Foundation Engineering, Inc.
Professional Geotechnical Services

Memorandum

REGISTERED PROFESSIONAL ENGINEER
10701
OREGON
JULY 18, 1980
JAMES K. MAITLAND
EXPIRES: 12/31/20

Date: July 16, 2020

To: Charles Wright, P.E.
Senior Associate Engineer
Kennedy Jenks

From: Erin J. Gillaspie, P.E.
James K. Maitland, P.E., G.E.

Subject: Geotechnical Investigation

Project: City of Albany, Class A Biosolids Composting Project
Project No.: 2191137

We have completed the requested geotechnical investigation for the above-referenced project. Details of our findings and recommendations are provided below.

BACKGROUND

The City of Albany plans to build a new biosolids processing facility at its Water Reclamation Facility (WRF) Solids Handling site near the intersection of NE Willamette Avenue and NE Davidson Street in Albany, Oregon. The site location is shown in Figure 1A (Appendix A).

The planned site layout is shown in Figure 2A (Appendix A) and an aerial photograph showing existing facilities is shown in Figure 3A (Appendix A). The WRF is located immediately south of the Willamette River. New fill will be required to raise the site above the 100-year flood elevation.

The City of Albany (City) is the owner. Kennedy Jenks is the prime consultant and retained Foundation Engineering as the geotechnical consultant. Our scope of work was outlined in a proposal dated September 17, 2019, and authorized by a signed agreement dated January 6, 2020. Foundation Engineering has completed previous investigations within the existing facility. Results from those investigations have been used to supplement the current work, where appropriate.

Primary current and future project elements include:

- A new ±9,000 square foot (SF) Composting Building with a fabric-type cover over the composting system. This type of structure with captions provided by Kennedy Jenks is depicted in Photo 1A (Appendix A). The Composting Building will have a slab-on-grade concrete floor over ±3 to 6 feet of new fill. The structure will have a concrete backwall and large concrete ecology block side walls and dividers.

- A future Secondary Composting Building similar to the Composting Building built on ±1 foot of new fill.

- A new ±9,000-SF Amendment Building with a fabric-type cover. This type of structure with captions provided by Kennedy Jenks is depicted in Photo 2A (Appendix A). The Amendment Building will be supported on columns with spread footings and have an asphaltic concrete (AC) paved floor. No new fill is anticipated for the Amendment Building.

- A new Biofilter with a concrete slab-on-grade and short curbs built on ±4 to 6 feet of new fill north of the Composting Building.

FIELD EXPLORATION

We excavated six exploratory test pits (TP-1 through TP-6) at the site on January 8, 2020, using a Takeuchi TB290 mini excavator. The test pit locations were selected, in part, to avoid underground utilities and paved areas. The approximate test pit locations are shown on Figure 2A and 3A (Appendix A).

The test pits extended to maximum depths ranging from ±4.5 to 11 feet. Disturbed soil samples were obtained at selected depths for possible laboratory testing and observation in our office. The soil profiles, sampling depths and strength measurements are summarized on the test pit logs (Appendix B). A deeper soil profile was estimated based on previous borings at the site. The subsurface conditions are discussed below.

LABORATORY TESTING

The laboratory work included moisture content and Atterberg Limits tests on selected soil samples to help classify the soils according to the Unified Soil Classification System (USCS) and estimate their overall engineering properties. Laboratory tests were limited to the fine-grained soils encountered in the current explorations. Non-tested samples were visually classified in accordance with ASTM D2488-09a and ASTM D2487-11. The laboratory test results are summarized in Table 1.

Table 1. Laboratory Test Results

Sample	Sample Depth (ft.)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS Designation
S-4-2	4.0 – 5.0	40.3	52	17	35	CH
S-6-1	3.0 – 4.0	31.0	57	30	27	CH

SITE CONDITIONS

Surface Conditions and Topography

AC pavement surrounds the existing clarifiers and extends into the portion of the site where the proposed structures are planned. The western portion of the site is typically covered with crushed gravel and/or grass. A large stockpile of soil currently occupies the northeast portion the planned composting facility. Site conditions at the time of our field exploration are shown in Photos 3A and 4A (Appendix A).

Most of the planned composting site is relatively flat but slopes down to the north along the north side of the WRF site (i.e., the south bank of the Willamette River). A topographic map provided by Kennedy Jenks indicates typical ground surface elevations in the vicinity of the proposed Composting and Biofilter structures ranging from ±El. 202 in the south to ±El. 198 in the northeast. The ground surface slopes down ±3:1 (H:V) to the north and northwest, and the ground surface at TP-1 is ±El. 198. The ground surface at the auxiliary area (i.e., in the vicinity of TP-6) slopes down ±15:1 (H:V) to the northeast, with ground surface elevations ranging from ±El. 201 to 212.

Subsurface Conditions

The following soil units were encountered in the test pits. Additional description of the individual layers is provided in the logs (Appendix B).

Silty sandy gravel (fill)**.** Test pits TP-1 through TP-5 encountered surficial silty sandy gravel (fill). TP-6 encountered this unit below ±4 feet. The gravel fill was typically moist, medium dense to very dense, and subrounded to rounded. The gravel becomes clayey with depth at some locations, and often contains cobbles. At TP-2 and TP-4, the site fill contains varying amounts of scattered construction debris, wood, and cobbles. The site fill extends to the maximum depth of most test pits. The gravel below ±6 feet in TP-2 contains some cobbles up to ±10 inches in diameter and may represent native alluvium.

Clay to silty clay (fill). Brown, medium to high plasticity silty clay was encountered to ±4 feet in TP-6. High plasticity clay was also encountered from ±4.5 to 6.5 feet (the limit of the test pit) in TP-4. These fill units were moist and stiff to very stiff at the time of the exploration.

A review of previous explorations by Foundation Engineering and others suggests the existing fill is underlain by fine-grained alluvium consisting of primarily clay to sandy clay to at least ±70 feet.

Stockpiled fill**.** The existing stockpile is planned for use as new General Site Fill. This material was generated during a recent sewerline project and consists of variable mixtures of silt, sand, gravel, and cobbles.

Ground Water. No seepage or groundwater was encountered in the explorations. We anticipate a good hydraulic connection between the ground water elevation at the site and the water elevation in the Willamette River. Therefore, the water level beneath the site will fluctuate seasonally and closely correspond to the water level in the river. Well logs suggest the static ground water level at the site is ±20 to 25 feet below current grades. Based on the lack of planned below-grade structures and the available information, ground water should not be a geotechnical issue for this project.

DISCUSSION OF GEOTECHNICAL CONSIDERATIONS

A general discussion of geotechnical considerations is provided in this section as they pertain to the proposed expansion. Specific construction recommendations for these items are provided in the recommendations section.

Re-Use of Stockpiled Fill as General Site Fill

Up to ±6 feet of fill will be required to raise the site grade above the100-year flood plain where new structures are planned. The City proposes to use the existing stockpiled fill for the build of the site grading. Based on our evaluation of the stockpiled material, we believe most of it will be suitable as General Site Fill, as described in the Recommendations section of this report. However, the fill is variable. Therefore, the fill should be re-evaluated as it is excavated as well as prior to placement to confirm its condition and suitability. The fill should be free of construction debris, organics, expansive clay, and/or other deleterious materials. Adequate moisture-conditioning and compaction of the fill should also be confirmed by a Foundation Engineering representative.

The stockpiled fill contains significant fine-grained soil. These soils will be moisture-sensitive and will soften considerably when wet and disturbed by construction traffic. Also, adequate compaction of the new fill will only be possible during dry weather, when moisture-conditioning (aeration) is possible. Therefore, we recommend completing the site grading and foundation construction during the dry summer months (typically mid-June through mid-October).

Beneath new structures, the approved General Site Fill should also be capped with compacted crushed gravel or rock (i.e., Select Fill, as defined below) to construct a building pad (see further discussions below).

Expansive Soils

Atterberg Limits tests (see Table 1, above) indicate the fine-grained fil encountered at TP-4 has a Liquid Limit of 52 and a Plasticity Index (PI) of 35. These limits correspond to a high plasticity clay (CH) designation according to the Unified Soil Classification System (USCS). CH soils are typically associated with a relatively high risk of swelling and shrinking due to seasonal changes in moisture content. However, at TP-4, the plastic clay is buried under ±4 feet of gravel and addition site fill is planned. Therefore, the risk of subgrade movement due to seasonal changes in moisture is minor. Future development in the grassy field surrounding TP-6 will likely require significant grading. The need for any mitigation of expansive soil at that location should be confirmed when the FFE and foundation depths are confirmed.

Full mitigation of the high plasticity clay would require full-depth removal and replacement with non-expansive soil (e.g., crushed rock or gravel). However, full mitigation may be costly depending on the depth and extent of the high plasticity clay, and we do not anticipate the planned structures will be particularly sensitive to minor differential movements. Therefore, we have recommended partial mitigation measures (described below) if high plasticity material is exposed at the subgrade level of slabs, foundations, or pavements to help further mitigate the risk to structures.

Existing Site Fill

The existing granular fill observed in the test pits at or below the proposed foundation level appears suitable to support new foundations and slabs in its current state. However, field confirmation of the suitability of the fill should be made at the time of construction because it may be more variable across the site. The existing clay fill encountered in TP-4 and TP-6, has relatively high plasticity and expansive if similar clay fill is encountered at the foundation level for any of the new structures, it should be mitigated by overexcavation and placement of at least 2 feet of compacted granular fill, as detailed in the Recommendations section of this report.

Foundation Soils

The soil encountered at the anticipated foundation elevation (where little or no new fill is anticipated) consists of silty sandy gravel. The foundation soils at the time of the exploration were typically moist to wet and medium dense to very dense. The existing foundation soils are suitable for supporting the planned buildings using conventional shallow spread footings and continuous wall footings. Existing granular fill at the subgrade level of planned structures should be compacted prior to construction.

In areas where additional fill is required for site grading, the ground surface should be stripped of any organics, if present, and recompacted prior to pacing ne fill. New fill should consist of Select Fill or approved General Site Fill, placed and compacted as described in the Recommendations section of this report.

Footings should also be underlain by ±12 inches of Select Fill. This fill thickness may need to be reduced to ±6 inches beneath the Amendment Building footings (to be confirmed during construction).

Building pads consisting of a minimum of 12 inches of Select Fill should be constructed beneath all new structures.

ENGINEERING ANALYSIS AND CONSTRUCTION CONSIDERATIONS

SEISMIC DESIGN

Site Response Spectrum. We developed a design spectral acceleration response spectrum for the site in accordance with the Oregon Structural Specialty Code (OSSC 2019), which is based on Section 1613 of the International Building Code (IBC 2018) and ASCE 7-16. Our current and previous explorations and local water well logs indicate the upper ±100 feet of the subsurface profile consist primarily of alternating layers of stiff fine-grained soil (i.e., silts and clays). Therefore, we have concluded a Site Class D (stiff soil profile) is appropriate for design.

When developing the design response spectrum for a Site Class D, ASCE 7-16 Section 11.4.8 requires a ground motion hazard analysis be performed in accordance with ASCE 7-16 Section 21.2 at sites where the 1.0 second spectral acceleration on rock (S_1) is greater than or equal to 0.2g. However, an exception in Section 11.4.8 stipulates a ground motion hazard analysis is not required when the seismic response coefficient C_s is calculated based on Eq. 12.8-2 for values of $T \leq 1.5T_S$ and taken as equal to 1.5 times the value computed using either Eq. 12.8-3 for $T > 1.5T_S$ or Eq. 12.8-4 for $T \geq 1.5T_L$ (where $T_S = S_{D1}/S_{DS}$ and T_L is the long-period transition period shown on Figure 22-14 in Chapter 22). The T_L value for Oregon is 16 seconds.

The adjustment in the C_s value is intended to better model long-period spectral accelerations for softer soils coupled with strong ground motions. However, the adjustment applies only to the design of long-period structures (i.e., typically structures with a height of five stories or greater). For the proposed ±20-foot tall structures, we anticipate the period of interest will be less than $1.5T_S$ and no C_s adjustment will be necessary when using the exception in Section 11.4.8. Therefore, we developed the site response spectrum shown on Figure 4A (Appendix A) using the mapped risk-targeted maximum considered earthquake (MCE_R) ground motions and the general procedure in Section 11.4.6 with F_a selected based on Table 11.4-1 and F_v selected based on Table 11.4-2. The risk-targeted maximum considered earthquake (MCE_R) ground motions were obtained from modified USGS 2014 maps with a 2% probability of exceedance in 50 years (i.e., a ±2,475-year return period). The modifications include factors to adjust the spectral accelerations to account for directivity and risk.

Liquefaction and Liquefaction-Induced Settlement. Liquefiable soils typically consist of saturated, loose sand and non-plastic silt. The risk of liquefaction and resulting settlement or lateral spread is considered very low due to the density of the shallow granular fill and the stiffness and plasticity of the deeper, (native) fine-grained soils that underlie the site.

Discussion of Anticipated Loads, Foundation Conditions, and Foundation Type

Anticipated foundation loads were not available at the time this report was prepared. However, we assumed the fabric-style structures will have a maximum column loads not exceeding 50 kips. We understand the perimeter of the structures will consist of precast concrete blocks to form bays that can be accessed from several directions.

Based on the existing site conditions, we anticipate conventional shallow foundations (i.e., spread footings and continuous strip footings) are adequate to support the new structures. We anticipate resistance to wind uplift, rather than structural load, will likely dictate the size of the foundations.

Bearing Capacity

The soil stockpiled in the northeastern portion of the site is expected to be used as General Site Fill. This stockpile represents material generated from local sewerline trenching consists of a variable mixture of silt, sand, clay, and gravel with scattered cobbles. Kennedy Jenks estimated that ±3 to 6 feet of new site fill will be required under the new Composting Building and ±1 foot of site fill will be required under the future Secondary Composting Building. The new Biofilter will require ±4 to 6 feet of new site fill. No significant filling is anticipated for the Amendment Building.

Assuming the stockpiled material is placed and compacted as specified herein, we recommend a presumptive (allowable) bearing capacity of 2,000 lb/ft^2 (psf) for the design of new footings. For planning purposes, this value may also be used for future construction in the grassy field (in the vicinity of TP-6). However, at that location, a significant amount of site grading will be required. Therefore, the allowable bearing pressure for new construction is this area should be confirmed based on the actual foundation conditions.

No significant new site fill is planned under the Amendment Building. If desired, an allowable bearing pressure of 3,000 psf may be used for footing design of the Amendment Building.

Settlement

The type of structures, construction materials, and intended use of the new facility suggest the new structures are not particularly settlement sensitive. Settlement due to consolidation of clay beneath the new building foundations is expected to be relatively small given the anticipated modest foundation loads, relatively small live loads from the stockpiled compost, and the observed stiffness of the fine-grained fill in TP-4. For the allowable bearing pressures discussed above, we anticipate a maximum foundation settlement of ± ½ inch or less where the foundations are underlain by fine-grained soil. No appreciable settlement is expected where foundations are underlain by dense gravel. Therefore, differential settlement between adjacent footings may also be up to ± ½ inch.

Sliding Coefficient and Passive Resistance for Footings

We have recommended below that all new footings be underlain by a nominal 6 to 12 inches of compacted Select Fill, as defined below. A sliding coefficient of 0.5 is recommended to analyze the sliding resistance of new footings constructed on the compacted Select Fill.

Passive resistance of the soil in front of buried footings was calculated as an equivalent fluid density. An equivalent fluid density of 150 pcf is recommended for the evaluation of new footings, assuming the backfill around the footings will consist of compacted Select Fill. A factor of safety has been applied to these values, since it is unlikely the footings will move lateral enough to mobilize the full passive resistance.

Floor Slab Design

We recommend the concrete floor slab for the Composting Building and Biofilter be designed using a modulus of subgrade reaction of 200 lb/in^3 (pci). This value assumes the floor slab will be constructed on a minimum of 12 inches of compacted crushed rock (i.e., Select Fill) over approved General Site Fill or over dense gravel (existing site fill). We recommend the concrete floor slab be reinforced due to anticipated heavy wheel loads from front-end loaders.

Lateral Loads

The materials to be stored will consist of raw compost (a mix of biosolids and carbon amendment) that will be placed in bays of the Composting Building. The carbon amendment (woodchips and yard debris) will be stored in the Amendment Building, as well as finished compost.

These materials are typically fibrous and do not act as a typical soil. For purposes of design, we have assumed the amendment materials and finished compost will act as a low unit weight "soil". We have used in our analysis a nominal unit weight of 60 lb/ft^3 (pcf) for the stored materials, assuming no soil is used as an amendment. Using a presumptive coefficient of lateral earth pressure of 0.5 for all of the amended materials, we estimate an equivalent fluid density of 30 pcf to represent lateral pressure on the bays and bin walls. This value may be used for analysis of the interior partitions and perimeter walls. It does not include any surcharge pressure the walls or partitions may feel in the event the front-end loader drives up onto the stored material.

Pavements

The new Amendment Building will have an AC floor. Rubber-tired front-end loaders will be used to move the compost materials. It is difficult to quantitatively analysis pavements for this type of equipment without more information about the size of the tires, tire pressures, wheel loads, etc. Therefore, no formal pavement design was performed. We recommend planning for a nominal pavement section consisting of 5 inches of AC over 12 inches of base rock. This section is recommended based on the assumption of the pavement will be subjected to relatively heavy industrial loading, with frequent passes and turns of the front-end loader.

RECOMMENDATIONS

The recommendations provided below are appropriate for dry weather construction only since the stockpiled fill (i.e., General Site Fill) is moisture-sensitive and cannot be compacted if excessively moist. Mitigation of silty soils may be required during early summer when the surface soils are wet, due to the possibility of rutting and pumping.

We recommend providing contractors a copy of this report. We should be provided an opportunity to meet with the earthwork contractor prior to construction to discuss the site conditions and the contractor's approach to site preparation.

Material Specifications and Compaction Requirements

1. Select Fill as defined in this report should consist of 1 or ¾-inch minus, clean (i.e., less than 5% passing the #200 U.S. Sieve), well-graded, crushed gravel or rock.
2. Granular Site Fill, as defined in this report should consist of ±3-inch minus, clean (i.e., less than 5% passing the #200 U.S. Sieve), well-graded, crushed gravel or rock, or approved rounded gravel. It may be used to raise site grades if there is insufficient General Site Fill.
3. General Site Fill should consist of existing stockpiled material approved by Foundation Engineering. The General Site Fill should be free of expansive clay, organic matter, or construction debris.

4. The Separation Geotextile should meet the minimum requirements of an AASHTO M 288-17 geotextile for separation and have Mean Average Roll Value (MARV) strength properties meeting the requirements of an AASHTO M 288-17 Class 2, woven geotextile. We should be provided a specification sheet on the selected geotextile for approval prior to delivery to the site.
5. Compact all fill in loose lifts not exceeding 12 inches. Thinner lifts of 8 inches or less will be required if light or hand-operated equipment is used. Compact all fill to a minimum of 95% relative compaction, unless otherwise specified. The maximum dry density of ASTM D 698 should be used as the standard for estimating relative compaction, unless otherwise specified. Field density tests should be run frequently to confirm adequate compaction of the fill.
6. The stockpiled General Site Fill is variable and contains oversized gravels and cobbles. Therefore, confirmation of adequate compaction of this material will require proof rolling. The proof rolling should be completed using a loaded water truck, dump truck or other approved vehicle and should be observed by a Foundation Engineering representative.
7. Shoring should be provided in any utility trenches according to OR-OSHA Standards to protect workers from sloughing or caving soils. Soil conditions encountered in the test pits typically correspond to OSHA Type C soils. Shoring and worker safety are the sole responsibility of the contractor.

Foundation Design and Construction

Foundation design and construction for all of the structures should be in general accordance with the following recommendations.

8. Design the foundations using an allowable bearing pressure of 2,000 psf. This value may be used for all new footings and for interior partitions and perimeter walls built using precast eco-blocks. An allowable bearing pressure of 3,000 psf may be used for the Amendment Building, if no General Site Fill is placed in this area.
9. Assume total and differential settlements of ½ inch or less, if the footings are designed and built as specified herein.
10. Design the structure using OSSC 2019 seismic parameters and response spectrum shown in Figure 4A (Appendix A).
11. Where practical, embed the base of all concrete ecology blocks at least 1 foot below finish grades. If blocks are to rest directly on the floor slab, they should be designed to resist sliding due to lateral forces from the retained materials. We assume new CIP footings will be extend a nominal 2 feet below floor slabs or AC surfaces.

12. Provide at least 12 inches of compacted Select Fill under new footings and ecology block walls underlain by General Site Fill. The Select Fill should extend at least 6 inches beyond the edges of all footings and blocks. The Select Fill beneath the footings may be reduced to a leveling course (±4 to 6 inches thick) where the footings extend to existing dense gravel site fill (e.g., at the Amendment Building). Any reduction of the Select Fill should be confirmed during construction.
13. Use an equivalent fluid density of 30 pcf to model the lateral pressure from stored materials on interior partitions or bins and perimeter walls. This value is likely an upper bound, but does not include any surcharge that could occur if the front-end loader is driven onto the stored material, near the bays or the perimeter walls.
14. Use a modulus of subgrade reaction, k_s, of 200 pci for floor slab design. This value assumes the slabs will be supported on a minimum of 12 inches of compacted Select Fill underlain by compacted subgrade. Reinforce all floor slabs to reduce the risk of cracking and warping. The thickness of the Select Fill may be reduced to 6 inches under the Amendment Building, if the subgrade condition is confirmed by a Foundation Engineering representative.

Site Preparation for New Structures. We recommend the site grading be completed in dry weather only. The soil stockpiled on site contains a significant amount of fines. Proper moisture-conditioning and compaction will require dry weather conditions. The site preparation should be done using the following guidelines:

15. Strip the foundation areas as required to remove concentrated roots and sod, existing pavements, or other construction debris. Dispose of all strippings outside of construction areas. Deeper stripping or excavation may be required if loose/unsuitable fill or debris is encountered. The condition of the stripped subgrade should be evaluated at the time of construction.
16. Excavate the existing backfill in the exploratory test pits that are within building footprints and replace with compacted Select Fill. Figures 2A and 3A show the approximate locations of the test pits. A Foundation Engineering representative is available to locate these test pits, if needed.
17. Compact the stripped surface prior to placing backfill. Proof roll the prepared subgrade prior to placing any new site fill. Overexcavate any disturbed or pumping areas and replace it with approved General Site Fill, Select Fill, or Granular Site Fill (if additional imported fill is required).

18. Where new site fill is required, place General Site Fill or Granular Site Fill in lifts and mechanically compact as specified above during dry weather only. The suitability of the stockpiled fill for use as General Site Fill should be confirmed by Foundation Engineering as it is placed. If needed, remove pockets of plastic clay, debris, or over-sized cobbles. Individual lifts should be constructed at slopes no steeper than 10:1 (H:V). Where practical, finished slopes should be graded at 3:1 (H:V), or flatter. In areas of limited space, the finished slope can be steepened to 2:1 (H:V).
19. Proof roll the new fill as it is placed using an approved truck or vehicle. Where more than 2 feet of fill is required, the fill should be proof rolled in lifts. The proof roll should be observed by Foundation Engineering. If excessive deflection or rutting is observed, the fill should be removed, moisture-conditioned (dried), re-compacted, and proof rolled again.
20. Cap General Site Fill and Granular Site Fill under all floor slabs or AC surfaces with at least 12 inches of Select Fill. Compact the Select Fill as recommended above. Do not allow heavy trucks on the building pads. Where no General Site Fill is required, the thickness of the Select Fill beneath the slab or AC surface can be reduced to 6 inches, if the subgrade consists of dense gravel (to be confirmed by Foundation Engineering).
21. Excavate for the footings using a hoe equipped with a smooth bucket to minimize subgrade disturbance. The excavations should extend at least 6 inches beyond the edges of the footings. The required excavation depths and the condition of the soil should be confirmed at the time of construction by a Foundation Engineering representative prior to backfilling.
22. Place at least 12 inches of compacted Select Fill under new footings or blocks. This thickness can be reduced to a leveling course (4 to 6 inches thick) in areas underlain by existing dense gravel.
23. Grade the finished ground surface surrounding the buildings to promote runoff away from the foundations.

Foundation Drainage. The static ground water table is expected to be well below the current limits of grading and excavations. Therefore, ground water is not expected to be a significant issue, except for possible perched water during periods of sustained rainfall.

We understand the new composting building will be surrounded partially by relatively impervious pavement and partially by gravel surfaces. The pavement surfaces will be flush with the interior floors to allow loaders and other equipment to drive into the composting building. The exterior pavements surface will be sloped to promote runoff away from the foundations. Based on the anticipated drainage characteristics of the existing site fill, the planned sloping of exterior surfaces, and the intended use of the facility, we do not anticipate the need for foundation drainage.

Pavement Subgrade Preparation and Construction (Dry Weather)

24. Strip the pavement areas as required to remove concentrated roots and sod, existing pavements, or other construction debris. Dispose of all strippings outside of construction areas.
25. Prepare, compact, and test the subgrade as specified above.
26. Place a Separation Geotextile on the prepared subgrade that meets the requirements specified above. The geotextile should be laid smooth, without wrinkles or folds in the direction of construction traffic. Overlap adjacent rolls a minimum of 2 feet. Pin fabric overlaps or place the building pad fill in a manner that will not separate the overlap during construction. Seams that have separated will require removal of the base rock to establish the required overlap.
27. Provide a nominal section of 5 inches of AC over 12 inches of Select Fill for those areas subject to heavy front-end loader traffic.

CONSTRUCTION OBSERVATION/TESTING

Foundation Engineering should be provided the opportunity to review all drawings and specifications that pertain to site preparation and foundation construction. Site preparation will require field confirmation of subgrade conditions and suitability of the existing stockpiled fill. Mitigation of any unsuitable fill, soft soils, ground water infiltration, or subgrade pumping will also require engineering review and judgment. That judgment should be provided by one of our representatives. Frequent field density tests should be run on all engineered fill, subgrade, and base rock (where applicable). In areas that cannot be tested, the adequacy of the compacted material should be established by proof rolls. We recommend that we be retained to provide the necessary construction observation.

VARIATION OF SUBSURFACE CONDITIONS, USE OF THIS REPORT, AND WARRANTY

The analysis, conclusions, and recommendations contained herein assume the subsurface profiles encountered in the test pits are representative of the site conditions. No changes in the enclosed recommendations should be made without our approval. We will assume no responsibility or liability for any engineering judgment, inspection, or testing performed by others.

This report was prepared for the exclusive use of Kennedy Jenks and other design consultants for the City of Albany, Class A Biosolids Composting project in Albany, Oregon. Information contained herein should not be used for other sites or for unanticipated construction without our written consent. This report is intended for planning and design purposes. Contractors using this information to estimate construction quantities, production rates, or costs do so at their own risk.

Our services do not include any survey or assessment of potential surface contamination or contamination of the soil or ground water by hazardous or toxic materials. We assume those services, if needed, have been completed by others. The recommendations provided herein are not intended to represent any warranty (expressed or implied) against the growth of mold, mildew or other organisms. Our work was done in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

We trust this report meets your current needs. Please feel free to contact us if you have any questions.

Attachments

REFERENCES

ASCE, 2016, *ASCE 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, American Society of Civil Engineers (ASCE).

ASTM, 2009, *Standard Test Method for Description and Identification of Soils (Visual-Manual Procedure)*: American Society of Testing and Materials (ASTM) International, ASTM Standard D2488, DOI: 10.1520/D2488-09A, 11 p.

ASTM, 2011, *Standard Test Method for Classification of Soils for Engineering Purposes (Unified Soil Classification System, USCS)*: American Society of Testing and Materials (ASTM) International, ASTM Standard D2487, DOI: 10.1520/D2487-11, 11 p.

IBC, 2018, *International Building Code*: International Code Council, Inc., Sections 1613 and 1803.

OR-OSHA, 2011, *Oregon Administrative Rules, Chapter 437, Division 3 - Construction, Subdivision P – Excavations*: Oregon Occupational Safety and Health Division (OR-OSHA).

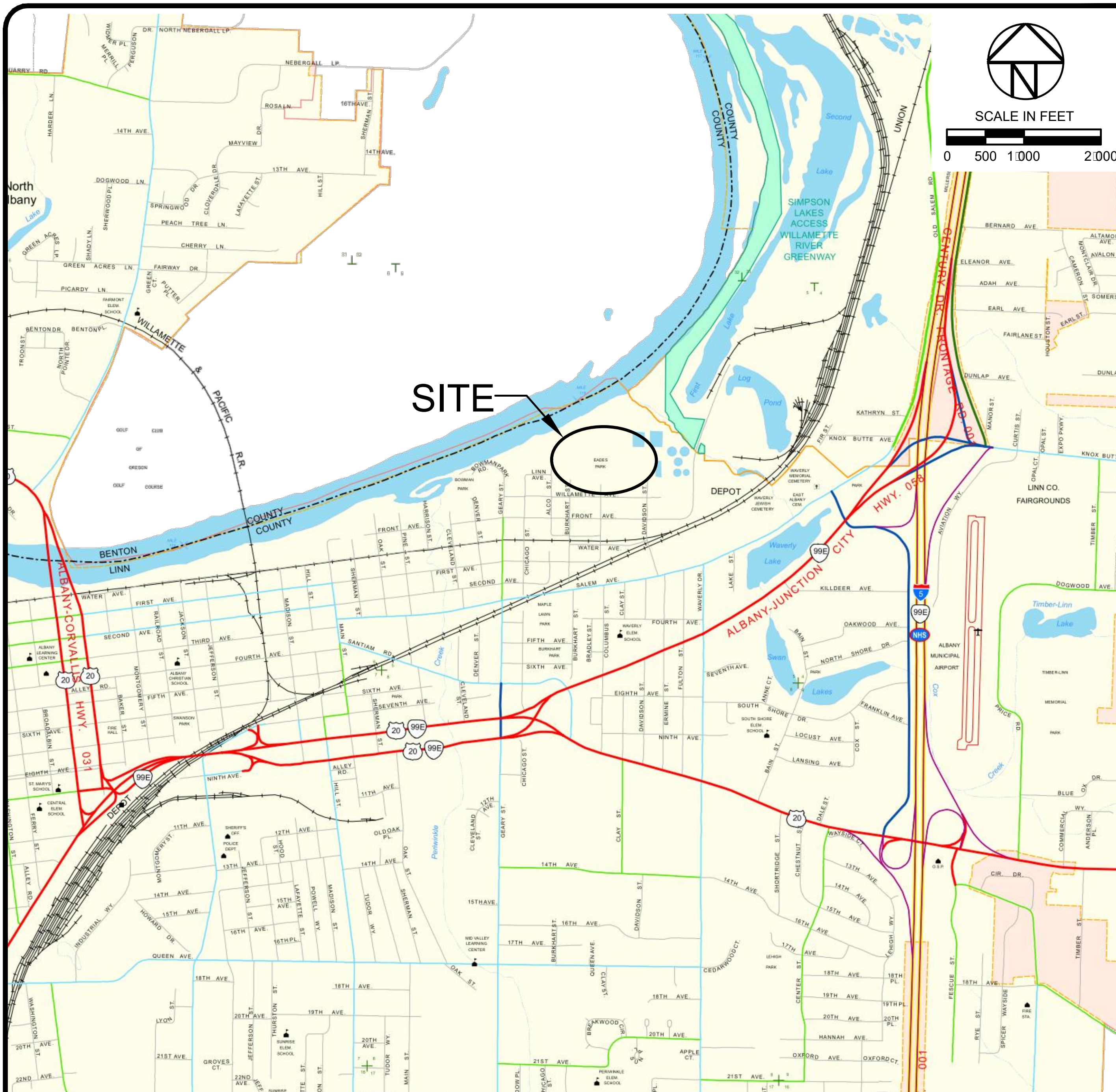
OSSC, 2019, *Oregon Structural Specialty Code (OSSC)*: Based on International Building Code (IBC) 2018, Sections 1613 and 1803.

Appendix A

Figures and Photographs

Professional Geotechnical Services

Foundation Engineering, Inc.



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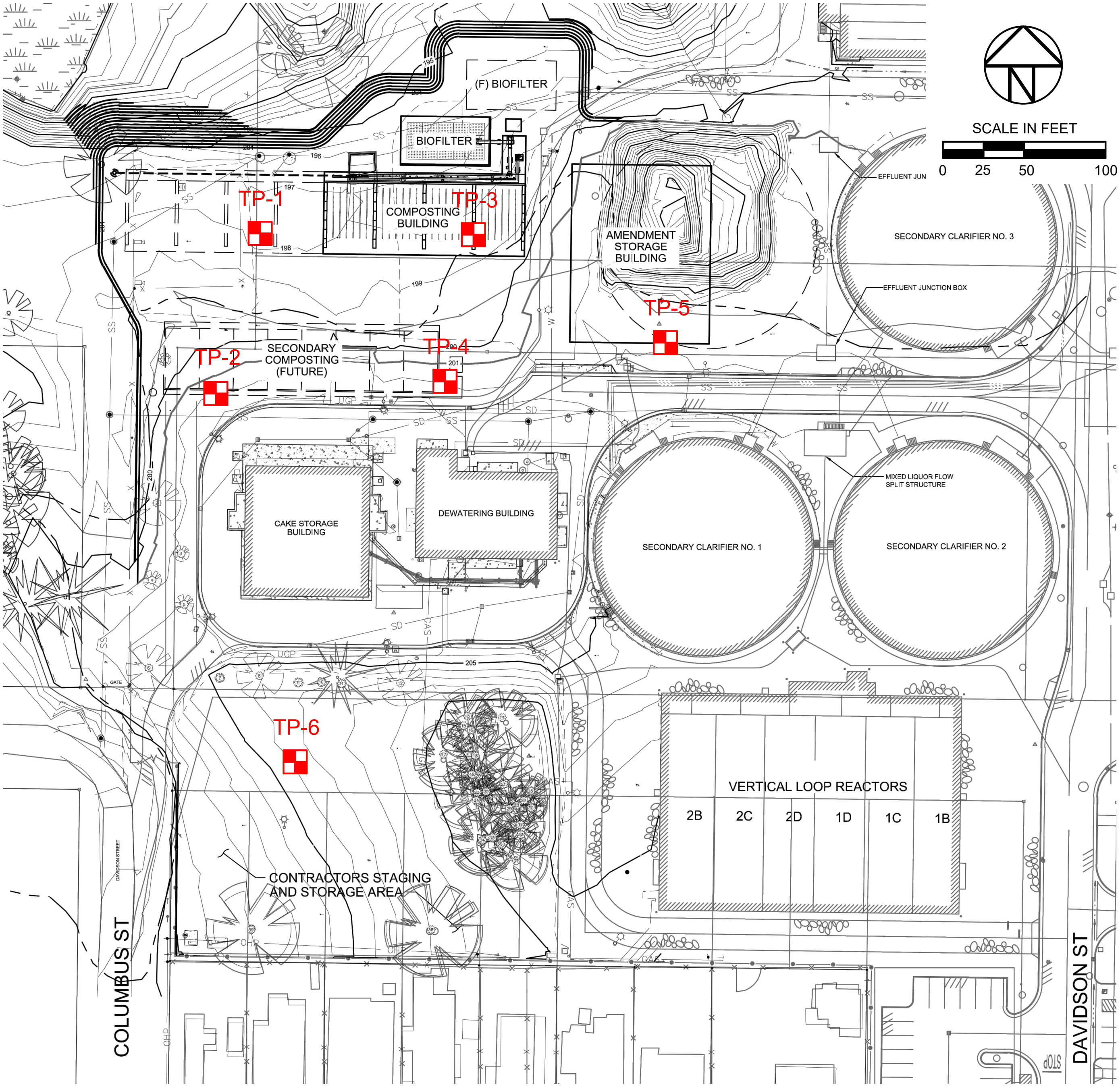
DATE DEC 2019
DWN. EJG
APPR.
REVIS.
PROJECT NO.
2191137

FOUNDATION ENGINEERING INC.
PROFESSIONAL GEOTECHNICAL SERVICES
820 NW CORNELL AVENUE
CORVALLIS, OR 97330-4517
BUS. (541) 757-7645 FAX (541) 757-7650

VICINITY MAP
CITY OF ALBANY,
CLASS A BIOSOLIDS COMPOSTING PROJECT
ALBANY, OREGON

FIGURE NO.
1A

FILE NAME: FIG 1A



NOTES:

1. TEST PIT LOCATIONS WERE ESTABLISHED BY VISUAL REFERENCE WITH AVAILABLE SURFACE FEATURES AND ARE APPROXIMATE.
2. BASE IMAGE PROVIDED BY KENNEDY JENKS.
3. SEE REPORT FOR A DISCUSSION OF SUBSURFACE CONDITIONS.

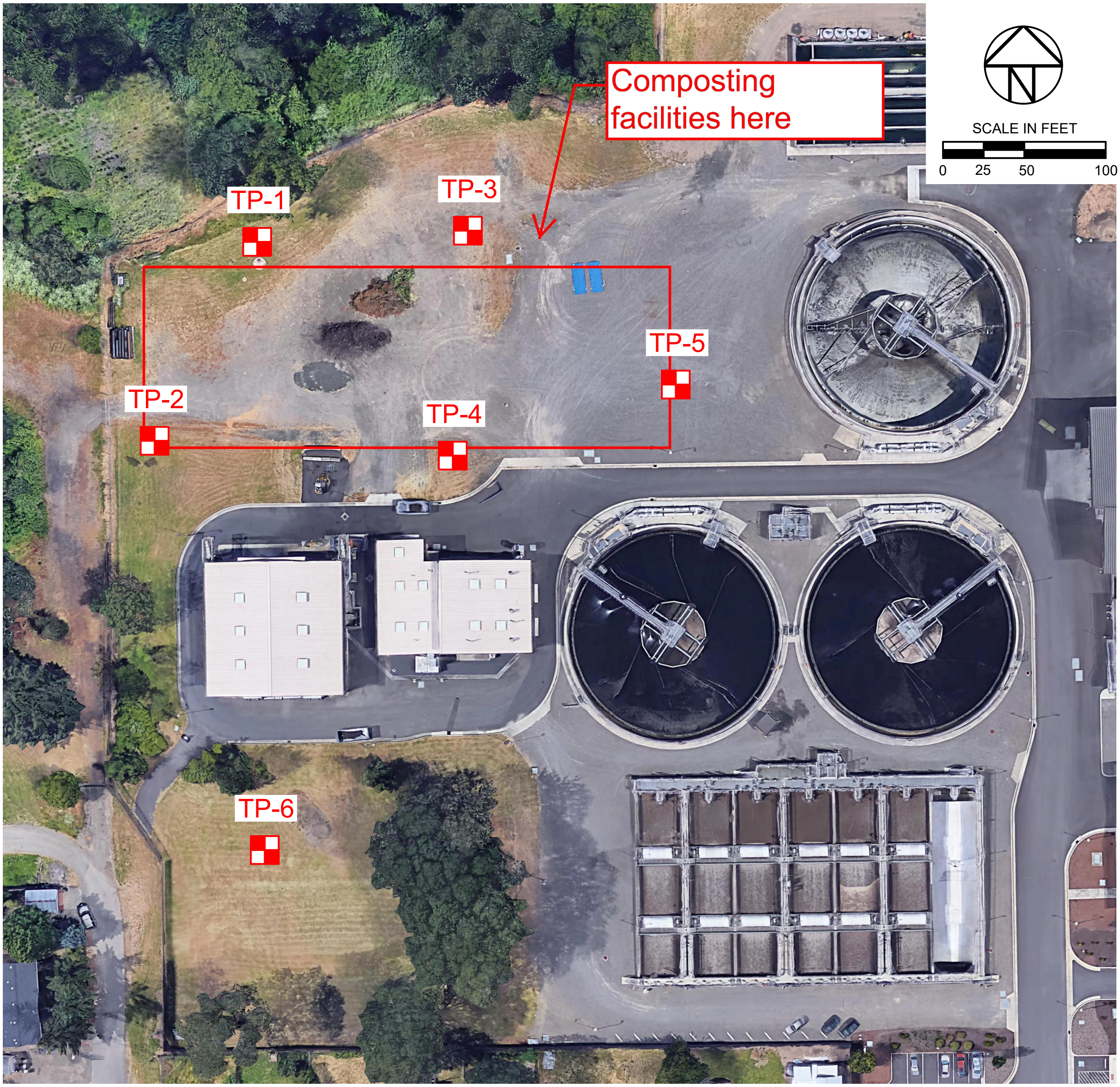
DATE JAN 2020
DWN. EJG
APPR.
REVIS.
PROJECT NO.
2191137

FOUNDATION ENGINEERING INC.
PROFESSIONAL GEOTECHNICAL SERVICES
820 NW CORNELL AVENUE
CORVALLIS, OR 97330-4517
BUS. (541) 757-7645 FAX (541) 757-7650

TEST PIT LOCATIONS
CITY OF ALBANY,
CLASS A BIOSOLIDS COMPOSTING PROJECT
ALBANY, OREGON

FIGURE NO.
2A

FILE NAME: FIG 2A



NOTES:

1. TEST PIT LOCATIONS WERE ESTABLISHED BY VISUAL REFERENCE WITH AVAILABLE SURFACE FEATURES AND ARE APPROXIMATE.
2. BASE IMAGE OBTAINED FROM GOOGLE EARTH.
3. SEE REPORT FOR A DISCUSSION OF SUBSURFACE CONDITIONS.

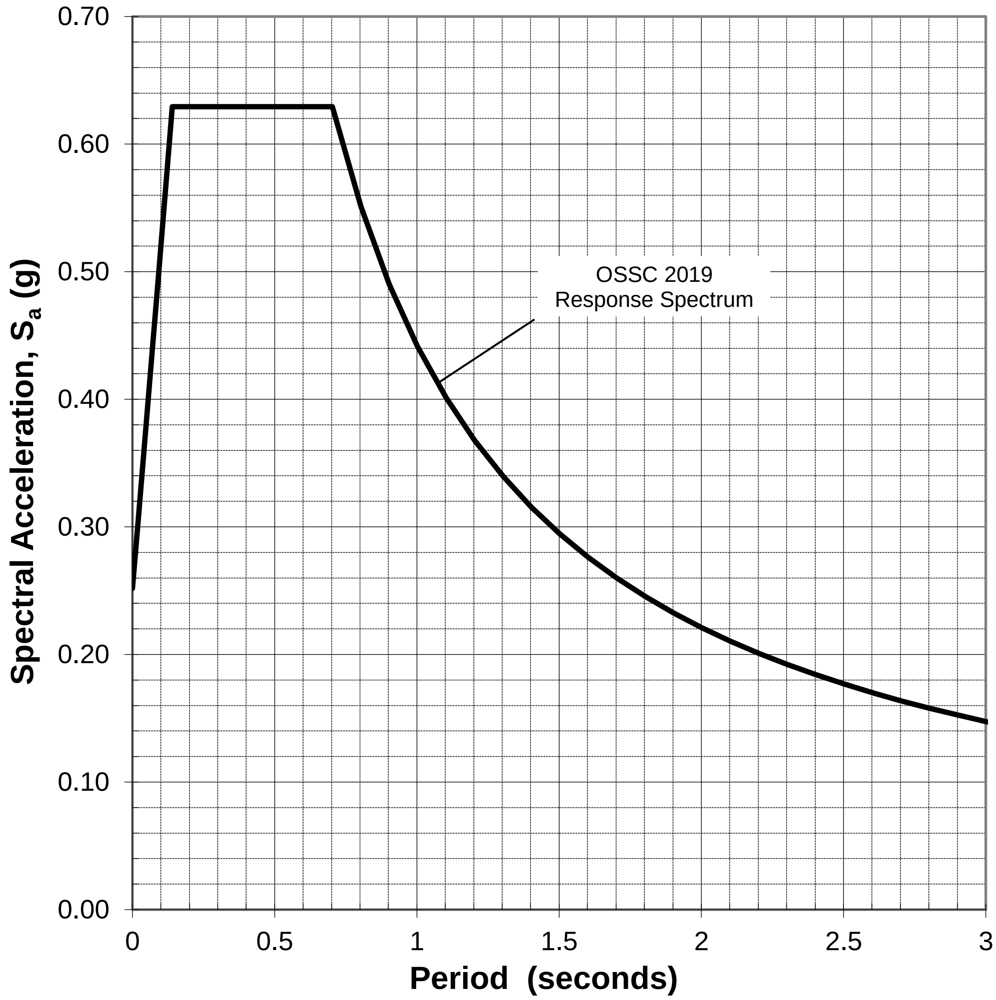
DATE JAN 2020
DWN. EJG
APPR.
REVIS.
PROJECT NO.
2191137

FOUNDATION ENGINEERING INC.
PROFESSIONAL GEOTECHNICAL SERVICES
820 NW CORNELL AVENUE
CORVALLIS, OR 97330-4517
BUS. (541) 757-7645 FAX (541) 757-7650

TEST PIT LOCATIONS
CITY OF ALBANY,
CLASS A BIOSOLIDS COMPOSTING PROJECT
ALBANY, OREGON

FIGURE NO.
3A

FILE NAME: FIG 3A



Notes:

1. The Design Response Spectrum is based on OSSC 2019 Section 1613.2 which is based on ASCE 7-16 Section 11.4.

2. The following parameters are based on the modified USGS 2014 maps provided in OSSC 2019:

   Site Class= D   Damping = 5%

S_S = 0.80	F_a = 1.18	S_{MS} = 0.94	S_{DS} = 0.63
S_1 = 0.42	F_v = 1.58	S_{M1} = 0.66	S_{D1} = 0.44

3. S_S and S_1 values indicated in Note 2 are the mapped, risk-targeted maximum considered earthquake spectral acclerations for 2% probability of exceedence in 50 years.

4. F_a and F_v were established based on OSSC 2019 Tables 1613.2.3(1) and 1613.2.3(2) using the selected S_S and S_1 values. S_{DS} and S_{D1} values include a 2/3 reduction on S_{MS} and S_{M1} as discussed in OSSC 2019 Section 1613.2.3.

5. Site location is: Latitude 44.6440, Longitude -123.0775.

FIGURE 4A
OSSC 2019 SITE RESPONSE SPECTRUM
City of Albany, Class A Biosolids Composting Project
Albany, Oregon
Project No. 2191137

Photo 1A. Typical Composting Building

Photo 2A. Typical Amendment Building

Photo 3A. Near TP-2 looking east.

Photo 4A. Looking west from soil stockpile.

Appendix B

Test Pit Logs

Professional
Geotechnical
Services

Foundation Engineering, Inc.

DISTINCTION BETWEEN FIELD LOGS AND FINAL LOGS

A field log is prepared for each boring or test pit by our field representative. The log contains information concerning sampling depths and the presence of various materials such as gravel, cobbles, and fill, and observations of ground water. It also contains our interpretation of the soil conditions between samples. The final logs presented in this report represent our interpretation of the contents of the field logs and the results of the sample examinations and laboratory test results. Our recommendations are based on the contents of the final logs and the information contained therein and not on the field logs.

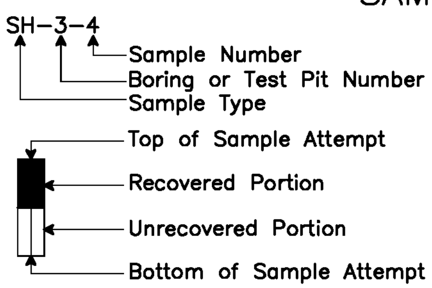
VARIATION IN SOILS BETWEEN TEST PITS AND BORINGS

The final log and related information depict subsurface conditions only at the specific location and on the date indicated. Those using the information contained herein should be aware that soil conditions at other locations or on other dates may differ. Actual foundation or subgrade conditions should be confirmed by us during construction.

TRANSITION BETWEEN SOIL OR ROCK TYPES

The lines designating the interface between soil, fill or rock on the final logs and on subsurface profiles presented in the report are determined by interpolation and are therefore approximate. The transition between the materials may be abrupt or gradual. Only at boring or test pit locations should profiles be considered as reasonably accurate and then only to the degree implied by the notes thereon.

SAMPLE OR TEST SYMBOLS



S – Grab Sample
SS – Standard Penetration Test Sample (split–spoon)
SH – Thin–walled Shelby Tube Sample
C – Pavement Core Sample
CS – Rock Core Sample

▲ Standard Penetration Test Resistance equals the number of blows a 140 lb. weight falling 30 in. is required to drive a standard split–spoon sampler 1 ft. Practical refusal is equal to 50 or more blows per 6 in. of sampler penetration.

● Water Content (%).

UNIFIED SOIL CLASSIFICATION SYMBOLS

G – Gravel	W – Well Graded
S – Sand	P – Poorly Graded
M – Silt	L – Low Plasticity
C – Clay	H – High Plasticity
Pt – Peat	O – Organic

FIELD SHEAR STRENGTH TEST

Shear strength measurements on test pit side walls, blocks of soil or Shelby tube samples are typically made with Torvane or Field Vane shear devices.

TYPICAL SOIL/ROCK SYMBOLS

Concrete	Sand	Basalt
Organics	Gravel	Sandstone
Clay	Silt	Siltstone

WATER TABLE

▼ Water Table Location

(1/31/16) Date of Measurement

FOUNDATION ENGINEERING INC.
PROFESSIONAL GEOTECHNICAL SERVICES

820 NW Cornell Avenue
Corvallis, OR 97330
BUS. (541) 757-7645

7857 SW CIRRUS DRIVE, BUILDING 24
BEAVERTON, OR 97008
BUS. (503) 641-1541

SYMBOL KEY

BORING AND TEST PIT LOGS

Explanation of Common Terms Used in Soil Descriptions

Field Identification	Cohesive Soils			Granular Soils	
	SPT*	S_u** (tsf)	Term	SPT*	Term
Easily penetrated several inches by fist.	0 – 2	< 0.125	Very Soft	0 – 4	Very Loose
Easily penetrated several inches by thumb.	2 – 4	0.125–0.25	Soft	4 – 10	Loose
Can be penetrated several inches by thumb with moderate effort.	4 – 8	0.25 – 0.50	Medium Stiff	10 – 30	Medium Dense
Readily indented by thumb but penetrated only with great effort.	8 – 15	0.50 – 1.0	Stiff	30 – 50	Dense
Readily indented by thumbnail.	15 – 30	1.0 – 2.0	Very Stiff	> 50	Very Dense
Indented with difficulty by thumbnail.	>30	> 2.0	Hard		

* SPT N–value in blows per foot (bpf)
** Undrained shear strength

Term	Soil Moisture Field Description
Dry	Absence of moisture. Dusty. Dry to the touch.
Damp	Soil has moisture. Cohesive soils are below plastic limit and usually moldable.
Moist	Grains appear darkened, but no visible water. Silt/clay will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grain surfaces. Sand and cohesionless silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is wetter than the optimum moisture content and above the plastic limit.

Term	PI	Plasticity Field Test
Non–plastic	0 – 3	Cannot be rolled into a thread at any moisture.
Low Plasticity	3 – 15	Can be rolled into a thread with some difficulty.
Medium Plasticity	15 – 30	Easily rolled into thread.
High Plasticity	> 30	Easily rolled and re–rolled into thread.

Term	Soil Structure Criteria
Stratified	Alternating layers at least ¼ inch thick.
Laminated	Alternating layers less than ¼ inch thick.
Fissured	Contains shears and partings along planes of weakness.
Slickensided	Partings appear glossy or striated.
Blocky	Breaks into small lumps that resist further breakdown.
Lensed	Contains pockets of different soils.

Term	Soil Cementation Criteria
Weak	Breaks under light finger pressure.
Moderate	Breaks under hard finger pressure.
Strong	Will not break with finger pressure.

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COMMON TERMS

SOIL DESCRIPTIONS

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
	1	S-1-1	■		196.5 / 1.5		Medium dense to dense silty sandy GRAVEL, scattered organics (GM); grey-brown, moist to wet, medium plasticity silt, fine to coarse sand, fine to coarse subrounded to rounded gravel, organics consist of fine roots, (fill).
	2						
	3	S-1-2	■				Dense silty sandy GRAVEL, scattered organics (GM); grey-brown, moist, low plasticity silt, fine to coarse sand, fine to coarse subrounded gravel, organics consist of wood, (fill).
	4						
	5						
No seepage or ground water encountered to the limit of exploration.	6				192.0 / 6.0		BOTTOM OF EXPLORATION
	7						
	8						
	9						
	10						
	11						
	12						

Project No.: 2191137

Surface Elevation: 198.0 feet (Approx.)

Date of Test Pit: January 8, 2020

Test Pit Log: TP-1
City of Albany,
Albany Class A Biosolids Composting Project
Albany, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
Abundant roots at ±16 inches.	1	S-2-1	■		199.8 / 1.2		Medium dense to dense silty sandy GRAVEL, scattered debris (GM); grey-brown, moist, medium plasticity silt, fine to coarse sand, fine to coarse subrounded to rounded gravel, debris consists of plastic pipe and AC fragments, (fill).
	2						Dense silty sandy GRAVEL (GM); grey-brown, moist, medium plasticity silt, fine to coarse sand, fine to coarse subrounded to rounded gravel, (possible fill/alluvium).
	3	S-2-2	■				
	4						
	5						Scattered cobbles up to ±6-inch diameter below ±5 feet.
	6				195.0 / 6.0		Medium dense clayey sandy GRAVEL, some cobbles (GC); grey-brown, wet, medium plasticity clay, fine to coarse sand, fine to coarse angular gravel, subrounded to rounded cobbles to ±10-inch diameter, (possible fill/alluvium).
	7						
	8	S-2-3	■				
	9						
	10						Dense below ±10 feet.
No seepage or ground water encountered to the limit of exploration.	11				190.0 / 11.0		BOTTOM OF EXPLORATION
	12						

Project No.: 2191137

Surface Elevation: 201.0 feet (Approx.)

Date of Test Pit: January 8, 2020

Test Pit Log: TP-2
City of Albany,
Albany Class A Biosolids Composting Project
Albany, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
	1	S-3-1					Dense to very dense silty sandy GRAVEL (GM); grey-brown, moist, low to medium plasticity silt, fine to coarse sand, fine to coarse subrounded to rounded gravel, (fill).
Gravelly sand lens from ±22 to 24 inches.	2						
	3	S-3-2			196.0 3.0		Dense to very dense clayey sandy GRAVEL, some cobbles (GC); grey-brown, moist, medium to high plasticity clay, fine to coarse sand, fine to coarse subangular gravel, cobbles to 6-inch diameter, (fill).
	4						
	5	S-3-3			194.5 4.5		Medium dense silty sandy GRAVEL (GM); grey, wet, medium plasticity silt, fine to coarse sand, fine to coarse subrounded to subangular gravel, (fill).
No seepage or ground water encountered to the limit of exploration.	6				192.5 6.5		BOTTOM OF EXPLORATION
	7						
	8						
	9						
	10						
	11						
	12						

Project No.: 2191137

Surface Elevation: 199.0 feet (Approx.)

Date of Test Pit: January 8, 2020

Test Pit Log: TP-3
City of Albany,
Albany Class A Biosolids Composting Project
Albany, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
Surface: grass	1						Very dense silty sandy GRAVEL (GM); grey-brown, damp to moist, low plasticity silt, fine to coarse sand, fine to coarse subrounded to rounded gravel, (fill).
	2	S-4-1					
	3				199.5 2.5		Dense clayey sandy GRAVEL, scattered cobbles and debris (GC); grey, moist, medium to high plasticity clay, fine to coarse sand, fine to coarse subrounded to rounded gravel, cobbles up to ±5-inch diameter, debris consists of plastic fragments, (fill).
	4						
	5	S-4-2			197.5 4.5		Stiff to very stiff CLAY, scattered organics and debris (CH); brown, moist, high plasticity, organics consist of grass, debris consists of paper, metal, and other rubbish, (fill). Medium stiff and wet below ±6 feet.
No seepage or ground water encountered to the limit of exploration.	6				195.5 6.5		BOTTOM OF EXPLORATION
	7						
	8						
	9						
	10						
	11						
	12						

Project No.: 2191137

Surface Elevation: 202.0 feet (Approx.)

Date of Test Pit: January 8, 2020

Test Pit Log: TP-4
City of Albany,
Albany Class A Biosolids Composting Project
Albany, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
	1 – 4	S-5-1 (at 1.5–2.5 ft)			198.0 / 4.0		Dense silty sandy GRAVEL, some cobbles, scattered debris (GM); grey-brown, moist, low plasticity silt, fine to coarse sand, fine to coarse subrounded gravel, cobbles up to ±5-inch diameter, (fill).
No seepage or ground water encountered to the limit of exploration.	4 – 4.5				197.5 / 4.5		Very dense CRUSHED GRAVEL (GP); grey-brown, moist, ¾-inch minus angular gravel, (fill).
Test pit terminated due to encountering possible utility trench backfill.	5 – 12						BOTTOM OF EXPLORATION

Project No.: 2191137

Surface Elevation: 202.0 feet (Approx.)

Date of Test Pit: January 8, 2020

Test Pit Log: TP-5
City of Albany,
Albany Class A Biosolids Composting Project
Albany, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
Surface: grass	1 – 4	S-6-1 (at 3–4 ft)			202.0 / 4.0		Stiff silty CLAY, scattered organics (CH); brown and iron-stained, moist, medium to high plasticity, organics consist of fine roots, (fill).
	4 – 5.5				200.5 / 5.5		Medium dense to dense silty sandy GRAVEL (GM); grey-brown, moist, low to medium plasticity silt, fine to coarse sand, fine to coarse subrounded gravel, (fill).
No seepage or ground water encountered to the limit of exploration.	6 – 12						BOTTOM OF EXPLORATION

Project No.: 2191137

Surface Elevation: 206.0 feet (Approx.)

Date of Test Pit: January 8, 2020

Test Pit Log: TP-6
City of Albany,
Albany Class A Biosolids Composting Project
Albany, Oregon