



PRELIMINARY TECHNICAL INFORMATION REPORT

Manning Meadows La Center, Washington

Prepared by:

**PLS Engineering
Consulting Engineers and Planners
604 W Evergreen Blvd
Vancouver, WA 98660
(360) 944-6519
pm@plsengineering.com**

Prepared for:

**LGI Homes
Ian McGrady
700 Washington Street, Suite 200
Vancouver, WA 98660
(509)998-6814
Ian.mcgrady-beach@lgihomes.com**

Submitted: June 24th 2025

TABLE OF CONTENTS

CERTIFICATE OF ENGINEER.....	1
SECTION A – PROJECT OVERVIEW	2
SECTION B – MINIMUM REQUIREMENTS.....	3
SECTION C – CONVEYANCE SYSTEMS ANALYSIS AND DESIGN	4
SECTION D – ADDITIONAL REQUIRMENTS	6

TECHNICAL APPENDICES:

Appendix A: Maps

- **Vicinity Map**
- **Soils Map**
- **Floodplains – N/A**
- **Shoreline Management Areas – N/A**
- **Critical Aquifer Recharge Areas – N/A**

Appendix B: Maintenance and Operations Manual

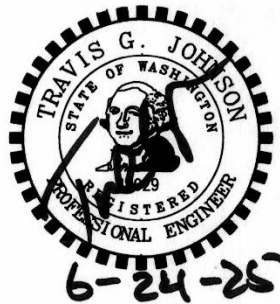
Appendix C: Geotech Report

Appendix D: Technical Data

CERTIFICATE OF ENGINEER

Manning Meadows Subdivision *Technical Information Report*

The technical information and data contained in this report was prepared under the direction and supervision of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below. This TIR meets the minimum requirements of CCC 40.386.



This document was
prepared by:

Victoriya Polishchuk
Victoriya Polishchuk, E.I.T

Section A – Project Overview

Section A.1 – Site Information

The proposed site is identified as parcel number 209048000 and is addressed as 1819 NE 339th Street, La Center, Washington, 98629. Located within the Northeast ¼ of Section 2, Township 4 North, Range 1 East of the Willamette Meridian. The parcel is approximately 11.60 acres however, including frontage improvements along NE 339th Street, approximately 12.06 acres will be disturbed during development. The applicant is proposing to rezone the site from LDR-7.5 to MDR-16. The subject property is bordered to the east and south by LDR-7.5 zoning and a school borders the west. The site will be accessed via NE 339th Street, classified as a major collector, running along the northern border of the parcel.

The property slopes downwards from the northeast to the southwest with slopes between 0% and 20%. Elevations range from 283' to 192'. There is currently a single-family home on the site. All proposed construction will take place on slopes ranging from 5-20% and will not increase the risk of unstable slopes on or adjacent to the site. Stormwater runoff from the site discharges towards to the southwest corner of the site and disperses into native vegetation.

The soil onsite has been mapped as GeB – Gee Silt Loam, 0 to 8% slopes and GeD – Gee Silt Loam, 8 to 20% slopes. A map of the areas has been included in Appendix A. Based on the geotechnical report prepared by Columbia West Engineering, Inc., infiltration on site is not feasible, a detention pond is proposed to store and pipe the stormwater toward the pre-developed stormwater discharge location.

This project proposes a total of 176,400 square feet of roof area, 42,000 square feet of driveway area, 152,637 square feet of impervious roadway and sidewalk area and 214,131 square feet of landscaping area.

On January 16th, 2025 Columbia West submitted a report with the soil conditions for the site. Infiltration was deemed not feasible, and the groundwater was determined to be perched (see Appendix C). Due to the infeasibility of infiltration on site, the development is proposing a combination of a wet pond and detention pond to treat and detain stormwater and then be outfallled at predeveloped rates back to the natural discharge point. Treatment catch basins by Contech will collect the runoff to treat the stormwater from pollution generating surfaces before the stormwater makes its way to the detention facility.

This TIR shall serve as the drainage plan for the lot. The applicant shall follow the plan as shown on the Stormwater Plan.

Section A.2 – Determination of Applicable Minimum Requirements

The site is a new development and results in more than 5,000 square feet of new and replaced hard surfaces, thus, Minimum Requirements #1 - #9 apply.

Existing hard surface	0 ft ²
New hard surface	371,037 ft ²
Replaced hard surface	0 ft ²
Native vegetation converted to lawn or landscaping	3.55 ac
Native vegetation converted to pasture	0 ft ²
Total land-disturbing activity	12.06 acre (525,551 ft ²)
Pollution-generating hard surface	194,637 ft ²
Pollution-generating pervious surface	0 ft ²
Total pollution-generating surfaces	194,637 ft ²
Total non-pollution-generating surfaces	176,400 ft ²

Section B – Minimum Requirements

Minimum Requirement 1: Preparation of Stormwater Site Plans

The information provided in this report, together with the associated drawings, satisfies the Cities Preparation of Stormwater Site Plans requirement. The preliminary submittal includes a Preliminary Development Plan, this Preliminary TIR, and a Stormwater Pollution Prevention Plan (SWPPP). The proposed site development will retain native vegetation and minimize the amount of new impervious surfaces.

Minimum Requirement 2: Construction Stormwater Pollution Prevention

A Stormwater Pollution Prevention Plan for this project will be provided with this report.

Minimum Requirement 3: Source Control of Pollution

A Stormwater Pollution Prevention Plan and Erosion Control Plan will be provided with this report. Both will provide for the short-term protection of the site and downstream areas from potential pollutants associated with the construction project. There are no long-term pollution risks associated with the project that necessitates a separate source control plan. Operation source control BMPs must be in accordance with Volume IV of the Stormwater Management Manual of Western Washington.

Minimum Requirement 4: Preservation of Natural Drainage Systems and Outfalls

The Stormwater Management Manual for Western Washington requires that natural drainage patterns be maintained and discharges from the project site shall occur at the natural location, to the maximum extent practicable. It also requires that the manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down-gradient properties. The site currently outfalls to a collector ditch on the southwest side of the property. The proposed project will maintain current drainage patterns and discharge locations. A flow control structure releasing stormwater at predeveloped rates will make sure downstream properties will not be adversely impacted by the proposed project. Stormwater modeling will show that all runoff area from the proposed development will be detained by the designed detention facility (see Minimum

Requirement 6). The result is that the capacity of the downstream drainage system will not be noticeably impacted, and water quality will be protected.

Minimum Requirement 5: On-site Stormwater Management

Minimum Requirement 5 requires the applicant to employ On-site Stormwater Management BMPs in accordance with the following project thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on-site to the maximum extent feasible without causing flooding or erosion impacts. The runoff from the entire site is planned to be routed and detained to a detention pond and then discharge into the native vegetation at the natural discharge point at predeveloped rates through a flow control manhole.

BMP T5.13 Post-Construction Soil Quality and Depth will be utilized for the landscape areas.

Minimum Requirement 6: Runoff Treatment Analysis and Design

Stormwater runoff will first be directed to a wet pond (BMP T10.10), where in stormwater will pond in order to settle particulate pollutants. The wet pond model can be found in Appendix D showing the elevation at which the WQ is needed.

Minimum Requirement 7: Flow Control Analysis and Design

Once treated in the wetpond, the stormwater will begin to detain, once detained, the outflow will be routed to a flow control manhole which will match predeveloped rates and route the stormwater to the southwest corner of the site and outflow to the natural vegetation. See Appendix D for detention pond outflow structure sizing.

Minimum Requirement 8: Wetlands Protection

No wetlands are present on site.

Minimum Requirement 9: Operations and Maintenance

See Appendix B for details and maintenance of the proposed stormwater facilities.

Section C – Conveyance Systems Analysis and Design

Conveyance calculation will be provided with Final Construction Submittal.

Section D – Additional Requirements

Section D.1 – Off-site Analysis

Off-site analysis can be provided during Final Construction Submittal.

Section D.2 – Closed Depression Analysis

There is no closed depression analysis required for this site.

Section D.3 – Other Permits

This project will require final engineering approval and final building permits.

Section D.4 – Approval Conditions Summary

There are currently no preliminary conditions for this project.

Section D.5 – Special Reports and Studies

No special reports needed at this time.

APPENDIX A

Maps



Figure A.1 Vicinity Map



Figure A.2 Soils Map: Natural Resources Conservation Service (NRCS) Web Soil Survey
 **Outlined Area of Interest (AOI) is an estimate of property boundary

Map Unit Legend:

GeB	(Gee silt loam, 0-8% Slopes):	28.3%
GeD	(Gee silt loam, 8-20% Slopes):	71.7%

APPENDIX B

Maintenance and Operations Manual

can cause air pollution include grain dust, sawdust, coal, gravel, crushed rock, cement, and boiler fly ash. Air emissions can contaminate stormwater. The objective of this BMP is to reduce the stormwater pollutants caused by dust generation and control.

Pollutant Control Approach: Prevent dust generation and emissions where feasible, regularly clean-up dust that can contaminate stormwater, and convey dust contaminated stormwater to proper treatment.

Applicable BMPs:

- Clean, as needed, powder material handling equipment and vehicles.
- Regularly sweep dust accumulation areas that can contaminate stormwater. Conduct sweeping using vacuum filter equipment to minimize dust generation and to ensure optimal dust removal.
- Use dust filtration/collection systems such as baghouse filters, cyclone separators, etc. to control vented dust emissions that could contaminate stormwater. Control of zinc dusts in rubber production is one example.
- Maintain on-site controls to prevent vehicle track-out.
- Maintain dust collection devices on a regular basis.

Recommended BMPs:

- In manufacturing operations, train employees to handle powders carefully to prevent generation of dust.
- Use water spray to flush dust accumulations to sanitary sewers where allowed by the local sewer authority or to other appropriate treatment system.
- Use approved dust suppressants such as those listed in *Methods for Dust Control* (Ecology, 2016b). Application of some products may not be appropriate in close proximity to receiving waters or conveyances close to receiving waters. For more information check with Ecology or the local jurisdiction.

Recommended Treatment BMPs

Install sedimentation basins, wet ponds, wet vaults, catch basin filters, vegetated filter strips, or equivalent sediment removal BMPs.

S411 BMPs for Landscaping and Lawn / Vegetation Management

Description of Pollutant Sources: Landscaping can include grading, soil transfer, vegetation planting, and vegetation removal. Examples include weed control on golf course lawns, access roads, and utility corridors and during landscaping; and residential lawn/plant care. Proper management of vegetation can minimize excess nutrients and pesticides.

Pollutant Control Approach: Maintain appropriate vegetation to control erosion and the discharge of stormwater pollutants. Prevent debris contamination of stormwater. Where practicable, grow plant species appropriate for the site, or adjust the soil properties of the site to grow desired plant species.

Applicable BMPs:

- Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas.
- Select the right plants for the planting location based on proposed use, available maintenance, soil conditions, sun exposure, water availability, height, sight factors, and space available.
- Ensure that plants selected for planting are not on the noxious weed list. For example, butterfly bush often gets planted as an ornamental but is actually on the noxious weed list.

The Washington State Noxious Weed List can be found at the following webpage:

<https://www.nwcb.wa.gov/printable-noxious-weed-list>

- Do not dispose of collected vegetation into waterways or storm sewer systems.
- Do not blow vegetation or other debris into the drainage system.
- Dispose of collected vegetation such as grass clippings, leaves, sticks by composting or recycling.
- Remove, bag, and dispose of class A & B noxious weeds in the garbage immediately.
- Do not compost noxious weeds as it may lead to spreading through seed or fragment if the composting process is not hot enough.
- Use manual and/or mechanical methods of vegetation removal (pincer-type weeding tools, flame weeders, or hot water weeders as appropriate) rather than applying herbicides, where practical.
- Use at least an eight-inch "topsoil" layer with at least 8 percent organic matter to provide a sufficient vegetation-growing medium.
 - Organic matter is the least water-soluble form of nutrients that can be added to the soil. Composted organic matter generally releases only between 2 and 10 percent of its total nitrogen annually, and this release corresponds closely to the plant growth cycle. Return natural plant debris and mulch to the soil, to continue recycling nutrients indefinitely.
- Select the appropriate turfgrass mixture for the climate and soil type.
 - Certain tall fescues and rye grasses resist insect attack because the symbiotic endophytic fungi found naturally in their tissues repel or kill common leaf and stem-eating lawn insects.

- The fungus causes no known adverse effects to the host plant or to humans.
 - Tall fescues and rye grasses do not repel root-feeding lawn pests such as Crane Fly larvae.
 - Tall fescues and rye grasses are toxic to ruminants such as cattle and sheep
- Endophytic grasses are commercially available; use them in areas such as parks or golf courses where grazing does not occur.
- Local agricultural or gardening resources such as Washington State University Extension office can offer advice on which types of grass are best suited to the area and soil type.
- Use the following seeding and planting BMPs, or equivalent BMPs, to obtain information on grass mixtures, temporary and permanent seeding procedures, maintenance of a recently planted area, and fertilizer application rates: BMP C120: Temporary and Permanent Seeding, BMP C121: Mulching, BMP C123: Plastic Covering, and BMP C124: Sodding.
- Adjusting the soil properties of the subject site can assist in selection of desired plant species. Consult a soil restoration specialist for site-specific conditions.

Recommended Additional BMPs:

- Conduct mulch-mowing whenever practicable.
- Use native plants in landscaping. Native plants do not require extensive fertilizer or pesticide applications. Native plants may also require less watering.
- Use mulch or other erosion control measures on soils exposed for more than one week during the dry season (May 1 to September 30) or two days during the rainy season (October 1 to April 30).
- Till a topsoil mix or composted organic material into the soil to create a well-mixed transition layer that encourages deeper root systems and drought-resistant plants.
- Apply an annual topdressing application of 3/8" compost. Amending existing landscapes and turf systems by increasing the percent organic matter and depth of topsoil can:
 - Substantially improve the permeability of the soil.
 - Increase the disease and drought resistance of the vegetation.
 - Reduces the demand for fertilizers and pesticides.
- Disinfect gardening tools after pruning diseased plants to prevent the spread of disease.
- Prune trees and shrubs in a manner appropriate for each species.
- If specific plants have a high mortality rate, assess the cause and replace with another more appropriate species.
- When working around and below mature trees, follow the most current American National Standards Institute (ANSI) ANSI A300 standards (see

http://www.tcia.org/TCIA/BUSINESS/ANSI_A300_Standards_/TCIA/BUSINESS/A300_Standards/A300_Standards.aspx?hkey=202ff566-4364-4686-b7c1-2a365af59669) and International Society of Arboriculture BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil).

- Monitor tree support systems (stakes, guys, etc.).
 - Repair and adjust as needed to provide support and prevent tree damage.
 - Remove tree supports after one growing season or maximum of 1 year.
 - Backfill stake holes after removal.
- When continued, regular pruning (more than one time during the growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location.
- Make reasonable attempts to remove and dispose of class C noxious weeds.
- Re-seed bare turf areas until the vegetation fully covers the ground surface.
- Watch for and respond to new occurrences of especially aggressive weeds such as Himalayan blackberry, Japanese knotweed, morning glory, English ivy, and reed canary grass to avoid invasions.
- Plant and protect trees per BMP T5.16: Tree Retention and Tree Planting.
- Aerate lawns regularly in areas of heavy use where the soil tends to become compacted. Conduct aeration while the grasses in the lawn are growing most vigorously. Remove layers of thatch greater than ¾-inch deep.
- Set the mowing height at the highest acceptable level and mow at times and intervals designed to minimize stress on the turf. Generally mowing only 1/3 of the grass blade height will prevent stressing the turf.
 - Mowing is a stress-creating activity for turfgrass.
 - Grass decreases its productivity when mowed too short and there is less growth of roots and rhizomes. The turf becomes less tolerant of environmental stresses, more disease prone and more reliant on outside means such as pesticides, fertilizers, and irrigation to remain healthy.

Additional BMP Information:

- King County's *Best Management Practices for Golf Course Development and Operation* (King County, 1993) has additional BMPs for Turfgrass Maintenance and Operation.
- King County, Seattle Public Utilities, and the Saving Water Partnership have created the following natural lawn and garden care resources that include guidance on building healthy soil with compost and mulch, selecting appropriate plants, watering, using alternatives to pesticides, and implementing natural lawn care techniques.

- *Natural Yard Care - Five steps to make your piece of the planet a healthier place to live* (King County and SPU, 2008)
- *The Natural Lawn & Garden Series: Smart Watering* (Saving Water Partnership, 2006)
- *Natural Lawn Care for Western Washington* (Saving Water Partnership, 2007)
- *The Natural Lawn & Garden Series: Growing Healthy Soil; Choosing the Right Plants; and Natural Pest, Weed and Disease Control* (Saving Water Partnership, 2012)
- The International Society of Arboriculture (ISA) is a group that promotes the professional practice of arboriculture and fosters a greater worldwide awareness of the benefits of trees through research, technology, and education. ISA standards used for managing trees, shrubs, and other woody plants are the American National Standards Institute (ANSI) A300 standards. The ANSI A300 standards are voluntary industry consensus standards developed by the Tree Care Industry Association (TCIA) and written by the Accredited Standards Committee (ASC). The ANSI standards can be found on the ISA website: www.isa-arbor.com/education/publications/index.aspx
- Washington State University's *Gardening in Washington State* website at <http://gardening.wsu.edu> contains Washington State specific information about vegetation management based on the type of landscape.
- See the *Pacific Northwest Plant Disease Management Handbook* (Pscheidt and Ocamb, 2016) for information on disease recognition and for additional resources.

S425 BMPs for Soil Erosion and Sediment Control at Industrial Sites

Description of Pollutant Sources: Industrial activities on soil areas; exposed and disturbed soils; steep grading; etc. can be sources of sediments that can contaminate stormwater runoff.

Pollutant Control Approach: Limit the exposure of erodible soil, stabilize, or cover erodible soil where necessary to prevent erosion, and/or provide treatment for stormwater contaminated with TSS caused by eroded soil.

Applicable BMPs:

- Limit the exposure of erodible soil.
- Stabilize entrances/exits to prevent track-out. See [BMP C105: Stabilized Construction Access](#).
- Stabilize or cover erodible soil to prevent erosion. Cover practice options include:
 - Use vegetative cover such as grass, trees, shrubs, on erodible soil areas.
 - Cover exposed areas with mats such as clear plastic, jute, synthetic fiber. See [BMP C122: Nets and Blankets](#) and [BMP C123: Plastic Covering](#).

intercepting surface drainage to retain their diversion shape and capability.

- Use temporary erosion and sediment control measures or re-vegetate as necessary to prevent erosion during ditch reshaping.
- Do not leave ditch cleanings on the roadway surfaces. Sweep, collect, and dispose of dirt and debris remaining on the pavement at the completion of ditch cleaning operations as described below:
 - Consider screening roadside ditch cleanings, not contaminated by spills or other releases and not associated with a stormwater treatment system such as a bioswale, to remove litter. Separate screenings into soil and vegetative matter (leaves, grass, needles, branches, etc.) categories. Compost or dispose of the vegetative matter in a municipal waste landfill. Consult with the jurisdictional health department to discuss use or disposal options for the soil portion. For more information, see [Appendix IV-B: Management of Street Waste Solids and Liquids](#).
 - Roadside ditch cleanings contaminated by spills or other releases known or suspected to contain dangerous waste must be handled following the Dangerous Waste Regulations ([Chapter 173 303 WAC](#)). If testing determines materials are not dangerous waste but contaminants are present, consult with the jurisdictional health department for disposal options.
- Examine culverts on a regular basis for scour or sedimentation at the inlet and outlet, and repair as necessary. Give priority to those culverts conveying perennial and/or salmon-bearing streams and culverts near streams in areas of high sediment load, such as those near subdivisions during construction. Maintain trash racks to avoid damage, blockage, or erosion of culverts.

Recommended Treatment BMPs:

Install biofiltration swales and filter strips (see [V-7 Biofiltration BMPs](#)) to treat roadside runoff wherever practicable and use engineered topsoils wherever necessary to maintain adequate vegetation. These systems can improve infiltration and stormwater pollutant control upstream of roadside ditches.

S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems

Description of Pollutant Sources: Facilities include roadside catch basins on arterials and within residential areas, conveyance systems, detention facilities such as ponds and vaults, oil/water separators, biofilters, settling basins, infiltration systems, and all other types of stormwater treatment systems presented in [Volume V](#). Oil and grease, hydrocarbons, debris, heavy metals, sediments and contaminated water are found in catch basins, oil and water separators, settling basins, etc.

Pollutant Control Approach: Provide maintenance and cleaning of debris, sediments, and other pollutants from stormwater collection, conveyance, and treatment systems to maintain proper operation.

Applicable Operational BMPs:

Maintain stormwater treatment facilities per the operations and maintenance (O&M) procedures presented in [Appendix V-A: BMP Maintenance Tables](#) in addition to the following BMPs:

- Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine necessary O&M improvements.
- Promptly repair any deterioration threatening the structural integrity of stormwater facilities. These include replacement of clean-out gates, catch basin lids, and rock in emergency spillways.
- Ensure adequacy of storm sewer capacities and prevent heavy sediment discharges to the sewer system.
- Regularly remove debris and sludge from BMPs used for peak-rate control, treatment, etc. and discharge to a sanitary sewer if approved by the sewer authority, or truck to an appropriate local or state government approved disposal site.
- Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin. However, in no case should there be less than six inches clearance from the debris surface to the invert of the lowest pipe. Some catch basins (for example, WSDOT's *Catch Basin Type 1L* (WSDOT, 2011)) may have as little as 12 inches sediment storage below the invert. These catch basins need frequent inspection and cleaning to prevent scouring. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach.
- Properly dispose of all solids, polluted material, and stagnant water collected through system cleaning. Do not decant water back into the drainage system from eductor trucks or vacuum equipment since there may be residual contaminants in the cleaning equipment. Do not jet material downstream into the public drainage system.
- Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.
- Post warning signs; "Dump No Waste - Drains to Ground Water," "Streams," "Lakes," or emboss on or adjacent to all storm drain inlets where possible.
- Disposal of sediments and liquids from the catch basins must comply with [Appendix IV-B: Management of Street Waste Solids and Liquids](#).

S421 BMPs for Parking and Storage of Vehicles and Equipment

Description of Pollutant Sources: Public and commercial parking lots such as retail store, fleet vehicle (including rent-a-car lots and car dealerships), equipment sale and rental parking lots, and

Catch Basin

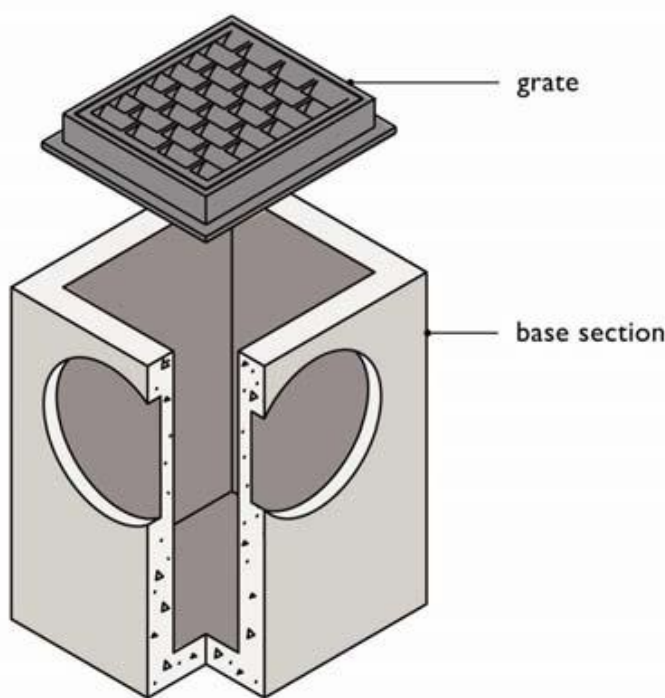
A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. There are two types.

A Type 1 catch basin is a rectangular box with approximate dimensions of 3'x2'x5'. Type 1 catch basins are utilized when the connected conveyance pipes are less than 18 inches in diameter and the depth from the gate to the bottom of the pipe is less than 5 feet.

A Type 2 catch basin, also commonly referred to as a storm manhole, is listed separately under “Manhole” in this book.

Catch basins typically provide a storage volume (sump) below the outlet pipe to allow sediments and debris to settle out of the stormwater runoff. Some catch basins are also fitted with a spill control device (inverted elbow on outlet pipe) intended to contain large quantities of grease or debris.

Catch basins are frequently associated with all stormwater facilities.



Type I

Key Operations and Maintenance Considerations

- The most common tool for cleaning catch basins is an industrial vacuum truck with a tank and vacuum hose (e.g. Vactor® truck) to remove sediment and debris from the sump.
- A catch basin may be an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a catch basin, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Catch Basin			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages.			
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin.
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin.)	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.

Stormwater Treatment, Flow Control, and Conveyance Facility Components

	Basin Walls/ Bottom	Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present. <ul style="list-style-type: none"> Identify and remove source, AND Report to Clark County Clean Water Program. 	No contaminants or pollutants present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Oil/Debris Trap (If Applicable)	Dislodged	Oil or debris trap is misaligned with or dislodged from the outlet pipe.	Trap is connected to and aligned with outlet pipe.

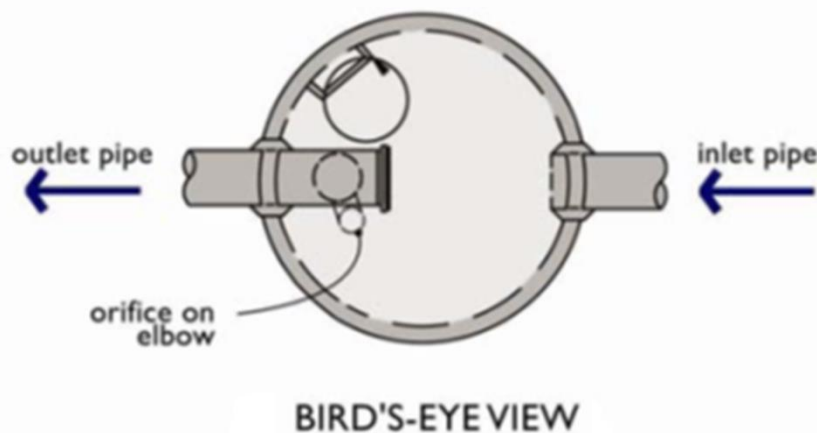
Control Structure/Flow Restrictor

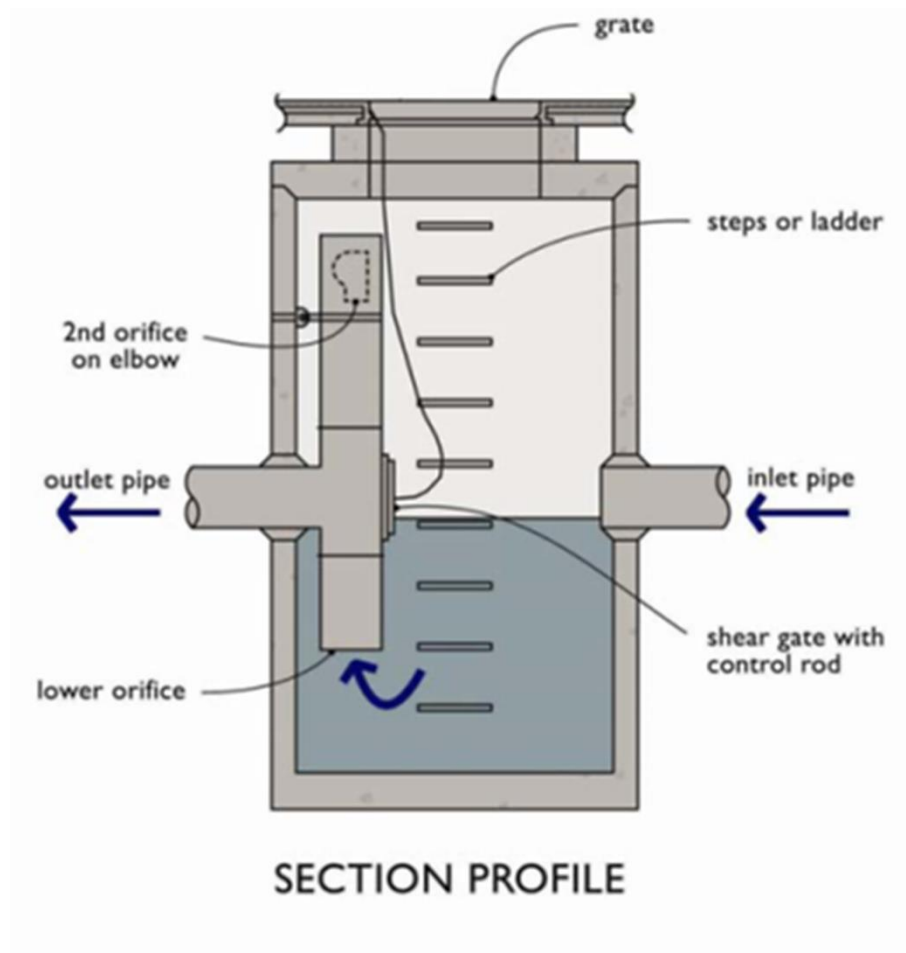
Flow control structures and flow restrictors direct or restrict flow in or out of facility components. Outflow controls on detention facilities are a common example where flow control structures slowly release stormwater at a specific rate. The flow is regulated by a combination of orifices (holes with specifically sized diameters) and weirs (plates with rectangular or “V” shaped notch). Lack of maintenance of the control structure can result in the plugging of an orifice. If these flow controls are damaged, plugged, bypassed, or not working properly, the facility could overtop or release water too quickly.

Control structures have a history of maintenance-related problems and it is imperative to establish a good maintenance program for them to function properly. Sediment typically builds up inside the structure, which blocks or restricts flow to the outlet. To prevent this problem, routinely clean out these structures and conduct regular inspections to detect the need for non-routine cleanout.

Facility objects that are typically associated with a control structure/flow restrictor include:

- detention ponds
- media cartridge filters
- closed detention system
- conveyance stormwater pipe





Key Operations and Maintenance Considerations

- Conduct regular inspections of control structures to detect the need for non-routine cleanout, especially if construction or land-disturbing activities occur in the contributing drainage area.
- The most common tool for cleaning control structures/flow restrictors is a truck with a tank and vacuum hose (Vactor® truck) to remove sediment and debris from the sump.
- A control structure is an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a control structure, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

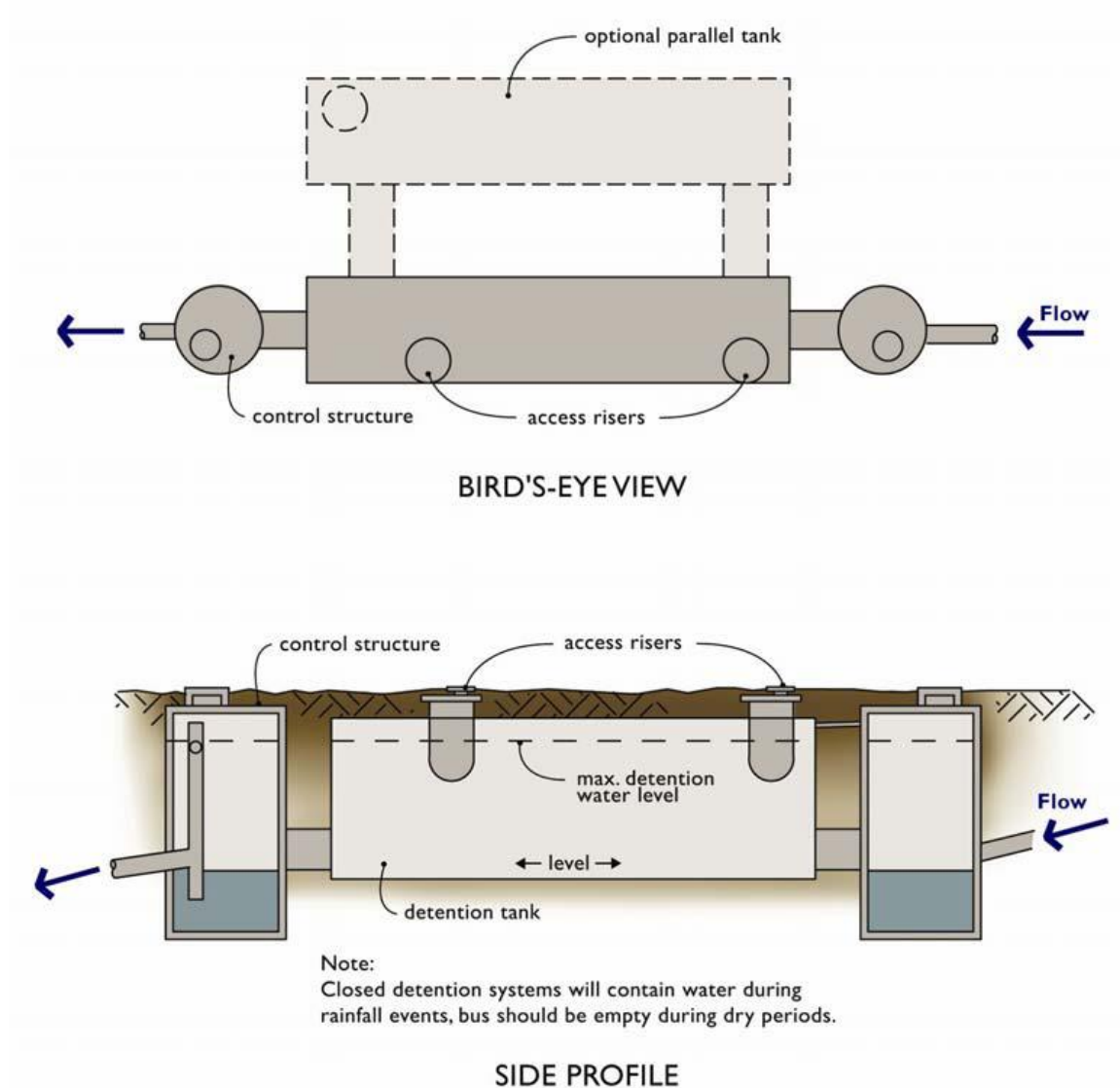
Control Structure/Flow Restrictor			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris has been removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes—other than designed holes—in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design specifications. Allows maintenance person safe access.
Catch Basins	See "Catch Basins"		

Closed Detention System (Tank/Vault)

A closed detention system functions similarly to a detention pond with the temporary storage volume provided by an underground structure to regulate the storm discharge rate from the site. The structure is typically constructed of large diameter pipe (48 inch diameter or greater) or a concrete box (vault). These systems are typically utilized for sites that do not have space available for an above-ground system and are more commonly associated with commercial sites.

Facility objects that are typically associated with a closed detention system include:

- access road or easement
- control structure/flow restrictor
- conveyance stormwater pipe



Key Operations and Maintenance Considerations

- The most common tool for cleaning closed detention systems is a truck with a tank and vacuum hose (Vactor® truck) to remove sediment and debris from the vault/tank.
- A closed detention system is an enclosed space where harmful chemicals and vapors can accumulate. Therefore, if the inspection and maintenance requires entering a closed detention system, it should be conducted by an individual trained and certified to work in hazardous confined spaces.

Closed Detention System (Tanks/Vaults)			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages			
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	Storage area free of sediment and debris.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability.)	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability.)	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.
	Vegetation Encroachment	Root encroachment of tree or shrub have impacted function or integrity of wetvault.	Roots are found in vault to be removed and repair vault.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.

Closed Detention System (Tanks/Vaults)			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages			
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design specifications. Allows maintenance person safe access.
Catch Basins	See "Catch Basins"		

Wet Vault			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Trash/Debris Accumulation	Trash and debris accumulated in vault, pipe, or inlet/outlet (includes floatables and non-floatables).	Vault is free of trash and debris.
	Sediment Accumulation in Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	Vault is free of sediment.
	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe has been repaired and/or replaced to design specifications.
	Access Cover Damaged/Not Working	Cover cannot be opened or removed, especially by one person.	Cover repaired or replaced to design specifications.
	Blocked Ventilation	Ventilation area blocked or plugged.	Blocking material has been cleared from ventilation area and removed. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Damage – Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made such that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection staff.	Baffles repaired or replaced to design specifications.
	Vegetation Encroachment	Root encroachment of tree or shrub have impacted function or integrity of wetvault.	Roots are found in vault to be removed and repair vault.
Ladder	Access Ladder Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracks and/or misaligned. Confined space warning sign missing.	Ladder replaced or repaired to design specifications, and is safe to use as determined by inspection personnel. Confined space entry warning and requirements sign is present, clean, and legible. Ladder and entry notification complies with OSHA standards.

Media Cartridge Filters

Media cartridge filters are passive, flow-through, stormwater treatment systems. They are comprised of one or more vaults that house rechargeable, media-filled filter cartridges. Stormwater passes through a filtering medium, which traps particulates and/or adsorb pollutants such as dissolved metals and hydrocarbons. Once filtered through the media, the treated stormwater is directed to a collection pipe or discharged into an open channel drainage way.

The filter media can be housed in cartridge filters enclosed in concrete vaults or catch basins. Structures will have vault doors or manhole lids (older designs) for maintenance access. Various types of filter media are available from system manufacturers.

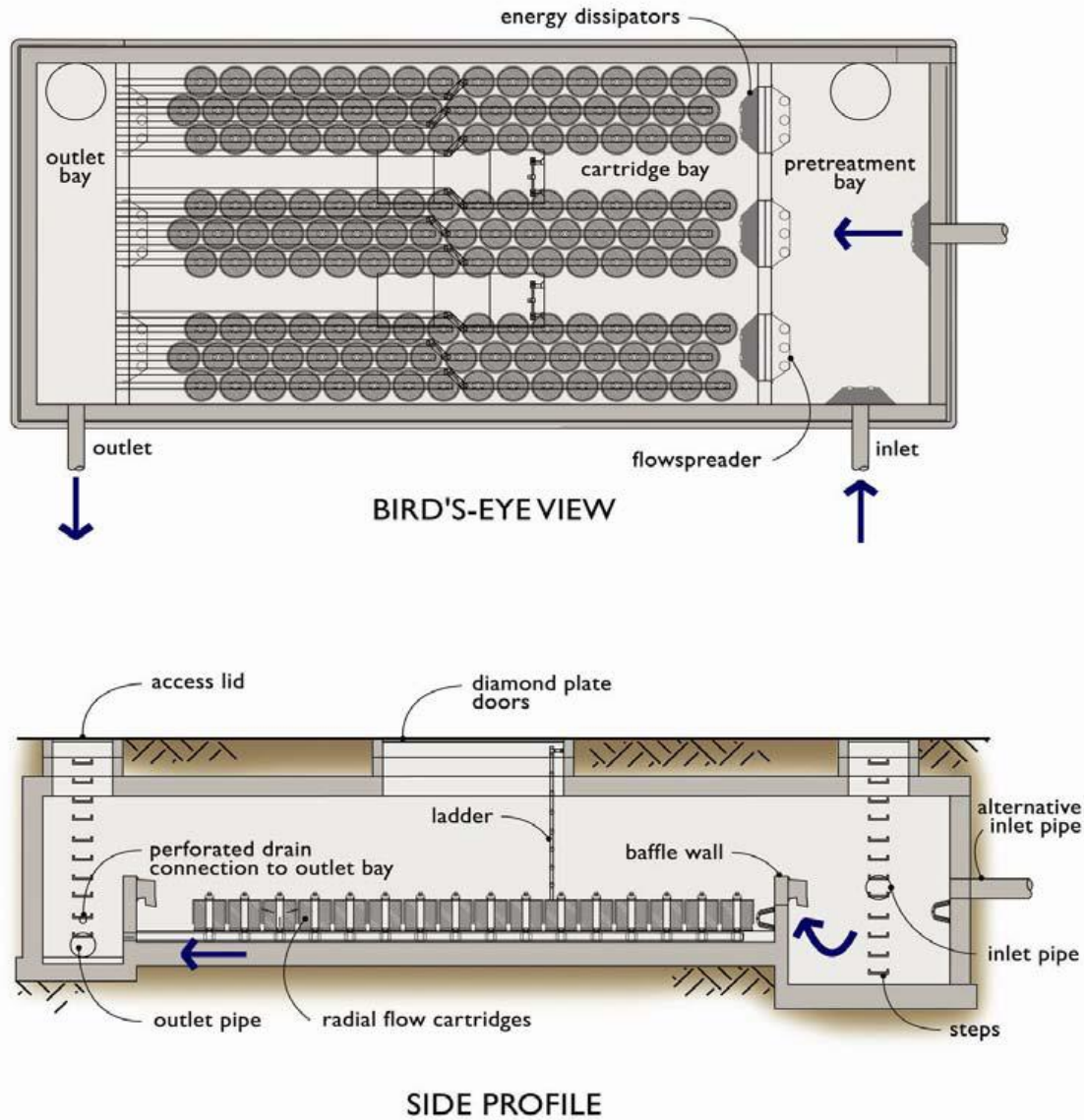
StormFilter® units are an example of a proprietary manufactured media cartridge filter system that is common in Clark County. See manufacturer's publications for additional maintenance information.

Facility objects that are typically associated with a manufactured media filter system include:

- access road or easement
- control structure/flow restrictor
- conveyance stormwater pipe



Media Cartridge Filter Vault with Accumulated Sediment



Key Operations and Maintenance Considerations

- The most common tool for cleaning media cartridge filters is a truck with a tank and vacuum hose (e.g. Vactor® truck) to remove sediment and debris from the vault.
- Media cartridge filters are enclosed spaces where harmful chemicals and vapors can accumulate. Therefore, the inspection and maintenance of these facilities should be conducted by an individual trained and certified to work in hazardous confined spaces.
- Cartridges require replacement when the individual cartridges no longer meet the specifications for pollutant removal.

Stormwater Treatment, Flow Control, and Conveyance Facility Components

Media Cartridge Filters			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages.			
Forebay	Sediment Accumulation	Sediment accumulation exceeds 6 inches or 1/3 of available sump.	Sediment accumulation less than 6 inches.
Media Filter Vault	Sediment Accumulation on Top Media Filters (Cartridges)	Sediment depth exceeds 0.25-inches (on top of filter cartridges).	No sediment deposits which would impede permeability of the compost media. No sediment deposits on top of cartridges. (Sediment on cartridges likely indicates that cartridges are plugged and require maintenance.)
	Sediment Accumulation in Vault	Sediment depth exceeds 4 inches in chamber. Look for other indicators of clogged cartridges or overflow.	No sediment deposits in vault bottom of first chamber. Cartridges have been checked and replaced or serviced as needed.
	Trash and Debris Accumulation	Trash and debris accumulated in vault.	No trash or debris in vault.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris has been removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced to design specifications.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure; corrosion/deformation of cover.	Cover repaired or replaced to design specifications.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2 inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4 inch at the joint of the inlet/outlet pipe.
	Baffles Damaged	Baffles corroding, cracking, warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to design specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets design specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Compost Media Clogging	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges have been replaced and drawdown time and overflow frequency are per design standards.

Media Cartridge Filters			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages.			
	Short Circuiting	Flows do not properly enter filter cartridges.	Flows are properly entering filter cartridges. Cartridges have been replaced if necessary.
	Filter Cartridges Submerged	Filter vault does not drain within 24 hours following storm. Look for evidence of submergence due to backwater or excessive hydrocarbon loading.	Filter media have been checked and replaced if needed and vault drains down within 24 of a storm event. (If cartridges are plugged with oil, additional treatment or source control BMP may be needed.)

Planter Box Media Filters

Planter box media filters are passive, flow-through, stormwater treatment systems. They are comprised of a planter box, treatment media and a tree. Stormwater runoff enters the planter box system through a curb-inlet opening or pipe and flows through a specially designed filter media mixture contained in a landscaped concrete container. The filter media captures pollutants; those pollutants are then decomposed, volatilized, and incorporated into the biomass of the system's micro/macro fauna and flora. Stormwater runoff flows through the media and into an underdrain system at the bottom of the container.

Filtterra® units are an example of a proprietary manufactured filter media planter box system that is becoming more common in Clark County. See manufacturer's publications for additional maintenance information.

Facility objects that are typically associated with a manufactured planter box media filter system include:

- conveyance stormwater pipe

Key Operations and Maintenance Considerations

- The main maintenance need is keeping the mulch surface permeable.
- Filter media may become clogged due to a pollutant discharge.
- The main treatment function is due to the tree roots and soil biota. Dead or severely damaged trees must be replaced.
- Trees may need to be trimmed to provide clear sight lines along roads.

Planter Box Media Filter Systems			
Drainage System Feature	Potential Defect	Conditions When Maintenance is Needed	Minimum Performance Standard
Inlet	Excessive Sediment or Trash Accumulation	Accumulated sediments or trash impair free flow of water into Filtterra.	Inlet should be free of obstructions, allowing free distributed flow of water into Filtterra
Mulch Cover	Trash and Floatable Debris Accumulation.	Excessive trash and/or debris accumulation.	Minimal trash or other debris on mulch cover
	"Ponding" of Water on Mulch Cover	Clogging due to excessive fine sediment accumulation or spill of petroleum oils.	Stormwater should drain freely and evenly through mulch cover

Vegetation	Plants not Growing or in Poor Conditions	Soil/mulch too wet, evidence of spill. Incorrect plant selection. Pest infestation. Vandalism to plants.	Plants should be healthy and pest free.
	Plant Growth Excessive	Tree growth inhibits traffic visibility and/or pedestrian access.	Trim tree in accordance with typical landscaping and safety.
Structure	Structure has Visible Cracks	Cracks wider than 1/2 inch or evidence of soil particles entering the structure through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.

APPENDIX C

Geotech Report

**Report of Geotechnical
Engineering Services**

Manning Meadows Subdivision

La Center, Washington

January 16, 2025

Geotechnical ■ Environmental ■ Special Inspections

Columbia West
Engineering, Inc



January 16, 2025

LGI Homes
12951 Bel-Red Road, Suite 150
Bellevue, WA 98005

**Re: Report of Geotechnical Engineering Services
Manning Meadows Subdivision
1819 NE 339th Street
La Center, Washington
CWE Project: LGI-14-01-1**

Columbia West Engineering, Inc. (Columbia West) is pleased to present this report of geotechnical engineering services for the proposed Manning Meadows Subdivision in La Center, Washington. Our services were conducted in accordance with our proposal dated November 27, 2024.

We appreciate the opportunity to work on the project. Please contact us if you have any questions regarding this report.

Sincerely,



Michael C. King, PE
Project Engineer



Shawn M. Dimke, PE
Principal Engineer



Signed 01/16/2025

MCK:SMD:kat

Attachments

Document ID: LGI-14-01-1-011625-geor.docx

EXECUTIVE SUMMARY

This section provides a summary of the geotechnical considerations associated with the proposed residential development in La Center, Washington. This summary is an overview and the report should be referenced for a thorough discussion of subsurface conditions and geotechnical recommendations for the project.

- The proposed lightly loaded residential structures can be supported by conventional spread footings bearing on firm soil as described in the report.
- The moisture content of the native soil at the time of exploration was considerably higher than the optimum moisture content required for compaction. Depending on the time of year, significant drying will likely be required before using the on-site clay and fine-grained soil as structural fill. Accordingly, the on-site clay and fine-grained soil can typically only be placed as structural fill during the dry summer months.
- The on-site soil will generally provide poor support for construction equipment during the wet construction season. Subgrade protection during construction will be important. Granular haul roads and working pads should be employed if earthwork occurs during the wet season or when the subgrade is wet of optimum moisture content.
- An approximately 12- to 18-inch-thick tilled zone was encountered at the site. Proper stripping operations will remove some of the tilled zones. The tilled zones not removed from cuts and site stripping will need to be removed or stabilized. Scarification and compaction of the tilled zones will likely not be possible, unless completed during the dry summer period. Removal and replacement of the tilled zones with granular material or cement amendment will be necessary if stabilization through moisture conditioning is not possible.
- Based on soil and groundwater conditions and the results of infiltration testing, on-site infiltration systems are not feasible at the site.
- Due to the sloping topography, predominantly clay subsurface soil, and perched groundwater encountered in our test pits, perimeter building foundation drains are recommended for all structures at the site.

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS

1.0	INTRODUCTION	1
2.0	BACKGROUND	1
3.0	PURPOSE AND SCOPE	1
4.0	SITE CONDITIONS	2
4.1	Geology	2
4.2	Surface Conditions	2
4.3	Subsurface Conditions	2
4.4	Infiltration Testing	3
4.4	Seismic Hazards	4
5.0	DESIGN	5
5.1	Shallow Foundation Support	5
5.2	Seismic Design Criteria	7
5.3	Permanent Slopes	7
5.4	Retaining Structures	8
5.5	Drainage	9
5.6	Pavement	9
6.0	CONSTRUCTION	10
6.1	Site Preparation	10
6.2	Construction Traffic and Staging	12
6.3	Slope Construction and Drainage	12
6.4	Excavation	13
6.5	Construction Dewatering	13
6.6	Materials	14
6.7	Erosion Control	19
7.0	OBSERVATION OF CONSTRUCTION	19
8.0	LIMITATIONS	19
	REFERENCES	21

FIGURES

Vicinity Map	Figure 1
Site Plan	Figure 2
Typical Minimum Foundation Slope Setback Detail	Figure 3
Surcharge-Induced Lateral Earth Pressures	Figure 4
Typical Cut and Fill Cross Section	Figure 5

APPENDICES

Appendix A	
Field Explorations	A-1
Exploration Legend	
Soil Classification System	
Test Pit Logs	

TABLE OF CONTENTS

APPENDICES (continued)

Appendix B

Laboratory Testing

B-1

Moisture Content, Percent Passing No. 200 Sieve by Washing

Atterberg Limits Reports

Organic Content Test Report

Appendix C

Report Limitations and Important Information

C-1

ABBREVIATIONS AND ACRONYMS

AC	asphalt concrete
AOS	apparent opening size
ASCE	American Society of Civil Engineers
ASTM	ASTM International
BGS	below ground surface
CSZ	Cascadia subduction zone
ESA	environmental site assessment
ESAL	equivalent single-axle load
g	gravitational acceleration (32.2 feet/second ²)
HMA	hot mix asphalt
H:V	horizontal to vertical
IBC	International Building Code
in/hr	inch(es) per hour
km	kilometers
MCE	maximum considered earthquake
M _w	moment magnitude
NRCS	Natural Resources Conservation Service
OSHA	Occupational Safety and Health Administration
pcf	pounds per cubic foot
pci	pounds per cubic inch
PG	performance grade
psf	pounds per square foot
psi	pounds per square inch
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WSS	Washington Standard Specifications for Road, Bridge, and Municipal Construction (2024)
WWHM	Western Washington Hydrology Model

REPORT OF GEOTECHNICAL ENGINEERING SERVICES MANNING MEADOWS SUBDIVISION LA CENTER, WASHINGTON

1.0 INTRODUCTION

Columbia West is pleased to submit this geotechnical engineering report for the proposed residential development in La Center, Washington. The approximately 9.83-acre site is located at 1819 NE 339th Street. The site is shown relative to surrounding physical features on Figure 1. Figure 2 shows the existing conditions at the site. Abbreviations and acronyms used herein are defined immediately following the Table of Contents.

The project includes the construction of approximately 100 residential lots. Improvements are also expected to consist of utility infrastructure, public and private AC-paved roadways, and stormwater management facilities. Grading plans were not finalized at the time of this report; however, based on the anticipated terraced-lot design, we expect cuts and fills to be on the order of 5 to 10 feet. We estimate that column and wall loads will not exceed 20 kips and 4 kips per lineal foot, respectively. Slab loads are not expected to exceed 100 psf.

2.0 BACKGROUND

Columbia West recently prepared a Phase I ESA for the site (Columbia West 2014). The site is currently partially developed with a single-family residence and associated outbuildings in the north portion of the site. The remainder of the site is undeveloped, and review of historical aerial photographs indicates the area was traditionally used for agricultural purposes. The Phase I ESA identified two septic systems and a decommissioned well at the site.

3.0 PURPOSE AND SCOPE

The purpose of our services was to provide geotechnical engineering recommendations for the proposed project. The specific scope of our services included the following:

- Reviewed information available in Columbia West's files for the site vicinity.
- Coordinated and managed the field exploration program, which included locating utilities, coordinating site access, and scheduling subcontractors and Columbia West's field staff.
- Conducted a subsurface exploration program that included the following:
 - Excavated nine test pits to depths between 14 and 15 feet BGS
- Collected geotechnical soil samples from the explorations and maintained a log of subsurface conditions encountered.
- Performed a laboratory testing program that consisted of the following tests:
 - Nineteen moisture content determinations in general accordance with ASTM D2216
 - Six particle-size analyses in general accordance with ASTM D1140
 - Two Atterberg limits tests in general accordance with ASTM D4318
 - One organic content test in general accordance with ASTM D2974

- Prepared this geotechnical engineering report that summarizes our explorations, laboratory testing, and analyses and provides geotechnical design criteria and construction recommendations for the proposed development, which includes the following:
 - Summary of subsurface conditions at the site
 - Recommendations for foundation support
 - Recommendations for floor slab subgrade preparation
 - Recommendations for retaining walls, including lateral earth pressures, backfill, compaction, and drainage
 - Recommendations for site preparation, including grading and drainage, stripping depths, fill type for imported material, compaction criteria, trench excavation and backfill, use of on-site soil, and wet/dry weather earthwork
 - Recommendations for managing groundwater conditions that may affect the performance of structures and site improvements
 - Recommendations for pavement design and construction
 - Seismic design coefficients in accordance with the 2021 IBC

4.0 SITE CONDITIONS

4.1 GEOLOGY

The site is located within the Willamette Valley/Puget Sound Lowland, a wide physiographic depression flanked by the mountainous Coast Range on the west and the Cascade Range on the east. Inclined or uplifted structural zones within the Puget Sound Lowland constitute highland areas, and depressed structural zones form sediment-filled basins. The site is located in the north portion of the Portland/Vancouver Basin, an open, somewhat elliptical, northwest-trending syncline approximately 60 miles wide.

The near-surface geologic unit is mapped as Pleistocene- to Pliocene-aged, semi-consolidated, pebble- to cobble-sized sedimentary Conglomerate with sandy and silty facies (QTc).

The USDA NRCS Web Soil Survey identifies the surface soil as Gee silt loam. Although soil conditions may vary from the broad NRCS descriptions, Gee soils are generally fine textured with low permeability and low to moderate shear strength. Gee soils exhibit a slight erosion hazard based primarily on slope grade.

4.2 SURFACE CONDITIONS

The approximately 9.83-acre site is currently occupied with a residential structure and garage in the north portion. Apart from the residential structure, the site is generally open and grassy. Mature tree growth is present along the northwestern site boundary.

4.3 SUBSURFACE CONDITIONS

4.3.1 General

Subsurface conditions at the site were explored by excavating nine test pits (TP-1 through TP-9) to depths between 14 and 15 feet BGS. The exploration locations are shown on Figure 2. A description of our field explorations and the exploration logs are presented in Appendix A. A description of our laboratory testing program and the testing results are presented in Appendix B. A summary of the subsurface conditions is presented below.

4.3.2 Soil Conditions

4.3.2.1 Root Zone and Topsoil/Tilled Zone

The surficial layer of soil covering the majority of the site consists of grass roots and a tilled zone. The tilled zone is generally 12 to 18 inches thick and consists of clay with sand and trace organics. The tilled zone generally contains a 3- to 4-inch-thick root zone.

4.3.2.2 Alluvium

Alluvial clay and silt were encountered beneath the tilled zone and extend to the maximum depths explored, except for test pit TP-4. The clay and silt are medium stiff and generally exhibit low plasticity. Laboratory testing indicates the moisture content of the soil varied between 29 and 55 percent at the time exploration and fines contents ranging from 76 to 88 percent for the tested samples.

4.3.2.3 Gravel

Dense clayey gravel was observed below the surficial clay in test pit TP-4 at a depth of 13 feet BGS. The tested moisture content of the gravel was 6 percent at the time of exploration. The gravel observed is likely related to the mapped dense sedimentary Conglomerate member.

4.3.3 Groundwater

Perched groundwater was observed in most test pit explorations at depths between 2 and 12 feet BGS. The observed rate of seepage generally ranges from slow to moderate; however, rapid seepage was observed in test pit TP-2 at a depth of 10 feet BGS. Perched water is likely to be present in isolated, discontinuous zones below the ground surface and particularly where more permeable soil is present above lower permeable soil. Groundwater levels are often subject to seasonal variation and may rise during extended periods of increased precipitation.

4.4 INFILTRATION TESTING

Infiltration testing was completed in two of the test pits to assist in the evaluation of stormwater management facilities for the project. The infiltration testing was conducted in general accordance with the recommendations for the encased falling head method per the *Clark County Stormwater Manual* (Clark County 2021). Table 1 summarizes our infiltration testing results and fines content determinations. The exploration logs and the laboratory testing results are presented in Appendices A and B, respectively.

Table 1. Infiltration Testing Results

Location	Depth (feet BGS)	Soil Type	Fines Content ¹ (percent)	Coefficient of Permeability, k (in/hr)
TP-1	2	CLAY	82	Negligible
TP-1	5	CLAY	84	Negligible
TP-2	2	CLAY	81	Negligible
TP-2	5	CLAY	76	Negligible

1. Fines content: percent passing U.S. Standard No. 200 sieve

As indicated in Table 1, near-surface infiltration rates were negligible in the tested locations. Based on review of Table 7-2 of the USDA hydrologic soil group criteria (USDA 2009), Appendix 2-A of the 2021 *Clark County Stormwater Manual*, and the *Clark County WWHM Soil Groupings* memorandum (Otak, Inc. 2010), the near-surface native soil meets the classification criteria for WWHM Soil Group 4. Based on the near-surface soil at the site and the results of testing, on-site infiltration systems are not feasible.

4.5 SEISMIC HAZARDS

4.5.1 Seismic Setting

4.5.1.1 Earthquake Sources

Three scenario earthquakes were considered for this study consistent with the local seismic setting. Two of the possible earthquake sources are associated with the CSZ, and the third event is a shallow, local crustal earthquake that could occur in the North American Plate. The three earthquake scenarios are discussed below.

4.5.1.2 Regional Events

The CSZ is the region where the Juan de Fuca Plate is being subducted beneath the North American Plate. This subduction is occurring in the coastal region between Vancouver Island and northern California. Evidence has accumulated suggesting that this subduction zone has generated eight great earthquakes in the last 4,000 years, with the most recent event occurring approximately 300 years ago (Weaver and Shedlock 1991). The fault trace is mapped approximately 50 to 120 km off the Washington Coast.

Two types of subduction zone earthquakes are possible and considered in this study:

1. An interface event earthquake on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the CSZ. This source is capable of generating earthquakes with a M_w of 9.0+.
2. A deep intraplate earthquake on the seismogenic part of the subducting Juan de Fuca Plate. These events typically occur at depths of between 30 and 60 km. This source is capable of generating an event with a M_w of up to 8.0.

4.5.1.3 Local Events

A significant earthquake could occur on a local fault near the site within the design life of the development. Such an event would cause ground shaking at the site that could be more intense than the CSZ events, although the duration would be shorter. Table 2 provides information on local faults close to the site.

Table 2. Nearest Mapped Crustal Faults

Source	Closest Mapped Distance ¹ (km)	Mapped Length ¹ (km)
Lacamas Lake fault	23	24
Portland Hills fault	28	49

1. Based on mapping by USGS (2018)

4.5.2 Seismic Settlement

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles. Granular soil, which relies on interparticle friction for strength, undergoes a loss of strength until the excess pore pressures dissipate. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. Silty soil with low plasticity can be susceptible to strain softening under relatively higher levels of ground shaking. Strain-softened soil has volumetric strains much smaller than liquefiable soil due to matrix effects. Based on the results of our subsurface explorations and review of groundwater mapping, liquefaction is not considered a hazard at the site.

4.5.3 Lateral Spreading

Lateral spreading is a liquefaction-related seismic hazard and occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement. Due to the low risk for liquefaction potential at the site, lateral spreading is not considered a hazard at the site.

5.0 DESIGN

Based on our subsurface explorations, laboratory testing, and analysis, the proposed development is generally compatible with the surface and subsurface soil, provided the recommendations presented in this report are incorporated into design and implemented during construction.

5.1 SHALLOW FOUNDATION SUPPORT

Based on the foundation loads in Section 1.0 (Introduction), the proposed buildings can be supported by conventional spread footings bearing on firm, native soil or engineered structural fill underlain by firm, native soil.

Foundations should not be supported by topsoil/buried topsoil or undocumented fill material. If encountered, these materials should be removed and replaced with structural fill/granular pads. If footings are constructed during wet weather conditions or when the footing subgrade soil is above its optimum moisture content, we recommend placing and compacting a thin layer of crushed rock (typically 2 to 4 inches) meeting the requirements for imported granular material described in Section 6.6.1 (Structural Fill) over the exposed subgrade soil.

5.1.1 Dimensions and Capacity

Continuous perimeter wall and isolated spread footings should have minimum widths of 16 and 20 inches, respectively. The bases of exterior footings should bear at least 18 inches below the lowest adjacent exterior grade. The bases of interior footings should bear at least 12 inches below the base of the floor slab.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,000 psf. As the allowable bearing pressure is a net bearing pressure, the weight of the footing and associated backfill may be ignored when calculating

footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and is typically increased by one-third for transient lateral forces such as seismic or wind.

5.1.2 Static Settlement

Foundation settlement tolerances should be provided to the design-build contractor who will design the ground improvement to meet the project requirements. Foundation static settlement tolerances for most structures is 1 inch of total settlement and 0.5 inch of differential settlement between similarly loads footings.

5.1.3 Resistance to Sliding

Lateral foundation loads can be resisted by passive earth pressure on the sides of footings and by friction at the bases of footings. Our analysis indicates the available passive earth pressure for footings confined by native soil or engineered structural fill is 325 pcf. Typically, the movement required to develop the available passive resistance may be relatively large; therefore, we recommend using a reduced passive equivalent fluid pressure of 250 pcf. The upper 12 inches of soil should be neglected when calculating passive pressure resistance. The recommended passive pressure resistance assumes that a minimum horizontal clearance of 10 feet is maintained between the footing face and adjacent down-gradient slopes and that groundwater remains below the bases of the footings.

The estimated unfactored coefficient of friction between in-situ native soil or engineered structural fill and in-place poured concrete is 0.35. The estimated unfactored coefficient of friction between compacted crushed aggregate and in-place poured concrete is 0.45.

5.1.4 Subgrade Observation

Footing and floor subgrade soil should be evaluated by Columbia West prior to placing forms or reinforcing bar to verify subgrade support conditions are as anticipated in this report. Subgrade observation should confirm that all disturbed material, organic material, unsuitable fill, remnant topsoil zones, and softened subgrade (if present) have been removed. Over excavation of footing subgrade soil may be required to remove deleterious material, particularly if footings are constructed during wet weather conditions. Footing excavations should be backfilled with compacted granular pads.

5.1.5 Floor Slabs

Floor slabs can be supported on firm, competent, native soil or engineered structural fill underlain by firm, native soil prepared as described in this report. Disturbed soil and unsuitable fill in proposed slab locations, if encountered, should be removed and replaced with structural fill.

To reduce slab shifting and moisture transmission, slabs should be underlain by at least 6 inches of compacted crushed aggregate. Geotextile may be used below the crushed aggregate layer to increase subgrade support. Recommendations for floor slab aggregate base and subgrade geotextile are discussed in Section 6.6 (Materials).

Slab thickness and reinforcement should be designed by an experienced structural engineer in accordance with anticipated loads. Concrete floor slabs with maximum loads of 100 psf may be designed assuming a modulus of subgrade reaction, k , of 150 pci for slabs-on-grade constructed on subgrade prepared as recommended in this report.

Flooring manufacturers often require vapor barriers to protect flooring and flooring adhesives. Many flooring manufacturers will warrant their product only if a vapor barrier is installed according to their recommendations. Selection and design of an appropriate vapor barrier, if needed, should be based on discussions among members of the design team.

5.2 SEISMIC DESIGN CRITERIA

Seismic design for the proposed structures is governed by ASCE 7-16. Based on review of geologic mapping and the results of our subsurface explorations, seismic design parameters for Site Class D are presented for the site in Table 3.

Table 3. ASCE 7-16 Seismic Design Parameters

Parameter	Short Period (T_s)	1 Second Period (T_1)
MCE spectral response acceleration, S	$S_s = 0.798 \text{ g}$	$S_1 = 0.375 \text{ g}$
Site class	D	
Site coefficient, F	$F_a = 1.2$	$F_v = 1.975$
Adjusted spectral response acceleration, S_M	$S_{MS} = 0.957 \text{ g}$	$S_{M1} = 0.741 \text{ g}$
Design spectral response acceleration, S_D	$S_{DS} = 0.638 \text{ g}$	$S_{D1} = 0.496 \text{ g}$

ASCE 7-16 Section 11.4.8 requires a site-specific seismic hazard evaluation in accordance with Section 21.2 for structures on Site Class D sites with S_1 greater than or equal to 0.2 g (S_1 at the site is 0.375 g). Exception 2 of ASCE 7-16 Section 11.4.8 indicates a site-specific seismic hazard evaluation is not required for structures on Site Class D sites with S_1 greater to or equal 0.2 g, provided the value of the seismic response coefficient C_s is determined by Eq. (12.8-2) for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Eq. (12.8-3) for $T_L \geq T > 1.5T_s$ or Eq. (12.8-4) for $T > T_L$. We anticipate the buildings will meet these requirements, but if Exception 2 is not applicable, a site-specific seismic hazard evaluation will be required. Columbia West recommends the project structural engineer evaluate these requirements and exceptions to determine if the parameters for Site Class D provided in Table 3 can be used for design or if a site-specific seismic hazard evaluation is required.

5.3 PERMANENT SLOPES

Permanent cut and fill slopes should not exceed 2H:1V. Slopes that will be maintained by mowing and slopes that will be below the potential inundation depth for stormwater detention ponds should not be constructed steeper than 3H:1V. Access roads and pavement should be located at least 5 feet from the top of cut and fill slopes. The horizontal setback should be increased to 10 feet for foundations. A minimum slope setback detail for structures is presented on Figure 3.

The slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the slope face.

5.4 RETAINING STRUCTURES

5.4.1 General

Retaining walls may be constructed at the site. Our retaining wall design recommendations are based on the following assumptions: (1) the walls consist of conventional, cantilevered retaining walls, (2) the walls are less than 10 feet in height, (3) the backfill is drained, and (4) the retained soil has a slope flatter than 4H:1V. Re-evaluation of our recommendations will be required if the retaining wall design criteria for the project varies from these assumptions.

5.4.2 Wall Design Parameters

Lateral earth pressures should be considered during design of retaining walls and below-grade structures. Hydrostatic pressure and additional surcharge loading should also be considered. Wall foundation construction and bearing capacity should adhere to specifications provided in Section 5.1 (Shallow Foundation Support).

Permanent retaining walls that are not restrained from rotation should be designed for active earth pressures using an equivalent fluid pressure of 35 pcf. Walls that are restrained from rotation should be designed for an at-rest equivalent fluid pressure of 55 pcf. Additional lateral earth pressures caused by surcharge loads (i.e., loads from construction, traffic, and adjacent structures) should be calculated based on the equations presented on Figure 4.

Provided the walls can yield a small amount from seismic loading, a superimposed seismic lateral force should be calculated based on a dynamic force of $7H^2$ pounds per lineal foot of wall, where H is the height of the wall in feet. The force should be applied as a uniformly distributed load with the resultant located at $0.5H$ from the base of the wall.

5.4.3 Backfill and Drainage

The above design parameters have been provided assuming that back-of-wall drains will be installed to prevent buildup of hydrostatic pressure behind all walls. If a drainage system is not installed, our office should be contacted for revised design forces.

A minimum 6-inch-diameter, perforated collector pipe should be placed at the bases of the walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of the finished grade. The drain rock and drainage geotextile fabric should meet specifications provided in Section 6.6 (Materials). The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipes should not be tied directly into stormwater drain systems, unless measures are taken to prevent backflow into the drainage system of the wall.

Backfill placed behind the walls and extending a horizontal distance of $\frac{1}{2}H$, where H is the height of the retaining wall, should consist of retaining wall select backfill placed and compacted in conformance with Section 6.6.1 (Structural Fill).

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend that construction of flatwork adjacent to retaining walls be postponed at least four weeks after backfilling of the wall, unless survey data indicates that settlement is complete prior to that time.

5.5 DRAINAGE

5.5.1 Temporary

During work at the site, the contractor should be made responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface. During rough and finished grading of the site, the contractor should keep all pads and subgrade free of ponding water.

5.5.2 Surface

The ground surface at finished pads should be sloped away from their edges at a minimum 2 percent gradient for a distance of at least 5 feet. Roof drainage from buildings should be directed into solid, smooth-walled drainage pipes that carry the collected water to the storm drain system.

5.5.3 Foundation Drains

Due to the sloping topography and subsurface conditions, perimeter building foundation drains are recommended for all structures at the site. Foundation drains are not necessary on the down-slope side of buildings constructed on slopes. Foundation drains should consist of a filter fabric-wrapped, drain rock-filled trench that extends at least 12 inches below the lowest adjacent grade (i.e., slab subgrade elevation). A perforated pipe should be placed at the base to collect water that gathers in the drain rock. The drain rock and filter fabric should meet specifications outlined in Section 6.6 (Materials). Discharge for footing drains should not be tied directly into the stormwater drainage system, unless mechanisms are installed to prevent backflow.

5.6 PAVEMENT

5.6.1 General

We recommend that public roadways for the subdivision be constructed in accordance with City of La Center standards. We have provided pavement sections for private automobile-only parking and drive aisles that will also service heavy vehicle traffic (i.e., garbage trucks, semi-trucks, etc.). Our pavement recommendations are based on the following design parameters and assumptions:

- The subgrade consists of firm, undisturbed, native soil or a minimum of 12 inches of subgrade soil directly below the pavement sections are compacted to at least 92 percent of maximum dry density, as determined by ASTM D1557.
- Resilient moduli for subgrade soil and aggregate base materials were assumed to be 4,000 psi and 20,000 psi, respectively.
- Pavement design life of 20 years with no expected traffic growth.
- Initial and terminal serviceability indices of 4.2 and 2.0, respectively.
- Structural coefficients of 0.42 and 0.10 for the AC and aggregate base, respectively.
- Reliability of 75 percent and standard deviation of 0.45.

- Truck traffic consists of two- and three-axle vehicles, such as delivery trucks.
- Pavement may be exposed to a fire apparatus load of 75,000 pounds on an infrequent basis.

If any of these assumptions are incorrect, Columbia West should be contacted with the appropriate information so that the pavement designs can be revised.

5.6.2 AC Pavement Design Sections

Based on the traffic assumptions stated above, we recommend the AC pavement sections presented in Table 4. Material properties and compaction recommendations for AC and aggregate base are presented in Section 6.6 (Materials).

**Table 4. Recommended AC Pavement Sections
Constructed over Native Soil or Engineered Fill**

Traffic	ESALs	AC Thickness (inches)	Aggregate Base Thickness ¹ (inches)
Drive aisles with limited trucks (up to five trucks per day)	25,000	3	9*
Automobile parking (no trucks)	5,000	2.5	8*

1. Aggregate base thickness can be decreased to 4 inches if the subgrade is cement amended to a minimum depth of 12 inches with a minimum unconfined compressive strength of 100 psi.

5.6.3 Construction Considerations

Recommended pavement section thicknesses are intended to be minimum acceptable values and do not include construction traffic loading. The recommendations assume that pavement construction will be completed during an extended period of warm, dry weather. Wet weather construction may require an increased thickness of aggregate base as discussed in Section 6.2 (Construction Traffic and Staging). Construction traffic should be limited to dedicated haul roads or non-structural, unpaved portions of the site. Construction traffic should not be permitted on new pavement, unless accounted for in the pavement design section.

6.0 CONSTRUCTION

6.1 SITE PREPARATION

6.1.1 General

Site grading should be performed in accordance with the requirements specified in the 2021 IBC, Chapter 18 and Appendix J, with exceptions noted in this report. Site preparation should be observed and documented by Columbia West.

6.1.2 Demolition

Where required, demolition includes removal of structural features that may be at the site. Abandoned foundations and utilities, if present, will need to be removed and the resulting excavations backfilled. Utility lines should be completely removed or, with prior approval, grouted

full if left in place. Excavations left from demolition and removal of existing structures should be backfilled with compacted structural fill in accordance with the recommendations in Section 6.6.1 (Structural Fill).

6.1.3 Stripping and Grubbing

Where encountered, existing root zones should be stripped and removed from all areas to receive new structural improvements. Based on our explorations, the average depth of stripping will be approximately 4 inches for most of the site. Increased stripping depths may be anticipated in areas with thicker vegetation and shrubs. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported offsite for disposal or used in landscaped areas.

6.1.4 Tilled Zone

An approximately 12- to 18-inch-thick tilled zone was observed throughout the site. Tilled zones typically have lower densities and contain slightly higher organic contents. The tilled zone generally exhibits low strength and does not provide adequate subgrade support for foundation elements or pavement. We recommend improving the tilled zone during site preparation where it will not be removed by site cuts.

In all structural fill, pavement, and improvement areas, the soil in tilled zones should be removed and replaced with structural fill or scarified and compacted in place. Scarification and compaction of the subgrade may be the most economical option for subgrade improvement; however, it will likely only be possible during extended dry periods and following moisture conditioning of the soil. As discussed further on in this report, cement amendment is an option for conditioning the soil for use as structural fill during periods of wet weather or when drying the soil is not an option.

6.1.5 Test Pit Locations

The test pit excavations were backfilled using the relatively minimal compactive effort of the excavator bucket. Soft spots can be expected at these locations. We recommend this relatively uncompacted soil be removed from the test pits to a depth of 3 feet below finished subgrade. If a test pit is located within 10 feet of a footing, we recommend full-depth removal of the uncompacted soil. The resulting excavation should be brought back to grade with structural fill.

6.1.6 Subgrade Evaluation

Upon completion of stripping and prior to the placement of structural fill or pavement improvements, exposed subgrade soil should be evaluated by proof rolling with a fully loaded dump truck or similar heavy, rubber-tired construction equipment. When the subgrade is too wet for proof rolling or access with a truck is not possible, a foundation probe may be used to identify areas of soft, loose, or unsuitable soil. Columbia West should perform subgrade evaluation. If soft or yielding subgrade areas are identified during evaluation, we recommend the subgrade be over excavated and backfilled with compacted imported granular fill.

6.2 CONSTRUCTION TRAFFIC AND STAGING

The near-surface fine-grained soil may be disturbed during construction. If not carefully executed, site preparation, utility trench work, and roadway excavation can create extensive soft areas and significant repair costs can result. Earthwork planning, regardless of the time of year, should include considerations for minimizing subgrade disturbance.

If construction occurs during or extends into the wet season or if the moisture content of the surficial soil is more than a couple percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment. Likewise, the use of granular haul roads and staging areas will be necessary for support of construction traffic during the rainy season or when the moisture content of the surficial soil is more than a few percentage points above optimum.

The aggregate base thickness for pavement areas is intended to support post-construction design traffic loads and is not designed to support construction traffic. Moreover, if construction is planned for periods when the subgrade soil is wet, staging and haul roads with increased thicknesses of aggregate base will be required. The amount of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's sequencing of a project and type/frequency of construction equipment and should, therefore, be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material are generally required in staging areas and between 18 and 24 inches in haul road areas. The contractor should also be responsible for selecting the type of material for construction of haul roads and staging areas. A geotextile fabric can be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic to help prevent silt migration into the aggregate base. The imported granular material, stabilization material, and geotextile fabric should meet the specifications in Section 6.6 (Materials).

Project stakeholders should understand that wet weather construction is risky and costly. Proper construction methods and techniques are critical to overall project integrity and should be observed and documented by Columbia West.

6.3 SLOPE CONSTRUCTION AND DRAINAGE

Fill slopes should consist of structural fill material as discussed in Section 6.6.1 (Structural Fill). Fill placed on existing grades steeper than 5H:1V should be horizontally benched at least 10 feet into the slope. Fill slopes with grades of 3H:1V or steeper should also be overbuilt by at least 3 feet and cut back to finish grade. A typical fill slope cross section is shown on Figure 5. Drainage implementations, including subdrains or perforated drainpipe trenches, may also be necessary in proximity to cut and fill slopes if seeps or springs are encountered. Drainage design may be performed on a case-by-case basis. The extent, depth, and location of drainage may be determined in the field by Columbia West during construction when soil conditions are exposed. Failure to provide adequate drainage may result in soil sloughing, settlement, or erosion. Fill slopes should be overbuilt, compacted, and trimmed at least 2 feet horizontally to provide adequate compaction of the outer slope face. Proper cut and fill slope construction is critical to overall project stability and should be observed and documented by Columbia West.

6.4 EXCAVATION

Conventional earthmoving equipment in proper working condition should be capable of making necessary site excavations. Temporary excavation sidewalls should maintain a vertical cut to a depth of approximately 4 feet BGS in the near-surface silt, provided groundwater seepage is not present in the sidewalls. In sandy soil, excavations will likely slough and cave, even at shallow depths. Open-cut excavation techniques may be used to excavate trenches between 4 and 8 feet deep, provided the walls of the excavation are cut at a maximum slope of 1.5H:1V and groundwater seepage does not occur. Excavation side slopes should be reduced to a stable inclination if excessive sloughing or raveling occurs.

Shoring may be required if open-cut excavations are not feasible. As a wide variety of shoring and dewatering systems are available, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems. If box shoring is used, the contractor should understand it is a safety feature used to protect workers and does not prevent caving. If excavations are left open, caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

Temporary excavation sidewalls should maintain a vertical cut to a depth of approximately 4 feet in the native soil, provided groundwater seepage is not present in the sidewalls. Open-cut excavation techniques may be used to excavate trenches between 4 and 8 feet deep, provided the walls of the excavation are cut at a maximum slope of 1H:1V and groundwater seepage is not present. Excavation slopes should be reduced to 1.5H:1V or 2H:1V if excessive sloughing or raveling occurs.

Shoring may be required if open-cut excavations are not feasible or if excavations are proposed adjacent to existing infrastructure and improvements. A wide variety of shoring and dewatering systems are available, and we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems.

All excavations should be made in accordance with applicable OSHA requirements and regulations of the state, county, and local jurisdiction. While this report describes certain approaches to excavation and dewatering, the contract documents should specify that the contractor is responsible for selecting the excavation and dewatering methods, monitoring the excavations for safety, and providing shoring (as required) to protect personnel and adjacent structural elements.

6.5 CONSTRUCTION DEWATERING

The contractor should be responsible for temporary drainage of surface water, perched water, and groundwater. Dewatering should be performed to the extent necessary to prevent standing water and/or erosion of exposed site soil. During rough and finished grading of building pad areas, the contractor should keep all footing excavations and slab subgrade soil free of standing water.

The need for dewatering will depend on the time of year and depth of excavations. If perched groundwater is encountered, pumping from a sump located within the trench may be effective in dewatering localized sections of trench. However, this method is unlikely to prove effective in dewatering long sections of trench or large excavations. In addition, the sidewalls of trench excavations will need to be flattened or shored if seepage is encountered. We note that these recommendations are for guidance only. Dewatering of excavations is the sole responsibility of the contractor, as the contractor is in the best position to select these systems based on their means and methods.

If groundwater is present at the bases of utility excavations, we recommend placing a minimum of 12 inches of stabilization material at the base of the excavation. The actual thickness of stabilization material should be determined at the time of construction based on observed field conditions. Trench stabilization material should be placed in one lift and compacted until well keyed. Stabilization material and geotextile fabric should meet the requirements in Section 6.6 (Materials).

6.6 MATERIALS

6.6.1 Structural Fill

6.6.1.1 General

Areas proposed for fill placement should be appropriately prepared as described in Section 6.1 (Site Preparation). Engineered fill placement should be observed by Columbia West. Compaction of engineered structural fill should be verified by proof rolling or nuclear gauge field compaction testing performed in accordance with ASTM D6938. Field compaction testing should be performed for each vertical foot of engineered fill placed.

Various materials may be acceptable for use as structural fill. Structural fill should be free of organic material or other unsuitable material and meet the specifications provided in the following sections. Representative samples of proposed engineered structural fill should be submitted for laboratory testing and approval by Columbia West prior to placement. All structural fill should be free of organic material and have a particle size of less than 6 inches.

6.6.1.2 On-Site Soil

The on-site soil is suitable for use as structural fill if adequately dried or moisture conditioned to achieve recommended compaction specifications. Based on laboratory testing, we anticipate that the moisture content of the soil will generally be above the optimum moisture content required to meet compaction requirements for the on-site soil and drying of the soil will be necessary. Accordingly, extended dry weather will be required to adequately condition and place the soil as structural fill. It will be difficult, if not impossible, to adequately compact on-site soil during the rainy season or during prolonged periods of rainfall.

On-site soil used as structural fill should be placed in loose lifts not exceeding 8 inches thick and compacted using standard conventional compaction equipment. The soil moisture content should be within a few percentage points of optimum conditions. The soil should be compacted to at least 92 percent of maximum dry density as determined by ASTM D1557.

The on-site soil will likely expand during excavation and transport and consolidate during compaction. Development of site-specific expansion and consolidation factors is beyond the scope of this study. We can provide site-specific factors upon request.

6.6.1.3 Imported Granular Material

Imported granular material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand meeting the specifications in WSS 9-03.14(1) – Gravel Borrow. Imported granular material should be placed in loose lifts not exceeding 12 inches thick and compacted to at least 95 percent of maximum dry density as determined by ASTM D1557. During wet weather conditions or where wet subgrade conditions are present, the initial loose lift of granular fill should be approximately 18 inches thick and should be compacted with a smooth-drum roller operating in static mode.

6.6.1.4 Stabilization Material

Stabilization material should consist of durable, 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is free of organic material and other deleterious material. The material should have a maximum particle size of 6 inches with less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should have at least two mechanically fractured faces.

Stabilization material should be placed in loose lifts between 12 and 24 inches thick and compacted to a firm, unyielding condition. Equipment with vibratory action should not be used when compacting stabilization material over wet, fine-grained soil. If stabilization material is used to stabilize soft subgrade below pavement or construction haul roads, a subgrade geotextile should be placed as a separation barrier between the soil subgrade and stabilization material.

6.6.1.5 Trench Backfill

Trench backfill placed below, adjacent to, and up to at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material meeting the specifications in WSS 9-03.12(3) – Gravel Backfill for Pipe Zone Bedding. Pipe zone backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D1557 or as required by the local jurisdictional agency or pipe manufacturer.

Within structural areas (below pavement and building pads), trench backfill above the pipe zone should consist of WSS 9-03.19 – Bank Run Gravel for Trench Backfill or WSS 9-03.14(2) – Select Borrow with a maximum particle size of 2½ inches. Trench backfill material within 18 inches of the top of utility pipes should be hand compacted (i.e., no heavy compaction equipment). Remaining trench backfill should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557 or as required by the local jurisdictional agency or pipe manufacturer.

Outside of structural areas, trench backfill placed above the pipe zone should be compacted to at least 90 percent of maximum dry density as determined by ASTM D1557 or as required by the local jurisdictional agency or pipe manufacturer.

6.6.1.6 Retaining Wall Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of $\frac{1}{2}H$, where H is the height of the retaining wall, should consist of free-draining granular material meeting the specifications in WSS 9-03.12(2) – Gravel Backfill for Walls. The wall backfill should be separated from structural fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

Wall backfill located within a horizontal distance of 3 feet from the face of a retaining wall should be compacted to 90 percent of maximum dry density as determined by ASTM D1557. Backfill placed within 3 feet of the wall should be compacted in loose lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). Remaining wall backfill should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557.

6.6.1.7 Retaining Wall Leveling Pad

Crushed aggregate used as a leveling pad for retaining wall footings should consist of 1¼-inch-minus crushed aggregate meeting the specifications in WSS 9-03.9(3) – Crushed Surfacing. The leveling pad material should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557.

6.6.1.8 Floor Slab and Pavement Aggregate Base

Aggregate base for building floor slabs and pavement should consist of 1¼-inch-minus crushed aggregate meeting the specifications in WSS 9-03.9(3) – Crushed Surfacing. Slab aggregate base should be compacted to at least 95 percent of maximum dry density as determined by ASTM D1557.

6.6.1.9 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches. The material should be free of roots, organic material, and other unsuitable material; should have less than 2 percent fines by dry weight; and should have at least two mechanically fractured faces. Drain rock should be compacted to a well-keyed, firm condition.

6.6.2 Geotextile Fabric

6.6.2.1 Subgrade Geotextile

Subgrade geotextile should meet the specifications in WSS 9-33.2(1), Table 3, Geotextile for Separation or Soil Stabilization. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles. All stabilization material should be underlain by a subgrade geotextile.

6.6.2.2 Drainage Geotextile

Subgrade geotextile should meet the specifications in WSS 9-33.2(1), Table 2, Geotextile for Underground Drainage Filtration Properties. The AOS should be between U.S. Standard No. 70 and No. 100 sieves. The geotextile should be installed in accordance with the manufacturer's recommendations. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

6.6.3 Pavement

6.6.3.1 AC

AC should consist of HMA Class ½" adhering to the specifications in WSS 9-03.8(6) - HMA Proportions of Materials. The asphalt binder should consist of PG 58-22 meeting the specifications in WSS 9-02.1(4) - Performance Graded (PG) Asphalt Binder. Asphalt should be compacted to 91 percent of the theoretical maximum density as determined by ASTM D2041. Minimum and maximum AC lift thicknesses should be 2 and 3 inches, respectively. Nuclear gauge density testing should be conducted to verify adherence to recommended specifications. Testing frequency should be in accordance with WSS and City of La Center specifications.

6.6.3.2 Cold Weather Paving Considerations

In general, AC paving is not recommended during cold weather (temperatures less than 40 degrees Fahrenheit). Compacting under these conditions can result in low compaction and premature pavement distress.

Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Washington, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thickness between 2 and 2.5 inches.

If paving activities must take place during cold weather construction as defined above, the project team should be consulted and a site meeting should be held to discuss ways to lessen low compaction risks.

6.6.4 Soil Amendment with Cement

The on-site soil can be amended with portland cement to obtain suitable properties for use as wet weather structural fill or subbase for pavement. The effectiveness of soil amendment is highly dependent on proper mixing techniques, soil moisture conditioning, and the quantity of cement. The quantity of cement applied during amendment should be based on an assumed dry unit weight of 100 pcf for the on-site soil.

6.6.4.1 Subbase Stabilization

Specific recommendations for soil amendment should be based on exposed site conditions at the time of construction. For preliminary design purposes, we recommend cement-amended subgrade for building pads and pavement subbase (below the aggregate base layer) achieve a target strength of 100 psi. The quantity of cement required to achieve the target strength will vary with moisture content and soil type. Laboratory testing of cement-amended soil should be used to confirm design expectations.

Based on our experience, the near-surface soil will require approximately 6 to 7 percent cement by weight to achieve the target strength of 100 psi. This cement percentage assumes that the soil moisture content does not exceed 25 percent at the time of amendment. If the soil moisture content is in the range of 25 to 35 percent, 7 to 8 percent cement by weight may be required to achieve the target strength. The amount of cement added to the soil at the time of construction

should be based on observed field conditions and subgrade performance. During extended periods of dry weather, water may need to be applied during the amendment and tilling process to achieve the optimum moisture content required for compaction.

Cement amendment equipment should have balloon tires to minimize softening, rutting, and disturbance of the fine-grained site soil. A sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction. Rollers with vibratory action should not be used to compact fine-grained, cement-amended soil. Final compaction should be conducted with a smooth-drum roller with a minimum applied linear force of 700 pounds per inch. The amended soil should be compacted to at least 95 percent of maximum dry density as determined by ASTM D558.

Following cement amendment, a minimum curing time of four days is required prior to exposure to construction traffic. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect cement-amended areas from damage, the finished surface should be covered with 4 to 6 inches of imported granular material. The protective layer of crushed rock often becomes contaminated with soil during construction, particularly in staging and haul road areas. Contaminated aggregate, where present, should be removed and replaced with clean crushed aggregate prior to construction of pavement or other permanent site improvements supported by aggregate base.

Cement amendment should not be attempted during moderate to heavy precipitation or when the ambient air temperature is below 40 degrees Fahrenheit. Cement should not be placed in areas of standing water or where saturated subgrade conditions exist.

6.6.4.2 Cement-Amended Structural Fill

If adequate compaction is not achievable with on-site soil due to moisture or weather conditions, the soil may be cement amended and placed as general structural fill. Prior to placement of cement-amended fill, subgrade soil should be prepared as described in Section 6.1 (Site Preparation). Where multiple lifts of cement-amended fill are necessary to meet finished grade, consecutive lifts may be placed immediately following amendment and compaction of the underlying lift. However, where the final lift of cement-amended fill will serve as building pad or pavement subbase material, the four-day cure period as discussed above is recommended.

6.6.4.3 Testing and Construction Observation

Cement amendment of the site soil should be observed and tested by Columbia West to document conformance with design recommendations. Cement spread rate should be verified by measuring the spread area relative to the weight of cement used or with a pan sample test conducted at one random location per lift per 20,000 square feet of cement-amended fill. Amendment depth should be verified through excavation of a small test pit and measurement at one random location per lift of cement-amended fill. Adequate compaction and moisture content should be verified by conducting nuclear gauge density testing at a frequency of approximately one test per 5,000 square feet of cement-amended fill in accordance with ASTM D6938. When amending pavement subgrade, at least one representative sample should be collected per day of

cement amendment, cured for seven days, and tested for unconfined compressive strength in accordance with ASTM D1633. The tested samples should have a minimum seven-day, unconfined compressive strength of 100 psi.

6.6.4.4 Drainage Considerations

Cement-amended soil will be poorly drained and will not be suitable for planting areas. The material may also be difficult to excavate with light-duty equipment. Proposed landscape areas should not be cement amended, unless accommodations are made for drainage and planting. Cement amendment within building pad areas should consider the potential for trapped water below the floor slab. Columbia West should be consulted to provide appropriate recommendations if cement amendment is proposed within building pad areas. Cement amendment should not be used if runoff during construction cannot be directed away from adjacent wetlands. Cement amendment runoff should be collected, monitored, and treated, if necessary, in accordance with applicable regulations prior to being discharged.

6.7 EROSION CONTROL

Soil at this site is susceptible to erosion by wind and water; therefore, erosion control measures should be carefully planned and installed before construction begins. Surface water runoff should be collected and directed away from sloped areas to prevent water from running down the slope face. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards.

7.0 OBSERVATION OF CONSTRUCTION

Satisfactory pavement, earthwork, and foundation performance depends to a large degree on the quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Columbia West should be retained to observe subgrade preparation, fill placement, foundation excavations, drainage system installation, and pavement placement and to review laboratory compaction and field moisture-density information.

Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

8.0 LIMITATIONS

We have prepared this report for use by the addressee and members of the design and construction team for the proposed project. This report is subject to the limitations expressed in Appendix C.



We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,



Michael C. King, PE
Project Engineer



Shawn M. Dimke, PE
Principal Engineer

REFERENCES

ASCE 2016. *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*. ASCE Standard ASCE/SEI 7-16.

Clark County 2021. *Clark County Stormwater Manual*, Clark County, Washington, July.

Columbia West 2024. *Phase I Environmental Site Assessment; Proposed Manning Meadows; 1819 NE 339th Street; La Center, Washington*, dated December 30, 2024. CWE Project: LGI-14-02-1.

ASTM International 2022. *Annual Book of ASTM Standards*, Volume 04.08: Soil and Rock (I), D420-D5876/D5876m.

International Code Council 2021. *2021 International Building Code*.

Otak, Inc. 2010. Memorandum, *Clark County WWHM Soil Groupings*, Clark County, Washington, December 21.

OSHA, Safety and Health Regulations for Construction, 29 CFR Part 1926, revised 2024.

USDA. Web Soil Survey. National Resources Conservation Services, website <https://websoilsurvey.nrcs.usda.gov/app/HomePage.htm>, accessed December 2024.

USDA 2009, "Chapter 7, Hydrologic Soil Groups," *National Engineering Handbook, Part 630 Hydrology*, National Resources Conservation Services, January.

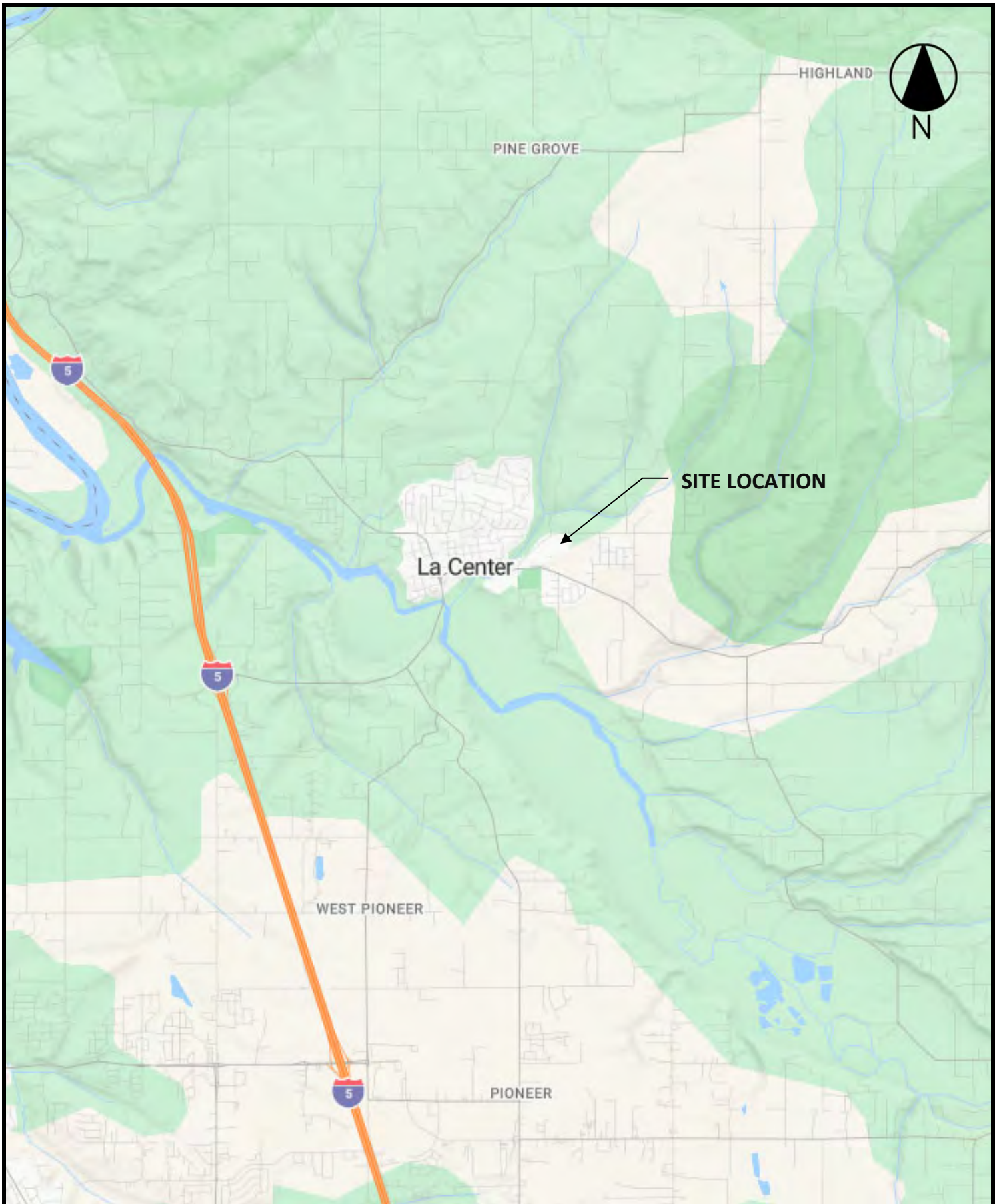
USGS 2018. Quaternary fault and fold database for the United States, <https://www.usgs.gov/natural-hazards/earthquake-hazards/faults>, accessed December 2024.

Washington State Department of Transportation 2024. *Standard Specifications for Road, Bridge, and Municipal Construction, M 41-10*.

Weaver, C.S., and K.M. Shedlock 1991. Program for earthquake hazards assessment in the Pacific Northwest: U.S. Geological Survey Circular 1067, 29 pgs.



FIGURES





LEGEND

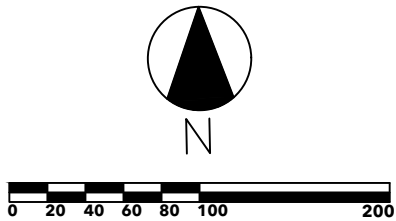
- [Dashed line] SITE BOUNDARY
- [Blue square] TEST PIT
- K UNFACTORED COEFFICIENT OF PERMEABILITY, IN/HR

MANNING MEADOWS SUBDIVISION
LA CENTER, WASHINGTON
1819 NE 339TH STREET

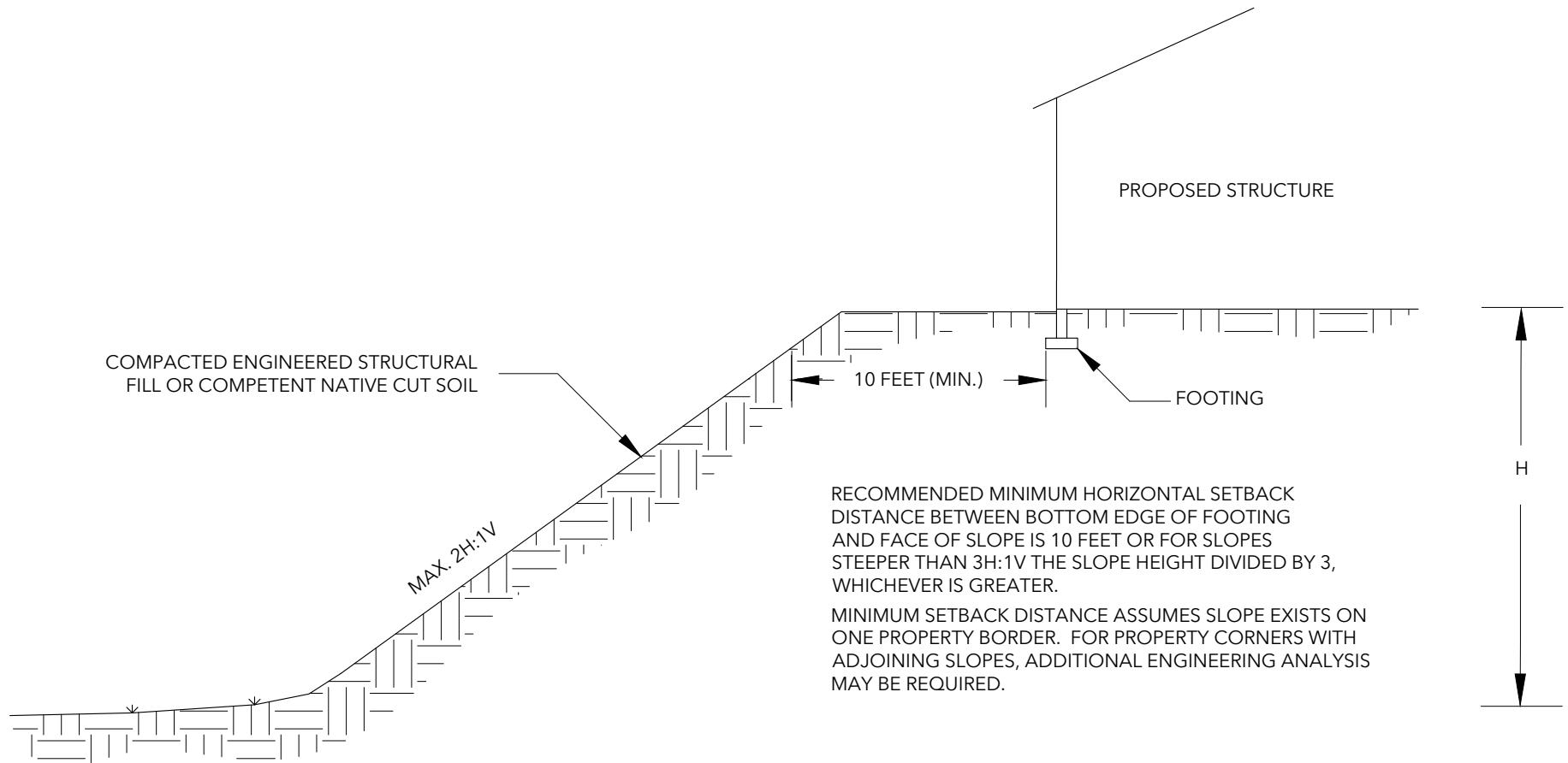
SITE PLAN

PROJECT NO:
LGI-14-01-1
JANUARY 2025

FIGURE
2



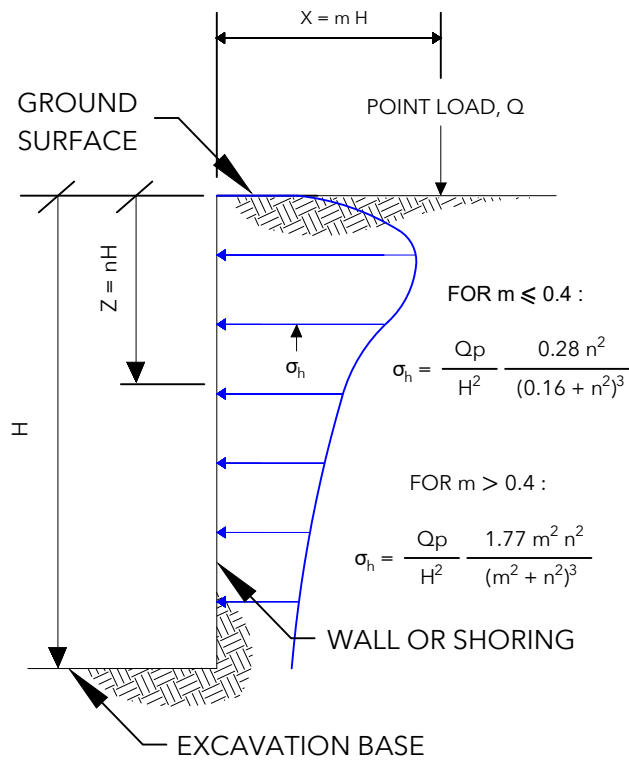
- NOTES:
- 1. AERIAL PHOTO SOURCED FROM GOOGLE EARTH.
 - 2. PRELIMINARY SITE PLAN PREPARED BY PLS ENGINEERING.
 - 3. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
 - 4. REFER TO REPORT TEXT FOR EXPLORATION



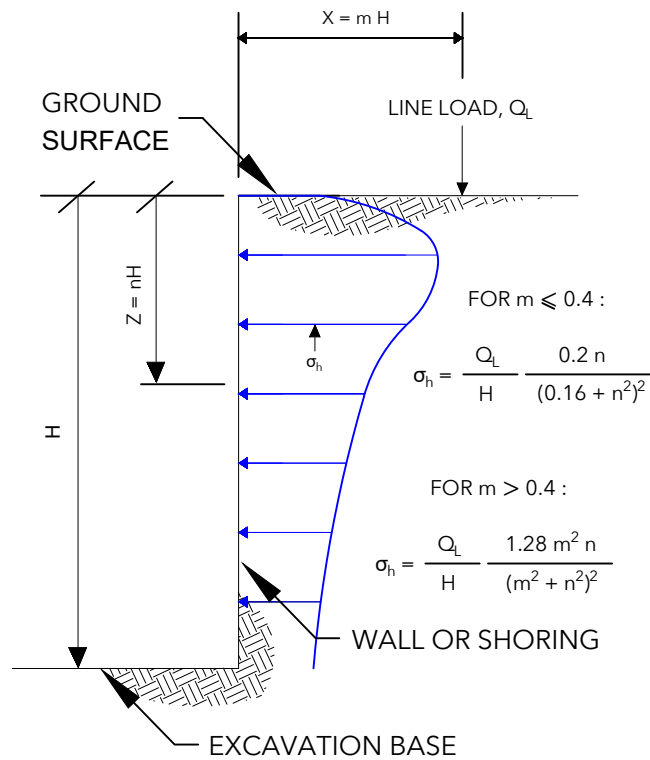
NOTES:

1. DRAWING IS NOT TO SCALE.
2. SLOPES AND PROFILES SHOWN ARE APPROXIMATE.
3. DRAWING REPRESENTS TYPICAL FOUNDATION SETBACK DETAIL AND MAY NOT BE SITE-SPECIFIC.

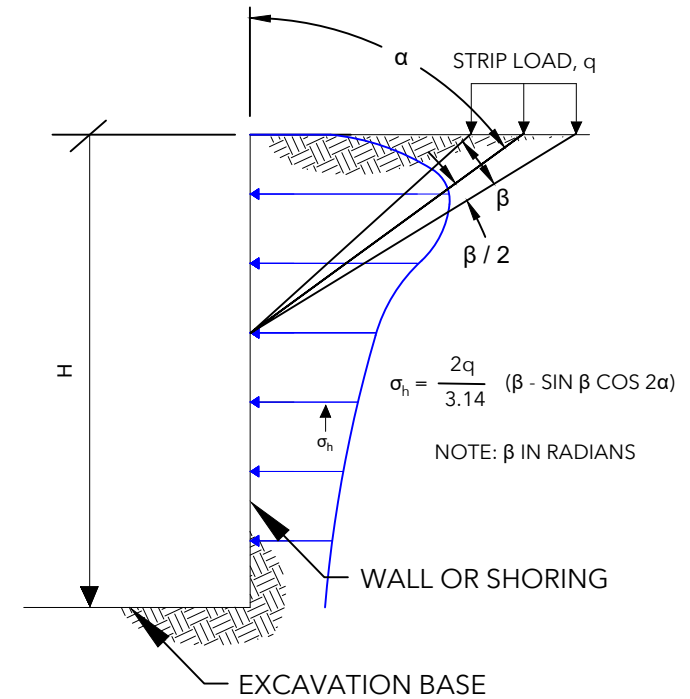
VERTICAL POINT LOAD



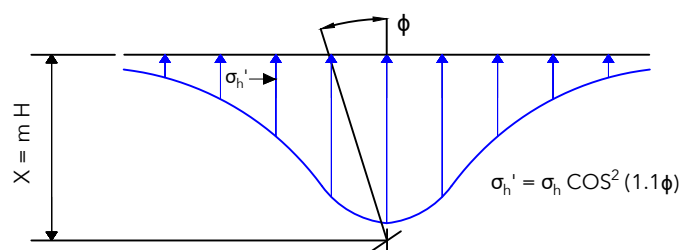
LINE LOAD PARALLEL TO WALL



STRIP LOAD PARALLEL TO WALL

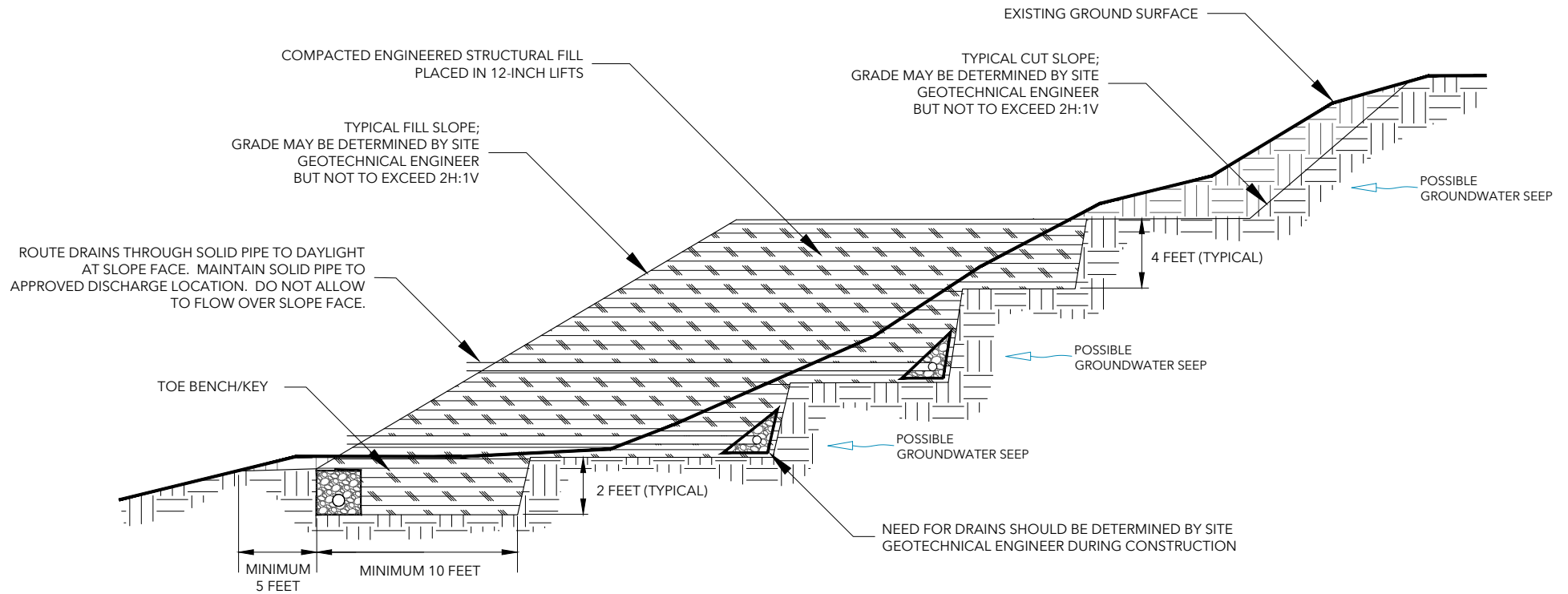


VERTICAL POINT LOAD HORIZONTAL PRESSURE DISTRIBUTION



NOTES:

1. FIGURE SHOULD BE USED JOINTLY WITH RECOMMENDATIONS PRESENTED IN THE REPORT TEXT.
2. LATERAL EARTH PRESSURES ASSUME RIGID WALLS WITH BACKFILL MATERIALS HAVING A POISSON'S RATIO OF 0.5.
3. TOTAL LATERAL EARTH PRESSURES RESULTING FROM COMBINED LOADS MAY BE CALCULATED USING SUPERPOSITION.
4. DRAWING IS NOT TO SCALE.

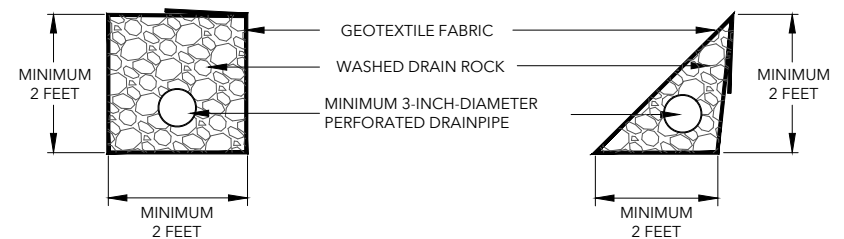


DRAIN SPECIFICATIONS

GEOTEXTILE FABRIC SHALL CONSIST OF MIRAFI 140N OR APPROVED EQUIVALENT WITH AOS BETWEEN U.S. STANDARD NO. 70 AND NO. 100 SIEVES.

WASHED DRAIN ROCK SHALL BE OPEN-GRADED ANGULAR DRAIN ROCK WITH LESS THAN 2 PERCENT PASSING THE U.S. STANDARD NO. 200 SIEVE AND A MAXIMUM PARTICLE SIZE OF 3 INCHES.

TYPICAL DRAIN SECTION DETAIL



TYPICAL CUT AND FILL
SLOPE CROSS SECTION

NOTES:
1. DRAWING IS NOT TO SCALE.
2. DRAWING REPRESENTS TYPICAL CUT AND FILL SLOPE CROSS SECTION AND MAY NOT BE SITE-SPECIFIC.

FIGURE
5



APPENDIX A

APPENDIX A FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at the site by excavating nine test pits (TP-1 through TP-9) to depths between 14 and 15 feet BGS. Excavation services were provided by L&S Contracting LLC of Yacolt, Washington, on December 12, 2024, using a track-mounted excavator. The explorations were logged on a full-time basis by Columbia West personnel. The exploration logs are presented in this appendix.

The exploration locations are shown on Figure 2. The exploration locations were determined in the field by pacing or measuring from existing site features. This information should be considered accurate only to the degree implied by the methods used.

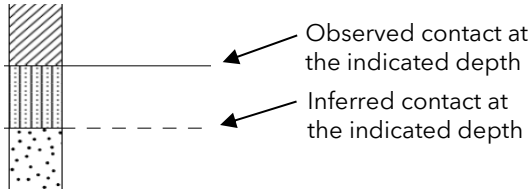
SOIL SAMPLING

Representative disturbed samples of soil observed in the test pit explorations were collected from the test pit walls and base using the excavator bucket. Sampling methods and intervals are shown on the exploration logs.

SOIL CLASSIFICATION

The soil samples were classified in the field in accordance with the "Exploration Legend" and "Soil Classification System," which are presented in this appendix. The exploration logs indicate the depths at which the soil characteristics change, although the change could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.

EXPLORATION LEGEND

SAMPLER TYPE	DESCRIPTION	
SPT	Sample collected from the indicated depth in general accordance with ASTM D1586, <i>Standard Penetration Test and Split-Barrel Sampling of Soils</i>	
SH	Sample collected from the indicated depth using thin-wall Shelby tube in general accordance with ASTM D1587, <i>Thin-Walled Tube Sampling of Fine-Grained Soils</i>	
D&M	Sample collected from the indicated depth using Dames & Moore sampler and 140-pound hammer or pushed	
CSS	Sample collected from the indicated depth using 3-inch-outside diameter California split-spoon sampler and 140-pound hammer	
GRAB	Grab sample collected from the indicated depth	
CORE	Pavement or rock core interval at the indicated depth	

GEOTECHNICAL ABBREVIATIONS AND ACRONYMS

ATT	Atterberg Limits	PP	Pocket Penetrometer
CBR	California Bearing Ratio	P200	Percent Passing No. 200 Sieve
CON	Consolidation Test	RES	Resilient Modulus
DD	Dry Density	SIEV	Sieve Analysis
DS	Direct Shear	TS	Torvane Shear
HYD	Hydrometer	tsf	Tons per Square Foot
MC	Moisture Content	UC	Unconfined Compressive Strength
MD	Moisture-Density Relationship	UU	Unconsolidated Undrained Triaxial Test
NP	Non-Plastic	VS	Vane Shear
OC	Organic Content	WD	Wet Density
P	Pushed Sample		

ENVIRONMENTAL ABBREVIATIONS AND ACRONYMS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
ppm	Parts per Million	MS	Moderate Sheen
		HS	Heavy Sheen

SOIL CLASSIFICATION SYSTEM

PARTICLE-SIZE CLASSIFICATION

COMPONENT	ASTM / USCS		AASHTO	
	Size Range	Sieve Size Range	Size Range	Sieve Size Range
Boulders	Greater than 300 mm	Greater than 12 inches	--	--
Cobbles	75 mm to 300 mm	3 inches to 12 inches	Greater than 75 mm	Greater than 3 inches
Gravel	75 mm to 4.75 mm	3 inches to No. 4 sieve	75 mm to 2.00 mm	3 inches to No. 10 sieve
Coarse	75 mm to 19.0 mm	3 inches to 3/4-inch sieve	--	--
Fine	19.0 mm to 4.75 mm	3/4-inch to No. 4 sieve	--	--
Sand	4.75 mm to 0.075 mm	No. 4 to No. 200 sieve	2.00 mm to 0.075 mm	No. 10 to No. 200 sieve
Coarse	4.75 mm to 2.00 mm	No. 4 to No. 10 sieve	2.00 mm to 0.425 mm	No. 10 to No. 40 sieve
Medium	2.00 mm to 0.425 mm	No. 10 to No. 40 sieve	--	--
Fine	0.425 mm to 0.075 mm	No. 40 to No. 200 sieve	0.425 mm to 0.075 mm	No. 40 to No. 200 sieve
Fines (Silt and Clay)	Less than 0.075 mm	Passing No. 200 sieve	Less than 0.075 mm	Passing No. 200 sieve

CONSISTENCY FOR COHESIVE SOIL

CONSISTENCY	SPT N-VALUE (blows per foot)	D&M N-VALUE (blows per foot)	POCKET PENETROMETER (unconfined compressive strength [tsf])
Very soft	0 to 2	0 to 3	Less than 0.25
Soft	2 to 4	3 to 6	0.25 to 0.5
Medium stiff	4 to 8	6 to 12	0.5 to 1.0
Stiff	8 to 15	12 to 25	1.0 to 2.0
Very stiff	15 to 30	25 to 65	2.0 to 4.0
Hard	Greater than 30	Greater than 30	Greater than 4.0

RELATIVE DENSITY FOR GRANULAR SOIL

RELATIVE DENSITY	SPT N-VALUE (blows per foot)	D&M N-VALUE (blows per foot)
Very loose	0 to 4	0 to 11
Loose	4 to 10	11 to 26
Medium dense	10 to 30	26 to 74
Dense	30 to 50	74 to 120
Very dense	Greater than 50	Greater than 120

MOISTURE DESIGNATIONS

TERM	FIELD IDENTIFICATION
Dry	Very low moisture, dry to touch
Moist	Damp, color appears darkened, without visible moisture, cohesive soil will clump, sand will bulk
Wet	Visible free water, usually saturated

ADDITIONAL CONSTITUENTS

Percent	SILT AND CLAY IN		Percent	SAND AND GRAVEL IN		Percent	SECONDARY MATERIAL
	Fine-Grained Soil	Coarse-Grained Soil		Fine-Grained Soil	Coarse-Grained Soil		Organics and Man-Made Debris
< 5	trace	trace	< 5	trace	trace	< 4	trace
5 - 12	minor	with	5 - 15	minor	minor	4 - 12	some
> 12	some	silty/clayey	15 - 30	with	with		
			> 30	sandy/gravelly	with		

PROJECT NAME Manning Meadows Subdivision **CLIENT** LGI Homes
PROJECT NO. LGI-14-01-1 **LOGGED BY** E. Uren **PROJECT LOCATION** La Center, Washington
CONTRACTOR L&S Contracting LLC **EQUIPMENT** CAT 307E
CAVING Not observed **DATE COMPLETED** 12/12/2024
GROUNDWATER Slow seepage at 3 and 6 feet **TIME STARTED** 8:21 AM **TIME COMPLETED** 12:20 PM

DEPTH (ft)	SAMPLE GRAPHIC	SAMPLE ID	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (LL-PL-Pi)	FINES (%)	REMARKS
					Soft, brown CLAY with sand, trace organics, moist (12-inch-thick tilled zone, 3-inch-thick root zone). 1.0					
	■	TP1.1			Medium stiff, brown-gray CLAY with sand, moist, low plasticity, sand is fine.	1.0	29	35-23-12	82	Infiltration test at 2 feet.
5	■	TP1.2				1.0				
							34		84	Infiltration test at 5 feet.
				CL						
	■	TP1.3			Brown-orange, trace gravel, gravel is fine at 11.5 feet.		37			
15					15.0					Test pit completed at 15 feet.

PROJECT NAME Manning Meadows Subdivision

CLIENT LGI Homes

PROJECT NO. LGI-14-01-1 **LOGGED BY** E. Uren

PROJECT LOCATION La Center, Washington

CONTRACTOR L&S Contracting LLC






EQUIPMENT CAT 307E

CAVING Not observed

DATE COMPLETED 12/12/2024

GROUNDWATER See remarks



TIME STARTED 8:58 AM **TIME COMPLETED** 12:20 PM

DEPTH (ft)	SAMPLE GRAPHIC	SAMPLE ID	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	FINES (%)	REMARKS
					Soft, brown CLAY with sand, trace organics, moist (15-inch-thick tilled zone, 3-inch-thick root zone). 1.3				
		TP2.1		CL	Medium stiff, brown-gray CLAY with sand, moist, sand is fine.	0.5	33	81	Infiltration test at 2 feet. Slow seepage at 2 feet.
						0.5			
5		TP2.2				55	76	Infiltration test at 5 feet. Moderate seepage at 5 feet.	
		TP2.3					40		
15					15.0				Test pit completed at 15 feet.

PROJECT NAME Manning Meadows Subdivision **CLIENT** LGI Homes
PROJECT NO. LGI-14-01-1 **LOGGED BY** E. Uren **PROJECT LOCATION** La Center, Washington
CONTRACTOR L&S Contracting LLC **EQUIPMENT** CAT 307E
CAVING Not observed **DATE COMPLETED** 12/12/2024
GROUNDWATER Not observed **TIME STARTED** 9:27 AM **TIME COMPLETED** 9:48 AM

DEPTH (ft)	SAMPLE GRAPHIC	SAMPLE ID	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (LL-PL-Pi)	FINES (%)	REMARKS
					Soft, brown SILT with sand, trace organics, moist (18-inch-thick tilled zone, 3-inch-thick root zone).	1.5				
					Medium stiff, brown-gray-orange SILT, some clay, minor sand, moist, low plasticity, sand is fine.	0.5				
5	■	TP3.1		ML		0.5		40-27-13		
					Medium stiff, brown CLAY with sand, moist, sand is fine.	6.0				
	■	TP3.2					38			
10				CL						
	■	TP3.3					31		79	
15						15.0				
Test pit completed at 15 feet.										

PROJECT NAME Manning Meadows Subdivision **CLIENT** LGI Homes
PROJECT NO. LGI-14-01-1 **LOGGED BY** E. Uren **PROJECT LOCATION** La Center, Washington
CONTRACTOR L&S Contracting LLC **EQUIPMENT** CAT 307E
CAVING Not observed **DATE COMPLETED** 12/12/2024
GROUNDWATER Slow seepage at 5 and 10 feet **TIME STARTED** 9:51 AM **TIME COMPLETED** 10:15 AM

DEPTH (ft)	SAMPLE GRAPHIC	SAMPLE ID	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	% Organic Material	REMARKS
	■	TP4.1			Soft, brown CLAY with sand, trace organics, moist (18-inch-thick tilled zone, 3-inch-thick root zone).		30	3.6	
					1.5 Medium stiff, gray-brown-orange CLAY, minor sand, moist, sand is fine.	0.5			
5					Brown at 5 feet.	0.5			
	■	TP4.2					31		
10	■	TP4.3			Brown-gray at 10 feet.		30		
	■	TP4.4		GC	Dense, brown clayey GRAVEL, moist, gravel is fine to coarse and rounded.	13.0	6		
					14.0				
15					Test pit completed at 14 feet.				

PROJECT NAME Manning Meadows Subdivision **CLIENT** LGI Homes
PROJECT NO. LGI-14-01-1 **LOGGED BY** E. Uren **PROJECT LOCATION** La Center, Washington
CONTRACTOR L&S Contracting LLC **EQUIPMENT** CAT 307E
CAVING Not observed **DATE COMPLETED** 12/12/2024
GROUNDWATER Slow seepage at 4 and 12 feet **TIME STARTED** 10:17 AM **TIME COMPLETED** 10:50 AM

DEPTH (ft)	SAMPLE GRAPHIC	SAMPLE ID	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
					Soft, brown CLAY with sand, trace organics, moist (18-inch-thick tilled zone, 4-inch-thick root zone).	1.5		
					Medium stiff, brown CLAY, minor sand, moist, sand is fine.	0.5		
5						0.5		
10				CL				
						14.0		
15					Test pit completed at 14 feet.			



PROJECT NAME Manning Meadows Subdivision **CLIENT** LGI Homes
PROJECT NO. LGI-14-01-1 **LOGGED BY** E. Uren **PROJECT LOCATION** La Center, Washington
CONTRACTOR L&S Contracting LLC **EQUIPMENT** CAT 307E
CAVING Not observed **DATE COMPLETED** 12/12/2024
GROUNDWATER Slow seepage at 7 feet **TIME STARTED** 10:51 AM **TIME COMPLETED** 11:13 AM

DEPTH (ft)	SAMPLE GRAPHIC	SAMPLE ID	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	FINES (%)	REMARKS
					Soft, brown CLAY with sand, trace organics, moist (18-inch-thick tilled zone, 4-inch-thick root zone).	1.5			
						1.0			
	■	TP6.1					36		
5						1.0			
	■	TP6.2					36		
10									
	■	TP6.3					30	88	
15						15.0			
Test pit completed at 15 feet.									

PROJECT NAME Manning Meadows Subdivision **CLIENT** LGI Homes
PROJECT NO. LGI-14-01-1 **LOGGED BY** E. Uren **PROJECT LOCATION** La Center, Washington
CONTRACTOR L&S Contracting LLC **EQUIPMENT** CAT 307E
CAVING Not observed **DATE COMPLETED** 12/12/2024
GROUNDWATER Slow seepage at 6 feet **TIME STARTED** 11:21 AM **TIME COMPLETED** 11:48 AM

DEPTH (ft)	SAMPLE GRAPHIC	SAMPLE ID	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
					Soft, brown CLAY with sand, trace organics, moist (18-inch-thick tilled zone, 4-inch-thick root zone).	1.5		
					Medium stiff, brown CLAY, minor sand, moist, sand is fine.	1.0		
5	■	TP7.1				1.0	33	
				CL				
	■	TP7.2					33	
						14.0		
15					Test pit completed at 14 feet.			

PROJECT NAME Manning Meadows Subdivision **CLIENT** LGI Homes
PROJECT NO. LGI-14-01-1 **LOGGED BY** E. Uren **PROJECT LOCATION** La Center, Washington
CONTRACTOR L&S Contracting LLC **EQUIPMENT** CAT 307E
CAVING Not observed **DATE COMPLETED** 12/12/2024
GROUNDWATER See remarks **TIME STARTED** 11:49 AM **TIME COMPLETED** 12:13 PM

DEPTH (ft)	SAMPLE GRAPHIC	SAMPLE ID	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
	■	TP8.1			Soft, brown CLAY with sand, trace organics, moist (18-inch-thick tilled zone, 4-inch-thick root zone).	1.5		
				CL	Medium stiff, brown-gray-orange CLAY, minor sand, moist, sand is fine.	1.0		
5					Brown at 4 feet.	1.0		
	■	TP8.2					32	Slow seepage at 8 feet.
10								Moderate seepage at 12 feet.
						14.0		
15					Test pit completed at 14 feet.			

PROJECT NAME Manning Meadows Subdivision

CLIENT LGI Homes

PROJECT NO. LGI-14-01-1 **LOGGED BY** E. Uren

PROJECT LOCATION La Center, Washington

CONTRACTOR L&S Contracting LLC





EQUIPMENT CAT 307E

CAVING Not observed

DATE COMPLETED 12/12/2024

GROUNDWATER Slow seepage at 11 feet

TIME STARTED 12:21 PM **TIME COMPLETED** 12:45 PM

DEPTH (ft)	SAMPLE GRAPHIC	SAMPLE ID	GRAPHIC LOG	USCS	MATERIAL DESCRIPTION	POCKET PEN (tsf)	MOISTURE CONTENT (%)	REMARKS
					Soft, brown CLAY with sand, trace organics, moist (18-inch-thick tilled zone, 3-inch-thick root zone).	1.3		
		TP9.1		CL	Medium stiff, brown-gray CLAY, minor sand, moist, sand is fine.	1.0	34	
5						1.0		
10		TP9.2						
14.0	Test pit completed at 14 feet.							



APPENDIX B

APPENDIX B LABORATORY TESTING

GENERAL

Laboratory testing was conducted on select soil samples to confirm field classifications and determine the index engineering properties and strength characteristics. The laboratory classifications are shown on the exploration logs if those classifications differed from the field classifications. The locations of the tested samples are shown on the exploration logs. Descriptions of the tests are presented below, and results of the testing are presented in this appendix.

PARTICLE-SIZE ANALYSIS

Particle-size analysis was completed on select soil samples in general accordance with ASTM D1140 (P200). This test is a quantitative determination of the percent passing the U.S. Standard No. 200 sieve by dry weight.

MOISTURE CONTENT

The natural moisture content of select soil samples was determined in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to dry soil in a test sample and is expressed as a percentage.

ATTERBERG LIMITS TESTING

Atterberg limits (plastic and liquid limits) testing was performed on select soil samples in general accordance with ASTM D4318. The plastic limit is defined as the moisture content where the soil becomes brittle. The liquid limit is defined as the moisture content where the soil begins to act similar to a liquid. The plasticity index is the difference between the liquid and plastic limits.

ORGANIC CONTENT TESTING

Organic content testing was completed on a select soil sample in general accordance with ASTM D2974. The moisture content of the sample was determined by drying the sample in a standard drying oven and is expressed as a percentage of the sample weight. The organic content is determined by igniting the oven-dried sample in a muffle furnace. The resulting substance is ash, which is expressed as a percentage of the oven-dried sample.

MOISTURE CONTENT, PERCENT PASSING NO. 200 SIEVE BY WASHING

PROJECT Manning Meadows Subdivision 1819 NE 339th Street La Center, Washington	CLIENT LGI Homes 700 Washington Street, Suite 200 Vancouver, WA 98660	PROJECT NO. LGI-14-01-1	
		ISSUE DATE 12/30/24	PAGE 1 of 2
		DATE SAMPLED 12/12/24	SAMPLED BY E. Uren

LABORATORY TEST DATA

TEST PROCEDURE

ASTM D2216 - Method A, ASTM D1140

LAB ID	CONTAINER MASS (g)	MOIST MASS + CONTAINER (g)	DRY MASS + CONTAINER (g)	AFTER WASH DRY MASS + CONTAINER (g)	FIELD ID	SAMPLE DEPTH (ft)	PERCENT MOISTURE CONTENT	PERCENT PASSING NO. 200 SIEVE
S24-2373	540.89	845.79	776.82	583.64	TP1.1	2	29%	82%
S24-2374	537.38	829.08	755.27	571.28	TP1.2	5	34%	84%
S24-2375	381.89	1,430.52	1,148.62	-	TP1.3	12	37%	-
S24-2376	579.12	892.74	815.07	623.90	TP2.1	2	33%	81%
S24-2377	548.47	1,083.64	893.33	631.21	TP2.2	5	55%	76%
S24-2378	87.56	312.35	248.64	-	TP2.3	13	40%	-
S24-2380	87.62	325.08	259.70	-	TP3.2	8	38%	-
S24-2381	542.53	827.06	759.80	588.60	TP3.3	14	31%	79%
S24-2383	87.55	298.22	248.03	-	TP4.2	6	31%	-
S24-2384	87.69	308.34	257.81	-	TP4.3	10	30%	-
S24-2385	866.50	3,799.50	3,626.88	-	TP4.4	13	6%	-
S24-2386	86.70	354.19	283.46	-	TP6.1	3	36%	-
S24-2387	87.42	308.66	249.79	-	TP6.2	6	36%	-
S24-2388	556.08	887.47	810.21	587.83	TP6.3	13	30%	88%
S24-2389	87.97	298.82	246.68	-	TP7.1	4	33%	-
S24-2390	86.86	335.60	273.95	-	TP7.2	12	33%	-

NOTES:

Sample weight received for Lab ID: S24-2385 did not meet the minimum size requirements; entire sample used for analysis.

DATE TESTED

12/19/24

TESTED BY

M. Scherette





ATTERBERG LIMITS REPORT

PROJECT Manning Meadows Subdivision 1819 NE 339 th Street La Center, Washington	CLIENT LGI Homes 700 Washington Street, Suite 200 Vancouver, WA 98660	PROJECT NO. LGI-14-01-1	
		ISSUE DATE 12/30/24	PAGE 1 of 1
		LAB ID S24-2373	FIELD ID TP1.1
		DATE SAMPLED 12/12/24	SAMPLED BY E. Uren

MATERIAL DATA

MATERIAL SAMPLED Lean CLAY with Sand	MATERIAL SOURCE Test Pit TP-1 depth = 2 feet	USCS SOIL TYPE no data provided
--	---	---

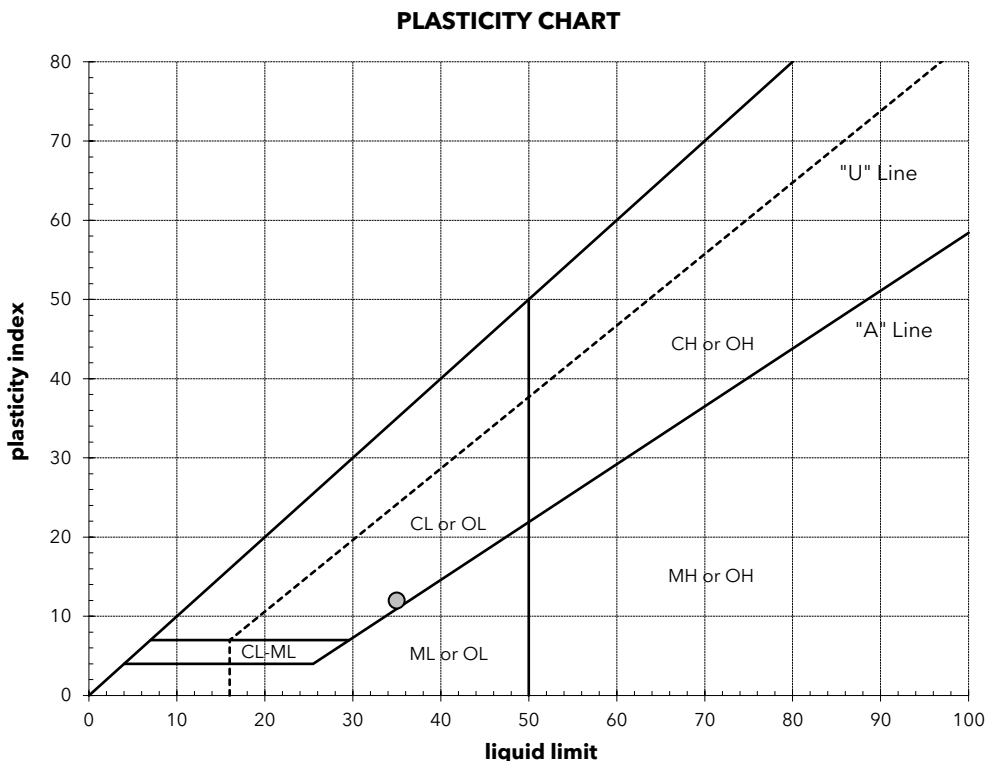
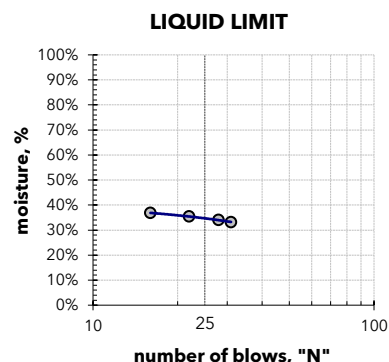
LABORATORY TEST DATA

LABORATORY EQUIPMENT Liquid Limit Machine, Hand Rolled	TEST PROCEDURE ASTM D4318 - Method A
--	--

ATTERBERG LIMITS liquid limit = 35 plastic limit = 23 plasticity index = 12	LIQUID LIMIT DETERMINATION				
		①	②	③	④
	wet soil + pan weight, g =	34.06	33.14	32.23	34.26
	dry soil + pan weight, g =	30.81	30.06	29.28	30.65
	pan weight, g =	21.00	21.02	20.97	20.84
	N (blows) =	31	28	22	16
	moisture, % =	33.1 %	34.1 %	35.5 %	36.8 %
SHRINKAGE shrinkage limit = n/a shrinkage ratio = n/a	PLASTIC LIMIT DETERMINATION				
		①	②	③	④
	wet soil + pan weight, g =	28.11	28.38		
	dry soil + pan weight, g =	26.78	27.02		
	pan weight, g =	20.87	21.02		
	moisture, % =	22.5 %	22.7 %		

LIQUID LIMIT

Number of blows, "N"	Moisture, %
31	33.1
28	34.1
22	35.5



ADDITIONAL DATA

% gravel = n/a
% sand = n/a
% silt and clay = n/a
% silt = n/a
% clay = n/a
moisture content = 29%

DATE TESTED 12/27/24 TESTED BY K. Summers

James C. Smith



ATTERBERG LIMITS REPORT

PROJECT Manning Meadows Subdivision 1819 NE 339th Street La Center, Washington	CLIENT LGI Homes 700 Washington Street, Suite 200 Vancouver, WA 98660	PROJECT NO. LGI-14-01-1	
		ISSUE DATE 12/30/24	PAGE 1 of 1
		LAB ID S24-2379	FIELD ID TP3.1
		DATE SAMPLED 12/12/24	SAMPLED BY E. Uren

MATERIAL DATA

MATERIAL SAMPLED SILT	MATERIAL SOURCE Test Pit TP-3 depth = 4 feet	USCS SOIL TYPE no data provided
--------------------------	--	------------------------------------

LABORATORY TEST DATA

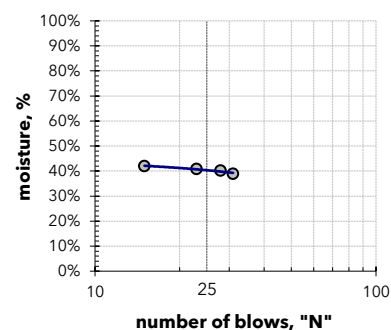
LABORATORY EQUIPMENT Liquid Limit Machine, Hand Rolled	TEST PROCEDURE ASTM D4318 - Method A
---	---

ATTERBERG LIMITS	LIQUID LIMIT DETERMINATION			
	①	②	③	④
liquid limit = 40	wet soil + pan weight, g = 30.66	30.39	30.15	30.48
plastic limit = 27	dry soil + pan weight, g = 27.95	27.69	27.50	27.63
plasticity index = 13	pan weight, g = 20.99	20.96	21.01	20.84
	N (blows) = 31	28	23	15
	moisture, % = 38.9 %	40.1 %	40.8 %	42.0 %
SHRINKAGE	PLASTIC LIMIT DETERMINATION			
	①	②	③	④
shrinkage limit = n/a	wet soil + pan weight, g = 28.47	28.92		
shrinkage ratio = n/a	dry soil + pan weight, g = 26.84	27.22		
	pan weight, g = 20.87	21.04		
	moisture, % = 27.3 %	27.5 %		

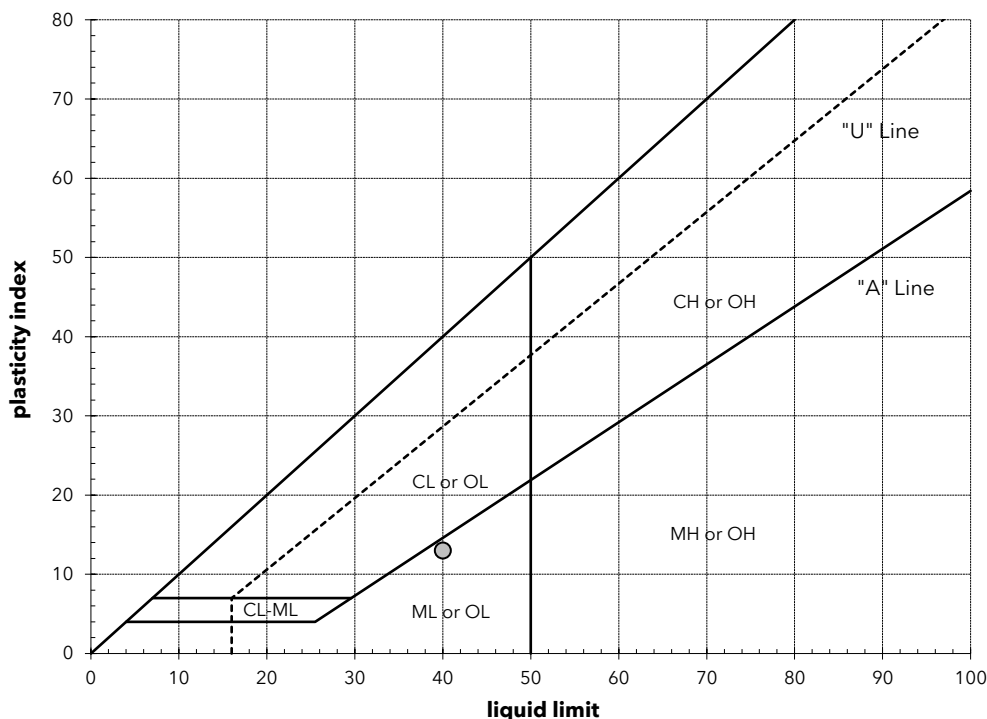
LIQUID LIMIT

Number of blows, "N"	Moisture, %
15	42.0
28	40.1
23	40.8
15	42.0

LIQUID LIMIT



PLASTICITY CHART



ADDITIONAL DATA

% gravel = n/a
% sand = n/a
% silt and clay = n/a
% silt = n/a
% clay = n/a
moisture content = n/a

DATE TESTED 12/26/24	TESTED BY C. Lillie
-------------------------	------------------------

James C. Lillie

ORGANIC CONTENT TEST REPORT

PROJECT Manning Meadows Subdivision 1819 NE 339th Street La Center, Washington	CLIENT LGI Homes 700 Washington Street, Suite 200 Vancouver, WA 98660	PROJECT NO. LGI-14-01-1	
		ISSUE DATE 12/30/24	PAGE 1 of 1
		DATE SAMPLED 12/12/24	SAMPLED BY E. Uren

LABORATORY TEST DATA

TEST PROCEDURE

ASTM D2974 - Method A (Furnace Temperature = 440°C)

[illegible]

NOTES:

DATE TESTED _____

12/19/24

TESTED BY

M. Scherette

James C. Smith



APPENDIX C

APPENDIX C REPORT LIMITATIONS AND IMPORTANT INFORMATION

Report Purpose, Use, and Standard of Care

This report has been prepared in accordance with standard fundamental principles and practices of geotechnical engineering and/or environmental consulting, and in a manner consistent with the level of care and skill typical of currently practicing local engineers and consultants. This report has been prepared to meet the specific needs of specific individuals for the indicated site. It may not be adequate for use by other consultants, contractors, or engineers, or if change in project ownership has occurred. It should not be used for any other reason than its stated purpose without prior consultation with Columbia West Engineering, Inc. (Columbia West). It is a unique report and not applicable for any other site or project. If site conditions are altered, or if modifications to the project description or proposed plans are made after the date of this report, it may not be valid. Columbia West cannot accept responsibility for use of this report by other individuals for unauthorized purposes, or if problems occur resulting from changes in site conditions for which Columbia West was not aware or informed.

Report Conclusions and Preliminary Nature

This geotechnical or environmental report should be considered preliminary and summary in nature. The recommendations contained herein have been established by engineering interpretations of subsurface soils based upon conditions observed during site exploration. The exploration and associated laboratory analysis of collected representative samples identifies soil conditions at specific discreet locations. It is assumed that these conditions are indicative of actual conditions throughout the subject property. However, soil conditions may differ between tested locations at different seasonal times of the year, either by natural causes or human activity. Distinction between soil types may be more abrupt or gradual than indicated on the soil logs. This report is not intended to stand alone without understanding of concomitant instructions, correspondence, communication, or potential supplemental reports that may have been provided to the client.

Because this report is based upon observations obtained at the time of exploration, its adequacy may be compromised with time. This is particularly relevant in the case of natural disasters, earthquakes, floods, or other significant events. Report conclusions or interpretations may also be subject to revision if significant development or other manmade impacts occur within or in proximity to the subject property. Groundwater conditions, if presented in this report, reflect observed conditions at the time of investigation. These conditions may change annually, seasonally or as a result of adjacent development.

Additional Investigation and Construction Observation

Columbia West should be consulted prior to construction to assess whether additional investigation above and beyond that presented in this report is necessary. Even slight variations in soil or site conditions may produce impacts to the performance of structural facilities if not adequately addressed. This underscores the importance of diligent construction observation and testing to verify soil conditions do not differ materially or significantly from the interpreted conditions utilized for preparation of this report.

Therefore, this report contains several recommendations for field observation and testing by Columbia West personnel during construction activities. Actual subsurface conditions are more readily observed and discerned during the earthwork phase of construction when soils are exposed. Columbia West cannot accept responsibility for deviations from recommendations described in this report or future performance of structural facilities if another consultant is retained during the construction phase or Columbia West is not engaged to provide construction observation to the full extent recommended.

Collected Samples

Uncontaminated samples of soil or rock collected in connection with this report will be retained for thirty days. Retention of such samples beyond thirty days will occur only at client's request and in return for payment of storage charges incurred. All contaminated or environmentally impacted materials or samples are the sole property of the client. Client maintains responsibility for proper disposal.

Report Contents

This geotechnical or environmental report should not be copied or duplicated unless in full, and even then, only under prior written consent by Columbia West, as indicated in further detail in the following text section entitled Report Ownership. The recommendations, interpretations, and suggestions presented in this report are only understandable in context of reference to the whole report. Under no circumstances should the soil boring or test pit excavation logs, monitor well logs, or laboratory analytical reports be separated from the remainder of the report. The logs or reports should not be redrawn or summarized by other entities for inclusion in architectural or civil drawings or other relevant applications.

Report Limitations for Contractors

Geotechnical or environmental reports, unless otherwise specifically noted, are not prepared for the purpose of developing cost estimates or bids by contractors. The extent of exploration or investigation conducted as part of this report is usually less than that necessary for contractor's needs. Contractors should be advised of these report limitations, particularly as they relate to development of cost estimates. Contractors may gain valuable information from this report, but should rely upon their own interpretations as to how subsurface conditions may affect cost, feasibility, accessibility and other components of the project work. If believed necessary or relevant, contractors should conduct additional exploratory investigation to obtain satisfactory data for the purposes of developing adequate cost estimates. Clients or developers cannot insulate themselves from attendant liability by disclaiming accuracy for subsurface ground conditions without advising contractors appropriately and providing the best information possible to limit potential for cost overruns, construction problems, or misunderstandings.

Report Ownership

Columbia West retains the ownership and copyright property rights to this entire report and its contents, which may include, but may not be limited to, figures, text, logs, electronic media, drawings, laboratory reports, and appendices. This report was prepared solely for the client, and other relevant approved users or parties, and its distribution must be contingent upon prior express written consent by Columbia West. Furthermore, client or approved users may not use, lend, sell, copy, or distribute this document without express written consent by Columbia West.

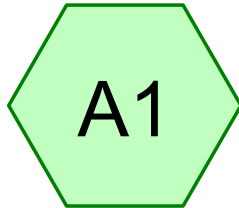
Client does not own nor have rights to electronic media files that constitute this report, and under no circumstances should said electronic files be distributed or copied. Electronic media is susceptible to unauthorized manipulation or modification, and may not be reliable.

Consultant Responsibility

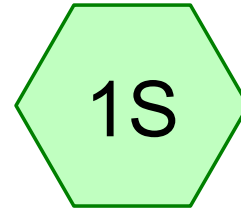
Geotechnical and environmental engineering and consulting is much less exact than other scientific or engineering disciplines, and relies heavily upon experience, judgment, interpretation, and opinion often based upon media (soils) that are variable, anisotropic, and non-homogenous. This often results in unrealistic expectations, unwarranted claims, and uninformed disputes against a geotechnical or environmental consultant. To reduce potential for these problems and assist relevant parties in better understanding of risk, liability, and responsibility, geotechnical and environmental reports often provide definitive statements or clauses defining and outlining consultant responsibility. The client is encouraged to read these statements carefully and request additional information from Columbia West if necessary.

APPENDIX D

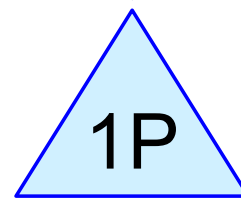
Technical Data



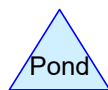
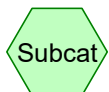
Pre Dev Basin 1



Area to Detention Pond



Detention Pond



Routing Diagram for 3849 PRELIM Detention pond

Prepared by HP Inc., Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Printed 6/24/2025

Page 2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
505,746	85	Pasture HSG C (A1)
154,514	86	Landscaping (1S)
42,000	98	Driveway (1S)
19,805	98	Impervious (A1)
152,637	98	Roads/Curb (1S)
176,400	98	Roof (1S)
1,051,102	90	TOTAL AREA

3849 PRELIM Detention pond

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 3

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
505,746	HSG C	A1
0	HSG D	
545,356	Other	1S, A1
1,051,102		TOTAL AREA

3849 PRELIM Detention pond

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 4

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchmen Numbers
0	0	0	0	42,000	42,000	Driveway	1 S
0	0	0	0	19,805	19,805	Impervious	A 1
0	0	0	0	154,514	154,514	Landscaping	1 S
0	0	505,746	0	0	505,746	Pasture	A 1
0	0	0	0	152,637	152,637	Roads/Curb	1 S
0	0	0	0	176,400	176,400	Roof	1 S
0	0	505,746	0	545,356	1,051,102	TOTAL AREA	

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 2 yr Rainfall=2.40"

Printed 6/24/2025

Page 5

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area to Detention Pond Runoff Area=525,551 sf 70.60% Impervious Runoff Depth=1.77"
Tc=6.0 min CN=94 Runoff=5.59 cfs 77,695 cf

Subcatchment A1: Pre Dev Basin 1 Runoff Area=525,551 sf 3.77% Impervious Runoff Depth=1.10"
Flow Length=942' Tc=33.9 min CN=85 Runoff=2.44 cfs 48,147 cf

Pond 1P: Detention Pond Peak Elev=1.98' Storage=10,685 cf Inflow=5.59 cfs 77,695 cf
Outflow=2.25 cfs 77,694 cf

Total Runoff Area = 1,051,102 sf Runoff Volume = 125,842 cf Average Runoff Depth = 1.44"
62.82% Pervious = 660,260 sf 37.18% Impervious = 390,842 sf

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 2 yr Rainfall=2.40"

Printed 6/24/2025

Page 6

Summary for Subcatchment 1S: Area to Detention Pond

Runoff = 5.59 cfs @ 7.91 hrs, Volume= 77,695 cf, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

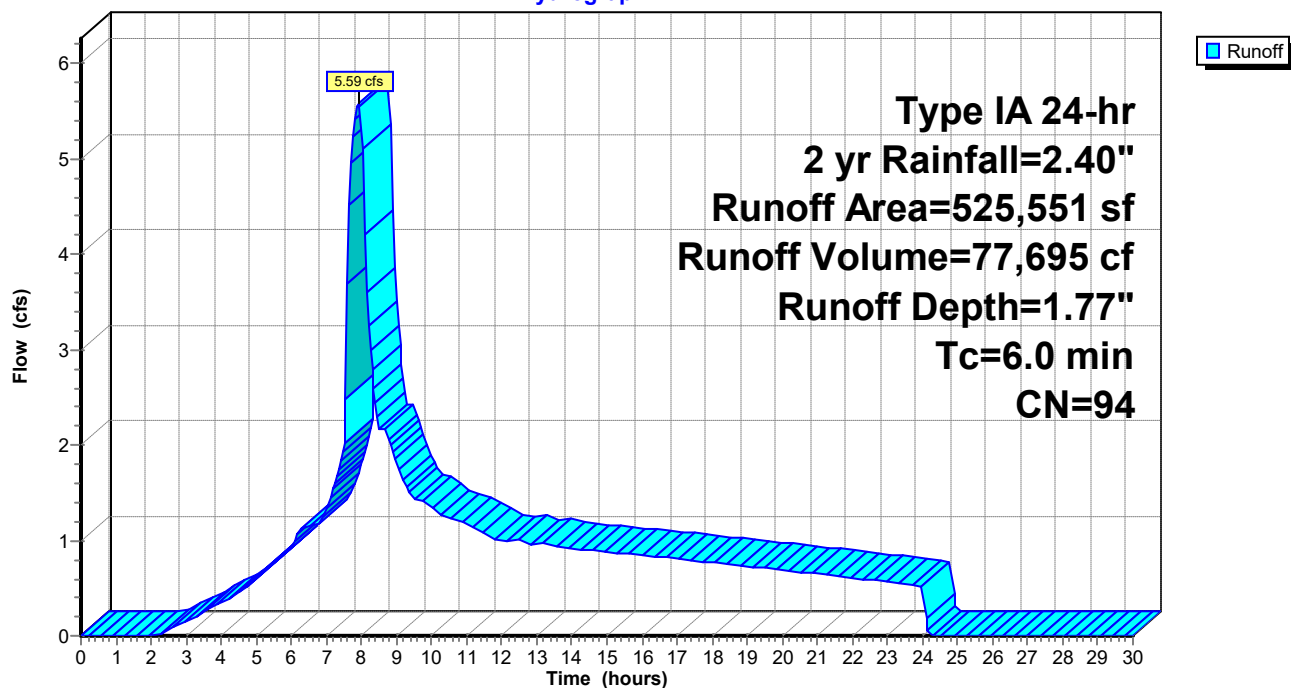
Type IA 24-hr 2 yr Rainfall=2.40"

	Area (sf)	CN	Description
*	152,637	98	Roads/Curb
*	176,400	98	Roof
*	42,000	98	Driveway
*	154,514	86	Landscaping
	525,551	94	Weighted Average
	154,514		29.40% Pervious Area
	371,037		70.60% Impervious Area

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

Subcatchment 1S: Area to Detention Pond

Hydrograph



3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 2 yr Rainfall=2.40"

Printed 6/24/2025

Page 7

Summary for Subcatchment A1: Pre Dev Basin 1

Runoff = 2.44 cfs @ 8.30 hrs, Volume= 48,147 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

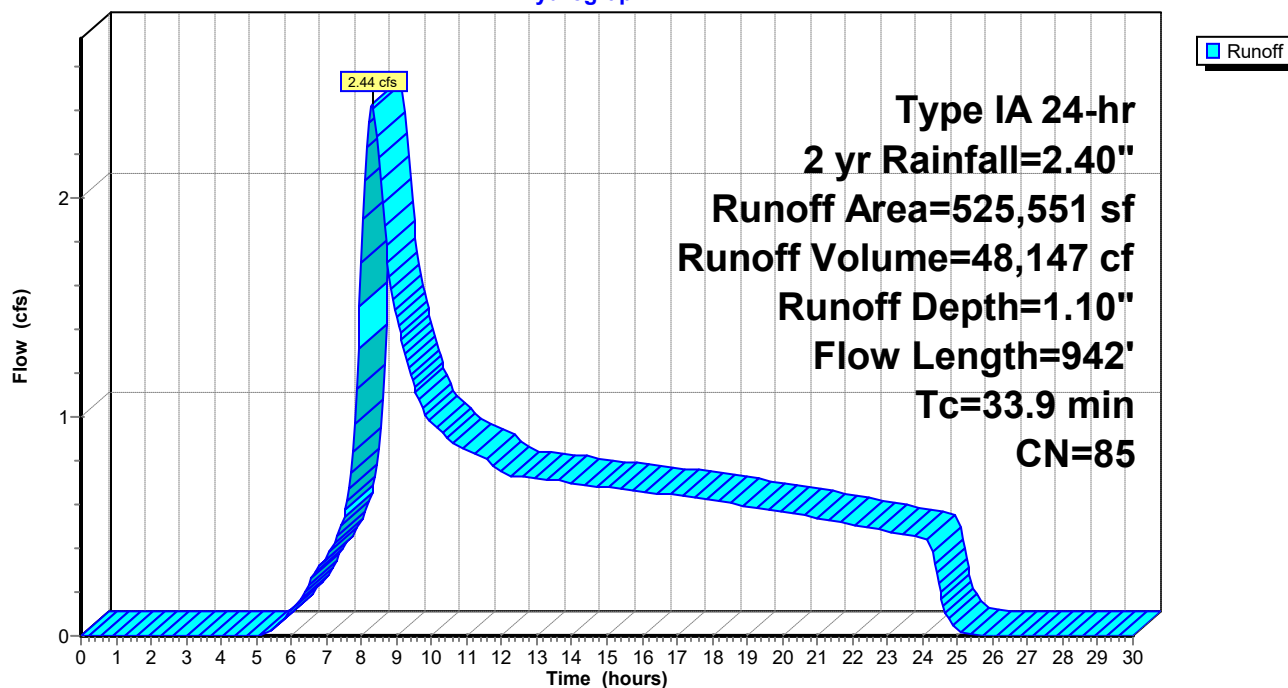
Type IA 24-hr 2 yr Rainfall=2.40"

	Area (sf)	CN	Description
*	505,746	85	Pasture HSG C
*	19,805	98	Impervious
	525,551	85	Weighted Average
	505,746		96.23% Pervious Area
	19,805		3.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.9	300	0.1300	0.17		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.30"
5.0	642	0.0934	2.14		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
33.9	942	Total			

Subcatchment A1: Pre Dev Basin 1

Hydrograph



3849 PRELIM Detention pond

Type IA 24-hr 2 yr Rainfall=2.40"

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 8

Summary for Pond 1P: Detention Pond

Inflow Area = 525,551 sf, 70.60% Impervious, Inflow Depth = 1.77" for 2 yr event
 Inflow = 5.59 cfs @ 7.91 hrs, Volume= 77,695 cf
 Outflow = 2.25 cfs @ 8.47 hrs, Volume= 77,694 cf, Atten= 60%, Lag= 33.5 min
 Primary = 2.25 cfs @ 8.47 hrs, Volume= 77,694 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 1.98' @ 8.47 hrs Surf.Area= 5,409 sf Storage= 10,685 cf

Plug-Flow detention time= 47.7 min calculated for 77,694 cf (100% of inflow)
 Center-of-Mass det. time= 47.6 min (776.5 - 728.9)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	39,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	7,512	0	0
1.00	7,512	7,512	7,512
2.00	7,512	7,512	15,024
3.00	8,646	8,079	23,103
4.00	9,815	9,231	32,334
5.00	11,019	10,417	42,751
6.00	12,256	11,638	54,388

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	7.8" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	2.18'	7.8" Vert. Orifice/Grate C= 0.600
#3	Primary	4.60'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.25 cfs @ 8.47 hrs HW=1.98' (Free Discharge)

1=Orifice/Grate (Orifice Controls 2.25 cfs @ 6.77 fps)

2=Orifice/Grate (Controls 0.00 cfs)

3=Orifice/Grate (Controls 0.00 cfs)

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

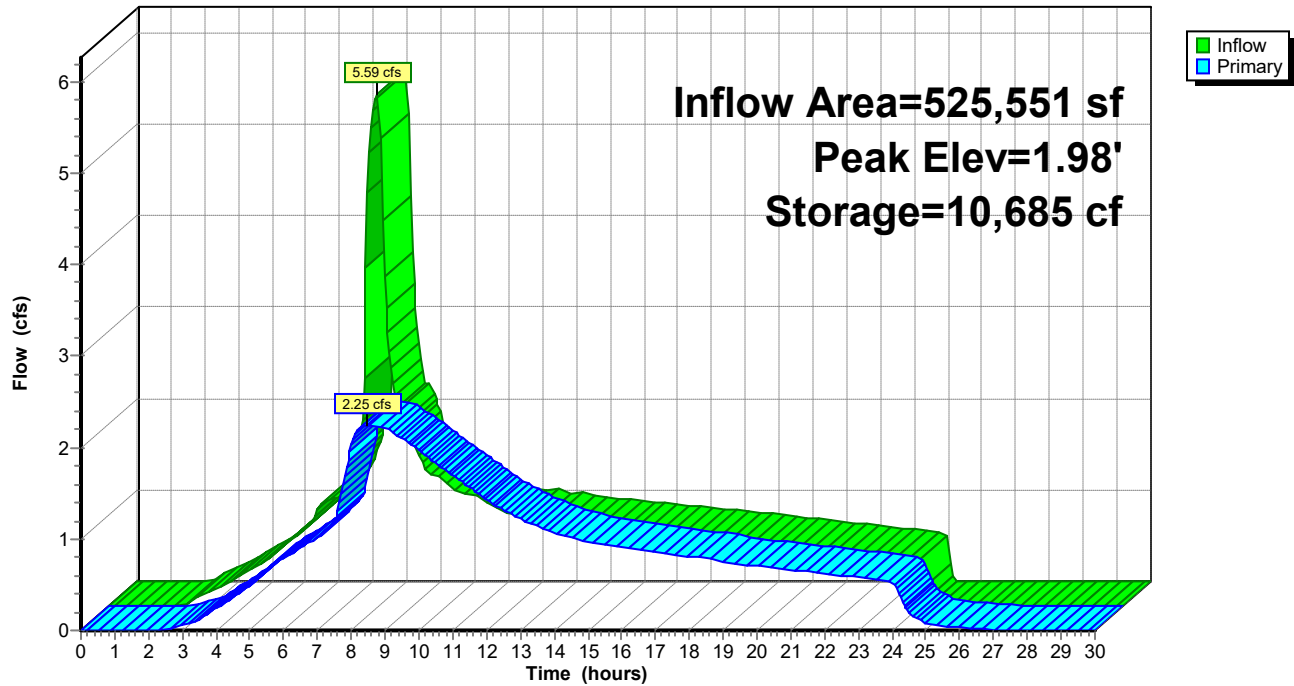
Type IA 24-hr 2 yr Rainfall=2.40"

Printed 6/24/2025

Page 9

Pond 1P: Detention Pond

Hydrograph



3849 PRELIM Detention pond

Type IA 24-hr 10 yr Rainfall=3.30"

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 10

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area to Detention Pond Runoff Area=525,551 sf 70.60% Impervious Runoff Depth=2.64"
Tc=6.0 min CN=94 Runoff=8.36 cfs 115,663 cf

Subcatchment A1: Pre Dev Basin 1 Runoff Area=525,551 sf 3.77% Impervious Runoff Depth=1.84"
Flow Length=942' Tc=33.9 min CN=85 Runoff=4.46 cfs 80,729 cf

Pond 1P: Detention Pond Peak Elev=3.06' Storage=16,994 cf Inflow=8.36 cfs 115,663 cf
Outflow=3.98 cfs 115,662 cf

Total Runoff Area = 1,051,102 sf Runoff Volume = 196,392 cf Average Runoff Depth = 2.24"
62.82% Pervious = 660,260 sf 37.18% Impervious = 390,842 sf

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 10 yr Rainfall=3.30"

Printed 6/24/2025

Page 11

Summary for Subcatchment 1S: Area to Detention Pond

Runoff = 8.36 cfs @ 7.90 hrs, Volume= 115,663 cf, Depth= 2.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

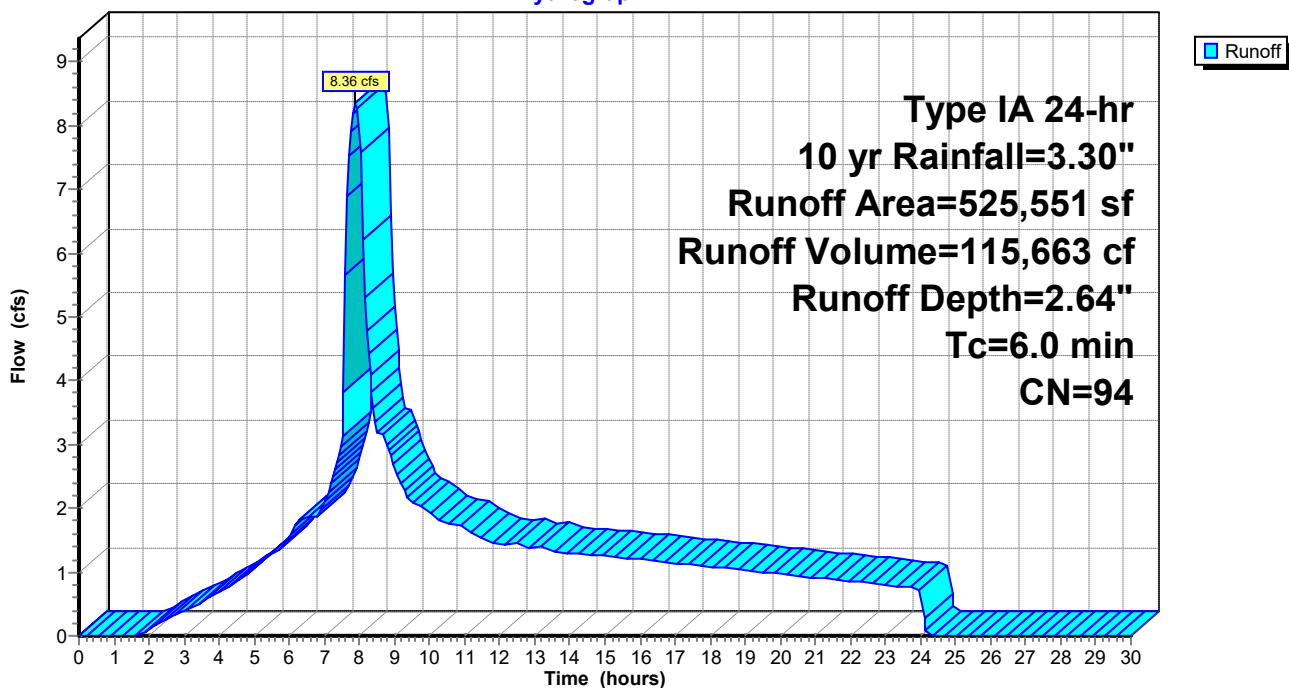
Type IA 24-hr 10 yr Rainfall=3.30"

	Area (sf)	CN	Description
*	152,637	98	Roads/Curb
*	176,400	98	Roof
*	42,000	98	Driveway
*	154,514	86	Landscaping
	525,551	94	Weighted Average
	154,514		29.40% Pervious Area
	371,037		70.60% Impervious Area

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

Subcatchment 1S: Area to Detention Pond

Hydrograph



3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 10 yr Rainfall=3.30"

Printed 6/24/2025

Page 12

Summary for Subcatchment A1: Pre Dev Basin 1

Runoff = 4.46 cfs @ 8.28 hrs, Volume= 80,729 cf, Depth= 1.84"

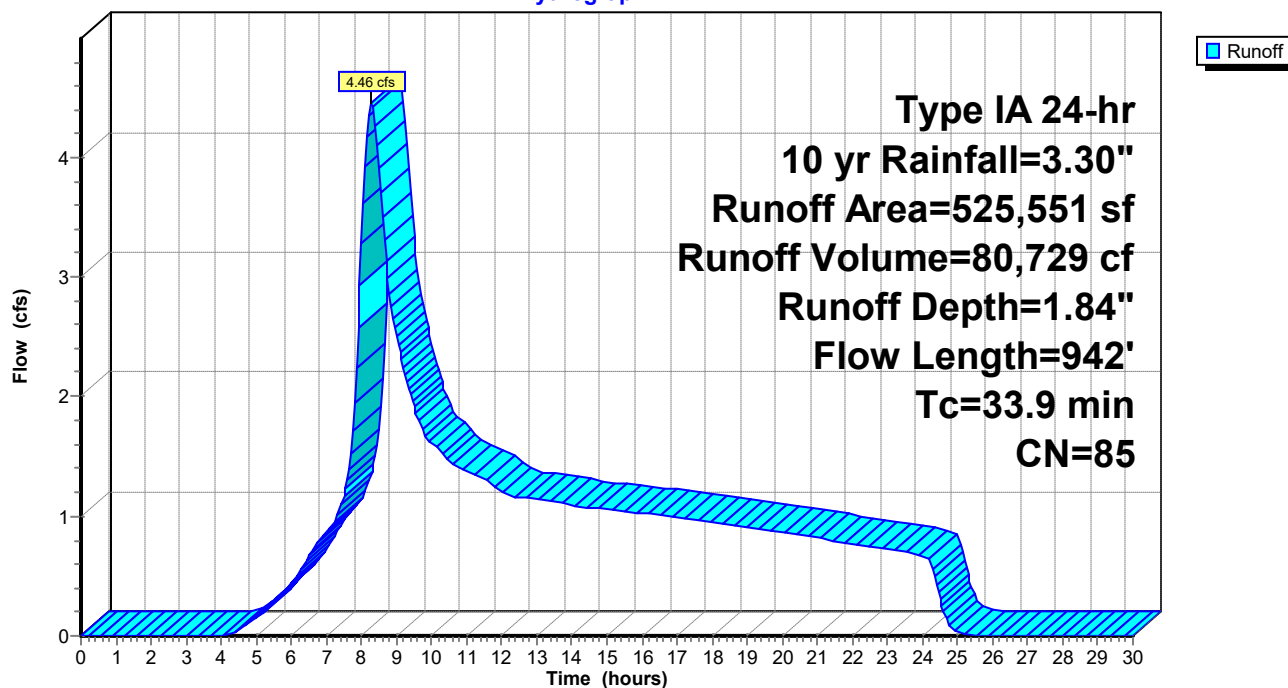
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 yr Rainfall=3.30"

	Area (sf)	CN	Description
*	505,746	85	Pasture HSG C
*	19,805	98	Impervious
	525,551	85	Weighted Average
	505,746		96.23% Pervious Area
	19,805		3.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.9	300	0.1300	0.17		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.30"
5.0	642	0.0934	2.14		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
33.9	942	Total			

Subcatchment A1: Pre Dev Basin 1

Hydrograph



3849 PRELIM Detention pond

Type IA 24-hr 10 yr Rainfall=3.30"

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 13

Summary for Pond 1P: Detention Pond

Inflow Area = 525,551 sf, 70.60% Impervious, Inflow Depth = 2.64" for 10 yr event
 Inflow = 8.36 cfs @ 7.90 hrs, Volume= 115,663 cf
 Outflow = 3.98 cfs @ 8.32 hrs, Volume= 115,662 cf, Atten= 52%, Lag= 25.4 min
 Primary = 3.98 cfs @ 8.32 hrs, Volume= 115,662 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.06' @ 8.32 hrs Surf.Area= 6,274 sf Storage= 16,994 cf

Plug-Flow detention time= 57.4 min calculated for 115,662 cf (100% of inflow)
 Center-of-Mass det. time= 57.3 min (767.2 - 709.9)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	39,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	7,512	0	0
1.00	7,512	7,512	7,512
2.00	7,512	7,512	15,024
3.00	8,646	8,079	23,103
4.00	9,815	9,231	32,334
5.00	11,019	10,417	42,751
6.00	12,256	11,638	54,388

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	7.8" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	2.18'	7.8" Vert. Orifice/Grate C= 0.600
#3	Primary	4.60'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.98 cfs @ 8.32 hrs HW=3.06' (Free Discharge)

1=Orifice/Grate (Orifice Controls 2.79 cfs @ 8.42 fps)
 2=Orifice/Grate (Orifice Controls 1.19 cfs @ 3.58 fps)
 3=Orifice/Grate (Controls 0.00 cfs)

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

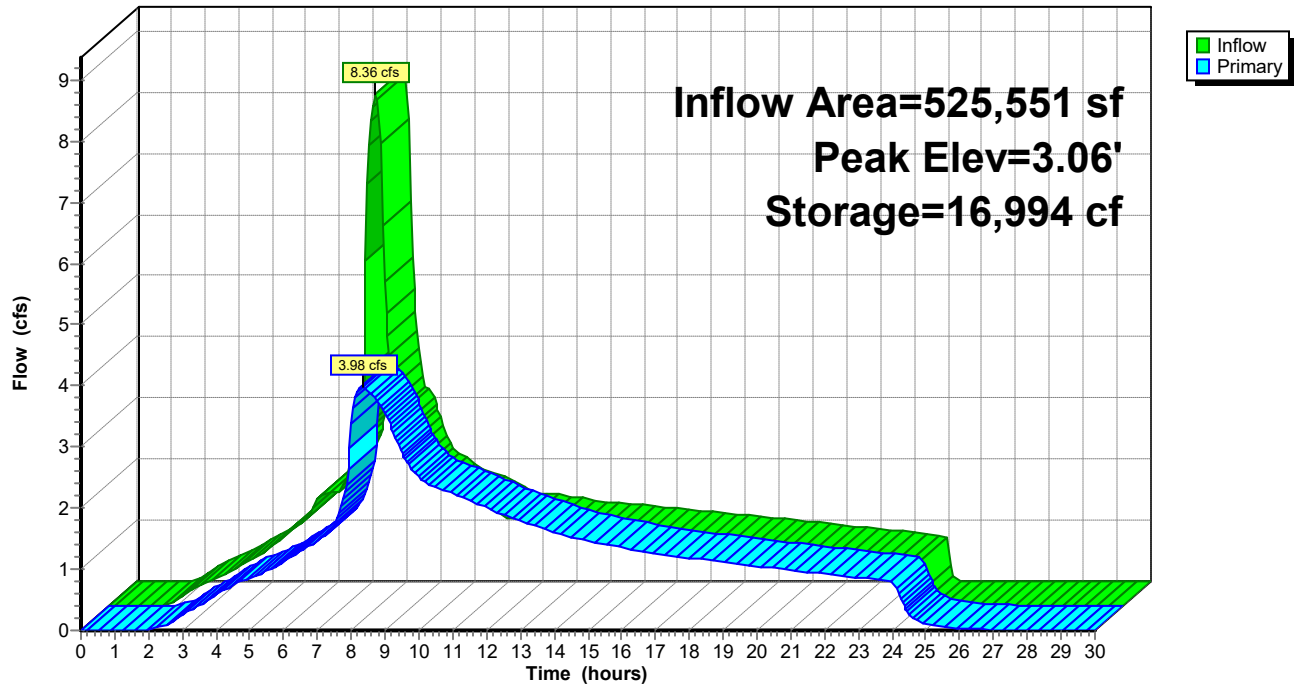
Type IA 24-hr 10 yr Rainfall=3.30"

Printed 6/24/2025

Page 14

Pond 1P: Detention Pond

Hydrograph



3849 PRELIM Detention pond

Type IA 24-hr 25 yr Rainfall=3.80"

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 15

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area to Detention Pond Runoff Area=525,551 sf 70.60% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=94 Runoff=9.90 cfs 137,018 cf

Subcatchment A1: Pre Dev Basin 1 Runoff Area=525,551 sf 3.77% Impervious Runoff Depth=2.28"
Flow Length=942' Tc=33.9 min CN=85 Runoff=5.66 cfs 99,850 cf

Pond 1P: Detention Pond Peak Elev=3.62' Storage=20,638 cf Inflow=9.90 cfs 137,018 cf
Outflow=4.72 cfs 137,016 cf

Total Runoff Area = 1,051,102 sf Runoff Volume = 236,868 cf Average Runoff Depth = 2.70"
62.82% Pervious = 660,260 sf 37.18% Impervious = 390,842 sf

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 25 yr Rainfall=3.80"

Printed 6/24/2025

Page 16

Summary for Subcatchment 1S: Area to Detention Pond

Runoff = 9.90 cfs @ 7.89 hrs, Volume= 137,018 cf, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

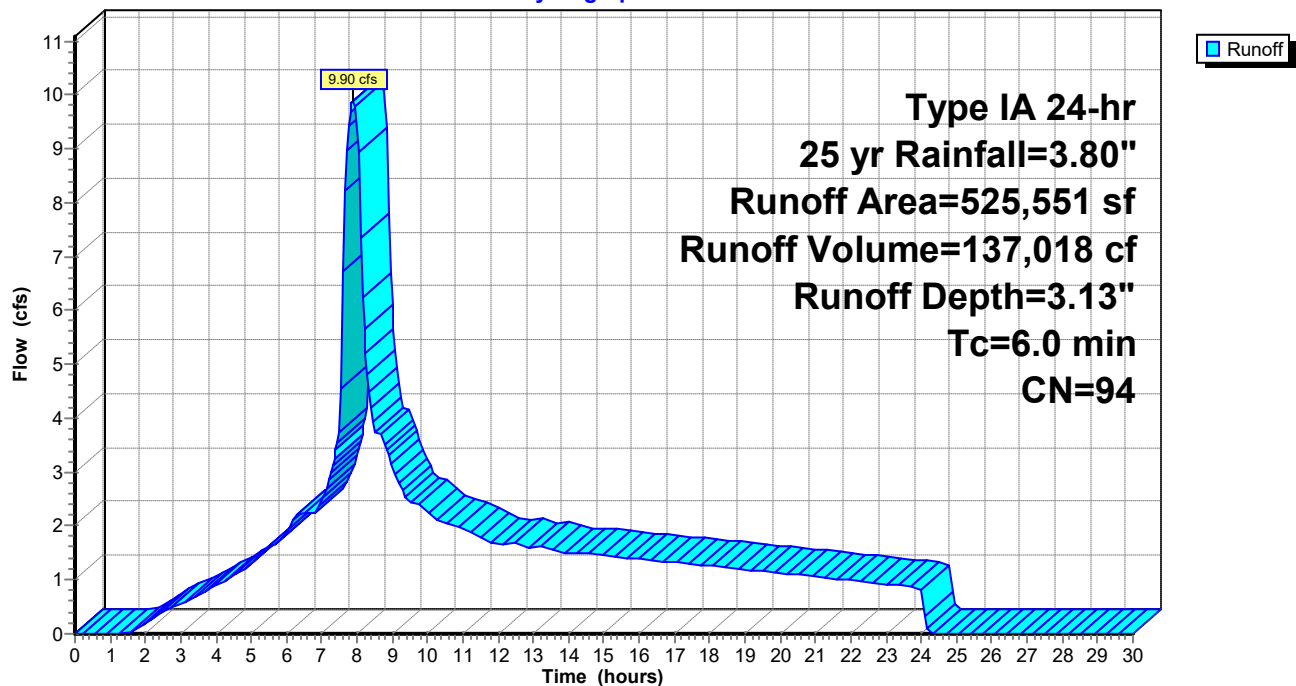
Type IA 24-hr 25 yr Rainfall=3.80"

	Area (sf)	CN	Description
*	152,637	98	Roads/Curb
*	176,400	98	Roof
*	42,000	98	Driveway
*	154,514	86	Landscaping
	525,551	94	Weighted Average
	154,514		29.40% Pervious Area
	371,037		70.60% Impervious Area

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

Subcatchment 1S: Area to Detention Pond

Hydrograph



3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 25 yr Rainfall=3.80"

Printed 6/24/2025

Page 17

Summary for Subcatchment A1: Pre Dev Basin 1

Runoff = 5.66 cfs @ 8.27 hrs, Volume= 99,850 cf, Depth= 2.28"

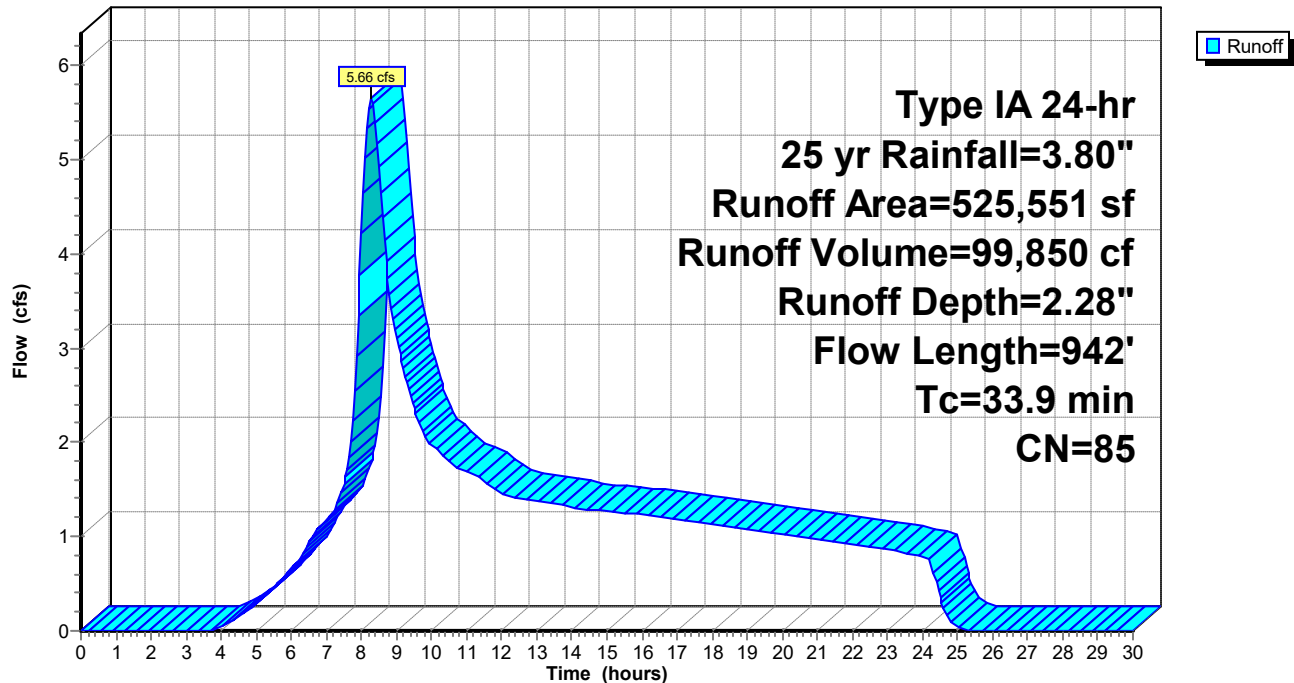
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 yr Rainfall=3.80"

	Area (sf)	CN	Description
*	505,746	85	Pasture HSG C
*	19,805	98	Impervious
	525,551	85	Weighted Average
	505,746		96.23% Pervious Area
	19,805		3.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.9	300	0.1300	0.17		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.30"
5.0	642	0.0934	2.14		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
33.9	942	Total			

Subcatchment A1: Pre Dev Basin 1

Hydrograph



3849 PRELIM Detention pond

Type IA 24-hr 25 yr Rainfall=3.80"

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 18

Summary for Pond 1P: Detention Pond

Inflow Area = 525,551 sf, 70.60% Impervious, Inflow Depth = 3.13" for 25 yr event
 Inflow = 9.90 cfs @ 7.89 hrs, Volume= 137,018 cf
 Outflow = 4.72 cfs @ 8.31 hrs, Volume= 137,016 cf, Atten= 52%, Lag= 25.4 min
 Primary = 4.72 cfs @ 8.31 hrs, Volume= 137,016 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 3.62' @ 8.31 hrs Surf.Area= 6,745 sf Storage= 20,638 cf

Plug-Flow detention time= 61.3 min calculated for 137,016 cf (100% of inflow)
 Center-of-Mass det. time= 61.1 min (763.7 - 702.5)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	39,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	7,512	0	0
1.00	7,512	7,512	7,512
2.00	7,512	7,512	15,024
3.00	8,646	8,079	23,103
4.00	9,815	9,231	32,334
5.00	11,019	10,417	42,751
6.00	12,256	11,638	54,388

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	7.8" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	2.18'	7.8" Vert. Orifice/Grate C= 0.600
#3	Primary	4.60'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.72 cfs @ 8.31 hrs HW=3.62' (Free Discharge)

1=Orifice/Grate (Orifice Controls 3.04 cfs @ 9.16 fps)
 2=Orifice/Grate (Orifice Controls 1.68 cfs @ 5.08 fps)
 3=Orifice/Grate (Controls 0.00 cfs)

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

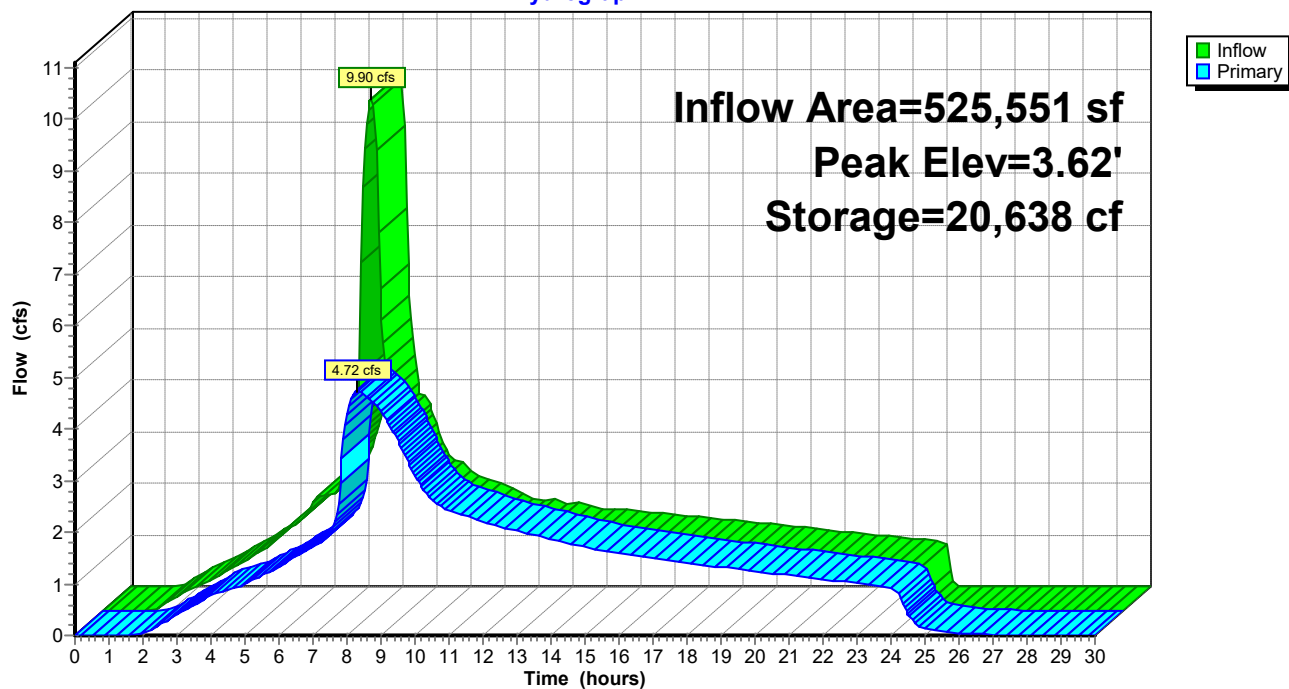
Type IA 24-hr 25 yr Rainfall=3.80"

Printed 6/24/2025

Page 19

Pond 1P: Detention Pond

Hydrograph



3849 PRELIM Detention pond

Type IA 24-hr 100 yr Rainfall=4.50"

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 20

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area to Detention Pond Runoff Area=525,551 sf 70.60% Impervious Runoff Depth=3.82"
Tc=6.0 min CN=94 Runoff=12.04 cfs 167,097 cf

Subcatchment A1: Pre Dev Basin 1 Runoff Area=525,551 sf 3.77% Impervious Runoff Depth=2.91"
Flow Length=942' Tc=33.9 min CN=85 Runoff=7.39 cfs 127,408 cf

Pond 1P: Detention Pond Peak Elev=4.41' Storage=26,237 cf Inflow=12.04 cfs 167,097 cf
Outflow=5.56 cfs 167,095 cf

Total Runoff Area = 1,051,102 sf Runoff Volume = 294,505 cf Average Runoff Depth = 3.36"
62.82% Pervious = 660,260 sf 37.18% Impervious = 390,842 sf

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 100 yr Rainfall=4.50"

Printed 6/24/2025

Page 21

Summary for Subcatchment 1S: Area to Detention Pond

Runoff = 12.04 cfs @ 7.89 hrs, Volume= 167,097 cf, Depth= 3.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

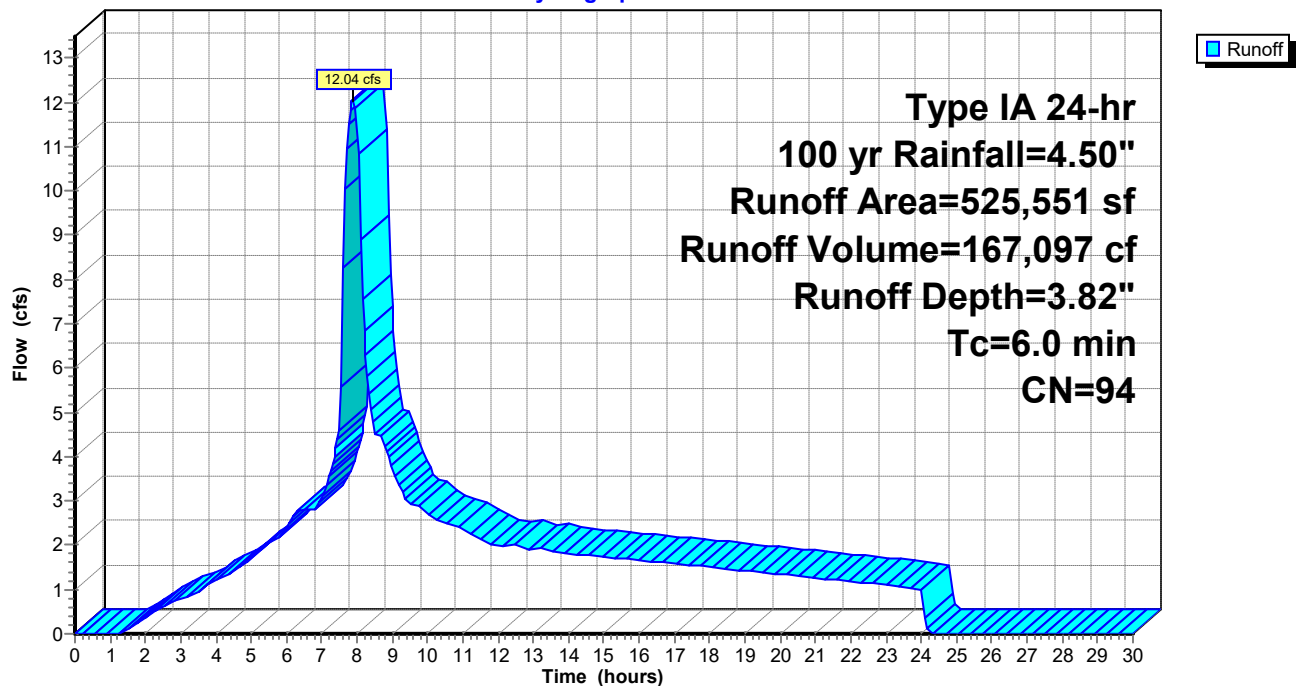
Type IA 24-hr 100 yr Rainfall=4.50"

	Area (sf)	CN	Description
*	152,637	98	Roads/Curb
*	176,400	98	Roof
*	42,000	98	Driveway
*	154,514	86	Landscaping
	525,551	94	Weighted Average
	154,514		29.40% Pervious Area
	371,037		70.60% Impervious Area

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

Subcatchment 1S: Area to Detention Pond

Hydrograph



3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 100 yr Rainfall=4.50"

Printed 6/24/2025

Page 22

Summary for Subcatchment A1: Pre Dev Basin 1

Runoff = 7.39 cfs @ 8.27 hrs, Volume= 127,408 cf, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

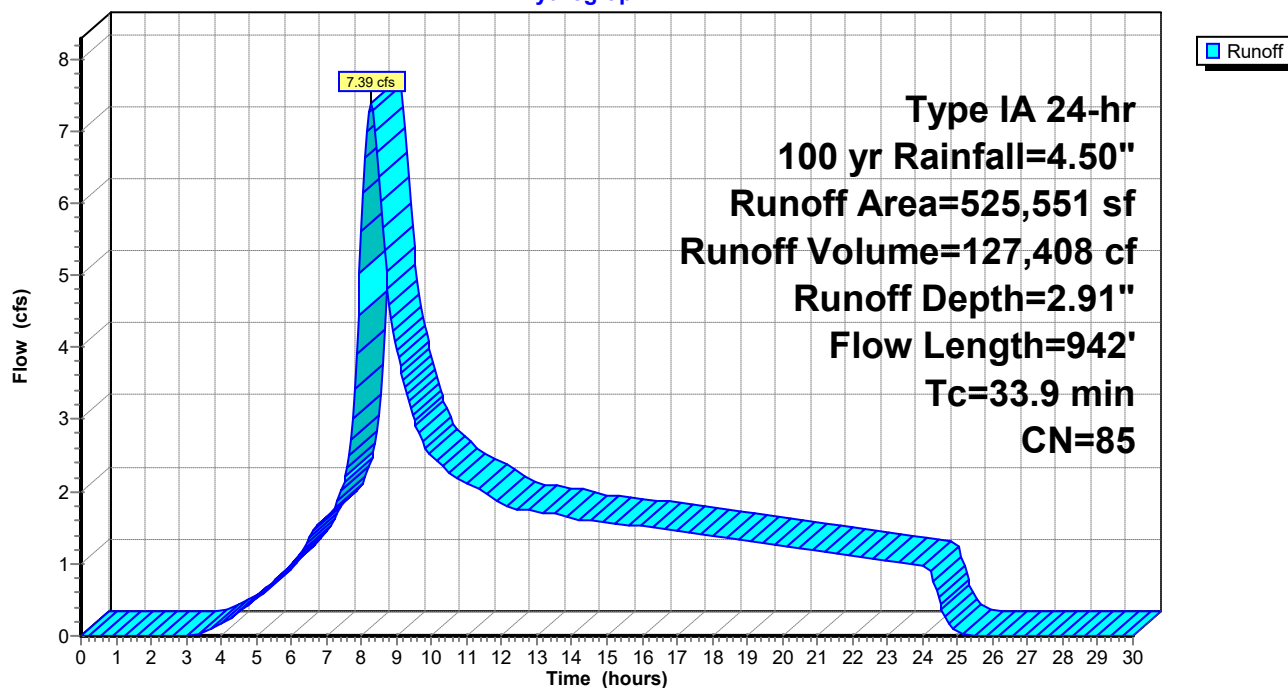
Type IA 24-hr 100 yr Rainfall=4.50"

	Area (sf)	CN	Description
*	505,746	85	Pasture HSG C
*	19,805	98	Impervious
	525,551	85	Weighted Average
	505,746		96.23% Pervious Area
	19,805		3.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.9	300	0.1300	0.17		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.30"
5.0	642	0.0934	2.14		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
33.9	942	Total			

Subcatchment A1: Pre Dev Basin 1

Hydrograph



3849 PRELIM Detention pond

Type IA 24-hr 100 yr Rainfall=4.50"

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 23

Summary for Pond 1P: Detention Pond

Inflow Area = 525,551 sf, 70.60% Impervious, Inflow Depth = 3.82" for 100 yr event
 Inflow = 12.04 cfs @ 7.89 hrs, Volume= 167,097 cf
 Outflow = 5.56 cfs @ 8.33 hrs, Volume= 167,095 cf, Atten= 54%, Lag= 26.8 min
 Primary = 5.56 cfs @ 8.33 hrs, Volume= 167,095 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 4.41' @ 8.33 hrs Surf.Area= 7,421 sf Storage= 26,237 cf

Plug-Flow detention time= 66.3 min calculated for 166,817 cf (100% of inflow)
 Center-of-Mass det. time= 66.4 min (760.8 - 694.4)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	39,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	7,512	0	0
1.00	7,512	7,512	7,512
2.00	7,512	7,512	15,024
3.00	8,646	8,079	23,103
4.00	9,815	9,231	32,334
5.00	11,019	10,417	42,751
6.00	12,256	11,638	54,388

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	7.8" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	2.18'	7.8" Vert. Orifice/Grate C= 0.600
#3	Primary	4.60'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=5.56 cfs @ 8.33 hrs HW=4.41' (Free Discharge)

1=Orifice/Grate (Orifice Controls 3.35 cfs @ 10.11 fps)
 2=Orifice/Grate (Orifice Controls 2.20 cfs @ 6.64 fps)
 3=Orifice/Grate (Controls 0.00 cfs)

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

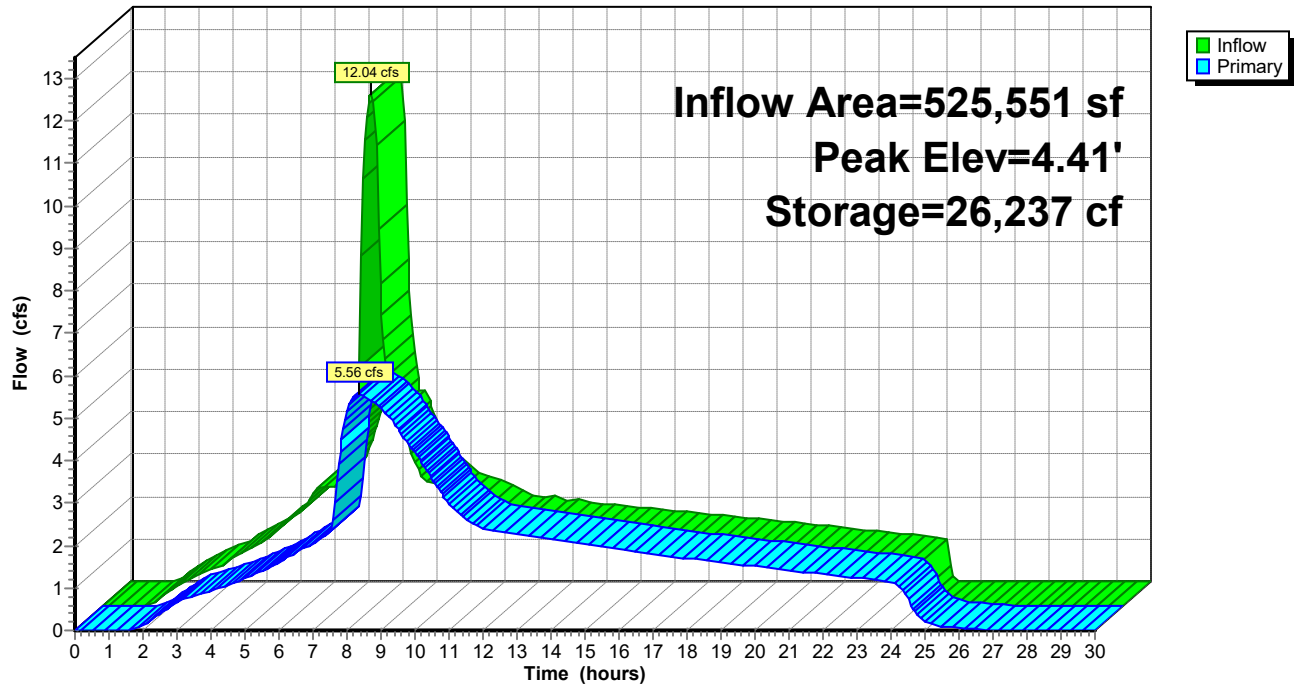
Type IA 24-hr 100 yr Rainfall=4.50"

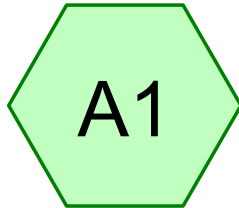
Printed 6/24/2025

Page 24

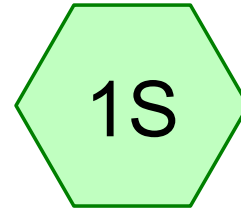
Pond 1P: Detention Pond

Hydrograph

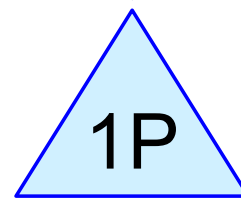




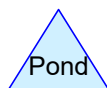
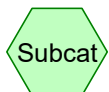
Pre Dev Basin 1



Area to Detention Pond



Detention Pond



Routing Diagram for 3849 PRELIM Detention pond

Prepared by HP Inc., Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Printed 6/24/2025

Page 2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
505,746	85	Pasture HSG C (A1)
154,514	86	Landscaping (1S)
42,000	98	Driveway (1S)
19,805	98	Impervious (A1)
152,637	98	Roads/Curb (1S)
176,400	98	Roof (1S)
1,051,102	90	TOTAL AREA

3849 PRELIM Detention pond

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 3

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
505,746	HSG C	A1
0	HSG D	
545,356	Other	1S, A1
1,051,102		TOTAL AREA

3849 PRELIM Detention pond

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 4

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchmen Numbers
0	0	0	0	42,000	42,000	Driveway	1 S
0	0	0	0	19,805	19,805	Impervious	A 1
0	0	0	0	154,514	154,514	Landscaping	1 S
0	0	505,746	0	0	505,746	Pasture	A 1
0	0	0	0	152,637	152,637	Roads/Curb	1 S
0	0	0	0	176,400	176,400	Roof	1 S
0	0	505,746	0	545,356	1,051,102	TOTAL AREA	

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 2 yr Rainfall=2.40"

Printed 6/24/2025

Page 5

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area to Detention Pond Runoff Area=525,551 sf 70.60% Impervious Runoff Depth=1.77"
Tc=6.0 min CN=94 Runoff=5.59 cfs 77,695 cf

Subcatchment A1: Pre Dev Basin 1 Runoff Area=525,551 sf 3.77% Impervious Runoff Depth=1.10"
Flow Length=942' Tc=33.9 min CN=85 Runoff=2.44 cfs 48,147 cf

Pond 1P: Detention Pond Peak Elev=1.98' Storage=10,685 cf Inflow=5.59 cfs 77,695 cf
Outflow=2.25 cfs 77,694 cf

Total Runoff Area = 1,051,102 sf Runoff Volume = 125,842 cf Average Runoff Depth = 1.44"
62.82% Pervious = 660,260 sf 37.18% Impervious = 390,842 sf

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 2 yr Rainfall=2.40"

Printed 6/24/2025

Page 6

Summary for Subcatchment 1S: Area to Detention Pond

Runoff = 5.59 cfs @ 7.91 hrs, Volume= 77,695 cf, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

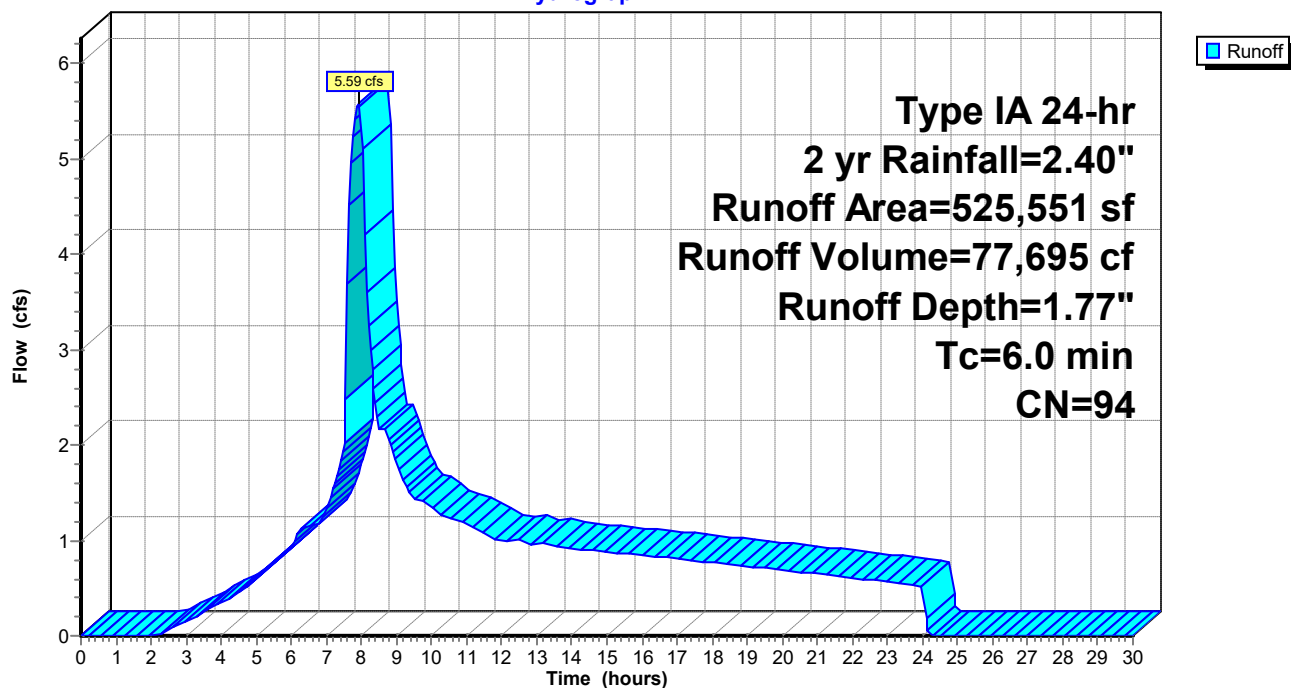
Type IA 24-hr 2 yr Rainfall=2.40"

	Area (sf)	CN	Description
*	152,637	98	Roads/Curb
*	176,400	98	Roof
*	42,000	98	Driveway
*	154,514	86	Landscaping
	525,551	94	Weighted Average
	154,514		29.40% Pervious Area
	371,037		70.60% Impervious Area

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

Subcatchment 1S: Area to Detention Pond

Hydrograph



3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr 2 yr Rainfall=2.40"

Printed 6/24/2025

Page 7

Summary for Subcatchment A1: Pre Dev Basin 1

Runoff = 2.44 cfs @ 8.30 hrs, Volume= 48,147 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

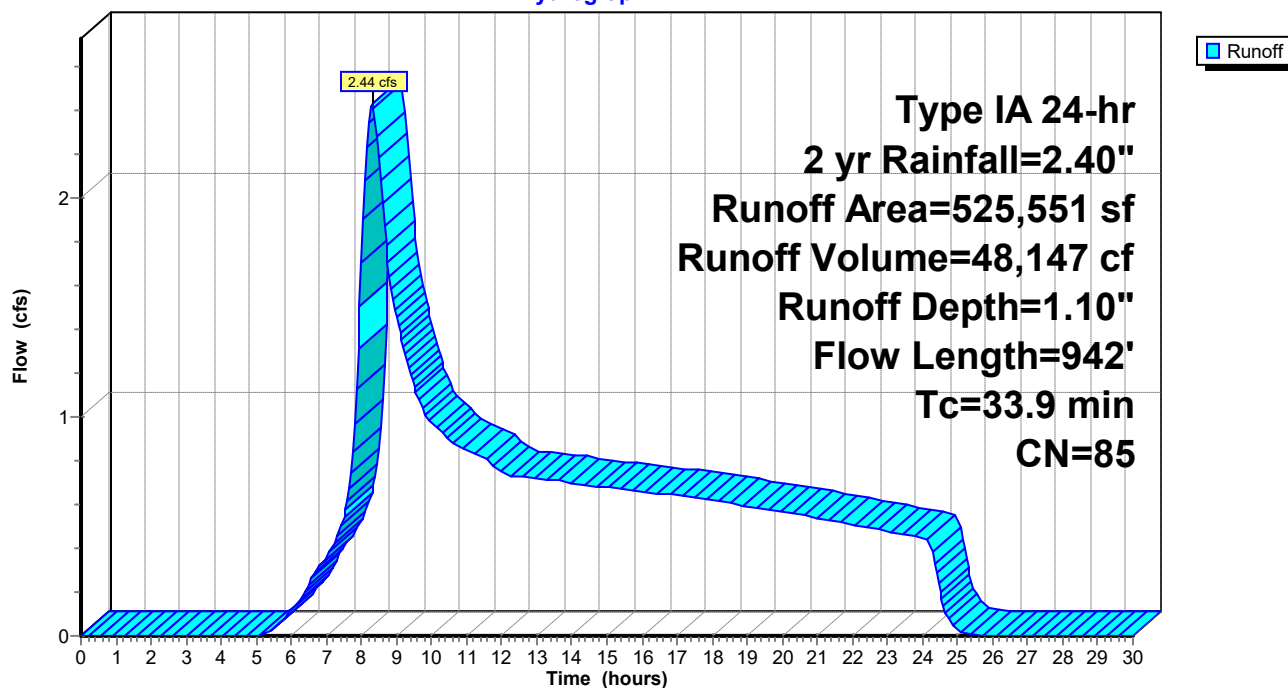
Type IA 24-hr 2 yr Rainfall=2.40"

	Area (sf)	CN	Description
*	505,746	85	Pasture HSG C
*	19,805	98	Impervious
	525,551	85	Weighted Average
	505,746		96.23% Pervious Area
	19,805		3.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.9	300	0.1300	0.17		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.30"
5.0	642	0.0934	2.14		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
33.9	942	Total			

Subcatchment A1: Pre Dev Basin 1

Hydrograph



3849 PRELIM Detention pond

Type IA 24-hr 2 yr Rainfall=2.40"

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 8

Summary for Pond 1P: Detention Pond

Inflow Area = 525,551 sf, 70.60% Impervious, Inflow Depth = 1.77" for 2 yr event
 Inflow = 5.59 cfs @ 7.91 hrs, Volume= 77,695 cf
 Outflow = 2.25 cfs @ 8.47 hrs, Volume= 77,694 cf, Atten= 60%, Lag= 33.5 min
 Primary = 2.25 cfs @ 8.47 hrs, Volume= 77,694 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 1.98' @ 8.47 hrs Surf.Area= 5,409 sf Storage= 10,685 cf

Plug-Flow detention time= 47.7 min calculated for 77,694 cf (100% of inflow)
 Center-of-Mass det. time= 47.6 min (776.5 - 728.9)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	39,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	7,512	0	0
1.00	7,512	7,512	7,512
2.00	7,512	7,512	15,024
3.00	8,646	8,079	23,103
4.00	9,815	9,231	32,334
5.00	11,019	10,417	42,751
6.00	12,256	11,638	54,388

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	7.8" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	2.18'	7.8" Vert. Orifice/Grate C= 0.600
#3	Primary	4.60'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.25 cfs @ 8.47 hrs HW=1.98' (Free Discharge)

1=Orifice/Grate (Orifice Controls 2.25 cfs @ 6.77 fps)

2=Orifice/Grate (Controls 0.00 cfs)

3=Orifice/Grate (Controls 0.00 cfs)

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

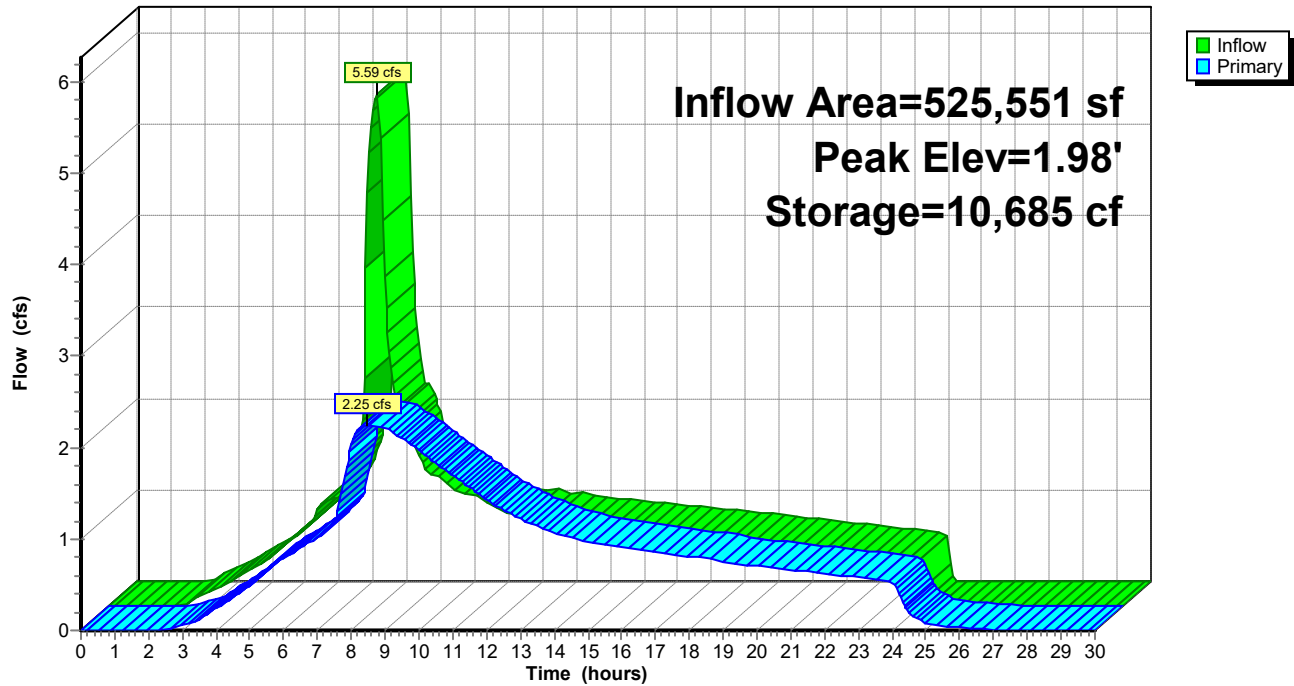
Type IA 24-hr 2 yr Rainfall=2.40"

Printed 6/24/2025

Page 9

Pond 1P: Detention Pond

Hydrograph



3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr WQ Rainfall=1.68"

Printed 6/24/2025

Page 10

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area to Detention Pond Runoff Area=525,551 sf 70.60% Impervious Runoff Depth=1.10"
Tc=6.0 min CN=94 Runoff=3.40 cfs 48,177 cf

Subcatchment A1: Pre Dev Basin 1 Runoff Area=525,551 sf 3.77% Impervious Runoff Depth=0.57"
Flow Length=942' Tc=33.9 min CN=85 Runoff=1.05 cfs 24,946 cf

Pond 1P: Detention Pond Peak Elev=1.00' Storage=5,408 cf Inflow=3.40 cfs 48,177 cf
Outflow=1.60 cfs 48,176 cf

Total Runoff Area = 1,051,102 sf Runoff Volume = 73,123 cf Average Runoff Depth = 0.83"
62.82% Pervious = 660,260 sf 37.18% Impervious = 390,842 sf

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr WQ Rainfall=1.68"

Printed 6/24/2025

Page 11

Summary for Subcatchment 1S: Area to Detention Pond

Runoff = 3.40 cfs @ 7.93 hrs, Volume= 48,177 cf, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

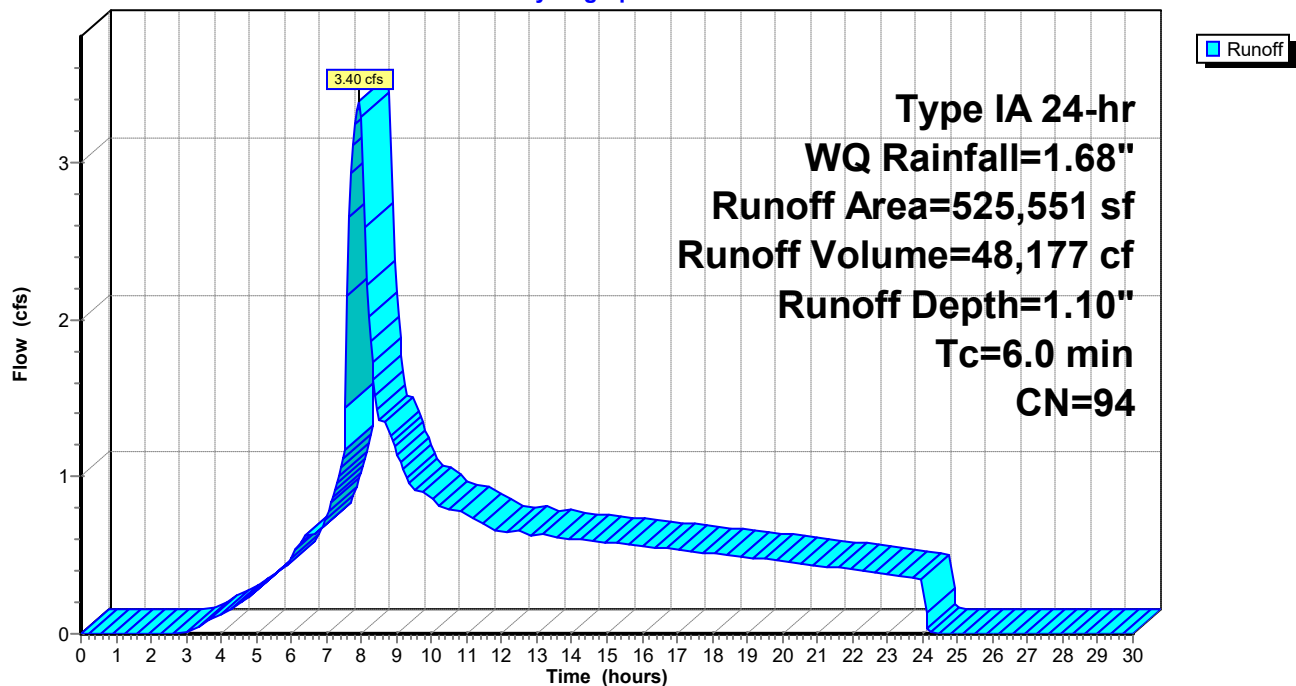
Type IA 24-hr WQ Rainfall=1.68"

	Area (sf)	CN	Description
*	152,637	98	Roads/Curb
*	176,400	98	Roof
*	42,000	98	Driveway
*	154,514	86	Landscaping
	525,551	94	Weighted Average
	154,514		29.40% Pervious Area
	371,037		70.60% Impervious Area

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

Subcatchment 1S: Area to Detention Pond

Hydrograph



3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr WQ Rainfall=1.68"

Printed 6/24/2025

Page 12

Summary for Subcatchment A1: Pre Dev Basin 1

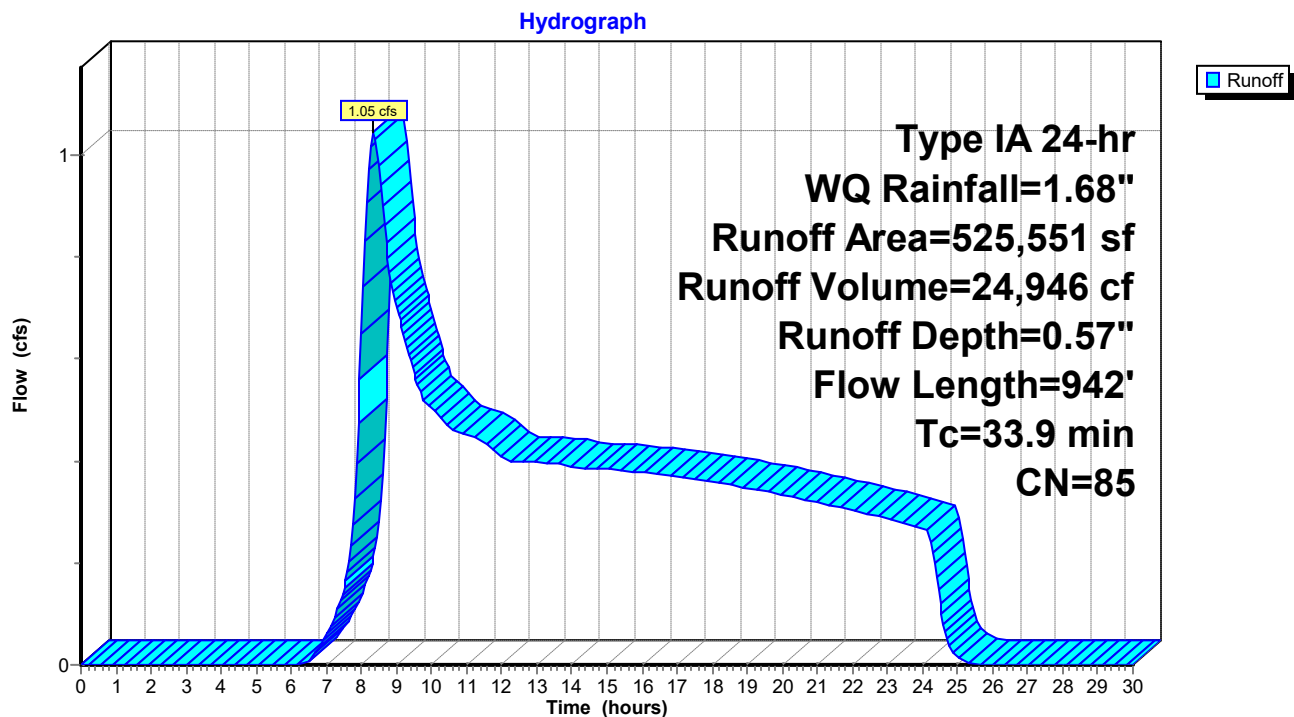
Runoff = 1.05 cfs @ 8.34 hrs, Volume= 24,946 cf, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Type IA 24-hr WQ Rainfall=1.68"

	Area (sf)	CN	Description
*	505,746	85	Pasture HSG C
*	19,805	98	Impervious
	525,551	85	Weighted Average
	505,746		96.23% Pervious Area
	19,805		3.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.9	300	0.1300	0.17		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 2.30"
5.0	642	0.0934	2.14		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
33.9	942	Total			

Subcatchment A1: Pre Dev Basin 1

3849 PRELIM Detention pond

Type IA 24-hr WQ Rainfall=1.68"

Prepared by HP Inc.

Printed 6/24/2025

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Page 13

Summary for Pond 1P: Detention Pond

Inflow Area = 525,551 sf, 70.60% Impervious, Inflow Depth = 1.10" for WQ event
 Inflow = 3.40 cfs @ 7.93 hrs, Volume= 48,177 cf
 Outflow = 1.60 cfs @ 8.36 hrs, Volume= 48,176 cf, Atten= 53%, Lag= 25.8 min
 Primary = 1.60 cfs @ 8.36 hrs, Volume= 48,176 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 1.00' @ 8.36 hrs Surf.Area= 5,409 sf Storage= 5,408 cf

Plug-Flow detention time= 37.4 min calculated for 48,096 cf (100% of inflow)
 Center-of-Mass det. time= 37.7 min (791.8 - 754.1)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	39,159 cf	Custom Stage Data (Prismatic) Listed below (Recalc) x 0.72

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
0.00	7,512	0	0
1.00	7,512	7,512	7,512
2.00	7,512	7,512	15,024
3.00	8,646	8,079	23,103
4.00	9,815	9,231	32,334
5.00	11,019	10,417	42,751
6.00	12,256	11,638	54,388

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	7.8" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Primary	2.18'	7.8" Vert. Orifice/Grate C= 0.600
#3	Primary	4.60'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.60 cfs @ 8.36 hrs HW=1.00' (Free Discharge)

1=Orifice/Grate (Orifice Controls 1.60 cfs @ 4.81 fps)
 2=Orifice/Grate (Controls 0.00 cfs)
 3=Orifice/Grate (Controls 0.00 cfs)

3849 PRELIM Detention pond

Prepared by HP Inc.

HydroCAD® 10.00 s/n 04953 © 2011 HydroCAD Software Solutions LLC

Type IA 24-hr WQ Rainfall=1.68"

Printed 6/24/2025

Page 14

Pond 1P: Detention Pond

Hydrograph

