GEOTECHNICAL ENGINEERING STUDY

McIntosh Residential Subdivision
3210 NW McIntosh Road
Camas, Washington 98607

Tax Lot No. (127449000)

Prepared for:

Sam Madison c/o John Colgate
3511 NW McMaster Drive
Camas, Washington 98606

Prepared By:

State of Washington
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3-4-22

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Project Engineer

Project No. G12-0122

{March 1st 2022}

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{G12-0122}

Earth Engineering, Inc.
Geotechnical & Environmental Consultants

Sam Madison c/o John Holgate
3511 NW McMaster Drive
Camas, Washington 98606

March 4th 2022
G12-0122

Subject: **Geotechnical Engineering Study**
McIntosh Property Subdivision
3210 NW McIntosh Road
Camas, Clark County, Washington

Hello Sam,

We are pleased to submit our engineering report for the subject property located in Camas, Washington. This report presents the results of our field exploration, selective laboratory tests, field testing and engineering analyses.

Based on the results of this study, it is our opinion that construction of the proposed residential subdivision is feasible from a geotechnical standpoint, provided recommendations presented in this report are included in the project design.

We appreciate the opportunity to have been of service to you and look forward to working with you in the future. Should you have any questions about the content of this report, or if we can be of further assistance, please call.

Respectfully Submitted,
Earth Engineering Inc.,

Donald J. Bruno, CEG
Engineering Geologist

INTRODUCTION

General

This report presents the results of the geotechnical engineering study completed by Earth Engineering, Inc. (EEI) for the proposed residential subdivision located in Camas, Washington. The general location of the site is shown on the *Vicinity Map, Figure 1.* At the time our study was performed, the site and our exploratory locations were approximately as shown on the *Site Plan, Figure 2.*

The purpose of this study was to explore subsurface conditions at the site and based on the conditions encountered, provide geotechnical recommendations for the proposed construction. In addition, we have provided infiltration testing to determine the feasibility for stormwater infiltration design as well as an assessment of the condition of onsite slopes.

Project Description

Based on the information that was provided to us by the project civil engineer (SGA) it is our understanding the proposed subdivision will consist of twenty-seven (27) single-family lots that will range in size from approximately 6,054 to 22,925 square feet in size. Site development will also include construction of a storm water system, subsurface utilities and an asphalt-paved roadway.

Preliminary grading plans indicate cuts as deep as ten feet and fill up to five feet will be required to achieve the desired design grade for building pads and the roadway. The residential buildings will most likely be constructed with wood frames, suspended floors and slab-on-grade garage floors.

Structural design loads were not available at the time this report was written. However, based on our experience with similar projects, we anticipate that wall and column loads will be approximately seven hundred and fifty (750) to one thousand five hundred (1500) pounds per lineal foot (maximum dead plus live loads). Slab-on-grade garage floor loads will most likely range from one hundred (100) to one hundred fifty (150) pounds per square foot (psf).

If any of the above information is incorrect or changes, we should be consulted to review the recommendations contained in this report. In any case, it is recommended that Earth Engineering, Inc. perform a general review of the final design for the proposed construction at each lot.

SITE CONDITIONS

Surface

The irregular shaped parcel encompasses approximately ten acres. In general, the property slopes gently downward from the central area of the site to the north and south with gradients ranging from about five to eight percent (5-8%), exclusive of the southeast section (~ 0.7 acres) which slopes moderately downward to the south with an approximate gradient of twenty-six percent (26%).

During the time of our study a gravel driveway extended from McIntosh Road to an existing shop at the central east area of the property. The driveway also extended past the shop to several off site single family homes located adjacent to the southwest area of the property. The property was covered predominately with pasture grass with some deciduous trees at the southeast section.

Subsurface & Soil Classification

For this study the site was explored by excavating two infiltration test pits and six additional test pits. The approximate locations of the test pits are shown on the Site Plan, Figure 2. All soil was classified following the Unified Soil Classification System (USCS). A USCS Legend is included as Plate A1. A description of the field exploration methods is included in Appendix A.

In general, in our test pits we encountered approximately four to twelve inches of topsoil underlain by firm to hard native Silt (ML) and elastic Silt (MH) to the maximum exploration depth of thirteen (13) feet below the existing ground surface. It should be noted that soft silt was encountered at test pits TP-5 and TP-6 to a depth of about two feet below the surface. Please refer to the test pit logs, Plates A2 thru A9, for a more detailed description of the conditions encountered.

Groundwater

During the time of our field exploration (February 2022) no groundwater or groundwater seepage was encountered in any of our test pits. Clark County "Generalized Water Altitude Maps" indicate that groundwater is greater than two hundred (200) feet below the surface.

Groundwater conditions are not static; fluctuations may be expected in the level and seepage flow depending on the season, amount of rainfall, surface water runoff, and other factors. Generally, groundwater levels and seepage rates are greater in the wetter winter months (typically October through May).

General Regional Geology

General information about geologic conditions and soil in the vicinity of the site was obtained by reviewing the Geologic Map of Washington-Southwest Quadrant, Washington Division of Geology and Earth Resources, (Geologic Map GM-34, 1987). This map provides general information about geologic units in the Camas, Clark County, Washington area.

Our review of existing geological information indicates that soils in the vicinity of the subject site were formed from alluvial deposits during the Quaternary Period. Outburst flood deposits from glacial Lake Missoula deposited these sedimentary soils. The material encountered in our test pits consists predominantly of Silt.

LABORATORY TESTING

Laboratory tests were conducted on representative soil samples to verify or modify the field soil classification of the units encountered, and to evaluate the general physical properties as well as the engineering characteristics of the soils encountered. The following provides information about the testing procedures performed on representative soil samples and the general condition of subsurface soil conditions encountered:

- Moisture Content (ASTM-D2216-92) tests were performed on representative samples. The native Silt and Elastic Silt has a moisture content that ranges from twenty-two to thirty percent (22% - 30%).

- Atterberg Limits *(ASTM-D4318-95)* were performed on representative samples to determine the "water-plasticity" ratio of in-situ soil. This test also provides an indication of relative soil strength as well as the potential for soil volume changes with variation in moisture content. The sub-grade soils encountered have an average liquid limit of forty-six (46) and a plasticity index of seventeen (17).

- In-Situ Soil Density (ASTM-D4564-93) utilizing the sleeve method was performed on representative samples to determine the wet and dry density of native soil. The in-situ density provides a relative indication of soil support characteristics. The wet density of the native silt is one hundred and sixteen (116) pounds per cubic foot (pcf). The dry density of this soil is ninety two (92) pcf. The wet density of the native elastic silt is one hundred and ten (110) pounds per cubic foot (pcf). The dry density of this soil is eighty-six (86) pcf.

Laboratory testing confirms that subsurface soil consists predominantly of Silt. Soils encountered at the subject site are sensitive to changes in moisture content. Moisture sensitive soils are discussed in more detail in the *Site Preparation and Grading* section of this report.

The results of laboratory tests performed on specific samples are provided at the appropriate sample depth on the individual test pit logs. However, it is important to note that some variation of subsurface conditions may exist. Our geotechnical recommendations are based on our interpretation of these test results.

SEISMIC HAZARD EVALUATION

The following provides a seismic hazard evaluation for the subject site. Our evaluation is based on subsurface conditions encountered at the site during the time of our geotechnical study and a review of applicable geologic maps (Washington Department of Natural Resources, Geologic Map of Washington-Southwest Quadrant, 1987) and the International Building Code (IBC-2015) guidelines.

In general, supportive soil at the subject site consists predominately of stiff to hard Silt. Geologic maps indicates that no known active faults are located within one-mile of the subject site. Soil encountered at the site are classified as a type "D" soil in accordance with "Seismic Design Categories" (IBC 2015, Section 1805.5.12). For more detail regarding soil conditions refer to the test pit logs in Appendix A of this report.

Liquefaction:

Structures are subject to damage from earthquakes due to direct and indirect action. Shaking represents direct action. Indirect action is represented by foundation failures and is typified by liquefaction. Liquefaction occurs when soil loses all shear strength for short periods of time during an earthquake. Ground shaking of sufficient duration results in the loss of grain to grain contact as well as a rapid increase in pore water pressure. This causes the soil to assume physical properties of a fluid.

To have potential for liquefaction a soil must be loose, cohesion-less (generally sands and silts), below the groundwater table, and must be subjected to sufficient magnitude and duration of ground shaking. The effects of liquefaction may be large total settlement and/or large differential settlement for structures with foundations in or above the liquefied soil. Based on the predominance of stiff to hard soil conditions, and the absence of a near surface groundwater table, it is not likely that soil liquefaction would occur at the subject site during a seismic event.

DISCUSSION AND RECOMMENDATIONS

General

Based on the results of our study, it is our opinion the residential subdivision can be developed as planned provided the geotechnical recommendations contained in this report are incorporated into the final design. The proposed buildings can be supported on conventional shallow spread footings bearing either entirely on competent native soil or compacted structural fill. Supporting the proposed buildings on homogeneous material will significantly decrease the potential for differential settlement across the foundation area.

As previously discussed, several feet of soft material was encountered in our test pits at the southeast area of the site (proposed lots 1&2). This material will not provide adequate support for foundations, floor slabs or driveways. To improve support conditions it will be necessary to remove the unsuitable material to competent native soil and replace it with compacted structural fill. Recommendations for the placement and compaction of fill is described in the *Site Preparation & Grading* section of this report.

This report has been prepared for specific application to this project only and in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area for the exclusive use of Sam Madison and his representatives. This report, in its entirety, should be included in the project documents for information to the contractor. No warranty, expressed or implied, is made.

Infiltration Testing

On February 10th 2022, infiltration testing was performed at two locations at a depth of four and five feet below the existing ground surface. The approximate location of the infiltration tests, I-1 and I-2 (also used for exploration test pits) is shown on the Site Plan, Figure 2.

Infiltration testing was conducted in general accordance with the Southwest Washington Storm Water Manual. The Encased Falling Head Test consists of driving a fifteen (15) inch long, six-inch diameter pipe six inches into the exposed ground surface at the bottom of the test pit.

The pipe is filled with water as the soil around the bottom and below the pipe is saturated for several hours. The pipe is filled again and the amount of time required for the water to fall, per inch, for six inches, is recorded. This step is performed a minimum of three times. The test results are averaged and calculated in inches per hour.

The following table provides the infiltration test results, soil classification and a summary of laboratory test results for soils encountered at the infiltration test areas:

LOCATION	*USCS SOIL TYPE	AASHTO SOIL TYPE	DEPTH (FT.)	MOISTURE CONTENT %	% PASSING # 200 SIEVE	FIELD INFILTRATION RATE (inches per hr.)	COEFFICIENT OF PERMEABILITY
I-1	MH	A-7	4.0	27	100	1.0 iph	0.5
I-2	ML	A-7	5.0	30	100	42.0 iph	21.0

Slope Conditions

The subject site is designated as being located in a geologically sensitive area under City of Camas code due to the moderate slopes on the property (>15% gradient). In addition to having moderate to steep slopes, to be considered as having a geologic landslide hazard, the site must also posses the following: relatively permeable sediments overlying relatively impermeable sediments or bedrock; and have the presence of groundwater seepage or springs.

A surface reconnaissance was performed at the site on January 26th and February 10 (2022) to look for the potential presence of slide activity at the southeast area of the site. During the time of our reconnaissance we did not observe any erosion, tension cracks, slide scarps, down set blocks, hillside seepage or other indications of an unstable slope.

Based on the soil and groundwater conditions encountered in our test pits as well as our review of geologic maps, the characteristics described above do not exist at the proposed building areas. Therefore, it is not likely that the building sites would be impacted by hazards associated with an unstable slope.

Primary factors that will adversely affect slope stability include: the placement of un-retained fill on or at the top of slopes, excavation of steep un-retained cuts at the toe of slopes and uncontrolled top of slope surface water runoff. At this time and to the best of our knowledge, none of these are planned for the development of this property.

Site Preparation and Grading

The site shall be stripped and cleared of all vegetation, organic matter and any other deleterious material. Stripped material should not be mixed with any soils to be used as fill. Stripped soil could potentially be used for topsoil at landscape areas after removing vegetation and screening out organic matter.

Building & Roadway Areas:

After clearing and grading, the building and pavement areas should be compacted to a dense non-yielding condition with suitable vibratory compaction equipment. This phase of earthwork compaction shall be performed prior to the placement of any structural fill, at the bottom of all foundation excavations, floor slabs, roadway and driveways, before the placement of base rock.

Structural Fill:

Structural fill is defined as any soil placed under buildings or any other load bearing-areas. Structural fill placed under footings and slab on grade should be placed in thin horizontal lifts not exceeding eight inches and compacted to a minimum ninety-five percent (95%) of its maximum dry density (Standard Proctor ASTM D698). The fill material should be placed within two to three percent of the optimum moisture content.

Fill under pavements should also be placed in lifts approximately eight inches in thickness, and compacted to a minimum of ninety two percent (92%) of its maximum dry density (Standard Proctor ASTM D698), except for the top twelve (12) inches which should be compacted to ninety-five percent (95%) of the maximum dry density.

On site material can be used as structural fill provided the soil is compacted at or near the optimum moisture content and in accordance with the compaction density parameters described above. It is possible that some soils will be too wet for compaction and will require improvement and/or replacement to achieve the desired density.

Preliminary plans indicate that exclusive of utility trench backfill (clean sand & gravel) imported structural fill will not be required to achieve the desired design grades. However, if imported structural fill is planned for onsite use, we recommend the material be submitted to our laboratory for testing and approval prior to import.

The placement and compaction of structural fill should be observed by a representative from our office to verify that fill has been placed and compacted in accordance with the approved project plans and specifications.

It should be noted that the depth of excavation to competent soil at foundation footings and floor slab areas could be greater or less than anticipated depending on conditions encountered. Our test pits provide general information about subsurface soil and groundwater conditions.

Wet Weather Construction & Moisture Sensitive Soils:

Field observations and laboratory testing indicates that soil encountered at the site consists of moisture sensitive Silt and elastic Silt. As such in an exposed condition moisture sensitive soil can become disturbed during normal construction activity, especially when in a wet or saturated condition. Once disturbed, in a wet condition, these soils will be unsuitable for support of foundations, floor slabs and pavements.

Therefore, where soil is exposed and will support new construction, care must be taken not to disturb their condition. If disturbed soil conditions develop, the affected soil must be removed and replaced with structural fill. The depth of removal will be dependent on the depth of disturbance developed during construction. Covering the excavated area with plastic and refraining from excavation activities during rainfall will minimize the disturbance and decrease the potential degradation of supportive soils.

Earthwork grading and foundation construction will be difficult during the wet winter and spring seasons. Based on this condition we suggest that grading and foundation construction be completed during the drier summer and fall seasons.

Foundations

Based on the encountered subsurface soil conditions, preliminary building design criteria, and assuming compliance with the preceding *Site Preparation and Grading* section, the proposed residential buildings may be supported on conventional shallow spread footings bearing either on competent native soil or compacted structural fill.

Individual spread footings or continuous wall footings providing support for the proposed buildings may be designed for a maximum allowable bearing value of one thousand five hundred (1500) pounds per square foot (psf).

Footings for a one level structure should be at least twelve (12) inches in width. Footings for a two-level structure should be a minimum of fifteen (15) inches in width. In either case, all footings should extend to a depth of at least eighteen (18) inches below the lowest adjacent finished sub grade.

These basic allowable bearing values are for dead plus live loads and may be increased one-third for combined dead, live, wind, and seismic forces. It is estimated that total and differential footing settlements for the relatively light building will be approximately one-half and one-quarter inches, respectively.

We recommend that all footing excavations be observed by a representative of EEI prior to placing forms or rebar, to verify that sub grade support conditions are as anticipated in this report, and/or provide modifications in the design as required.

Lateral loads can be resisted by friction between the foundation and the supporting sub grade or by passive earth pressure acting on the buried portions of the foundation. For the latter, the foundations must be poured "neat" against the existing soil or backfilled with a compacted fill meeting the requirements of structural fill.

- Passive Pressure = 300 pcf equivalent fluid weight
- Coefficient of Friction = 0.40

The above values include a safety factor of 1.5. In order to mobilize full passive resistance, the ground surface adjacent to the foundation elements must be level for a minimum distance of eight feet.

Slab on Grade

The sub-grade for all concrete floor slab areas should be compacted to a dense non-yielding condition prior to the placement of base rock. It is important to note that the existing sub-grade soil may become too wet to re-compact due to weather conditions. If supportive soils become saturated it may be necessary to remove the unsuitable material and replace it with imported granular structural fill.

Interior floor slabs should be provided with a minimum of eight inches of compacted granular structural fill after compacting the sub-grade. In areas where moisture is undesirable, a vapor barrier such as an 8-mil plastic membrane should be placed beneath the slab.

Temporary Excavations

The following information is provided solely as a service to our client. Under no circumstances should this information be interpreted to mean that Earth Engineering, Inc. is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred. In no case should excavation slopes be greater than the limits specified in local, state and federal safety regulations.

Based on the information obtained from our field exploration and laboratory testing, the site soils expected to be encountered in excavations, stiff to hard Silt would be classified as a Type "B" soil by OSHA guidelines.

Therefore, temporary excavations and cuts greater than four feet in height, should be sloped at an inclination no steeper than 1:1V (horizontal:vertical) for type "B" soils. If slopes of this inclination, or flatter, cannot be constructed or if excavations greater than ten feet in depth are required, temporary shoring will be necessary.

Site Drainage

The site should be graded so that surface water is directed off the site. Water should not be allowed to stand in any area where buildings or slabs are to be constructed. Loose surfaces should be sealed at the end of each workday by compacting the surface to reduce the potential for moisture infiltration into the soils. Final site grades should allow for drainage away from the building foundation.

The ground should be sloped at a gradient of three percent for a distance of at least ten feet away from the buildings. We recommend that a footing drain be installed around the perimeter of the buildings just below the invert of the footing with a gradient sufficient to initiate flow.

Under no circumstances should the roof down spouts be connected to the footing drain system. We suggest that clean outs be installed at several accessible locations to allow for the periodic maintenance of the footing drain system. Details for the footing drain have been included on *Figure 3, Typical Footing Drain Detail.*

Interceptor Drains:

In addition to the foundation footing drains we recommend that an interceptor drain be installed along the up-gradient side of the proposed residences that are constructed on moderate sloping parcels (northeast, southeast and central east). The installation of these drains will divert stormwater away from the buildings. The drain should consist of a four-inch diameter perforated pipe with holes facing down and installed in an envelope of clean drain rock or pea gravel wrapped with free draining filter fabric. The drain should be a minimum of one foot wide and two feet deep with sufficient gradient to initiate flow.

The drain should be routed to a suitable discharge area and rock spalls placed at the outlet to dissipate flow from the system. A representative from our office can determine the location of the drains during construction for the applicable lots. A *Typical Interceptor Drain Detail, Figure 4,* has been included with this report.

Utility Support and Back Fill

Based on the conditions encountered, the soil to be exposed by utility trenches should provide adequate support for utilities. Utility trench backfill is a concern in reducing the potential for settlement along utility alignments, particularly in pavement areas. It is also important that each section of utility line be adequately supported in the bedding material. The back fill material should be hand tamped to ensure support is provided around the pipe haunches.

Fill should be carefully placed and hand tamped to about twelve inches above the crown of the pipe before any compaction equipment is used. The remainder of the trench back fill should be placed in lifts having a loose thickness of eight inches.

A typical trench backfill section and compaction requirements for load supporting and non-load supporting areas is presented on *Figure 5, Utility Trench Backfill Detail.* Trench back fill may consist of imported granular fill provided the material is approved, placed and compacted near the optimum moisture content.

Imported granular material or on-site soil to be used as backfill should be submitted to our laboratory at least one week prior to construction so that we can provide a laboratory proctor for field density testing. If native soil is planned for use as backfill, additional testing will be required to determine the suitability of the material.

Pavements

The durability of pavements is related in part to the condition of the underlying sub grade. To provide a properly prepared sub grade for pavements, we recommend the sub grade be treated and prepared as described in the *Site Preparation and Grading* section of this report.

It is possible that some localized areas of soft, wet or unstable sub grade may still exist after this process. Before placement of any base rock, the sub grade should be compacted with suitable compaction equipment. Yielding areas that are identified should be excavated to firm material and replaced with compacted one and one quarter inch-minus clean-crushed rock.

The following pavement sections are recommended for the proposed pavement areas:

- Three inches of Asphalt Concrete (AC) over nine inches of compacted Crushed Rock Base (CRB) material or,
- Three inches of Asphalt Concrete (AC) over seven inches of compacted Crushed Rock Base (CRB) material, over a geo-grid consisting of Tensar Triax or equivalent.

The geo-grid should be placed directly on the sub grade surface of the roadway prior to placement of base rock. Appropriate geo-textiles have been designed to increase the strength of the sub grade and extend pavement life.

Asphaltic Cement (AC) and Crushed Rock Base (CRB) materials should conform to WSDOT specifications. All base rock should be compacted to at least ninety five percent (95%) of the ASTM (D698) laboratory test standard.

We recommend that a minimum of eight inches of compacted CRB be placed below all exterior slabs. Exterior concrete slabs that are subject to vehicle traffic loads should be at least four inches in thickness. It is also suggested that nominal reinforcement such as "6x6-10/10" welded wire mesh be installed, near midpoint, in new exterior concrete slabs and paving. Fiber mesh concrete may be used in lieu of welded wire mesh.

Additional Services & Earthwork Monitoring

Earth Engineering, Inc. will be available to provide consultation services related to review of the final design to verify that the recommendations within our purview have been properly interpreted and implemented in the approved construction plans and specifications. A representative from our office will be available to attend a pre-construction meeting to discuss and/or clarify all geotechnical issues related to the proposed project.

In addition, it is suggested that our office be retained to provide geotechnical services during construction to observe compliance with the design concepts and project specifications and to allow design changes in the event subsurface conditions differ from those anticipated.

Our construction services would include monitoring and documenting the following:

- Provide erosion control monitoring and documentation.
- Observe and document the removal of site stripping & organic materials
- If required, provide infiltration system testing to verify the design infiltration rates.
- Laboratory proctor tests on structural fill and roadway area materials.
- Observe compaction and provide testing of structural fill at buildings and roadway.
- Observe compaction and provide testing of utility trench backfill.
- Observe excavations and condition of exposed bearing soils at the building areas.
- Provide footing inspection at buildings to verify soil bearing capacity.
- Verify the installation of all building and site drainage elements.

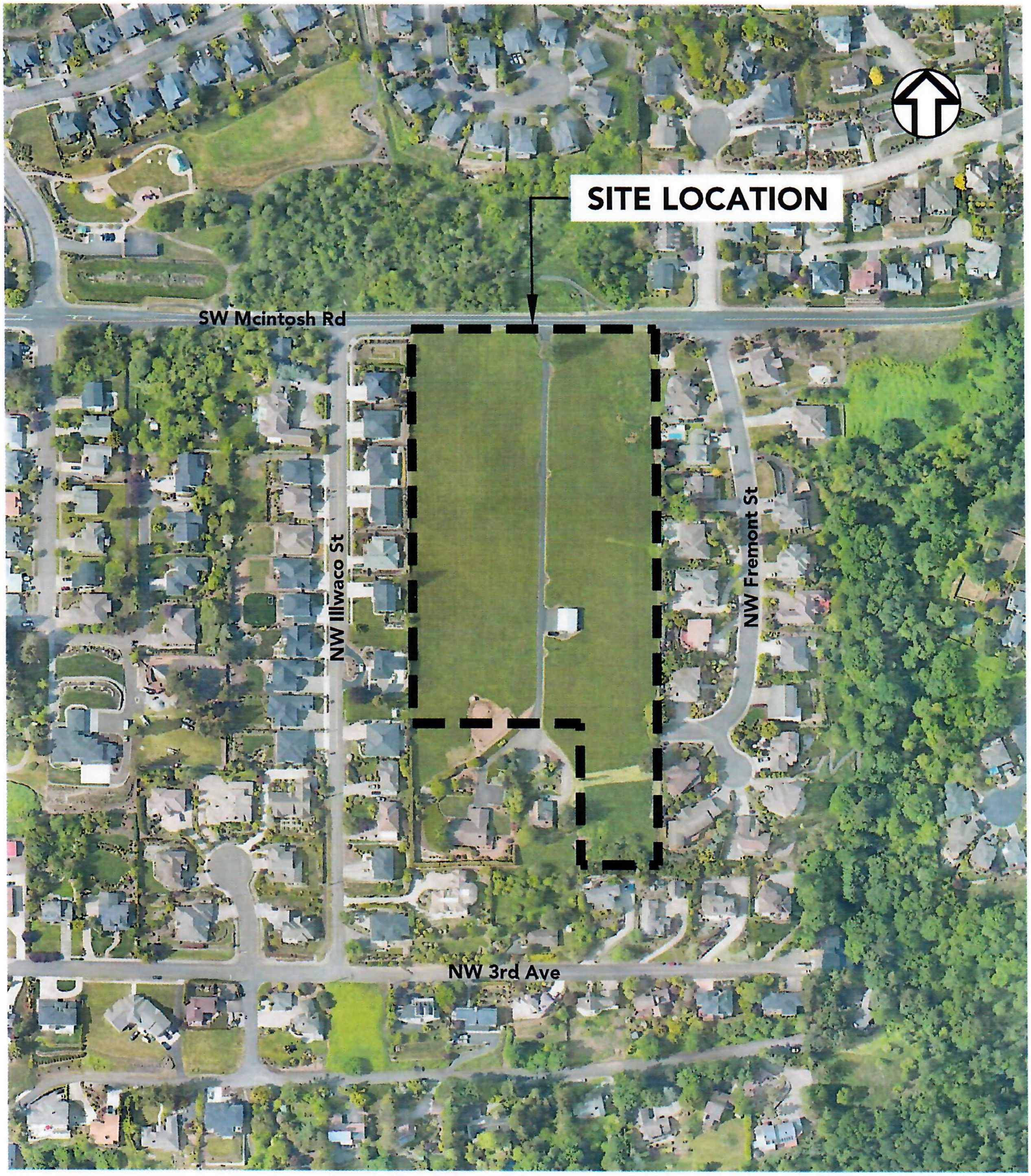
LIMITATIONS

Our recommendations and conclusions are based on the site materials observed, selective laboratory testing, engineering analyses, the design information provided to Earth Engineering, Inc. and our experience as well as engineering judgment. The conclusions and recommendations are professional opinions derived in a manner consistent with that level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area. No warranty is expressed or implied.

The recommendations submitted in this report are based upon the data obtained from the test pit excavations. Soil and groundwater conditions may vary from those encountered. The nature and extent of variations may not become evident until construction. If variations do appear, Earth Engineering, Inc. should be requested to reevaluate the recommendations contained in this report and to modify or verify them in writing prior to proceeding with the proposed construction.

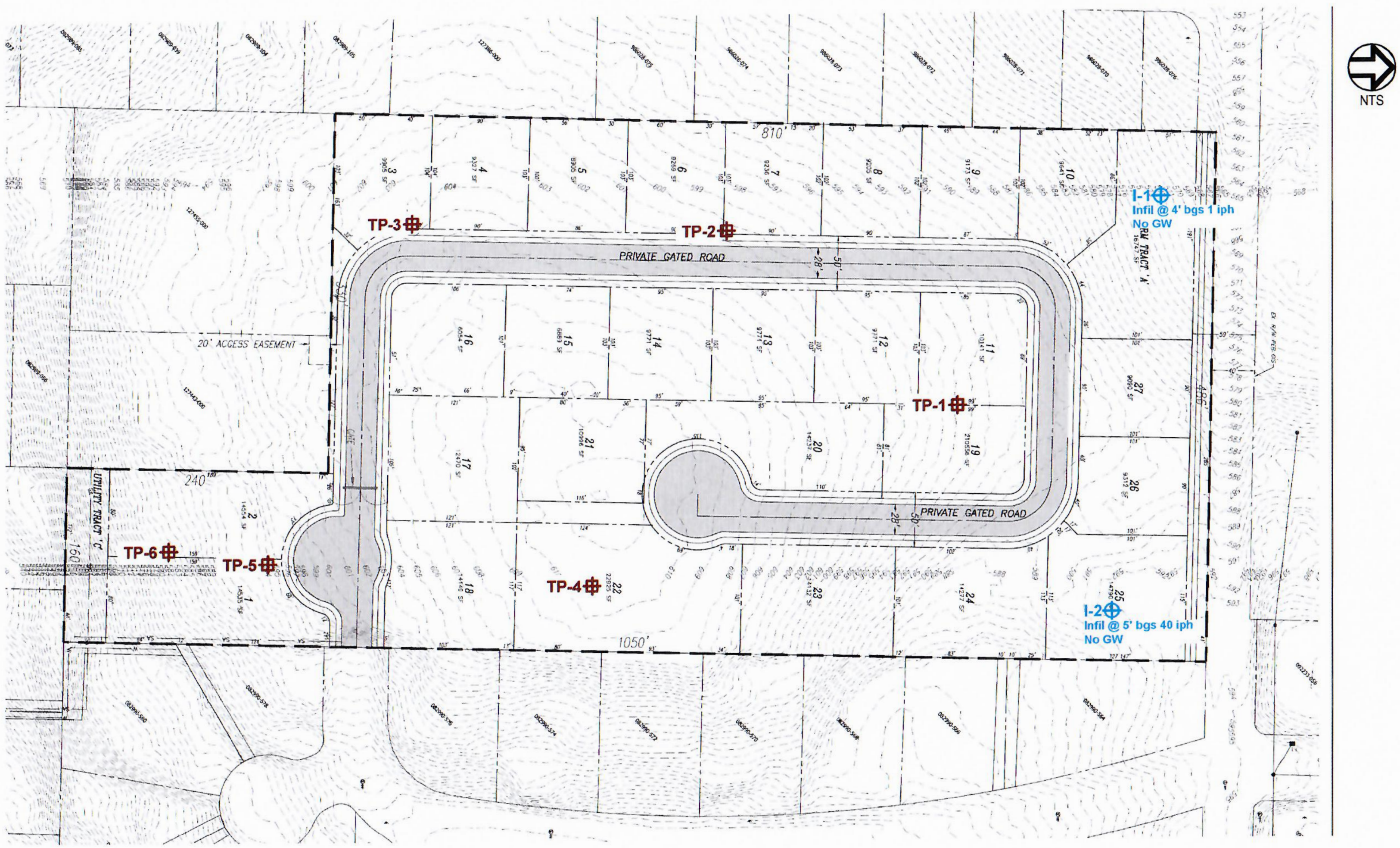
It is important to note that part of our study has included an assessment of the condition of the exiting on site slopes and not a slope stability analyses. Our opinion about the stability of the site slopes is limited to our field reconnaissance, review of geologic maps and knowledge of soils in the area. A slope stability analyses would require deep borings, extensive laboratory testing and rigorous calculations that are beyond the scope of our services.

VICINITY MAP



Earth Engineering GEOTECHNICAL & ENVIRONMENTAL SERVICES	CLIENT: MADISON	DRAWN: CCK
	PROJECT: MCINTOSH PROPERTY SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE: 3/2022
		FIGURE: 1
		PRO. #: G12-0122

SITE PLAN



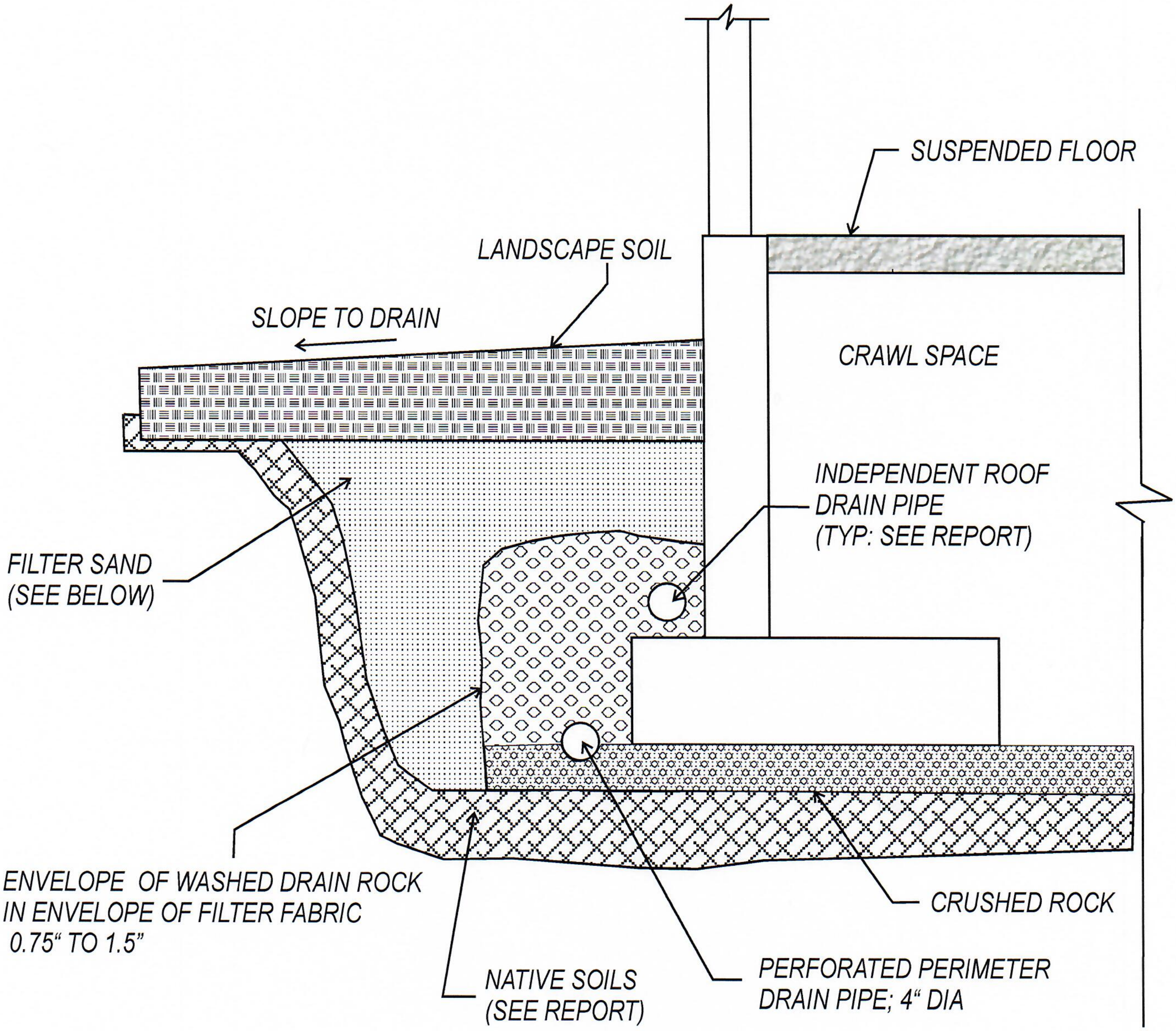
LEGEND

TP-1 Approximate Location of Test Pits

I-1 Approximate Location of Infiltration Test Pits

Earth Engineering
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT: MADISON	DRAWN: CCK
PROJECT: MCINTOSH PROPERTY SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE: 3/2022
	FIGURE: 2
	PRO. #: G12-0122



NOTES:

1. FILTER SAND - FINE AGGREGATE FOR PORTLAND CEMENT; SECTION 9=03.1(2)
2. PERFORATED OR SLOTTED RIGID PVC PIPE WITH A POSITIVE DRAINAGE GRADIENT
3. FILTER FABRIC OPTIONAL IF FILTER SAND USED

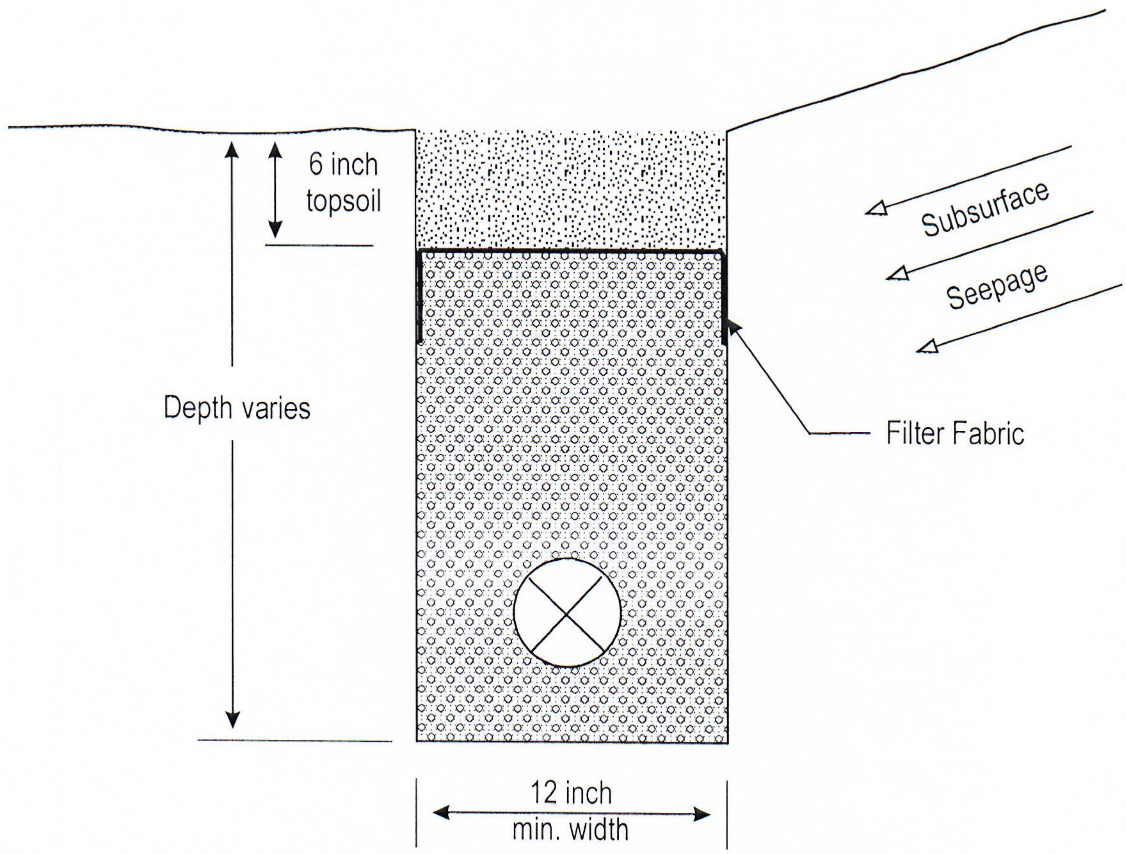
TYPICAL FOOTING DRAIN DETAIL

Not to Scale

Earth Engineering, Inc. GEOTECHNICAL & ENVIRONMENTAL SERVICES	CLIENT: MADISON	DRAWN: DB
	PROJECT: MCINTOSH PROPERTY SUBDIVSION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE: 03/2022
		FIGURE: 3
		PRO. #: G12-0122

TYPICAL INTERCEPTOR DRAIN DETAIL

Not to Scale



Legend

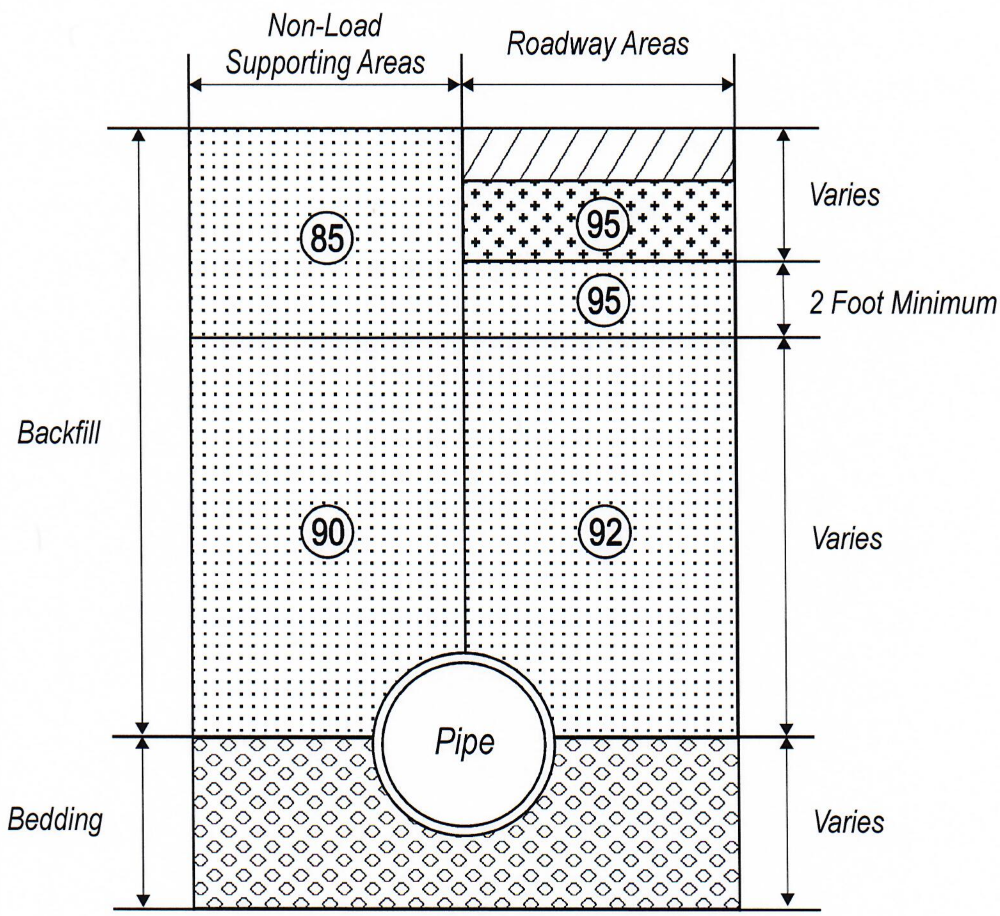
Native soil backfill.

Free-draining material composed of clean round gravel, pea gravel, etc.

Minimum 4 inch perforated pipe wrapped with free draining filter fabric or equivalent placed at a positive gradient to a suitable permanent discharge area.

Note: A field representative from this office should be present to establish the depth and lateral extent of the interceptor trench during construction.

Earth Engineering, Inc. GEOTECHNICAL & ENVIRONMENTAL CONSULTANTS	CLIENT: MADISON	DRAWN: DB
	PROJECT: MCINTOSH PROPERTY SUBDIVISION. 3210 NW MCINTOSH ROAD CAMAS,WA	DATE: 03/2022
		FIGURE: 4
		PRO. #: G12-0122



LEGEND

(hatched)	Asphalt or Concrete Pavement
(crosses)	Roadway Base Material or Base Rock
(dots)	Backfill: Compacted on-site soil or imported select fill material as described in the site preparation of the general Earthwork Section of the attached report text.
(92)	Minimum percentage of maximum Laboratory Dry Density as determined by ASTM Test method D698 (Standard Proctor), unless otherwise specified in the attached report text.
(diamonds)	Bedding Material: Material type depends on type of pipe and laying conditions. Bedding should conform to the manufacturer's recommendations for the type of pipe selected.

UTILITY TRENCH BACKFILL DETAIL

Not to Scale

Earth Engineering, Inc. GEOTECHNICAL & ENVIRONMENTAL CONSULTANTS	CLIENT: MADISON	DRAWN: DB
	PROJECT: MCINTOSH SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE: 03/2022
		FIGURE: 5
		PRO. #: G12-0122

APPENDIX A

(FIELD EXPLORATION)

FIELD EXPLORATION

Our field exploration was performed on February 10th 2022. Subsurface conditions at the site were explored by excavating eight test pits. The test pits were excavated with a track-hoe to a maximum depth of thirteen (13) feet below the existing ground surface.

The test pits were located by pacing from property features. The locations are shown on the Site Plan, Figure 2. Field exploration was monitored by an Earth Engineering, Inc. representative, who classified the soils that we encountered and maintained a log of each test pit, obtained representative samples, and observed pertinent site features. Representative soil samples were placed in closed containers and returned to the laboratory for further examination and testing.

All samples were identified using the Standard Classification of Soils for Engineering Purposes (ASTM D2487-93) in accordance with the Unified Soil Classification System (USCS), which is presented on Plate A-1. The test pit logs are presented in Appendix A. The final log represents our interpretations of the field logs and the results of the laboratory tests on field samples.

UNIFIED SOIL CLASSIFICATION SYSTEM
LEGEND

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION
Coarse Grained Soils More Than 50% Material Larger Than No 200 Sieve Size	Gravel and Gravelly Soils More Than 50% Coarse Fraction Retained on No 4 Sieve	Clean Gravels (little or no fines)		GW gw	Well-Graded Gravels, Gravel-Sand Mixtures Little or no Fines
				GP gp	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or no Fines
		Gravels with Fines (appreciable amount of fines)		GM gm	Silty Gravels, Gravel-Sand-Silt Mixtures
				GC gc	Clayey Gravels, Gravel-Sand-Clay Mixtures
	Sand and Sandy Soils More Than 50% Coarse Fraction Passing No 4 Sieve	Clean Sand (little or no fines)		SW sw	Well-graded Sands, Gravelly Sands Little or no Fines
				SP sp	Poorly-Graded Sands, Gravelly Sands Little or no Fines
		Sands with Fines (appreciable amount of fines)		SM sm	Silty Sands, Sand-Silt Mixtures
				SC sc	Clayey Sands, Sand-Clay Mixtures
Fine Grained Soils More Than 50% Material Smaller Than No 200 Sieve Size	Silts and Clays	Liquid Limit Less than 50		ML ml	Inorganic Silts and Very Fine Sands, Rock Flour, Silty-Clayey Fine Sands; Clayey Silts w/ slight Plasticity
				CL cl	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean
				OL ol	Organic Silts and Organic Silty Clays of Low Plasticity
	Silts and Clays	Liquid Limit Greater than 50		MH mh	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils
				CH ch	Inorganic Clays of High Plasticity, Fat Clays
				OH oh	Organic Clays of Medium to High Plasticity, Organic Silts
Highly Organic Soils				PT pt	Peat, Humus, Swamp Soils with High Organic Contents

Topsoil		Humus and Duff Layer
Fill		Highly Variable Constituents

Earth Engineering Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	MADISON	DRAWN:	DB
PROJECT:	MCINTOSH PROPERTY SUBDIVISION. 3210 NW MCINTOSH ROAD CAMAS,WA	DATE:	03/2022
		PLATE:	A1
		PRO. #:	G12-0122

LOG OF TEST PIT I-1

(Northwest)

ELEVATION: **+/- 570 feet**

EXPLORATORY EQUIPMENT: **TRACK HOE**

DATE: **02/10/2022**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
0–6.5	2 (sample), 4 (sample)	8" Topsoil Wet γ ~110 pcf Dry γ ~86 pcf **elastic Silt (MH)** Field infiltration rate @ 1 inch per hour (Native)		Brown Grey	Moist	Stiff to Very Stiff	28 27	- -
6.5–10	10 (sample)	**sandy Silt (ML)**		Light Brown	Moist	Firm	22	-

Bottom of test pit at 10.0 feet below existing ground surface.
No groundwater encountered.

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	MADISON	DRAWN:	EG
PROJECT:	MCINTOSH PROPERTY SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE:	02/2022
		PLATE:	A2
		PRO. #:	G12-0122

LOG OF TEST PIT I-2

(Northeast)

ELEVATION: **+/- 592 feet**

EXPLORATORY EQUIPMENT: **TRACK HOE**

DATE: **02/10/2022**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
0–7	● (3), ● (5)	6" Topsoil **Silt (ML)** - Field infiltration rate @ 40 inches per hour (Native)		Brown	Moist	Stiff to Very Stiff	27 30	- -
7–11	● (10)	**elastic Silt (MH)**		Orange Grey	Moist	Very Stiff to Hard	28	-

Bottom of test pit at 11.0 feet below existing ground surface.
No groundwater encountered.

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	MADISON	DRAWN:	EG
PROJECT:	MCINTOSH PROPERTY SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE:	02/2022
		PLATE:	A3
		PRO. #:	G12-0122

LOG OF TEST PIT TP-1
(North Central)

ELEVATION: **+/- 596 feet**
EXPLORATORY EQUIPMENT: **TRACK HOE**
DATE: **02/10/2022**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
0–2		6" Topsoil **Silt (ML)** (Native)		Dark Brown	Moist	Firm	-	-
2–5	● (4.5)	**elastic Silt (MH)**		Orange Grey	Moist	Stiff to Very Stiff	27	-

Bottom of test pit at 5.0 feet below existing ground surface.
No groundwater encountered.

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	MADISON	DRAWN:	EG
PROJECT:	MCINTOSH PROPERTY SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE:	02/2022
		PLATE:	A4
		PRO. #:	G12-0122

LOG OF TEST PIT TP-2
(West Central)

ELEVATION: **+/- 601 feet**
EXPLORATORY EQUIPMENT: **TRACK HOE**
DATE: **02/10/2022**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
1–2		4" Topsoil **Silt (ML)** (Native)		Dark Brown	Moist	Stiff	-	-
2–4	● (at 4)	**elastic Silt (MH)**		Orange Grey	Moist	Stiff to Very Stiff	29	-

Bottom of test pit at 4.0 feet below existing ground surface.
No groundwater encountered.

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	MADISON	DRAWN:	EG
PROJECT:	MCINTOSH PROPERTY SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE:	02/2022
		PLATE:	A5
		PRO. #:	G12-0122

LOG OF TEST PIT TP-3
(Southwest)

ELEVATION: **+/- 604 feet**
EXPLORATORY EQUIPMENT: **TRACK HOE**
DATE: **02/10/2022**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
0–2		6" Topsoil **Silt (ML)** (Native)		Dark Brown	Moist	Firm	-	-
2–5	• (at ~4.5)	**elastic Silt (MH)**		Orange Grey	Moist	Stiff	24	-

Bottom of test pit at 5.0 feet below existing ground surface.
No groundwater encountered.

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	MADISON
PROJECT:	MCINTOSH PROPERTY SUBDIVISION, 3210 NW MCINTOSH ROAD, CAMAS, WA
DRAWN:	EG
DATE:	02/2022
PLATE:	A6
PRO. #:	G12-0122

LOG OF TEST PIT TP-4
(East Central)

ELEVATION: **+/- 610 feet**
EXPLORATORY EQUIPMENT: **TRACK HOE**
DATE: **02/10/2022**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
0–3	X (at 2)	4" Topsoil **Silt (ML)** Wet γ ~116 pcf Dry γ ~92 pcf (Native)		Dark Brown	Moist	Firm to Stiff	26	-
3–5	• (at 4.5)	**elastic Silt (MH)**		Orange Grey	Moist	Very Stiff	24	-

Bottom of test pit at 5.0 feet below existing ground surface.
No groundwater encountered.

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	MADISON	DRAWN:	EG
PROJECT:	MCINTOSH PROPERTY SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE:	02/2022
		PLATE:	A7
		PRO. #:	G12-0122

LOG OF TEST PIT TP-5
(Southeast)

ELEVATION: **+/- 594 feet**
EXPLORATORY EQUIPMENT: **TRACK HOE**
DATE: **02/10/2022**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
0–2.5	● (2)	4" Topsoil **Silt (ML)**		Brown	Moist	Soft to Firm	26	-
2.5–3.5		**lean Clay (CL)**		Orange Grey	Moist	Stiff	-	-
3.5–12	● (4), ● (12)	**Silt (ML)** (Native)		Brown	Moist	Very Stiff to Hard	25 30	- -

Bottom of test pit at 12.0 feet below existing ground surface.
No groundwater encountered.

Earth Engineering, Inc.
GEOTECHNICAL & ENVIRONMENTAL SERVICES

CLIENT:	MADISON	DRAWN:	EG
PROJECT:	MCINTOSH PROPERTY SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE:	02/2022
		PLATE:	A8
		PRO. #:	G12-0122

LOG OF TEST PIT TP-6
(Southeast)

ELEVATION: **+/- 583 feet**
EXPLORATORY EQUIPMENT: **TRACK HOE**
DATE: **02/10/2022**

DEPTH IN FEET	SAMPLES	SOILS CLASSIFICATION	LITHOLOGY (USGS)	COLOR	MOISTURE	CONSISTENCY	MOISTURE CONTENT % OF DRY WEIGHT	PERCENT PASS NUMBER 200
0–1		12" Topsoil						
2	⊠	Wet γ ~116 pcf Dry γ ~93 pcf					24	-
3–5						Soft to Firm		
6–7		**Silt (ML)**		Dark Brown to Brown	Moist			
9	●						26	-
10–12						Very Stiff to Hard		
12–13		(Native)						

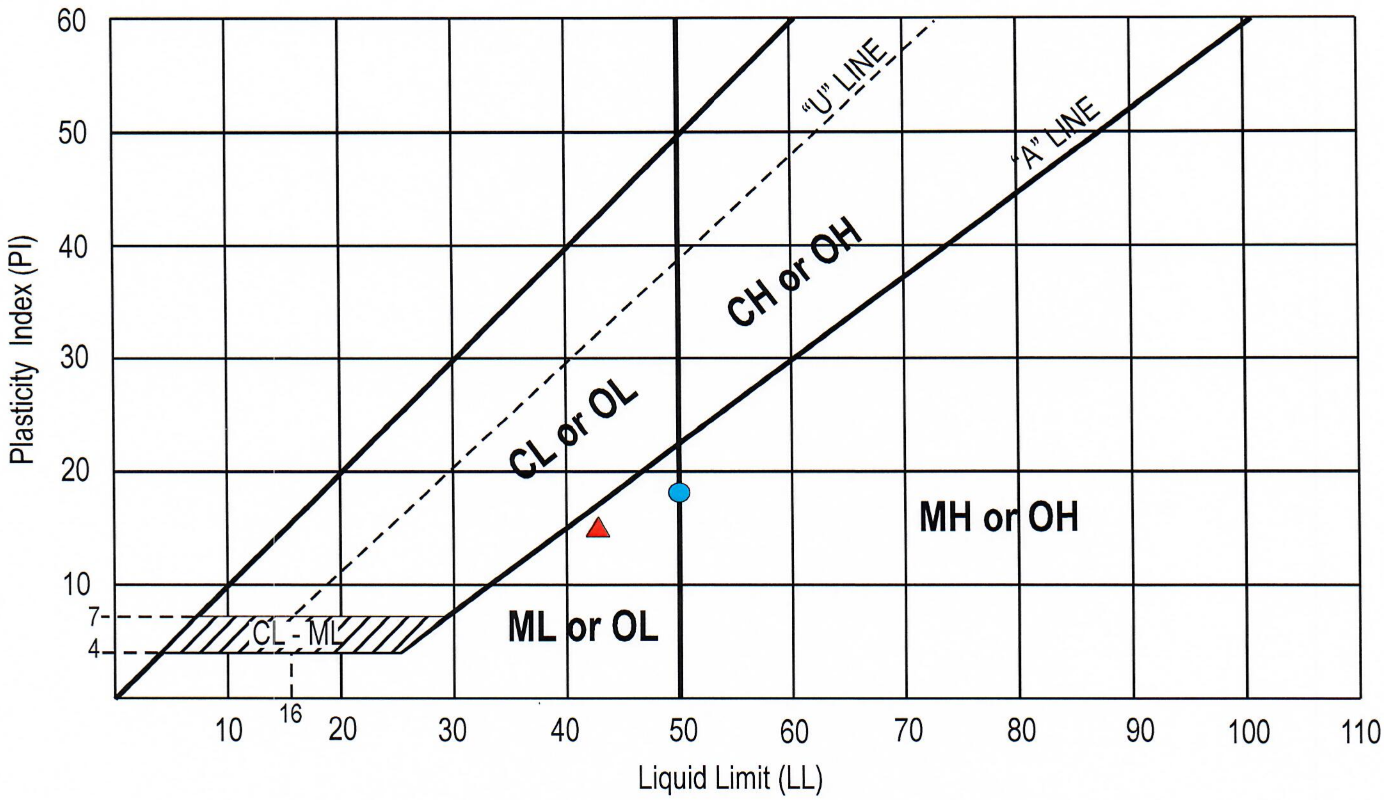
Bottom of test pit at 13.0 feet below existing ground surface.
No groundwater encountered.

Earth Engineering, Inc. GEOTECHNICAL & ENVIRONMENTAL SERVICES	CLIENT: MADISON	DRAWN: EG
	PROJECT: MCINTOSH PROPERTY SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE: 02/2022
		PLATE: A9
		PRO. #: G12-0122

APPENDIX B

(LABORATORY TESTING)

ATTERBERG LIMITS
ASTM D4318-95



● I-1 @ 4.0 feet bgs - Elastic Silt (MH)
Liquid Limit = 50 Plasticity Index = 19

▲ TP-6 @ 9.0 feet bgs - Silt (ML)
Liquid Limit = 42 Plasticity Index = 15

Earth Engineering, Inc. GEOTECHNICAL & ENVIRONMENTAL SERVICES	CLIENT: MADISON	DRAWN: DB
	PROJECT: MCINTOSH SUBDIVISION 3210 NW MCINTOSH ROAD CAMAS, WA	DATE: 03/2022
		PLATE: B1
		PRO. #: G12-0122

DISTRIBUTION

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