CUMMINGS GEOTECHNOLOGY, INC.

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CITY OF SPOKANE
PLANNING SERVICES

February 22, 2010

Mr. John Pilcher
JRP Land LLC
c/o Mr. Jeff Logan
USKH
621 W. Mallon Avenue, Suite 309
Spokane, Washington 99201

RESULTS OF A PRELIMINARY GEOTECHNICAL SITE CHARACTERIZATION STUDY, LATAH CREEK PRELIMINARY PLAT, 3515 S. INLAND EMPIRE WAY, SPOKANE, WASHINGTON

Dear John,

This letter report presents the results of a preliminary geotechnical site characterization study for your proposed new residential subdivision along Latah Creek. The purpose of my services was to investigate surface and subsurface conditions at the project site and develop preliminary recommendations required for the approval of the preliminary plat. The study was conducted in accordance with my proposal letter of February 11, 2010, and generally accepted geotechnical engineering practice common to this area.

SITE AND PROJECT DESCRIPTIONS

It is my understanding that you are currently planning the development of a new single-family residential subdivision on a 43 acre parcel located on the east side of Latah Creek, about 2 miles south of I-90. The parcel is irregularly shaped with plan dimensions of about 1100 feet in the east-west direction and about 1900 feet in the north-south direction. Boundaries of the parcel are shown on Figure 1.

The east boundary is on the flank of a steep west facing slope and the west boundary is the right bank of Latah Creek. Other than the steep slope in the east part of the site, the ground surface is a relatively level to gently rolling alluvial terrace. There are scattered ponderosa pine trees, mostly in the west half of the site, and there is a residence and several out-buildings near the southwest corner.

There is an existing gravel roadway (see Figure 1) traversing roughly north-south through the center of the site. According to information provided to me by Mr. Logan the project will include a maximum of 88 residential lots and several thousand linear feet of paved roadway. I understand that the stormwater disposal system will include designed release to Latah Creek, surface infiltration of stored water from the bottoms of the swales, and possibly subsurface infiltration by means of drywells.

SUMMARY OF GEOLOGY MAPPING

The project site is located in the Spokane 1:100,000 Topographic Quadrangle, which was geologically mapped by Ms. Nancy Joseph of the Washington Department of Natural Resources in 1990. Ms. Joseph mapped the steep slope on the east part of the site as being underlain by Quaternary Flood Deposits-Gravel (Qfg). This geologic unit is described as a poorly sorted, stratified mixture of boulders, cobbles, gravel, and sand resulting from multiple episodes of catastrophic outbursts from glacier-dammed lakes. It is typically found in floodplains, terraces, and valley bottoms and is the predominant near-surface geologic unit in much of Spokane and Spokane Valley. In this area this geologic unit typically has a moderate to high shear strength and is noncohesive.

The west part of the site is mapped as being underlain by Glaciolacustrine and Flood Deposits. Along Latah Creek this geologic unit is described as consisting of 5 to 15 foot thick layers of medium to coarse-grained glaciofluvial deposits, interbedded with 1 to 8 inch thick layers of fine-grained lacustrine (lake deposited) sediments.

SUMMARY OF SOILS MAPPING

The NRCS Web Soil Survey and the Spokane County Soil Survey (SCSS) map three soil types and one land type within the boundaries of the project site. The approximate boundaries of these soil types are shown on Figure 1.

Springdale gravelly loamy sand, 30-70 % slopes (SzE), is mapped on the steeper slopes in the eastern part of the site and on a narrow north-south trending strip near the west edge of the site. The SCSS describes this soil type as consisting of somewhat excessively drained, coarse textured, gravelly and cobbly soils, formed in glacial outwash. It occurs primarily on terrace breaks and steep colluvial slopes along major drainageways. It is also described as having a low to moderate resistance to erosion, moderate to rapid permeability, and high shear strength.

Marble sandy loam, 0-8 % slopes (McB), is mapped on the lower part of the steep slope in the east and north parts of the site. The SCSS describes this soil type as consisting of excessively drained, coarse sandy soils, formed on glacial outwash terraces in the central part of Spokane County. It is also described as having low resistance to erosion, moderately rapid to rapid permeability, and high shear strength.

Hardesty silt loam, 0 to 5 % slopes (HhA) is mapped on the more level parts of the project site between the Marble/Springdale soils on the east and the Springdale soils on the west. This soil type is described by the SCSS as moderately well-drained, medium textured soils, containing volcanic ash. It is said to occur in slight depressions and very nearly level areas along drainage ways. This soil type is also described as having a moderate resistance to erosion, moderate to rapid permeability, low stability in embankments, and very low shear strength.

Riverwash (Rh) is mapped in and adjacent to the channel of Latah Creek on the west edge of the site. The SCSS states "This land type is on low bottoms along perennial an intermittent streams. It consists of gravel, cobblestones, and stones and very little finer material. The areas are flooded nearly every year by runoff from melting snow." Engineering properties are not included for this land type because the composition is so variable.

SUBSURFACE INVESTIGATION

In order to investigate the subsurface conditions at the project site, I directed the excavation of six backhoe test pits, designated TP-101 through TP-106, on February 17, 2010. They were excavated with a backhoe and operator provided by Mueller Excavating and ranged from 10 to 15 feet in depth. The depth was limited on three of the test pits because of severe sidewall caving.

I examined and logged the subsoils in each test pit and collected representative samples for laboratory testing. Logs of the test pits are included as Table 1. Their approximate locations are shown on Figure 1.

I located the test pits with a hand-held GPS and plotted the locations using UTM coordinates on a scaled map from the NRCS Web Soil Survey. After they were examined, logged and sampled, the test pits were backfilled with the excavated soil material.

LABORATORY TESTING

The soil samples were tested for moisture content in accordance with ASTM Test Method D-2116. A portion of each sample was weighed and then oven dried until achieving a constant weight. The calculated moisture contents, expressed as a percentage of dry weight, are presented in the test pit logs, Table 1.

Grain size distribution analysis (sieve analysis) was conducted on four representative soil samples in accordance with ASTM Test Methods D-421 and D-422. Each analysis was conducted by weighing a dry portion of the sample, washing it through a #200 mesh sieve, drying it again, and shaking it through a stack of sieves that have openings that are progressively smaller toward the bottom of the stack. The analysis was completed by weighing the portions retained on each sieve, and then the percentage of the sample that is finer than each sieve was calculated and plotted. The results of the analyses, plotted in standard format on semilog paper, are presented on Figures 2 through 5.

These soil samples were also classified by the Unified Soil Classification System (ASTM D-2487). This classification system is based primarily on the particle size distribution and the plasticity of the fine fraction of the soil. The classifications of these samples are presented on Figures 2 through 5.

Wash analysis was conducted on eight representative samples of sand, silty sand, and sandy silt. Each analysis was conducted by passing the sample through a 3/4 inch sieve, weighing a dry portion of the minus 3/4 inch fraction, washing it thoroughly through a #200 mesh sieve, drying it again, weighing the remaining sample portion, and calculating the percent passing the #200 sieve. The results of the analyses, expressed as a percentage passing the #200 sieve in the minus 3/4 inch fraction, are summarized in Table 2.

SURFACE RECONNAISSANCE

On February 20, I conducted a reconnaissance of the project site and parts of adjacent properties to observe existing surface conditions. I measured slope angles in several locations with a 4 foot "Smart Level". My observations are as follows.

Most of the surface area of the project site consists of a level to gently rolling alluvial terrace. The terrace terminates abruptly to the east and north at a relatively steep, south to west facing slope near the north end and east side of the site. This steeper slope consists both of natural slope, cut into the natural slope on the east side of the existing gravel road, and the embankment that is supporting the road. The natural slope gradient ranges up to about 65 %, while the gradient of the road cuts ranges up to about 80 %, and the embankment gradient ranges up to about 75%.

I observed a small and shallow slope failure located above the road near TP-106. It is about 15 to 20 feet wide and 100 feet long. At the upper edge the scarp slope gradient is about 90%. The disturbed sandy soil in the center of the failure appears to be at about its angle of repose at 70%. At the toe of the failure (at the upper edge of the road) there is a loose accumulation of the transported sand. Farther south from the slope failure in the road cut there are numerous shallow erosions rills, up to about 2 inches deep and a few inches wide.

Along most of the length of the project, except for the north and south ends, the west project boundary is along on the inside of a broad curve in Latah Creek and the alluvial terrace gently transitions into the flood plain of the creek. However, on the north and south ends, the west boundary is on the outside of sharper curves in the creek. In these locations the alluvial terrace ends abruptly at very steep to near-vertical banks that have been eroded at some times in the past, likely during very high water events. The banks in these areas have been armored with riprap and concrete rubble.

In most areas of the alluvial terrace the ground surface is covered with a moderate to dense growth of grasses and forbs. There are also scattered ponderosa pine trees on the west where the terrace transitions into the flood plain. At the south end near the existing buildings there are also scattered deciduous trees. In the flood plain there are numerous native shrubs.

On most areas of the steep slopes the growth of grasses and forbs is only sparse to moderate.

Much of the area of the observed slope failure above the road is devoid of vegetation. On much of the steep slopes on the west side of the project there are numerous ponderosa pines and occasional native shrubs.

ASSESSMENT OF SUBSURFACE CONDITIONS

At the end of the last Ice Age, the Spokane area was inundated by several episodes of catastrophic glacial flooding. In many areas the underlying basalt bedrock was severely eroded and scoured to an irregular surface. During later stages of flooding, a layer of medium to coarse-grained alluvial soil was deposited, with brief periods of lacustrine (lake) deposition. Later deposition of loess (wind blown silty soil) and volcanic ash added a fine-grained component to the surface layer of the alluvial soil.

Observations of the test pit sidewalls indicate that in the upper 10 to 15 feet the stratigraphic section consists of existing fill and six distinct native geologic strata:

- Existing fill
- Topsoil
- Silty sand
- Sand
- Sand with silty interbeds
- Sandy gravel
- Coarse sand

Existing fill was encountered at the ground surface at TP-104 to a depth of 2.5 feet. It consists of loose, dark brown, slightly organic, silty sand. A rusted tin can was found at the base.

A layer of topsoil was encountered at the ground surface at all of the test pits except TP-103 and TP-104. This unit typically consists of loose, dark brown, slightly organic, silty sand. Its thickness ranges from about 0.8 to 1.8 feet.

Silty sand was encountered below the topsoil or at the ground surface in all of the test pits except TP-104 and TP-106. It typically consists of medium dense, brown, silty, medium grained sand. The thickness of this unit ranges from about 2 to 4.5 feet and its moisture content ranged from 11 to 14 %.

Sand was encountered below the topsoil at TP-106 and consists of medium dense, brown, slightly silty, slightly gravelly, well graded sand. Its thickness is unknown because it was not completely penetrated.

Sand with silty interbeds was encountered below the fill or the silty sand at all of the test pits except TP-106. It generally consists of medium dense, gray to gray-brown, slightly silty, medium sand, with lenses and interbeds up to about 12 inches thick of tan silty sand to very sandy silt. The thickness of this unit ranges from 1 to 6 feet. The natural moisture content of the sand portion varied from 2 to 7 % while the moisture content of the silty layers was 14%

Sandy gravel was encountered below the sand with silty interbeds at all but TP-106, and consists of dense, gray-brown, clean to slightly silty, sandy gravel with numerous cobbles and boulders. The coarser fragments are subangular to subrounded and are mostly basalt. Where completely penetrated, this unit is 2 to 4 feet thick.

Coarse sand was encountered below the sandy gravel at TP-101, TP-103, and TP-104. This unit consists of dense, brown, clean to slightly silty, slightly gravelly, coarse or medium to coarse sand and its natural moisture content ranged from 11 to 20 %. Its thickness is unknown because it was not completely penetrated.

Groundwater was encountered at a depth of 8.5 feet at TP-104, which has a surface elevation several feet lower than the others. If excavated deep enough, the other test pits would probably all intersect the groundwater table. In my opinion the groundwater elevation at this site probably has some correlation to the surface water level in Latah Creek, but the correlation is probably more tenuous with increasing distance from the creek channel.

DISCUSSION AND CONCLUSIONS

Slopes

The steep natural slopes on the east side and north end of the site appear to be composed of glaciofluvial flood deposits, which are relatively clean sand with some gravel, cobbles and boulders. These deposits have relatively high shear strength and permeability, but no cohesion. I did not observe any abnormally moist zones that could indicate these deposits include finer grained layers that can temporarily perch groundwater. In their undisturbed state these sandy soils appear to have a slight amount of weak cementation, but when disturbed the cementation no longer exists.

In their undisturbed native state with a slope gradient of about 65 % or less, the slopes are relatively stable. As evidenced by the previously described slope failure, when they are disturbed by making too steep of a road cut, they become unstable and start to slide and ravel. The angle of repose of the sand in its disturbed state appears to be about 70 %. At this slope gradient the factor of safety is about 1.

Based on these observations I conclude that attempting to cut into the slopes to develop building lots is problematic. To develop such lots safely, temporary shoring and permanent engineered retaining structures would be required, and may be cost prohibitive.

There exists substantial riprap, concrete armoring and embedded rocks along areas of potential erosion or channel migration of Latah Creek in the area of the subject property. These protection measures have effectively restricted the movement of the main channel of the creek and protected infrastructure such as Highway 195, the railroad track fill area, the private single-lane bridge and other areas of the property. In particular, the extreme south end armoring adjacent to the high bank should be monitored, maintained and reinforced, if necessary, to assure proper bank protection particularly during extraordinary flood events.

Site Drainage and Groundwater Considerations

The near surface soils below the topsoil are composed of silty sand. Wash analyses show that the percentage passing the # 200 sieve ranges between 10 and 25 % and averages 19 %. According to charts contained in the Spokane 200 Method, soils of this composition may allow an infiltration rate on the order of magnitude of about 1 to 10 inches per hour. In my opinion, depending on the depth of water, it is probable that surface infiltration in the bottoms of swales would be sufficient to drain within a few days.

Although the near surface soils are rather silty, the deeper soils, the sandy gravel and the coarse sand, are quite clean, averaging about 2 % passing the 200 sieve. Soils of this fines content will allow the use of drywells for subsurface infiltration, but only if double depth drywells are used.

Groundwater was encountered in only one test pit (TP-104) at a depth of 8.5 feet. Groundwater would probably have been found in some of the others if they would have been excavated deeper than 15 feet. Depending on the depth and location of the future sanitary sewer system, groundwater could be a design and construction issue.

RECOMMENDATIONS

I advise against developing building lots by excavating into the steep slopes, unless a site-specific slope stability study is conducted on such lots. Under no circumstances should fill be placed on a slope steeper than 50 %

Existing bank armoring in the south property area should be studied by a stream erosion specialist as to the need for possible reinforcements or enhancements.

Once the design of site drainage progresses far enough to locate swales and drywells, a geotechnical study should be conducted to assist in the design of surface and subsurface infiltration. The study should include investigation of groundwater in the areas of the deepest proposed subsurface structures, such as sewer lift stations

LIMITATIONS

This report has been prepared for your use and for the use of USKH for preliminary civil engineering planning and design of the new subdivision to be developed at your property. The conclusions and recommendations presented in this report are based on limited visual observations of surface conditions and of subsurface conditions exposed in six test pits. Cummings Geotechnology has endeavored to comply with generally accepted geotechnical engineering practice common to this area for a preliminary geotechnical site characterization study report and makes no other warranty, express or implied. It should not be considered a complete geotechnical investigation, a certification of natural, embankment, or cut slope stability, or a warranty of interpreted subsurface conditions.

This preliminary geotechnical site characterization study report does not address environmental issues such as existing or future soil or groundwater contamination or the presence or absence of hazardous materials or chemicals.

Thank you for the opportunity to assist you with this interesting project. If you have any questions concerning any of the information or recommendations presented in this report, please contact me.

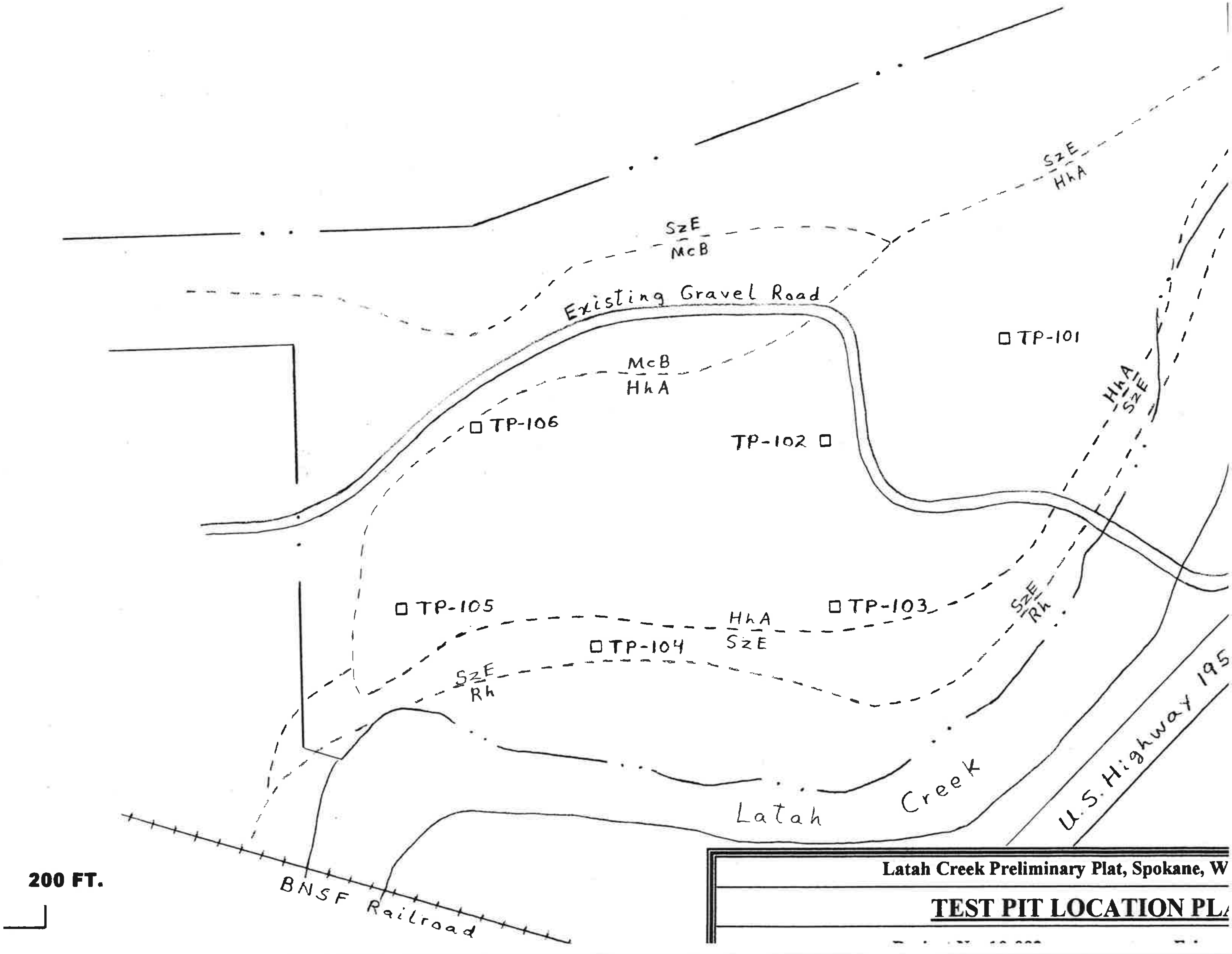
Sincerely,

Grant R. Cummings, P.E.,P.G.

GRANT RICHARD CUMMINGS
STATE OF WASHINGTON
27912
REGISTERED
PROFESSIONAL ENGINEER
EXPIRES 06-06-11

2/22/10

cc: Mr. Jeff Logan, P.E., USKH



Latah Creek Preliminary Plat, Spokane, W

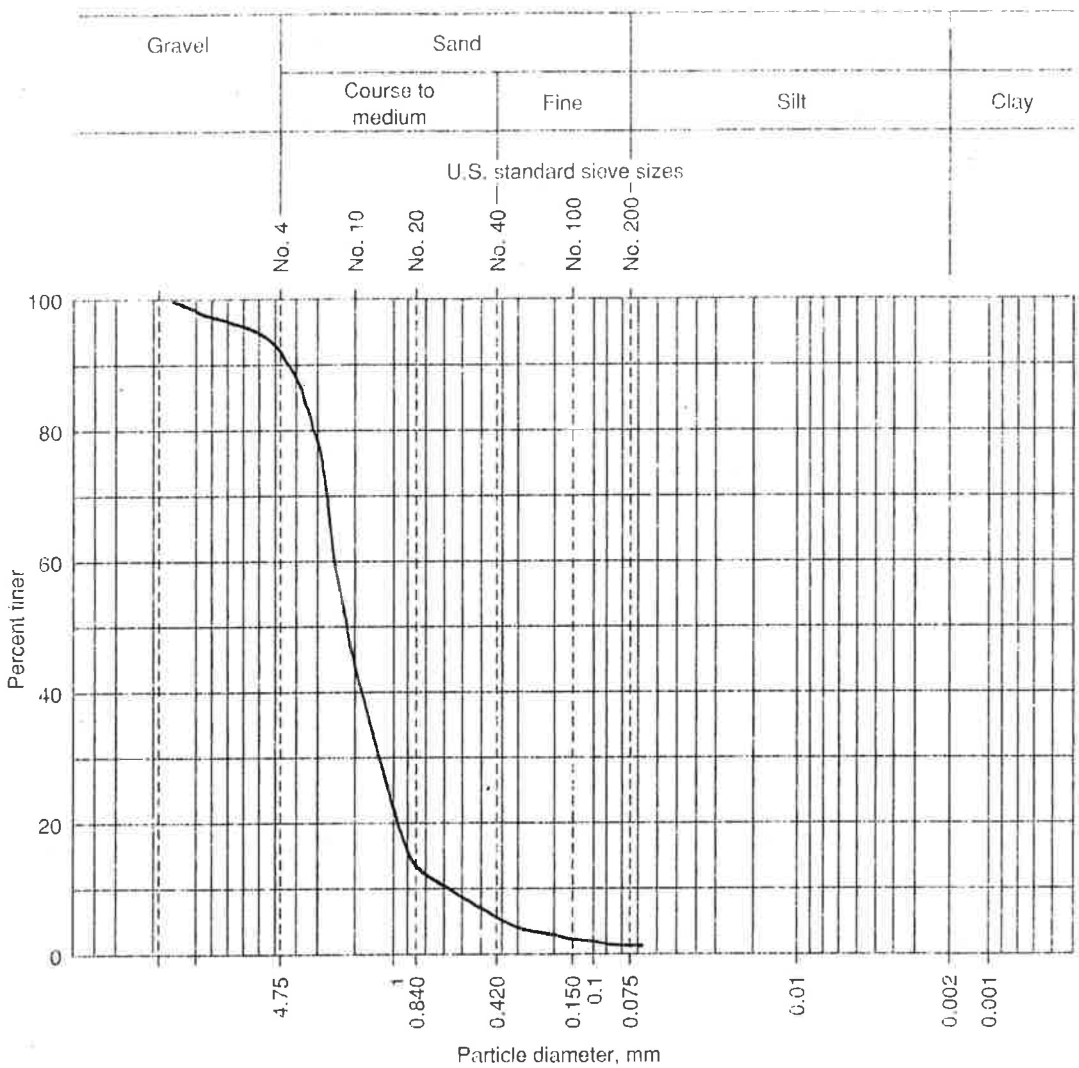
TEST PIT LOCATION PL

GRAIN SIZE DISTRIBUTION

Project Latah Creek Preliminary Plat Job No. 10-002

Location of Project Spokane, Washington Boring No TP-101 Sample No. 3 (9.5-10')

Tested By Grant R. Cummings Date of Testing 2/19/10



Visual soil description Slightly silty, slightly gravelly sand

Soil classification S P (Coarse-grained sand)

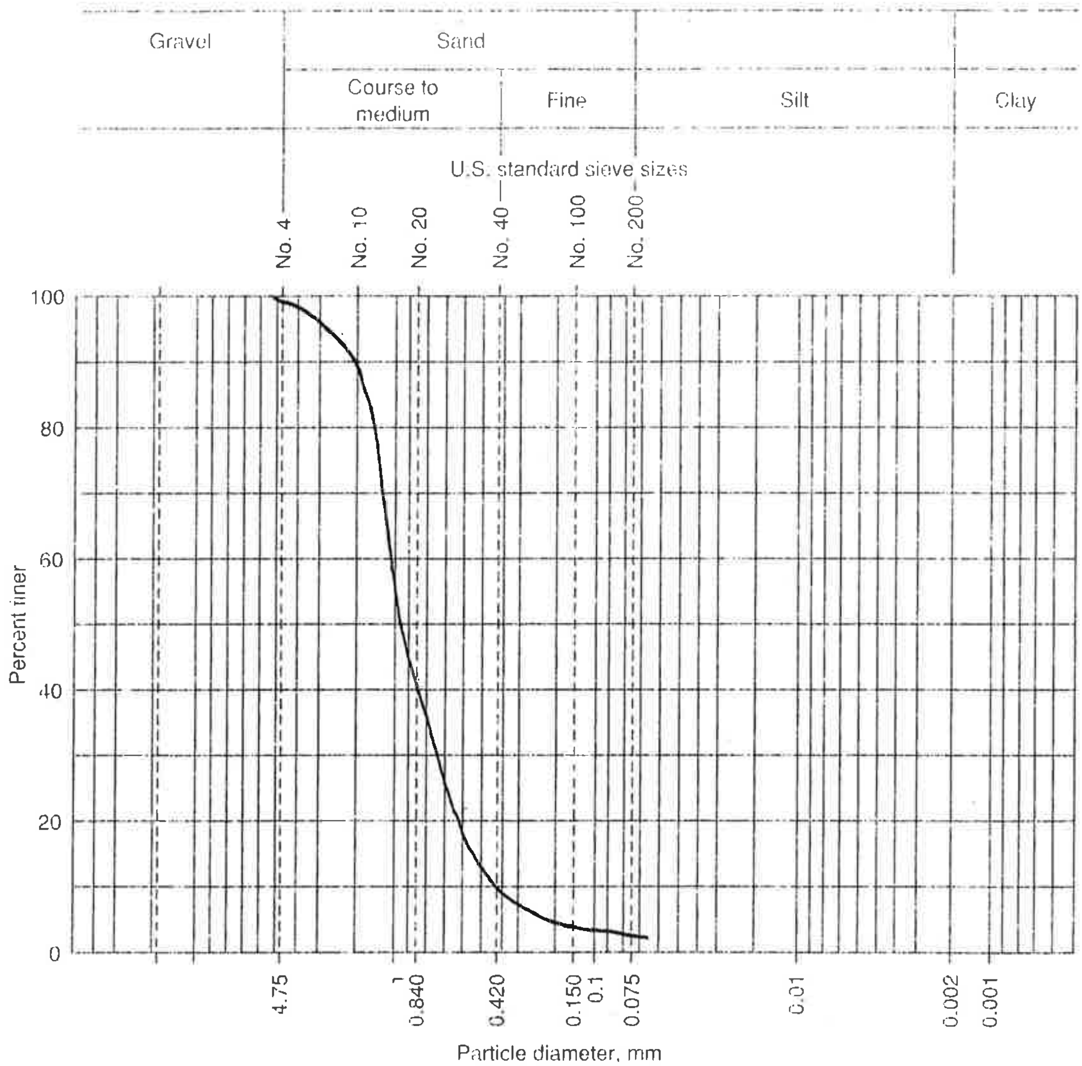
System Unified

GRAIN SIZE DISTRIBUTION

Project: Latah Creek Preliminary Plat — Job No. 10-002

Location of Project: Spokane, Washington — Boring No. TP-103 — Sample No. 4 (12.5-13.5')

Tested By: Grant R. Cummings — Date of Testing: 2/19/10



Visual soil description: Slightly silty sand

Soil classification: S P (Medium to coarse-grained sand)

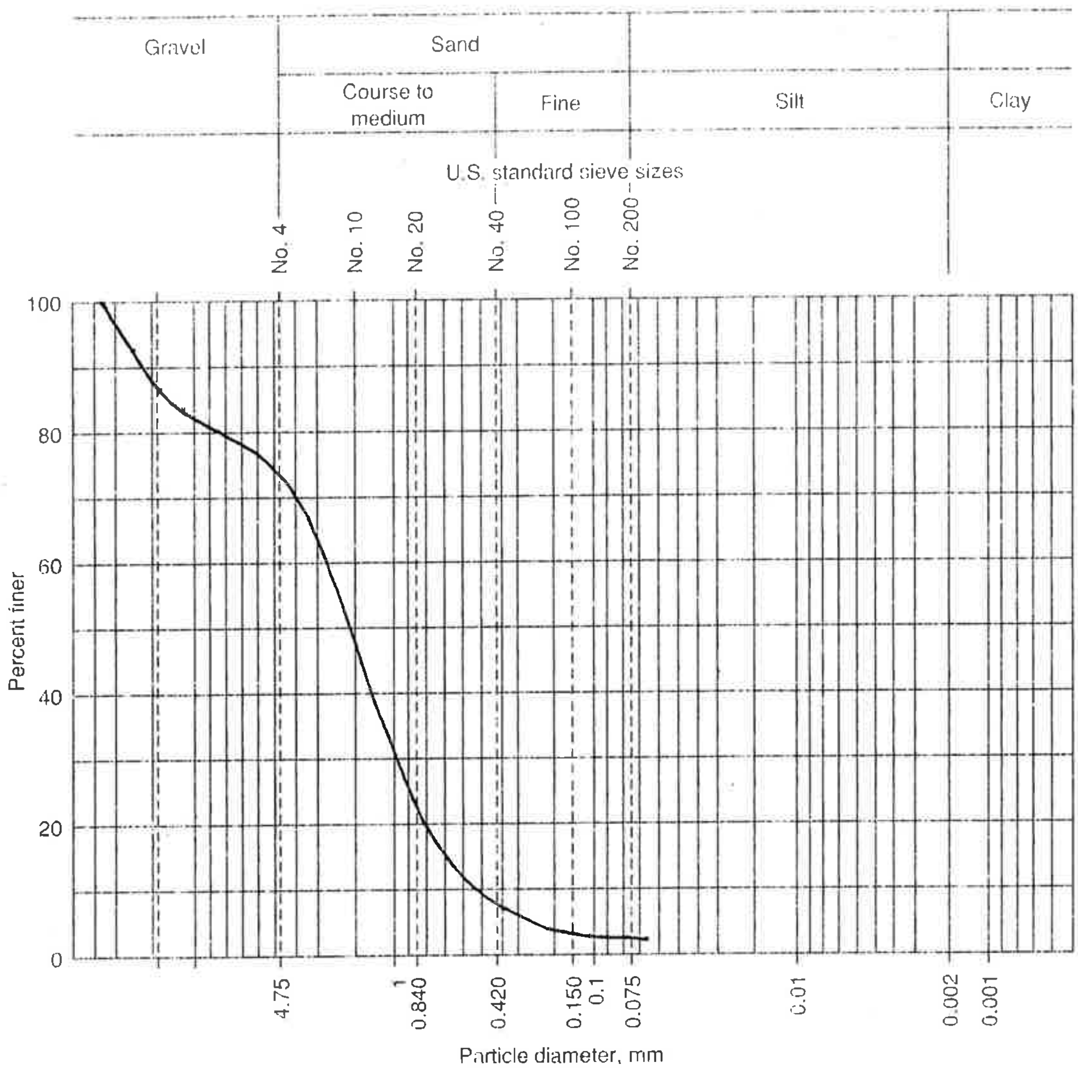
System: Unified

GRAIN SIZE DISTRIBUTION

Project Latah Creek Preliminary Plat Job No. 10-002

Location of Project Spokane, Washington Boring No. TP-104 Sample No. 1 (3.5-5')

Tested By Grant R. Cummings Date of Testing 2/19/10



Visual soil description Slightly silty, gravelly sand

Soil classification S P (Coarse-grained sand)

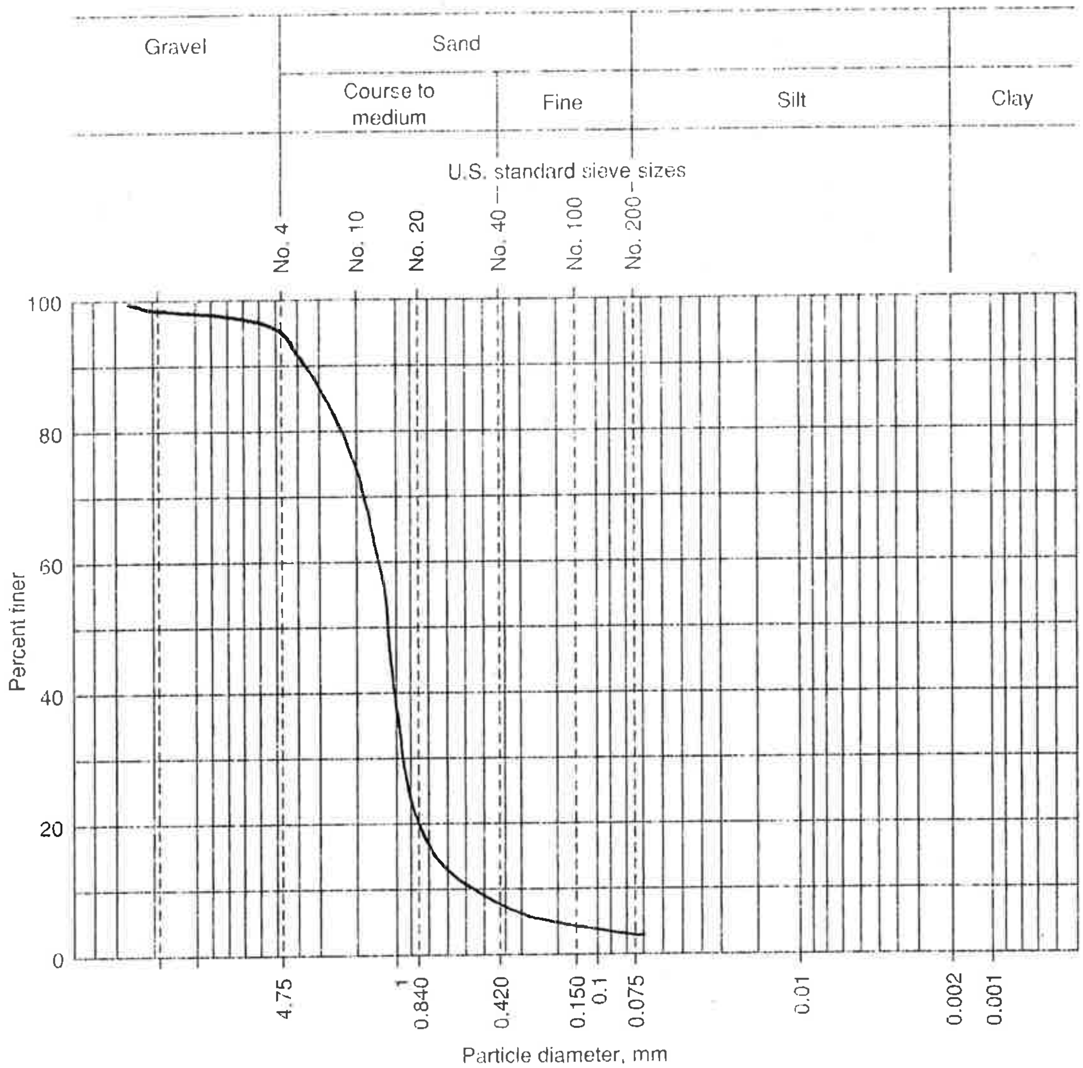
System Unified

GRAIN SIZE DISTRIBUTION

Project Latah Creek Preliminary Plat Job No. 10-002

Location of Project Spokane, Washington Boring No. TP-104 Sample No. 2 (7-8')

Tested By Grant R. Cummings Date of Testing 2/19/10



Visual soil description Slightly silty, slightly gravelly sand

Soil classification S P (Coarse-grained sand)

System Unified

Table 1

Test Pit Logs

February 17, 2010

TP-101

0.0-1.8 ft.	Loose, dark brown, slightly organic, silty sand (topsoil); moist.
1.8-4.0 ft.	Medium dense, brown, silty sand; moist, poorly graded, medium sand. Moisture content = 12 %.
4.0-7.0 ft.	Medium dense, gray to gray-brown, slightly silty sand with lenses of tan silty sand; slightly moist. Moisture content = 3 %.
7.0-9.0 ft.	Dense, gray-brown, clean to slightly silty, sandy gravel with numerous cobbles and boulders (mostly basalt); moist, subangular to subrounded.
9.0-14.0 ft.	Dense, brown, clean to slightly silty, slightly gravelly sand; moist to very moist, poorly graded (coarse sand). Moisture content = 11 %. Note: no groundwater encountered, no soil mottling observed.

TP-102

0.0-1.0 ft.	Loose, dark brown, slightly organic, silty sand (topsoil); moist.
1.0-5.5 ft.	Medium dense, brown, silty sand; moist, poorly graded, medium sand. Moisture content = 14 %.
5.5-6.5 ft.	Medium dense, tan (variegated with orange brown), very sandy silt; moist. Moisture content = 14 %.
6.5-8.5 ft.	Medium dense, gray to gray-brown, slightly silty sand with lenses of tan silty sand; moist.

8.5-12.5 ft. Dense, gray-brown, clean to slightly silty, sandy gravel with numerous cobbles and boulders (mostly basalt); moist, subangular to subrounded. Test pit terminated because of severe caving.

Note: no groundwater encountered, no soil mottling observed.

TP-103

0-2.0 ft. Medium dense, brown, silty sand; moist, poorly graded, medium sand.
Moisture content = 11 %.

2.0-6.0 ft. Medium dense, gray to gray-brown, slightly silty sand with lenses of tan silty sand; slightly moist.
Moisture content = 7 to 14 %.

6.0-6.5 ft. Medium dense, tan (variegated with orange brown), very sandy silt; moist.

6.5-7.5 ft. Medium dense, gray to gray-brown, slightly silty sand with lenses of tan silty sand; slightly moist.

7.5-10.5 ft. Dense, gray-brown, clean to slightly silty, sandy gravel with numerous cobbles and boulders (mostly basalt); moist, subangular to subrounded.

10.5-15 ft. Dense, brown, clean to slightly silty sand; moist to very moist, poorly graded (medium to coarse sand).
Moisture content = 20 %.

Note: no groundwater encountered, no soil mottling observed.

TP-104

0.0-2.5 ft. Loose, brown to dark brown, slightly organic, silty sand FILL; moist, rusted tin can buried at 2.5 ft.

2.5-3.5 ft. Medium dense, gray to gray-brown, slightly silty sand; moist.