BUCKHORN GEOTECH

Civil, Structural & Geotechnical Engineers

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GEOTECHNICAL REPORT
KVLE TOWER REPLACEMENT
GUNNISON
GUNNISON COUNTY, COLORADO

July 26, 2013

Prepared for:

World Telecom Sites
2300 5th Avenue, Suite 131
Vero Beach, FL 32960

Prepared by:

Buckhorn Geotech,
222 South Park Ave.
Montrose, CO 81401

Introduction

Buckhorn Geotech, Inc. conducted a limited evaluation of shallow subsurface and site conditions on July 8, 2013 at the proposed tower and in a conceptual guy anchor layout. This work was performed at the request of Ron Crider, representing World Telecom Sites. The purpose of our services was to evaluate the site for a 200 foot tall replacement tower. The evaluation consisted of a site reconnaissance, subsurface exploration by three soil borings, and analysis of available data. This report presents the findings of our evaluation and our geotechnical engineering recommendations for foundation subgrade preparation and foundation design.

Construction Plans

Based on preliminary plans provided to us by Mr. Crider, we understand the construction will consist of a new tower just northeast of the existing tower and three guy anchors roughly equally spaced and anchored about 70 to 110 feet away radially from the tower. The tower is to be supported on a 2.5 foot tall pedestal on a 1.5 foot thick by 10.5 foot square foundation. The guy anchors will be attached to a 3 foot thick, 6 foot by 12 foot rectangular deadman with base embedded 9 feet below grade. We were not provided with expected structural loadings. As an alternative, the tower and anchors may be supported by a shaft due to high water table conditions.

Site Conditions

The site is about two miles north of the center of Gunnison and is currently occupied by a radio tower with three roughly equally spaced guys anchors on an approximate 80 foot radius from the tower. A residential structure is located about 35 feet north of the tower. The lot is relatively level and vegetated with grasses and scrub. There are two irrigation ditches east and northwest of the tower that limited our access beyond. Refer to the attached Vicinity Map for general location.

Geology

The open expanse of the Gunnison Valley region encompasses some of the oldest and the youngest rock in Colorado. As indicated in *Geology and Mineral Resources of Gunnison County, Colorado* (Colorado Geological Survey Resource Series 37, Streufert, 1999), Precambrian crystalline rock including felsic and hornblende gneiss, biotite gneiss, mafic intrusive rocks and granitic rocks outcrop in the hills and mountains south and east of the City of Gunnison. These rocks are the oldest rock in the region and date from 1,800 million years ago. The ancient formations were uplifted during the Laramide Orogeny as the Sawatch Uplift in eastern part of Gunnison County and the Gunnison Uplift in southern Gunnison County. The Sawatch Uplift, extending from the Gunnison River east to beyond the Gunnison County line, is highly faulted and fractured. The crest of this uplift coincides with the Continental Divide and contains many of the regions productive mining districts. Younger Paleozoic and Mesozoic rock were eroded off this uplift, exposing the older Precambrian rock underneath, east and south of Gunnison (Streufert, 1999).

To the north and west of Gunnison, eroded remnants of the younger Paleozoic and Mesozoic bedrock units remain. These sedimentary bedrock units outcrop along the East River from Almont up to Crested Butte and in the vicinity of Blue Mesa Reservoir. Much of this sedimentary rock is completely covered by the West Elk Breccia, an extensive volcanic deposit that mantles an area north from Blue Mesa Reservoir and east from Ohio Creek. This volcanic rock is composed of lava flows and ejected rubble mixed with mud and debris flows derived from the West Elk volcanic field approximately 20 miles northwest of Gunnison. Subsequent to this episode of volcanic deposition, extensive ash flow tuffs were deposited from the San Juan volcanic field to the south. These ash flow deposits feather out to the north across the surface of the underlying West Elk Breccia. The ash flows also extend to the east where they directly overlie the older Precambrian metamorphic and intrusive rock, south of Gunnison (Streufert, 1999).

Erosion and re-deposition of eroded material created the landscape seen today. Glacial meltwater from at least four episodes of glaciation in the alpine regions surrounding Gunnison incised the valleys of the present East, Taylor, and Gunnison Rivers and Tomichi Creek. Tributary drainages cut canyons into the volcanic rock and softer sedimentary rock. Surficial runoff and sheet flow transported weathered rock down slope to the drainage systems, redepositing the material as river alluvium. Where steeper slopes of weathered bedrock became saturated, mass wasting occurred in the form of landslides, debris flows, and smaller earthflows. According to the Gunnison geologic map, the proposed building site is mapped as Stream Terrace Alluvium. The soils found in our borings are consistent with what is typically found in the area on these types of deposits and are discussed in the *Subsurface Conditions* section of this report.

Geologic Hazards

Flooding

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map for Gunnison County, Community Panel Number 0615B , the property is located in Zone X. Zone X consists of areas determined to be outside the 500-year flood plain, where no special precautions are required to mitigate potential flood hazards.

Seismicity

There are numerous faults mapped in Gunnison County, but most of these are considered to be ancient and inactive, associated with the Tertiary volcanics to the west and north of the Slate River valley and the Laramide Sawatch Uplift to the east. According to the *Geology and Mineral Resources of Gunnison County, Colorado* (CGS Resource Series 37, by R. Streufert: 1999), there are dozens of north- to northwest-trending faults located east of State Highway 135 and extending from Highway 50, southeast of Gunnison, north towards Aspen and Marble. None of these are identified as geologically recent (Quaternary-aged) or potentially active faults in the Colorado Geological Survey (CGS) reports relating to earthquake potential [*Earthquake Potential in Colorado—A Preliminary Evaluation* (Bulletin #43: Kirkham and Rogers, 1981) and

Preliminary Quaternary Fault and Fold Map and Database of Colorado (Open-file Report 98-8: Widmann et al., 1998)]. The only mapped potentially active faults in Gunnison County belong to the Cimarron Fault group, a segmented fault zone located 22 miles southwest of Gunnison and continuing for roughly 35 miles to the northwest. The Cimarron Fault group consists of five distinct sections with apparently different ages and amounts of movement associated with the Laramide Gunnison Uplift that was later reactivated in the Quaternary. The maximum credible earthquake inferred for the Cimarron Fault group is M6.75.

Gunnison is located in Western Mountain Seismotectonic Province in Colorado, where maximum credible earthquakes are estimated to be on the order of magnitude 6 to 6.5, equivalent to Modified Mercalli (MM) VI to VIII (CGS Bulletin #43). Please refer to the *Seismic Design Criteria* Section of the *Recommendations* section for site-specific seismic design recommendations interpreted from the *2003 International Building Code* (IBC).

Radon Gas

Since the proposed tower facility does not include habitable structures, radon gas is not a consideration.

Subsurface Conditions

Three borings (BH#1, BH#2 and BH#3) were drilled to depths of 14 to 21 feet using a Dietrich D-90 truck-mounted drill rig at the locations noted on the attached Site Plan. The locations of the borings were selected based on available information at the time of drilling which was that the new tower would be close to the existing and that the guy anchors would be about 50 foot radially from the tower. It appears that the guy anchors will be about double that radius from the tower. The boreholes were drilled with an 8 inch diameter hollow stem auger to keep the holes open for SPOT sampling within the auger stem. Soil samples were obtained at discrete depths by withdrawing the inner drill string and inserting either a standard 1.375-inch inside diameter (I.D.) split-spoon sampler without liners to perform in-situ Standard Penetration Tests (SPTs) in general accordance with ASTM Standard D-1586. The number of blows required to drive the sampler 12 inches in 6-inch increments were recorded (SPT "N" penetration resistance values) and, when properly evaluated, indicate the relative density or consistency of the soils.

The soil, bedrock, and groundwater conditions were logged, and representative samples of subsurface materials were tested in our laboratory. The subsurface conditions found in the borings and laboratory results are shown on the attached Borehole Logs.

The borings found similar conditions at all three locations. There was a 6 to 12 inch surficial layer of silty sand underlain by sandy gravel and cobbles to the full depths explored. The blow count (N-value) of the deposits indicated very dense conditions, ranging from 50 blows per 6 inches to 50 blows per 12 inches. In boring BH#3, the inner drill bit was melted on an undetermined cobble at 14 feet below grade and the boring terminated.

Laboratory tests were performed on the selected native soils to evaluate the particle size and corrosion characteristics (see attached Hydrometer Analysis results). No atterberg limits tests were conducted as the soils are non-plastic.

The hydrometer analyses indicate that the soils are composed of less than 5% fines with the remainder varying from 50+% gravel or sand. It should be noted that the drilling process ground up larger gravels and cobbles so the gradations are not representative of actual in-situ conditions. Based on these laboratory test results, this soils classify as SANDS AND GRAVELS [SW, SP-SM, and GW-GM] according to the Unified Soil Classification System (USCS).

A series of geochemical tests were conducted on one sample taken from a depths of 5-6 feet in BH#1. The soil samples were tested for water soluble sulfates content, chloride content, pH, and electro-conductivity to evaluate the corrosivity of the soil. Sample DS1 had a water soluble sulfate concentration of 0.010%, a chloride content of 15 mg/L, an electro-conductivity of 30 µS/cm, and a pH of 7.74. The water electro-conductivity is indicative of highly corrosive soil. Recommendations for addressing the corrosive nature of the soil are presented in the *Recommendations* Section of this report.

In summary, the soils found in the borings are similar in composition, color, and physical properties. The field observations and laboratory testing indicates that the soils to the depths explored are non-plastic, dense and granular.

RECOMMENDATIONS

Based upon our limited site evaluation and results of our subsurface testing, it appears that the proposed tower site soils are suitable for support of the intended tower and guy anchors. Groundwater is shallow and will influence construction of the guy anchor deadman and possibly the tower foundation dependent upon time of year of construction. Recommendations to guide foundation subgrade preparation and foundation design are presented below.

This report does not contain project specifications. The recommendations given are provided to guide the design process. We anticipate these recommendations, together with site-specific geotechnical information, will be used by the design team to formulate project specifications.

Seismic Design Criteria

In accordance with Section 1615 of the *2009 International Building Code* (IBC) and our knowledge of the site, we conservatively recommend that this site be designated as Site Class; C=very dense soil and soft rock with N>50. This classification is based on limited shallow exploratory data and assumes that subsurface conditions similar to those encountered during our site evaluation extend to a depth of 100 feet. For Site Class B, the mapped spectral response acceleration at short periods (0.2 second, $\mathbf{S_s}$) is 0.353g and at one second ($\mathbf{S_1}$) is 0087g. ***These values should be adjusted for the proper site class given above.*** The values are taken from the USGS website based on the latitude and longitude coordinates for the site and they are referenced to the National Earthquake Hazard Reduction Program (NEHRP) 1997 and 2000 maps, reproduced in the IBC.

Foundation

The tower and deadman foundations may be supported on the native sandy gravel and cobbles. The following recommendations are provided to guide foundation design and construction.

1. The foundations should be placed on the prepared native sandy gravel and cobbles and should be designed using an allowable bearing capacity ($\mathbf{q_a}$) of 4000 psf.

2. After excavation to foundation depth, the exposed soil surface should be proof-compacted using vibratory or roller compaction equipment to provide a uniformly dense surface prior to placement of footing forms. If the presence of large rocks makes disturbing the native soils below footing elevation unavoidable, then the rocks should be removed and replaced with compacted structural fill. If soft or yielding soils are encountered, Buckhorn Geotech should be contacted to assess the soil conditions and recommend remedial measures. Typical procedures involve removing soft/yielding subgrade soils to firm material and replacing them with compacted structural fill or excavated gravelly, native soil.

3. Once the excavation is exposed, but prior to placement of footing forms, a representative of Buckhorn Geotech should be called out to verify the nature and density of the foundation excavations, to ensure that relatively uniform soil conditions are present and to confirm that our recommendations are consistent with actual conditions. If we do not verify the soil conditions, Buckhorn Geotech cannot be held responsible for recommendations that may be inconsistent with actual conditions.

4. Observation and testing during construction is essential to ensure that the geotechnical recommendations are consistent with conditions and that the project is constructed in compliance with project design and specifications. Any geotechnical observations or testing will be provided at additional charge and we should be contacted at least 2 days in advance for scheduling site visits. In addition to excavation observations, we can provide observation and testing of soil density, concrete and grout, foundation forms and rebar, pile installation, steel, welds, grading features, and drain systems.

5. All concrete used in foundation components at this site in contact with native soil should comply with the recommendations in the *Concrete* Section of these recommendations.

Drilled Shafts

As an alternative, the tower and deadmen may be supported on drilled shafts to avoid the potential issues associated with dewatering. The shafts should extend a minimum depth of 10 feet below existing grade and the upper 4 feet of embedment should be neglected for support. For drilled shaft design, we recommend the shafts be designed for skin friction only using an allowable skin friction value of 2000 pounds per square foot (psf). If designed for end bearing only, an allowable bearing capacity of 15 tons per square foot may be used for design. If both friction and end bearing are considered for support, then only one form of support can be considered as dominant (using 100 percent of the values given above) and the other considered

secondary (using 25% of the values given above). Input parameters for lateral pile analysis are as follows:

K_s - Subgrade Modulus – 125 pci

Φ – Friction Angle – 34°

γ – Unit Weight – 130 pcf

Lateral Earth Pressure

No retaining walls are planned but the design of the foundations may require active, at rest and passive pressure parameters which are provided in Table 1 below.

Table 1. Lateral Earth Pressures

	Native Sandy Gravel and Cobbles	
Active Earth Pressure	34	pcf*
Passive Earth Pressure	500	pcf*
At-Rest Earth Pressure	58	pcf*
Unit weight of soil	130	pcf**
Coefficient of Friction	0.32	***

* pounds per cubic foot (fluid equivalent)
** pounds per cubic foot
*** concrete on dry soil conditions

Site Preparation and Grading

Site grading is expected to be minimal. The excavated native sandy gravel and cobbles will make suitable fill provided the rocks larger than 6 inches in diameter are removed prior to compacting. Although not expected to be used, Table 2 provides recommendations for fill material.

Table 2. Gradation Requirements for Fill Material

Type	Sieve	% Passing, by weight
Structural Fill (CDOT Class 6 roadbase)	3/4" (19.0 mm)	100
	#4 (4.75 mm)	30-65
	#8 (2.36 mm)	25-55
	#200 (0.075 mm)	3-12
Structural Fill (CDOT Class 1)	2.5" (63.5 mm)	100
	2" (50 mm)	95-100

	#4 (4.75 mm) #200 (0.075 mm)	30-65 3-15
Fill under exterior concrete flatwork	3" (75 mm) #200 (0.075 mm)	100 0-5
Free-draining fill	3" (75 mm) ¾" (19 mm) #4 (4.75 mm) #200 (0.075 mm)	100 20-90 0-20 0-3

Note: The Plasticity Index for all fill soils should be less than 6.

Table 3. Compaction Requirements for Fill Material

Application	Compaction Requirement	Proctor	Moisture
Under footings and slabs	95% max. dry density	Modified	±2% of optimum
Under exterior flatwork	90% max. dry density	Modified	±2% of optimum
Behind retaining walls	Per project specifications*		
Utility Trenches	Per project specifications*		
General landscaping	Per project specifications*		

*As specified by the structural design engineer on project documents or in accordance with local municipal requirements.

Concrete

Because of the high corrosivity indicated by the resistivity test results, Type I/II sulfate-resistant cement should be used in all concrete at this site.

Excavation and Shoring

Excavations of 4 to 9 feet deep will be required for foundation construction. The resulting excavation walls will require temporary support or layback during construction.

1. Temporary excavations should be in accordance with Occupational Safety and Health Administration (OSHA) regulations and with worker safety in mind.

2. Construction equipment, materials, and soil stockpiles should be located a minimum horizontal distance equal to the height of the excavation from the crest of the excavation unless otherwise approved by the structural design engineer.

3. An excavation bracing plan is recommended for all temporary excavations of 10 feet or more. There are numerous methods of providing support for the excavation walls.

Buckhorn Geotech should be contacted to provide geotechnical input into the design of the excavation support once the foundation plan is available.

4. Based upon our evaluation, the sandy gravel and cobbles found in our borings would be most nearly represented by an OSHA Type C soil. Our assessment is based upon the soil and groundwater conditions found in our limited evaluation and sampling. The contractor's "competent person" (defined by OSHA as "an individual capable of identifying existing and predictable hazards...and who has the authorization to take prompt corrective measures to eliminate or manage these hazards and conditions) should evaluate the soil materials exposed during excavation based on composition, structure, and environmental conditions per 29 CFR 1926 and recommend appropriate slope laybacks or shoring, as required. Refer to OSHA's Technical Manual Section V: Chapter 2 on *Excavations: Hazard Recognition in Trenching and Shoring* (available on-line at: *www.osha.gov*) for further excavation guidelines. We can provide these services, as requested.

5. If the excavations will be made or remain open during wet weather, it is recommended that polyethylene sheeting be secured over the excavation face to minimize sediment runoff and deterioration of the foundation soils. Surface runoff above the cuts should be directed away from the excavation using berms or diversion ditches. Large rocks exposed in the excavation face should be removed for worker safety.

6. Excavation dewatering will likely be required for the guy anchors and possibly the tower foundation if the excavation is made during peak groundwater season or during the time the nearby irrigation ditches are running (springtime and summer). The site sandy gravels and cobbles are highly permeable, so dewatering should anticipate such conditions. The excavation should be designed to accommodate clarification and discharge of this intercepted water.

7. Excavations may be performed during the low groundwater season (late fall through early spring) to minimize the amount of water that needs to be removed during shoring and construction operations.

8. Groundwater monitoring is recommended so that if groundwater levels drop below 10 feet during portions of the year when construction vcan proceed, dewatering can be minimized or eliminated.

9. We anticipate that the excavation of the site soils can be accomplished by conventional excavating equipment.

Closing Considerations

Standard of Care and Interpretation of Subsurface Data

This report has been prepared in a manner consistent with local standards of professional geotechnical engineering practice. We note that we did not perform an evaluation of deep subsurface conditions. Evaluation of environmental contaminants was not part of our scope of services performed at this site. The classification of soils and interpretation of subsurface conditions is based on our training and years of experience, but is necessarily based on limited subsurface observation and testing. As such, inferred ground conditions cannot be guaranteed to be exact. No other warranty, express or implied, is made.

Observations of the foundation subgrade by Buckhorn Geotech prior to erection of the foundation systems are integral parts of these recommendations. If subsurface conditions differing from those described herein are discovered during excavation, construction should be stopped until the situation has been assessed by a representative of Buckhorn Geotech. Construction should be resumed only when remedies or design adjustments, as necessary, have been prescribed.

Use of This Report

This report is intended for use by the design team specifically to address the site and subsurface conditions as they relate to the proposed structure(s) described in the *Construction Plans* Section. Changes to the site or proposed development plans may alter or invalidate the recommendations contained herein.

Buckhorn Geotech retains an ownership and property interest in this report. Consistent with the industry, copies of this document that may be relied upon by the design team are limited to those that are signed and sealed by the Geotechnical Engineer (*Standard Form of Agreement Between Owner and Geotechnical Engineer for Professional Services*, Engineer's Joint Contract Documents Committee, 1996). This report together with ancillary data, analyses, test results, and other components and/or supporting parts are not intended or represented to be suitable for reuse by the design team or others on extensions to this project or on any other project. Any such reuse or modification invalidates all aspects of the report and excuses the Geotechnical Engineer for all responsibility and liability or legal exposure.

This report is considered valid for a period of two years from the date of issue provided the site conditions and development plans have not changed from what is referenced in this report. Changes to the site may occur due to development or natural processes. Additionally, technological advances made in construction and changes in legislation may alter the recommendations made herein. Depending upon the site and proposed development changes, Buckhorn Geotech may require additional evaluation (at additional cost) to update the recommendations contained herein.

Retention of Samples

Samples of soil and rock collected during the course of our geotechnical evaluation(s) are routinely held in our laboratory for a period of three months from the date of the evaluation and then are discarded. A written request by the client or design team is required for samples to be stored for a longer period.

Additional Services

To provide continuity and consistency from project start to finish, we should be retained to make observations and carry out material testing as a service to the owner. As noted above, we recommend the owner contact us to discuss required services and scheduling in advance of the construction phase.

Buckhorn Geotech is a full-service engineering firm providing foundation, on-site wastewater system, site drainage, structural and retaining structure design services, as well as surveying, construction materials testing, and inspections. Please visit **www.buckhorngeo.com** for a full description of our services.

Thank you for the opportunity to perform this geotechnical evaluation for you. If you require any of the above services or have any questions regarding this report, please contact us.

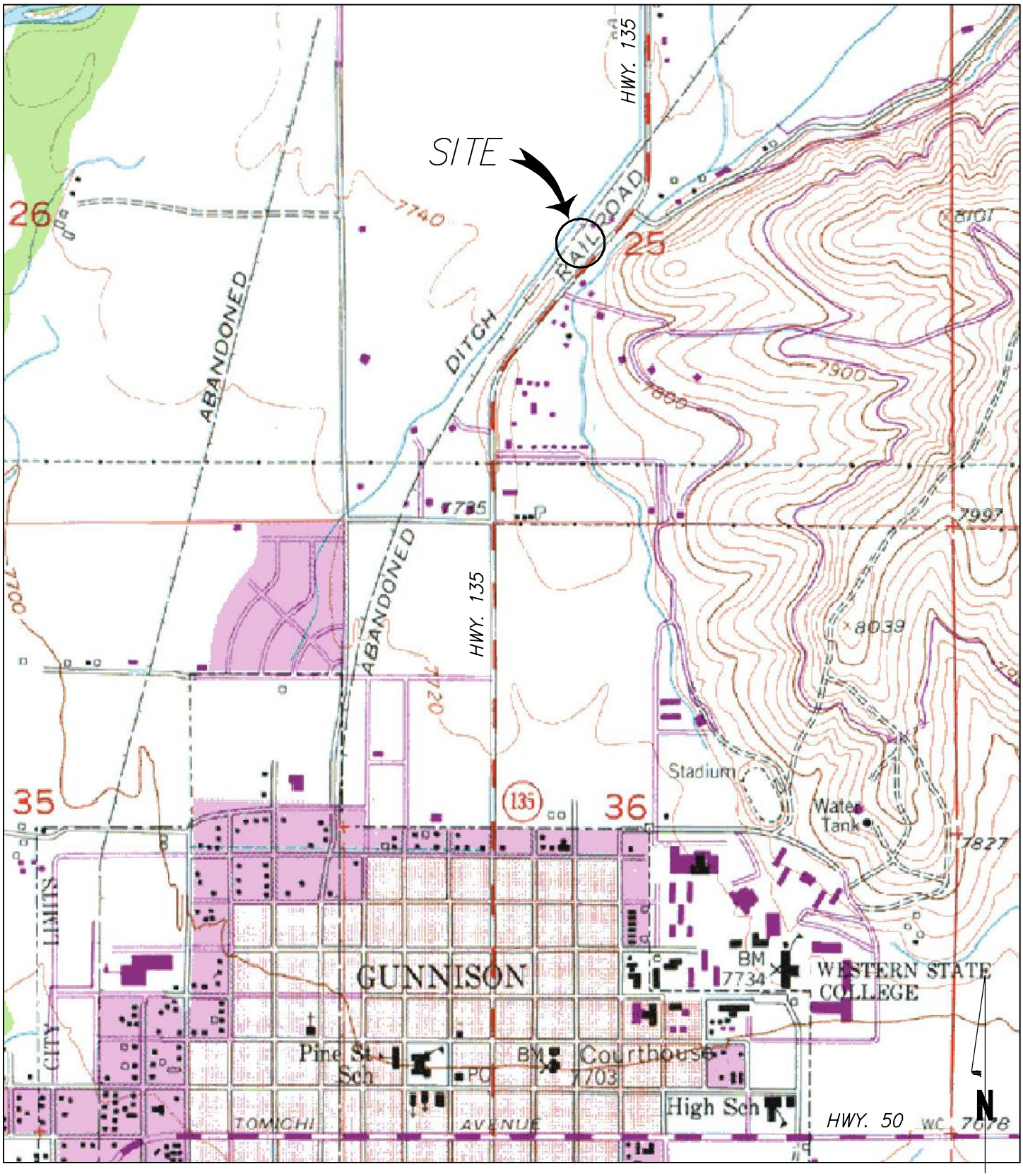
Respectfully Submitted
ELECTRONICALLY,
Buckhorn Geotech, Inc.

Wayne Pandorf, P.E.
Professional Engineer

WP/kdr

Enclosures: Vicinity Map, Site Plan, Borehole Logs, , Sieve/Hydrometer Analysis, Corrosivity Series results

VICINITY MAP



Not to Scale

MAP NUMBER 1 OF 2	FIELD STAFF	W.P.
	DRAFTING	J.C.
	FIELD DATE	7/8/2013
	JOB NO.	13-153-GEO

World Telecom Sites
KVLE Tower
Gunnison, Colorado

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SITE PLAN

MAP NUMBER 2 OF 2	FIELD STAFF	W.P.
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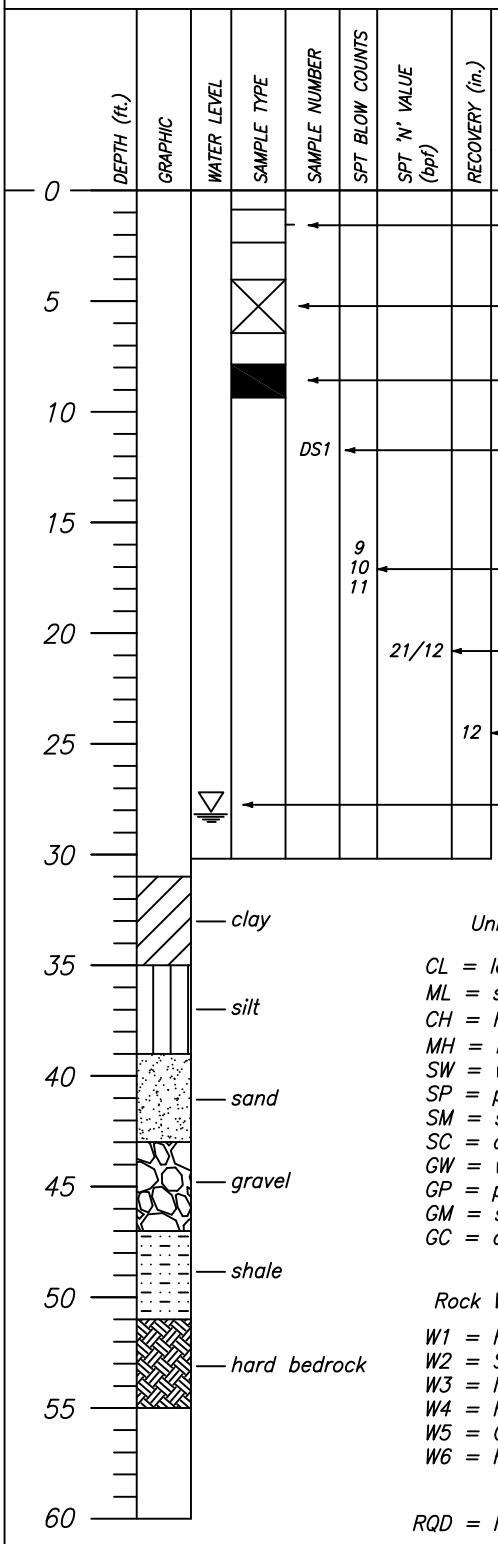
BOREHOLE LOG KEY

BOREHOLE LOCATION:
SURFACE ELEVATION:
NOTES:

DRILLER:
DRILL RIG:
DRILL STEM:
SAMPLER:



SOIL DESCRIPTION

(stratigraphic transitions are approximate and are inferred from cuttings and driller's comments)

drive sample

bulk sample

core sample

DS1 ← Sample identifier: DS = Drive sample
GS = Grab (bulk) sample from augers
CS = Core sample

9
10
11 ← Blows required to drive sampler 6 inches each
First 6 inches is considered to be the "seating" drive

21/12 ← indicates 21 blows required to drive the sampler 12 inches with a 140–lb hammer falling 30 inches

12 ← length of intact soil plug recovered from the sampler

free water depth at time of drilling

Unified Soil Classification System (ASTM D–2487)

CL = lean clay to sandy/gravelly lean clay
ML = silt to sandy/gravelly silt
CH = high plasticity clay to sandy/gravelly high plasticity clay
MH = high elasticity silt to sandy/gravelly high elasticity silt
SW = well–graded sand or well–graded sand with gravel
SP = poorly graded sand or poorly graded sand with gravel
SM = silty sand to silty sand with gravel
SC = clayey sand to clayey sand with gravel
GW = well–graded gravel or well–graded gravel with sand
GP = poorly graded gravel or poorly graded gravel with sand
GM = silty gravel or silty gravel with sand
GC = clayey gravel or clayey gravel with sand

Rock Weathering Classification

W1 = Fresh
W2 = Slightly weathered
W3 = Moderately weathered
W4 = Highly weathered
W5 = Completely weathered
W6 = Residual soil, no structure

RQD = Rock Quality Designation

Intact Rock Strength Classification

R0 = Extremely weak rock, 35 – 150 psi
R1 = Very weak rock, 150 – 725 psi
R2 = Weak rock, 725 – 3625 psi
R3 = Medium strong rock, 3625 – 7250 psi
R4 = Strong rock, 7250 – 14500 psi
R5 = Very strong rock, 14500 – 36000 psi
R6 = Extremely strong rock, >36000 psi

FIELD & LABORATORY TEST RESULTS

Notes in this column indicate tests performed and test results:

DD: dry density in pcf
MC: % moisture content
LL: Liquid Limit
PL: Plastic Limit
PI: Plasticity Index
GF: Gravel fraction (%)
SF: Sand fraction (%)
F200: Silt/Clay (%)
Sh: Shear resistance
P: Penetration resistance
CBR: California Bearing Ratio
SP: swelling pressure
TM: total movement under constant pressure
UCS: unconfined com–pressive strength
psf: pounds/square foot
pcf: pounds/cubic foot
psi: pounds/square inch

SPT N value vs. density:

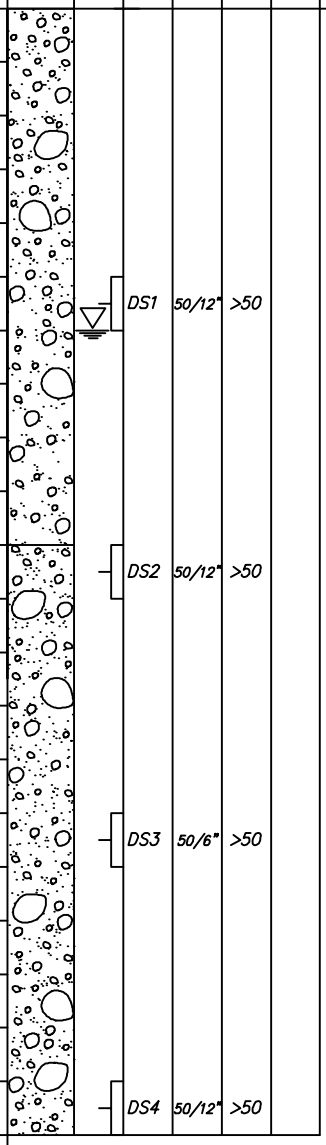
N	rel. density
sands (non–cohesive):	
0–4	very loose
4–10	loose
10–30	medium
30–50	dense
>50	v. dense
clays (cohesive):	
<2	v. soft
2–4	soft
4–8	medium
8–15	stiff
15–30	v. stiff
>30	hard

BOREHOLE LOG KEY	FIELD STAFF	BOREHOLE LOG KEY	BUCKHORN GEOTECH
1	DRAFTING STAFF		Civil, Structural, and Geotechnical Engineers, Inc. 222 South Park Avenue Montrose, Colorado 81401 Phone (970) 249-6828 Fax (970) 249-0945
OF 1	FIELD DATE		
	PROJECT #		

BOREHOLE LOG – BOREHOLE #1 (BH#1)

BORE HOLE LOCATION: North of existing tower ≈15'
SURFACE ELEVATION:
NOTES: Hollow stem auger

EXCAVATION COMPANY: GDI Drilling
OPERATOR:
EQUIPMENT: Diedrich D-90



DEPTH (ft.)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS	BPF	RECOVERY	SUBSURFACE DESCRIPTION	FIELD & LABORATORY TEST RESULTS
0							
1							
2							
3						Brown, sandy GRAVEL to gravelly SAND and COBBLES; hard drilling (0–10')	
4							
5							DS1 (GW–GM) Sulfates= 0.010% Chlorides= 15 ppm Conductivity= 30 μs/cm PH= 7.74
6		DS1	50/12"	>50		drive sample DS1 @ 5–6' Groundwater encountered @ 6' during drilling	
7							
8							
9							
10							DS2 (SP–SM) Clay= 2.5% Silt= 5.3% Sand= 63.2% Gravel= 29%
11		DS2	50/12"	>50		drive sample DS2 @ 10–11'	
12							
13							
14						Coarse SAND, GRAVEL and COBBLES (10–21')	
15							
16		DS3	50/6"	>50		drive sample DS3 @ 15–16'	
17							
18							
19							
20							DS4 (GW–GM) Clay= 1.3% Silt= 4.0% Sand= 40.4% Gravel= 54.3%
21		DS4	50/12"	>50		drive sample DS4 @ 20–21' end of BH @ 21' no bedrock encountered	
22							
23							
24							
25							

BORE HOLE LOG
BH#1
OF 3

FIELD STAFF	W.P.
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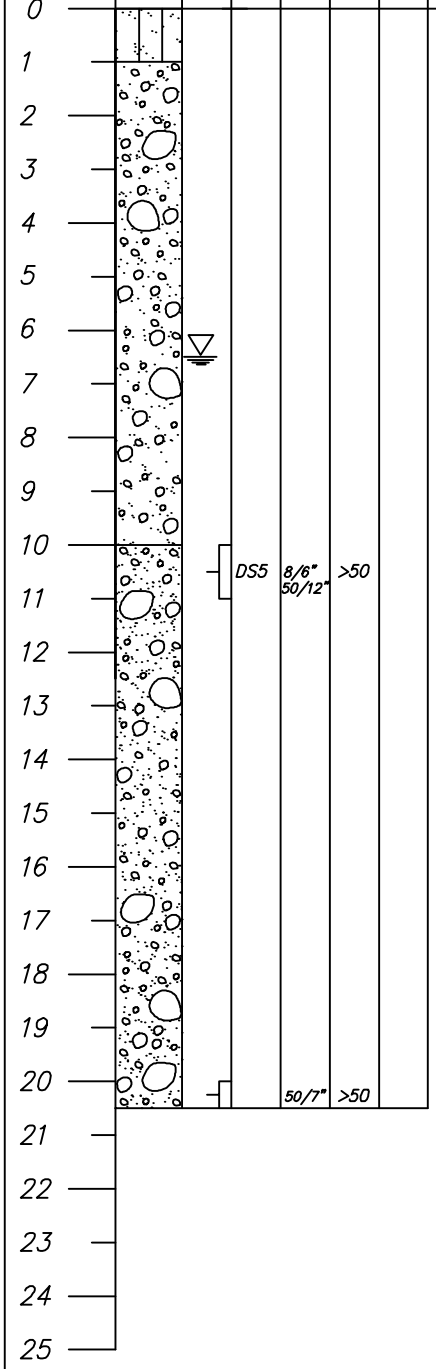
BOREHOLE LOG – BOREHOLE #2 (BH#2)

BORE HOLE LOCATION: South of tower ≈50'
SURFACE ELEVATION:
NOTES: Hollow stem auger

EXCAVATION COMPANY: GDI Drilling
OPERATOR:
EQUIPMENT: Diedrich D-90



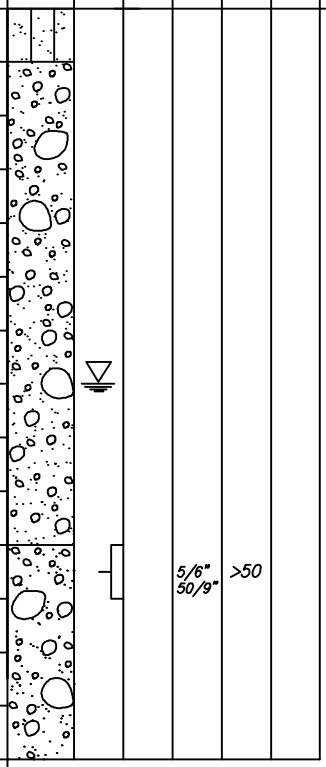
SUBSURFACE DESCRIPTION	FIELD & LABORATORY TEST RESULTS
Light brown, silty SAND (0–1')	
Brown, sandy GRAVEL to gravelly SAND and COBBLES (0–10')	
Groundwater encountered @ 6.5' during drilling	
drive sample DS5 @ 10–11'	DS5 (SW) Clay= 0.5% Silt= 1.4% Sand= 53.4% Gravel= 44.7%
Coarse SAND, GRAVEL and COBBLES (10–20.5')	
end of BH @ 20.5' no bedrock encountered	

BORE HOLE LOG BH#2 OF 3	FIELD STAFF W.P. DRAFTING J.C. FIELD DATE 7/8/2013 JOB NO. 13–153–GEO	World Telecom Sites KVLE Tower Gunnison, Colorado	BUCKHORN GEOTECH Civil, Structural, and Geotechnical Engineers, Inc. 222 South Park Avenue Montrose, Colorado 81401 Phone (970) 249-6828 Fax (970) 249-0945

BOREHOLE LOG – BOREHOLE #3 (BH#3)

BORE HOLE LOCATION: 30' from SE corner of house
SURFACE ELEVATION:
NOTES: Hollow stem auger

EXCAVATION COMPANY: GDI Drilling
OPERATOR:
EQUIPMENT: Diedrich D-90



DEPTH (ft.)	SAMPLE	SAMPLE NUMBER	BLOW COUNTS	BPF	RECOVERY	SUBSURFACE DESCRIPTION	FIELD & LABORATORY TEST RESULTS
0–1						Red brown, silty SAND (0–1')	
1–10						Brown, sandy GRAVEL to gravelly SAND and COBBLES (0–10')	
7	▽					Groundwater encountered @ 7.0' during drilling	
10			5/6" 50/9"	>50			
10–14						Coarse SAND, GRAVEL and COBBLES (10–14')	
14						end of BH @ 14' (5 minutes w/ no progress under full weight of rig @ 30,000 ft. lbs. torque) (Bit melted)	

BORE HOLE LOG BH#3 OF 3	FIELD STAFF	W.P.	World Telecom Sites KVLE Tower Gunnison, Colorado
	DRAFTING	J.C.	
	FIELD DATE	7/8/2013	
	JOB NO.	13–153–GEO	

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Sieve / Hydrometer Analysis and Atterberg Limits

Project Name	KVLE Tower	Date	7/16/2013
Project Location	Gunnison, CO	Project #	13-153-GEO
Client	W.T.S	Sample by	KR/WP
Test Location	BH#1 @10-11'	Tested by	SJ/KB
Sample #	DS2		

Hydrometer Analysis

ASTM D422

Sieve	Opening (mm)	% Passing
3"	76.2	100.0
3/4"	19.1	100.0
3/8"	9.5	84.2
#4	4.75	71.0
#10	2.0	64.7
#40	0.425	21.2
#200	0.075	7.8

Atterberg Limits

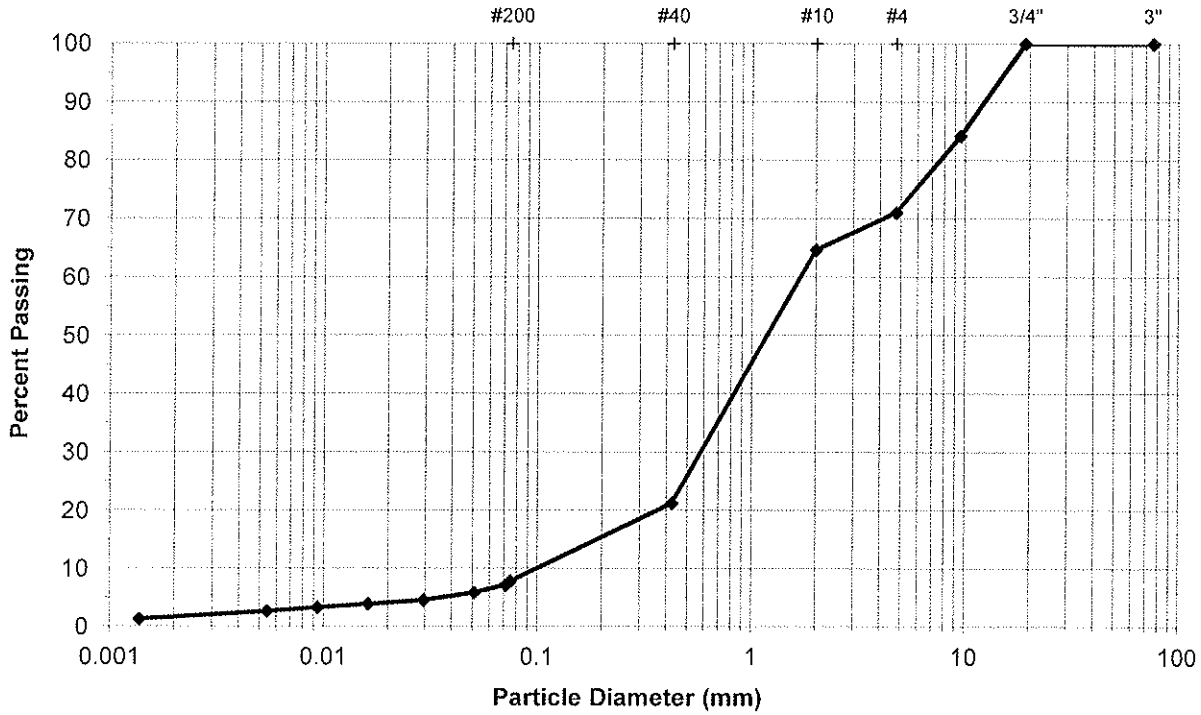
ASTM D4318

Liquid Limit (LL)	NR
Plastic Limit (PL)	NR
Plasticity Index (PI)	NR

NR = Not Requested

Soil Description: brown poorly-graded SAND with silt and gravel

USCS Classification: SP-SM ASTM D2488



Clay	Silt	Fine	Medium	Coarse	Fine	Coarse
FINES		SAND			GRAVEL	

% Clay = 2.5 % Silt = 5.3 % Sand = 63.2 % Gravel = 29.0

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Sieve / Hydrometer Analysis and Atterberg Limits

Project Name	KVLE Tower	Date	7/16/2013
Project Location	Gunnison, CO	Project #	13-153-GEO
Client	W.T.S	Sample by	KR/WP
Test Location	BH#1 @20-21'	Tested by	SJ/KB
Sample #	DS4		

Hydrometer Analysis

ASTM D422

Sieve	Opening (mm)	% Passing
3"	76.2	100.0
3/4"	19.1	87.7
3/8"	9.5	63.6
#4	4.75	45.7
#10	2.0	33.6
#40	0.425	17.0
#200	0.075	5.3

Atterberg Limits

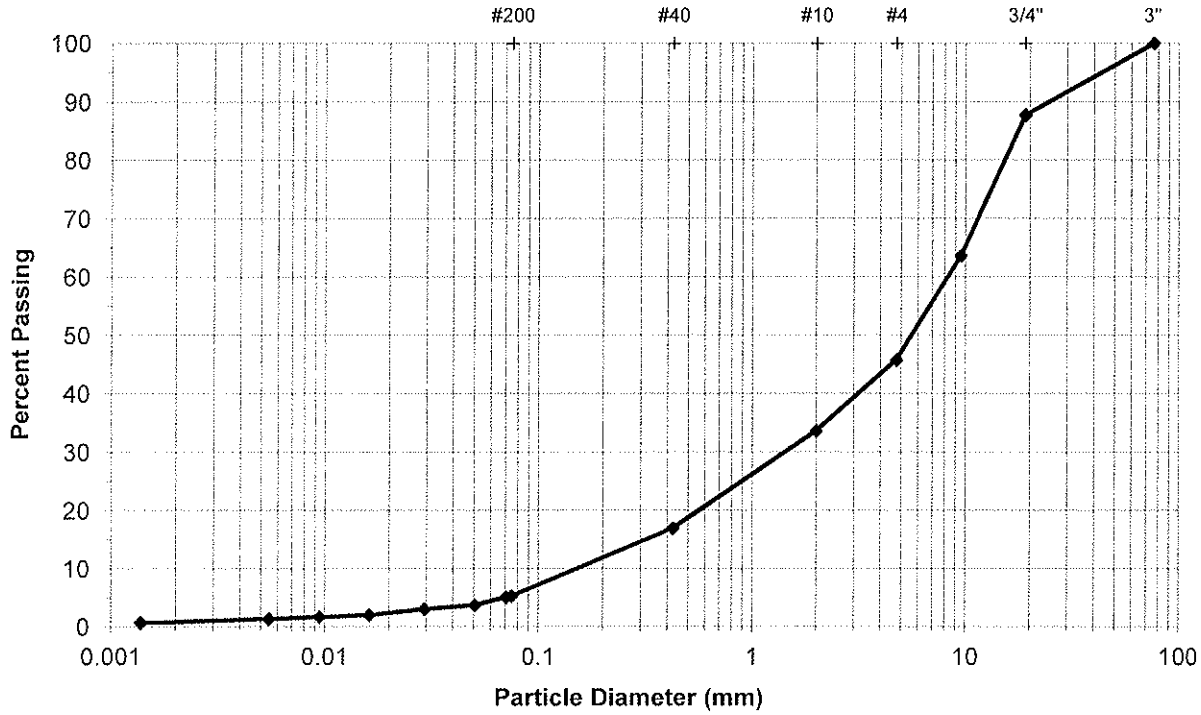
ASTM D4318

Liquid Limit (LL)	NR
Plastic Limit (PL)	NR
Plasticity Index (PI)	NR

NR = Not Requested

Soil Description: brown well-graded GRAVEL with silt and sand

USCS Classification: GW-GM ASTM D2488



Clay	Silt	Fine	Medium	Coarse	Fine	Coarse
FINES		SAND			GRAVEL	

% Clay = 1.3 % Silt = 4.0 % Sand = 40.4 % Gravel = 54.3

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Sieve / Hydrometer Analysis and Atterberg Limits

Project Name	KVLE Tower	Date	7/16/2013
Project Location	Gunnison, CO	Project #	13-153-GEO
Client	W.T.S	Sample by	KR/WP
Test Location	BH#2 @10-11'	Tested by	SJ/KB
Sample #	DS5		

Hydrometer Analysis

ASTM D422

Sieve	Opening (mm)	% Passing
3"	76.2	100.0
3/4"	19.1	82.0
3/8"	9.5	73.0
#4	4.75	55.3
#10	2.0	26.4
#40	0.425	6.8
#200	0.075	1.9

Atterberg Limits

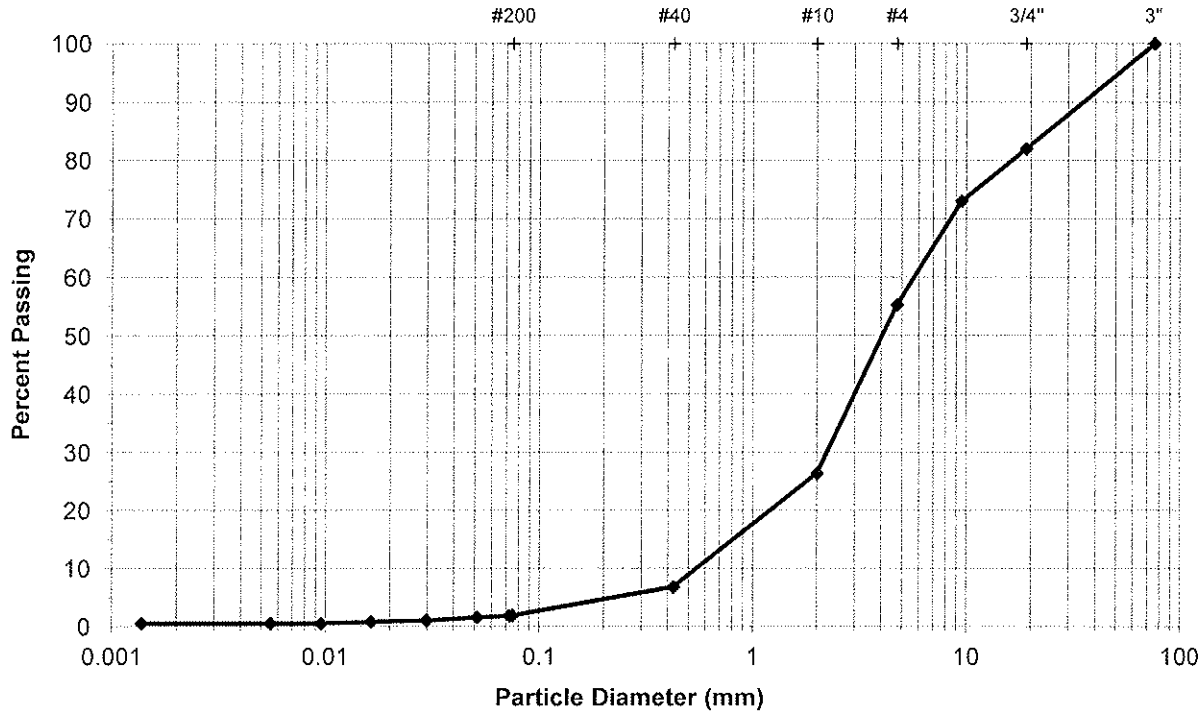
ASTM D4318

Liquid Limit (LL)	NR
Plastic Limit (PL)	NR
Plasticity Index (PI)	NR

NR = Not Requested

Soil Description: brown well-graded SAND with gravel

USCS Classification: SW ASTM D2488



Clay	Silt	Fine	Medium	Coarse	Fine	Coarse
FINES		SAND			GRAVEL	

% Clay = 0.5 % Silt = 1.4 % Sand = 53.4 % Gravel = 44.7

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Corrosivity Series

Based on HACH methods

Project Name	KVLE Tower	Date Tested	7/23/2013
Project Location	Gunnison, CO	Project #	13-153-GEO
Client	W.T.S.	Sample by	KR/WP
Test Location	BH#1 @5-6'	Tested by	SJ
Sample #	DS1		
Soil Description	brown GRAVEL with clay and sand	ASTM D2488	

Water-soluble sulfates, dry soil basis	**0.010**	**%**
Chlorides	**15**	**ppm**
Electro-conductivity	**30**	**µS/cm**
pH	**7.74**	