



Preliminary Storm Drainage Report City of Carnation

For

**Boyd Short Plat
31964 E Blanche St
Carnation WA, 98014**

November 22, 2023



11/22/2023

Encompass Engineering Job No. 23608

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- A. *Infiltration Evaluation* by Robinson Noble dated September 15, 2023.
- B. Operation & Maintenance Manual

I. PROJECT OVERVIEW

Project: Boyd Short Plat
Site Address: 31964 E Blanche St, Carnation, WA 98014 (Vicinity Map below)
Tax Parcel: 306010-0120
Zoning: R24 (Single-Family Residential)
Site Area: 10,368 SF (0.24 acres) – as surveyed

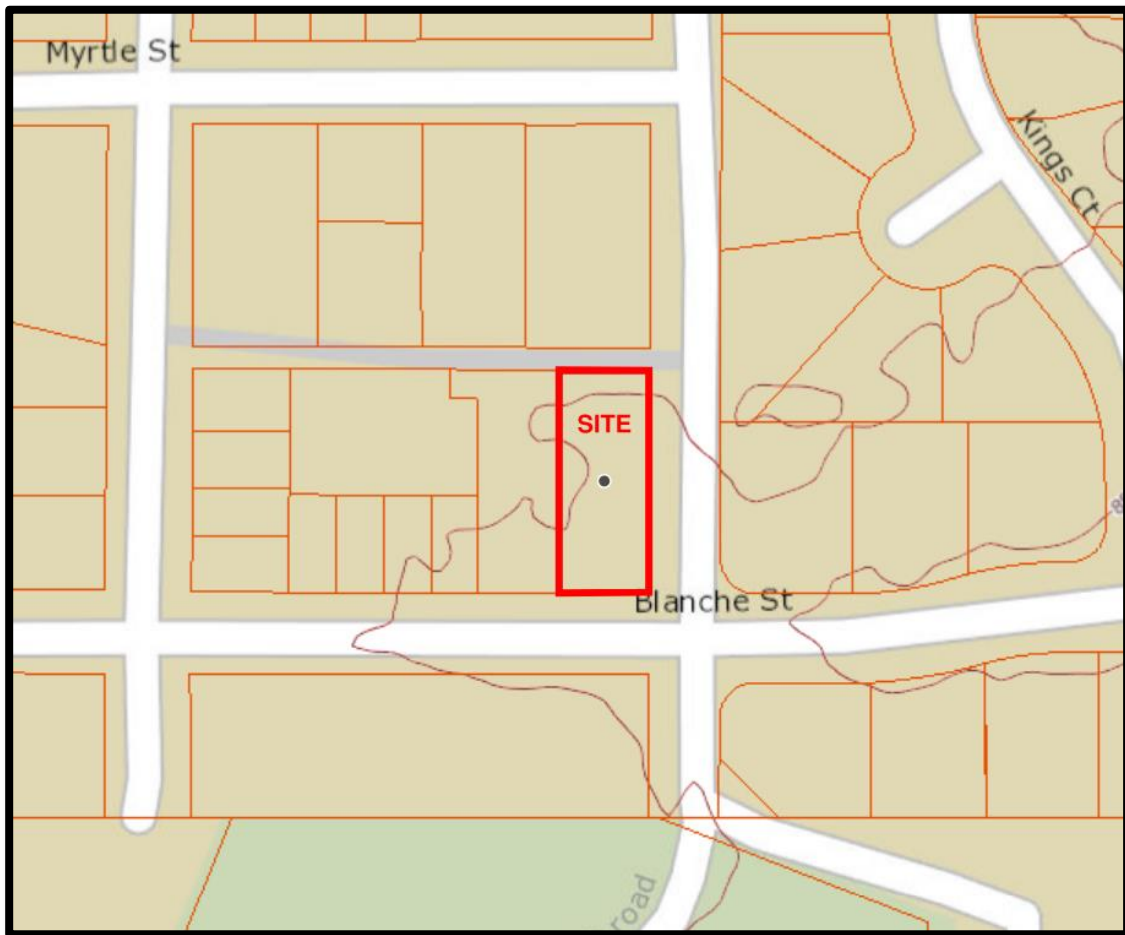


Figure 1: Vicinity Map

Existing Adjacent Development:

Existing development adjacent to the subject site includes the following:

- North – Alley
- East – Stossel Ave
- West – Single Family Residence
- South – Blanche St

Existing Conditions:

The southern half of the 0.24-acre parcel is currently developed with a single-family residence with access from Blanche Street via a concrete driveway. Several small sheds are located in the northern portion of the property. The vegetation on the site consists of some shrubs and lawn. Runoff from the existing residence is routed underground via roof drains and is assumed to connect to the City of Carantion's public stormwater system in Blanche Street. Runoff from the existing driveway/walkway surfaces sheet flows into the right-of-way (ROW) for Blanche Street where it enters the public stormwater system. Please refer to the Existing Conditions Map (Figure 3) on the following page.

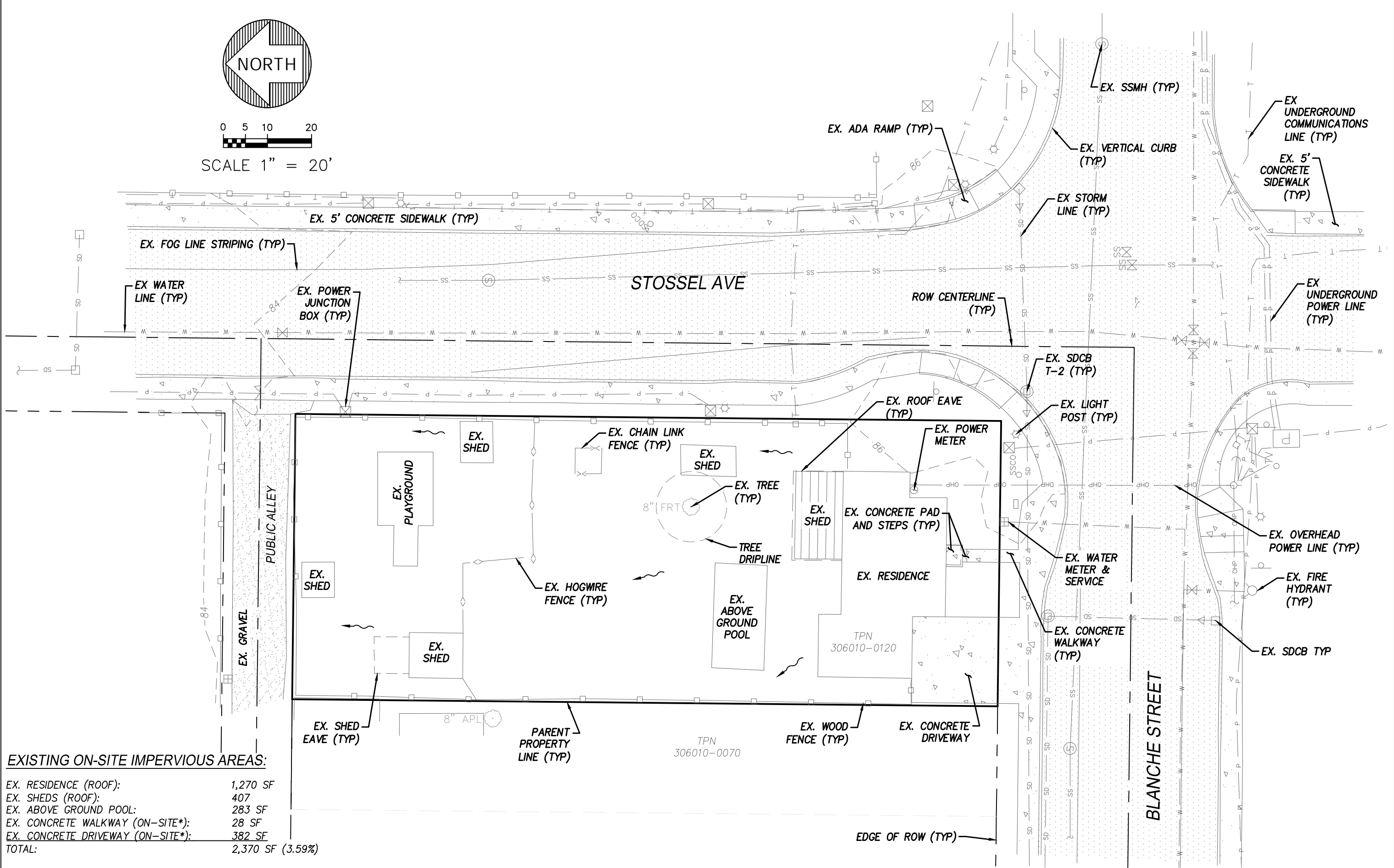
The project site is generally flat with mild slopes of 1 to 2 percent to the south. The *Infiltration Evaluation* by Robinson Noble dated September 15, 2023 (Appendix A) identified the site soil as unconsolidated alluvium (Qa). These alluvial sediments consist of medium dense, silty medium sand with gravel. Based on the site soil exploration, the report states that the onsite storm water infiltration is feasible and recommends a design infiltration rate of 7.6 inches/hour when designing infiltration trench and drywell facilities.



Figure 2: Existing Site Photo



SCALE 1" = 20'



EXISTING ON-SITE IMPERVIOUS AREAS:

EX. RESIDENCE (ROOF):	1,270 SF
EX. SHEDS (ROOF):	407
EX. ABOVE GROUND POOL:	283 SF
EX. CONCRETE WALKWAY (ON-SITE*):	28 SF
EX. CONCRETE DRIVEWAY (ON-SITE*):	382 SF
TOTAL:	2,370 SF (3.59%)

*NOTE: AN ADDITIONAL 13 SF OF CONCRETE WALKWAY AND 49 SF OF CONCRETE DRIVEWAY IS LOCATED OFF-SITE IN THE ROW.

REVISIONS	
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Developed Site Conditions:

The project proposes the subdivision of the existing parcel into two (2) residential lots. The southern lot (Lot 1) will encompass the existing residence, which is proposed to remain and will be accessed off of Blanche Street. The northern lot (lot 2) will include two (2) new residential attached townhomes with joint driveway access off the public alley to the north. The proposal incorporates the construction of on-site infrastructure (i.e. water, sewer, storm service) to support the future construction of the townhomes on Lot 2. Water and sewer services for the two (2) proposed townhomes will be provided from the existing public water in sewer mains in Stossel Avenue. Stormwater will be managed on-site via a full infiltration trench and pervious pavement. Please refer to Section III of this Report for further discussion on the selected stormwater BMPs. Please refer to the Developed Conditions Map (Figure 4) on the following page.

Area Calculations:

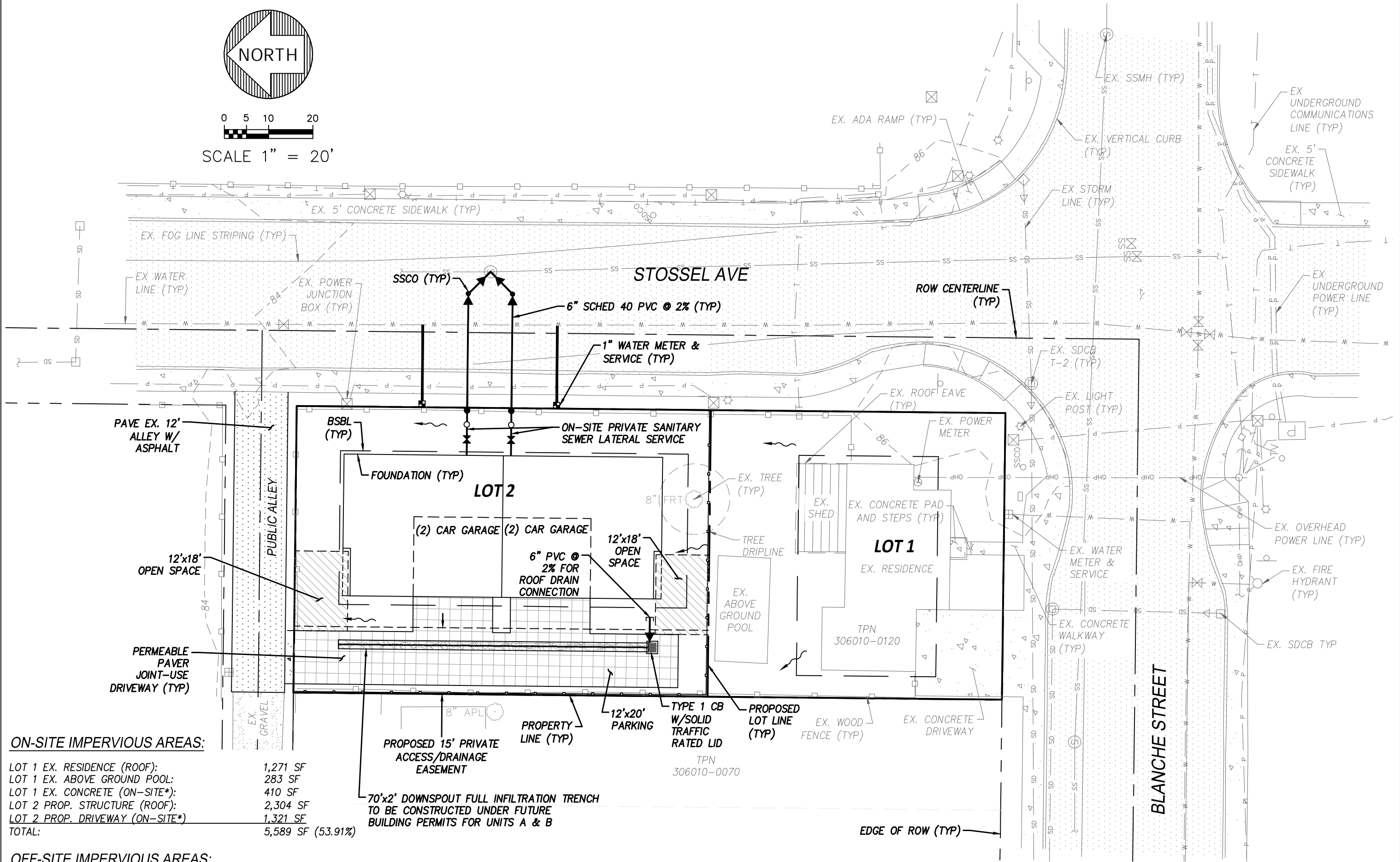
The total site area is 10,368 SF (0.24 acres) and will be subdivided into two (2) lots. Lot 1 is proposed to be 4,307 SF (southern lot), Lot 2 is proposed to be 6,061 SF (northern lot). The future development of lot 2 will include 2,304 SF of new rooftop and 1,321 SF of new driveway. No new/replaced impervious surfaces are proposed on Lot 1. Approximately 816 SF of existing gravel alley will be repaved with asphalt in the public right-of-way (ROW).

Impervious Surface Area Summary:

<u>Lot 1:</u>	Existing House	1,271 SF
	Existing Concrete Driveway/Walkways	410 SF
	<u>Existing Pool</u>	<u>283 SF</u>
	TOTAL (EXISTING)	1,964 SF
<u>Lot 2:</u>	Proposed Townhomes	2,304 SF
	<u>Proposed Driveway</u>	<u>1,321 SF</u>
	TOTAL (PROPSOED)	3,625 SF
<u>Off-Site:</u>	Proposed Driveway Apron	20 SF
	<u>Proposed Asphalt Alley</u>	<u>816 SF</u>
	TOTAL (PROPSOED)	836 SF
Total New/Replaced Impervious Area (On- and Off-Site):		4,461 SF < 10,000 SF
Total New/Replaced Pervious Area (On- and Off-Site):		6,061 SF < ¼ AC
Total New/Replaced Pollution Generating Impervious Surface (PGIS):		2,157 SF < 5,000 SF



SCALE 1" = 20'



ON-SITE IMPERVIOUS AREAS:

LOT 1 EX. RESIDENCE (ROOF):	1,271 SF
LOT 1 EX. ABOVE GROUND POOL:	283 SF
LOT 1 EX. CONCRETE (ON-SITE*):	410 SF
LOT 2 PROP. STRUCTURE (ROOF):	2,304 SF
LOT 2 PROP. DRIVEWAY (ON-SITE*)	1,321 SF
TOTAL:	5,589 SF (53.91%)

OFF-SITE IMPERVIOUS AREAS:

PROP. DRIVEWAY IN ALLEY:	20 SF
PROP. ASPHALT ALLEY:	816 SF
TOTAL:	836 SF

70'x2' DOWNSPOUT FULL INFILTRATION TRENCH TO BE CONSTRUCTED UNDER FUTURE BUILDING PERMITS FOR UNITS A & B

II. CONDITIONS AND REQUIREMENTS SUMMARY

The project site has less than 35% of existing impervious coverage and generates less than 5,000 SF of new plus replaced impervious surface area. Based on Figure I-3.1 of the 2019 Department of Ecology (DOE) Stormwater Management Manual for Western Washington (SMMWW), only Minimum Requirements 1 through 5 are applicable for this project. See Figure 5 below.

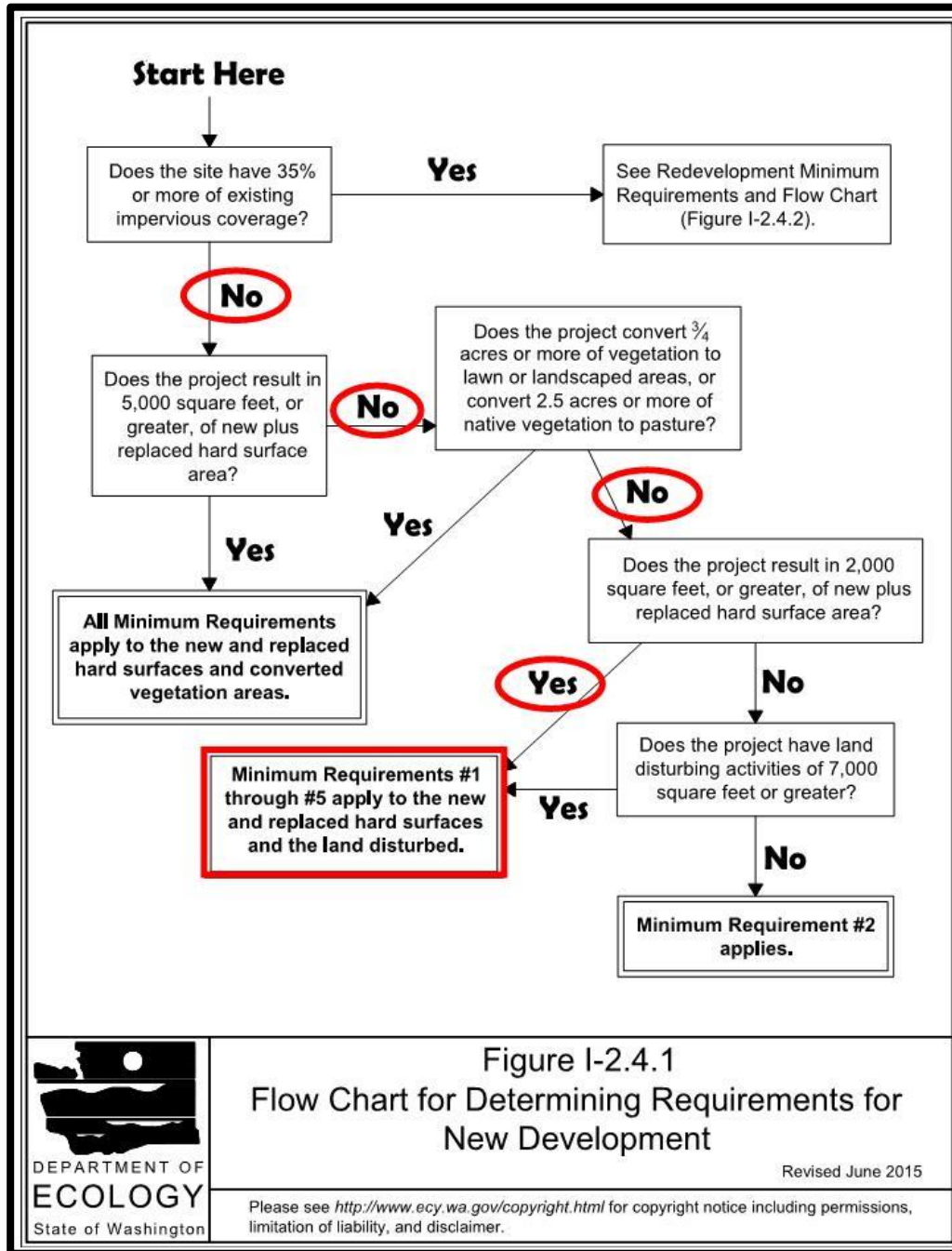


Figure 5: Flow Chart for Determining Requirements for New Development

MINIMUM REQUIREMENTS:**Minimum Requirement #1: Preparation of Stormwater Site Plans**

Stormwater site plans for the proposed residence have been prepared and are included with the submittal. These plans were prepared in accordance with Chapter I-3.4.1 – Preparation of Stormwater Site Plans.

Minimum Requirement #2: Construction Stormwater Pollution Prevention (CSWPPP)

A Temporary Erosion and Sediment Control (TESC) plan has been created and is included in the engineering plan set. The limits of disturbance for this project are less than 1 acre; therefore, a formal CSWPPP is not required. An abbreviated CSWPPP for small projects has been provided under Section VIII of this Report.

Minimum Requirement #3: Source Control of Pollution

Source control is not required for single-family residential construction.

Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

The proposed on-site drainage patterns emulate those of the existing site conditions. Onsite storm water from the developed site will be fully infiltrated and/or dispersed to the natural discharge location. The stormwater system has been designed to not cause significant adverse impacts to downstream receiving waters or down gradient properties.

Minimum Requirement #5: On-Site Stormwater Management

This project, per Table I-3.2, is designed to comply with the requirements of List #1 of the 2019 DOE SWMMWW. Flow control BMPs were considered and selected for all new/replaced surfaces. See the engineering plan sheets for further details.

Lawn and Landscaped Areas:

All pervious areas disturbed by construction activities shall achieve final stabilization per the requirements detailed by BMP T5.13 in the 2019 DOE SWMMWW.

Rooftop Areas:

The estimated 2,304 SF of rooftop area associated with the future construction of the townhomes on Lot 2 will mitigate runoff via the use of a Downspout Full Infiltration Trench per BMP T5.10A. The site is underlain by silty medium sand and gravel per the *Infiltration Evaluation* by Robinson Noble (Appendix A). Therefore, the infiltration trench on Lot 1 has been sized at 30 LF of trench per 1000 SF of tributary target impervious surface per BMP T5.10A. For the estimated 2,304 SF of rooftop area, a 70 LF trench is required. If during building permit application, a larger rooftop area is proposed on Lot 2, the trench should be lengthened based on a ratio of 30 LF of trench per 1,000 SF of tributary rooftop. Similarly, if a smaller rooftop area is ultimately proposed, the trench length may be reduced in accordance with this ratio. The Downspout Full Infiltration trench will be constructed with the future building permit.

Other Hard Surface Areas:

Permeable Pavers (BMP T5.15) will be utilized for the new shared driveway on Lot 2 for Units A and B.

III. OFF-SITE ANALYSIS

An Offsite Analysis was performed based on the requirements in the 2019 DOE SWMMWW. A Downstream Drainage Map (Figure 6), which summarizes the downstream drainage components for one-quarter mile, has been included at the end of this section to aid in this discussion.

Resource Review

For the Resource Review, relevant existing information was analyzed for the roughly half-mile downstream flowpath from the site. See below for a summary of this information.

FEMA Maps

According to King County iMap, the entirety of the site is located within the 500-year FEMA floodplain for the Snoqualmie River. However, the 500-year floodplain does not warrant any additional flood analysis.

Sensitive Areas

According to King County iMap, the site does not contain any environmentally sensitive areas.

Soils Survey (United States Dept. of Agriculture/Natural Resources Conservation Service)

The NRCS Soil Survey indicates that the native soil underlying the site consists of Oridia silt loam. This soil is classified as till, which typically has a moderately high runoff potential. However, the *Infiltration Evaluation* by Robinson Noble dated September 15, 2023 (Appendix A) identified the site soil as unconsolidated alluvium (Qa). These alluvial sediments consist of medium dense, silty medium sand with gravel. Based on the site soil exploration, the report states that the onsite storm water infiltration is feasible.

Drainage Complaints

Per King County iMap, there have been no flooding related drainage complaints within a quarter mile downstream of the site.

Upstream Tributary Basin

Due to site topography, there are no significant upstream tributary areas.

Downstream Drainage Route

Stormwater runoff from the site typically infiltrates into the native soils found on-site; however, in the event of an extreme rain event, runoff would sheet flow to the northeast across lawn surfaces at mild grades of 1 to 2 percent (A). The only natural discharge area (NDA) for the site is located in the northeastern portion of the property, which results in a total of one threshold discharge area (TDA) for the site. Once the stormwater sheet flows off the northeastern portion of the site, it enters a catch basin located in Stossel Avenue just north of the site (B). After entering the public stormwater system, stormwater continues flowing north within the public stormwater system within Stossel Avenue at the ¼ mile downstream limit (C). No signs of erosion or drainage concerns were observed during the site visit. Please refer to the Downstream Drainage Map below for the referenced points of interest in the above. The site proposed to fully infiltrate all runoff

generated from the proposed development; therefore, we do not anticipate any impact to the downstream public stormwater system.

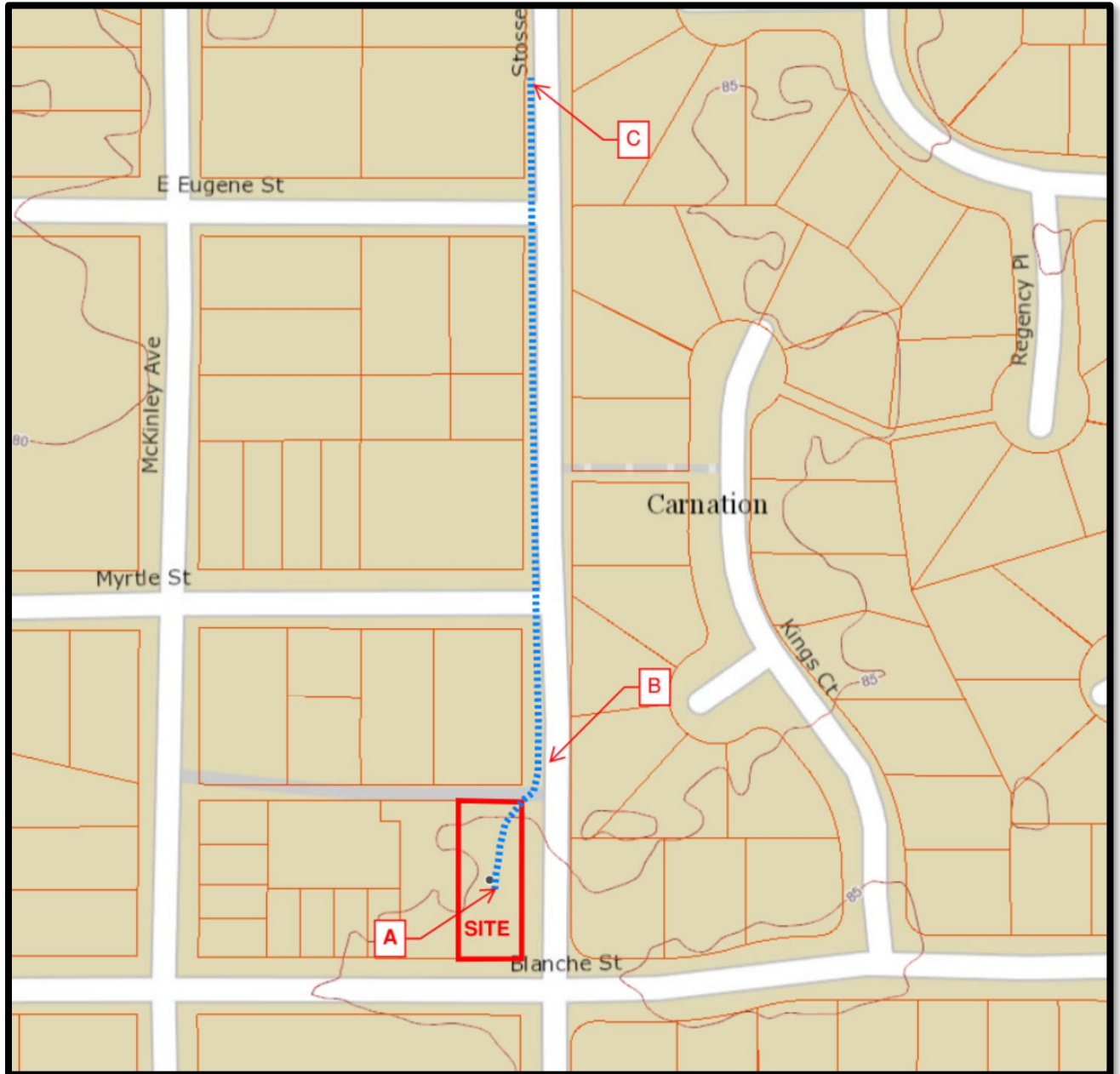


Figure 6: Downstream Drainage Map

IV. FLOW CONTROL AND WATER QUALITY FACILITY ANALYSIS AND DESIGN

The following onsite stormwater BMP's will be utilized for the project:

- New Roofs: Downspout Full Infiltration Trench (BMP T5.10A)
- New Driveway: Permeable Pavers (BMP T5.15)

The minimum length for the infiltration trench is based on soil type of the site. Based on the geotechnical recommendation soil type of "Medium sands and gravel", 30 LF of trench length per 1,000 sf of roof area has been utilized for the future infiltration trench on Lot 2. Based on the assumed 2,304 SF of total new rooftop area for the future townhomes, a 70 LF trench will be required.

For the proposed driveway, permeable pavers (BMP T5.15) will be utilized to mitigate the 1,341 SF of new shared driveway on Lot 2.

Further flow control and water quality analysis is not required as this project proposes less than 10,000 SF of new/replaced impervious and less than 5,000 SF of new/replaced PGIS, respectively.

V. CONVEYANCE SYSTEM ANALYSIS AND DESIGN

Conveyance system analysis will be completed if requested by the City of Carnation.

VI. SPECIAL REPORTS AND STUDIES

- *Infiltration Investigation* by Robinson Noble dated September 15, 2023 (Appendix A).

VII. OTHER PERMITS

- Drainage Permit (City of Carnation)
- Clearing & Grading Permit (City of Carnation)
- Right-of-Way Use Permit (City of Carnation)
- Side Sewer Permit (City of Carnation)
- Water Service Permit (City of Carnation)
- Building Permit (City of Carnation)

VIII. TESC ANALYSIS AND DESIGN

The potential for erosion within the site will be mitigated by use of erosion control measures during clearing, grading, and site development activities. Filter fences will be installed along the downhill perimeter of the site to protect adjacent properties from sediment-laden water. A rocked construction entrance will be installed at the entrance to the site to protect mud from entering the paved roadway. Stockpiles and exposed disturbed areas will be covered to protect from erosion and sediment runoff.

Element 1: Mark Clearing Limits. All clearing, grading, sensitive areas, and buffers will be clearly marked in the field prior to construction in accordance with the plans and specifications. Prior to beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area. These will be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts. Plastic, metal, or stake wire fence may be used to mark the clearing limits.

Element 2: Establish Construction Access. Construction access will be from the public alley to the north of the property. Stabilize the construction access with rock per the stormwater plans. Access points will be stabilized with a pad of quarry spalls, crushed rock, or equivalent BMP prior to traffic leaving the construction site to minimize the tracking of sediment onto all roads and accesses.

Element 3: Control Flow Rates. It is anticipated that construction site runoff will infiltrate into the ground naturally. To control construction flow rates if this fails to adequately infiltrate, a temporary sediment pond may be utilized. Natural drainage patterns will be protected as much as possible during construction, and concentrated flow should not be permitted. Properties and waterways downstream from development sites will be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.

Element 4: Install Sediment Controls. Soils should be covered if not worked for 7 days during the dry season or 2 days during the wet season. The street should be swept each night or as required. If the minimum BMPs fail to retain sediment on the site, additional BMPs will be used.

Element 5: Stabilize Soils. Soils will be covered if not worked for 7 days during the dry season or 2 days during the wet season. Soil stockpiles will be covered unless worked. Soil stockpiles will be located away from drain inlets and surface water discharge locations. Soil stockpiles will be stabilized and covered as needed. Soils will be stabilized at the end of the shift before holidays or weekends if needed based on weather forecast.

Element 6: Protect Slopes. Slope protection is not proposed as there are no slopes on the site.

Element 7: Protect Drain Inlets. Grated catch basins in the immediate vicinity of the project will be protected. The new catch basins associated with the infiltration trench will be protected under the associated building permit.

Element 8: Stabilize Channels and Outlets. There are no existing or proposed channels or drainage outlets associated with this project.

Element 9: Control Pollutants. Pollution generated from construction must be controlled at all times. Control of pollutants other than sediments includes the following:

- All pollutants other than sediments will be handled and disposed of in a manner that does not cause contamination of stormwater.
- Cover, containment and protection from vandalism will be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the project site.
- Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces will be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.
- Wheel wash or tire bath wastewater will be discharged to a separate on-site treatment system or to the sanitary sewer, if available.

Element 10: Control De-Watering. De-watering is not anticipated for the site. In the event that dewatering is

necessary, the waste water will be treated such that sediment remains on site. This will be done by routing the storm water through a straw filter or sediment trap.

Element 11: Maintain BMPs. BMPs will be inspected monthly and after every significant storm event, Sediment will be removed from the BMPs as necessary for them to continue operating at the required performance level. In the event that a BMPs has been damaged, it will be replaced immediately.

Element 12: Manage the Project. Construction activities will be phased such that the impact to the area will be kept at a minimum. Coordination will occur with all utility agencies that are affected by this project. BMPs will be inspected regularly and after each significant storm event. The Contractor will provide a Certified Erosion and Sediment Control Specialist. If for any reason a BMPs is not sufficient for the project, additional BMPs will be installed.

IX. OPERATION AND MAINTENANCE MANUAL

An Operation and Maintenance Manual is included in Appendix B.

Appendix A

Infiltration Evaluation by Robinson Noble dated September 15, 2023



ROBINSONSM
NOBLE

a terraphase company

September 15, 2023

Mr. Shane Fortney
Manager
Fortwest, LLC
Post Office Box 522
Woodinville, Washington 98072

sent via email to sfortney@live.com

Subject: Infiltration Evaluation

Dear Mr. Fortney:

This letter has been prepared on behalf of Fortwest, LLC by Robinson Noble (RN), a wholly owned subsidiary of Terraphase Engineering Inc. This letter presents our evaluation of infiltration feasibility for the proposed residential project located at 31964 East Blanche Street, Carnation, Washington (King County parcel number 3060100120). The approximate location of the project is shown on the Vicinity Map, presented as Figure 1.

The project site is approximately 0.24 acres in size and is currently developed with a single-family residence. We understand that you plan to redevelop the approximate northern 2/3 of the property with a duplex. The existing residence at the southern end of the parcel is to remain.

1 Surface and Subsurface Conditions

Surface Conditions

The surface conditions consist of grass covered lawn. A few small landscaping trees were near the existing residence to the south and along the edges of the property.

Subsurface Conditions

The geology of the area is mapped on the Washington State Department of Natural Resources Geologic Information Portal (<https://geologyportal.dnr.wa.gov>). The site is mapped as being underlain by alluvium (Qa). These deposits are not glacially consolidated and generally consist of sorted combinations of sand, silt, and gravel.

We explored subsurface conditions at the site on August 22, 2023 by excavating two test pits with a mini trackhoe. Both test pits were excavated to depths of approximately 4.5 feet below the ground surface (bgs). The explorations were located in the field by representatives from this firm who also examined the soils and geologic conditions encountered and maintained logs of the explorations. The approximate locations of the explorations are shown on the Site Plan in Figure 2. The soils were visually classified in

general accordance with the Unified Soil Classification System, a copy of which is presented as Figure 3. The logs of the explorations are presented in Figures 4 and 5.

The explorations generally revealed an approximate 0.5-foot-thick surficial layer of topsoil. Underlying the topsoil, we encountered medium dense, dry to moist, brown silty sand with some gravel to about 3½ feet. Underlying the silty sand in PIT-1 we observed medium dense, moist brown silty fine to medium sand to the depths explored. Below the silty sand, PIT-2 revealed medium dense, dry to moist, brown silty fine to medium sand with gravel and cobbles to the depths explored.

Groundwater was not observed during our explorations. Rust mottled and wet soils were also not observed. Review of nearby well logs indicate no groundwater was observed within at least 15 feet of the ground surface.

2 Pilot Infiltration Tests

The project site is located in Carnation and is subject to the 2014 Department of Ecology Stormwater Management Manual for Western Washington (DOE). We understand that infiltration is proposed to be sited west of the planned duplex. The DOE requires that Small Pilot Infiltration Tests (PITs) be performed at the infiltration facility location. We excavated test pits near the proposed infiltration facility to observe the subsurface soil and groundwater conditions and determine an appropriate depth for the small pilot infiltration tests (PITs). The PITs were performed in general accordance with the DOE within the location of the proposed infiltration facility as shown on the Site Plan in Figure 2.

The small-scale PIT involves excavating a test pit with a base area between 12 and 32 square feet. This test pit is then pre-soaked with 12 inches or more of water for a period of 6 hours. After the pre-soak is complete, the water depth is maintained for at least one hour to measure the steady state infiltration rate. Every 15 minutes the cumulative water volume, water depth, and flow rate are recorded. After one hour the water is shut off and the water depth is recorded every 15 minutes in order to measure the falling head infiltration rate.

The small PITs were completed at a depth of approximately 4.5 feet bgs with a base area of about 18 ft² for PIT-1 and 12.8 ft² for PIT-2. The maximum available flow from the provided hose bib into PIT-2 did not allow the entire area to be wetted or any head to be built up and maintained. Therefore, the steady state was determined using the maximum flow rate into the PIT over the observed wetted area.

2.1 Design Infiltration Rate

The measured saturated hydraulic conductivity ($K_{sat,initial}$) for each test is shown in Table 1 below. The design saturated hydraulic conductivity ($K_{sat,design}$) is determined by applying correction factors to the measured rate as prescribed in Volume III, Section 3.3.6 of the DOE. The measured rate must be reduced through appropriate correction factors for site variability (CF_v), uncertainty of test method (CF_t), and degree of influent control (CF_m) to prevent siltation and bio-buildup. It should be noted that construction traffic or other disturbance to the target infiltration area could compact the soil, which may decrease the effective infiltration rates. The correction factors and resulting design infiltration rates are

also shown in Table 1 below. We selected a site variability factor of 0.7 due to the variability of performance of the silty sand with varying amounts of gravel soils tested across the site.

Table 1: Measured and Design Infiltration Rates

Test Number	Test Depth (ft)	USCS	K _{sat,initial} (in/hr)	Correction Factors			K _{sat,design} (in/hr)
				CF _V	CF _T	CF _M	
PIT-1	4.5	SM	24	0.7	0.5	0.9	7.6
PIT-2	4.5	SM	37	0.7	0.5	0.9	11.6

2.2 Laboratory Testing

For groundwater protection requirements, cation exchange capacity (CEC) and organic content of samples of the soil at the infiltration testing depth of each PIT were determined by a subcontracted testing laboratory. The test results are shown in Table 2 and attached as Appendix A of this letter.

Table 2: Chemical Properties of Soil at Infiltration Test Locations

Test Number	Test Depth (ft)	USCS	CEC (meq/100g)	Organic Content
PIT-1	4.5	SM	4.7	1.0
PIT-2	4.5	SM	12.0	4.4

3 Conclusions and Recommendations

In our opinion infiltration at the site is feasible. We recommend that a design saturated hydraulic conductivity of 7.6 inches per hour be used for all facilities at the site, when designing facilities for the underlying silty sand soils. If the sand soils are not encountered during construction of the facilities at the design depth then the facility should be overexcavated until the silty sand soils are encountered.

For infiltration facilities used for water treatment purposes, DOE Section 3.3.7 Site Suitability Criteria (SSC) #4 requires measured saturated hydraulic conductivity rates to be 9 inches per hour or less. The measured rates for the silty sand layer at the site exceed this criterion, and will require the facility to be designed with an additional sand layer to reduce the infiltration rate. Additionally, SSC #6 requires the soil to have a CEC of 5 meq/100g or greater and organic content of 1.0% or greater. All of the samples met the criteria of SSC #6.

4 Closing

Terraphase is grateful for the opportunity to offer our services on this important project. If you have any questions or comments regarding this submittal, please contact Barbara Gallagher at (425) 488-0599.

Sincerely,

for Terraphase Engineering Inc.



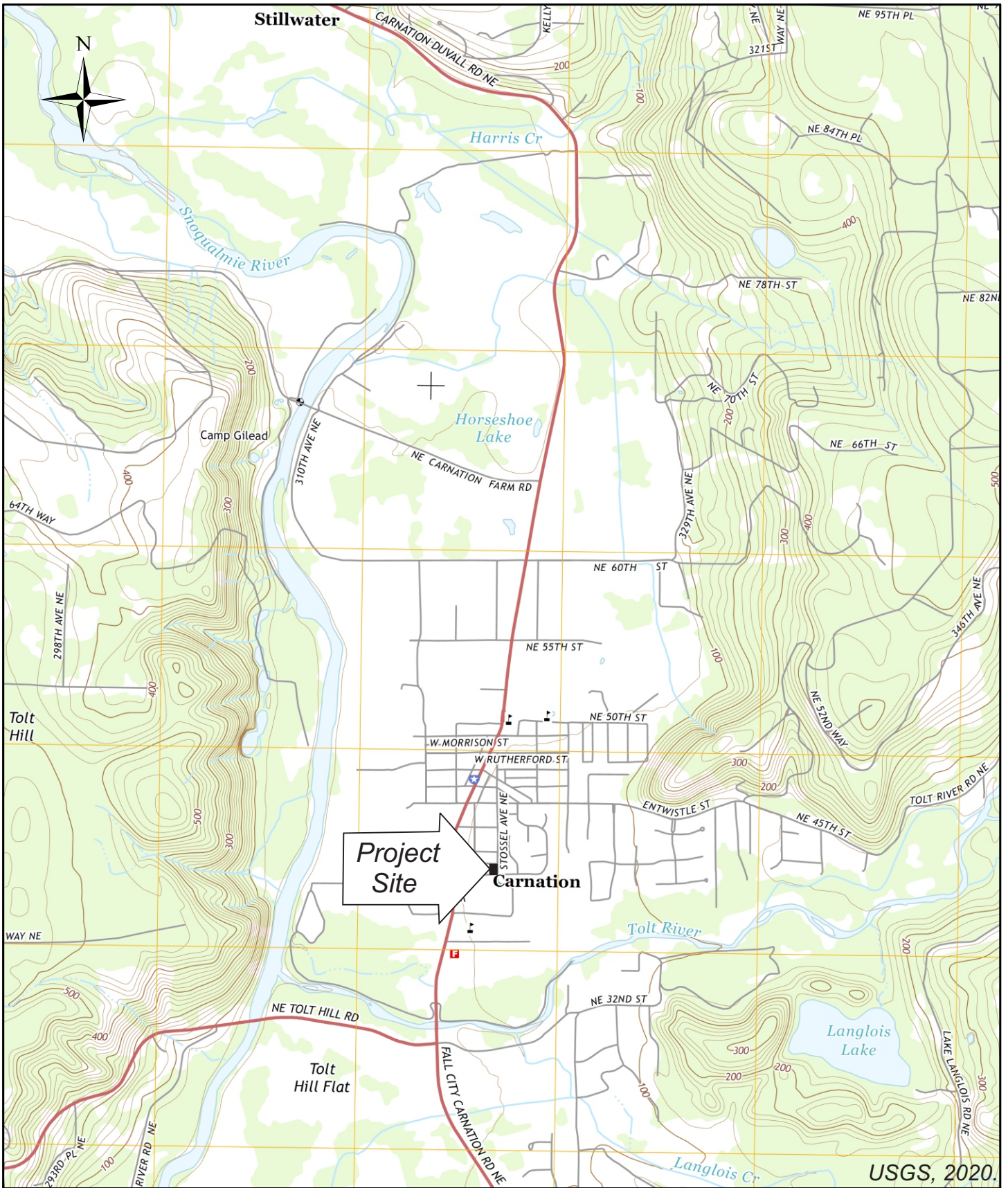
Barbara Gallagher, PE
Associate

BG:RP:am


Attachments (3):

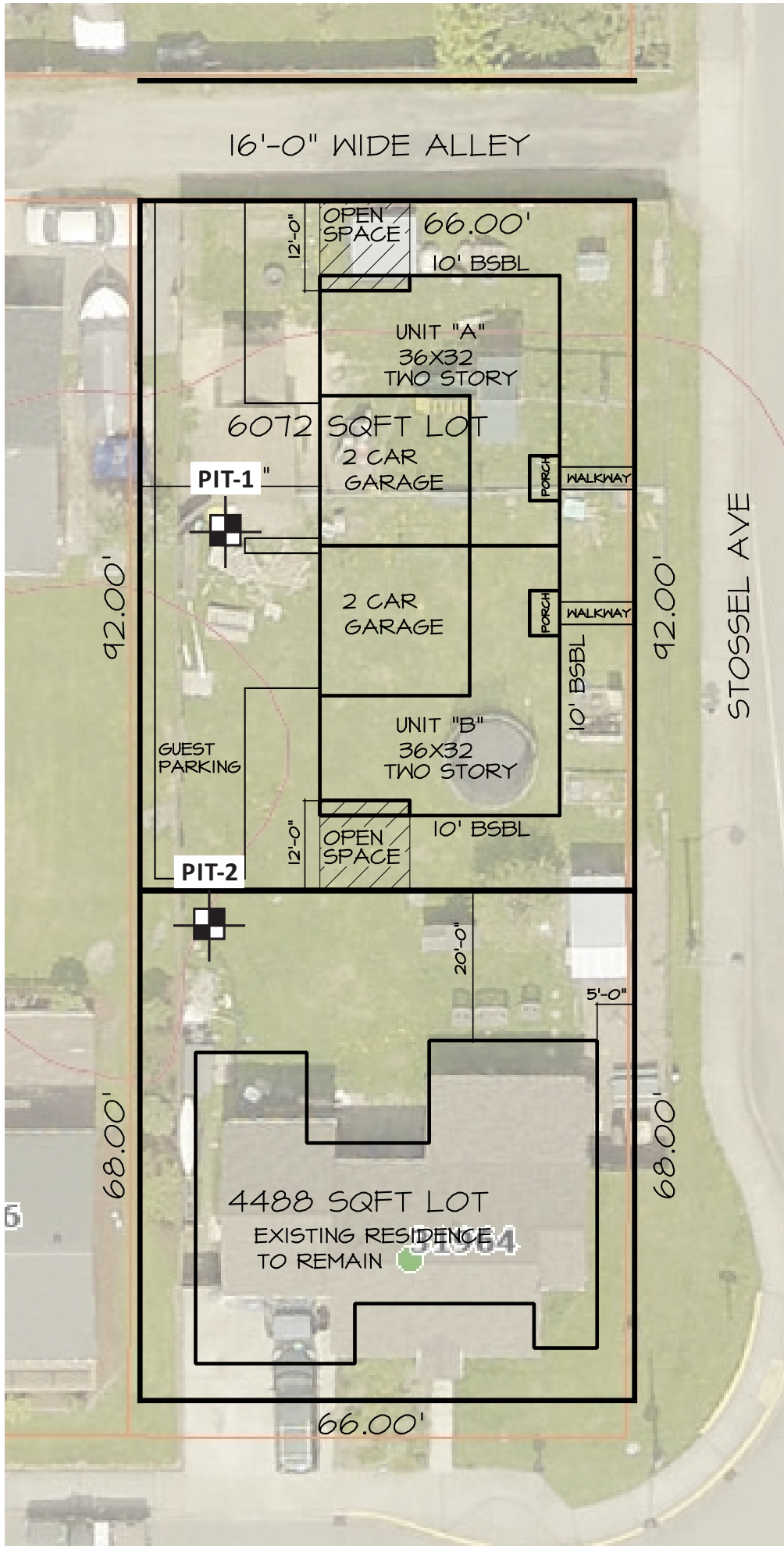
- Figure 1 - Vicinity Map
- Figure 2 – Site Plan
- Figure 3 – PIT-1
- Figure 4 – PIT-2
- Appendix A – Amtest results

Figures



USGS, 2020.

<p>SAFETY FIRST</p>	<p>CLIENT: Fortwest, LLC</p>	<p>Vicinity Map</p>
 <p>ROBINSON NOBLE</p>	<p>PROJECT: East Blanche Street Carnation, WA</p>	
<p>a terraphase company</p>	<p>PROJECT NUMBER: W112.001.001</p>	<p>FIGURE 1</p>



Legend

PIT-1



Approximate Infiltration Test Location



0 10 20 40 Feet

1 inch = 20 feet

Imagery Source: King County iMap and untitled site plan provided by client

SAFETY FIRST



ROBINSON NOBLE

a terraphase company

CLIENT: Fortwest, LLC

PROJECT: East Blanche Street Carnation, WA

PROJECT NUMBER: W112.001.001

Site Plan

FIGURE 2

Unified Soil Classification System

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME	
COARSE - GRAINED SOILS MORE THAN 50% RETAINED ON number 200 SIEVE	GRAVEL	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL	
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVEL WITH FINES	GP	POORLY-GRADED GRAVEL	
			GM	SILTY GRAVEL	
			GC	CLAYEY GRAVEL	
			SW	WELL-GRADED SAND, FINE TO COARSE SAND	
	MORE THAN 50% OF COARSE FRACTION PASSES NO. 4 SIEVE	SAND CLEAN SAND	SP	POORLY-GRADED SAND	
			SAND WITH FINES	SM	SILTY SAND
				SC	CLAYEY SAND
FINE - GRAINED SOILS MORE THAN 50% PASSES NO. 200 SIEVE			SILT AND CLAY	INORGANIC	ML
	LIQUID LIMIT LESS THAN 50%	CL	CLAY		
	SILT AND CLAY LIQUID LIMIT 50% OR MORE	INORGANIC	ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
			MH	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
				CH	CLAY OF HIGH PLASTICITY, FAT CLAY
			ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT	

NOTES:



- 1) Field classification is based on visual examination of soil in general accordance with ASTM D 2488-83.
- 2) Soil classification using laboratory tests is based on ASTM D 2487-83.
- 3) Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.


SOIL MOISTURE MODIFIERS

Dry- Absence of moisture, dusty, dry to the touch

Moist- Damp, but no visible water



Wet- Visible free water or saturated, usually soil is obtained from below water table


	CLIENT: Fortwest, LLC	Unified Soil Classification System
	PROJECT: East Blanche Street Carnation, WA	
PROJECT NUMBER: W112.001.001		FIGURE 3

Depth (ft.)	Soil Description	USC	View of PIT-1
0.0 - 0.5	Light brown silty fine sand with gravel and organics (loose, dry to moist) (Topsoil)	SM	
0.5 - 3.5	Brown silty sand with some gravel and trace organics (medium dense, dry to moist)	SM	
3.5 - 4.5	Brown silty fine to medium sand (medium dense, moist)	SM	

Notes

- Test pit completed at 4.5 feet
- Groundwater was not observed
- Samples collected at 4.3 feet

<p><u>Tacoma</u> 2105 South C Street Tacoma, Washington 98402 253.475.7711</p> <p><u>Woodinville</u> 17625 - 130th Avenue NE, Suite 102 Woodinville, Washington 98072 425.488.0599</p>	 <p>ROBINSONSM NOBLE</p> <p> a terraphase company</p> <p>East Blanche Street Infiltration Evaluation W112.001.001</p> <p>Figure 4</p>
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Depth (ft.)	Soil Description	USC	View of PIT-2
0.0 - 0.5	Light brown silty fine sand with gravel and organics (loose, dry to moist) (Topsoil)	SM	
0.5 - 3.5	Brown silty sand with some gravel and trace organics (medium dense, dry to moist)	SM	
3.5 - 4.5	Brown silty fine to medium sand with gravel (medium dense, dry to moist)	GP-GM	

Notes

- Test pit completed at 4.5 feet
- Groundwater was not observed
- Samples collected at 4.5 feet

Tacoma
 2105 South C Street
 Tacoma, Washington 98402
 253.475.7711

Woodinville
 17625 - 130th Avenue NE, Suite 102
 Woodinville, Washington 98072
 425.488.0599



ROBINSONSM

NOBLE

a terraphase company

East Blanche Street Infiltration Evaluation

W112.001.001

Figure 5

Appendix A



Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664

Professional
Analytical
Services

Sep 14 2023
ROBINSON NOBLE
31964 BLANCHE STREET
CARNATION, WA 98014
Attention: BARBARA GALLAGHER

Dear BARBARA GALLAGHER:

Enclosed please find the analytical data for your project.

The following is a cross correlation of client and laboratory identifications for your convenience.

CLIENT ID	MATRIX	AMTEST ID	TEST
PIT 1 (BROWN SILTY SAND)	Soil	23-A014719	CONV, OM std mth
PIT 2 (BROWN SILTY SAND W/ GRAVEL/C	Soil	23-A014720	CONV, OM std mth

Your samples were received on Tuesday, August 29, 2023. At the time of receipt, the samples were logged in and properly maintained prior to the subsequent analysis.

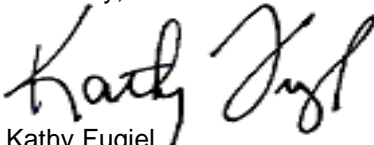
The analytical procedures used at AmTest are well documented and are typically derived from the protocols of the EPA, USDA, FDA or the Army Corps of Engineers.

Following the analytical data you will find the Quality Control (QC) results.

Please note that the detection limits that are listed in the body of the report refer to the Practical Quantitation Limits (PQL's), as opposed to the Method Detection Limits (MDL's).

If you should have any questions pertaining to the data package, please feel free to contact me.

Sincerely,


Kathy Fugiel
President

PO Number: 253-475-7711

BACT = Bacteriological
CONV = Conventional

MET = Metals
ORG = Organics

NUT=Nutrients
DEM=Demand

MIN=Minerals

Am Test Inc.
13600 NE 126TH PL
Suite C
Kirkland, WA 98034
(425) 885-1664
www.amtestlab.com



*Professional
Analytical
Services*

ANALYSIS REPORT

ROBINSON NOBLE
31964 BLANCHE STREET
CARNATION, WA 98014
Attention: BARBARA GALLAGHER
PO Number: 253-475-7711
All results reported on an as received basis.

Date Received: 08/29/23
Date Reported: 9/14/23

AMTEST Identification Number 23-A014719
Client Identification PIT 1 (BROWN SILTY SAND)
Sampling Date 08/22/23, 10:30

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	4.7	meq/100g		0.5	SW-846 9081	CM	09/14/23

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Organic Matter	1.0	%			SM 2540G	HV	09/14/23

ROBINSON NOBLE
Project Name:
AmTest ID: 23-A014720

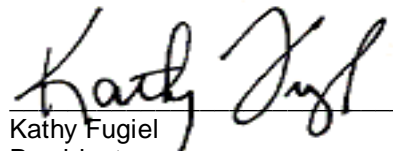
AMTEST Identification Number 23-A014720
Client Identification PIT 2 (BROWN SILTY SAND W/ GRAVEL/C
Sampling Date 08/22/23, 17:10

Conventionals

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANALYST	DATE
Cation Exchange Capacity	12.	meq/100g		0.5	SW-846 9081	CM	09/14/23

Miscellaneous

PARAMETER	RESULT	UNITS	Q	D.L.	METHOD	ANLST	DATE
Organic Matter	4.4	%			SM 2540G	HV	09/14/23



Kathy Fugiel
President

Am Test Inc.
 13600 NE 126th PL
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 Kirkland, WA, 98034
 (425) 885-1664
 www.amtestlab.com



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QC Summary for sample numbers: 23-A014719 to 23-A014720

DUPLICATES

SAMPLE #	ANALYTE	UNITS	SAMPLE VALUE	DUP VALUE	RPD
23-A014720	Cation Exchange Capacity	meq/100g	12.	10.	18.
23-A014720	Organic Matter	%	4.4	4.7	6.6

STANDARD REFERENCE MATERIALS

ANALYTE	UNITS	TRUE VALUE	MEASURED VALUE	RECOVERY
Cation Exchange Capacity	meq/100g	2.0	2.1	105. %

BLANKS

ANALYTE	UNITS	RESULT
Cation Exchange Capacity	meq/100g	< 0.5



AmTest Chain of Custody Record

13600 NE 126th PL, Suite C, Kirkland, WA 98034

Ph (425) 885-1664 Fx (425) 820-0245

www.amtestlab.com

Chain of Custody No. 253475

Client Name & Address: Robinson Able 31964 Blanche Street, Camas WA	Invoice To: ← Robinson Able a terraphase Company
Contact Person: Barbara Callagher Barbara Callagher	Invoice Contact: Sherrie Hanson
Phone No: 253-475-7711 206-227-0105	PO Number: 253-475-7711
Fax No:	Invoice Ph/Fax:
E-mail: barbarac@terrapphase.com barbarac@terrapphase.com	Invoice E-mail: Sherrie.hanson@terrapphase.com
Report Delivery: (Choose all that apply) Mail / Fax / <u>Email</u> / Posted Online	Data posted to online account: YES / NO Web Login ID:

Special Instructions:

Requested TAT: (Rush must be pre-approved by lab)
 Standard RUSH (5 Day / 3 Day / 48 HR / 24 HR) Temperature upon Receipt: 23.9°C

Project Name:		Date Sampled	Time Sampled	Matrix	No. of containers	Analysis Requested										QA/QC
Project Number:						Organic Content	Cation Exchange Capacity									
AmTest ID	Client ID (35 characters max)															
14719	Pit 1 (Brown silty sand)	08/22/23	10:30	Soil	1	X	X									
14720	Pit 2 (Brown silty sand w/ gravel)	09/22/23	17:10	Soil	1	X	X									

Collected/Relinquished By: <i>Nancy Squatos</i>	Date 8/29/23	Time 12:42	Received By: <i>KL</i>	Date 8/29/23	Time 12:42
Relinquished By:	Date	Time	Received By:	Date	Time
Relinquished By:	Date	Time	Received By:	Date	Time

COMMENTS:

Appendix B

Operations & Maintenance Manual

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Sediment	Sediment exceeds 60% of the depth from the bottom of the catch basin to the invert of the lowest pipe into or out of the catch basin or is within 6 inches of the invert of the lowest pipe into or out of the catch basin.	Sump of catch basin contains no sediment.
	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the catch basin by more than 10%.	No Trash or debris blocking or potentially blocking entrance to catch basin.
		Trash or debris in the catch basin that exceeds 1/3 the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.
		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 catch basin.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that catch basin is unsound.	Catch basin is sealed and is structurally sound.
		Cracks wider than ½ 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.	No cracks more than 1/4 inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the catch basin at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.
Trash and debris		Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
Damaged		Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Metal Grates (Catch Basins)	Unsafe grate opening	Grate with opening wider than $\frac{7}{8}$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris.
	Damaged or missing	Grate missing or broken member(s) of the grate. Any open structure requires urgent maintenance.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. Any open structure requires urgent maintenance.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

NO. 6 – CONVEYANCE PIPES AND DITCHES

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Pipes	Sediment & debris accumulation	Accumulated sediment or debris that exceeds 20% of the diameter of the pipe.	Water flows freely through pipes.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damage to protective coating or corrosion	Protective coating is damaged; rust or corrosion is weakening the structural integrity of any part of pipe.	Pipe repaired or replaced.
	Damaged	Any dent that decreases the cross section area of pipe by more than 20% or is determined to have weakened structural integrity of the pipe.	Pipe repaired or replaced.
Ditches	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment accumulation	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion damage to slopes	Any erosion observed on a ditch slope.	Slopes are not eroding.
	Rock lining out of place or missing (If Applicable)	One layer or less of rock exists above native soil area 5 square feet or more, any exposed native soil.	Replace rocks to design standards.

NO. 11 – GROUNDS (LANDSCAPING)

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash or litter	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Trees and Shrubs	Hazard	Any tree or limb of a tree identified as having a potential to fall and cause property damage or threaten human life. A hazard tree identified by a qualified arborist must be removed as soon as possible.	No hazard trees in facility.
	Damaged	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trees and shrubs with less than 5% of total foliage with split or broken limbs.
		Trees or shrubs that have been blown down or knocked over.	No blown down vegetation or knocked over vegetation. Trees or shrubs free of injury.
	Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Tree or shrub in place and adequately supported; dead or diseased trees removed.	

NO. 12 – ACCESS ROADS

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet (i.e., trash and debris would fill up one standards size garbage can).	Roadway drivable by maintenance vehicles.
		Debris which could damage vehicle tires or prohibit use of road.	Roadway drivable by maintenance vehicles.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Blocked roadway	Any obstruction which reduces clearance above road surface to less than 14 feet.	Roadway overhead clear to 14 feet high.
Any obstruction restricting the access to a 10- to 12 foot width for a distance of more than 12 feet or any point restricting access to less than a 10 foot width.		At least 12-foot of width on access road.	
Road Surface	Erosion, settlement, potholes, soft spots, ruts	Any surface defect which hinders or prevents maintenance access.	Road drivable by maintenance vehicles.
	Vegetation on road surface	Trees or other vegetation prevent access to facility by maintenance vehicles.	Maintenance vehicles can access facility.
Shoulders and Ditches	Erosion	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Shoulder free of erosion and matching the surrounding road.
	Weeds and brush	Weeds and brush exceed 18 inches in height or hinder maintenance access.	Weeds and brush cut to 2 inches in height or cleared in such a way as to allow maintenance access.
Modular Grid Pavement	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damaged or missing	Access surface compacted because of broken or missing modular block.	Access road surface restored so road infiltrates.

NO. 26 – GRAVEL FILLED INFILTRATION TRENCH BMP

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Preventative	Blocking, obstructions	Debris or trash limiting flow to infiltration trench.	Infiltration trench able to receive full flow prior to and during wet season.
Site	Trash and debris	Trash or debris that could end up in the infiltration trench is evident.	No trash or debris that could get into the infiltration trench can be found.
Pipes	Inlet is plugged	The entrance to the pipe is restricted due to sediment, trash, or debris.	The entrance to the pipe is not restricted.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Plugged	Sediment or other material prevents free flow of water through the pipe.	Water flows freely through pipes.
	Broken or joint leaks.	Damage to the pipe or pipe joints allowing water to seep out.	Pipe does not allow water to exit other than at the outlet to the trench.
Structure	Flow not reaching trench	Flows are not getting into the trench as designed.	Water enters and exits trench as designed.
	Cleanout/inspection access does not allow cleaning or inspection of trench	The cleanout/inspection access is not available.	Cleanout/inspection access is available.
Filter Media	Filter media plugged	Filter media plugged.	Flow through filter media is normal.
Inspection	Frequency	Annually and prior to and following significant storms.	Inspect infiltration trench system for any defects or deficiencies.