



G2 ASSOCIATES INC.

503-292-7939

GEOLOGY • SOILS • ENVIRONMENTAL • DEVELOPMENT

February 15, 2008

Gresham Civic Drive Project
C/O Meganne Steele, Development Project Manager
Metro TOD and Centers Program
600 NE Grand Avenue
Portland, OR 97232-2736

RE: Metro Contract No. 928383
Soils and Foundation Investigation
Proposed 4.35 Acre, Civic Neighborhood Project
West Side of NW Civic Drive, From NW 13th Street, North to Light Rail Tracks
Gresham, OR

This report is in response to your request for technical support and the investigation of the subject property in the areas of soil, geology, groundwater, and design support information for this development. The field work portion of this engagement was commenced on Monday, January 14, 2008, using a track-mounted hoe and professional operator to conduct a series of test explorations at key accessible points around the project site. Following this phase of the investigation, we determined that more information (at depth) was required. We attended an onsite meeting with you, the architect, Brain Laramie of the Myhre Group, Mike Rossman, Developer and other interested parties to review the preliminary data attained. At our request and with your understanding of the objectives, we re-focused the budget to address the need for some deep drilling efforts to better assess the desired supporting geologic units. These materials included sand and gravel previously utilized on "The Crossings" project located east of Civic Drive. In preparation for this work we also visited our files pertaining to several local prior soils related projects for support information regarding soil and groundwater conditions. Having completed these efforts, we are pleased to present this report of those findings, conclusions and recommendations for your consideration on this project.

SITE DESCRIPTION

The subject property is reportedly a 4.35 acre parcel of former farmland, trapezoidal in shape, and lies west of NW Civic Drive, north of NE 13th Street, and extends northward to the Light Rail right-of-way. Newly constructed apartments bound the site along its entire western side. Grounds to the south of 13th Street include the entire Gresham Station commercial development. Land east of Civic Drive consists of a commercial and high-rise condominium projects completed in part, with our involvement, in recent years.

At this writing, this site was devoid of structures, was partially tree and brush covered over its western half (more or less), and has been filled along its eastern and southern boundaries as a result of the local development of buildings and streets.

The site is currently a topographic "bowl" being lower than all of the development on all four sides by several feet. Based on the undated topographic information provided this office; we are holding the site related grade of 306 for the existing sidewalks as a means of consistent reference for the discussions held herein. We have noted the tendency for a large internal wet land issue since external disposal of groundwater, surface runoff and internal water collection has yet to be addressed.

INVESTIGATION OF FIELD CONDITIONS

Subsurface soil and groundwater conditions at the site were investigated using a track-mounted hoe and operator to conduct a series of backhoe test explorations (test pits) at accessible points over this property. As time marched on during our work, the weather worsened considerably, forcing the second testing phase (test borings) to be done on top of the existing fill units at street grade. The collective runoff concerns into this site fully saturated the top one to five foot soil and fill surfaces, thereby making drill equipment access impossible during this time. The test pit explorations had previously been conducted at the bottom of the "bowl" for assessment of native soils and groundwater occurrences. Therefore, conducting the borings at street grade fits well for the purposes of information gathering. These test locations are presented on the attached site survey map provided by your office. Field locates of all known or suspected underground utilities was conducted by this firm through the regional utility locates system as required by law. We do recommend that they all be located on paper by the project engineer/surveyor as soon as practicable. Their positions will become an issue for planning and construction since most of the utilities lie within the projected building boundaries, as we understand the project layout at this writing.

The backhoe test explorations were conducted to the limit of the reach of the available equipment, based on site conditions, which was between 4.5 and 14 feet below ground surface. The test borings were conducted to depths of 20 to 38 feet as measured from the sidewalk elevation (held) of elevation 306 for purposes of reference. Information in our files from other nearby projects divulged facts about soil, rock and groundwater conditions to as deep as 38 feet in this vicinity and will be further discussed within this report.

SOILS AND GEOLOGY

This site lies on a terrace of dense clays, thin stratified layers of clay silts, silts, and fine to medium sand in discontinuous layers. At greater depth we found coarse sand

containing variable quantities of pebble to cobble gravel with rock to 8 inches in dimension in open excavation. These test borings and other data in this area reveal moderately loose to very dense sandy gravel to gravelly sand strata and thin fine sand zones are intercalated throughout to depths of 40 to 60 feet or more. This evidence was partially evidenced by the performance of the former gravel pit once located on the ridge north of Burnside Street three blocks north of this project. Underlying that horizon we have previously investigated the hard clays and gravel assigned to units such as the Rhododendron formation of much older age. These units continue with depth and include the Pliocene age Troutdale Formation that contains sandstone layers, gravel, clay beds and cemented gravel formed in a quartzitic cementation process millions of years ago. Deeper (sand and gravel) units are all substantial and capable of supporting structures of the type proposed for this site.

The specific units encountered during these test explorations consisted of: (1) Discontinuous and relatively thin topsoil zones and surface fills of crushed rock and gravel over the site "floor". The "engineered" and non-engineered fills used to elevate the streets and those filled slopes extending into the subject property can, from our experience with this area also contain, boulders, concrete and asphalt rubble blended into the soil fills. (2) The underlying units or layers of silt, fine to coarse sand and variable quantities of gravel strewn throughout the sand and silt horizons. These materials have been lumped into a zone that ranges up to 18 feet or more, in thickness under this site. All test explorations bottomed into these upper two soil units. We anticipate the foundations for this five- to seven-story frame structure will be founded into the lowermost unit, which was found beginning as shallow as 20 feet beneath this site at one location. We point out that the higher density sand with gravel is projected to lie at depths of 30 feet or about elevation 276, more or less. A higher sand density, greater consistency in the sand texture and a greater presence of gravel were all noted at this depth and are believed to provide a better support horizon for the proposed structures.

GROUNDWATER CONDITIONS

This field work was conducted during the wettest time, during January and February, of this winter season. Due to that circumstance, we did encounter surface puddling, and near surface water infiltration generally between depths of 1.5 to 5 feet. The water level in one locale was at 10 feet bgs; however, we interpret this to be a part of the surface water source and is being locally controlled by the silt formation in some areas. Managing this near surface and surface run off is viewed as being the most important issue for safeguarding these structures and should be addressed by some form of dewatering system installed at the project commencement. This water source is likely to continue in perpetuity since all grades to the south shall remain higher than this property. The rock placed under the streets is also viewed as a series of several horizontal "French drains" collecting water and redirecting it towards this "bowl" shaped surface within this site.

The true groundwater or static water level was determined during the drilling phase of this investigation, to lie at approximately 23 to 24 feet as measured below existing ground surface elevations in the site bottom. With the surface runoff properly managed, and stored or disposed, we do not anticipate that groundwater should negatively affect the planned construction outlined for this project. The sole remaining concern lies with the effects that surface runoff has created within the near surface soil layers (above the sand and gravel stratum) which should be addressed through the dewatering process.

GEOLOGIC HAZARDS

Groundwater in the form of near surface runoff flow presents the primary concern at this site. To address the potential of soil liquefaction from this water source, we recommend the installation of field drains to be used to permanently dewater the soils around these structures. This water should be cycled to the storm detention ponds architecturally planned for this project. Line placement, pipe sizing and grades may be further discussed in meetings to come during the planning phase of this project. At this writing, we do not know whether collected water will be filtered and then permitted access into the lower existing storm water piping that cuts across this site.

PROPOSED CONSTRUCTION PLANS

We have reviewed some of the preliminary schematic plans being formulated for this project, including the enclosed color copy of one architectural rendering of the structure elevations. The latest project plan (enclosed) currently indicates that two long multi-story structures with open parking garages under and below street grade, a commercial plaza at sidewalk elevations, with multiple floors of high density living spaces above that point. Those buildings will be sited along the northern light-rail boundary and the east side of this parcel along the NW Civic Drive improvements. We are advised that the steel and concrete frame will extend upwards through the commercial level and that "stick" frame will take over above that elevation. Specific structure loading has not been discussed at this writing.

CONCLUSIONS AND RECOMMENDATIONS

Based on our findings at this site, our conversations with you and the design team about the project, we offer the following conclusions and principal recommendations for your consideration in planning this project.

1. The uppermost non-intentional fills and native soil layers were determined to be anywhere from a few inches to 4 or 5 feet in thickness generally over the

site floor area and outside of the brushy tree covered areas. Topsoil zones were heavily wood-laden and will be subject to serious consolidation under added loads, and should be fully removed from the site except for landscaping and pond feature areas of this property. Excavations for structure foundation pads, parking features and other key grades at this site will encounter silts, clayey silts, clays and occasional fine sand ribbons intercalated within the clayey silt formation to be found under the fills. Dewatering lines placed at strategic locations should properly drain the uppermost soils and keep them stable for uses such as parking spaces. Soil cement application into this soil outside of structures will enhance the stability of wet soils.

2. The road shoulder and support slope fill units are of at least three distinct generations and do contain varying amounts of deleterious debris making the fills in some areas questionable engineered bodies. We shall remain available to assist you in the field during construction to sort out the danger areas where fills competency (for cut and fill embankments) may occur due to moisture conditions. Other relatively thin layers and bodies of mixed soil, gravel, asphaltic concrete (AC), minor tree roots and wood debris cover portions of the southern and eastern margins of this site. It is estimated that fill bodies may extend up to 20 feet in depth with the deepest leg of the fill lying in the northeast corner of this project. All fills are currently viewed as poor support units due to their undocumented content and a lack of documented compaction histories. These conditions will be reviewed with your contractor during the commencement of the actual construction cycle.
3. Adequate support for all proposed site loads will be found at an estimated depth of 30 feet as measured from the sidewalk elevation (assumed 306) beneath site grades within the undisturbed higher density clays and sand and gravel units. Due to the inaccessibility of the west end of the northern building, we recommend for further drilling investigation in that area when the site has been cleared and equipment access has been greatly improved. It is likely that additional funding will be required for this isolated task. However, the costs are easily controlled by this office in your best interests and will be addressed later when the design grades are also better understood.
4. The presence of highly saturated silt, clays and fine sand in the uppermost native soil horizon above the sand and gravel presents concerns for potential consolidation under the anticipated structure loads expected from these structures. Should dewatering attempts not fully drain the soils they would continue to present potential for liquefaction and post-construction settlement thereafter.

5. Even in consideration for the positive effects which soil dewatering could create, we continue to hold concerns for consolidation of the intermediate soil "sandwich" under the anticipated building dead and live loads. Two options present themselves as being viable for the improvement of conditions to permit building support in a conventional means at this site. These include: (A) A removal of the soil in question, with a return to design grade using a select crushed rock fill compacted in lifts in keeping with the recommendations made herein. This would create a large soil processing phase for site development with the potential of extending the building cycle. OR (B) The transfer of all structure loads into the sand and gravelly sand formation using an element such as reinforced concrete (auger-cast) pier using a surface grade beam foundation (our preference). This option would leave the soil intact to be utilized for slab support; however a soil removal with replacement engineered rock fill material would greatly improve the floor slab support issues. Depending on field soil conditions at construction, it may be possible to utilize this same soil as engineered fill in the ancillary parking and traffic areas under pavement. The pros and cons of both options should be fully weighed for cost and time frame aspects.
6. Foundations for this project may be constructed in compacted structural fills at shallow depth beneath finished grades, (minimum 18 inches recommended) using bearing pressures of 2,000 psf and a minimum footing width of 18 inches. Due to the potential differential settlement viewed for the in place saturated native soil zone, we do not assign a value for that unit in its present condition. Piers embedded into the sand and gravel as discussed, may use a bearing value of 4,000 psf with a minimum of 5 feet of unit penetration. The use of the reinforced pier system will have a large advantage in avoiding the slope retention costs, lowering the costs of excavation, and reducing the costs of fill to be imported for placement under the structures.
7. Structural Fill – Site Preparation. Site preparation could be accomplished by a number of methods depending on grades selected for the project. All building areas would have to be stripped to a point near the sand and gravel horizon with site materials and imported rock to be recompacted in lifts. All organics or otherwise unsuitable materials should be removed from the building zones for use in non-structural support activities or be exported from the site to an approved disposal location. We anticipate that stripping to depths of 10 to 25 feet might be necessary within the building areas. Due to the highly saturated soil conditions and poor site accessibility along the northern boundary, we could not acquire information in that area regarding stripping or gravel depths. This area should be further pursued during the initial site stripping phase of the development.

8. We point out that favorable weather will be required for operations in which fine-grained materials are being worked; consequently, it would be advisable to conduct the site preparation phase of the project prior to the on set of the rainy season. In the event that rainy weather is encountered during site preparation, it may be necessary to suspend operations or use a clean granular material (i.e., sand, gravel or crushed rock). We already understand that a site deficit in fill materials exists and that imported rock will be required in large quantities under this site development option. Granular fills can be constructed in any kind of weather and can be compacted to support even heavy structures with comparatively modest compactive effort. Structural fills should be spread in uniform lifts not exceeding 8 inches loose thickness with each lift thoroughly compacted by repeated coverages of loaded hauling equipment, heavy crawler tractors, or vibratory rollers. Fills should be compacted to 95 percent of maximum density as determined by laboratory compaction test ASTM D-1557.
9. Foundation Preparation. Inasmuch as the native soil units which will provide support for the main portion of the structure are extremely sensitive to disturbance in the presence of excess moisture, care should be taken to protect prepared bearing surfaces until footing concrete can be placed. Precautions to achieve this end would consist of (1) covering of prepared bearing surfaces with impervious membranes or granular blankets (4-inch minimum thickness) or (2) cessation of work during rainy weather.
10. The second and likely more attractive foundation support option is the drilling and casting of reinforced piers embedded into the sand and gravel formation at depth of approximately 30 feet as measured below the sidewalk elevation assumed by this office as presented on information provided to us during the investigative phase. Since the sidewalk elevation of 306 seems generally consistent based on that topographic sheet, this would place the pier tips at or near elevation 276 based on the best information available at this writing.
11. All pier installations should be witnessed and monitored by this office to assure a consistency of pier depths and that the field conditions remain as expected throughout the project.
12. Surface runoff (from roofs, parking areas, etc.) should be tight-lined to the storm sewer or other approved disposal areas such as the pond feature previously discussed. Under no circumstances should surface run-off be led into foundation drains.
13. Any areas of the building which are to be developed below the exterior site grade must be provided with a well-designed drainage system, in order to

control hydrostatic pressure against walls, seepage of groundwater through base walls, etc.

14. Lateral earth pressures on retaining walls, etc., may be calculated on the basis of equivalent fluid pressure of 45 pcf for level backfill.
15. All backfill of retaining walls, foundations, foundation drains, etc., should be made with select granular material (sand, gravel, or crushed rock). We anticipate that on-site materials will not be suitable for this purpose and that it will be necessary to import material to the project for backfill of wall features.
16. Temporary earth slopes, for sewers, utility corridors or basements, may be cut near-vertical to heights of 5 to 6 feet, during dry weather conditions only, above which height lower declivities and/or slope protection may be required. We estimate that slopes of 1 vertical to 1 horizontal may be used for slope heights of 10 to 12 feet. Above 10 or 12 feet, 1 vertical to 1.5 horizontal should be used for temporary excavations in which no bracing is applied. As with the previous project across the street, we have experience with this fill and prefer to judge its stability in the field during construction. As some may recall, that unit did actually hold in the vertical position very well and did not require artificial support systems.
17. Asphalt Pavement. We recommend that asphalt pavement be designed for a subgrade CBR of 4 which yields the following recommended thickness in accordance to Asphalt Institute Manual MSI:

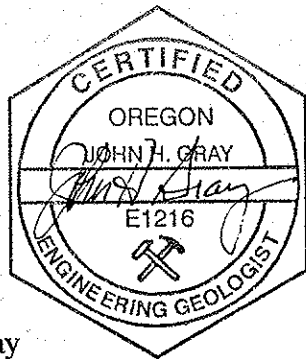
	Thickness	
	Entrance and Service Roads	Car Parking
Asphalt Pavement (Oregon St. Class C)	3 inch	2 inch
Crushed Rock Base (Oregon St. Spec.)	12 inch	8 inch

Concrete Pavement. We recommend that concrete pavement be designed for a subgrade reaction of 50 pick. A typical concrete pavement section would be:

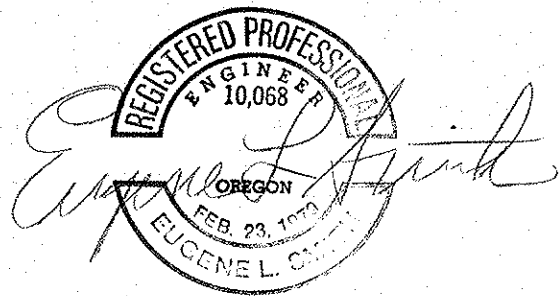
	Thickness	
	Entrance and Service Roads	Car Parking
Leveling Coarse (Sand)	2 inch	2 inch
Concrete (3,000 psi)	6 inch	4 inch

18. We request that we examine and identify soil exposures created during project excavations in order to verify that soil conditions are as anticipated. We recommend that the structural fills be continuously inspected by a representative of a recognized testing laboratory in order to insure the thoroughness and uniformity of their compaction and that the results meet or exceed the project standards set forth in this report.
19. We request that the final plans be submitted to us for review of the foundation design prior to their submittal to the Bureau of Building. We also request that we be given an opportunity to inspect the footing excavations prior to the placement of concrete.
20. We shall be pleased to provide such additional assistance or information as you may require in the balance of the design phase of this project and to aid in construction control or solution of unforeseen conditions which may arise during the construction period.

Sincerely,



John H. Gray
Principal
Certified Engineering Geologist 1216



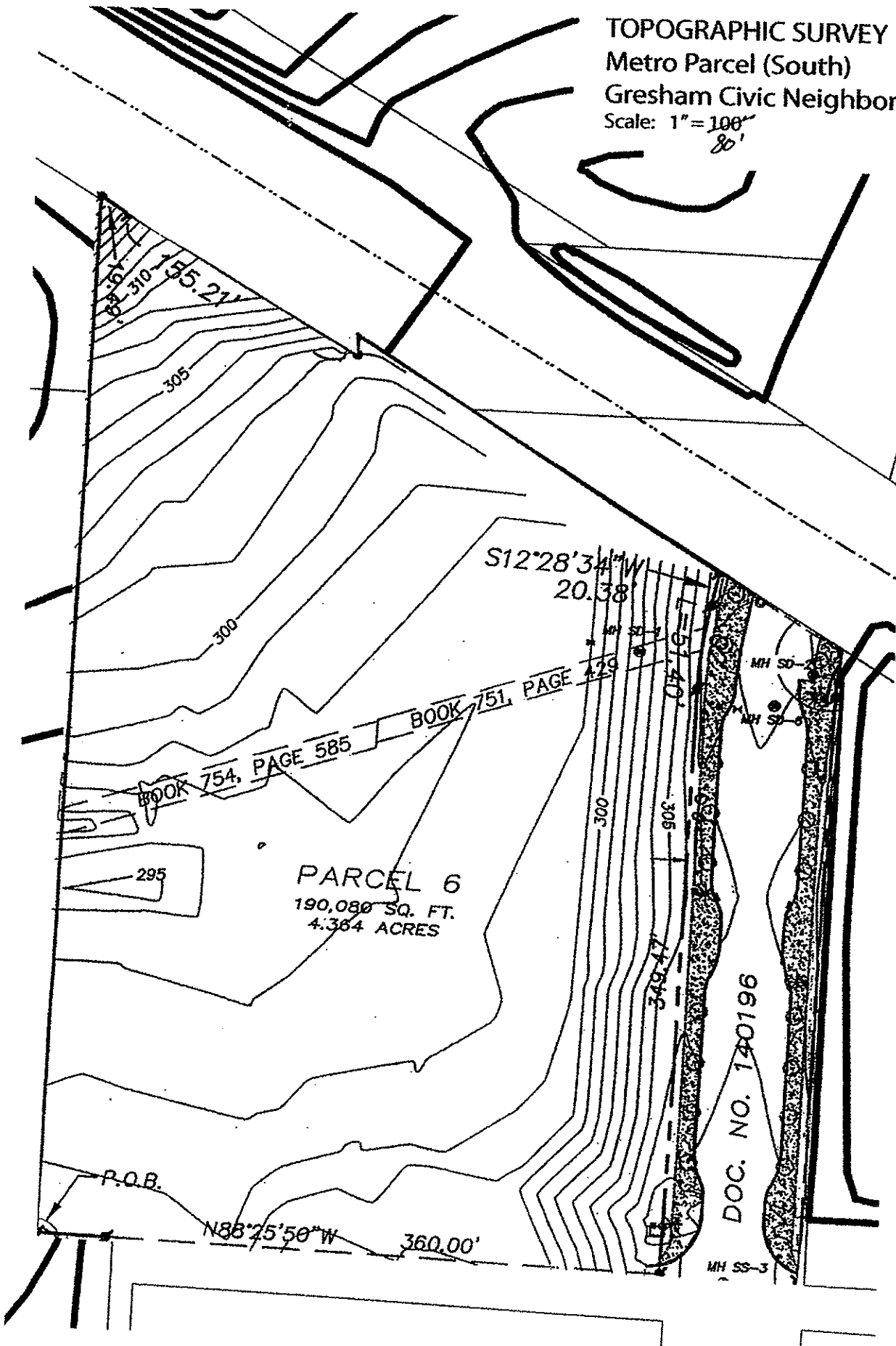
EXPIRES: 02/28/2009
Eugene L. Smith, PE
Associate Engineer





TEST PIT AND BORING EXPLORATION LOCATIONS
 January 14 and February 2, 2008 Respectively)
 G2 Associates, Inc., 503.292.7939

TOPOGRAPHIC SURVEY
Metro Parcel (South)
Gresham Civic Neighborhood
Scale: 1" = 100'
80'



BACKHOE TEST PIT EXPLORATION #1

**Metro/Rossman Project
NW Civic Drive and 13th
Gresham, OR**

Southeastern Corner of site at base of two fill slopes, approx. 8' lower than sidewalk.

0 to 0.67 Feet Very soft saturated brown clayey silt with grass roots.

0.67 to 2.0 Ft. Brown silty gravel **FILL**, likely colluvial wash from adjacent fill slopes.

2. to 4.5 Ft. Combined unit of Troutdale Formation cemented gravel, silt dark brown clay **FILL** contact.

4.5 to 12.0 Ft Series of alluvial clays, and silts with interbedded medium sand ribbons. Native unit often invaded in some areas by localized groundwater occurrences. Drainage tends to be slow due to the lack of continuity of sand ribbons and a limited (soil) means for water to move laterally at a measurable pace.

12.0 Feet Coarse sand clayey silt with pebbles. Unit in this area appearing to be sandier than east side of Civic Drive. Material should drain at this depth or greater. End of exploration.

8.0 Feet Groundwater free flowing in upper one-third of this native stratum. Surface flow estimated at 3.0 gpm.

BACKHOE TEST PIT EXPLORATION #2

**Metro/Rossman Project
NW Civic Drive and 13th
Gresham, OR**

North of TP 1, toe of filled slope, one-third the way north on the east side of site.

0 to 2.5 Feet Firm brown silt to clayey silt, **FILL**.

2.5 to 5.0 Ft. Blue-gray silt with wood debris up to 6-inch diameter. Native topsoil should be removed due to potential for consolidation under loading.

5.0 to 12.0 Ft. Stiff mottled brown clayey silt grading to hard silt with intercalated medium sand, native. No gravel noted to this depth. End of exploration.

10.0 Feet Groundwater as a seep. Estimate 0.1 gpm.

BACKHOE TEST PIT EXPLORATIONS #3

**Metro/Rossman Project
NW Civic Drive and 13th
Gresham, OR**

North of TP 2, toe of filled slope, two-thirds of way north on east side of site.

- 0 to 2.0 Feet Soft gray-brown clay with roots, No FILL.
- 2.0 to 9.0 Ft. Moderately soft to stiff tan mottle clayey silt, native.
- 9.0 to 14.0 ft. Moderately dense sit w/ occasional medium sand and some cobbles, 2 to 5 inch diameters and flat.
- 5.0 feet Groundwater with active flow. Surface flow estimated 1.3 gpm.

BACKHOE TEST PIT EXPLORATION #4

**Metro/Rossman Project
NW Civic Drive and 13th
Gresham, OR**

Northeast corner of site, toe of compound fill slopes (2).

- 0 to 1.5 Feet Loose brown silt, topsoil with roots.
- 1.5 to 7.5 Ft. Saturated gray-brown clay with medium sand and occasional cobbles. Native.
- 7.5 to 9.0 Ft. Gravelly silty sandy clay, active. End of exploration.
- 3.0 Feet Groundwater, active flow. Surface flow estimated 1.0 gpm.

BACKHOE TEST PIT EXPLORATION #5
Metro/Rossman Project
NW Civic Drive and 13th
Gresham, OR

Northwest of #4 at railroad fill toe and existing brush line, approximately one-third length into northern building envelope.

- 0 to 2.0 Feet Soft dark brown clay topsoil with roots, undisturbed but located in a surface bowl catching localized runoff from north and east.
- 2.0 to 6.0 Ft. Moderately soft to soft mottled brown clay, saturated.
- 6.0 to 8.0 Ft. Dense clays with cobbles could be a Troutdale Formation limb supplying materials, abundant groundwater through this zone. End of exploration.
- 5.0 feet Groundwater flow. Surface flow estimated 1.3 gpm.

BACKHOE TEST PIT EXPLORATIONS
Metro/Rossman Project
NW Civic Drive and 13th
Gresham, OR

TEST PIT EXPLORATION #6A FILL, Abandoned test due to concern for fill indicating possible sewer location in this alignment across this property. No encounter was made with any utility in this area.

TEST PIT EXPLORATION #6B (7)
North-central lowland through where tree-cutting was previously conducted, possibly during sewer work years ago.

- 0 to 2.0 Feet Very soft brown clayey silt with forest duff f organics and FILL rock.
- 2.0 to 8.0 Feet moderately stiff mottled brown tan clayey silt to clay, dry to down to water table at 3.5 feet.
- 8.0 to 10.0 Ft. Stiff clay with minor medium sand and 4-inch cobbles to depth of penetration.
- 3.5 Feet Groundwater active. Surface flow estimated 2.3 gpm.

BACKHOE TEST PIT EXPLORATION #8
Metro/Rossman Project
NW Civic Drive and 13th
Gresham, OR

South-central area of site, south of "pond" at eastern edge of tree line.

0 to 1.5 Feet Soft gray clay.

1.5 to 8.0 Ft. Moderately stiff tan mottled brown clayey silt, topsoil. Contains cobbles and fine sand occasionally to 6.0 foot depth.

8.0 Feet Dense clay with medium sand and cobbles to 10-inch diameter between 6.0 and 8.0 foot depth.

No groundwater activity noted to depth of exploration.

BACKHOE TEST PIT EXPLORATION #9
Metro/Rossman Project
NW Civic Drive and 13th
Gresham, OR

West of TP 2, at east edge of brush line.

0 to 1.5 Feet Soft brown clayey silt with roots.

1.5 to 8.5 Ft. Moderately stiff tan mottled rust clayey silt to clay with occasional cobbles ranging from 2 to 8 inches in diameter. Friable medium to coarse sand laminations in lower unit below 5 foot depth.

4.0 Feet Groundwater seep. Surface flow estimated 0.3 gpm.

8.5 Feet Dense sandy, stiff clayey gravel formation. End of exploration.

BACKHOE TEST PIT EXPLORATION #10
Metro/Rossman Project
NW Civic Drive and 13th
Gresham, OR

West of TP 1, along the southern fill toe.

0 to 1.0 Feet Soil Fill, soft with roots.

1.0 to 4.5 Ft. Stiff tan mottled rust clayey silt, wet.

4.5 to 7.0 Feet Stiff brown clay containing coarse sand with pebbles and cobbles
commencing at about the 5 foot depth.

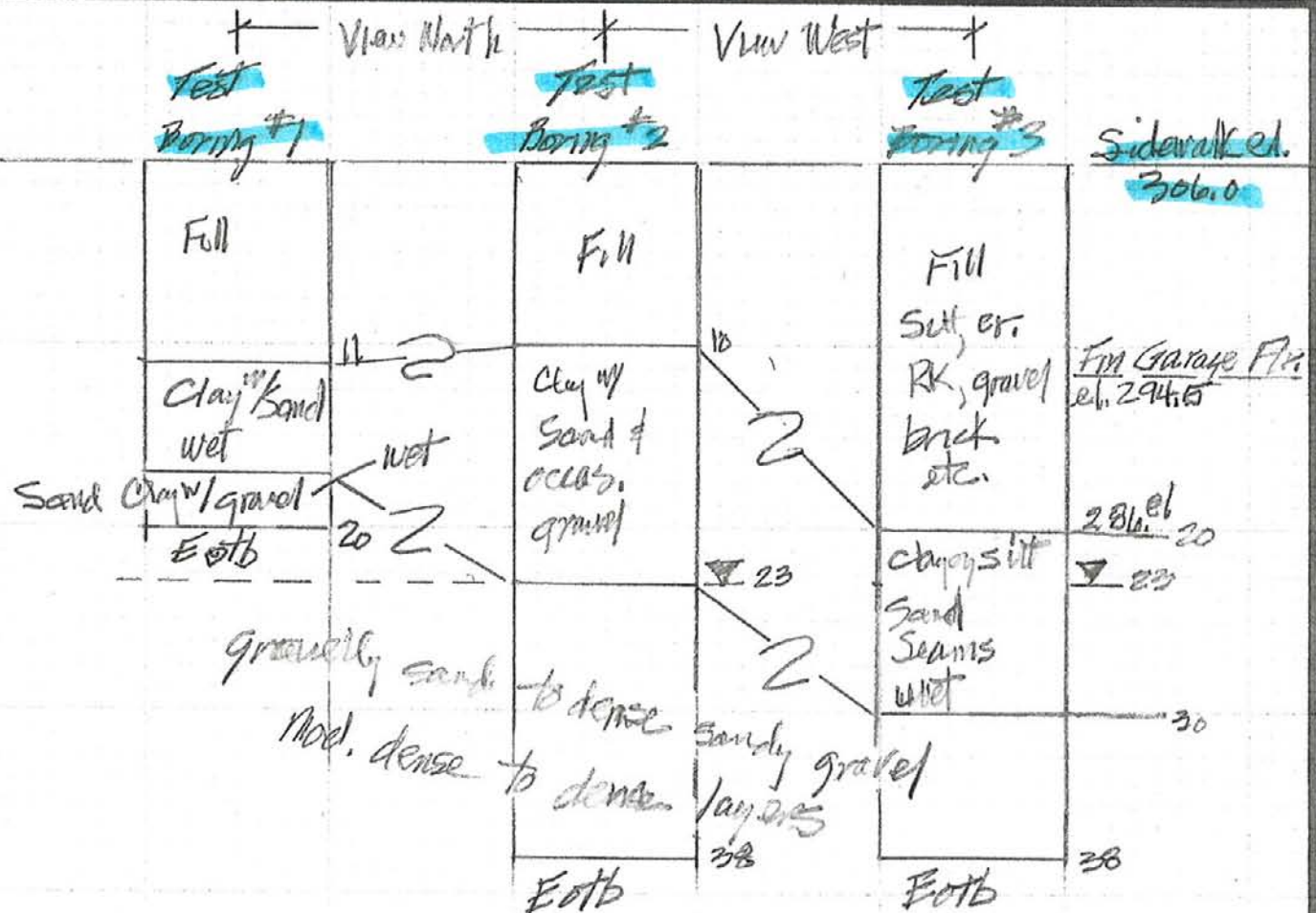
4.5 Feet Groundwater flowing to north. Surface flow estimated 0.3 gpm.

PROJECT *Metro/Kossman*JOB *08-115*

CONTRACTOR

SHEET *1/1**1111 Civic Drive, Gresham, OR*DATE *2-07-08*BY *JAG*

Check

Geologic Cross-sections

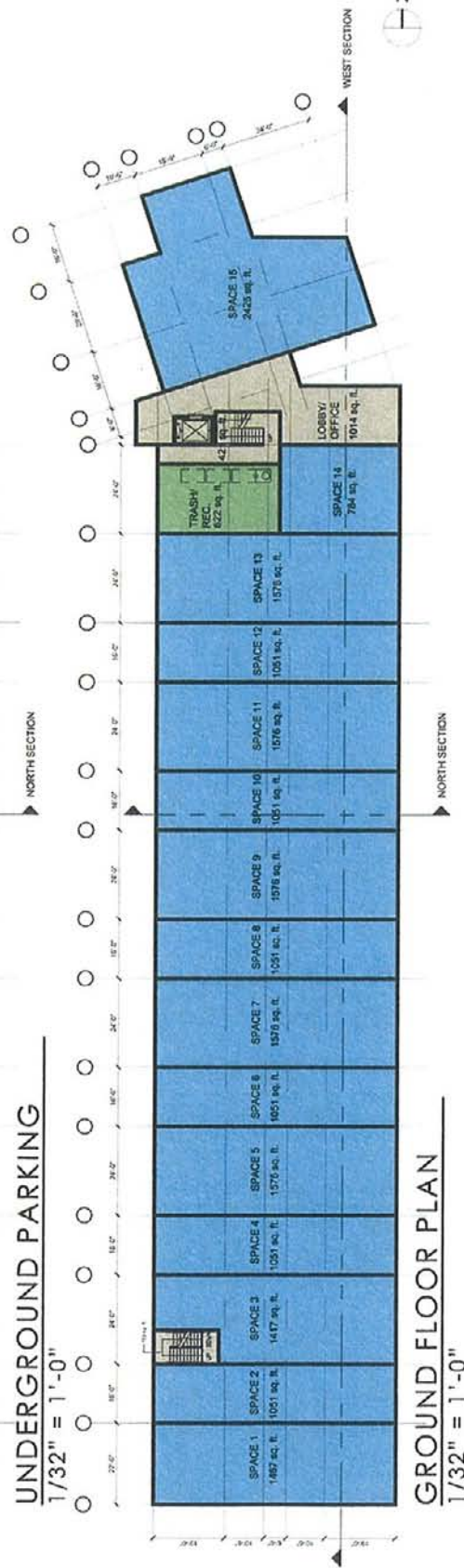
Vertical 1" = 10'

HORIZ. N.T.S.

JUL 08/15

**GRESHAM STATION PHASE II PROJECT
CURRENT BUILDING A AND B DOCUMENTS
GRESHAM, OR**





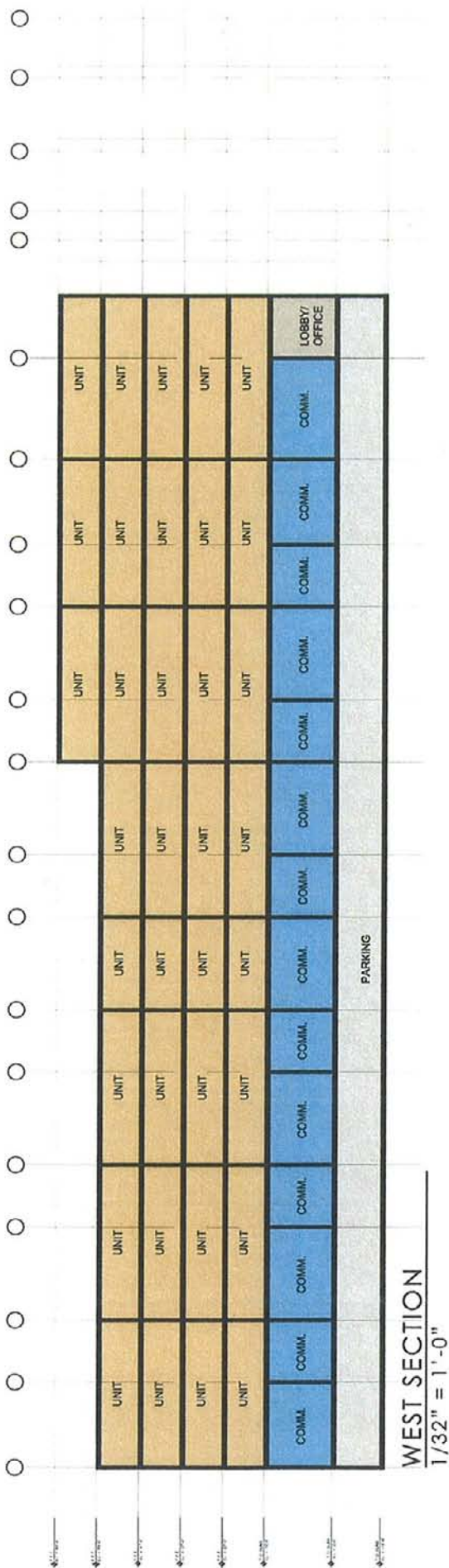
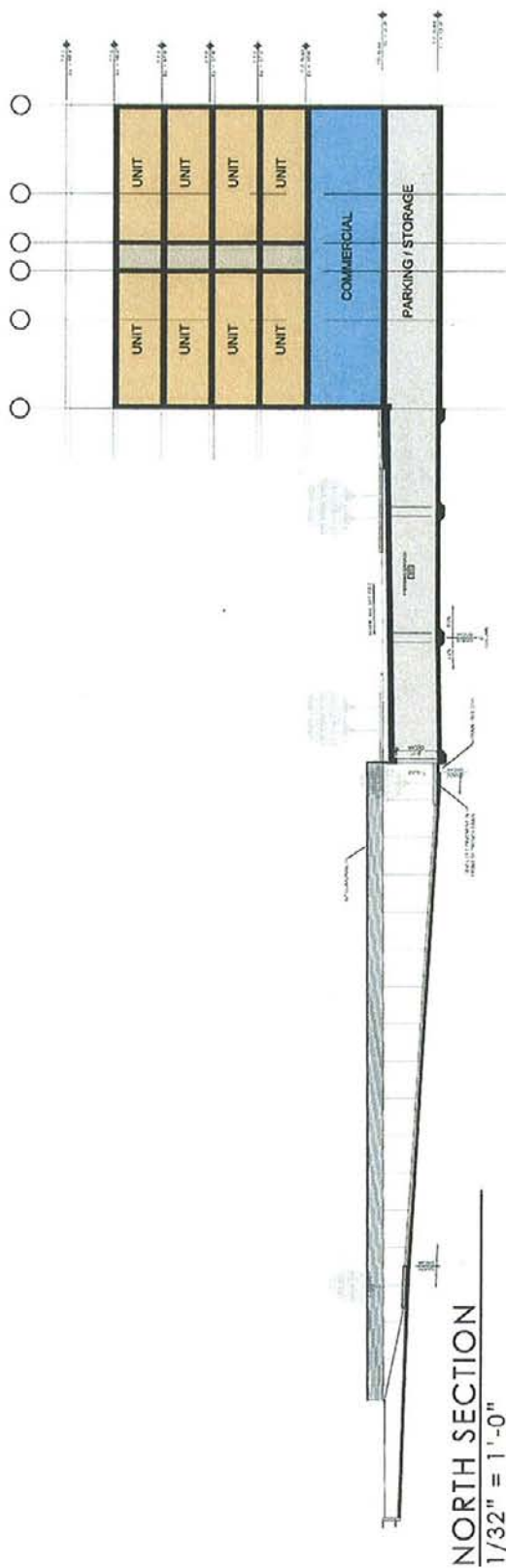
MYHRE GROUP

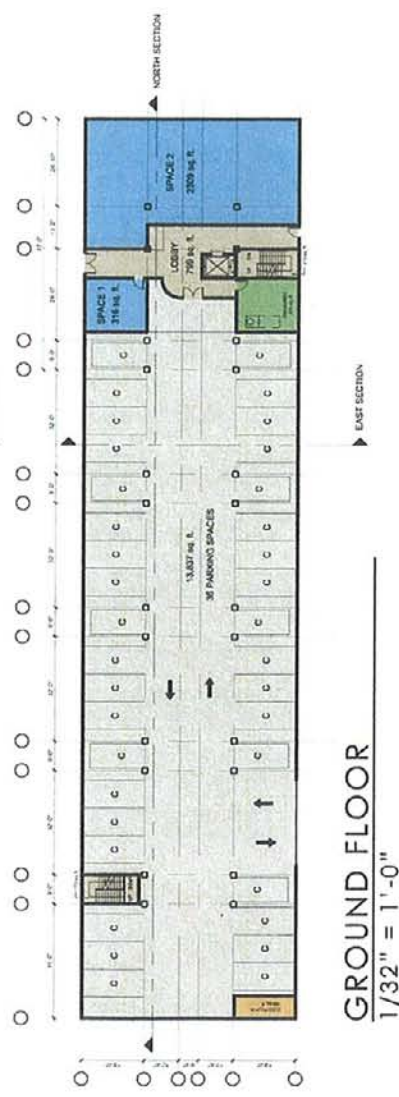
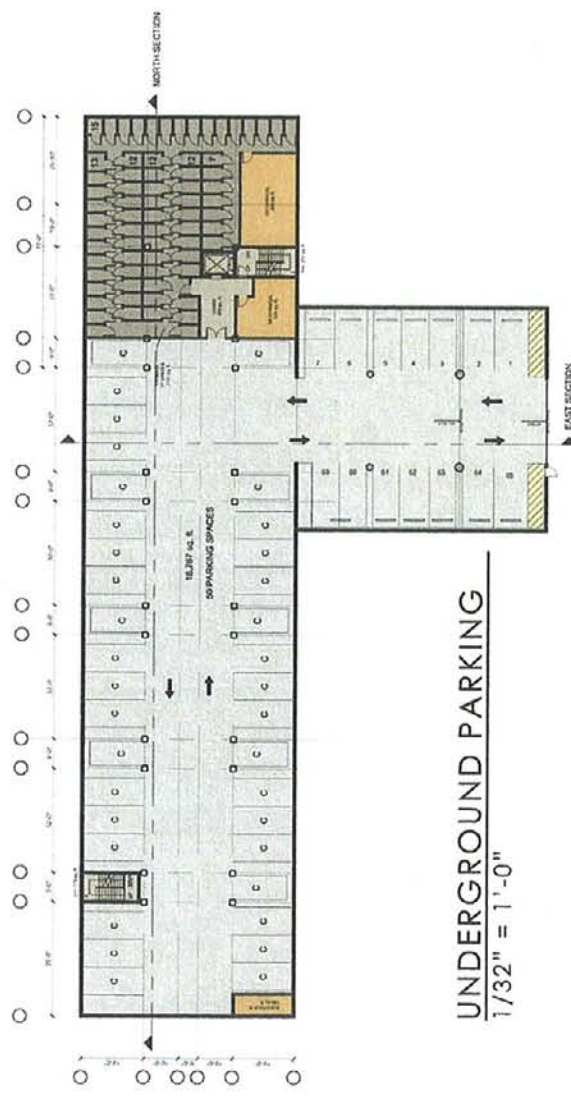
Architects
700 SW Broadway, Suite 400 Portland, Oregon 97205
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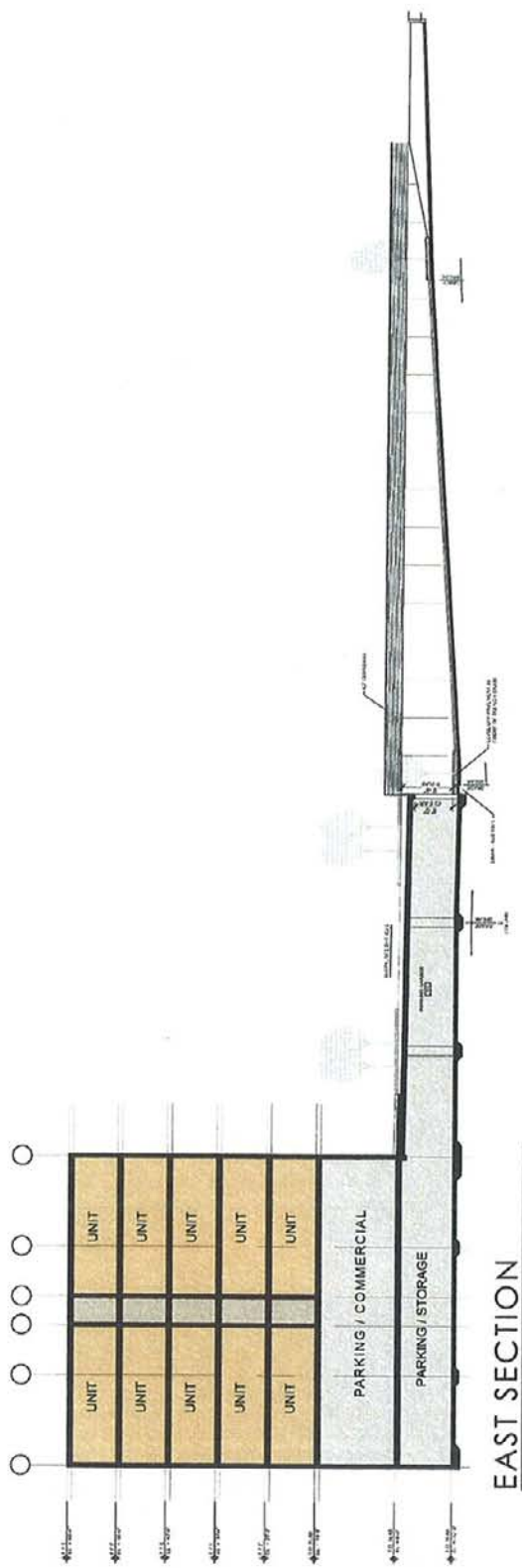
BUILDING A

GRESHAM STATION PHASE II

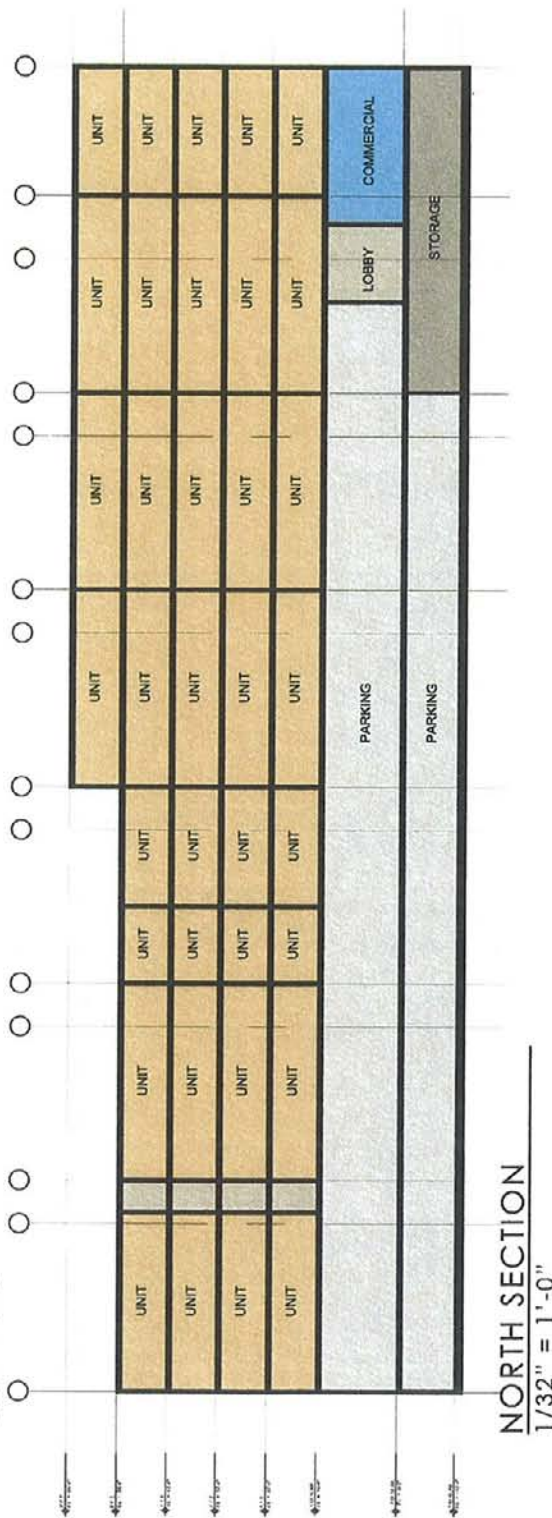
Gresham, Or. 07/5280 02/12/08







EAST SECTION



NORTH SECTION