

DP NICOLI

AUGUST 14, 2020

DESIGN REVIEW SUBMITTAL - MODIFICATION



15895 SW 72ND AVE SUITE 200
PORTLAND, OREGON 97224
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WWW.CIDAINC.COM



City of Wilsonville
Exhibit B1 DB20-0035 et seq

PROJECT #180146.03

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- narrative
- master plan
- arborist report
- storm report
- landscape elevation exhibit
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WILSONVILLE
OREGON

29799 SW Town Center Loop E, Wilsonville, OR 97070
Phone: 503.682.4960 Fax: 503.682.7025
Web: www.ci.wilsonville.or.us

Planning Division
Development Permit Application

Final action on development application or zone change is required within 120 days in accordance with provisions of ORS 227.175

A pre application conference is normally required prior to submittal of an application. Please visit the City's website for submittal requirements

Pre-Application Meeting Date: 09/19/19

Incomplete applications will not be scheduled for public hearing until all of the required materials are submitted.

Applicant:

Name: Gavin Russell
Company: CIDA
Mailing Address: 15895 SW 72nd Ave., Suite 200
City, State, Zip: Portland, OR, 97224
Phone: 503-226-1285 Fax: 503-226-1670
E-mail: gavindr@cidainc.com

Authorized Representative:

Name: _____
Company: _____
Mailing Address: _____
City, State, Zip: _____
Phone: _____ Fax: _____
E-mail: _____

Property Owner:

Name: Dave Nicoli
Company: Nicoli Pacific LLC.
Mailing Address: P.O. Box 2401
City, State, Zip: Lake Oswego, OR, 97035
Phone: 503-209-6970 Fax: _____
E-mail: dnicoli@dpnicoli

Property Owner's Signature:

David P Nicoli
Printed Name: DAVID P NICOLI Date: 6-29-20

Applicant's Signature: (if different from Property Owner)

Gavin Russell
Printed Name: GAVIN RUSSELL Date: 7-1-2020

Site Location and Description:

Project Address if Available: 28,370 SW Boberg Rd. Suite/Unit _____
Project Location: South of Boakman Rd. on SW Boberg Rd.
Tax Map #(s): 14A Tax Lot #(s): 500 County: Washington Clackamas

Request:

Modification to site design and master plan. 33,118 SF site expansion for outdoor storage.

Project Type: Class I Class II Class III

Residential Commercial Industrial Other: _____

Application Type(s):

- | | | | |
|--|---|---|---|
| <input type="checkbox"/> Annexation | <input type="checkbox"/> Appeal | <input type="checkbox"/> Comp Plan Map Amend | <input type="checkbox"/> Parks Plan Review |
| <input type="checkbox"/> Final Plat | <input type="checkbox"/> Major Partition | <input type="checkbox"/> Minor Partition | <input type="checkbox"/> Request to Modify Conditions |
| <input type="checkbox"/> Plan Amendment | <input type="checkbox"/> Planned Development | <input type="checkbox"/> Preliminary Plat | <input checked="" type="checkbox"/> Site Design Review |
| <input type="checkbox"/> Request for Special Meeting | <input type="checkbox"/> Request for Time Extension | <input type="checkbox"/> Signs | <input checked="" type="checkbox"/> Stage II Final Plan |
| <input type="checkbox"/> SROZ/SRIR Review | <input type="checkbox"/> Staff Interpretation | <input checked="" type="checkbox"/> Stage I Master Plan | <input type="checkbox"/> Variance |
| <input checked="" type="checkbox"/> Type C Tree Removal Plan | <input type="checkbox"/> Tree Permit (B or C) | <input type="checkbox"/> Temporary Use | <input type="checkbox"/> Other (describe) |
| <input type="checkbox"/> Villebois SAP | <input type="checkbox"/> Villebois PDP | <input type="checkbox"/> Villebois FDP | |
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SUMMARY

We are proposing a modification to the previously approved site design; this modification requires a Stage I Master Plan and Stage II Final Plan review. The following is an overview of the proposed modification.

The outdoor storage yard, as currently approved under phase 1, is insufficient in area for the equipment that will be stored on site. We are proposing a 33,118 Square foot expansion of the project site by utilizing the owners unused abutting property on lot 300. This expansion will allow for a more efficient outdoor storage layout that will improve onsite safety and maneuverability for workers.

The site expansion will be used for outdoor storage only. Sensitive Area E and SB Overlay Zone standards will be applied along the property abutting the Walnut Mobile Home Park. Perimeter screening and Landscaping of the storage yard will meet all required standards; two existing trees will need to be removed. Stormwater, from 27,319 square feet of new paved area, will be directed to the swales on the south side of the property. There is no modification to the property line, building, parking or signage. Please Refer to the new Master Plan and drawings package for further clarification.

DEVELOPMENT PHASES

Phase-1

The proposed Phase -1 development is located on undeveloped lot 500 (31W14A 00500) in Wilsonville, OR. The site, adjusted after the replat, is approximately 2.35 acres. The lot is zoned PDI (Planned Development Industrial). The project will include (1) single story 11,400 sf metal building with an 1,800 sf storage mezzanine (mezzanine is not counted toward building area or number of stories). The building uses include 2,024 sf of office and 11,176 sf of warehouse (warehouse square footage includes accessory wash bay, repair areas and storage mezzanine). The site will have an approximately 85,818 sf paved open storage yard (includes the expansion on lot 300). Required parking, landscaping and trash/recycling enclosure are provide onsite.

In addition to onsite improvements, this Phase-1 development requires half street improvements along SW Boberg Road. The half street improvements include new road paving, curbing, landscaping, potentially new streetlighting, sidewalk and stormwater retention area. A 3.5 foot landscape dedication and an 8 foot utility easement will be needed in order to accommodate these public improvements.

This phase is currently under construction.

MODIFICATION SUMMARY

Phase-2:

Phase-2 includes the construction of an approximately 53,000 square foot industrial/flex building on lot 300. In addition, the development will contain new landscaping, parking stalls, trash/recycling enclosure and one access driveway off SW Boones Ferry Road.

Phase-3

Phase-3 includes the construction of an approximately 19,000 square foot industrial/flex building on lot 300. In addition, the development will contain new landscaping, parking stalls and trash/recycling enclosure.

DEVELOPMENT SCHEDULE

Phase-1: Currently under construction

Phase-2: Construction estimated to begin June 2024

Phase-3: Construction estimated to begin June 2029

AREA OF SPECIAL CONCERN E (AREA E)

The development is in Wilsonville Comprehensive Plan Area of Special Concern E (Area E), Design Objectives 1,2 and 3 are applicable. Ongoing effort has been taken to ensure the design addresses the city's concerns and takes the adjacent residential neighborhood into consideration.

- i. Encourage Consolidation of smaller lots to allow for master planning of large areas.

Response:

Lots 300 & 500 are not being consolidated; however, we are proposing a modification to the phase 1 development which includes the use of a portion of lot 300. Lot 500 and 300 are to be developed in phases as a coordinated industrial development.

- ii. Provide buffer adjacent to the mobile home park e.g., increased landscaped setback or complimentary uses.

Response:

It is the intent of this proposed modification to provide necessary screening. The proposed buffer will meet SB overlay standards. A 30-foot setback has been established along the southern property line and a High Screen Standard for landscaping has been applied. The 6-foot-high chain-link fence with slats and required landscape provide a visual/noise barrier. Existing trees along the property will be preserved as much as possible. However, many of the trees are in poor or fair condition (see tree survey) and these trees as well as overgrowth on the property will be removed and replaced with plantings that meet city standards. See provide landscape plan for further information.

- iii. Minimize traffic (truck) conflicts with residential activities, including pedestrian.

Response:

The proposed modification will not impact traffic.

Section 4.008. Application Procedures - In General.

(.01) The general application procedures listed in Sections 4.008 through 4.024 apply to all land use and development applications governed by Chapter 4 of the Wilsonville Code. These include applications for all of the following types of land use or development approvals:

- A. Class I and Class II Administrative Reviews, pursuant to Section 4.030;
- B. Stage I and Stage II Site Development Permits, pursuant to Section 4.035;
- C. Conditional Use Permits, pursuant to Section 4.184;
- D. Variances, pursuant to Section 4.196;
- E. Quasi-judicial zone changes, pursuant to Section 4.197;
- F. Changes to the text of Chapter 4, pursuant to Section 4.197;
- G. Quasi-judicial changes to the map or maps of the Comprehensive Plan, pursuant to Section 4.198;
- H. Changes to the text of the Comprehensive Plan, including adoption of new Plan elements or sub-elements, pursuant to Section 4.198;
- I. Subdivisions, condominium divisions, and land partitions, pursuant to Section 4.200;
- J. Expedited land divisions, pursuant to Section 4.232;
- K. Annexations, pursuant to Section 4.700; and
- L. Street vacations, pursuant to ORS 271 and Sections 4.031 and 4.032 of this Code.
- M. Specific Area Plans, preliminary Development Plans and Final Development Plans, pursuant to Section 4.125. (Added by Ord. 557 adopted 9/5/03)

[Response: This application is for a modification to the Stage I Master Plan, Stage II Final Plan and requires a site design review.](#)

(.02) Unique features of Wilsonville's development review processes. The Wilsonville Land Development and Planning Ordinance is structured and implemented differently than the Codes of most other cities. These differences are summarized below:

- A. Most of Wilsonville's vacant land (without active approved projects) is zoned RA-H, a Residential-Agricultural holding zone with a large minimum lot size. Properties in this holding zone must be rezoned to conform with the Comprehensive Plan as part of the planned development review process.
- B. If the subject property is over 2 acres in size, it must be zoned in one of the Planned Development categories, (PDR, PDC, TC, PDI, RN etc.), or zoned for public use, before it can be developed. [Definition amended by Ord. 835, 6/5/19]
- C. Some portions of a parcel may have development constraints because of such things as steep slopes, wetlands, wildlife habitat, hazard areas, or trees.
- D. In residential developments, at least 25% of the site area must be preserved as open space, unless otherwise provided for in a legislative master plan. Some of the site is also typically required to be recreational area. See Section 4.113 for

more information on requirements for open space and recreational area in residential developments. For all projects, at least 15% of the net site area must be landscaped including vegetative plant materials. [Definitions amended by Ord. 806, 07/17/17]

E. Unless waived by the Community Development Director for good cause, a traffic study must be completed to determine that the City's level of service standards can be met, considering the subject development and all previously approved projects.

F. For a Planned Development there are four (4) phases of project approval. Some of these phases may be combined, but generally the approvals move from the conceptual stage through to detailed architectural, landscape and site plan review in stages:

1. Rezoning;
2. Stage 1 - Preliminary Plan;
3. Stage 2 - Final Plan; and
4. Site Design Review.

G. Approval of each stage shall remain valid unless it expires as provided in Section 4.023. A Stage I approval will not be revoked or substantially altered during the Stage II review process, unless requested by the applicant. Stage II approval will not be revoked or substantially altered during the Site Design Review process, unless requested by the applicant. Zoning may be changed by action of the City Council, but will not be subject to automatic revocation unless such revocation is specifically made a condition of approval at the time of the original zone change.

H. In Wilsonville, the practice is to review each new phase in light of previous approvals and conditions. At construction and occupancy, the review includes inspections to verify compliance with conditions of approval. These inspections include detailed site comparison with previous plan approvals (including number and types of plants and design of elevations and setbacks). Developers are often required to post a bond or provide other financial security for the completion of the conditions of approval for the project.

I. Wilsonville uses a "concurrency" requirement regarding public services and facilities. Basically, the needed services and facilities must be scheduled for completion within two years of occupancy and a positive finding of such concurrency must be made prior to project approval.

J. Wilsonville expects project progress to be made in a timely fashion. For each step in the Planned Development, the applicant must take action to "exercise" the approval within a given time period or the approval lapses.

K. Special additional features include: mixed use provisions for most zones ability to "waive" many of the typical development standards based on design improvements that will result; density transfers; strong variance provisions; tree protection with mitigation requirements for tree cutting; City Council "Call Up" provisions; heavy landscaping requirements; owner/developer signature to accept and abide by conditions; limited administrative approval power; enforcement powers and practice.

[Section 4.008(.02)(K.) amended by Ord. No. 574, 11/1/04]

L. For Land in the Village zone, there are three (3) phases of project approval. Some of these phases may be combined, but generally the approvals move from the conceptual stage through to detailed architectural, landscape and plan review in phases:

1. Specific Area Plan (SAP);
2. Preliminary Development Plan (PDP), Rezoning, and Final Development Plan (FDP); and
3. Land Division Approval.

Land within the Central SAP or multi-family dwellings outside of the Central SAP may be developed in four phases, with the application and approval of an FDP occurring after PDP approval.

[Added by Ord. 557 adopted 9/5/03]

[Section 4.008(.02)(L) amended by Ord. No. 587, 5/16/05.]

Response: Noted.

Section 4.009. Who May Initiate Applications.

(.01) Except for a Specific Area Plan (SAP), applications involving specific sites may be filed only by the owner of the subject property, by a unit of government that is in the process of acquiring the property, or by an agent who has been authorized by the owner, in writing, to apply. Changes to the Comprehensive Plan or zoning may also be initiated by the City Council, Planning Commission, or Development Review Board, acting by motion. Applications involving a Specific Area Plan shall be initiated as provided in Section 4.125(.18)(C) and (D). [Amended by Ord. 557 adopted 9/5/03]

Response: Application is initiated by the Dave Nicoli (property owner) and CIDA (architect) is an authorized agent.

(.02) Applications involving large areas of the community or proposed amendments to the text of this Chapter or the Comprehensive Plan may be initiated by any property owner, business proprietor, or resident of the City, as well as by the City Council, Planning Commission, or Development Review Board acting by motion.

Response: N/A

(.03) A decision by the City Council, Planning Commission, or Development Review Board to initiate an action under this Section does not predetermine that the same body will approve or adopt the proposed change after concluding public hearings.

Response: Noted.

(.04) In the event that the City of Wilsonville is the applicant, the City Manager may authorize any City employee or consultant to act as the City's agent.

Response: N/A

Section 4.010. How To Apply.

(.01) Contact Planning Department. Prospective applicants are advised to contact the Planning Department of the City's Community Development Department for application forms and information on application procedures.

(.02) Pre-Application Conference

- A. An applicant or the applicant's authorized representative shall contact the Planning Department to arrange a pre-application conference, unless the applicant and the Planning Director agree the conference is not needed.
- B. The conference shall be held within thirty (30) days of the request.
- C. The purpose of the conference shall be to acquaint the applicant with the substantive and procedural requirements of the Code, provide for an exchange of information regarding applicable elements of the Comprehensive Plan and development standards, arrange such technical and design assistance as will aid the applicant, and to otherwise identify policies and regulations that create opportunities or pose significant constraints for the proposed development.
- D. Such conferences will be open to the public unless the prospective applicant requests a private conference. Private pre-application conferences are conducted in order to protect the interests of those who have not yet completed property acquisition arrangements, or who are concerned about providing proprietary information that may give an advantage to competing developers or businesses. However, once an application has been filed with the City, all information that is part of the public record will be available for public review.
- E. The Planning Department if requested in writing by the applicant at least one week in advance of the pre-application conference, shall provide the applicant with a written summary of the conference within five (5) working days after the conference. If prepared, written summaries of pre-application conferences shall be available for public review. Summaries shall include:
 - 1. Confirmation of the procedures to be used to process the application;
 - 2. A list of materials to be submitted; and
 - 3. The criteria and standards which may apply to the approval of the application.

Response: A preapplication conference for this development was held on 9/19/19.

Section 4.011. How Applications are Processed.

(.01) Applications submitted without the required filing fee shall not be considered to be "filed" and shall be returned to the prospective applicant without being processed.

Response: Filing fee to be will be paid at time of submittal.

- (.02) After filing, all applications shall be reviewed by City staff for completeness.
- A. In the event that an application is found to be incomplete in any way, the Planning Director shall notify the applicant in writing within thirty (30) days of the original filing and shall list the deficiencies in the application.
 - B. City Council Resolution No. 796 precludes the approval of any development application without the prior payment of all applicable City liens for the subject property. Applicants shall be encouraged to contact the City Finance Department to verify that there are no outstanding liens. If the Planning Director is advised of outstanding liens while an application is under consideration, the Director shall advise the applicant that payments must be made current or the existence of liens will necessitate denial of the application.
 - C. Failure of an applicant to remedy any deficiencies in an application prior to the preparation of the staff report on the matter shall constitute adequate grounds for denial of the application by the appropriate decision-making body. Failure of an applicant to provide the deficient information may be considered to be a "refusal" as the term is used in ORS 197, and the application shall be processed accordingly.
 - D. Upon concluding that an application is complete, or that it will be processed in spite of the applicant's failure or refusal to correct any deficiencies in the application, the Planning Director shall provide copies of the application materials to other affected agencies and City departments, requesting their input and recommendations for the record.
 - 1. Such other agencies and departments shall be given a specified amount of time to respond, sufficient to allow the planning staff an opportunity to complete the preparation of a written staff report for the review of the public and decision-makers. For public hearing items, staff reports are printed and available for review seven (7) days prior to the time when a public hearing is conducted.
 - 2. Each written staff report includes a list of the agencies and departments contacted in the review process and their written comments, if any.

Response: Noted.

(.03) Written testimony that is sent via mail, facsimile, or computer will be processed as specified in Section 4.035. All parties are discouraged from relying exclusively on these means of submitting testimony unless verification is received that the subject testimony has been received and made part of the record.

Response: Noted.

Section 4.014. Burden of Proof.

The burden of proving that the necessary findings of fact can be made for approval of any land use or development application rests with the applicant in the case. In the case of an appeal, the burden of proof rests with the appellant.

Response: Noted. The submittal package will provide necessary information to determine approval.

Section 4.031. Authority of the Development Review Board.

(.01) As specified in Chapter 2 of the Wilsonville Code and except as specified herein, the Board shall have authority to act on the following types of applications:

- A. Class II development applications referred to the Board by the Planning Director, as authorized in Section 4.030.
- B. Call-ups or appeals of staff decisions or interpretations involving quasi-judicial applications or procedures, as authorized in Sections 4.022 and 4.172.
- C. Review of tentative subdivision and condominium plats, as authorized in Section 4.210, other than those processed as expedited land divisions.
- D. Conditional Use Permits, as authorized in Section 4.184.
- E. Variances, as authorized in Section 4.196, other than those that are reviewed and acted upon by the Planning Director through Administrative Review processes.
- F. Initial review of quasi-judicial applications for zone changes, as authorized in Section 4.197.
- G. Initial review of quasi-judicial applications for amendments to one or maps in the Comprehensive Plan, as authorized in Section 4.198.
- H. Site design review, as authorized in Section 4.400.
- I. Review of Stage I and Stage II Planned Development applications.
- J. Acceptance, rejection, or modification of traffic studies prepared for projects or developments. A traffic study prepared by the City's consultant shall not be rejected or modified by the Board unless substantial evidence exists in the record to justify such action. If the Board rejects a traffic study prepared by the City's consultant, the fee paid by the applicant for that study shall be refunded.
- K. Initial review of requests for quasi-judicial annexations to the City of Wilsonville.

L. Street vacations, where a specific development application has been filed for the subject property. If no specific development application has been filed for the subject property, the vacation request shall be considered by the Planning Commission. Action of the Planning Commission or Board on a street vacation request shall be a recommendation to the City Council.

M. Class III Sign Permits, Master Sign Plans, and all sign permits and approvals not specifically authorized for administrative review or exempt from permitting requirements. [Added by Ord. No. 704, 6/18/12.]

Response: Noted. This application is for a modification to the Stage I Master Plan, Stage II Final Plan and requires a site design review.

(.02) Once an application is determined or deemed to be complete pursuant to Section 4.011, it shall be scheduled for public hearing before the Development Review Board. The City shall provide public notice of the hearing as specified in Section 4.012.

Response: Noted.

(.03) At the public hearing, the staff, any applicant, and interested persons may present information relevant to the policies, criteria and standards pertinent to the proposal, giving reasons why the application should or should not be approved or proposing modifications or conditions and the reasons the person believes they are necessary for approval. The hearing body shall make a finding for each of the applicable policies, criteria and standards, including whether the proposal conforms to the Comprehensive Plan. The decision, including findings of the hearing body shall be adopted by Resolution, setting forth all Conditions of Approval and relevant time periods for compliance with said conditions.

A. If the application is approved, that approval shall constitute a Development Permit when the applicant has complied with the other requirements of this Chapter or the applicant has filed with the Planning Director a written agreement to comply with all conditions of approval.

B. A decision of the Board may be appealed to the City Council by any party to the hearing in accordance with Section 4.022.

Response: Noted.

Section 4.034. Application Requirements.

Applications shall be reviewed as follows:

(.01) A zone change shall be reviewed in accordance with the standards and procedures set forth in Section 4.197.

Response: N/A

(.02) Applications for Conditional Use Permits shall be reviewed in accordance with the standards and procedures set forth in Section 4.184.

Response: N/A

(.03) Applications for Variances shall be reviewed in accordance with the standards and procedures set forth in Section 4.196.

Response: N/A

(.04) Applications for Planned Development Approvals shall be reviewed in accordance with the standards and procedures set forth in Section 4.035.

Response: Noted, modification to the Stage I Master Plan, Stage II Final Plan and requires a site design review.

(.05) Applications for subdivisions, condominium divisions, lot line adjustments and land partitions shall be reviewed in accordance with the standards and procedures set forth in Section 4.210.

Response: N/A

(.06) Applications for Site Development Permits shall be reviewed in accordance with the standards and procedures set forth in Section 4.035:

Response: Noted, modification to the Stage I Master Plan, Stage II Final Plan and requires a site design review.

(.07) Applications for street vacations shall be reviewed in accordance with the standards and procedures set forth in ORS 271.

Response: N/A

(.08) Applications for development approvals within the Village zone shall be reviewed in accordance with the standards and procedures set forth in Section 4.125. [Added by Ord. 557, adopted 9/5/03]

Response: N/A

Section 4.035. Site Development Permits.

(.04) Site Development Permit Application.

A. An application for a Site Development Permit shall consist of the materials specified as follows, plus any other materials required by this Code.

1. A completed Permit application form, including identification of the project coordinator, or professional design team.
2. An explanation of intent, stating the nature of the proposed development, reasons for the Permit request, pertinent background information, information required by the development standards and other information specified by the Director as required by other sections of this Code because of the type of development proposal or the area involved or that may have a bearing in determining the action to be taken. As noted in Section 4.014, the applicant bears the burden of proving that the application meets all requirements of this Code.
3. Proof that the property affected by the application is in the exclusive ownership of the applicant, or that the applicant has the consent of all individuals or partners in ownership of the affected property.
4. Legal description of the property affected by the application.
5. The application shall include conceptual and quantitatively accurate representations of the entire development sufficient to judge the scope, size and impact of the development on the community, public facilities and adjacent properties; and except as otherwise specified in this Code, shall be accompanied by the following information,
6. Unless specifically waived by the Director, the submittal shall include: ten (10) copies folded to 9" x 12" or (one (1) set of full-sized scaled drawings and nine (9) 8 1/2" x 11" reductions of larger drawings) of the proposed Site Development Plan, including a small scale vicinity map and showing:
 - a. Streets, private drives, driveways, sidewalks, pedestrian ways, off-street parking, loading areas, garbage and recycling storage areas, power lines and railroad tracks, and shall indicate the direction of traffic flow into and out of off-street parking and loading areas, the location of each parking space and each loading berth and areas of turning and maneuvering vehicles.
 - b. The Site Plan shall indicate how utility service , including sanitary sewer, water and storm drainage, are to be provided. The Site Plan shall also show the following off-site features: distances from the subject property to any structures on adjacent properties and the locations and uses of streets, private drives, or driveways on adjacent properties.
 - c. Location and dimensions of structures, utilization of structures, including activities and the number of living units.
 - d. Major existing landscaping features including trees to be saved, and existing and proposed contours.
 - e. Relevant operational data, drawings and/or elevations clearly establishing

the scale, character and relationship of buildings, streets, private drives, and open space.

f. Topographic information sufficient to determine direction and percentage of slopes, drainage patterns, and in environmentally sensitive areas, e.g., flood plain, forested areas, steep slopes or adjacent to stream banks, the elevations of all points used to determine contours shall be indicated and said points shall be given to true elevation above mean sea level as determined by the City Engineer. The base data shall be clearly indicated and shall be compatible to City datum, if bench marks are not adjacent.

The following intervals shall be shown:

- i. One (1) foot contours for slopes of up to five percent (5%);
- ii. Two (2) foot contours for slopes of from six percent (6%) to twelve percent (12%);
- iii. Five (5) foot contours for slopes of from twelve percent (12%) to twenty percent (20%). These slopes shall be clearly identified, and
- iv. Ten (10) foot contours for slopes exceeding twenty percent (20%).

g. A tabulation of land area, in square feet, devoted to various uses such as building area (gross and net rentable), parking and paving coverage, landscaped area coverage and average residential density per net acre.

h. An application fee as set by the City Council.

i. If there are trees in the development area, an arborist's report, as required in Section 4.600. This report shall also show the impacts of grading on the trees.

j. A list of all owners of property within 250 feet of the subject property, printed on label format. The list is to be based on the latest available information from the County Assessor.

[Section 4.035(.04) amended by Ord. 682, 9/9/10]

Response: Noted. The submittal package will provide necessary information to determine approval.

(.05) Complete Submittal Required. Application materials shall be submitted to the Planning Director who shall have the date of submission indicated on each copy submitted. Within thirty (30) calendar days from the date of submission, the Director shall determine whether an application is complete. An application is not complete unless accompanied by a traffic study, as prescribed by the City Engineer; except in cases where the requirement of a traffic study has been specifically waived by the Community Development Director.

A. If the Director determines that the application is incomplete or otherwise does not conform to the provisions of this Code, the applicant shall immediately be notified in writing, conveying an explanation and a submittal deadline for completion or correction of the application. If the applicant fails or refuses to provide the necessary information, the application will be processed as specified

in Section 4.011 (How Applications Are Processed) in order to assure that statutory time limits are met.

B. If an application is determined to be complete and in conformance with the provisions of this Ordinance, the Director shall accept it and note the date of acceptance on the application form. The Director shall then schedule the appropriate review and notify the applicant of the date of the final decision or hearing as set forth in this Chapter.

C. Materials submitted to the Planning Department staff after the preparation of the staff report shall be date-stamped and passed on to the appropriate decision makers. If there is insufficient time for the staff to prepare an analysis of such information, the decision-makers may choose to postpone action until such an analysis can be completed. If statutory time limits for action on the application preclude postponement, the decision makers may request a summary of the new information from the party presenting it. If information is received too late to be adequately evaluated within the legal time limits for action on the application, the decision-makers shall so state and shall make the decision, indicating within the adopted findings of fact the extent to which that information was considered in rendering the decision.

D. Written testimony that is sent via mail, facsimile, or computer and received by the City Recorder or the Recorder's designee prior to a public hearing shall be included in the record and considered to be originals, provided the document bears the name of the person testifying. Persons sending such documents shall be responsible for verifying that the documents have been received by the intended recipient on City staff. The City will make all reasonable attempts to convert testimony sent by telecommunication to paper format but bears no responsibility for doing so.

Response: Noted.

Section 4.110. Zoning - Zones.

(.01) The following Base Zones are established by this Code:

- A. Residential Agricultural H Holding, which shall be designated "RA-H".
- B. Residential, which shall be designated "R".
- C. Planned Development Residential, which shall be designated "PDR," and further divided into:
 - PDR-1
 - PDR-2
 - PDR-3
 - PDR-4
 - PDR-5
 - PDR-6
 - PDR-7.
- D. Planned Development Commercial, which shall be designated "PDC." [Section 4.110(.01)(D) amended by Ord. 835, 6/5/19]
- E. Planned Development Industrial, which shall be designated "PDI."
- F. Public Facility, which shall be designated "PF."
- G. Public Facility - Corrections, which shall be designated "PF-C."
- H. Village, which shall be designated "V". [Added by Ord 557, adopted 9/5/03]
- I. Residential Neighborhood, which shall be designated "RN". The RN zone is a Planned Development Residential zone. [Added by Ord. 806 adopted 07/17]
- J. Town Center, which shall be designated "TC". The TC zone is a Planned Development zone. [Section 4.110(.01)(J) added by Ord. 835, 6/5/19]

Response: The proposed expansion and entire development is zoned PDI.

(.02) The following Overlay Zones, to be used in combination with the underlying base zones, are established by this Code.

- A. Solar-Friendly (S) overlay zone;
- B. Screening and Buffering (SB) overlay zone;
- C. Old Town (O) overlay zone; and
- D. Coffee Creek Industrial Design Overlay District (CCDOD).

Response: The proposed expansion and entire development is within the (SB) overlay zone.

(.03) The use of any building or premises or the construction of any development shall be in conformity with the regulations set forth in this Code for each Zoning District in which it is located, except as provided in Sections 4.189 through 4.192. Section 4.008. Application Procedures - In General.

Response: The proposed expansion and entire development complies with the applicable development code.

(.04) The General Regulations listed in Sections 4.150 through 4.199 shall apply to all zones unless the text indicates otherwise. [Section 4.110(.04) Amended by Ord. #812, 2/22/18]

Response: The proposed expansion and development complies with the General Regulations.

Section 4.117. Standards Applying To Industrial Developments In Any Zone.

- (.01) All industrial developments, uses, or activities are subject to performance standards. If not otherwise specified in the Planning and Development Code, industrial developments, uses, and activities shall be subject to the performance standards specified in Section 4. 135 (.05) (PDI Zone).

Response: The development, including the site expansion, for DP Nicoli will meet the performance standards specified in 4.135(.05).

Section 4.118. Standards applying to all Planned Development Zones:

- (.01) Height Guidelines: In “S” overlay zones, the solar access provisions of Section 4.137 shall be used to determine maximum building heights. In cases that are subject to review by the Development Review Board, the Board may further regulate heights as follows:

- A. Restrict or regulate the height or building design consistent with adequate provision of fire protection and fire-fighting apparatus height limitations.
- B. To provide buffering of low density developments by requiring the placement of three or more story buildings away from the property lines abutting a low density zone.
- C. To regulate building height or design to protect scenic vistas of Mt. Hood or the Willamette River.

Response: The subject site is does not include an “S” overlay zone therefore the solar access provisions are not applicable to this development.

- (.02) Underground Utilities shall be governed by Sections 4.300 to 4.320. All utilities above ground shall be located so as to minimize adverse impacts on the site and neighboring properties.

Response: All site utilities are underground.

- (.03) Notwithstanding the provisions of Section 4.140 to the contrary, the Development Review Board, in order to implement the purposes and objectives of Section 4.140, and based on findings of fact supported by the record may:

- A. Waive the following typical development standards:

- 1. minimum lot area;

Response: No waiver for lot area requested. Existing lot to remain.

- 2. lot width and frontage;

Response: No waiver for lot width or frontage requested. Existing lot dimensions to remain.

- 3. height and yard requirements;

Response: No waiver for height or yard requirements requested.

4. lot coverage;

Response: No waiver for lot coverage is requested. The proposed development complies with the allowed coverage requirements.

5. lot depth;

Response: No waiver for lot depth requested. Existing lot dimensions to remain.

6. street widths;

Response: No adjustment to the existing streets are proposed.

7. sidewalk requirements;

Response: No waiver for sidewalk requirements requested.

8. height of buildings other than signs;

Response: No waiver for height or yard requirements requested.

9. parking space configuration and drive aisle design;

Response: No waiver for parking or drive aisle design. Layout and sizing meet the development code standards.

10. minimum number of parking or loading spaces;

Response: No waiver for parking quantities requested. See description of use and calculations for required parking in Section 4.155.

11. shade tree islands in parking lots, provided that alternative shading is provided;

Response: No waiver for tree islands requested.

12. fence height;

Response: No waiver for fence height is requested.

13. architectural design standards;

Response: The development expansion does not request any waiver of architectural design standards.

14. transit facilities; and

Response: Proposed development does not include transit facilities.

15. On-site pedestrian access and circulation standards; and

Response: No waiver of on-site pedestrian access or circulation standards is proposed.

16. Solar access standards, as provided in section 4.137.

Response: No requirement for solar access "S" overlay.

[Amended by Ord. #719, 6/17/13.]

B. The following shall not be waived by the Board, unless there is substantial evidence in the whole record to support a finding that the intent and purpose of the standards will be met in alternative ways:

1. open space requirements in residential areas;

Response: Not applicable, the proposed development is not located in a residential area.

2. minimum density standards of residential zones;

Response: Not applicable, the proposed development is not located in a residential zone.

3. minimum landscape, buffering, and screening standards;

Response: No waiver for landscape, buffering or screening standard is requested.

C. The following shall not be waived by the Board, unless there is substantial evidence in the whole record to support a finding that the intent and purpose of the standards will be met in alternative ways, and the action taken will not violate any applicable federal, state, or regional standards:

1. maximum number of parking spaces;

Response: The proposed expansion does not impact parking. Existing parking exceeds maximum number of parking spaces noted in Section 4.155.

2. standards for mitigation of trees that are removed;

Response: Trees to be removed are mitigated through the proposed landscape plan. See landscape plan and arborist report.

3. standards for mitigation of wetlands that are filled or damaged; and

Response: Not applicable, there are no wetlands on the site being impacted.

4. trails or pathways shown in the Parks and Recreation Master Plan.

Response: Not applicable, there are no trails or pathways as part of the proposed development.

D. Locate individual building, accessory buildings, off-street parking and loading facilities, open space and landscaping and screening without reference to lot lines; and

E. Adopt other requirements or restrictions, inclusive of, but not limited to, the following:

1. Percent coverage of land by buildings and structures in relationship to property boundaries to provide stepped increases in densities away from low-density development.

Response: The expansion will does not impact the building. Development did not seek lot coverage beyond maximum percentage noted.

2. Parking ratios and areas expressed in relation to use of various portions of the property and/or building floor area.

Response: The proposed expansion does not impact parking..

3. The locations, width and improvement of vehicular and pedestrian access to various portions of the property, including portions within abutting street or private drive. [amended by Ord. 682, 9/9/10]

Response: Proposed site expansion does not modify existing vehicular access.

4. Arrangement and spacing of buildings and structures to provide appropriate open spaces around buildings.

Response: The proposed site expansion does not impact the exiting building.

5. Location and size of off-street loading areas and docks.

Response: The proposed site expansion does not impact off-street loading areas.

6. Uses of buildings and structures by general classification, and by specific designation when there are unusual requirements for parking, or when the use involves noise, dust, odor, fumes, smoke, vibration, glare or radiation incompatible with present or potential development of surrounding property. Such incompatible uses may be excluded in the amendment approving the zone change or the approval of requested permits.

Response: Development provides parking ratios based on proposed primary uses of office, storage and manufacturing, as noted within the Parking Section 4.155. Proposed site expansion does not impact.

7. Measures designed to minimize or eliminate noise, dust, odor, fumes, smoke, vibration, glare, or radiation which would have an adverse effect on the present or potential development on surrounding properties.

Response: The site expansion will mitigate on the south property line with required landscape buffer.

8. Schedule of time for construction of the proposed buildings and structures and any stage of development thereof to insure consistency with the City's adopted Capital Improvements Plan and other applicable regulations.

Response: Construction schedules should not impede or create inconsistency with City plans.

9. A waiver of the right of remonstrance by the applicant to the formation of a Local Improvement District (LID) for streets, utilities and/or other public purposes.

Response: The proposed site expansion does not impact city Improvements along SW Boberg Rd.

10. Modify the proposed development in order to prevent congestion of streets and/or to facilitate transportation.

Response: The proposed site expansion does not impact street congestion.

11. Condition the issuance of an occupancy permit upon the installation of landscaping or upon a reasonable scheduling for completion of the installation of landscaping. In the latter event, a posting of a bond or other security in an amount equal to one hundred ten percent (110%) of the cost of the landscaping and installation may be required.

Response: Owner will work with the contractor and city on coordination of landscape installation schedule relative to occupancy and obtain necessary bond as indicated if required.

12. A dedication of property for streets, pathways, and bicycle paths in accordance with adopted Facilities Master Plans or such other streets necessary to provide proper development of adjacent properties.

Response: The proposed site expansion does not impact city Improvements along SW Boberg Rd. SW Boberg Road includes a 3.5" landscape dedication.

- (.04) The Planning Director and Development Review Board shall, in making their determination of compliance in attaching conditions, consider the effects of this action on availability and cost. The provisions of this section shall not be used in such a manner that additional conditions, either singularly or cumulatively, have the effect of unnecessarily increasing the cost of development. However, consideration of these factors shall not prevent the Board from imposing conditions of approval necessary to meet the minimum requirements of the Comprehensive Plan and Code.

Response: Applicant is aware of standards for conditions of approval for development and will work with the City staff on applied conditions and timelines associated with each item.

- (.05) The Planning Director, Development Review Board, or on appeal, the City Council, may as a condition of approval for any development for which an application is submitted, require that portions of the tract or tracts under consideration be set aside, improved, conveyed or dedicated for the following uses:
 - A. Recreational Facilities: The Director, Board, or Council, as the case may be, may require that suitable area for parks or playgrounds be set aside, improved or permanently reserved for the owners, residents, employees or patrons of the development consistent with adopted Park standards and Parks and Recreation Master Plan.
 - B. Open Space Area: Whenever private and/or common open space area is provided, the City shall require that an association of owners or tenants be established which shall adopt such Articles of Incorporation, By-Laws or other appropriate agreement, and shall adopt and impose such Declaration of Covenants and Restrictions on such open space areas and/or common areas that are acceptable to the Development Review Board. Said association shall be formed and continued for the purpose of maintaining such open space area. Such an association, if required, may undertake other functions. It shall be created in such a manner that owners of property shall automatically be members and shall be subject to assessments levied to maintain said open space area for the purposes intended. The period of existence of such association shall be not less than twenty (20) years and it shall continue thereafter and until a majority vote of the members shall terminate it, and the City Council formally votes to accept such termination.

- C. Easements: Easements necessary to the orderly extension of public utilities, and the protection of open space, may be required as a condition of approval. When required, such easements must meet the requirements of the City Attorney prior to recordation.

Response: The proposed site expansion does not impact city Improvements along SW Boberg Rd.

- (.06) Nothing in this Code shall prevent the owner of a site that is less than two (2) acres in size from filing an application to rezone and develop the site as a Planned Development. Smaller properties may or may not be suitable for such development, depending upon their particular sizes, shapes, locations, and the nature of the proposed development, but Planned Developments shall be encouraged at any appropriate location.

Response: This site is zoned PDI, no change to zoning rproposed.

- (.07) Density Transfers. In order to protect significant open space or resource areas, the Development Review Board may authorize the transfer of development densities from one portion of a proposed development to another. Such transfers may go to adjoining properties, provided that those properties are considered to be part of the total development under consideration as a unit.

Response: Proposed site expansion is not subject to code stated density and will not require or propose density transfer.

- (.08) Wetland Mitigation and other mitigation for lost or damaged resources. The Development Review Board may, after considering the testimony of experts in the field, allow for the replacement of resource areas with newly created or enhanced resource areas. The Board may specify the ratio of lost to created and/or enhanced areas after making findings based on information in the record. As much as possible, mitigation areas shall replicate the beneficial values of the lost or damaged resource areas.

Response: The developed property and site expansions do not contain existing wetlands therefore mitigation requirements are not required.

- (.09) Habitat-Friendly Development Practices. To the extent practicable, development and construction activities of any lot shall consider the use of habitat-friendly development practices, which include:

- A. Minimizing grading, removal of native vegetation, disturbance and removal of native soils, and impervious area;
- B. Minimizing adverse hydrological impacts on water resources, such as using the practices described in Part (a) of Table NR-2 in Section 4.139.03, unless their use is prohibited by an applicable and required state or federal permit, such as a permit required under the federal Clean Water Act, 33 U.S.C. §§1251 et seq., or the federal Safe Drinking Water Act, 42 U.S.C. §§300f et seq., and including conditions or plans required by such permit;

- C. Minimizing impacts on wildlife corridors and fish passage, such as by using the practices described in Part (b) of Table NR-2 in Section 4.139.03; and
- D. Using the practices described in Part (c) of Table NR-2 in Section 4.139.03. [Section 4.118(.09) added by Ord. # 674 11/16/09]

Response: The proposed site expansion is develop site to the above standards. Trees and vegetation removed will be mitigated with new vegetation and trees per code requirements. Expansion will have no impact on hydrological, water resources, wildlife corridors or fish passage.

Section 4.135. PDI- Planned Development Industrial Zone.

- (.01) Purpose: The purpose of the PDI zone is to provide opportunities for a variety of industrial operations and associated uses.

[Response: The proposed development uses are permitted in the PDI zone.](#)

- (.02) The PDI Zone shall be governed by Section 4.140, Planned Development Regulations, and as otherwise set forth in this Code.

[Response: See response to Section 4.140 for specific responses.](#)

- (.03) Uses that are typically permitted:

- A. Warehouses and other buildings for storage of wholesale goods, including cold storage plants.
- B. Storage and wholesale distribution of agricultural and other bulk products, provided that dust and odors are effectively contained within the site.
- C. Assembly and packing of products for wholesale shipment
- D. Manufacturing and processing
- E. Motor vehicle services, or other services complementary or incidental to primary uses, and which support the primary uses by allowing more efficient or cost-effective operations
- F. Manufacturing and processing of electronics, technical instrumentation components and health care equipment.
- G. Fabrication
- H. Office complexes - Technology
- I. Corporate headquarters
- J. Call centers
- K. Research and development
- L. Laboratories
- M. Repair, finishing and testing of product types manufactured or fabricated within the zone.
- N. Industrial services
- O. Any use allowed in a PDC Zone, subject to the following limitations:
 - 1. Service Commercial uses (defined as professional services that cater to daily customers such as financial, insurance, real estate, legal, medical or dental offices) not to exceed 5000 square feet of floor area in a single building, or 20,000 square feet of combined floor area within a multi-building development.

2. Office Complex Use (as defined in Section 4.001) shall not exceed 30% of total floor area within a project site.
 3. Retail uses, not to exceed 5000 square feet of indoor and outdoor sales, service or inventory storage area for a single building and 20,000 square feet of indoor and outdoor sales, service or inventory storage area for multiple buildings.
 4. Combined uses under Subsections 4.135(.03)(O.)(1.) and (3.) shall not exceed a total of 5000 square feet of floor area in a single building or 20,000 square feet of combined floor area within a multi-building development.
- P. Training facilities whose primary purpose is to provide training to meet industrial needs.
- Q. Public facilities.
- R. Accessory uses, buildings and structures customarily incidental to any permitted uses.
- S. Temporary buildings or structures for uses incidental to construction work. Such structures to be removed within 30 days of completion or abandonment of the construction work.
- T. Other similar uses, which in the judgment of the Planning Director, are consistent with the purpose of the PDI Zone.

Response: The proposed uses in this development include Office Complex, Warehousing and Manufacturing. The proposed site expansion does not impact uses.

(.04) Block and access standards:

The PDI zone shall be subject to the same block and access standards as the PDC zone, Section 4.131(.02) and (.03).

Response: The development provides adequate pedestrian and vehicle connectivity along SW Boberg Rd. The proposed expansion of the site will not impact access standards.

(.05) Performance Standards. The following performance standards apply to all industrial properties and sites within the PDI Zone, and are intended to minimize the potential adverse impacts of industrial activities on the general public and on other land uses or activities. They are not intended to prevent conflicts between different uses or activities that may occur on the same property.

- A. All uses and operations except storage, off-street parking, loading and unloading shall be confined, contained, and conducted wholly within completely enclosed buildings, unless outdoor activities have been approved as part of Stage II, Site Design or Administrative Review.

Response: Storage is permitted in in outdoor yard.

- B. Vibration: Every use shall be so operated that the ground vibration inherently and recurrently generated from equipment other than vehicles is not perceptible without instruments at any boundary line of the property on which the use is located.

Response: The proposed use does not generate any equipment vibration.

- C. Emission of odorous gases or other odorous matter in quantities as detectable at any point on any boundary line of the property on which the use is located shall be prohibited.

Response: The proposed use does not use odorous gases or other matters and therefore will not emit these odors.

- D. Any open storage shall comply with the provisions of Section 4.176, and this Section.

Response: The development contains an 85,818 sf storage yard for shoring equipment and material. The 33,118 sf of that storage yard is the proposed expansion on to lot 300. The yard will be properly screened with fencing and landscaping. Additional information is provided in section 4.176.

- E. No building customarily used for night operation, such as a baker or bottling and distribution station, shall have any opening, other than stationary windows or required fire exits, within one hundred (100) feet of any residential district and any space used for loading or unloading commercial vehicles in connection with such an operation shall not be within one hundred (100) feet of any residential district.

Response: The proposed expanded storage yard is not intended for night operation. On rare occasions emergency services may be requested beyond normal operating hours from municipalities in need of shoring equipment. If such an emergency occurs, truck circulation would be directed through the north drive aisle. All work performed would be on the north side of the building which is greater than (100) feet from the residential mobile home park.

- F. Heat and Glare:

1. Operations producing heat or glare shall be conducted entirely within an enclosed building.
2. Exterior lighting on private property shall be screened, baffled, or directed away from adjacent residential properties. This is not intended to apply to street lighting.

Response: The operation within the expansion will not produce heat or glare.

All exterior lighting in expansion will be limited to a pole mounted light. All lights are noted with directional throw and/or cutoffs to not produce light off the property.

- F. Dangerous Substances: Any use which involves the presence, storage or handling of any explosive, nuclear waste product, or any other substance in a manner which would cause a health or safety hazard for any adjacent land use or site shall be prohibited.

Response: The use does not involve the use or handling of the materials noted.

- H. Liquid and Solid Wastes:

1. Any storage of wastes which would attract insects or rodents or otherwise create a health hazard shall be prohibited.
2. Waste products which are stored outside shall be concealed from view from any property line by a sight-obscuring fence or planting as required in Section 4.176.
3. No connection with any public sewer shall be made or maintained in violation of applicable City or State standards.
4. No wastes conveyed shall be allowed to or permitted, caused to enter, or allowed to flow into any public sewer in violation of applicable City or State standards.
5. All drainage permitted to discharge into a street gutter, caused to enter or allowed to flow into any pond, lake, stream, or other natural water course shall be limited to surface waters or waters having similar characteristics as determined by the City, County, and State Department of Environmental Quality.
6. All operations shall be conducted in conformance with the City's standards and ordinances applying to sanitary and storm sewer discharges.

Response: The proposed yard expansion does not include the storage of liquid and solid wastes beyond typical materials recycling and garbage collection which will be stored within the noted enclosure on the site plan.

- I. Noise: Noise generated by the use, with the exception of traffic noises from automobiles, trucks, and trains, shall not violate any applicable standards adopted by the Oregon Department of Environmental Quality and W.C. 6.204 governing noise control in the same or similar locations. [Amended by Ord. 631, 7/16/07]

Response: The proposed yard expansion will not produce excessive noise as defined by W.C. 6.204. Primary functions take place during city noted allowed hours.

- J. Electrical Disturbances. Except for electrical facilities wherein the City is preempted by other governmental entities, electrical disturbances generated by uses within the PDI zone which interfere with the normal operation of equipment or instruments within the PDI Zone are prohibited. Electrical disturbances which routinely cause interference with normal activity in abutting residential use areas are also prohibited.

Response: The proposed yard expansion has no function or construction methods etc. which would interfere with electrical systems. Any construction activity which may require temporary electrical disruption for safety or connection reasons will be limited to the project site and coordinated by the contractor and electrical subcontractor with the appropriate utilities.

- K. Discharge Standards: There shall be no emission of smoke, fallout, fly ash, dust, vapor, gases, or other forms of air pollution that may cause a nuisance or injury to human, plant, or animal life, or to property. Plans of construction and operation shall be subject to the recommendations and regulations of the State Department of Environmental Quality. All measurements of air pollution shall be by the procedures and with equipment approved by the State Department of Environmental Quality or equivalent and acceptable methods of measurement approved by the City. Persons responsible for a suspected source of air pollution upon the request of the City shall provide quantitative and qualitative information regarding the discharge that will adequately and accurately describe operation conditions.

Response: The proposed uses in the storage yard expansion do not produce emissions of the noted air pollutants. Construction activities will be monitored for air pollutants and use Best Management Practices for control of dust and other forms of pollutants including those methods depicted within the civil documents for construction entrances and wash downs.

- L. Open burning is prohibited.

Response: Open burning is not proposed.

- M. Storage:

1. Outdoor storage must be maintained in an orderly manner at all times.
2. Outdoor storage area shall be gravel surface or better and shall be suitable for the materials being handled and stored. If a gravel surface is not sufficient to meet the performance standards for the use, the area shall be suitably paved.
3. Any open storage that would otherwise be visible at the property line shall be concealed from view at the abutting property line by a sight obscuring fence or planting not less than six (6) feet in height.

Response: The storage area will be maintained and organized. The proposed expanded storage yard is an asphalt surface. The storage will be screened by a 6' high fence with slats and plantings in front of the fence that will grow to 6' in height around the west, north and east sides.

- N. Landscaping:

1. Unused property, or property designated for expansion or other future use, shall be landscaped and maintained as approved by the Development Review Board. Landscaping for unused property disturbed during construction shall

include such things as plantings of ornamental shrubs, lawns, native plants, and mowed, seeded fieldgrass.

Response: lot 500 will be 100% developed with either building, parking and circulation (pedestrian and vehicle) or landscaping. Lot 300, utilized for the site exposition, will be partially developed and the rest is allocated for future phase 2 use.

2. Contiguous unused areas of undisturbed fieldgrass may be maintained in their existing state. Large stands of invasive weeds such as Himalayan blackberries, English ivy, cherry Laurel, reed canary grass or other identified invasive plants shall be removed and/or mowed at least annually to reduce fire hazard. These unused areas, located within a phased development project or a future expansion cannot be included in the area calculated to meet the landscape requirements for the initial phase(s) of the development.

Response: The unused property on lot 300, which is undisturbed Fieldglass will be maintained in its existing state. The unused areas are not included in area calculation for the phase (1) development.

3. Unused property shall not be left with disturbed soils that are subject to siltation and erosion. Any disturbed soil shall be seeded for complete erosion cover germination and shall be subject to applicable erosion control standards.

Response: Any disturbed soil on unused property will be seeded for erosion.

(.06) Other Standards:

- A. Minimum Individual Lot Size: No limit save and except as shall be consistent with the other provisions of this Code (e.g., landscaping, parking, etc.).

Response: Both lot 500 & 300 meet lot size standards.

- B. Maximum Lot Coverage: No limit save and except as shall be consistent with the other provisions of this Code (e.g., landscaping, parking, etc.).

Response: The proposed site expansion meets standard.

- C. Front Yard Setback: Thirty (30) feet. Structures on corner or through lots shall observe the minimum front yard setback on both streets. Setbacks shall also be maintained from the planned rights-of-way shown on any adopted City street plan.

Response: The proposed expansion will not impact building location at front yard setbacks.

- D. Rear and Side Yard Setback: Thirty (30) feet. Structures on corner or through lots shall observe the minimum rear and side yard setbacks on both streets. Setbacks shall also be maintained from the planned rights-of-way shown on any adopted City street plan.

Response: The proposed expansion will not impact building location. The proposed setback more than 30' on North and South sides.

- E. No setback is required when side or rear yards abut on a railroad siding.

Response: N/A, The property does not abut a railroad.

- F. Corner Vision: Corner lots shall have no sight obstruction to exceed the vision clearance standards of Section 4.177.

Response: N/A, The property is not a corner lot.

- G. Off-Street Parking and Loading: As provided in Section 4.155.

Response: The proposed expansion will not impact parking. The parking lot requirements are in compliance with Section 4.155 as noted within this section.

- H. Signs: As provided in Sections 4.156.01 through 4.156.11. [Amended by Ord. No. 704, 6/18/12]

Response: The proposed site expansion/modification will not impact signage.

[Section 4.135 amended by Ordinance No. 574, 11/1/04.]

Section 4.135.5: Planned Development Industrial – Regionally Significant Industrial Area

- (.01) Purpose. The purpose of the PDI-RSIA Zone is to provide opportunities for regionally significant industrial operations along with a limited and appropriate range of related and compatible uses; to provide the flexibility to accommodate the changing nature of industrial employment centers, to protect industrially zoned lands for industrial uses, primarily in those areas near significant transportation facilities for the movement of freight and to facilitate the redevelopment of under-utilized industrial sites.

Response: The proposed expansion is not located within a PDI-RSIA zone. Section 4.125.5 and subsections below are not applicable.

- (.02) The PDI-RSIA Zone shall be governed by Section 4.140, Planned Development Regulations, and as otherwise set forth in this Code.

- (.03) Uses that are typically permitted:

- A. Wholesale houses, storage units, and warehouses.
- B. Laboratories, storage buildings, warehouses, and cold storage plants.
- C. Assembly of electrical equipment, including the manufacture of small parts.
- D. The light manufacturing, simple compounding or processing packaging, assembling and/or treatment of products, cosmetics, drugs, and food products, unless such use is inconsistent with air pollution, excess noise, or water pollution standards.
- E. Office Complexes-Technology (as defined in Section 4.001).

- F. Experimental, film or testing laboratories.
 - G. Storage and distribution of grain, livestock feed, provided dust and smell is effectively controlled.
 - H. Motor vehicle service facilities complementary or incidental to permitted uses.
 - I. Any use allowed in a PDC Zone or any other light industrial uses provided that any such use is compatible with industrial use and is planned and developed in a manner consistent with the purposes and objectives of Sections 4.130 to 4.140 and is subject to the following criteria:
 - 1. Service Commercial (defined as professional services that cater to daily customers such as financial, insurance, real estate, legal, medical or dental offices) shall not exceed 3000 square feet of floor space in a single building or 20,000 square feet of combined floor area within a multiple building development.
 - 2. Office Use (as defined in Section 4.001) shall not exceed 20% of total floor area within a project site.
 - 3. Retail uses not to exceed 3000 square feet of indoor and outdoor sales, service, or inventory storage area for a single building or 20,000 square feet of indoor and outdoor sales, service or inventory storage area for multiple buildings.
 - 4. Combined uses under I.1 and 3. above shall not exceed a total of 3000 square feet of floor area in a single building or 20,000 square feet of combined floor area within a multi-building development.
 - J. Residential uses shall not exceed 10% of total floor area.
 - K. Accessory uses, buildings and structures customarily incidental to any of the aforesaid principal permitted uses.
 - L. Temporary buildings or structures for uses incidental to construction work, which buildings or structures shall be removed upon completion or abandonment of the construction work.
 - M. Expansion of a building, structure or use approved prior to October 25, 2004 of up to 20% additional floor area and/or 10% additional land area.
 - N. Other similar uses which in the judgment of the Planning Director are consistent with the purpose of the PDI-RSIA Zone.
- (.04) Prohibited uses.
- A. Retail operations exceeding 3,000 square feet of area for sales, service area or storage area for retail inventory in a single building, or 20,000 square feet of sales, service or storage area for multiple buildings, except training facilities whose primary purpose is to provide training to meet industrial needs.

- B. Any use or activity that violates the performance standards specified in Subsection 4.135.5(.06), below.
- (.05) Block and Access Standards. The PDI-RSIA Zone shall be subject to the same block and access standards as the PDC Zone [Section 4.131(.02) and (.03)].
- (.06) Performance Standards. The following performance standards apply to all industrial properties and sites within the PDI-RSIA Zone, and are intended to minimize the potential adverse impacts of industrial activities on the general public and on other land uses or activities. They are not intended to prevent conflicts between different uses or activities that may occur on the same property or site.
- A. All uses and operations except storage, off-street parking, loading and unloading shall be confined, contained and conducted wholly within completely enclosed buildings, unless outdoor activities have been approved as part of Stage II, Site Design or Administrative Review.
 - B. Vibration: Every use shall be so operated that the ground vibration inherently and recurrently generated from equipment other than vehicles is not perceptible without instruments at any boundary line of the property or site on which the use is located.
 - C. Emission of odorous gases or other odorous matter in quantities detectable at any time and at any point on any boundary line of the property or site on which the use is located are prohibited.
 - D. Any open storage shall comply with the provisions of Section 4.176 and this Section.
 - E. No building customarily used for night operation, such as a bakery, bottling and distribution plant or other similar use, shall have any opening, other than stationary windows or required fire exits, within one hundred (100) feet of any residential district and any space used for loading or unloading commercial vehicles in connection with such an operation shall not be within one hundred (100) feet of any residential district.
 - F. Heat and Glare.
 - 1. Operations producing heat or glare shall be conducted entirely within an enclosed building.
 - 2. Exterior lighting on private property shall be screened, baffled, or otherwise directed away from adjacent residential properties. This is not intended to apply to street lighting.
 - G. Dangerous Substances: Any use which involves the presence, storage or handling of any explosive, nuclear waste product or any other substance in a manner which would cause a health or safety hazard on any adjacent land use or site shall be prohibited.
 - H. Liquid and Solid Wastes:

1. Any storage of wastes which would attract rodents or insects or otherwise create a health hazard shall be prohibited.
 2. Waste products which are stored outside shall be concealed from view from any property line by a sight-obscuring fence or planting as required by Section 4.176.
 3. No connection with any public sewer shall be made or maintained in violation of applicable City or State standards.
 4. No wastes conveyed shall be allowed to or permitted, caused to enter, or allowed to flow into any public sewer in violation of applicable City or State standards.
 5. All drainage permitted to discharge into a street gutter, caused to enter or allowed to flow into any pond, lake, stream or other natural water course shall be limited to surface waters or waters having similar characteristics as determined by the City, County, and State Department of Environmental Quality.
 6. All operations shall be conducted in conformance with the city's standards and ordinances applying to sanitary and storm sewer discharges.
- I. Noise: Noise generated by the use, with the exception of traffic uses from automobiles, trucks and trains, shall not violate any applicable standards adopted by the Oregon Department of Environmental Quality and W.C. 6.204 governing noise control in the same or similar locations. [Amended by Ord. 631, 7/16/07]
- J. Electrical Disturbances. Except for electrical facilities wherein the City is pre-empted by other governmental entities, electrical disturbances generated by uses within the PDI-RSIA Zone which interfere with the normal operation of equipment or instruments within the PDI-RSIA Zone are prohibited. Electrical disturbances which routinely cause interference with normal activity in abutting residential uses are also prohibited.
- K. Discharge Standards: There shall be no emission of smoke, fallout, fly ash, dust, vapors, gases or other forms of air pollution that may cause a nuisance or injury to human, plant or animal life or to property. Plans for construction and operation shall be subject to the recommendations and regulations of the State Department of Environmental Quality. All measurements of air pollution shall be by the procedures and with equipment approved by the State Department of Environmental Quality or equivalent and acceptable methods of measurement approved by the City. Persons responsible for a suspected source of air pollution upon request of the City shall provide quantitative and qualitative information regarding the discharge that will adequately and accurately describe operation conditions.
- L. Open burning is prohibited.
- M. Storage.

1. Outdoor storage must be maintained in an orderly manner at all times.
2. Outdoor storage areas shall be gravel surfaced or better and shall be sufficient for the materials being handled and stored. If a gravel surface is not sufficient to meet the performance standards for the use, the area shall be suitably paved.
3. Any open storage that would otherwise be visible at the property line shall be concealed from view at the abutting property line by a sight obscuring fence or planting not less than 6' in height.

N. Landscaping.

1. Unused property, or property designated for expansion or other future use shall be landscaped and maintained as approved by the Development Review Board. Landscaping for unused property disturbed during construction shall include such materials as plantings of ornamental shrubs, lawns, native plants, and mowed, seeded fieldgrass.
2. Contiguous unused areas of undisturbed fieldgrass may be maintained in their existing state. Large stands of invasive weeds such as Himalayan blackberry, English ivy, cherry laurel, reed canary grass or other identified invasive species shall be removed and/or mowed at least annually to reduce fire hazard. These unused areas, located with a phased development project or a future expansion cannot be included in the area calculated to meet the landscape requirements for the initial phase(s) of the development.
3. Unused property shall not be left with disturbed soils that are subject to siltation and erosion. Any disturbed soil shall be seeded for complete erosion cover germination and shall be subject to applicable erosion control standards.

(.07) Other Standards.

A. Lot Size:

1. Parcels less than 50 acres in size at the time of adoption of this amended Section: Land divisions may occur in conformance with an approved Master Plan consistent with the requirements of this section. No lot size limit, save and except as shall be consistent with the other provisions of this code.
2. Parcels 50 acres or greater in size existing on October 25, 2004 may be divided into any number of parcels or lots pursuant to an approved Master Plan provided that at least one lot or parcel of at least 50 acres in size remains. Provided further however, at least forty percent (40%) of the lot or parcel so created has been developed or planned for industrial uses and associated accessory uses and no portion has been developed or planned for the uses listed in Section 4.135.5(03)(I.)(1.) through (3).
3. Uses not subject to the foregoing lot size provisions:
 - a. Public facilities and services

- b. Separation of a lot or parcel in order to protect a natural resource, to provide a public amenity, or to implement a remediation plan for a site identified by DEQ pursuant to ORS 465.225.
 - c. Separation of a lot or parcel containing a nonconforming use from the remainder of the site in order to improve the utility of the remainder site for the intended industrial uses
 - d. Separation for the purposes of financing when the new lot or parcel is consistent with the approved Master Plan.
 - e. Division of lots or parcels consistent with a Master Plan approved by the City prior to July 1, 2004.
- B. Maximum Lot Coverage. No limit save and except as shall be consistent with the other provisions of this code.
- C. Front Yard Setback. Thirty (30) feet. Structures on corner or through lots shall observe the minimum front yard setback on both streets. Setbacks shall also be maintained from the planned rights-of-way shown on any adopted City street plan.
- D. Rear and Side Yard Setback. Thirty (30) feet. Structures on corner or through lots shall observe the minimum rear and side yard setback on both streets. Setbacks shall also be maintained from the planned rights-of-way shown on any adopted City street plan.
- E. No setback is required when rear or side yards abut a railroad siding.
- F. Corner Vision. Corner lots shall have no lot obstruction to exceed the vision clearance standards of Section 4.177.
- G. Off-street Parking and Loading. As required in Section 4.155.
- H. Signs. As required in Sections 4.156.01 through 4.156.11. [Amended by Ord. No. 704, 6/18/12]

[Section 4.135.5 added by Ordinance No. 574, 11/1/04.]

SECTION 4.137.5 SCREENING & BUFFERING (SB) OVERLAY ZONE

(.01) Purpose. The Screening and Buffering Overlay Zone is intended to be used with any underlying base zone to specify appropriate screening and buffering standards for areas where residential and nonresidential uses abut. The “SB” Overlay Zone is used to assure that there is adequate separation and screening between potentially conflicting land uses. The buffering is achieved by restricting access, increasing setbacks, requiring additional landscaping, restricting signs, and, in some cases, by requiring additional information and proof of mitigation for uses that may otherwise cause off-site impacts or nuisances.

Response:

The SB Overlay Zone has been applied to the proposed site expansion. Care has been taken in the design to mitigate potential disturbances with the adjacent mobile home park. The full length of the south property has a 6’ chain link fence with privacy slats. Beyond the fence is a 30 foot planting area that meets the L-3 landscape standard (High Screen Landscaping). This landscape buffer with fencing dampens sound transmittance and blocks visual connection to the industrial site. Access into the landscaped buffer area is for maintenance purposes only.

(.02) Where the “SB” Overlay Zone is to be Applied. The Screening and Buffering Overlay Zone is to be applied primarily along the edge of nonresidential zones abutting, or located directly across the street from, residential zones. As with any zoning, the “SB” Overlay Zone is only applied where established by action of the City Council.

Response:

The adjacent lot to the south contains a mobile home park is an RA-H zone. SB overlay standards will be applied.

(.03) Landscaped Areas. The following landscape requirements apply to the “SB” Overlay Zone. Structures, exterior storage and exterior display of merchandise are prohibited in these landscaped areas.

A. Commercial Properties. For land zoned PDC, a ten (10) foot deep area landscaped to at least the L-3 standard, specified in Section 4.176, must be provided along all street frontages across from properties zoned or designated in the Comprehensive Plan for residential use. (See Figure 23: High Screen Landscaping.) A ten (10) foot deep landscaped area shall also be provided at any point where the property adjoins a property that is planned or zoned for residential use.

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B. Industrial Properties. For land zoned PDI, a twenty (20) foot deep area landscaped to at least the L-3 standard, or a ten (10) foot deep area landscaped to at least the L-4 standard, shall be provided along all property lines where the “SB” Overlay Zone is applied. (See Figures 23: High Screen Landscaping and Figure 24: High Wall Landscaping.)

Response:

This site zoned PDI. A minimum (20) foot setback and (L-3) landscape Standards have been applied along the southern property line. No storage, structures or displays of merchandise will be in this buffer area.

(.04) Ingress and Egress. Motor vehicle access shall be limited through any landscaped area required in the “SB” Overlay Zone. The Development Review Board may impose additional landscape requirements to minimize the visual impacts of any vehicle access points that are approved.

Response:

No vehicle access is proposed in landscape buffer.

(.05) Exterior Work. No exterior manufacturing, storage, sales, or other similar work shall be performed within the “SB” Overlay Zone.

Response:

No work will be performed in the buffer.

(.06) Signs. No signs, other than approved monument signs, shall be permitted within the “SB” Overlay Zone.

Response:

No signage is proposed in the buffer.

(.07) Performance Standards and Off-Site Impacts. Many of Wilsonville’s base zones contain performance standards to limit impacts on surrounding properties and the overall community. Developers shall be encouraged to utilize the standards of the “SB” Overlay Zone to help assure compliance with the performance standards.

Response:

All base zone standards will be applied and complied with.

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Section 4.140. Planned Development Regulations.

(.01) Purpose.

- A. The provisions of Section 4.140 shall be known as the Planned Development Regulations. The purposes of these regulations are to encourage the development of tracts of land sufficiently large to allow for comprehensive master planning, and to provide flexibility in the application of certain regulations in a manner consistent with the intent of the Comprehensive Plan and general provisions of the zoning regulations and to encourage a harmonious variety of uses through mixed use design within specific developments thereby promoting the economy of shared public services and facilities and a variety of complimentary activities consistent with the land use designation on the Comprehensive Plan and the creation of an attractive, healthful, efficient and stable environment for living, shopping or working.

Response: We are requesting a modification to the Stage-1 Master Plan under DB19-0005. Lots 300 & 500 will continue as a phased development. The property owner would like to utilize his abutting property on lot 300 to increase the area of storage by 33,118 square feet. The current property line will remain as is, no buildings or structures will be erected within this expansion. This site expansion will be utilized for storage only and will maintain the proper landscape buffering and screening. No modification will be made to the building, parking or onsite circulation for the development. Stormwater from the expansion will be directed to swales on the south side of the property. Refer to the new Master Plan diagram and provided sheets for further clarification.

The following are the proposed phases:

Phase-1

The proposed Phase -1 development is located on undeveloped lot 500 (31W14A 00500) in Wilsonville, OR. The site, adjusted after the replat, is approximately 2.35 acres. The lot is zoned PDI (Planned Development Industrial). The project will include (1) single story 11,400 sf metal building with an 1,800 sf storage mezzanine (mezzanine is not counted toward building area or number of stories). The building uses include 2,024 sf of office and 11,176 sf of warehouse (warehouse square footage includes accessory wash bay, repair areas and storage mezzanine). The site will have an approximately 85,818 sf paved open storage yard, 33,118 sf of this storage yard will be located on part of lot 300. Required parking, landscaping and trash/recycling enclosure are provide onsite.

Phase-2:

Phase-2 includes the construction of an approximately 53,000 square foot industrial/flex building on lot 300. In addition, the development will contain new landscaping, parking stalls, trash/recycling enclosure and one access driveway off SW Boones Ferry Road.

Phase-3

Phase-3 includes the construction of an approximately 19,000 square foot industrial/flex building on lot 300. In addition, the development will contain new landscaping, parking stalls and trash/recycling enclosure.

- B. It is the further purpose of the following Section:
1. To take advantage of advances in technology, architectural design, and functional land use design:
 2. To recognize the problems of population density, distribution and circulation and to allow a deviation from rigid established patterns of land uses, but controlled by defined policies and objectives detailed in the comprehensive plan;
 3. To produce a comprehensive development equal to or better than that resulting from traditional lot land use development.
 4. To permit flexibility of design in the placement and uses of buildings and open spaces, circulation facilities and off-street parking areas, and to more efficiently utilize potentials of sites characterized by special features of geography, topography, size or shape or characterized by problems of flood hazard, severe soil limitations, or other hazards;
 5. To permit flexibility in the height of buildings while maintaining a ratio of site area to dwelling units that is consistent with the densities established by the Comprehensive Plan and the intent of the Plan to provide open space, outdoor living area and buffering of low-density development.
 6. To allow development only where necessary and adequate services and facilities are available or provisions have been made to provide these services and facilities.
 7. To permit mixed uses where it can clearly be demonstrated to be of benefit to the users and can be shown to be consistent with the intent of the Comprehensive Plan.
 8. To allow flexibility and innovation in adapting to changes in the economic and technological climate.

(.02) Lot Qualification.

- A. Planned Development may be established on lots which are suitable for and of a size to be planned and developed in a manner consistent with the purposes and objectives of Section 4.140.

Response: Both lots (300 & 500) are suitable for the proposed use.

- B. Any site designated for development in the Comprehensive Plan may be developed as a Planned Development, provided that it is zoned "PD." All sites which are greater than two (2) acres in size, and designated in the Comprehensive Plan for commercial, residential, or industrial use shall be developed as Planned Developments, unless approved for other uses permitted by the Development Code. Smaller sites may also be developed through the City's PD procedures, provided that the location, size, lot configuration, topography, open space and natural vegetation of the site warrant such development.

Response: The site is over (2) acres and is developed as a Planned Development.

(.03) Ownership.

- A. The tract or tracts of land included in a proposed Planned Development must be in one (1) ownership or control or the subject of a joint application by the owners of all the property included. The holder of a written option to purchase, with written authorization by the owner to make applications, shall be deemed the owner of such land for the purposes of Section 4.140.

Response: The property is under one ownership.

- B. Unless otherwise provided as a condition for approval of a Planned Development permit, the permittee may divide and transfer units or parcels of any development. The transferee shall use and maintain each such unit or parcel in strict conformance with the approval permit and development plan.

Response: Division and transfer of units is not proposed with this development.

(.04) Professional Design.

- A. The applicant for all proposed Planned Developments shall certify that the professional services of the appropriate professionals have been utilized in the planning process for development.

Response: The owner has engaged appropriate professionals in the planning and design of the proposed addition including survey, geotechnical engineering, civil and landscape, architectural and structural design team members along with their commercial general contractor.

- B. Appropriate professionals shall include, but not be limited to the following to provide the elements of the planning process set out in Section 4.139:

1. An architect licensed by the State of Oregon;

Principal Architect is Tara Lund with CIDA Inc., license ARI-4212

2. A landscape architect registered by the State of Oregon;

Response: Landscape Architect is David Anderson.

3. An urban planner holding full membership in the American Institute of Certified Planners, or a professional planner with prior experience representing clients before the Development Review Board, Planning Commission, or City Council; or

Response: Project planning services are being provided by CIDA Architects & Engineers and AAI Engineering, both with vast experience working with jurisdictions include the City of Wilsonville.

4. A registered engineer or a land surveyor licensed by the State of Oregon.

Civil Engineer is Craig Harris with AAI, license 58412PE

- B. One of the professional consultants chosen by the applicant from either 1, 2, or 3, above, shall be designated to be responsible for conferring with the planning staff with respect to the concept and details of the plan.

Response: The project architects are designated as the primary point of contact for jurisdictional correspondence and coordination.

- C. The selection of the professional coordinator of the design team will not limit the owner or the developer in consulting with the planning staff.

Response: The owner, Dave Nicoli, has directed correspondence and coordination with the City of Wilsonville.

(.05) Planned Development Permit Process.

- A. All parcels of land exceeding two (2) acres in size that are to be used for residential, commercial or industrial development, shall, prior to the issuance of any building permit:

1. Be zoned for planned development;
2. Obtain a planned development permit; and
3. Obtain Development Review Board, or, on appeal, City Council approval.

Response: The subject parcels are greater than (2) acres and will go through/obtain the above approvals prior to issuance of the building permit.

- B. Zone change and amendment to the zoning map are governed by the applicable provisions of the Zoning Sections, inclusive of Section 4.197

Response: No zone change is requested.

- D. Development Review Board approval is governed by Sections 4.400 to 4.450

Response: See response to Sections 4.400 – 4.450 below.

- D. All planned developments require a planned development permit. The planned development permit review and approval process consists of the following multiple stages, the last two or three of which can be combined at the request of the applicant:

1. Pre-application conference with Planning Department;

Response: Pre-application conference was held on 9/19/19.

2. Preliminary (Stage I) review by the Development Review Board. When a zone change is necessary, application for such change shall be made simultaneously with an application for preliminary approval to the Board; and

Response: Application includes modification to the Stage 1 and Stage 2.

3. Final (Stage II) review by the Development Review Board

Response: Application includes modification to the Stage 1 and Stage 2.

4. In the case of a zone change and zone boundary amendment, City Council approval is required to authorize a Stage I preliminary plan.

Response: No zone change or amendment is proposed.

(.06) Staff Report:

- A. The planning staff shall prepare a report of its findings and conclusions as to whether the use contemplated is consistent with the land use designated on the Comprehensive Plan. If there is a disagreement as to whether the use contemplated is consistent, the applicant, by request, or the staff, may take the preliminary information provided to the Development Review Board for a use interpretation.
- B. The applicant may proceed to apply for Stage I - Preliminary Approval - upon determination by either staff or the Development Review Board that the use contemplated is consistent with the Comprehensive Plan.

(.07) Preliminary Approval (Stage One):

- A. Applications for preliminary approval for planned developments shall:
 1. Be made by the owner of all affected property or the owner's authorized agent; and
 2. Be filed on a form prescribed by the City Planning Department and filed with said Department.
 3. Set forth the professional coordinator and professional design team as provided in subsection (.04), above.
 4. State whether the development will include mixed land uses, and if so, what uses and in what proportions and locations.

Response: The application is made by the owner on the approved form as provided following our pre-application conference and designates the professional design team and coordinator. The development does not include mixed land uses, only a single land use is proposed on the existing development.

- B. The application shall include conceptual and quantitatively accurate representations of the entire development sufficient to judge the scope, size, and impact of the development on the community; and, in addition to the requirements set forth in Section 4.035, shall be accompanied by the following information:
1. A boundary survey or a certified boundary description by a registered engineer or licensed surveyor.
 2. Topographic information as set forth in Section 4.035
 3. A tabulation of the land area to be devoted to various uses, and a calculation of the average residential density per net acre.
 4. A stage development schedule demonstrating that the developer intends receive Stage II approval within two (2) years of receiving Stage I approval, and to commence construction within two (2) years after the approval of the final development plan, and will proceed diligently to completion; unless a phased development schedule has been approved; in which case adherence to that schedule shall be considered to constitute diligent pursuit of project completion.
 5. A commitment by the applicant to provide in the Final Approval (Stage II) a performance bond or other acceptable security for the capital improvements required by the project.
 6. If it is proposed that the final development plan will be executed in stages, a schedule thereof shall be provided.
 7. Statement of anticipated waivers from any of the applicable site development standards.

[Response: The application package contains sufficient information for the stage 1 review.](#)

- C. An application for a Stage I approval shall be considered by the Development Review Board as follows:
1. A public hearing as provided in Section 4.013.
 2. After such hearing, the Board shall determine whether the proposal conforms to the permit criteria set forth in this Code, and may approve or disapprove the application and the accompanying preliminary development plan or require such changes therein or impose such conditions of approval as are in its judgment, necessary to ensure conformity to said criteria and regulations. In so doing, the Board may, in its discretion, authorize submission of the final development plan in stages, corresponding to different units or elements of the development. It shall do so only upon evidence assuring completion of the entire development in accordance with the preliminary development plan and stage development schedule.
 3. A final decision on a complete application and preliminary plan shall be rendered within one hundred and twenty (120) days after the application is

deemed complete unless a continuance is agreed upon by the applicant and the appropriate City decision-making body.

4. The determination of the Development Review Board shall become final at the end of the appeal period for the decision, unless appealed to the City Council in accordance with Section 4.022 of this Code.

Response: By way of this application we have prepared materials for the Design Review Board hearing.

(.09) Final Approval (Stage Two):

[Note: Outline Number is incorrect.]

- A. Unless an extension has been granted by the Development Review Board, within two (2) years after the approval or modified approval of a preliminary development plan (Stage I), the applicant shall file with the City Planning Department a final plan for the entire development or when submission in stages has been authorized pursuant to Section 4.035 for the first unit of the development, a public hearing shall be held on each such application as provided in Section 4.013.

Response: The application is for the modification are running concurrently.

After such hearing, the Development Review Board shall determine whether the proposal conforms to the permit criteria set forth in this Code, and shall approve, conditionally approve, or disapprove the application.

Response: Applicant is aware of standards for conditions of approval for development and will work with the City staff on applied conditions and timelines associated with each item.

- C. The final plan shall conform in all major respects with the approved preliminary development plan, and shall include all information included in the preliminary plan plus the following:
 1. The location of water, sewerage and drainage facilities;
 2. Preliminary building and landscaping plans and elevations, sufficient to indicate the general character of the development;
 3. The general type and location of signs;
 4. Topographic information as set forth in Section 4.035;
 5. A map indicating the types and locations of all proposed uses; and
 6. A grading plan.

Response: The noted items were included with the original application package for Stage 1 & Stage 2. A modification of site elements is being submitted with the appropriate documents for confirmation of conformity as noted by the planning department.

- B. The final plan shall be sufficiently detailed to indicate fully the ultimate operation and appearance of the development or phase of development. However, Site Design Review is a separate and more detailed review of proposed design features, subject to the standards of Section 4.400.

[Response: The provided application of sufficient detail for review of the proposed modification.](#)

- E. Copies of legal documents required by the Development Review Board for dedication or reservation of public facilities, or for the creation of a non-profit homeowner's association, shall also be submitted.

[Response: Proposed development does not trigger submission of these documents.](#)

- E. Within thirty (30) days after the filing of the final development plan, the Planning staff shall forward such development plan and the original application to the Tualatin Valley Fire and Rescue District, if applicable, and other agencies involved for review of public improvements, including streets, sewers and drainage. The Development Review Board shall not act on a final development plan until it has first received a report from the agencies or until more than thirty (30) days have elapsed since the plan and application were sent to the agencies, whichever is the shorter period.

[Response: Applicant understands the public agency notification timeline.](#)

- G. Upon receipt of the final development plan, the Development Review Board shall conduct a public hearing and examine such plan and determine:
1. Whether it conforms to all applicable criteria and standards; and
 2. Whether it conforms in all substantial respects to the preliminary approval; or
 3. Require such changes in the proposed development or impose such conditions of approval as are in its judgment necessary to insure conformity to the applicable criteria and standards.

[Response: Applicant understands the function of the DRB and hearing.](#)

- H. If the Development Review Board permits the applicant to revise the plan, it shall be resubmitted as a final development plan within sixty (60) days. If the Board approves, disapproves or grants such permission to resubmit, the decision of the Board shall become final at the end of the appeal period for the decision, unless appealed to the City Council, in accordance with Sections 4.022 of this Code.

[Response: Applicant understands the DRB routing options and timeline.](#)

- I. All Stage II Site Development plan approvals shall expire two years after their approval date, if substantial development has not occurred on the property prior to that time. Provided, however, that the Development Review Board may extend these expiration times for up to three (3) additional periods of not more than one (1) year each. Applicants seeking time extensions shall make their

requests in writing at least thirty (30) days in advance of the expiration date. Requests for time extensions shall only be granted upon (1) a showing that the applicant has in good faith attempted to develop or market the property in the preceding year or that development can be expected to occur within the next year, and (2) payment of any and all Supplemental Street SDCs applicable to the development. Upon such payment, the development shall have vested traffic generation rights under 4.140 (.10), provided however, that if the Stage II approval should expire, the vested right to use trips is terminated upon City repayment, without interest, of Supplemental Street SDCs. For purposes of this Ordinance, “substantial development” is deemed to have occurred if the required building permits or public works permits have been issued for the development, and the development has been diligently pursued, including the completion of all conditions of approval established for the permit. [Amended by Ord 561, adopted 12/15/03.]

Response: Applicant understands the expiration timeline associated with the DRB decision date.

- J. A planned development permit may be granted by the Development Review Board only if it is found that the development conforms to all the following criteria, as well as to the Planned Development Regulations in Section 4.140:
1. The location, design, size and uses, both separately and as a whole, are consistent with the Comprehensive Plan, and with any other applicable plan, development map or Ordinance adopted by the City Council.

Response: Proposed application is presented as consistent with the applicable development requirements.

2. That the location, design, size and uses are such that traffic generated by the development at the most probable used intersection(s) can be accommodated safely and without congestion in excess of Level of Service D, as defined in the Highway Capacity Manual published by the National Highway Research Board, on existing or immediately planned arterial or collector streets and will, in the case of commercial or industrial developments, avoid traversing local streets. Immediately planned arterial and collector streets are those listed in the City’s adopted Capital Improvement Program, for which funding has been approved or committed, and that are scheduled for completion within two years of occupancy of the development or four year if they are an associated crossing, interchange, or approach street improvement to Interstate 5.
 - a. In determining levels of Service D, the City shall hire a traffic engineer at the applicant’s expense who shall prepare a written report containing the following minimum information for consideration by the Development Review Board:
 - i. An estimate of the amount of traffic generated by the proposed development, the likely routes of travel of the estimated generated traffic, and the source(s) of information of the estimate of the traffic

- generated and the likely routes of travel; [Added by Ord. 561, adopted 12/15/03.]
- ii. What impact the estimate generated traffic will have on existing level of service including traffic generated by (1) the development itself, (2) all existing developments, (3) Stage II developments approved but not yet built, and (4) all developments that have vested traffic generation rights under section 4.140(.10), through the most probable used intersection(s), including state and county intersections, at the time of peak level of traffic. This analysis shall be conducted for each direction of travel if backup from other intersections will interfere with intersection operations. [Amended by Ord 561, adopted 12/15/03.]
- b. The following are exempt from meeting the Level of Service D criteria standard:
 - i. A planned development or expansion thereof which generates three (3) new p.m. peak hour traffic trips or less;
 - ii. A planned development or expansion thereof which provides an essential governmental service.
 - c. Traffic generated by development exempted under this subsection on or after Ordinance No. 463 was enacted shall not be counted in determining levels of service for any future applicant. [Added by Ord 561, adopted 12/15/03.]
 - d. Exemptions under 'b' of this subsection shall not exempt the development or expansion from payment of system development charges or other applicable regulations. [Added by Ord 561, adopted 12/15/03.]
 - e. In no case will development be permitted that creates an aggregate level of traffic at LOS "F". ([Added by Ord 561, adopted 12/15/03.]

Response: The proposed modification does not impact traffic.

- 3. That the location, design, size and uses are such that the residents or establishments to be accommodated will be adequately served by existing or immediately planned facilities and services.

Response: Based on designs by the noted professionals and review of conditions the existing facilities and services in the area are adequate for the proposed development.

- K. Mapping: Whenever a Planned Development permit has been granted, and so long as the permit is in effect, the boundary of the Planned Development shall be indicated on the Zoning Map of the City of Wilsonville as the appropriate "PD" Zone.

Response: The subject parcel is noted as a PD zone.

- L. Adherence to Approved Plan and Modification Thereof: The applicant shall agree in writing to be bound, for her/himself and her/his successors in interest, by the conditions prescribed for approval of a development. The approved final

plan and stage development schedule shall control the issuance of all building permits and shall restrict the nature, location and design of all uses. Minor changes in an approved preliminary or final development plan may be approved by the Director of Planning if such changes are consistent with the purposes and general character of the development plan. All other modifications, including extension or revision of the stage development schedule, shall be processed in the same manner as the original application and shall be subject to the same procedural requirements.

Response: Following issuance of the city decision, the applicant will coordinate any future adjustments or revisions with the city staff as noted.

M. In the event of a failure to comply with the approved plan or any prescribed condition of approval, including failure to comply with the stage development schedule, the Development Review Board may, after notice and hearing, revoke a Planned Development permit. General economic conditions that affect all in a similar manner may be considered as a basis for an extension of a development schedule. The determination of the Board shall become final thirty (30) days after the date of decision unless appealed to the City Council.

Response: Applicant understands the requirement to comply with the decision and timelines related to expiration of approvals.

- (.10) Early Vesting of Traffic Generation. Applicants with Stage I or Master Plan approvals occurring after June 2, 2003 may apply to vest the right to use available transportation capacity at the intersections of Wilsonville Road with Boone’s Ferry Road and with Town Center Loop West, and/or the I-5 interchange. Vesting for properties with such approvals shall occur upon execution of a vesting agreement satisfactory to the city, which agreement shall include a proposed development schedule or phasing plan and either provide for the payment of any and all Supplemental Street SDCs or provide other means of financing public improvements. Vesting for properties pending such approvals shall occur upon such agreement and the date the approvals are final.

The number of trips vested is subject to modification based upon updated traffic analysis associated with subsequent development approvals for the property. A reduction in vested trips shall attend repayment of vesting fees by the City. An increase in available vested trips shall occur upon payment of necessary vesting fees.

Vesting shall remain valid and run with the property, unless an approval that is necessary for vesting to occur is terminated or a vesting agreement is terminated. If the vested right to use certain trips is lost or terminated, as determined by the Community Development Director with the concurrence of City Council, such trips shall be made available to other development upon City repayment, without interest, of associated vesting fees. [Added by Ord. 561, adopted 12/15/03.]

Response: No vesting is proposed.

Section 4.154. On-site Pedestrian Access and Circulation.

Response: The proposed site modification does not impact on-site pedestrian access or circulation.

(.01) On-site Pedestrian Access and Circulation

- A. The purpose of this section is to implement the pedestrian access and connectivity policies of the Transportation System Plan. It is intended to provide for safe, reasonably direct, and convenient pedestrian access and circulation.
- B. Standards. Development shall conform to all of the following standards:
 1. Continuous Pathway System. A pedestrian pathway system shall extend throughout the development site and connect to adjacent sidewalks, and to all future phases of the development, as applicable.
 2. Safe, Direct, and Convenient. Pathways within developments shall provide safe, reasonably direct, and convenient connections between primary building entrances and all adjacent parking areas, recreational areas/playgrounds, and public rights-of-way and crosswalks based on all of the following criteria:
 - a. Pedestrian pathways are designed primarily for pedestrian safety and convenience, meaning they are free from hazards and provide a reasonably smooth and consistent surface.
 - b. The pathway is reasonably direct. A pathway is reasonably direct when it follows a route between destinations that does not involve a significant amount of unnecessary out-of-direction travel.
 - c. The pathway connects to all primary building entrances and is consistent with the Americans with Disabilities Act (ADA) requirements.
 - d. All parking lots larger than three acres in size shall provide an internal bicycle and pedestrian pathway pursuant to Section 4.155(.03)(B.)(3.)(d.).
 3. Vehicle/Pathway Separation. Except as required for crosswalks, per subsection 4, below, where a pathway abuts a driveway or street it shall be vertically or horizontally separated from the vehicular lane. For example, a pathway may be vertically raised six inches above the abutting travel lane, or horizontally separated by a row of bollards.
 4. Crosswalks. Where a pathway crosses a parking area or driveway, it shall be clearly marked with contrasting paint or paving materials (e.g., pavers, light-color concrete inlay between asphalt, or similar contrast).
 5. Pathway Width and Surface. Primary pathways shall be constructed of concrete, asphalt, brick/masonry pavers, or other durable surface, and not

less than five (5) feet wide. Secondary pathways and pedestrian trails may have an alternative surface except as otherwise required by the ADA.

6. All pathways shall be clearly marked with appropriate standard signs.

[Added by Ord. #719, 6/17/13]

Section 4.155. General Regulations - Parking, Loading and Bicycle Parking.

(.01) Purpose:

- A. The design of parking areas is intended to enhance the use of the parking area as it relates to the site development as a whole, while providing efficient parking, vehicle circulation and attractive, safe pedestrian access.

Response: The proposed site expansion will not alter parking and loading.

As much as possible, site design of impervious surface parking and loading areas shall address the environmental impacts of air and water pollution, as well as climate change from heat islands.

Response: The proposed storage yard expansion includes a new swale.

The view from the public right of way and adjoining properties is critical to meet the aesthetic concerns of the community and to ensure that private property rights are met. Where developments are located in key locations such as near or adjacent to the I-5 interchanges, or involve large expanses of asphalt, they deserve community concern and attention.

Response: The expanded yard will be obscured from the right-of-way with full perimeter landscaping and fencing.

(.02) General Provisions:

Response: The proposed site expansion will not alter parking and loading.

- A. The provision and maintenance of off-street parking spaces is a continuing obligation of the property owner. The standards set forth herein shall be considered by the Development Review Board as minimum criteria.
 - 1. The Board shall have the authority to grant variances or planned development waivers to these standards in keeping with the purposes and objectives set forth in the Comprehensive Plan and this Code.
 - 2. Waivers to the parking, loading, or bicycle parking standards shall only be issued upon a findings that the resulting development will have no significant adverse impact on the surrounding neighborhood, and the community, and that the development considered as a whole meets the purposes of this section.
- B. No area shall be considered a parking space unless it can be shown that the area is accessible and usable for that purpose, and has maneuvering area for the vehicles, as determined by the Planning Director.

- C. In cases of enlargement of a building or a change of use from that existing on the effective date of this Code, the number of parking spaces required shall be based on the additional floor area of the enlarged or additional building, or changed use, as set forth in this Section. Current development standards, including parking area landscaping and screening, shall apply only to the additional approved parking area.
- D. In the event several uses occupy a single structure or parcel of land, the total requirement for off-street parking shall be the sum of the requirements of the several uses computed separately, except as modified by subsection "E," below.
- E. Owners of two (2) or more uses, structures, or parcels of land may utilize jointly the same parking area when the peak hours of operation do not overlap, provided satisfactory legal evidence is presented in the form of deeds, leases, or contracts securing full and permanent access to such parking areas for all the parties jointly using them. [Amended by Ord. # 674 11/16/09]
- F. Off-street parking spaces existing prior to the effective date of this Code may be included in the amount necessary to meet the requirements in case of subsequent enlargement of the building or use to which such spaces are necessary.
- G. Off-Site Parking. Except for single-family dwellings, the vehicle parking spaces required by this Chapter may be located on another parcel of land, provided the parcel is within 500 feet of the use it serves and the DRB has approved the off-site parking through the Land Use Review. The distance from the parking area to the use shall be measured from the nearest parking space to the main building entrance, following a sidewalk or other pedestrian route. The right to use the off-site parking must be evidenced in the form of recorded deeds, easements, leases, or contracts securing full and permanent access to such parking areas for all the parties jointly using them. [Amended by Ord. # 674 11/16/09]
- H. The conducting of any business activity shall not be permitted on the required parking spaces, unless a temporary use permit is approved pursuant to Section 4.163.
- I. Where the boundary of a parking lot adjoins or is within a residential district, such parking lot shall be screened by a sight-obscuring fence or planting. The screening shall be continuous along that boundary and shall be at least six (6) feet in height.
- J. Parking spaces along the boundaries of a parking lot shall be provided with a sturdy bumper guard or curb at least six (6) inches high and located far enough within the boundary to prevent any portion of a car within the lot from extending over the property line or interfering with required screening or sidewalks.

- K. All areas used for parking and maneuvering of cars shall be surfaced with asphalt, concrete, or other surface, such as pervious materials (i. e. pavers, concrete, asphalt) that is found by the City's authorized representative to be suitable for the purpose. In all cases, suitable drainage, meeting standards set by the City's authorized representative, shall be provided. [Amended by Ord. # 674 11/16/09]
- L. Artificial lighting which may be provided shall be so limited or deflected as not to shine into adjoining structures or into the eyes of passers-by.
- M. Off-street parking requirements for types of uses and structures not specifically listed in this Code shall be determined by the Development Review Board if an application is pending before the Board. Otherwise, the requirements shall be specified by the Planning Director, based upon consideration of comparable uses.
- N. Up to forty percent (40%) of the off-street spaces may be compact car spaces as identified in Section 4.001 - "Definitions," and shall be appropriately identified.
- O. Where off-street parking areas are designed for motor vehicles to overhang beyond curbs, planting areas adjacent to said curbs shall be increased to a minimum of seven (7) feet in depth. This standard shall apply to a double row of parking, the net effect of which shall be to create a planted area that is a minimum of seven (7) feet in depth.

(.03) Minimum and Maximum Off-Street Parking Requirements:

[Response: The proposed site expansion will not alter parking. Previously approved parking meets all applicable requirements.](#)

- A. Parking and loading or delivery areas shall be designed with access and maneuvering area adequate to serve the functional needs of the site and shall:
 - 1. Separate loading and delivery areas and circulation from customer and/or employee parking and pedestrian areas. Circulation patterns shall be clearly marked.
 - 2. To the greatest extent possible, separate vehicle and pedestrian traffic.
- B. Parking and loading or delivery areas shall be landscaped to minimize the visual dominance of the parking or loading area, as follows:
 - 1. Landscaping of at least ten percent (10%) of the parking area designed to be screened from view from the public right-of-way and adjacent properties. This landscaping shall be considered to be part of the fifteen percent (15%) total landscaping required in Section 4.176.03 for the site development.
 - 2. Landscape tree planting areas shall be a minimum of eight (8) feet in width and length and spaced every eight (8) parking spaces or an equivalent aggregated amount.

- a. Trees shall be planted in a ratio of one (1) tree per eight (8) parking spaces or fraction thereof, except in parking areas of more than two hundred (200) spaces where a ratio of one (1) tree per six (six) spaces shall be applied as noted in subsection (.03)(B.)(3.). A landscape design that includes trees planted in areas based on an aggregated number of parking spaces must provide all area calculations.
 - b. Except for trees planted for screening, all deciduous interior parking lot trees must be suitably sized, located, and maintained to provide a branching minimum of seven (7) feet clearance at maturity.
3. Due to their large amount of impervious surface, new development with parking areas of more than two hundred (200) spaces that are located in any zone, and that may be viewed from the public right of way, shall be landscaped to the following additional standards:
- a. One (1) trees shall be planted per six (6) parking spaces or fraction thereof. At least twenty-five percent (25%) of the required trees must be planted in the interior of the parking area.
 - b. Required trees may be planted within the parking area or the perimeter, provided that a minimum of forty percent (40%) of the canopy dripline of mature perimeter trees can be expected to shade or overlap the parking area. Shading shall be determined based on shadows cast on the summer solstice.
 - c. All parking lots in excess of two hundred (200) parking spaces shall provide an internal pedestrian walkway for every six (6) parking aisles. Minimum walkway clearance shall be at least five (5) feet in width. Walkways shall be designed to provide pedestrian access to parking areas in order to minimize pedestrian travel among vehicles. Walkways shall be designed to channel pedestrians to the front entrance of the building.
 - d. Parking lots more than three acres in size shall provide street-like features along principal drive isles, including curbs, sidewalks, street trees or planting strips, and bicycle routes.
 - e. All parking lots viewed from the public right of way shall have a minimum twelve (12) foot landscaped buffer extending from the edge of the property line at the right of way to the edge of the parking area. Buffer landscaping shall meet the low screen standard of 4.176(.02)(D) except that trees, groundcovers and shrubs shall be grouped to provide visual interest and to create view openings no more than ten (10) feet in length and provided every forty (40) feet. Notwithstanding this requirement, view of parking area that is unscreened from the right of way due to slope or topography shall require an increased landscaping standard under 4.176(.02) in order to buffer and soften the view of vehicles as much as possible. For purposes of this section, "view from the public right of way" is intended to mean the view from the sidewalk directly

across the street from the site, or if no sidewalk, from the opposite side of the adjacent street or road.

- f. Where topography and slope condition permit, the landscape buffer shall integrate parking lot storm water treatment in bioswales and related plantings. Use of berms or drainage swales are allowed provided that planting areas with lower grade are constructed so that they are protected from vehicle maneuvers. Drainage swales shall be constructed to Public Works Standards.
- g. In addition to the application requirements of section 4.035(.04)(6)(d), where view of signs is pertinent to landscape design, any approved or planned sign plan shall accompany the application for landscape design approval.

[Amended by Ord. #719, 6/17/13]

- C. Off Street Parking shall be designed for safe and convenient access that meets ADA and ODOT standards. All parking areas which contain ten (10) or more parking spaces, shall for every fifty (50) standard spaces., provide one ADA-accessible parking space that is constructed to building code standards, Wilsonville Code 9.000.
- D. Where possible, parking areas shall be designed to connect with parking areas on adjacent sites so as to eliminate the necessity for any mode of travel of utilizing the public street for multiple accesses or cross movements. In addition, on-site parking shall be designed for efficient on-site circulation and parking.
- E. In all multi-family dwelling developments, there shall be sufficient areas established to provide for parking and storage of motorcycles, mopeds and bicycles. Such areas shall be clearly defined and reserved for the exclusive use of these vehicles.
- F. On-street parking spaces, directly adjoining the frontage of and on the same side of the street as the subject property, may be counted towards meeting the minimum off-street parking standards.
- G. Tables 5 shall be used to determine the minimum and maximum parking standards for various land uses. The minimum number of required parking spaces shown on Tables 5 shall be determined by rounding to the nearest whole parking space. For example, a use containing 500 square feet, in an area where the standard is one space for each 400 square feet of floor area, is required to provide one off-street parking space. If the same use contained more than 600 square feet, a second parking space would be required. Structured parking and on-street parking are exempted from the parking maximums in Table 5. [Amended by Ordinance No. 538, 2/21/02.]
- H. Electrical Vehicle Charging Stations:

1. Parking spaces designed to accommodate and provide one or more electric vehicle charging stations on site may be counted towards meeting the minimum off-street parking standards.
2. Modification of existing parking spaces to accommodate electric vehicle charging stations on site is allowed outright.

I. Motorcycle parking:

1. Motorcycle parking may substitute for up to 5 spaces or 5 percent of required automobile parking, whichever is less. For every 4 motorcycle parking spaces provided, the automobile parking requirement is reduced by one space.
2. Each motorcycle space must be at least 4 feet wide and 8 feet deep. Existing parking may be converted to take advantage of this provision.

[Amended by Ord. #719, 6/17/13]

(.04) Bicycle Parking:

[Response: The proposed site expansion will not alter bike parking.](#)

A. Required Bicycle Parking - General Provisions.

1. The required minimum number of bicycle parking spaces for each use category is shown in Table 5, Parking Standards.
2. Bicycle parking spaces are not required for accessory buildings. If a primary use is listed in Table 5, bicycle parking is not required for the accessory use.
3. When there are two or more primary uses on a site, the required bicycle parking for the site is the sum of the required bicycle parking for the individual primary uses.
4. Bicycle parking space requirements may be waived by the Development Review Board per Section 4.118(.03)(A.)(9.) and (10.).

B. Standards for Required Bicycle Parking

1. Each space must be at least 2 feet by 6 feet in area and be accessible without moving another bicycle.
2. An aisle at least 5 feet wide shall be maintained behind all required bicycle parking to allow room for bicycle maneuvering. Where the bicycle parking is adjacent to a sidewalk, the maneuvering area may extend into the right-of-way.
3. When bicycle parking is provided in racks, there must be enough space between the rack and any obstructions to use the space properly.
4. Bicycle lockers or racks, when provided, shall be securely anchored.
5. Bicycle parking shall be located within 30 feet of the main entrance to the building or inside a building, in a location that is easily accessible for bicycles.

For multi-tenant developments, with multiple business entrances, bicycle parking may be distributed on-site among more than one main entrance.

C. Long-term Bicycle Parking

1. Long-term bicycle parking provides employees, students, residents, commuters, and others who generally stay at a site for several hours a weather-protected place to park bicycles.
2. For a proposed multi-family residential, retail, office, or institutional development, or for a park and ride or transit center, where six (6) or more bicycle parking spaces are required pursuant to Table 5, 50% of the bicycle parking shall be developed as long-term, secure spaces. Required long-term bicycle parking shall meet the following standards:
 - a. All required spaces shall meet the standards in subsection (B.) above, and must be covered in one of the following ways: inside buildings, under roof overhangs or permanent awnings, in bicycle lockers, or within or under other structures.
 - b. All spaces must be located in areas that are secure or monitored (e.g., visible to employees, monitored by security guards, or in public view).
 - c. Spaces are not subject to the locational criterion of (B.)(5.).

[Section 4.155(.04) Added by Ord. #719, 6/17/13]

e. Commercial			
1. Retail store except supermarkets and stores selling bulky merchandise and grocery stores 1500 sq. ft. gross floor area or less	4.1 per 1000 sq. ft.	6.2 per 1000 sq. ft.	1 per 4000 sq. ft. Min. of 2
2. Commercial retail, 1501 sq. ft. or more	4.1 per 1000 sq. ft.	6.2 per 1000 sq. ft.	1 per 4000 sq. ft. Min. of 2
3. Service or repair shops	4.1 per 1000 sq. ft.	6.2 per 1000 sq. ft.	1 per 4000 sq. ft.
4. Retail stores and outlets selling furniture, automobiles or other bulky merchandise where the operator can show the bulky merchandise occupies the major areas of the building	1.67 per 1000 sq. ft.	6.2 per 1000 sq. ft.	1 per 8000 sq. ft. Min. of 2
5. Office or flex space (except medical and dental)	2.7 per 1000 sq. ft.	4.1 per 1000 sq. ft.	1 per 5000 sq. ft. Min. of 2
Bank with drive-thru	4.3 per 1000 sq. ft.	6.5 per 1000 sq. ft.	
6. Medical and dental office or clinic area	3.9 per 1000 sq. ft.	5.9 per 1000 sq. ft.	1 per 5000 sq. ft. Min. of 2
7. Eating or drinking establishments	15.3 per 1000 sq. ft.	23 per 1000 sq. ft.	1 per 4000 sq. ft.
Fast food (with drive-thru)	9.9 per 1000 sq. ft.	14.9 per 1000 sq. ft.	Min. of 4
Other			

8. Mortuaries	1 space/4 seats, or 8ft. of bench length in chapels	No Limit	Min. of 2
f. Industrial			
1. Manufacturing establishment	1.6 per 1000 sq. ft.	No Limit	1 per 10,000 sq. ft. Min. of 6
2. Storage warehouse, wholesale establishment, rail or trucking freight terminal	.3 per 1000 sq. ft.	.5 per 1000 sq. ft.	1 per 20,000 sq. ft. Min. of 2
g. Park & Ride or Transit Parking	As needed	No Limit	10 per acre, with 50% in lockable enclosures

[Table 5 amended by Ordinance No. 538, 2/21/02]

[Table 5 amended by Ordinance No. 548, 10/9/02]

[Table 5 amended by Ordinance No. 719, 6/17/13]

(.05) Minimum Off-Street Loading Requirements:

Response: The proposed site expansion will not alter loading.

A. Every building that is erected or structurally altered to increase the floor area, and which will require the receipt or distribution of materials or merchandise by truck or similar vehicle, shall provide off-street loading berths on the basis of minimum requirements as follows:

1. Commercial, industrial, and public utility uses which have a gross floor area of 5,000 square feet or more, shall provide truck loading or unloading berths in accordance with the following tables:

Square feet of Floor Area	Number of Berths Required
Less than 5,000	0
5,000 - 30,000	1
30,000 - 100,000	2
100,000 and over	3

2. Restaurants, office buildings, hotels, motels, hospitals and institutions, schools and colleges, public buildings, recreation or entertainment facilities, and any similar use which has a gross floor area of 30,000 square feet or more, shall provide off-street truck loading or unloading berths in accordance with the following table:

Square feet of Floor Area	Number of Berths Required
Less than 30,000	0
30,000 - 100,000	1
100,000 and over	2

3. A loading berth shall contain space twelve (12) feet wide, thirty-five (35) feet long, and have a height clearance of fourteen (14) feet. Where the vehicles generally used for loading and unloading exceed these dimensions, the required length of these berths shall be increased to accommodate the larger vehicles.
4. If loading space has been provided in connection with an existing use or is added to an existing use, the loading space shall not be eliminated if elimination would result in less space than is required to adequately handle the needs of the particular use.
5. Off-street parking areas used to fulfill the requirements of this Ordinance shall not be used for loading and unloading operations except during periods of the day when not required to meet parking needs.

B Exceptions and Adjustments.

1. The Planning Director or Development Review Board may approve a loading area adjacent to or within a street right-of-way where it finds that loading and unloading operations:
 - a. Are short in duration (*i.e.*, less than one hour);
 - b. Are infrequent (less than three operations daily);
 - c. Do not obstruct traffic during peak traffic hours;
 - d. Do not interfere with emergency response services or bicycle and pedestrian facilities; and
 - e. Are acceptable to the applicable roadway authority.

(.06) Carpool and Vanpool Parking Requirements:

Response: N/A.

A. Carpool and vanpool parking spaces shall be identified for the following uses:

1. New commercial and industrial developments with seventy-five (75) or more parking spaces,
2. New institutional or public assembly uses, and
3. Transit park-and-ride facilities with fifty (50) or more parking spaces.

B. Of the total spaces available for employee, student, and commuter parking, at least five percent, but not fewer than two, shall be designated for exclusive carpool and vanpool parking.

C. Carpool and vanpool parking spaces shall be located closer to the main employee, student or commuter entrance than all other parking spaces with the exception of ADA parking spaces.

D. Required carpool/vanpool spaces shall be clearly marked "Reserved - Carpool/Vanpool Only."

(.07) Parking Area Redevelopment. The number of parking spaces may be reduced by up to 10% of the minimum required parking spaces for that use when a portion of the existing parking area is modified to accommodate or provide transit-related amenities such as transit stops, pull-outs, shelters, and park and ride stations.

Response: The proposed site expansion will not alter parking.

[Section 4.155 Amended by Ordinance. No. 536, 1/7/02]

[Section 4.155 Amended by Ordinance. No. 719, 6/17/13]

Section 4.167. General Regulations - Access, Ingress and Egress.

(.01) Each access onto streets or private drives shall be at defined points as approved by the City and shall be consistent with the public's health, safety and general welfare. Such defined points of access shall be approved at the time of issuance of a building permit if not previously determined in the development permit. [Amended by Ord. 682, 9/9/10] Section 4.008. Application Procedures - In General.

Response: The proposed modification to the site plan does not impact ingress of egress.

Section 4.176. Landscaping, Screening, and Buffering.

Note: the reader is encouraged to see Section 4.179, applying to screening and buffering of storage areas for solid waste and recyclables.

- (.01) Purpose. This Section consists of landscaping and screening standards and regulations for use throughout the City. The regulations address materials, placement, layout, and timing of installation. The City recognizes the ecological and economic value of landscaping and requires the use of landscaping and other screening or buffering to:
 - A. Promote the re-establishment of vegetation for aesthetic, health, erosion control, flood control and wildlife habitat reasons;
 - B. Restore native plant communities and conserve irrigation water through establishment, or re-establishment, of native, drought-tolerant plants;
 - C. Mitigate for loss of native vegetation;
 - D. Establish and enhance a pleasant visual character which recognizes aesthetics and safety issues;
 - E. Promote compatibility between land uses by reducing the visual, noise, and lighting impacts of specific development on users of the site and abutting sites or uses;
 - F. Unify development and enhance and define public and private spaces;
 - G. Promote the retention and use of existing topsoil and vegetation. Amended soils benefit stormwater retention and promote infiltration;
 - H. Aid in energy conservation by providing shade from the sun and shelter from the wind; and
 - I. Screen from public view the storage of materials that would otherwise be considered unsightly.
 - J. Support crime prevention, create proper sight distance clearance, and establish other safety factors by effective landscaping and screening.
 - K. Provide landscaping materials that minimize the need for excessive use of fertilizers, herbicides and pesticides, irrigation, pruning, and mowing to conserve and protect natural resources, wildlife habitats, and watersheds.
- (.02) Landscaping and Screening Standards.
 - A. Subsections “C” through “I,” below, state the different landscaping and screening standards to be applied throughout the City. The locations where the landscaping and screening are required and the depth of the landscaping and screening is stated in various places in the Code.
 - B. All landscaping and screening required by this Code must comply with all of the provisions of this Section, unless specifically waived or granted a Variance as otherwise provided in the Code. The landscaping standards are minimum requirements; higher standards can be substituted as long as fence and

vegetation-height limitations are met. Where the standards set a minimum based on square footage or linear footage, they shall be interpreted as applying to each complete or partial increment of area or length (e.g., a landscaped area of between 800 and 1600 square feet shall have two trees if the standard calls for one tree per 800 square feet.

C. General Landscaping Standard.

1. Intent. The General Landscaping Standard is a landscape treatment for areas that are generally open. It is intended to be applied in situations where distance is used as the principal means of separating uses or developments and landscaping is required to enhance the intervening space. Landscaping may include a mixture of ground cover, evergreen and deciduous shrubs, and coniferous and deciduous trees.
2. Required materials. Shrubs and trees, other than street trees, may be grouped. Ground cover plants must fully cover the remainder of the landscaped area (see Figure 21: General Landscaping). The General Landscaping Standard has two different requirements for trees and shrubs:
 - a. Where the landscaped area is less than 30 feet deep, one tree is required for every 30 linear feet.
 - b. Where the landscaped area is 30 feet deep or greater, one tree is required for every 800 square feet and two high shrubs or three low shrubs are required for every 400 square feet.

Response: The landscaped area on the south perimeter is 30' deep and a total of 11,945 s.f. Requirements: (1) tree per every 800 s.f. (15 trees required) and (2) high shrubs per every 400 s.f. (60 shrubs required). We are proposing 32 trees and 63 high shrubs. Note: Calculation includes expansion of site.

D. Low Screen Landscaping Standard.

1. Intent. The Low Screen Landscaping Standard is a landscape treatment that uses a combination of distance and low screening to separate uses or developments. It is intended to be applied in situations where low screening is adequate to soften the impact of one use or development on another, or where visibility between areas is more important than a total visual screen. The Low Screen Landscaping Standard is usually applied along street lot lines or in the area separating parking lots from street rights-of-way.
2. Required materials. The Low Screen Landscaping Standard requires sufficient low shrubs to form a continuous screen three (3) feet high and 95% opaque, year-round. In addition, one tree is required for every 30 linear feet of landscaped area, or as otherwise required to provide a tree canopy over the landscaped area. Ground cover plants must fully cover the remainder of the landscaped area. A three (3) foot high masonry wall or a berm may be substituted for the shrubs, but the trees and ground cover plants are still required. When applied along street lot lines, the screen or wall is to be placed

along the interior side of the landscaped area. (See Figure 22: Low Screen Landscaping).

[Response: Low Screen Landscaping is provided on the north, east and west perimeters. Screening along the west side separates parking lots from Boberg Road. Screening along the north and east is adequate to separate drive aisle and storage yard from similar adjacent uses. See sheet L1.02 landscape code requirement numbers and planting plan.](#)

E. High Screen Landscaping Standard.

1. Intent. The High Screen Landscaping Standard is a landscape treatment that relies primarily on screening to separate uses or developments. It is intended to be applied in situations where visual separation is required.
2. Required materials. The High Screen Landscaping Standard requires sufficient high shrubs to form a continuous screen at least six (6) feet high and 95% opaque, year-round. In addition, one tree is required for every 30 linear feet of landscaped area, or as otherwise required to provide a tree canopy over the landscaped area. Ground cover plants must fully cover the remainder of the landscaped area. A six (6) foot high masonry wall or a berm may be substituted for the shrubs, but the trees and ground cover plants are still required. When applied along street lot lines, the screen or wall is to be placed along the interior side of the landscaped area. (See Figure 23: High Screen Landscaping).

[Response: High Screen Landscaping is provided on the south perimeter to visually separate the residential development to the south. See sheet L1.02 landscape code requirement numbers and planting plan](#)

F. High Wall Standard.

1. Intent. The High Wall Standard is intended to be applied in situations where extensive screening to reduce both visual and noise impacts is needed to protect abutting uses or developments from one-another. This screening is most important where either, or both, of the abutting uses or developments can be expected to be particularly sensitive to noise or visual impacts, or where there is little space for physical separation.
2. Required materials. The High Wall Standard requires a masonry wall at least six (6) feet high along the interior side of the landscaped area (see Figure 24: High Wall Landscaping). In addition, one tree is required for every 30 linear feet of wall, or as otherwise required to provide a tree canopy over the landscaped area. Ground cover plants must fully cover the remainder of the landscaped area.

[Response: N/A](#)

G. High Berm Standard.

1. Intent. The High Berm Standard is intended to be applied in situations where extensive screening to reduce both visual and noise impacts is needed to

protect abutting uses or developments from one-another, and where it is desirable and practical to provide separation by both distance and sight-obscuring materials. This screening is most important where either, or both, of the abutting uses or developments can be expected to be particularly sensitive to noise or visual impacts.

2. Required materials. The High Berm Standard requires a berm at least four (4) feet high along the interior side of the landscaped area (see Figure 25: High Berm Landscaping). If the berm is less than six (6) feet high, low shrubs meeting the Low Screen Landscaping Standard, above, are to be planted along the top of the berm, assuring that the screen is at least six (6) feet in height. In addition, one tree is required for every 30 linear feet of berm, or as otherwise required to provide a tree canopy over the landscaped area. Ground cover plants must fully cover the remainder of the landscaped area.

Response: N/A

H. Partially Sight-Obscuring Fence Standard.

1. Intent. The Partially Sight-Obscuring Fence Standard is intended to provide a tall, but not totally blocked, visual separation. The standard is applied where a low level of screening is adequate to soften the impact of one use or development on another, and where some visibility between abutting areas is preferred over a total visual screen. It can be applied in conjunction with landscape plantings or applied in areas where landscape plantings are not necessary and where nonresidential uses are involved.
2. Required materials. Partially Sight-Obscuring Fence Standard are to be at least six (6) feet high and at least 50% sight-obscuring. Fences may be made of wood (other than plywood or particle-board), metal, bricks, masonry or other permanent materials (see Figure 26: Partially Sight-Obscuring Fence).

Response: N/A

I. Fully Sight-Obscuring Fence Standard.

1. Intent. The Fully Sight-Obscuring Fence Standard is intended to provide a totally blocked visual separation. The standard is applied where full visual screening is needed to reduce the impact of one use or development on another. It can be applied in conjunction with landscape plantings or applied in areas where landscape plantings are not necessary.
2. Required materials. Fully sight-obscuring fences are to be at least six (6) feet high and 100% sight-obscuring. Fences may be made of wood (other than plywood or particle-board), metal, bricks, masonry or other permanent materials (see Figure 27: Totally Sight-Obscuring Fence).

Response: N/A

- (.03) Landscape Area. Not less than fifteen percent (15%) of the total lot area, shall be landscaped with vegetative plant materials. The ten percent (10%) parking area landscaping required by section 4.155.03(B)(1) is included in the fifteen percent (15%)

total lot landscaping requirement. Landscaping shall be located in at least three separate and distinct areas of the lot, one of which must be in the contiguous frontage area. Planting areas shall be encouraged adjacent to structures. Landscaping shall be used to define, soften or screen the appearance of buildings and off-street parking areas. Materials to be installed shall achieve a balance between various plant forms, textures, and heights. The installation of native plant materials shall be used whenever practicable. (For recommendations refer to the Native Plant List maintained by the City of Wilsonville). [Amended by Ord. # 674 11/16/09]

Response: 15.2% of the total lot area is to be landscaped. The landscape percentage is taking in to account the proposed site exiation onto lot 300 for the phase 1 development. Landscaping is located in the parking area in the contiguous frontage area and around the entire perimeter of the lot. Landscaping is used to screen and soften off-street parking and storage areas. Native plants have been used where practical. See sheet L1.02 for landscape code requirement calculations. See sheets L1.01 and L1.02 for plant schedule. See L1.03 for typical planting elevation and plant images.

(.04) Buffering and Screening. Additional to the standards of this subsection, the requirements of the Section 4.137.5 (Screening and Buffering Overlay Zone) shall also be applied, where applicable.

A. All intensive or higher density developments shall be screened and buffered from less intense or lower density developments.

Response: Low screen landscaping is used to separate similar developments to the north and east. See sheet L1.02.

B. Activity areas on commercial and industrial sites shall be buffered and screened from adjacent residential areas. Multi-family developments shall be screened and buffered from single-family areas.

Response: High screen landscaping separates activity areas on the PDI zoned property from the residential area along the south perimeter. See sheet L1.02 for planting plan and landscape code requirement information.

C. All exterior, roof and ground mounted, mechanical and utility equipment shall be screened from ground level off-site view from adjacent streets or properties.

Response: N/A

D. All outdoor storage areas shall be screened from public view, unless visible storage has been approved for the site by the Development Review Board or Planning Director acting on a development permit.

Response: 6' chain link fence with privacy slats and landscape screening is proposed around storage yard.

E. In all cases other than for industrial uses in industrial zones, landscaping shall be designed to screen loading areas and docks, and truck parking.

Response: Loading docks and truck parking associated with this project will be screened by fencing and landscaping.

- F. In any zone any fence over six (6) feet high measured from soil surface at the outside of fenceline shall require Development Review Board approval.

Response: No fence over 6'-0" tall is proposed.

- (.05) Sight-Obscuring Fence or Planting. The use for which a sight-obscuring fence or planting is required shall not begin operation until the fence or planting is erected or in place and approved by the City. A temporary occupancy permit may be issued upon a posting of a bond or other security equal to one hundred ten percent (110%) of the cost of such fence or planting and its installation. (See Sections 4.400 to 4.470 for additional requirements.)

- (.06) Plant Materials.

- A. Shrubs and Ground Cover. All required ground cover plants and shrubs must be of sufficient size and number to meet these standards within three (3) years of planting. Non-horticultural plastic sheeting or other impermeable surface shall not be placed under mulch. Native topsoil shall be preserved and reused to the extent feasible. Surface mulch or bark dust are to be fully raked into soil of appropriate depth, sufficient to control erosion, and are confined to areas around plantings. Areas exhibiting only surface mulch, compost or barkdust are not to be used as substitutes for plant areas. [Amended by Ord. # 674 11/16/09]

1. Shrubs. All shrubs shall be well branched and typical of their type as described in current AAN Standards and shall be equal to or better than 2-gallon containers and 10" to 12" spread.

Response: See sheet L1.01 and L1.02 for planting notes and schedule. All plant material shall meet industry standard for quality and shall be at least 2-gallon containers.

2. Ground cover. Shall be equal to or better than the following depending on the type of plant materials used: gallon containers spaced at 4 feet on center minimum, 4" pot spaced 2 feet on center minimum, 2-1/4" pots spaced at 18 inch on center minimum. No bare root planting shall be permitted. Ground cover shall be sufficient to cover at least 80% of the bare soil in required landscape areas within three (3) years of planting. Where wildflower seeds are designated for use as a ground cover, the City may require annual re-seeding as necessary.

Response: See sheet L1.01 and L1.02 for planting notes and schedule. All groundcover shall meet industry standard for quality and shall be 1-gallon containers spaced no more than 36" O.C.

3. Turf or lawn in non-residential developments. Shall not be used to cover more than ten percent (10%) of the landscaped area, unless specifically approved based on a finding that, due to site conditions and availability of water, a larger percentage of turf or lawn area is appropriate. Use of lawn fertilizer shall be

discouraged. Irrigation drainage runoff from lawns shall be retained within lawn areas.

Response: N/A

4. Plant materials under trees or large shrubs. Appropriate plant materials shall be installed beneath the canopies of trees and large shrubs to avoid the appearance of bare ground in those locations.

Response: See sheet L1.02 for planting plan. Appropriate groundcover is provided under all trees to avoid bare ground.

5. Integrate compost-amended topsoil in all areas to be landscaped, including lawns, to help detain runoff, reduce irrigation and fertilizer needs, and create a sustainable, low-maintenance landscape. [Added by Ord. # 674 11/16/09]

Response: See 05/L1.03 for planting bed soil preparation detail. (2) inches of organic compost will be tilled into native soils and topped with mulch.

- B. Trees. All trees shall be well-branched and typical of their type as described in current American Association of Nurserymen (AAN) Standards and shall be balled and burlapped. The trees shall be grouped as follows:

1. Primary trees which define, outline or enclose major spaces, such as Oak, Maple, Linden, and Seedless Ash, shall be a minimum of 2" caliper.
2. Secondary trees which define, outline or enclose interior areas, such as Columnar Red Maple, Flowering Pear, Flame Ash, and Honeylocust, shall be a minimum of 1-3/4" to 2" caliper.
3. Accent trees which, are used to add color, variation and accent to architectural features, such as Flowering- Pear and Kousa Dogwood, shall be 1-3/4" minimum caliper.
4. Large conifer trees such as Douglas-Fir or Deodar Cedar shall be installed at a minimum height of eight (8) feet.
5. Medium-sized conifers such as Shore Pine, Western Red Cedar or Mountain Hemlock shall be installed at a minimum height of five to six (5 to 6) feet.

Response: See sheet L1.04 for tree plan. All trees are a minimum of 2" caliper or 6' tall.

- C. Where a proposed development includes buildings larger than twenty-four (24) feet in height or greater than 50,000 square feet in footprint area, the Development Review Board may require larger or more mature plant materials:

1. At maturity, proposed trees shall be at least one-half the height of the building to which they are closest, and building walls longer than 50 feet shall require tree groups located no more than fifty (50) feet on center, to break up the length and height of the façade.
2. Either fully branched deciduous or evergreen trees may be specified depending upon the desired results. Where solar access is to be preserved,

only solar-friendly deciduous trees are to be used. Where year-round sight obscuring is the highest priority, evergreen trees are to be used.

3. The following standards are to be applied:
 - a. Deciduous trees:
 - i. Minimum height of ten (10) feet; and
 - ii. Minimum trunk diameter (caliper) of 2 inches (measured at four and one-half [4 1/2] feet above grade).
 - b. Evergreen trees: Minimum height of twelve (12) feet.

Response: N/A

- C. Street Trees. In order to provide a diversity of species, the Development Review Board may require a mix of street trees throughout a development. Unless the Board waives the requirement for reasons supported by a finding in the record, different types of street trees shall be required for adjoining blocks in a development.

Response: The site expansion is not impacting street trees.

1. All trees shall be standard base grafted, well branched and typical of their type as described in current AAN Standards and shall be balled and burlapped (b&b). Street trees shall be planted at sizes in accordance with the following standards:
 - a. Arterial streets - 3" minimum caliper
 - b. Collector streets - 2" minimum caliper.
 - c. Local streets or residential private access drives - 1-3/4" minimum caliper. [Amended by Ord. 682, 9/9/10]
 - d. Accent or median tree -1-3/4" minimum caliper.
2. The following trees and varieties thereof are considered satisfactory street trees in most circumstances; however, other varieties and species are encouraged and will be considered:
 - a. Trees over 50 feet mature height: Quercus garryana (Native Oregon White Oak), Quercus rubra borealis (Red Oak), Acer Macrophyllum (Native Big Leaf Maple), Acer nigrum (Green Column Black Maple), Fraxinus americanus (White Ash), Fraxinus pennsylvannica 'Marshall' (Marshall Seedless Green Ash), Quercus coccinea (Scarlet Oak), Quercus pulustris (Pin-Oak), Tilia americana (American Linden).
 - b. Trees under 50 feet mature height: Acer rubrum (Red Sunset Maple), Cornus nuttallii (Native Pacific Dogwood), Gleditsia triacanthos (Honey Locust), Pyrus calleryana 'Bradford' (Bradford Pear), Tilia cordata (Little Leaf Linden), Fraxinus oxycarpa (Flame Ash).
 - c. Other street tree species. Other species may be specified for use in certain situations. For instance, evergreen species may be specified where year-

round color is desirable and no adverse effect on solar access is anticipated. Water-loving species may be specified in low locations where wet soil conditions are anticipated.

[Section 4.176(.06)(D.) amended by Ordinance No. 538, 2/21/02.]

E. Types of Plant Species.

1. Existing landscaping or native vegetation may be used to meet these standards, if protected and maintained during the construction phase of the development and if the plant species do not include any that have been listed by the City as prohibited. The existing native and non-native vegetation to be incorporated into the landscaping shall be identified.
3. Selection of plant materials. Landscape materials shall be selected and sited to produce hardy and drought-tolerant landscaping. Selection shall be based on soil characteristics, maintenance requirements, exposure to sun and wind, slope and contours of the site, and compatibility with other vegetation that will remain on the site. Suggested species lists for street trees, shrubs and groundcovers shall be provided by the City of Wilsonville.
3. Prohibited plant materials. The City may establish a list of plants that are prohibited in landscaped areas. Plants may be prohibited because they are potentially damaging to sidewalks, roads, underground utilities, drainage improvements, or foundations, or because they are known to be invasive to native vegetation.

[Section 4.176(.06)(E.) amended by Ordinance No. 538, 2/21/02.]

Response: All plants have been chosen for their ease of maintenance and drought tolerance with priority given to native species where appropriate. No damaging or invasive species have been used. See sheets L1.01 and L1.02 for plant schedule.

F. Tree Credit.

Existing trees that are in good health as certified by an arborist and are not disturbed during construction may count for landscaping tree credit as follows (measured at four and one-half feet above grade and rounded to the nearest inch):

Existing trunk diameter	Number of Tree Credits
18 to 24 inches in diameter	3 tree credits
25 to 31 inches in diameter	4 tree credits
32 inches or greater	5 tree credits

[Amended by Ord. # 674 11/16/09]

1. It shall be the responsibility of the owner to use reasonable care to maintain preserved trees. Trees preserved under this section may only be removed if an application for removal permit under Section 4.610.10(01)(H) has been approved. Required mitigation for removal shall be replacement with the number of trees credited to the preserved and removed tree.

2. Within five years of occupancy and upon notice from the City, the property owner shall replace any preserved tree that cannot be maintained due to disease or damage, or hazard or nuisance as defined in Chapter 6 of this code. The notice shall be based on complete information provided by an arborist. Replacement with the number of trees credited shall occur within one (1) growing season of notice.

Response: N/A

- F. Exceeding Standards. Landscape materials that exceed the minimum standards of this Section are encouraged, provided that height and vision clearance requirements are met. [Amended by Ordinance No. 538, 2/21/02.]
- G. Compliance with Standards. The burden of proof is on the applicant to show that proposed landscaping materials will comply with the purposes and standards of this Section.[Amended by Ordinance No. 538, 2/21/02.]

(.07) Installation and Maintenance.

- A. Installation. Plant materials shall be installed to current industry standards and shall be properly staked to assure survival. Support devices (guy wires, etc.) shall not be allowed to interfere with normal pedestrian or vehicular movement.

Response: See sheets L1.01 and L1.02 for planting notes. All plants shall be installed to current industry standard and properly staked.

- B. Maintenance. Maintenance of landscaped areas is the on-going responsibility of the property owner. Any landscaping installed to meet the requirements of this Code, or any condition of approval established by a City decision-making body acting on an application, shall be continuously maintained in a healthy, vital and acceptable manner. Plants that die are to be replaced in kind, within one growing season, unless appropriate substitute species are approved by the City. Failure to maintain landscaping as required in this Section shall constitute a violation of this Code for which appropriate legal remedies, including the revocation of any applicable land development permits, may result.

Response: N/A

- C. Irrigation. The intent of this standard is to assure that plants will survive the critical establishment period when they are most vulnerable due to a lack of watering and also to assure that water is not wasted through unnecessary or inefficient irrigation. Approved irrigation system plans shall specify one of the following:

1. A permanent, built-in, irrigation system with an automatic controller. Either a spray or drip irrigation system, or a combination of the two, may be specified.

Response: See sheet L1.02 for irrigation notes. A permanent automatic irrigation system will be installed to provide full coverage to all proposed planting areas.

3. A permanent or temporary system designed by a landscape architect licensed to practice in the State of Oregon, sufficient to assure that the plants will become established and drought-tolerant.

4. Other irrigation system specified by a licensed professional in the field of landscape architecture or irrigation system design.
 5. A temporary permit issued for a period of one year, after which an inspection shall be conducted to assure that the plants have become established. Any plants that have died, or that appear to the Planning Director to not be thriving, shall be appropriately replaced within one growing season. An inspection fee and a maintenance bond or other security sufficient to cover all costs of replacing the plant materials shall be provided, to the satisfaction of the Community Development Director. Additionally, the applicant shall provide the City with a written license or easement to enter the property and cause any failing plant materials to be replaced.
- C. Protection. All required landscape areas, including all trees and shrubs, shall be protected from potential damage by conflicting uses or activities including vehicle parking and the storage of materials.

Response: N/A

- (.08) Landscaping on Corner Lots. All landscaping on corner lots shall meet the vision clearance standards of Section 4.177. If high screening would ordinarily be required by this Code, low screening shall be substituted within vision clearance areas. Taller screening may be required outside of the vision clearance area to mitigate for the reduced height within it.

Response: N/A

- (.09) Landscape Plans. Landscape plans shall be submitted showing all existing and proposed landscape areas. Plans must be drawn to scale and show the type, installation size, number and placement of materials. Plans shall include a plant material list. Plants are to be identified by both their scientific and common names. The condition of any existing plants and the proposed method of irrigation are also to be indicated. Landscape plans shall divide all landscape areas into the following categories based on projected water consumption for irrigation:
- A. High water usage areas (+/- two (2) inches per week): small convoluted lawns, lawns under existing trees, annual and perennial flower beds, and temperamental shrubs;
 - B. Moderate water usage areas (+/- one (1) inch per week): large lawn areas, average water-using shrubs, and trees;
 - C. Low water usage areas (Less than one (1) inch per week, or gallons per hour): seeded fieldgrass, swales, native plantings, drought-tolerant shrubs, and ornamental grasses or drip irrigated areas.
 - D. Interim or unique water usage areas: areas with temporary seeding, aquatic plants, erosion control areas, areas with temporary irrigation systems, and areas with special water-saving features or water harvesting irrigation capabilities.

These categories shall be noted in general on the plan and on the plant material list.

Response: Landscape plans shall be submitted that meet the above requirements. See sheet L1.02 for water consumption notes. All proposed areas are low water usage (less than one inch per week).

- (.10) Completion of Landscaping. The installation of plant materials may be deferred for a period of time specified by the Board or Planning Director acting on an application, in order to avoid hot summer or cold winter periods, or in response to water shortages. In these cases, a temporary permit shall be issued, following the same procedures specified in subsection (.07)(C)(3), above, regarding temporary irrigation systems. No final Certificate of Occupancy shall be granted until an adequate bond or other security is posted for the completion of the landscaping, and the City is given written authorization to enter the property and install the required landscaping, in the event that the required landscaping has not been installed. The form of such written authorization shall be submitted to the City Attorney for review.
- (.11) Street Trees Not Typically Part of Site Landscaping. Street trees are not subject to the requirements of this Section and are not counted toward the required standards of this Section. Except, however, that the Development Review Board may, by granting a waiver or variance, allow for special landscaping within the right-of-way to compensate for a lack of appropriate on-site locations for landscaping. See subsection (.06), above, regarding street trees.
- (.12) Mitigation and Restoration Plantings. A mitigation plan is to be approved by the City's Development Review Board before the destruction, damage, or removal of any existing native plants. Plantings intended to mitigate the loss of native vegetation are subject to the following standards. Where these standards conflict with other requirements of this Code, the standards of this Section shall take precedence. The desired effect of this section is to preserve existing native vegetation.

Response: N/A

- A. Plant Sources. Plant materials are to be native and are subject to approval by the City. They are to be non-clonal in origin; seed source is to be as local as possible, and plants must be nursery propagated or taken from a pre-approved transplantation area. All of these requirements are to be addressed in any proposed mitigation plan.
- B. Plant Materials. The mitigation plan shall specify the types and installation sizes of plant materials to be used for restoration. Practices such as the use of pesticides, fungicides, and fertilizers shall not be employed in mitigation areas unless specifically authorized and approved.
- C. Installation. Install native plants in-suitable soil conditions. Plant materials are to be supported only when necessary because of extreme winds at the site. Where

support is necessary, all stakes, guy wires or other measures are to be removed as soon as the plants can support themselves. Protect from animal and fowl predation and foraging until establishment.

- D. Irrigation. Permanent irrigation systems are generally not appropriate in restoration situations, and manual or temporary watering of new plantings is often necessary. The mitigation plan shall specify the method and frequency of manual watering, including any that may be necessary after the first growing season.
- E. Monitoring and Reporting. Monitoring of native landscape areas is the on-going responsibility of the property owner. Plants that die are to be replaced in kind and quantity within one year. Written proof of the survival of all plants shall be required to be submitted to the City's Planning Department one year after the planting is completed.

[Section 4.176 amended by Ordinance No. 536. 1/7/02]



Figure 21: General Landscaping



Figure 22: Low Screen Landscaping

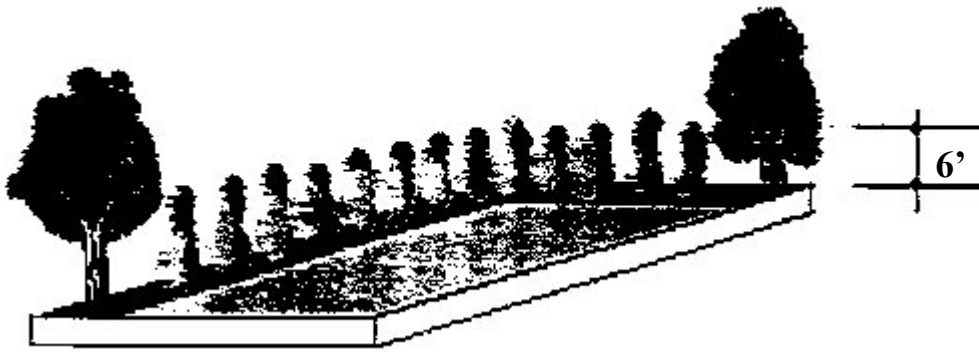


Figure 23: High Screen Landscaping

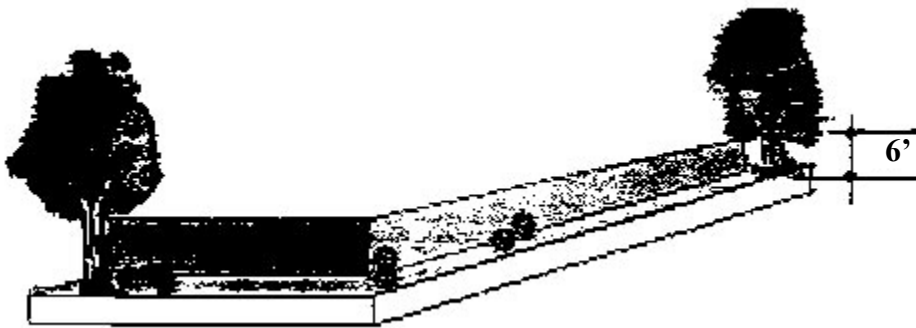


Figure 24: High Wall Landscaping

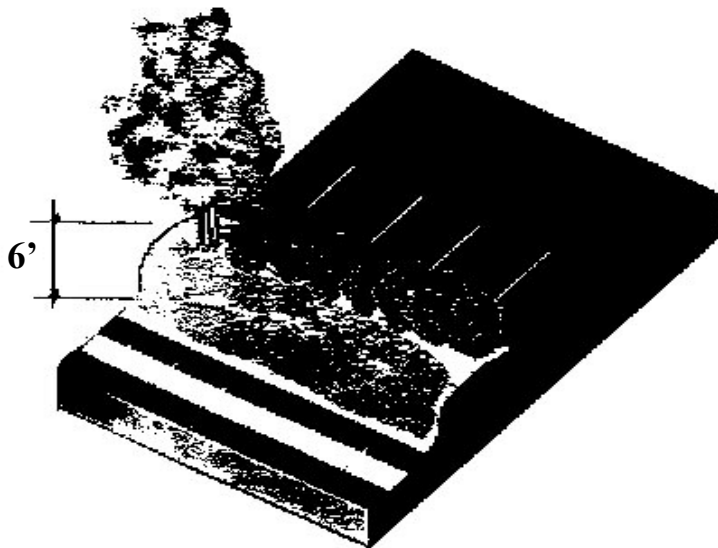


Figure 25: High Berm Landscaping

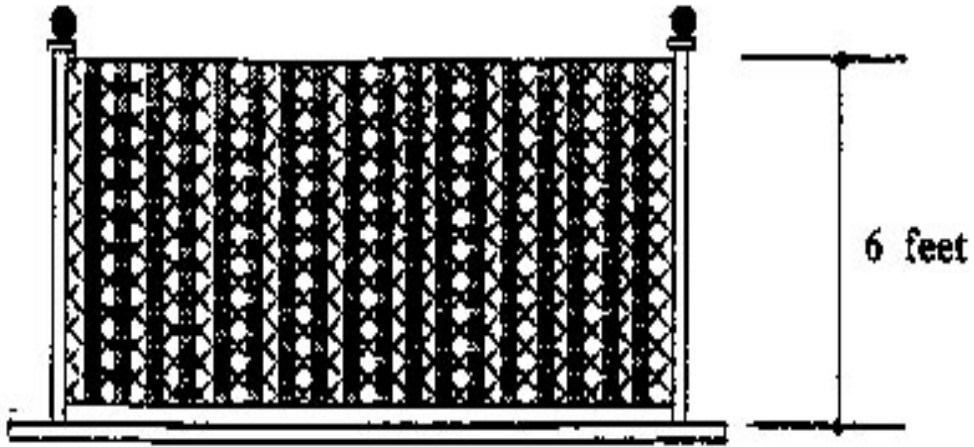


Figure 26: Partially Sight-Obscuring Fence



Figure 27: Totally Sight-Obscuring Fence

TREE CLEARANCES

The Landscaping Graphics

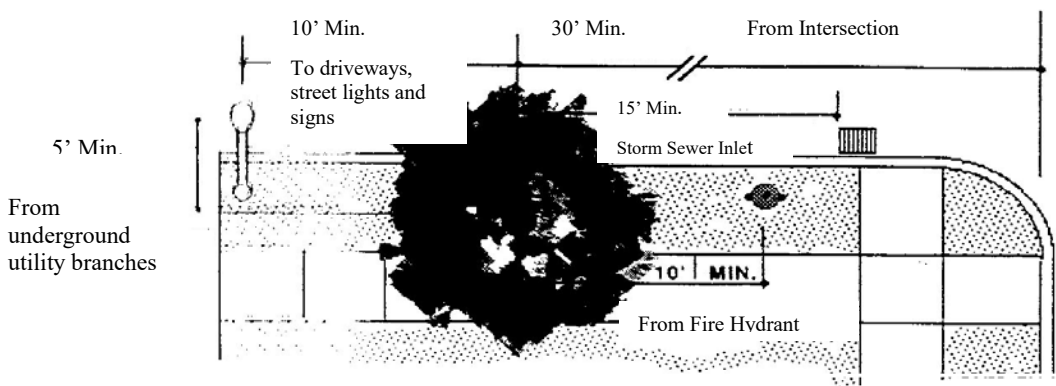
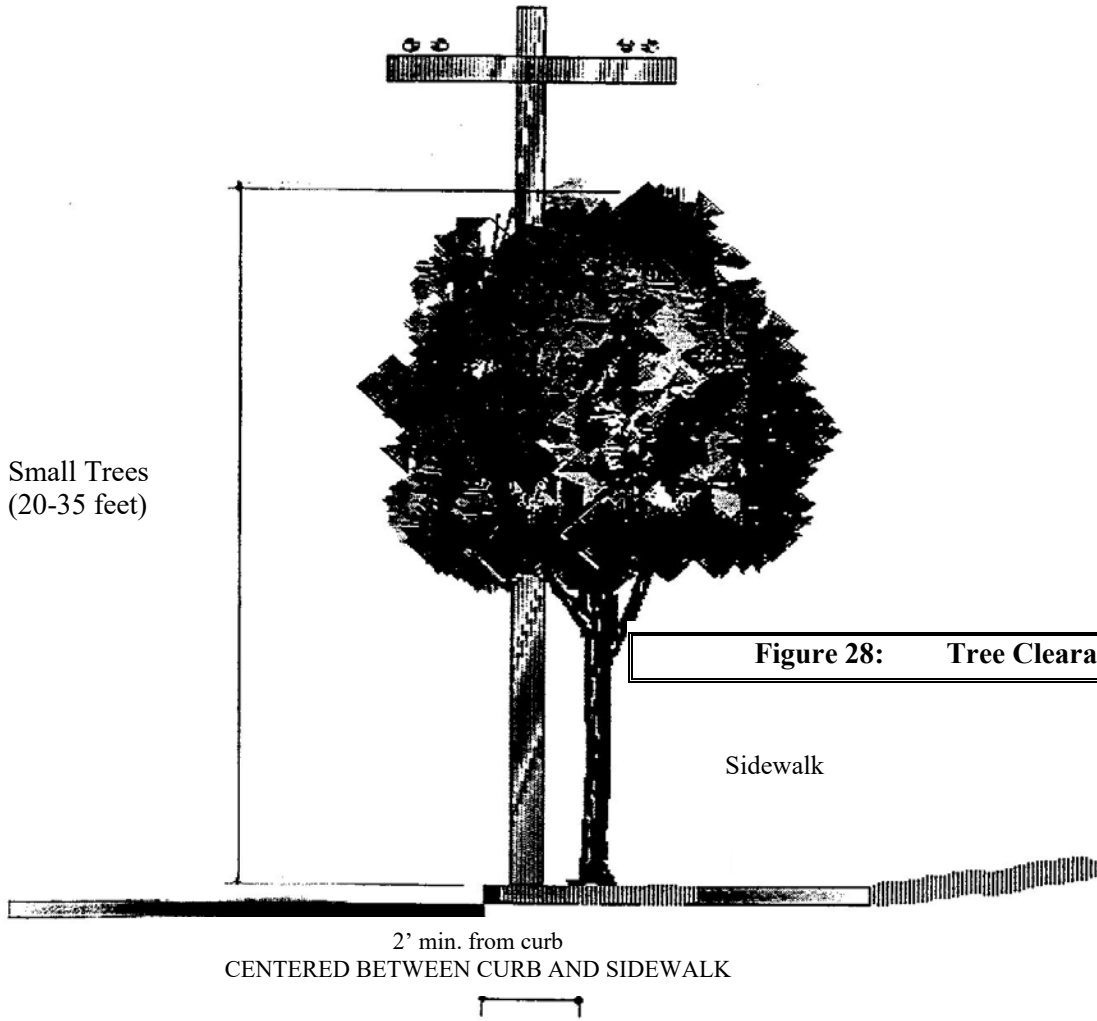


Figure 29: Tree Clearances

Section 4.199 OUTDOOR LIGHTING

- Section 4.199.10 Outdoor Lighting In General.
- Section 4.199.20 Applicability.
- Section 4.199.30 Lighting Zones.
- Section 4.199.40 Lighting Systems Standards for Approval.
- Section 4.199.50 Submittal Requirements.
- Section 4.199.60 Major Additions or Modifications.

Section 4.199.10. Outdoor Lighting In General.

- (.01) Purpose: The purpose of this Code is to provide regulations for outdoor lighting that will:
 - A. Permit reasonable uses of outdoor lighting for nighttime safety, utility, security, productivity, enjoyment and commerce.
 - B. Conserve energy and resources to the greatest extent possible.
 - C. Minimize glare, particularly in and around public rights-of-way; and reduce visual discomfort and improve visual acuity over large areas by avoiding “light islands” and “spotlighting” that result in reduced visual perception in areas adjacent to either the source of the glare or the area illuminated by the glare.
 - D. Minimize light trespass, so that each owner of property does not cause unreasonable light spillover to other property.
 - E. Curtail the degradation of the nighttime environment and the night sky.
 - F. Preserve the dark night sky for astronomy and enjoyment.
 - G. Protect the natural environment, including wildlife, from the damaging effects of night lighting from human sources.

Response: (1) pole mounted light fixture will be located in the proposed expanded storage yard.

- (.02) Purpose Statement as Guidelines: Declaration of purpose statements are guidelines and not approval criteria in the application of WC Section 4.199.

Section 4.199.20. Applicability.

- (.01) This Ordinance is applicable to:
 - A. Installation of new exterior lighting systems in public facility, commercial, industrial and multi-family housing projects with common areas.

Response: The project includes exterior lighting on a commercial project.

- B. Major additions or modifications (as defined in this Section) to existing exterior lighting systems in public facility, commercial, industrial and multi-family housing projects with common areas.

Response: N/A

(.02) Exemption. The following luminaires and lighting systems are EXEMPT from these requirements:

- A. Interior lighting.
- B. Internally illuminated signs.
- C. Externally illuminated signs.
- D. Temporary lighting for theatrical, television, and performance areas.
- E. Lighting in swimming pools and other water features governed by Article 680 of the National Electrical Code.
- F. Building Code required exit path lighting.
- G. Lighting specifically for stairs and ramps.
- H. Temporary and seasonal lighting provided that individual lamps are 10 watts or less.
- I. Lighting required and/or regulated by the City (i.e. construction related activities), Federal Aviation Administration, U.S. Coast Guard or other Federal or State agency.
- J. Single-family residential lighting.
- K. Code Required Signs.
- L. American flag.
- M. Landscape lighting.
- N. Lights approved by the City through an Administrative Review Temporary Use Permit process.
- O. Public street lights.
- P. ATM security lighting.
- Q. Those "Exceptions" listed in the "Exterior Lighting Power Allowance" provisions of the *Oregon Energy Efficiency Specialty Code*. [Added by Ord. 688, 11/15/10]

Response: The project includes several lighting systems noted as exempt including signage, interior, landscape lighting, egress lighting and building exits.

Section 4.199.30. Lighting Overlay Zones.

(.01) The designated Lighting Zone as indicated on the Lighting Overlay Zone Map for a commercial, industrial, multi-family or public facility parcel or project shall

determine the limitations for lighting systems and fixtures as specified in this Ordinance.

- A. Property may contain more than one lighting zone depending on site conditions and natural resource characteristics.

Response: The subject property is the LZ2 shaded zone on the overlay map. The site is indicated on the map below with a star.

(.02) The Lighting Zones shall be:

- A. LZ 1. Developed areas in City and State parks, recreation areas, SROZ wetland and wildlife habitat areas; developed areas in natural settings; sensitive night environments; and rural areas. This zone is intended to be the default condition for rural areas within the City.
- B. LZ 2. Low-density suburban neighborhoods and suburban commercial districts, industrial parks and districts. This zone is intended to be the default condition for the majority of the City.
- C. LZ 3. Medium to high-density suburban neighborhoods and districts, major shopping and commercial districts as depicted on the Lighting Overlay Zone Map.
- D. LZ 4. Reserved for limited applications with special lighting requirements. This zone is appropriate for users who have unique site or operating circumstances that warrant additional light. This zone shall not be applied to residential or agricultural areas.

[Section 4.199.30(.02) amended by Ord. 688, 11/15/10]

Response: The subject property is the LZ2 shaded zone on the overlay map. The site is indicated on the map below with a star.

(.03) Modification of Lighting Zones.

- A. The City Council may modify the designated Lighting Zones of one or more parcels if the City Council finds that the original Lighting Zone was in error, a change in circumstances has occurred warranting the change since the designation was established or the purposes of this section are better served.

Response: The proposed expansion does not request modification of the designated lighting zone.

- B. The Development Review Board (DRB) may modify the designated Lighting Zones as part of the Stage II, Site Design Review Process if the DRB finds that the original Lighting Zone was in error, or a change in circumstances has occurred warranting the change since the designation was established or the purposes of this section are better served.

Response: The proposed expansions does not request modification of the designated lighting zone.

- C. This ordinance establishes a Lighting Overlay Zone Map. The Planning Division shall maintain the current Lighting Overlay Zone Map.

Response: The map, included with this section, has been reviewed for the subject site which is indicated with a star below.

Section 4.199.40. Lighting Systems Standards for Approval.

(.01) Non-Residential Uses and Common Residential Areas.

- A. All outdoor lighting shall comply with either the Prescriptive Option or the Performance Option below.
- B. Prescriptive Option. If the lighting is to comply with this Prescriptive Option, the installed lighting shall meet all of the following requirements according to the designated Lighting Zone.
1. The maximum luminaire lamp wattage and shielding shall comply with Table 7.
 2. Except for those exemptions listed in Section 4.199.20(.02), the exterior lighting for the site shall comply with the *Oregon Energy Efficiency Specialty Code, Exterior Lighting*.
 3. The maximum pole or mounting height shall be consistent with Table 8.
 4. Each luminaire shall be set back from all property lines at least 3 times the mounting height of the luminaire:
 - a. Exception 1: If the subject property abuts a property with the same base and lighting zone, no setback from the common lot lines is required.
 - b. Exception 2: If the subject property abuts a property which is zoned (base and lighting) other than the subject parcel, the luminaire shall be setback three times the mounting height of the luminaire, measured from the abutting parcel's setback line. (Any variance or waiver to the abutting property's setback shall not be considered in the distance calculation).
 - c. Exception 3: If the luminaire is used for the purpose of street, parking lot or public utility easement illumination and is located less than 3 mounting heights from the property line, the luminaire shall include a house side shield to protect adjoining property.
 - d. Exception 4: If the subject property includes an exterior column, wall or abutment within 25 feet of the property line, a luminaire partly shielded or better and not exceeding 60 lamp watts may be mounted onto the exterior column, wall or abutment or under or within an overhang or canopy attached thereto.
 - e. Exception 5: Lighting adjacent to SROZ areas shall be set back 3 times the mounting height of the luminaire, or shall employ a house side shield to protect the natural resource area.

Response: The exterior lighting design shall comply with the prescriptive option per the Oregon Energy Specialty Code Comcheck Compliance forms. All luminaires that face away from the property-lines to include a house side shield. All wall mounted luminaire wattages are below 60 lamp watts.

- C. Performance Option. If the lighting is to comply with the Performance Option, the proposed lighting design shall be submitted by the applicant for approval by the City meeting all of the following:
1. The weighted average percentage of direct uplight lumens shall be less than the allowed amount per Table 9.
 2. The maximum light level at any property line shall be less than the values in Table 9, as evidenced by a complete photometric analysis including horizontal illuminance of the site and vertical illuminance on the plane facing the site up to the mounting height of the luminaire mounted highest above grade. The Building Official or designee may accept a photometric test report, demonstration or sample, or other satisfactory confirmation that the luminaire meets the shielding requirements of Table 7. Luminaires shall not be mounted so as to permit aiming or use in any way other than the manner maintaining the shielding classification required herein:
 - a. Exception 1. If the property line abuts a public right-of-way, including a sidewalk or street, the analysis may be performed across the street at the adjacent property line to the right-of-way.
 - b. Exception 2. If, in the opinion of the Building Official or designee, compliance is impractical due to unique site circumstances such as lot size or shape, topography, or size or shape of building, which are circumstances not typical of the general conditions of the surrounding area. The Building Official may impose conditions of approval to avoid light trespass to the maximum extent possible and minimize any additional negative impacts resulting to abutting and adjacent parcels, as well as public rights-of-way, based on best lighting practices and available lighting technology.
 3. The maximum pole or mounting height shall comply with Table 8.

Response: N/A

- D. Curfew. All prescriptive or performance based exterior lighting systems shall be controlled by automatic device(s) or system(s) that:
1. Initiate operation at dusk and either extinguish lighting one hour after close or at the curfew times according to Table 10; or
 2. Reduce lighting intensity one hour after close or at the curfew time to not more than 50% of the requirements set forth in the *Oregon Energy Efficiency Specialty Code* unless waived by the DRB due to special circumstances; and

3. Extinguish or reduce lighting consistent with 1. and 2. above on Holidays.

The following are exceptions to curfew:

- a. Exception 1: Building Code required lighting.
- b. Exception 2: Lighting for pedestrian ramps, steps and stairs.
- c. Exception 3: Businesses that operate continuously or periodically after curfew.

[Section 4.199.40 amended by Ord. 688, 11/15/10]

Response: No change in expansion. All lighting branch circuits to be routed through automatic lighting control. Luminaires to be 50% dimmed after dusk. Integral photocell on each luminaire to activate luminaire to 100% lumen output upon activation by motion.

(.02) Special Permit for Specific Lighting Fixtures and Systems and When Exceeding Lighting Requirements.

- A. This section is intended to apply to situations where more than normal foot candles are required due to a unique circumstance or use or where it is absolutely essential to perform the proposed activities after dark. All special permits shall be reviewed by the DRB.
- B. Upon issuance of a special permit by the Development Review Board (DRB), lighting systems not complying with the technical requirements of this Ordinance may be installed, maintained, and replaced for lighting that exceeds the maximums permitted by this Ordinance. This section is intended to be applied to uses such as sports lighting systems including but not limited to, sport fields and stadiums, such as baseball and football field lighting, tennis court lighting, swimming pool area lighting and prisons; other very intense lighting defined as having a light source exceeding 200,000 lumens or an intensity in any direction of more than 2,000,000 candelas; building façade lighting of portions of buildings over two stories high; and public monuments.
- C. To obtain such a permit, applicants shall demonstrate that the proposed lighting installation:
 1. Is within Lighting Zone 3 or above.
 2. Has been designed to minimize obtrusive light and artificial sky glow, supported by a signed statement from a registered civil or electrical engineer describing the mitigation measures. Such statement shall be accompanied by calculations indicating the light trespass levels (horizontal and vertical at ground level) at the property line.
 3. Will not create excessive glare, sky glow, or light trespass beyond that which can be reasonably expected by application of best lighting practices, and available technology.
 4. Provides appropriate lighting curfew hours based on the use and the surrounding areas.

- D. The DRB may impose conditions of approval to mitigate any negative impacts resulting to the abutting parcel, based on best lighting practices and available lighting technology.
- E. The City may charge a review fee and may, at the Building Official's option, employ the services of a qualified professional civil or electrical engineer to review such submittals and the cost thereof shall be an additional fee charged to the applicant.

Response: The site has no special activities to warrant any special lighting levels.

Section 4.199.50. Submittal Requirements.

- (.01) Applicants shall submit the following information as part of DRB review or administrative review of new commercial, industrial, multi-family or public facility projects:
 - A. A statement regarding which of the lighting methods will be utilized, prescriptive or performance, and a map depicting the lighting zone(s) for the property.
 - B. A site lighting plan that clearly indicates intended lighting by type and location. For adjustable luminaires, the aiming angles or coordinates shall be shown.
 - C. For each luminaire type, Ddrawings, cut sheets or other documents containing specifications for the intended lighting including but not limited to, luminaire description, mounting, mounting height, lamp type and manufacturer, lamp watts, ballast, optical system/distribution, and accessories such as shields.
 - D. Calculations demonstrating compliance with *Oregon Energy Efficiency Specialty Code, Exterior Lighting*, as modified by Section 4.199.40(.01)(B.)(2.) [Amended by Ord. 688, 11/15/10]
 - E. Lighting plans shall be coordinated with landscaping plans so that pole lights and trees are not placed in conflict with one another. The location of lights shall be shown on the landscape plan. Generally, pole lights should not be placed within one pole length of landscape and parking lot trees.
 - F. Applicants shall identify the hours of lighting curfew.

Response: Design review package for site expansion contains a lighting plan. Lighting fixture type has not been altered, cutsheets can be found with original review package.

- (.02) In addition to the above submittal requirements, Applicants using the Prescriptive Method shall submit the following information as part of the permit set plan review:
 - A. A site lighting plan (items 1 A - F, above) which indicates for each luminaire the 3 mounting height line to demonstrate compliance with the setback requirements. For luminaires mounted within 3 mounting heights of the property line the compliance exception or special shielding requirements shall be clearly indicated.

(.03) In addition to the above submittal requirements, Applicants using the Performance Method shall submit the following information as part of the permit set plan review:

- A. Site plan showing horizontal isocandle lines, or the output of a point-by-point computer calculation of the horizontal illumination of the site, showing property lines and light levels immediately off of the subject property.
- B. For each side of the property, the output of a point-by-point vertical footcandle calculation showing illumination in the vertical plane at the property line from grade to at least 10 feet higher than the height of the tallest pole.
- C. Lighting plans shall be prepared by a qualified licensed engineer.

Response: Not performance method. N/A

(.04) In addition to the above applicable submittal requirements, Applicants for Special Permits shall submit the following to the DRB for review:

- A. Tabulation of International Engineering Society of North America (IESNA) lighting recommendations for each task including area illuminated, recommended illumination level, actual maintained illumination level, and luminaires used specifically to achieve the indicated criteria.
- B. Lighting plans shall be prepared by a qualified licensed engineer.

Response: N/A

(.05) For all calculations, the following light loss factors shall be used unless an alternative is specifically approved by the City:

Metal halide	0.6
High pressure sodium	0.8
Compact fluorescent	0.7
Full size fluorescent	0.75
Incandescent	0.9
Halogen	0.95
Other	As approved

Response: Drawings to comply with submittal process requirements above. All LEDs are calculated with a 0.9 light loss factor.

Section 4.199.60. Major Additions or Modifications to Pre-Existing Sites.

(01.) Major Additions. If a major addition occurs on a property, all of the luminaires on the site shall comply with the requirements of this Section. For purposes of this subsection, the following are considered to be major additions:

- A. Additions of 50 percent or more in terms of additional dwelling units, gross floor area, seating capacity, or parking spaces, either with a single addition or with cumulative additions after July 2, 2008.
- B. Modification or replacement of 50 percent or more of the outdoor lighting luminaires' within a 5-year timeframe existing as of July 2, 2008.

Response: N/A

Lighting Zone	Fully Shielded	Shielded	Partly Shielded	Unshielded
LZ 1	70	20	13	Low voltage landscape lighting 50 watts or less
LZ 2	100	35	39	Low voltage landscape lighting 50 watts or less
LZ 3	250	100	70	Landscape and facade lighting 100 watts or less; ornamental lighting on private drives of 39 watts and less
LZ 4	450	150	150	Landscape and facade lighting 250 watts or less; ornamental lights on private drives and lanterns 70 watts or less; marquee lighting not employing medium based lamps

[Table 7 amended by Ord. 682, 9/9/10; Ord. 688, 11/15/10]

Lighting Zone	Lighting for private drives, driveways, parking, bus stops and other transit facilities	Lighting for walkways, bikeways, plazas and other pedestrian areas	All other lighting
LZ 0	20	8	4
LZ 1	25	12	4
LZ 2	40	18	8
LZ 3	40	18	16
LZ 4	Height limit to be determined by Special Use Permit Only		

Lighting mounted onto buildings or other structures shall not exceed a mounting height greater than 4 feet higher than the tallest part of the building or structure at the place where the lighting is installed, nor higher than 33.33 percent of the horizontal distance of the light from the nearest property line, whichever is less.

[Table amended by Ord. 682, 9/9/10]

Table 9: Performance Method			
Lighting Zone	Maximum percentage of direct upright lumens	Maximum Light Level at Property Line	
		Horizontal plane at grade (foot candles - fc)	Vertical plane facing the site in question, from grade to mounting height of highest mounted luminaire (foot candles – fc)
LZ 0	0	0.01 fc	0.02 fc
LZ 1	1%	0.05 fc	0.1 fc
LZ 2	5%	0.2 fc	0.4 fc
LZ 3	10%	0.4 fc	0.8 fc
LZ 4	20%	0.8 fc	1.6 fc

Table 10: Curfew	
Lighting Zone	Curfew Time
LZ 0	8:00 PM (2000 hours)
LZ 1	
LZ 2	10:00 PM (2200 hours)
LZ 3	Midnight (2400 hours)
LZ 4	

[Tables, above, renumbered by Ord. 688, 11/15/10

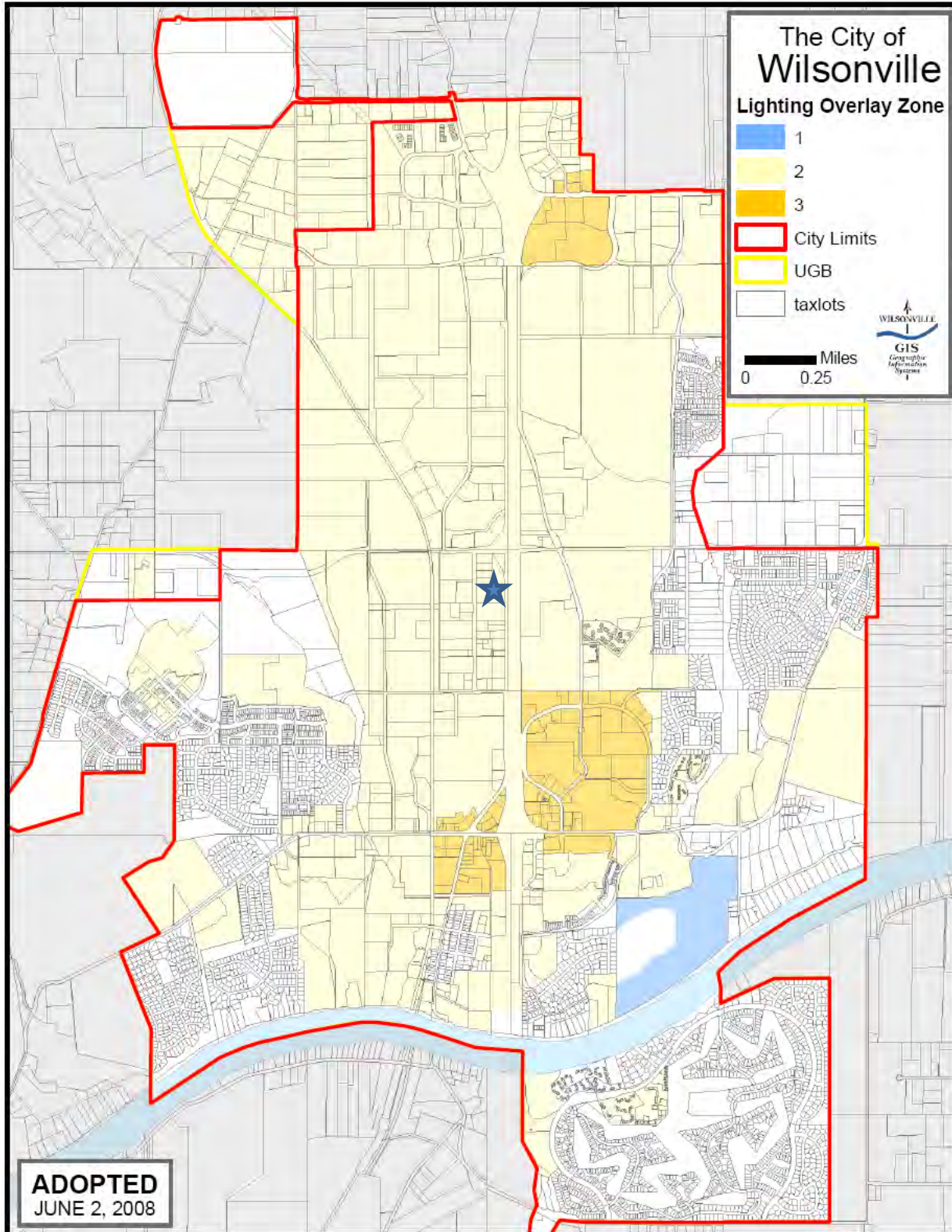


Figure 30: Lighting Overlay Zone Map

[Section 4.199 – 4.199.60 added by Ord. No. 649, adopted 6/2/08]

UNDERGROUND UTILITIES

Section 4.300. General.

- (.01) The City Council deems it reasonable and necessary in order to accomplish the orderly and desirable development of land within the corporate limits of the City, to require the underground installation of utilities in all new developments.

Response: All utility connections and services within the proposed site expansion will be completed underground with no aerial utilities or connections proposed.

- (.02) After the effective date of this Code, the approval of any development of land within the City will be upon the express condition that all new utility lines, including but not limited to those required for power, communication, street lighting, gas, cable television services and related facilities, shall be placed underground.

Response: All proposed utility connections and services within the proposed site expansion will be completed underground with no aerial utilities or connections proposed.

- (.03) The construction of underground utilities shall be subject to the City's Public Works Standards and shall meet applicable requirements for erosion control and other environmental protection.

Response: All proposed utilities within the proposed site expansion are designed to meet the City's public works standards.

Section 4.310 Exceptions.

Section 4.300 of this Code shall not apply to surface-mounted transformers, surface-mounted connection boxes, wireless communication facilities, and meter cabinets and other appurtenances which are reasonably necessary to be placed above ground, or to temporary utility service facilities during construction, or to high capacity electric and communication feeder lines, or to utility transmission lines operating at 50,000 volts or more.

Section 4.320. Requirements.

- (.01) The developer or subdivider shall be responsible for and make all necessary arrangements with the serving utility to provide the underground services (including cost of rearranging any existing overhead facilities). All such underground facilities as described shall be constructed in compliance with the rules and regulations of the Public Utility Commission of the State of Oregon relating to the installation and safety of underground lines, plant, system, equipment and apparatus.

Response: All proposed site expansion utility connections and services will be completed underground with no aerial utilities or connections proposed. All proposed utilities are designed to meet the Public Utility standards.

- (.02) The location of the buried facilities shall conform to standards supplied to the subdivider by the City. The City also reserves the right to approve location of all surface-mounted transformers.

Response: Coordination will be completed with the City to verify the layout and locations of all proposed utilities.

- (.03) Interior easements (back lot lines) will only be used for storm or sanitary sewers, and front easements will be used for other utilities unless different locations are approved by the City Engineer. Easements satisfactory to the serving utilities shall be provided by the developer and shall be set forth on the plat.

Response: Outside of PUE easements requested by the City, no other public utility easements are anticipated.

SITE DESIGN REVIEW.

Section 4.400. Purpose.

- (.01) Excessive uniformity, inappropriateness or poor design of the exterior appearance of structures and signs and the lack of proper attention to site development and landscaping in the business, commercial, industrial and certain residential areas of the City hinders the harmonious development of the City, impairs the desirability of residence, investment or occupation in the City, limits the opportunity to attain the optimum use in value and improvements, adversely affects the stability and value of property, produces degeneration of property in such areas and with attendant deterioration of conditions affecting the peace, health and welfare, and destroys a proper relationship between the taxable value of property and the cost of municipal services therefor.

Response: The proposed site expansion will remain consistent with the design elements that were set forth in the initial review. No modification is proposed to the building, parking layout or signage.

- (.02) The City Council declares that the purposes and objectives of site development requirements and the site design review procedure are to:

A. Assure that Site Development Plans are designed in a manner that insures proper functioning of the site and maintains a high quality visual environment.

Response: The site layout, with the inclusion of the expansion, is efficient and well-functioning for its proposed industrial use. Perimeter landscaping and screening will encompass the open storage area to create a high-quality visual environment.

B. Encourage originality, flexibility and innovation in site planning and development, including the architecture, landscaping and graphic design of said development;

Response: The site expansion is an example of the flexibility built into the initial planning design.

C. Discourage monotonous, drab, unsightly, dreary and inharmonious developments;

Response: Landscaping and screening consistent with the design of the rest of the site will be carried through to the expanded area.

D. Conserve the City's natural beauty and visual character and charm by assuring that structures, signs and other improvements are properly related to their sites, and to surrounding sites and structures, with due regard to the aesthetic qualities of the natural terrain and landscaping, and that proper attention is given to exterior appearances of structures, signs and other improvements;

Response: The proposed site expansion will include landscape design elements that are appropriate for the surrounding context and enhance the visual characteristics of the site.

- E. Protect and enhance the City's appeal and thus support and stimulate business and industry and promote the desirability of investment and occupancy in business, commercial and industrial purposes;

Response: The site expansion will be consistent with the initial development concept. This project will enhance the industrial fabric of this area, contribute to the local economy, grow community and improve Wilsonville. In turn this new development would attract additional investment in the surrounding properties.

- F. Stabilize and improve property values and prevent blighted areas and, thus, increase tax revenues;

Response: This site is currently undeveloped and is an excellent opportunity to enhance and maintain the property.

- G. Insure that adequate public facilities are available to serve development as it occurs and that proper attention is given to site planning and development so as to not adversely impact the orderly, efficient and economic provision of public facilities and services.

Response: Public facilities and improvements included with the initial design will not be impacted by the proposed site expansion.

- H. Achieve the beneficial influence of pleasant environments for living and working on behavioral patterns and, thus, decrease the cost of governmental services and reduce opportunities for crime through careful consideration of physical design and site layout under defensible space guidelines that clearly define all areas as either public, semi-private, or private, provide clear identity of structures and opportunities for easy surveillance of the site that maximize resident control of behavior -- particularly crime;

Response: The storage yard is clearly delineated with fencing. A 30' buffer with landscape and 6' high chain link fence will protect the adjacent low-income housing.

- I. Foster civic pride and community spirit so as to improve the quality and quantity of citizen participation in local government and in community growth, change and improvements;

Response: This project is intended to foster civic pride by enhancing a previously undeveloped lot with an attractive industrial facility, while being sensitive to the adjacent low-income housing.

- J. Sustain the comfort, health, tranquility and contentment of residents and attract new residents by reason of the City's favorable environment and, thus, to promote and protect the peace, health and welfare of the City.

Response: The project location is adjacent to the Walnut Mobile Park, which is a small pocket of low-income mobile homes situated amongst existing industrial

facilities. A 30' landscape buffer with a 6' chain link fence will provide a further buffer between lots.

Section 4.420. Jurisdiction and Powers of the Board.

- (.01) Application of Section. Except for single-family or two-family dwellings in any residential zoning district, and in the Village zone, row houses or apartments, no Building Permit shall be issued for a new building or major exterior remodeling of an existing building, and no Sign Permit, except as permitted in Sections 4.156.02 and 4.156.05, shall be issued for the erection or construction of a sign relating to such new building or major remodeling, until the plans, drawings, sketches and other documents required for a Sign Permit application have been reviewed and approved by the Board. [Amended by Ord. No. 538, 2/21/02.] [Amended by Ord. No. 557, 9/5/03.] [Amended by Ord. No. 704, 6/18/12]

Response: DRB approval is required for proposed modification to the previously approved site design.

- (.02) Development in Accord with Plans. Construction, site development and landscaping shall be carried out in substantial accord with the plans, drawings, sketches and other documents approved by the Board, unless altered with Board approval. Nothing in this subsection shall be construed to prevent ordinary repair, maintenance and replacement of any part of the building or landscaping which does not involve a substantial change from the purpose of Section 4.400. If the Board objects to such proposed changes, they shall be subject to the procedures and requirements of the site design review process applicable to new proposals.

Response: Board approval is required for the proposed modification to the approved plan. The proposed modification, once approved by the Board, will be developed with substantial conformance to the design package. Any further adjustments will be coordinated with the city to determine those adjustment require DRB approval.

- (.03) Variances. The Board may authorize variances from the site development requirements, based upon the procedures, standards and criteria listed in Section 4.196. Variances shall be considered in conjunction with the site design review process.

Response: No requests for variances.

Section 4.421. Criteria and Application of Design Standards.

- (.01) The following standards shall be utilized by the Board in reviewing the plans, drawings, sketches and other documents required for Site Design Review. These standards are intended to provide a frame of reference for the applicant in the development of site and building plans as well as a method of review for the Board. These standards shall not be regarded as inflexible requirements. They are not intended to discourage creativity, invention and innovation. The specifications of

one or more particular architectural styles is not included in these standards. (Even in the Boones Ferry Overlay Zone, a range of architectural styles will be encouraged.)

- A. Preservation of Landscape. The landscape shall be preserved in its natural state, insofar as practicable, by minimizing tree and soils removal, and any grade changes shall be in keeping with the general appearance of neighboring developed areas.

Response: Site grading and layout were adjusted as much as possible to preserve existing landscaping.

- B. Relation of Proposed Buildings to Environment. Proposed structures shall be located and designed to assure harmony with the natural environment, including protection of steep slopes, vegetation and other naturally sensitive areas for wildlife habitat and shall provide proper buffering from less intensive uses in accordance with Sections 4.171 and 4.139 and 4.139.5. The achievement of such relationship may include the enclosure of space in conjunction with other existing buildings or other proposed buildings and the creation of focal points with respect to avenues of approach, street access or relationships to natural features such as vegetation or topography.

Response: The site does not have steep slopes, natural vegetation or sensitive areas for wildlife habitat. The surrounding uses are of similar intensity and landscaping at the site perimeter provides sufficient buffering to these adjacent properties.

- C. Drives, Parking and Circulation. With respect to vehicular and pedestrian circulation, including walkways, interior drives and parking, special attention shall be given to location and number of access points, general interior circulation, separation of pedestrian and vehicular traffic, and arrangement of parking areas that are safe and convenient and, insofar as practicable, do not detract from the design of proposed buildings and structures and the neighboring properties.

Response: The proposed site expansion does not impact drives, parking or circulation.

- D. Surface Water Drainage. Special attention shall be given to proper site surface drainage so that removal of surface waters will not adversely affect neighboring properties of the public storm drainage system.

Response: The proposed stormwater management the proposed expansion will be completed through the installation of a swale on site. This facility is located at the south side of the expansion to ensure that the facilities capture all stormwater runoff and will not allow runoff on to the adjacent properties and public right-of-way.

- E. Utility Service. Any utility installations above ground shall be located so as to have a harmonious relation to neighboring properties and site. The proposed method of sanitary and storm sewage disposal from all buildings shall be indicated.

Response: The complete storm and sewer design is shown on the submitted plans. The design and layout of these utilities is in accordance with the City requirements and will meet this code.

F. Advertising Features. In addition to the requirements of the City's sign regulations, the following criteria should be included: the size, location, design, color, texture, lighting and materials of all exterior signs and outdoor advertising structures or features shall not detract from the design of proposed buildings and structures and the surrounding properties.

Response: The signage will not be impacted by the site expansion.

G. Special Features. Exposed storage areas, exposed machinery installations, surface areas, truck loading areas, utility buildings and structures and similar accessory areas and structures shall be subject to such setbacks, screen plantings or other screening methods as shall be required to prevent their being incongruous with the existing or contemplated environment and its surrounding properties. Standards for screening and buffering are contained in Section 4.176.

Response: The project, with the site expansion, includes an 85,818 square foot storage yard and truck loading area. The storage area will be properly screened by a 6' tall fence and landscaping.

(.02) The standards of review outlined in Sections (a) through (g) above shall also apply to all accessory buildings, structures, exterior signs and other site features, however related to the major buildings or structures.

Response: The site expansion does not include any accessory buildings or structures.

(.03) The Board shall also be guided by the purpose of Section 4.400, and such objectives shall serve as additional criteria and standards.

Response: As noted in response to Section 4.400 above, the proposed development, including the site expansion, is believed to be in strong support of the purpose and goals of this chapter, the underlying zoning district standards, the surrounding area and other standards of the Wilsonville Development Code.

(.04) Conditional application. The Planning Director, Planning Commission, Development Review Board or City Council may, as a Condition of Approval for a zone change, subdivision, land partition, variance, conditional use, or other land use action, require conformance to the site development standards set forth in this Section.

Response: The applicant is aware that review of this application through the DRB may include conditions in response to the application.

(.05) The Board may attach certain development or use conditions in granting an approval that are determined necessary to insure the proper and efficient functioning of the development, consistent with the intent of the Comprehensive Plan, allowed

densities and the requirements of this Code. In making this determination of compliance and attaching conditions, the Board shall, however, consider the effects of this action on the availability and cost of needed housing. The provisions of this section shall not be used in such a manner that additional conditions either singularly or accumulatively have the effect of unnecessarily increasing the cost of housing or effectively excluding a needed housing type.

Response: Applicant is aware of standards for conditions of approval for development and will work with the City staff on applied conditions and timelines associated with each item.

- (.06) The Board or Planning Director may require that certain paints or colors of materials be used in approving applications. Such requirements shall only be applied when site development or other land use applications are being reviewed by the City.
- A. Where the conditions of approval for a development permit specify that certain paints or colors of materials be used, the use of those paints or colors shall be binding upon the applicant. No Certificate of Occupancy shall be granted until compliance with such conditions has been verified.
- B. Subsequent changes to the color of a structure shall not be subject to City review unless the conditions of approval under which the original colors were set included a condition requiring a subsequent review before the colors could be changed.

Response: The proposed site modification does not include changes to the building.

Section 4.430. Location, Design and Access Standards for mixed Solid Waste and Recycling Areas

Response: The proposed site modification does not impact the solid waste and recycling area.

- (.01) The following locations, design and access standards for mixed solid waste and recycling storage areas shall be applicable to the requirements of Section 4.179 of the Wilsonville City Code.
- (.02) Location Standards:
- A. To encourage its use, the storage area for source separated recyclables shall be co-located with the storage area for residual mixed solid waste.
- B. Indoor and outdoor storage areas shall comply with Uniform Building and Fire Code requirements.
- C. Storage area space requirements can be satisfied with a single location or multiple locations and can combine with both interior and exterior locations.

- D. Exterior storage areas can be located within interior side yard or rear yard areas. Minimum setback shall be three (3) feet. Exterior storage areas shall not be located within a required front yard setback, including double frontage lots.
- E. Exterior storage areas shall be located in central and visible locations on a site to enhance security for users.
- F. Exterior storage areas can be located in a parking area if the proposed use provides at least the minimum number of parking spaces required for the use after deducting the area used for storage. Storage areas shall be appropriately screened according to the provisions of Section 4.430 (.03), below.
- G. The storage area shall be accessible for collection vehicles and located so that the storage area will not obstruct pedestrian or vehicle traffic movement on the site or on public streets adjacent to the site.

(.03) Design Standards.

- A. The dimensions of the storage area shall accommodate containers consistent with current methods of local collection.
- B. Storage containers shall meet Uniform Fire Code standards and be made of or covered with waterproof materials or situated in a covered area.
- C. Exterior storage areas shall be enclosed by a sight obscuring fence, wall or hedge at least six (6) feet in height. Gate openings for haulers shall be a minimum of ten (10) feet wide and shall be capable of being secured in a closed or open position. In no case shall exterior storage areas be located in conflict with the vision clearance requirements of Section 4.177.
- D. Storage area(s) and containers shall be clearly labeled to indicate the type of materials accepted.

(.04) Access Standards.

- A. Access to storage areas can be limited for security reasons. However, the storage area shall be accessible to users at convenient times of the day and to collect service personnel on the day and approximate time they are scheduled to provide collection service.
- B. Storage areas shall be designed to be easily accessible to collection trucks and equipment, considering paving, grade and vehicle access. A minimum of ten (10) feet horizontal clearance and eight feet of vertical clearance is required if the storage area is covered.
- C. Storage areas shall be accessible to collection vehicles without requiring backing out of a driveway onto a public street. If only a single access point is available to the storage area, adequate turning radius shall be provided to allow collection vehicles to safely exit the site in a forward motion. (Added by Ordinance #426, April 4, 1994.)

Section 4.440. Procedure.

(.01) Submission of Documents. A prospective applicant for a building or other permit who is subject to site design review shall submit to the Planning Department, in addition to the requirements of Section 4.035, the following:

- A. A site plan, drawn to scale, showing the proposed layout of all structures and other improvements including, where appropriate, driveways, pedestrian walks, landscaped areas, fences, walls, off-street parking and loading areas, and railroad tracks. The site plan shall indicate the location of entrances and exits and direction of traffic flow into and out of off-street parking and loading areas, the location of each parking space and each loading berth and areas of turning and maneuvering vehicles. The site plan shall indicate how utility service and drainage are to be provided.

Response: The submitted drawing package includes a scaled site plan on sheet A0.1 which indicates the proposed site modifications.

- B. A Landscape Plan, drawn to scale, showing the location and design of landscaped areas, the variety and sizes of trees and plant materials to be planted on the site, the location and design of landscaped areas, the varieties, by scientific and common name, and sizes of trees and plant materials to be retained or planted on the site, other pertinent landscape features, and irrigation systems required to maintain trees and plant materials. An inventory, drawn at the same scale as the Site Plan, of existing trees of 4" caliper or more is required. However, when large areas of trees are proposed to be retained undisturbed, only a survey identifying the location and size of all perimeter trees in the mass is necessary.

Response: Landscape plans with the proposed modifications are included with this submittal package.

- C. Architectural drawings or sketches, drawn to scale, including floor plans, in sufficient detail to permit computation of yard requirements and showing all elevations of the proposed structures and other improvements as they will appear on completion of construction. Floor plans shall also be provided in sufficient detail to permit computation of yard requirements based on the relationship of indoor versus outdoor living area, and to evaluate the floor plan's effect on the exterior design of the building through the placement and configuration of windows and doors.

Response: The submitted drawing package does not include floor plans. The proposed modification does not impact the building plan.

- D. A Color Board displaying specifications as to type, color, and texture of exterior surfaces of proposed structures. Also, a phased development schedule if the development is constructed in stages.

Response: A color board of representative colors was included with the original submittal package and was approved. There are no proposed changes to the materials or colors.

E. A sign Plan, drawn to scale, showing the location, size, design, material, color and methods of illumination of all exterior signs.

Response: There are no alterations to the proposed signs that were previously approved.

F. The required application fee.

Response: In coordination with City Staff, the following fees were noted as applicable for our proposed modifications to the site design.

The fees for the land use applications would be as follows:

Stage I Master Plan Modification - \$1,262

Stage II Final Plan Modification - \$2,992

Site Design Review - \$2,249 + \$1,607 (net site area) = \$3,856

DRB Review of Type C Tree Removal Plan - \$164

(.02) As soon as possible after the preparation of a staff report, a public hearing shall be scheduled before the Development Review Board. In accordance with the procedures set forth in Section 4.010(2) and 4.012, the Development Review Board shall review and approve, approve with conditions, or deny the proposed architectural, site development, landscaping or sign plans of the applicant. If the Board finds that additional information or time are necessary to render a decision, the matter may be continued to a date certain. The applicant shall be immediately notified in writing of any such continuation or delay together with the scheduled date of review.

Response: Applicant representatives will be in attendance the DRB hearing.

Section 4.441. Effective Date of Decisions.

A decision of the Board shall become effective fourteen (14) calendar days after the date of the decision, unless the decision is appealed to, or called up by, the Council. If the decision of the Board is appealed to, or called up by, the City Council, the decision of the Council shall become effective immediately.

Response: The applicant understands the associated appears timeline.

Section 4.442. Time Limit on Approval.

Site design review approval shall be void after two (2) years unless a building permit has been issued and substantial development pursuant thereto has taken place; or an extension is granted by motion of the Board.

Response: The applicant is aware of the expiration timeframes relative building permit issuances and development of the project.

Section 4.443. Preliminary Consideration.

An applicant may request preliminary consideration by the Board of general plans prior to seeking a building permit. When seeking preliminary consideration, the applicant shall submit a site plan showing the proposed structures, improvements and parking, together with a general description of the plans. The Board shall approve or reject all or part of the applicant's general plan within the normal time requirements of a formal application. Preliminary approval shall be deemed to be approval of the final plan to the extent that the final design contains the characteristics of the preliminary design.

Response: The application is not seeking preliminary consideration with this application.

Section 4.450. Installation of Landscaping.

- (.01) All landscaping required by this section and approved by the Board shall be installed prior to issuance of occupancy permits, unless security equal to one hundred and ten percent (110%) of the cost of the landscaping as determined by the Planning Director is filed with the City assuring such installation within six (6) months of occupancy. "Security" is cash, certified check, time certificates of deposit, assignment of a savings account or such other assurance of completion as shall meet with the approval of the City Attorney. In such cases the developer shall also provide written authorization, to the satisfaction of the City Attorney, for the City or its designees to enter the property and complete the landscaping as approved. If the installation of the landscaping is not completed within the six-month period, or within an extension of time authorized by the Board, the security may be used by the City to complete the installation. Upon completion of the installation, any portion of the remaining security deposited with the City shall be returned to the applicant.

Response: The applicant assumes this requirement will be listed as a condition of approval similar to previous experience and understanding of construction schedules that may necessitate this requirement.

- (.02) Action by the City approving a proposed landscape plan shall be binding upon the applicant. Substitution of plant materials, irrigation systems, or other aspects of an approved landscape plan shall not be made without official action of the Planning Director or Development Review Board, as specified in this Code.

Response: The applicant will coordinate with the city updates to the design to determine those adjustment which require review through the DRB.

- (.03) All landscaping shall be continually maintained, including necessary watering, weeding, pruning, and replacing, in a substantially similar manner as originally approved by the Board, unless altered with Board approval.

Response: Owner shall continually maintain landscaping.

- (.04) If a property owner wishes to add landscaping for an existing development, in an effort to beautify the property, the Landscape Standards set forth in Section 4.176 shall not apply and no Plan approval or permit shall be required. If the owner wishes to modify or remove landscaping that has been accepted or approved through the City's development review process, that removal or modification must first be approved through the procedures of Section 4.010.

Response: N/A, no existing development.

TREE PRESERVATION AND PROTECTION

Section 4.600. Purpose and Declaration

- (.01) Rapid growth, the spread of development, need for water and increasing demands upon natural resources have the effect of encroaching upon, despoiling, or eliminating many of the trees, other forms of vegetation, and natural resources and processes associated therewith which, if preserved and maintained in an undisturbed and natural condition, constitute important physical, aesthetic, recreational and economic assets to existing and future residents of the City of Wilsonville.
- (.02) Specifically, the City Council finds that:
- A. Woodland growth protects public health through the absorption of air pollutants and contamination, through the reduction of excessive noise and mental and physical damage related to noise pollution, and through its cooling effect in the summer months, and insulating effects in winter;
 - B. Woodlands provide for public safety through the prevention of erosion, siltation, and flooding; and
 - C. Trees make a positive contribution to water quality and water supply by absorbing rainfall, controlling surface water run-off, and filtering and assisting in ground water recharge; and
 - D. Trees and woodland growth are an essential component of the general welfare of the City of Wilsonville by producing play areas for children and natural beauty, recreation for all ages and an irreplaceable heritage for existing and future City residents.
- (.03) Therefore, the purposes of this subchapter are:
- A. To preserve Significant Resource Overlay Zone areas, recognizing that development can and will occur.
 - B. To provide for the protection, preservation, proper maintenance and use of trees and woodlands in order to protect natural habitat and prevent erosion.
 - C. To protect trees and other wooded areas for their economic contribution to local property values when preserved, and for their natural beauty and ecological or historical significance.
 - D. To protect water quality, control surface water run-off, and protect ground water recharge.
 - E. To reflect the public concern for these natural resources in the interest of health, safety and general welfare of Wilsonville residents.
 - F. To encourage replanting where trees are removed.

Section 4.600.20. Applicability of Subchapter

- (.01) The provisions of this subchapter apply to the United States and the State of Oregon, and to their agencies and subdivisions, including the City of Wilsonville, and to the employees and agents thereof.
- (.02) By this subchapter, the City of Wilsonville regulates forest practices on all lands located within its urban growth boundary, as provided by ORS 527.722.
- (.03) The provisions of this subchapter apply to all land within the City limits, including property designated as a Significant Resource Overlay Zone or other areas or trees designated as protected by the Comprehensive Plan, City zoning map, or any other law or ordinance; except that any tree activities in the Willamette River Greenway that are regulated by the provisions of WC 4.500 - 4.514 and requiring a conditional use permit shall be reviewed by the DRB under the application and review procedures set forth for Tree Removal Permits.

Response: Noted.

Section 4.600.30. Tree Removal Permit Required

- (.01) Requirement Established. No person shall remove any tree without first obtaining a Tree Removal Permit (TRP) as required by this subchapter.
- (.02) Tree Removal Permits will be reviewed according to the standards provided for in this subchapter, in addition to all other applicable requirements of Chapter 4.
- (.03) Although tree activities in the Willamette River Greenway are governed by WC 4.500 - 4.514, the application materials required to apply for a conditional use shall be the same as those required for a Type B or C permit under this subchapter, along with any additional materials that may be required by the Planning Department. An application for a Tree Removal Permit under this section shall be reviewed by the Development Review Board.

Response: See sheet L1.04 for proposed protection and removal of trees.

Section 4.600.40. Exceptions

- (.01) Exception from requirement. Notwithstanding the requirement of WC 4.600.30(1), the following activities are allowed without a Tree Removal Permit, unless otherwise prohibited:

- A. Agriculture, Commercial Tree Farm or Orchard. Tree removal or transplanting occurring during use of land for commercial purposes for agriculture, orchard(s), or tree farm(s), such as Christmas tree production.
- B. Emergencies. Actions made necessary by an emergency, such as tornado, windstorm, flood, freeze, utility damage or other like disasters, in order to prevent imminent injury or damage to persons or property or restore order and it is impractical due to circumstances to apply for a permit.
 - 1. When an emergency has occurred, a Tree Removal Permit must be applied for within thirty (30) days following the emergency tree removal under the application procedures established in this subchapter.
 - 2. In addition to complying with the permit application requirements of this subchapter, an applicant shall provide a photograph of any tree removed and a brief description of the conditions that necessitated emergency removal. Such photograph shall be supplied within seven days of application for a permit. Based on good cause shown arising out of the emergency, the Planning Director may waive any or all requirements of this section.
 - 3. Where a Type A Permit is granted for emergency tree removal, the permittee is encouraged to apply to the City Tree Fund for replanting assistance.
- C. City utility or road work in utility or road easements, in utility or road right-of-ways, or in public lands. However, any trees removed in the course of utility work shall be mitigated in accordance with the standards of this subchapter.
- D. Nuisance abatement. The City is not required to apply for a Tree Removal Permit to undertake nuisance abatement as provided in WC 6.200 et seq. However, the owner of the property subject to nuisance abatement is subject to all the provisions of this subchapter in addition to the requirements of WC 6.200 et seq.
- E. The removal of filbert trees is exempt from the requirements of this subchapter.
- F. The Charbonneau District, including its golf course, is exempt from the requirements of WC 4.600.30(1) on the basis that by and through the current CC&R's of the Charbonneau Country Club, the homeowners' association complies with all requirements of WC 4.610.30(1)(C)(1). This exception has been based upon the Tree Maintenance and Protection Plan that has been submitted by the Charbonneau Country Club and approved by the Planning Director. Tree removal activities remain subject to all applicable standards of this subchapter. Unless authorized by the City, this exception does not include tree removal upon any public easements or public property within the district. In the event that the CC&R's are changed relative to the effect of the Tree Maintenance and Protection Plan, then the Planning Director shall review whether such effect is material, whether it can be mitigated, and if not, may disallow the exemption.

Section 4.600.50. Application For Tree Removal Permit

- (.01) Application for Permit. A person seeking to remove one or more trees shall apply to the Director for a Tree Removal Permit for a Type A, B, C, or D permit, depending on the applicable standards as provided in this subchapter.
- (A) An application for a tree removal permit that does not meet the requirements of Type A may be submitted as a Type B application.
- (.02) Time of Application. Application for a Tree Removal Permit shall be made before removing or transplanting trees, except in emergency situations as provided in WC 4.600.40 (1)(B) above. Where the site is proposed for development necessitating site plan or plat review, application for a Tree Removal Permit shall be made as part of the site development application as specified in this subchapter.
- (.03) Fees. A person applying for a Tree Removal Permit shall pay a non-refundable application fee; as established by resolution of the City Council.
- A. By submission of an application, the applicant shall be deemed to have authorized City representatives to have access to applicant's property as may be needed to verify the information provided, to observe site conditions, and if a permit is granted, to verify that terms and conditions of the permit are followed.

Response: The proposed expansion of the site will require the removal of existing trees and a Type C review is required.

Section 4.610.00. Application Review Procedure

- (.01) The permit applicant shall provide complete information as required by this subchapter in order for the City to review the application.
- (.02) Departmental Review. All applications for Tree Removal Permits must be deemed complete by the City Planning Department before being accepted for review. When all required information has been supplied, the Planning Department will verify whether - the application is complete. Upon request of either the applicant or the City, the City may conduct a field inspection or review meeting. City departments involved in the review shall submit their report and recommendations to the Planning Director who shall forward them to the appropriate reviewing authority.
- (.03) Reviewing Authority.
- A. Type A or B. Where site plan review or plat approval by the Development Review Board is not required by City ordinance, the grant or denial of the Tree Removal Permit application shall be the responsibility of the Planning Director. The Planning Director has the authority to refer a Type B permit application to the DRB under the Class II administrative review procedures of this Chapter. The decision to grant or deny a permit shall be governed by the applicable review standards enumerated in WC 4.610.10

- B. Type C. Where the site is proposed for development necessitating site plan review or plat approval by the Development Review Board, the Development Review Board shall be responsible for granting or denying the application for a Tree Removal Permit, and that decision may be subject to affirmance, reversal or modification by the City Council, if subsequently reviewed by the Council.
 - C. Type D. Type D permit applications shall be subject to the standards and procedures of Class I administrative review and shall be reviewed for compliance with the Oregon Forest Practice Rules and Statutes. The Planning Director shall make the decision to grant or deny an application for a Type D permit.
 - D. Review period for complete applications. Type A permit applications shall be reviewed within 10 (ten) working days. Type B permit applications shall be reviewed by the Planning Director within thirty (30) calendar days, except that the DRB shall review any referred application within sixty (60) calendar days. Type C permit applications shall be reviewed within the time frame established by this Chapter. Type D permit applications shall be reviewed within 15 calendar days.
- (.04) Notice. Before the granting of a Type C Tree Removal Permit, notice of the application shall be sent by regular mail to all owners within two hundred fifty feet (250') of the property where the trees are located as provided for in WC 4.010. The notice shall indicate where the application may be inspected and when a public hearing on the application will be held.
- (.05) Denial of Tree Removal Permit. Whenever an application for a Tree Removal Permit is denied, the permit applicant shall be notified, in writing, of the reasons for denial.
- (.06) Grant of a Tree Removal Permit. Whenever an application for a Type B, C or D Tree Removal Permit is granted, the reviewing authority shall:
- A. Conditions. Attach to the granting of the permit any reasonable conditions considered necessary by the reviewing authority including, but not limited to, the recording of any plan or agreement approved under this subchapter, to ensure that the intent of this Chapter will be fulfilled and to minimize damage to, encroachment on or interference with natural resources and processes within wooded areas;
 - B. Completion of Operations. Fix a reasonable time to complete tree removal operations; and
 - C. Security. Require the Type C permit grantee to file with the City a cash or corporate surety bond or irrevocable bank letter of credit in an amount determined necessary by the City to ensure compliance with Tree Removal Permit conditions and this Chapter.

1. This requirement may be waived by the Planning Director if the tree removal must be completed before a plat is recorded, and the applicant has complied with WC 4.264(1) of this Code.

Response: Noted.

Section 4.610.10. Standards For Tree Removal, Relocation Or Replacement

- (.01) Except where an application is exempt, or where otherwise noted, the following standards shall govern the review of an application for a Type A, B, C or D Tree Removal Permit:
- A. Standard for the Significant Resource Overlay Zone. The standard for tree removal in the Significant Resource Overlay Zone shall be that removal or transplanting of any tree is not inconsistent with the purposes of this Chapter.
 - B. Preservation and Conservation. No development application shall be denied solely because trees grow on the site. Nevertheless, tree preservation and conservation as a design principle shall be equal in concern and importance to other design principles.
 - C. Developmental Alternatives. Preservation and conservation of wooded areas and trees shall be given careful consideration when there are feasible and reasonable location alternatives and design options on-site for proposed buildings, structures or other site improvements.
 - D. Land Clearing. Where the proposed activity requires land clearing, the clearing shall be limited to designated street rights-of-way and areas necessary for the construction of buildings, structures or other site improvements.
 - E. Residential Development. Where the proposed activity involves residential development, residential units shall, to the extent reasonably feasible, be designed and constructed to blend into the natural setting of the landscape.
 - F. Compliance With Statutes and Ordinances. The proposed activity shall comply with all applicable statutes and ordinances.
 - G. Relocation or Replacement. The proposed activity shall include necessary provisions for tree relocation or replacement, in accordance with WC 4.620.00, and the protection of those trees that are not to be removed, in accordance with WC 4.620.10.
 - H. Limitation. Tree removal or transplanting shall be limited to instances where the applicant has provided completed information as required by this Chapter and the reviewing authority determines that removal or transplanting is necessary based on the criteria of this subsection.
 1. Necessary For Construction. Where the applicant has shown to the satisfaction of the reviewing authority that removal or transplanting is

necessary for the construction of a building, structure or other site improvement, and that there is no feasible and reasonable location alternative or design option on-site for a proposed building, structure or other site improvement; or a tree is located too close to existing or proposed buildings or structures, or creates unsafe vision clearance.

2. Disease, Damage, or Nuisance, or Hazard. Where the tree is diseased, damaged, or in danger of falling, or presents a hazard as defined in WC 6.208, or is a nuisance as defined in WC 6.200 et seq., or creates unsafe vision clearance as defined in this Code.
 - (a) As a condition of approval of Stage II development, filbert trees must be removed if they are no longer commercially grown or maintained.
 3. Interference. Where the tree interferes with the healthy growth of other trees, existing utility service or drainage, or utility work in a previously dedicated right-of-way, and it is not feasible to preserve the tree on site.
 4. Other. Where the applicant shows that tree removal or transplanting is reasonable under the circumstances.
- I. Additional Standards for Type C Permits.
1. Tree survey. For all site development applications reviewed under the provisions of Chapter 4 Planning and Zoning, the developer shall provide a Tree Survey before site development as required by WC 4.610.40, and provide a Tree Maintenance and Protection plan, unless specifically exempted by the Planning Director or DRB, prior to initiating site development.
 2. Platted Subdivisions. The recording of a final subdivision plat whose preliminary plat has been reviewed and approved after the effective date of Ordinance 464 by the City and that conforms with this subchapter shall include a Tree Survey and Maintenance and Protection Plan, as required by this subchapter, along with all other conditions of approval.
 3. Utilities. The City Engineer shall cause utilities to be located and placed wherever reasonably possible to avoid adverse environmental consequences given the circumstances of existing locations, costs of placement and extensions, the public welfare, terrain, and preservation of natural resources. Mitigation and/or replacement of any removed trees shall be in accordance with the standards of this subchapter.
- J. Exemption. Type D permit applications shall be exempt from review under standards D, E, H and I of this subsection.

Response: Noted.

Section 4.610.20. Type A Permit

- (.01) Approval to remove one to three trees within a twelve (12) month period on any property shall be granted if the application meets all of the following requirements:
 - A. The trees subject to removal are not located in the Significant Resource Overlay Zone; and
 - B. The trees subject to removal are not located in the Willamette River Greenway;
 - C. The trees subject to removal are not Heritage Trees.
 - D. The trees subject to removal are not street trees;
 - E. The trees subject to removal must not be retained as a condition of site development approval.
- (.02) Where the City determines that an application to remove a tree or trees does not meet the criteria of 1(A) - (E) of this section, then the application may be submitted as a Type B application.
- (.03) An application for a Type A Permit shall contain the following information:
 - A. A brief statement explaining why tree removal is necessary.
 - B. A brief description of the trees proposed for removal or relocation, including common name, approximate height, diameter (or circumference) at four and one-half (4 1/2) feet d.b.h. above grade, and apparent health.
 - C. A drawing that depicts where trees are located and provides sufficient detail to indicate to a City reviewer where removal or relocation will occur.
 - D. The name of the person who will perform the removal or transplanting, if known, and the approximate date of removal.
 - E. Additional supporting information which the Planning Department requests, in order to determine whether an application meets the requirements of this section.
- (.04) The City shall accept a Type A permit application under the following procedure:
 - A. Review Period. Completed Type A permit applications shall be reviewed within ten (10) working days. The grant or denial of the Tree Removal Permit application shall be the responsibility of the Planning Director.
 - B. The Type A permit application shall be reviewed under the standards of Class I administrative review and applicable requirements of this subchapter.

Response: N/A

Section 4.610.30. Type B Permit

- (.01) An applicant may apply for a Type B Permit based on the following criteria:

- A. The applicant proposes to remove four (4) or more trees on property not subject to site development review; or
 - B. The applicant proposes major or minor changes in a condition or conditions of a development permit previously approved under the provisions of this Chapter; or
 - C. The applicant is a homeowners' association that proposes to remove trees on property previously approved by the City for development.
 - 1. A Tree Maintenance and Protection Plan submitted for approval-under (1)(C) of this subsection shall meet the following criteria:
 - a. The Development Review Board shall review the Covenants, Conditions and Restrictions (CC&R's) to verify that the homeowners' association is designated and authorized by the CC&R's to review tree maintenance, removal, and planting requests.
 - b. A request for tree removal shall indicate the reason for the request, as well as the location, size, species and health of tree.
 - c. Decisions on requests and actions taken are documented and retained and shall be made available to the City's Development Review Board upon request.
 - d. A replanting program is established and reviewed on an annual basis. Where such a program is approved, mitigation under this Chapter shall not be required.
 - 2. Any permit approved under this subsection shall require that all maintenance, planting, and removal be performed to the standards established in this subchapter and in Wilsonville Code.
 - 3. Failure of a homeowners' association to meet the requirements of this subsection shall be grounds for revocation of a Type B permit.
- (.02) Application for the Type B permit shall consist of the information required for a Type A Permit, as provided in WC 4.610.20, and a Tree Maintenance and Protection Plan, which shall contain the following information:
- A. An accurate topographical survey, subdivision map or plat map, that bears the signature of a qualified, registered surveyor or engineer, and which shows:
 - 1. the shape and dimensions of the property, and the location of any existing and proposed structure or improvement,
 - 2. the location of the trees on the site, and indicating species, approximate height, d.b.h. diameter, canopy spread and common name,
 - 3. the location of existing and proposed easements, as well as setbacks required by existing zoning requirements.
 - B. In lieu of the map or survey, an applicant proposing to remove trees under (1)(B) or (1)(C) of this subsection may provide aerial photographs with overlays, GIS

documentation, or maps approved by the Planning Director, and clearly indicating the information required by (2)(A) of this subsection.

- C. Arborist Report. The report shall describe the health and condition of all trees subject to removal or transplanting, and shall include information on species, common name, diameter at four and one-half (4 1/2) feet d.b.h., approximately height and age.
- D. Tree Protection. Unless specifically exempted by the Planning Director, a statement describing how trees intended to remain will be protected during tree removal, and how remaining trees will be maintained.
- E. Tree Identification. Unless specifically exempted by the Planning Director, a statement that any trees proposed for removal will be identified by a method obvious to a site inspector, such as tagging, painting, or flagging, in addition to clear identification on construction documents.
- F. Replacement Trees. A description of the proposed tree replacement program with a detailed explanation including the number, size, and species, and cost. In lieu of replacing trees, the applicant may propose to pay into the City Tree Fund an amount equivalent to the value of the replacement trees after installation, as provided in this subchapter.
- G. Covenants, Conditions and Restrictions (CC&R's). Where the applicant is proposing to remove trees on common areas, the applicant shall provide a copy of the applicable CC&R's, including any landscaping provisions.
- H. Waiver of documentation. The Planning Director may waive an application document where the required information has already been made available to the City, or where the Director determines the information is not necessary to review the application.

(.03) Review.

- A. The Type B permit application, including major or minor changes in a condition or conditions of a development permit previously approved under the provisions of this chapter, shall be reviewed under the standards of Class II administrative review and the requirements of this subchapter. Where site plan review or plat approval by the Development Review Board is not required by City ordinance, the grant or denial of the Type B permit shall be the responsibility of the Planning Director. The Planning Director has the authority to refer a Type B permit application to DRB under the Class II administrative review procedures of this Chapter.
- B. The DRB shall review and render a decision on any application referred by the Planning Director within sixty (60) days. The Planning Director shall review a completed permit application within thirty (30) days.
- C. The decision to grant or deny a Type B permit shall be governed by the standards established in WC 4.610.10.

Response: N/A

Section 4.610.40. Type C Permit

- (.01) Approval to remove any trees on property as part of a site development application may be granted in a Type C permit. A Type C permit application shall be reviewed by the standards of this subchapter and all applicable review criteria of Chapter 4. Application of the standards of this section shall not result in a reduction of square footage or loss of density, but may require an applicant to modify plans to allow for buildings of greater height. If an applicant proposes to remove trees and submits a landscaping plan as part of a site development application, an application for a Tree Removal Permit shall be included. The Tree Removal Permit application will be reviewed in the Stage II development review process, and any plan changes made that affect trees after Stage II review of a development application shall be subject to review by DRB. Where mitigation is required for tree removal, such mitigation may be considered as part of the landscaping requirements as set forth in this Chapter. Tree removal shall not commence until approval of the required Stage II application and the expiration of the appeal period following that decision. If a decision approving a Type C permit is appealed, no trees shall be removed until the appeal has been settled.
- (.02) The applicant must provide ten copies of a Tree Maintenance and Protection Plan completed by an arborist that contains the following information:
- A. A plan, including a topographical survey bearing the stamp and signature of a qualified, registered professional containing all the following information:
1. Property Dimensions. The shape and dimensions of the property, and the location of any existing and proposed structure or improvement.

Response: See sheet L1.04 for proposed protection and removal of trees.

2. Tree survey. The survey must include:
 - a. An accurate drawing of the site based on accurate survey techniques at a minimum scale of one inch (1") equals one hundred feet (100') and which provides a) the location of all trees having six inches (6") or greater d.b.h. likely to be impacted, b) the spread of canopy of those trees, (c) the common and botanical name of those trees, and d) the approximate location and name of any other trees on the property.
 - b. A description of the health and condition of all trees likely to be impacted on the site property. In addition, for trees in a present or proposed public street or road right-of-way that are described as unhealthy, the description shall include recommended actions to restore such trees to full health. Trees proposed to remain, to be transplanted or to be removed shall be so designated. All trees to remain on the site are to be designated with metal tags that are to remain in place throughout the

development. Those tags shall be numbered, with the numbers keyed to the tree survey map that is provided with the application.

- c. Where a stand of twenty (20) or more contiguous trees exist on a site and the applicant does not propose to remove any of those trees, the required tree survey may be simplified to accurately show only the perimeter area of that stand of trees, including its drip line. Only those trees on the perimeter of the stand shall be tagged, as provided in "b," above.
- d. All Oregon white oaks, native yews, and any species listed by either the state or federal government as rare or endangered shall be shown in the tree survey.

Response: Please see evaluation by Northwest Tree Specialists and attached tree report.

3. Tree Protection. A statement describing how trees intended to remain will be protected during development, and where protective barriers are necessary, that they will be erected before work starts. Barriers shall be sufficiently substantial to withstand nearby construction activities. Plastic tape or similar forms of markers do not constitute "barriers."

Response: Please see evaluation by Northwest Tree Specialists and attached tree report.

4. Easements and Setbacks. Location and dimension of existing and proposed easements, as well as all setbacks required by existing zoning requirements.

Response: Please see Landscape sheets L1.02.

5. Grade Changes. Designation of grade changes proposed for the property that may impact trees.

Response: Please see Landscape sheets L1.02.

6. Cost of Replacement. A cost estimate for the proposed tree replacement program with a detailed explanation including the number, size and species.

Response: NA

7. Tree Identification. A statement that all trees being retained will be identified by numbered metal tags, as specified in subsection "A," above in addition to clear identification on construction documents.

Response: NA

Section 4.610.50. Type D Permit

- (.01) The owner or operator of a commercial woodlot shall apply and receive approval for a Type D Permit before beginning harvesting operations of more than three (3) trees within any twelve (12) month period. Type D permit applications shall be subject to the standards and procedures of Class I administrative review and shall be reviewed for compliance with the Oregon Forest Practice Rules. The removal of three (3) or fewer trees in a commercial woodlot within any twelve (12) month period shall not require a tree removal permit.

- (.02) Sites which meet the following criteria on the effective date of this regulation shall be designated as commercial woodlots by the Planning Director:
- A. The site is at least 30,000 square feet.
 - B. Trees have been maintained on the site for the purpose of harvesting.
 - C. The property from which the forest species are to be harvested are in a property tax deferred status based on agricultural and/or forest use under state law provisions for Farm Deferral, Forest Land Deferral, or Small Woodlands Deferral.
- (.03) All other sites which potentially meet the criteria of WC 4.610.50(B) shall be reviewed by the Development Review Board, which shall determine whether a site meets the criteria for a commercial woodlot designation when an application is submitted for a tree removal permit.
- (.04) Approval to remove trees as part of a commercial harvest shall be granted if a plan meets all of the following criteria:
- A. Trees will be grown and maintained according to an established plan.
 - B. Approved forestry practices will be followed. Forest practices include the administrative rules as adopted by the Oregon Department of Forestry.
 - C. Harvested trees will be replanted according to an established plan. Where trees are proposed to be removed as a final harvest and no further planting, maintenance, or rotation of trees will occur after trees are removed, the applicant shall propose an erosion control and revegetation plan for review.

Response: N/A

Section 4.620.00. Tree Relocation, Mitigation, Or Replacement

- (.01) Requirement Established. A Type B or C Tree Removal Permit grantee shall replace or relocate each removed tree having six (6) inches or greater d.b.h. within one year of removal.

Response: Trees will be planted as part of the site expansion.

- (.02) Basis For Determining Replacement. The permit grantee shall replace removed trees on a basis of one (1) tree replanted for each tree removed. All replacement trees must measure two inches (2") or more in diameter. Alternatively, the Planning Director or Development Review Board may require the permit grantee to replace removed trees on a per caliper inch basis, based on a finding that the large size of the trees being removed justifies an increase in the replacement trees required. Except, however, that the Planning Director or Development Review Board may allow the use of replacement Oregon white oaks and other uniquely valuable trees with a smaller diameter.

Response: Trees with a min. 2" cal. are proposed throughout. Please see landscape plans L1.01, L1.02 and L1.03.

- (.03) Replacement Tree Requirements. A mitigation or replacement tree plan shall be reviewed by the City prior to planting and according to the standards of this subsection.
- A. Replacement trees shall have shade potential or other characteristics comparable to the removed trees, shall be appropriately chosen for the site from an approved tree species list supplied by the City, and shall be state Department of Agriculture Nursery Grade No. 1 or better.

Response: Please see landscape plans L1.01, L1.02 and L1.03.

- B. Replacement trees must be staked, fertilized and mulched, and shall be guaranteed by the permit grantee or the grantee's successors-in-interest for two (2) years after the planting date.

Response: Noted

- C. A "guaranteed" tree that dies or becomes diseased during that time shall be replaced.

Response: Noted

- D. Diversity of tree species shall be encouraged where trees will be replaced, and diversity of species shall also be maintained where essential to preserving a wooded area or habitat.

Response: Please see landscape plans L1.01, L1.02 and L1.03.

- (.04) All trees to be planted shall consist of nursery stock that meets requirements of the American Association of Nurserymen (AAN) American Standards for Nursery Stock (ANSI Z60.1) for top grade.

Response: Noted

- (.05) Replacement Tree Location.

- A. City Review Required. The City shall review tree relocation or replacement plans in order to provide optimum enhancement, preservation and protection of wooded areas. To the extent feasible and desirable, trees shall be relocated or replaced on-site and within the same general area as trees removed.

Response: Noted

- B. Relocation or Replacement Off-Site. When it is not feasible or desirable to relocate or replace trees on-site, relocation or replacement may be made at another location-approved by the City.

Response: Noted

- (.06) City Tree Fund. Where it is not feasible to relocate or replace trees on site or at another approved location in the City, the Tree Removal Permit grantee shall pay into the City Tree Fund, which fund is hereby created, an amount of money approximately the value as defined by this subchapter, of the replacement trees that would otherwise be required by this subchapter. The City shall use the City Tree Fund for the purpose of producing, maintaining and preserving wooded areas and heritage trees, and for planting trees within the City.
- A. The City Tree Fund shall be used to offer trees at low cost on a first-come, first-serve basis to any Type A Permit grantee who requests a tree and registers with the City Tree Fund.
 - B. In addition, and as funds allow, the City Tree Fund shall provide educational materials to assist with tree planting, mitigation, and relocation.

Response: NA

- (.07) Exception. Tree replacement may not be required for applicants in circumstances where the Director determines that there is good cause to not so require. Good cause shall be based on a consideration of preservation of natural resources, including preservation of mature trees and diversity of ages of trees. Other criteria shall include consideration of terrain, difficulty of replacement and impact on adjacent property.

Response: NA

Section 4.620.10. Tree Protection During Construction

- (.01) Where tree protection is required by a condition of development under Chapter 4 or by a Tree Maintenance and Protection Plan approved under this subchapter, the following standards apply:
- A. All trees required to be protected must be clearly labeled as such.
 - B. Placing Construction Materials Near Tree. No person may conduct any construction activity likely to be injurious to a tree designated to remain, including, but not limited to, placing solvents, building material, construction equipment, or depositing soil, or placing irrigated landscaping, within the drip line, unless a plan for such construction activity has been approved by the Planning Director or Development Review Board based upon the recommendations of an arborist.
 - C. Attachments to Trees During Construction. Notwithstanding the requirement of WC 4.620.10(1)(A), no person shall attach any device or wire to any protected tree unless needed for tree protection.
 - D. Protective Barrier. Before development, land clearing, filling or any land alteration for which a Tree Removal Permit is required, the developer shall erect

and maintain suitable barriers as identified by an arborist to protect remaining trees. Protective barriers shall remain in place until the City authorizes their removal or issues a final certificate of occupancy, whichever occurs first. Barriers shall be sufficiently substantial to withstand nearby construction activities. Plastic tape or similar forms of markers do not constitute "barriers." The most appropriate and protective barrier shall be utilized. Barriers are required for all trees designated to remain, except in the following cases:

1. Right-of-Ways and Easements. Street right-of-way and utility easements may be cordoned by placing stakes a minimum of fifty (50) feet apart and tying ribbon, plastic tape, rope, etc., from stake to stake along the outside perimeters of areas to be cleared.
2. Any property area separate from the construction or land clearing area onto which no equipment will venture may also be cordoned off as described in paragraph (D) of this subsection, or by other reasonable means as approved by the reviewing authority.

Response: See sheet L1.04 for proposed protection and removal of trees.

Section 4.620.20. Maintenance And Protection Standards

- (.01) The following standards apply to all activities affecting trees, including, but not limited to, tree protection as required by a condition of approval on a site development application brought under this Chapter or as required by an approved Tree Maintenance and Protection Plan.
- A. Pruning activities shall be guided by the most recent version of the ANSI 300 Standards for Tree, Shrub, and Other Woody Plant Maintenance. Information on these standards shall be available upon request from the Planning Department.

Response: Pruning will be guided by ANSI 300 standards for tree, shrub, and other woody plant maintenance.

- B. Topping is prohibited.
1. Exception from this section may be granted under a Tree Removal Permit if necessary for utility work or public safety.

Response: Noted

Section 4.630.00. Appeal

- (.01) The City shall not issue a Tree Removal Permit until approval has been granted by either the Planning Director or the DRB. Any applicant denied a Type A or B permit may appeal the decision as provided for in review of Class I Development Applications, or Class II Development Applications, whichever is applicable. Decisions by the Planning Director may be appealed to the DRB as provided in WC 4.022. Decisions by the DRB may be appealed to the City Council as provided in WC 4.022.

- (.02) The City shall not issue a Tree Removal Permit approved by the Development Review Board until fifteen (15) calendar days have passed following the approval. The grant or denial of a Tree Removal Permit may be appealed to the City Council in the same manner as provided for in WC 4.022. An appeal must be filed in writing, within the fifteen (15) calendar day period following the decision being appealed. The timely filing of an appeal shall have the effect of suspending the issuance of a permit pending the outcome of the appeal. The City Council, upon review, may affirm, reverse or modify the decision rendered by the Development Review Board based upon the same standards of review specified for the DRB in the Wilsonville Code.

Response: Noted.

Section 4.630.10. Display Of Permit; Inspection

The Tree Removal Permit grantee shall conspicuously display the permit on-site. The permit grantee shall display the permit continuously while trees are being removed or replaced or while activities authorized under the permit are performed. The permit grantee shall allow City representatives to enter and inspect the premises at any reasonable time, and failure to allow inspection shall constitute a violation of this subchapter.

Response: Noted.

Section 4.630.20. Variance For Hardship

Any person may apply for a variance of this subchapter as provided for in Section 4.196 of this Chapter.

Response: Noted.

Section 4.630.30. Severability

If any part of this ordinance is found by a court of competent jurisdiction to be invalid, that part shall be severable and the remainder of this ordinance shall not be affected.

Response: Noted.

Section 4.640.00. Violation; Enforcement

- (.01) The cutting, damaging, or removal of any individual tree without a permit as required by this ordinance constitutes a violation punishable as a separate infraction under WC 1.013. In addition, each violation of a condition or a violation of any requirement of this Chapter shall constitute a separate infraction.
- (.02) Retroactive Permit. A person who removes a tree without obtaining a Type A or Type B permit may apply retroactively for a permit. In addition to all application

requirements of this Chapter, the person must be able to demonstrate compliance with all requirements of this subchapter, in addition to paying a triple permit fee and a penalty per tree in an amount established by resolution of City Council. Mitigation requirements of this subchapter apply to all retroactive permits.

- (.03) Nuisance Abatement. Removal of a tree in violation of this Chapter is a nuisance and may be abated as provided in Sections 6.230 to 6.244, 6.250, and 6.260 of the Wilsonville Code.
- (.04) Withholding Certificate of Occupancy. The City Building Official has the authority to issue a stop-work order, withhold approval of a final plat, or withhold issuance of a certificate of occupancy, permits or inspections until the provisions of this Chapter, including any conditions attached to a Tree Removal Permit, have been fully met.
- (.05) Fines. Fines for a violation shall be imposed according to WC 1.012.
- (.06) Mitigation. The City shall require the property owner to replace illegally removed or damaged trees. The City may also require a combination of payment and tree replacement.
 - A. The City shall notify the property owner in writing that a violation has occurred and mitigation is required. Within thirty (30) days of the date of mailing of the notice, the property owner shall provide a mitigation plan to the City. The plan shall provide for replacement of a tree of similar species and size taking into account the suitability of the site and nursery stock availability.
 - B. Replacement will be on an inch-for-inch basis computed by adding the total diameter measured at d.b.h. in inches of the illegally removed or damaged trees. The City may use any reasonable means to estimate the tree loss if destruction of the illegally removed or damaged trees prevents exact measurement. All replaced trees must be a minimum two-inch (2") caliper. If the mitigation requirements cannot be completed on the property, the City may require completion at another approved location. Alternatively, the City may require payment into the City Tree Fund of the value of the removed tree as established by the Planning Department.

Response: Noted.

Section 4.640.10. Alternative Enforcement

- (.01) In the event that a person commits more than one violation of WC 4.600.30 to WC 4.630.00, the following alternative sentence may be imposed:
 - A. If a person has gained money or property through the commission of an offense under this section, then upon conviction thereof, the court, in lieu of imposing a fine, may sentence the person to pay an amount, fixed by the court, not to exceed double the amount of the gain from the commission of the offense.

- B. "Gain" is defined as the amount of money or value of property derived from the commission of the violation, less the amount of money or value of property seized by or surrendered to the City. "Value" shall be the greater of the market value or replacement cost as determined by a licensed professional in the tree, nursery, or landscape field.
- C. Any fines collected by the City under this section shall accrue to the City Tree Fund.

Response: Noted.

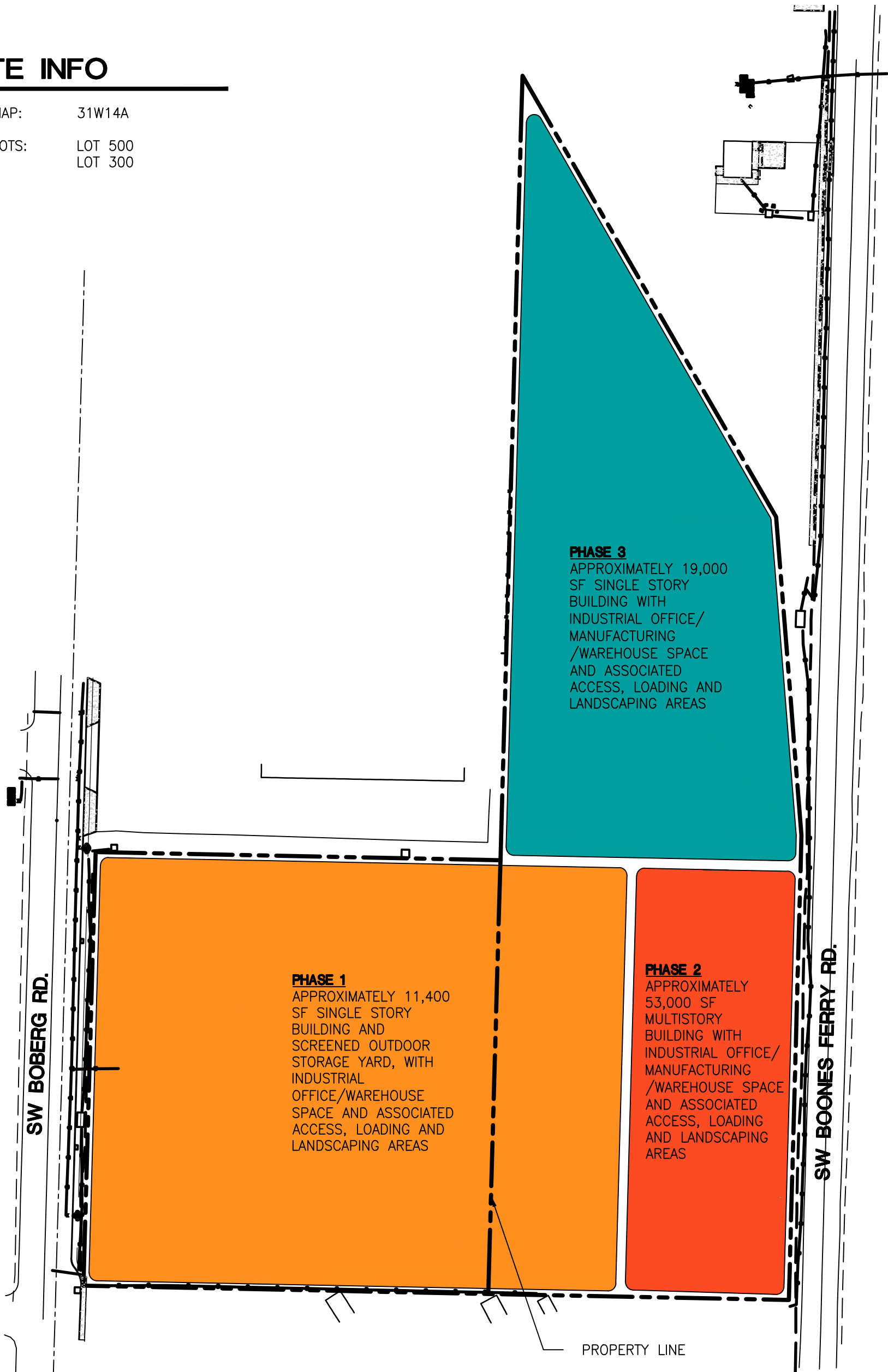
Section 4.640.20. Responsibility For Enforcement.

Compliance with this Chapter shall be enforced by the City Attorney, the City Attorney's designee, and Clackamas County or Washington County law enforcement officers.

Response: Noted.

SITE INFO

TAX MAP: 31W14A
TAX LOTS: LOT 500
LOT 300



PHASE 1
APPROXIMATELY 11,400 SF SINGLE STORY BUILDING AND SCREENED OUTDOOR STORAGE YARD, WITH INDUSTRIAL OFFICE/WAREHOUSE SPACE AND ASSOCIATED ACCESS, LOADING AND LANDSCAPING AREAS

PHASE 2
APPROXIMATELY 53,000 SF MULTISTORY BUILDING WITH INDUSTRIAL OFFICE/ MANUFACTURING /WAREHOUSE SPACE AND ASSOCIATED ACCESS, LOADING AND LANDSCAPING AREAS

PHASE 3
APPROXIMATELY 19,000 SF SINGLE STORY BUILDING WITH INDUSTRIAL OFFICE/ MANUFACTURING /WAREHOUSE SPACE AND ASSOCIATED ACCESS, LOADING AND LANDSCAPING AREAS

SW BOBERG RD.

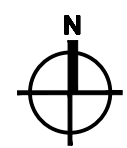
SW BOONES FERRY RD.

PROPERTY LINE



DP NICOLI (INDUSTRIAL FOCUS) WILSONVILLE, OREGON

15895 SW 72ND AVE SUITE 200
PORTLAND, OREGON 97224
TEL: 503.226.1285
FAX: 503.226.1670



MASTER PLAN

SCALE: 1"=80'-0"
180146.01

Monday, August 17, 2020



Peter van Oss

Arboricultural Consultant
ISA Cert# PN-8145A TRAQ
503-512-3826 | peter@nwtreespecialists.com



City of Wilsonville – Industrial Focus

Arboricultural assessment, addendum to the TPP

Addendum to the original tree inventory

The report produced on May 29th, 2019 indicates the trees that were scheduled for removal. CIDA recently submitted modifications to the development that will expand the site, this will require the removal of two additional trees on the South property line.

Additional Trees

The two additional trees are trees 14 and 15 per the landscape plan L1.04.

- Tree 14 is a multi-stem Acer macrophyllum measuring 8" and 11" DBH
- Tree 15 is a multi-stem Acer macrophyllum measuring two 8" and three 7" stems DBH

Both trees are in fair to poor condition and have poor structure due to powerline clearance cuts.

If you have any questions, please give me a call at: 503-512-3826. I hope this information is helpful in moving forward with the project.

Sincerely,

A handwritten signature in blue ink, appearing to read "P. van Oss".

Peter van Oss
NW Tree Specialists
Certified Arborist PN-8145A
ISA Qualified Tree Risk Assessor
503-512-3826 (Direct/ Cell)
peter@nwtreespecialists.com



NEW CONSTRUCTION FOR:
DP NICOLI
 NO SITUS - 3W1A 00500
 WILSONVILLE, OR 97070

TREE PLAN

PROJECT NO.	07/01/2000
DATE	07/01/2000
PROJECT NAME	0707000 - CITY RESIDENTIAL
CLIENT	0707000 - CITY RESIDENTIAL

L1.04
 TREE PLAN

TREE SCHEDULE

SYMBOL	BOTANICAL NAME	COMMON NAME	DECIDUOUS / EVERGREEN	SIZE	SPACING	CONDITION	NOTES
○	ACER CRYPTOMERIA	VINE MAPLE	D	12" CAL	AS SHOWN	18 R	17
○	COLUMBIAN REDWOOD	COLUMBIAN REDWOOD	D	12" CAL	AS SHOWN	18 R	18
○	CARPANUS RETICULOS	UPPERCOTT EUROPEAN	D	12" CAL	AS SHOWN	18 R	19
○	FAUCONIA	HORSEMAN	D	12" CAL	AS SHOWN	18 R	20
○	QUERCUS	WHITE OAK	D	12" CAL	AS SHOWN	18 R	21
○	ALNUS RUBRA	RED ALDER	D	12" CAL	AS SHOWN	18 R	22

TREE REMOVAL AND PROTECTION LEGEND

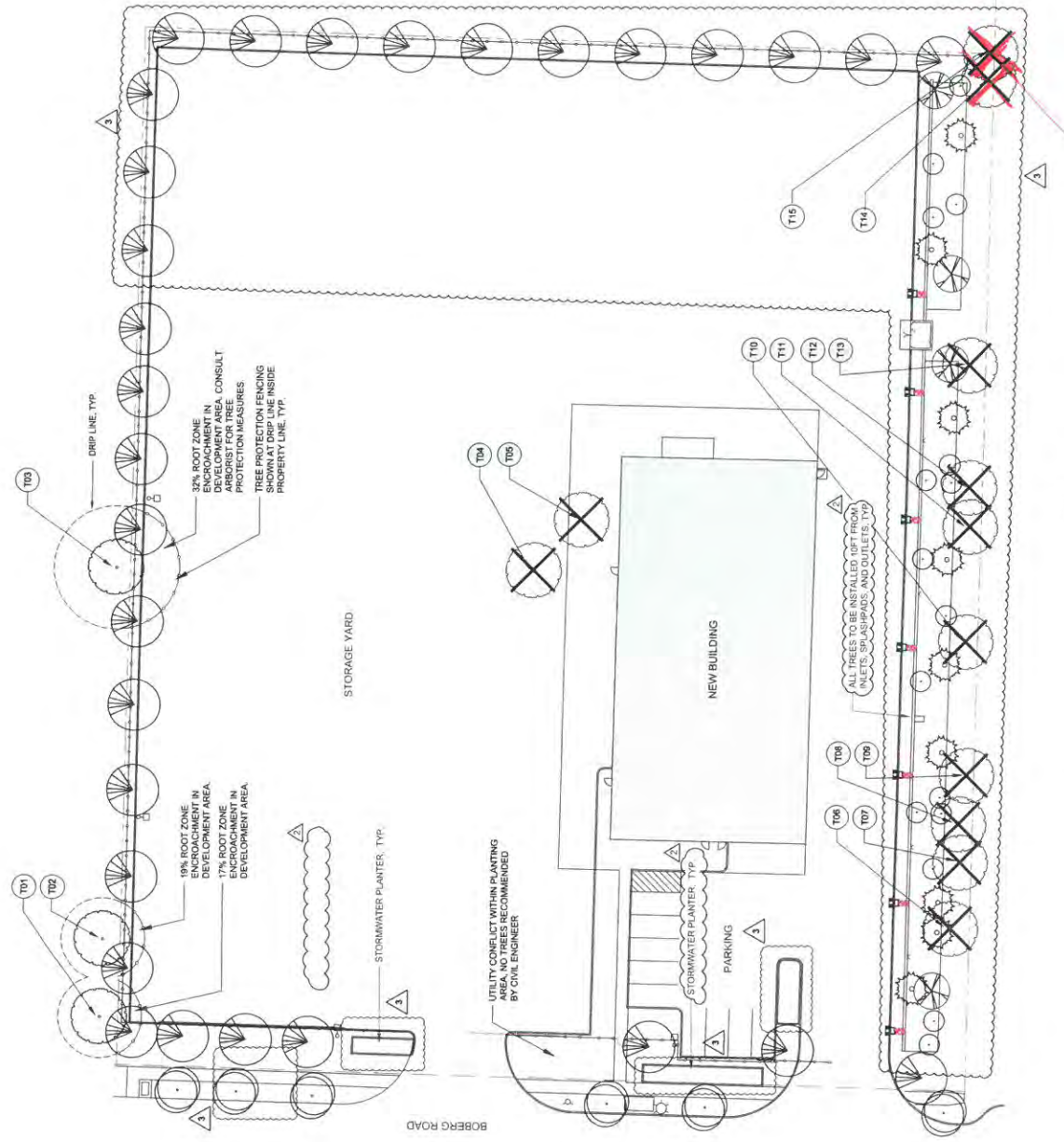
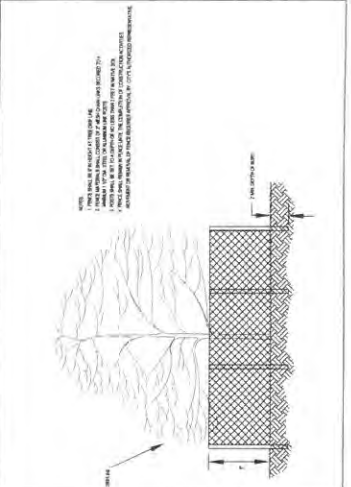
PROPERTY LINE
 TREE PROTECTION FENCING
 EXISTING TREES TO BE PROTECTED
 EXISTING TREES TO BE REMOVED

EXISTING TREE TABLE

NO.	TRUNK DIA.	PROTECTION ZONE	SPECIES	REMOVE	PROTECT	CONDITION NOTES
1	18"	CONSULT ARBORIST	DECIDUOUS	X	X	POOR
2	16"	CONSULT ARBORIST	DECIDUOUS	X	X	POOR
3	13.5"	CONSULT ARBORIST	DECIDUOUS	X	X	POOR
4	13.5"	CONSULT ARBORIST	DECIDUOUS	X	X	POOR
5	13.5"	NA	RED OAK	X	X	POOR
6	12"	NA	HAWTHORN	X	X	POOR
7	12"	NA	BIG LEAF MAPLE	X	X	POOR
8	12"	NA	HAZELNUT	X	X	POOR
9	12"	NA	HAZELNUT	X	X	POOR
10	12"	NA	HAZELNUT	X	X	POOR
11	8"	NA	BIG LEAF MAPLE	X	X	POOR
12	8"	NA	BIG LEAF MAPLE	X	X	POOR
13	8"	NA	BIG LEAF MAPLE	X	X	POOR
14	8"	NA	BIG LEAF MAPLE	X	X	POOR
15	8"	NA	BIG LEAF MAPLE	X	X	POOR

TREE PRESERVATION AND REMOVAL NOTES

- TREE PROTECTION ZONE SHOWN AT 1 FT RADIUS FOR EVERY CALIPER INCH OF TREE TRUNK. ARBORIST TO VERIFY PROTECTION MEASURES EVERY GRADE DISTURBANCE IS WITHIN PROTECTION ZONE.
- SEE ARBORIST REPORT FOR PRESERVATION AND REMOVAL RECOMMENDATIONS.
- THIS PLAN INCLUDES TREES THAT WILL BE CUT BY DEVELOPER. SEE ARBORIST REPORT FOR ADDITIONAL TREES OUTSIDE THE LIMIT OF DEVELOPMENT.
- SUITABLE PROTECTION FENCING AS IDENTIFIED BY ARBORIST SHALL BE INSTALLED BEFORE ANY GRADING OR DISTURBING ACTIVITIES INCLUDING CLEARING AND GRADING OR CONSTRUCTION STARTS AND SHALL REMAIN IN PLACE THROUGHOUT CONSTRUCTION.
- TREES TO BE REMOVED DURING THIS DEVELOPMENT SHALL BE IDENTIFIED BY THIS PLAN AND SHALL REMAIN IN PLACE THROUGHOUT CONSTRUCTION. THIS WILL BE NUMBERED AND NOTED TO THIS PLAN.



01 TREE PLAN
 1" = 20'-0"

02 RD - 1230 TREE PROTECTION FENCING
 1" = 10'-0"



Certified Arboricultural Assessment

29 March 2019

Gavin Russell

CIDA

Industrial Focus
SW Boberg Rd and Boeckman Rd
Wilsonville, Or 97070

This letter is intended to summarize a visual arboricultural inspection of all trees located at the above address. The trees were inspected from ground level at approximately 3 pm on March 22, 2019. The assessments provided are intended to perform a general health evaluation as well as identification of species and size of trees on site. This tree evaluation is for possible development.

Observations

This site has 25 trees with a six inch or greater diameter at breast height.

Most trees are located along the south property line and are located under powerlines. For this survey, the power poles were used as south edge of inventory. Most of these trees had been removed and are now root suckers that have reached a diameter large enough to be considered a tree.

The Hawthorn and Black Locust trees, six of the trees, would be considered as invasive trees in most public jurisdictions.

Recommend to retain corresponds to long term health and safety for size, species, and locations of trees. There are multiple homes to the south near property line.

One tree to be aware of for development is a D. Fir with a 33" dbh. This tree is located south of the development site between tree 18 and 20 on the attached site plan. I recommend that all intended construction within 15 feet of this D. Fir tree be reviewed by site arborist as well as all construction activities be supervised within same distance.

Thank you and please let me know if there are further questions.

Sincerely,

Trevor March

Certified Arborist PN 5740 BM

503-380-6688

Tree Risk Assessment:
Trevor March



Friday, March 22, 2019

Tree #	Common Name	Scientific Name	DBH	Condition	Structure	Comments	Recommend to Retain
1	Red Oak	Quercus rubra	13.5"	Fair	Fair		
2	Red Oak	Quercus rubra	13.5"	Fair	Fair		
3	Hawthorn	Crataegus monogyna	27"	Poor	Poor	Poor structure, over mature, topped for powerline clearance	No
4	Big Leaf Maple	Acer macrophylla	27"	Poor	Poor	Poor structure and topped for powerline clearance	No
5	Hazelnut	Corylus americana	Multi-stem	Poor	Fair	Poor structure and topped for powerline clearance	No
6	Hazelnut	Corylus americana	Multi-stem	Poor	Fair	Poor structure and topped for powerline clearance	No
7	Hazelnut	Corylus americana	Multi-stem	Poor	Fair	Poor structure and topped for powerline clearance	No

Northwest Tree Specialists

21600 NW Mauzey Ct. Hillsboro, OR 97124

Phone: 503-380-6688 Email: Trevor@nwtreespecialists.com

Tree Risk Assessment:

Trevor March



Friday, March 22, 2019

Tree #	Common Name	Scientific Name	DBH	Condition	Structure	Comments	Recommend to Retain
8	Big Leaf Maple	Acer macrophyllum	6"	Fair	Poor	Tree has been topped for line clearance	N
9	Big Leaf Maple	Acer macrophyllum	6"	Fair	Poor	Trees are stump sprouts	N
10	Big Leaf Maple	Acer macrophyllum	6"	Fair	Poor	Tree has been topped for line clearance	N
11	Big Leaf Maple	Acer macrophyllum	16"	Fair	Poor	Trees are stump sprouts	N
12	Big leaf Maple	Acer macrophyllum	19"	Fair	Poor	Co-dominant with poor structure	N
13	Big Leaf Maple	Acer macrophyllum	17"	Fair	Poor	Tree has been topped for line clearance	N
14	Big Leaf Maple	Acer macrophyllum	15"	Fair	Poor	Trees are stump sprouts	N

Northwest Tree Specialists

21600 NW Mauzey Ct. Hillsboro, OR 97124

Phone: 503-380-6688 Email: Trevor@nwtreespecialists.com

Tree Risk Assessment:
Trevor March



Friday, March 22, 2019

Tree #	Common Name	Scientific Name	DBH	Condition	Structure	Comments	Recommend to Retain
15	Big Leaf Maple	Acer macrophyllum	21"	Fair	Poor	Trees are stump sprouts	N
16	Big Leaf Maple	Acer macrophyllum	8"	Fair	Poor	Trees are stump sprouts	N
17	Big Leaf Maple	Acer macrophyllum	18"	Fair	Poor	Trees are stump sprouts	N
18	Big Leaf Maple	Acer macrophyllum	6"	Fair	Poor	Trees are stump sprouts	N
19	Black Locust	Robinia pseudoacacia	19"	Fair	Poor	Tree has been trimmed for line clearance And has poor structure	N
20	Big Leaf Maple	Acer macrophyllum	14"	Fair	Poor	Trees are stump sprouts	N
21	Big Leaf Maple	Acer macrophyllum	6"	Fair	Poor	Trees are stump sprouts	N

Northwest Tree Specialists

21600 NW Mauzey Ct. Hillsboro, OR 97124

Phone: 503-380-6688 Email: Trevor@nwtreespecialists.com

Tree Risk Assessment:
Trevor March



Friday, March 22, 2019

Tree #	Common Name	Scientific Name	DBH	Condition	Structure	Comments	Recommend to Retain
22	Black Locust	Robinia pseudoacacia	11"	Fair	Poor	Trees are stump sprouts	N
23	Black Locust	Robinia pseudoacacia	8"	Fair	Poor	Trees are stump sprouts	N
24	Black Locust	Robinia pseudoacacia	12"	Fair	Poor	Trees are stump sprouts	N
25	Black Locust	Robinia pseudoacacia	8"	Fair	Poor	Trees are stump sprouts	N

Northwest Tree Specialists
21600 NW Mauzey Ct. Hillsboro, OR 97124
Phone: 503-380-6688 Email: Trevor@nwtreespecialists.com

DP NICOLI

STORMWATER REPORT & CALCULATIONS

Wilsonville, Oregon



April 30th, 2020
Updated June 17th, 2020
Updated July 21st, 2020
Updated August 5th, 2020

The information contained in this report was prepared by
and under direct supervision of the undersigned:

Craig Harris, PE
AAI Engineering
4875 S.W. Griffith Drive
Suite 300
Beaverton, Oregon 97005
PH 503.620.3030 FX 503.620.5539
Craig@aieng.com
AAI Project Number: A18234.10

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VI. Operations and Maintenance	5
VII. Engineering Conclusion.....	5

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Appendices

Appendix A

Existing Conditions

Appendix B

Site Plan

Appendix C

Storm Plans

Appendix D

BMP Sizing Tool Report

Appendix E

Geotechnical Report

Appendix F

Operation and Maintenance Manual

I. Project Summary

This report has been prepared to outline the existing and proposed on-site and off-site stormwater conditions for the DP Nicoli project. This report is based on existing topographic survey, geotechnical report and site investigation.

The project site is located in Wilsonville, Oregon. The total pre-developed on-site area is approximately 135,940 square feet (3.12 acres). The site currently consists of a grass field. The current site slopes from east to west. The offsite improvement area consists of approximately 11,265 square feet (0.26 acres). The predeveloped area consists a public road.

See Appendix A – Existing Conditions

The primary purpose of this project is to develop the site for a proposed building, parking and drive aisles. The onsite improvements will be approximately 119,540 square feet (2.74 acres) of total impervious area. The offsite improvements consist of a partial resurfacing of SW Boberg Road, new curbing and a sidewalk and planters.

See Table 2.1 – Onsite Basin Properties and Table 2.2 – Offsite Basin Properties

TABLE 2.1: Onsite Basin Properties

Basin	Drainage Source	Impervious Area (sf)	Connected Treatment Type
1	Asphalt/Concrete Pavement	108,140	Storm Facility
2	Roof	11,400	Storm Facility

TABLE 2.2: Offsite Basin Properties

Basin	Drainage Source	Impervious Area (sf)	Connected Treatment Type
1	Asphalt/Concrete Pavement	9,940	Storm Facility

The total onsite area including pervious will be approximately 135,940 sf (3.12 acres). The total offsite area including pervious will be 11,265 sf (0.26 acres). In addition to the site improvements, stormwater conveyance, water quality treatment, detention, and flow control devices are also included in both the onsite and offsite proposed designs.

See Appendix B – Site Plan and Appendix C – Storm Plans

II. Stormwater Calculations

The stormwater quality and quantity required for this project are designed according to the requirements of the City of Wilsonville and the BMP sizing tool. Due to limitations from low infiltration rates onsite, infiltration rain gardens and planters were not utilized. The onsite and offsite stormwater facilities have been modeled with one filtration rain garden and three filtration planters in order to meet the treatment and flow control requirements for above ground detention. The areas of the filtration systems that were outputted by the BMP sizing tool are shown in table 2.3 and 2.4. The current sizing design of our rain garden and planters do not use a 25% reduction factor.

TABLE 2.3: Onsite Facility Areas

Facility	BMP Size (sf)
Rain Garden	4680
Planter – North	135
Planter – South	208

TABLE 2.4: Offsite Facility Areas

Facility	BMP Size (sf)
Planter	296

See Appendix D – BMP Sizing Tool Report and Appendix E-Geotechnical Report

III. Stormwater Design

The proposed stormwater facilities are designed to capture all runoff within the proposed onsite and offsite improvements. No runoff from adjacent properties is anticipated to be captured by the proposed facilities. In addition, all site impervious runoff will be completely managed on site and will not drain onto adjacent properties.

All onsite stormwater runoff will be collected by catch basins, downspouts, and/or flow through curb cuts into the storm facilities at different locations onsite. The onsite stormwater management will be accomplished with 1 filtration rain garden and 2 filtration planters.

All offsite stormwater runoff will be collected by curb cuts. The offsite stormwater management will be accomplished with 1 filtration planters on the east side of SW Boberg Road with inlets in the right-of-way.

All onsite and offsite treatment techniques serve to meet the water quality and flow control requirements of the project for the 10-year design stormwater event. Water quality treatment is achieved by flowing through 18” of growing medium. The stormwater will then enter a 6” perforated pipe embedded in 12” of drain rock that will ultimately outfall into the public storm system via a flow control device located inside the overflow structures.

IV. Conveyance Calculations

See Appendix E

V. Downstream Analysis

No negative impacts are anticipated downstream as post-developed flow is being limited to pre-developed flow.

VI. Operations and Maintenance

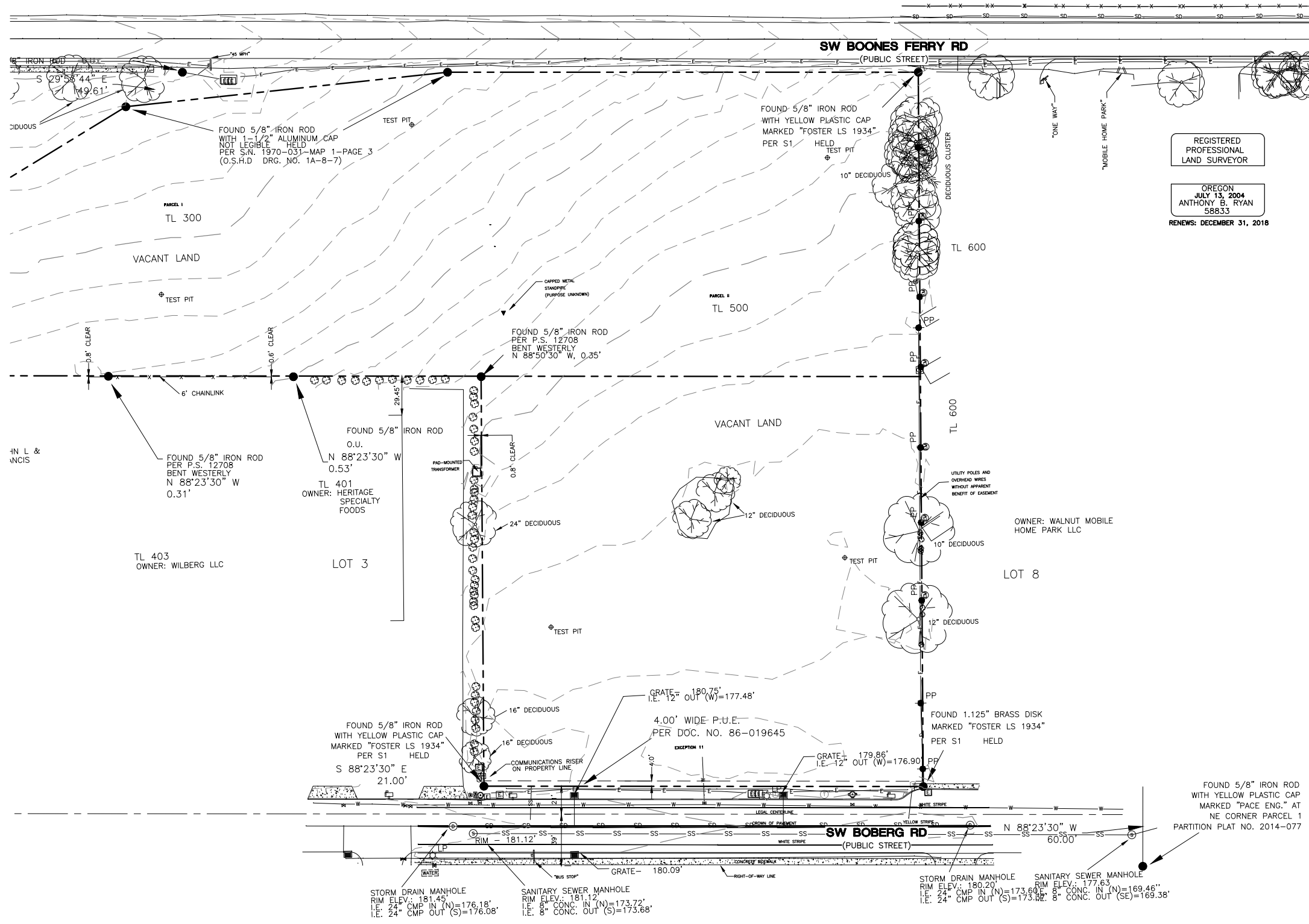
See Appendix F-Operations and Maintenance Manual.

VII. Engineering Conclusion

Based on the requirements of using low impact development and the BMP sizing tool the proposed onsite and offsite facilities are adequately designed to manage the proposed development conditions and should be approved as designed.

Appendix A

Existing Conditions



SHEET NOTES

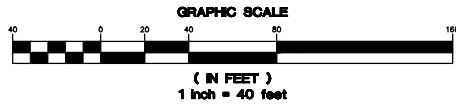
- 1 THE BASIS OF BEARING FOR THIS SURVEY IS PER SURVEY NO. SN2015-164, CLACKAMAS COUNTY RECORDS. THIS IS NOT A RECORDABLE SURVEY.
- 2 UNDERGROUND UTILITIES ARE SHOWN PER SURFACE MARKINGS AND AS-BUILT INFORMATION PROVIDED BY THE CONTROLLING JURISDICTIONS. THE SURVEYOR MAKES NO GUARANTEE AS TO THE EXACT LOCATION, EXISTENCE, NON-EXISTENCE OR COMPLETENESS OF ANY SUBSURFACE UTILITIES SHOWN, OR NOT SHOWN ON THE MAP. CALL 811 BEFORE DIGGING.
- 3 THE BENCHMARK USED FOR THIS SURVEY IS AN OPUS GPS DERIVED ELEVATION ON A NAIL NEAR THE NW PROPERTY CORNER. ELEVATION: 181.11' (NAVD 88)

LEGEND

- BOLLARD
- CABLE TELEVISION VAULT
- COLUMN
- COMMUNICATIONS RISER
- CURB INLET
- DECIDUOUS TREE
- FIRE HYDRANT
- FOUND MONUMENT AS NOTED
- GPS OCCUPATION
- MAILBOX
- GAS VALVE
- LIGHT POLE
- POWER POLE
- POWER METER
- POWER PANEL
- POWER VAULT
- PUBLIC UTILITY EASEMENT
- SANITARY SEWER MANHOLE
- SHRUB
- SIGN AS INDICATED
- STORM SEWER MANHOLE
- TELEPHONE MANHOLE
- TEST PIT
- TRANSFORMER
- UTILITY VAULT
- WATER METER
- WATER VALVE
- WATER VAULT
- BUILDING
- BUILDING OVERHANG
- FENCE
- GAS LINE
- OVERHEAD POWER
- SANITARY SEWER
- STORM SEWER
- UNDERGROUND TELEVISION
- WATER LINE
- CONCRETE

REGISTERED PROFESSIONAL LAND SURVEYOR

OREGON
JULY 13, 2004
ANTHONY B. RYAN
58833
RENEWS: DECEMBER 31, 2018



ISSUED DATE

1	01/10/20	PLANNING REVIEW
2	04/10/20	BUILDING PERMIT
3	04/27/20	CITY RESUBMITTAL - CIVIL
4	05/11/20	CITY RESUBMITTAL
5	05/27/20	CITY RESUBMITTAL
6	06/17/2020	REVISIONS TO PERMIT
7	07/15/2020	FIELD REVISIONS



15895 SW 72ND AVE SUITE 200
PORTLAND, OREGON 97224
TEL: 503.228.1288
FAX: 503.228.1870
WWW.CIDAINC.COM

NEW CONSTRUCTION FOR:
DP NICOLI
28370 SW BOBERG RD
WILSONVILLE, OR 97070

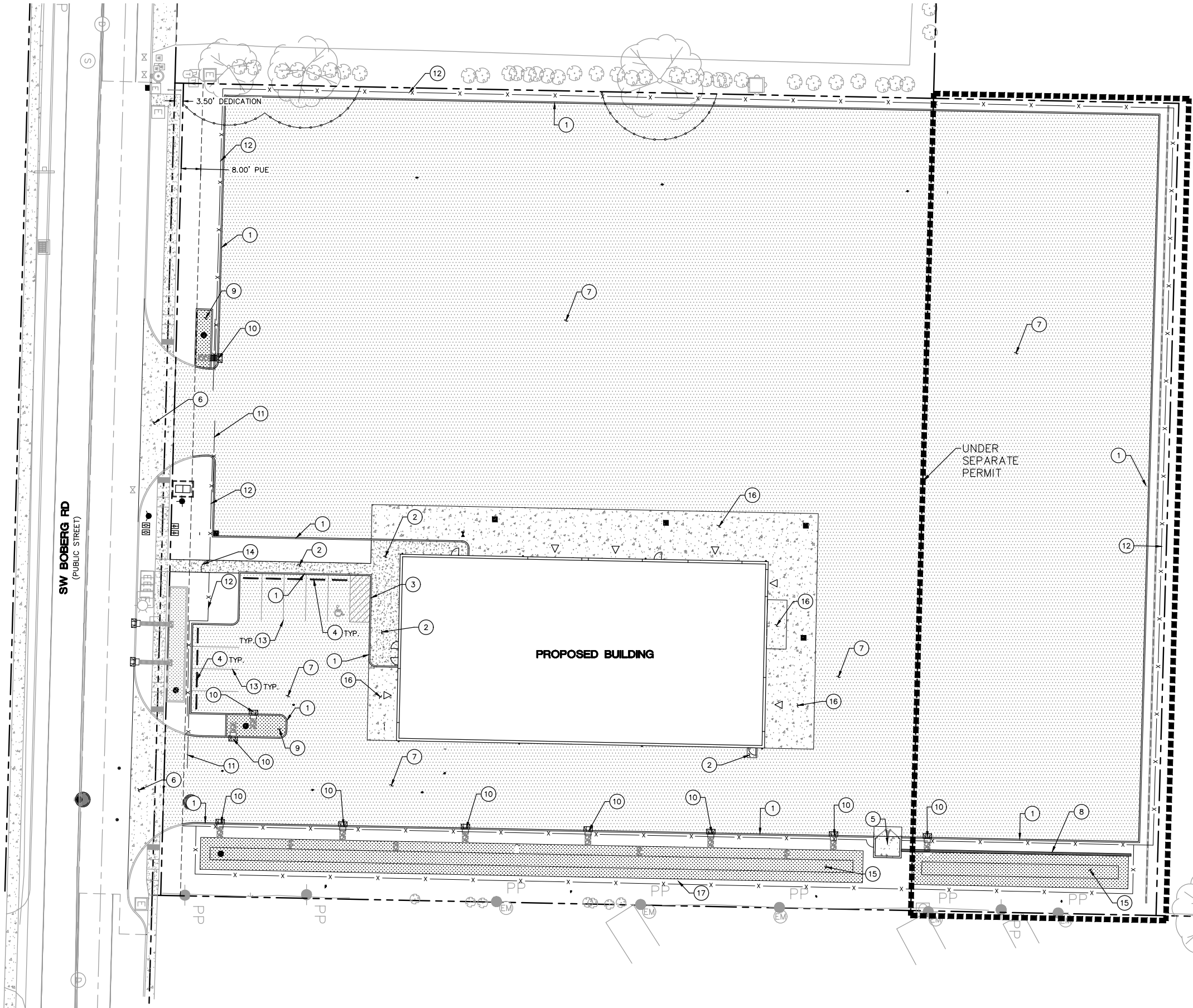
EXISTING CONDITIONS
C0.2
JOB NO. 180146.03
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P:\2018\180146.03 - Industrial\Drawings\180146.03-02-Ex.dwg - Extended.dwg Aug 05, 2020 - 4:55pm

Appendix B

Site Plan

P:\2019\18254.0 - Industrial Front\CD - Civil\Drawings\18254-010.dwg - External.dwg Aug 05, 2020 - 4:56pm



SHEET NOTES

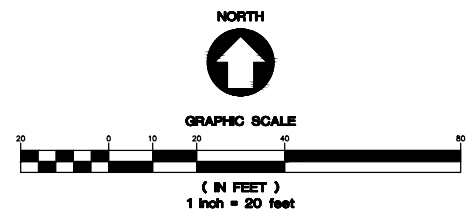
1. SEE SHEET C0.1 FOR GENERAL SHEET NOTES.
2. SEE ARCHITECTURAL PLANS FOR ADDITIONAL SITE INFORMATION.
3. THE CONTRACTOR SHALL HAVE A FULL SET OF THE CURRENT APPROVED CONSTRUCTION DOCUMENTS INCLUDING ADDENDA ON THE PROJECT SITE AT ALL TIMES.
4. THE CONTRACTOR SHALL KEEP THE ENGINEER AND JURISDICTION INFORMED OF CONSTRUCTION PROGRESS TO FACILITATE SITE OBSERVATIONS AT REQUIRED INTERVALS. 24-HOUR NOTICE IS REQUIRED.

(X) CONSTRUCTION NOTES

- 1 INSTALL PRIVATE CURB PER DETAIL 1/C4.0
- 2 INSTALL PRIVATE SIDEWALK PER DETAIL 2/C4.0
- 3 INSTALL ADA RAMP PER DETAIL 2/C4.0
- 4 INSTALL WHEELSTOP PER DETAIL 3/C4.0
- 5 INSTALL TRASH ENCLOSURE, SEE ARCHITECTURAL PLANS FOR ADDITIONAL INFORMATION
- 6 INSTALL DRIVEWAY, UNDER CURRENT PW PERMIT
- 7 INSTALL ASPHALT SURFACING PER DETAIL 4/C4.0
- 8 INSTALL WALL, DESIGN BY OTHERS
- 9 INSTALL STORMWATER FILTRATION PLANTER. SEE SHEET C3.0 FOR ADDITIONAL INFORMATION
- 10 INSTALL CURB INLETS, UNDER SEPARATE PERMIT
- 11 INSTALL GATE, SEE ARCHITECTURAL PLANS FOR ADDITIONAL INFORMATION
- 12 INSTALL FENCE, SEE ARCHITECTURAL PLANS FOR ADDITIONAL INFORMATION
- 13 INSTALL STRIPING. SEE ARCHITECTURAL PLANS FOR MORE INFORMATION
- 14 INSTALL MANDOOK, SEE ARCHITECTURAL PLANS FOR MORE INFORMATION
- 15 INSTALL STORMWATER FILTRATION RAIN GARDEN, UNDER SEPARATE PERMIT
- 16 INSTALL CONCRETE SURFACING PER DETAIL 5/C4.0
- 17 INSTALL CMU WALL, DESIGN BY OTHERS

LEGEND

- PROPERTY LINE
- CONCRETE SIDEWALK SURFACING
- ASPHALT SURFACING
- TREE PROTECTION



ISSUED DATE	DESCRIPTION
01/10/20	PLANNING REVIEW
04/10/20	BUILDING PERMIT
04/27/20	CITY RESUBMITTAL
05/11/20	CITY RESUBMITTAL
05/27/20	CITY RESUBMITTAL
06/17/2020	REVISIONS TO PERMIT
07/15/2020	FIELD REVISIONS



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NEW CONSTRUCTION FOR:
DP NICOLI
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PRIVATE
 HARDSCAPE
 PLAN
C1.0

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01/15/2020
04/12/2020
04/27/2020
05/11/2020
05/27/2020
06/17/2020
07/15/2020

ISSUE DATE
PLANNING REVIEW
BUILDING PERMIT - CIVIL
CITY RESUBMITTAL
CITY RESUBMITTAL
REVISIONS TO PERMIT
FIELD REVISIONS



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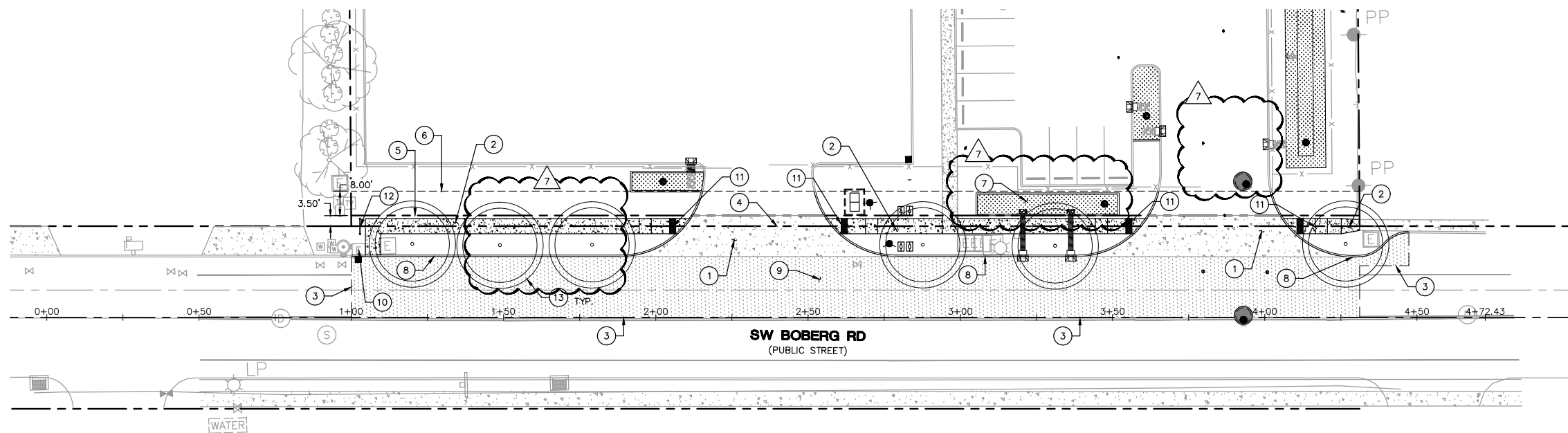
NEW CONSTRUCTION
DP NICOLI - OFFSITE
28370 SW BOBERG RD
WILSONVILLE, OREGON 97070

SW BOBERG RD PLAN AND PROFILE

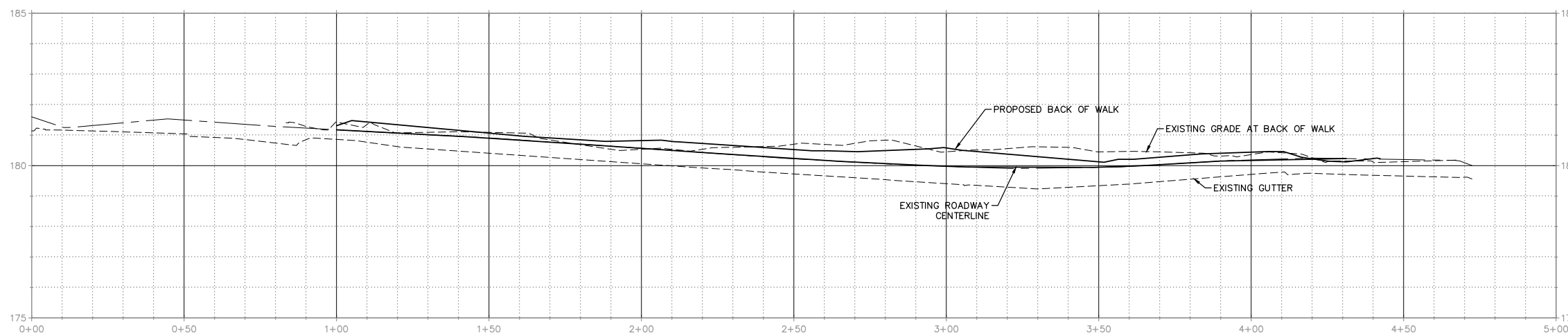
R1.0

180146.03

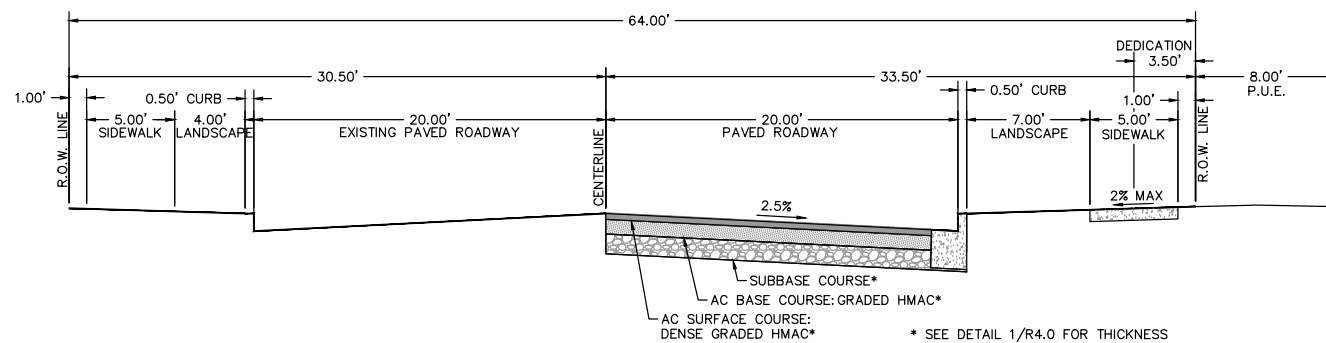
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SW BOBERG RD PLAN
SCALE: 1" = 20'



SW BOBERG RD PROFILE
SCALE: HORIZ: 1" = 20'
VERT: 1" = 2'



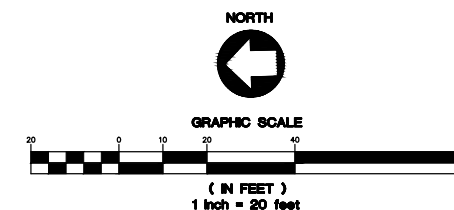
SW BOBERG RD SECTION
SCALE: HORIZ: 1" = 5'
VERT: 1" = 2.5'

SHEET NOTES

- SEE SHEETS R0.2-R0.4 FOR GENERAL SITE NOTES.

(X) CONSTRUCTION NOTES

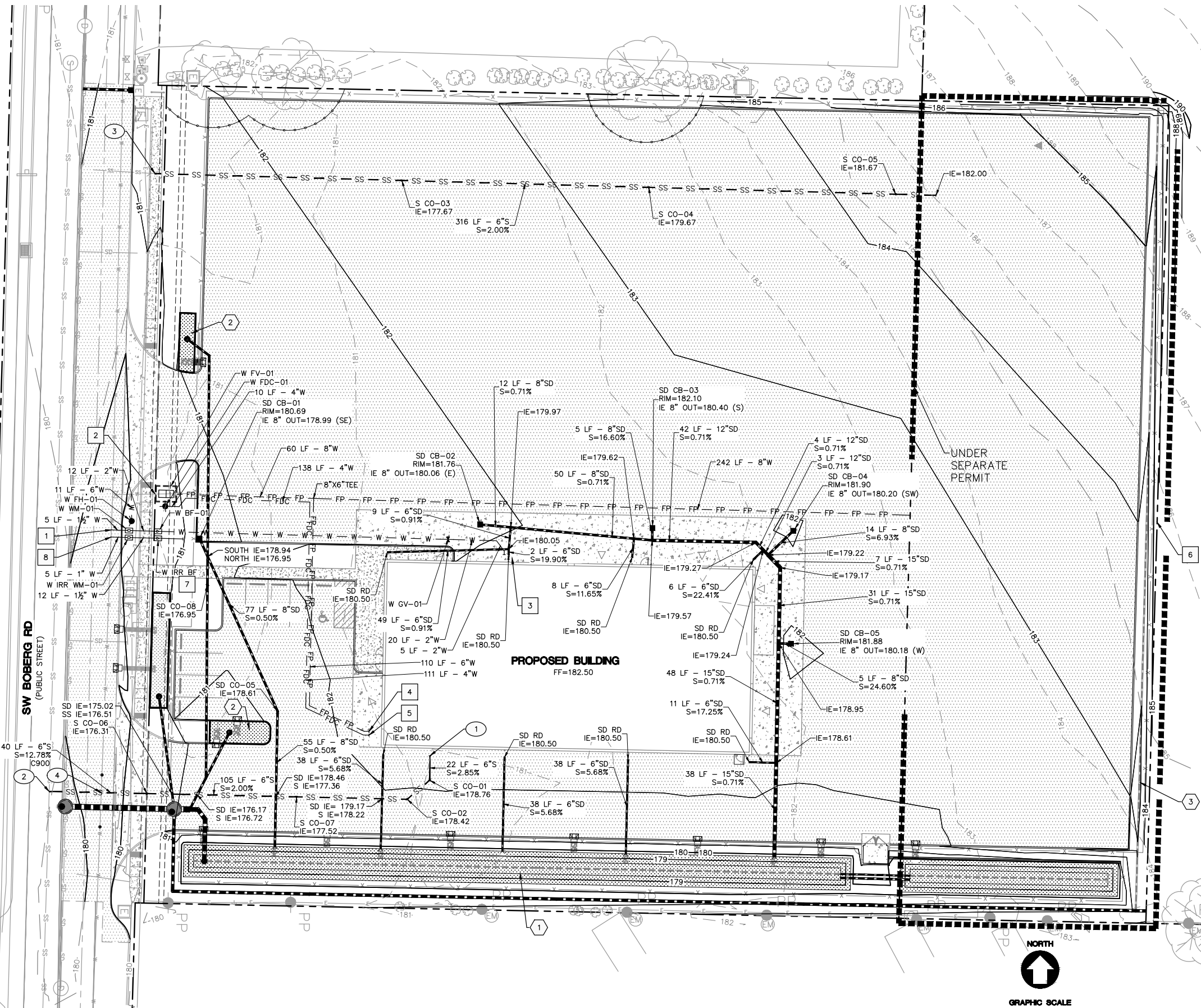
- INSTALL DRIVEWAY PER CITY OF WILSONVILLE DETAIL RD-1100/R3.0
- INSTALL PUBLIC SIDEWALK PER CITY OF WILSONVILLE RD-1075/R3.0
- SAWCUT EXISTING ASPHALT
- EXISTING PROPERTY LINE TO BE ABANDONED
- PROPOSED PROPERTY LINE
- 8' PUBLIC UTILITY EASEMENT
- INSTALL PUBLIC PLANTER PER CITY OF WILSONVILLE ST-6005/R3.0
- INSTALL PUBLIC CURB PER CITY OF WILSONVILLE RD-1055/R3.0
- INSTALL AC PER DETAIL 1/R4.0 PER GEOTECH REPORT BY GEODESIGN DATED 4/8/20 - PAGE 5, SECTION 6.2
- CONTRACTOR TO COORDINATE WITH FRANCHISE UTILITIES IF RELOCATION IS REQUIRED
- INSTALL PUBLIC ADA RAMPS PER DETAILS RD-1115/R4.0
- INSTALL BARRICADE, DESIGN BY OTHERS
- TREES TO BE INSTALLED, LOCATION IS APPROXIMATE. SEE LANDSCAPE PLANS FOR MORE DETAIL AND PLANTING PLAN.



Appendix C

Storm Plans

P:\2018\180146.0 - Industrial Front\CD - Civil\Drawings\180146.0 - C3.0.018 - Extremedrawing Aug 05, 2020 - 4:56pm

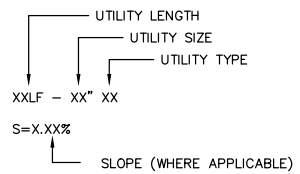


SHEET NOTES

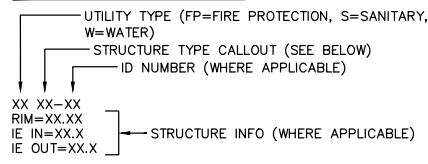
- SEE SHEET C0.1 FOR GENERAL SHEET NOTES.
- STRUCTURES HORIZONTAL LOCATIONS AND PIPE INVERTS ARE BASED ON THE CENTER OF THE STRUCTURE.
- PIPE BEDDING AND BACKFILL UTILITIES SHALL BE DONE PER DETAIL 6/C4.0.
- ALL WATER LINES TO BE MECHANICALLY RESTRAINED.
- ALL SANITARY PIPING SHALL BE PVC 3034 OR APPROVED EQUAL UNLESS NOTED OTHERWISE.
- THIS PLAN IS GENERALLY DIAGRAMMATIC. IT DOES NOT SHOW EVERY JOINT, BEND, FITTING, OR ACCESSORY REQUIRED FOR CONSTRUCTION.
- CLEAN OUTS SHALL BE INSTALLED IN CONFORMANCE WITH UPC CHAPTER SEVEN, SECTION 707 AND SECTION 719. NOT ALL REQUIRED CLEAN OUTS ARE SHOWN.
- DOMESTIC WATER LINES AND ACCESSORIES BETWEEN THE WATER METER AND THE BUILDING SHALL BE INSTALLED BY A LICENSED PLUMBER EMPLOYED BY A LICENSED PLUMBING CONTRACTOR.
- UTILITIES WITHIN FIVE FEET OF A BUILDING SHALL BE CONSTRUCTED OF MATERIALS APPROVED FOR INTERIOR USE AS DESCRIBED IN THE CURRENT EDITION OF THE UPC.
- INLETS AND OUTLETS TO ON-SITE MANHOLES SHALL HAVE FLEXIBLE CONNECTION NO CLOSER THAN 12" AND NO FARTHER THAN 36" FROM THE MANHOLE.
- CONTRACTOR TO VERIFY SANITARY AND WATER SIZING WITH APPROVED PLUMBING PLANS PRIOR TO ORDERING MATERIALS OR BEGINNING CONSTRUCTION OF SAID UTILITIES.

LABEL LEGEND

PIPE LABELS



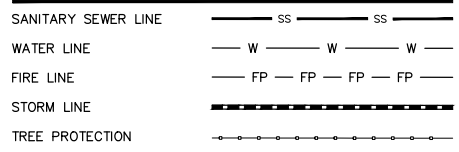
STRUCTURE LABELS



STRUCTURE TYPES

CALLOUT	DESCRIPTION
BF	BACKFLOW PREVENTOR PER DETAIL 9/4.0
CB	CATCH BASIN PER DETAIL OLDCASTLE/C4.0
FDC	FIRE DEPARTMENT CONNECTION PER DETAILS/C4.0
FH	FIRE HYDRANT, UNDER SEPARATE PERMIT
FV	FIRE VAULT PER DETAIL 7/C4.0
RD	ROOF DRAIN
WM	WATER METER, UNDER SEPARATE PERMIT

LEGEND



SANITARY NOTES

- CONNECT SANITARY SEWER TO BUILDING IE=176.32
- CONNECT TO TEE AT EXISTING MAIN, UNDER SEPARATE PERMIT.
- CONTRACTOR TO TIE INTO EXISTING SANITARY STUB. CONTRACTOR TO MATCH EXISTING PIPE SIZE AND RUN PIPE AT 2% TO EAST PROPERTY LINE. STUB INVERT 175.67. CONTRACTOR TO VERIFY.
- CONTRACTOR TO LAY ONE STICK OF C900 ON CENTER AT WATER CROSSING

WATER NOTES

- TAP WATER MAIN FOR DOMESTIC WATER SERVICE, UNDER SEPARATE PERMIT
- TAP EXISTING LATERAL FOR FIRE SERVICE
- POINT OF CONNECTION FOR DOMESTIC WATER SERVICE
- POINT OF CONNECTION FOR FIRE SERVICE
- POINT OF CONNECTION FOR FDC
- CONTRACTOR TO RUN FIRE SERVICE STUB TO ADJACENT PROPERTY
- INSTALL 1/2" IRRIGATION BACKFLOW AND STUB
- TAP WATER MAIN FOR IRRIGATION SYSTEM, UNDER SEPARATE PERMIT

STORM NOTES

- INSTALL FILTRATION RAIN GARDEN, UNDER SEPARATE PERMIT
- INSTALL FILTRATION PLANTER, UNDER SEPARATE PERMIT
- INSTALL FRENCH DRAIN PER DETAIL 10/C4.0



ISSUED DATE
1 01/10/20 PLANNING REVIEW
2 04/10/20 BUILDING PERMIT
3 04/27/20 CITY RESUBMITTAL - CIVIL
4 05/11/20 CITY RESUBMITTAL
5 05/27/20 CITY RESUBMITTAL
6 06/17/2020 REVISIONS TO PERMIT
7 07/15/2020 FIELD REVISIONS

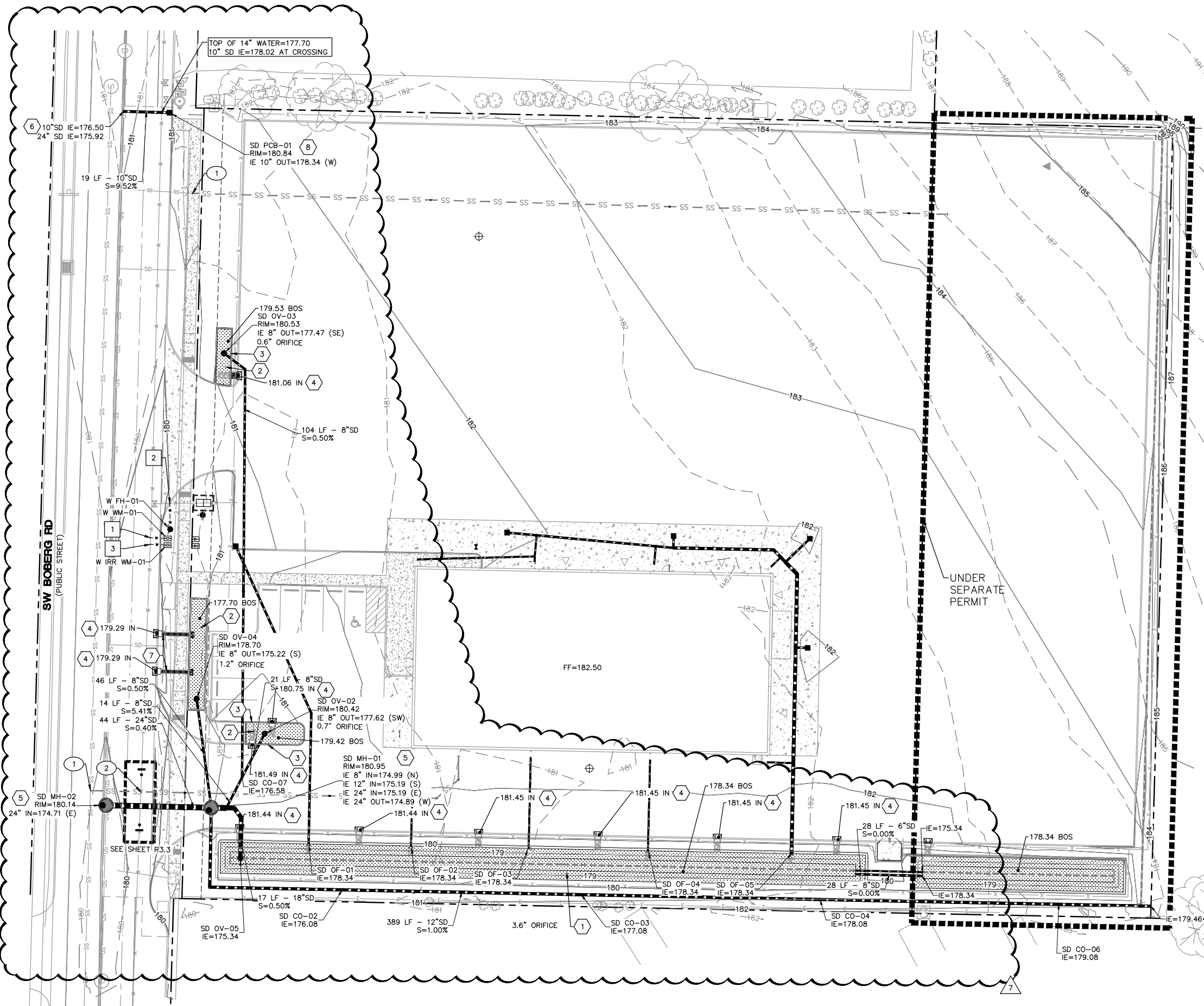


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NEW CONSTRUCTION FOR:
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WILSONVILLE, OR 97070

PRIVATE UTILITY PLAN
C3.0
JOB NO. 180146.03
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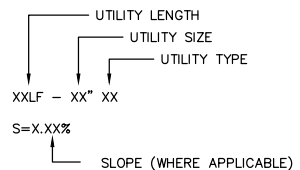


SHEET NOTES

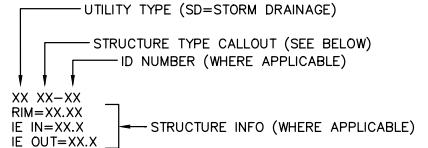
- SEE SHEETS R0.2-R0.4 FOR GENERAL SHEET NOTES.
- STRUCTURES HORIZONTAL LOCATIONS AND PIPE INVERTS ARE BASED ON THE CENTER OF THE STRUCTURE.
- ALL STORM PIPING SHALL BE PVC 3034 OR APPROVED EQUAL AT 1.0% MIN SLOPE, UNLESS NOTED OTHERWISE.
- PIPE BEDDING AND BACKFILL FOR ALL UTILITIES SHALL BE DONE.
- THIS PLAN IS GENERALLY DIAGRAMMATIC. IT DOES NOT SHOW EVERY JOINT, BEND, FITTING, OR ACCESSORY REQUIRED FOR CONSTRUCTION.
- CLEAN OUTS SHALL BE INSTALLED IN CONFORMANCE WITH UPC CHAPTER SEVEN, SECTION 707 AND SECTION 719. NOT ALL REQUIRED CLEAN OUTS ARE SHOWN.
- UTILITIES WITHIN FIVE FEET OF A BUILDING SHALL BE CONSTRUCTED OF MATERIALS APPROVED FOR INTERIOR USE AS DESCRIBED IN THE CURRENT EDITION OF THE UPC.
- CHANGES IN DIRECTION OF DRAINAGE PIPING SHALL BE MADE BY THE APPROPRIATE USE OF APPROVED FITTINGS AND SHALL BE OF THE ANGLES PRESENTED BY ONE-SIXTEENTH BEND, ONE-EIGHTH BEND, ONE-SIXTH BEND OR OTHER APPROVED FITTINGS OF EQUIVALENT SWEEP.
- INLETS AND OUTLETS TO ON-SITE MANHOLES SHALL HAVE FLEXIBLE CONNECTION NO CLOSER THAN 12" AND NO FARTHER THAN 36" FROM THE MANHOLE.

LABEL LEGEND

PIPE LABELS



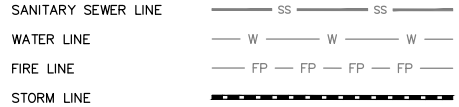
STRUCTURE LABELS



STRUCTURE TYPES

CALLOUT	DESCRIPTION
PCB	PUBLIC CATCH BASIN PER DETAIL S-2095/R4.1
CO	CLEANOUT PER DETAIL S-2180-R4.1
OF	OUTFALL PER DETAIL S-2115/R4.2
OV	OVERFLOW PER DETAIL S-2112/R4.2
FH	FIRE HYDRANT PER DETAIL WT-3060/R4.1

LEGEND



STORM NOTES

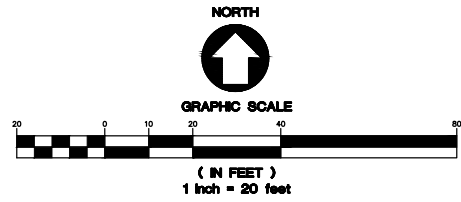
- INSTALL FILTRATION RAIN GARDEN PER DETAIL ST-6020/R4.2
- INSTALL FILTRATION PLANTER PER DETAIL ST-6005/R4.2
- INSTALL STEM WALL PER DETAIL ST-6011/R4.2
- INSTALL INLET PER DETAIL ST-6012/R4.2
- INSTALL MANHOLE PER DETAIL S-2005/R4.2
- 10" 3034 PVC TAP TO SD MAIN
- INSTALL CONCRETE CHANNEL PER DETAIL ST-6013/R4.1
- INSTALL CURB INLET PER DETAIL S-2085/R4.2

WATER NOTES

- 1 1/2" COPPER WET TAP TO WATER MAIN PER DETAIL WT-3045/R4.1
- 6" DUCTILE IRON TAP TO EXISTING WATER LATERAL
- 1" COPPER WET TAP TO WATER MAIN PER DETAIL WT-3030/R4.2

SANITARY NOTES

- CONTRACTOR TO TIE 6" C900 PVC INTO EXISTING TEE ON SANITARY MAIN IE=171.25
- CONTRACTOR TO LAY ONE STICK OF C900 CENTERED AT WATER LINE CROSSING



ISSUE DATE

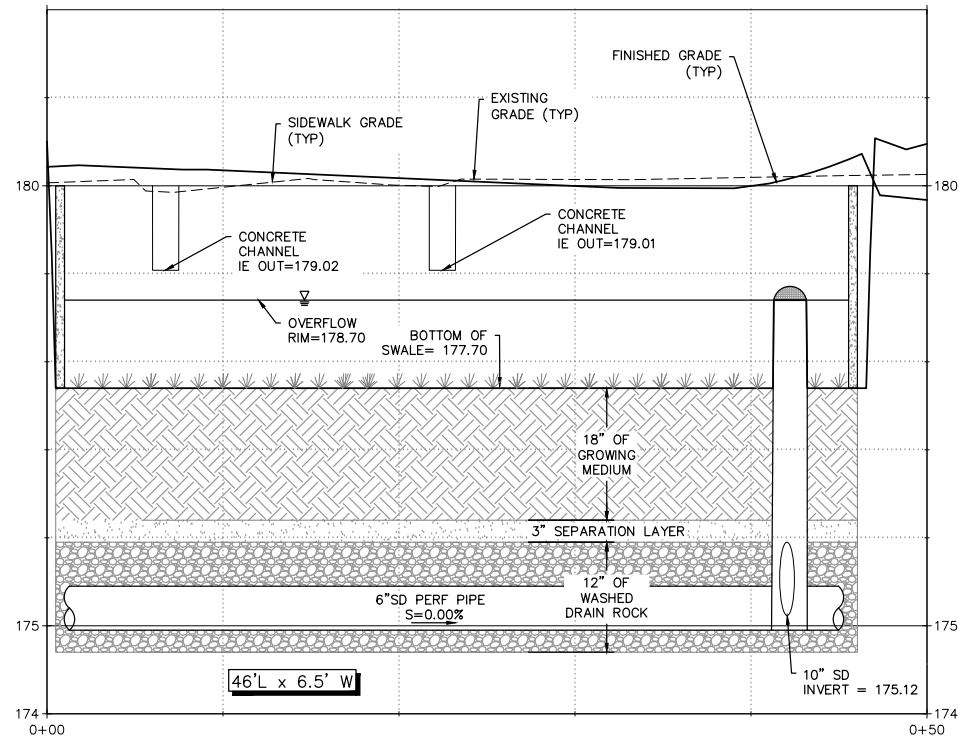
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2	02/26/2020
3	04/27/2020
4	05/12/2020
5	05/27/2020
6	08/17/2020
7	07/15/2020



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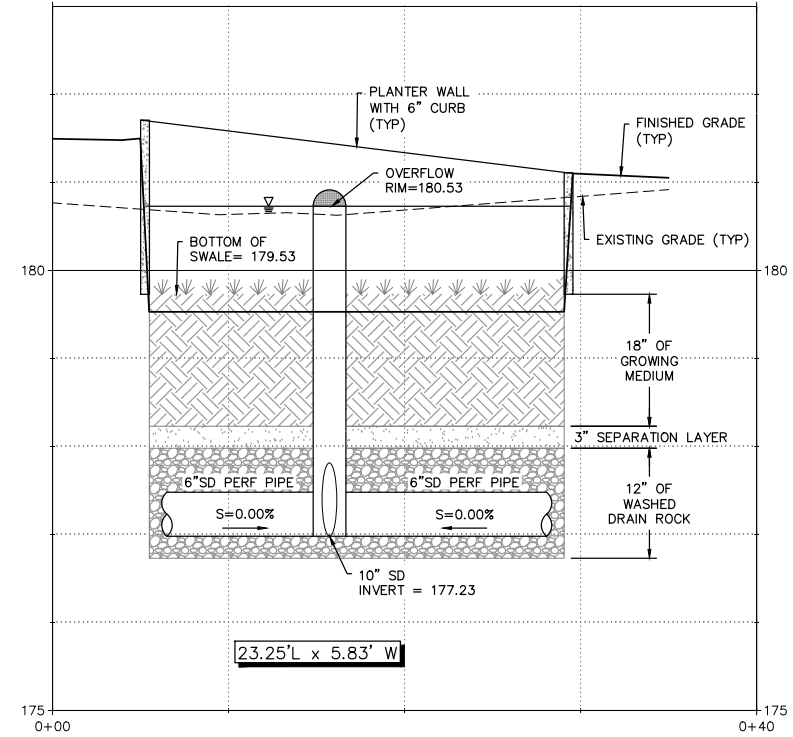
NEW CONSTRUCTION
DP NICOLI - OFFSITE
 28370 SW BOBERG RD
 WILSONVILLE, OREGON 97070

LID AND UTILITY PLAN
R3.0
 180146.03
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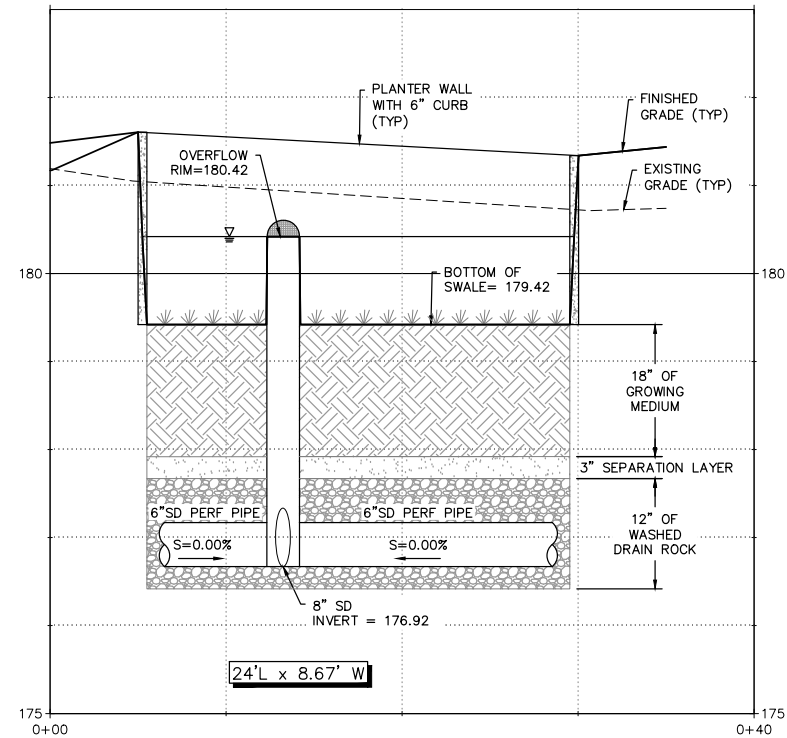
OFFSITE - PLANTER PROFILE

SCALE: HORZ: 1" = 5'
VERT: 1" = 1'



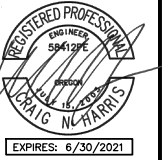
ONSITE - NORTH PLANTER PROFILE

SCALE: HORZ: 1" = 5'
VERT: 1" = 1'



ONSITE - SOUTH PLANTER PROFILE

SCALE: HORZ: 1" = 5'
VERT: 1" = 1'



01/15/2020
04/22/2020
04/27/2020
05/12/2020
05/27/2020
06/17/2020
07/15/2020

ISSUE DATE
1 PLANNING REVIEW
2 BUILDING PERMIT - CIVIL
3 CITY RESUBMITTAL
4 CITY RESUBMITTAL
5 REVISIONS TO PERMIT
6 REVISIONS TO PERMIT
7 FIELD REVISIONS



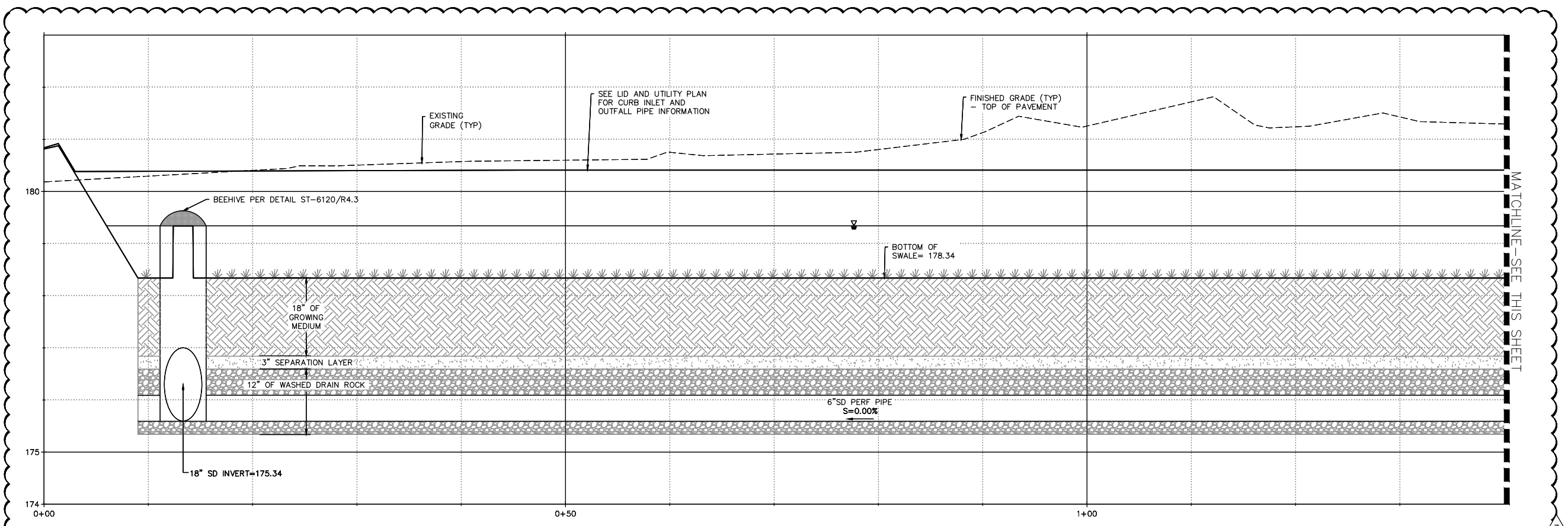
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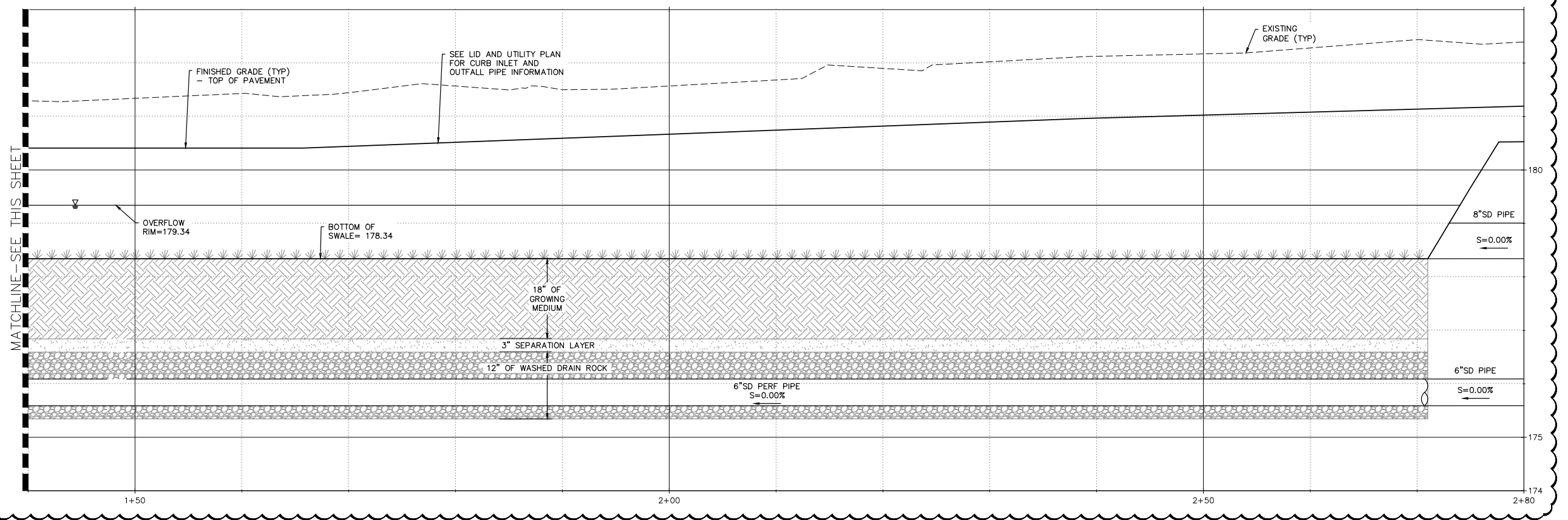
STORM FACILITY
PROFILES

R3.1

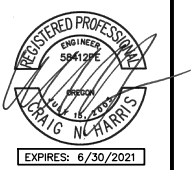
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ONSITE - RAIN GARDEN PROFILE
 SCALE: HORZ: 1" = 5'
 VERT: 1" = 1'



ONSITE - RAIN GARDEN PROFILE
 SCALE: HORZ: 1" = 5'
 VERT: 1" = 1'



ISSUE DATE	PLANNING REVIEW	BUILDING PERMIT - CIVIL	CITY RESUBMITTAL	CITY RESUBMITTAL	REVISIONS TO PERMIT	FIELD REVISIONS
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04/02/2020						
04/27/2020						
05/12/2020						
06/27/2020						
08/17/2020						
07/15/2020						

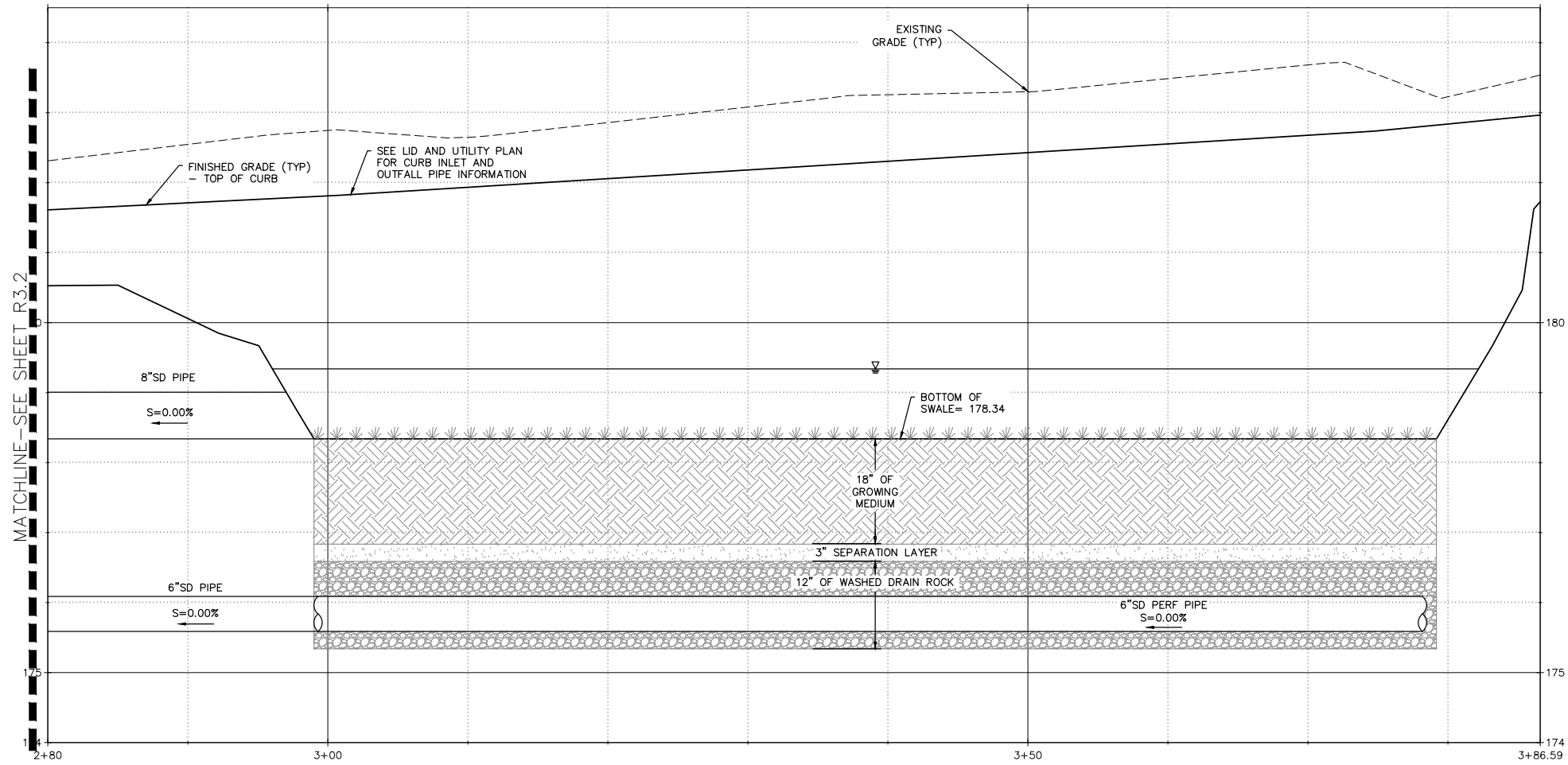


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STORM FACILITY PROFILES
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ONSITE - RAIN GARDEN EXTENSION PROFILE

SCALE: HORIZ: 1" = 5'
VERT: 1" = 1'



ISSUE DATE	PLANNING REVIEW	DESIGN REVIEW	CITY RESUBMITTAL	REVISIONS TO PERMIT	FIELD REVISIONS
01/10/2020					
04/22/2020					
04/27/2020					
05/12/2020					
05/27/2020					
06/17/2020					
07/15/2020					



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STORM FACILITY
PROFILES
R3.3
180146.03
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Appendix D

BMP Sizing Tool Report

WES BMP Sizing Report

Project Information

Project Name	Industrial Focus
Project Type	Commercial
Location	
Stormwater Management Area	4450
Project Applicant	
Jurisdiction	CCSD1NCSA

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
Sidewalk and Asphalt A	66,795	Grass	Conventional Concrete	D	Rain Garden
Roof A	11,400	Grass	Roofs	D	Rain Garden
Pervious A	16,400	Grass	Grass	D	Rain Garden
Sidewalk and Asphalt B	4,425	Grass	Conventional Concrete	D	Planter B
Sidewalk and Asphalt C	2,880	Grass	Conventional Concrete	D	Planter C
Extension*	34,040	Grass	Conventional Concrete	D	Rain Garden

*Extension not apart of current permit

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
Rain Garden	Flow Control and Treatment	Rain Garden - Filtration	D1	4,679.6	4,679.7	3.6
Planter B	Flow Control and Treatment	Stormwater Planter - Filtration	D1	132.8	208.0	0.7
Planter C	Flow Control and Treatment	Stormwater Planter - Filtration	D1	86.4	135.0	0.6

Pond Sizing Details

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only
2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation

layer and growing media).

3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.

4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

WES BMP Sizing Report

Project Information

Project Name	DP NICOLI
Project Type	Commercial
Location	BOBERG RD, WILSONVILLE
Stormwater Management Area	420
Project Applicant	
Jurisdiction	CCSD1NCSA

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
Sidewalk, Roadway, Driveway B	9,390	Grass	Conventional Concrete	D	South Planter
Grass B	1,905	Grass	Grass	D	South Planter

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
South Planter	Flow Control and Treatment	Stormwater Planter - Filtration	D1	298.3	299.0	1.2

Pond Sizing Details

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only
2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).
3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.
4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

Appendix E

Conveyance Report and Map

Project N+A1:S45ame: DP NICOLI
 Project #: A18234.11

Design Frequency: 25yr

Designed By: TRH
 Checked By: CNH

Date: 7/21/2020

Upstream Structure	downstream Structure	Area (A) sqft	Area (A) acres	Runoff Coeff. (c)	Equiv. Area (cA) acres	Total Drainage Area (cA) acres	Time of Concent. Or Flow Time (t) min	Total Time of Concent. (T) min	Average Rainfall Intensity (I) in/hr	Design Discharge (Q) cfs	IE (in) ft	IE (out) ft	Pipe Length (L) ft	Min. Invert Slope (s) %	Pipe Size (D) in	Capacity Flowing Full (Q) cfs	Velocity Flowing Full (V) fps	Flow Time (t) min
CB-02	342	8818.5	0.202	0.90	0.182	0.182	5.0	5.0	3.40	0.619	180.06	179.97	12.41	0.7%	8	1.03	2.95	0.1
RD-01	306	948.5	0.022	0.90	0.020	0.020	5.0	5.0	3.40	0.067	180.50	180.05	49.15	0.9%	6	0.54	2.74	0.3
RD-02	306	1897	0.044	0.90	0.039	0.039	5.0	5.0	3.40	0.133	180.50	180.05	2.26	19.9%	6	2.51	12.78	0.0
306	342	2845.5	0.065	0.90	0.059	0.059	5.0	5.0	3.40	0.200	180.05	179.97	8.87	0.9%	6	0.53	2.72	0.1
342	343	11664	0.268	0.90	0.241	0.241	5.0	5.0	3.40	0.819	179.97	179.62	50.06	0.7%	8	1.01	2.90	0.3
RD-03	343	1897	0.044	0.90	0.039	0.039	5.0	5.0	3.40	0.133	180.50	179.62	7.55	11.7%	6	1.92	9.78	0.0
343	308	13561	0.311	0.90	0.280	0.280	5.0	5.0	3.40	0.953	179.62	179.57	7.43	0.7%	8	0.99	2.85	0.0
CB-03	308	26536	0.609	0.90	0.548	0.548	5.0	5.0	3.40	1.864	180.40	179.57	5.00	16.6%	8	4.93	14.13	0.0
308	272	40097	0.921	0.90	0.828	0.828	5.0	5.0	3.40	2.817	179.57	179.27	41.99	0.7%	12	3.02	3.84	0.2
272	273	40097	0.921	0.90	0.828	0.828	5.0	5.0	3.40	2.817	179.27	179.24	4.28	0.7%	12	2.99	3.81	0.0
RD-04	273	948.5	0.022	0.90	0.020	0.020	5.0	5.0	3.40	0.067	180.50	179.24	5.62	22.4%	6	2.66	13.56	0.0
273	314	41045.5	0.942	0.90	0.848	0.848	5.0	5.0	3.40	2.883	179.24	179.22	2.80	0.7%	12	3.02	3.84	0.0
CB-04	314	19549.54	0.449	0.90	0.404	0.404	5.0	5.0	3.40	1.373	180.20	179.22	14.14	6.9%	8	3.19	9.13	0.0
314	275	60595.04	1.391	0.90	1.252	1.252	5.0	5.0	3.40	4.257	179.22	179.17	7.07	0.7%	15	5.44	4.44	0.0
275	346	60595.04	1.391	0.90	1.252	1.252	5.0	5.0	3.40	4.257	179.17	178.95	30.73	0.7%	15	5.48	4.46	0.1
CB-05	346	11464.76	0.263	0.90	0.237	0.237	5.0	5.0	3.40	0.805	180.18	178.95	5.00	24.6%	8	6.01	17.21	0.0
346	304	72059.8	1.654	0.90	1.489	1.489	5.0	5.0	3.40	5.062	178.95	178.61	48.39	0.7%	15	5.43	4.42	0.2
RD-05	304	948.5	0.022	0.90	0.020	0.020	5.0	5.0	3.40	0.067	180.50	178.61	10.96	17.2%	6	2.33	11.89	0.0
304	OF-05	73008.3	1.676	0.90	1.508	1.508	5.0	5.0	3.40	5.129	178.61	178.34	37.93	70.0%	12	29.87	38.04	0.0
RD-06	OF-04	1897	0.044	0.90	0.039	0.039	5.0	5.0	3.40	0.133	180.50	178.34	38.05	5.7%	6	1.34	6.82	0.1
RD-07	OF-03	1897	0.044	0.90	0.039	0.039	5.0	5.0	3.40	0.133	180.50	178.34	38.05	5.7%	6	1.34	6.82	0.1

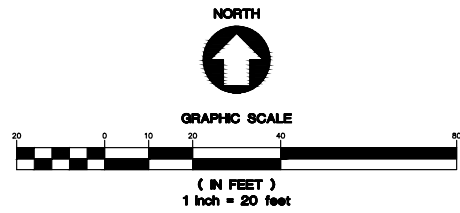
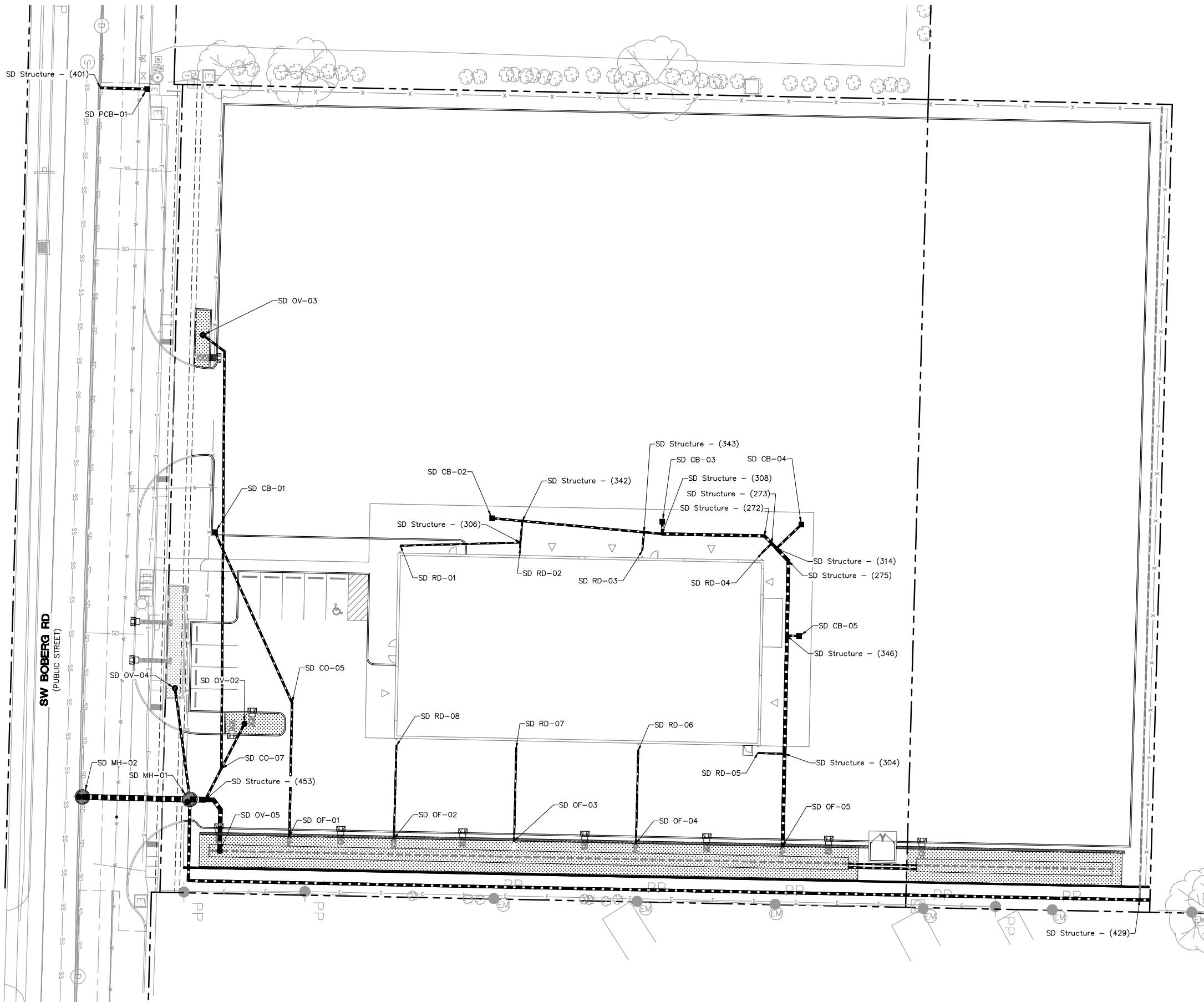
Project N+A1:S45ame: DP NICOLI
 Project #: A18234.11

Design Frequency: 25yr

Designed By: TRH
 Checked By: CNH

Date: 7/21/2020

Upstream Structure	downstream Structure	Area (A) sqft	Area (A) acres	Runoff Coeff. (c)	Equiv. Area (cA) acres	Total Drainage Area (cA) acres	Time of Concent. Or Flow Time (t) min	Total Time of Concent. (T) min	Average Rainfall Intensity (I) in/hr	Design Discharge (Q) cfs	IE (in) ft	IE (out) ft	Pipe Length (L) ft	Min. Invert Slope (s) %	Pipe Size (D) in	Capacity Flowing Full (Q) cfs	Velocity Flowing Full (V) fps	Flow Time (t) min
RD-08	OF-02	948.5	0.022	0.90	0.020	0.020	5.0	5.0	3.40	0.067	180.50	178.34	38.05	5.7%	6	1.34	6.82	0.1
CB-01	CO-05	3588	0.082	0.90	0.074	0.074	5.0	5.0	3.40	0.252	178.99	178.61	76.70	0.5%	8	0.85	2.44	0.5
CO-05	OF-01	3588	0.082	0.90	0.074	0.074	5.0	5.0	3.40	0.252	178.61	178.34	54.81	0.5%	8	0.85	2.43	0.4
OV-05	453	94595	2.172	0.90	1.954	1.954	5.0	5.0	3.40	6.645	175.34	175.22	25.17	0.5%	18	7.27	4.11	0.1
OV-03	CO-07	8104	0.186	0.90	0.167	0.167	5.0	5.0	3.40	0.569	177.47	176.55	182.14	0.5%	8	0.86	2.47	1.2
OV-02	CO-07	3460	0.079	0.90	0.071	0.071	5.0	5.0	3.40	0.243	177.62	176.55	20.67	5.2%	8	2.76	7.89	0.0
CO-07	453	11564	0.265	0.90	0.239	0.239	5.0	5.0	3.40	0.812	176.58	175.80	14.37	5.4%	8	2.82	8.08	0.0
453	MH-01	106159	2.437	0.90	2.193	2.193	5.0	5.0	3.40	7.457	175.22	175.19	6.30	0.5%	24	15.65	4.98	0.0
OV-04	MH-01	9615	0.221	0.90	0.199	0.199	5.0	5.0	3.40	0.675	175.22	174.99	46.01	0.5%	8	0.86	2.45	0.3
429	MH-01	34040	0.781	0.90	0.703	0.703	5.0	5.0	3.40	2.391	179.42	175.19	423.23	1.0%	12	3.57	4.55	1.6
MH-01	MH-02	149814	3.439	0.90	3.095	3.095	5.0	5.0	3.40	10.524	174.89	174.71	44.06	0.4%	24	14.50	4.61	0.2



ISSUED DATE	DESCRIPTION
1 01/10/20	PLANNING REVIEW
2 04/10/20	BUILDING PERMIT
3 04/27/20	CITY RESUBMITTAL - CIVIL
4 05/11/20	CITY RESUBMITTAL
5 05/27/20	CITY RESUBMITTAL
6 06/17/2020	REVISIONS TO PERMIT
7 07/15/2020	FIELD REVISIONS



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NEW CONSTRUCTION FOR:
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28370 SW BOBERG RD
WILSONVILLE, OR 97070

CONVEYANCE
MAP

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Appendix F

Geotechnical Report

GEODESIGN^{INC}



REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Wilsonville Facilities
Tax Lots 300 and 500
Wilsonville, Oregon

For
D.P. Nicoli, Inc.
November 14, 2018

GeoDesign Project: DPNicoli-5-01

November 14, 2018

D.P. Nicoli, Inc.
PO Box 2401
Lake Oswego, OR 97035

Attention: Stephanie Nanna and Dave Nicoli

Report of Geotechnical Engineering Services
Wilsonville Facilities
Tax Lots 300 and 500
Wilsonville, Oregon
GeoDesign Project: DPNicoli-5-01

GeoDesign, Inc. is pleased to submit this report of geotechnical engineering services for the proposed development, which includes Tax Lots 300 and 500 of Clackamas County Tax Map 3S1W14A in Wilsonville, Oregon. Our services for this project were conducted in accordance with our proposal dated August 27, 2018.

We appreciate the opportunity to be of service to you. Please call if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.



George Saunders, P.E., G.E.
Principal Engineer

cc: Tara Lund, CIDA, Inc. (via email only)
Craig Harris, AAI Engineering (via email only)

JLM:TVS:GPS:kt

Attachments

One copy submitted (via email only)

Document ID: DPNicoli-5-01-111418-geor.docx

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EXECUTIVE SUMMARY

In our opinion, the site can be developed as we have identified in the "Project Understanding" section provided the recommendations in this report are incorporated into design and implemented during construction. This summary is an overview and the report should be referenced for a more thorough discussion of the subsurface conditions and geotechnical recommendations for the project. The following factors will have an impact on design and construction of the proposed development:

- A formal grading plan had not been developed by the time of this report; however, preliminary estimates are that cuts and fills will likely be in the 3- to 5-foot range.
- Assuming the distributed floor slab live loads, foundation loads, and the preliminary finished floor grade provided in this report, our analysis indicates that post-construction settlements will be within typical structural tolerances and the proposed structures can be supported by conventional shallow foundations.
- The footings should bear on granular pads underlain by firm, undisturbed native soil or on structural fill overlying firm, undisturbed native soil. Excavations up to 2.0 feet BGS may be required to remove disturbed native soil or undocumented fill material from the influence zones of footings.
- The site was previously used for agricultural purposes. Consequently, a tilled zone is present at the ground surface. We recommend that subgrade for floor slabs and pavements be improved as described in the "Site Preparation" section.
- The fine-grained soil at the site is sensitive to small changes in moisture content and difficult, if not impossible, to adequately compact during wet weather or when the moisture content of the soil is more than a couple percent above the optimum moisture content required for compaction.

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ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ACI	American Concrete Institute
ACP	asphalt concrete pavement
ADTT	average daily truck traffic
ASTM	American Society for Testing and Materials
BGS	below ground surface
CBR	California Bearing Ratio
DCP	dynamic cone penetrometer
ESAL	equivalent single-axle load
FHWA	Federal Highway Administration
g	gravitational acceleration (32.2 feet/second ²)
H:V	horizontal to vertical
IBC	International Building Code
MCE	maximum considered earthquake
NA	not applicable
ODOT	Oregon Department of Transportation
OSHA	Occupational Safety and Health Administration
OSSC	Oregon Standard Specifications for Construction (2018)
PCC	portland cement concrete
pcf	pounds per cubic foot
pci	pounds per cubic inch
psi	pounds per square inch
PG	performance grade
psf	pounds per square foot
SOSSC	State of Oregon Structural Specialty Code
SPT	standard penetration test
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

GeoDesign, Inc. is pleased to submit this report providing geotechnical engineering recommendations for use in design and construction of the proposed development, which includes Tax Lots 300 and 500 of Clackamas County Tax Map 3S1W14A in Wilsonville, Oregon. Figure 1 shows the site relative to existing topographic and physical features. Figure 2 shows the proposed site layout and the approximate locations of our explorations. Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

2.0 PROJECT UNDERSTANDING

The proposed development consists of two parcels that are oriented north and south of each other and located south of SW Boeckman Road between SW Boberg Road and SW Boones Ferry Road. The north and south parcels encompass 2.09 and 4.07 acres, respectively. We understand that three industrial facilities are proposed to be constructed with loading docks and surrounding paved driveways and parking areas. The preliminary site plan indicates that the buildings are 22,000, 30,000, and 32,250 square feet. We understand that, initially, only one or two buildings will be constructed and the undeveloped area will be used as a yard for storing shoring elements.

It is our understanding that the buildings will be concrete tilt-up structures. Column and wall loads were not provided at the time of this report. Based on our experience with similar structures, we anticipate maximum column and wall loads to be less than 150 kips and 5 kips per lineal foot, respectively. We anticipate floor slab loads will be less than 300 psf.

Based on preliminary grading estimates from Craig Harris of AAI Engineering, we understand that cuts and fills are expected to be less than 3 to 5 feet.

3.0 PURPOSE AND SCOPE

The purpose of our services was to explore subsurface conditions at the site and provide geotechnical engineering recommendations for design and construction of the proposed facilities. Specifically, we completed the following scope of services:

- Reviewed readily available geologic maps and our in-house files for existing information on subsurface conditions in the site vicinity, including review of our previous explorations at nearby surrounding sites.
- Coordinated and managed the field explorations, including utility locates and scheduling subcontractors and GeoDesign field staff.
- Conducted the following explorations:
 - Five borings within the proposed building areas to a depth of 21.5 feet BGS.
 - Two borings at the site to a depth of 31.5 feet BGS.
- Classified the material encountered in the explorations and maintained a detailed log of each exploration.
- Collected disturbed and undisturbed soil samples for laboratory testing at select depths from the explorations.

- Performed one field infiltration test in one boring at a depth 5.5 feet BGS.
- Performed DCP testing at all boring locations.
- Performed the following laboratory tests on select samples collected from the explorations:
 - Twenty-three natural moisture content determinations
 - Three particle-size analyses
 - One Atterberg limits test
 - One consolidation test to evaluate soil compressibility
- Provided recommendations for site preparation, grading and drainage, stripping depths, fill type for imported material, compaction criteria, trench excavation and backfill, use of on-site soil, and wet/dry weather earthwork.
- Provided recommendations for design and construction of shallow spread foundations, including allowable design bearing pressure, minimum footing depth and width, passive resistance capacity, and coefficient of friction.
- Provided recommendations for preparation of floor slab subgrade.
- Provided design criteria recommendations for retaining walls, including lateral earth pressures, backfill, compaction, and drainage.
- Provided infiltration test results and recommendations for design infiltration rates.
- Provided recommendations for the management of identified groundwater conditions that may affect the performance of structures.
- Provided design and construction recommendations for on-site pavement for access roads, parking areas, and the storage yard for shoring elements. Our design recommendations include the following:
 - Standard pavement sections consisting of AC supported on aggregate base
 - Pavement sections consisting of AC supported on cement-amended soil for access roads and parking areas
 - Pavement sections with surfacing that consists of gravel, AC, or PCC for the storage yard (underlain with aggregate base for the AC and PCC options)
 - Pavement sections of gravel, AC, or PCC on cement-amended soil
- Provided recommendations for subsurface drainage of foundations and pavements.
- Provided recommendations for IBC seismic coefficients and provided a discussion of potential geologic hazards at the site.
- Provided this report summarizing the results of our geotechnical evaluation.

4.0 SITE CONDITIONS

4.1 SURFACE CONDITIONS

The proposed development includes Tax Lots 300 and 500 of Clackamas County Tax Map 3S1W14A and encompasses a cumulative 6.16 acres of vacant land. Based on historical aerial photographs in our project files, between at least the early 1900s and 2005 the site was used for agricultural purposes and a tilled (cultivated) zone is anticipated at the ground surface. The properties gradually slope from north to the south. In general, the surrounding properties of the site are industrial. At the time of our explorations, standing water was not observed at the ground surface of the site.

4.2 SUBSURFACE CONDITIONS

4.2.1 General

Our knowledge of subsurface conditions at the site is based on drilling seven borings (B-1 through B-7). The borings were drilled using mud rotary methods to depths between 21.5 and 31.5 feet BGS. The top 5 feet of boring B-4 was drilled using a 4-inch-diameter hollow-stem auger to facilitate infiltration testing. Figure 2 shows the approximate exploration locations. The exploration logs and laboratory test results are presented in Appendix A.

Based on historical aerial photographs in our project files, between at least the early 1900s and 2005 the site was used for agricultural purposes and a tilled (cultivated) zone is anticipated at the ground surface. In general, the subsurface conditions consist of silt underlain by layers of gravel, clay, and sand. The following sections provide a summary of the soil units encountered.

4.2.2 Silt

Silt was encountered in all of borings from the ground surface to depths between 14 and 18 feet BGS. Root zones encountered in our borings vary between 3 and 4 inches thick. In most cases, the root zone includes fine roots and rootlets up to ¼-inch diameter. Based on SPT blow counts, the silt is medium stiff to stiff near the ground surface and is very soft to soft at depths between 7 and 18 feet BGS in borings B-1 through B-6. Medium stiff conditions were observed throughout the surficial silt layer in boring B-7. A layer of medium stiff silt was observed between depths of 23 and 28 feet BGS in boring B-1. Laboratory testing of select samples indicates the silt had in-place moisture contents between 26 and 42 percent at the time of our explorations and moderate to high compressibility.

4.2.3 Gravel

Gravel with varying sand and silt content was encountered beneath the silt at depths between 14 and 18 feet BGS in borings B-1 and B-4 through B-6. Based on SPT blow counts, the gravel is medium dense to dense. Laboratory testing of select samples indicates the gravel unit had in-place moisture contents between 15 and 27 percent at the time of our explorations.

4.2.4 Fat Clay

In general, we encountered fat clay beneath the silt and gravel layers at depths between 17 and 18.5 feet BGS in borings B-1 through B-5. A deeper second layer of clay was encountered in boring B-4 between depths of 25.5 and 29 feet BGS. Based on SPT blow counts, the clay is medium stiff to stiff and varies in sand content. Laboratory testing of select samples indicates the fat clay had in-place moisture contents between 38 and 44 percent at the time of our explorations.

4.2.5 Sand

We encountered layers of sand with silt at depths extending between 24 and 31.5 feet BGS in borings B-1 and B-4. We also encountered a layer of sand with silt and gravel at a depth of 15 feet BGS in boring B-7. Based on SPT blow counts, the sand is primarily medium dense. One of the two layers of sand with silt encountered in boring B-4 is loose. Field observations indicated the sand layers were moist at the time of our explorations.

4.2.6 Groundwater

Groundwater could not be measured directly in the mud rotary borings due to the presence of drilling fluid and groundwater was not encountered during the initial 5 feet of drilling of B-4 using hollow-stem drilling methods. Drill logs available from the Oregon Water Resources Department webpage indicated that groundwater is encountered at depths of 10 to 15 feet BGS at sites in the general vicinity of the subject site. Based on our experience in the area, groundwater may rise to within approximately 5 to 7 feet BGS following prolonged winter wet weather and shallower perched water should be expected. The depth to groundwater may fluctuate in response to seasonal changes, water levels in nearby bodies of water, changes in surface topography, and other factors not observed in this study.

4.3 DCP TESTING

We performed DCP testing at each boring location on September 4 and 5, 2018. Approximate locations of the tests are shown on Figure 2. Details of our test program and plots of the summarized data are presented in Appendix B. A summary of the estimated subgrade resilient modulus at each test location is presented in Table 1.

Table 1. DCP Test Results

Boring Number	Estimated Resilient Modulus (psi)
B-1	6,870
B-2	6,280
B-3	6,450
B-4	6,430
B-5	6,590
B-6	6,510
B-7	5,560

4.4 INFILTRATION TESTING

We completed a falling-head infiltration test in boring B-4 at a depth of 5.5 feet BGS. We saturated the underlying soil before taking measurements under low-head conditions of approximately 12 inches or less of water. Table 2 summarizes the measured infiltration rate.

Table 2. Observed Infiltration Rates

Boring	Depth (feet BGS)	Soil Type at Test Depth	Observed Infiltration Rate (inches per hour)
B-4	5.5	SILT, minor sand	0.4

The infiltration rate provided above is an unfactored measured rate with no factor of safety. We recommend a minimum factor of safety of 2 and correction factors should be applied as well by the civil engineer during design to account for the degree of long-term maintenance and influent/pre-treatment control, as well as the potential for long-term clogging due to siltation and bio-buildup, depending on the proposed length, location, and type of infiltration facility. If built,

we recommend that the installation of the stormwater basins be observed by a qualified geotechnical engineer to confirm that the soil conditions are consistent with our observations during our explorations.

4.5 GEOLOGICAL HAZARDS

4.5.1 Liquefaction and Lateral Spreading

Liquefaction is a phenomenon caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. The excessive buildup of pore water pressure results in the sudden loss of shear strength in a soil. Granular soil, which relies on inter-particle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upwards, carrying soil particles with the draining water. In general, loose, saturated sandy soil with low silt and clay content is the most susceptible to liquefaction. Thin layers of sand were encountered during the explorations; however, given thickness and/or relative density of the material, we estimate that liquefaction-induced settlement (if present) will be less than 1 inch and we do not anticipate liquefaction to be a site hazard.

Lateral spreading is a liquefaction-related seismic hazard and occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Since there are no nearby open faces, lateral spreading is not considered a hazard at the site.

4.5.2 Fault Surface Rupture

The closest mapped fault to the site is the Canby-Molalla fault. It is mapped approximately 4 miles to the east (USGS, 2018). Since faults are not mapped beneath the site, we conclude that the probability of surface fault rupture beneath the site is low.

5.0 CONCLUSIONS

In our opinion, the site can be developed as we have identified in the "Project Understanding" section provided the recommendations in this report are incorporated into design and implemented during construction. A summary of the geotechnical factors impacting the design and construction of the proposed development are provided in the "Executive Summary." The following sections present specific recommendations for use in design and construction of the proposed development.

6.0 SITE DEVELOPMENT RECOMMENDATIONS

6.1 SITE PREPARATION

6.1.1 Grubbing and Stripping

The existing root zone should be stripped and removed from the site in all proposed building and pavement areas. Based on our explorations, the depth of stripping will be 4 inches. Greater stripping depths may be required to remove localized zones of loose or organic soil. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

6.1.2 Tilled Zone

Based on historical aerial photographs in our project files, between at least the early 1900s and 2005 the site was used for agricultural purposes and a tilled (cultivated) zone is anticipated at the ground surface. Typically, tilled zones are approximately 12 to 16 inches deep. Reliable strength properties are extremely difficult to predict for the tilled zone material. There is a high risk for poor performance of floor slabs and pavement established directly over loosened soil. To reduce the risk of settlement, we recommend the tilled zone be improved during site preparation in areas where planned cuts do not extend to the bottom of the tilled zone. Prior to fill placement and construction, the tilled zone should be improved by removing and replacing with structural fill or scarifying and re-compacting to structural fill requirements.

As discussed in the "Structural Fill" section, the native soil can be sensitive to small changes in moisture content and will be difficult, if not impossible, to compact adequately during wet weather. While scarification and compaction of the subgrade is the best option for subgrade improvement, it will likely only be possible during extended dry periods and following moisture conditioning of the soil. As discussed further on in this report, cement amendment is an option for conditioning the soil for use as structural fill during periods of wet weather or when drying the soil is not an option.

6.1.3 Subgrade Preparation and Evaluation

Following stripping and subgrade stabilization and prior to placing fill, pavement, or building improvements, the exposed subgrade should be evaluated by proof rolling. The subgrade should be proof rolled with a fully loaded dump truck or similar heavy, rubber tire construction equipment to identify soft, loose, or unsuitable areas. A member of our geotechnical staff should observe proof rolling to evaluate yielding of the ground surface. Soft or loose zones identified during proof rolling should be excavated and replaced with compacted structural fill. Areas that appear too wet or soft to support proof rolling equipment should be prepared in accordance with recommendations for wet weather construction provided in the "Construction Considerations" section.

6.2 CONSTRUCTION CONSIDERATIONS

Fine-grained soil present on this site is easily disturbed during the wet season. If not carefully executed, earthwork activity can create extensive soft areas and significant repair costs can result. Earthwork planning should include considerations for minimizing subgrade disturbance.

If construction occurs during the wet season, or if the moisture content of the soil is more than a few percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment, loading removed material into trucks supported on granular haul roads.

The base rock thickness for pavement areas is intended to support post-construction design traffic loads and not intended to support construction traffic. The thickness of the granular material for haul roads and staging areas will depend on the amount and type of construction traffic and should be the responsibility of the contractor. Generally, a 12- to 18-inch-thick mat of granular material is sufficient for light staging areas and the basic building pad but is generally not expected to be adequate to support heavy equipment or truck traffic. The granular mat for

haul roads and areas with repeated heavy construction traffic typically needs to be increased to between 18 and 24 inches. The actual thickness of haul roads and staging areas should be based on the contractor's approach to site development and the amount and type of construction traffic. The material used to construct haul roads and staging areas should also be selected by the contractor.

As an alternative to thickened crushed rock sections, haul roads and utility work zones may be constructed using cement-amended subgrades overlain by a crushed rock wearing surface. If this approach is used, the thickness of granular material in staging areas and along haul roads can typically be reduced to between 6 and 9 inches. This recommendation is based on an assumed minimum unconfined compressive strength of 100 psi for subgrade amended to a depth of 12 to 16 inches. The actual thickness of the amended material and imported granular material will depend on the contractor's means and methods and, accordingly, should be the contractor's responsibility. Cement amendment is discussed in the "Structural Fill" section.

6.3 EXCAVATION

6.3.1 Excavation and Shoring

Temporary excavation sidewalls should stand vertical to a depth of approximately 4 feet, provided groundwater seepage is not observed in the sidewalls. Open excavation techniques may be used to excavate trenches with depths between 4 and 8 feet, provided the walls of the excavation are cut at a slope of 1.5H:1V and groundwater seepage is not present. At this inclination, the slopes with sand may ravel and require some ongoing repair. Excavations should be flattened if excessive sloughing or raveling occurs. In lieu of large and open cuts, approved temporary shoring may be used for excavation support. A wide variety of shoring and dewatering systems are available. Consequently, we recommend the contractor be responsible for selecting the appropriate shoring and dewatering systems.

If box shoring is used, it should be understood that box shoring is a safety feature used to protect workers and does not prevent caving. If the excavations are left open for extended periods of time, caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

If shoring is used, we recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation. All excavations should be made in accordance with applicable OSHA and state regulations.

6.3.2 Trench Dewatering

Shallow excavations could encounter perched groundwater, and significant dewatering operations may be necessary during the rainy season. If stormwater runoff seeps into trenches, it should be removed by pumping from a sump. Water should be routed to a suitable discharge point.

If groundwater is present at the base of utility trench excavations, we recommend placing up to 12 inches of stabilization material at the base of the excavations. Trench stabilization material should meet the requirements provided in the "Structural Fill" section.

We note that these recommendations are for guidance only. The dewatering of excavations is the sole responsibility of the contractor, as the contractor is in the best position to select these systems based on their means and methods.

6.3.3 Safety

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

6.4 STRUCTURAL FILL

Structural fill includes fill beneath foundations, slabs, pavements, any other areas intended to support structures, or within the influence zones of structures. Structural fill should be free of organic matter and other deleterious material and, in general, should consist of particles no larger than 3 inches in diameter. Recommendations for suitable fill material are provided in the following sections.

6.4.1 On-Site Native Soil

The on-site native soil will be suitable for use as structural fill only if it can be moisture conditioned. The on-site silty soil is sensitive to small changes in moisture content and may be difficult, if not impossible, to compact adequately during wet weather or when its moisture content is more than a few percentage points above optimum. This soil may require extensive drying if it becomes wet. Extended dry weather may be required to adequately condition the on-site silty soil for use as structural fill. We recommend using imported granular material for structural fill if the on-site silty soil cannot be moisture conditioned to within 3 percentage points of its optimum moisture content. Native soil should be placed in lifts with a maximum uncompacted thickness of 8 inches and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D1557.

6.4.2 Imported Granular Material

Imported granular material should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is fairly well graded between coarse and fine and has less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve. All granular material must be durable such that there is no degradation of the material during and after installation as structural fill. The percentage of fines can be increased to 12 percent if the fill is placed during dry weather; will be used for general fill and not for staging or haul roads, or floor slab or pavement aggregate base; and provided the fill material is moisture conditioned, as necessary, for proper compaction. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by

ASTM D1557. During the wet season or when wet subgrade conditions exist, the initial lift should have a maximum thickness of 15 inches and should be compacted with a smooth-drum roller without the use of vibratory action.

6.4.3 Floor Slab Base Rock

Imported durable, granular material placed beneath building floor slabs should be clean crushed rock or crushed gravel and sand that is fairly well graded between coarse and fine. The granular material should have a maximum particle size of 1½ inches, have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve, and have at least two mechanically fractured surfaces. The imported base rock should be placed in one lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

6.4.4 Recycled Concrete

Recycled concrete can be used for structural fill, provided the concrete is processed to a relatively well-graded material with a maximum particle size of 3 inches. This material can be used as trench backfill and general structural fill if it meets the requirements for imported granular material, which would require a smaller maximum particle size. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

6.4.5 Trench Backfill

Trench backfill for the utility pipe base and pipe zone should consist of durable, well-graded, granular material containing no organic or other deleterious material, should have a maximum particle size of ¾ inch, and should have less than 8 percent by dry weight passing the U.S. Standard No. 200 sieve.

Backfill for the pipe base and to the spring line of the pipe should be placed in maximum 12-inch-thick lifts and compacted to not less than 90 percent of the maximum dry density, as determined by ASTM D1557, or as recommended by the pipe manufacturer. Backfill above the spring line of the pipe should be placed in maximum 12-inch-thick lifts and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D1557. Trench backfill located within 2 feet of finish subgrade elevation should be placed in maximum 12-inch-thick lifts and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

6.4.6 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches and should meet OSSC 00430.11 (Granular Drain Backfill Material). The material should be free of roots, organic matter, and other unsuitable materials and have less than 2 percent by dry weight passing the U.S. Standard No. 200 sieve (washed analysis). The drain rock should be wrapped in a Type 1 drainage geotextile that meets the specifications provided in OSSC Table 02320-1. The geotextile should be installed in conformance with OSSC 00350 (Geosynthetic Installation). Drain rock should be compacted to a firm condition.

6.4.7 Stabilization Material

If perched groundwater is encountered and is present at the base of utility excavations, we recommend placing trench stabilization material at the base of the excavation consisting of at least 2 feet of well-graded gravel, crushed gravel, or crushed rock with a minimum particle size of 4 inches and less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should be free of organic matter and other deleterious material and should be placed in one lift and compacted until "well keyed."

6.4.8 Cement Amendment

6.4.8.1 General

In conjunction with an experienced contractor, the on-site soil can be amended with portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Soil amending should be conducted in accordance with the specifications provided in OSSC 00344 (Treated Subgrade). The amount of cement used during treatment should be based on an assumed soil dry unit weight of 100 pcf.

Portland cement-amended soil is hard and has low permeability; therefore, this soil does not drain well and it is not suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be planned for drainage and planting.

6.4.8.2 Stabilization

Specific recommendations based on exposed site conditions for soil amending can be provided if necessary. However, for preliminary design purposes, we recommend a target seven-day unconfined compressive strength for cement-amended subgrade for building and pavement subbase (below aggregate base) soil of 100 psi. The amount of cement used to achieve this target generally varies with moisture content and soil type. It is difficult to predict field performance of soil to cement amendment due to variability in soil response, and we recommend laboratory testing to confirm expectations. Generally, 5 percent cement by weight of dry soil can be used when the soil moisture content does not exceed approximately 20 percent. If the soil moisture content is in the range of 25 to 35 percent, 6 to 8 percent by weight of dry soil is recommended. The amount of cement added to the soil may need to be adjusted based on field observations and performance. Moreover, depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content.

For building and pavement subbase, we recommend assuming a minimum cement ratio of 6 percent (by dry weight). If the soil moisture content exceeds 30 percent, a cement ratio of 7 to 8 percent will likely be needed.

A minimum curing of four days is required between treatment and construction traffic access. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect the cement-amended surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material. The crushed rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas.

Treatment depths for buildings, haul roads, and staging areas are typically on the order of 12, 16, and 18 inches, respectively. The actual thickness of the amended material and imported granular material for haul roads and staging areas will depend on the anticipated construction traffic as well as the contractor's means and methods and, accordingly, should be the contractor's responsibility. Treatment depths for pavements are provided in the "Pavement Recommendations" section.

6.4.8.3 Structural

On-site soil that would not otherwise be suitable for structural fill may be amended and placed as fill over a subgrade prepared in conformance with the "Site Preparation" section. The cement ratio for general cement-amended fill can generally be reduced by 1 percent (by dry weight). Typically, a minimum curing of four days is required between treatment and construction traffic access. Consecutive lifts of fill may be treated immediately after the previous lift has been amended and compacted (e.g., the four-day wait period does not apply). However, where the final lift of fill is a building or roadway subgrade, the four-day wait period is in effect.

6.4.8.4 Compaction

A static, sheepsfoot or segment pad roller with a minimum static weight of 40,000 pounds should be used for compaction of fine-grained soil followed by final compaction using a smooth-drum roller with a minimum applied lineal force of 700 pounds per inch. The amended soil should be compacted to at least 92 percent of the achievable dry density at the moisture content of the material, as defined by ASTM D1557.

6.4.8.5 Specifications Recommendations

We recommend the following comments be included in the specifications for the project:

- **Mixing Equipment**
 - Use a pulverizer/mixer capable of uniformly mixing the cement into the soil to the design depth. Blade mixing will not be allowed.
 - Pulverize the soil-cement mixture such that 100 percent by dry weight passes a 1-inch sieve and a minimum of 70 percent passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves. If water is required, the pulverizer should be equipped to inject water to a tolerance of ¼ gallon per square foot of surface area.
 - Use machinery that will not disturb the subgrade, such as using low-pressure "balloon" tires on the pulverizer/mixer vehicle. If subgrade is disturbed, the tilling/treatment depth shall extend the full depth of the disturbance.
 - Multiple "passes" of the tiller will likely be required to adequately blend the cement and soil mixture.
- **Spreading Equipment**
 - Use a spreader capable of distributing the cement uniformly on the ground to within 5 percent variance of the specified application rate.
 - Use machinery that will not disturb the subgrade, such as using low-pressure "balloon" tires on the spreader vehicle. If subgrade is disturbed, the tilling/treatment depth shall extend the full depth of the disturbance.

- **Compaction Equipment**
 - Use a static, sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds for initial compaction of fine-grained soil (silt and clay) or an alternate approved by the geotechnical engineer.
 - Use a vibratory, smooth-drum roller with a minimum applied lineal force of 600 pounds per inch for final compaction or an alternate approved by the geotechnical engineer.

6.5 TEMPORARY SLOPES

Temporary slopes should be no steeper than 1.5H:1V. If slopes greater than 10 feet high are required, GeoDesign should be contacted to make additional recommendations. All cut slopes should be protected from erosion by covering them during wet weather. If sloughing or instability is observed, the slope should be flattened or the cut supported by shoring.

6.6 EROSION CONTROL

The on-site soil is moderately susceptible to erosion. Consequently, we recommend that slopes be covered with an appropriate erosion control product if construction occurs during periods of wet weather. We recommend that all slope surfaces be planted as soon as practical to minimize erosion. Surface water runoff should be collected and directed away from slopes to prevent water from running down the slope face. Erosion control measures such as straw bales, sediment fences, and temporary detention and settling basins should be used in accordance with local and state ordinances.

7.0 FOUNDATION SUPPORT RECOMMENDATIONS

A formal grading plan had not been developed by the time of this report; however, preliminary estimates are that cuts and fills will likely be in the 3- to 5-foot range. Assuming the distributed floor slab live loads, foundation loads, and the preliminary finished floor grade provided in the "Project Understanding" section, our analysis indicates that the proposed structures can be supported by conventional shallow foundations. The planned structures may be supported by continuous wall and isolated column footings founded on firm, undisturbed native soil or on structural fill overlying firm, undisturbed native soil. Our recommendations for use in foundation design and construction are provided in the following sections.

7.1 SPREAD FOOTINGS

7.1.1 Bearing Capacity

If encountered, undocumented fill and disturbed native soil should be removed from the influence zones of footings. The excavations should be backfilled with granular structural fill that extends beyond the footing perimeter by 6 inches for every foot they extend beneath the footing subgrade. The structural fill should meet the requirements of the "Imported Granular Material" section and compacted to at least 95 percent of the maximum dry density, as determined by ASTM D1557. Due to the presence of an agricultural tilled zone at the site, we recommend that we be retained to observe the footing subgrades.

We recommend that footings be sized based on an allowable bearing pressure of 2,500 psf. This is a net bearing pressure; the weight of the footing and overlying backfill can be ignored in calculating footing sizes. The recommended allowable bearing pressure applies to the total of

dead plus long-term live loads. Continuous wall and spread footings should be at least 18 and 24 inches wide, respectively. The bottom of exterior footings should be at least 18 inches below the lowest adjacent final grade. The bottom of interior footings should be placed at least 12 inches below the base of the floor slab.

Total post-construction settlement is expected to be less than 1½ inches. Differential settlement is expected to be less than ½ inch over 50 feet. We recommend that GeoDesign review the final grading plan to re-evaluate the settlement estimates. A preload or surcharge plan may be necessary if the finished floor grades are more than 5 feet above existing site grades.

7.1.2 Lateral Resistance

Lateral loads on footings can be resisted by passive earth pressure on the sides of the footings and by friction on the base of the footings. The available passive earth pressure for footings confined by native soil and structural fill is 250 pcf. Adjacent floor slabs, pavements, or the upper 12-inch depth of adjacent unpaved areas should not be considered when calculating passive resistance. For computing the friction capacity of building foundations, we recommend friction coefficients of 0.35 for footings bearing on native soil and 0.45 for footings bearing on gravel or crushed rock.

8.0 SLABS ON GRADE

A minimum 6-inch-thick layer of base rock should be placed and compacted over the prepared subgrade to assist as a capillary break. The base rock should be crushed rock or crushed gravel and sand meeting the requirements outlined in the "Structural Fill" section. The imported granular material should be placed in one lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557. A subgrade modulus of 120 pci can be used to design the floor slab. Floor slab base rock should be replaced if it becomes contaminated with excessive fines (greater than 5 percent by dry weight passing the U.S. Standard No. 200 sieve).

Vapor barriers are often required by flooring manufacturers to protect flooring and flooring adhesives. Many flooring manufacturers will warrant their product only if a vapor barrier is installed according to their recommendations. Selection and design of an appropriate vapor barrier (if needed) should be based on discussions among members of the design team. We can provide additional information to assist you with your decision.

9.0 RETAINING STRUCTURES

9.1 ASSUMPTIONS

Our retaining wall design recommendations are based on the following assumptions: (1) the walls consist of conventional, cantilevered retaining walls, (2) the walls are less than 8 feet in height, (3) the backfill is drained and consists of imported granular materials, and (4) the backfill has a slope flatter than 4H:1V. Re-evaluation of our recommendations will be required if the retaining wall design criteria for the project varies from these assumptions.

9.2 WALL DESIGN PARAMETERS

For unrestrained retaining walls, an active pressure of 35 pcf equivalent fluid pressure should be used for design. For embedded building walls, a superimposed seismic lateral force should be calculated based on a dynamic force of $7H^2$ pounds per lineal foot of wall (where H is the height of the wall in feet) and applied a distance of 0.6H from the base of the wall. Where retaining walls are restrained from rotation prior to being backfilled, a pressure of 55 pcf equivalent fluid pressure should be used for design.

If surcharges (e.g., retained slopes, building foundations, vehicles, steep slopes, terraced walls, etc.) are located within a horizontal distance from the back of a wall equal to twice the height of the wall, additional pressures will need to be accounted for in the wall design. Our office should be contacted for appropriate wall surcharges based on the actual magnitude and configuration of the applied loads.

The base of the wall footing excavations should extend a minimum of 18 inches below lowest adjacent grade. The footing excavations should then be lined with a minimum 6-inch-thick layer of compacted imported granular material, as described in the "Structural Fill" section.

The wall footings should be designed in accordance with the guidelines provided in the "Foundation Support Recommendations" section.

9.3 WALL DRAINAGE AND BACKFILL

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

Backfill material placed behind retaining walls and extending a horizontal distance of $\frac{1}{2}H$ (where H is the height of the retaining wall) should consist of well-graded sand or gravel, with not more than 5 percent by dry weight passing the U.S. Standard No. 200 sieve and meeting OSSC 00510.12 (Granular Wall Backfill). We recommend the select granular wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric that meets the requirements provided in OSSC 00350 (Geosynthetic Installation) and OSSC 02320 (Geosynthetics) for drainage geotextiles.

Alternatively, the native, silty soil can be used as backfill material provided a minimum 2-foot-wide column of angular drain rock wrapped in a geotextile is placed against the wall and the native soil can be adequately moisture conditioned for compaction. The rock column should extend from the perforated drainpipe or foundation drains to within approximately 1 foot of the ground surface. The angular drain rock should meet the requirements provided in the "Structural Fill" section.

The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D1557. However, backfill located within a horizontal distance of 3 feet from a retaining wall should only be compacted to approximately 90 percent of the maximum dry density, as determined by ASTM D1557. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (such as a

jumping jack or vibratory plate compactor). If flatwork (sidewalks or pavements) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 95 percent of the maximum dry density, as determined by ASTM D1557.

Perforated collector pipes should be placed at the base of the granular backfill behind the walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock. The drain rock should meet specifications provided in the "Structural Fill" section. The drain rock should be wrapped in a geotextile fabric that meets the specifications provided in OSSC 00350 (Geosynthetic Installation) and OSSC 02320 (Geosynthetics) for drainage geotextiles. The collector pipes should discharge at an appropriate location away from the base of the wall. Unless measures are taken to prevent backflow into the drainage system of the wall, the discharge pipe should not be tied directly into stormwater drain systems.

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

10.0 DRAINAGE CONSIDERATIONS

10.1 TEMPORARY

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

10.2 SURFACE

The finished ground surface around buildings should be sloped away from their foundations at a minimum 2 percent gradient for a distance of at least 5 feet. Downspouts or roof scuppers should discharge into a storm drain system that carries the collected water to an appropriate stormwater system. Trapped planter areas should not be created adjacent to the buildings without providing means for positive drainage (i.e., swales or catch basins).

The site will include unpaved gravel surfaces, which unless the subgrade is graded to drain and route stormwater, will result in areas of ponding following moderate to heavy rainfall.

10.3 SUBSURFACE

We recommend that GeoDesign review the final grading plan to determine whether footing drains will be required around portions of the proposed buildings within cut areas. We do not anticipate that floor slab drains will be needed but will depend on review of the final grading plan. Footing drains should be considered in areas where landscaping planters are placed approximate to the foundations or where surface grades cannot be completed as outlined above.

If installed, the footing drains should consist of a filter fabric-wrapped, drain rock-filled trench that extends at least 12 inches below the lowest adjacent grade (i.e., slab subgrade elevation). A

perforated pipe should be placed at the base to collect water that gathers in the drain rock. The drain rock and filter fabric should meet specifications outlined in the “Structural Fill” section. Discharge for the footing drain should not be tied directly into the stormwater drainage system, unless mechanisms are installed to prevent backflow.

11.0 SEISMIC DESIGN CRITERIA

Seismic design is prescribed by the 2015 IBC and 2014 SOSSC. Table 3 presents the site design parameters prescribed by the 2015 IBC for the site.

Table 3. IBC Seismic Design Parameters

Parameter	Short Period ($T_s = 0.2$ second)	1 Second Period ($T_1 = 1.0$ second)
MCE Spectral Acceleration, S	$S_s = 0.928$ g	$S_1 = 0.410$ g
Site Class	D	
Site Coefficient, F	$F_a = 1.129$	$F_v = 1.590$
Adjusted Spectral Acceleration, S_M	$S_{MS} = 1.047$ g	$S_{M1} = 0.652$ g
Design Spectral Response Acceleration Parameters, S_D	$S_{DS} = 0.698$ g	$S_{D1} = 0.435$ g

12.0 PAVEMENT RECOMMENDATIONS

We developed pavement design recommendations for the storage yard as well for the other pavement areas at the site. We used the following design standards and software for developing our pavement recommendations:

- Design of Aggregate Surfaced Roads and Airfields (Department of the Army, 1990)
- Gravel Roads Construction & Maintenance Guide (FHWA, 2015)
- AASHTO Guide for Design of Pavement Structures (AASHTO, 1993; AASHTO guide)
- Pavement Designer design tools for streets, local roads, parking lots, and intermodal/ industrial facilities (Pavement Designer, 20180)
- ODOT Pavement Design Guide (ODOT, 2011; ODOT guide)
- Guide for the Design and Construction of Concrete Parking Lots (ACI, 2008; ACI guide)
- Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures (ARA, 2004)
- PCASE version 2.09, herein referred to as PCASE (USACE, 2010)

12.1 DESIGN ASSUMPTIONS AND PARAMETERS

The design subgrade resilient modulus and CBR values are based on field explorations and DCP testing. Traffic loading in the storage area is based on information provided by you and forecasted for future traffic loading for design periods of 10, 15, and 20 years. Traffic loading in

the other pavement areas is based on assumed traffic and forecasted for a design period of 20 years. Additional details of our input parameters are summarized below. If any of our design assumptions are incorrect, our office should be contacted with the appropriate information so that the pavement designs can be revised.

12.1.1 Traffic Loading

Based on instructions from you, we used the traffic operations presented in our geotechnical and pavement engineering services report (GeoDesign, 2018) for your Seattle yard to represent traffic operations for the proposed storage yard at the Wilsonville site. Aside from this information we do not have specific information on the types and frequencies of vehicles expected in other areas at the site. Accordingly, we assumed a breakdown of the types and frequencies of vehicles likely to use the other areas of the site. Additional details regarding traffic loading based on pavement usage is presented below.

12.1.1.1 Storage Yard

We used the traffic operations for your Seattle yard to represent traffic operations for the proposed storage yard at the Wilsonville site. For convenience, a duplicate of estimated traffic operations by design period is shown in Table 4. Additional details of our estimation methodology, as well as truck axle configurations and loads, are presented in Appendix C of our 2018 geotechnical and pavement engineering services report for your Seattle yard (GeoDesign, 2018).

Table 4. Estimated Total Passes of Loaded Trucks by Design Life

Truck Type	Estimated Total Passes of Loaded Trucks for Indicated Design Life		
	10 Years	15 Years	20 Years
Five-Axle Haul Truck	65,000	97,500	130,000
Hyster H230HD2 Forklift	260,000	390,000	520,000

We used a conservative estimate of a fully loaded five-axle truck to represent loads imparted by the haul trucks. We used half the payload load capacity of the Hyster forklift truck added to its unladen weight for a total load of 45,144 pounds to represent average loading conditions imparted by the forklift truck to the storage yard pavement.

12.1.1.2 Other Pavement Areas

In areas other than the storage yard, we understand the site will include pavement areas for passenger vehicle parking and drive aisles for access to the proposed buildings. We have assumed traffic in these other pavement areas will consist of passenger cars in parking areas and a mixture of cars and trucks in the drive aisles. In addition, we have assumed the access road to the site and to the storage yard will need to accommodate haul truck traffic for shoring elements in addition to car and truck traffic to the other on-site pavement areas. Due to differences in design procedures used for flexible versus rigid pavement design, we estimated traffic differently for each pavement type. Further details of our assumptions for traffic loading are presented below.

Flexible Pavement Traffic Loading

We used the AASHTO guide for flexible pavement design for pavement areas other than in the storage yard, which requires an estimate of anticipated ESALs over the design period. Estimating ESALs, in turn, requires an estimate of the types and frequencies of trucks that will traffic the pavement. Regarding the types of trucks, and aside from the haul trucks for shoring elements, we have estimated the other on-site truck traffic will be comprised of the following:

- 50 percent two axle (FHWA Class 5)
- 30 percent three axle (FHWA Class 6)
- 10 percent four axle (FHWA Class 8)
- 10 percent five axle (FHWA Class 9)

Based on the above distribution of trucks and assuming a range of daily truck traffic, our estimate of 20-year flexible pavement ESALs by ADTT and pavement type is presented in Table 5. We used the methodology presented in the ODOT guide to estimate the ESAL values assuming no growth and construction will occur in the year 2019. The ESAL estimates for the access road are based on traffic comprised of haul trucks for shoring elements in addition to car and truck traffic to the other on-site pavement areas. We used two passes for each truck in drive aisles to account for the possibility that drivers will retrace their inbound path on the outbound trip.

Table 5. Estimated 20-Year Flexible Pavement ESALs by ADTT and Pavement Type

ADTT	Passenger Vehicle Parking	Truck Passes per Day		20-Year ESALs	
		Drive Aisles ¹	Access Road ²	Drive Aisles	Access Road
0	10,000	NA	NA	NA	NA
10	NA	20	35	84,000	147,000
25	NA	50	50	210,000	210,000
50	NA	100	75	419,000	314,000

1. Two passes per truck in drive aisles.
2. One pass per haul truck to the storage yard area plus one pass per truck to other pavement areas.

Rigid Pavement Traffic Loading

We used the Pavement Designer design tool for rigid pavement design for pavement areas other than in the storage yard, which requires an estimate of the number of axles of an imposed load on the pavement per 1,000 trucks. We based the axle-load distributions on traffic Category B presented in the ACI guide. However, we adjusted the number of axles per 1,000 trucks for each axle load so that the resulting ESALs are similar to those calculated using the methodology presented in the ODOT guide for rigid pavements using the same number of truck passes per day as listed in Table 5 for flexible pavements. The axle-load distributions we used for designing rigid pavements are presented in Table 6 and the approximate 20-year rigid pavement ESALs by ADTT and pavement type are presented in Table 7. We assumed a 6-inch concrete slab depth and a terminal serviceability of 3.0 in approximating the ESALs based on the axle-load distributions listed in Table 6.

Table 6. Axle-Load Distributions Used for Designing Rigid Pavements

Axle Load (kips)	Number of Axles per 1,000 Trucks	
	Single Axles	Tandem Axles
4	1693.31	31.90
6	732.28	---
8	483.10	85.59
10	204.96	---
12	124.00	139.30
14	56.11	---
16	38.02	75.02
18	15.81	---
20	4.23	57.10
22	0.96	---
24	---	39.18
26	---	---
28	---	68.48
32	---	69.59
36	---	4.19

Table 7. Approximate 20-Year Rigid Pavement ESALs by ADTT and Pavement Type

ADTT	Passenger Vehicle Parking	Truck Passes per Day		Approximate 20-Year ESALs	
		Drive Aisles ¹	Access Road ²	Drive Aisles	Access Road
0	10,000	NA	NA	NA	NA
10	NA	20	35	108,740	190,300
25	NA	50	50	271,850	271,850
50	NA	100	75	543,700	407,780

1. Two passes per truck in drive aisles.
2. One pass per haul truck to the storage yard area plus one pass per truck to other pavement areas.

12.1.2 Pavement Layer and Subgrade Properties

All the methods we used for pavement design require stiffness or strength parameters for each pavement layer as well as for the subgrade soil. In addition to stiffness/strength parameters, PCASE requires the Poisson's ratio for each layer as well as interlayer slip, which simulates friction between layers, for flexible and rigid pavement design. Pavement layer and subgrade properties used in our designs are presented in Table 8.

Table 8. Pavement Layer and Subgrade Properties Used for Design

Layer	Resilient Modulus (psi)	CBR Value	Poisson's Ratio	Interlayer Slip
AC	450,000	NA	0.35	0 (complete adhesion)
PCC ¹	4,000,000	NA	0.15	1,000 (no adhesion)
Gravel Surfacing	NA	100	NA	NA
Aggregate Base	20,000	100	0.35	0 (complete adhesion)
Cement-Amended Soil	120,000	100	0.25	0 (complete adhesion)
Subgrade	6,380	4	0.40	0 (complete adhesion)

1. PCC with minimum 28-day flexural strength of 600 psi.

12.1.3 Other Design Parameters

Other pavement design parameters used in our analyses are summarized as follows:

- Reliability of 80 percent
- Overall standard deviation of 0.49 for flexible pavement design using the AASHTO method
- Initial and terminal serviceability of 4.2 and 2.7, respectively, for flexible pavement design using the AASHTO method
- Drainage coefficient of 1.0 for aggregate base
- Jointed concrete pavement with dowel bars for the storage yard and without dowels for the other pavement areas
- PCC slabs have edge support
- Percent of cracked slabs at end of design life of 1 percent

12.2 DESIGN METHODS

We used various design methods for developing our recommendations. We used the method that, in our opinion, is appropriate for the types of pavement layers considered and the types of traffic loads expected. The design methods we used for each pavement area and pavement type are summarized in Table 9.

Table 9. Pavement Design Method by Pavement Area and Pavement Type

Pavement Area	Design Method by Pavement Type		
	Gravel Surfacing	Flexible Pavement	Rigid Pavement
Storage Yard	PCASE	PCASE	PCASE
Access Road	NA	AASHTO	Pavement Designer
Drive Aisles	NA	AASHTO	Pavement Designer
Parking Area	NA	AASHTO	Pavement Designer

12.3 PAVEMENT SECTIONS

Our recommendations for pavement sections apply to the proposed storage yard and other proposed pavement areas at the site. We offer sections for flexible and rigid pavements for all

pavement areas. We also offer sections comprised of crushed rock gravel surfacing, in addition to the flexible and rigid pavement sections, for the storage yard. Our recommendations for minimum pavement sections are presented below. In all cases, the materials recommended should conform to the requirements presented in the "Pavement Materials" section.

12.3.1 Storage Yard

12.3.1.1 Crushed Rock Gravel Surfacing Sections for the Storage Yard

Our recommendations for sections comprised of crushed rock gravel surfacing for the storage yard are presented in Table 10. The PCASE reports for each design are presented in Appendix C.

Table 10. Recommended Minimum Crushed Rock Gravel Surfacing Sections for the Storage Yard

Design Life (years)	Gravel Surfacing		Gravel Surfacing on Cement-Amended Soil	
	Crushed Rock Gravel Surfacing (inches)	Aggregate Base ¹ (inches)	Crushed Rock Gravel Surfacing (inches)	Cement Amendment ² (inches)
10	6.0	13.0	7.0	12.0
15	6.0	14.0	8.0	12.0
20	6.0	14.0	8.0	12.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base.
2. Assumes a minimum seven-day unconfined compressive strength of 100 psi.

12.3.1.2 Flexible Pavement Sections for the Storage Yard

Our recommendations for flexible pavement sections for the storage yard are presented in Table 11. The PCASE reports for each design are presented in Appendix C.

Table 11. Recommended Minimum Flexible Pavement Sections for the Storage Yard

Design Life (years)	Conventional Flexible Pavement		AC on Cement-Amended Soil		
	AC (inches)	Aggregate Base ¹ (inches)	AC (inches)	Aggregate Base (inches)	Cement Amendment ² (inches)
10	8.5	16.0	6.0	4.0	12.0
15	9.0	16.0	6.5	4.0	12.0
20	9.5	16.0	7.0	4.0	12.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base.
2. Assumes a minimum seven-day unconfined compressive strength of 100 psi.

12.3.1.3 Rigid Pavement Sections for the Storage Yard

Our recommendations for rigid pavement sections for the storage yard are presented in Table 12. The PCASE reports for each design are presented in Appendix C. Additional recommendations for PCC slab construction are provided in the “Pavement Construction Considerations” section.

Table 12. Recommended Minimum Rigid Pavement Sections for the Storage Yard

Design Life (years)	Conventional Rigid Pavement		PCC on Cement-Amended Soil		
	PCC (inches)	Aggregate Base ¹ (inches)	PCC (inches)	Aggregate Base (inches)	Cement Amendment ² (inches)
10	11.3	6.0	10.7	4.0	16.0
15	11.5	6.0	10.9	4.0	16.0
20	11.7	6.0	11.0	4.0	16.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base.
2. Assumes a minimum seven-day unconfined compressive strength of 100 psi.

12.3.2 Other Pavement Areas

12.3.2.1 Flexible Pavement Sections for Other Pavement Areas

Our recommendations for flexible pavement sections for other pavement areas apply to the passenger vehicle parking areas, drive aisles around and between the proposed buildings, and the access road to the site. Our recommendations for flexible pavement sections on native soil and on cement-amended soil are presented in Tables 13 and 14, respectively. We note that if the flexible pavements over cement-amended soil option is used, the soil amendment and paving should be completed during dry weather. Our calculation sheets for each design are presented in Appendix C.

Table 13. Recommended Minimum Flexible Pavement Sections on Native Soil for Other Pavement Areas

ADTT	Passenger Vehicle Parking		Drive Aisles		Access Road	
	AC (inches)	Aggregate Base ¹ (inches)	AC (inches)	Aggregate Base ¹ (inches)	AC (inches)	Aggregate Base ¹ (inches)
0	2.5	6.0	NA	NA	NA	NA
10	NA	NA	3.5	9.0	4.0	9.0
25	NA	NA	4.5	9.0	4.5	9.0
50	NA	NA	5.0	10.0	4.5	10.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base. We recommend that the soil amendment and paving be completed during dry weather.

**Table 14. Recommended Minimum Flexible Pavement Sections
on Cement-Amended Soil for Other Pavement Areas**

ADTT	Passenger Vehicle Parking		Drive Aisles		Access Road	
	AC (inches)	Cement Amended ¹ (inches)	AC (inches)	Cement Amended ¹ (inches)	AC (inches)	Cement Amended ¹ (inches)
0	2.5	12.0	NA	NA	NA	NA
10	NA	NA	3.0	12.0	4.0	12.0
25	NA	NA	4.0	12.0	4.5	12.0
50	NA	NA	4.5	12.0	5.0	12.0

1. Assumes a minimum seven-day unconfined compressive strength of 100 psi. We recommend that the soil amendment and paving be completed during dry weather.

12.3.2.2 Rigid Pavement Sections for Other Pavement Areas

Our recommendations for rigid pavement sections for other pavement areas apply to the passenger vehicle parking areas, drive aisles around and between the proposed buildings, and the access road to the site. Our recommendations for rigid pavement sections on native soil and on cement-amended soil are presented in Tables 15 and 16, respectively. The Pavement Designer Reports are presented in Appendix C.

**Table 15. Recommended Minimum Rigid Pavement Sections
on Native Soil for Other Pavement Areas**

ADTT	Passenger Vehicle Parking		Drive Aisles and Access Road	
	PCC (inches)	Aggregate Base ¹ (inches)	PCC (inches)	Aggregate Base ¹ (inches)
0	5.0	6.0	NA	NA
10	NA	NA	6.0	6.0
25	NA	NA	6.0	6.0
50	NA	NA	6.3	6.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base.

**Table 16. Recommended Minimum Rigid Pavement Sections
on Cement-Amended Soil for Other Pavement Areas**

ADTT	Passenger Vehicle Parking			Drive Aisles and Access Road		
	PCC (inches)	Aggregate Base (inches)	Cement Amended' (inches)	PCC (inches)	Aggregate Base (inches)	Cement Amended' (inches)
0	5.0	4.0	12.0	NA	NA	NA
10	NA	NA	NA	5.5	4.0	12.0
25	NA	NA	NA	5.8	4.0	12.0
50	NA	NA	NA	5.8	4.0	12.0

1. Assumes a minimum seven-day unconfined compressive strength of 100 psi.

12.4 PAVEMENT CONSTRUCTION CONSIDERATIONS

12.4.1 Drainage

The performance of the pavement sections will depend on providing positive drainage for the unbound materials (aggregate base and gravel surfacing) within the pavement structures. Accordingly, grading of the subgrade during construction operations should be completed to facilitate drainage of unbound layers. If cement amendment of the subgrade is performed in planned pavement areas, final grading of the cement-amended soil should also facilitate drainage of any unbound layers placed over the amended material.

12.4.2 Subgrade Preparation

The pavement subgrade should be prepared in accordance with the "Site Preparation" and "Structural Fill" sections. If the subgrade soil is not amended with cement, then the top 12 inches of subgrade below the pavement should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D1557, or until proof rolling with a fully loaded dump or water truck indicates an unyielding, non-pumping subgrade is present.

12.4.3 Wet Weather Construction

The designs of the recommended pavement sections are based on the assumption that construction will be completed during an extended period of dry weather. Wet weather construction could require an increased thickness of aggregate base. In addition, to prevent strength loss during curing, cement-amended soil should be allowed to cure for at least four days prior to construction traffic or placing the base rock. Lastly, the amended subgrade should be protected with a minimum of 4.0 inches of base rock prior to construction traffic access. Base rock to protect the amended subgrade can become contaminated by construction operations. Accordingly, base rock contaminated during construction operations should be removed and replaced prior to construction of overlying layers.

12.4.4 Construction Traffic

Construction traffic should be limited to non-building, unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavements. If construction traffic is to be allowed on newly constructed pavement sections, an allowance for this additional traffic will need

to be made in the design pavement sections. The base rock thickness for pavement areas is intended to support post-construction design traffic loads and not designed to support construction traffic (see the "Construction Consideration" section).

12.4.5 PCC Slab Construction

Additional recommendations for construction of the PCC pavement slabs are as follows:

- Dowel bars meeting OSSC 02510.40 (Dowels) should be placed in accordance with OSSC 00756.43 (Placing Dowel Bars and Tie Bars) at all transverse joints. We recommend dowel bars with a diameter of 1¼ inches and a length of 18 inches. Dowel bars should be placed at mid-depth in the slabs, spaced at 12 inches on-center, and centered across the joint.
- Tie bars meeting OSSC 02510.10 (Deformed Bars Reinforcement) should be placed in accordance with OSSC 00756.43 (Placing Dowel Bars and Tie Bars) at all longitudinal joints. We recommend #5 tie bars 40 inches in length for Grade 60 steel and spaced a maximum of 36 inches apart on-center. If constructed, curb and gutter should be tied to adjoining slabs.
- Adjust joints to meet utility structures and place an isolation joint around the structures.
- Wherever possible, lay out joints to create slabs of approximately square shape (length-to-width ratio between 0.80 and 1.25). Where this is not possible, lay out joints to create slabs of triangular shape. Avoid angles less than 60 degrees (approximately 90 degrees is best). Avoid slabs less than 1 foot in any dimension.
- Maximum joint spacing is 20 feet in any direction.
- PCC slabs abutting AC pavement should be constructed with a thickened edge along the edge abutting the AC pavement. We recommend thickening the PCC slab depth by 20 percent at the joint and tapering the thickness over a minimum distance of 4.5 feet and a maximum distance of 7.0 feet.

12.5 PAVEMENT MATERIALS

A submittal should be made for each pavement material prior to the start of paving operations. Each submittal should include the test information necessary to evaluate the degree to which the properties of the materials comply with the properties that were recommended or specified. The geotechnical engineer and other appropriate members of the design team should review each submittal.

12.5.1 AC

The AC should be Level 2, ½-inch, dense ACP as described in OSSC 00744 (Asphalt Concrete Pavement). The AC should be placed in one lift and compacted to at least 92 percent of the theoretical maximum density of the material, as determined by AASHTO T 209. Asphalt binder should be performance graded. For typical Level 2 ACP we recommend PG 64-22 binder; however, the binder grade should be adjusted depending on the aggregate gradation and amount of reclaimed asphalt pavement and/or recycled asphalt shingles in the contractor's mix design submittal.

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

Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Oregon, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thickness between 2.0 and 2.5 inches.

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

12.5.2 PCC

PCC should be Class 4000-1½ (Paving) concrete according to OSSC 02001 (Concrete) with a with a maximum water/cementitious material ratio of 0.40 and a minimum 28-day flexural strength of 600 psi and placed in accordance with OSSC 00756 (Plain Concrete Pavement). Placement of tie bars and dowel bars should conform to OSSC 00756.43 (Placing Dowel Bars and Tie Bars). Reinforcing steel, if used, should conform to OSSC 02510 (Reinforcement) and placed in accordance with OSSC 0758.43 (Placing Reinforcement).

12.5.3 Aggregate Base

Imported granular material used as aggregate base should be clean, crushed rock or crushed gravel and sand that are dense-graded. The aggregate base should meet the gradation defined in OSSC 00641 (Aggregate Subbase, Base, and Shoulders), with the exception that the aggregate has less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve, a maximum particle size of 1½ inches, and at least two mechanically fractured faces. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T 99.

12.5.4 Crushed Rock Gravel Surfacing

Imported granular material used as gravel surfacing should be relatively clean, crushed rock or crushed gravel and sand that are dense graded. The aggregate base should meet the gradation defined in OSSC 00641 (Aggregate Subbase, Base, and Shoulders), with the exception that the aggregate has less than 8 percent by dry weight passing the U.S. Standard No. 200 sieve, a maximum particle size of ¾ inch, and at least two mechanically fractured faces. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T 99.

12.5.5 Cement-Amended Soil

See “Cement Amendment” under the “Structural Fill” section.

12.5.6 Subgrade Geotextile

The subgrade geotextile should meet the requirements in OSSC 02320 (Geosynthetics) for subgrade geotextiles and be installed in conformance with OSSC 00350 (Geosynthetic Installation).

13.0 OBSERVATION OF CONSTRUCTION

Satisfactory earthwork and foundation performance depends to a large degree on the quality of construction. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated. In addition, sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications.

14.0 LIMITATIONS

We have prepared this report for use by D.P. Nicoli and their consultants. The data and report can be used for estimating purposes, but our report, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions and are not applicable to other sites.

Soil explorations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The site development plans and design details were not finalized at the time this report was prepared. When the design has been finalized and if there are changes in the site grades or location, configuration, design loads, or type of construction, the conclusions and recommendations presented may not be applicable. If design changes are made, we should be retained to review our conclusions and recommendations and to provide a written evaluation or modification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

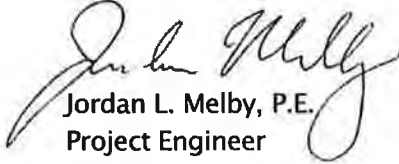
Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

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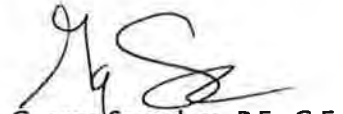
We appreciate the opportunity to be of service to you. Please contact us if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.


Jordan L. Melby, P.E.
Project Engineer


Todd V. Scholz P.E., Ph.D.
Senior Associate Engineer


George Saunders, P.E., G.E.
Principal Engineer



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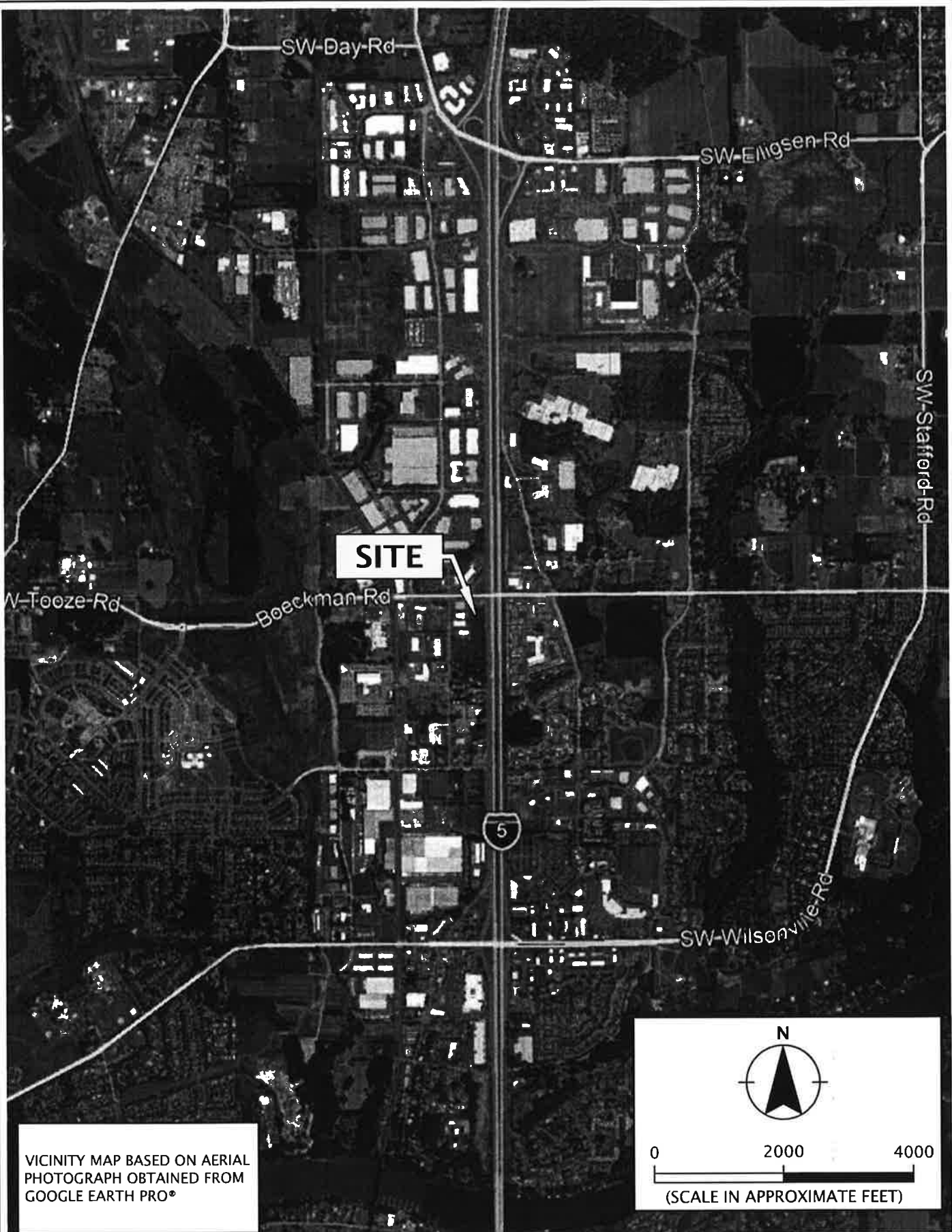
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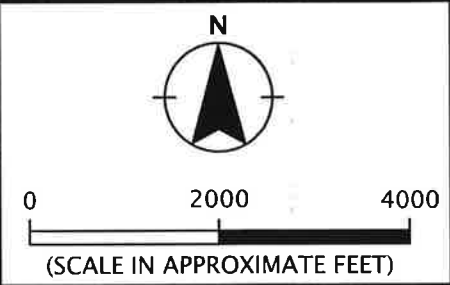
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FIGURES



VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®



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 File Name: J:\A-D\DPNicolli\DPNicolli-5\DPNicolli-5-01\Figures\CAD\DPNicolli-5-01-VM01.dwg | Layout: FIGURE 1

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DPNICOLI-5-01

NOVEMBER 2018

VICINITY MAP

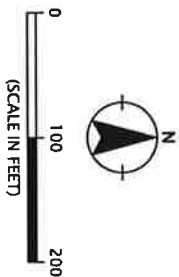
WILSONVILLE FACILITIES
 WILSONVILLE, OR

FIGURE 1




LEGEND:

B-1  BORING



SITE PLAN BASED ON AERIAL PHOTOGRAPH
 OBTAINED FROM GOOGLE EARTH PRO®,
 SEPTEMBER 12, 2018

 9450 SW Commerce Circle - Suite 300 Wilsonville, OR 97070 503.968.8287 www.geodesigninc.com	DPNICOLI-5-01	SITE PLAN	
	NOVEMBER 2018	WILSONVILLE FACILITIES WILSONVILLE, OR	FIGURE 2

APPENDIX A

APPENDIX A

FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at the site by drilling seven borings (B-1 through B-7) to depths between 21.5 and 31.5 feet BGS. The explorations were completed by Western States Soil Conservation, Inc. of Hubbard, Oregon, on September 4 and 5, 2018 using mud rotary methods. The top 5 feet of boring B-4 was drilled using a 4-inch-diameter, hollow-stem auger to facilitate infiltration testing. The exploration logs are presented in this appendix.

The locations of the explorations were determined in the field by pacing from existing site features. This information should be considered accurate to the degree implied by the method used.

SOIL SAMPLING

Samples were collected from the borings using a 1½-inch-inside diameter (SPT) split-spoon sampler in general accordance with ASTM D1586. The split-spoon samplers were driven into the soil with a 140-pound hammer free-falling 30 inches. The samplers were driven a total distance of 18 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the boring logs, unless otherwise noted. Higher quality, relatively undisturbed samples were collected using a standard Shelby tube in general accordance with ASTM D1587. Sampling methods and intervals are shown on the exploration logs.

The average efficiency of the automatic SPT hammer used by Western States Soil Conservation, Inc. was 90.4 percent. The calibration testing results are presented at the end of this appendix.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the "Exploration Key" (Table A-1) and "Soil Classification System" (Table A-2), which are presented in this appendix. The exploration logs indicate the depths at which the soil or its characteristics change, although the change actually could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.

LABORATORY TESTING

CLASSIFICATION

The soil samples were classified in the laboratory to confirm field classifications. The laboratory classifications are shown on the exploration logs if those classifications differed from the field classifications.

MOISTURE CONTENT

We determined the natural moisture content of select soil samples in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

CONSOLIDATION TESTING

A one-dimensional consolidation test was completed on one relatively undisturbed soil sample in general accordance with ASTM D2435. The test measures the volume change (consolidation) of a soil sample under predetermined loads. The test results are presented in this appendix.

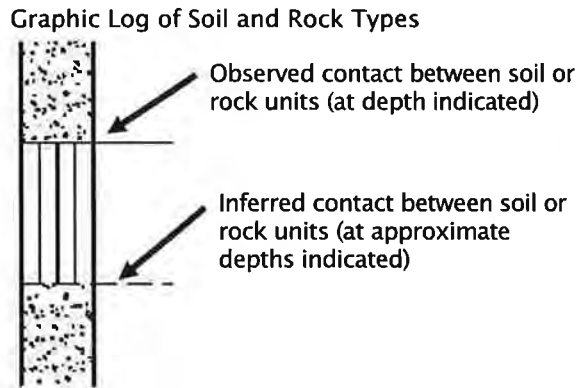
ATTERBERG LIMITS TESTING

The plastic limit and liquid limit (Atterberg limits) of a select soil sample were determined in accordance with ASTM D4318. The Atterberg limits and the plasticity index were completed to aid in the classification of the soil. The plastic limit is defined as the moisture content, in percent, where the soil becomes brittle. The liquid limit is defined as the moisture content where the soil begins to act similar to a liquid. The plasticity index is the difference between the liquid and plastic limits. The test results are presented in this appendix.

PARTICLE-SIZE ANALYSIS

We completed particle-size analyses on select soil samples in accordance with ASTM D1140. The tests determined percent fines (passing the U.S. Standard No. 200 Sieve) only. The test results are presented in this appendix.

SYMBOL	SAMPLING DESCRIPTION
	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test with recovery
	Location of sample obtained using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D 1587 with recovery
	Location of sample obtained using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample obtained using Dames & Moore and 140-pound hammer or pushed with recovery
	Location of sample obtained using 3-inch-O.D. California split-spoon sampler and 140-pound hammer
	Location of grab sample
	Rock coring interval
	Water level during drilling
	Water level taken on date shown




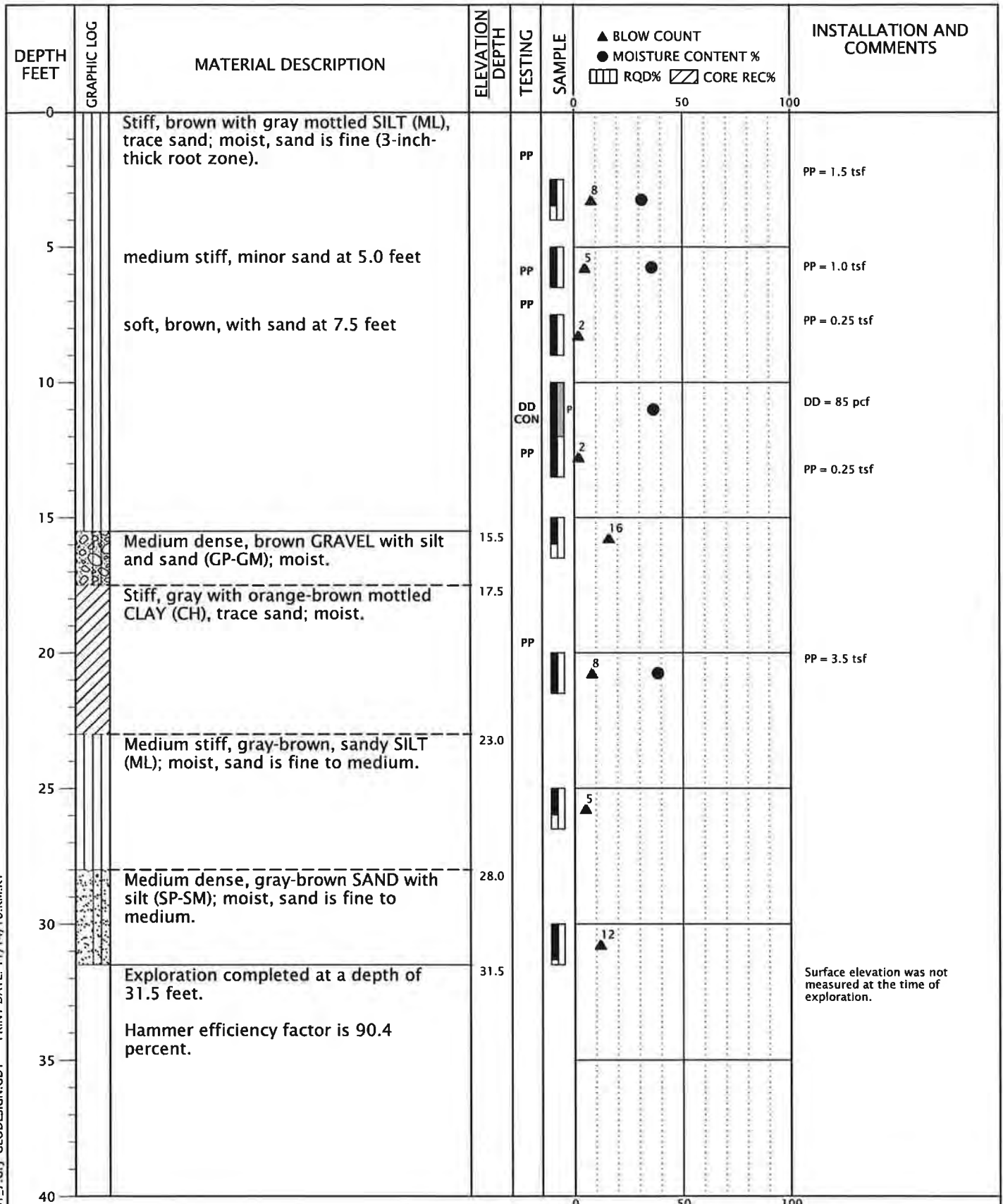
GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	P	Pushed Sample
CBR	California Bearing Ratio	PP	Pocket Penetrometer
CON	Consolidation	P200	Percent Passing U.S. Standard No. 200 Sieve
DD	Dry Density	RES	Resilient Modulus
DS	Direct Shear	SIEV	Sieve Gradation
HYD	Hydrometer Gradation	TOR	Torvane
MC	Moisture Content	UC	Unconfined Compressive Strength
MD	Moisture-Density Relationship	VS	Vane Shear
NP	Nonplastic	kPa	Kilopascal
OC	Organic Content		

ENVIRONMENTAL TESTING EXPLANATIONS

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

RELATIVE DENSITY - COARSE-GRAINED SOIL							
Relative Density	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)				
Very Loose	0 - 4	0 - 11	0 - 4				
Loose	4 - 10	11 - 26	4 - 10				
Medium Dense	10 - 30	26 - 74	10 - 30				
Dense	30 - 50	74 - 120	30 - 47				
Very Dense	More than 50	More than 120	More than 47				
CONSISTENCY - FINE-GRAINED SOIL							
Consistency	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)			
Very Soft	Less than 2	Less than 3	Less than 2	Less than 0.25			
Soft	2 - 4	3 - 6	2 - 5	0.25 - 0.50			
Medium Stiff	4 - 8	6 - 12	5 - 9	0.50 - 1.0			
Stiff	8 - 15	12 - 25	9 - 19	1.0 - 2.0			
Very Stiff	15 - 30	25 - 65	19 - 31	2.0 - 4.0			
Hard	More than 30	More than 65	More than 31	More than 4.0			
PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME			
COARSE-GRAINED SOIL (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)	GW or GP	GRAVEL			
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt			
			GW-GC or GP-GC	GRAVEL with clay			
		GRAVEL WITH FINES (> 12% fines)	GM	silty GRAVEL			
	GC		clayey GRAVEL				
	GC-GM		silty, clayey GRAVEL				
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)	SW or SP	SAND			
		SAND WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt			
			SW-SC or SP-SC	SAND with clay			
		SAND WITH FINES (> 12% fines)	SM	silty SAND			
SC			clayey SAND				
SC-SM			silty, clayey SAND				
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)	SILT AND CLAY Liquid limit less than 50	ML	SILT				
		CL	CLAY				
		CL-ML	silty CLAY				
		OL	ORGANIC SILT or ORGANIC CLAY				
	SILT AND CLAY Liquid limit 50 or greater	MH	SILT				
		CH	CLAY				
		OH	ORGANIC SILT or ORGANIC CLAY				
		PT	PEAT				
HIGHLY ORGANIC SOIL			PT	PEAT			
MOISTURE CLASSIFICATION		ADDITIONAL CONSTITUENTS					
Term	Field Test	Secondary granular components or other materials such as organics, man-made debris, etc.					
		Percent	Silt and Clay In:		Percent	Sand and Gravel In:	
	Fine-Grained Soil		Coarse-Grained Soil			Fine-Grained Soil	Coarse-Grained Soil
dry	very low moisture, dry to touch	< 5	trace	trace	< 5	trace	trace
moist	damp, without visible moisture	5 - 12	minor	with	5 - 15	minor	minor
		> 12	some	silty/clayey	15 - 30	with	with
wet	visible free water, usually saturated				> 30	sandy/gravelly	Indicate %
 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com		SOIL CLASSIFICATION SYSTEM				TABLE A-2	



BORING LOG DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: J. Pence

COMPLETED: 09/04/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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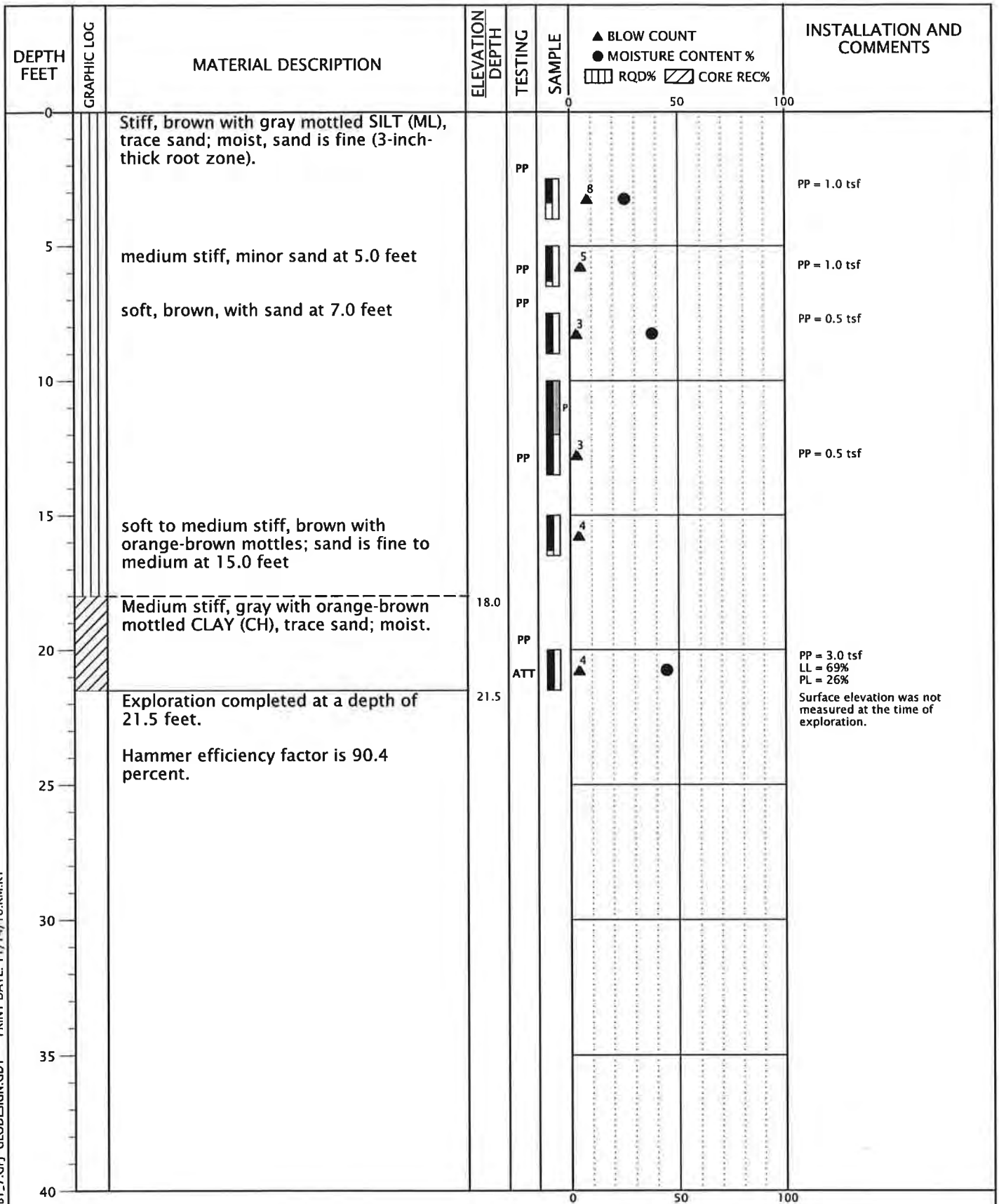
DPNICOLI-5-01

BORING B-1

NOVEMBER 2018

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-1



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LOGGED BY: J. Pence

COMPLETED: 09/04/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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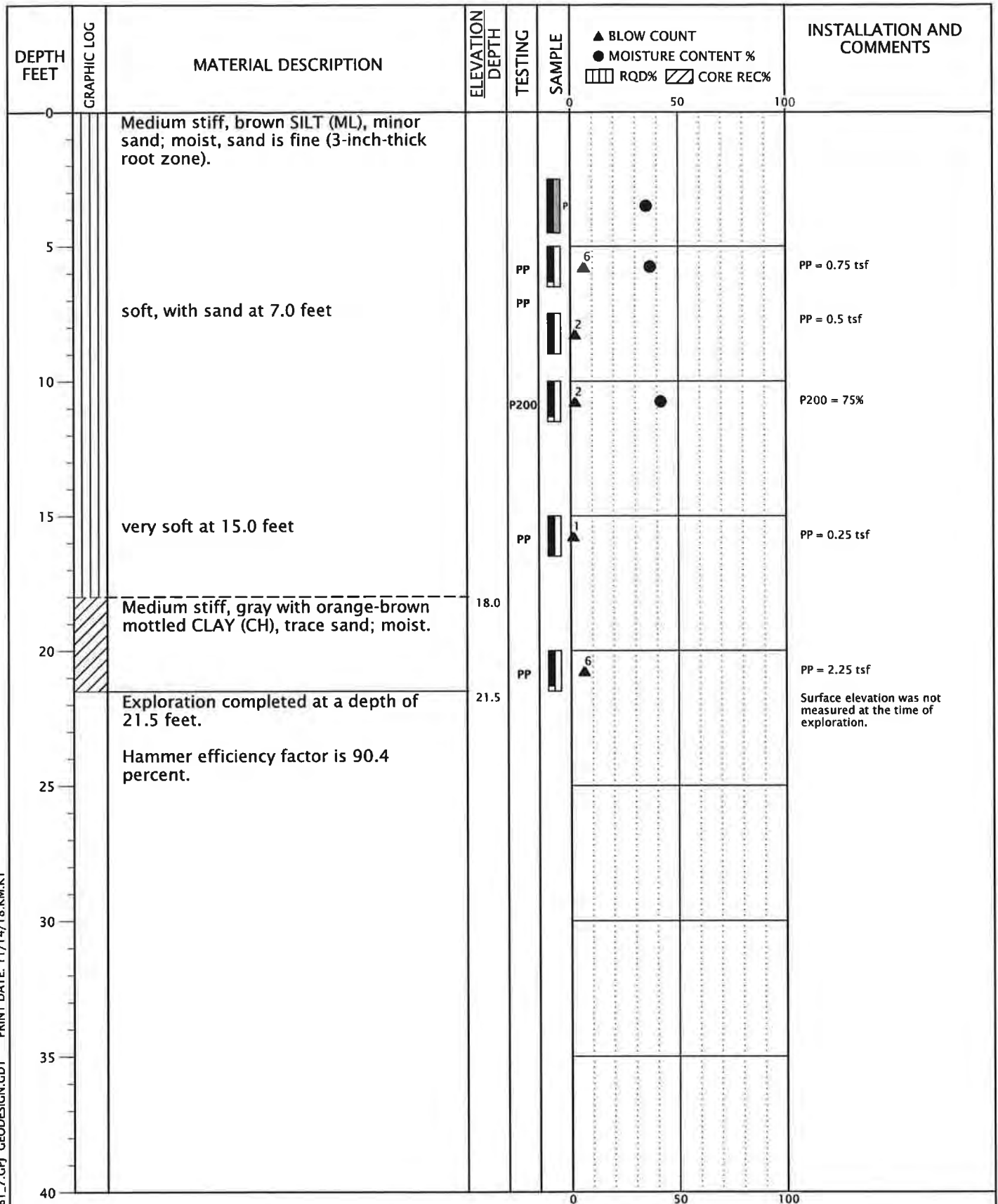
NOVEMBER 2018

BORING B-2

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-2

BORING LOG DPNICOLI-5-01-81_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: J. Pence

COMPLETED: 09/04/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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DPNICOLI-5-01

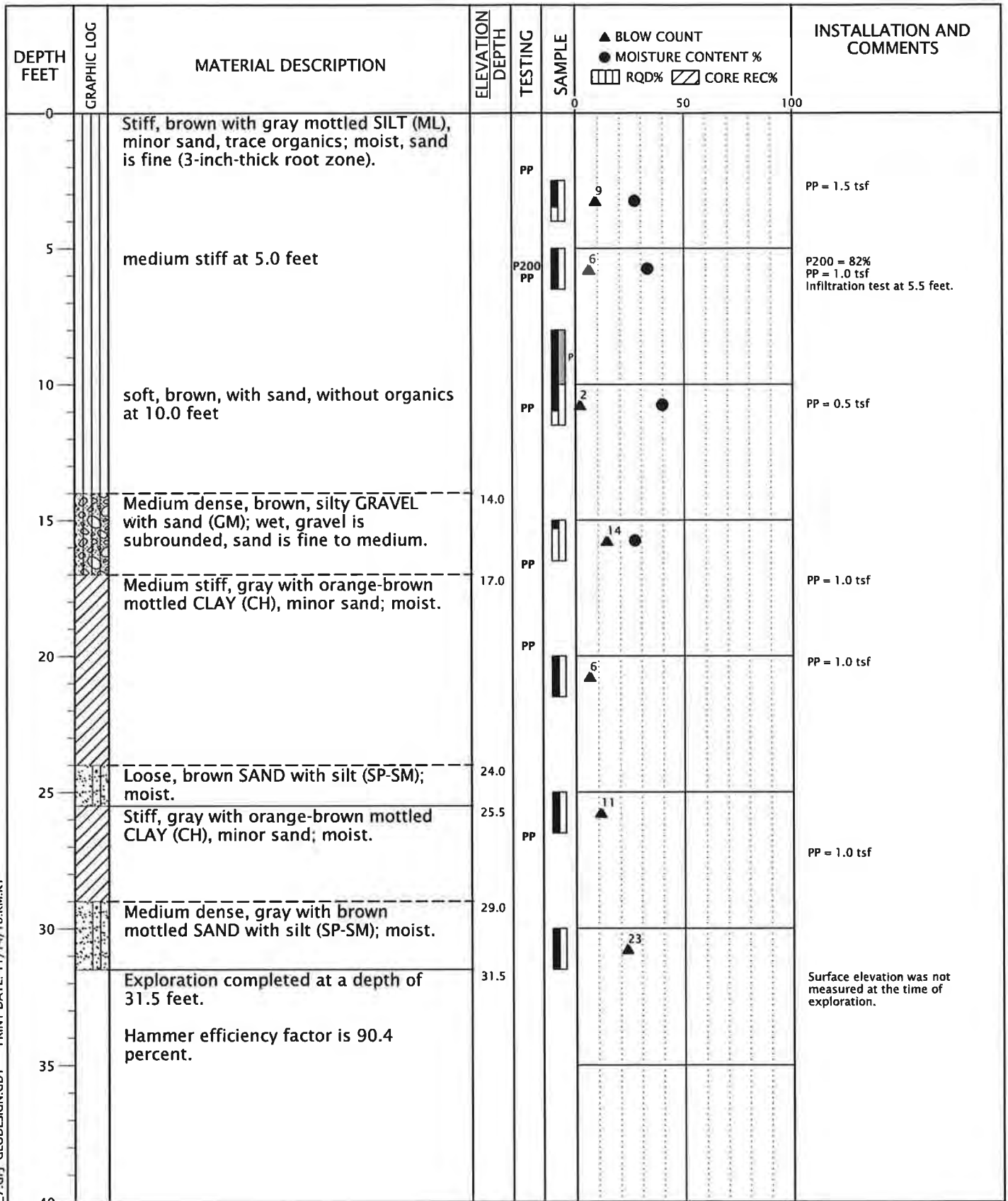
BORING B-3

NOVEMBER 2018

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-3

BORING LOG: DPNICOLI-5-01-B1_7.CPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT

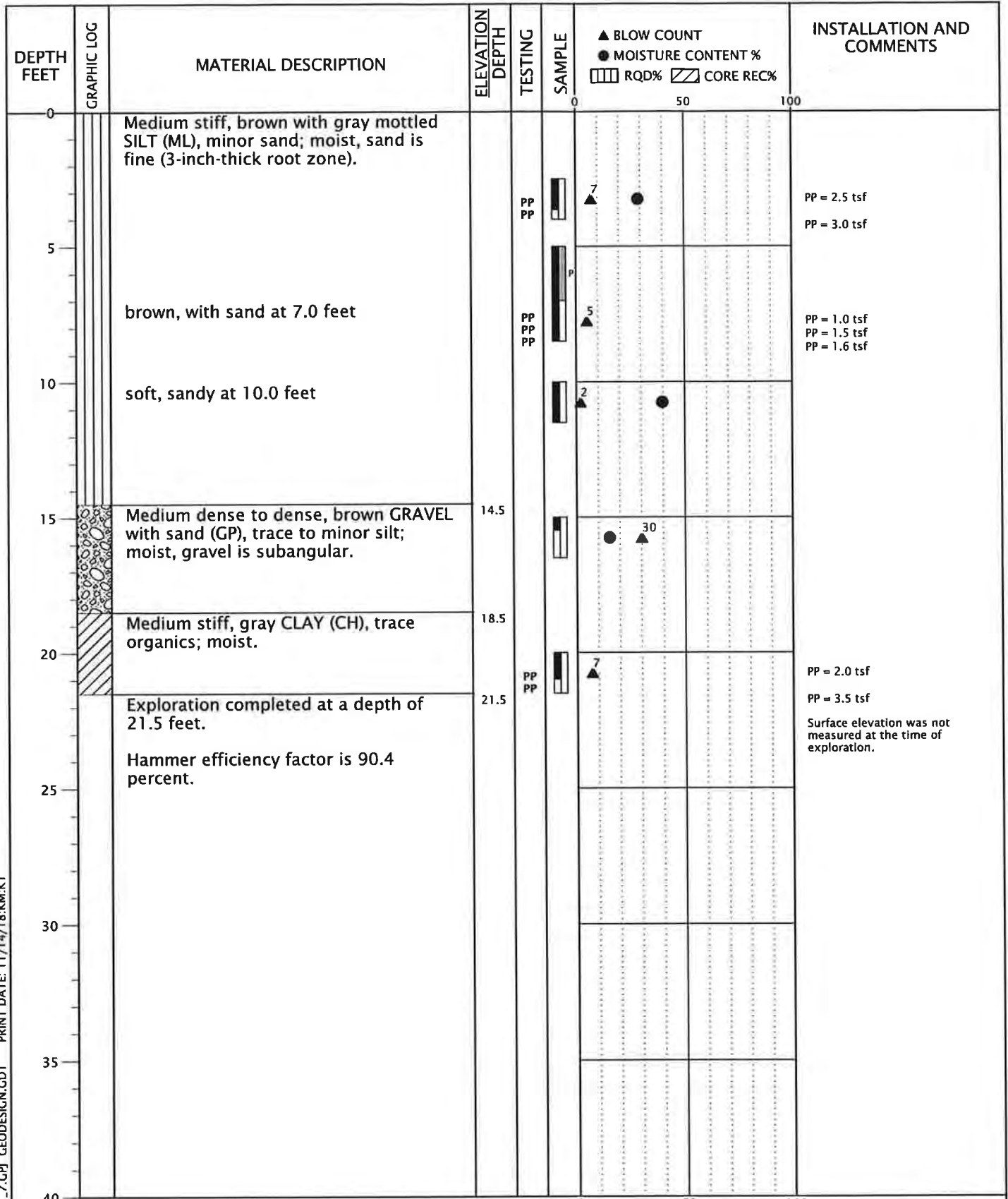


BORING LOG DPNICOLI-5-01-B1-7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT

DRILLED BY: Western States Soil Conservation, Inc. LOGGED BY: J. Pence COMPLETED: 09/04/18

BORING METHOD: hollow-stem auger and mud rotary (see document text) BORING BIT DIAMETER: 4 Inches/3 Inches

 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	DPNICOLI-5-01	BORING B-4	
	NOVEMBER 2018	WILSONVILLE FACILITIES WILSONVILLE, OR	FIGURE A-4



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: T. Hainley

COMPLETED: 09/05/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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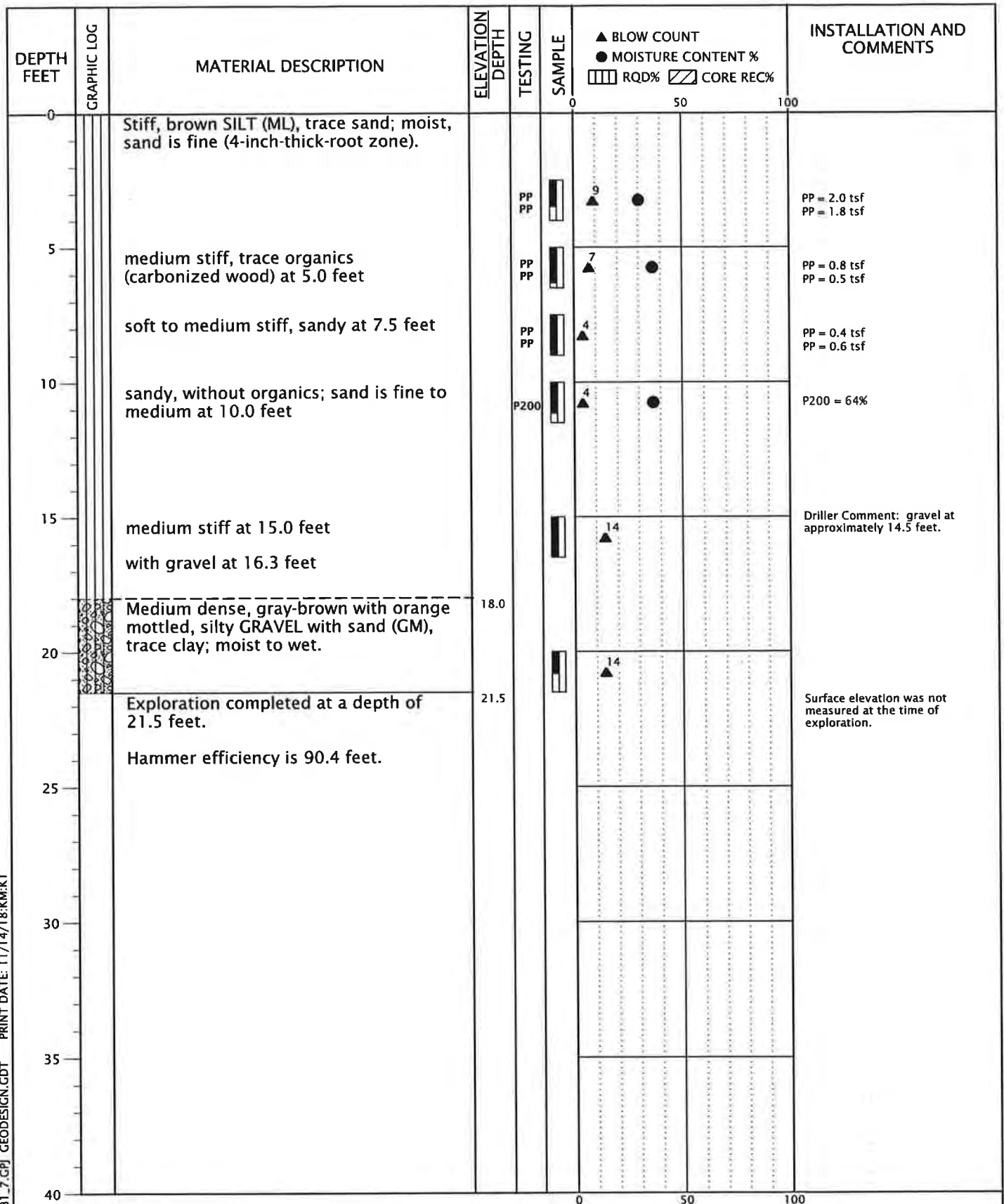
BORING B-5

NOVEMBER 2018

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-5

BORING LOG DPNICOLI-5-01-B1_7.GPJ_GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT



DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: T. Hainley

COMPLETED: 09/05/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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DPNICOLI-5-01

NOVEMBER 2018

BORING B-6

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-6

BORING LOG DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▨ RQD% ▩ CORE REC%	INSTALLATION AND COMMENTS
0		Medium stiff, brown SILT (ML), trace to minor sand, trace organics (rootlets); moist, sand is fine (4-inch-thick root zone).					
5		with sand at 5.0 feet without organics at 6.3 feet		PP	5		PP = 1.0 tsf
				PP	5		PP = 1.0 tsf
				PP	5		PP = 0.8 tsf
10		sandy; sand is fine to medium at 10.0 feet			5		
15		Medium dense, brown SAND with silt and gravel (SP-SM); moist, sand is medium to coarse.	15.0		18		
20		gray-brown with orange mottles, trace clay at 20.0 feet			25		
21.5		Exploration completed at a depth of 21.5 feet. Hammer efficiency factor is 90.4 percent.	21.5				Surface elevation was not measured at the time of exploration.
25							
30							
35							
40							

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: T. Hainley

COMPLETED: 09/05/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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DPNICOLI-5-01

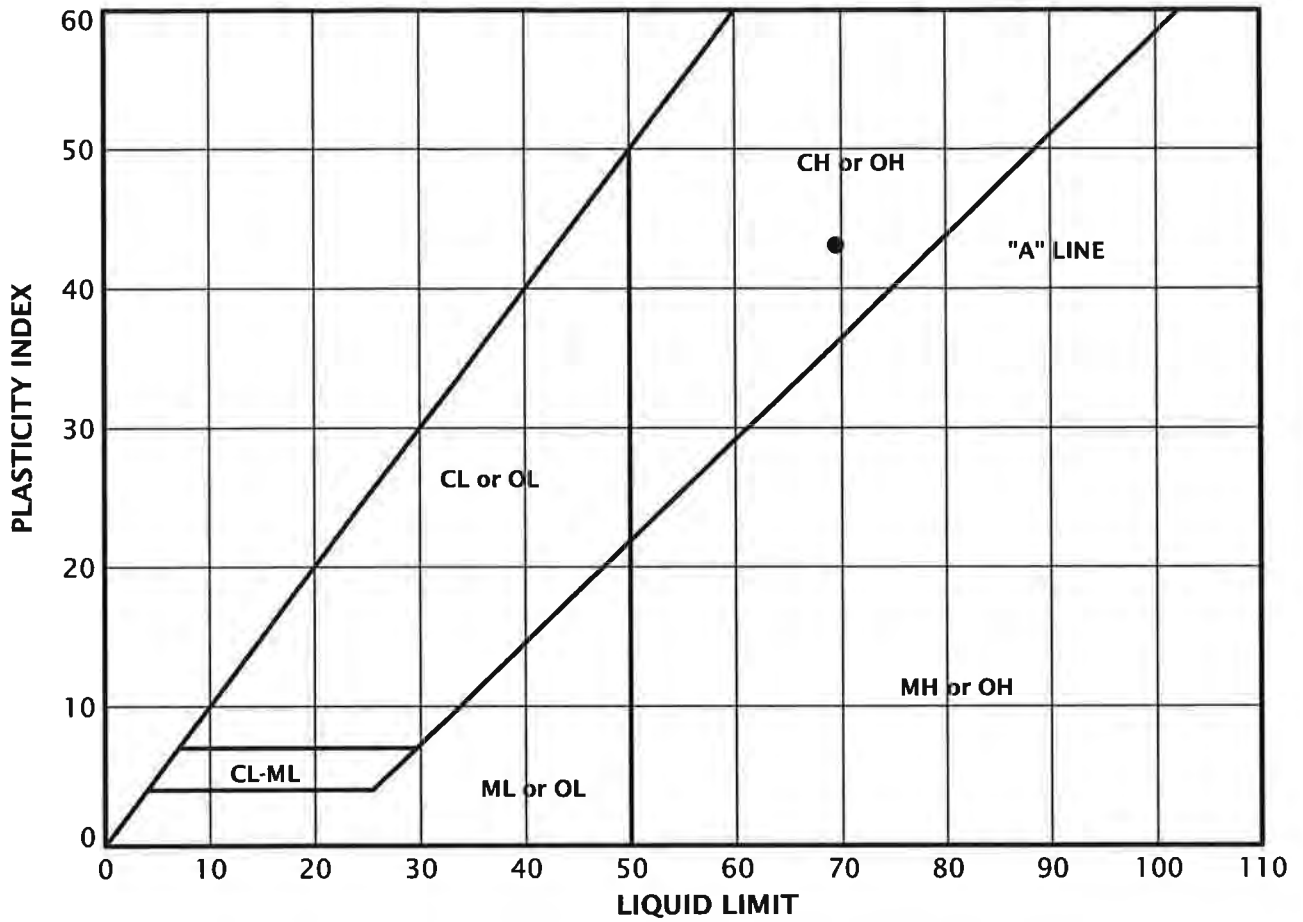
BORING B-7

NOVEMBER 2018

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-7

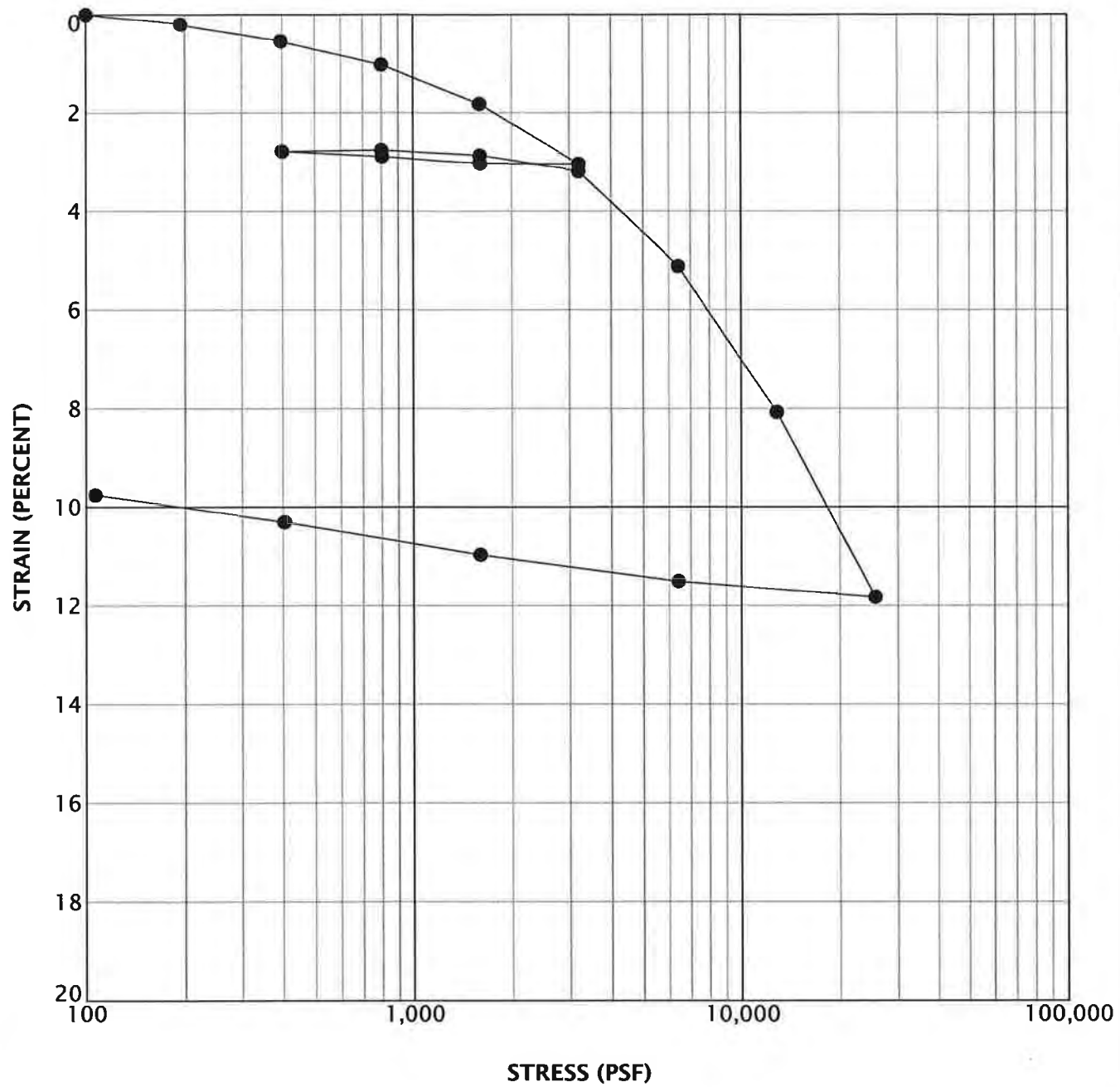
BORING LOG: DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-2	20.0	44	69	26	43

ATTERBERG_LIMITS 7 DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/13/18:KT

CONSOL_STRAIN_100K DPNICOLI-5-01-B1_7.CPJ GEODESIGN.GDT PRINT DATE: 11/13/18:KT



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)
●	B-1	10.0	37	85

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		31							
B-1	5.0		36							
B-1	10.0		37	85						
B-1	20.0		38							
B-2	2.5		26							
B-2	7.5		38							
B-2	20.0		44				69	26	43	
B-3	2.5		35							
B-3	5.0		37							
B-3	10.0		42			75				
B-4	2.5		27							
B-4	5.0		33			82				
B-4	10.0		40							
B-4	15.0		27							
B-5	2.5		29							
B-5	10.0		40							
B-5	15.0		15							
B-6	2.5		30							
B-6	5.0		36							
B-6	10.0		37			64				
B-7	2.5		26							
B-7	5.0		37							
B-7	10.0		36							

LAB SUMMARY DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/13/18:KT



DPNICOLI-5-01

NOVEMBER 2018

SUMMARY OF LABORATORY DATA

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-10

Summary of SPT Test Results

Project: WSSC-8-02, Test Date: 12/29/2017

EMX: Maximum Energy		Start Depth		Final Depth		N	N60	ETR: Energy Transfer Ratio - Rated	
Instr. Length	ft	ft	ft	ft	ft	Value	Value	Average EMX	Average ETR
								ft-lb	%
15.00		0.00		0.00		0	0	317	90.4

Overall Average Values: 317 90.4
 Standard Deviation: 10 2.8
 Overall Maximum Value: 335 95.7
 Overall Minimum Value: 293 83.7

APPENDIX B

APPENDIX B

DCP TESTING

DCP DATA

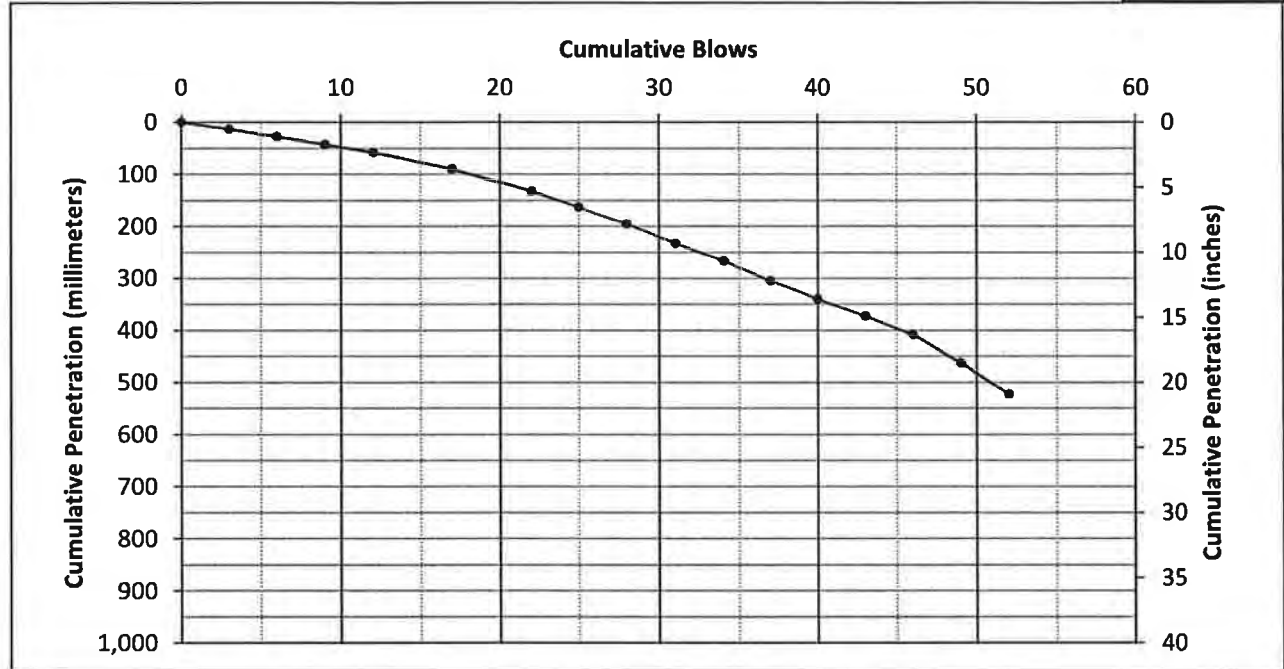
GeoDesign performed DCP testing of the base material and subgrade soil at each boring location on September 4 and 5, 2018. We conducted tests in general accordance with ASTM D6951. We recorded penetration depth of the cone for each blow of the hammer and terminated testing when at refusal of penetration or end of rod length. We summarized the data by plotting depth of penetration versus blow count. Plots of the summarized DCP test data are presented in this appendix.

RESILIENT MODULUS ESTIMATION

Using the summarized DCP test data, we visually assessed where slopes of the data are relatively constant and at which depths they change significantly. We used changes in slope with depth to identify transitions between soil strata with differing shear resistance characteristics. We used least squares regression to determine the slopes and the equation shown on the data sheets to estimate the resilient modulus of each stratum using a correction factor $C_r = 0.35$ for subgrade soil. In cases where we encountered strata with distinctly different shear resistance characteristics, we used Odemark's Method of Equivalent Thickness to estimate an equivalent resilient modulus of the combined strata.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-1

Layer	Layer Type and Location	Slope (mm/blow)	C_f	M_R (psi)
1	Subgrade below AC and aggregate base	5.3	0.35	8,980
2	Subgrade below AC and aggregate base	12.1	0.35	6,480
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,870



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

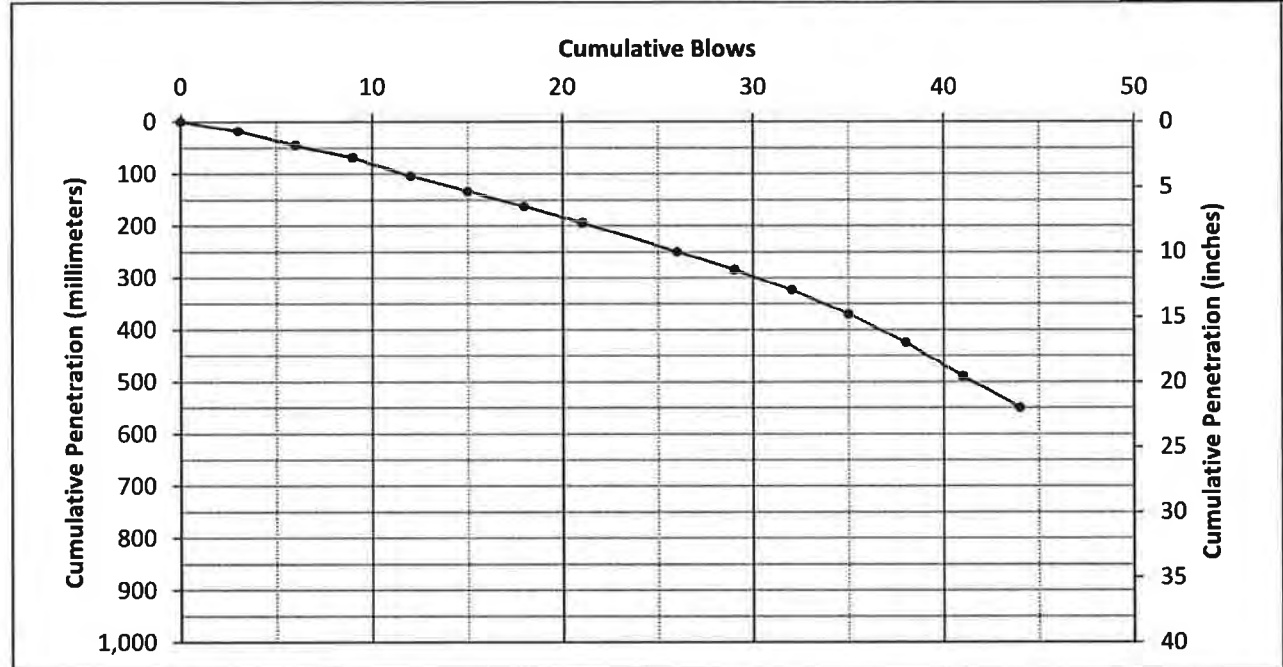
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-2

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	10.2	0.35	6,930
2	Subgrade below AC and aggregate base	19.1	0.35	5,430
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,280



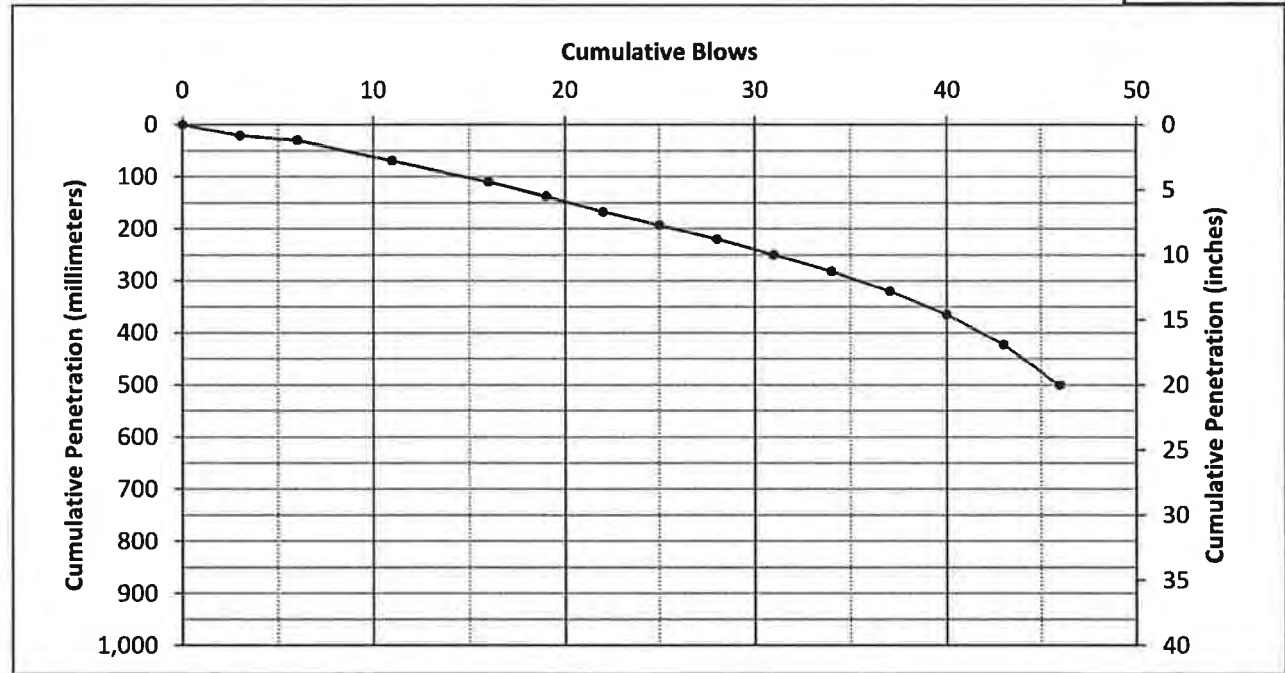
$M_R = C_f \times 49023 \times S^{-0.39}$
 M_R = resilient modulus (pounds per square inch)
 C_f = conversion coefficient
 S = slope (millimeters per blow)

References:

- ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.
- Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.
- Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-3

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	9.2	0.35	7,210
2	Subgrade below AC and aggregate base	19.9	0.35	5,340
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,450



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

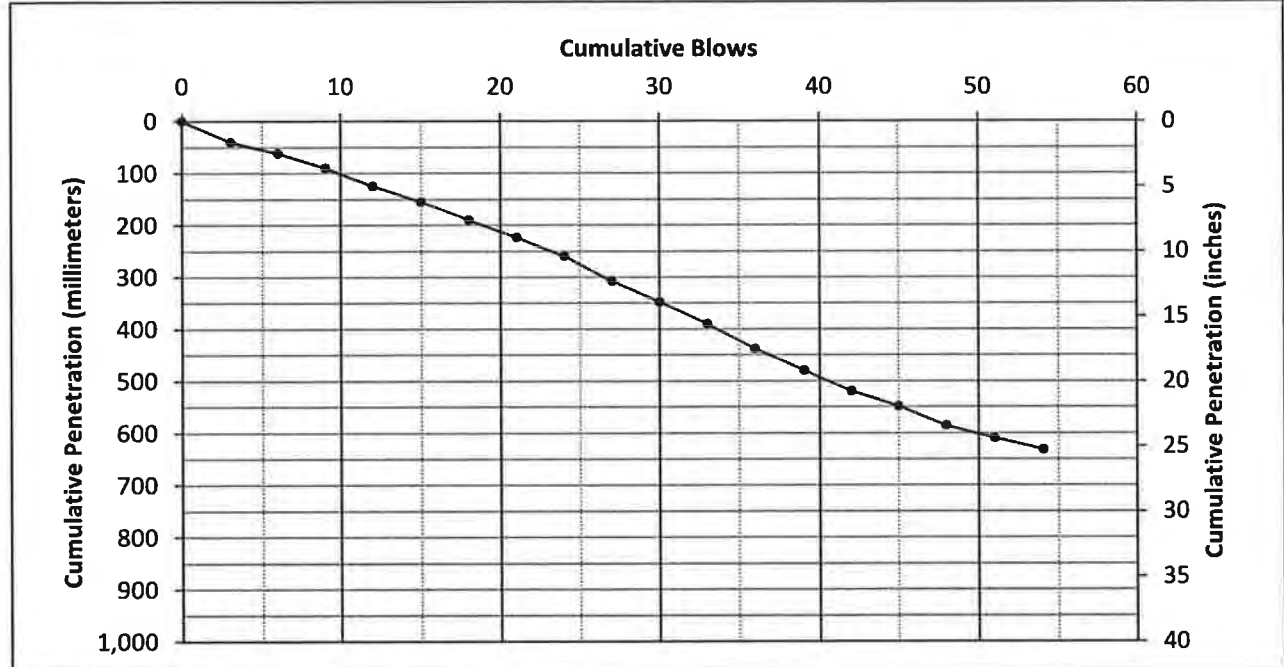
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-4

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	12.4	0.35	6,430
2		---	---	---
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				---



$M_R = C_f \times 49023 \times S^{-0.39}$
 M_R = resilient modulus (pounds per square inch)
 C_f = conversion coefficient
 S = slope (millimeters per blow)

References:

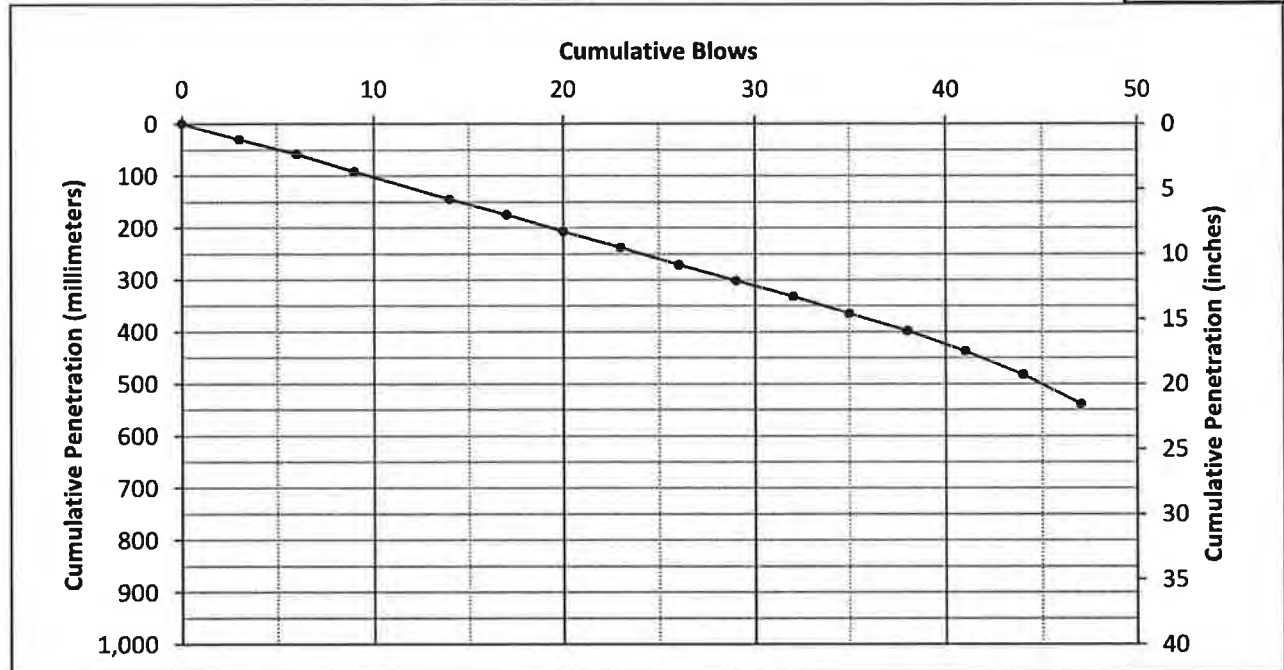
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-5

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	10.5	0.35	6,860
2	Subgrade below AC and aggregate base	15.6	0.35	5,880
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,590



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

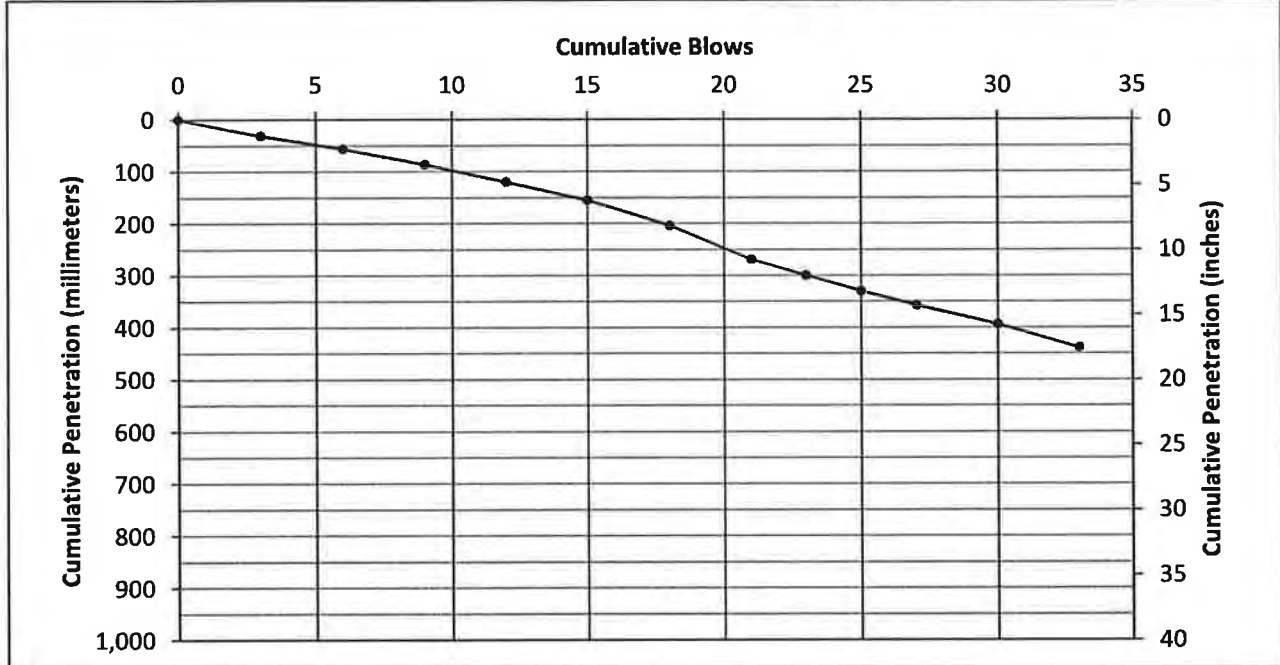
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-6

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	10.2	0.35	6,930
2	Subgrade below AC and aggregate base	13.9	0.35	6,140
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,510



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

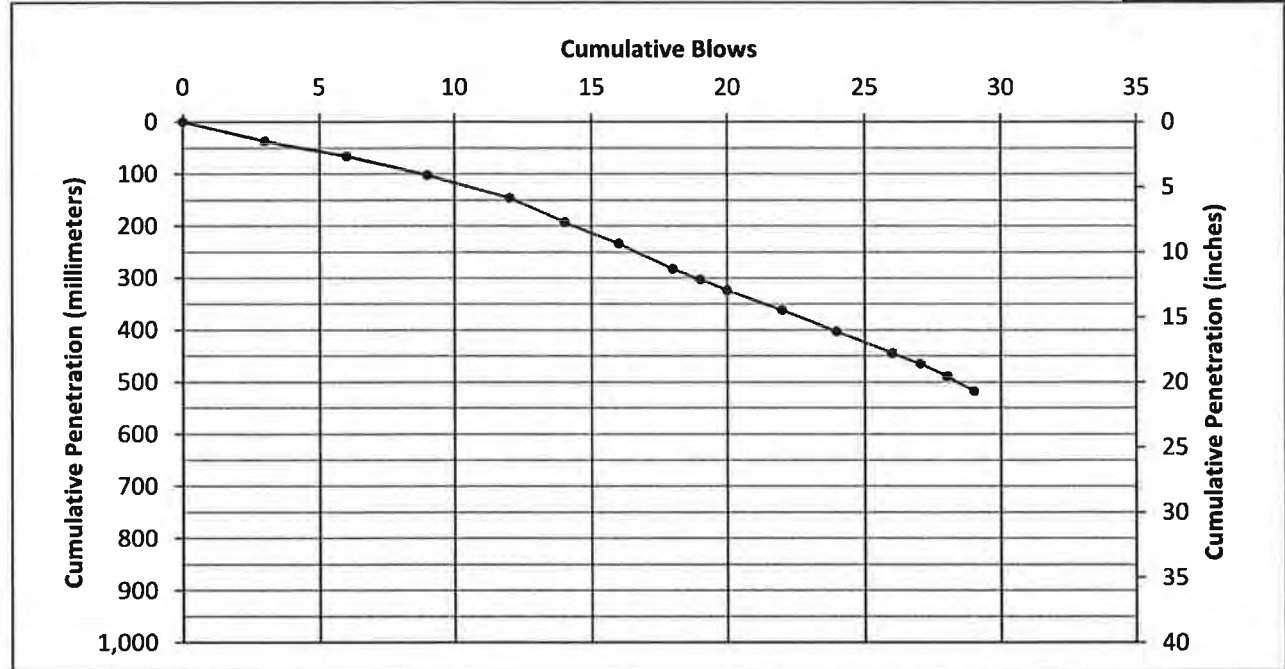
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-7

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	11.9	0.35	6,530
2	Subgrade below AC and aggregate base	21.3	0.35	5,210
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				5,560



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

APPENDIX C

APPENDIX C

PAVEMENT DESIGN REPORTS AND CALCULATION SHEETS

STORAGE YARD

We performed our pavement designs for the storage yard using PCASE. The reports generated by PCASE are presented in this appendix. Acronyms and abbreviations used in the PCASE reports are listed below.

CBR	California Bearing Ratio
in	inches
LED	layered-elastic design
N/A	not applicable
NFS	non-frost susceptible
Pr	Poisson's ratio
psi	pounds per square inch
SCI	structural condition index

OTHER PAVEMENT AREAS

We used the methods presented in the AASHTO guide for flexible pavement design and the Pavement Designer design tools for rigid pavement design for the other pavement areas. The AASHTO method calculation sheets and the Pavement Designer reports are presented in this appendix.

Design Name : GRVL_10YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	18.75	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	65000	1
HYSTER H230HD2 - HALF LOAD	45144	260000	260000
HYSTER H230HD2 - HALF LOAD	45144		260001

Design Name : GRVL_15YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetratio n (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	19.41	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	97500	1
HYSTER H230HD2 - HALF LOAD	45144	390000	390000
HYSTER H230HD2 - HALF LOAD	45144		390001

Pavement Design Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : GRVL_20YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	19.87	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	130000	1
HYSTER H230HD2 - HALF LOAD	45144	520000	520000
HYSTER H230HD2 - HALF LOAD	45144		520001

Pavement Design Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : 3RVL_CAS_10YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	6.75	0	0	100
Stabilized Subbase	PCC Stab-ML, MH, CL, CH	NFS	Manual	12	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	65000	1
HYSTER H230HD2 - HALF LOAD	45144	260000	260000
HYSTER H230HD2 - HALF LOAD	45144		260001

Design Name : 3RVL_CAS_15YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	7.41	0	0	100
Stabilized Subbase	PCC Stab-ML, MH, CL, CH	NFS	Manual	12	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	97500	1
HYSTER H230HD2 - HALF LOAD	45144	390000	390000
HYSTER H230HD2 - HALF LOAD	45144		390001

Pavement Design Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : 3RVL_CAS_20YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	7.87	0	0	100
Stabilized Subbase	PCC Stab-ML, MH, CL, CH	NFS	Manual	12	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	130000	1
HYSTER H230HD2 - HALF LOAD	45144	520000	520000
HYSTER H230HD2 - HALF LOAD	45144		520001

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : FLEX_10YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Manual	8.5	Yes	450000	0.35	0
Base	Unbound Crushed Stone	Compute	15.9	N/A	20000	0.35	0
Natural Subgrade	Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	65000
HYSTER H230HD2 - HALF LOAD	45144	260000

Pavement Thickness Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : FLEX_15YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Manual	9	Yes	450000	0.35	0
Base	Unbound Crushed Stone	Compute	15.83	N/A	20000	0.35	0
Natural Subgrade	Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	97500
HYSTER H230HD2 - HALF LOAD	45144	390000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : FLEX 20YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Manual	9.5	Yes	450000	0.35	0
Base	Unbound Crushed Stone	Compute	15.37	N/A	20000	0.35	0
Natural Subgrade	Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	130000
HYSSTER H230HD2 - HALF LOAD	45144	520000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : FLEX_CAS_10YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Compute	6	Yes	450000	0.35	0
Base	Unbound Crushed Stone	Compute	4	N/A	20000	0.35	0
Stabilized Subbase	PCC Stab- ML,MH,CL,CH	Manual	12	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	65000
HYSTER H230HD2 - HALF LOAD	45144	260000

Pavement Thickness Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : FLEX_CAS_15YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Compute	6.5	Yes	450000	0.35	0
Base	Unbound Crushed Stone	Compute	4	N/A	20000	0.35	0
Stabilized Subbase	PCC Stab- ML,MH,CL,CH	Manual	12	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	97500
HYSTER H230HD2 - HALF LOAD	45144	390000

Pavement Thickness Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : FLEX_CAS_20YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Compute	6.93	Yes	450000	0.35	0
Base	Unbound Crushed Stone	Compute	4	N/A	20000	0.35	0
Stabilized Subbase	PCC Stab- ML,MH,CL,CH	Manual	12	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life
5-AXLE TRUCK	80000	Span 130000
HYSTER H230HD2 - HALF LOAD	45144	520000

Pavement Thickness Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : RIGID_10YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter: 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	11.28	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	6	N/A	20000	0.35	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	65000
HYSTER H230HD2 - HALF LOAD	45144	260000

Pavement Thickness Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : RIGID_15YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter: 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	11.5	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	6	N/A	20000	0.35	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	97500
HYSTER H230HD2 - HALF LOAD	45144	390000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RIGID_20YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter: 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	11.65	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	6	N/A	20000	0.35	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	130000
HVSTER H230HD2 - HALF LOAD	45144	520000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RIGID_CAS_10YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter : 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	10.63	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	16	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	65000
HYSTER H230HD2 - HALF LOAD	45144	260000

Pavement Thickness Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : RIGID_CAS_15YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter : 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	10.87	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	16	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	97500
HYSTER H230HD2 - HALF LOAD	45144	390000

Pavement Thickness Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : RIGID_CAS_20YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter : 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	11.03	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	16	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	130000
HYSTER H230HD2 - HALF LOAD	45144	520000

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01 Date: 23-Oct-18 Design life (years) = 20	AC on aggregate base Parking and Drive Aisles				
INPUTS FOR STRUCTURAL NUMBER (SN) CALCULATIONS					
Variable	Value	Reference	Coefficient	Value	Reference
$S_0 =$	0.49	I-62, III-51	m_2 (Base) =	1.00	II-26
Subgrade $M_R =$	6,380	I-14	m_3 (Subbase) =	1.00	II-26
$p_0 =$	4.2	II-12	a_1 (AC) =	0.42	II-19
$p_t =$	2.5	II-12	a_2 (Base) =	0.10	II-20
$\Delta PSI =$	1.7	II-12	a_3 (Subbase) =	0.08	II-20
Design ESALs =	see below				

MINIMUM ASPHALT CONCRETE THICKNESS

Base Rock $M_R =$	20,000 psi			
	Parking	Drive,ADTT=10	Drive,ADTT=25	Drive,ADTT=50
Reliability (Ref II-9)	80	80	80	80
Z_R	-0.841	-0.841	-0.841	-0.841
ESALs	10,000	84,000	210,000	419,000
SN estimate	0.947	1.452	1.713	1.930
ESALs from SN est.	10,000	84,000	210,000	419,000
FINAL SN =	0.95	1.46	1.72	1.94
Min AC Thickness	2.26	3.48	4.10	4.62
	Parking	Drive,ADTT=10	Drive,ADTT=25	Drive,ADTT=50
Resilient Modulus	6,380	6,380	6,380	6,380
ESALs	10,000	84,000	210,000	419,000
SN estimate	1.597	2.302	2.681	3.007
ESALs from SN est.	10,000	84,000	210,000	419,000
FINAL SN =	1.60	2.31	2.69	3.01

If LOCK AC is set to "1", the Calc AC button will not change AC thickness value

NEW PAVEMENT ANALYSIS

						LOCK AC
						0
New Pavement, Parking			10,000 ESALs			
Coefficient	Value	Ref	$SN = a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$			
m_2 (Base)	1.00	II-26				
m_3 (Subbase)	1.00	II-26	Thickness	SN	Total SN	
a_1 (AC)	0.42	II-19	2.5	1.05	1.05	
a_2 (Base)	0.10	II-20	5.5	0.55	1.60	
a_3 (Subbase)	0.08	II-20	0.0	0.00	1.60	
Total Thickness			8.00			
						LOCK AC
						0
New Pavement, Drive,ADTT=10			84,000 ESALs			
Coefficient	Value	Ref	$SN = a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$			
m_2 (Base)	1.00	II-26				
m_3 (Subbase)	1.00	II-26	Thickness	SN	Total SN	
a_1 (AC)	0.42	II-19	3.5	1.47	1.47	
a_2 (Base)	0.10	II-20	8.5	0.85	2.32	
a_3 (Subbase)	0.08	II-20	0.0	0.00	2.32	
			12.00			

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01			AC on aggregate base		
Date: 23-Oct-18			Parking and Drive Aisles		
Design life (years) = 20					
					LOCK AC
New Pavement, Drive,ADTT=25			210,000 ESALs		0
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m₂ (Base)	1.00	II-26			
m₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a₁ (AC)	0.42	II-19	4.5	1.89	1.89
a₂ (Base)	0.10	II-20	8.5	0.85	2.74
a₃ (Subbase)	0.08	II-20	0.0	0.00	2.74
			13.00		
					LOCK AC
New Pavement, Drive,ADTT=50			419,000 ESALs		0
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m₂ (Base)	1.00	II-26			
m₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a₁ (AC)	0.42	II-19	5.0	2.10	2.10
a₂ (Base)	0.10	II-20	9.5	0.95	3.05
a₃ (Subbase)	0.08	II-20	0.0	0.00	3.05
			14.50		

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01	AC on aggregate base				
Date: 23-Oct-18	Access Road				
Design life (years) = 20					
INPUTS FOR STRUCTURAL NUMBER (SN) CALCULATIONS					
Variable	Value	Reference	Coefficient	Value	Reference
$S_0 =$	0.49	I-62, III-51	m_2 (Base) =	1.00	II-26
Subgrade $M_R =$	6,380	I-14	m_3 (Subbase) =	1.00	II-26
$p_0 =$	4.2	II-12	a_1 (AC) =	0.42	II-19
$p_t =$	2.5	II-12	a_2 (Base) =	0.10	II-20
$\Delta PSI =$	1.7	II-12	a_3 (Subbase) =	0.08	II-20
Design ESALs =	see below				

MINIMUM ASPHALT CONCRETE THICKNESS

Base Rock $M_R =$ 20,000 psi

	Access,ADTT=10	Access,ADTT=25	Access,ADTT=50	Alternative 4
Reliability (Ref II-9)	80	80	80	80
Z_R	-0.841	-0.841	-0.841	-0.841
ESALs	147,000	210,000	314,000	147,000
SN estimate	1.608	1.713	1.837	1.608
ESALs from SN est.	147,000	210,000	314,000	147,000
FINAL SN =	1.61	1.72	1.84	1.61
Min AC Thickness	3.83	4.10	4.38	3.83

	Access,ADTT=10	Access,ADTT=25	Access,ADTT=50	Alternative 4
Resilient Modulus	6,380	6,380	6,380	6,380
ESALs	147,000	210,000	314,000	147,000
SN estimate	2.527	2.681	2.867	2.527
ESALs from SN est.	147,000	210,000	314,000	147,000
FINAL SN =	2.53	2.69	2.87	2.53

If LOCK AC is set to "1", the Calc AC button will not change AC thickness value

NEW PAVEMENT ANALYSIS

LOCK AC					
New Pavement, Access,ADTT=10					147,000 ESALs
Coefficient	Value	Ref	$SN = a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		0
m_2 (Base)	1.00	II-26			
m_3 (Subbase)	1.00	II-26	Thickness	SN	Total SN
a_1 (AC)	0.42	II-19	4.0	1.68	1.68
a_2 (Base)	0.10	II-20	8.5	0.85	2.53
a_3 (Subbase)	0.08	II-20	0.0	0.00	2.53
Total Thickness			12.50		
LOCK AC					
New Pavement, Access,ADTT=25					210,000 ESALs
Coefficient	Value	Ref	$SN = a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		0
m_2 (Base)	1.00	II-26			
m_3 (Subbase)	1.00	II-26	Thickness	SN	Total SN
a_1 (AC)	0.42	II-19	4.5	1.89	1.89
a_2 (Base)	0.10	II-20	8.5	0.85	2.74
a_3 (Subbase)	0.08	II-20	0.0	0.00	2.74
			13.00		

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01		AC on aggregate base	
Date: 23-Oct-18		Access Road	
Design life (years) = 20			
			LOCK AC
New Pavement, Access,ADTT=50			314,000 ESALs
			0
Coefficient	Value	Ref	SN= $a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$
m ₂ (Base)	1.00	II-26	
m ₃ (Subbase)	1.00	II-26	
a ₁ (AC)	0.42	II-19	Thickness SN
a ₂ (Base)	0.10	II-20	4.5 1.89
a ₃ (Subbase)	0.08	II-20	10.0 1.00
			0.0 0.00
			14.50
			Total SN
			1.89
			2.89
			2.89

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01	AC on cement-amended soil				
Date: 23-Oct-18	Parking and Drive Aisles				
Design life (years) = 20					
INPUTS FOR STRUCTURAL NUMBER (SN) CALCULATIONS					
Variable	Value	Reference	Coefficient	Value	Reference
$S_0 =$	0.49	I-62, III-51	m_2 (Base) =	1.00	II-26
Subgrade $M_R =$	6,380	I-14	m_3 (Subbase) =	1.00	II-26
$p_0 =$	4.2	II-12	a_1 (AC) =	0.42	II-19
$p_t =$	2.5	II-12	a_2 (Base) =	0.10	II-20
$\Delta PSI =$	1.7	II-12	a_3 (Subbase) =	0.08	II-20
Design ESALs =	see below				

MINIMUM ASPHALT CONCRETE THICKNESS

Base Rock $M_R =$	120,000	psi			
	Parking	Drive,ADTT=10	Drive,ADTT=25	Drive,ADTT=50	
Reliability (Ref II-9)	80	80	80	80	
Z_R	-0.841	-0.841	-0.841	-0.841	
ESALs	10,000	84,000	210,000	419,000	
SN estimate	0.248	0.566	0.728	0.861	
ESALs from SN est.	10,000	84,000	210,000	419,000	
FINAL SN =	0.25	0.57	0.73	0.87	
Min AC Thickness	0.60	1.36	1.74	2.07	
	Parking	Drive,ADTT=10	Drive,ADTT=25	Drive,ADTT=50	
Resilient Modulus	6,380	6,380	6,380	6,380	
ESALs	10,000	84,000	210,000	419,000	
SN estimate	1.597	2.302	2.681	3.007	
ESALs from SN est.	10,000	84,000	210,000	419,000	
FINAL SN =	1.60	2.31	2.69	3.01	

If LOCK AC is set to "1", the Calc AC button will not change AC thickness value

NEW PAVEMENT ANALYSIS

LOCK AC					
0					
New Pavement, Parking			10,000 ESALs		
Coefficient	Value	Ref	$SN = a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m_2 (Base)	1.00	II-26			
m_3 (Subbase)	1.00	II-26	Thickness	SN	Total SN
a_1 (AC)	0.42	II-19	2.5	1.05	1.05
a_2 (Base)	0.10	II-20	5.5	0.55	1.60
a_3 (Subbase)	0.08	II-20		0.00	1.60
Total Thickness			8.00		
LOCK AC					
0					
New Pavement, Drive,ADTT=10			84,000 ESALs		
Coefficient	Value	Ref	$SN = a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m_2 (Base)	1.00	II-26			
m_3 (Subbase)	1.00	II-26	Thickness	SN	Total SN
a_1 (AC)	0.42	II-19	3.0	1.26	1.26
a_2 (Base)	0.10	II-20	10.5	1.05	2.31
a_3 (Subbase)	0.08	II-20		0.00	2.31
			13.50		

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01		AC on cement-amended soil			
Date: 23-Oct-18		Parking and Drive Aisles			
Design life (years) = 20					
					LOCK AC
New Pavement, Drive,ADTT=25					210,000 ESALs
					0
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	4.0	1.68	1.68
a ₂ (Base)	0.10	II-20	10.5	1.05	2.73
a ₃ (Subbase)	0.08	II-20		0.00	2.73
			14.50		
					LOCK AC
New Pavement, Drive,ADTT=50					419,000 ESALs
					0
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	4.5	1.89	1.89
a ₂ (Base)	0.10	II-20	11.5	1.15	3.04
a ₃ (Subbase)	0.08	II-20		0.00	3.04
			16.00		

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01 Date: 23-Oct-18 Design life (years) = 20	AC on cement-amended soil Access Road				
INPUTS FOR STRUCTURAL NUMBER (SN) CALCULATIONS					
Variable	Value	Reference	Coefficient	Value	Reference
S ₀ =	0.49	I-62, III-51	m ₂ (Base) =	1.00	II-26
Subgrade M _R =	6,380	I-14	m ₃ (Subbase) =	1.00	II-26
p ₀ =	4.2	II-12	a ₁ (AC) =	0.42	II-19
p _t =	2.5	II-12	a ₂ (Base) =	0.10	II-20
ΔPSI =	1.7	II-12	a ₃ (Subbase) =	0.08	II-20
Design ESALs =	see below				

MINIMUM ASPHALT CONCRETE THICKNESS

Base Rock M_R = 120,000 psi

	Access,ADTT=10	Access,ADTT=25	Access,ADTT=50	Alternative 4
Reliability (Ref II-9)	80	80	80	80
Z _R	-0.841	-0.841	-0.841	-0.841
ESALs	147,000	210,000	314,000	147,000
SN estimate	0.663	0.728	0.804	0.663
ESALs from SN est.	147,000	210,000	314,000	147,000
FINAL SN =	0.67	0.73	0.81	0.67
Min AC Thickness	1.60	1.74	1.93	1.60

	Access,ADTT=10	Access,ADTT=25	Access,ADTT=50	Alternative 4
Resilient Modulus	6,380	6,380	6,380	6,380
ESALs	147,000	210,000	314,000	147,000
SN estimate	2.527	2.681	2.867	2.527
ESALs from SN est.	147,000	210,000	314,000	147,000
FINAL SN =	2.53	2.69	2.87	2.53

If LOCK AC is set to "1", the Calc AC button will not change AC thickness value

NEW PAVEMENT ANALYSIS

LOCK AC					
New Pavement, Access,ADTT=10					147,000 ESALs
Coefficient	Value	Ref	SN=a ₁ ×D ₁ +a ₂ ×D ₂ ×m ₂ +a ₃ ×D ₃ ×m ₃		0
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	3.5	1.47	1.47
a ₂ (Base)	0.10	II-20	11.0	1.10	2.57
a ₃ (Subbase)	0.08	II-20		0.00	2.57
Total Thickness			14.50		
LOCK AC					
New Pavement, Access,ADTT=25					210,000 ESALs
Coefficient	Value	Ref	SN=a ₁ ×D ₁ +a ₂ ×D ₂ ×m ₂ +a ₃ ×D ₃ ×m ₃		0
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	4.0	1.68	1.68
a ₂ (Base)	0.10	II-20	10.5	1.05	2.73
a ₃ (Subbase)	0.08	II-20		0.00	2.73
Total Thickness			14.50		

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01		AC on cement-amended soil	
Date: 23-Oct-18		Access Road	
Design life (years) = 20			
New Pavement, Access,ADTT=50			LOCK AC
			0
			314,000 ESALs
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$
m_2 (Base)	1.00	II-26	
m_3 (Subbase)	1.00	II-26	
a_1 (AC)	0.42	II-19	Thickness
a_2 (Base)	0.10	II-20	SN
a_3 (Subbase)	0.08	II-20	Total SN
			16.00



DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)

DATE CREATED:

Sat Oct 27 2018 17:47:00 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.00 in.	6.00 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	5.77 in.	5.77 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobuffers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

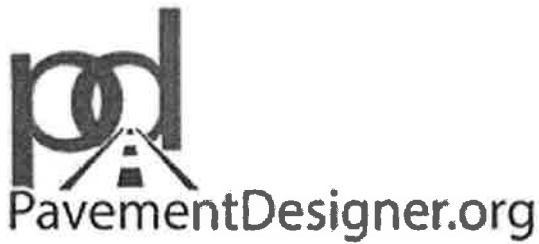
Project Level

TRAFFIC
 Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years
USER DEFINED TRAFFIC
 Trucks Per Day: 20
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL
 Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %
 Avg Trucks/Day in Design Lane Over the Design Life: 20
 Total Trucks in Design Lane Over the Design Life: 146,100

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



DESIGN SUMMARY REPORT FOR
 JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)
 DATE CREATED:

Sat Oct 27 2018 17:51:00 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.00 in.	6.00 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	5.91 in.	5.91 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrob fibers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC
 Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years
USER DEFINED TRAFFIC
 Trucks Per Day: 35
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL
 Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %
 Avg Trucks/Day in Design Lane Over the Design Life: 35
 Total Trucks in Design Lane Over the Design Life: 255,675

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)

DATE CREATED:

Sat Oct 27 2018 17:51:51 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.00 in.	6.00 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	6.00 in.	6.00 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 50
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 50
 Total Trucks in Design Lane Over the Design Life: 365,250

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 17:52:42 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.25 in.	6.25 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	6.09 in.	6.09 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobuffers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC
 Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC
 Trucks Per Day: 75
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL
 Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 75
 Total Trucks in Design Lane Over the Design Life: 547,875

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



DESIGN SUMMARY REPORT FOR

JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)

DATE CREATED:

Sat Oct 27 2018 17:53:25 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.25 in.	6.25 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	6.16 in.	6.16 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 100
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 100
 Total Trucks in Design Lane Over the Design Life: 730,500

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)

DATE CREATED:

Sat Oct 27 2018 17:56:26 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.50 in.	5.50 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.33 in.	5.33 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSFG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 20
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 20
 Total Trucks in Design Lane Over the Design Life: 146,100

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)

DATE CREATED:

Sat Oct 27 2018 18:13:09 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.50 in.	5.50 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.46 in.	5.46 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrofibers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 35
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 35
 Total Trucks in Design Lane Over the Design Life: 255,675

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)

DATE CREATED:

Sat Oct 27 2018 18:14:38 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.75 in.	5.75 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.54 in.	5.54 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC
 Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years
USER DEFINED TRAFFIC
 Trucks Per Day: 50
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL
 Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %
 Avg Trucks/Day in Design Lane Over the Design Life: 50
 Total Trucks in Design Lane Over the Design Life: 365,250

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



DESIGN SUMMARY REPORT FOR
 JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)
 DATE CREATED:

Sat Oct 27 2018 18:15:20 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.75 in.	5.75 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.63 in.	5.63 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 75
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 75
 Total Trucks in Design Lane Over the Design Life: 547,875

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



DESIGN SUMMARY REPORT FOR
 JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)
 DATE CREATED:

Sat Oct 27 2018 18:16:02 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.75 in.	5.75 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.70 in.	5.70 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrofibers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 100
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

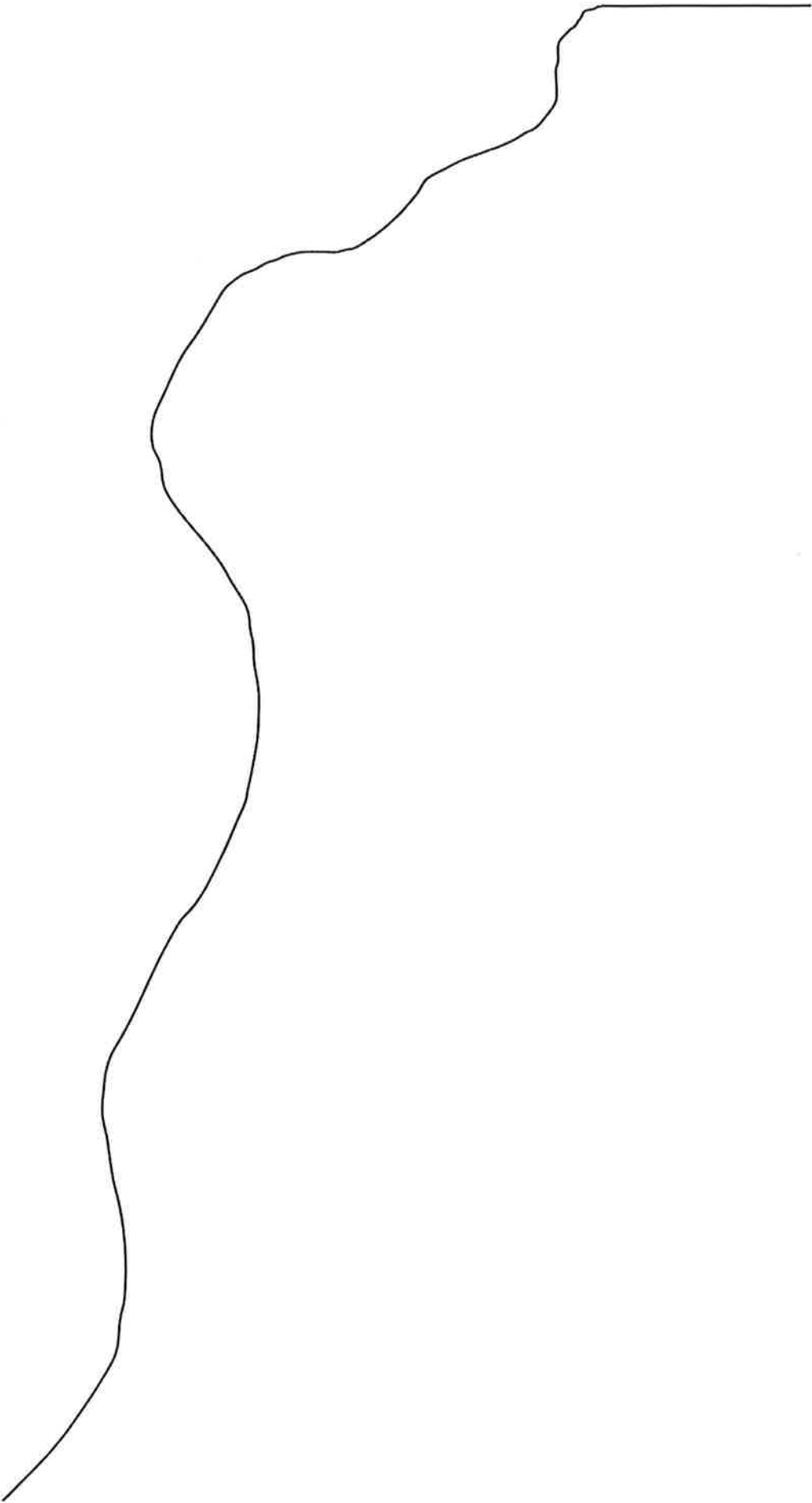
GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 100
 Total Trucks in Design Lane Over the Design Life: 730,500

Design Method

The PCA design methodology from StreetPave, was used to produce these results.





PAVEMENT DESIGN REPORT

Industrial Focus – Phase 1
SW Boberg Road
Wilsonville, Oregon

For
D.P. Nicoli, Inc.
April 8, 2020

GeoDesign Project: DPNicoli-5-02



April 8, 2020

D.P. Nicoli, Inc.
PO Box 2401
Lake Oswego, OR 97035

Attention: Dave Nicoli

Pavement Design Report
Industrial Focus - Phase 1
SW Boberg Road
Wilsonville, Oregon
GeoDesign Project: DPNicoli-5-02

GeoDesign, Inc. is pleased to submit this report of pavement design services for the off-site improvements associated with the proposed Industrial Focus - Phase 1 development, which includes Tax Lots 300 and 500 of Clackamas County Tax Map 3S1W14A, in Wilsonville, Oregon. We appreciate the opportunity to be of service to D.P. Nicoli, Inc. Please contact us if you have any questions regarding this report.

Sincerely,

GeoDesign, Inc.

A handwritten signature in blue ink, appearing to read "KDY", is written over a light blue circular stamp.

Krey D. Younger, P.E., G.E.
Senior Associate Engineer

A handwritten signature in blue ink, appearing to read "GS", is written over a light blue circular stamp.

George Saunders, P.E., G.E.
Principal Engineer

cc: Greg Parsons, D.P. Nicoli, Inc. (via email only)

JLM:KDY:GPS:kt

Attachments

One copy submitted (via email only)

Document ID: DPNicoli-5-02-040820-geor.docx

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ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ACP	asphalt concrete pavement
ASTM	American Society for Testing and Materials
BGS	below ground surface
ESAL	equivalent single-axle load
FWD	falling weight deflectometer
ODOT	Oregon Department of Transportation
OSSC	Oregon Standard Specifications for Construction (2018)
OWT	outside wheel track
PG	performance grade
psi	pounds per square inch
SPT	standard penetration test

1.0 INTRODUCTION

GeoDesign, Inc. is pleased to submit this report of pavement design services for the off-site improvements associated with the proposed Industrial Focus – Phase 1 development, which includes Tax Lots 300 and 500 of Clackamas County Tax Map 3S1W14A, in Wilsonville, Oregon. Figure 1 presents the approximate project location and Figure 2 presents a site plan with our exploration locations. Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents. For the purpose of brevity, SW Boberg Road will be referred to as “Boberg” in this report.

2.0 PROJECT UNDERSTANDING

The pavement investigation was conducted to evaluate the pavement conditions of Boberg along the Industrial Focus – Phase 1 development. We previously completed a geotechnical engineering services report for the project in November 2018.¹ Based on the City of Wilsonville (City) land use requirements, we understand that a half-street improvement is required for the development if the life of the adjoining pavement is less than 20 years. Based on discussion with you and a site reconnaissance conducted at the beginning of the pavement evaluation, we understand that a half-street improvement on the northbound lane of Boberg is required.

We understand that Boberg is classified by the City as a collector street. Section 201.2.05 of the City of Wilsonville Public Works Standards requires a minimum of 5 inches of AC for collector streets, with the provision that the thicknesses of the AC and underlying aggregate base be determined by the pavement designer.

3.0 PURPOSE AND SCOPE

We conducted FWD testing and pavement subsurface explorations to estimate the existing pavement thicknesses and underlying subgrade conditions of the northbound lane of Boberg along the development frontage. In conjunction with the explorations, we performed analysis to provide design properties and construction recommendations for a new pavement section. We completed the following specific scope of services:

- Reviewed available information regarding the existing road section within the project area.
- Obtained one-call utility locates for explorations and necessary permits through the City.
- Provided traffic control during field explorations through our subcontractor.
- Drilled three diamond core and solid-stem auger pavement borings within the road surface to a depth of 6.5 feet BGS.
- Collected soil samples directly under the pavement structure and maintained a log of subsurface conditions encountered in each boring.
- Conducted FWD tests at 50-foot intervals in the OWT of the northbound travel lane.

¹ GeoDesign, Inc., 2018. *Report of Geotechnical Engineering Services: Wilsonville Facilities: Tax Lots 300 and 500: Wilsonville, Oregon*, dated November 14, 2018. GeoDesign Project: DPNicoli-5-01

- Conducted a visual distress survey of the existing pavement, including logging the extent and severity of existing distresses. Marked coring locations in the field.
- Performed the following laboratory tests on soil samples collected from the explorations:
 - Six moisture content determinations in general accordance with ASTM D2216
 - One Atterberg limits test in general accordance with ASTM D4318
 - One particle-size analysis for material passing the U.S. Standard No. 200 sieve in general accordance with ASTM D1140
- Analyzed the FWD data to back-calculate the in situ resilient modulus of the subgrade soil and the effective structural number of the existing pavement structure.
- Estimated traffic loading by calculating ESALs based on classified traffic count information from a 2019 study conducted by DKS Associates.²
- Evaluated rehabilitation and reconstruction options based on FWD testing, subgrade conditions, soil borings, laboratory results, and traffic data.
- Provided pavement structural design recommendations for a new pavement section, if required.
- Provided this pavement design report that presents the results of our findings, conclusions, and recommendations.

4.0 SITE CONDITIONS

Boberg is an AC-surfaced collector road with one lane in each direction that is generally oriented in a north/south direction. Concrete curbs and gutters are present at the road edges in both directions along the Industrial Focus – Phase 1 development frontage.

4.1 EXISTING SURFACE CONDITIONS

GeoDesign performed a visual survey of Boberg for pavement distress along the Industrial Focus – Phase 1 development. Overall, the pavement in the northbound direction is in poor condition. A significant amount of the road surface has moderate to severe fatigue distress on the OWT and block cracking throughout.

4.2 SUBSURFACE CONDITIONS

We completed three borings (C-1 through C-3). The borings were extended through the AC and into the subgrade to a depth of 6.5 feet BGS. The approximate exploration locations are shown on Figure 2. The exploration logs are presented in Appendix A. Table 1 presents the thickness of AC and aggregate base encountered at each boring location.

² DKS Associates, 2019. *Wilsonville Industrial Focus Transportation Impact Study*, dated January 25, 2019.

Table 1. Existing Pavement Thickness

Boring Number	Direction	Location	Thickness of AC (inches)	Thickness of Aggregate Base (inches)	Distress Mode
C-1	Northbound	OWT	5.3	17.0	Fatigue crack to 3.0 inches
C-2	Northbound	OWT	5.0	18.0	Fatigue crack to 1.7 inches
C-3	Northbound	OWT	5.3	17.0	Fatigue crack to 4.5 inches

In general, subsurface soil conditions encountered beneath the existing pavement section consist of clay with varying amounts of sand to the maximum depth explored. Based on SPTs, the clay is generally medium stiff to stiff. Specific consistencies and layer thicknesses are identified on the exploration logs presented in Appendix A.

Laboratory testing of select samples indicates the aggregate base had in-place moisture contents of between 14 and 18 percent, whereas the clay with sand had in-place moisture contents of between 30 and 34 percent at the time of our explorations. Based on Atterberg limits testing, the clay has medium to high plasticity. Soil of this type and consistency generally exhibits relatively low strength and moderate compressibility. A summary of the laboratory test results is presented in Appendix A.

4.3 FWD TESTING

Deflection testing was performed by GeoDesign on March 6, 2020. Tests were performed in the OWT of the northbound travel lane at approximately 50-foot intervals. Tests were performed at loads of approximately 6,000, 9,000, and 12,000 pounds, and the results were normalized for a 9,000-pound load. Deflections were recorded at 0, 8, 12, 18, 24, 36, 48, 60, and 72 inches from the impact location. The test data and back-calculation summary are presented in Appendix B.

5.0 PAVEMENT DESIGN

The subgrade resilient modulus and structural number of the existing pavement are based on subsurface explorations and FWD testing on the existing pavement. Traffic loading is based on classification counts. Descriptions of our input parameters and the recommended pavement designs are summarized below.

5.1 DESIGN STANDARDS

The standards used for pavement design are listed below:

- ODOT Pavement Design Guide, ODOT (January 2019) (ODOT guide)
- Guide for Design of Pavement Structures, AASHTO (1993) (AASHTO guide)
- City of Wilsonville Design and Construction Standards (2018) (City standards)

5.2 ESAL CALCULATIONS

We received traffic classification counts recorded for the 2019 traffic study conducted by DKS Associates.² Counts consist of 72-hour classification tube counts collected by Quality Counts from January 8 through 10, 2019 approximately 100 feet south of the Boeckman Road interchange. Based on the classification counts, we calculated approximately 14 percent heavy vehicles. Our calculations are based on a 1.2 percent growth rate supplied by DKS Associates. The resulting 15- and 20-year design ESALs are listed in Table 2. Average counts, our calculation methodology, and our calculation sheet are presented in Appendix C.

Table 2. 15- and 20-Year Design ESAL Values

Location	15-Year Design ESALs	20-Year Design ESALs
100 feet south of Boeckman Road	693,000	953,000

Our design is based on the 20-year ESAL calculation.

5.3 BACK-CALCULATED SUBGRADE RESILIENT MODULUS

FWD data and back-calculation analysis are used to determine subgrade resilient modulus values. Details of the FWD testing are presented in Appendix B. Table B-1 provides the FWD test data and analysis results, and Figure B-1 shows the results graphically for the northbound direction. The average resilient modulus at the locations tested is 3,500 psi, which reflects the relative low strength of the subgrade soil.

5.4 BACK-CALCULATED ROADWAY STRUCTURAL CAPACITY

We performed back-calculation analysis of the FWD data to also determine the structural capacity of the road section. The effective pavement structural number, derived as a function of unit stiffness and pavement depth, was calculated according to the AASHTO design method. The effective structural numbers at FWD test locations are provided on Figure B-1 and in Table B-1.

5.5 REQUIRED STRUCTURAL NUMBER FOR AC PAVEMENT

We used the procedure in the AASHTO guide to determine the required structural numbers for new and rehabilitated pavement. We recommend a design structural number of 4.45 for a 20-year design ESAL, resilient modulus values discussed previously, and the other design parameters discussed next. The 20-year required structural number compared to the FWD data is presented graphically on Figure B-1.

5.6 OTHER DESIGN PARAMETERS

Other pavement design parameters used in our analysis are summarized below. These input parameters are as specified in the City standards.

5.6.1 Reliability

We used a reliability of 85 percent for the road section classified as a collector street.

5.6.2 Serviceability

We used initial and terminal serviceability values of 4.2 and 2.5, respectively.

5.6.3 Overall Standard Deviation

We used an overall standard deviation value of 0.49.

5.6.4 Structural Layer Coefficients

We used structural layer coefficients of 0.42 for AC and 0.10 for new aggregate base.

6.0 RECONSTRUCTION RECOMMENDATIONS

6.1 PROJECT OVERVIEW

Based on our FWD analysis, the capacity of the existing pavement is low and would require approximately 3.5 inches of AC overlay. In addition, we observed significant fatigue cracking in the outer half of the road section. The relatively poor condition of the pavement is likely associated with the 5.0- to 5.3-inch-thick pavement, which, based on the traffic loading and subgrade conditions, corresponds to an approximately 11- to 12-year design life.

Accordingly, we recommend half-street reconstruction. Our specific recommendations for design and construction of the roadway are presented in the following sections. These should be incorporated into the design and implemented during construction of the proposed development. The AC, aggregate base, stabilization aggregate, and subgrade geotextile recommended below should conform to the specifications presented in the “Pavement Materials” section.

6.2 FULL-DEPTH RECONSTRUCTION

We recommend the following half-street reconstruction pavement section:

Reconstruction

- 2.0 inches of Level 3, ½-inch, dense ACP wearing course
- 5.0 inches of Level 3, ½-inch, dense ACP base course (two lifts)
- 13.5-inch-thick aggregate base
- Stabilization aggregate (if required)
- Subgrade geotextile

The actual thickness of the aggregate base and stabilization material will depend on the depth required to reach firm subgrade. Firm subgrade shall consist of undisturbed material that, based on proof rolling (see caution below) or foundation probing, indicates medium stiff, fine-grained soil or medium dense, granular material. Site preparation should follow the “Construction Recommendations” section.

6.3 PAVEMENT MATERIALS

A submittal should be made for each pavement material prior to the start of paving operations. Each submittal should include the test information necessary to evaluate the degree to which the properties of the material comply with the properties that were recommended or specified. The geotechnical engineer and other appropriate members of the design team should review each submittal.

6.3.1 AC

The AC should be Level 3, ½-inch, dense ACP according to OSSC 00744 (Asphalt Concrete Pavement). Minimum and maximum lift thicknesses are 2.0 and 3.0 inches for ½-inch ACP, respectively. An adjustment to lift thicknesses outside this range should be reviewed by both GeoDesign and the project team. Asphalt binder should be performance graded. We recommend PG 64–22 binder; however, the binder grade should be adjusted depending on the aggregate gradation and amount of recycled asphalt pavement and/or recycled asphalt shingles in the contractor’s mix design submittal.

6.3.2 Aggregate Base

Imported granular material used as aggregate base should be clean crushed rock or crushed gravel and sand that are well graded. The aggregate base should meet the gradation defined in OSSC 00641 (Aggregate Subbase, Base, and Shoulders), with the exception that the aggregate should have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve, should have a maximum particle size of ¾ inch to 1½ inches, and should have at least two mechanically fractured faces. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T 99.

6.3.3 Stabilization Aggregate

Stabilization material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the requirements set forth in OSSC 00330.14 (Selected Granular Backfill) and OSSC 00330.15 (Selected Stone Backfill), with a maximum particle size of 3 inches for selected granular backfill and 6 inches for selected stone backfill, less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, and at least two mechanically fractured faces. The material should be free of organic and other deleterious materials. Stabilization material should be placed over a geotextile fabric in one lift and compacted to a firm condition.

6.3.4 Subgrade Geotextile

The subgrade geotextile should conform to OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles.

7.0 CONSTRUCTION RECOMMENDATIONS

Our specific recommendations should be implemented during construction and design of the proposed improvements. The AC recommended in the following sections should conform to the specifications presented in the “Pavement Materials” section.

7.1 SUBGRADE PREPARATION/IMPROVEMENT/OVER-EXCAVATION

Given the laboratory results, our experience with subgrade below existing AC, and as further discussed below, we anticipate elevated moisture contents and subgrade soil that is sensitive to disturbance and easily damaged by construction equipment.

As discussed in the “Subgrade Protection” section, we recommend that the excavation of the existing AC and aggregate base be advanced from equipment supported on the existing AC. The amount of material removed will depend on the subgrade conditions. It is likely that soft subgrade areas exist within the proposed half-street improvement area. Soft or damaged

subgrade may not possess the resilient modulus value assumed in our design and the recommended pavement sections may not be adequate. These areas should be observed by the project geotechnical engineer to determine the extent of improvement necessary. Improvement can consist of removal and replacement or, if weather conditions allow, scarifying and re-compacting the soft area prior to placing additional fill or base rock materials over a geotextile. We note that the moisture contents from our soil samples were considerably above that required for compaction and moisture conditioning (aeration/drying) would be required to compact the subgrade soil as structural fill. If the soil cannot be properly moisture conditioned, the subgrade should be removed (over-excavated) and replaced with granular material (aggregate base or stabilization material). Cement amendment is also an option, and recommendations can be provided if this option is considered.

The project budget should include a contingency for over-excavation of soft subgrade. It is difficult to estimate the quantity of over-excavation that will be necessary due to soft subgrade. Based on our experience and the 17 to 18 inches of aggregate base currently present, the total area of over-excavation could exceed 50 percent of the improvement area and the average depth of removal (over-excavation) to be approximately 12 inches. For these reasons, subgrade protection will be an essential component of the work.

7.2 SUBGRADE EVALUATION

A member of our geotechnical staff should observe subgrades once exposed to determine if there are areas of unsuitable or unstable soil. In areas large enough to accommodate construction vehicles, the subgrade should be proof rolled with a fully loaded dump truck or similar heavy, rubber tire construction equipment to identify soft, loose, or unsuitable areas after subgrade compaction is complete. Proof rolling should be observed by a qualified geotechnical engineer or their representative. However, we anticipate wet and sensitive subgrade soil and recommend that proof rolling not be attempted without qualified geotechnical engineer. Areas that appear to be too wet and soft to support proof rolling equipment or are too small to accommodate construction vehicles should be evaluated by probing. Prepared subgrade will be considered subgrade that has been approved by the geotechnical engineer and repaired where necessary.

7.3 SUBGRADE PROTECTION

The on-site soil will provide poor support for construction traffic. If not carefully executed, site preparation, utility trench work, and roadway excavation can create extensive soft areas and significant repair costs can result. Earthwork planning, regardless of the time of year, should include considerations for minimizing subgrade disturbance. To the extent possible, we recommend keeping the existing AC in place to assist in protecting the subgrade. We also recommend that construction equipment not traffic the prepared subgrade.

We note that the aggregate base thickness for pavement areas is intended to support post-construction design traffic loads and is not intended to support construction traffic. Generally, a 12- to 18-inch-thick granular pad is sufficient for light staging areas but is not expected to be adequate to support heavy equipment or truck traffic for haul roads and areas with repeated heavy construction. In our experience, an 18- to 24-inch-thick section should be adequate. The actual thickness of haul roads and staging areas should be based on the contractor's approach

to site development and the amount and type of construction traffic. Consequently, the contractor should be responsible for selecting the locations of staging areas and haul roads and selecting the appropriate thickness of granular material for these areas.

The imported granular material should be placed in one lift over the prepared, undisturbed subgrade and compacted using a smooth drum roller without the use of vibratory action. In addition, a geotextile fabric can be placed as a barrier between the subgrade and granular material in areas of repeated construction traffic, if required. The granular material and geotextile should meet the specifications for imported granular material in the "Pavement Materials" section.

8.0 OBSERVATION OF CONSTRUCTION

Satisfactory earthwork and pavement performance depend to a large degree on the quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to determine if subsurface conditions change significantly from those anticipated.

9.0 LIMITATIONS

We have prepared this report for use by D.P. Nicoli, Inc. for the proposed project. The report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other sites.

Exploration observations indicate soil conditions and pavement conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata, pavement, or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in this report for consideration in design.

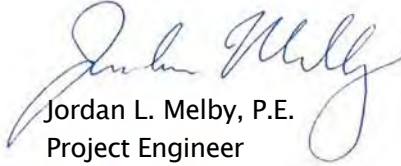
Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time this report was prepared. No warranty, express or implied, should be understood.

◆ ◆ ◆

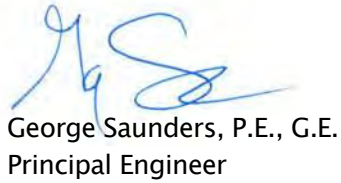
We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

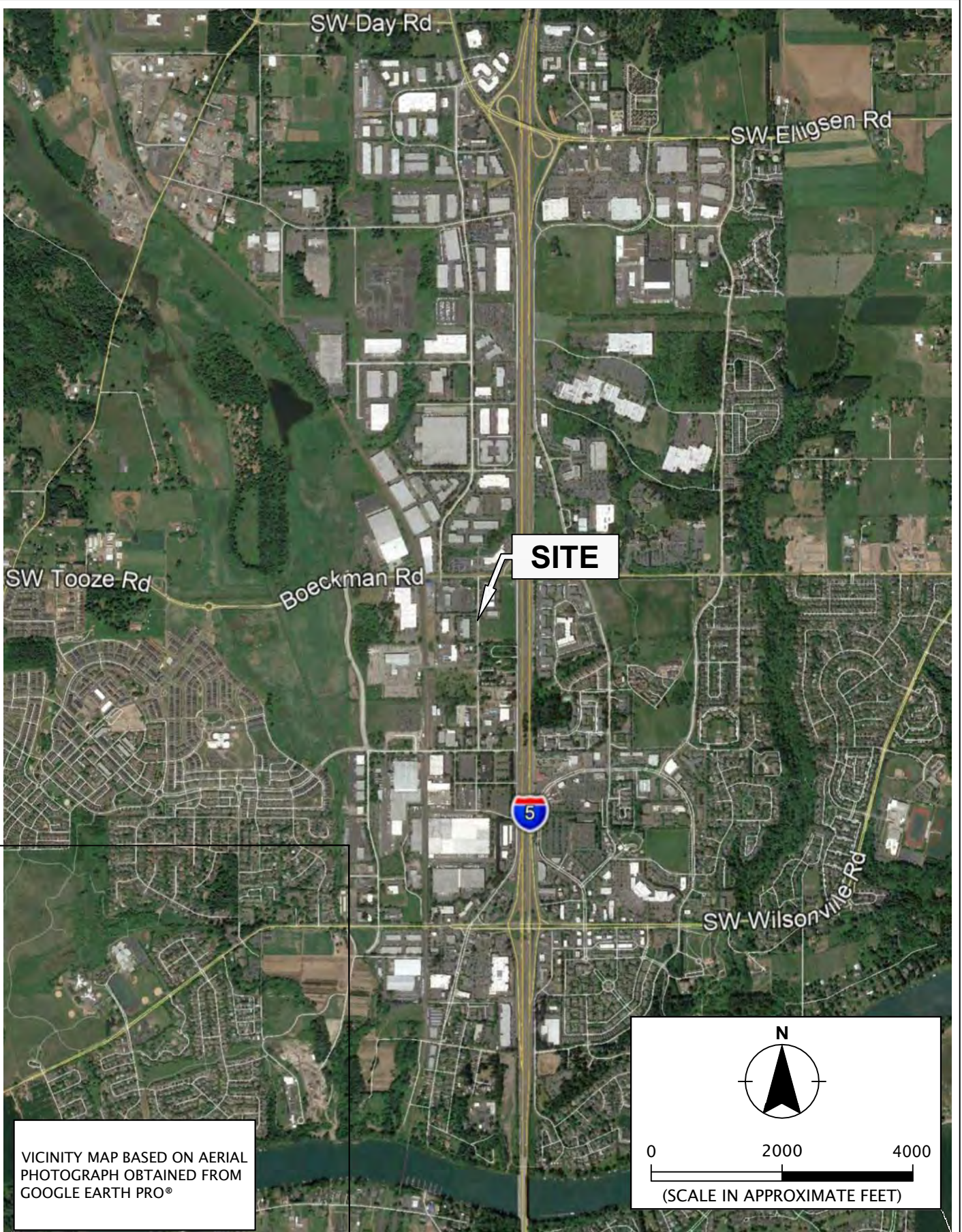

Jordan L. Melby, P.E.
Project Engineer


Krey D. Younger, P.E., G.E.
Senior Associate Engineer


George Saunders, P.E., G.E.
Principal Engineer

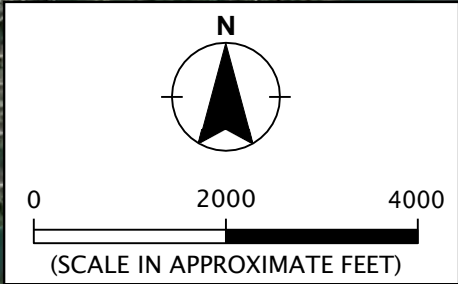


FIGURES



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 File Name: J:\A-D\DPNICOLI\DPNICOLI-5\DPNICOLI-5-02\Figures\CAD\DPNICOLI-5-02-VM01.dwg | Layout: FIGURE 1

VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®



GEODESIGN INC
 AN **NIVIS** COMPANY

DPNICOLI-5-02

APRIL 2020

VICINITY MAP

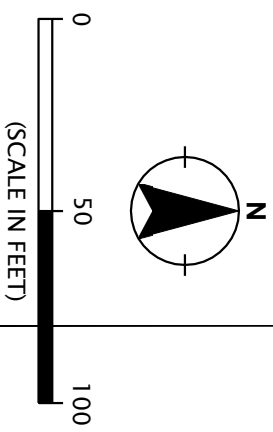
INDUSTRIAL FOCUS - PHASE 1
 WILSONVILLE, OR

FIGURE 1




LEGEND:

C-1  PAVEMENT CORE BORING



SITE PLAN BASED ON AERIAL PHOTOGRAPH
 OBTAINED FROM GOOGLE EARTH PRO®,
 MARCH 3, 2020

 AN NIVIS COMPANY	DPNICOLI-5-02	SITE PLAN	
	APRIL 2020	INDUSTRIAL FOCUS - PHASE 1 WILSONVILLE, OR	FIGURE 2

APPENDIX A

APPENDIX A

FIELD EXPLORATION DATA

GENERAL

We explored the existing pavement conditions along the roadway by drilling three pavement borings (C-1 through C-3). The locations of these borings are shown on Figure 2. The borings were completed by Dan J. Fischer Excavating, Inc. of Forest Grove, Oregon, on March 6, 2020. The asphalt cores were recovered using a portable core drill with a 5-inch-diameter, diamond core barrel, and the borings were advanced with a 4-inch-diameter, solid-stem auger. The borings were filled with polymer-modified cold-patch asphalt. The exploration logs are presented in this appendix.

SOIL SAMPLING

A member of our geotechnical staff observed the explorations. We collected representative samples of the various soils encountered in the borings for geotechnical evaluation. Samples were collected from the borings using 1½-inch-inside diameter, split-spoon sampler (SPT). The split-spoon sampling was conducted in general accordance with ASTM D1586. The split-spoon samplers were driven into the soil with a 140-pound hammer free-falling 30 inches. The samplers were driven a total distance of 18 inches. The number of blows required to drive the sampler the final 12 inches is recorded in the exploration logs, unless otherwise noted. Representative grab samples of the soil were collected from the auger cuttings. Sampling methods and intervals are shown on the exploration logs.

The SPTs completed by Dan J. Fischer Excavating, Inc. were conducted using two wraps around the cathead.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the “Exploration Key” (Table A-1) and “Soil Classification System” (Table A-2), which are presented in this appendix. The exploration logs indicate the depths at which the soil or its characteristics change, although the change actually could be gradual. Classifications are shown on the exploration logs.

LABORATORY TESTING

MOISTURE CONTENT










We tested the natural moisture content of select soil samples in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to the weight of soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

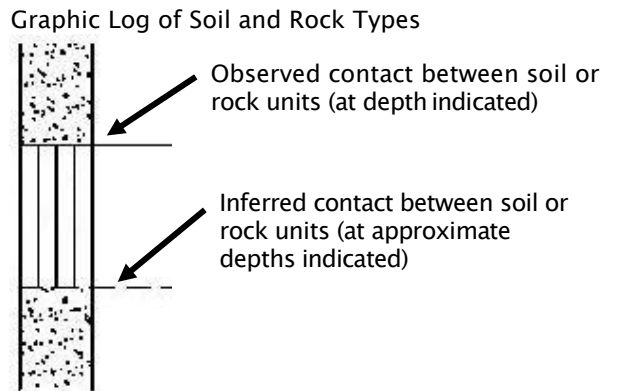
PARTICLE-SIZE ANALYSIS

We completed particle-size analysis on a select soil sample in general accordance with ASTM D1140. This test determines the weight of soil particles that pass the U.S. Standard No. 200 sieve expressed as a percentage of the dry weight of the sample. The test results are presented in this appendix.

ATTERBERG LIMITS TESTING

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

SYMBOL	SAMPLING DESCRIPTION
	Location of sample collected in general accordance with ASTM D1586 using Standard Penetration Test with recovery
	Location of sample collected using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D1587 with recovery
	Location of sample collected using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample collected using Dames & Moore sampler and 140-pound hammer or pushed with recovery
	Location of sample collected using 3-inch-O.D. California split-spoon sampler and 140-pound hammer with recovery
	Location of grab sample
	Rock coring interval
	Water level during drilling
	Water level taken on date shown




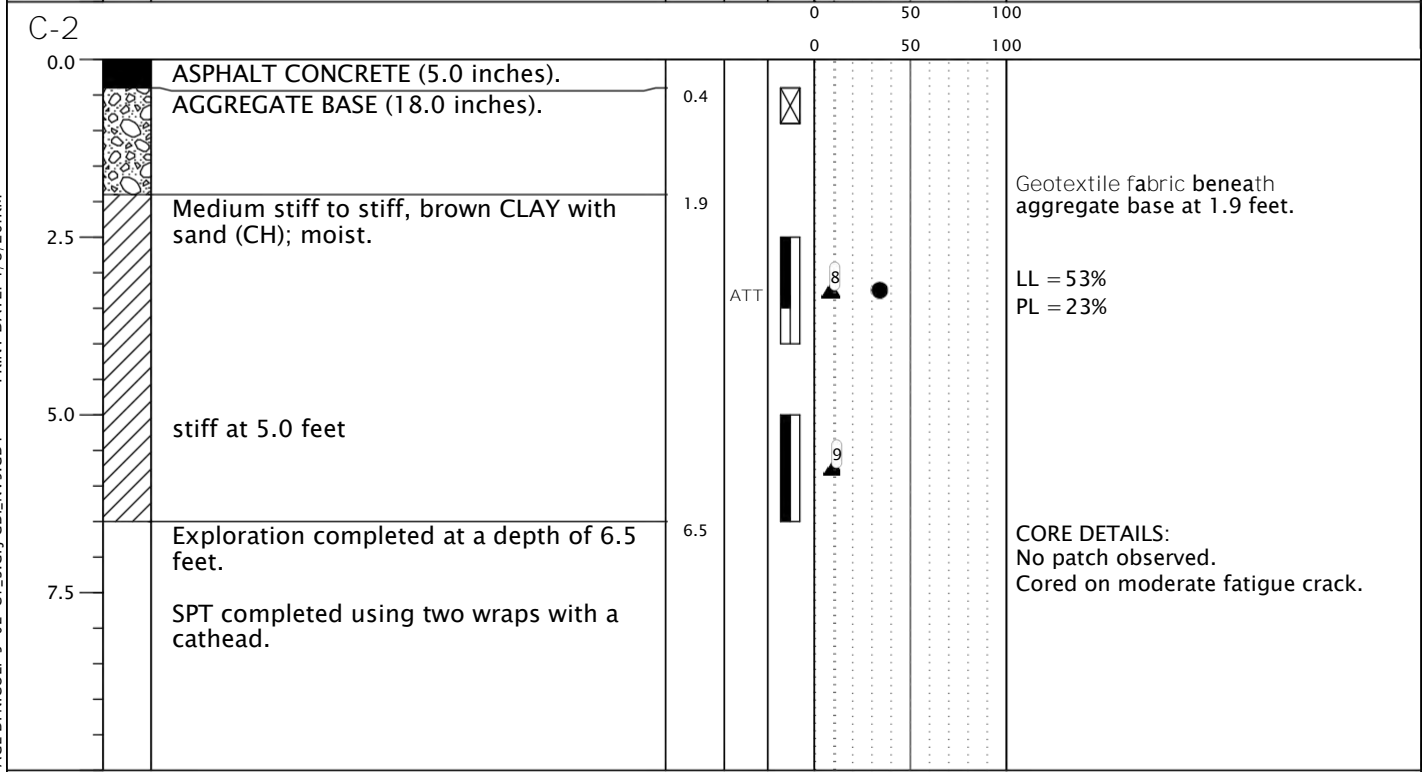
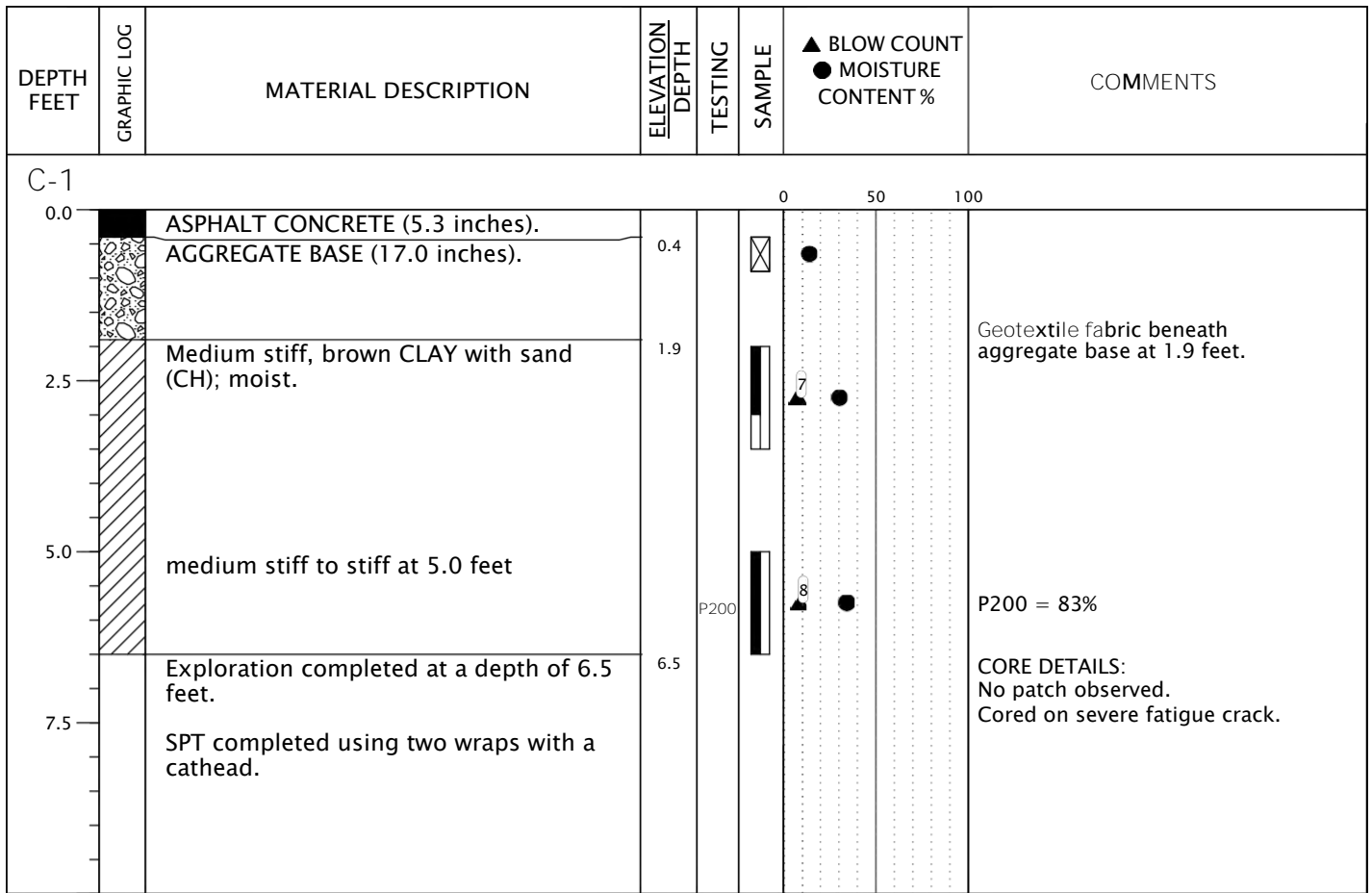
GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	P	Pushed Sample
CBR	California Bearing Ratio	PP	Pocket Penetrometer
CON	Consolidation	P200	Percent Passing U.S. Standard No. 200 Sieve
DD	Dry Density	RES	Resilient Modulus
DS	Direct Shear	SIEV	Sieve Gradation
HYD	Hydrometer Gradation	TOR	Torrane
MC	Moisture Content	UC	Unconfined Compressive Strength
MD	Moisture-Density Relationship	VS	Vane Shear
NP	Non-Plastic	kPa	Kilopascal
OC	Organic Content		

ENVIRONMENTAL TESTING EXPLANATIONS

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

RELATIVE DENSITY - COARSE-GRAINED SOIL									
Relative Density		Standard Penetration Resistance		Dames & Moore Sampler (140-pound hammer)		Dames & Moore Sampler (300-pound hammer)			
Very Loose		0 - 4		0 - 11		0 - 4			
Loose		4 - 10		11 - 26		4 - 10			
Medium Dense		10 - 30		26 - 74		10 - 30			
Dense		30 - 50		74 - 120		30 - 47			
Very Dense		More than 50		More than 120		More than 47			
CONSISTENCY - FINE-GRAINED SOIL									
Consistency		Standard Penetration Resistance		Dames & Moore Sampler (140-pound hammer)		Dames & Moore Sampler (300-pound hammer)		Unconfined Compressive Strength (tsf)	
Very Soft		Less than 2		Less than 3		Less than 2		Less than 0.25	
Soft		2 - 4		3 - 6		2 - 5		0.25 - 0.50	
Medium Stiff		4 - 8		6 - 12		5 - 9		0.50 - 1.0	
Stiff		8 - 15		12 - 25		9 - 19		1.0 - 2.0	
Very Stiff		15 - 30		25 - 65		19 - 31		2.0 - 4.0	
Hard		More than 30		More than 65		More than 31		More than 4.0	
PRIMARY SOIL DIVISIONS					GROUP SYMBOL		GROUP NAME		
COARSE-GRAINED SOIL (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)			GW or GP		GRAVEL		
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)			GW-GM or GP-GM		GRAVEL with silt		
					GW-GC or GP-GC		GRAVEL with clay		
		GRAVEL WITH FINES (> 12% fines)			GM		silty GRAVEL		
	GC				clayey GRAVEL				
	GC-GM				silty, clayey GRAVEL				
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)			SW or SP		SAND		
		SAND WITH FINES (≥ 5% and ≤ 12% fines)			SW-SM or SP-SM		SAND with silt		
					SW-SC or SP-SC		SAND with clay		
		SAND WITH FINES (> 12% fines)			SM		silty SAND		
SC					clayey SAND				
SC-SM					silty, clayey SAND				
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50			ML		SILT		
					CL		CLAY		
					CL-ML		silty CLAY		
					OL		ORGANIC SILT or ORGANIC CLAY		
	Liquid limit 50 or greater			MH		SILT			
				CH		CLAY			
				OH		ORGANIC SILT or ORGANIC CLAY			
HIGHLY ORGANIC SOIL					PT		PEAT		
MOISTURE CLASSIFICATION			ADDITIONAL CONSTITUENTS						
Term	Field Test	Secondary granular components or other materials such as organics, man-made debris, etc.							
		Percent	Silt and Clay In:		Percent	Sand and Gravel In:			
	Fine-Grained Soil		Coarse-Grained Soil			Fine-Grained Soil	Coarse-Grained Soil		
dry	very low moisture, dry to touch	< 5	trace	trace	< 5	trace	trace		
moist	damp, without visible moisture	5 - 12	minor	with	5 - 15	minor	minor		
wet	visible free water, usually saturated	> 12	some	silty/clayey	15 - 30	with	with		
					> 30	sandy/gravelly	Indicate %		
			SOIL CLASSIFICATION SYSTEM				TABLE A-2		



BORING LOG - GDI-NV5 - 2 PER PAGE DPNICOLI-5-02-C1-3.GPJ GDI-NV5.GDT PRINT DATE: 4/8/20-KM

DRILLED BY: Dan J. Fischer Excavating, Inc.

LOGGED BY: J. Pence

COMPLETED: 03/06/20

BORING METHOD: core drill/solid-stem auger (see document text)

BORING BIT DIAMETER: 5 inches/4 inches



DPNICOLI-5-02

BORING

APRIL 2020

INDUSTRIAL FOCUS - PHASE 1
WILSONVILLE, OR

FIGURE A-1

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT %	COMMENTS
C-3 0.0		ASPHALT CONCRETE (5.3 inches). AGGREGATE BASE (17.0 inches).	0.4				
2.5		Medium stiff, brown CLAY with sand (CH); moist.	1.9				Geotextile fabric beneath aggregate base at 1.9 feet.
5.0							
6.5		Exploration completed at a depth of 6.5 feet. SPT completed using two wraps with a cathead.	6.5				CORE DETAILS: No patch observed. Cored on severe fatigue crack.
7.5							

PRINT DATE: 4/8/20:KM

BORING LOG - GDI-NV5 - 2 PER PAGE DPNICOLI-5-02-C1-3.GPJ GDI_NV5.GDT

DRILLED BY: Dan J. Fischer Excavating, Inc.

LOGGED BY: J. Pence

COMPLETED: 03/06/20

BORING METHOD: core drill/solid-stem auger (see document text)

BORING BIT DIAMETER: 5 inches/4 inches

DPNICOLI-5-02

BORING
(continued)

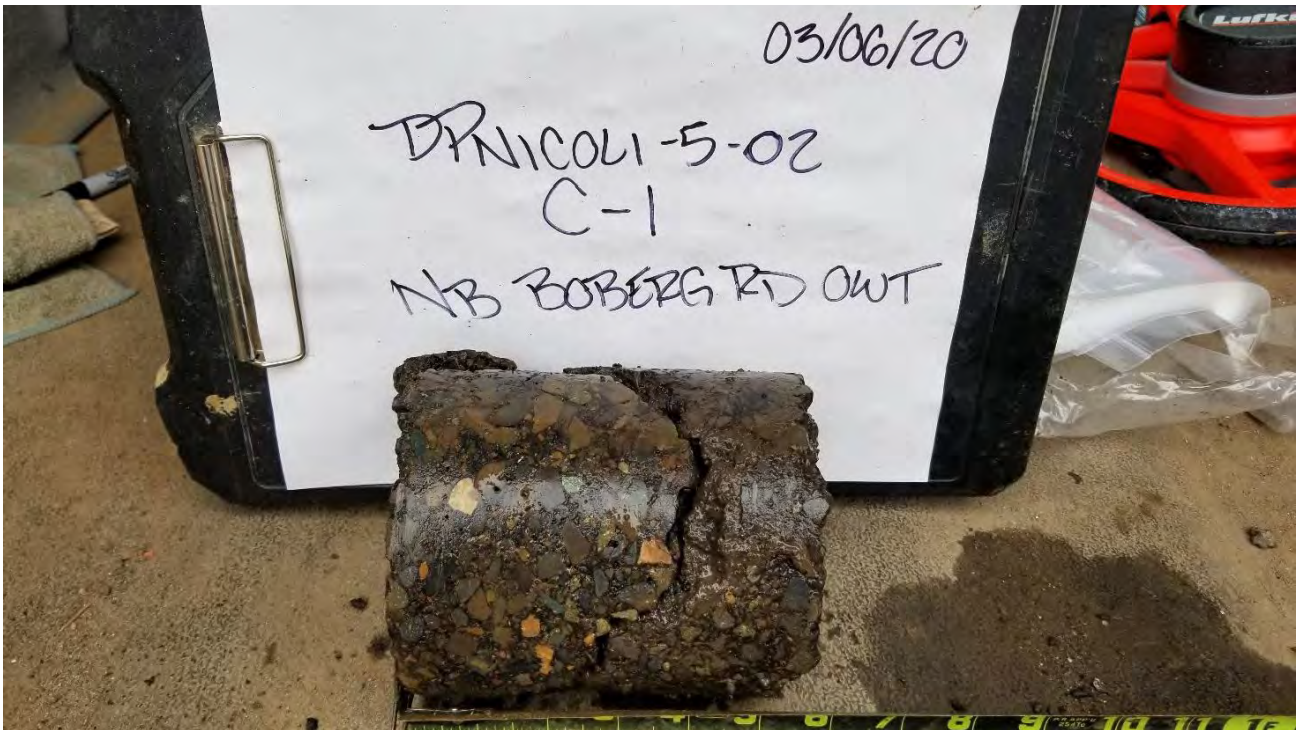
APRIL 2020

INDUSTRIAL FOCUS - PHASE 1
WILSONVILLE, OR

FIGURE A-2



CORE LOCATION C-1.

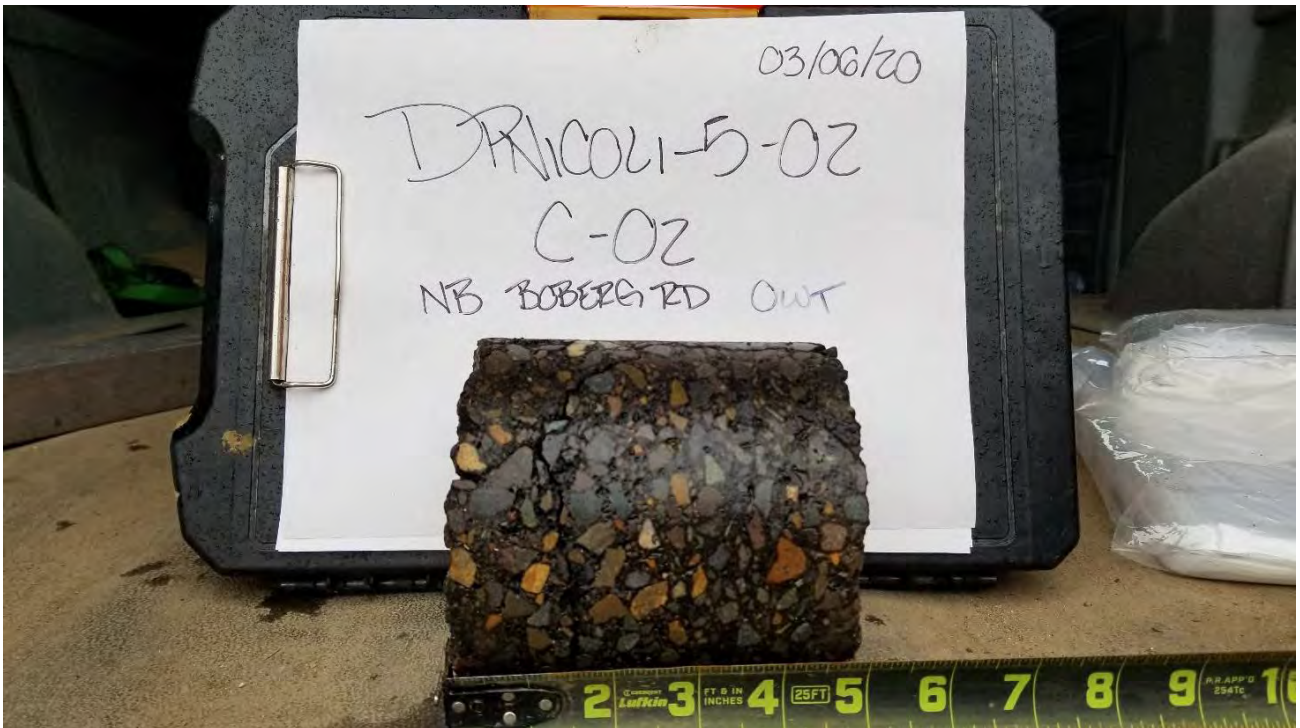


CORE C-1.

DPNICOLI-5-02-FA3_A5-CPH.docx Print Date: 4/3/20



CORE LOCATION C-2.



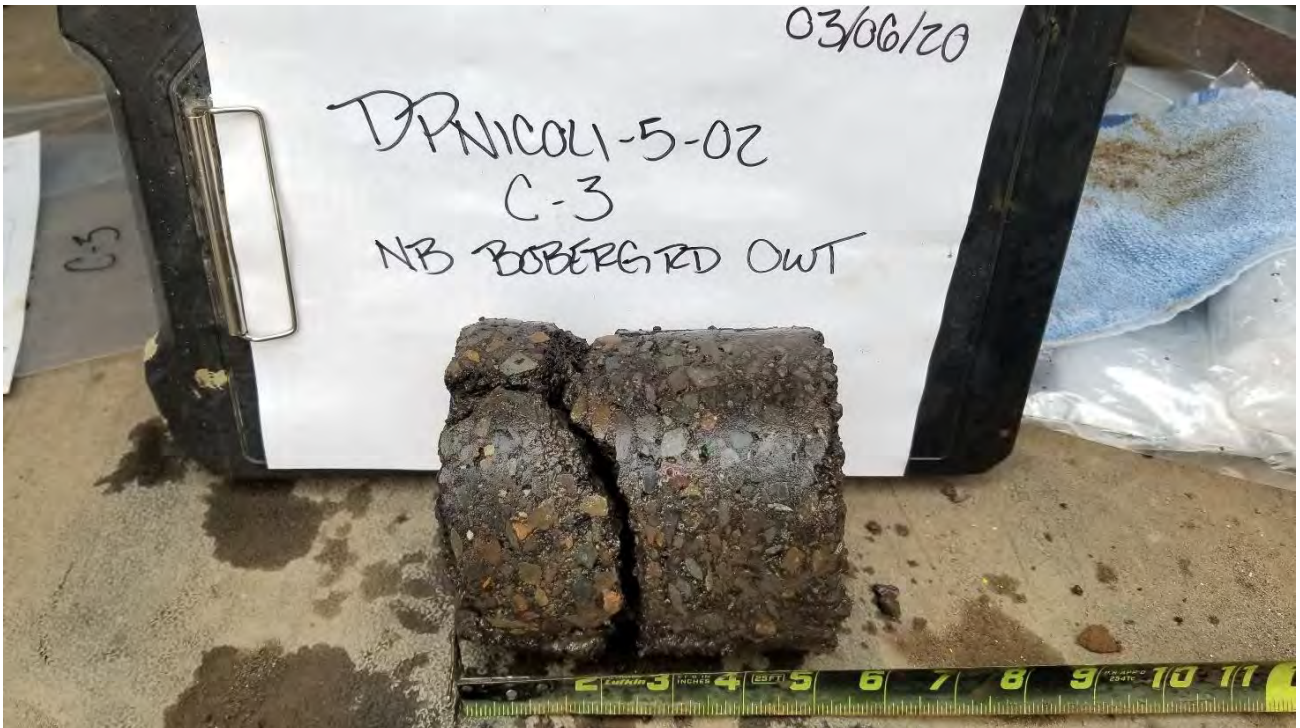
CORE C-2.

DPNICOLI-5-02-FA3_A5-CPH.docx Print Date: 4/3/20

	DPNICOLI-5-02	CORE LOCATION AND CORE PHOTOGRAPHS	
	APRIL 2020	INDUSTRIAL FOCUS - PHASE 1 WILSONVILLE, OR	FIGURE A-4



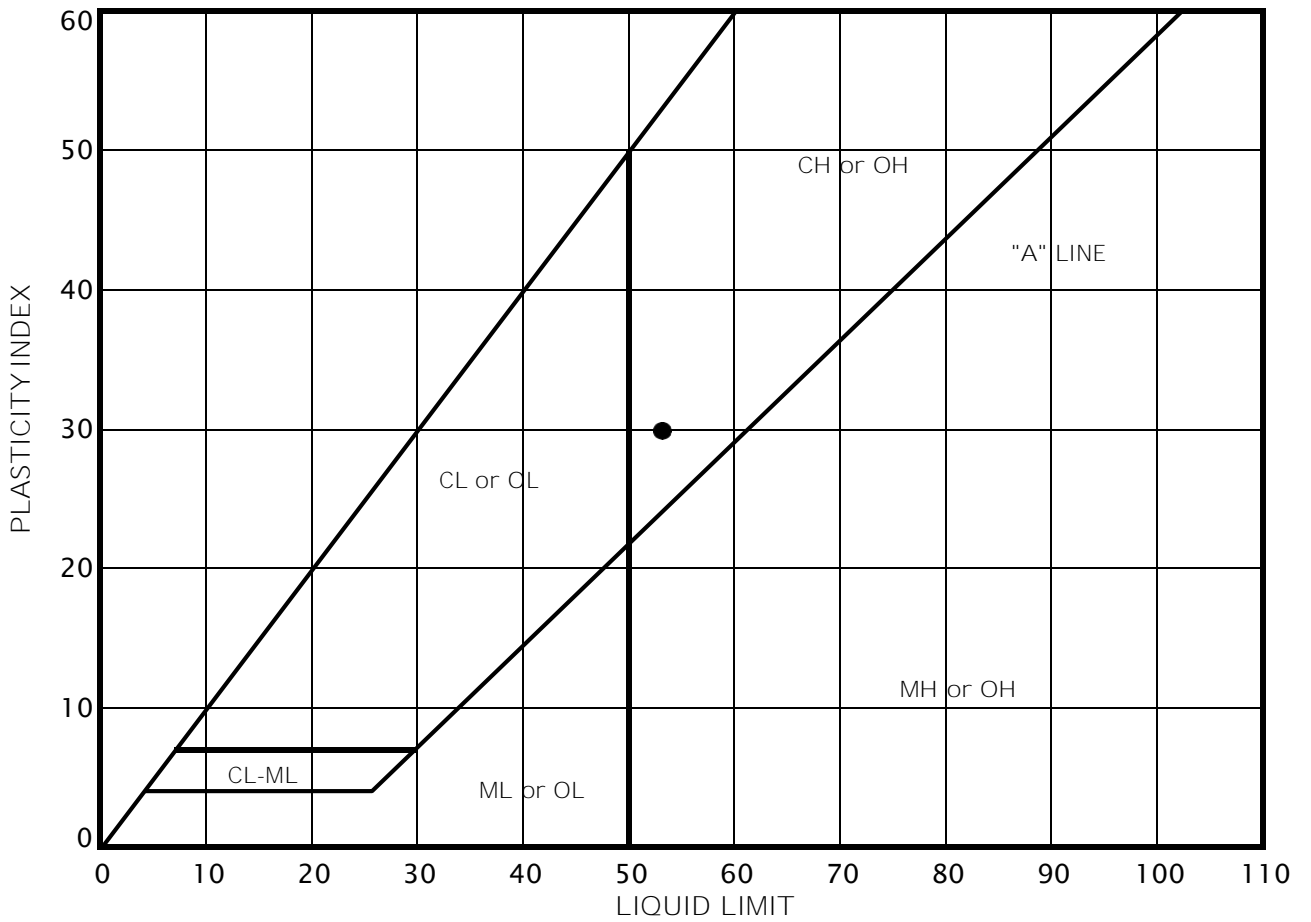
CORE LOCATION C-3.



CORE C-3.

DPNICOLI-5-02-FA3_A5-CPH.docx Print Date: 4/3/20

ATTERBERG_LIMITS 7 DPNICOLI-5-02-C1_3.GPJ GEODESIGN.GDT PRINT DATE: 4/7/20:KM



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	C-2	2.5	34	53	23	30



DPNICOLI-5-02

ATTERBERG LIMITS TEST RESULTS


APRIL 2020

INDUSTRIAL FOCUS - PHASE 1
WILSONVILLE, OR

FIGURE A-6

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
C-1	0.4		14							
C-1	2.0		30							
C-1	5.0		34			83				
C-2	2.5		34				53	23	30	
C-3	0.4		18							
C-3	5.0		34							

LAB SUMMARY - GDI-NV5 DPNICOLI-5-02-C1_3.CPJ GDI_NV5_GDT PRINT DATE: 4/7/20:KM

	DPNICOLI-5-02	SUMMARY OF LABORATORY DATA		
	APRIL 2020	INDUSTRIAL FOCUS - PHASE 1 WILSONVILLE, OR		FIGURE A-7

APPENDIX B

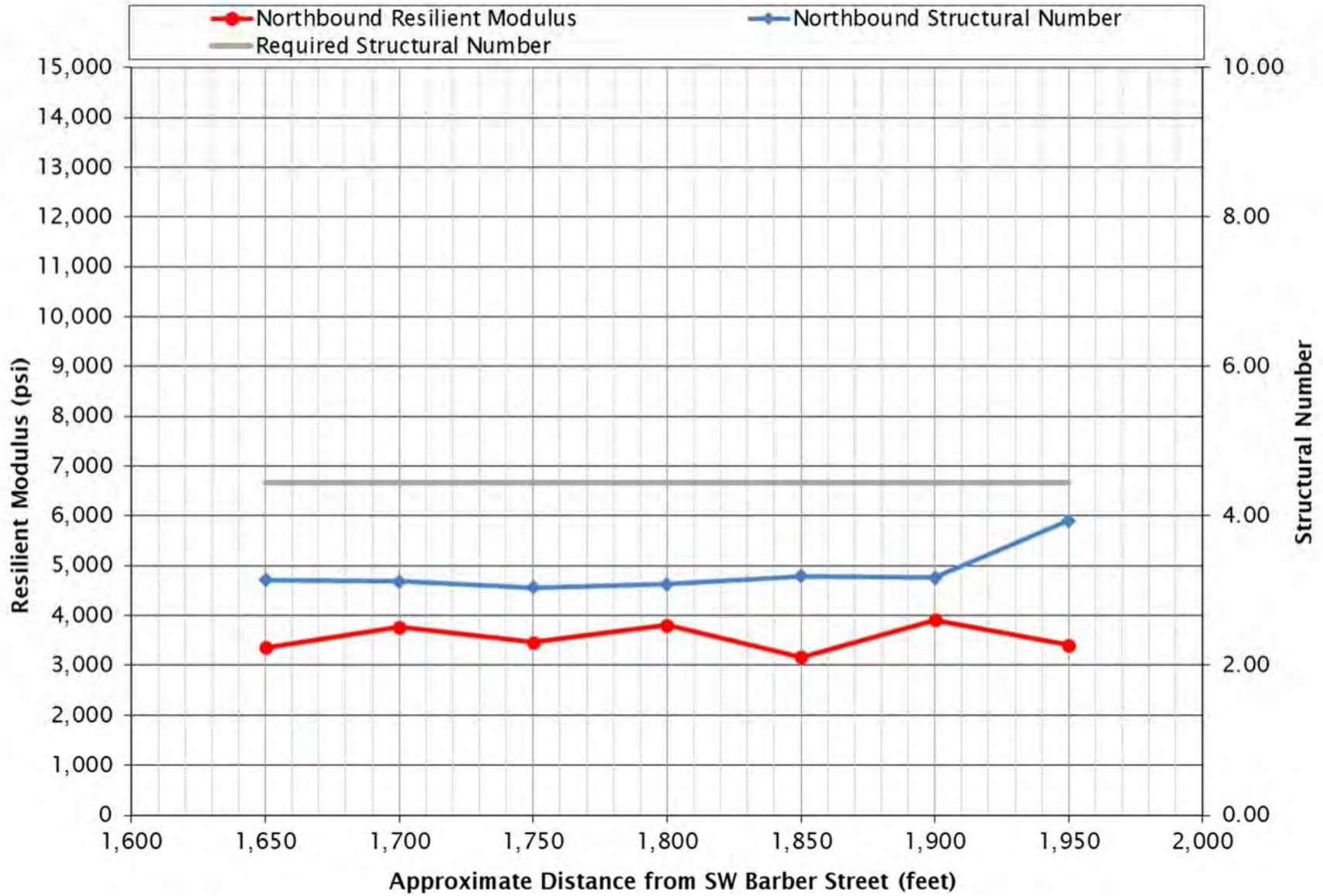
APPENDIX B

FWD DATA

FWD testing was completed on March 6, 2020. FWD test locations were correlated to the distance from SW Barber Street. Tests were performed in accordance with ASTM D4695 using a Level II testing effort, as described by the ASTM method. Testing was completed using a JILS 20 FWD trailer.

FWD test data, normalized to a 9,000-pound load, were used to back-calculate values for subgrade resilient modulus using an adjustment factor of 0.33 as per AASHTO guide recommendations in Part III, Chapter 5, Section 5.3.4. From these, the design value was computed as the average result along the design section.

The FWD test data and back-calculated results are presented in this appendix. Back-calculated subgrade moduli and pavement effective structural numbers at each test station are listed in the following table and displayed graphically in the following chart.



DPNICOLI-5-02

APRIL 2020

FWD RESULTS

INDUSTRIAL FOCUS - PHASE 1
WILSONVILLE, OR

FIGURE B-1

**TABLE B-1
FWD Results
Boberg
Wilsonville, Oregon**

Approximate Distance from SW Barber Street (feet)	Lane	Load (pounds)	Surface Temperature (degrees Fahrenheit)	Normalized Deflections (mils)									Back-Calculated Subgrade Resilient Modulus (psi)	Back-Calculated Effective Pavement Modulus (psi)	Back-Calculated Effective Structural Number
				D0	D8	D12	D18	D24	D36	D48	D60	D72			
1,650	Northbound	9,000	49.9	26.23	22.80	18.34	13.31	9.38	5.84	4.28	3.58	0.04	3,358	31,971	3.14
1,700	Northbound	9,000	50.8	25.82	21.65	16.70	12.08	8.35	5.08	4.04	3.44	0.01	3,772	31,405	3.12
1,750	Northbound	9,000	53.4	28.57	20.97	17.24	12.97	9.11	4.51	3.29	3.15	0.01	3,458	28,943	3.04
1,800	Northbound	9,000	51.6	26.54	24.72	20.68	14.63	10.73	5.52	3.92	3.28	0.01	3,802	30,350	3.09
1,850	Northbound	9,000	52.2	26.25	23.64	19.84	15.69	11.82	6.63	4.40	3.47	0.01	3,168	33,536	3.19
1,900	Northbound	9,000	50.7	24.64	21.56	17.47	13.29	9.61	5.37	4.10	3.07	0.01	3,911	33,026	3.18
1,950	Northbound	9,000	51.5	16.88	15.87	13.87	11.38	9.27	6.18	4.33	3.15	1.98	3,401	63,028	3.94

APPENDIX C

APPENDIX C

ESAL CALCULATIONS

TABLE C-1
ESAL Calculations: Boberg, 100 Feet South of Boeckman Road
Traffic volumes according to information provided by Quality Counts, LLC and DKS Associates.

Year of Traffic Count	2019	Pavement Type	Flexible
Average Daily Traffic	3,300	Construction Year¹	2020
One-way or Two-way	Two-way	Lane Distribution Factor	100
Compound Growth Rate (%)	1.20	Percent Heavy Trucks	14.0

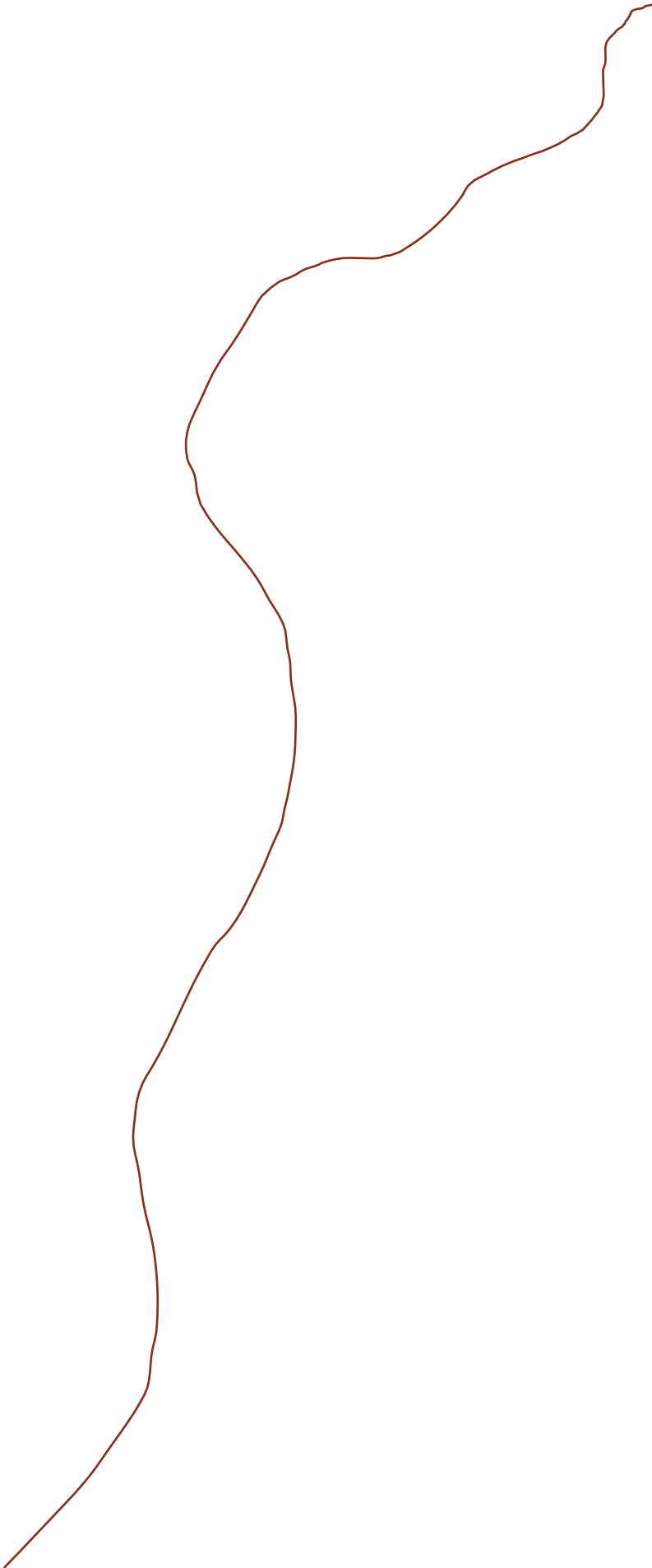
¹Assumes pavement put into service in the following year

FHWA Classification	Average Daily Traffic by Classification in 2019	Conversion Factor²	ESALs in 2019	
4	43	135.3	5,818	
5	333	57.2	19,048	
6	18	156.2	2,812	
7	3	416.4	1,249	
8	43	139.2	5,983	
9	14	256.3	3,588	
10	4	308.6	1,234	
11	0	331.7	0	
12	0	300.3	0	
13	3	570.4	1,711	
² Directional Factor = 55 percent			Total ESALs in 2019	41,443
			ESALs in Construction Year (2020)	41,940

Year	ESALs	Cumulative ESALs³	Year	ESALs	Cumulative ESALs³
2021 (1)	42,444	84,384	2046 (26)	57,191	1,328,053
2022 (2)	42,953	127,337	2047 (27)	57,877	1,385,930
2023 (3)	43,468	170,805	2048 (28)	58,572	1,444,502
2024 (4)	43,990	214,795	2049 (29)	59,274	1,503,776
2025 (5)	44,518	259,313	2050 (30)	59,986	1,563,762
2026 (6)	45,052	304,365	2051 (31)	60,706	1,624,467
2027 (7)	45,593	349,958	2052 (32)	61,434	1,685,901
2028 (8)	46,140	396,098	2053 (33)	62,171	1,748,073
2029 (9)	46,694	442,792	2054 (34)	62,917	1,810,990
2030 (10)	47,254	490,046	2055 (35)	63,672	1,874,662
2031 (11)	47,821	537,866	2056 (36)	64,436	1,939,098
2032 (12)	48,395	586,261	2057 (37)	65,210	2,004,308
2033 (13)	48,976	635,237	2058 (38)	65,992	2,070,300
2034 (14)	49,563	684,800	2059 (39)	66,784	2,137,084
2035 (15)	50,158	734,958	2060 (40)	67,585	2,204,669
2036 (16)	50,760	785,718	2061 (41)	68,396	2,273,066
2037 (17)	51,369	837,087	2062 (42)	69,217	2,342,283
2038 (18)	51,985	889,072	2063 (43)	70,048	2,412,331
2039 (19)	52,609	941,681	2064 (44)	70,888	2,483,219
2040 (20)	53,241	994,922	2065 (45)	71,739	2,554,958
2041 (21)	53,879	1,048,801	2066 (46)	72,600	2,627,558
2042 (22)	54,526	1,103,327	2067 (47)	73,471	2,701,029
2043 (23)	55,180	1,158,508	2068 (48)	74,353	2,775,382
2044 (24)	55,842	1,214,350	2069 (49)	75,245	2,850,627
2045 (25)	56,513	1,270,863	2070 (50)	76,148	2,926,774

³Includes ESALs in construction year as per method in ODOT Pavement Design Guide

2-Year ESALs	15-Year ESALs	20-Year ESALs	30-Year ESALs	40-Year ESALs	50-Year ESALs
85,000	693,000	953,000	1,522,000	2,163,000	2,885,000



REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Wilsonville Facilities
Tax Lots 300 and 500
Wilsonville, Oregon

For
D.P. Nicoli, Inc.
November 14, 2018

GeoDesign Project: DPNicoli-5-01

November 14, 2018

D.P. Nicoli, Inc.
PO Box 2401
Lake Oswego, OR 97035

Attention: Stephanie Nanna and Dave Nicoli

Report of Geotechnical Engineering Services

Wilsonville Facilities
Tax Lots 300 and 500
Wilsonville, Oregon
GeoDesignProject: DPNicoli-5-01

GeoDesign, Inc. is pleased to submit this report of geotechnical engineering services for the proposed development, which includes Tax Lots 300 and 500 of Clackamas County Tax Map 3S1W14A in Wilsonville, Oregon. Our services for this project were conducted in accordance with our proposal dated August 27, 2018.

We appreciate the opportunity to be of service to you. Please call if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.



George Saunders, P.E., G.E.
Principal Engineer

cc: Tara Lund, CIDA, Inc. (via email only)
Craig Harris, AAI Engineering (via email only)

JLM:TVS:GPS:kt

Attachments

One copy submitted (via email only)

Document ID: DPNicoli-5-01-111418-geor.docx

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EXECUTIVE SUMMARY

In our opinion, the site can be developed as we have identified in the “Project Understanding” section provided the recommendations in this report are incorporated into design and implemented during construction. This summary is an overview and the report should be referenced for a more thorough discussion of the subsurface conditions and geotechnical recommendations for the project. The following factors will have an impact on design and construction of the proposed development:

- A formal grading plan had not been developed by the time of this report; however, preliminary estimates are that cuts and fills will likely be in the 3- to 5-foot range.
- Assuming the distributed floor slab live loads, foundation loads, and the preliminary finished floor grade provided in this report, our analysis indicates that post-construction settlements will be within typical structural tolerances and the proposed structures can be supported by conventional shallow foundations.
- The footings should bear on granular pads underlain by firm, undisturbed native soil or on structural fill overlying firm, undisturbed native soil. Excavations up to 2.0 feet BGS may be required to remove disturbed native soil or undocumented fill material from the influence zones of footings.
- The site was previously used for agricultural purposes. Consequently, a tilled zone is present at the ground surface. We recommend that subgrade for floor slabs and pavements be improved as described in the “Site Preparation” section.
- The fine-grained soil at the site is sensitive to small changes in moisture content and difficult, if not impossible, to adequately compact during wet weather or when the moisture content of the soil is more than a couple percent above the optimum moisture content required for compaction.

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ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ACI	American Concrete Institute
ACP	asphalt concrete pavement
ADTT	average daily truck traffic
ASTM	American Society for Testing and Materials
BGS	below ground surface
CBR	California Bearing Ratio
DCP	dynamic cone penetrometer
ESAL	equivalent single-axle load
FHWA	Federal Highway Administration
g	gravitational acceleration (32.2 feet/second ²)
H:V	horizontal to vertical
IBC	International Building Code
MCE	maximum considered earthquake
NA	not applicable
ODOT	Oregon Department of Transportation
OSHA	Occupational Safety and Health Administration
OSSC	Oregon Standard Specifications for Construction (2018)
PCC	portland cement concrete
pcf	pounds per cubic foot
pci	pounds per cubic inch
psi	pounds per square inch
PG	performance grade
psf	pounds per square foot
SOSSC	State of Oregon Structural Specialty Code
SPT	standard penetration test
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

GeoDesign, Inc. is pleased to submit this report providing geotechnical engineering recommendations for use in design and construction of the proposed development, which includes Tax Lots 300 and 500 of Clackamas County Tax Map 3S1W14A in Wilsonville, Oregon. Figure 1 shows the site relative to existing topographic and physical features. Figure 2 shows the proposed site layout and the approximate locations of our explorations. Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

2.0 PROJECT UNDERSTANDING

The proposed development consists of two parcels that are oriented north and south of each other and located south of SW Boeckman Road between SW Boberg Road and SW Boones Ferry Road. The north and south parcels encompass 2.09 and 4.07 acres, respectively. We understand that three industrial facilities are proposed to be constructed with loading docks and surrounding paved driveways and parking areas. The preliminary site plan indicates that the buildings are 22,000, 30,000, and 32,250 square feet. We understand that, initially, only one or two buildings will be constructed and the undeveloped area will be used as a yard for storing shoring elements.

It is our understanding that the buildings will be concrete tilt-up structures. Column and wall loads were not provided at the time of this report. Based on our experience with similar structures, we anticipate maximum column and wall loads to be less than 150 kips and 5 kips per lineal foot, respectively. We anticipate floor slab loads will be less than 300 psf.

Based on preliminary grading estimates from Craig Harris of AAI Engineering, we understand that cuts and fills are expected to be less than 3 to 5 feet.

3.0 PURPOSE AND SCOPE

The purpose of our services was to explore subsurface conditions at the site and provide geotechnical engineering recommendations for design and construction of the proposed facilities. Specifically, we completed the following scope of services:

- Reviewed readily available geologic maps and our in-house files for existing information on subsurface conditions in the site vicinity, including review of our previous explorations at nearby surrounding sites.
- Coordinated and managed the field explorations, including utility locates and scheduling subcontractors and GeoDesign field staff.
- Conducted the following explorations:
 - Five borings within the proposed building areas to a depth of 21.5 feet BGS.
 - Two borings at the site to a depth of 31.5 feet BGS.
- Classified the material encountered in the explorations and maintained a detailed log of each exploration.
- Collected disturbed and undisturbed soil samples for laboratory testing at select depths from the explorations.

- Performed one field infiltration test in one boring at a depth 5.5 feet BGS.
- Performed DCP testing at all boring locations.
- Performed the following laboratory tests on select samples collected from the explorations:
 - Twenty-three natural moisture content determinations
 - Three particle-size analyses
 - One Atterberg limits test
 - One consolidation test to evaluate soil compressibility
- Provided recommendations for site preparation, grading and drainage, stripping depths, fill type for imported material, compaction criteria, trench excavation and backfill, use of on-site soil, and wet/dry weather earthwork.
- Provided recommendations for design and construction of shallow spread foundations, including allowable design bearing pressure, minimum footing depth and width, passive resistance capacity, and coefficient of friction.
- Provided recommendations for preparation of floor slab subgrade.
- Provided design criteria recommendations for retaining walls, including lateral earth pressures, backfill, compaction, and drainage.
- Provided infiltration test results and recommendations for design infiltration rates.
- Provided recommendations for the management of identified groundwater conditions that may affect the performance of structures.
- Provided design and construction recommendations for on-site pavement for access roads, parking areas, and the storage yard for shoring elements. Our design recommendations include the following:
 - Standard pavement sections consisting of AC supported on aggregate base
 - Pavement sections consisting of AC supported on cement-amended soil for access roads and parking areas
 - Pavement sections with surfacing that consists of gravel, AC, or PCC for the storage yard (underlain with aggregate base for the AC and PCC options)
 - Pavement sections of gravel, AC, or PCC on cement-amended soil
- Provided recommendations for subsurface drainage of foundations and pavements.
- Provided recommendations for IBC seismic coefficients and provided a discussion of potential geologic hazards at the site.
- Provided this report summarizing the results of our geotechnical evaluation.

4.0 SITE CONDITIONS

4.1 SURFACE CONDITIONS

The proposed development includes Tax Lots 300 and 500 of Clackamas County Tax Map 3S1W14A and encompasses a cumulative 6.16 acres of vacant land. Based on historical aerial photographs in our project files, between at least the early 1900s and 2005 the site was used for agricultural purposes and a tilled (cultivated) zone is anticipated at the ground surface. The properties gradually slope from north to the south. In general, the surrounding properties of the site are industrial. At the time of our explorations, standing water was not observed at the ground surface of the site.

4.2 SUBSURFACE CONDITIONS

4.2.1 General

Our knowledge of subsurface conditions at the site is based on drilling seven borings (B-1 through B-7). The borings were drilled using mud rotary methods to depths between 21.5 and 31.5 feet BGS. The top 5 feet of boring B-4 was drilled using a 4-inch-diameter hollow-stem auger to facilitate infiltration testing. Figure 2 shows the approximate exploration locations. The exploration logs and laboratory test results are presented in Appendix A.

Based on historical aerial photographs in our project files, between at least the early 1900s and 2005 the site was used for agricultural purposes and a tilled (cultivated) zone is anticipated at the ground surface. In general, the subsurface conditions consist of silt underlain by layers of gravel, clay, and sand. The following sections provide a summary of the soil units encountered.

4.2.2 Silt

Silt was encountered in all of borings from the ground surface to depths between 14 and 18 feet BGS. Root zones encountered in our borings vary between 3 and 4 inches thick. In most cases, the root zone includes fine roots and rootlets up to ¼-inch diameter. Based on SPT blow counts, the silt is medium stiff to stiff near the ground surface and is very soft to soft at depths between 7 and 18 feet BGS in borings B-1 through B-6. Medium stiff conditions were observed throughout the surficial silt layer in boring B-7. A layer of medium stiff silt was observed between depths of 23 and 28 feet BGS in boring B-1. Laboratory testing of select samples indicates the silt had in-place moisture contents between 26 and 42 percent at the time of our explorations and moderate to high compressibility.

4.2.3 Gravel

Gravel with varying sand and silt content was encountered beneath the silt at depths between 14 and 18 feet BGS in borings B-1 and B-4 through B-6. Based on SPT blow counts, the gravel is medium dense to dense. Laboratory testing of select samples indicates the gravel unit had in-place moisture contents between 15 and 27 percent at the time of our explorations.

4.2.4 Fat Clay

In general, we encountered fat clay beneath the silt and gravel layers at depths between 17 and 18.5 feet BGS in borings B-1 through B-5. A deeper second layer of clay was encountered in boring B-4 between depths of 25.5 and 29 feet BGS. Based on SPT blow counts, the clay is medium stiff to stiff and varies in sand content. Laboratory testing of select samples indicates the fat clay had in-place moisture contents between 38 and 44 percent at the time of our explorations.

4.2.5 Sand

We encountered layers of sand with silt at depths extending between 24 and 31.5 feet BGS in borings B-1 and B-4. We also encountered a layer of sand with silt and gravel at a depth of 15 feet BGS in boring B-7. Based on SPT blow counts, the sand is primarily medium dense. One of the two layers of sand with silt encountered in boring B-4 is loose. Field observations indicated the sand layers were moist at the time of our explorations.

4.2.6 Groundwater

Groundwater could not be measured directly in the mud rotary borings due to the presence of drilling fluid and groundwater was not encountered during the initial 5 feet of drilling of B-4 using hollow-stem drilling methods. Drill logs available from the Oregon Water Resources Department webpage indicated that groundwater is encountered at depths of 10 to 15 feet BGS at sites in the general vicinity of the subject site. Based on our experience in the area, groundwater may rise to within approximately 5 to 7 feet BGS following prolonged winter wet weather and shallower perched water should be expected. The depth to groundwater may fluctuate in response to seasonal changes, water levels in nearby bodies of water, changes in surface topography, and other factors not observed in this study.

4.3 DCP TESTING

We performed DCP testing at each boring location on September 4 and 5, 2018. Approximate locations of the tests are shown on Figure 2. Details of our test program and plots of the summarized data are presented in Appendix B. A summary of the estimated subgrade resilient modulus at each test location is presented in Table 1.

Table 1. DCP Test Results

Boring Number	Estimated Resilient Modulus (psi)
B-1	6,870
B-2	6,280
B-3	6,450
B-4	6,430
B-5	6,590
B-6	6,510
B-7	5,560

4.4 INFILTRATION TESTING

We completed a falling-head infiltration test in boring B-4 at a depth of 5.5 feet BGS. We saturated the underlying soil before taking measurements under low-head conditions of approximately 12 inches or less of water. Table 2 summarizes the measured infiltration rate.

Table 2. Observed Infiltration Rates

Boring	Depth (feet BGS)	Soil Type at Test Depth	Observed Infiltration Rate (inches per hour)
B-4	5.5	SILT, minor sand	0.4

The infiltration rate provided above is an unfactored measured rate with no factor of safety. We recommend a minimum factor of safety of 2 and correction factors should be applied as well by the civil engineer during design to account for the degree of long-term maintenance and influent/pre-treatment control, as well as the potential for long-term clogging due to siltation and bio-buildup, depending on the proposed length, location, and type of infiltration facility. If built,

we recommend that the installation of the stormwater basins be observed by a qualified geotechnical engineer to confirm that the soil conditions are consistent with our observations during our explorations.

4.5 GEOLOGICAL HAZARDS

4.5.1 Liquefaction and Lateral Spreading

Liquefaction is a phenomenon caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. The excessive buildup of pore water pressure results in the sudden loss of shear strength in a soil. Granular soil, which relies on inter-particle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upwards, carrying soil particles with the draining water. In general, loose, saturated sandy soil with low silt and clay content is the most susceptible to liquefaction. Thin layers of sand were encountered during the explorations; however, given thickness and/or relative density of the material, we estimate that liquefaction-induced settlement (if present) will be less than 1 inch and we do not anticipate liquefaction to be a site hazard.

Lateral spreading is a liquefaction-related seismic hazard and occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Since there are no nearby open faces, lateral spreading is not considered a hazard at the site.

4.5.2 Fault Surface Rupture

The closest mapped fault to the site is the Canby-Molalla fault. It is mapped approximately 4 miles to the east (USGS, 2018). Since faults are not mapped beneath the site, we conclude that the probability of surface fault rupture beneath the site is low.

5.0 CONCLUSIONS

In our opinion, the site can be developed as we have identified in the “Project Understanding” section provided the recommendations in this report are incorporated into design and implemented during construction. A summary of the geotechnical factors impacting the design and construction of the proposed development are provided in the “Executive Summary.” The following sections present specific recommendations for use in design and construction of the proposed development.

6.0 SITE DEVELOPMENT RECOMMENDATIONS

6.1 SITE PREPARATION

6.1.1 Grubbing and Stripping

The existing root zone should be stripped and removed from the site in all proposed building and pavement areas. Based on our explorations, the depth of stripping will be 4 inches. Greater stripping depths may be required to remove localized zones of loose or organic soil. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

6.1.2 Tilled Zone

Based on historical aerial photographs in our project files, between at least the early 1900s and 2005 the site was used for agricultural purposes and a tilled (cultivated) zone is anticipated at the ground surface. Typically, tilled zones are approximately 12 to 16 inches deep. Reliable strength properties are extremely difficult to predict for the tilled zone material. There is a high risk for poor performance of floor slabs and pavement established directly over loosened soil. To reduce the risk of settlement, we recommend the tilled zone be improved during site preparation in areas where planned cuts do not extend to the bottom of the tilled zone. Prior to fill placement and construction, the tilled zone should be improved by removing and replacing with structural fill or scarifying and re-compacting to structural fill requirements.

As discussed in the "Structural Fill" section, the native soil can be sensitive to small changes in moisture content and will be difficult, if not impossible, to compact adequately during wet weather. While scarification and compaction of the subgrade is the best option for subgrade improvement, it will likely only be possible during extended dry periods and following moisture conditioning of the soil. As discussed further on in this report, cement amendment is an option for conditioning the soil for use as structural fill during periods of wet weather or when drying the soil is not an option.

6.1.3 Subgrade Preparation and Evaluation

Following stripping and subgrade stabilization and prior to placing fill, pavement, or building improvements, the exposed subgrade should be evaluated by proof rolling. The subgrade should be proof rolled with a fully loaded dump truck or similar heavy, rubber tire construction equipment to identify soft, loose, or unsuitable areas. A member of our geotechnical staff should observe proof rolling to evaluate yielding of the ground surface. Soft or loose zones identified during proof rolling should be excavated and replaced with compacted structural fill. Areas that appear too wet or soft to support proof rolling equipment should be prepared in accordance with recommendations for wet weather construction provided in the "Construction Considerations" section.

6.2 CONSTRUCTION CONSIDERATIONS

Fine-grained soil present on this site is easily disturbed during the wet season. If not carefully executed, earthwork activity can create extensive soft areas and significant repair costs can result. Earthwork planning should include considerations for minimizing subgrade disturbance.

If construction occurs during the wet season, or if the moisture content of the soil is more than a few percentage points above optimum, site stripping and cutting may need to be accomplished using track-mounted equipment, loading removed material into trucks supported on granular haul roads.

The base rock thickness for pavement areas is intended to support post-construction design traffic loads and not intended to support construction traffic. The thickness of the granular material for haul roads and staging areas will depend on the amount and type of construction traffic and should be the responsibility of the contractor. Generally, a 12- to 18-inch-thick mat of granular material is sufficient for light staging areas and the basic building pad but is generally not expected to be adequate to support heavy equipment or truck traffic. The granular mat for

haul roads and areas with repeated heavy construction traffic typically needs to be increased to between 18 and 24 inches. The actual thickness of haul roads and staging areas should be based on the contractor's approach to site development and the amount and type of construction traffic. The material used to construct haul roads and staging areas should also be selected by the contractor.

As an alternative to thickened crushed rock sections, haul roads and utility work zones may be constructed using cement-amended subgrades overlain by a crushed rock wearing surface. If this approach is used, the thickness of granular material in staging areas and along haul roads can typically be reduced to between 6 and 9 inches. This recommendation is based on an assumed minimum unconfined compressive strength of 100 psi for subgrade amended to a depth of 12 to 16 inches. The actual thickness of the amended material and imported granular material will depend on the contractor's means and methods and, accordingly, should be the contractor's responsibility. Cement amendment is discussed in the "Structural Fill" section.

6.3 EXCAVATION

6.3.1 Excavation and Shoring

Temporary excavation sidewalls should stand vertical to a depth of approximately 4 feet, provided groundwater seepage is not observed in the sidewalls. Open excavation techniques may be used to excavate trenches with depths between 4 and 8 feet, provided the walls of the excavation are cut at a slope of 1.5H:1V and groundwater seepage is not present. At this inclination, the slopes with sand may ravel and require some ongoing repair. Excavations should be flattened if excessive sloughing or raveling occurs. In lieu of large and open cuts, approved temporary shoring may be used for excavation support. A wide variety of shoring and dewatering systems are available. Consequently, we recommend the contractor be responsible for selecting the appropriate shoring and dewatering systems.

If box shoring is used, it should be understood that box shoring is a safety feature used to protect workers and does not prevent caving. If the excavations are left open for extended periods of time, caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

If shoring is used, we recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation. All excavations should be made in accordance with applicable OSHA and state regulations.

6.3.2 Trench Dewatering

Shallow excavations could encounter perched groundwater, and significant dewatering operations may be necessary during the rainy season. If stormwater runoff seeps into trenches, it should be removed by pumping from a sump. Water should be routed to a suitable discharge point.

If groundwater is present at the base of utility trench excavations, we recommend placing up to 12 inches of stabilization material at the base of the excavations. Trench stabilization material should meet the requirements provided in the “Structural Fill” section.

We note that these recommendations are for guidance only. The dewatering of excavations is the sole responsibility of the contractor, as the contractor is in the best position to select these systems based on their means and methods.

6.3.3 Safety

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

6.4 STRUCTURAL FILL

Structural fill includes fill beneath foundations, slabs, pavements, any other areas intended to support structures, or within the influence zones of structures. Structural fill should be free of organic matter and other deleterious material and, in general, should consist of particles no larger than 3 inches in diameter. Recommendations for suitable fill material are provided in the following sections.

6.4.1 On-Site Native Soil

The on-site native soil will be suitable for use as structural fill only if it can be moisture conditioned. The on-site silty soil is sensitive to small changes in moisture content and may be difficult, if not impossible, to compact adequately during wet weather or when its moisture content is more than a few percentage points above optimum. This soil may require extensive drying if it becomes wet. Extended dry weather may be required to adequately condition the on-site silty soil for use as structural fill. We recommend using imported granular material for structural fill if the on-site silty soil cannot be moisture conditioned to within 3 percentage points of its optimum moisture content. Native soil should be placed in lifts with a maximum uncompacted thickness of 8 inches and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D1557.

6.4.2 Imported Granular Material

Imported granular material should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand that is fairly well graded between coarse and fine and has less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve. All granular material must be durable such that there is no degradation of the material during and after installation as structural fill. The percentage of fines can be increased to 12 percent if the fill is placed during dry weather; will be used for general fill and not for staging or haul roads, or floor slab or pavement aggregate base; and provided the fill material is moisture conditioned, as necessary, for proper compaction. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by

ASTM D1557. During the wet season or when wet subgrade conditions exist, the initial lift should have a maximum thickness of 15 inches and should be compacted with a smooth-drum roller without the use of vibratory action.

6.4.3 Floor Slab Base Rock

Imported durable, granular material placed beneath building floor slabs should be clean crushed rock or crushed gravel and sand that is fairly well graded between coarse and fine. The granular material should have a maximum particle size of 1½ inches, have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve, and have at least two mechanically fractured surfaces. The imported base rock should be placed in one lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

6.4.4 Recycled Concrete

Recycled concrete can be used for structural fill, provided the concrete is processed to a relatively well-graded material with a maximum particle size of 3 inches. This material can be used as trench backfill and general structural fill if it meets the requirements for imported granular material, which would require a smaller maximum particle size. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

6.4.5 Trench Backfill

Trench backfill for the utility pipe base and pipe zone should consist of durable, well-graded, granular material containing no organic or other deleterious material, should have a maximum particle size of ¾ inch, and should have less than 8 percent by dry weight passing the U.S. Standard No. 200 sieve.

Backfill for the pipe base and to the spring line of the pipe should be placed in maximum 12-inch-thick lifts and compacted to not less than 90 percent of the maximum dry density, as determined by ASTM D1557, or as recommended by the pipe manufacturer. Backfill above the spring line of the pipe should be placed in maximum 12-inch-thick lifts and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D1557. Trench backfill located within 2 feet of finish subgrade elevation should be placed in maximum 12-inch-thick lifts and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

6.4.6 Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches and should meet OSSC 00430.11 (Granular Drain Backfill Material). The material should be free of roots, organic matter, and other unsuitable materials and have less than 2 percent by dry weight passing the U.S. Standard No. 200 sieve (washed analysis). The drain rock should be wrapped in a Type 1 drainage geotextile that meets the specifications provided in OSSC Table 02320-1. The geotextile should be installed in conformance with OSSC 00350 (Geosynthetic Installation). Drain rock should be compacted to a firm condition.

6.4.7 Stabilization Material

If perched groundwater is encountered and is present at the base of utility excavations, we recommend placing trench stabilization material at the base of the excavation consisting of at least 2 feet of well-graded gravel, crushed gravel, or crushed rock with a minimum particle size of 4 inches and less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve. The material should be free of organic matter and other deleterious material and should be placed in one lift and compacted until "well keyed."

6.4.8 Cement Amendment

6.4.8.1 General

In conjunction with an experienced contractor, the on-site soil can be amended with portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Soil amending should be conducted in accordance with the specifications provided in OSSC 00344 (Treated Subgrade). The amount of cement used during treatment should be based on an assumed soil dry unit weight of 100 pcf.

Portland cement-amended soil is hard and has low permeability; therefore, this soil does not drain well and it is not suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be planned for drainage and planting.

6.4.8.2 Stabilization

Specific recommendations based on exposed site conditions for soil amending can be provided if necessary. However, for preliminary design purposes, we recommend a target seven-day unconfined compressive strength for cement-amended subgrade for building and pavement subbase (below aggregate base) soil of 100 psi. The amount of cement used to achieve this target generally varies with moisture content and soil type. It is difficult to predict field performance of soil to cement amendment due to variability in soil response, and we recommend laboratory testing to confirm expectations. Generally, 5 percent cement by weight of dry soil can be used when the soil moisture content does not exceed approximately 20 percent. If the soil moisture content is in the range of 25 to 35 percent, 6 to 8 percent by weight of dry soil is recommended. The amount of cement added to the soil may need to be adjusted based on field observations and performance. Moreover, depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content.

For building and pavement subbase, we recommend assuming a minimum cement ratio of 6 percent (by dry weight). If the soil moisture content exceeds 30 percent, a cement ratio of 7 to 8 percent will likely be needed.

A minimum curing of four days is required between treatment and construction traffic access. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect the cement-amended surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material. The crushed rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas.

Treatment depths for buildings, haul roads, and staging areas are typically on the order of 12, 16, and 18 inches, respectively. The actual thickness of the amended material and imported granular material for haul roads and staging areas will depend on the anticipated construction traffic as well as the contractor's means and methods and, accordingly, should be the contractor's responsibility. Treatment depths for pavements are provided in the "Pavement Recommendations" section.

6.4.8.3 Structural

On-site soil that would not otherwise be suitable for structural fill may be amended and placed as fill over a subgrade prepared in conformance with the "Site Preparation" section. The cement ratio for general cement-amended fill can generally be reduced by 1 percent (by dry weight). Typically, a minimum curing of four days is required between treatment and construction traffic access. Consecutive lifts of fill may be treated immediately after the previous lift has been amended and compacted (e.g., the four-day wait period does not apply). However, where the final lift of fill is a building or roadway subgrade, the four-day wait period is in effect.

6.4.8.4 Compaction

A static, sheepsfoot or segment pad roller with a minimum static weight of 40,000 pounds should be used for compaction of fine-grained soil followed by final compaction using a smooth-drum roller with a minimum applied lineal force of 700 pounds per inch. The amended soil should be compacted to at least 92 percent of the achievable dry density at the moisture content of the material, as defined by ASTM D1557.

6.4.8.5 Specifications Recommendations

We recommend the following comments be included in the specifications for the project:

- **Mixing Equipment**
 - Use a pulverizer/mixer capable of uniformly mixing the cement into the soil to the design depth. Blade mixing will not be allowed.
 - Pulverize the soil-cement mixture such that 100 percent by dry weight passes a 1-inch sieve and a minimum of 70 percent passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves. If water is required, the pulverizer should be equipped to inject water to a tolerance of ¼ gallon per square foot of surface area.
 - Use machinery that will not disturb the subgrade, such as using low-pressure "balloon" tires on the pulverizer/mixer vehicle. If subgrade is disturbed, the tilling/treatment depth shall extend the full depth of the disturbance.
 - Multiple "passes" of the tiller will likely be required to adequately blend the cement and soil mixture.
- **Spreading Equipment**
 - Use a spreader capable of distributing the cement uniformly on the ground to within 5 percent variance of the specified application rate.
 - Use machinery that will not disturb the subgrade, such as using low-pressure "balloon" tires on the spreader vehicle. If subgrade is disturbed, the tilling/treatment depth shall extend the full depth of the disturbance.

- **Compaction Equipment**
 - Use a static, sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds for initial compaction of fine-grained soil (silt and clay) or an alternate approved by the geotechnical engineer.
 - Use a vibratory, smooth-drum roller with a minimum applied lineal force of 600 pounds per inch for final compaction or an alternate approved by the geotechnical engineer.

6.5 TEMPORARY SLOPES

Temporary slopes should be no steeper than 1.5H:1V. If slopes greater than 10 feet high are required, GeoDesign should be contacted to make additional recommendations. All cut slopes should be protected from erosion by covering them during wet weather. If sloughing or instability is observed, the slope should be flattened or the cut supported by shoring.

6.6 EROSION CONTROL

The on-site soil is moderately susceptible to erosion. Consequently, we recommend that slopes be covered with an appropriate erosion control product if construction occurs during periods of wet weather. We recommend that all slope surfaces be planted as soon as practical to minimize erosion. Surface water runoff should be collected and directed away from slopes to prevent water from running down the slope face. Erosion control measures such as straw bales, sediment fences, and temporary detention and settling basins should be used in accordance with local and state ordinances.

7.0 FOUNDATION SUPPORT RECOMMENDATIONS

A formal grading plan had not been developed by the time of this report; however, preliminary estimates are that cuts and fills will likely be in the 3- to 5-foot range. Assuming the distributed floor slab live loads, foundation loads, and the preliminary finished floor grade provided in the "Project Understanding" section, our analysis indicates that the proposed structures can be supported by conventional shallow foundations. The planned structures may be supported by continuous wall and isolated column footings founded on firm, undisturbed native soil or on structural fill overlying firm, undisturbed native soil. Our recommendations for use in foundation design and construction are provided in the following sections.

7.1 SPREAD FOOTINGS

7.1.1 Bearing Capacity

If encountered, undocumented fill and disturbed native soil should be removed from the influence zones of footings. The excavations should be backfilled with granular structural fill that extends beyond the footing perimeter by 6 inches for every foot they extend beneath the footing subgrade. The structural fill should meet the requirements of the "Imported Granular Material" section and compacted to at least 95 percent of the maximum dry density, as determined by ASTM D1557. Due to the presence of an agricultural tilled zone at the site, we recommend that we be retained to observe the footing subgrades.

We recommend that footings be sized based on an allowable bearing pressure of 2,500 psf. This is a net bearing pressure; the weight of the footing and overlying backfill can be ignored in calculating footing sizes. The recommended allowable bearing pressure applies to the total of

dead plus long-term live loads. Continuous wall and spread footings should be at least 18 and 24 inches wide, respectively. The bottom of exterior footings should be at least 18 inches below the lowest adjacent final grade. The bottom of interior footings should be placed at least 12 inches below the base of the floor slab.

Total post-construction settlement is expected to be less than 1½ inches. Differential settlement is expected to be less than ½ inch over 50 feet. We recommend that GeoDesign review the final grading plan to re-evaluate the settlement estimates. A preload or surcharge plan may be necessary if the finished floor grades are more than 5 feet above existing site grades.

7.1.2 Lateral Resistance

Lateral loads on footings can be resisted by passive earth pressure on the sides of the footings and by friction on the base of the footings. The available passive earth pressure for footings confined by native soil and structural fill is 250 pcf. Adjacent floor slabs, pavements, or the upper 12-inch depth of adjacent unpaved areas should not be considered when calculating passive resistance. For computing the friction capacity of building foundations, we recommend friction coefficients of 0.35 for footings bearing on native soil and 0.45 for footings bearing on gravel or crushed rock.

8.0 SLABS ON GRADE

A minimum 6-inch-thick layer of base rock should be placed and compacted over the prepared subgrade to assist as a capillary break. The base rock should be crushed rock or crushed gravel and sand meeting the requirements outlined in the “Structural Fill” section. The imported granular material should be placed in one lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557. A subgrade modulus of 120 pci can be used to design the floor slab. Floor slab base rock should be replaced if it becomes contaminated with excessive fines (greater than 5 percent by dry weight passing the U.S. Standard No. 200 sieve).

Vapor barriers are often required by flooring manufacturers to protect flooring and flooring adhesives. Many flooring manufacturers will warrant their product only if a vapor barrier is installed according to their recommendations. Selection and design of an appropriate vapor barrier (if needed) should be based on discussions among members of the design team. We can provide additional information to assist you with your decision.

9.0 RETAINING STRUCTURES

9.1 ASSUMPTIONS

Our retaining wall design recommendations are based on the following assumptions: (1) the walls consist of conventional, cantilevered retaining walls, (2) the walls are less than 8 feet in height, (3) the backfill is drained and consists of imported granular materials, and (4) the backfill has a slope flatter than 4H:1V. Re-evaluation of our recommendations will be required if the retaining wall design criteria for the project varies from these assumptions.

9.2 WALL DESIGN PARAMETERS

For unrestrained retaining walls, an active pressure of 35 pcf equivalent fluid pressure should be used for design. For embedded building walls, a superimposed seismic lateral force should be calculated based on a dynamic force of $7H^2$ pounds per lineal foot of wall (where H is the height of the wall in feet) and applied a distance of 0.6H from the base of the wall. Where retaining walls are restrained from rotation prior to being backfilled, a pressure of 55 pcf equivalent fluid pressure should be used for design.

If surcharges (e.g., retained slopes, building foundations, vehicles, steep slopes, terraced walls, etc.) are located within a horizontal distance from the back of a wall equal to twice the height of the wall, additional pressures will need to be accounted for in the wall design. Our office should be contacted for appropriate wall surcharges based on the actual magnitude and configuration of the applied loads.

The base of the wall footing excavations should extend a minimum of 18 inches below lowest adjacent grade. The footing excavations should then be lined with a minimum 6-inch-thick layer of compacted imported granular material, as described in the "Structural Fill" section.

The wall footings should be designed in accordance with the guidelines provided in the "Foundation Support Recommendations" section.

9.3 WALL DRAINAGE AND BACKFILL

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

Backfill material placed behind retaining walls and extending a horizontal distance of $\frac{1}{2}H$ (where H is the height of the retaining wall) should consist of well-graded sand or gravel, with not more than 5 percent by dry weight passing the U.S. Standard No. 200 sieve and meeting OSSC 00510.12 (Granular Wall Backfill). We recommend the select granular wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric that meets the requirements provided in OSSC 00350 (Geosynthetic Installation) and OSSC 02320 (Geosynthetics) for drainage geotextiles.

Alternatively, the native, silty soil can be used as backfill material provided a minimum 2-foot-wide column of angular drain rock wrapped in a geotextile is placed against the wall and the native soil can be adequately moisture conditioned for compaction. The rock column should extend from the perforated drainpipe or foundation drains to within approximately 1 foot of the ground surface. The angular drain rock should meet the requirements provided in the "Structural Fill" section.

The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D1557. However, backfill located within a horizontal distance of 3 feet from a retaining wall should only be compacted to approximately 90 percent of the maximum dry density, as determined by ASTM D1557. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (such as a

jumping jack or vibratory plate compactor). If flatwork (sidewalks or pavements) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 95 percent of the maximum dry density, as determined by ASTM D1557.

Perforated collector pipes should be placed at the base of the granular backfill behind the walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock. The drain rock should meet specifications provided in the “Structural Fill” section. The drain rock should be wrapped in a geotextile fabric that meets the specifications provided in OSSC 00350 (Geosynthetic Installation) and OSSC 02320 (Geosynthetics) for drainage geotextiles. The collector pipes should discharge at an appropriate location away from the base of the wall. Unless measures are taken to prevent backflow into the drainage system of the wall, the discharge pipe should not be tied directly into stormwater drain systems.

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

10.0 DRAINAGE CONSIDERATIONS

10.1 TEMPORARY

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

10.2 SURFACE

The finished ground surface around buildings should be sloped away from their foundations at a minimum 2 percent gradient for a distance of at least 5 feet. Downspouts or roof scuppers should discharge into a storm drain system that carries the collected water to an appropriate stormwater system. Trapped planter areas should not be created adjacent to the buildings without providing means for positive drainage (i.e., swales or catch basins).

The site will include unpaved gravel surfaces, which unless the subgrade is graded to drain and route stormwater, will result in areas of ponding following moderate to heavy rainfall.

10.3 SUBSURFACE

We recommend that GeoDesign review the final grading plan to determine whether footing drains will be required around portions of the proposed buildings within cut areas. We do not anticipate that floor slab drains will be needed but will depend on review of the final grading plan. Footing drains should be considered in areas where landscaping planters are placed approximate to the foundations or where surface grades cannot be completed as outlined above.

If installed, the footing drains should consist of a filter fabric-wrapped, drain rock-filled trench that extends at least 12 inches below the lowest adjacent grade (i.e., slab subgrade elevation). A

perforated pipe should be placed at the base to collect water that gathers in the drain rock. The drain rock and filter fabric should meet specifications outlined in the “Structural Fill” section. Discharge for the footing drain should not be tied directly into the stormwater drainage system, unless mechanisms are installed to prevent backflow.

11.0 SEISMIC DESIGN CRITERIA

Seismic design is prescribed by the 2015 IBC and 2014 SOSSC. Table 3 presents the site design parameters prescribed by the 2015 IBC for the site.

Table 3. IBC Seismic Design Parameters

Parameter	Short Period ($T_s = 0.2$ second)	1 Second Period ($T_1 = 1.0$ second)
MCE Spectral Acceleration, S	$S_s = 0.928$ g	$S_1 = 0.410$ g
Site Class	D	
Site Coefficient, F	$F_a = 1.129$	$F_v = 1.590$
Adjusted Spectral Acceleration, S_M	$S_{MS} = 1.047$ g	$S_{M1} = 0.652$ g
Design Spectral Response Acceleration Parameters, S_D	$S_{DS} = 0.698$ g	$S_{D1} = 0.435$ g

12.0 PAVEMENT RECOMMENDATIONS

We developed pavement design recommendations for the storage yard as well for the other pavement areas at the site. We used the following design standards and software for developing our pavement recommendations:

- Design of Aggregate Surfaced Roads and Airfields (Department of the Army, 1990)
- Gravel Roads Construction & Maintenance Guide (FHWA, 2015)
- AASHTO Guide for Design of Pavement Structures (AASHTO, 1993; AASHTO guide)
- Pavement Designer design tools for streets, local roads, parking lots, and intermodal/ industrial facilities (Pavement Designer, 20180)
- ODOT Pavement Design Guide (ODOT, 2011; ODOT guide)
- Guide for the Design and Construction of Concrete Parking Lots (ACI, 2008; ACI guide)
- Guide for Mechanistic–Empirical Design of New and Rehabilitated Pavement Structures (ARA, 2004)
- PCASE version 2.09, herein referred to as PCASE (USACE, 2010)

12.1 DESIGN ASSUMPTIONS AND PARAMETERS

The design subgrade resilient modulus and CBR values are based on field explorations and DCP testing. Traffic loading in the storage area is based on information provided by you and forecasted for future traffic loading for design periods of 10, 15, and 20 years. Traffic loading in

the other pavement areas is based on assumed traffic and forecasted for a design period of 20 years. Additional details of our input parameters are summarized below. If any of our design assumptions are incorrect, our office should be contacted with the appropriate information so that the pavement designs can be revised.

12.1.1 Traffic Loading

Based on instructions from you, we used the traffic operations presented in our geotechnical and pavement engineering services report (GeoDesign, 2018) for your Seattle yard to represent traffic operations for the proposed storage yard at the Wilsonville site. Aside from this information we do not have specific information on the types and frequencies of vehicles expected in other areas at the site. Accordingly, we assumed a breakdown of the types and frequencies of vehicles likely to use the other areas of the site. Additional details regarding traffic loading based on pavement usage is presented below.

12.1.1.1 Storage Yard

We used the traffic operations for your Seattle yard to represent traffic operations for the proposed storage yard at the Wilsonville site. For convenience, a duplicate of estimated traffic operations by design period is shown in Table 4. Additional details of our estimation methodology, as well as truck axle configurations and loads, are presented in Appendix C of our 2018 geotechnical and pavement engineering services report for your Seattle yard (GeoDesign, 2018).

Table 4. Estimated Total Passes of Loaded Trucks by Design Life

Truck Type	Estimated Total Passes of Loaded Trucks for Indicated Design Life		
	10 Years	15 Years	20 Years
Five-Axle Haul Truck	65,000	97,500	130,000
Hyster H230HD2 Forklift	260,000	390,000	520,000

We used a conservative estimate of a fully loaded five-axle truck to represent loads imparted by the haul trucks. We used half the payload load capacity of the Hyster forklift truck added to its unladen weight for a total load of 45,144 pounds to represent average loading conditions imparted by the forklift truck to the storage yard pavement.

12.1.1.2 Other Pavement Areas

In areas other than the storage yard, we understand the site will include pavement areas for passenger vehicle parking and drive aisles for access to the proposed buildings. We have assumed traffic in these other pavement areas will consist of passenger cars in parking areas and a mixture of cars and trucks in the drive aisles. In addition, we have assumed the access road to the site and to the storage yard will need to accommodate haul truck traffic for shoring elements in addition to car and truck traffic to the other on-site pavement areas. Due to differences in design procedures used for flexible versus rigid pavement design, we estimated traffic differently for each pavement type. Further details of our assumptions for traffic loading are presented below.

Flexible Pavement Traffic Loading

We used the AASHTO guide for flexible pavement design for pavement areas other than in the storage yard, which requires an estimate of anticipated ESALs over the design period. Estimating ESALs, in turn, requires an estimate of the types and frequencies of trucks that will traffic the pavement. Regarding the types of trucks, and aside from the haul trucks for shoring elements, we have estimated the other on-site truck traffic will be comprised of the following:

- 50 percent two axle (FHWA Class 5)
- 30 percent three axle (FHWA Class 6)
- 10 percent four axle (FHWA Class 8)
- 10 percent five axle (FHWA Class 9)

Based on the above distribution of trucks and assuming a range of daily truck traffic, our estimate of 20-year flexible pavement ESALs by ADTT and pavement type is presented in Table 5. We used the methodology presented in the ODOT guide to estimate the ESAL values assuming no growth and construction will occur in the year 2019. The ESAL estimates for the access road are based on traffic comprised of haul trucks for shoring elements in addition to car and truck traffic to the other on-site pavement areas. We used two passes for each truck in drive aisles to account for the possibility that drivers will retrace their inbound path on the outbound trip.

Table 5. Estimated 20-Year Flexible Pavement ESALs by ADTT and Pavement Type

ADTT	Passenger Vehicle Parking	Truck Passes per Day		20-Year ESALs	
		Drive Aisles ¹	Access Road ²	Drive Aisles	Access Road
0	10,000	NA	NA	NA	NA
10	NA	20	35	84,000	147,000
25	NA	50	50	210,000	210,000
50	NA	100	75	419,000	314,000

1. Two passes per truck in drive aisles.
2. One pass per haul truck to the storage yard area plus one pass per truck to other pavement areas.

Rigid Pavement Traffic Loading

We used the Pavement Designer design tool for rigid pavement design for pavement areas other than in the storage yard, which requires an estimate of the number of axles of an imposed load on the pavement per 1,000 trucks. We based the axle-load distributions on traffic Category B presented in the ACI guide. However, we adjusted the number of axles per 1,000 trucks for each axle load so that the resulting ESALs are similar to those calculated using the methodology presented in the ODOT guide for rigid pavements using the same number of truck passes per day as listed in Table 5 for flexible pavements. The axle-load distributions we used for designing rigid pavements are presented in Table 6 and the approximate 20-year rigid pavement ESALs by ADTT and pavement type are presented in Table 7. We assumed a 6-inch concrete slab depth and a terminal serviceability of 3.0 in approximating the ESALs based on the axle-load distributions listed in Table 6.

Table 6. Axle-Load Distributions Used for Designing Rigid Pavements

Axle Load (kips)	Number of Axles per 1,000 Trucks	
	Single Axles	Tandem Axles
4	1693.31	31.90
6	732.28	---
8	483.10	85.59
10	204.96	---
12	124.00	139.30
14	56.11	---
16	38.02	75.02
18	15.81	---
20	4.23	57.10
22	0.96	---
24	---	39.18
26	---	---
28	---	68.48
32	---	69.59
36	---	4.19

Table 7. Approximate 20-Year Rigid Pavement ESALs by ADTT and Pavement Type

ADTT	Passenger Vehicle Parking	Truck Passes per Day		Approximate 20-Year ESALs	
		Drive Aisles ¹	Access Road ²	Drive Aisles	Access Road
0	10,000	NA	NA	NA	NA
10	NA	20	35	108,740	190,300
25	NA	50	50	271,850	271,850
50	NA	100	75	543,700	407,780

1. Two passes per truck in drive aisles.
2. One pass per haul truck to the storage yard area plus one pass per truck to other pavement areas.

12.1.2 Pavement Layer and Subgrade Properties

All the methods we used for pavement design require stiffness or strength parameters for each pavement layer as well as for the subgrade soil. In addition to stiffness/strength parameters, PCASE requires the Poisson's ratio for each layer as well as interlayer slip, which simulates friction between layers, for flexible and rigid pavement design. Pavement layer and subgrade properties used in our designs are presented in Table 8.

Table 8. Pavement Layer and Subgrade Properties Used for Design

Layer	Resilient Modulus (psi)	CBR Value	Poisson's Ratio	Interlayer Slip
AC	450,000	NA	0.35	0 (complete adhesion)
PCC ¹	4,000,000	NA	0.15	1,000 (no adhesion)
Gravel Surfacing	NA	100	NA	NA
Aggregate Base	20,000	100	0.35	0 (complete adhesion)
Cement-Amended Soil	120,000	100	0.25	0 (complete adhesion)
Subgrade	6,380	4	0.40	0 (complete adhesion)

1. PCC with minimum 28-day flexural strength of 600 psi.

12.1.3 Other Design Parameters

Other pavement design parameters used in our analyses are summarized as follows:

- Reliability of 80 percent
- Overall standard deviation of 0.49 for flexible pavement design using the AASHTO method
- Initial and terminal serviceability of 4.2 and 2.7, respectively, for flexible pavement design using the AASHTO method
- Drainage coefficient of 1.0 for aggregate base
- Jointed concrete pavement with dowel bars for the storage yard and without dowels for the other pavement areas
- PCC slabs have edge support
- Percent of cracked slabs at end of design life of 1 percent

12.2 DESIGN METHODS

We used various design methods for developing our recommendations. We used the method that, in our opinion, is appropriate for the types of pavement layers considered and the types of traffic loads expected. The design methods we used for each pavement area and pavement type are summarized in Table 9.

Table 9. Pavement Design Method by Pavement Area and Pavement Type

Pavement Area	Design Method by Pavement Type		
	Gravel Surfacing	Flexible Pavement	Rigid Pavement
Storage Yard	PCASE	PCASE	PCASE
Access Road	NA	AASHTO	Pavement Designer
Drive Aisles	NA	AASHTO	Pavement Designer
Parking Area	NA	AASHTO	Pavement Designer

12.3 PAVEMENT SECTIONS

Our recommendations for pavement sections apply to the proposed storage yard and other proposed pavement areas at the site. We offer sections for flexible and rigid pavements for all

pavement areas. We also offer sections comprised of crushed rock gravel surfacing, in addition to the flexible and rigid pavement sections, for the storage yard. Our recommendations for minimum pavement sections are presented below. In all cases, the materials recommended should conform to the requirements presented in the “Pavement Materials” section.

12.3.1 Storage Yard

12.3.1.1 Crushed Rock Gravel Surfacing Sections for the Storage Yard

Our recommendations for sections comprised of crushed rock gravel surfacing for the storage yard are presented in Table 10. The PCASE reports for each design are presented in Appendix C.

Table 10. Recommended Minimum Crushed Rock Gravel Surfacing Sections for the Storage Yard

Design Life (years)	Gravel Surfacing		Gravel Surfacing on Cement-Amended Soil	
	Crushed Rock Gravel Surfacing (inches)	Aggregate Base ¹ (inches)	Crushed Rock Gravel Surfacing (inches)	Cement Amendment ² (inches)
10	6.0	13.0	7.0	12.0
15	6.0	14.0	8.0	12.0
20	6.0	14.0	8.0	12.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base.
2. Assumes a minimum seven-day unconfined compressive strength of 100 psi.

12.3.1.2 Flexible Pavement Sections for the Storage Yard

Our recommendations for flexible pavement sections for the storage yard are presented in Table 11. The PCASE reports for each design are presented in Appendix C.

Table 11. Recommended Minimum Flexible Pavement Sections for the Storage Yard

Design Life (years)	Conventional Flexible Pavement		AC on Cement-Amended Soil		
	AC (inches)	Aggregate Base ¹ (inches)	AC (inches)	Aggregate Base (inches)	Cement Amendment ² (inches)
10	8.5	16.0	6.0	4.0	12.0
15	9.0	16.0	6.5	4.0	12.0
20	9.5	16.0	7.0	4.0	12.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base.
2. Assumes a minimum seven-day unconfined compressive strength of 100 psi.

12.3.1.3 Rigid Pavement Sections for the Storage Yard

Our recommendations for rigid pavement sections for the storage yard are presented in Table 12. The PCASE reports for each design are presented in Appendix C. Additional recommendations for PCC slab construction are provided in the “Pavement Construction Considerations” section.

Table 12. Recommended Minimum Rigid Pavement Sections for the Storage Yard

Design Life (years)	Conventional Rigid Pavement		PCC on Cement-Amended Soil		
	PCC (inches)	Aggregate Base ¹ (inches)	PCC (inches)	Aggregate Base (inches)	Cement Amendment ² (inches)
10	11.3	6.0	10.7	4.0	16.0
15	11.5	6.0	10.9	4.0	16.0
20	11.7	6.0	11.0	4.0	16.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base.
2. Assumes a minimum seven-day unconfined compressive strength of 100 psi.

12.3.2 Other Pavement Areas

12.3.2.1 Flexible Pavement Sections for Other Pavement Areas

Our recommendations for flexible pavement sections for other pavement areas apply to the passenger vehicle parking areas, drive aisles around and between the proposed buildings, and the access road to the site. Our recommendations for flexible pavement sections on native soil and on cement-amended soil are presented in Tables 13 and 14, respectively. We note that if the flexible pavements over cement-amended soil option is used, the soil amendment and paving should be completed during dry weather. Our calculation sheets for each design are presented in Appendix C.

Table 13. Recommended Minimum Flexible Pavement Sections on Native Soil for Other Pavement Areas

ADTT	Passenger Vehicle Parking		Drive Aisles		Access Road	
	AC (inches)	Aggregate Base ¹ (inches)	AC (inches)	Aggregate Base ¹ (inches)	AC (inches)	Aggregate Base ¹ (inches)
0	2.5	6.0	NA	NA	NA	NA
10	NA	NA	3.5	9.0	4.0	9.0
25	NA	NA	4.5	9.0	4.5	9.0
50	NA	NA	5.0	10.0	4.5	10.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base. We recommend that the soil amendment and paving be completed during dry weather.

**Table 14. Recommended Minimum Flexible Pavement Sections
on Cement-Amended Soil for Other Pavement Areas**

ADTT	Passenger Vehicle Parking		Drive Aisles		Access Road	
	AC (inches)	Cement Amended ¹ (inches)	AC (inches)	Cement Amended ¹ (inches)	AC (inches)	Cement Amended ¹ (inches)
0	2.5	12.0	NA	NA	NA	NA
10	NA	NA	3.0	12.0	4.0	12.0
25	NA	NA	4.0	12.0	4.5	12.0
50	NA	NA	4.5	12.0	5.0	12.0

1. Assumes a minimum seven-day unconfined compressive strength of 100 psi. We recommend that the soil amendment and paving be completed during dry weather.

12.3.2.2 Rigid Pavement Sections for Other Pavement Areas

Our recommendations for rigid pavement sections for other pavement areas apply to the passenger vehicle parking areas, drive aisles around and between the proposed buildings, and the access road to the site. Our recommendations for rigid pavement sections on native soil and on cement-amended soil are presented in Tables 15 and 16, respectively. The Pavement Designer Reports are presented in Appendix C.

**Table 15. Recommended Minimum Rigid Pavement Sections
on Native Soil for Other Pavement Areas**

ADTT	Passenger Vehicle Parking		Drive Aisles and Access Road	
	PCC (inches)	Aggregate Base ¹ (inches)	PCC (inches)	Aggregate Base ¹ (inches)
0	5.0	6.0	NA	NA
10	NA	NA	6.0	6.0
25	NA	NA	6.0	6.0
50	NA	NA	6.3	6.0

1. Place a subgrade geotextile over the prepared subgrade prior to placing the aggregate base.

**Table 16. Recommended Minimum Rigid Pavement Sections
on Cement-Amended Soil for Other Pavement Areas**

ADTT	Passenger Vehicle Parking			Drive Aisles and Access Road		
	PCC (inches)	Aggregate Base (inches)	Cement Amended ¹ (inches)	PCC (inches)	Aggregate Base (inches)	Cement Amended ¹ (inches)
0	5.0	4.0	12.0	NA	NA	NA
10	NA	NA	NA	5.5	4.0	12.0
25	NA	NA	NA	5.8	4.0	12.0
50	NA	NA	NA	5.8	4.0	12.0

1. Assumes a minimum seven-day unconfined compressive strength of 100 psi.

12.4 PAVEMENT CONSTRUCTION CONSIDERATIONS

12.4.1 Drainage

The performance of the pavement sections will depend on providing positive drainage for the unbound materials (aggregate base and gravel surfacing) within the pavement structures. Accordingly, grading of the subgrade during construction operations should be completed to facilitate drainage of unbound layers. If cement amendment of the subgrade is performed in planned pavement areas, final grading of the cement-amended soil should also facilitate drainage of any unbound layers placed over the amended material.

12.4.2 Subgrade Preparation

The pavement subgrade should be prepared in accordance with the “Site Preparation” and “Structural Fill” sections. If the subgrade soil is not amended with cement, then the top 12 inches of subgrade below the pavement should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D1557, or until proof rolling with a fully loaded dump or water truck indicates an unyielding, non-pumping subgrade is present.

12.4.3 Wet Weather Construction

The designs of the recommended pavement sections are based on the assumption that construction will be completed during an extended period of dry weather. Wet weather construction could require an increased thickness of aggregate base. In addition, to prevent strength loss during curing, cement-amended soil should be allowed to cure for at least four days prior to construction traffic or placing the base rock. Lastly, the amended subgrade should be protected with a minimum of 4.0 inches of base rock prior to construction traffic access. Base rock to protect the amended subgrade can become contaminated by construction operations. Accordingly, base rock contaminated during construction operations should be removed and replaced prior to construction of overlying layers.

12.4.4 Construction Traffic

Construction traffic should be limited to non-building, unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavements. If construction traffic is to be allowed on newly constructed pavement sections, an allowance for this additional traffic will need

to be made in the design pavement sections. The base rock thickness for pavement areas is intended to support post-construction design traffic loads and not designed to support construction traffic (see the “Construction Consideration” section).

12.4.5 PCC Slab Construction

Additional recommendations for construction of the PCC pavement slabs are as follows:

- Dowel bars meeting OSSC 02510.40 (Dowels) should be placed in accordance with OSSC 00756.43 (Placing Dowel Bars and Tie Bars) at all transverse joints. We recommend dowel bars with a diameter of 1¼ inches and a length of 18 inches. Dowel bars should be placed at mid-depth in the slabs, spaced at 12 inches on-center, and centered across the joint.
- Tie bars meeting OSSC 02510.10 (Deformed Bars Reinforcement) should be placed in accordance with OSSC 00756.43 (Placing Dowel Bars and Tie Bars) at all longitudinal joints. We recommend #5 tie bars 40 inches in length for Grade 60 steel and spaced a maximum of 36 inches apart on-center. If constructed, curb and gutter should be tied to adjoining slabs.
- Adjust joints to meet utility structures and place an isolation joint around the structures.
- Wherever possible, lay out joints to create slabs of approximately square shape (length-to-width ratio between 0.80 and 1.25). Where this is not possible, lay out joints to create slabs of triangular shape. Avoid angles less than 60 degrees (approximately 90 degrees is best). Avoid slabs less than 1 foot in any dimension.
- Maximum joint spacing is 20 feet in any direction.
- PCC slabs abutting AC pavement should be constructed with a thickened edge along the edge abutting the AC pavement. We recommend thickening the PCC slab depth by 20 percent at the joint and tapering the thickness over a minimum distance of 4.5 feet and a maximum distance of 7.0 feet.

12.5 PAVEMENT MATERIALS

A submittal should be made for each pavement material prior to the start of paving operations. Each submittal should include the test information necessary to evaluate the degree to which the properties of the materials comply with the properties that were recommended or specified. The geotechnical engineer and other appropriate members of the design team should review each submittal.

12.5.1 AC

The AC should be Level 2, ½-inch, dense ACP as described in OSSC 00744 (Asphalt Concrete Pavement). The AC should be placed in one lift and compacted to at least 92 percent of the theoretical maximum density of the material, as determined by AASHTO T 209. Asphalt binder should be performance graded. For typical Level 2 ACP we recommend PG 64-22 binder; however, the binder grade should be adjusted depending on the aggregate gradation and amount of reclaimed asphalt pavement and/or recycled asphalt shingles in the contractor’s mix design submittal.

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

Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Oregon, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thickness between 2.0 and 2.5 inches.

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

12.5.2 PCC

PCC should be Class 4000-1½ (Paving) concrete according to OSSC 02001 (Concrete) with a with a maximum water/cementitious material ratio of 0.40 and a minimum 28-day flexural strength of 600 psi and placed in accordance with OSSC 00756 (Plain Concrete Pavement). Placement of tie bars and dowel bars should conform to OSSC 00756.43 (Placing Dowel Bars and Tie Bars). Reinforcing steel, if used, should conform to OSSC 02510 (Reinforcement) and placed in accordance with OSSC 0758.43 (Placing Reinforcement).

12.5.3 Aggregate Base

Imported granular material used as aggregate base should be clean, crushed rock or crushed gravel and sand that are dense-graded. The aggregate base should meet the gradation defined in OSSC 00641 (Aggregate Subbase, Base, and Shoulders), with the exception that the aggregate has less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve, a maximum particle size of 1½ inches, and at least two mechanically fractured faces. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T 99.

12.5.4 Crushed Rock Gravel Surfacing

Imported granular material used as gravel surfacing should be relatively clean, crushed rock or crushed gravel and sand that are dense graded. The aggregate base should meet the gradation defined in OSSC 00641 (Aggregate Subbase, Base, and Shoulders), with the exception that the aggregate has less than 8 percent by dry weight passing the U.S. Standard No. 200 sieve, a maximum particle size of ¾ inch, and at least two mechanically fractured faces. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T 99.

12.5.5 Cement-Amended Soil

See “Cement Amendment” under the “Structural Fill” section.

12.5.6 Subgrade Geotextile

The subgrade geotextile should meet the requirements in OSSC 02320 (Geosynthetics) for subgrade geotextiles and be installed in conformance with OSSC 00350 (Geosynthetic Installation).

13.0 OBSERVATION OF CONSTRUCTION

Satisfactory earthwork and foundation performance depends to a large degree on the quality of construction. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated. In addition, sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications.

14.0 LIMITATIONS

We have prepared this report for use by D.P. Nicoli and their consultants. The data and report can be used for estimating purposes, but our report, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions and are not applicable to other sites.

Soil explorations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The site development plans and design details were not finalized at the time this report was prepared. When the design has been finalized and if there are changes in the site grades or location, configuration, design loads, or type of construction, the conclusions and recommendations presented may not be applicable. If design changes are made, we should be retained to review our conclusions and recommendations and to provide a written evaluation or modification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

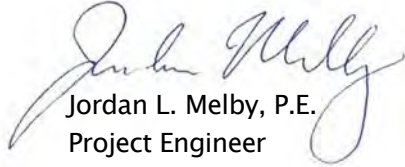
Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

◆ ◆ ◆


We appreciate the opportunity to be of service to you. Please contact us if you have questions regarding this report.

Sincerely,


GeoDesign, Inc.



Jordan L. Melby, P.E.
Project Engineer



Todd V. Scholz P.E., Ph.D.
Senior Associate Engineer



George Saunders, P.E., G.E.
Principal Engineer



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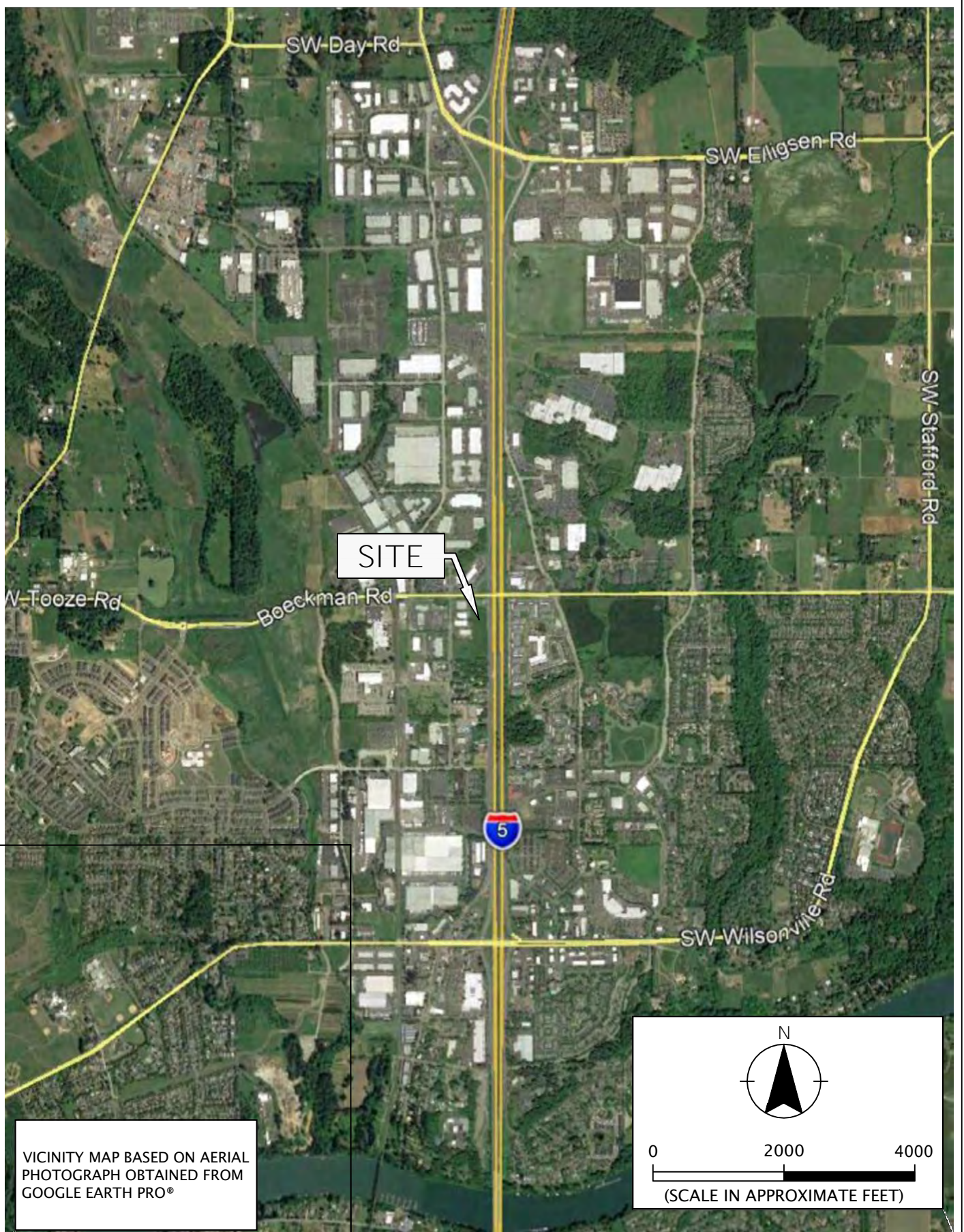
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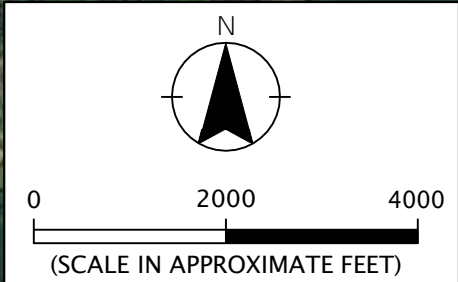
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USGS, 2018. Quaternary Fault and Fold Database for the United States. Accessed on September 5, 2018 from USGS website: <https://earthquake.usgs.gov/hazards/qfaults/>.

FIGURES



VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®



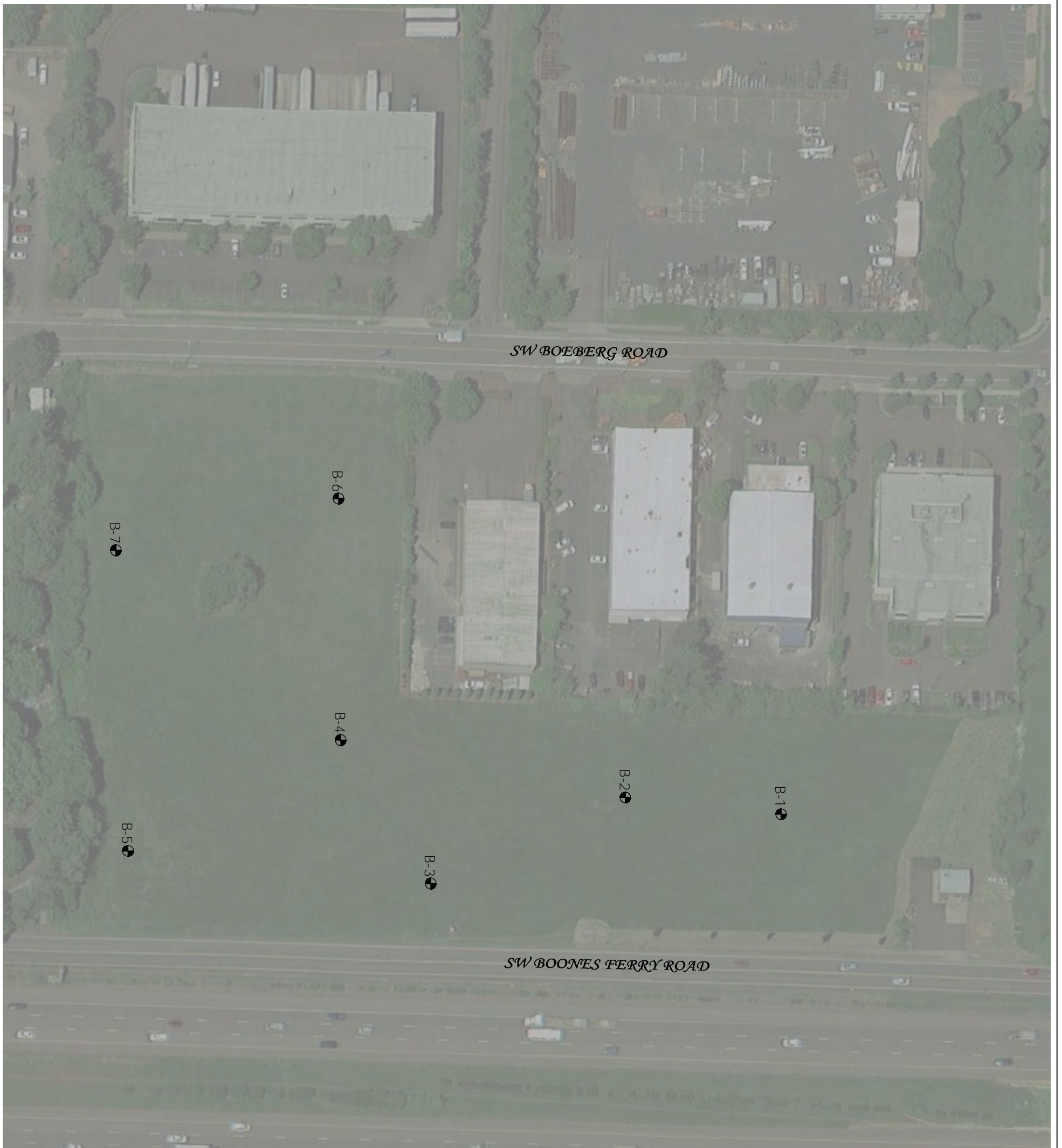
Printed By: mmiller | Print Date: 11/13/2018 12:49:34 PM
 File Name: J:\A-D\DPNicolli\DPNicolli-5\DPNicolli-5-01\Figures\CAD\DPNicolli-5-01-VM01.dwg | Layout: FIGURE 1

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DPNICOLI-5-01
 NOVEMBER 2018

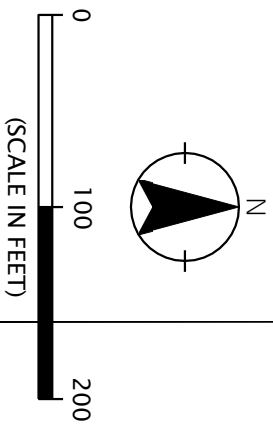
VICINITY MAP
 WILSONVILLE FACILITIES
 WILSONVILLE, OR

FIGURE 1




LEGEND:

B-1  BORING



SITE PLAN BASED ON AERIAL PHOTOGRAPH
 OBTAINED FROM GOOGLE EARTH PRO®,
 SEPTEMBER 12, 2018

 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	DPNICOLI-5-01	SITE PLAN	
	NOVEMBER 2018	WILSONVILLE FACILITIES WILSONVILLE, OR	FIGURE 2

APPENDIX A

APPENDIX A

FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at the site by drilling seven borings (B-1 through B-7) to depths between 21.5 and 31.5 feet BGS. The explorations were completed by Western States Soil Conservation, Inc. of Hubbard, Oregon, on September 4 and 5, 2018 using mud rotary methods. The top 5 feet of boring B-4 was drilled using a 4-inch-diameter, hollow-stem auger to facilitate infiltration testing. The exploration logs are presented in this appendix.

The locations of the explorations were determined in the field by pacing from existing site features. This information should be considered accurate to the degree implied by the method used.

SOIL SAMPLING

Samples were collected from the borings using a 1½-inch-inside diameter (SPT) split-spoon sampler in general accordance with ASTM D1586. The split-spoon samplers were driven into the soil with a 140-pound hammer free-falling 30 inches. The samplers were driven a total distance of 18 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the boring logs, unless otherwise noted. Higher quality, relatively undisturbed samples were collected using a standard Shelby tube in general accordance with ASTM D1587. Sampling methods and intervals are shown on the exploration logs.

The average efficiency of the automatic SPT hammer used by Western States Soil Conservation, Inc. was 90.4 percent. The calibration testing results are presented at the end of this appendix.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the “Exploration Key” (Table A-1) and “Soil Classification System” (Table A-2), which are presented in this appendix. The exploration logs indicate the depths at which the soil or its characteristics change, although the change actually could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.

LABORATORY TESTING

CLASSIFICATION

The soil samples were classified in the laboratory to confirm field classifications. The laboratory classifications are shown on the exploration logs if those classifications differed from the field classifications.

MOISTURE CONTENT

We determined the natural moisture content of select soil samples in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

CONSOLIDATION TESTING

A one-dimensional consolidation test was completed on one relatively undisturbed soil sample in general accordance with ASTM D2435. The test measures the volume change (consolidation) of a soil sample under predetermined loads. The test results are presented in this appendix.

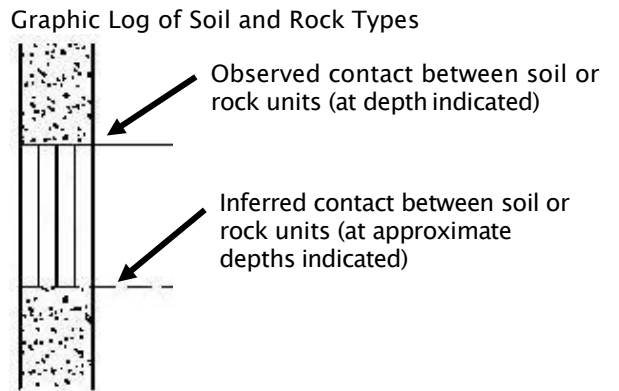
ATTERBERG LIMITS TESTING

The plastic limit and liquid limit (Atterberg limits) of a select soil sample were determined in accordance with ASTM D4318. The Atterberg limits and the plasticity index were completed to aid in the classification of the soil. The plastic limit is defined as the moisture content, in percent, where the soil becomes brittle. The liquid limit is defined as the moisture content where the soil begins to act similar to a liquid. The plasticity index is the difference between the liquid and plastic limits. The test results are presented in this appendix.

PARTICLE-SIZE ANALYSIS

We completed particle-size analyses on select soil samples in accordance with ASTM D1140. The tests determined percent fines (passing the U.S. Standard No. 200 Sieve) only. The test results are presented in this appendix.

SYMBOL	SAMPLING DESCRIPTION
	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test with recovery
	Location of sample obtained using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D 1587 with recovery
	Location of sample obtained using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample obtained using Dames & Moore and 140-pound hammer or pushed with recovery
	Location of sample obtained using 3-inch-O.D. California split-spoon sampler and 140-pound hammer
	Location of grab sample
	Rock coring interval
	Water level during drilling
	Water level taken on date shown




GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	P	Pushed Sample
CBR	California Bearing Ratio	PP	Pocket Penetrometer
CON	Consolidation	P200	Percent Passing U.S. Standard No. 200 Sieve
DD	Dry Density	RES	Resilient Modulus
DS	Direct Shear	SIEV	Sieve Gradation
HYD	Hydrometer Gradation	TOR	Torvane
MC	Moisture Content	UC	Unconfined Compressive Strength
MD	Moisture-Density Relationship	VS	Vane Shear
NP	Nonplastic	kPa	Kilopascal
OC	Organic Content		

ENVIRONMENTAL TESTING EXPLANATIONS

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

RELATIVE DENSITY - COARSE-GRAINED SOIL									
Relative Density		Standard Penetration Resistance		Dames & Moore Sampler (140-pound hammer)		Dames & Moore Sampler (300-pound hammer)			
Very Loose		0 - 4		0 - 11		0 - 4			
Loose		4 - 10		11 - 26		4 - 10			
Medium Dense		10 - 30		26 - 74		10 - 30			
Dense		30 - 50		74 - 120		30 - 47			
Very Dense		More than 50		More than 120		More than 47			
CONSISTENCY - FINE-GRAINED SOIL									
Consistency		Standard Penetration Resistance		Dames & Moore Sampler (140-pound hammer)		Dames & Moore Sampler (300-pound hammer)		Unconfined Compressive Strength (tsf)	
Very Soft		Less than 2		Less than 3		Less than 2		Less than 0.25	
Soft		2 - 4		3 - 6		2 - 5		0.25 - 0.50	
Medium Stiff		4 - 8		6 - 12		5 - 9		0.50 - 1.0	
Stiff		8 - 15		12 - 25		9 - 19		1.0 - 2.0	
Very Stiff		15 - 30		25 - 65		19 - 31		2.0 - 4.0	
Hard		More than 30		More than 65		More than 31		More than 4.0	
PRIMARY SOIL DIVISIONS					GROUP SYMBOL		GROUP NAME		
COARSE-GRAINED SOIL (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)			GW or GP		GRAVEL		
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)			GW-GM or GP-GM		GRAVEL with silt		
					GW-GC or GP-GC		GRAVEL with clay		
		GRAVEL WITH FINES (> 12% fines)			GM		silty GRAVEL		
					GC		clayey GRAVEL		
					GC-GM		silty, clayey GRAVEL		
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)			SW or SP		SAND		
		SAND WITH FINES (≥ 5% and ≤ 12% fines)			SW-SM or SP-SM		SAND with silt		
					SW-SC or SP-SC		SAND with clay		
		SAND WITH FINES (> 12% fines)			SM		silty SAND		
SC					clayey SAND				
SC-SM					silty, clayey SAND				
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50			ML		SILT		
					CL		CLAY		
					CL-ML		silty CLAY		
		Liquid limit 50 or greater			OL		ORGANIC SILT or ORGANIC CLAY		
					MH		SILT		
					CH		CLAY		
				OH		ORGANIC SILT or ORGANIC CLAY			
	HIGHLY ORGANIC SOIL					PT		PEAT	
MOISTURE CLASSIFICATION			ADDITIONAL CONSTITUENTS						
Term		Field Test		Secondary granular components or other materials such as organics, man-made debris, etc.					
				Silt and Clay In:			Sand and Gravel In:		
				Percent	Fine-Grained Soil	Coarse-Grained Soil	Percent	Fine-Grained Soil	Coarse-Grained Soil
dry		very low moisture, dry to touch							
moist		damp, without visible moisture		< 5	trace	trace	< 5	trace	trace
				5 - 12	minor	with	5 - 15	minor	minor
wet		visible free water, usually saturated		> 12	some	silty/clayey	15 - 30	with	with
							> 30	sandy/gravelly	Indicate %
 9450 SW Commerce Circle - Suite 200 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com			SOIL CLASSIFICATION SYSTEM				TABLE A-2		

BORING LOG DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	INSTALLATION AND COMMENTS
0		Stiff, brown with gray mottled SILT (ML), trace sand; moist, sand is fine (3-inch-thick root zone).				
5		medium stiff, minor sand at 5.0 feet		PP	8	PP = 1.5 tsf
7.5		soft, brown, with sand at 7.5 feet		PP	5	PP = 1.0 tsf
10				PP	2	PP = 0.25 tsf
15				DD CON	P	DD = 85 pcf
15.5		Medium dense, brown GRAVEL with silt and sand (GP-GM); moist.	15.5		16	
17.5		Stiff, gray with orange-brown mottled CLAY (CH), trace sand; moist.	17.5			
20				PP	8	PP = 3.5 tsf
23.0		Medium stiff, gray-brown, sandy SILT (ML); moist, sand is fine to medium.	23.0			
25					5	
28.0		Medium dense, gray-brown SAND with silt (SP-SM); moist, sand is fine to medium.	28.0			
30					12	
31.5		Exploration completed at a depth of 31.5 feet. Hammer efficiency factor is 90.4 percent.	31.5			Surface elevation was not measured at the time of exploration.
40						

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: J. Pence

COMPLETED: 09/04/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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DPNICOLI-5-01

BORING B-1

NOVEMBER 2018

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-1

BORING LOG DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	INSTALLATION AND COMMENTS
0		Stiff, brown with gray mottled SILT (ML), trace sand; moist, sand is fine (3-inch-thick root zone).				PP = 1.0 tsf
5		medium stiff, minor sand at 5.0 feet				PP = 1.0 tsf
7		soft, brown, with sand at 7.0 feet				PP = 0.5 tsf
15		soft to medium stiff, brown with orange-brown mottles; sand is fine to medium at 15.0 feet				PP = 0.5 tsf
18.0		Medium stiff, gray with orange-brown mottled CLAY (CH), trace sand; moist.	18.0			
21.5		Exploration completed at a depth of 21.5 feet. Hammer efficiency factor is 90.4 percent.	21.5	ATT		PP = 3.0 tsf LL = 69% PL = 26% Surface elevation was not measured at the time of exploration.

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: J. Pence

COMPLETED: 09/04/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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DPNICOLI-5-01

BORING B-2

NOVEMBER 2018

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-2

BORING LOG DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18 KM:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▨ RQD% ▩ CORE REC%	INSTALLATION AND COMMENTS
0		Medium stiff, brown SILT (ML), minor sand; moist, sand is fine (3-inch-thick root zone).					
5		soft, with sand at 7.0 feet			P		
					PP	6	PP = 0.75 tsf
					PP	2	PP = 0.5 tsf
10					P200	2	P200 = 75%
15		very soft at 15.0 feet			PP	1	PP = 0.25 tsf
18.0		Medium stiff, gray with orange-brown mottled CLAY (CH), trace sand; moist.	18.0				
20					PP	6	PP = 2.25 tsf
21.5		Exploration completed at a depth of 21.5 feet. Hammer efficiency factor is 90.4 percent.	21.5				Surface elevation was not measured at the time of exploration.
25							
30							
35							
40							

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: J. Pence

COMPLETED: 09/04/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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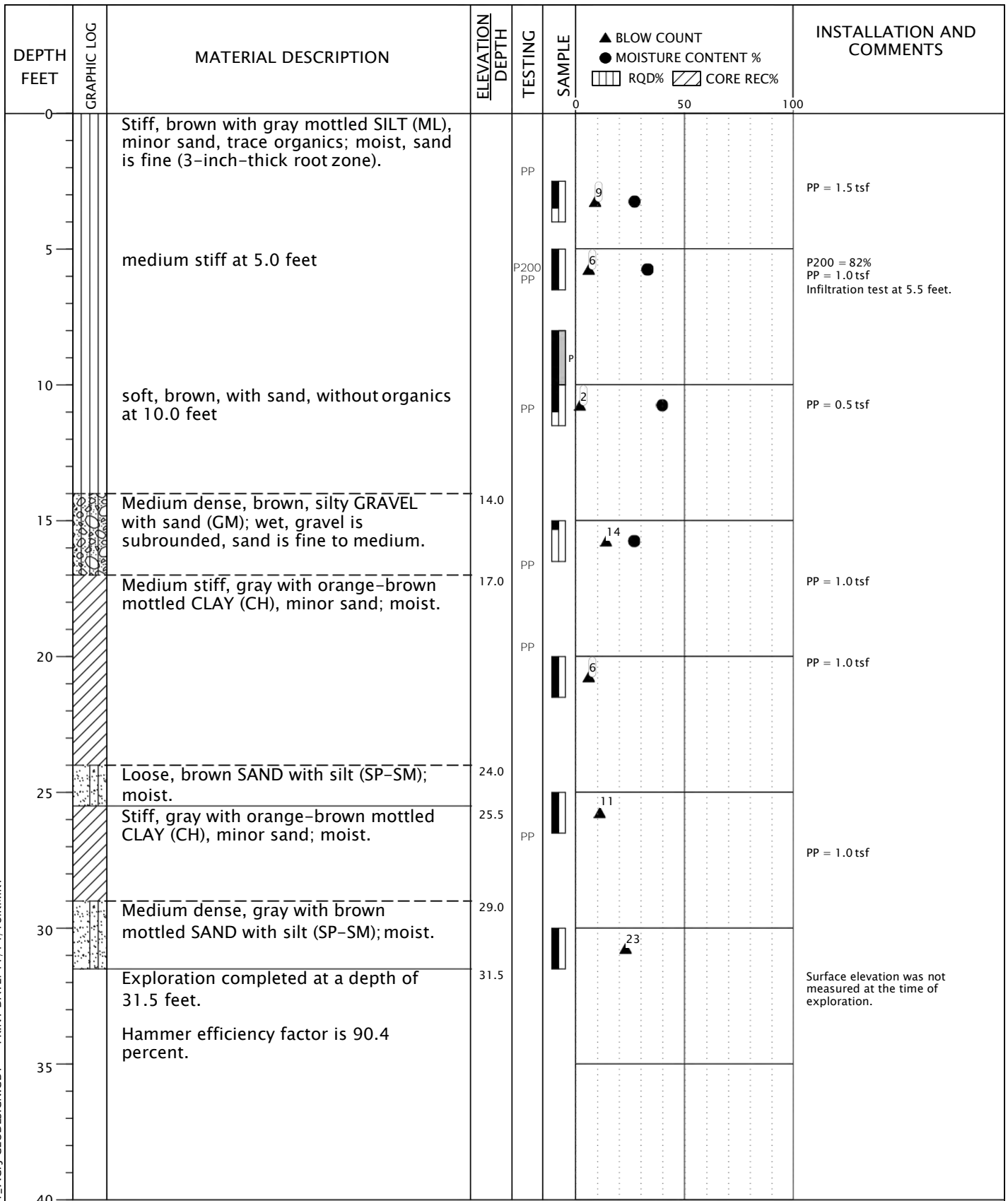
DPNICOLI-5-01

BORING B-3

NOVEMBER 2018

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-3



BORING LOG DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: J. Pence

COMPLETED: 09/04/18

BORING METHOD: hollow-stem auger and mud rotary (see document text)

BORING BIT DIAMETER: 4 inches/3 inches



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BORING B-4

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-4

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	INSTALLATION AND COMMENTS
0		Medium stiff, brown with gray mottled SILT (ML), minor sand; moist, sand is fine (3-inch-thick root zone).				PP = 2.5 tsf PP = 3.0 tsf
5		brown, with sand at 7.0 feet				PP = 1.0 tsf PP = 1.5 tsf PP = 1.6 tsf
10		soft, sandy at 10.0 feet				
15		Medium dense to dense, brown GRAVEL with sand (GP), trace to minor silt; moist, gravel is subangular.	14.5			
20		Medium stiff, gray CLAY (CH), trace organics; moist.	18.5			PP = 2.0 tsf PP = 3.5 tsf
21.5		Exploration completed at a depth of 21.5 feet. Hammer efficiency factor is 90.4 percent.	21.5			Surface elevation was not measured at the time of exploration.
25						
30						
35						
40						

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: T. Hainley

COMPLETED: 09/05/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches

BORING LOG DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT



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NOVEMBER 2018

BORING B-5

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-5

BORING LOG DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18:KM:KT

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▨ RQD% ▩ CORE REC%	INSTALLATION AND COMMENTS
0		Stiff, brown SILT (ML), trace sand; moist, sand is fine (4-inch-thick-root zone).					
5		medium stiff, trace organics (carbonized wood) at 5.0 feet					PP = 2.0 tsf PP = 1.8 tsf
7.5		soft to medium stiff, sandy at 7.5 feet					PP = 0.8 tsf PP = 0.5 tsf
10		sandy, without organics; sand is fine to medium at 10.0 feet					PP = 0.4 tsf PP = 0.6 tsf
15		medium stiff at 15.0 feet with gravel at 16.3 feet					P200 = 64%
18.0		Medium dense, gray-brown with orange mottled, silty GRAVEL with sand (GM), trace clay; moist to wet.	18.0				Driller Comment: gravel at approximately 14.5 feet.
21.5		Exploration completed at a depth of 21.5 feet. Hammer efficiency is 90.4 feet.	21.5				Surface elevation was not measured at the time of exploration.

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: T. Hainley

COMPLETED: 09/05/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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DPNICOLI-5-01

BORING B-6

NOVEMBER 2018

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-6

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	INSTALLATION AND COMMENTS
0		Medium stiff, brown SILT (ML), trace to minor sand, trace organics (rootlets); moist, sand is fine (4-inch-thick root zone).				
5		with sand at 5.0 feet without organics at 6.3 feet		PP		PP = 1.0 tsf
10		sandy; sand is fine to medium at 10.0 feet		PP PP		PP = 1.0 tsf PP = 0.8 tsf
15		Medium dense, brown SAND with silt and gravel (SP-SM); moist, sand is medium to coarse.	15.0			
20		gray-brown with orange mottles, trace clay at 20.0 feet				
21.5		Exploration completed at a depth of 21.5 feet. Hammer efficiency factor is 90.4 percent.	21.5			Surface elevation was not measured at the time of exploration.
25						
30						
35						
40						

DRILLED BY: Western States Soil Conservation, Inc.

LOGGED BY: T. Hainley

COMPLETED: 09/05/18

BORING METHOD: mud rotary (see document text)

BORING BIT DIAMETER: 3 inches



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DPNICOLI-5-01

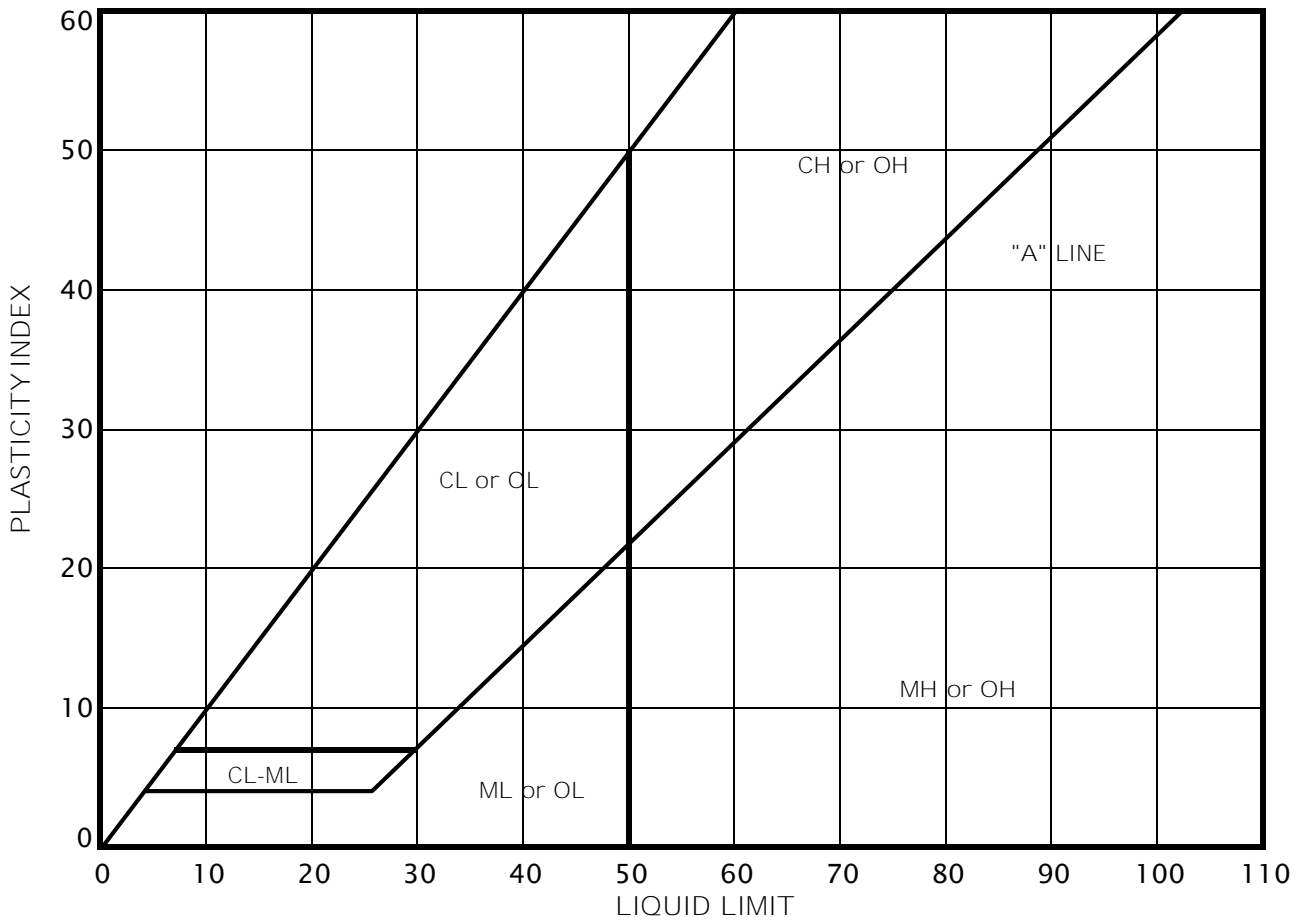
BORING B-7

NOVEMBER 2018

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-7

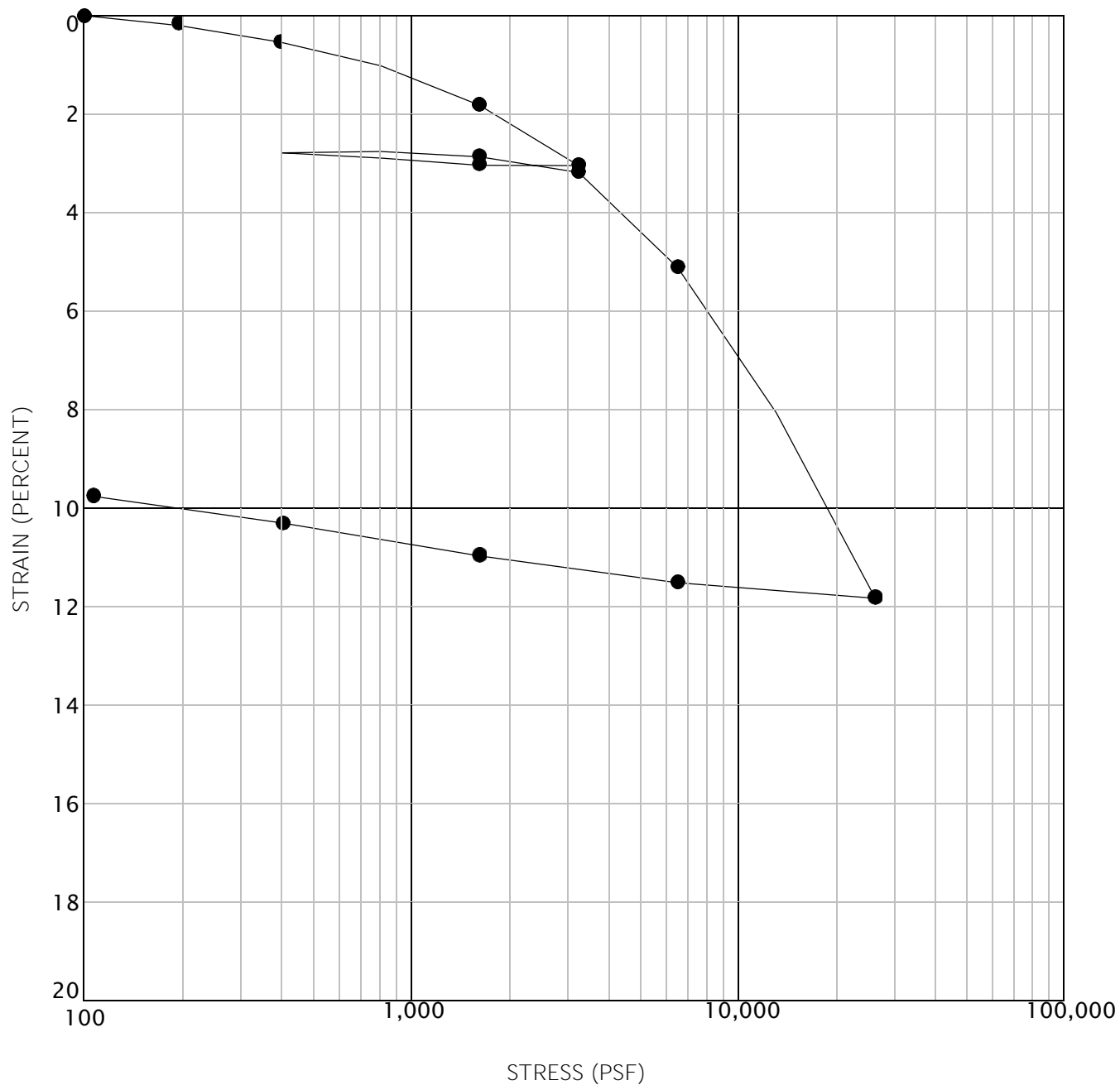
BORING LOG DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/14/18 10:18 AM



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-2	20.0	44	69	26	43

ATTERBERG_LIMITS 7 DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/13/18:KT

CONSOL_STRAIN_100K DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/13/18:KT



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)
●	B-1	10.0	37	85

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		31							
B-1	5.0		36							
B-1	10.0		37	85						
B-1	20.0		38							
B-2	2.5		26							
B-2	7.5		38							
B-2	20.0		44				69	26	43	
B-3	2.5		35							
B-3	5.0		37							
B-3	10.0		42			75				
B-4	2.5		27							
B-4	5.0		33			82				
B-4	10.0		40							
B-4	15.0		27							
B-5	2.5		29							
B-5	10.0		40							
B-5	15.0		15							
B-6	2.5		30							
B-6	5.0		36							
B-6	10.0		37			64				
B-7	2.5		26							
B-7	5.0		37							
B-7	10.0		36							

LAB SUMMARY DPNICOLI-5-01-B1_7.GPJ GEODESIGN.GDT PRINT DATE: 11/13/18:KT



DPNICOLI-5-01

NOVEMBER 2018

SUMMARY OF LABORATORY DATA

WILSONVILLE FACILITIES
WILSONVILLE, OR

FIGURE A-10

Summary of SPT Test Results

Project: WSSC-8-02, Test Date: 12/29/2017

EMX: Maximum Energy				ETR: Energy Transfer Ratio - Rated		
Instr. Length ft	Start Depth ft	Final Depth ft	N Value	N60 Value	Average EMX ft-lb	Average ETR %
15.00	0.00	0.00	0	0	317	90.4
Overall Average Values:					317	90.4
Standard Deviation:					10	2.8
Overall Maximum Value:					335	95.7
Overall Minimum Value:					293	83.7

APPENDIX B

APPENDIX B

DCP TESTING

DCP DATA

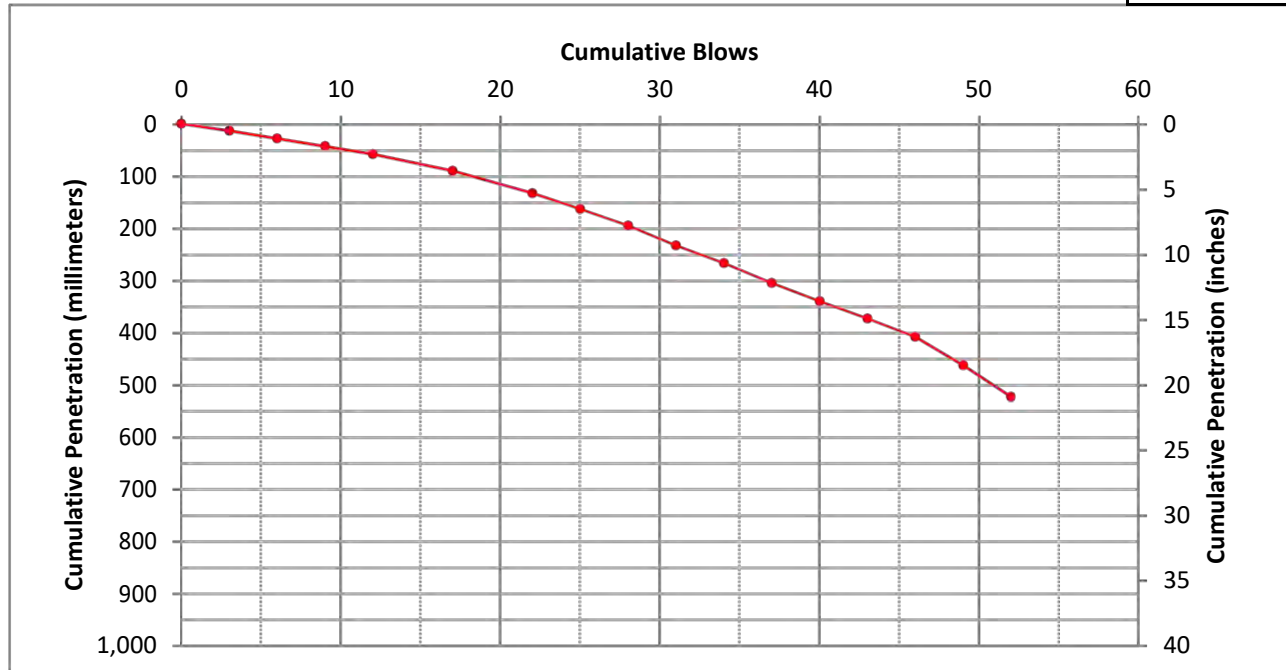
GeoDesign performed DCP testing of the base material and subgrade soil at each boring location on September 4 and 5, 2018. We conducted tests in general accordance with ASTM D6951. We recorded penetration depth of the cone for each blow of the hammer and terminated testing when at refusal of penetration or end of rod length. We summarized the data by plotting depth of penetration versus blow count. Plots of the summarized DCP test data are presented in this appendix.

RESILIENT MODULUS ESTIMATION

Using the summarized DCP test data, we visually assessed where slopes of the data are relatively constant and at which depths they change significantly. We used changes in slope with depth to identify transitions between soil strata with differing shear resistance characteristics. We used least squares regression to determine the slopes and the equation shown on the data sheets to estimate the resilient modulus of each stratum using a correction factor $C_f = 0.35$ for subgrade soil. In cases where we encountered strata with distinctly different shear resistance characteristics, we used Odemark's Method of Equivalent Thickness to estimate an equivalent resilient modulus of the combined strata.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-1

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	5.3	0.35	8,980
2	Subgrade below AC and aggregate base	12.1	0.35	6,480
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,870



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

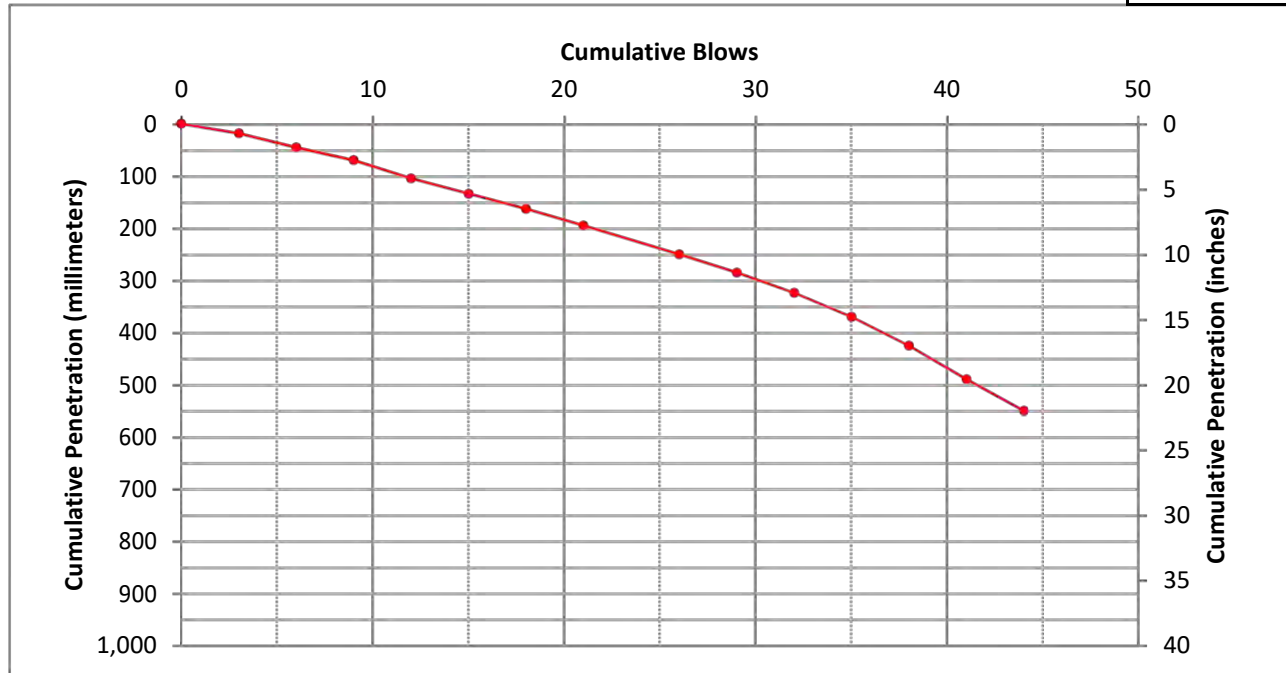
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-2

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	10.2	0.35	6,930
2	Subgrade below AC and aggregate base	19.1	0.35	5,430
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,280



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

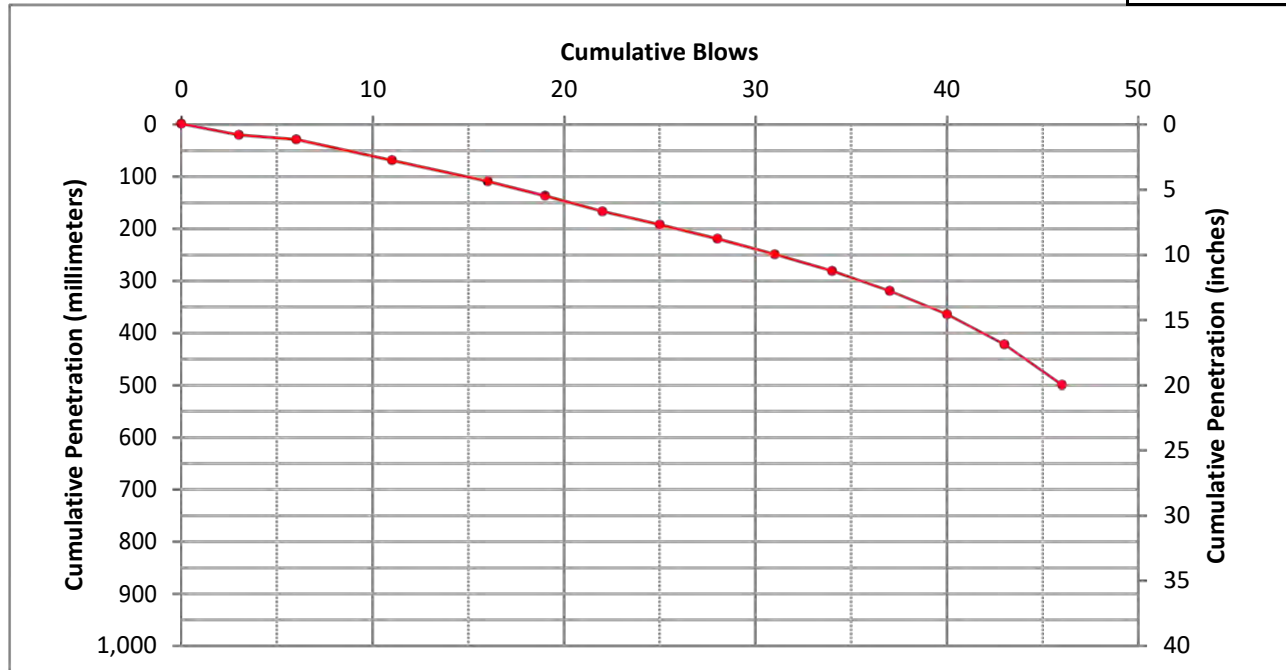
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-3

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	9.2	0.35	7,210
2	Subgrade below AC and aggregate base	19.9	0.35	5,340
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,450



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-4

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	12.4	0.35	6,430
2		---	---	---
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				---



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

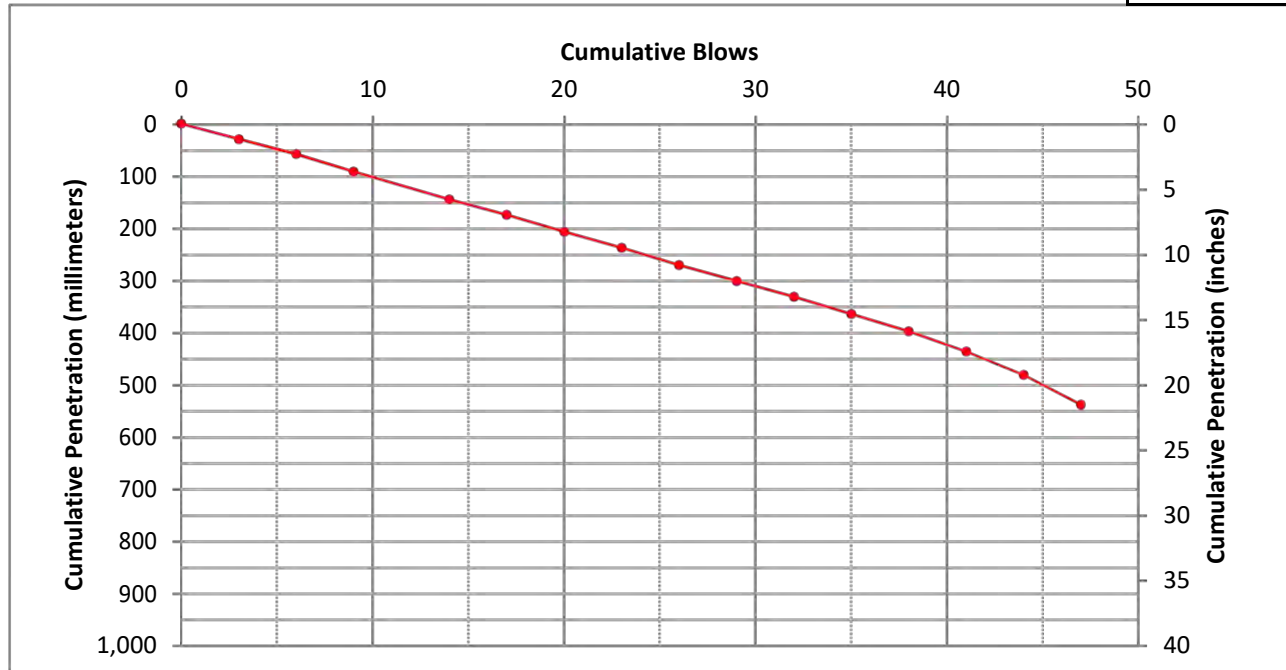
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-5

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	10.5	0.35	6,860
2	Subgrade below AC and aggregate base	15.6	0.35	5,880
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,590



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

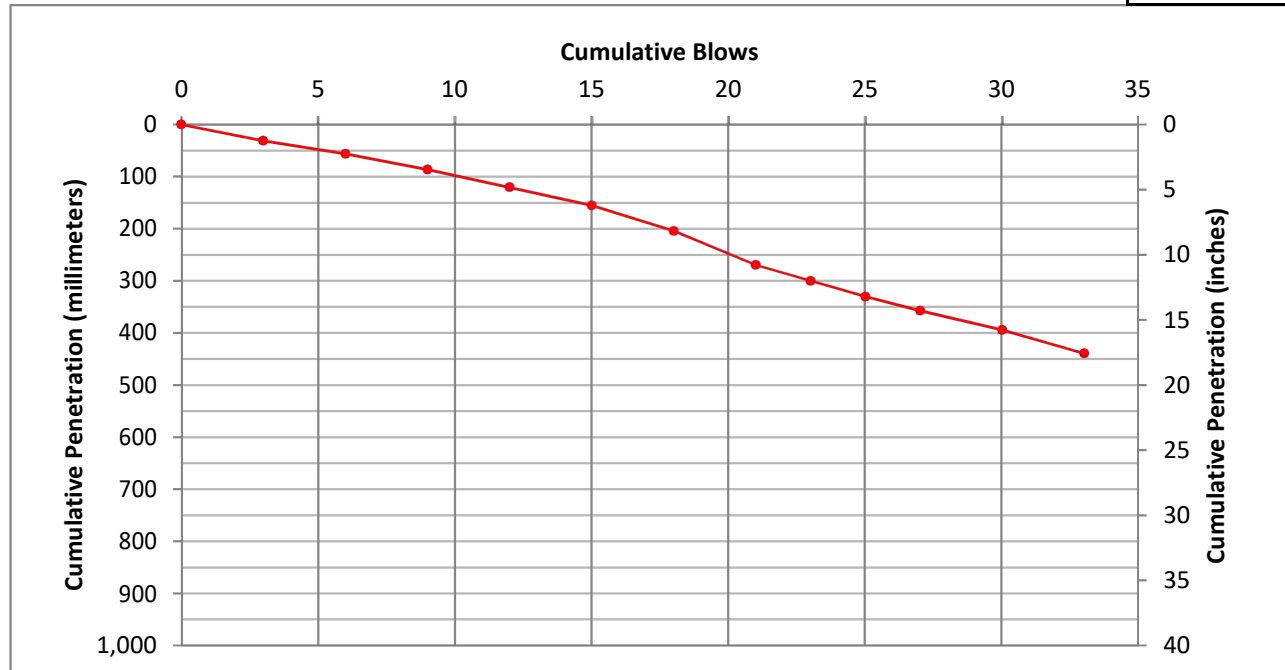
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-6

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	10.2	0.35	6,930
2	Subgrade below AC and aggregate base	13.9	0.35	6,140
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				6,510



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

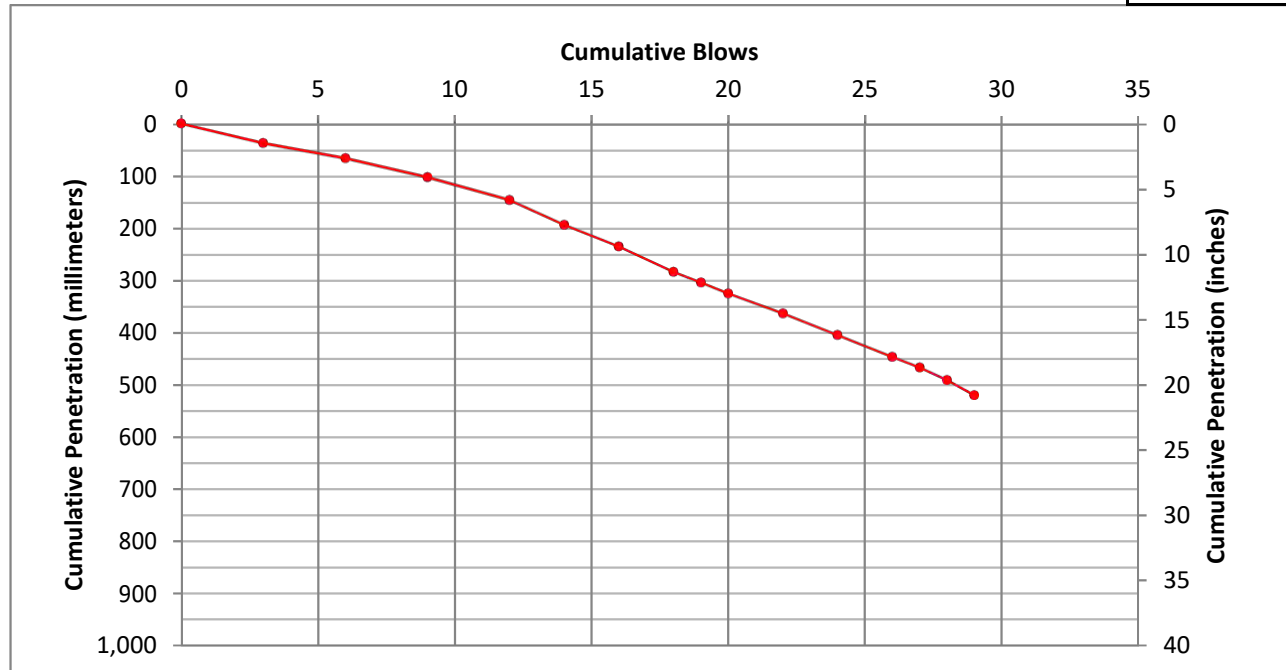
ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

DYNAMIC CONE PENETROMETER RESULTS - BORING B-7

Layer	Layer Type and Location	Slope (mm/blow)	C _f	M _R (psi)
1	Subgrade below AC and aggregate base	11.9	0.35	6,530
2	Subgrade below AC and aggregate base	21.3	0.35	5,210
3		---	---	---
Equivalent subgrade modulus based on Odemark's Method of Equivalent Thickness				5,560



$$M_R = C_f \times 49023 \times S^{-0.39}$$

M_R = resilient modulus (pounds per square inch)

C_f = conversion coefficient

S = slope (millimeters per blow)

References:

ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, April 2011.

Jianzhou Chen, Mustaque Hossain, and Todd M. LaTorella, "Use of Falling Weight Deflectometer and Dynamic Cone Penetrometer in Pavement Evaluation," *Paper No. 99-1007*, Transportation Research Record 1655, pp 145-151, Transportation Research Board, Washington, D.C., 1999.

Per Ullidtz, *Modelling Flexible Pavement Response and Performance*, Tech Univ. of Denmark Polytekn, 1998.

APPENDIX C

APPENDIX C

PAVEMENT DESIGN REPORTS AND CALCULATION SHEETS

STORAGE YARD

We performed our pavement designs for the storage yard using PCASE. The reports generated by PCASE are presented in this appendix. Acronyms and abbreviations used in the PCASE reports are listed below.

CBR	California Bearing Ratio
in	inches
LED	layered-elastic design
N/A	not applicable
NFS	non-frost susceptible
Pr	Poisson's ratio
psi	pounds per square inch
SCI	structural condition index

OTHER PAVEMENT AREAS

We used the methods presented in the AASHTO guide for flexible pavement design and the Pavement Designer design tools for rigid pavement design for the other pavement areas. The AASHTO method calculation sheets and the Pavement Designer reports are presented in this appendix.

Pavement Design Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : GRVL_10YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	18.75	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	65000	1
HYSTER H230HD2 - HALF LOAD	45144	260000	260000
HYSTER H230HD2 - HALF LOAD	45144		260001

Pavement Design Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : GRVL_15YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	19.41	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	97500	1
HYSTER H230HD2 - HALF LOAD	45144	390000	390000
HYSTER H230HD2 - HALF LOAD	45144		390001

Pavement Design Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : GRVL_20YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	19.87	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	130000	1
HYSTER H230HD2 - HALF LOAD	45144	520000	520000
HYSTER H230HD2 - HALF LOAD	45144		520001

Pavement Design Report
U.S. Army Corps of Engineers
PCASE Version 2.09.05
Date : 11/1/2018

Design Name : RVL_CAS_10YR
Design Type : Roads
Pavement Type : Unsurfaced
Road Type : Road
Terrain Type : Flat
Analysis Type : CBR
Depth of Frost (in) : 0
Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	6.75	0	0	100
Stabilized Subbase	PCC Stab-ML,MH,CL,CH	NFS	Manual	12	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	65000	1
HYSTER H230HD2 - HALF LOAD	45144	260000	260000
HYSTER H230HD2 - HALF LOAD	45144		260001

Pavement Design Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RVL_CAS_15YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	7.41	0	0	100
Stabilized Subbase	PCC Stab-ML,MH,CL,CH	NFS	Manual	12	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	97500	1
HYSTER H230HD2 - HALF LOAD	45144	390000	390000
HYSTER H230HD2 - HALF LOAD	45144		390001

Pavement Design Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RVL_CAS_20YR
 Design Type : Roads
 Pavement Type : Unsurfaced
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : CBR
 Depth of Frost (in) : 0
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Frost Code	Analysis	Non frost Design Thickness (in)	Reduced Subgrade Strength (in)	Limited Subgrade Penetration (in)	CBR Strength
Unsurfaced	Unbound Aggregate	NFS	Compute	7.87	0	0	100
Stabilized Subbase	PCC Stab-ML,MH,CL,CH	NFS	Manual	12	0	0	100
Natural Subgrade	Cohesive Cut	NFS	Manual	0	0	0	4

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span	Equivalent Passes
5-AXLE TRUCK	80000	130000	1
HYSTER H230HD2 - HALF LOAD	45144	520000	520000
HYSTER H230HD2 - HALF LOAD	45144		520001

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : FLEX_10YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Manual	8.5	Yes	450000	0.35	0
Base	Unbound	Compute	15.9	N/A	20000	0.35	0
Natural Subgrade	Crushed Stone Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	65000
HYSTER H230HD2 - HALF LOAD	45144	260000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : FLEX_15YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Manual	9	Yes	450000	0.35	0
Base	Unbound	Compute	15.83	N/A	20000	0.35	0
Natural Subgrade	Crushed Stone Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	97500
HYSTER H230HD2 - HALF LOAD	45144	390000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : FLEX_20YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Manual	9.5	Yes	450000	0.35	0
Base	Unbound	Compute	15.37	N/A	20000	0.35	0
Natural Subgrade	Crushed Stone Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	130000
HYSTER H230HD2 - HALF LOAD	45144	520000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : FLEX_CAS_10YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Compute	6	Yes	450000	0.35	0
Base	Unbound	Compute	4	N/A	20000	0.35	0
	Crushed Stone						
Stabilized Subbase	PCC Stab- ML,MH,CL,CH	Manual	12	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	65000
HYSTER H230HD2 - HALF LOAD	45144	260000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : FLEX_CAS_15YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Compute	6.5	Yes	450000	0.35	0
Base	Unbound Crushed Stone	Compute	4	N/A	20000	0.35	0
Stabilized Subbase	PCC Stab- ML,MH,CL,CH	Manual	12	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	97500
HYSTER H230HD2 - HALF LOAD	45144	390000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : FLEX_CAS_20YR
 Design Type : Roads
 Pavement Type : Flexible
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35

Layer Information

Layer Type	Material Type	Analysis	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
Asphalt	Asphalt	Compute	6.93	Yes	450000	0.35	0
Base	Unbound	Compute	4	N/A	20000	0.35	0
	Crushed Stone						
Stabilized Subbase	PCC Stab- ML,MH,CL,CH	Manual	12	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	Manual	0	Yes	6380	0.40	0

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	130000
HYSTER H230HD2 - HALF LOAD	45144	520000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RIGID_10YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter: 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	11.28	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	6	N/A	20000	0.35	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	65000
HYSTER H230HD2 - HALF LOAD	45144	260000

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RIGID_15YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter: 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	11.5	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	6	N/A	20000	0.35	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	97500
HYSTER H230HD2 - HALF	45144	390000

LOAD

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RIGID_20YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter: 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	11.65	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	6	N/A	20000	0.35	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	130000
HYSTER H230HD2 - HALF	45144	520000

LOAD

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RIGID_CAS_10YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter: 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	10.63	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	16	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(10-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	65000
HYSTER H230HD2 - HALF	45144	260000

LOAD

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RIGID_CAS_15YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter: 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	10.87	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	16	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(15-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	97500
HYSTER H230HD2 - HALF	45144	390000

LOAD

Pavement Thickness Report
 U.S. Army Corps of Engineers
PCASE Version 2.09.05
 Date : 11/1/2018

Design Name : RIGID_CAS_20YR
 Design Type : Roads
 Pavement Type : Rigid
 Traffic Area : N/A
 Road Type : Road
 Terrain Type : Flat
 Analysis Type : LED
 SCI : 50
 Wander Width (in) : 33.35
 % Load Transfer : 25
 Joint Spacing : 15 to 20 ft
 Dowel Spacing : 12.00 in
 Dowel Length : 16.00 in
 Dowel Diameter: 1.00 in

Layer Information

Layer Type	Material Type	Flexural Strength (psi)	Analysis	Minimum Thickness (in)	Design Thickness (in)	Calculate at this Depth	Modulus (psi)	Pr	Slip
PCC	N/A	600	Compute	6	11.03	N/A	4000000	0.15	1000
Base	Unbound Crushed Stone	0	Manual	4	16	N/A	120000	0.25	0
Natural Subgrade	Cohesive Cut	0	Manual	4	0	No	6380	0.40	0

Traffic Information

Pattern Name : YARD(20-YEAR)

Vehicles	Weight (lb)	Passes per Life Span
5-AXLE TRUCK	80000	130000
HYSTER H230HD2 - HALF	45144	520000

LOAD

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01	AC on aggregate base				
Date: 23-Oct-18	Parking and Drive Aisles				
Design life (years) = 20					
INPUTS FOR STRUCTURAL NUMBER (SN) CALCULATIONS					
Variable	Value	Reference	Coefficient	Value	Reference
S ₀ =	0.49	I-62, III-51	m ₂ (Base) =	1.00	II-26
Subgrade M _R =	6,380	I-14	m ₃ (Subbase) =	1.00	II-26
p ₀ =	4.2	II-12	a ₁ (AC) =	0.42	II-19
p _t =	2.5	II-12	a ₂ (Base) =	0.10	II-20
ΔPSI =	1.7	II-12	a ₃ (Subbase) =	0.08	II-20
Design ESALs =	see below				

MINIMUM ASPHALT CONCRETE THICKNESS

Base Rock M_R = 20,000 psi

	Parking	Drive,ADTT=10	Drive,ADTT=25	Drive,ADTT=50
Reliability (Ref II-9)	80	80	80	80
Z _R	-0.841	-0.841	-0.841	-0.841
ESALs	10,000	84,000	210,000	419,000
SN estimate	0.947	1.452	1.713	1.930
ESALs from SN est.	10,000	84,000	210,000	419,000
FINAL SN =	0.95	1.46	1.72	1.94
Min AC Thickness	2.26	3.48	4.10	4.62

	Parking	Drive,ADTT=10	Drive,ADTT=25	Drive,ADTT=50
Resilient Modulus	6,380	6,380	6,380	6,380
ESALs	10,000	84,000	210,000	419,000
SN estimate	1.597	2.302	2.681	3.007
ESALs from SN est.	10,000	84,000	210,000	419,000
FINAL SN =	1.60	2.31	2.69	3.01

If LOCK AC is set to "1", the Calc AC button will not change AC thickness value

NEW PAVEMENT ANALYSIS

					LOCK AC
New Pavement, Parking					0
					10,000 ESALs
Coefficient	Value	Ref	SN=a ₁ ×D ₁ +a ₂ ×D ₂ ×m ₂ +a ₃ ×D ₃ ×m ₃		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	2.5	1.05	1.05
a ₂ (Base)	0.10	II-20	5.5	0.55	1.60
a ₃ (Subbase)	0.08	II-20	0.0	0.00	1.60
Total Thickness					8.00
					LOCK AC
New Pavement, Drive,ADTT=10					0
					84,000 ESALs
Coefficient	Value	Ref	SN=a ₁ ×D ₁ +a ₂ ×D ₂ ×m ₂ +a ₃ ×D ₃ ×m ₃		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	3.5	1.47	1.47
a ₂ (Base)	0.10	II-20	8.5	0.85	2.32
a ₃ (Subbase)	0.08	II-20	0.0	0.00	2.32
					12.00

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01	AC on aggregate base
Date: 23-Oct-18	Parking and Drive Aisles
Design life (years) = 20	

					LOCK AC
New Pavement, Drive,ADTT=25			210,000 ESALs		0
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	4.5	1.89	1.89
a ₂ (Base)	0.10	II-20	8.5	0.85	2.74
a ₃ (Subbase)	0.08	II-20	0.0	0.00	2.74
			13.00		

					LOCK AC
New Pavement, Drive,ADTT=50			419,000 ESALs		0
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	5.0	2.10	2.10
a ₂ (Base)	0.10	II-20	9.5	0.95	3.05
a ₃ (Subbase)	0.08	II-20	0.0	0.00	3.05
			14.50		

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01		AC on aggregate base			
Date: 23-Oct-18		Access Road			
Design life (years) = 20					
INPUTS FOR STRUCTURAL NUMBER (SN) CALCULATIONS					
Variable	Value	Reference	Coefficient	Value	Reference
S ₀ =	0.49	I-62, III-51	m ₂ (Base) =	1.00	II-26
Subgrade M _R =	6,380	I-14	m ₃ (Subbase) =	1.00	II-26
p ₀ =	4.2	II-12	a ₁ (AC) =	0.42	II-19
p _t =	2.5	II-12	a ₂ (Base) =	0.10	II-20
ΔPSI =	1.7	II-12	a ₃ (Subbase) =	0.08	II-20
Design ESALs =	see below				

MINIMUM ASPHALT CONCRETE THICKNESS

Base Rock M_R = 20,000 psi

	Access,ADTT=10	Access,ADTT=25	Access,ADTT=50	Alternative 4
Reliability (Ref II-9)	80	80	80	80
Z _R	-0.841	-0.841	-0.841	-0.841
ESALs	147,000	210,000	314,000	147,000
SN estimate	1.608	1.713	1.837	1.608
ESALs from SN est.	147,000	210,000	314,000	147,000
FINAL SN =	1.61	1.72	1.84	1.61
Min AC Thickness	3.83	4.10	4.38	3.83

	Access,ADTT=10	Access,ADTT=25	Access,ADTT=50	Alternative 4
Resilient Modulus	6,380	6,380	6,380	6,380
ESALs	147,000	210,000	314,000	147,000
SN estimate	2.527	2.681	2.867	2.527
ESALs from SN est.	147,000	210,000	314,000	147,000
FINAL SN =	2.53	2.69	2.87	2.53

If LOCK AC is set to "1", the Calc AC button will not change AC thickness value

NEW PAVEMENT ANALYSIS

LOCK AC					
New Pavement, Access,ADTT=10				147,000 ESALs	
0					
Coefficient	Value	Ref	$SN = a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	4.0	1.68	1.68
a ₂ (Base)	0.10	II-20	8.5	0.85	2.53
a ₃ (Subbase)	0.08	II-20	0.0	0.00	2.53
Total Thickness	12.50				

LOCK AC					
New Pavement, Access,ADTT=25				210,000 ESALs	
0					
Coefficient	Value	Ref	$SN = a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	4.5	1.89	1.89
a ₂ (Base)	0.10	II-20	8.5	0.85	2.74
a ₃ (Subbase)	0.08	II-20	0.0	0.00	2.74
	13.00				

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01	AC on aggregate base
Date: 23-Oct-18	Access Road
Design life (years) = 20	

New Pavement, Access,ADTT=50				314,000 ESALs		LOCK AC
						0
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$			
m ₂ (Base)	1.00	II-26				
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN	
a ₁ (AC)	0.42	II-19	4.5	1.89	1.89	
a ₂ (Base)	0.10	II-20	10.0	1.00	2.89	
a ₃ (Subbase)	0.08	II-20	0.0	0.00	2.89	
			14.50			

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01	AC on cement-amended soil				
Date: 23-Oct-18	Parking and Drive Aisles				
Design life (years) = 20					
INPUTS FOR STRUCTURAL NUMBER (SN) CALCULATIONS					
Variable	Value	Reference	Coefficient	Value	Reference
S ₀ =	0.49	I-62, III-51	m ₂ (Base) =	1.00	II-26
Subgrade M _R =	6,380	I-14	m ₃ (Subbase) =	1.00	II-26
p ₀ =	4.2	II-12	a ₁ (AC) =	0.42	II-19
p _t =	2.5	II-12	a ₂ (Base) =	0.10	II-20
ΔPSI =	1.7	II-12	a ₃ (Subbase) =	0.08	II-20
Design ESALs =	see below				

MINIMUM ASPHALT CONCRETE THICKNESS

Base Rock M_R = 120,000 psi

	Parking	Drive,ADTT=10	Drive,ADTT=25	Drive,ADTT=50
Reliability (Ref II-9)	80	80	80	80
Z _R	-0.841	-0.841	-0.841	-0.841
ESALs	10,000	84,000	210,000	419,000
SN estimate	0.248	0.566	0.728	0.861
ESALs from SN est.	10,000	84,000	210,000	419,000
FINAL SN =	0.25	0.57	0.73	0.87
Min AC Thickness	0.60	1.36	1.74	2.07

	Parking	Drive,ADTT=10	Drive,ADTT=25	Drive,ADTT=50
Resilient Modulus	6,380	6,380	6,380	6,380
ESALs	10,000	84,000	210,000	419,000
SN estimate	1.597	2.302	2.681	3.007
ESALs from SN est.	10,000	84,000	210,000	419,000
FINAL SN =	1.60	2.31	2.69	3.01

If LOCK AC is set to "1", the Calc AC button will not change AC thickness value

NEW PAVEMENT ANALYSIS

					LOCK AC
New Pavement, Parking					0
					10,000 ESALs
Coefficient	Value	Ref	SN=a ₁ ×D ₁ +a ₂ ×D ₂ ×m ₂ +a ₃ ×D ₃ ×m ₃		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	2.5	1.05	1.05
a ₂ (Base)	0.10	II-20	5.5	0.55	1.60
a ₃ (Subbase)	0.08	II-20		0.00	1.60
Total Thickness					8.00
					LOCK AC
New Pavement, Drive,ADTT=10					0
					84,000 ESALs
Coefficient	Value	Ref	SN=a ₁ ×D ₁ +a ₂ ×D ₂ ×m ₂ +a ₃ ×D ₃ ×m ₃		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	3.0	1.26	1.26
a ₂ (Base)	0.10	II-20	10.5	1.05	2.31
a ₃ (Subbase)	0.08	II-20		0.00	2.31
					13.50

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01	AC on cement-amended soil
Date: 23-Oct-18	Parking and Drive Aisles
Design life (years) = 20	

				LOCK AC	
New Pavement, Drive,ADTT=25			210,000 ESALs		
			0		
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	4.0	1.68	1.68
a ₂ (Base)	0.10	II-20	10.5	1.05	2.73
a ₃ (Subbase)	0.08	II-20		0.00	2.73
			14.50		

				LOCK AC	
New Pavement, Drive,ADTT=50			419,000 ESALs		
			0		
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$		
m ₂ (Base)	1.00	II-26			
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN
a ₁ (AC)	0.42	II-19	4.5	1.89	1.89
a ₂ (Base)	0.10	II-20	11.5	1.15	3.04
a ₃ (Subbase)	0.08	II-20		0.00	3.04
			16.00		

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01		AC on cement-amended soil			
Date: 23-Oct-18		Access Road			
Design life (years) = 20					
INPUTS FOR STRUCTURAL NUMBER (SN) CALCULATIONS					
Variable	Value	Reference	Coefficient	Value	Reference
S ₀ =	0.49	I-62, III-51	m ₂ (Base) =	1.00	II-26
Subgrade M _R =	6,380	I-14	m ₃ (Subbase) =	1.00	II-26
p ₀ =	4.2	II-12	a ₁ (AC) =	0.42	II-19
p _t =	2.5	II-12	a ₂ (Base) =	0.10	II-20
ΔPSI =	1.7	II-12	a ₃ (Subbase) =	0.08	II-20
Design ESALs =	see below				

MINIMUM ASPHALT CONCRETE THICKNESS

Base Rock M_R = 120,000 psi

	Access,ADTT=10	Access,ADTT=25	Access,ADTT=50	Alternative 4
Reliability (Ref II-9)	80	80	80	80
Z _R	-0.841	-0.841	-0.841	-0.841
ESALs	147,000	210,000	314,000	147,000
SN estimate	0.663	0.728	0.804	0.663
ESALs from SN est.	147,000	210,000	314,000	147,000
FINAL SN =	0.67	0.73	0.81	0.67

	Access,ADTT=10	Access,ADTT=25	Access,ADTT=50	Alternative 4
Min AC Thickness	1.60	1.74	1.93	1.60
Resilient Modulus	6,380	6,380	6,380	6,380
ESALs	147,000	210,000	314,000	147,000
SN estimate	2.527	2.681	2.867	2.527
ESALs from SN est.	147,000	210,000	314,000	147,000
FINAL SN =	2.53	2.69	2.87	2.53

If LOCK AC is set to "1", the Calc AC button will not change AC thickness value

NEW PAVEMENT ANALYSIS

New Pavement, Access,ADTT=10						147,000 ESALs	LOCK AC
						0	
Coefficient	Value	Ref	SN=a ₁ ×D ₁ +a ₂ ×D ₂ ×m ₂ +a ₃ ×D ₃ ×m ₃				
m ₂ (Base)	1.00	II-26					
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN		
a ₁ (AC)	0.42	II-19	3.5	1.47	1.47		
a ₂ (Base)	0.10	II-20	11.0	1.10	2.57		
a ₃ (Subbase)	0.08	II-20		0.00	2.57		
Total Thickness			14.50				

New Pavement, Access,ADTT=25						210,000 ESALs	LOCK AC
						0	
Coefficient	Value	Ref	SN=a ₁ ×D ₁ +a ₂ ×D ₂ ×m ₂ +a ₃ ×D ₃ ×m ₃				
m ₂ (Base)	1.00	II-26					
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN		
a ₁ (AC)	0.42	II-19	4.0	1.68	1.68		
a ₂ (Base)	0.10	II-20	10.5	1.05	2.73		
a ₃ (Subbase)	0.08	II-20		0.00	2.73		
Total Thickness			14.50				

1993 AASHTO FLEXIBLE PAVEMENT DESIGN

Job ID: DPNicoli-5-01	AC on cement-amended soil
Date: 23-Oct-18	Access Road
Design life (years) = 20	

New Pavement, Access,ADTT=50				314,000 ESALs		LOCK AC
						0
Coefficient	Value	Ref	$SN=a_1 \times D_1 + a_2 \times D_2 \times m_2 + a_3 \times D_3 \times m_3$			
m ₂ (Base)	1.00	II-26				
m ₃ (Subbase)	1.00	II-26	Thickness	SN	Total SN	
a ₁ (AC)	0.42	II-19	4.0	1.68	1.68	
a ₂ (Base)	0.10	II-20	12.0	1.20	2.88	
a ₃ (Subbase)	0.08	II-20		0.00	2.88	
			16.00			



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 17:47:00 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.00 in.	6.00 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	5.77 in.	5.77 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 20
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 20
 Total Trucks in Design Lane Over the Design Life: 146,100

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 17:51:00 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.00 in.	6.00 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	5.91 in.	5.91 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 35
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 35
 Total Trucks in Design Lane Over the Design Life: 255,675

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 17:51:51 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.00 in.	6.00 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	6.00 in.	6.00 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 50
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 50
 Total Trucks in Design Lane Over the Design Life: 365,250

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 17:52:42 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.25 in.	6.25 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	6.09 in.	6.09 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 75
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 75
 Total Trucks in Design Lane Over the Design Life: 547,875

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 17:53:25 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	6.25 in.	6.25 in.	Maximum Joint Spacing:	10 ft.	10 ft.
Calculated Minimum Thickness:	6.16 in.	6.16 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 327 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	6 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 100
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 17:53:26 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.50 in.	5.50 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.33 in.	5.33 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobuffers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 20
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 20
 Total Trucks in Design Lane Over the Design Life: 146,100

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 18:13:09 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.50 in.	5.50 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.46 in.	5.46 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobuffers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 35
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 35
 Total Trucks in Design Lane Over the Design Life: 255,675

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 18:14:38 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.75 in.	5.75 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.54 in.	5.54 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 50
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 50
 Total Trucks in Design Lane Over the Design Life: 365,250

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 18:15:20 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.75 in.	5.75 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.63 in.	5.63 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrobbers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 75
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 75
 Total Trucks in Design Lane Over the Design Life: 547,875

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



**DESIGN SUMMARY REPORT FOR
JOINTED-PLAIN CONCRETE PAVEMENT (JPCP)**

DATE CREATED:

Sat Oct 27 2018 18:16:02 GMT-0700 (Pacific Daylight Time)

Project Description

Project Name: DPNicoli-5-01 Owner: D.P. Nicoli Zip Code:
 Designer's Name: TVS Route:
 Project Description:

Design Summary

	Doweled	Undoweled		Doweled	Undoweled
Recommended Design Thickness:	5.75 in.	5.75 in.	Maximum Joint Spacing:	8 ft.	8 ft.
Calculated Minimum Thickness:	5.70 in.	5.70 in.			

Pavement Structure

SUBBASE

Calculated Composite K-Value of Substructure: 593 psi/in

Layer Type	Resilient Modulus	Layer Thickness
JOINTED PLAIN CONCRETE SURFACE		
Granular Base	20,000 psi	4 in
Cement Stabilized Subgrade	120,000 psi	12 in
SUBGRADE		

CONCRETE

28-Day Flex Strength: 600 psi Edge Support: Yes
 Modulus of Elasticity: 4000000 psi Macrob fibers in Concrete: No

SUBGRADE

Known MRSG Value: 6,380 psi

Project Level

TRAFFIC

Spectrum Type: Custom Traffic Spectrum
 Design Life: 20 years

USER DEFINED TRAFFIC

Trucks Per Day: 100
 Traffic Growth Rate %: 0 % per year
 Directional Distribution: 100 %
 Design Lane Distribution: 100 %

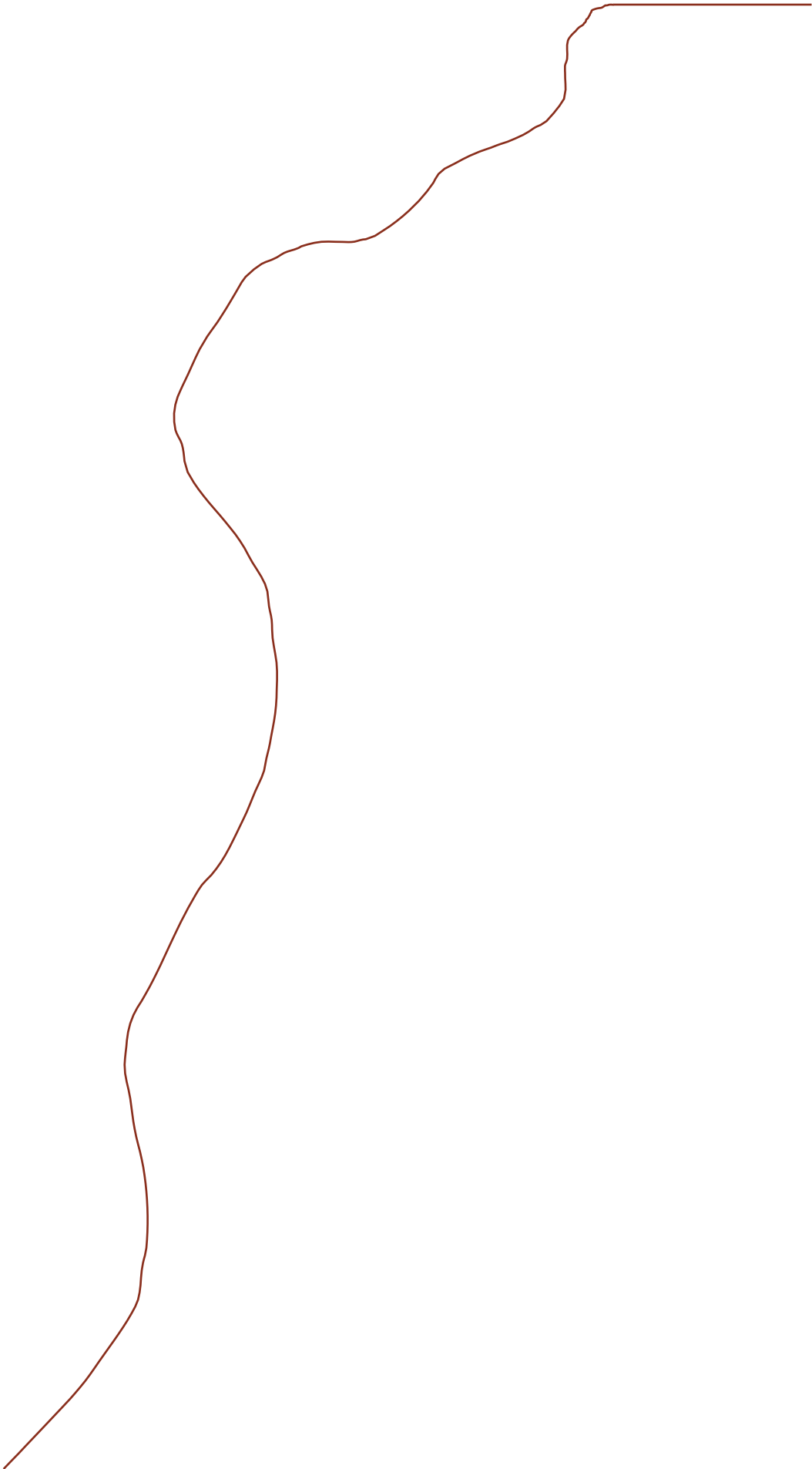
GLOBAL

Reliability: 80 %
 % Slabs Cracked at End of Design Life: 1 %

Avg Trucks/Day in Design Lane Over the Design Life: 100
 Total Trucks in Design Lane Over the Design Life: 730,500

Design Method

The PCA design methodology from StreetPave, was used to produce these results.



Appendix G

Operation and Maintenance Manual

Vegetated, Grassy, and Street Swales Operations & Maintenance Plan

Swales are planted or grassed open channels that trap pollutants by filtering and slowing flows, allowing particles to settle out. The swale should drain within 48 hours of a storm event. All facility components, vegetations, and source controls shall be inspected for proper operations and structural stability, at a minimum, quarterly for the first 2 years from the date of installation, 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

Swale Inlet (such as curb cuts or pipes) shall maintain a calm flow of water entering the swale.

- Source of erosion shall be identified and controlled when native soil is exposed or erosion channels are forming.
- Sediment accumulation shall be hand-removed with minimum damage to vegetation using proper erosion control measures. Sediment shall be removed if it is more than 4" thick as to damage or kill vegetation.
- Inlet shall be cleared when conveyance capacity is plugged. Sources of sediment and debris shall be identified and corrected.
- Rock splash pads shall be replenished to prevent erosion.

Side Slopes shall be maintained to prevent erosion that introduces sediment into the swale.

- Slopes shall be stabilized and planted using appropriate erosion control measures when native soil is exposed or erosion channels are forming.

Swale Media shall allow stormwater to percolated uniformly through the landscape swale. If the swale does not drain within 48 hours, it shall be tilled and replanted according to design specifications.

- Annual or semi-annual tilling shall be implemented if compaction or clogging continues.
- Debris in quantities that inhibit operation shall be removed routinely (e.g., no less than quarterly), or upon discovery.

Swale Outlet shall maintain sheet flow of water exiting swale unless a collection drain is used. Source of erosion damage shall be identified and controlled when native soil is exposed or erosion channels are forming.

- Outlets such as drains and overland flow paths shall be cleared when 50% of the conveyance capacity is plugged.
- Sources of sediment shall be identified and corrected.

Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion. Mulch shall be replenished as needed to ensure survival of vegetation.

- Vegetation, large shrubs or trees that interfere with landscape swale operation shall be pruned.
- Fallen leaves and debris from deciduous plant foliage shall be removed.
- Grassy swales shall be mowed to keep grass 4" to 9" in height.

- Nuisance prohibited vegetation from the Portland Plant List (such as blackberries and English Ivy) shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced.
- Dead vegetation and woody material shall be removed to maintain less than 10% of area coverage of when swale function is impaired. Vegetation shall be replaced within 3 months, or immediately if required to maintain cover density and control erosion where soils are exposed.

Spill Prevention measures shall be exercised when handling substances that contaminate stormwater. Releases of pollutants shall be corrected as soon as identified.

Training and/or written guidance information for operating and maintaining swales shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.

Access to the swale shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadway shall be maintained to accumulated size and weight of vehicles, if applicable.

- Obstacles preventing maintenance personnel and/or equipment access to the swale shall be removed.
- Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic.

Insects & Rodents shall not be harbored in the swale. Pest control shall be taken when insect/rodents are found to be present.

- If sprays are considered, then a mosquito larvacide, such as Bacillus thurensensis or Altoside formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
- Holes in the ground located in and around the swale shall be filled.

If used at this site, the following will be applicable:

Check Dams shall control and distribute flow.

- Causes for altered water flow shall be identified, and obstructions cleared upon discovery.
- Causes for channelization shall be identified and repaired.



LANDSCAPE ELEVATION