**	14.5%
USCS Descripton:	Silty Sand with Gravel	**Technician:**	S. Cochran
USCS Class.:	SM	**Specification:**	N/A
		Reviewed By:	B. Bem

Sieve Size	Percent Passing
3"	100%
2"	100%
1 1/2"	100%
1"	99%
3/4"	98%
1/2"	95%
3/8"	92%
#4	82%
#10	72%
#20	67%
#40	59%
#60	50%
#100	39%
#200	24.5%

Cu =
Cc =

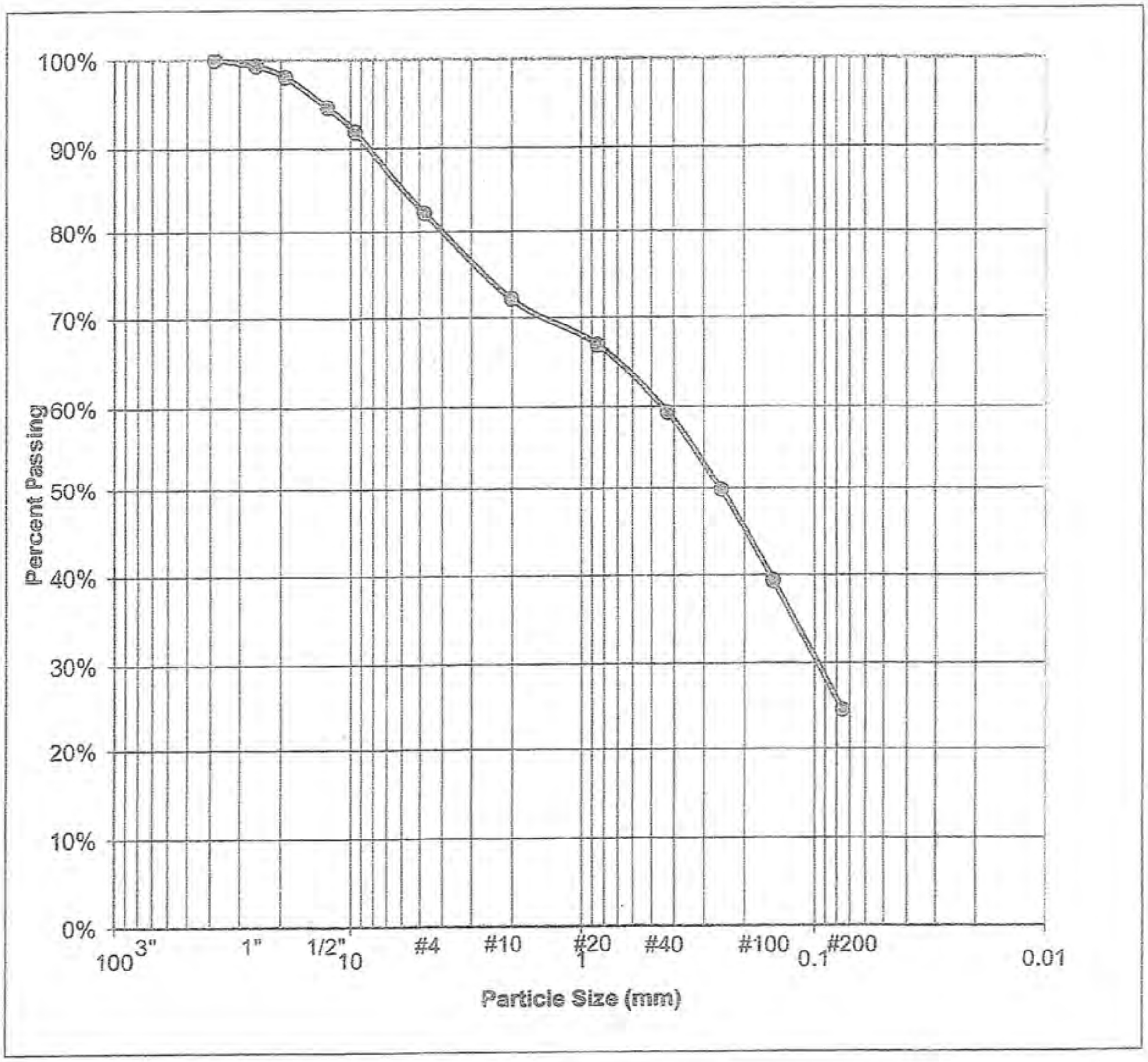

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FIGURE C-1

KLEINFELDER

An employee-owned company

SIEVE ANALYSIS

(ASTM C117 / C136)

Client:	DesertScape, LLC	**Project No.:**	76018 A01
Project Name:	RedRock Center	**Lab No.:**	B03307
Sample Description:	Silty Sand	**Date Sampled:**	10/25/06
Material Source:	Test Pit Sample	**Date Analyzed:**	11/7/2006
Sample Location:	TP-03 at 1-1.5ft bgs	**Moisture %:**	9.0%
USCS Descripton:	Silty Sand with Gravel	**Technician:**	S. Cochran
USCS Class.:	SM	**Specification:**	N/A
		Reviewed By:	B. Br[illegible]

Sieve Size	Percent Passing
3"	100%
2"	100%
1 1/2"	100%
1"	99%
3/4"	99%
1/2"	98%
3/8"	97%
#4	89%
#10	82%
#20	76%
#40	67%
#60	54%
#100	40%
#200	26.6%

Cu =

Cc =

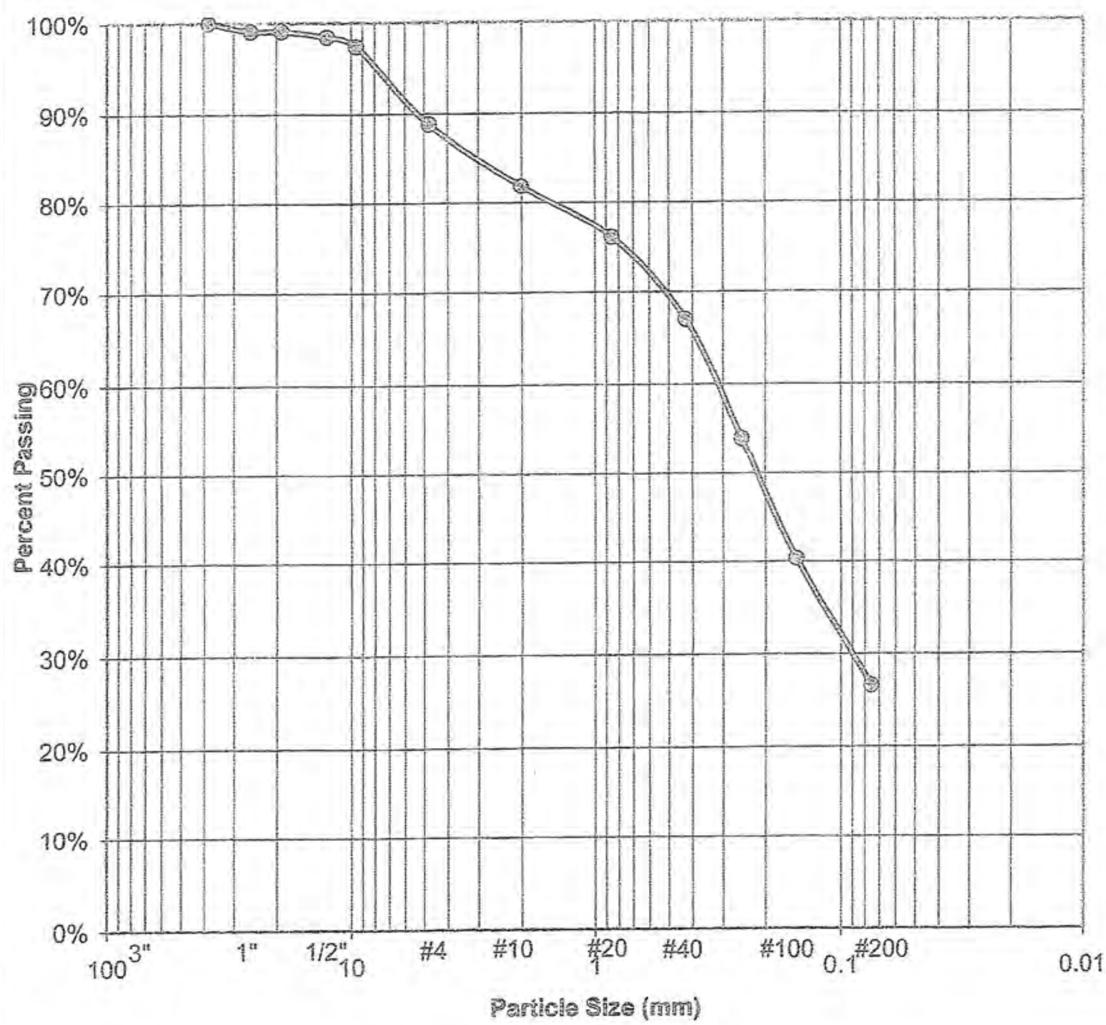

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FIGURE C-2

KLEINFELDER
An employee-owned company

SIEVE ANALYSIS

(ASTM C117 / C136)

Client:	DesertScape, LLC	**Project No.:**	76018 A01
Project Name:	RedRock Center	**Lab No.:**	B03307
Sample Description:	Silty Sand	**Date Sampled:**	10/25/06
Material Source:	Test Pit Sample	**Date Analyzed:**	11/7/2006
Sample Location:	TP-04 at 1.5-2ft bgs	**Moisture %:**	8.8%
USCS Descripton:	Silty Sand with Gravel	**Technician:**	S. Cochran
USCS Class.:	SM	**Specification:**	N/A
		Reviewed By:	B. Baum

Sieve Size	Percent Passing
3"	100%
2"	100%
1 1/2"	100%
1"	98%
3/4"	96%
1/2"	93%
3/8"	89%
#4	80%
#10	74%
#20	68%
#40	60%
#60	50%
#100	38%
#200	25.9%

Cu =
Cc =

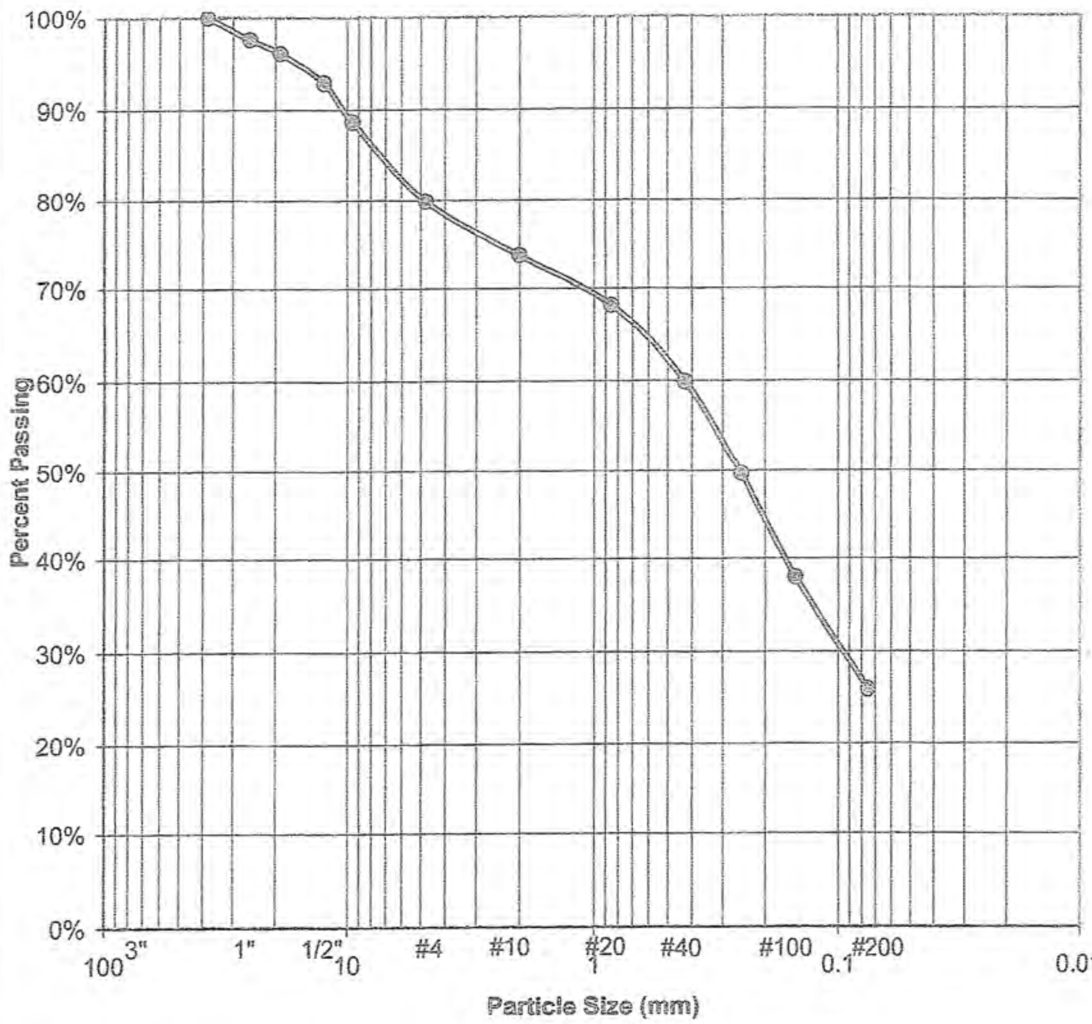

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FIGURE C-3

KLEINFELDER

An employee-owned company

SIEVE ANALYSIS

(ASTM C117 / C136)

Client:	DesertScape, LLC	**Project No.:**	76018 A01
Project Name:	RedRock Center	**Lab No.:**	B03307
Sample Description:	Silty Sand	**Date Sampled:**	10/25/06
Material Source:	Test Pit Sample	**Date Analyzed:**	11/7/2006
Sample Location:	TP-06 at 1.5-2ft bgs	**Moisture %:**	6.8%
USCS Descripton:	Silty Sand with Gravel	**Technician:**	S. Cochran
USCS Class.:	SM	**Specification:**	N/A
		Reviewed By:	B. [signature]

Sieve Size	Percent Passing
3"	100%
2"	100%
1 1/2"	98%
1"	98%
3/4"	98%
1/2"	96%
3/8"	95%
#4	92%
#10	89%
#20	85%
#40	77%
#60	66%
#100	52%
#200	37.1%

Cu =
Cc =

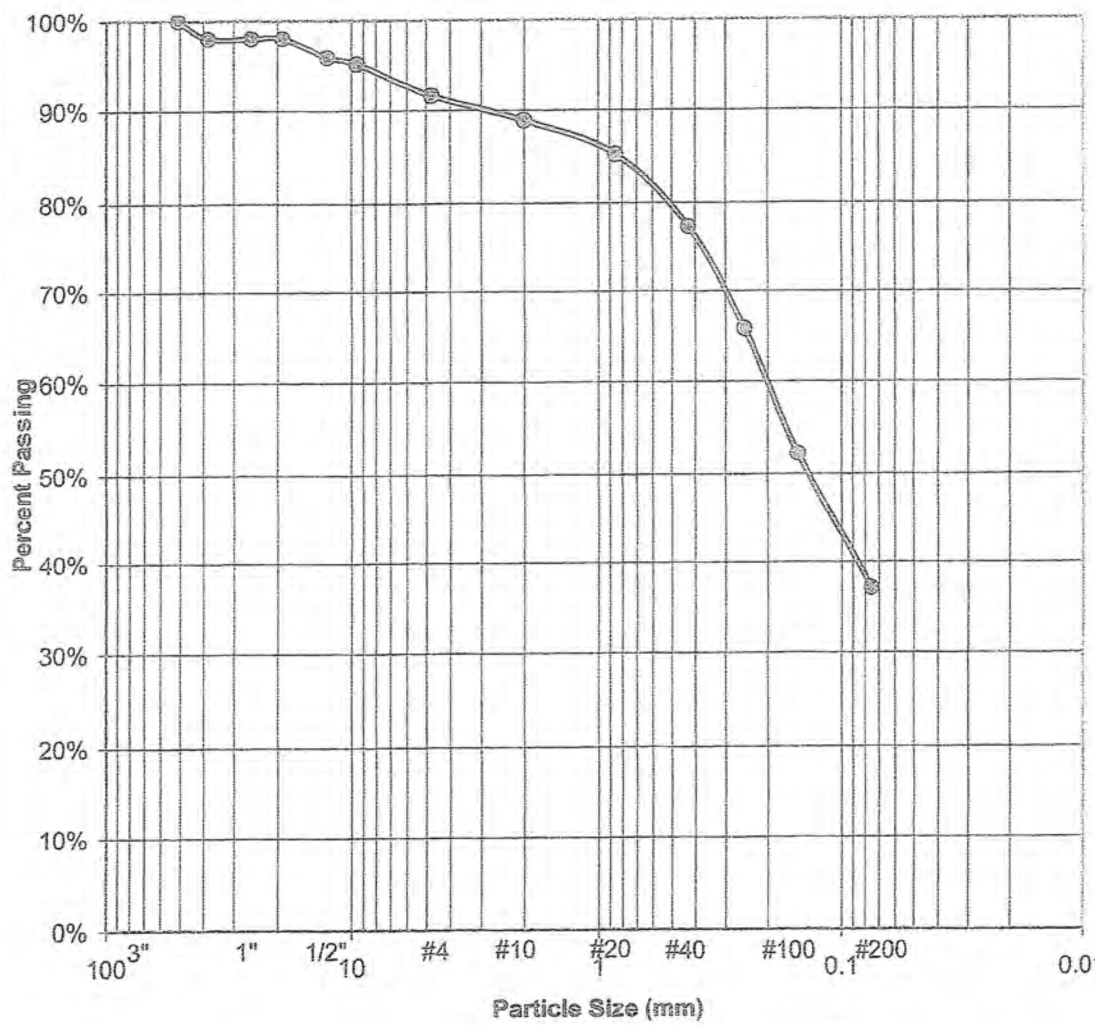

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FIGURE C-4

KLEINFELDER

An employee-owned company

SIEVE ANALYSIS

(ASTM C117 / C136)

Client: DesertScape, LLC
Project Name: RedRock Center
Sample Description: Silty Sand
Material Source: Test Pit Sample
Sample Location: TP-07 at 1.0-1.5 ft bgs
USCS Descripton: Silty Sand with Gravel
USCS Class.: SM

Project No.: 76018 A01
Lab No.: B03307
Date Sampled: 10/25/06
Date Analyzed: 11/7/2006
Moisture %: 6.1%
Technician: S. Cochran
Specification: N/A
Reviewed By: B. Bern

Sieve Size	Percent Passing
3"	100%
2"	100%
1 1/2"	100%
1"	95%
3/4"	93%
1/2"	88%
3/8"	85%
#4	79%
#10	75%
#20	71%
#40	63%
#60	50%
#100	37%
#200	25.8%

Cu =
Cc =

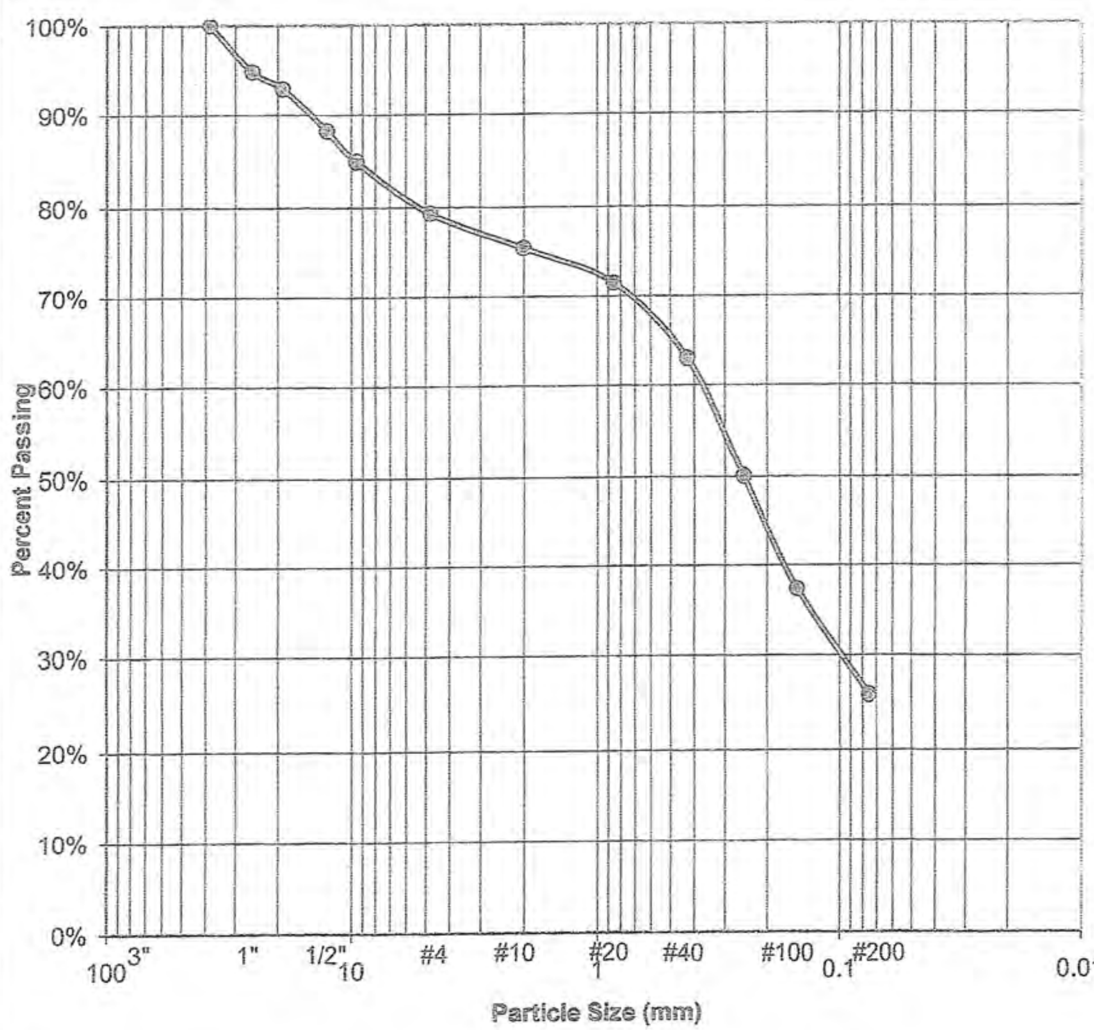

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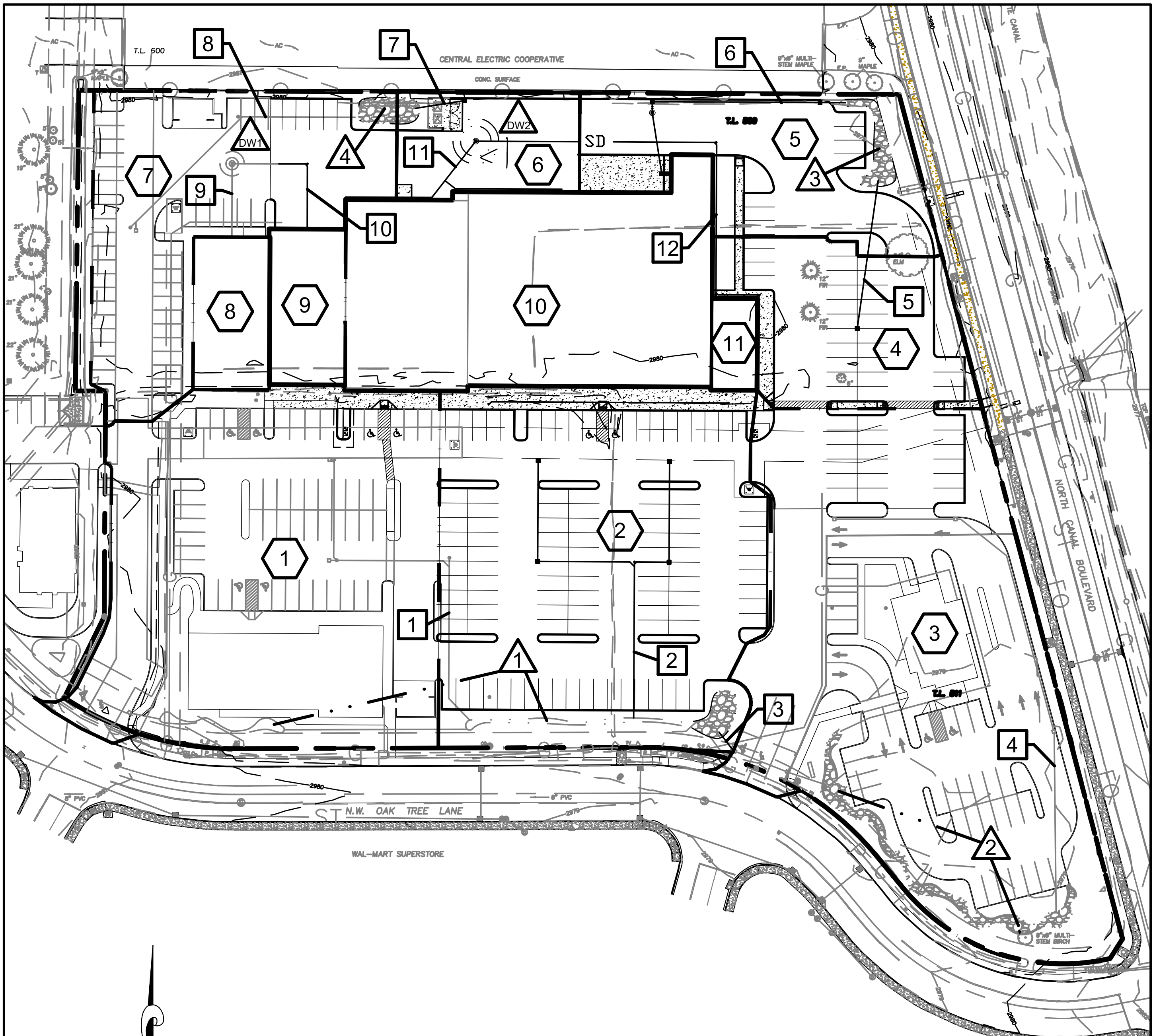
FIGURE C-5

Appendix C



STORMWATER SITEPLAN

Red Rock Commercial Center - Final Phase 3
June, 2021

1"=100'

RHINE-CROSS GROUP LLC
ENGINEERING - SURVEYING - PLANNING
112 N 5th ST - SUITE 200 - P.O. BOX 909
KLAMATH FALLS, OREGON 97601
Phone: (541) 851-9405 Fax: (541) 273-9200 admin@rc-grp.com

Legend:

- XX (hexagon) - subcatchment number
- XX (square) - reach number (pipe, etc)
- X (triangle) - infiltration facility number

Appendix D

R-C RHINE-CROSS GROUP

RHINE-CROSS GROUP LLC

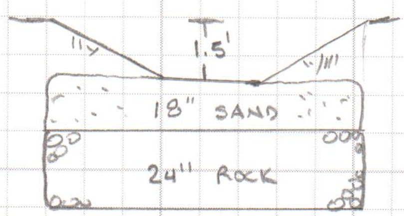
ENGINEERING – SURVEYING – PLANNING
112 N 5th STREET, Ste 200, P.O. BOX 909
KLAMATH FALLS, OREGON 97601

PHONE: (541) 851-9405 FAX: (541) 273-9200 EMAIL: marc@rc-grp.com

JOB: REDMOND RED ROCK PH 3
DRAWN BY: MDC
CHECKED BY:
DATE: 6/1/2021

POND 1P - EXISTING FACILITY WITH PHASE 2 + EXPANSION AT END

DRAINROCK FOOTPRINT : 3890 sf at Base Elevation 2973.5
BOTTOM of SWALE : 1230 sf at Elevation 2977.0
TOP OF SWALE : 3890 sf at Elevation 2978.5



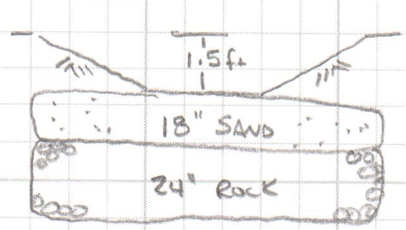
2978.5 = 5
2977.0 = 3.5
2975.5 = 2
2973.5 = 0

@ 0.0 VOLUME = 0
@ 2.0 VOLUME = (3890 × 2ft) × 1/3 VOIDS
= 2593 cu.ft.
@ 3.5 VOLUME = (3890 × 1.5ft) × 1/3 VOIDS
= 2593 cu ft + 1945 cu ft
= 4538 cu ft
@ 5.0 VOLUME = (1230 sf × 1.5ft) +
[(3890 sf − 1230 sf) × 1.5ft] × 1/2 ~~× 1/3 voids~~
= 3840 cu ft + 4538 cu ft
= 8378 cu ft

Infiltration rate = 3890 sf × 1.4 in/hr × 1ft/12in × 1hr/3600s
= 0.13 cfs

POND 2P - FACILITY CONSTRUCTED WITH SELCO

DRAINROCK FOOTPRINT : 4830 sf at Base Elevation = 2973.0
BOTTOM of SWALE : 1809 sf at Elevation = 2976.5
TOP OF SWALE : 4830 sf at Elevation = 2978.0



2978.0 = 5
2976.5 = 3.5
2976.0 = 2
2974.0 = 0

@ 0.0 VOLUME = 0
@ 2.0 VOLUME = (4830 sf × 2ft) 1/3 VOIDS
= 3220 cu. ft.
@ 3.5 VOLUME = (4830 sf × 1.5ft) 1/3 VOIDS
= 3220 cu ft + 2415 cu ft
= 5635 cu ft
@ 5.0 VOLUME = (1809 sf × 1.5 ft) +
1/2 (4830 − 1809 sf) × 1.5ft
= 5635 cu ft + 4980 cu ft
= 10,615 cu. ft.

Infiltration rate = 4830 sf × 1.4 in/hr × 1ft/12in × 1hr/3600s
= 0.16 cfs

R-C RHINE-CROSS GROUP

RHINE-CROSS GROUP LLC

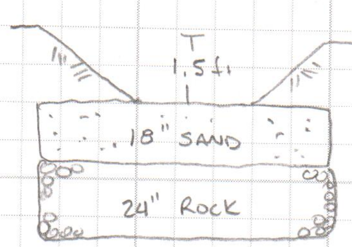
ENGINEERING – SURVEYING – PLANNING
112 N 5th STREET, Ste 200, P.O. BOX 909
KLAMATH FALLS, OREGON 97601

PHONE: (541) 851-9405 FAX: (541) 273-9200 EMAIL: marc@rc-grp.com

JOB: RED ROCK PH 3
DRAWN BY: MDC
CHECKED BY:
DATE: 6/1/2021

POND 3P – NEW POND NE COR OF SITE

DRAINROCK FOOTPRINT: 1658 sf at Base Elevation 2973.5
BOTTOM OF SWALE: 692 sf at Elevation 2977.0
TOP of SWALE: 1658 sf at Elevation 2978.5



2978.5 = 5.0
2977.0 = 3.5
2975.5 = 2
2973.5 = 0

@ 0.0 VOLUME = 0

@ 2.0 VOLUME = (1658 sf × 2 ft) × 1/3 VOIDS
= 1105 cu. ft

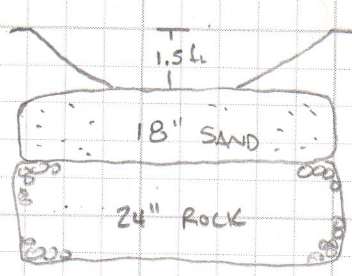
@ 3.5 VOLUME = (1658 sf × 1.5 ft) × 1/3 VOIDS
= 1105 cu. ft. + 829 cu. ft
= 1934 cu. ft.

@ 5.0 VOLUME = (692 sf × 1.5 ft) + 1/2 [(1658 sf − 692 sf) × 1.5 ft]
= 1934 cu. ft + 1762 cu ft
= 3696 cu. ft.

Infiltration Rate = 1658 sf × 1.4 in/hr × 1 ft/12 in × 1 hr/3600 s
= 0.05 cfs

POND 4P – POND BACK OF STORES

DRAINROCK FOOTPRINT: 1104 sf at Base Elevation
BOTTOM of SWALE: 625 sf at Elevation 2977.0
TOP of SWALE: 1104 sf at Elevation 2978.5



2978.5 = 5.0
2977.0 = 3.5
2975.5 = 2.0
2973.5 = 0.0

@ 0.0 VOLUME = 0

@ 2.0 Volume = (1104 sf × 2 ft) × 1/3 VOIDS
= 736 cu ft

@ 3.5 VOLUME = (1104 sf × 1.5 ft) × 1/3 VOIDS
= 736 cu ft + 552 cu ft
= 1288 cu ft

@ 5.0 VOLUME = (625 sf × 1.5 ft) + [(1104 sf − 625 sf) × 1.5 ft] 1/2
= 1288 cu ft + 1297 cu ft
= 2585 cu. ft.

Infiltration Rate = 1104 sf × 1.4 in/hr × 1 ft/12 in × 1 hr/3600 s
= 0.04 cfs

R-C RHINE-CROSS GROUP

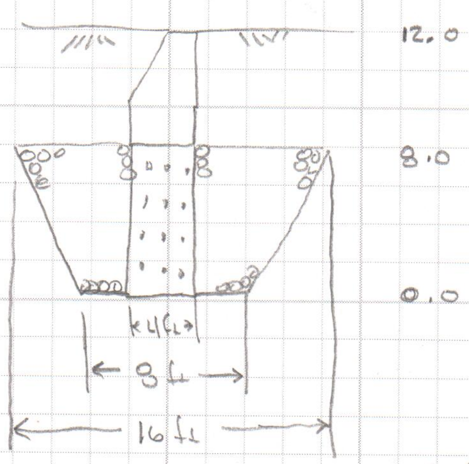
RHINE-CROSS GROUP LLC

ENGINEERING – SURVEYING – PLANNING
112 N 5th STREET, Ste 200, P.O. BOX 909
KLAMATH FALLS, OREGON 97601

PHONE: (541) 851-9405 FAX: (541) 273-9200 EMAIL: marc@rc-grp.com

JOB: RED ROCK PH 3
DRAWN BY: MDC
CHECKED BY:
DATE: 6/1/2021
REVISED 9/20/2021

DRYWELL #1 EXISTING DRYWELL BACK OF MAURICES



@ 0.0 VOLUME = 0

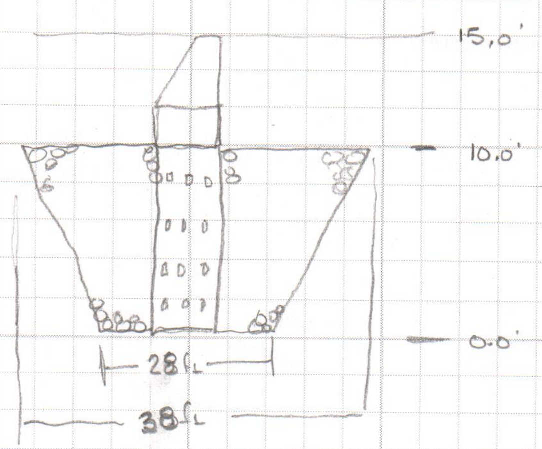
@ 8.0 VOLUME = $(2ft)^2\pi \times 8ft$ +
$8ft\left[(8ft)^2\pi - (4ft)^2\pi\right]\frac{1}{2} \times \frac{1}{3}$ VOIDS +
$8ft\left(4ft^2\pi - 2ft^2\pi\right) \times \frac{1}{3}$ voids
= 402 cu ft

@ 12.0 Volume = $(2ft)^2\pi \times 4ft$
= 402 cu ft + 50 cu ft
= 452 cu ft

Infiltration Rate = @ 0.1' $50sf \times 5.95 in/hr \times \frac{1ft}{12in} \times \frac{1hr}{3600s} = 0.01cfs$
@ 8.0 $201sf \times 5.95 in/hr \times \frac{1ft}{12in} \times \frac{1hr}{3600s} = 0.03cfs$

*NOTE: DW#1 TESTED IN 2015 AT ± 72 in/hr
USING MAXIMUM ALLOWABLE 5.95 in/hr

Drywell #2 NEW DRYWELL FOR MARSHALL'S, ULTA BEAUTY, RETAIL SHOP

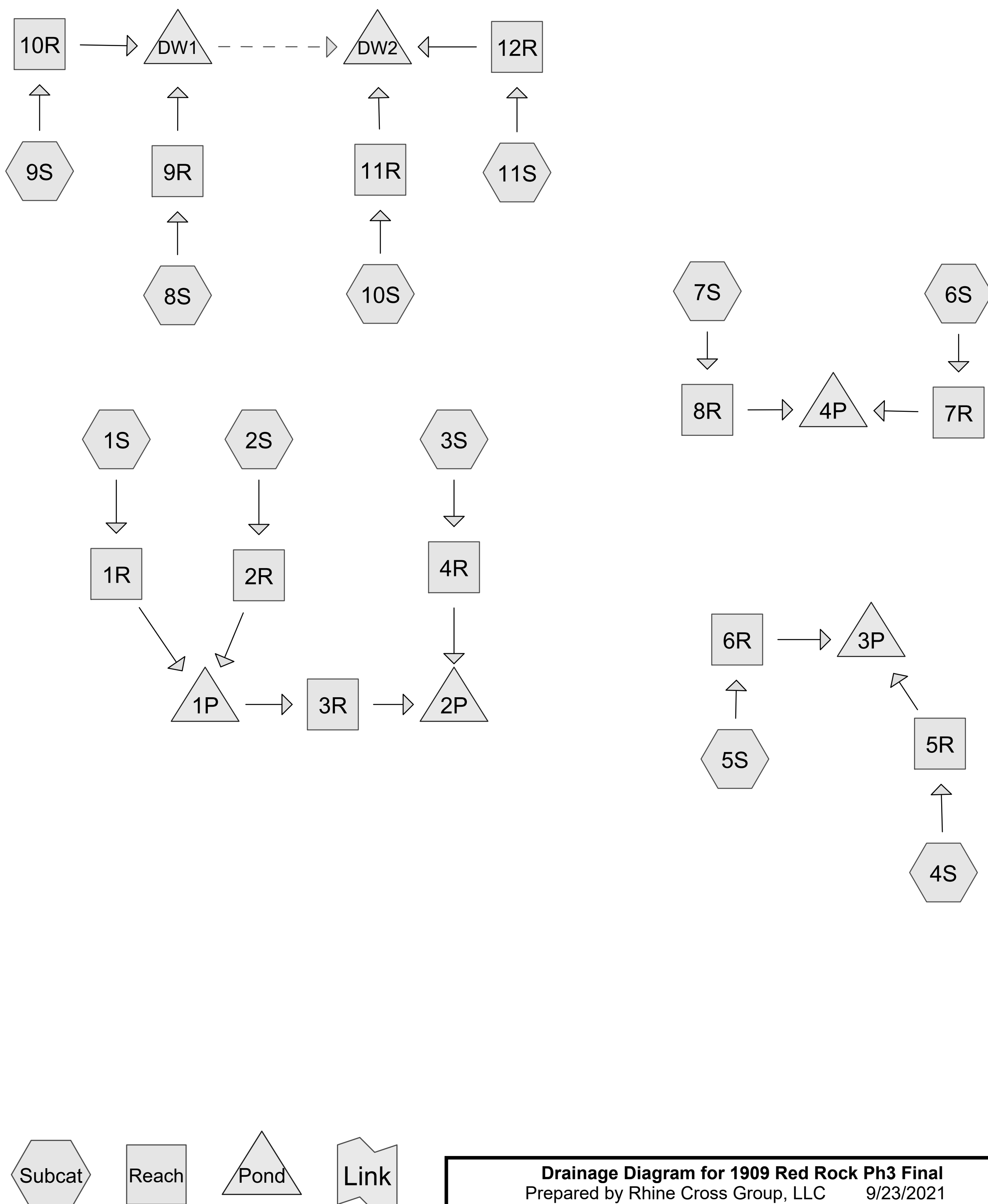


@ 0.0 VOLUME = 0 cuft

@ 10.0 VOLUME = $(2ft)^2\pi \times 10ft$ +
$10ft\left[14ft^2\pi - 2ft^2\pi\right] \times \frac{1}{3}$ VOIDS +
$10ft\left[19ft^2\pi - 14ft^2\pi\right] \times \frac{1}{2} \times \frac{1}{3}$ VOIDS
= 3001 cu.ft.

@ 15.0 Volume = $2ft^2\pi \times 5ft$
= 1785 cuft + 63 cuft
= 3064 cu ft

Infiltration Rate = @ 0.1' = $618sf \times 1.98 in/hr \times \frac{1ft}{12in} \times \frac{1hr}{3600s} = 0.04cfs$
@ 10ft = $1134sf \times 1.98 in/hr \times \frac{1ft}{12in} \times \frac{1hr}{3600s} = 0.10cfs$



Drainage Diagram for 1909 Red Rock Ph3 Final
Prepared by Rhine Cross Group, LLC 9/23/2021
HydroCAD® 6.10 s/n 002306 © 1986-2002 Applied Microcomputer Systems

Subcatchment 1S: Existing Phase 1 Area

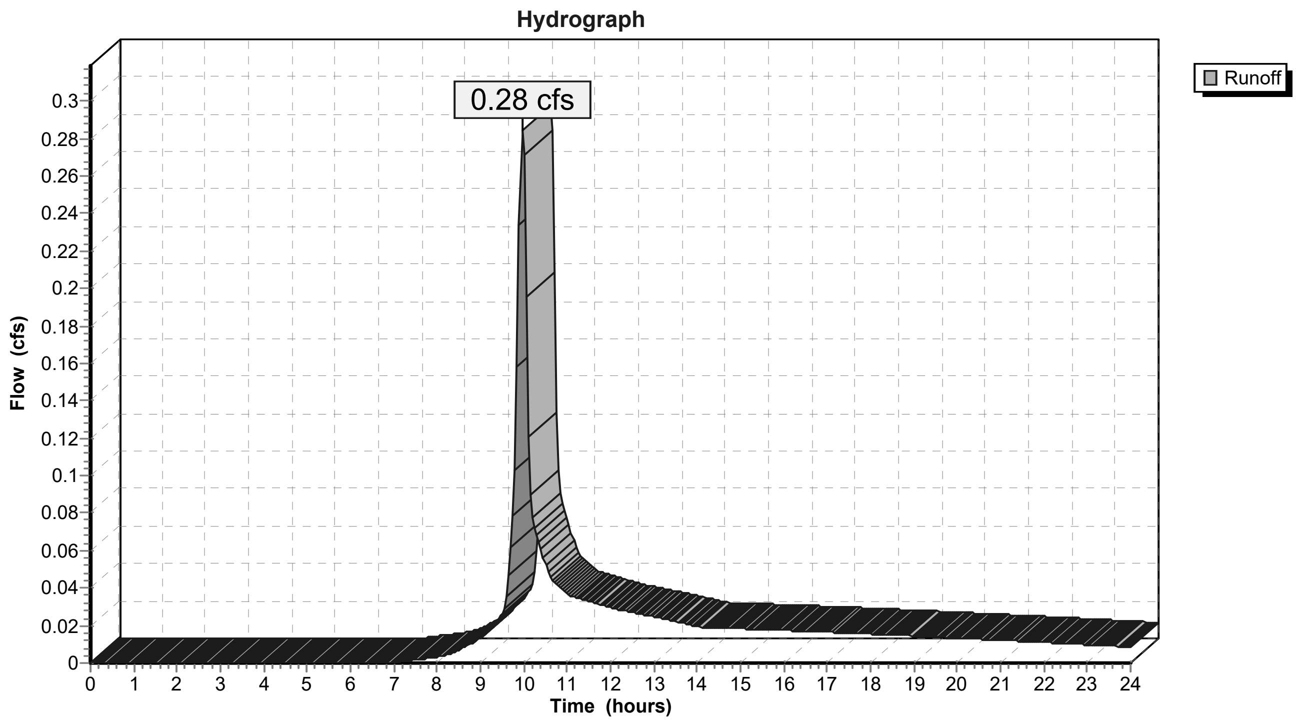
Runoff = 0.28 cfs @ 9.97 hrs, Volume= 0.031 af, Depth= 0.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
6,787	98	Roof
36,802	98	Asphalt & Sidewalk
7,393	79	<50% Grass cover, Poor, HSG B
50,982	95	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 1S: Existing Phase 1 Area



Subcatchment 2S: New Phase 3 Parking Area

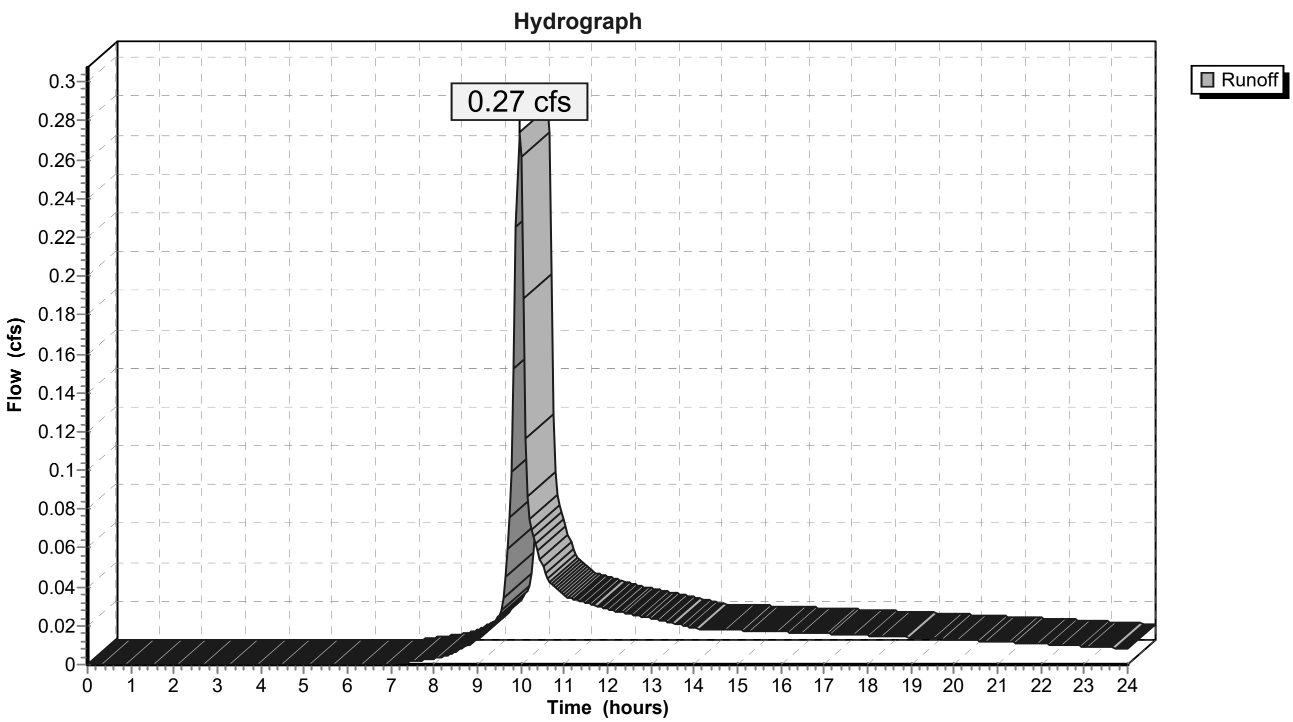
Runoff = 0.27 cfs @ 9.97 hrs, Volume= 0.030 af, Depth= 0.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
41,516	98	Asphalt & Sidewalk
7,610	79	<50% Grass cover, Poor, HSG B
49,126	95	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 2S: New Phase 3 Parking Area



Subcatchment 3S: SELCO improvement area

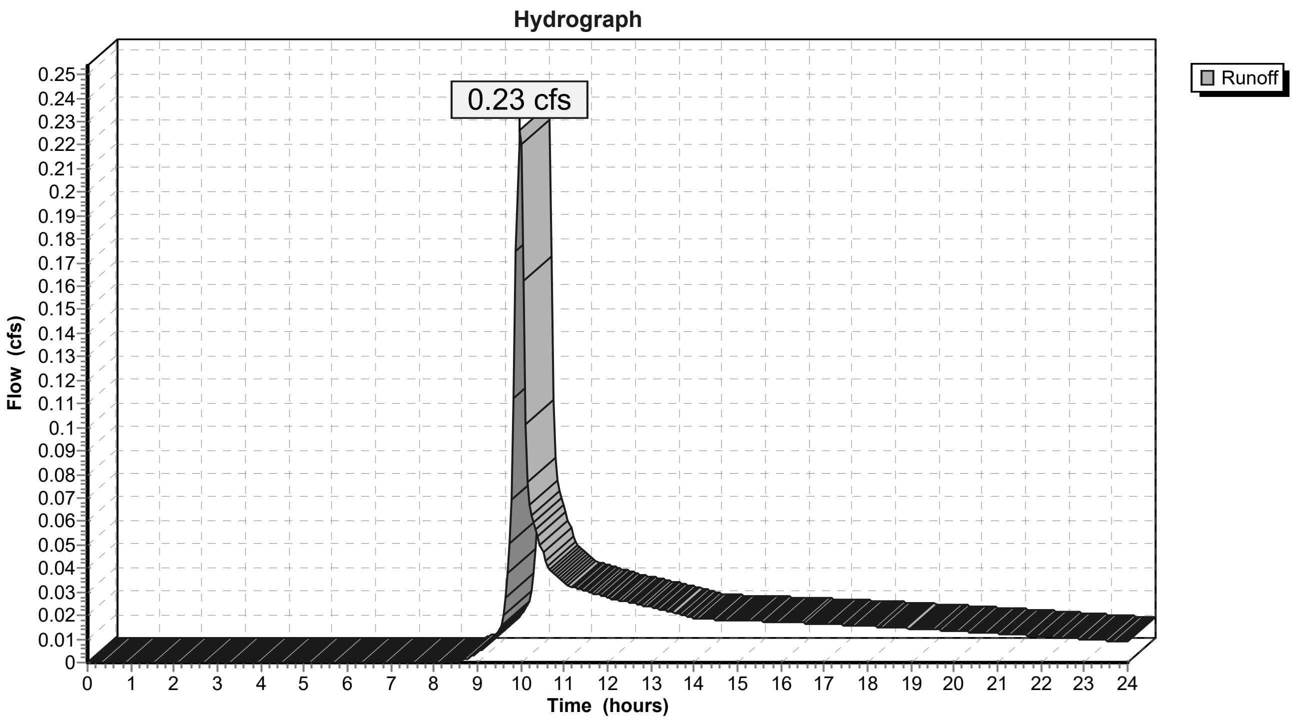
Runoff = 0.23 cfs @ 9.97 hrs, Volume= 0.027 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
41,367	98	Asphalt & Sidewalk Area
2,657	98	Roof Area
17,061	79	<50% Grass cover, Poor, HSG B
61,085	93	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Impervious**

Subcatchment 3S: SELCO improvement area



Subcatchment 4S: Developed #4

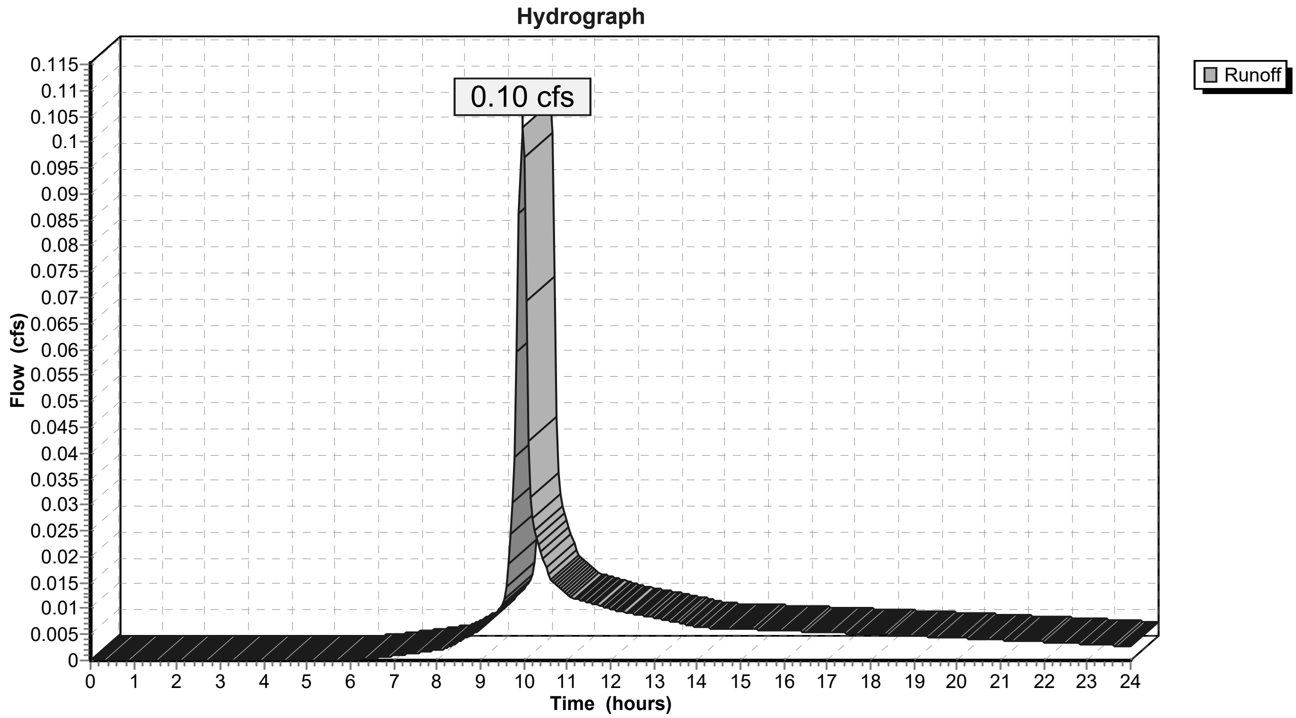
Runoff = 0.10 cfs @ 9.96 hrs, Volume= 0.011 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
13,631	98	Asphalt & Sidewalk
1,648	79	<50% Grass cover, Poor, HSG B
15,279	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 4S: Developed #4



Subcatchment 5S: Developed #5

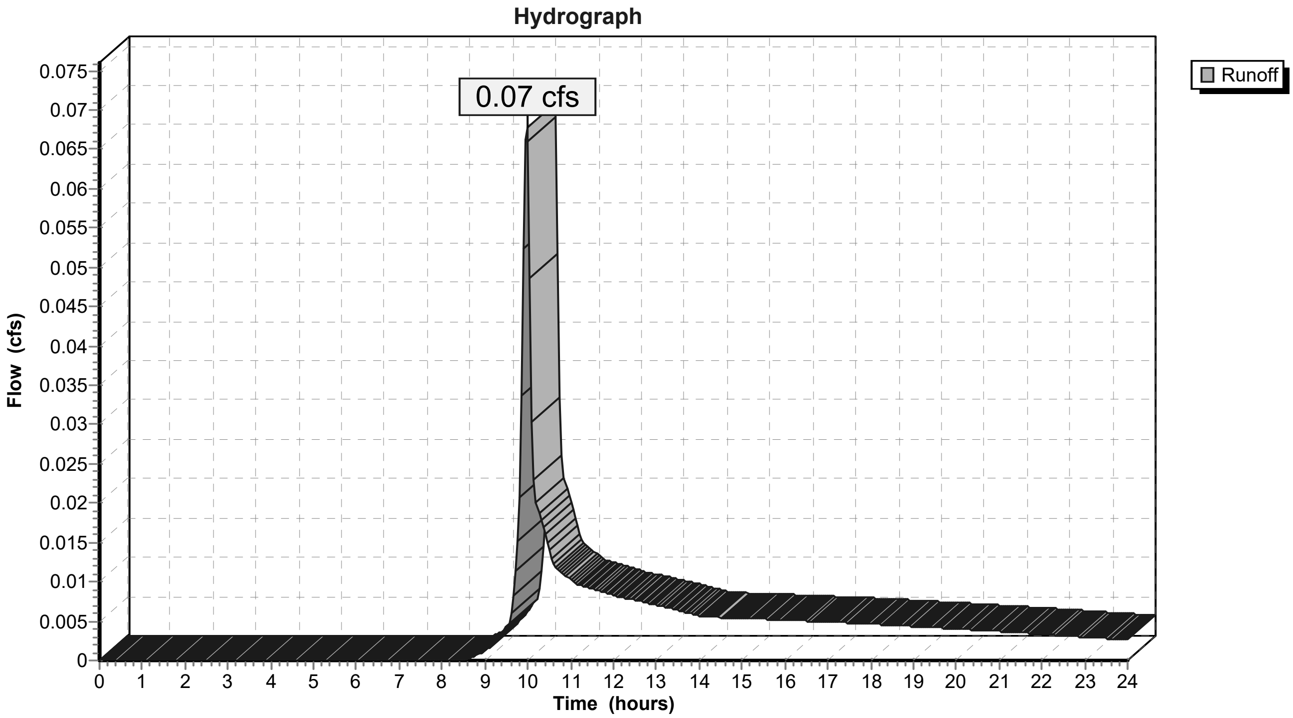
Runoff = 0.07 cfs @ 9.97 hrs, Volume= 0.008 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
13,257	98	Asphalt & Sidewalk
5,042	79	<50% Grass cover, Poor, HSG B
18,299	93	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 5S: Developed #5



Subcatchment 6S: Developed #6

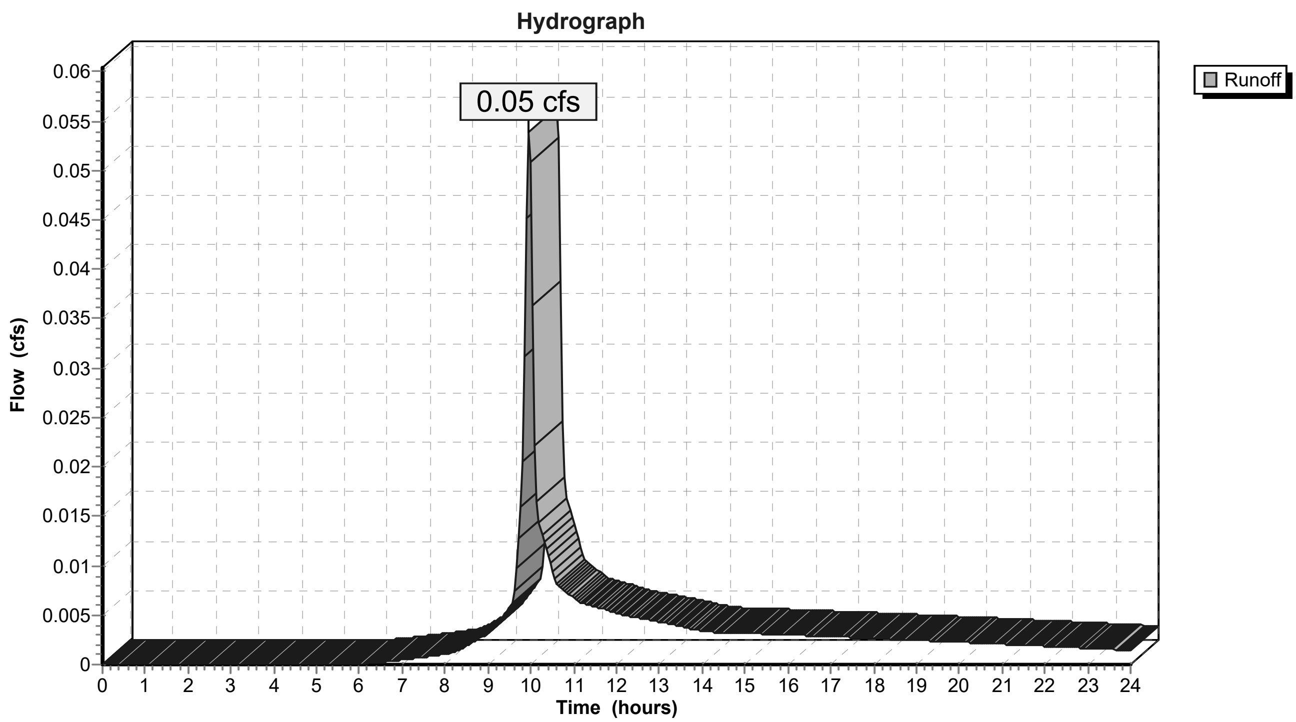
Runoff = 0.05 cfs @ 9.96 hrs, Volume= 0.006 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
7,031	98	Asphalt & Sidewalk
973	79	<50% Grass cover, Poor, HSG B
8,004	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 6S: Developed #6



Subcatchment 7S: Developed #7

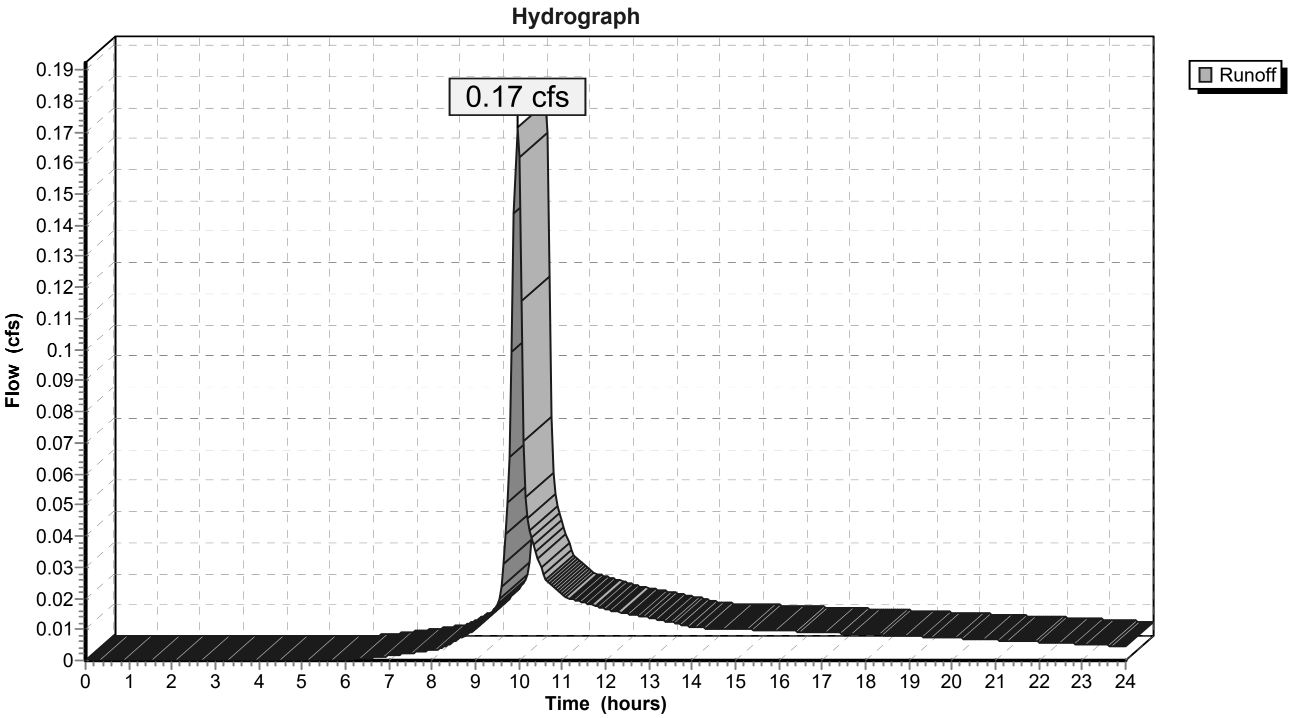
Runoff = 0.17 cfs @ 9.96 hrs, Volume= 0.018 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
22,443	98	Asphalt & Sidewalk
3,033	79	<50% Grass cover, Poor, HSG B
25,476	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 7S: Developed #7



Subcatchment 8S: Maurices Roof

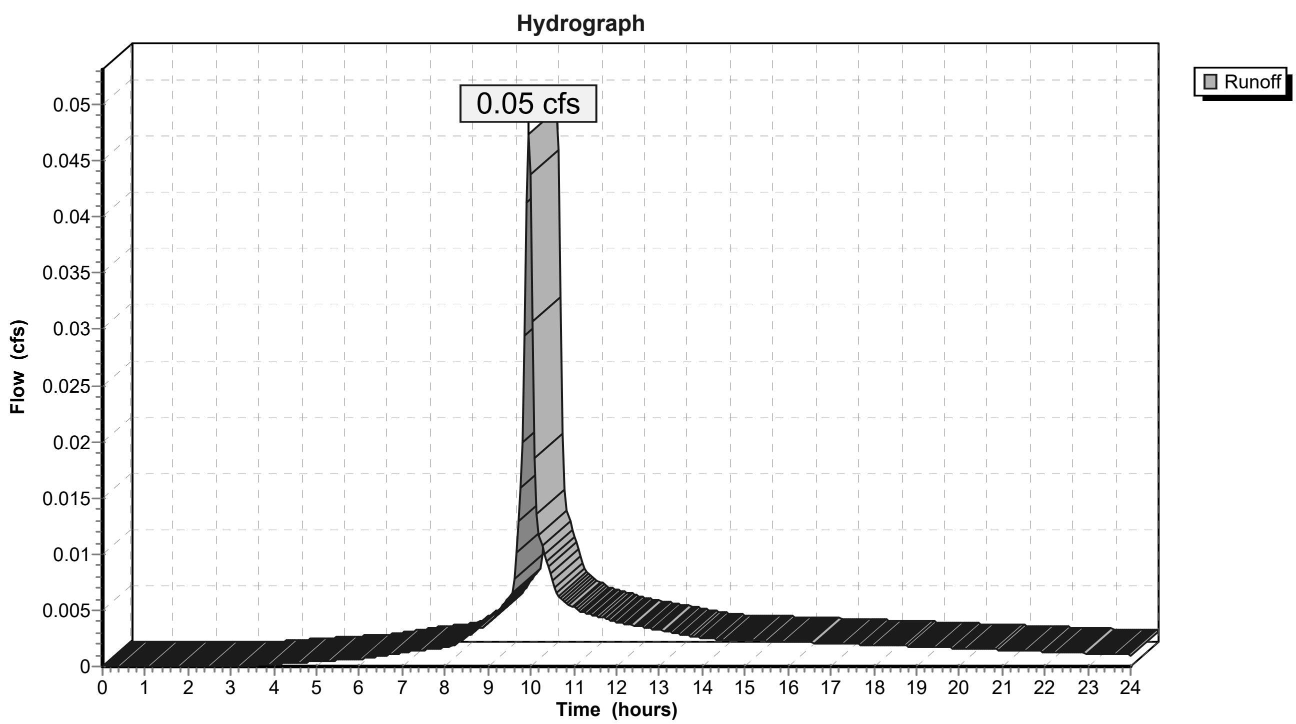
Runoff = 0.05 cfs @ 9.96 hrs, Volume= 0.005 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
5,000	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 8S: Maurices Roof



Subcatchment 9S: Famous Footwear Roof

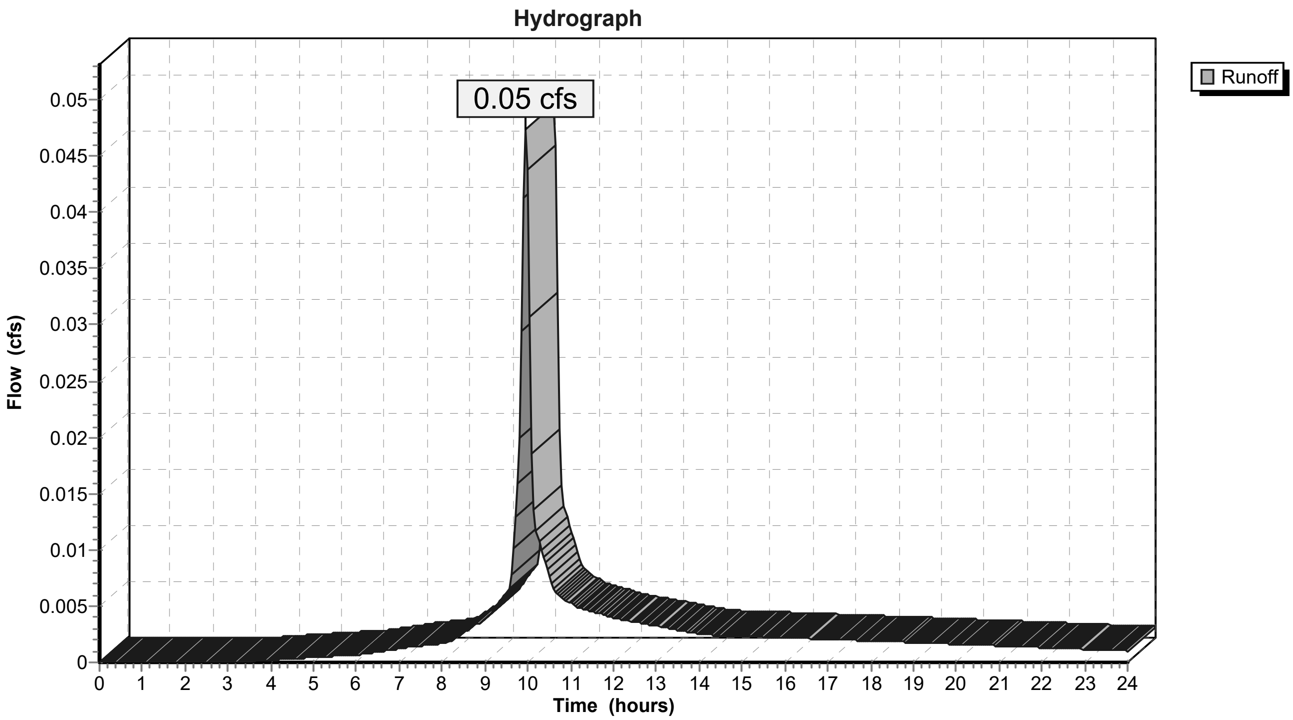
Runoff = 0.05 cfs @ 9.96 hrs, Volume= 0.005 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
5,000	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 9S: Famous Footwear Roof



Subcatchment 10S: Ulta & Marshall's Roof

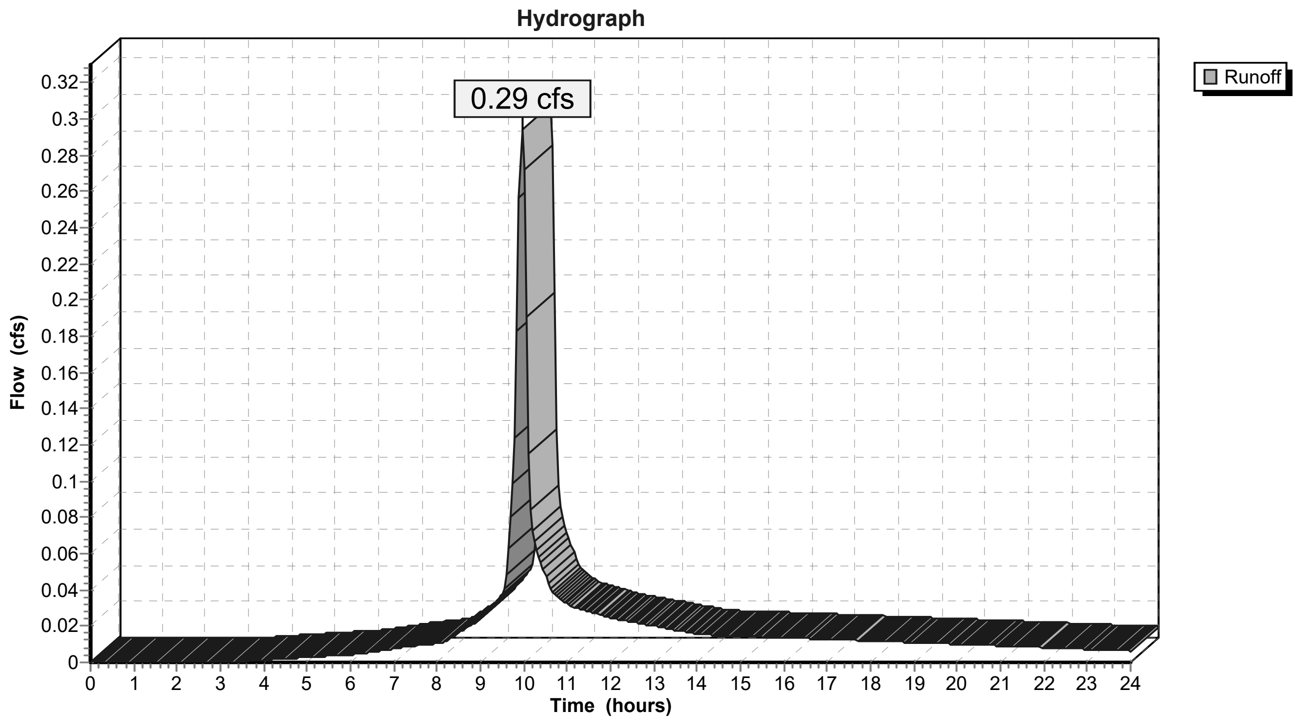
Runoff = 0.29 cfs @ 9.96 hrs, Volume= 0.030 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
31,064	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 10S: Ulta & Marshall's Roof



Subcatchment 11S: Small Retail Roof

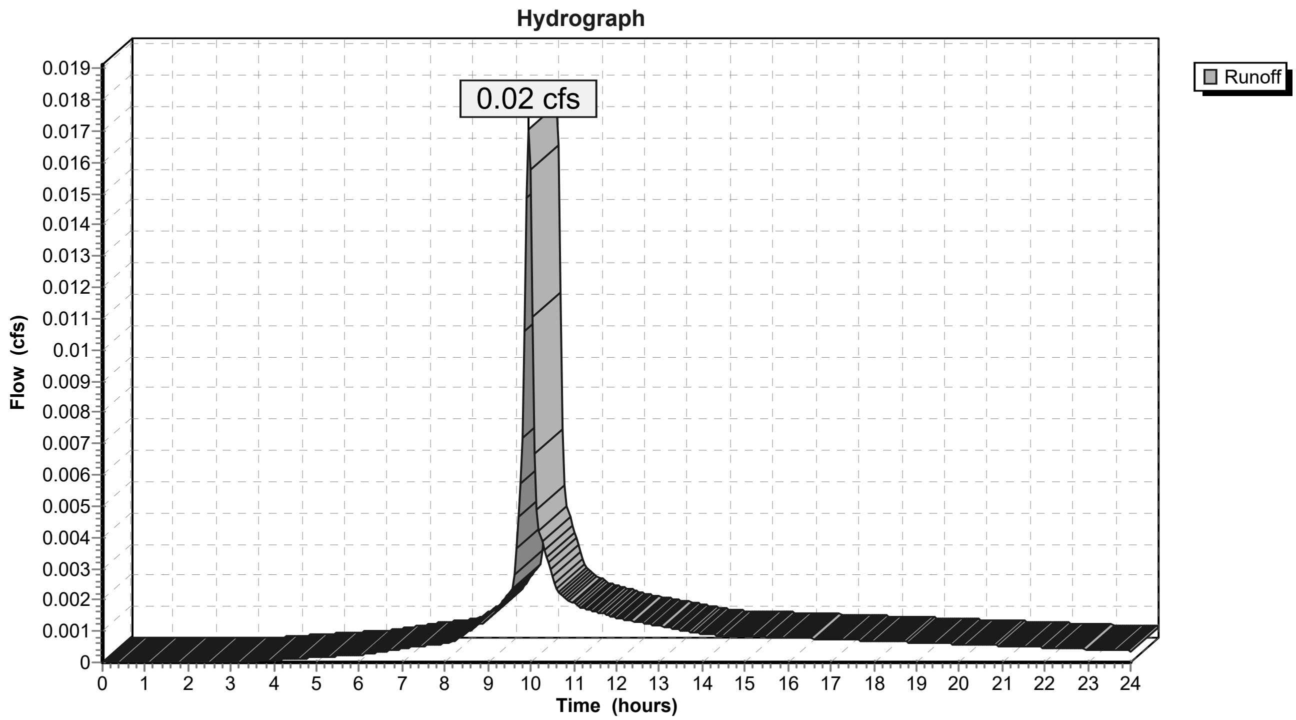
Runoff = 0.02 cfs @ 9.96 hrs, Volume= 0.002 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=0.70"

Area (sf)	CN	Description
1,800	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 11S: Small Retail Roof



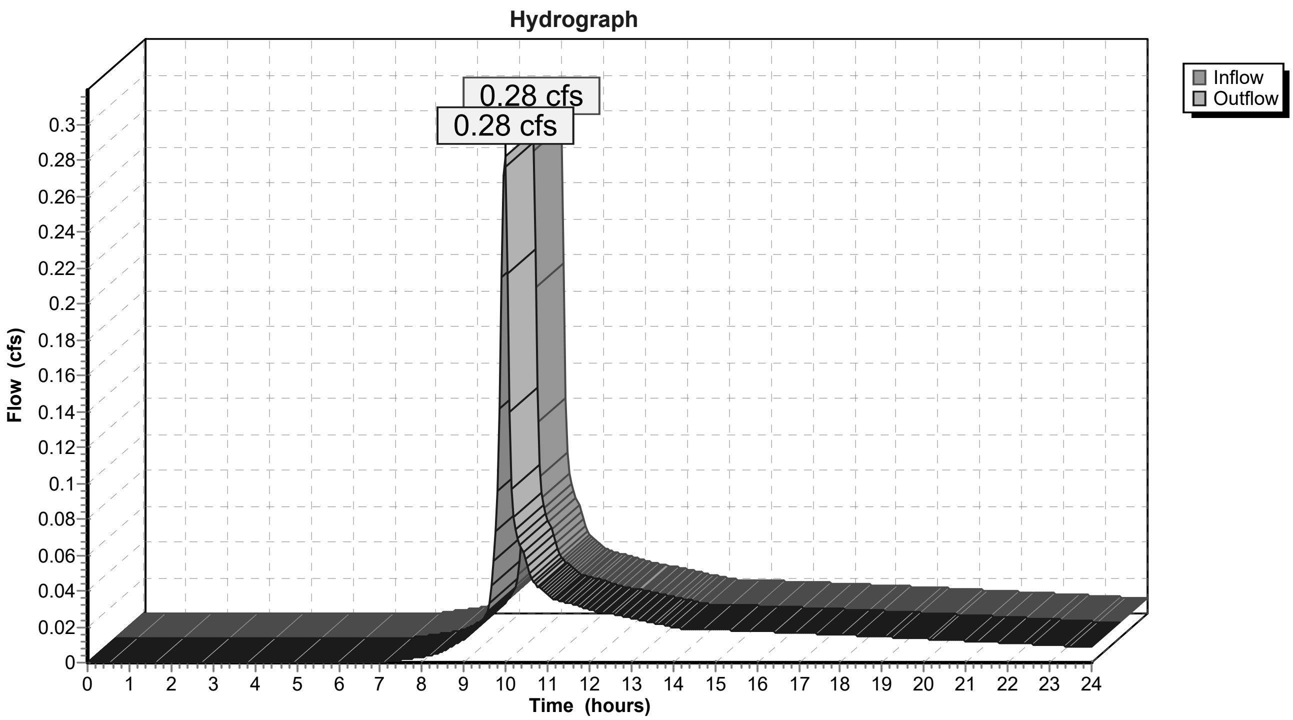
Reach 1R: Phase 2 pipe

Inflow Area = 1.170 ac, Inflow Depth = 0.32"
Inflow = 0.28 cfs @ 9.97 hrs, Volume= 0.031 af
Outflow = 0.28 cfs @ 9.98 hrs, Volume= 0.031 af, Atten= 1%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.8 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.7 fps, Avg. Travel Time= 1.0 min

Peak Depth= 0.18'
Capacity at bank full= 1.85 cfs
8.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0200 '/'

Reach 1R: Phase 2 pipe



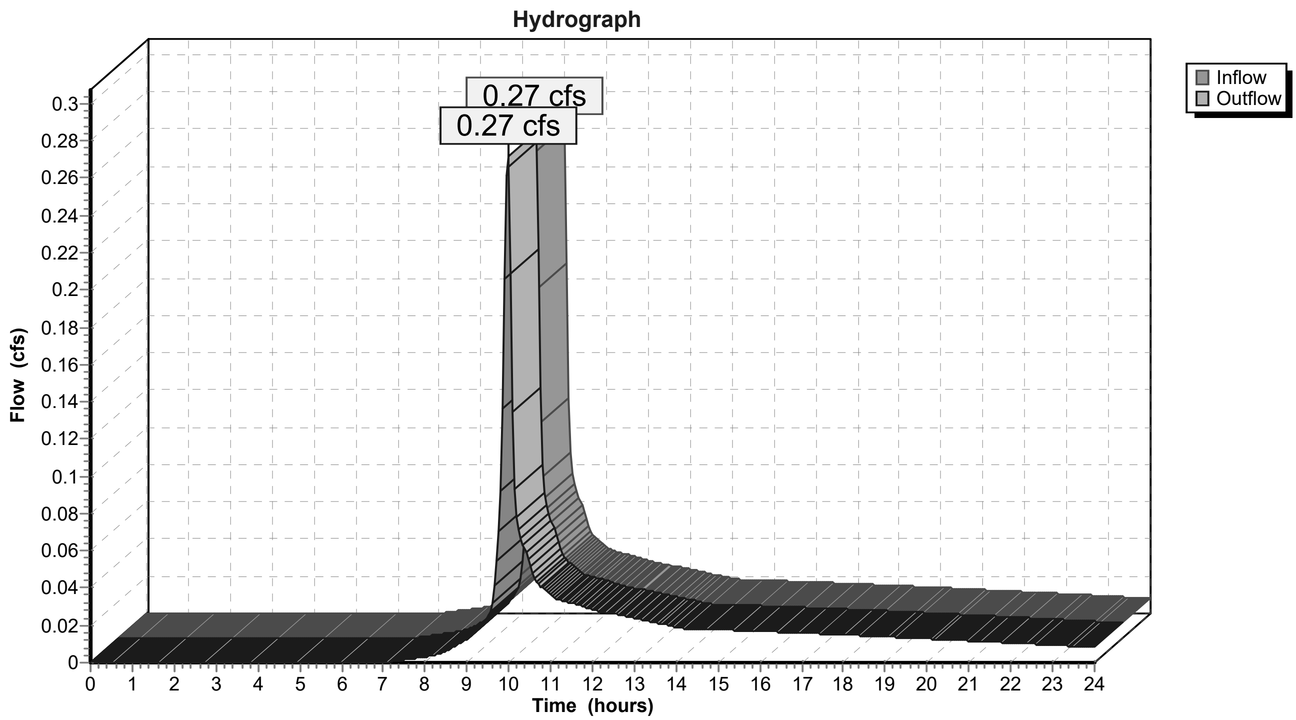
Reach 2R: Phase 3 Pipe

Inflow Area = 1.128 ac, Inflow Depth = 0.32"
Inflow = 0.27 cfs @ 9.97 hrs, Volume= 0.030 af
Outflow = 0.27 cfs @ 9.98 hrs, Volume= 0.030 af, Atten= 1%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.8 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 1.0 min

Peak Depth= 0.17'
Capacity at bank full= 1.85 cfs
8.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0200 '/'

Reach 2R: Phase 3 Pipe



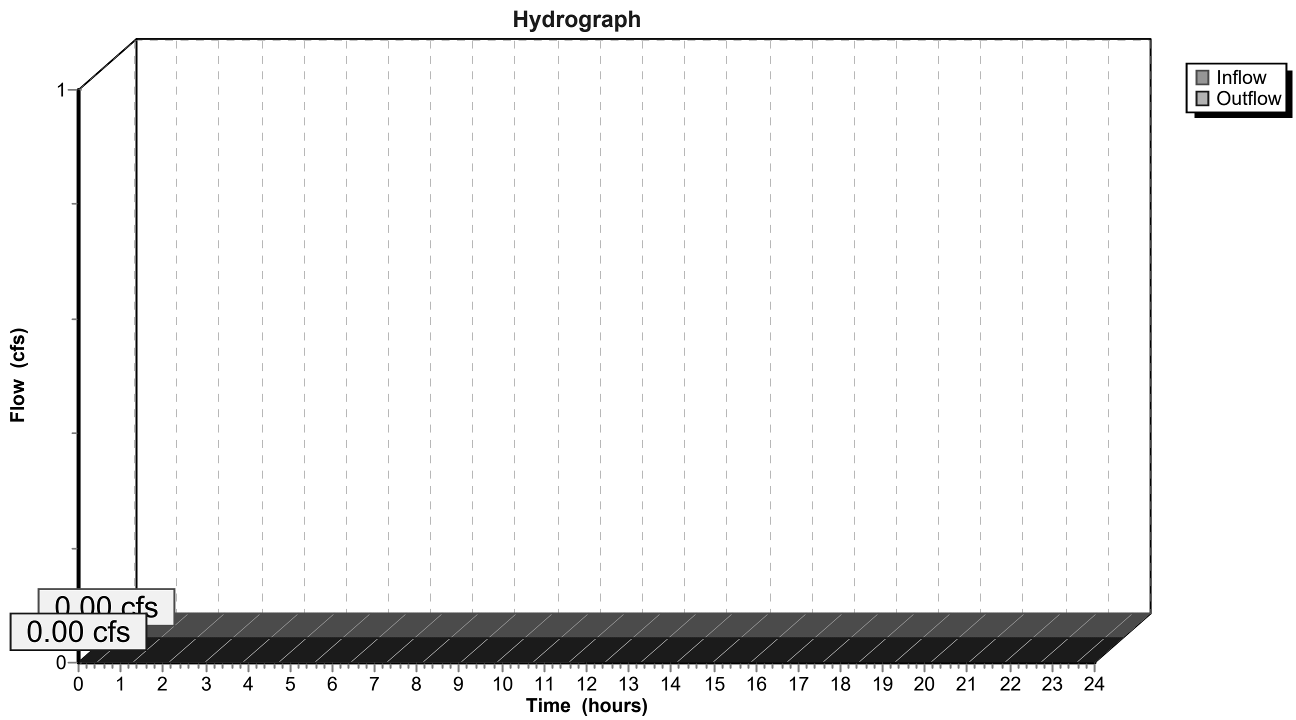
Reach 3R: (new Reach)

Inflow Area = 2.298 ac, Inflow Depth = 0.00"
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.0 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.0 fps, Avg. Travel Time= 0.0 min

Peak Depth= 0.00'
Capacity at bank full= 1.51 cfs
8.0" Diameter Pipe n= 0.012 Length= 15.0' Slope= 0.0133 '/'

Reach 3R: (new Reach)



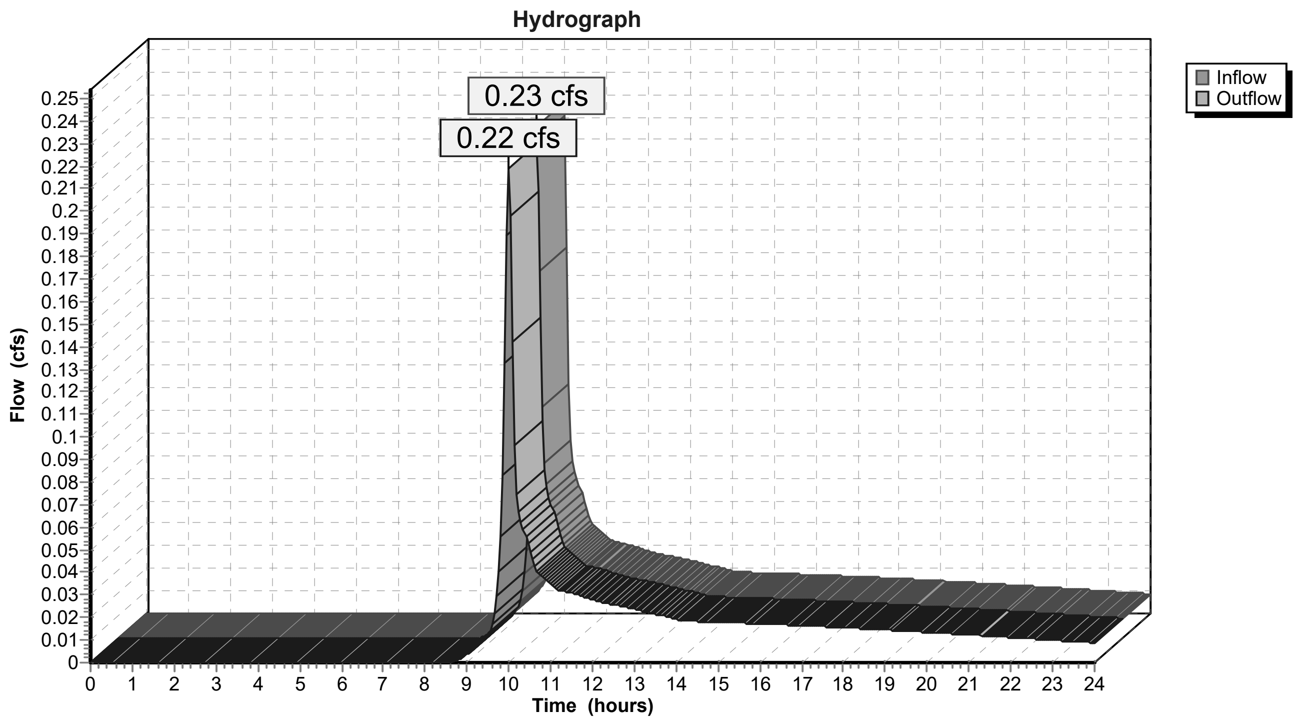
Reach 4R: 12" Pipe

Inflow Area = 1.402 ac, Inflow Depth = 0.23"
Inflow = 0.23 cfs @ 9.97 hrs, Volume= 0.027 af
Outflow = 0.22 cfs @ 10.00 hrs, Volume= 0.027 af, Atten= 3%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.7 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 2.4 min

Peak Depth= 0.22'
Capacity at bank full= 2.11 cfs
12.0" Diameter Pipe n= 0.012 Length= 117.0' Slope= 0.0030 '/'

Reach 4R: 12" Pipe



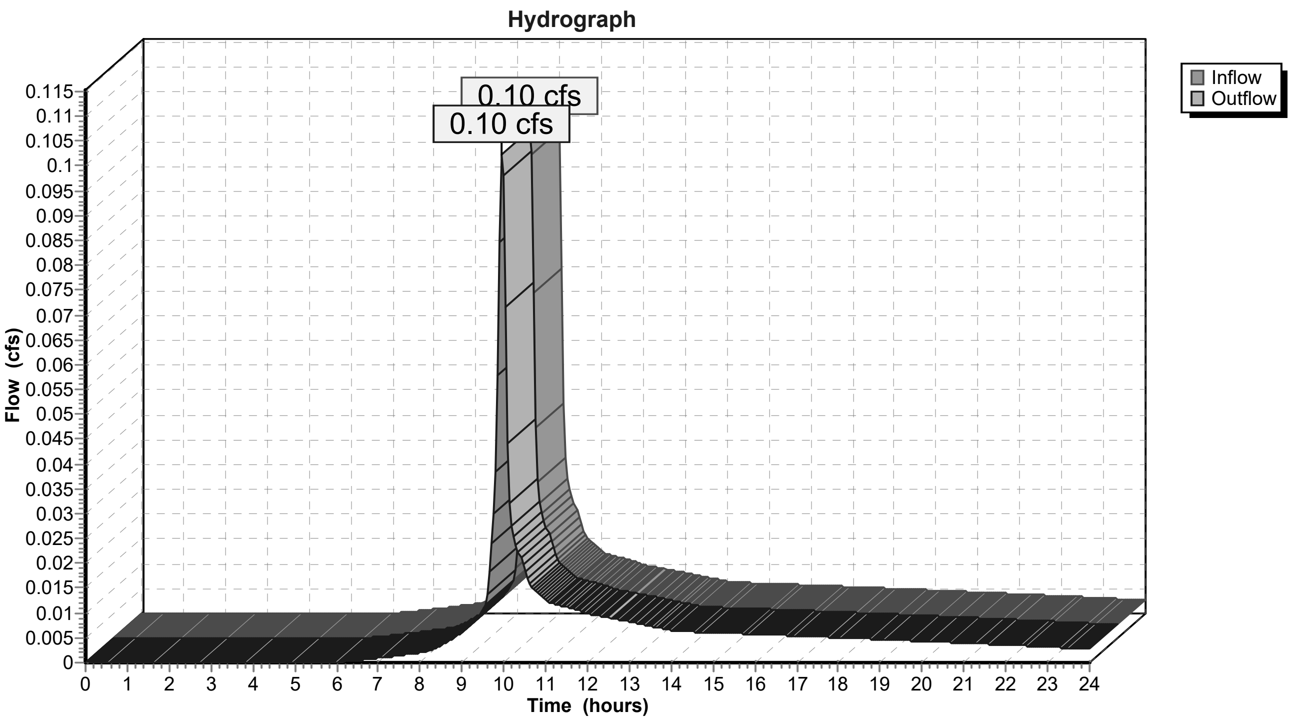
Reach 5R: New Pipe

Inflow Area = 0.351 ac, Inflow Depth = 0.37"
Inflow = 0.10 cfs @ 9.96 hrs, Volume= 0.011 af
Outflow = 0.10 cfs @ 9.97 hrs, Volume= 0.011 af, Atten= 1%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.3 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 0.9 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.13'
Capacity at bank full= 1.33 cfs
8.0" Diameter Pipe n= 0.012 Length= 16.5' Slope= 0.0103 '/'

Reach 5R: New Pipe



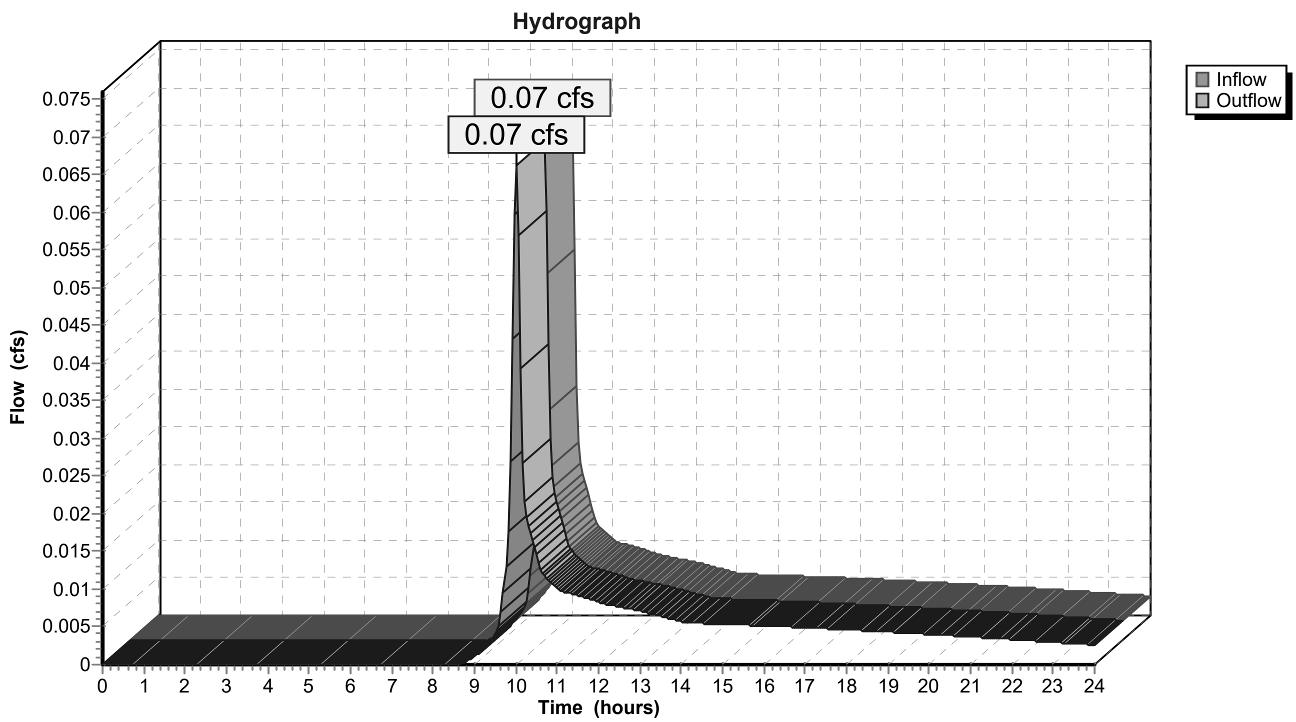
Reach 6R: New Pipe

Inflow Area = 0.420 ac, Inflow Depth = 0.23"
Inflow = 0.07 cfs @ 9.97 hrs, Volume= 0.008 af
Outflow = 0.07 cfs @ 10.00 hrs, Volume= 0.008 af, Atten= 2%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 1.7 min

Peak Depth= 0.11'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0100 '/'

Reach 6R: New Pipe



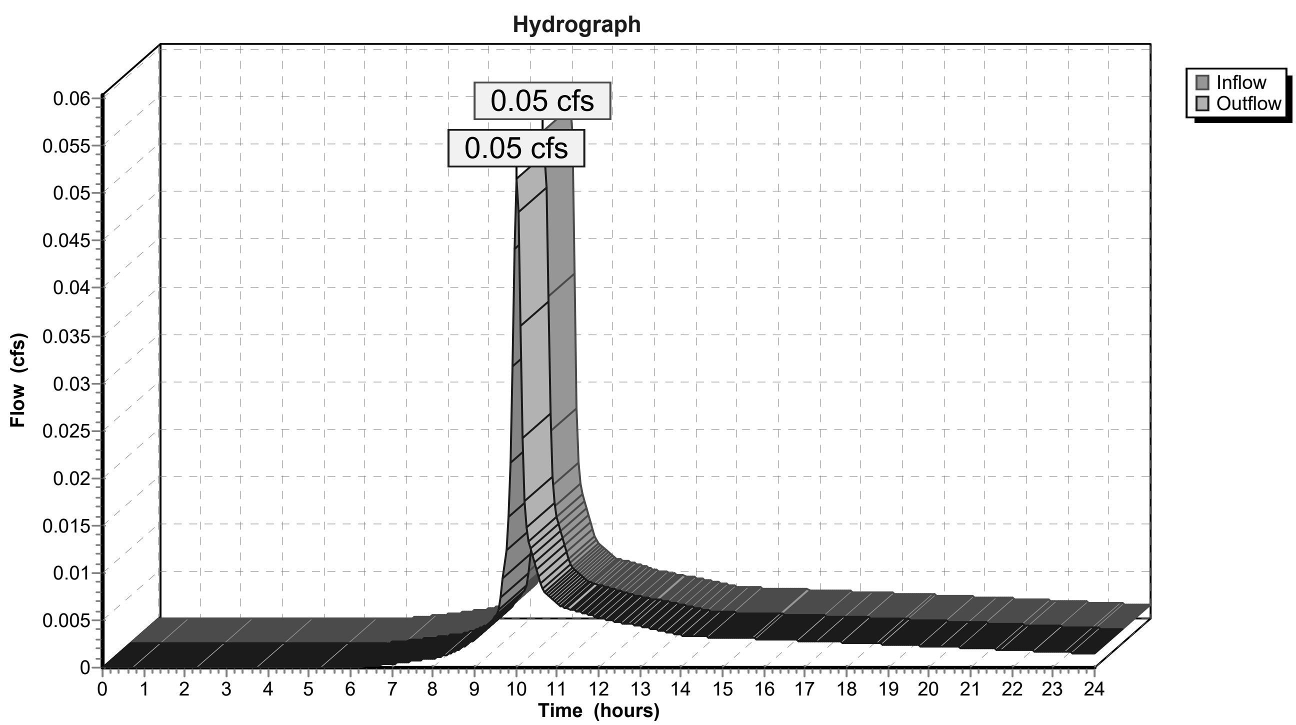
Reach 7R: Existing Pipe

Inflow Area = 0.184 ac, Inflow Depth = 0.37"
Inflow = 0.05 cfs @ 9.96 hrs, Volume= 0.006 af
Outflow = 0.05 cfs @ 10.01 hrs, Volume= 0.006 af, Atten= 4%, Lag= 2.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 3.9 min

Peak Depth= 0.09'
Capacity at bank full= 1.31 cfs
8.0" Diameter Pipe n= 0.012 Length= 180.0' Slope= 0.0100 '/'

Reach 7R: Existing Pipe



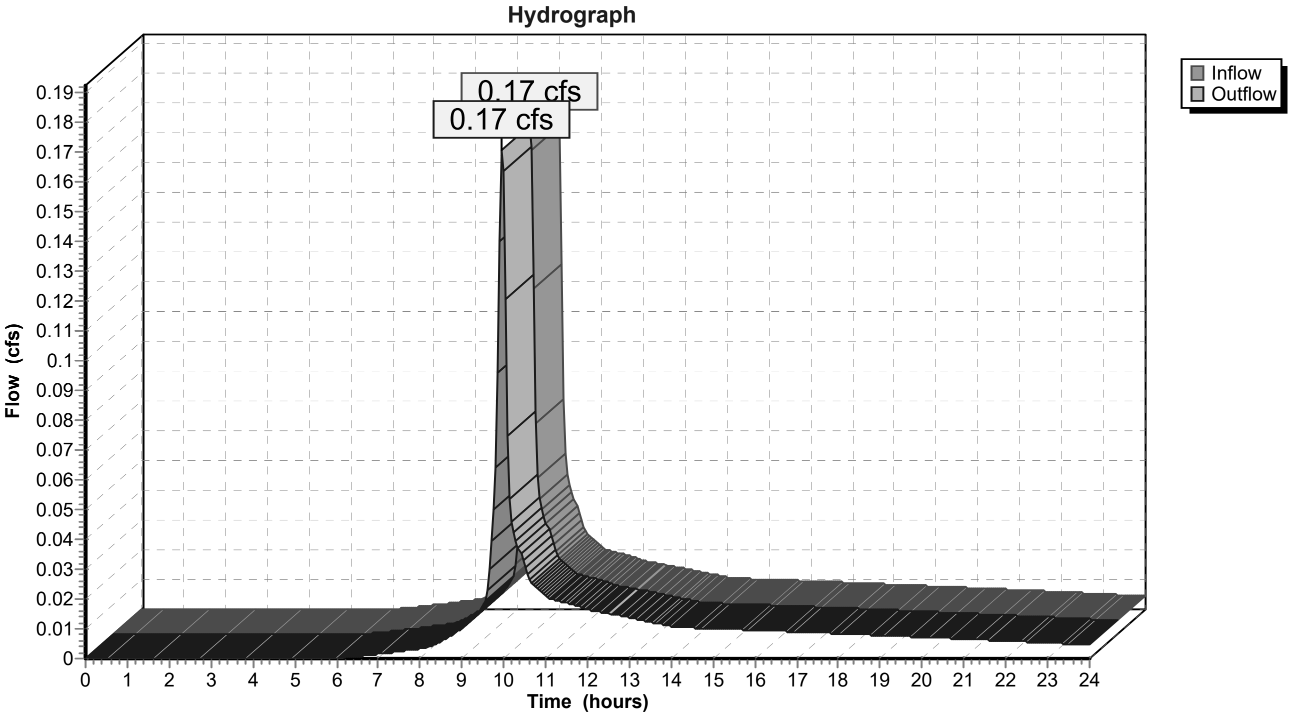
Reach 8R: New Pipe

Inflow Area = 0.585 ac, Inflow Depth = 0.37"
Inflow = 0.17 cfs @ 9.96 hrs, Volume= 0.018 af
Outflow = 0.17 cfs @ 9.97 hrs, Volume= 0.018 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 0.4 min

Peak Depth= 0.18'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 25.0' Slope= 0.0100 '/'

Reach 8R: New Pipe



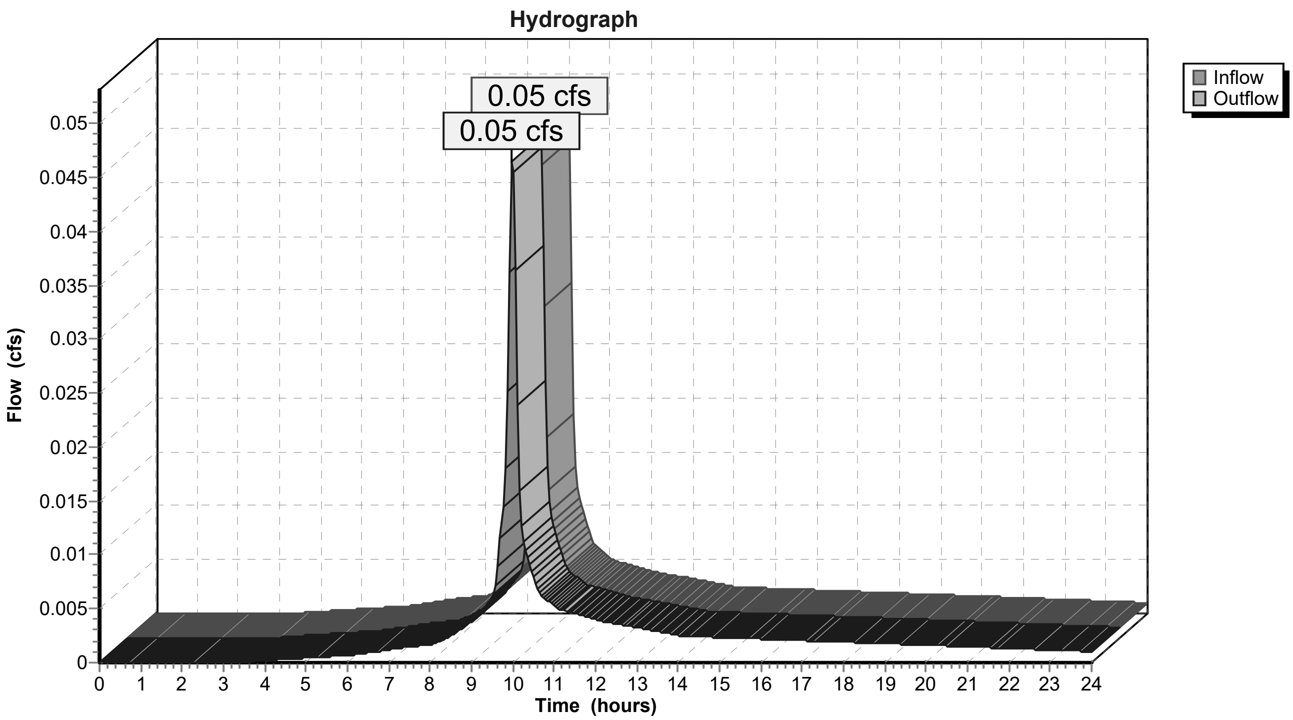
Reach 9R: Roof Drain Pipe

Inflow Area = 0.115 ac, Inflow Depth = 0.50"
Inflow = 0.05 cfs @ 9.96 hrs, Volume= 0.005 af
Outflow = 0.05 cfs @ 9.98 hrs, Volume= 0.005 af, Atten= 2%, Lag= 1.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 1.9 min

Peak Depth= 0.09'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 80.0' Slope= 0.0100 '/'

Reach 9R: Roof Drain Pipe



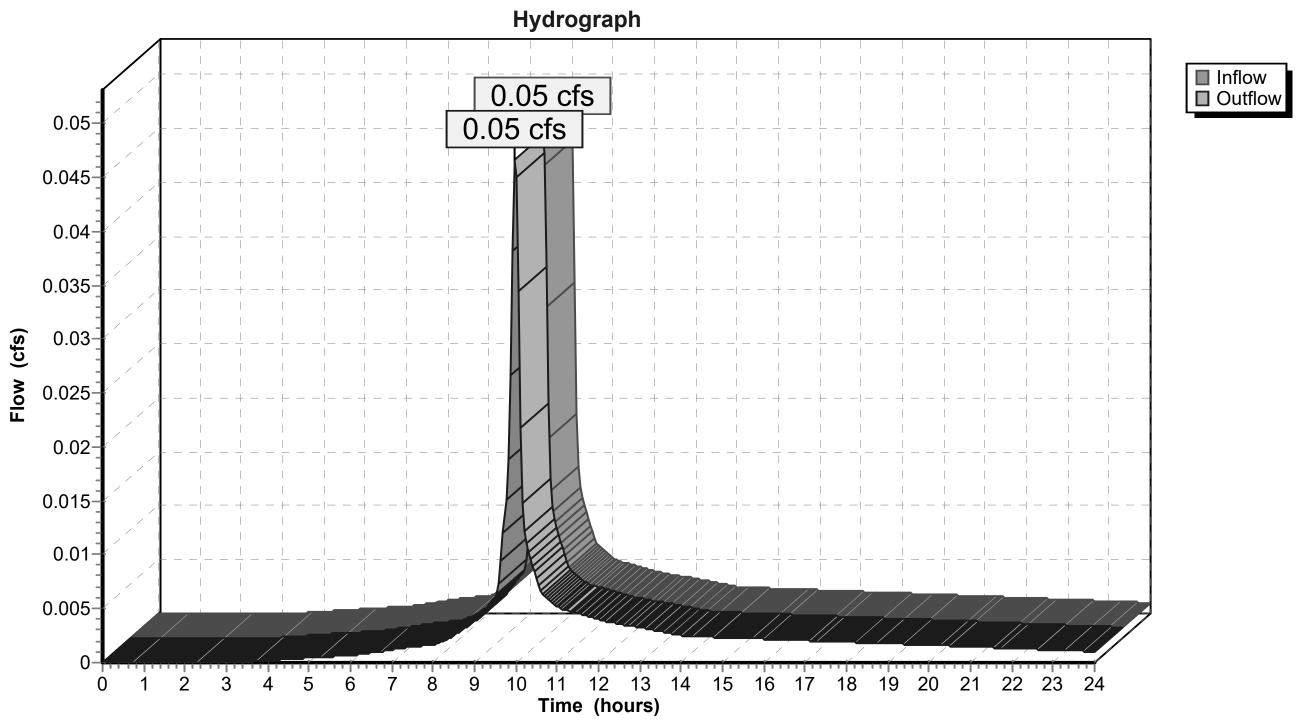
Reach 10R: Roof Drain Pipe

Inflow Area = 0.115 ac, Inflow Depth = 0.50"
Inflow = 0.05 cfs @ 9.96 hrs, Volume= 0.005 af
Outflow = 0.05 cfs @ 9.97 hrs, Volume= 0.005 af, Atten= 2%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.8 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 1.2 min

Peak Depth= 0.09'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 50.0' Slope= 0.0100 '/'

Reach 10R: Roof Drain Pipe



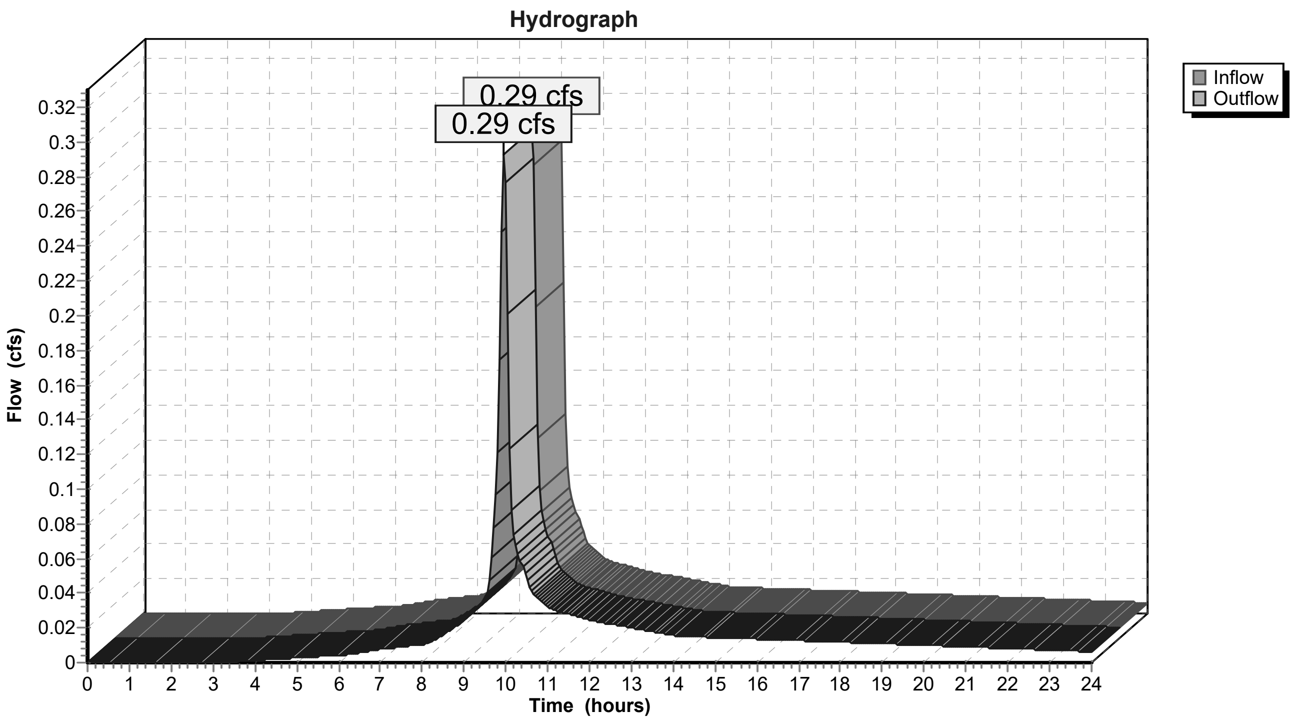
Reach 11R: Roof Drain Pipe

Inflow Area = 0.713 ac, Inflow Depth = 0.50"
Inflow = 0.29 cfs @ 9.96 hrs, Volume= 0.030 af
Outflow = 0.29 cfs @ 9.96 hrs, Volume= 0.030 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.1 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 0.5 min

Peak Depth= 0.25'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 35.0' Slope= 0.0100 '/'

Reach 11R: Roof Drain Pipe



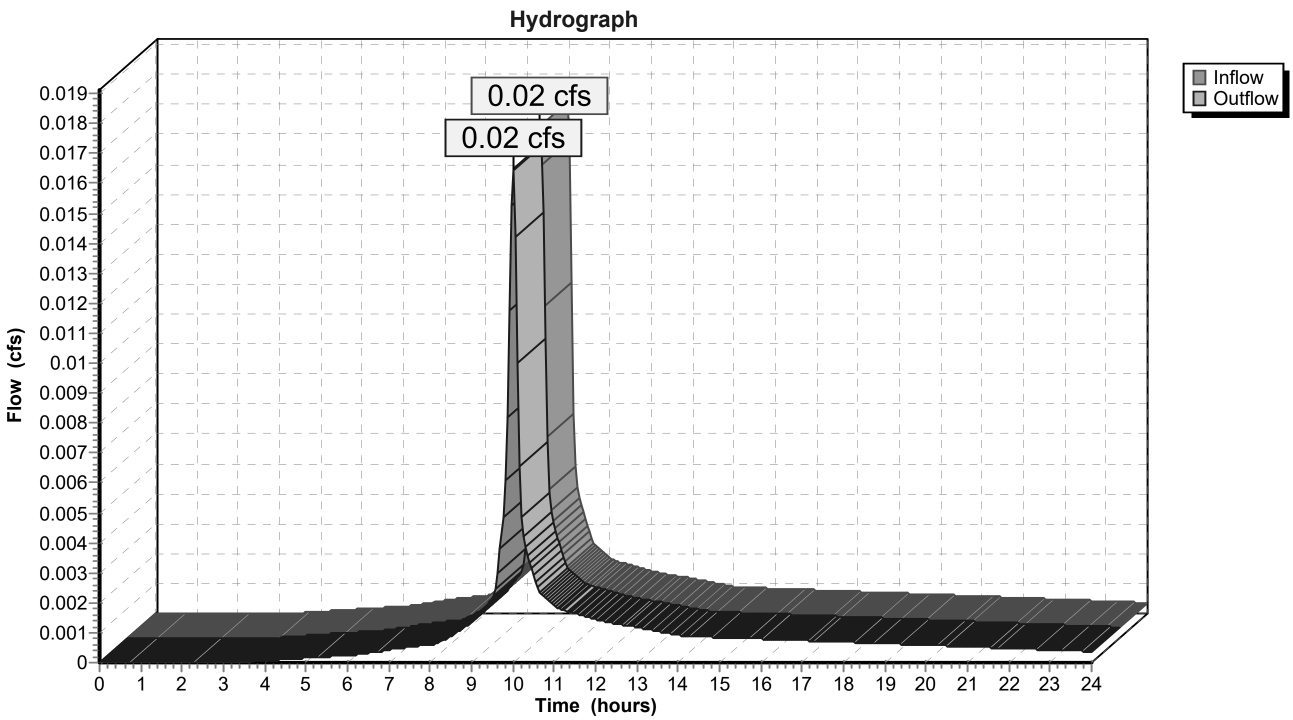
Reach 12R: Roof Drain Pipe

Inflow Area = 0.041 ac, Inflow Depth = 0.50"
Inflow = 0.02 cfs @ 9.96 hrs, Volume= 0.002 af
Outflow = 0.02 cfs @ 9.99 hrs, Volume= 0.002 af, Atten= 3%, Lag= 2.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.3 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 0.5 fps, Avg. Travel Time= 3.1 min

Peak Depth= 0.06'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0100 '/'

Reach 12R: Roof Drain Pipe



Pond 1P: Phase 2 Pond plus Expansion Area

Inflow Area =	2.298 ac,	Inflow Depth = 0.31"		
Inflow =	0.55 cfs @	9.98 hrs, Volume=	0.060 af	
Outflow =	0.00 cfs @	0.00 hrs, Volume=	0.000 af,	Atten= 100%, Lag= 0.0 min
Discarded =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 2.02' Storage= 2,625 cf
Plug-Flow detention time= (not calculated)

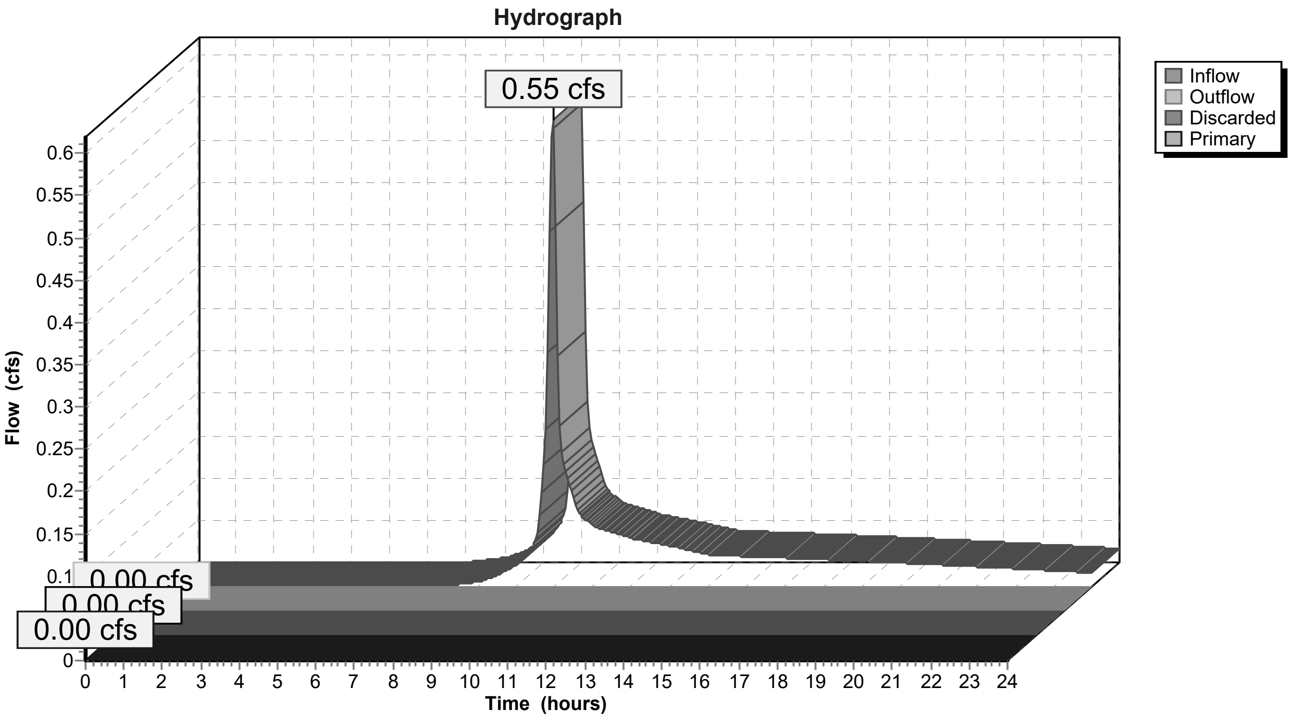
Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	2,593
3.50	4,538
5.00	8,378

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Infiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.00 0.00
2	Primary	3.70'	**8.0" x 15.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3.50' S= 0.0133 '/' n= 0.012 Cc= 0.900

Pond 1P: Phase 2 Pond plus Expansion Area



Pond 2P: (new Pond)

Inflow Area = 3.700 ac, Inflow Depth = 0.09"
Inflow = 0.22 cfs @ 10.00 hrs, Volume= 0.027 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

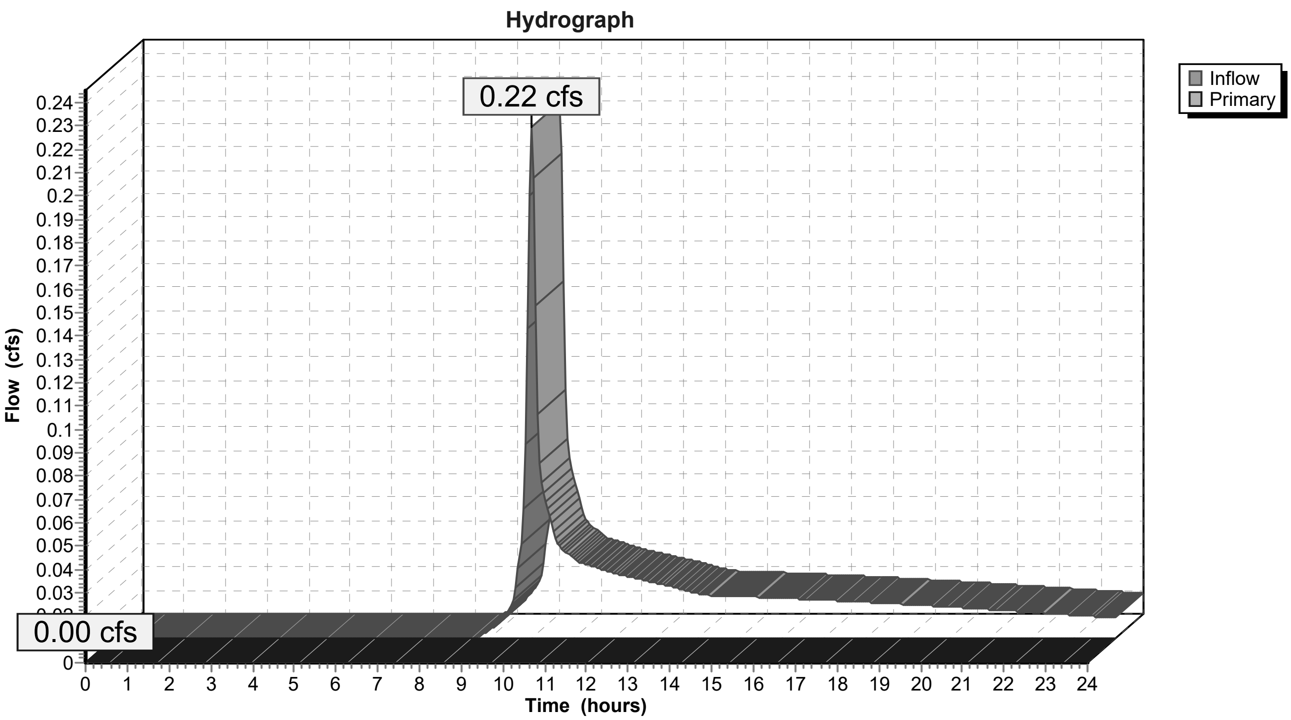
Peak Elev= 0.73' Storage= 1,175 cf
Plug-Flow detention time= (not calculated)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	3,220
3.50	5,635
5.00	10,615

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Special (user-defined)** (Controls 0.00 cfs)

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**Special (user-defined)** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.00 0.00

Pond 2P: (new Pond)



Pond 3P: New Pond NE Corner of Site

Inflow Area = 0.771 ac, Inflow Depth = 0.29"
Inflow = 0.17 cfs @ 9.98 hrs, Volume= 0.019 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

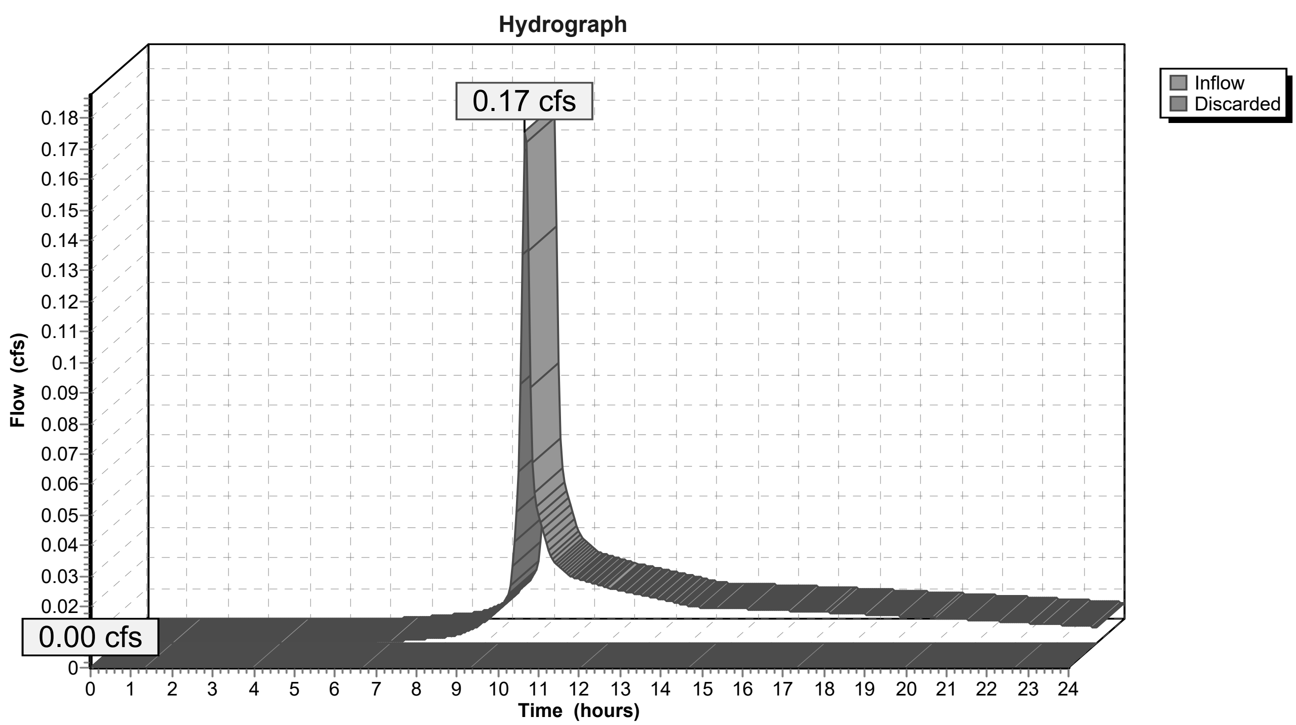
Peak Elev= 1.48' Storage= 820 cf
Plug-Flow detention time= (not calculated)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	1,105
3.50	1,934
5.00	3,696

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Infiltration** (Controls 0.00 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.00 0.00

Pond 3P: New Pond NE Corner of Site



Pond 4P: Pond Back of Stores

Inflow Area =	0.769 ac,	Inflow Depth = 0.37"		
Inflow =	0.22 cfs @	9.98 hrs,	Volume=	0.024 af
Outflow =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af, Atten= 100%, Lag= 0.0 min
Discarded =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

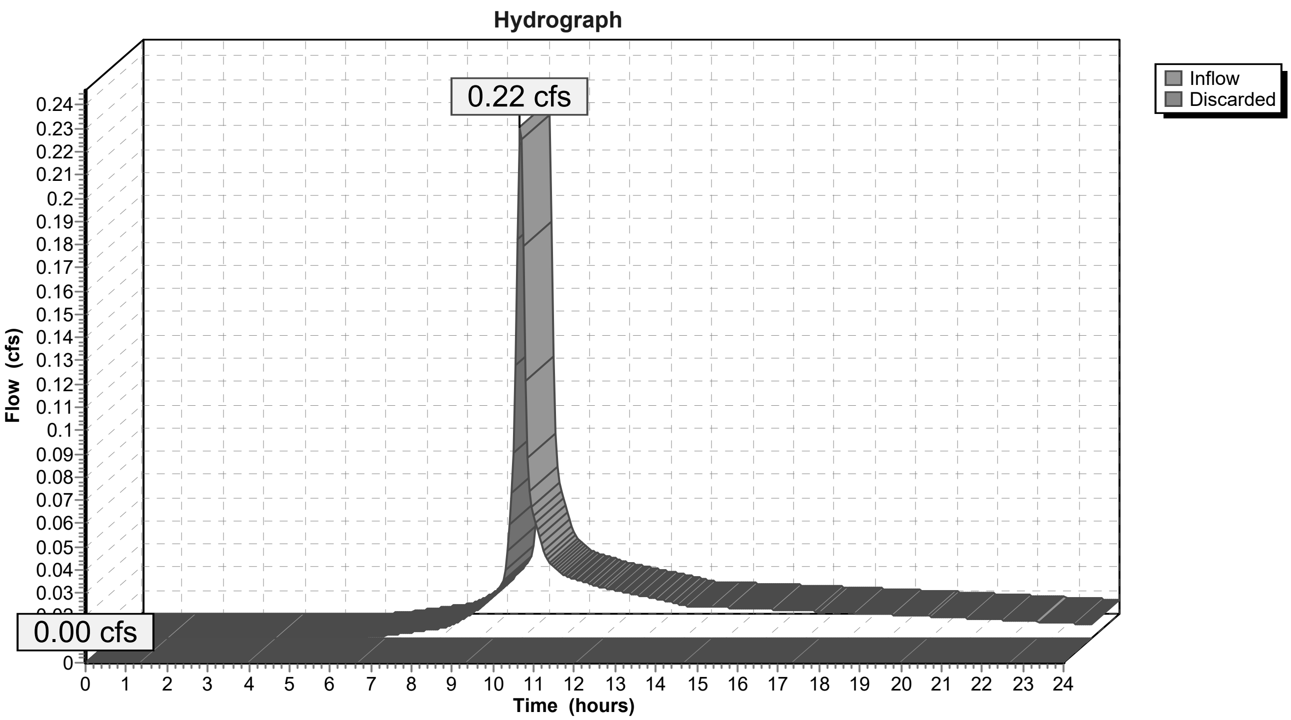
Peak Elev= 2.78' Storage= 1,024 cf
Plug-Flow detention time= (not calculated)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	736
3.50	1,288
5.00	2,585

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Infiltration** (Controls 0.00 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.00 0.00

Pond 4P: Pond Back of Stores



Pond DW1: Existing Drywell at Maurices

Inflow Area = 0.230 ac, Inflow Depth = 0.50"
Inflow = 0.09 cfs @ 9.97 hrs, Volume= 0.010 af
Outflow = 0.00 cfs @ 22.15 hrs, Volume= 0.000 af, Atten= 97%, Lag= 730.6 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 22.15 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 8.02' Storage= 402 cf
Plug-Flow detention time= 1,012.5 min calculated for 0.000 af (4% of inflow)

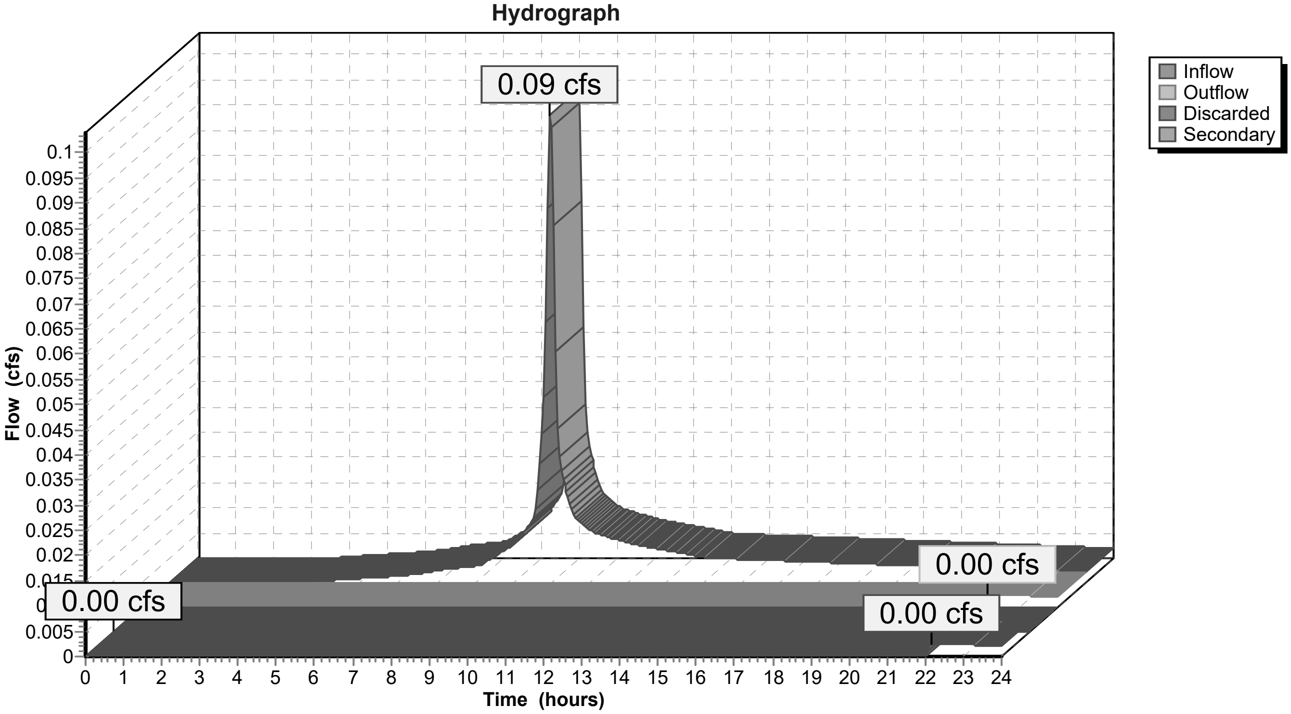
Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
8.00	402
12.00	452

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
└─**1=Infiltration** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 22.15 hrs HW=8.02' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 8.00 12.00 Disch. (cfs) 0.00 0.00 0.00 0.00
2	Secondary	8.00'	**6.0" Vert. Orifice/Grate** C= 0.600

Pond DW1: Existing Drywell at Maurices



Pond DW2: New Drywell

Inflow Area = 0.754 ac, Inflow Depth = 0.51"
Inflow = 0.31 cfs @ 9.96 hrs, Volume= 0.032 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

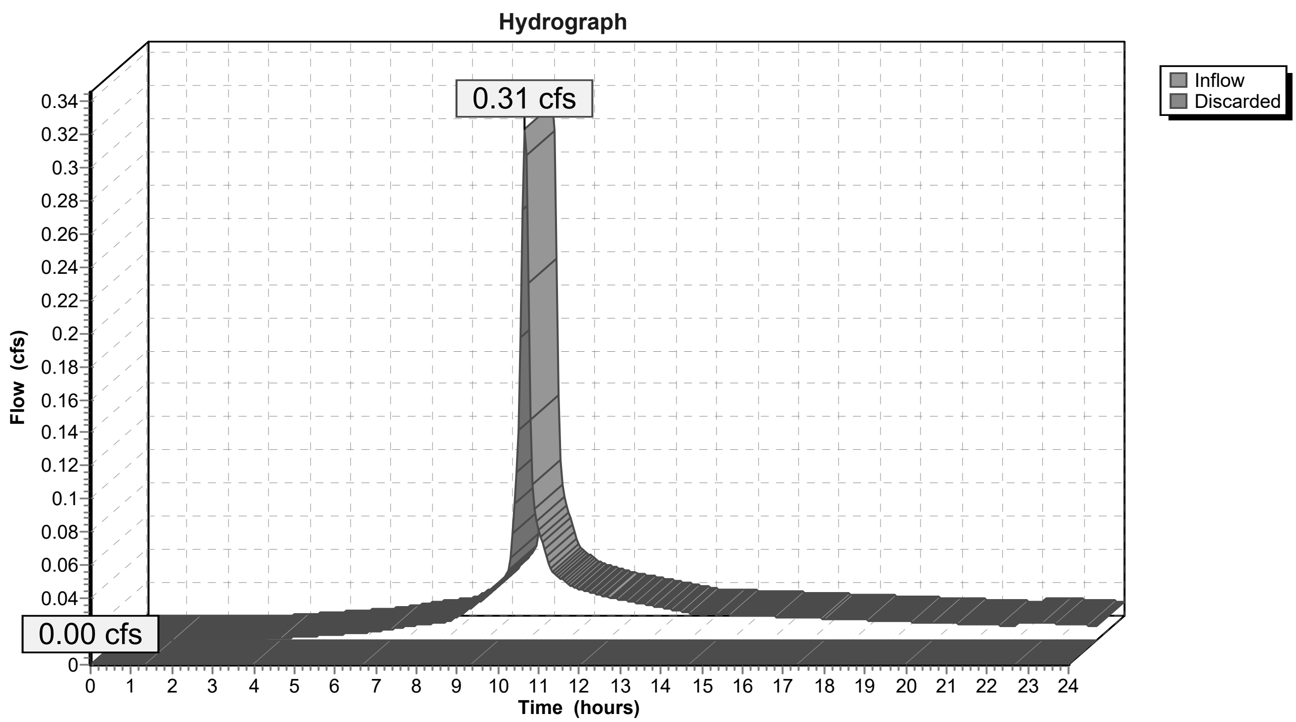
Peak Elev= 4.64' Storage= 1,392 cf
Plug-Flow detention time= (not calculated)

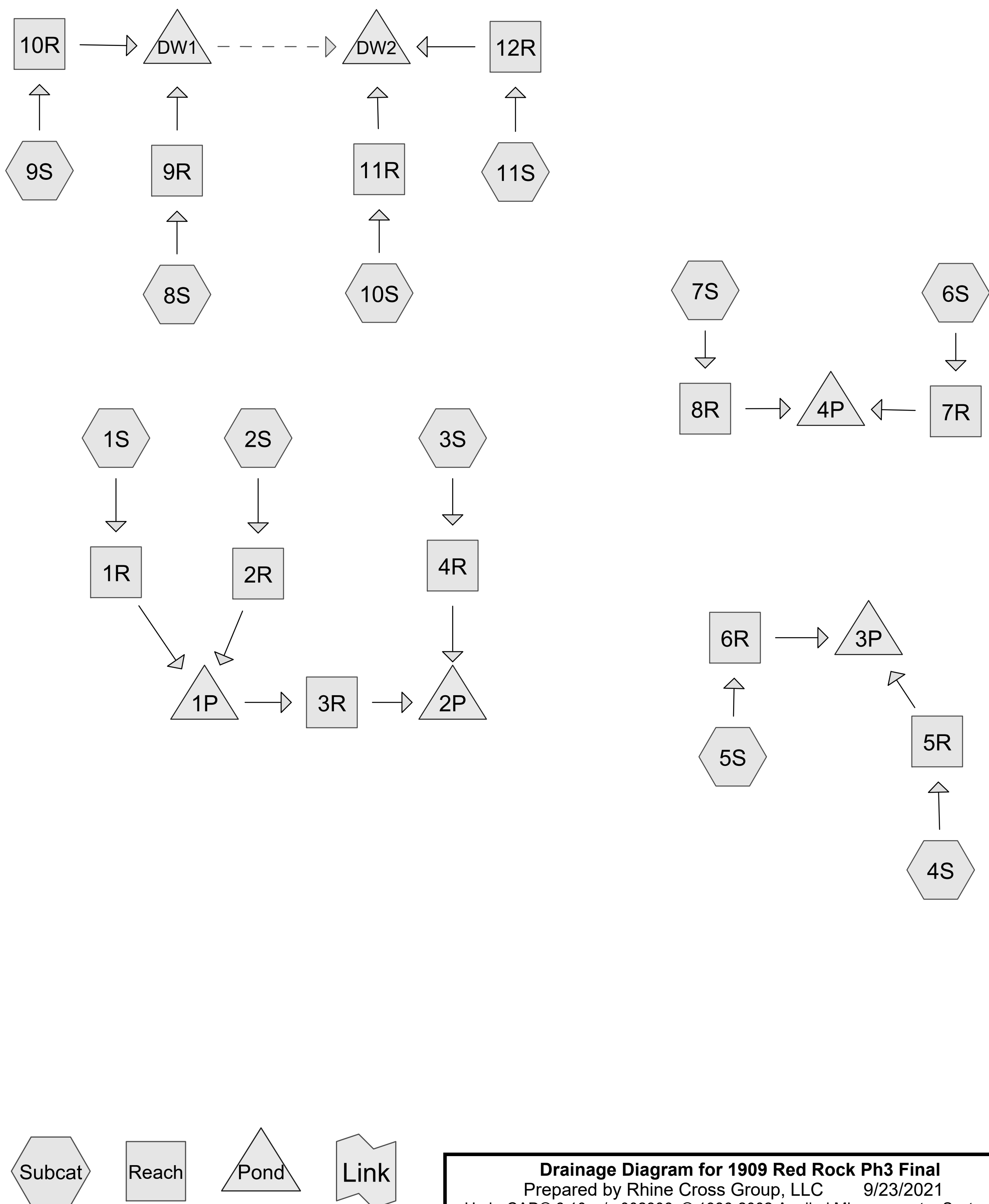
Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
10.00	3,001
15.00	3,064

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=0.00' (Free Discharge)
↑—**1=Infiltration** (Controls 0.00 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 10.00 15.00 Disch. (cfs) 0.00 0.00 0.00 0.00

Pond DW2: New Drywell





Drainage Diagram for 1909 Red Rock Ph3 Final
Prepared by Rhine Cross Group, LLC 9/23/2021
HydroCAD® 6.10 s/n 002306 © 1986-2002 Applied Microcomputer Systems

Subcatchment 1S: Existing Phase 1 Area

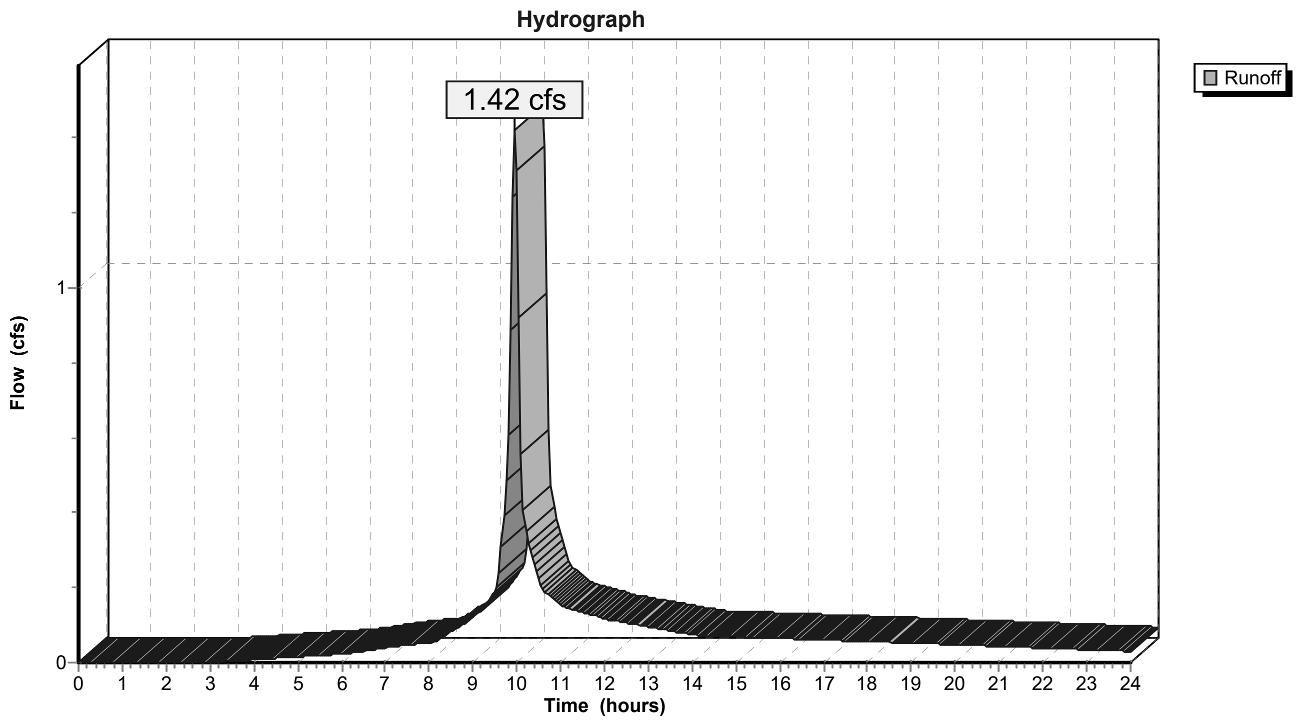
Runoff = 1.42 cfs @ 9.96 hrs, Volume= 0.144 af, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
6,787	98	Roof
36,802	98	Asphalt & Sidewalk
7,393	79	<50% Grass cover, Poor, HSG B
50,982	95	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 1S: Existing Phase 1 Area



Subcatchment 2S: New Phase 3 Parking Area

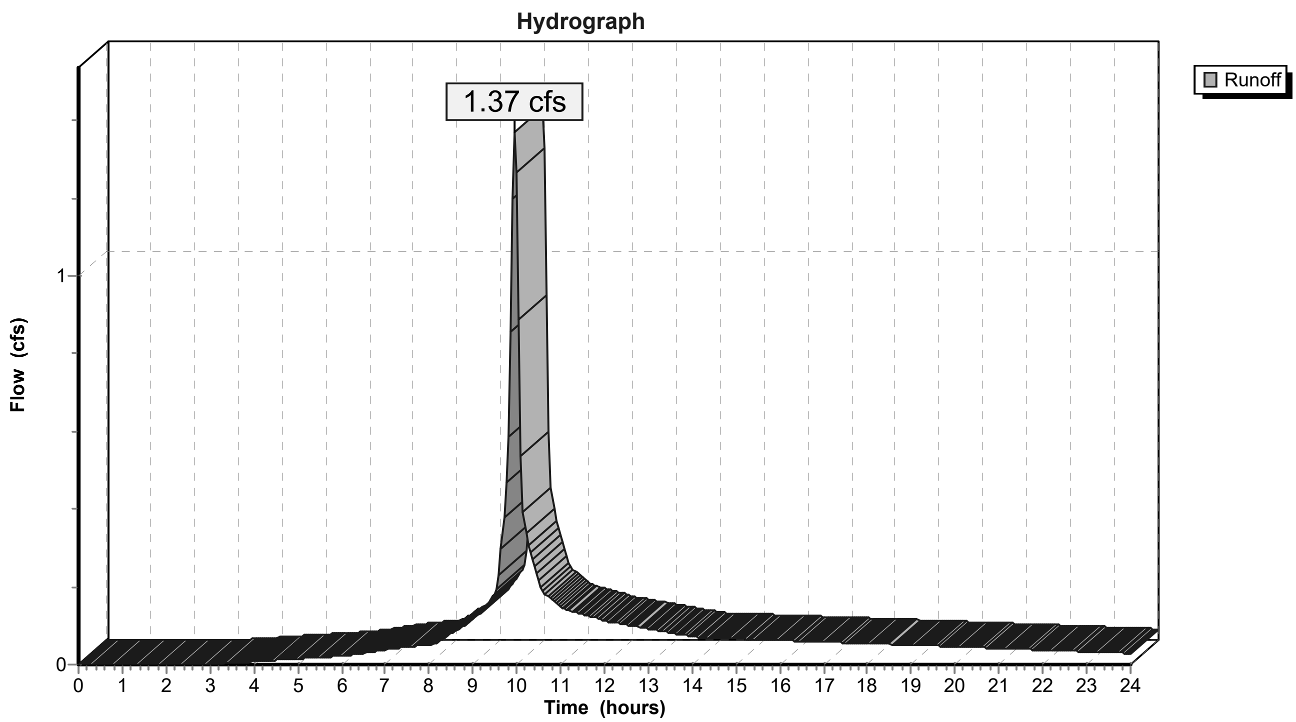
Runoff = 1.37 cfs @ 9.96 hrs, Volume= 0.139 af, Depth= 1.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
41,516	98	Asphalt & Sidewalk
7,610	79	<50% Grass cover, Poor, HSG B
49,126	95	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 2S: New Phase 3 Parking Area



Subcatchment 3S: SELCO improvement area

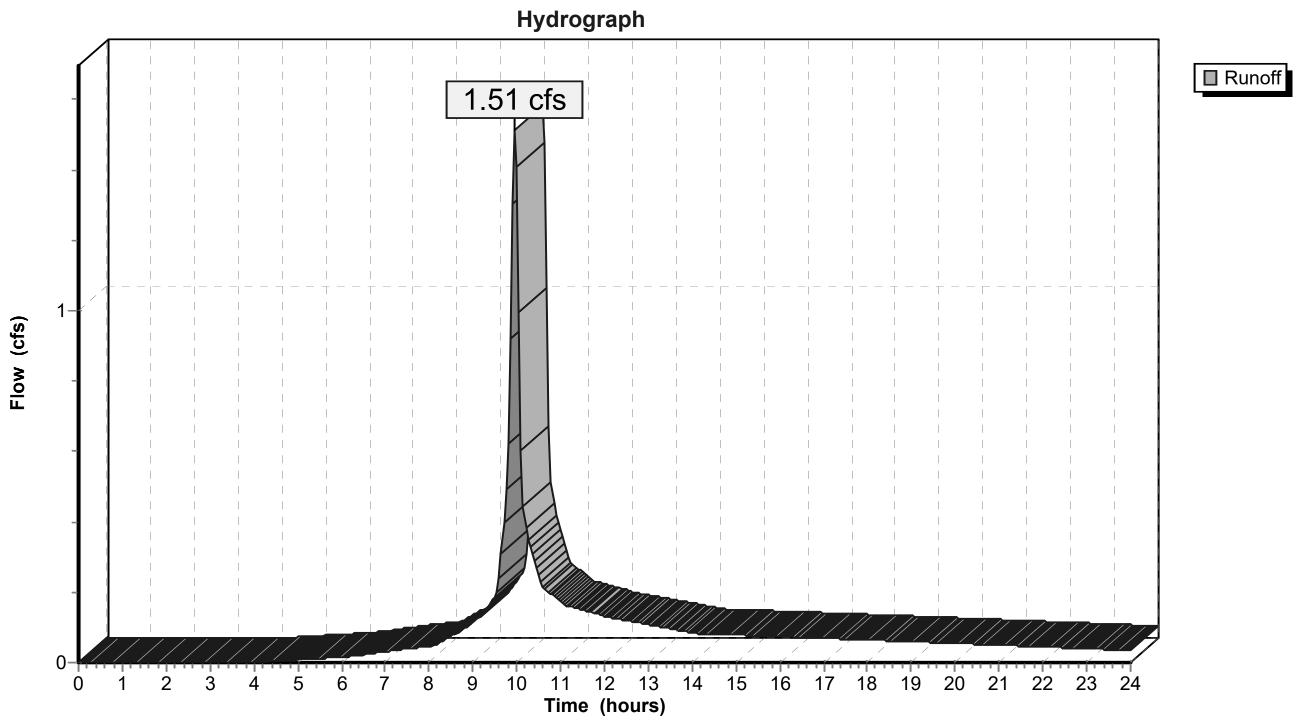
Runoff = 1.51 cfs @ 9.96 hrs, Volume= 0.153 af, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
41,367	98	Asphalt & Sidewalk Area
2,657	98	Roof Area
17,061	79	<50% Grass cover, Poor, HSG B
61,085	93	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Impervious**

Subcatchment 3S: SELCO improvement area



Subcatchment 4S: Developed #4

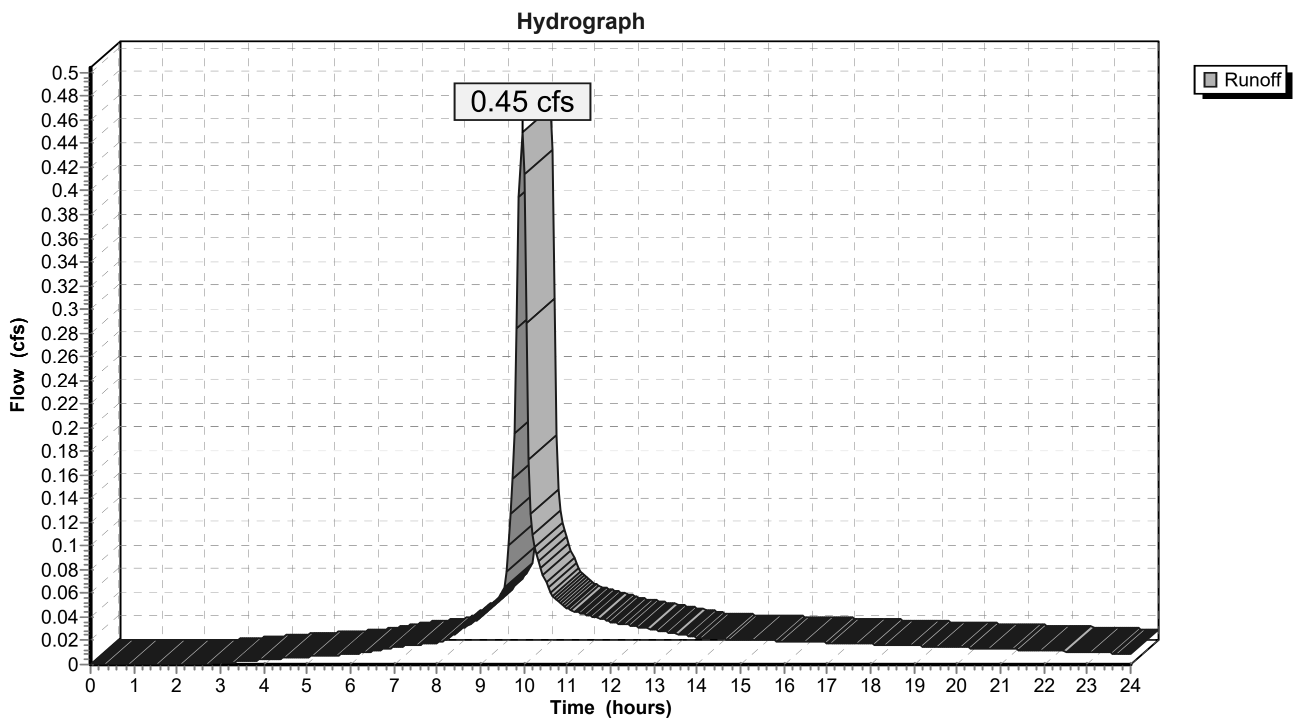
Runoff = 0.45 cfs @ 9.96 hrs, Volume= 0.046 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
13,631	98	Asphalt & Sidewalk
1,648	79	<50% Grass cover, Poor, HSG B
15,279	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 4S: Developed #4



Subcatchment 5S: Developed #5

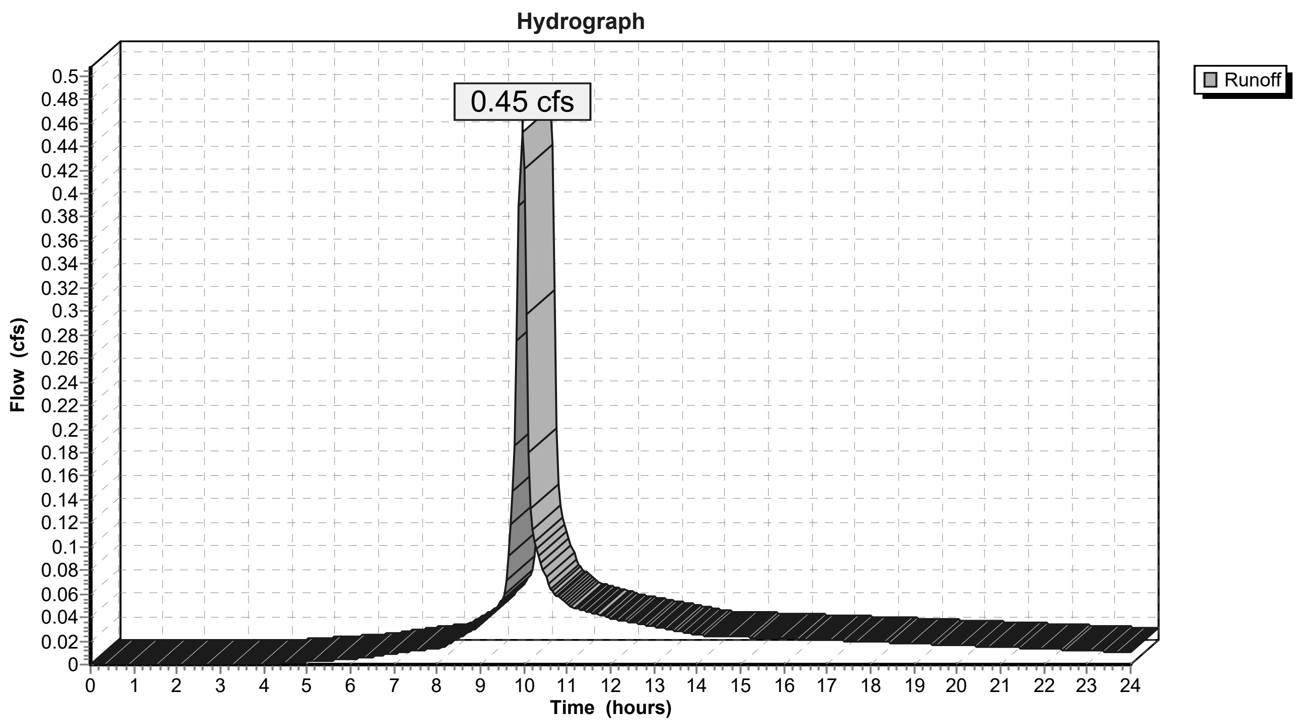
Runoff = 0.45 cfs @ 9.96 hrs, Volume= 0.046 af, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
13,257	98	Asphalt & Sidewalk
5,042	79	<50% Grass cover, Poor, HSG B
18,299	93	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 5S: Developed #5



Subcatchment 6S: Developed #6

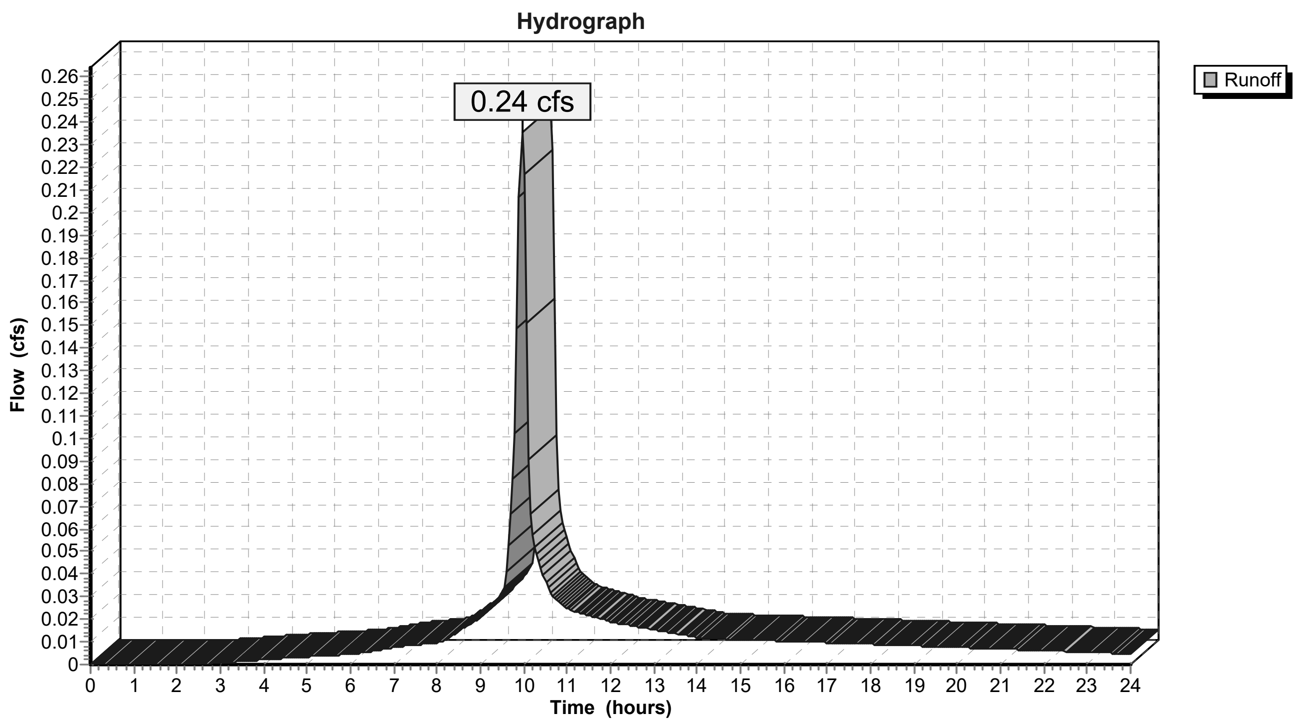
Runoff = 0.24 cfs @ 9.96 hrs, Volume= 0.024 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
7,031	98	Asphalt & Sidewalk
973	79	<50% Grass cover, Poor, HSG B
8,004	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 6S: Developed #6



Subcatchment 7S: Developed #7

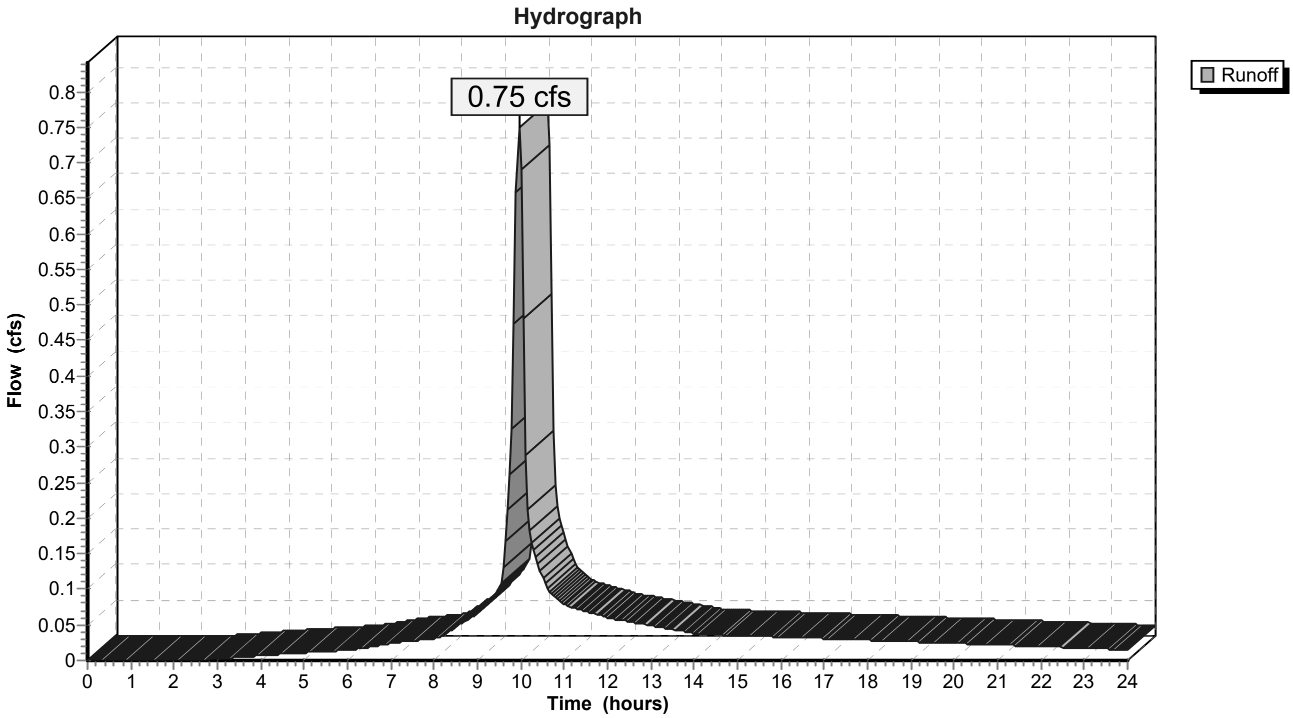
Runoff = 0.75 cfs @ 9.96 hrs, Volume= 0.077 af, Depth= 1.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
22,443	98	Asphalt & Sidewalk
3,033	79	<50% Grass cover, Poor, HSG B
25,476	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 7S: Developed #7



Subcatchment 8S: Maurices Roof

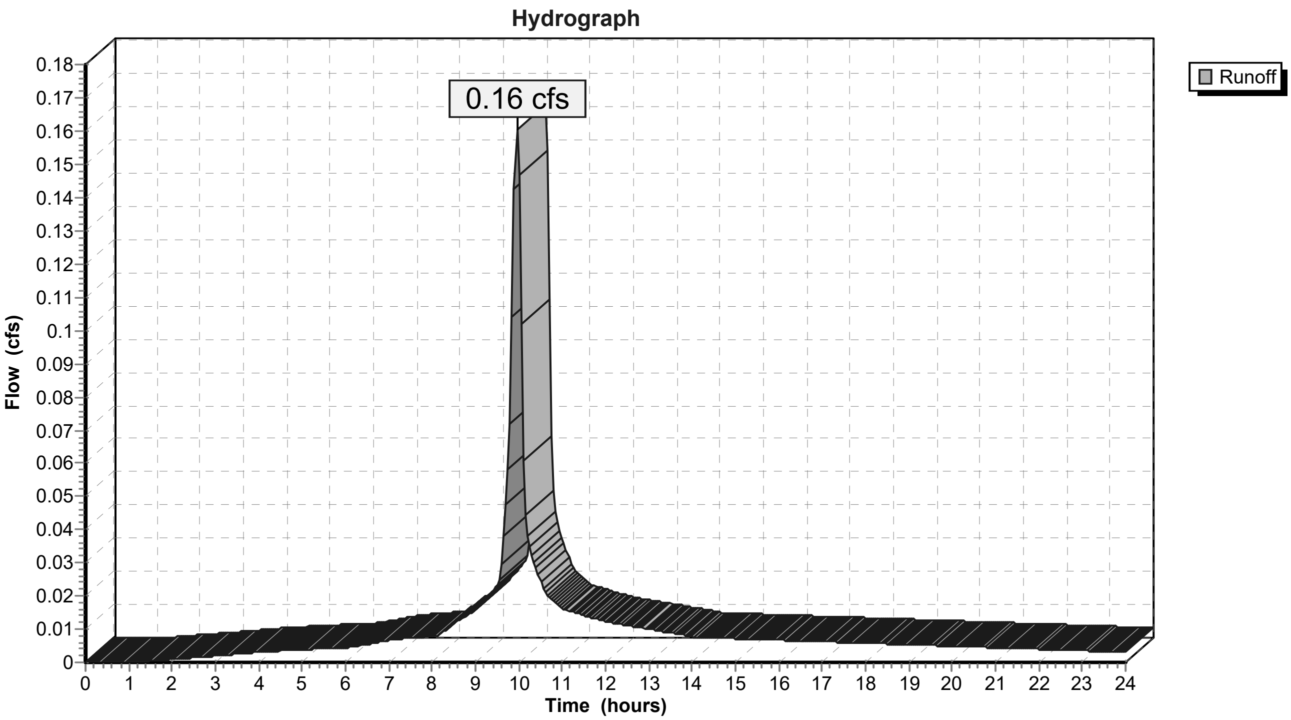
Runoff = 0.16 cfs @ 9.95 hrs, Volume= 0.017 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
5,000	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 8S: Maurices Roof



Subcatchment 9S: Famous Footwear Roof

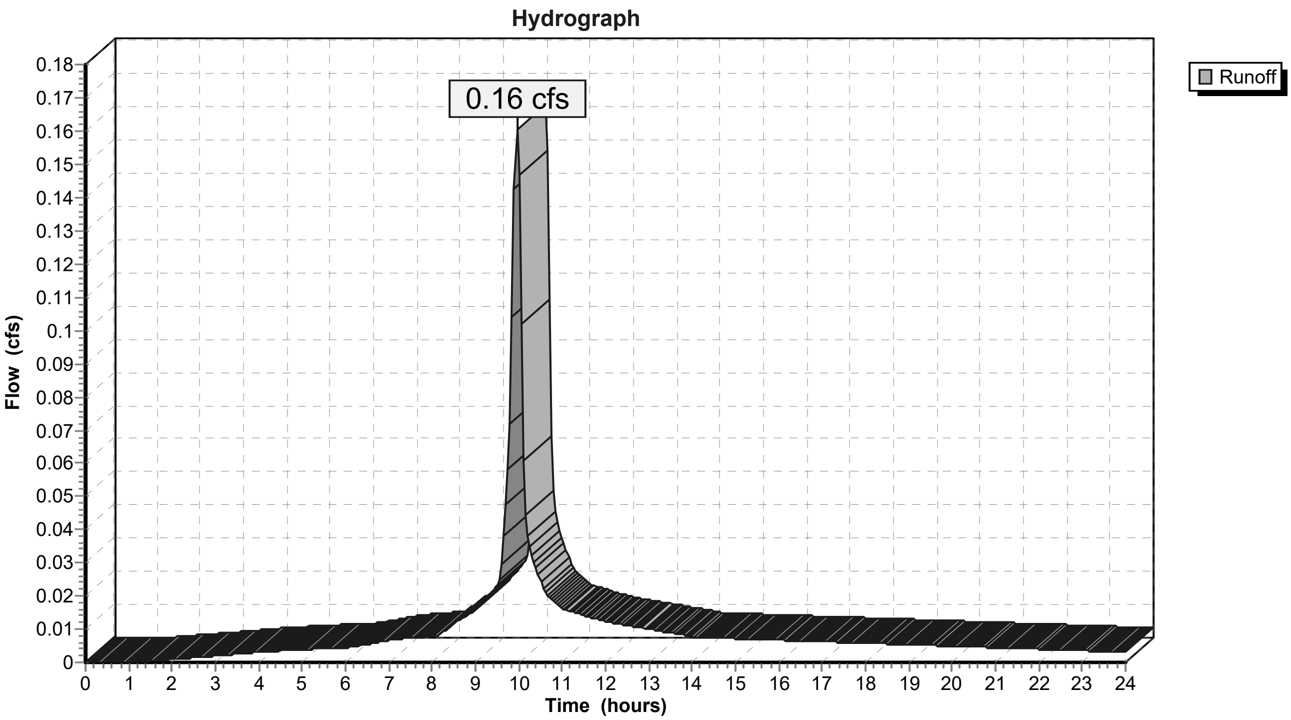
Runoff = 0.16 cfs @ 9.95 hrs, Volume= 0.017 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
5,000	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 9S: Famous Footwear Roof



Subcatchment 10S: Ulta & Marshall's Roof

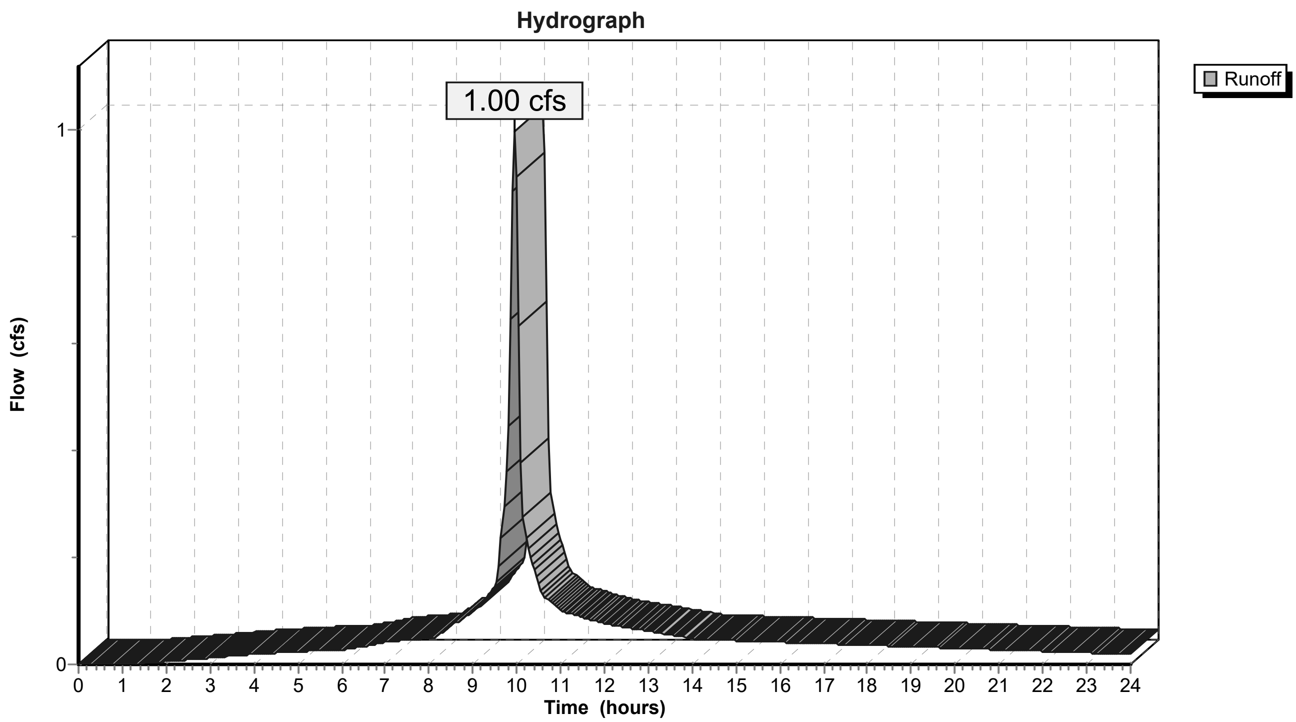
Runoff = 1.00 cfs @ 9.95 hrs, Volume= 0.105 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
31,064	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 10S: Ulta & Marshall's Roof



Subcatchment 11S: Small Retail Roof

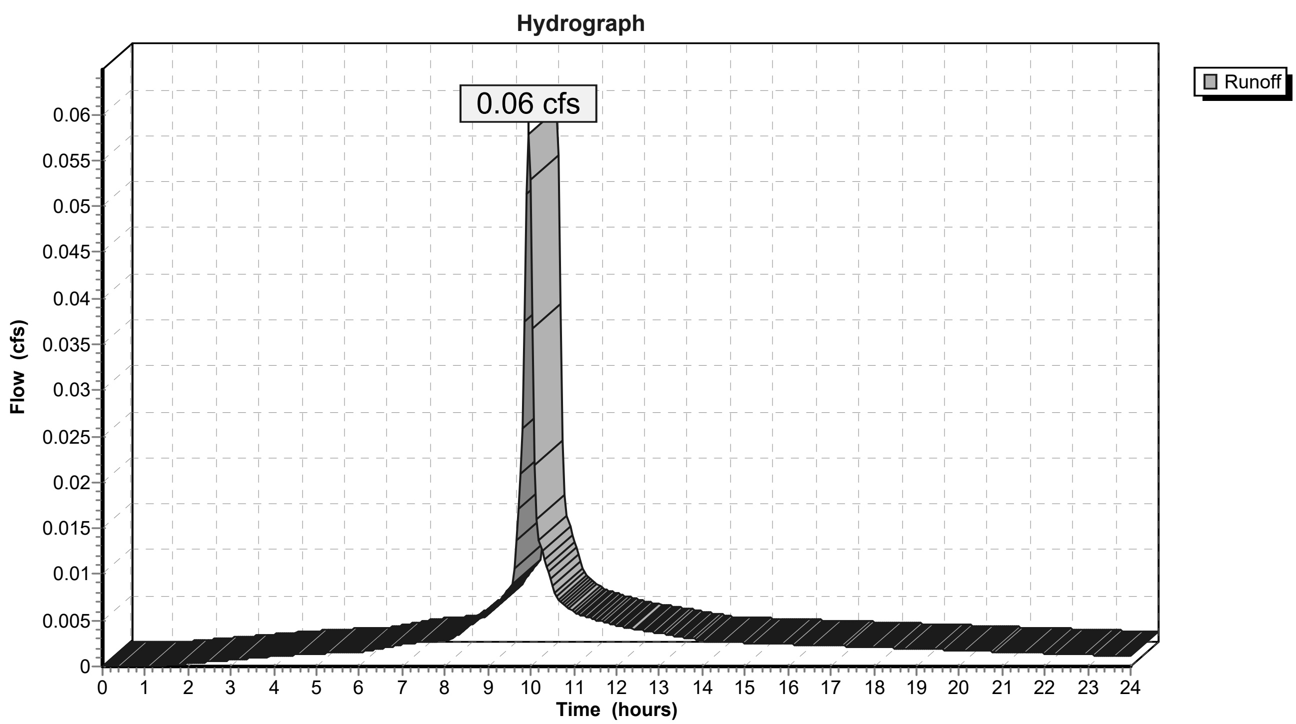
Runoff = 0.06 cfs @ 9.95 hrs, Volume= 0.006 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.00"

Area (sf)	CN	Description
1,800	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 11S: Small Retail Roof



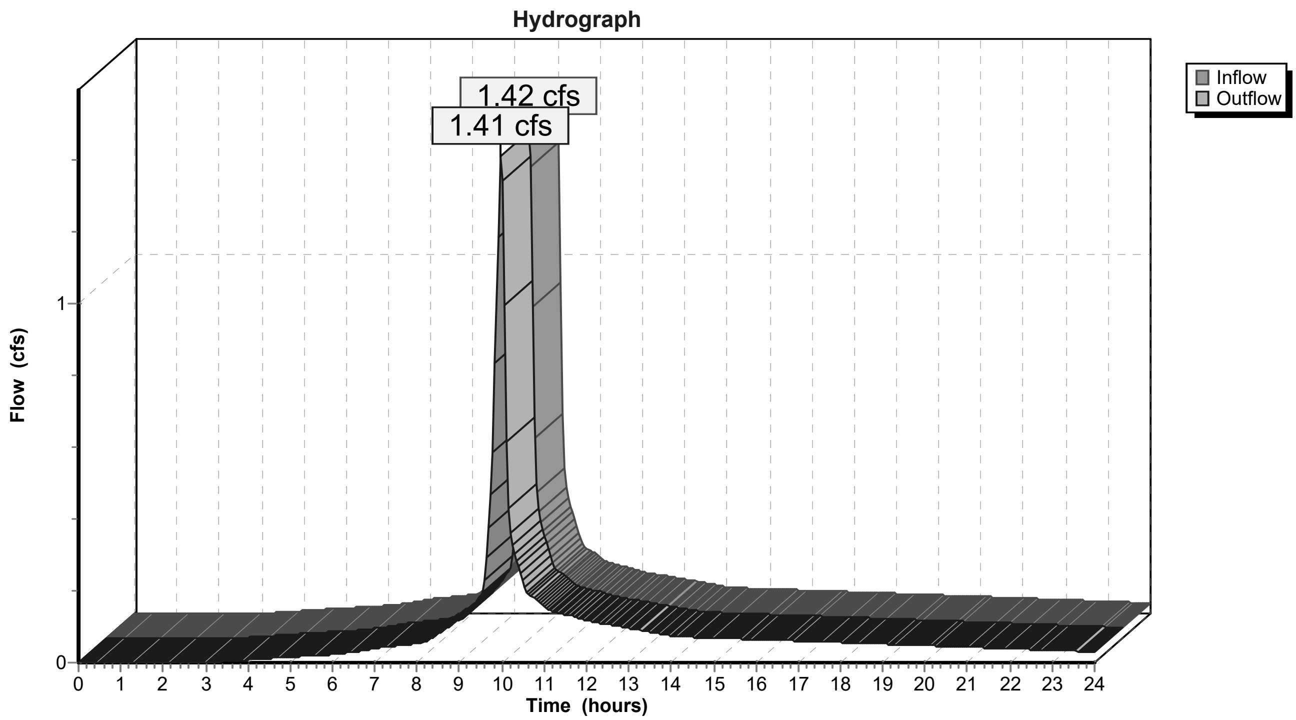
Reach 1R: Phase 2 pipe

Inflow Area = 1.170 ac, Inflow Depth = 1.48"
Inflow = 1.42 cfs @ 9.96 hrs, Volume= 0.144 af
Outflow = 1.41 cfs @ 9.96 hrs, Volume= 0.144 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.8 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.4 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.44'
Capacity at bank full= 1.85 cfs
8.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0200 '/'

Reach 1R: Phase 2 pipe



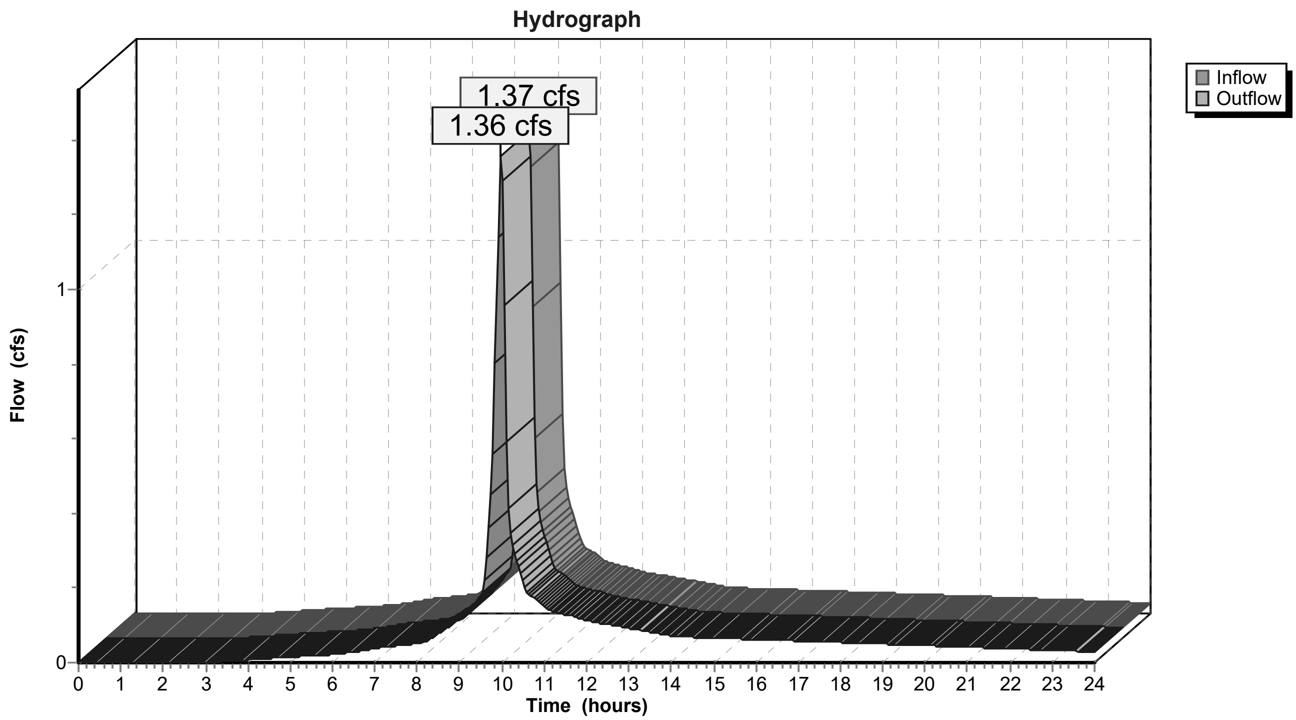
Reach 2R: Phase 3 Pipe

Inflow Area = 1.128 ac, Inflow Depth = 1.48"
Inflow = 1.37 cfs @ 9.96 hrs, Volume= 0.139 af
Outflow = 1.36 cfs @ 9.96 hrs, Volume= 0.139 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.8 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.4 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.43'
Capacity at bank full= 1.85 cfs
8.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0200 '/'

Reach 2R: Phase 3 Pipe



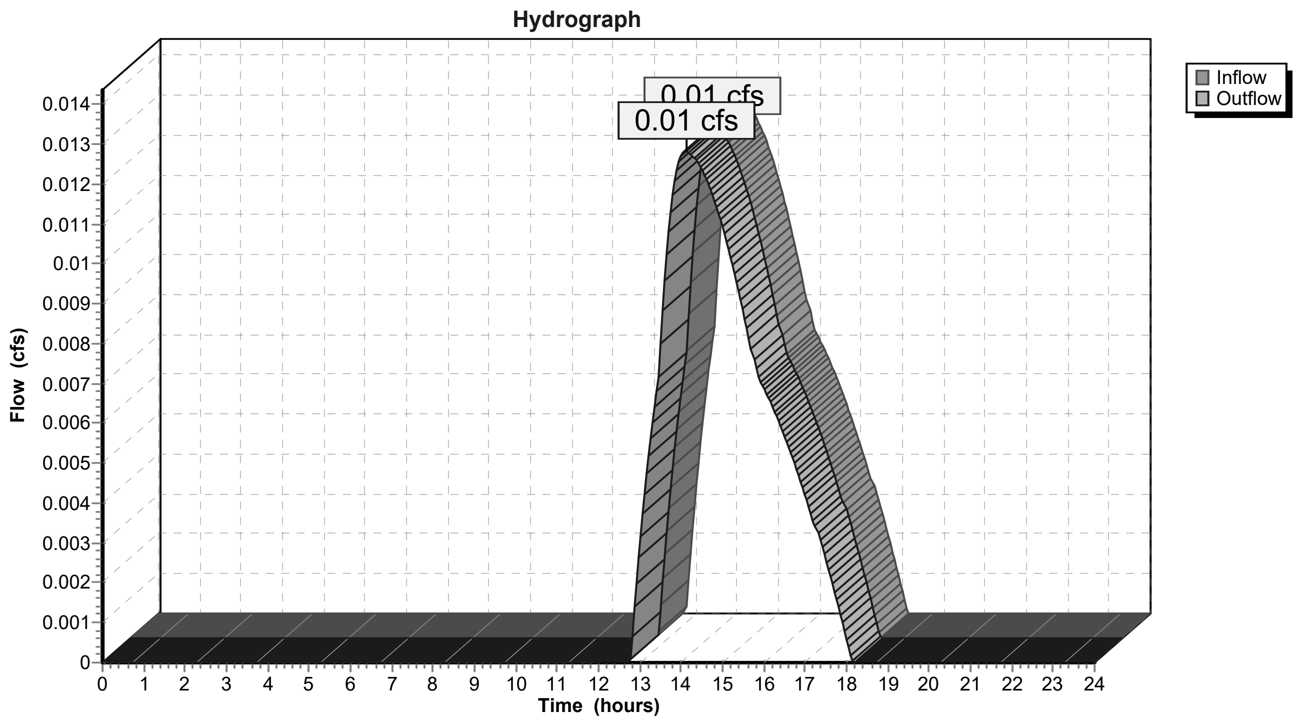
Reach 3R: (new Reach)

Inflow Area = 2.298 ac, Inflow Depth = 0.02"
Inflow = 0.01 cfs @ 14.10 hrs, Volume= 0.003 af
Outflow = 0.01 cfs @ 14.11 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.3 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.04'
Capacity at bank full= 1.51 cfs
8.0" Diameter Pipe n= 0.012 Length= 15.0' Slope= 0.0133 '/'

Reach 3R: (new Reach)



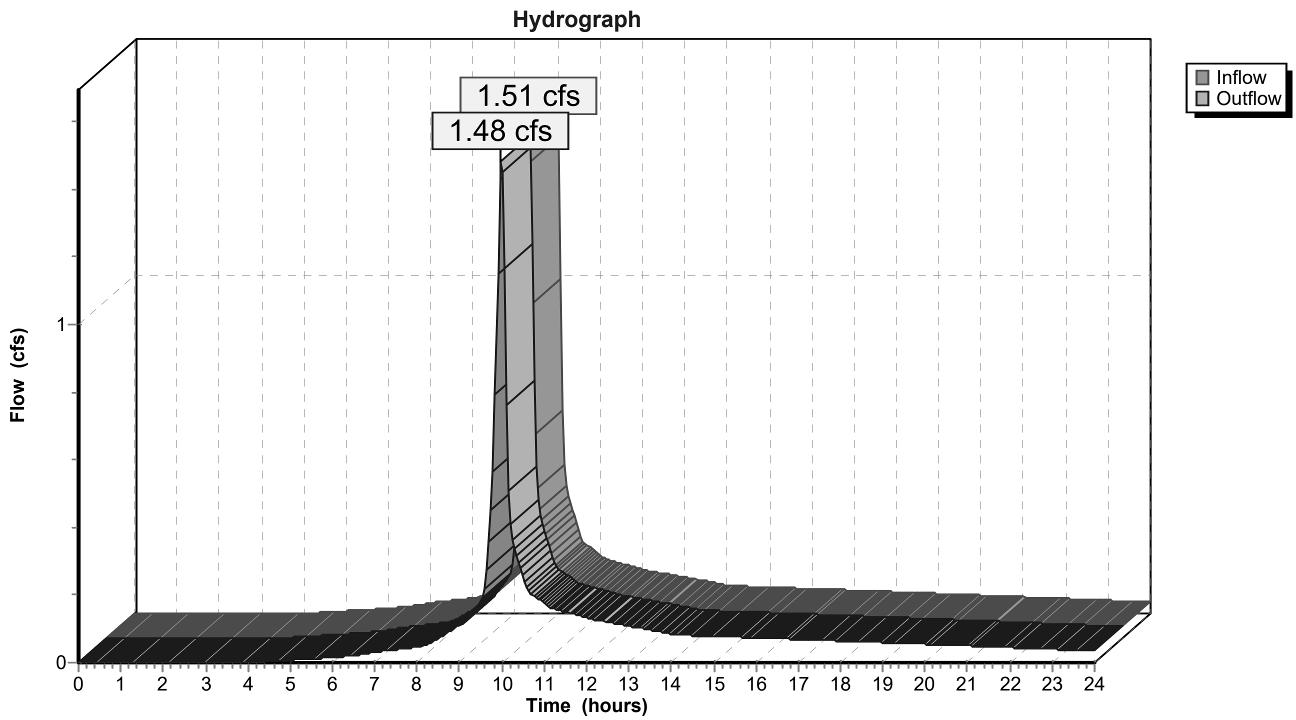
Reach 4R: 12" Pipe

Inflow Area = 1.402 ac, Inflow Depth = 1.31"
Inflow = 1.51 cfs @ 9.96 hrs, Volume= 0.153 af
Outflow = 1.48 cfs @ 9.98 hrs, Volume= 0.153 af, Atten= 2%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.9 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 1.6 min

Peak Depth= 0.62'
Capacity at bank full= 2.11 cfs
12.0" Diameter Pipe n= 0.012 Length= 117.0' Slope= 0.0030 '/'

Reach 4R: 12" Pipe



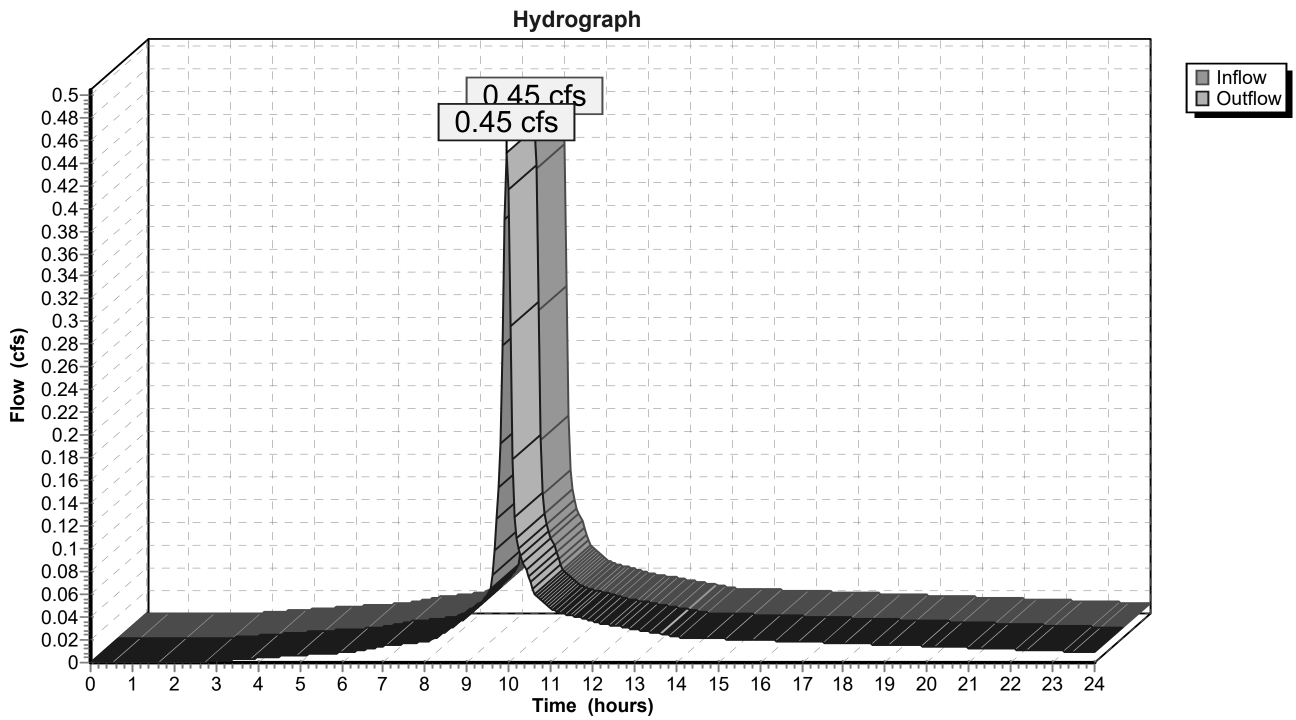
Reach 5R: New Pipe

Inflow Area = 0.351 ac, Inflow Depth = 1.57"
Inflow = 0.45 cfs @ 9.96 hrs, Volume= 0.046 af
Outflow = 0.45 cfs @ 9.96 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.4 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.27'
Capacity at bank full= 1.33 cfs
8.0" Diameter Pipe n= 0.012 Length= 16.5' Slope= 0.0103 '/'

Reach 5R: New Pipe



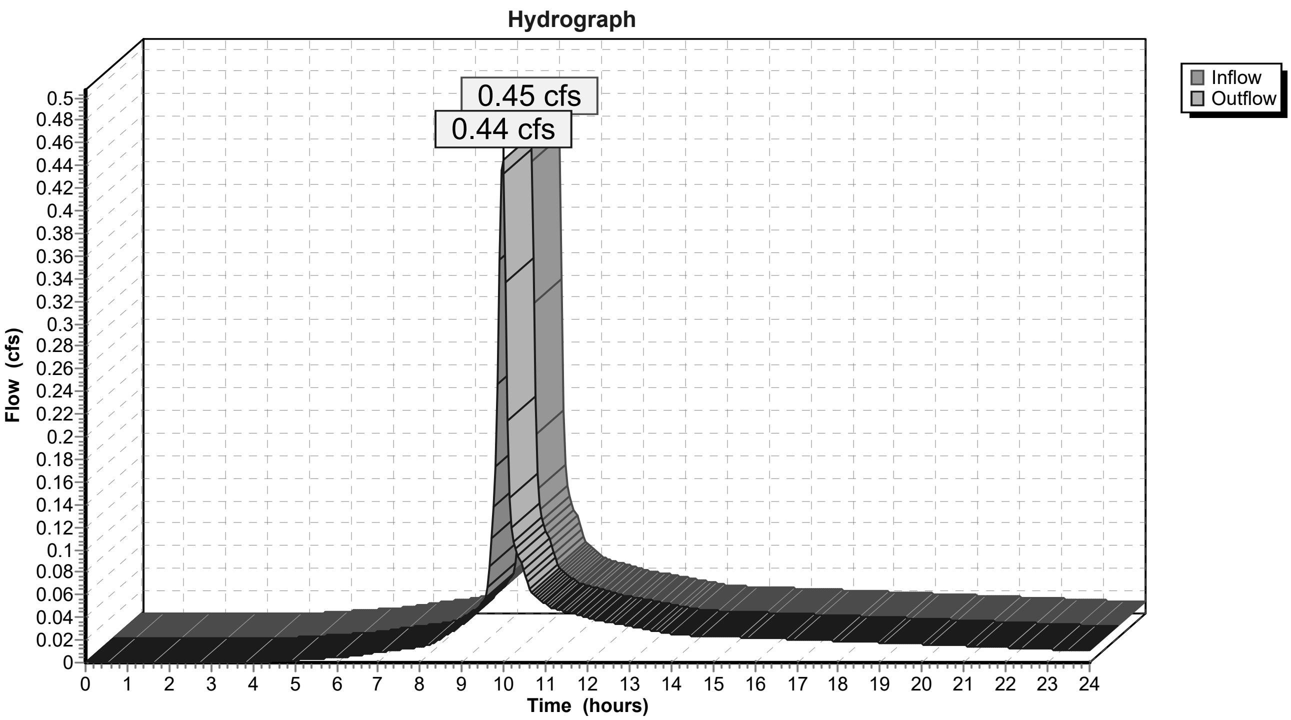
Reach 6R: New Pipe

Inflow Area =	0.420 ac,	Inflow Depth = 1.31"		
Inflow =	0.45 cfs @	9.96 hrs,	Volume=	0.046 af
Outflow =	0.44 cfs @	9.97 hrs,	Volume=	0.046 af, Atten= 2%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.4 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.4 fps, Avg. Travel Time= 1.2 min

Peak Depth= 0.32'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0100 '/'

Reach 6R: New Pipe



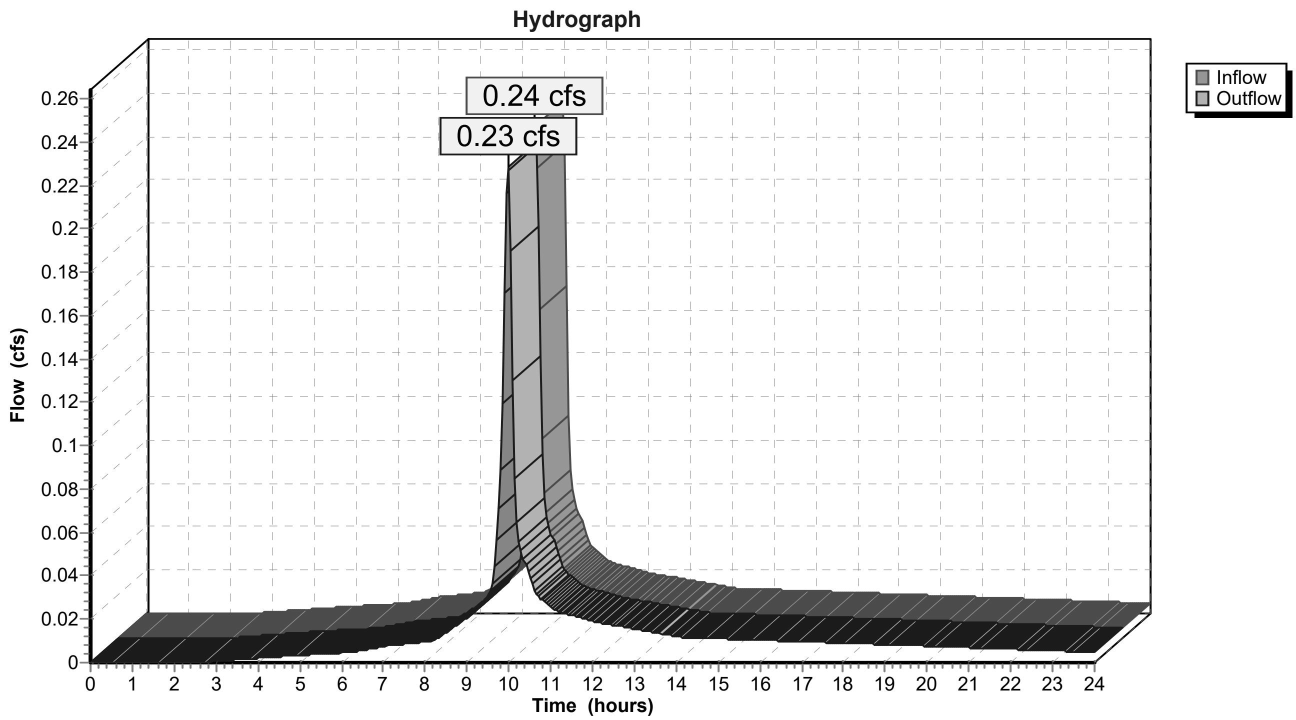
Reach 7R: Existing Pipe

Inflow Area = 0.184 ac, Inflow Depth = 1.57"
Inflow = 0.24 cfs @ 9.96 hrs, Volume= 0.024 af
Outflow = 0.23 cfs @ 9.99 hrs, Volume= 0.024 af, Atten= 3%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.8 fps, Min. Travel Time= 1.1 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 2.7 min

Peak Depth= 0.19'
Capacity at bank full= 1.31 cfs
8.0" Diameter Pipe n= 0.012 Length= 180.0' Slope= 0.0100 '/'

Reach 7R: Existing Pipe



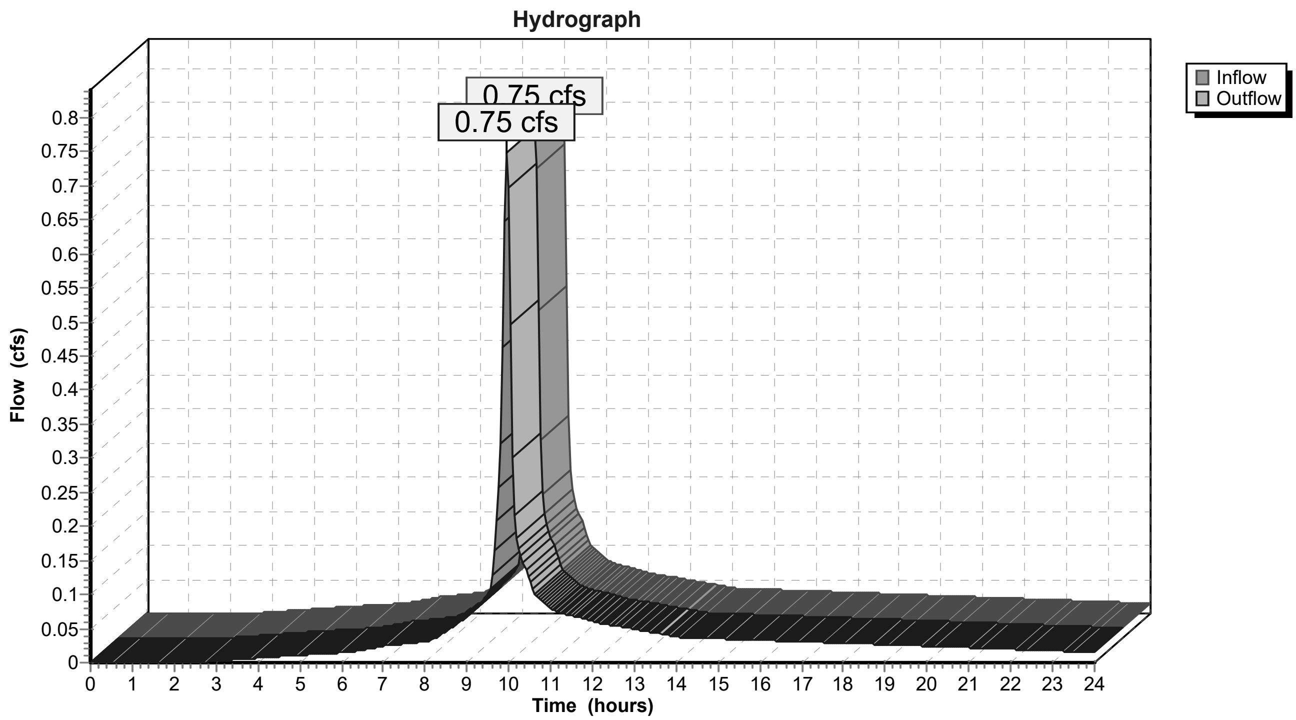
Reach 8R: New Pipe

Inflow Area = 0.585 ac, Inflow Depth = 1.57"
Inflow = 0.75 cfs @ 9.96 hrs, Volume= 0.077 af
Outflow = 0.75 cfs @ 9.96 hrs, Volume= 0.077 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.9 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.36'
Capacity at bank full= 1.31 cfs
8.0" Diameter Pipe n= 0.012 Length= 25.0' Slope= 0.0100 '/'

Reach 8R: New Pipe



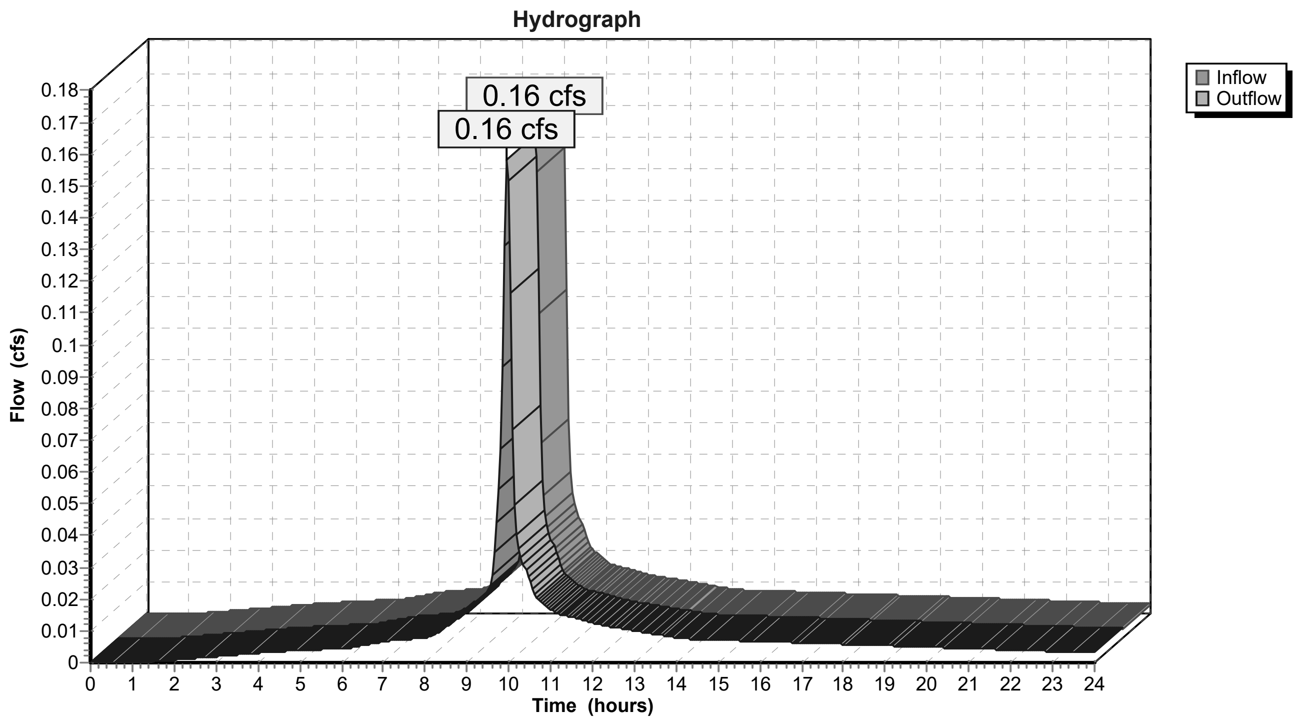
Reach 9R: Roof Drain Pipe

Inflow Area = 0.115 ac, Inflow Depth = 1.77"
Inflow = 0.16 cfs @ 9.95 hrs, Volume= 0.017 af
Outflow = 0.16 cfs @ 9.97 hrs, Volume= 0.017 af, Atten= 2%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.6 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 1.3 min

Peak Depth= 0.18'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 80.0' Slope= 0.0100 '/'

Reach 9R: Roof Drain Pipe



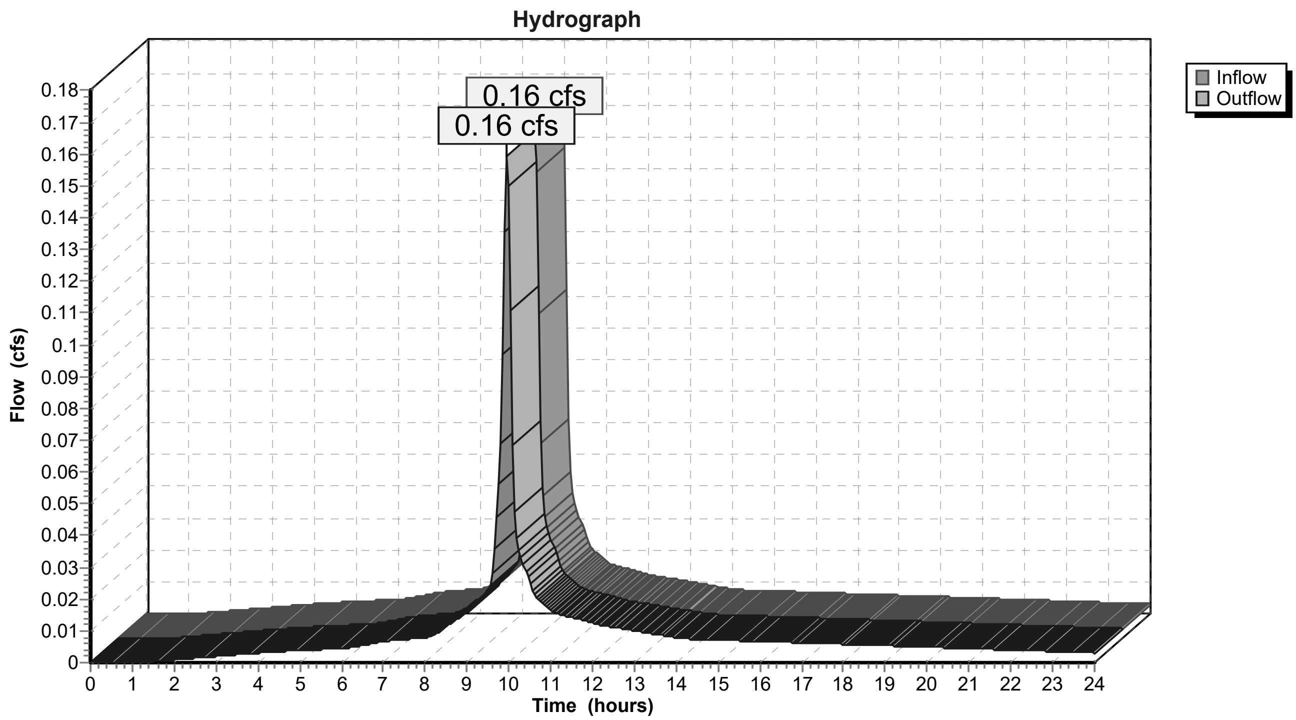
Reach 10R: Roof Drain Pipe

Inflow Area = 0.115 ac, Inflow Depth = 1.77"
Inflow = 0.16 cfs @ 9.95 hrs, Volume= 0.017 af
Outflow = 0.16 cfs @ 9.96 hrs, Volume= 0.017 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.6 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.18'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 50.0' Slope= 0.0100 '/'

Reach 10R: Roof Drain Pipe



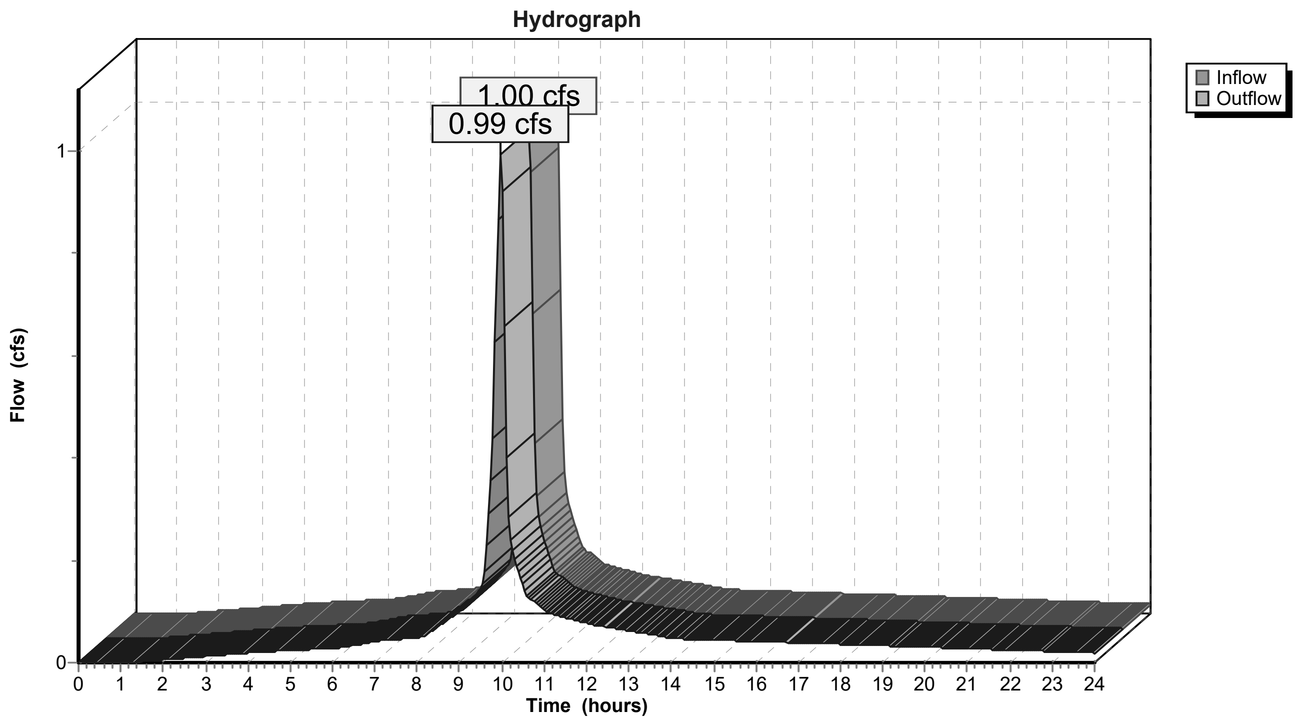
Reach 11R: Roof Drain Pipe

Inflow Area = 0.713 ac, Inflow Depth = 1.77"
Inflow = 1.00 cfs @ 9.95 hrs, Volume= 0.105 af
Outflow = 0.99 cfs @ 9.96 hrs, Volume= 0.105 af, Atten= 1%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.1 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.7 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.44'
Capacity at bank full= 1.31 cfs
8.0" Diameter Pipe n= 0.012 Length= 35.0' Slope= 0.0100 '/'

Reach 11R: Roof Drain Pipe



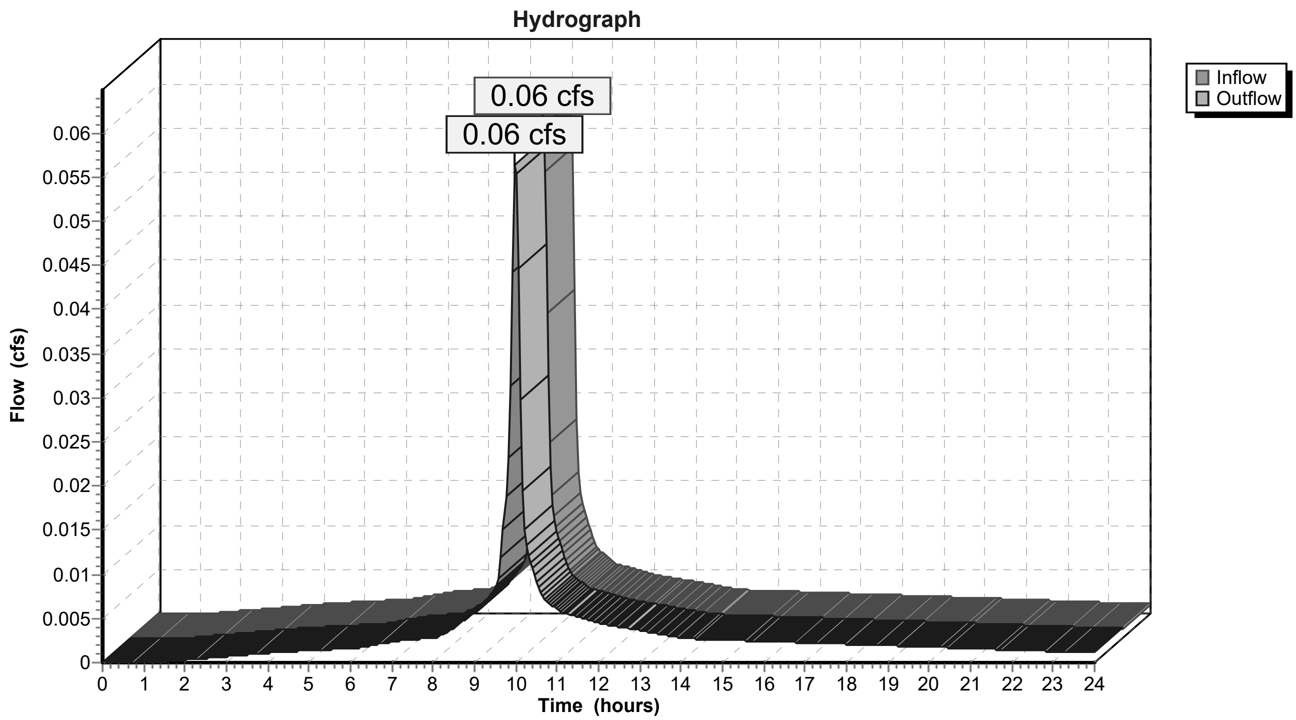
Reach 12R: Roof Drain Pipe

Inflow Area = 0.041 ac, Inflow Depth = 1.77"
Inflow = 0.06 cfs @ 9.95 hrs, Volume= 0.006 af
Outflow = 0.06 cfs @ 9.98 hrs, Volume= 0.006 af, Atten= 3%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.9 fps, Min. Travel Time= 0.9 min
Avg. Velocity = 0.7 fps, Avg. Travel Time= 2.2 min

Peak Depth= 0.10'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0100 '/'

Reach 12R: Roof Drain Pipe



Pond 1P: Phase 2 Pond plus Expansion Area

Inflow Area =	2.298 ac,	Inflow Depth = 1.48"		
Inflow =	2.76 cfs @	9.96 hrs,	Volume=	0.284 af
Outflow =	0.14 cfs @	14.10 hrs,	Volume=	0.190 af, Atten= 95%, Lag= 248.3 min
Discarded =	0.13 cfs @	8.55 hrs,	Volume=	0.187 af
Primary =	0.01 cfs @	14.10 hrs,	Volume=	0.003 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 3.76' Storage= 5,213 cf
Plug-Flow detention time= 312.7 min calculated for 0.190 af (67% of inflow)

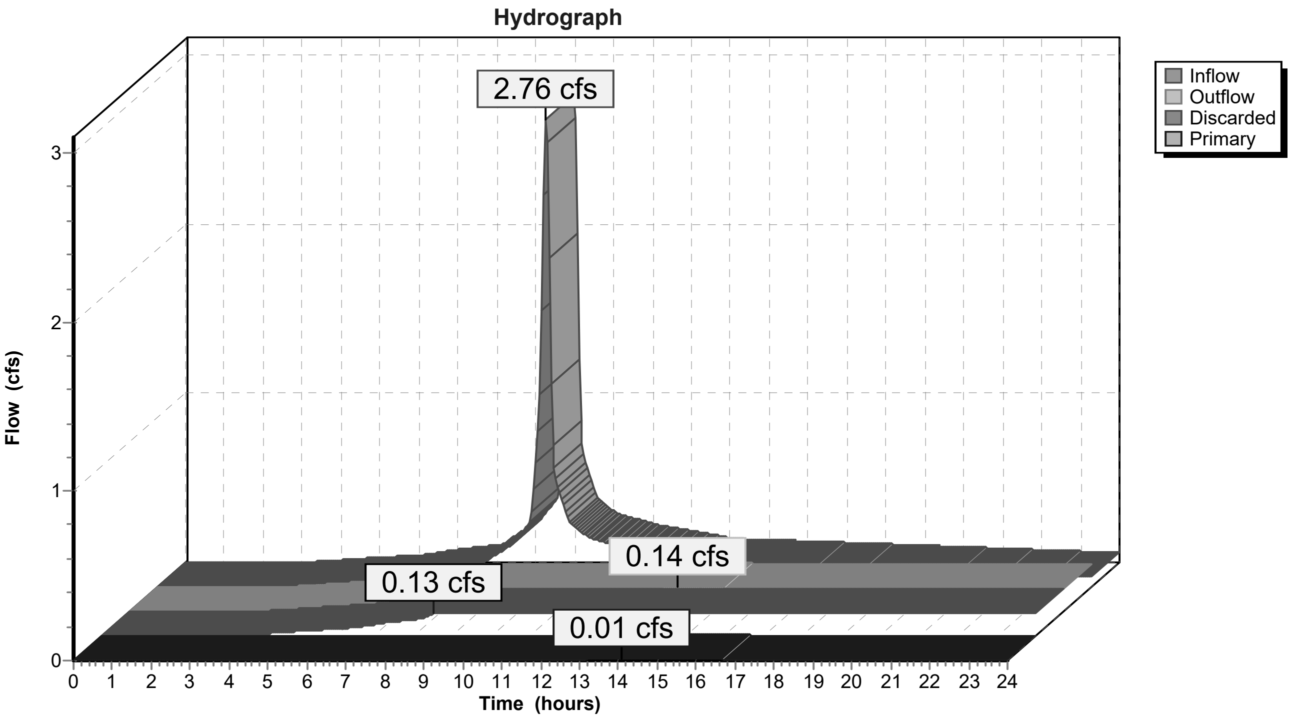
Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	2,593
3.50	4,538
5.00	8,378

Discarded OutFlow Max=0.13 cfs @ 8.55 hrs HW=0.10' (Free Discharge)
└─**1=Infiltration** (Controls 0.13 cfs)

Primary OutFlow Max=0.01 cfs @ 14.10 hrs HW=3.76' (Free Discharge)
└─**2=Culvert** (Controls 0.01 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.13 0.13
2	Primary	3.70'	**8.0" x 15.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3.50' S= 0.0133 '/' n= 0.012 Cc= 0.900

Pond 1P: Phase 2 Pond plus Expansion Area



Pond 2P: (new Pond)

Inflow Area = 3.700 ac, Inflow Depth = 0.51"
Inflow = 1.48 cfs @ 9.98 hrs, Volume= 0.156 af
Outflow = 0.16 cfs @ 9.65 hrs, Volume= 0.156 af, Atten= 89%, Lag= 0.0 min
Primary = 0.16 cfs @ 9.65 hrs, Volume= 0.156 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

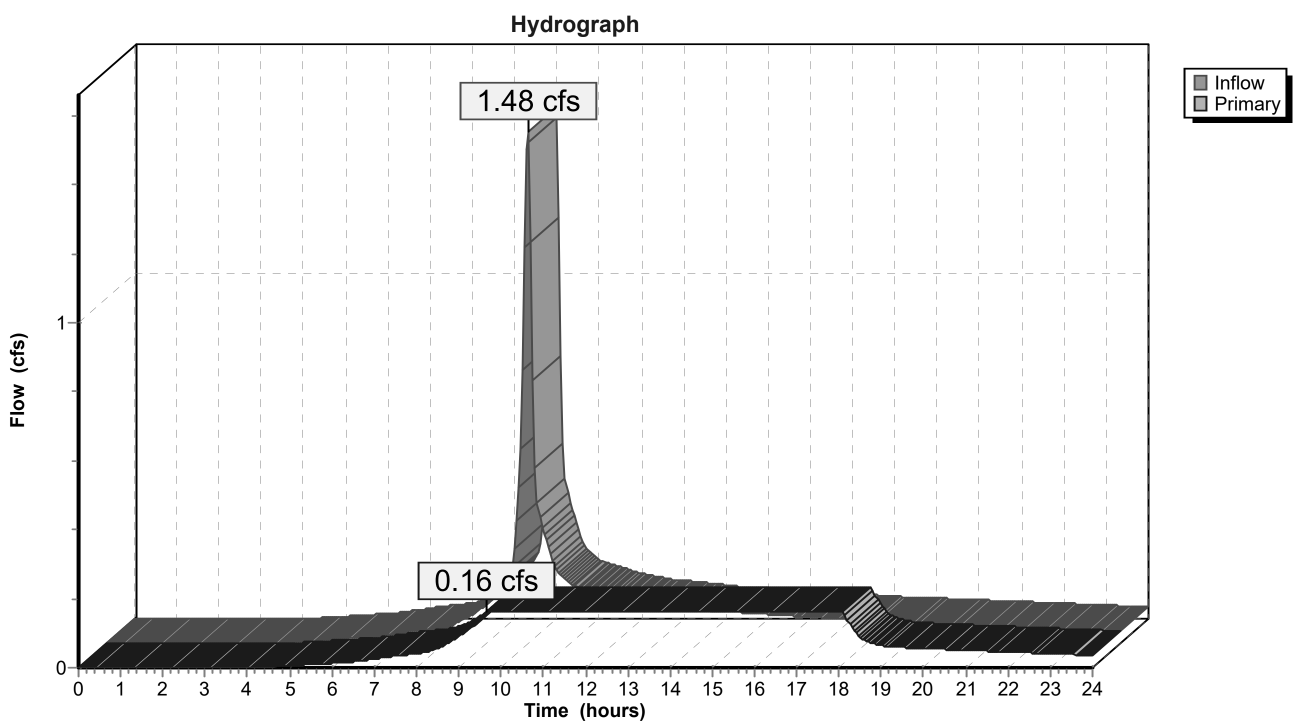
Peak Elev= 1.07' Storage= 1,727 cf
Plug-Flow detention time= 91.4 min calculated for 0.155 af (99% of inflow)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	3,220
3.50	5,635
5.00	10,615

Primary OutFlow Max=0.16 cfs @ 9.65 hrs HW=0.11' (Free Discharge)
└─**1=Special (user-defined)** (Controls 0.16 cfs)

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**Special (user-defined)** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.16 0.16

Pond 2P: (new Pond)



Pond 3P: New Pond NE Corner of Site

Inflow Area = 0.771 ac, Inflow Depth = 1.43"
Inflow = 0.89 cfs @ 9.96 hrs, Volume= 0.092 af
Outflow = 0.05 cfs @ 8.80 hrs, Volume= 0.070 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.05 cfs @ 8.80 hrs, Volume= 0.070 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

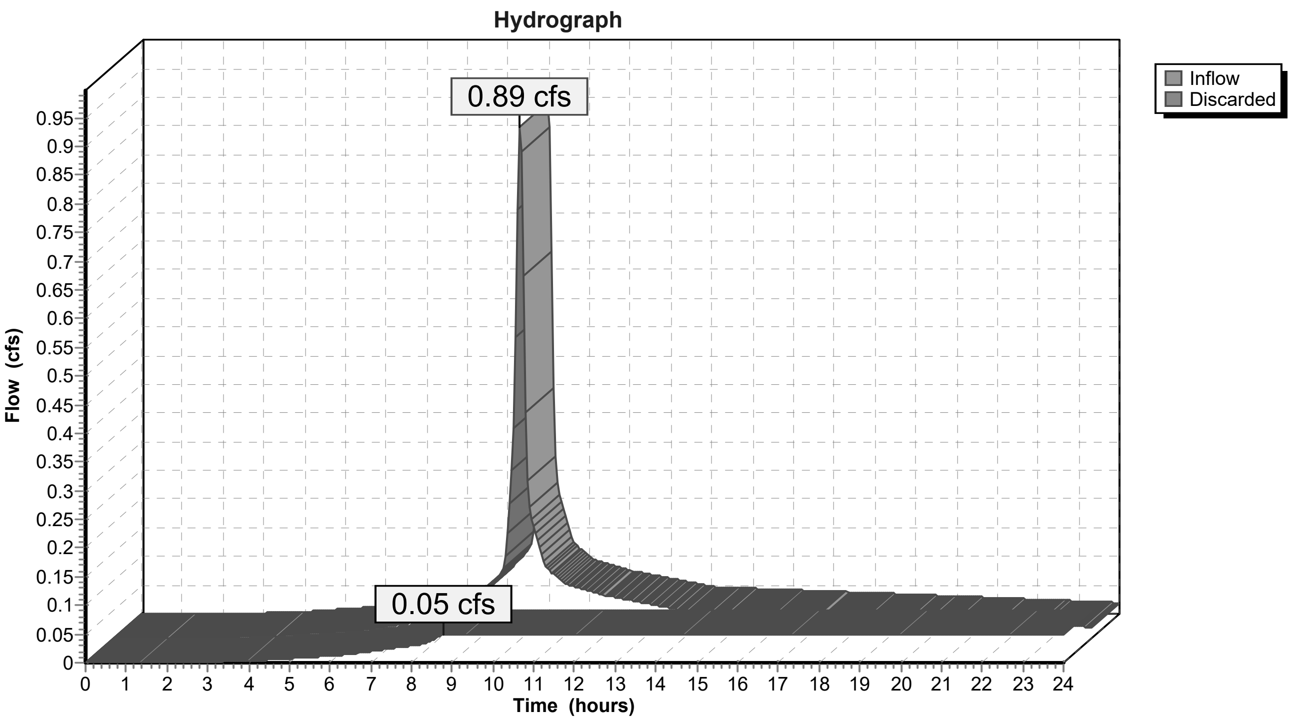
Peak Elev= 2.80' Storage= 1,548 cf
Plug-Flow detention time= 290.6 min calculated for 0.070 af (76% of inflow)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	1,105
3.50	1,934
5.00	3,696

Discarded OutFlow Max=0.05 cfs @ 8.80 hrs HW=0.10' (Free Discharge)
└─**1=Infiltration** (Controls 0.05 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.05 0.05

Pond 3P: New Pond NE Corner of Site



Pond 4P: Pond Back of Stores

Inflow Area = 0.769 ac, Inflow Depth = 1.57"
Inflow = 0.97 cfs @ 9.96 hrs, Volume= 0.101 af
Outflow = 0.04 cfs @ 8.20 hrs, Volume= 0.060 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.04 cfs @ 8.20 hrs, Volume= 0.060 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

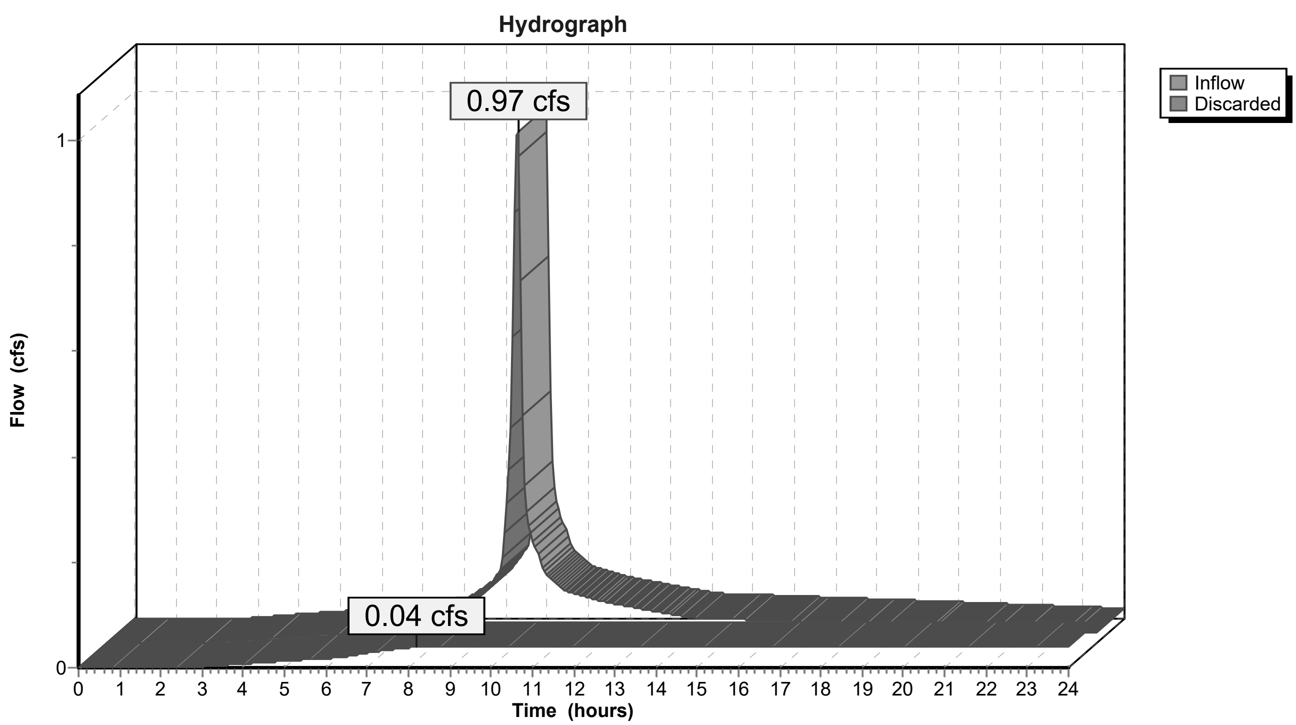
Peak Elev= 4.35' Storage= 2,021 cf
Plug-Flow detention time= 320.7 min calculated for 0.060 af (60% of inflow)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	736
3.50	1,288
5.00	2,585

Discarded OutFlow Max=0.04 cfs @ 8.20 hrs HW=0.10' (Free Discharge)
└─**1=Infiltration** (Controls 0.04 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.04 0.04

Pond 4P: Pond Back of Stores



Pond DW1: Existing Drywell at Maurices

Inflow Area = 0.230 ac, Inflow Depth = 1.77"
Inflow = 0.32 cfs @ 9.96 hrs, Volume= 0.034 af
Outflow = 0.16 cfs @ 10.15 hrs, Volume= 0.033 af, Atten= 51%, Lag= 10.9 min
Discarded = 0.03 cfs @ 10.10 hrs, Volume= 0.031 af
Secondary = 0.13 cfs @ 10.15 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 8.21' Storage= 405 cf
Plug-Flow detention time= 145.5 min calculated for 0.033 af (97% of inflow)

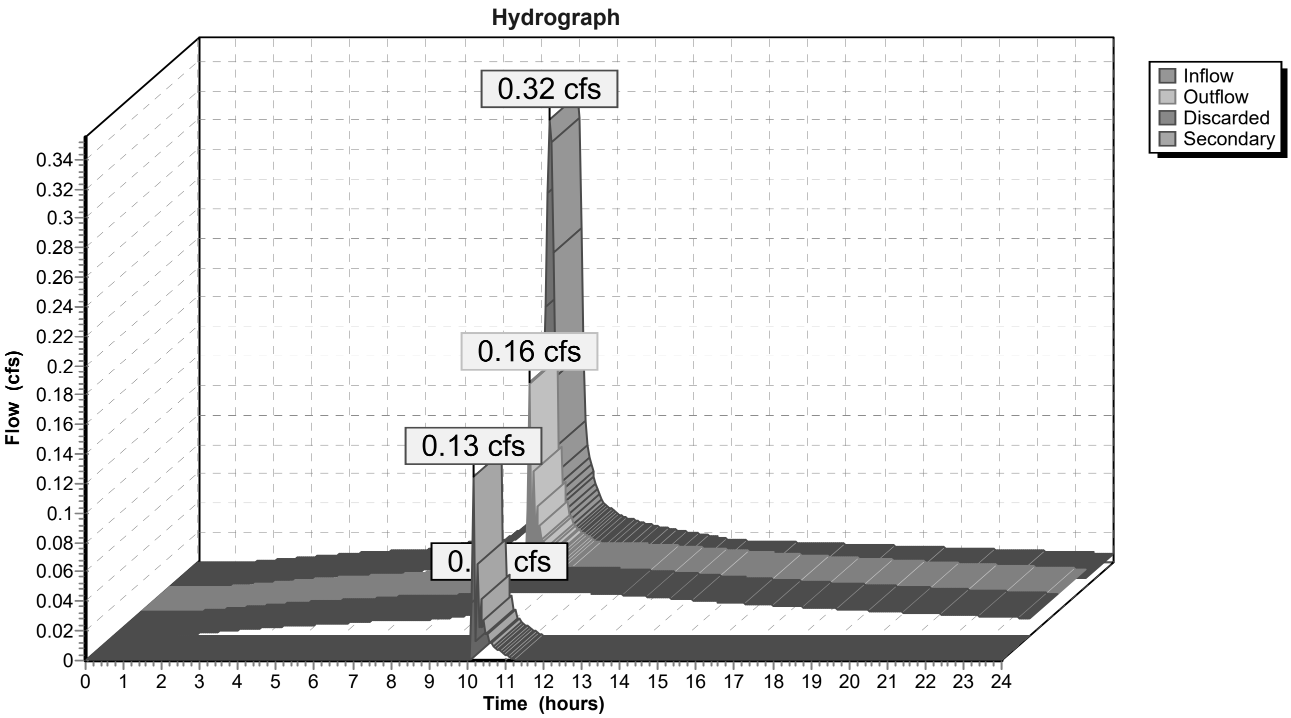
Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
8.00	402
12.00	452

Discarded OutFlow Max=0.03 cfs @ 10.10 hrs HW=8.10' (Free Discharge)
└─**1=Infiltration** (Controls 0.03 cfs)

Secondary OutFlow Max=0.11 cfs @ 10.15 hrs HW=8.20' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.11 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 8.00 12.00 Disch. (cfs) 0.00 0.01 0.03 0.03
2	Secondary	8.00'	**6.0" Vert. Orifice/Grate** C= 0.600

Pond DW1: Existing Drywell at Maurices



Pond DW2: New Drywell

Inflow Area = 0.754 ac, Inflow Depth = 1.80"
Inflow = 1.05 cfs @ 9.96 hrs, Volume= 0.113 af
Outflow = 0.05 cfs @ 15.37 hrs, Volume= 0.068 af, Atten= 96%, Lag= 324.7 min
Discarded = 0.05 cfs @ 15.37 hrs, Volume= 0.068 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

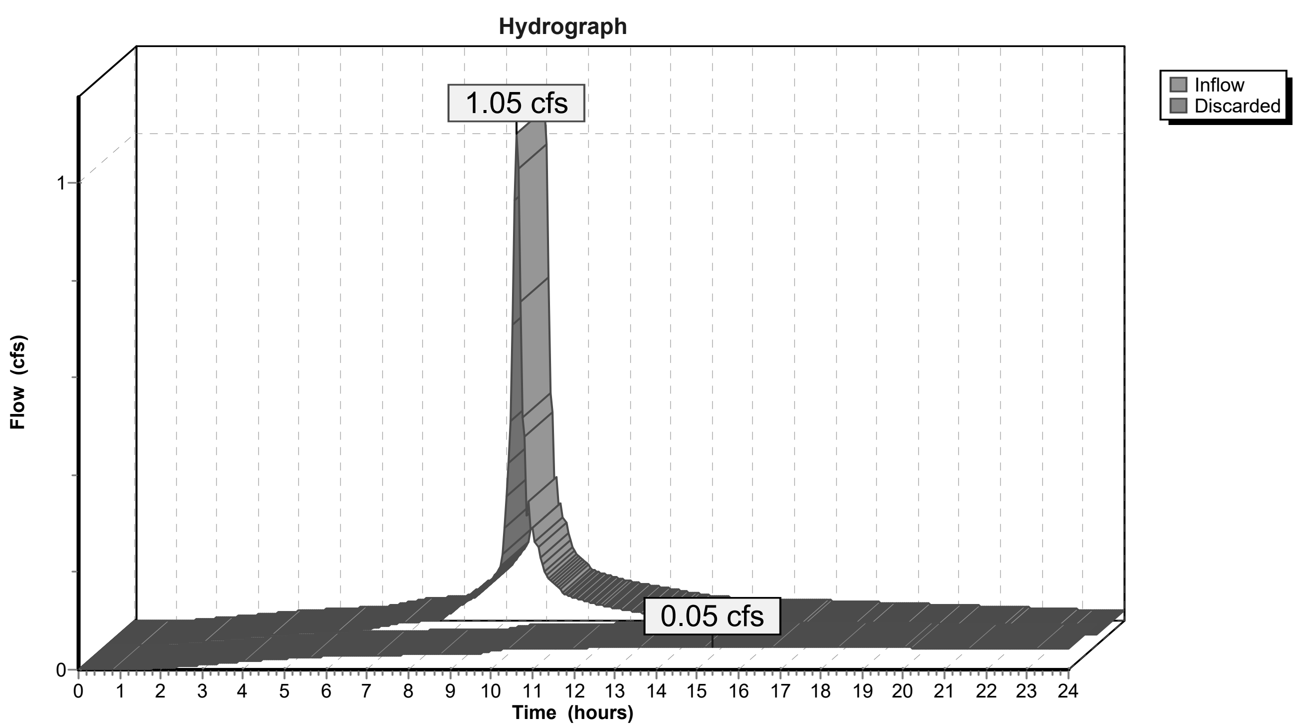
Peak Elev= 7.89' Storage= 2,368 cf
Plug-Flow detention time= 333.9 min calculated for 0.067 af (60% of inflow)

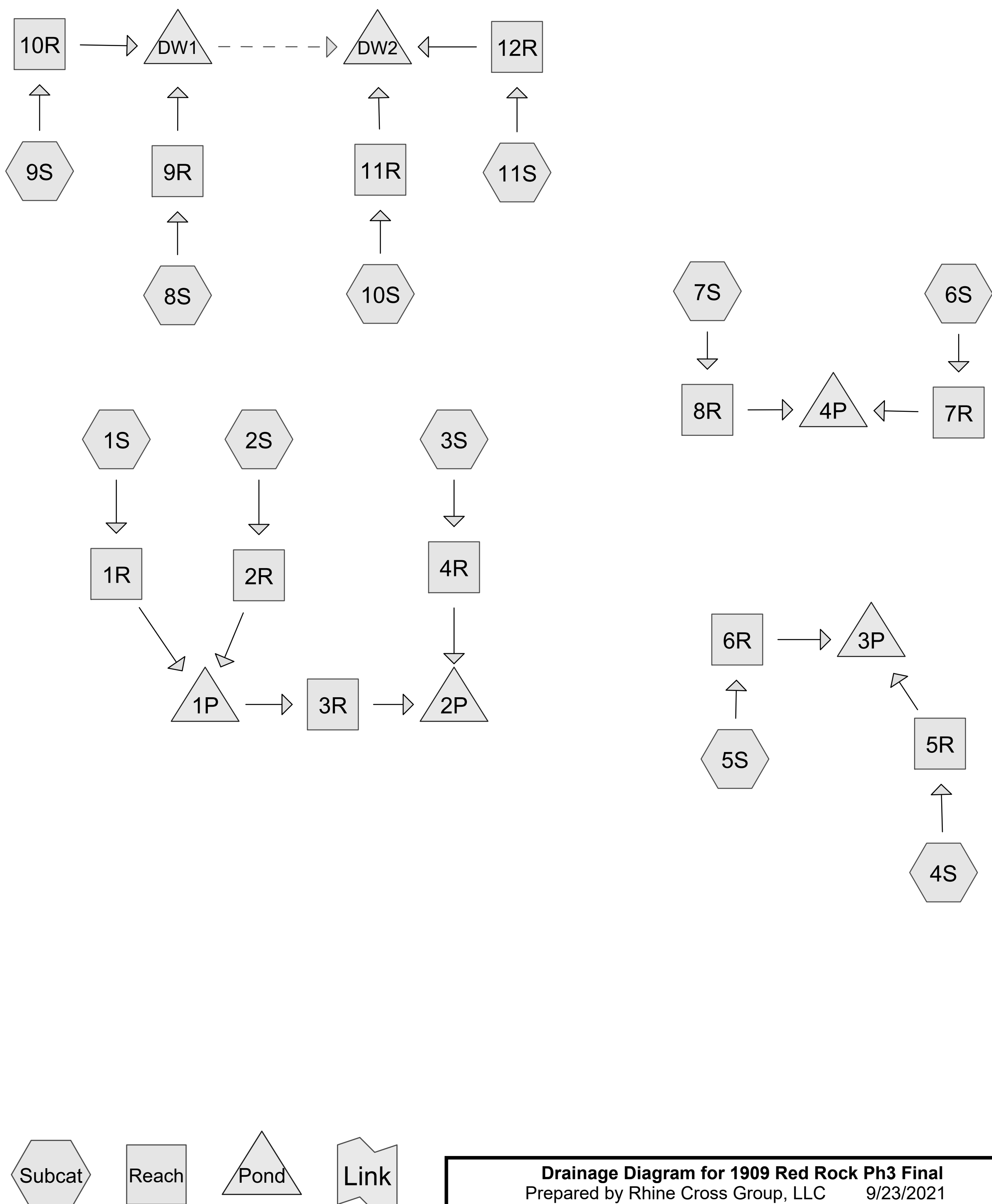
Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
10.00	3,001
15.00	3,064

Discarded OutFlow Max=0.05 cfs @ 15.37 hrs HW=7.89' (Free Discharge)
└─**1=Infiltration** (Controls 0.05 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 10.00 15.00 Disch. (cfs) 0.00 0.03 0.05 0.05

Pond DW2: New Drywell





Drainage Diagram for 1909 Red Rock Ph3 Final
Prepared by Rhine Cross Group, LLC 9/23/2021
HydroCAD® 6.10 s/n 002306 © 1986-2002 Applied Microcomputer Systems

Subcatchment 1S: Existing Phase 1 Area

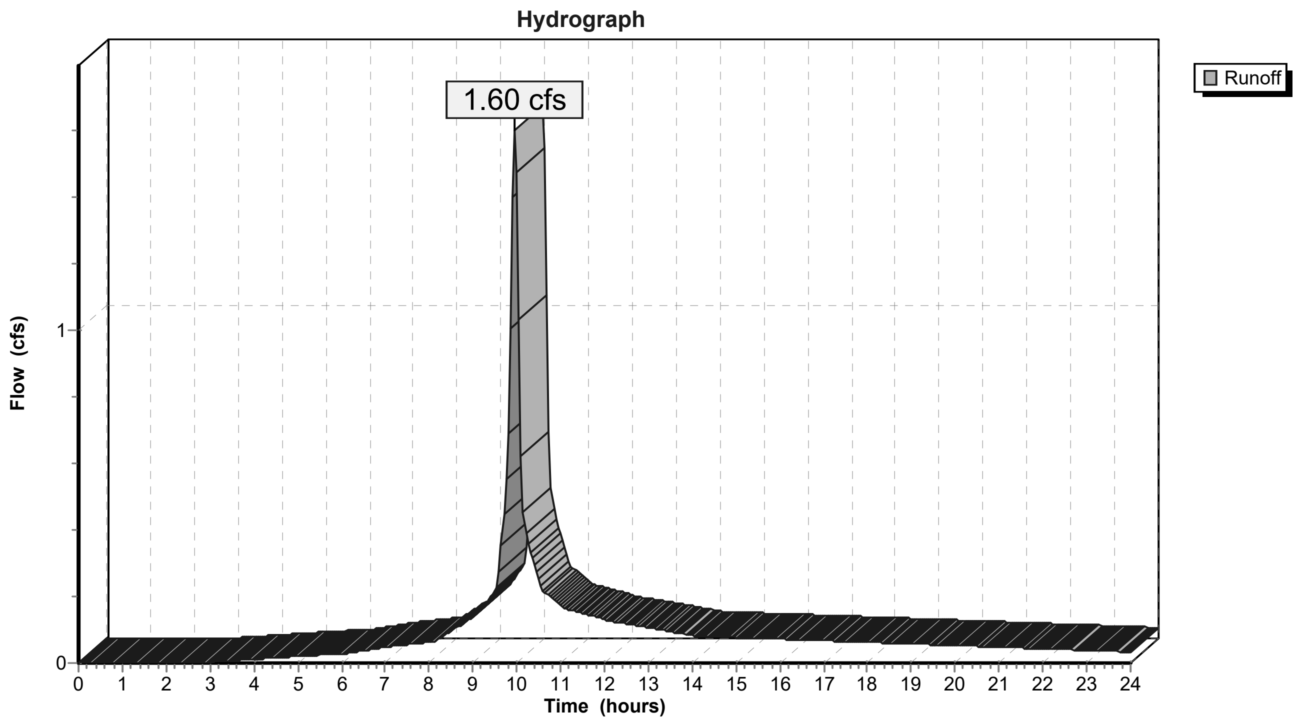
Runoff = 1.60 cfs @ 9.96 hrs, Volume= 0.163 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
6,787	98	Roof
36,802	98	Asphalt & Sidewalk
7,393	79	<50% Grass cover, Poor, HSG B
50,982	95	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 1S: Existing Phase 1 Area



Subcatchment 2S: New Phase 3 Parking Area

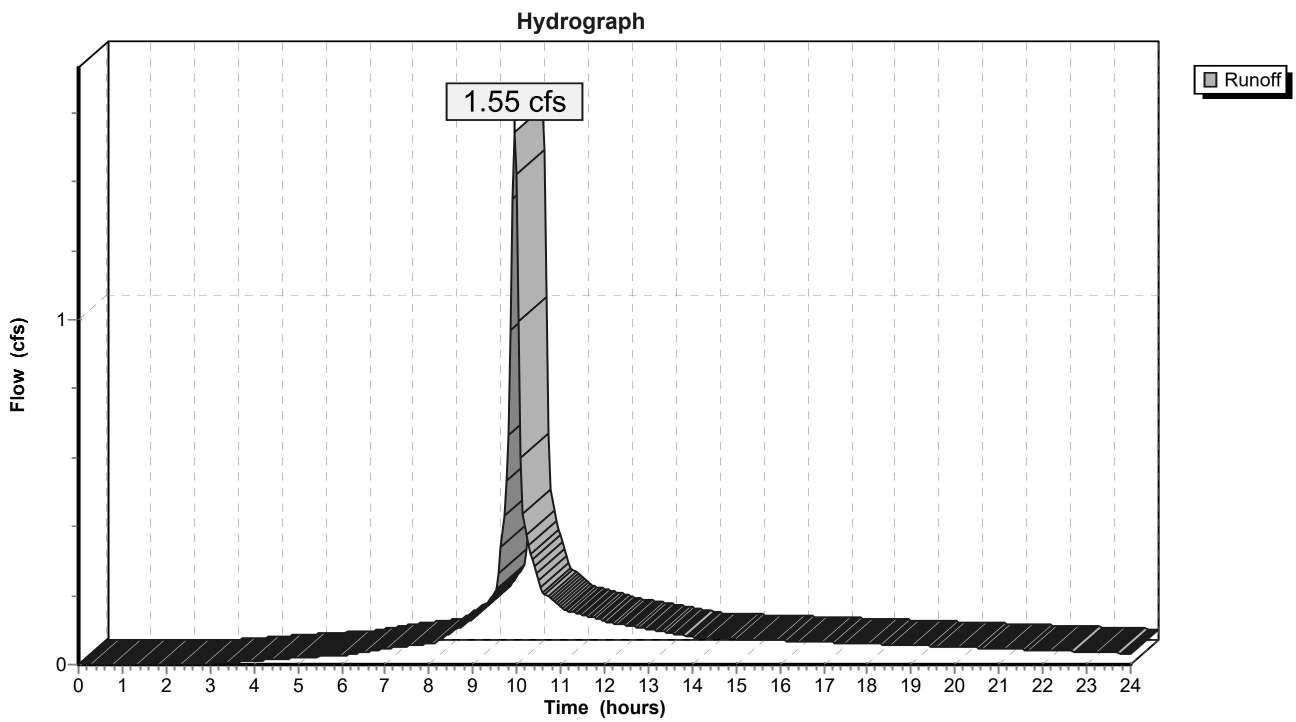
Runoff = 1.55 cfs @ 9.96 hrs, Volume= 0.157 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
41,516	98	Asphalt & Sidewalk
7,610	79	<50% Grass cover, Poor, HSG B
49,126	95	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 2S: New Phase 3 Parking Area



Subcatchment 3S: SELCO improvement area

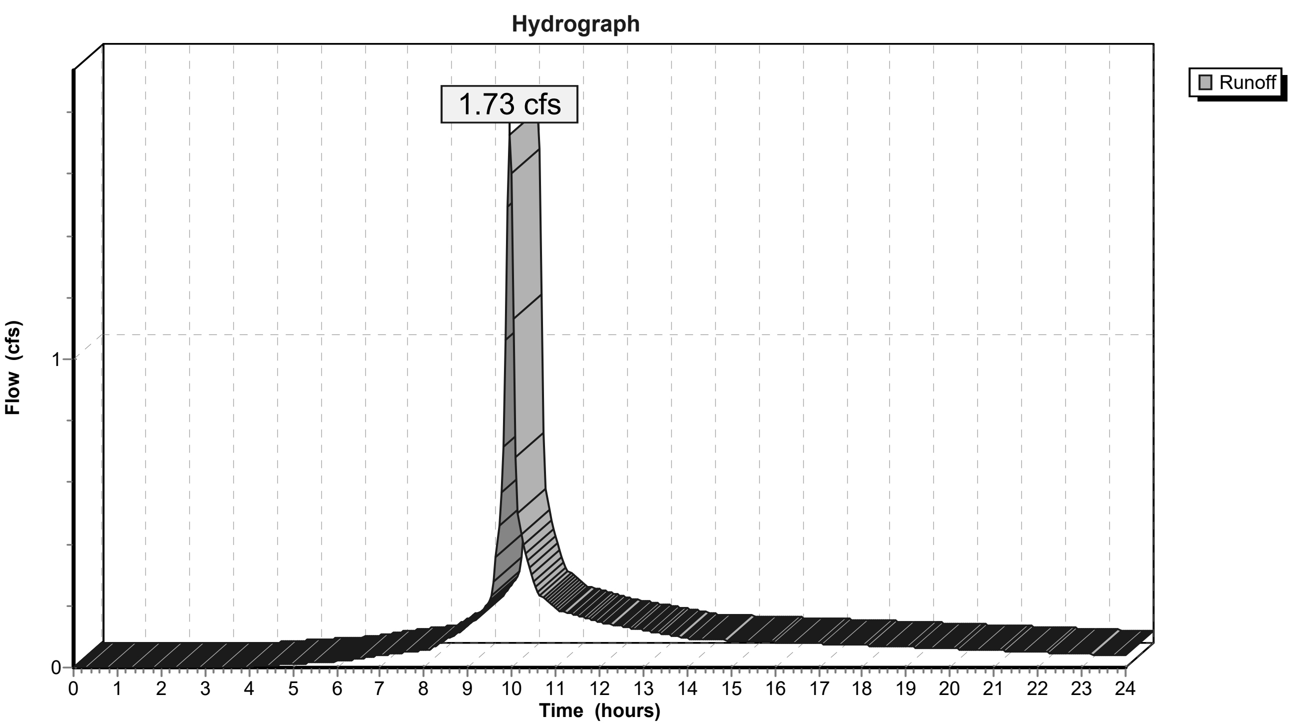
Runoff = 1.73 cfs @ 9.96 hrs, Volume= 0.175 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
41,367	98	Asphalt & Sidewalk Area
2,657	98	Roof Area
17,061	79	<50% Grass cover, Poor, HSG B
61,085	93	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct Impervious**

Subcatchment 3S: SELCO improvement area



Subcatchment 4S: Developed #4

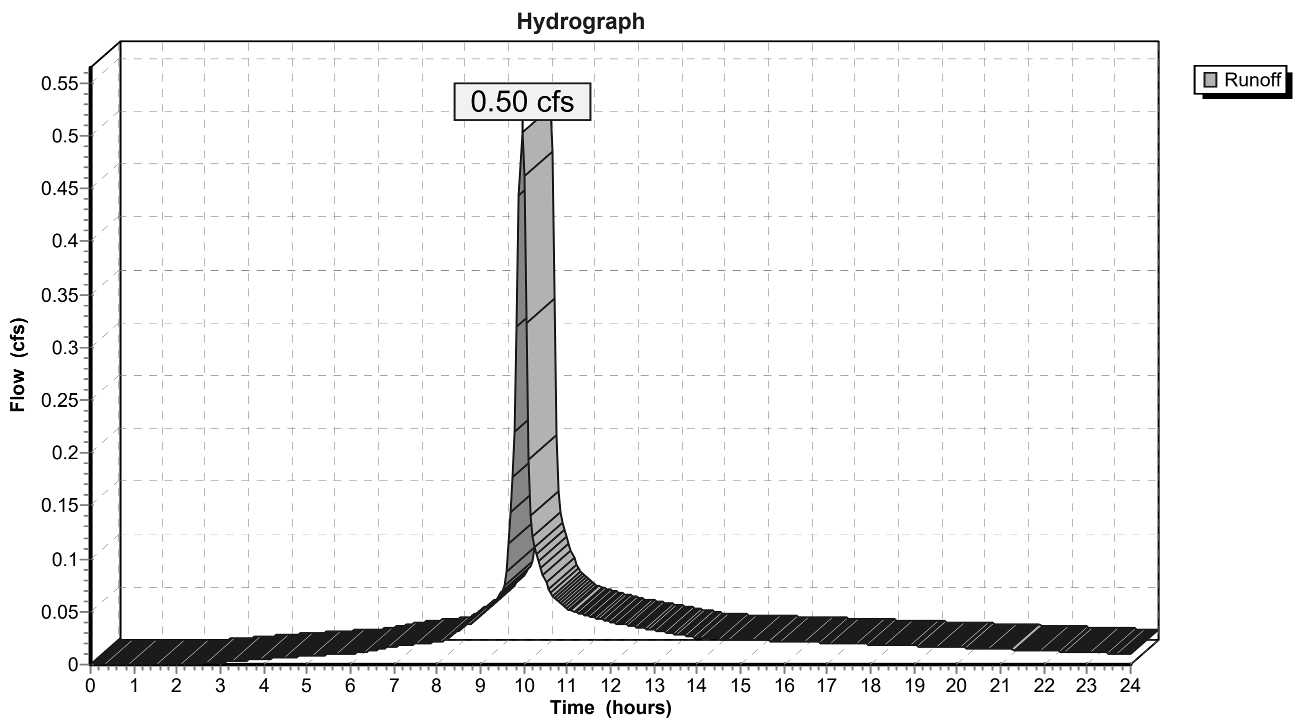
Runoff = 0.50 cfs @ 9.95 hrs, Volume= 0.052 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
13,631	98	Asphalt & Sidewalk
1,648	79	<50% Grass cover, Poor, HSG B
15,279	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 4S: Developed #4



Subcatchment 5S: Developed #5

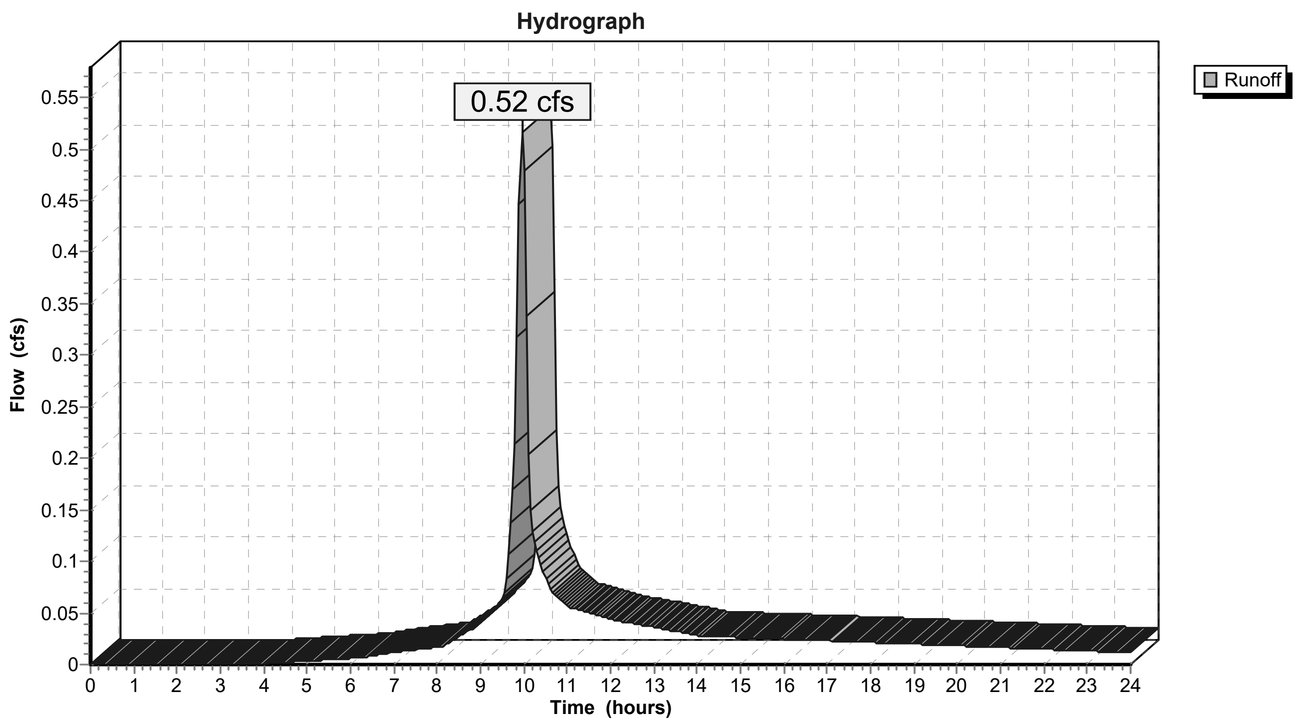
Runoff = 0.52 cfs @ 9.96 hrs, Volume= 0.052 af, Depth= 1.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
13,257	98	Asphalt & Sidewalk
5,042	79	<50% Grass cover, Poor, HSG B
18,299	93	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 5S: Developed #5



Subcatchment 6S: Developed #6

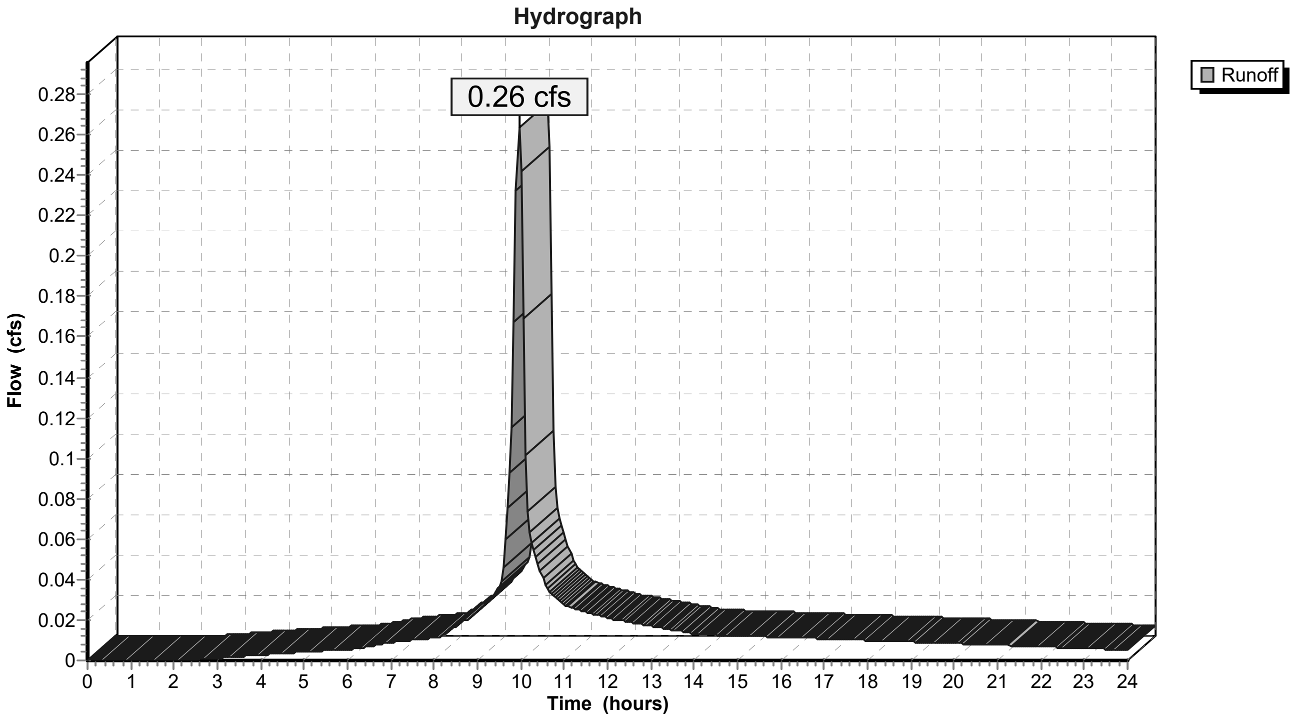
Runoff = 0.26 cfs @ 9.95 hrs, Volume= 0.027 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
7,031	98	Asphalt & Sidewalk
973	79	<50% Grass cover, Poor, HSG B
8,004	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 6S: Developed #6



Subcatchment 7S: Developed #7

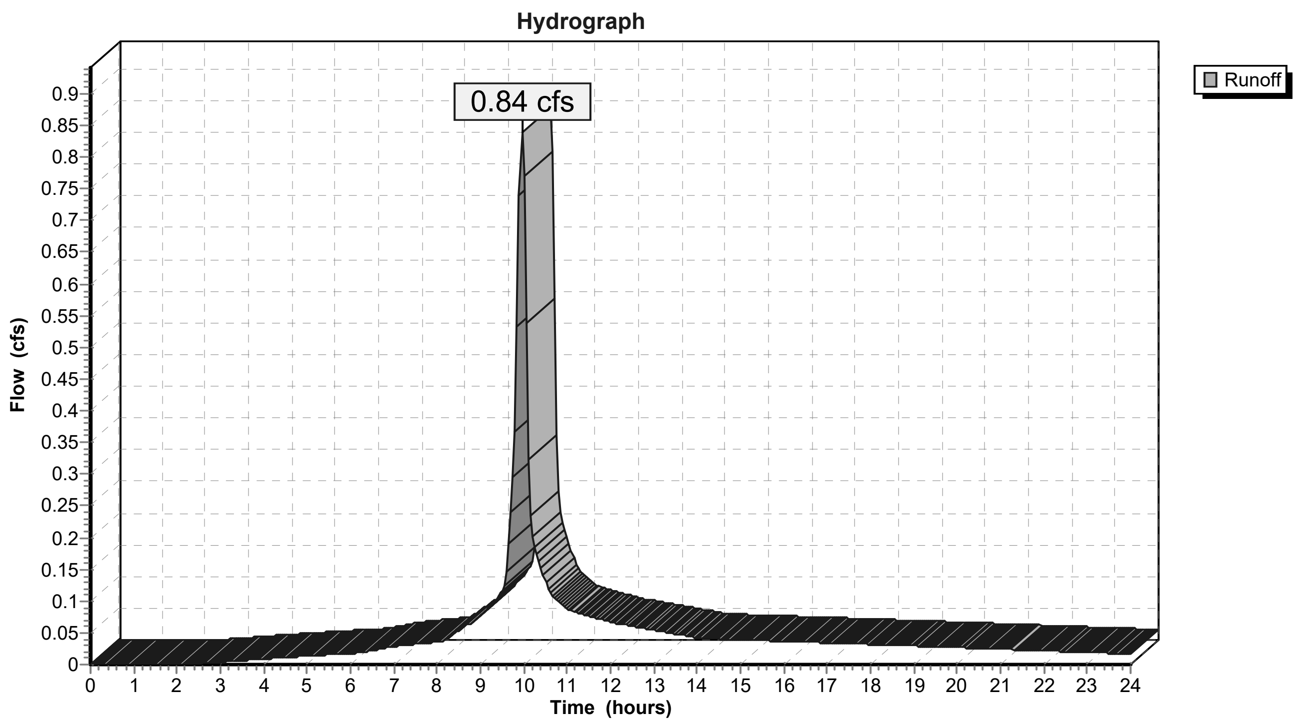
Runoff = 0.84 cfs @ 9.95 hrs, Volume= 0.086 af, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
22,443	98	Asphalt & Sidewalk
3,033	79	<50% Grass cover, Poor, HSG B
25,476	96	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 7S: Developed #7



Subcatchment 8S: Maurices Roof

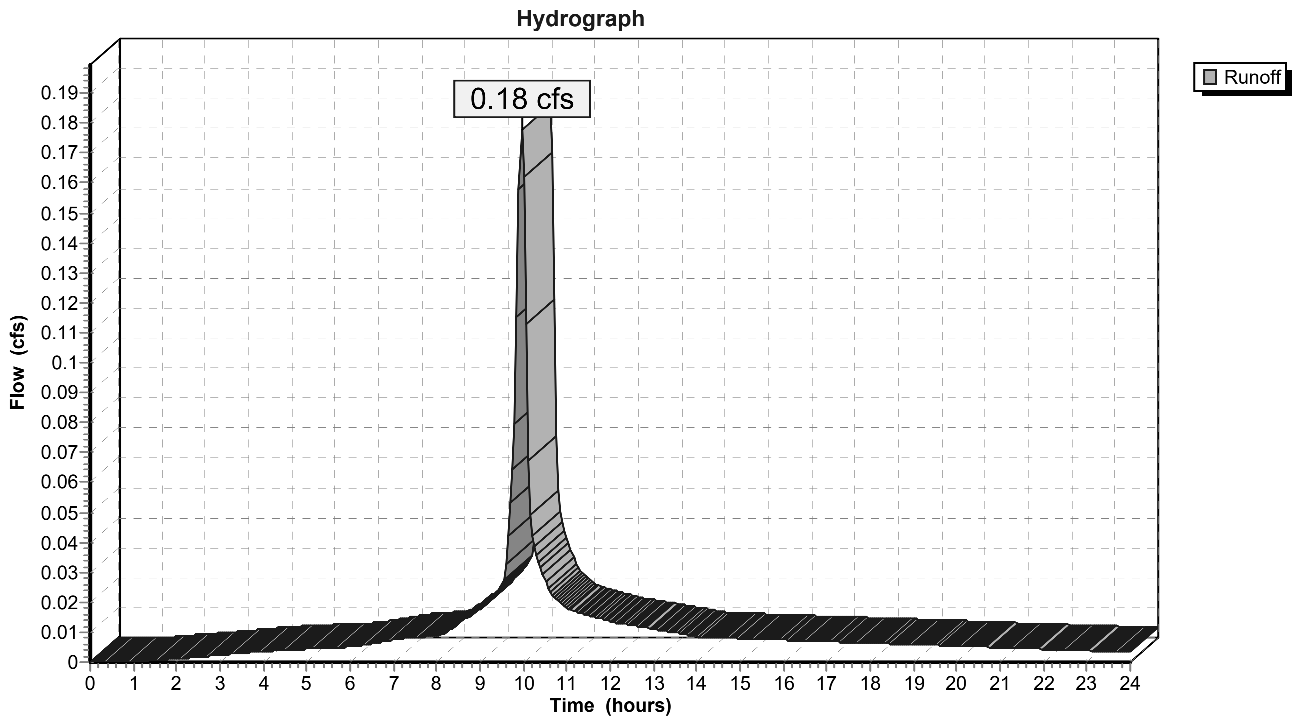
Runoff = 0.18 cfs @ 9.95 hrs, Volume= 0.019 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
5,000	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 8S: Maurices Roof



Subcatchment 9S: Famous Footwear Roof

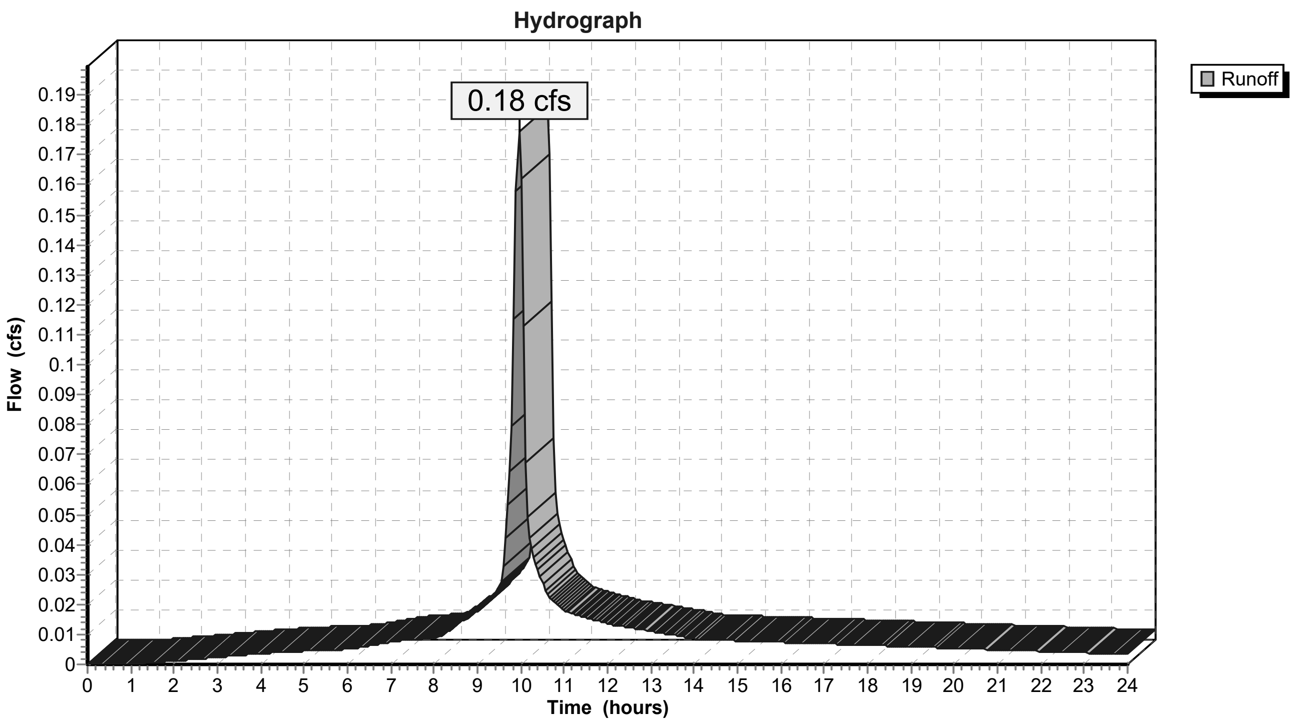
Runoff = 0.18 cfs @ 9.95 hrs, Volume= 0.019 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
5,000	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 9S: Famous Footwear Roof



Subcatchment 10S: Ulta & Marshall's Roof

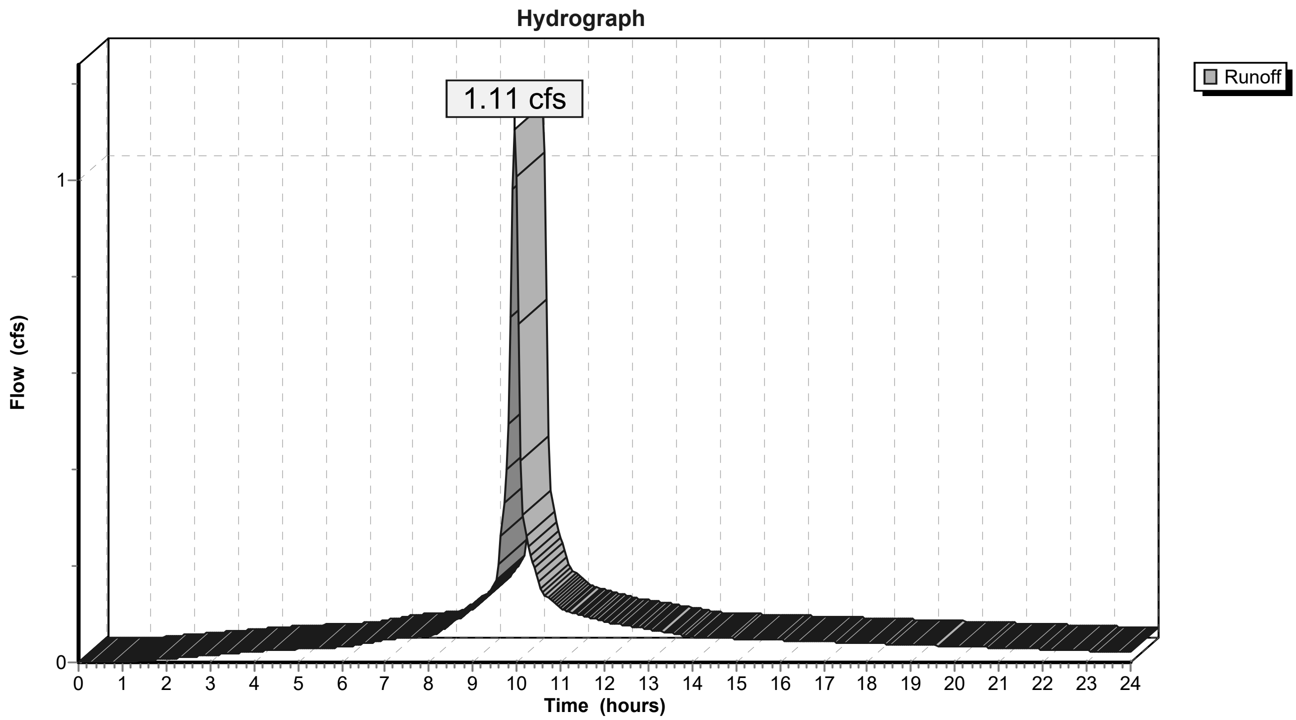
Runoff = 1.11 cfs @ 9.95 hrs, Volume= 0.117 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
31,064	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 10S: Ulta & Marshall's Roof



Subcatchment 11S: Small Retail Roof

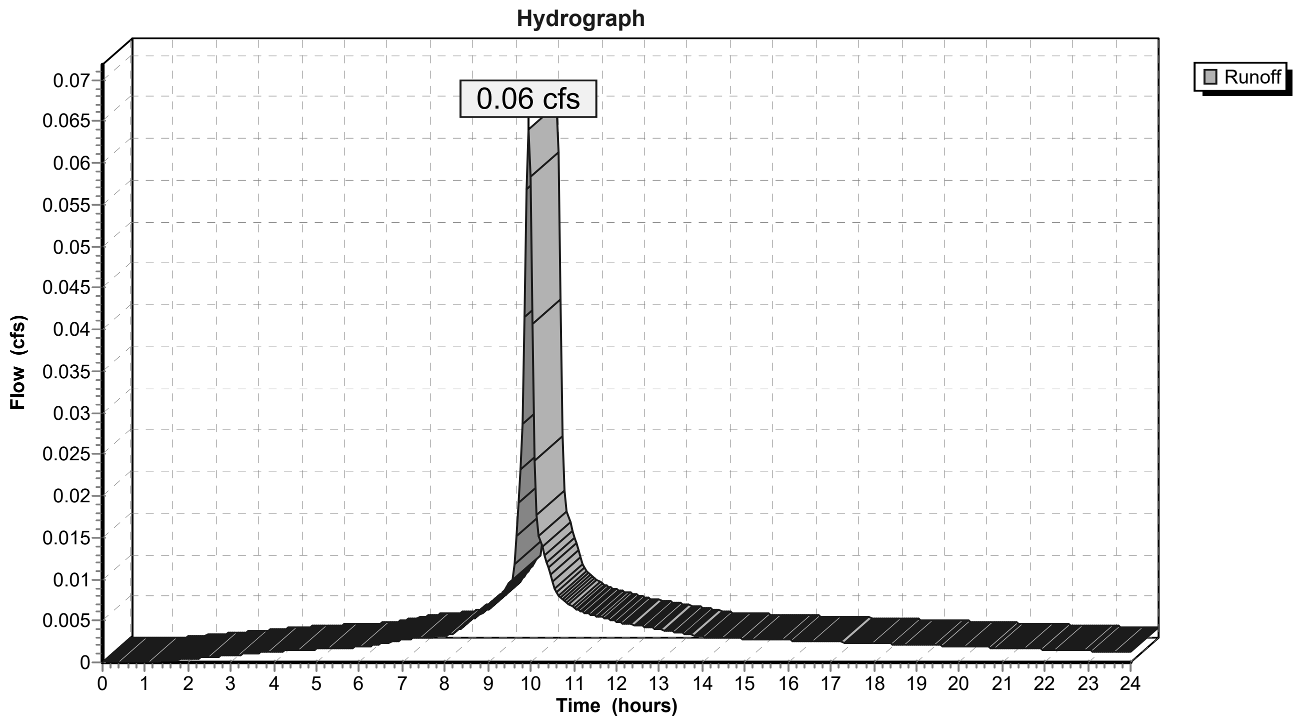
Runoff = 0.06 cfs @ 9.95 hrs, Volume= 0.007 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type I 24-hr Rainfall=2.20"

Area (sf)	CN	Description
1,800	98	Roof

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Direct**

Subcatchment 11S: Small Retail Roof



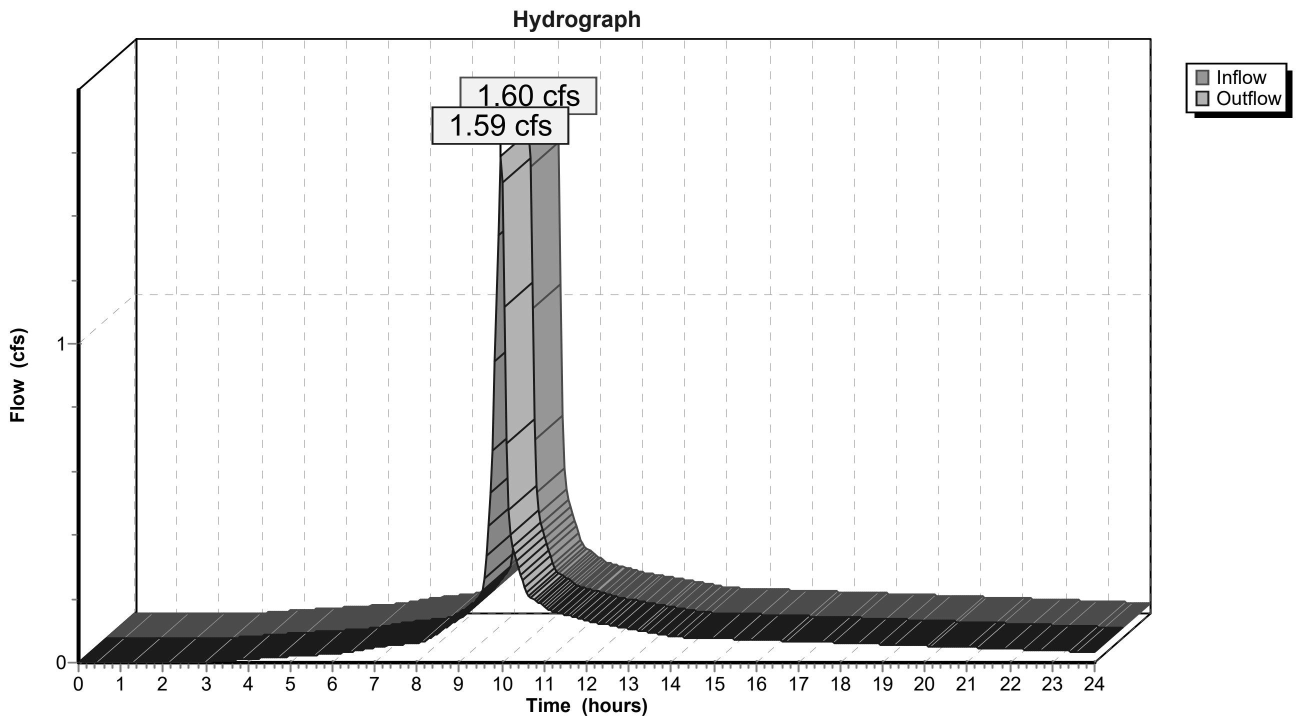
Reach 1R: Phase 2 pipe

Inflow Area = 1.170 ac, Inflow Depth = 1.67"
Inflow = 1.60 cfs @ 9.96 hrs, Volume= 0.163 af
Outflow = 1.59 cfs @ 9.96 hrs, Volume= 0.163 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.0 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.5 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.48'
Capacity at bank full= 1.85 cfs
8.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0200 '/'

Reach 1R: Phase 2 pipe



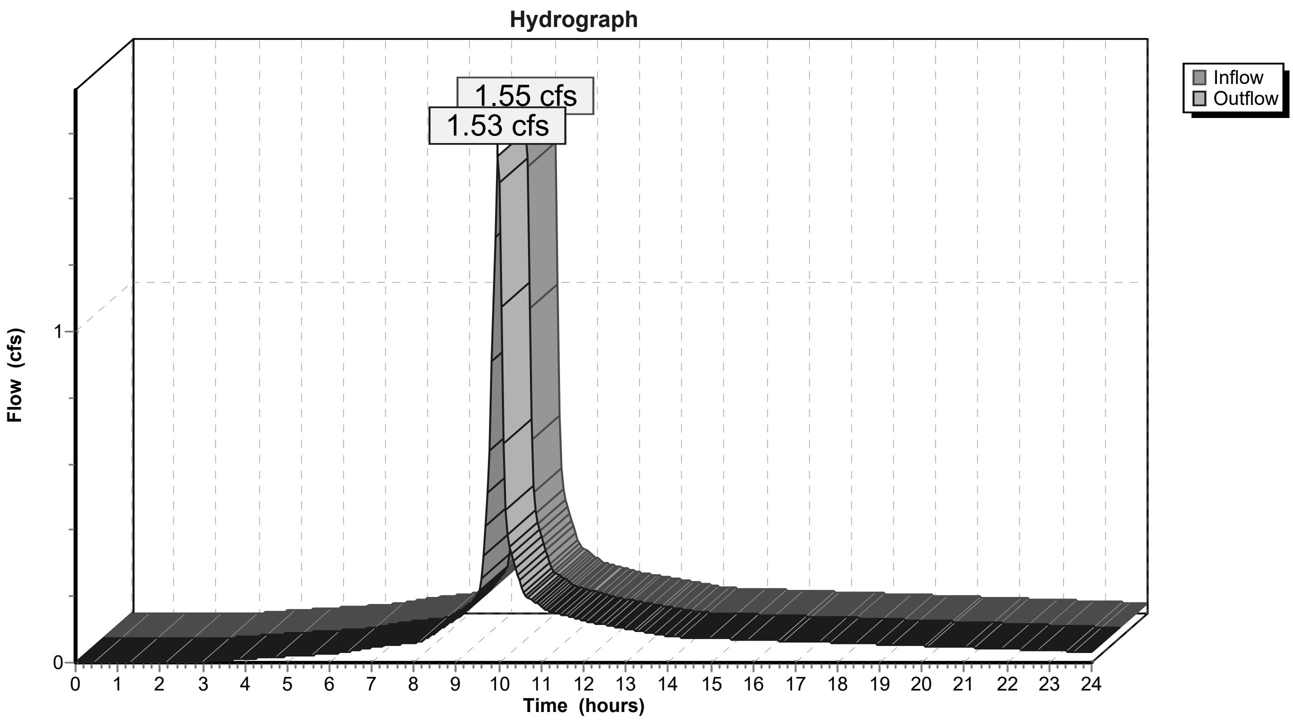
Reach 2R: Phase 3 Pipe

Inflow Area = 1.128 ac, Inflow Depth = 1.67"
Inflow = 1.55 cfs @ 9.96 hrs, Volume= 0.157 af
Outflow = 1.53 cfs @ 9.96 hrs, Volume= 0.157 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.9 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.5 fps, Avg. Travel Time= 0.7 min

Peak Depth= 0.46'
Capacity at bank full= 1.85 cfs
8.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0200 '/'

Reach 2R: Phase 3 Pipe



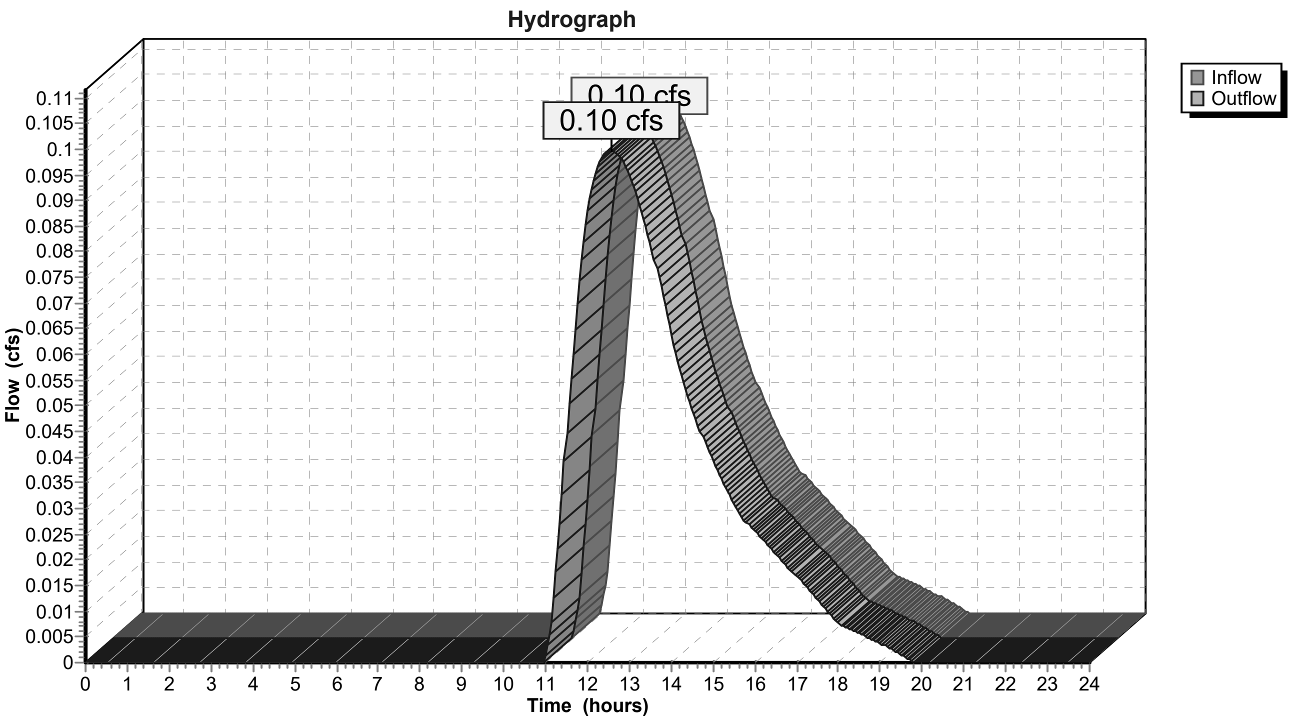
Reach 3R: (new Reach)

Inflow Area = 2.298 ac, Inflow Depth = 0.15"
Inflow = 0.10 cfs @ 12.56 hrs, Volume= 0.028 af
Outflow = 0.10 cfs @ 12.56 hrs, Volume= 0.028 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.5 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.7 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.12'
Capacity at bank full= 1.51 cfs
8.0" Diameter Pipe n= 0.012 Length= 15.0' Slope= 0.0133 '/'

Reach 3R: (new Reach)



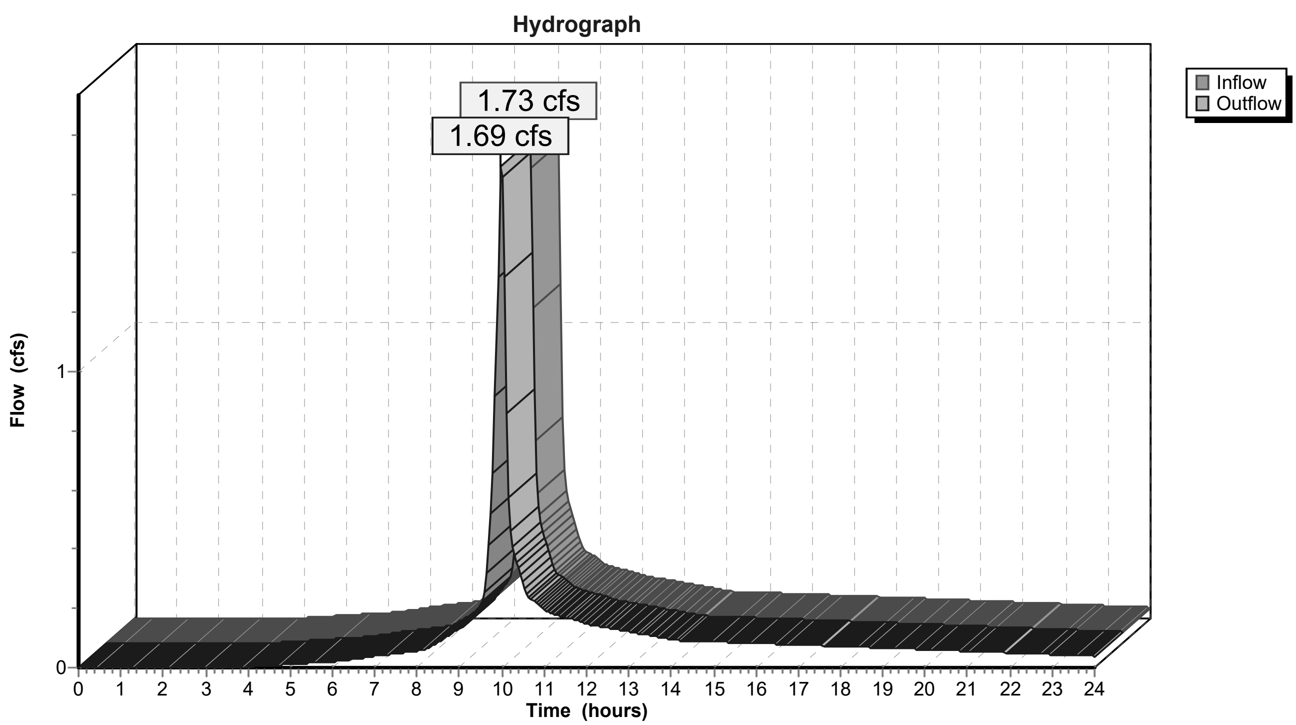
Reach 4R: 12" Pipe

Inflow Area = 1.402 ac, Inflow Depth = 1.50"
Inflow = 1.73 cfs @ 9.96 hrs, Volume= 0.175 af
Outflow = 1.69 cfs @ 9.98 hrs, Volume= 0.175 af, Atten= 2%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.0 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.3 fps, Avg. Travel Time= 1.6 min

Peak Depth= 0.68'
Capacity at bank full= 2.11 cfs
12.0" Diameter Pipe n= 0.012 Length= 117.0' Slope= 0.0030 '/'

Reach 4R: 12" Pipe



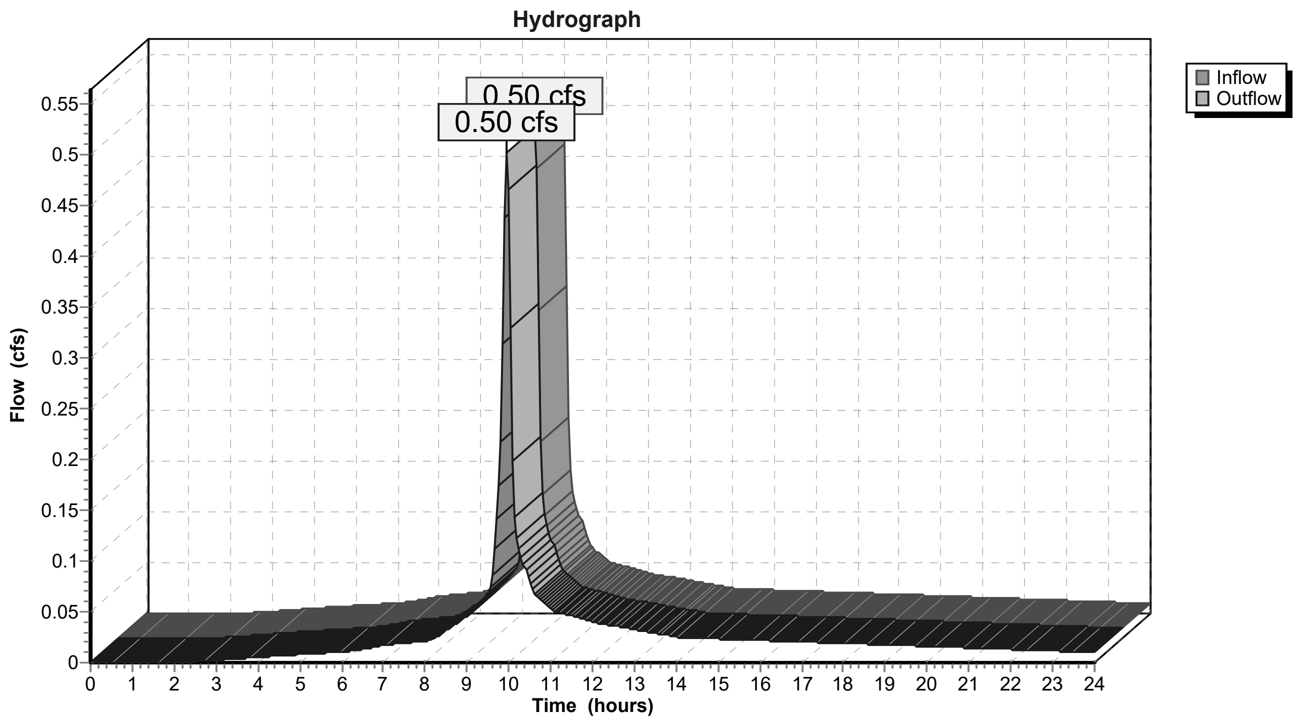
Reach 5R: New Pipe

Inflow Area = 0.351 ac, Inflow Depth = 1.77"
Inflow = 0.50 cfs @ 9.95 hrs, Volume= 0.052 af
Outflow = 0.50 cfs @ 9.96 hrs, Volume= 0.052 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.5 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.4 fps, Avg. Travel Time= 0.2 min

Peak Depth= 0.28'
Capacity at bank full= 1.33 cfs
8.0" Diameter Pipe n= 0.012 Length= 16.5' Slope= 0.0103 '/'

Reach 5R: New Pipe



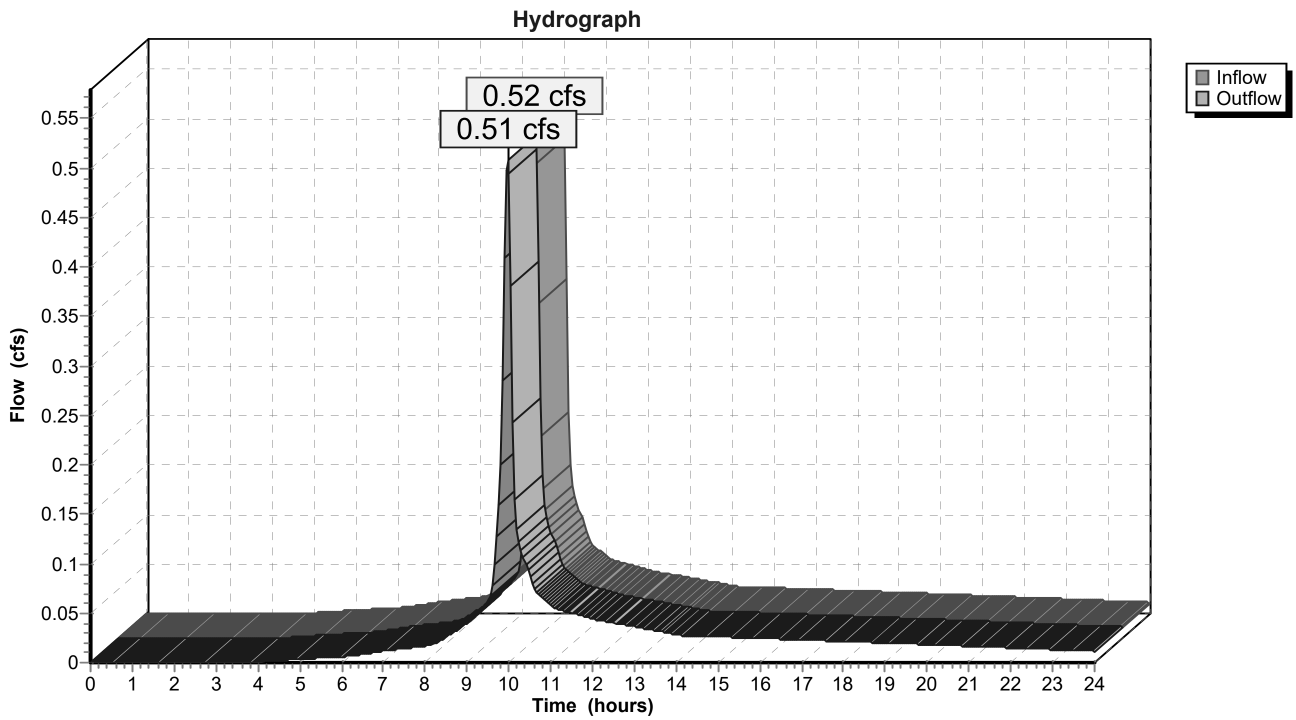
Reach 6R: New Pipe

Inflow Area = 0.420 ac, Inflow Depth = 1.50"
Inflow = 0.52 cfs @ 9.96 hrs, Volume= 0.052 af
Outflow = 0.51 cfs @ 9.97 hrs, Volume= 0.052 af, Atten= 2%, Lag= 0.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.5 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.5 fps, Avg. Travel Time= 1.1 min

Peak Depth= 0.35'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0100 '/'

Reach 6R: New Pipe



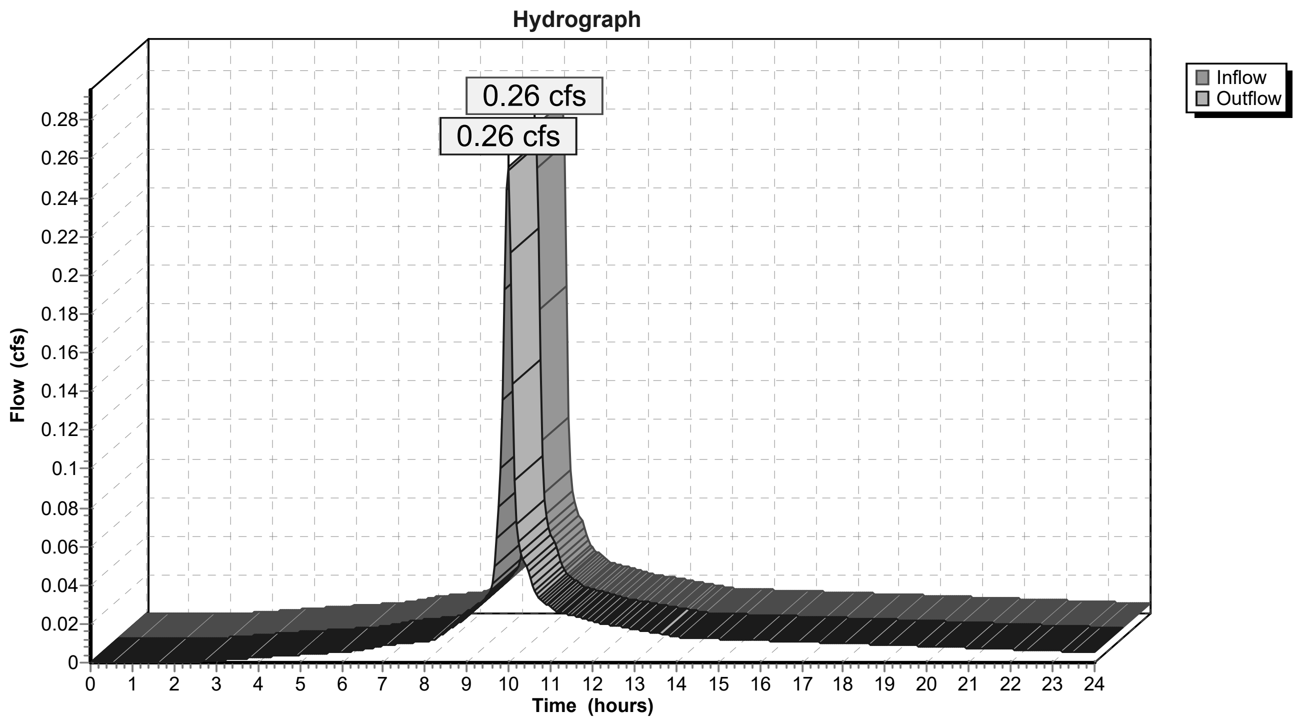
Reach 7R: Existing Pipe

Inflow Area =	0.184 ac,	Inflow Depth = 1.77"			
Inflow =	0.26 cfs @	9.95 hrs,	Volume=	0.027 af	
Outflow =	0.26 cfs @	9.98 hrs,	Volume=	0.027 af,	Atten= 3%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.9 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.1 fps, Avg. Travel Time= 2.6 min

Peak Depth= 0.20'
Capacity at bank full= 1.31 cfs
8.0" Diameter Pipe n= 0.012 Length= 180.0' Slope= 0.0100 '/'

Reach 7R: Existing Pipe



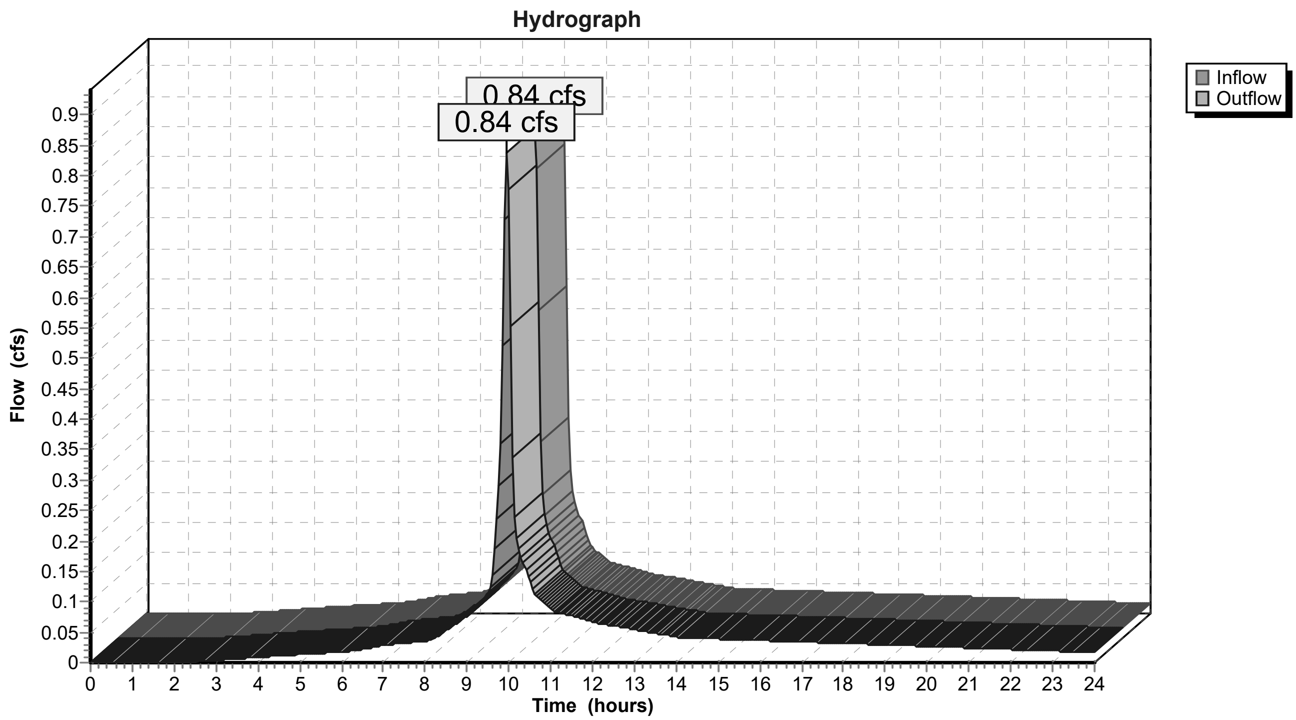
Reach 8R: New Pipe

Inflow Area = 0.585 ac, Inflow Depth = 1.77"
Inflow = 0.84 cfs @ 9.95 hrs, Volume= 0.086 af
Outflow = 0.84 cfs @ 9.96 hrs, Volume= 0.086 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.0 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.6 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.39'
Capacity at bank full= 1.31 cfs
8.0" Diameter Pipe n= 0.012 Length= 25.0' Slope= 0.0100 '/'

Reach 8R: New Pipe



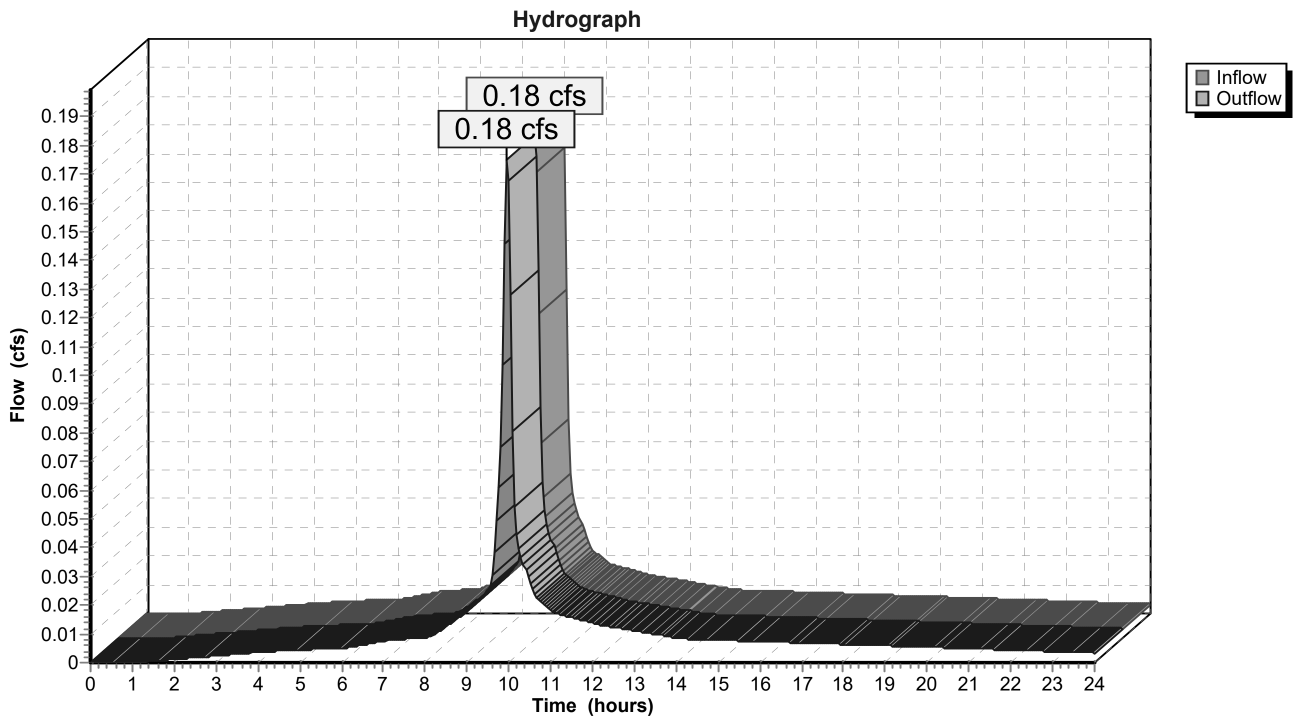
Reach 9R: Roof Drain Pipe

Inflow Area = 0.115 ac, Inflow Depth = 1.97"
Inflow = 0.18 cfs @ 9.95 hrs, Volume= 0.019 af
Outflow = 0.18 cfs @ 9.97 hrs, Volume= 0.019 af, Atten= 2%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 1.3 min

Peak Depth= 0.19'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 80.0' Slope= 0.0100 '/'

Reach 9R: Roof Drain Pipe



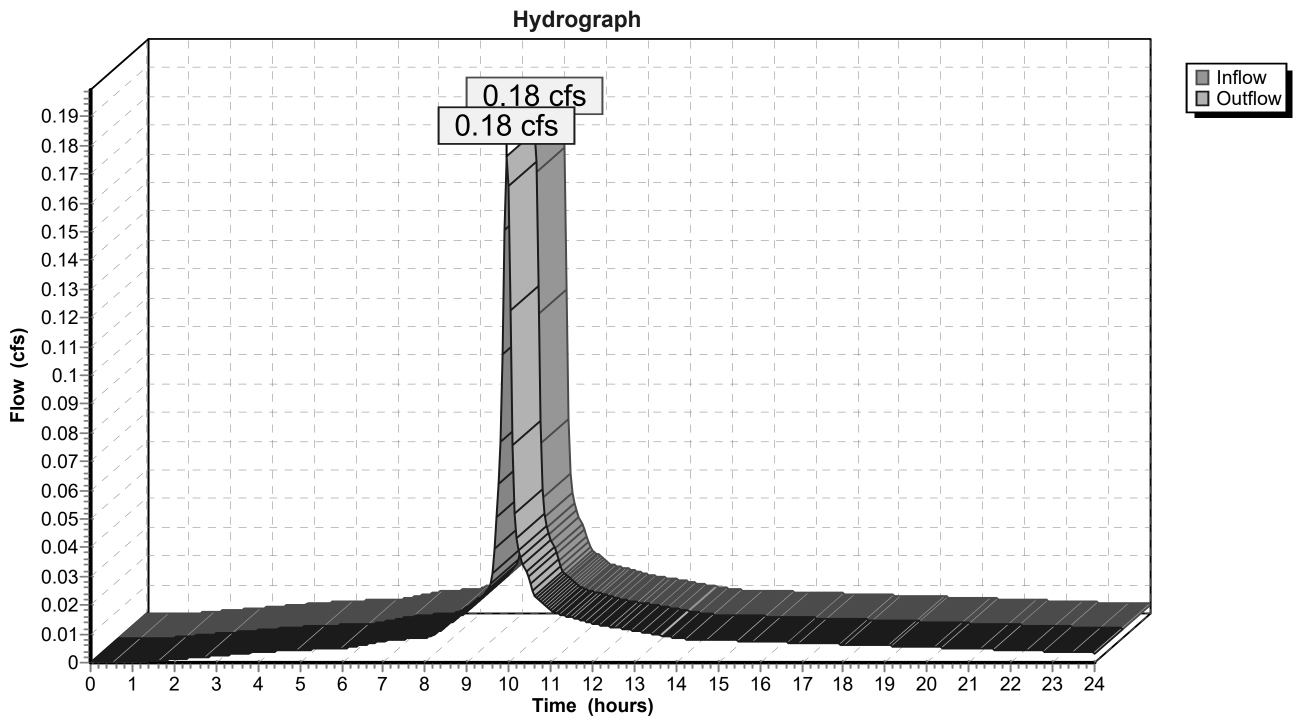
Reach 10R: Roof Drain Pipe

Inflow Area = 0.115 ac, Inflow Depth = 1.97"
Inflow = 0.18 cfs @ 9.95 hrs, Volume= 0.019 af
Outflow = 0.18 cfs @ 9.96 hrs, Volume= 0.019 af, Atten= 1%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.7 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.0 fps, Avg. Travel Time= 0.8 min

Peak Depth= 0.19'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 50.0' Slope= 0.0100 '/'

Reach 10R: Roof Drain Pipe



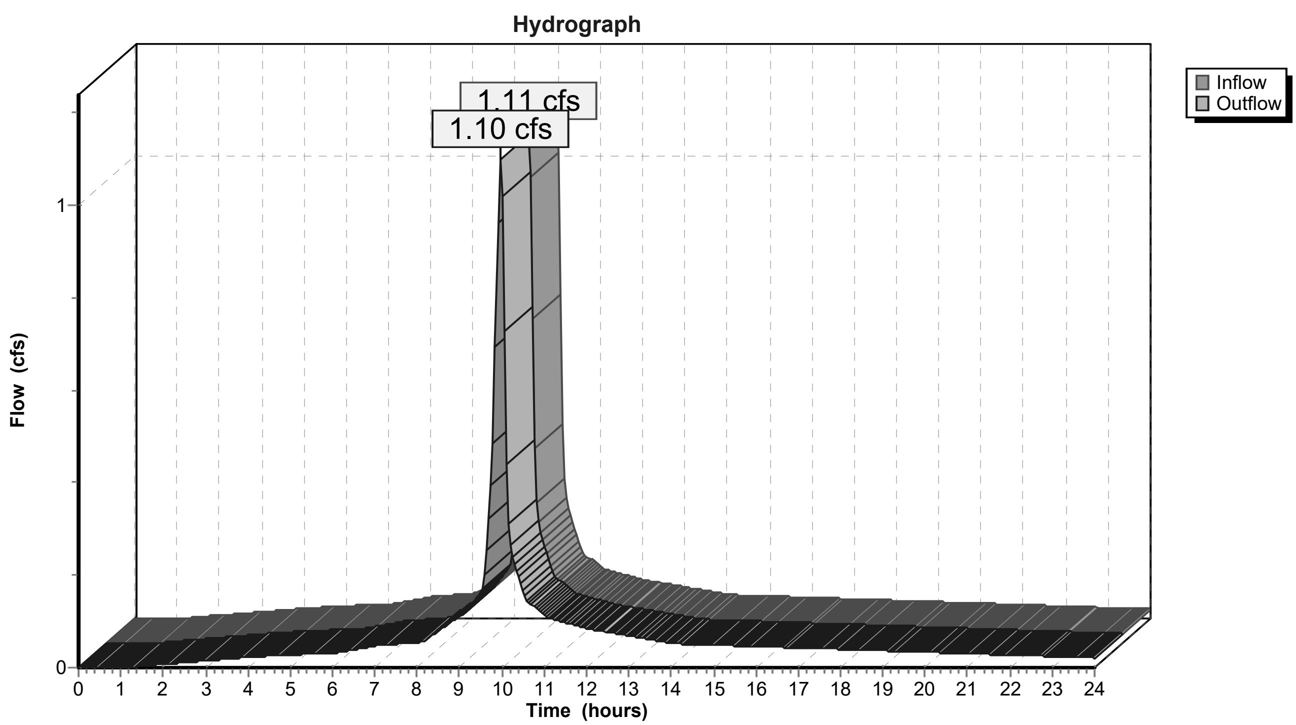
Reach 11R: Roof Drain Pipe

Inflow Area = 0.713 ac, Inflow Depth = 1.97"
Inflow = 1.11 cfs @ 9.95 hrs, Volume= 0.117 af
Outflow = 1.10 cfs @ 9.96 hrs, Volume= 0.117 af, Atten= 1%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.2 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.7 fps, Avg. Travel Time= 0.3 min

Peak Depth= 0.47'
Capacity at bank full= 1.31 cfs
8.0" Diameter Pipe n= 0.012 Length= 35.0' Slope= 0.0100 '/'

Reach 11R: Roof Drain Pipe



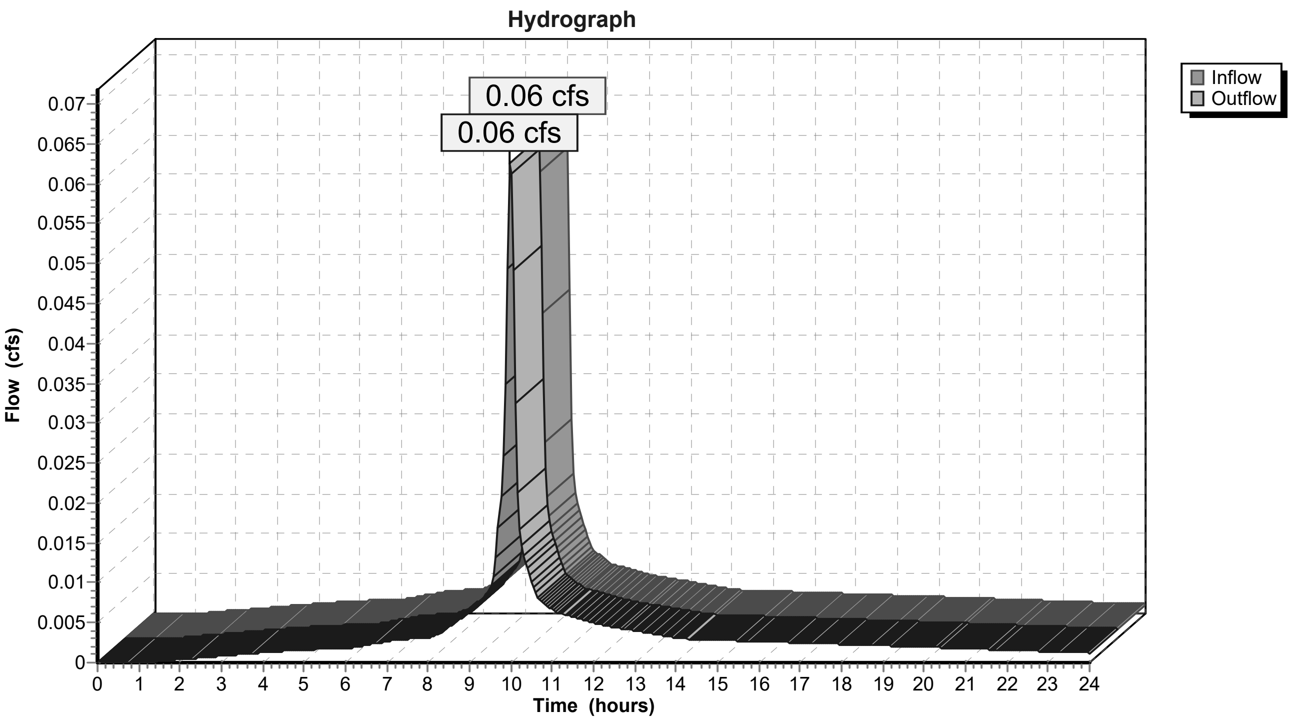
Reach 12R: Roof Drain Pipe

Inflow Area = 0.041 ac, Inflow Depth = 1.97"
Inflow = 0.06 cfs @ 9.95 hrs, Volume= 0.007 af
Outflow = 0.06 cfs @ 9.98 hrs, Volume= 0.007 af, Atten= 3%, Lag= 1.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.0 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 0.8 fps, Avg. Travel Time= 2.2 min

Peak Depth= 0.11'
Capacity at bank full= 0.61 cfs
6.0" Diameter Pipe n= 0.012 Length= 100.0' Slope= 0.0100 '/'

Reach 12R: Roof Drain Pipe



Pond 1P: Phase 2 Pond plus Expansion Area

Inflow Area =	2.298 ac,	Inflow Depth = 1.67"			
Inflow =	3.11 cfs @	9.96 hrs,	Volume=	0.320 af	
Outflow =	0.23 cfs @	12.56 hrs,	Volume=	0.220 af,	Atten= 93%, Lag= 155.6 min
Discarded =	0.13 cfs @	8.35 hrs,	Volume=	0.192 af	
Primary =	0.10 cfs @	12.56 hrs,	Volume=	0.028 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 3.89' Storage= 5,544 cf
Plug-Flow detention time= 289.5 min calculated for 0.220 af (69% of inflow)

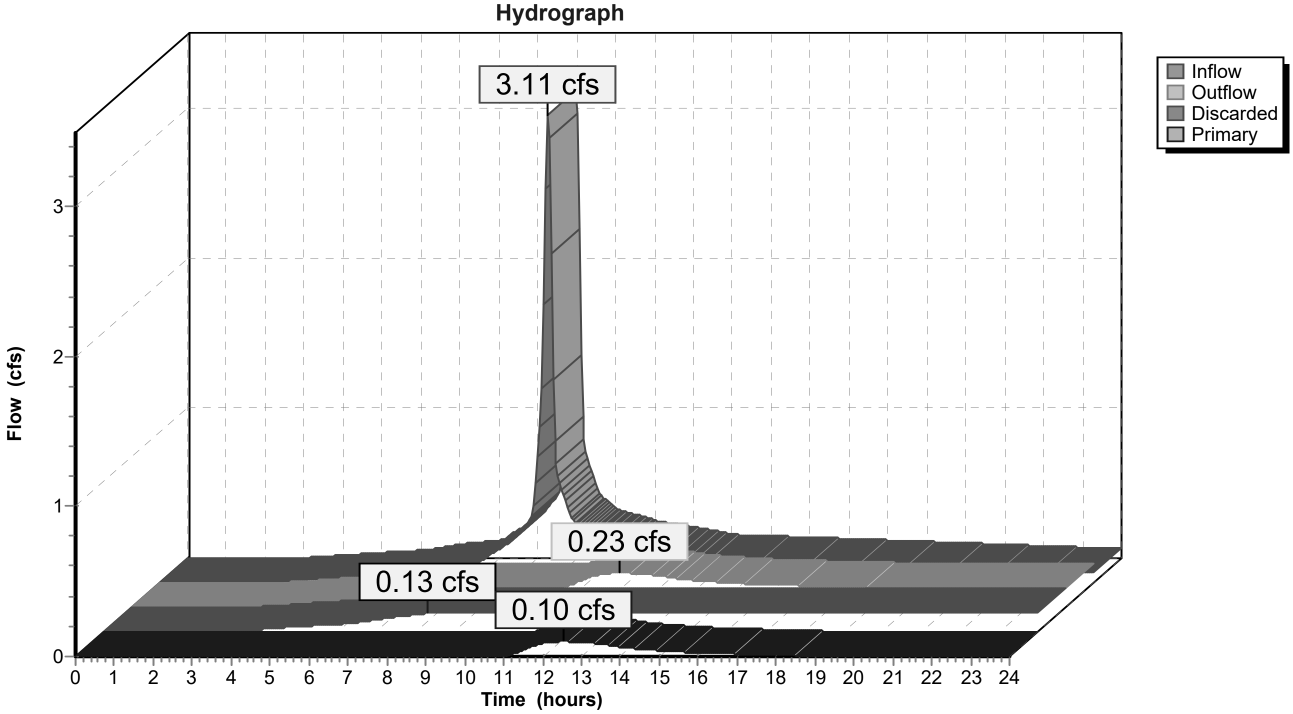
Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	2,593
3.50	4,538
5.00	8,378

Discarded OutFlow Max=0.13 cfs @ 8.35 hrs HW=0.10' (Free Discharge)
└─**1=Infiltration** (Controls 0.13 cfs)

Primary OutFlow Max=0.10 cfs @ 12.56 hrs HW=3.89' (Free Discharge)
└─**2=Culvert** (Controls 0.10 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.13 0.13
2	Primary	3.70'	**8.0" x 15.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 3.50' S= 0.0133 '/' n= 0.012 Cc= 0.900

Pond 1P: Phase 2 Pond plus Expansion Area



Pond 2P: (new Pond)

Inflow Area =	3.700 ac, Inflow Depth = 0.66"		
Inflow =	1.69 cfs @	9.98 hrs, Volume=	0.203 af
Outflow =	0.16 cfs @	9.50 hrs, Volume=	0.202 af, Atten= 91%, Lag= 0.0 min
Primary =	0.16 cfs @	9.50 hrs, Volume=	0.202 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

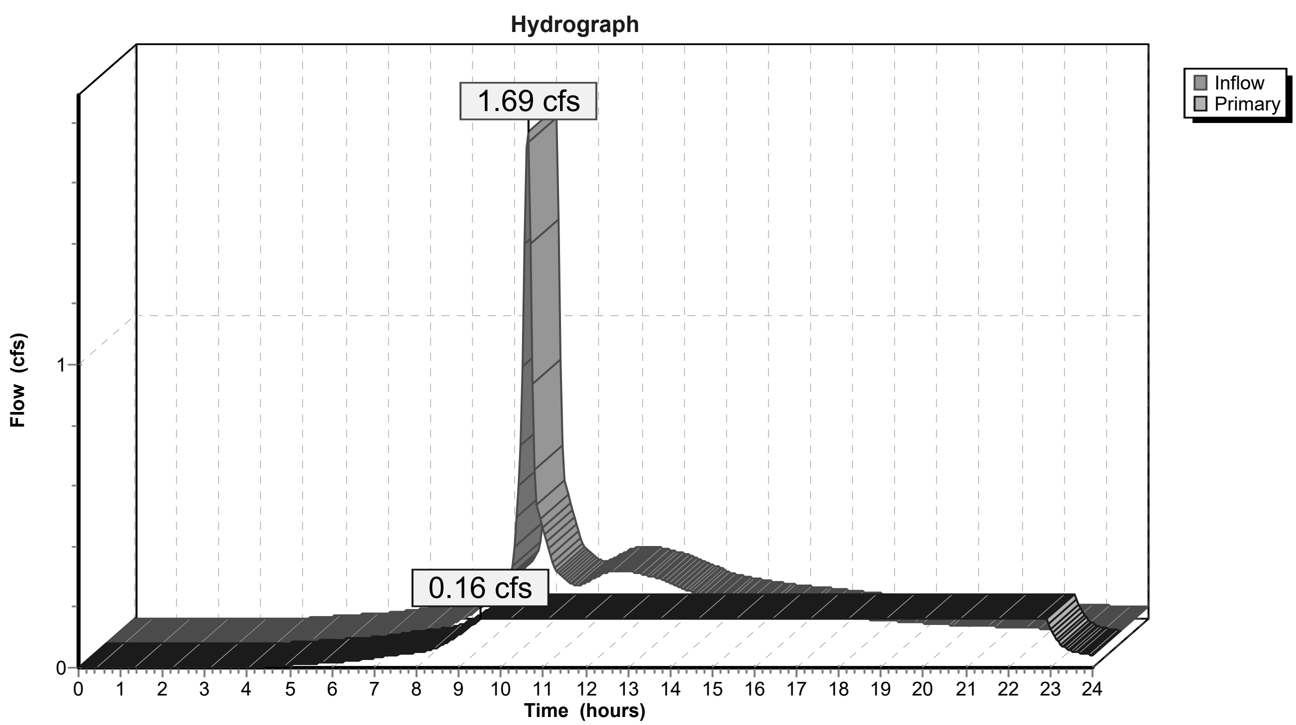
Peak Elev= 1.64' Storage= 2,643 cf
Plug-Flow detention time= 166.7 min calculated for 0.202 af (100% of inflow)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	3,220
3.50	5,635
5.00	10,615

Primary OutFlow Max=0.16 cfs @ 9.50 hrs HW=0.11' (Free Discharge)
└─**1=Special (user-defined)** (Controls 0.16 cfs)

#	Routing	Invert	Outlet Devices
1	Primary	0.00'	**Special (user-defined)** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.16 0.16

Pond 2P: (new Pond)



Pond 3P: New Pond NE Corner of Site

Inflow Area =	0.771 ac,	Inflow Depth = 1.62"		
Inflow =	1.01 cfs @	9.96 hrs,	Volume=	0.104 af
Outflow =	0.05 cfs @	8.60 hrs,	Volume=	0.072 af, Atten= 95%, Lag= 0.0 min
Discarded =	0.05 cfs @	8.60 hrs,	Volume=	0.072 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

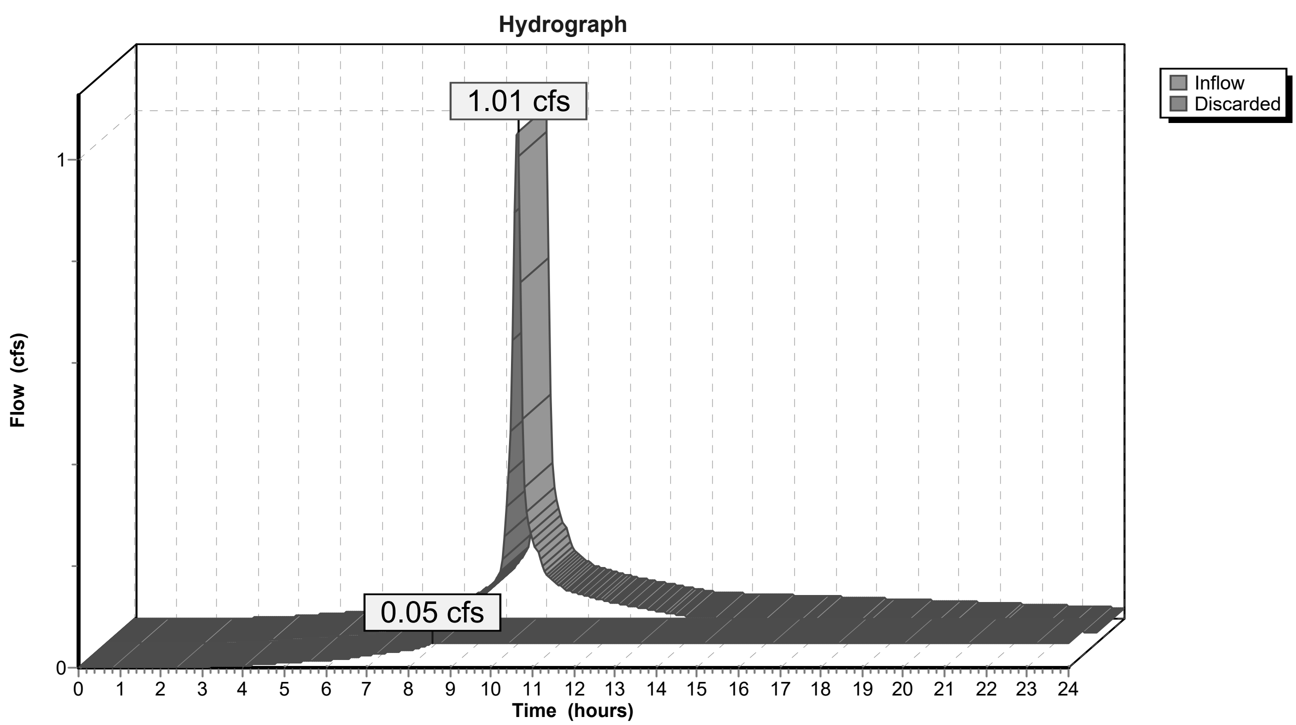
Peak Elev= 3.40' Storage= 1,877 cf
Plug-Flow detention time= 309.3 min calculated for 0.072 af (69% of inflow)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	1,105
3.50	1,934
5.00	3,696

Discarded OutFlow Max=0.05 cfs @ 8.60 hrs HW=0.10' (Free Discharge)
└─**1=Infiltration** (Controls 0.05 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.05 0.05

Pond 3P: New Pond NE Corner of Site



Pond 4P: Pond Back of Stores

Inflow Area = 0.769 ac, Inflow Depth = 1.77"
Inflow = 1.09 cfs @ 9.96 hrs, Volume= 0.113 af
Outflow = 0.04 cfs @ 7.60 hrs, Volume= 0.061 af, Atten= 96%, Lag= 0.0 min
Discarded = 0.04 cfs @ 7.60 hrs, Volume= 0.061 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

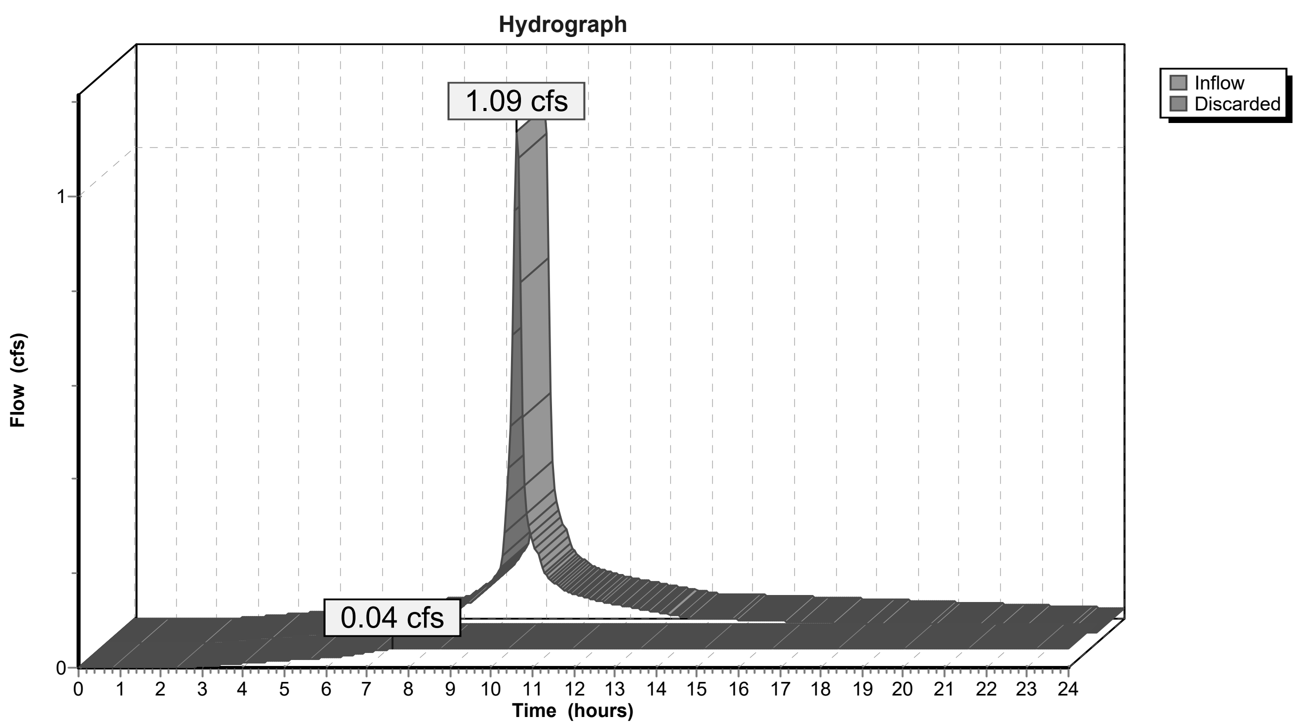
Peak Elev= 4.82' Storage= 2,430 cf
Plug-Flow detention time= 323.1 min calculated for 0.061 af (54% of inflow)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
2.00	736
3.50	1,288
5.00	2,585

Discarded OutFlow Max=0.04 cfs @ 7.60 hrs HW=0.10' (Free Discharge)
└─**1=Infiltration** (Controls 0.04 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 5.00 Disch. (cfs) 0.00 0.04 0.04

Pond 4P: Pond Back of Stores



Pond DW1: Existing Drywell at Maurices

Inflow Area = 0.230 ac, Inflow Depth = 1.97"
Inflow = 0.35 cfs @ 9.96 hrs, Volume= 0.038 af
Outflow = 0.32 cfs @ 10.05 hrs, Volume= 0.036 af, Atten= 8%, Lag= 5.4 min
Discarded = 0.03 cfs @ 10.05 hrs, Volume= 0.032 af
Secondary = 0.29 cfs @ 10.05 hrs, Volume= 0.004 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 8.38' Storage= 407 cf
Plug-Flow detention time= 141.2 min calculated for 0.036 af (96% of inflow)

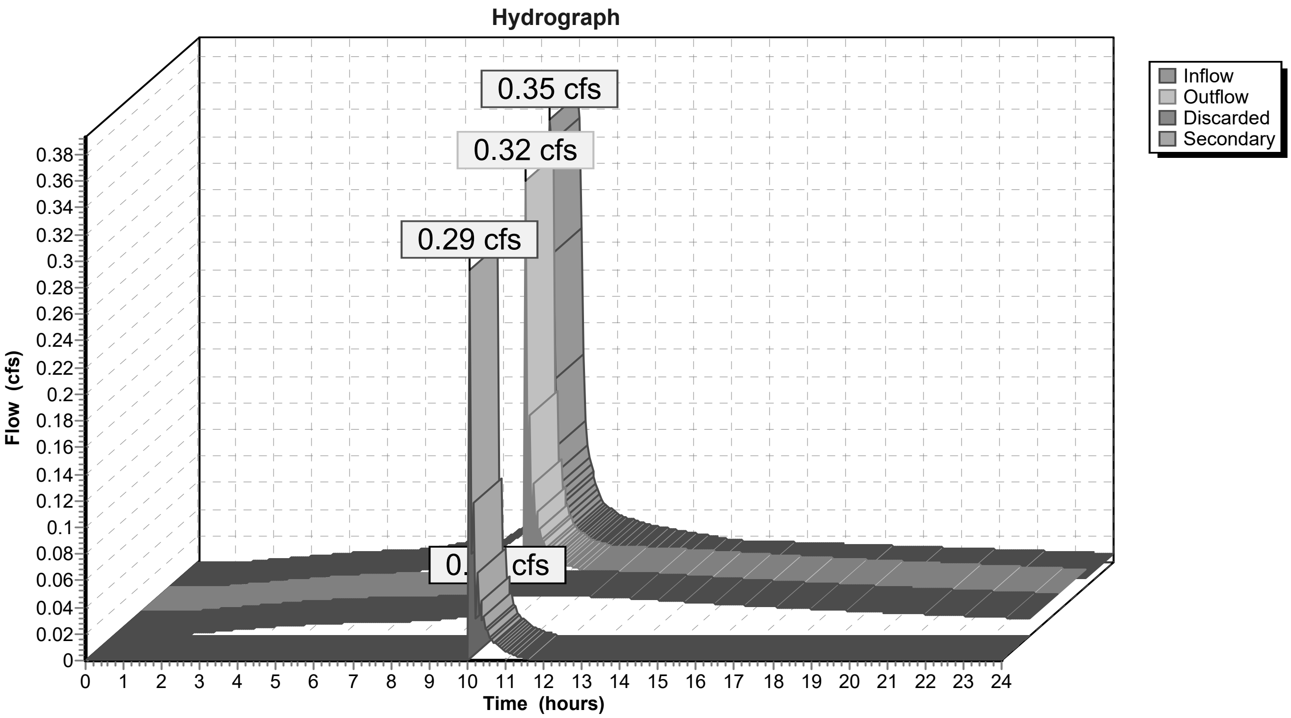
Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
8.00	402
12.00	452

Discarded OutFlow Max=0.03 cfs @ 10.05 hrs HW=8.35' (Free Discharge)
└─**1=Infiltration** (Controls 0.03 cfs)

Secondary OutFlow Max=0.27 cfs @ 10.05 hrs HW=8.33' (Free Discharge)
└─**2=Orifice/Grate** (Controls 0.27 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 8.00 12.00 Disch. (cfs) 0.00 0.01 0.03 0.03
2	Secondary	8.00'	**6.0" Vert. Orifice/Grate** C= 0.600

Pond DW1: Existing Drywell at Maurices



Pond DW2: New Drywell

Inflow Area =	0.754 ac, Inflow Depth = 2.03"		
Inflow =	1.16 cfs @ 9.96 hrs, Volume=	0.128 af	
Outflow =	0.05 cfs @ 15.94 hrs, Volume=	0.072 af,	Atten= 96%, Lag= 358.7 min
Discarded =	0.05 cfs @ 15.94 hrs, Volume=	0.072 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 9.29' Storage= 2,788 cf
Plug-Flow detention time= 340.3 min calculated for 0.072 af (56% of inflow)

Elevation (feet)	Cum.Store (cubic-feet)
0.00	0
10.00	3,001
15.00	3,064

Discarded OutFlow Max=0.05 cfs @ 15.94 hrs HW=9.29' (Free Discharge)
└─**1=Infiltration** (Controls 0.05 cfs)

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**Infiltration** Elev. (feet) 0.00 0.10 10.00 15.00 Disch. (cfs) 0.00 0.03 0.05 0.05

Pond DW2: New Drywell