WESTERN ENGINEERING CONSULTANTS, Inc LLC
127 S. Denver Avenue, Ft. Lupton CO 80621
2501 Mill St. Brush, CO 80723
Ph. 303-913-7341, Fax 720-294-1330
Email: firstname.lastname@westerneci.com

June 25, 2021

Town of Keenesburg
140 S. Main St
Keenesburg, CO 80643

RE: HIGH PLAINS BANK DRAINAGE NARRATIVE

Dear Mr. Bruxvoort,

Western Engineering Consultants inc. LLC (WEC) appreciates the opportunity to submit this Drainage Narrative Letter on behalf of High Plains Bank.

EXISTING RATIONAL DRAINAGE DESCRIPTION

The 1.01 acre site is entirely composed of an NRCS Soil Classification C, Map Unit Symbol 79 (Weld loam). The entire site was modeled as Unit 79 (Soil Type C).

The site lies almost entirely within the RG1 Basin of the Market St Business Park Subdivision Interim Drainage Plan, with the southwest corner of the site falling withing the RG2 Basin.

The existing site generally drains from the northwest corner southeast at approximately 1.4%.

The runoff calculated for the 1.85 ac Basin RG1 is 0.18 cfs and 4.14 cfs for the 5yr (minor) and 100yr (major) storm events, respectively.

DEVELOPED RATIONAL METHOD DRAINAGE ANALYSIS – PER APPROVED SUBDIVISION FDR

The entire 1.01 acre lot has been mapped as Basin L2 in the Final Drainage Plan for Market St Business Park Subdivision. The 5yr and 100yr runoffs from Basin L2 were previously calculated at 2.94 cfs and 7.67 cfs respectively, with an assumed imperviousness of 87.93% per the approved Market Street Subdivision Business Park Drainage Report.

The Subdivision grading and drainage design is intended to convey all runoff on site to the existing pond ‘C’. This site drainage design follows the same intention by directing all site runoff to Design Point 9.

The proposed grading will begin at the northwest corner of the lot. Runoff will flow overland around the proposed building to either Swale 2S along the south property line or to the proposed curb and gutter to the east of the building. Runoff will then be conveyed to the southeast corner of the property at Design Point 9 where it will then travel south along Swale 2/3 to STIN B1 of Storm Line B of Market St Business Park and ultimately to Pond ‘C’.

The imperviousness of basin L2 has been updated to match the site as currently designed. The basin area remains 1.01 acres including the proposed building, surrounding concrete, and asphalt access/parking. The updated imperviousness for Basin L2 is 56.29%. The runoff calculated is 1.91 cfs and 6.43 cfs for the minor and major storm events, respectively. As mentioned above, the approved Basin L2 from the Subdivision Drainage Report was designed at an imperviousness of 87.93% with calculated runoff values of 2.94 cfs and 7.67 cfs for the minor and major storm events, respectively.

SWALE CAPACITIES

Attached is the UDFCD UD Channels v1.05 spreadsheet for swale capacity calculations. Since there is additional area west of the proposed bank that could be further developed in the future, WEC has used the assumed Basin L2 imperviousness from the approved Subdivision Drainage Report of 87.93% to design the capacity of the swales this site is tributary to.

Per the approved Subdivision Drainage Report, swale 2S was designed to handle 100% of the buildout Basin L2 runoff of 7.67 cfs. Swale 2S was analyzed to have capacity with 4:1 side slopes and a 0.60' depth. The 100 year runoff from the current bank site (6.43 cfs) will not exceed the designed swale capacity.

Per the approved Subdivision Drainage Report, swale 2/3 was designed to handle 100% of the Basin L2 and Basin L3 runoff of 15.60 cfs (7.67 cfs + 7.93 cfs). Swale 2/3 was analyzed to have capacity with 4:1 side slopes and a 0.75' depth. As the developed runoff from this site is below the assumed 100 year runoff of Basin L2, the runoff entering Swale 2/3 will not exceed the designed swale capacity.

STORM POND STORAGE & RELEASE

Due to the current decreased imperviousness and storm event runoff of the developed bank site, no changes are necessary for the existing detention pond.

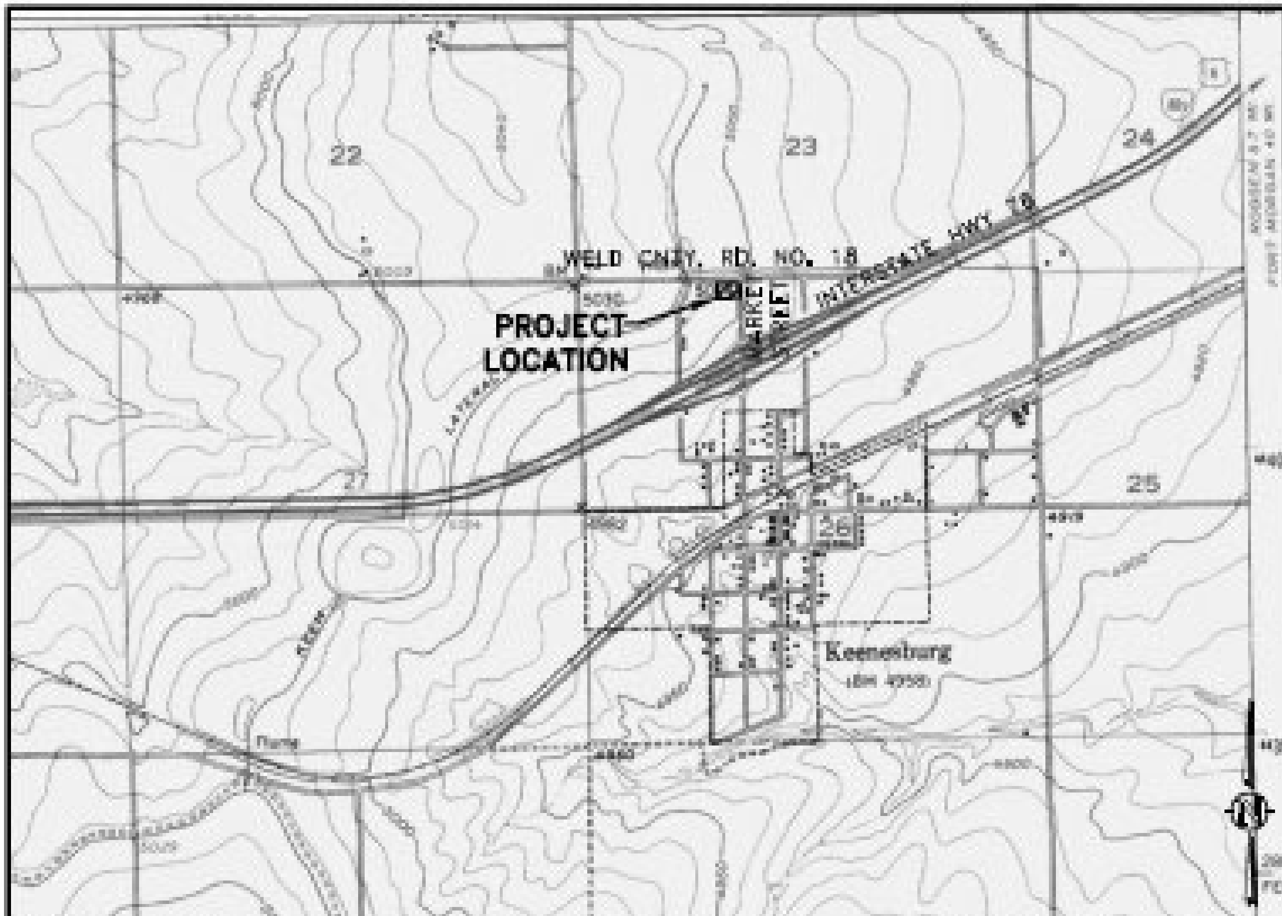
For all other capacity and storm system design parameters, please reference the approved Subdivision Drainage Report. In short, the current proposed improvements generate less runoff than the approved Master Study. Any additional site improvements will require evaluation of such.

Please find all supporting calculations attached and please contact me with any questions!

Western Engineering Consultants inc., LLC
Chadwin F. Cox, P.E.
Senior Project Manager

APPENDIX A

Vicinity Map (USGS) / Key Map / FEMA Firmette / Legal Description / Soil Survey Map & Soil Legend / Geotechnical Study



NE 1/4 S26, T2N, R64W, 6th PM
SHOWN VICINITY MAP TAKEN FROM USGS QUAD – KEENESBURG 40104-A5

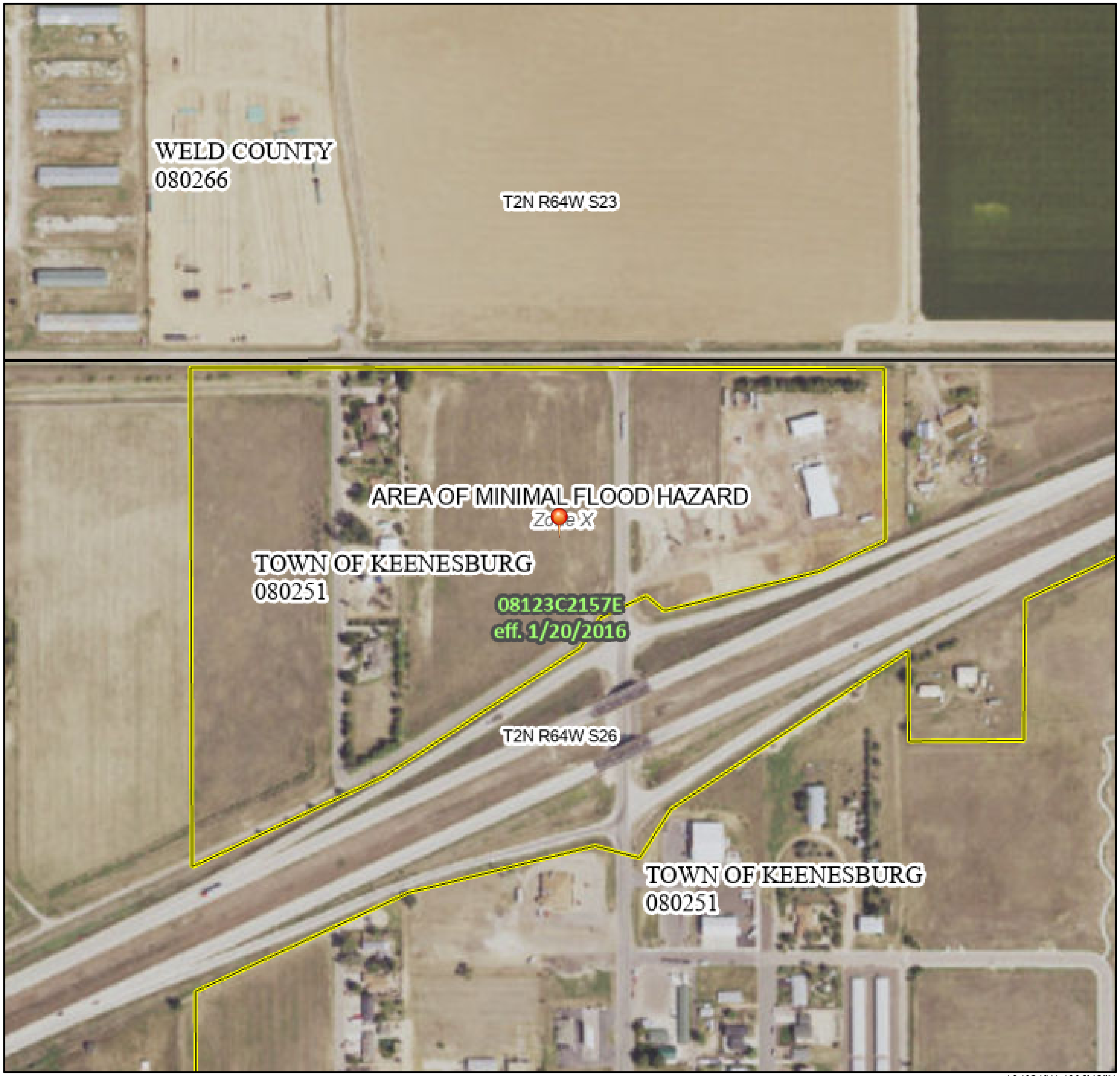
VICINITY MAP
1" = 1,000'


High Plains Bank
Lot 2 Market St Business Park Subdivision
THIS PROJECT
57
18
6
398
16
59
55
N Cedar St
Pippin Ln
Market St
N 1st St
Broadway
N Pine St
E Kiser Ave
Miller St
Woodward Ave
Co Rd 16 1/2
Keenesburg
Gandy Ave
Lambert St
Dickson St
Crawford Ave
Trade St
Owen Ave
Joshua Ave
Ash St
Main St
Elm St
S Pine St
Cedar St
Google Earth
Image © 2021 Maxar Technologies
N
3000 ft

National Flood Hazard Layer FIRMette

FEMA

104°31'37"W 40°7'9"N



104°31'W 40°6'42"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/8/2021 at 7:02 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

LEGAL DESCRIPTION:

LOT 2 MARKET STREET BUSINESS PARK SUBDIVISION, PART OF THE NORTHWEST 1/4 OF SECTION 26, TOWNSHIP 2 NORTH, RANGE 64 WEST OF THE 6TH P.M., TOWN OF KEENESBURG, COUNTY OF WELD, STATE OF COLORADO.

BASIS OF BEARING:

THE NORTH LINE OF THE NORTHWEST 1/4 OF SECTION 26, TOWNSHIP 2 NORTH, RANGE 64 WEST OF THE 6TH P.M., IN WELD COUNTY, COLORADO IS ASSUMED TO BEAR SOUTH 89D59’30” EAST, AS MONUMENTED HEREON, WITH ALL BEARINGS CONTAINED HEREON RELATIVE THERETO.

PROJECT BENCHMARK:

COLORADO DEPARTMENT OF TRANSPORTATION CONTROL POINT “CP 3892 / MP 38.92” 3 1/4 “ ALUMINUM CAP IN THE WEST CENTER MEDIAN OF INTERSTATE 76 AT KEENESBURG EXIT. ELEVATION 1525.646 METERS OR 5005.40 FEET (NAVD 1988).

SITE BENCHMARK:

WAS ESTABLISHED BEING A 3” BRASS CAP IN CONCRETE LYING FIVE FEET WEST OF A CONCRETE IRRIGATION DITCH NEAR THE INTERSECTION OF COUNTY ROAD 18 AND NORTH CEDAR STREET, AND THIRTY FEET NORTH OF THE CENTERLINE OF COUNTY ROAD 18. STAMPED “NATIONAL GEODETIC SURVEY ACD 1” HAVING AN ELEVATION OF 5015.39 FEET (NAVD 1988).

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for
Weld County, Colorado, Southern Part

June 2, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


104° 31' 26" W
104° 31' 14" W
40° 7' 0" N
40° 6' 48" N
540570
540610
540650
540690
540730
540770
540810
540850
4440830
4440790
4440750
4440710
4440670
4440630
4440590
4440550
4440510
4440470
County Road 18
Market St
Pippin Ln
Market
76
15
79
Soil Map may not be valid at this scale.
Map Scale: 1:1,900 if printed on A portrait (8.5" x 11") sheet.
Meters
0 25 50 100 150
Feet
0 50 100 200 300
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Weld County, Colorado, Southern Part
Survey Area Data: Version 19, Jun 5, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 19, 2018—Aug 10, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
15	Colby loam, 1 to 3 percent slopes	0.0	0.1%
79	Weld loam, 1 to 3 percent slopes	11.2	99.9%
Totals for Area of Interest		**11.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Weld County, Colorado, Southern Part

15—Colby loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 361q
Elevation: 4,850 to 5,050 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Colby and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Colby

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous eolian deposits

Typical profile

H1 - 0 to 7 inches: loam
H2 - 7 to 60 inches: silt loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water capacity: High (about 10.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Minor Components

Wiley

Percent of map unit: 9 percent
Hydric soil rating: No

Keith

Percent of map unit: 6 percent

Hydric soil rating: No

79—Weld loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2x0hw
Elevation: 3,600 to 5,750 feet
Mean annual precipitation: 12 to 17 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 115 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Weld and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Weld

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous loess

Typical profile

Ap - 0 to 8 inches: loam
Bt1 - 8 to 12 inches: clay
Bt2 - 12 to 15 inches: clay loam
Btk - 15 to 28 inches: loam
Bk - 28 to 60 inches: silt loam
C - 60 to 80 inches: silt loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 14 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 5.0
Available water capacity: High (about 11.3 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Minor Components

Adena

Percent of map unit: 8 percent
Landform: Interfluves
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Colby

Percent of map unit: 7 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Keith

Percent of map unit: 3 percent
Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Baca

Percent of map unit: 2 percent
Landform: Interfluves
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

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GEOTECHNICAL ENGINEERING REPORT
HIGH PLAINS BANK
LOT 2, MARKET STREET BUSINESS PARK
KEENESBURG, COLORADO
EEC PROJECT NO. 3212008

Prepared for:

DBSI, Inc.
6950 West Morelos Place
Chandler, Arizona 85226

Prepared by:

Earth Engineering Consultants, LLC
2400 East Bijou Avenue, Suite B
Fort Morgan, Colorado 80701

EARTH ENGINEERING CONSULTANTS, LLC

June 3, 2021

DBSI, Inc.
6950 West Morelos Place
Chandler, Arizona 85226

Attn: Ms. Jennifer Dumphy (JDumphy@dbsi-inc.com)

Re: Geotechnical Engineering Report
High Plains Bank
Lot 2, Market Street Business Park
Keenesburg, Colorado
EEC Project No. 3212008

Ms. Dumphy:

Enclosed, herewith, are the results of the subsurface exploration completed by Earth Engineering Consultants, LLC (EEC) for the referenced project. For this exploration, six (6) test borings were advanced to depths of approximately 10 to 35 feet below existing site grades. This subsurface exploration was carried out in general accordance with our proposal dated May 6, 2021.

In summary, the subsurface conditions encountered in the test borings generally consisted of clay with various amounts of sand, underlain by highly weathered claystone bedrock, generally at depths of about 9 feet below ground surface. At current moisture and density conditions, the subgrades/bedrock exhibited moderate to high swell potential. Groundwater was encountered in only one of the test borings at a depth of approximately 24 feet below ground surface.

The expansive soils encountered present a risk of post-construction heaving of site improvements should those subgrades become wet subsequent to construction. Therefore, to reduce the risk of post-construction movement of site improvements, it is our opinion that planned lightly loaded building should be supported on drilled pier foundations. The building floor slab should consist of a structural slab also supported on drilled piers independent of the underlying subsoils. We anticipate that site roadways and associated flatwork could be supported on a shallow zone of

2400 EAST BIJOU AVENUE, SUITE B
FORT MORGAN, COLORADO 80701
(970) 867-1224 FAX (970) 663-0282
www.earth-engineering.com

over excavated and backfilled material with the acceptance of higher risk of movement. Geotechnical recommendations concerning design and construction of foundations and support of floor slabs and pavements are presented in the text of the attached report.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the enclosed report, or if we can be of further service to you in any other way, please do not hesitate to contact us.

Very truly yours,
Earth Engineering Consultants, LLC

COLORADO LICENSED
ETHAN PATRICK WIECHERT
40838
6/3/21
PROFESSIONAL ENGINEER

Ethan P. Wiechert, P.E.
Senior Project Engineer

Reviewed by: David A. Richer, P.E.
Senior Geotechnical Engineer

GEOTECHNICAL ENGINEERING REPORT
HIGH PLAINS BANK
LOT 2, MARKET STREET BUSINESS PARK
KEENESBURG, COLORADO
EEC PROJECT NO. 3212008

June 3, 2021

INTRODUCTION

The geotechnical subsurface exploration for the proposed High Plains Bank planned for construction on Lot 2 in the Market Street Business Park in Keenesburg, Colorado has been completed. To develop subsurface information in the proposed development area, six (6) test borings were drilled to depths of approximately 10 to 35 feet below existing site grades. Individual boring logs and a diagram indicating the approximate boring locations are included with this report.

We understand the planned development would include an approximate 3,000 square-foot commercial building and drive thru, with associated site pavements and concrete flatwork. The building would likely be a one- or two-story, steel-frame structure constructed at-grade (no basement). We estimate foundation loads for the planned building would be relatively light with continuous wall loads less than 3 kips-per-foot and individual column loads less than 25 kips. Floor loads are expected to be relatively light, consistent with commercial use. We anticipate roadways would be utilized by low volumes of light passenger vehicles with areas designated for low volumes of light truck traffic. Based on areal imagery of the site, we anticipate cuts and fill to develop site grades would be less than 2 feet.

The purpose of this report is to describe the subsurface conditions encountered in the test borings, analyze, and evaluate the test data, and provide geotechnical recommendations concerning design and construction building foundations and floor slabs, and support of site flatwork and pavements. Recommended pavement sections, which are based on assumed traffic conditions, are also included.

EXPLORATION AND TESTING PROCEDURES

The test boring locations were selected by DBSI, Inc. and established in the field by EEC personnel by pacing and estimating angles from identifiable site features. The approximate locations of the borings are shown on the attached boring location diagram. The boring locations should be considered accurate only to the degree implied by the methods used to make the field measurements.

The test borings were advanced using a truck mounted, CME-55 drill rig equipped with a hydraulic head employed in drilling and sampling operations. The boreholes were advanced using 4-inch nominal diameter continuous flight augers. Samples of the subsurface materials encountered were obtained using split-barrel and California barrel sampling procedures in general accordance with ASTM Specifications D1586 and D3550, respectively.

In the split-barrel and California barrel sampling procedures, standard sampling spoons are advanced into the ground by means of a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the split-barrel and California barrel samplers is recorded and is used to estimate the in-situ relative density of cohesionless soils and, to a lesser degree of accuracy, the consistency of cohesive soils. In the California barrel sampling procedure, relatively intact samples are obtained in removable brass liners. All samples obtained in the field were sealed and returned to our laboratory for further examination, classification, and testing.

Laboratory testing on the recovered samples included moisture content with unconfined compressive strength of appropriate samples estimated using a calibrated hand penetrometer. Atterberg limits and washed sieve analysis tests were completed on select samples to evaluate the quantity and plasticity of fines in the subgrades. Swell/consolidation tests were performed on select samples to evaluate the potential for the subgrade materials to change volume with variation in moisture content and load. The quantity of water-soluble sulfates was determined on numerous samples to evaluate the potential for sulfate attack on site concrete and for selection of appropriate soil stabilization materials if needed. Results of the outlined tests are indicated on the attached boring logs and summary sheets.

As part of the testing program, all samples were examined in the laboratory and classified in general accordance with the attached General Notes and the Unified Soil Classification System, based on the soil's texture and plasticity. The estimated group symbol for the Unified Soil Classification System is indicated on the boring logs and a brief description of that classification system is included with this report. Classification of the bedrock was based on visual and tactual observations of disturbed samples; coring or petrograph analysis may reveal other rock types.

SITE AND SUBSURFACE CONDITIONS

The development property is located on Lot 2 in the Market Street Business Park, southwest of County Road 18 and Market Street in Keenesburg. Lot 2 is in the northeast corner of the subdivision. At the time of our site visit, the development property was vacant. Preliminary grading of the site appeared accomplished along with numerous dirt stockpiles across the site. Aside from the stockpiles, the ground surface was relatively flat and covered with sparse vegetation. Evidence of prior building construction was not observed in the development area. Site photos taken at the time of our drilling operations are included with this report.

EEC field personnel were on site during drilling to evaluate the subsurface conditions encountered and direct the drilling activities. Field logs prepared by EEC site personnel were based on visual and tactual observation of disturbed samples and auger cuttings. The final boring logs included with this report may contain modifications to the field logs based on results of laboratory testing and evaluation. Based on results of the field borings and laboratory testing, subsurface conditions can be generalized as follows.

From the ground surface, brown to light brown lean clay with various amounts of sand was encountered and extended to the bottom of test boring B-3, or to depths of approximately 9 to 10 feet below ground surface in the remaining test borings. The clay soils were relatively dry, dense, stiff to very stiff and exhibited high potential to swell with increases in moisture content at current moisture and density conditions. The lean clay soils were underlain by bedrock which extended to the bottom of the completed test borings. The bedrock generally consist of highly weathered claystone with interbedded sandstone. The bedrock was relatively soft to moderately hard with depth and exhibited a moderate swell potential.

The stratification boundaries indicated on the boring logs represent the approximate location of changes in soil types; in-situ, the transition of materials may be gradual and indistinct.

GROUNDWATER CONDITIONS

Observations were made while drilling and after completion of the borings to detect the presence and depth to hydrostatic groundwater. At the time of drilling, free water was observed in only one of the test borings while drilling at a depth of about 24 feet below ground surface. The borings were backfilled upon completion of the drilling operations; therefore, subsequent groundwater measurements were not obtained. The groundwater level observations are included on the attached boring logs.

Fluctuations in groundwater levels can occur over time depending on variations in hydrologic conditions, and other conditions not apparent at the time of this report. Long-term monitoring of water levels in cased wells, which are sealed from the influence of surface water, would be required to more evaluate fluctuations in groundwater levels at the site. We have typically noted deepest groundwater levels in late winter and shallowest groundwater levels in mid to late summer.

ANALYSIS AND RECOMMENDATIONS

General

The subgrades encountered in the test borings generally consisted of moderately plastic clay soils overlying claystone bedrock. The clay soils were relatively dry, dense, stiff to very stiff, and at current moisture and density conditions, exhibited a high potential to swell with increase in moisture content. Movement of foundations, pavements and other at-grade improvements placed on the expansive soils would be expected if the moisture content of those materials increases subsequent to construction.

Therefore, care will be needed to see that site preparation and design of site improvements include measures to mitigate the potential of heaving of the site improvements to an acceptable level. Outlined herein are recommendations for development of this site; however, the client should recognize that building on expansive soils is risky, even when mitigation plans are followed. Mitigation plans outlined herein would reduce the risk of heaving of site improvements, but that risk cannot be eliminated.

Site Preparation

Prior to placement of any fill and/or improvements, we recommend any topsoil, vegetation, and the existing dirt stockpiles be removed from the planned improvement areas. After stripping the site and after making all cuts and prior to placing any fill, we recommend over excavating the subgrades beneath pavements and exterior flatwork (sidewalks, curb-and-gutter, etc.). The over excavations should extend to a depth of at least 3 feet below ground surface and extend laterally 8 inches for every 12 inches of over excavation depth. Over excavation in the building area is not necessary; additional recommendations for preparation in the building area is included in the section titled *Building Foundations* and *Building Floors Slabs*. The over excavation depths recommended should reduce the amount of heaving of site pavements and exterior flatwork; however, that risk would not be eliminated. If those subgrades become substantially wet subsequent to construction, heaving of about 5 inches could be possible. If that is not acceptable, greater over excavation depths should be considered. EEC should be contacted to provide alternative recommendations if that is desirable.

After completing the over excavations, the exposed soils should be scarified to a depth of 9 inches, adjusted in moisture content and compacted to at least 95% of the material's maximum dry density as determined by ASTM Specification D698, the standard Proctor procedure. The moisture content should be adjusted to within -1 to +3% of optimum moisture content.

Fill soils should consist of approved materials which are free from organic matter and debris. In our opinion, the over excavated clay soils or similar soils could be used. The fill soils should be placed in loose lifts not to exceed 9 inches in thickness, adjusted in moisture content and compacted as recommended for the scarified soils. Care will be needed to maintain the recommended moisture content prior to and during construction of overlying improvements. Care should be taken after preparation of the subgrades to avoid disturbing the subgrade materials. Materials which are loosened or disturbed should be reworked prior to placement of site improvements.

Building Foundations

Based on the materials encountered in the completed test borings, it our opinion the proposed lightly loaded building could be supported on drilled pier foundations. We recommend drilled piers extend to bear at least 15 feet into firm competent bedrock and have a minimum length of at least 30 feet; both minimum length and minimum penetration into the underlying bedrock should be met.

For design of drilled piers, we recommend using a total end bearing pressure not to exceed 15 kips per square foot, along with a skin friction of 1.5 kips per square foot for the portion of the pier in the firm and/or harder bedrock formation. That skin friction could also be used for resistance to uplift forces. Piers should be designed with a minimum dead load of 5 kips per square foot. Lower design values may be appropriate for pier groups depending on pier diameter and spacing.

If the minimum dead load cannot be satisfied in the design, the drilled piers should be designed to balance the potential uplift forces with greater penetration into the bedrock. The skin friction for the portion of the pier extending beyond the recommended minimum length of bedrock penetration could be used to offset an inability to develop the minimum dead load on the piers. The uplift force on each pier can be determined on the basis of the following equation:

$$U_p = 50 \times D$$

Where: U_p = the uplift force in kips
D = the pier diameter in feet

When the lateral capacity of drilled piers is evaluated by the LPILE program, we recommend that internally generated load-deformation (P-Y) curves be used. Table 1 below includes recommended soil parameters for design of drilled piers using LPILE.

Table 1. Soil parameters for design of drilled piers using LPILE program.

Parameters	Clay Soils	Bedrock
Unit Weight of Soil (pcf)	130[1]	130[1]
Undrained Shear Strength (psf)	2,000	4,000
Angle of Internal Friction, ϕ (degrees)	25	20
Strain Corresponding to ½ Max. Principal Stress Difference, ε_{50}	0.01	0.005

Unit weights in Table 1 should be adjusted for buoyant conditions as appropriate.

The drilled piers should be designed with full-length reinforcement to resist stress from the applied axial, lateral, and uplift loads imposed. Grade beams between the drilled piers should be designed with a minimum of 12 inches of void space between the grade beam and the underlying subgrades. Exterior foundation grade beams, or foundations in unheated areas should be located a minimum of 30 inches below adjacent exterior grade to provide frost protection.

Drilling caissons to design depth should be possible with conventional heavy-duty single flight power augers equipped with rock teeth; however, areas of well-cemented bedrock lenses may be encountered throughout the site at various depths where specialized drilling equipment and/or rock excavating equipment may be required. We do not believe temporary casing would be needed in the overlying cohesive soils; however, could be necessary where groundwater is encountered with depth.

Due to the presence of groundwater on the site, we expect some water may infiltrate the drilled shaft borehole. A maximum 3-inch depth of groundwater is acceptable in each pier prior to concrete placement. If pier concrete cannot be placed in relatively dry conditions, a tremie should be used for concrete placement. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes. Pier concrete with slumps in the range of 6 to 8 inches is recommended. If casing is used for the pier construction, it should be withdrawn in a slow and continuous manner maintaining a sufficient head of concrete to prevent influx of water and/or the creation of voids in the pier concrete.

The foundation pier excavations should be observed by the geotechnical engineer. A representative of the geotechnical engineer should inspect the bearing surface and pier configuration. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations could be required.

We estimate the long-term settlement of drilled pier foundations designed and constructed as outlined above would be less than 1 inch.

Building Floor Slabs

Building floor slabs should consist of structural floor systems to reduce the risk for post-construction movement of caused by the swelling of the underlying expansive subgrades/bedrock. Structural floors should be supported on drilled pier foundations with minimum 12-inch void space between the bottom of the floor system and underlying expansive subgrade materials. Drilled piers should be designed and constructed as recommended in the section *Building Foundations*.

Foundation Wall and Utility Backfill

Backfill needed to develop site grades following installation of foundations and site utilities should consist of low volume change materials which are free of organic matter and debris. In our opinion the site clay soils could be used. Backfill soils should be placed in loose lifts not to exceed 9 inches in thickness, adjusted in moisture content, and compacted to at least 95% of the material's maximum dry density as determined by ASTM Specification D698, the standard Proctor procedure. The moisture content should be adjusted to with -1 to +3% of optimum moisture content.

Seismic

The site soil conditions consist of stiff to very stiff lean clay overlying moderately hard bedrock to the depths explored. For those site conditions, the International Building Code indicates a Seismic Site Classification of D. Evaluating borings to a greater depth could reveal an alternative site classification.

Corrosion Potential for Site Concrete

Results of water-soluble sulfate testing on three (3) select subgrade samples indicate sulfate (SO_4) contents ranging from 0.06 to 0.40%. ACI 318, Section 4.2 indicates the site soils have a severe risk of sulfate attack on Portland cement concrete and indicates site concrete should be designed using a sulfate exposure of S2. Note that concrete mixtures with a severe sulfate exposure may require sulfate resistant cements and/or pozzolans in the mixtures; refer to ACI 318 Section 4.3 for mixture design.

Pavements

Pavement subgrades should be prepared as outlined in the section *Site Preparation*. Once the subgrades are prepared as recommended and prior to surfacing with aggregate base, we recommend proof rolling the pavement subgrades to identify any soft, wet, and yielding areas. Yielding and/or soft areas in the subgrades should be reworked and/or replaced prior to placement of aggregate base materials. Note that laboratory testing indicated the subgrades contain appreciable amounts of water-soluble sulfates, as such, stabilizing the soil with calcium-based materials (i.e., Class C fly ash, lime, cement) is not recommended.

We anticipate the site pavements would include areas designated for low volumes of light weight passenger vehicles (Light Duty) and areas of low volumes of light trucks (Heavy Duty). Equivalent daily load application (EDLA) values of 15 and 5 were assumed for the Heavy Duty and Light Duty areas, respectively. Based on the subsurface conditions encountered at the site, an assumed R-value of 5 was used in design of the pavement sections.

Recommended minimum pavement sections are provided below in Table 2. Asphalt pavement sections may show rutting/distress in truck loading and drive areas; therefore, concrete pavements should be considered in those areas. The recommended pavement sections are considered minimum; thus, periodic maintenance should be expected.

Table 2. Recommended minimum pavement sections for estimated traffic loads.

Design Information	Heavy Duty	Light Duty
EDLA	15	5
Reliability (%)	80	80
Resilient Modulus (psi)	3025	3025
Serviceability Loss (psi)	2.2	2.2
Design Structure Number	3.05	2.57
Option 1: Composite Pavement		
Asphalt Pavement	5"	4"
Aggregate Base	8"	8"
Option 2: PCC (Non-reinforced)	6.5"	5.5"

We recommend aggregate base meet CDOT Class 5 or Class 6 aggregate base. Aggregate base should be adjusted in moisture content and compacted to achieve a minimum of 95% of standard Proctor maximum dry density.

Asphalt pavements should be graded as S or SX and prepared with 75 gyrations using a Superpave gyratory compactor in accordance with CDOT standards. Grading SX is recommended for surface course of the pavement. The asphalt mixture should consist of PG 58-28 or PG 64-22; however, if the mixture contains reclaimed asphalt pavement (RAP), we recommend using PG 58-28 binder. The hot mix asphalt in field should be compacted to achieve 92 to 96% of the mix's theoretical maximum specific gravity (Rice Value).

Portland cement concrete should be an approved exterior pavement mix with a minimum 28-day compressive strength of 4,500 psi and should be air entrained. Based on appreciable amounts of water-soluble sulfate contents in the subgrades, concrete pavement should be designed using a severe sulfate exposure of S2. Wire mesh or fiber could be considered to reduce shrinkage cracking.

Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/contraction and isolation. The location and extent of joints should be based upon the final pavement geometry. Sawed joints should be cut in general accordance with ACI recommendations. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

Other Considerations

Positive drainage should be developed away from the structures and pavement areas with a minimum slope of 1 inch per foot for the first 10 feet away from the improvements in landscape areas. Care should be taken in planning of landscaping adjacent to the buildings to avoid features which would pond water adjacent to the foundations or stem walls. Placement of plants which require irrigation systems or could result in fluctuations of the moisture content of the subgrade material should be avoided adjacent to site improvements. Irrigation systems should not be placed within 5 feet of the perimeter of the buildings and parking areas. Spray heads should be designed not to spray water on or immediately adjacent to the structures or site pavements. Roof drains should be designed to discharge at least 5 feet away from the structures and away from the pavement areas.

The site contractors should be made responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. All excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

GENERAL COMMENTS

The analysis and recommendations presented in this report are based upon the data obtained from the soil borings performed at the indicated locations and from any other information discussed in this report. This report does not reflect any variations, which may occur between borings or across the site. The nature and extent of such variations may not become evident until construction. If variations appear evident, it will be necessary to re-evaluate the recommendations of this report.

It is recommended that the geotechnical engineer be retained to review the plans and specifications so comments can be made regarding the interpretation and implementation of our geotechnical recommendations in the design and specifications. It is further recommended that the geotechnical engineer be retained for testing and observations during earthwork phases to help determine that the design requirements are fulfilled.

This report has been prepared for the exclusive use of DBSI, Inc. for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranty, express or implied, is made. In the event that any changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report are modified or verified in writing by the geotechnical engineer.

DRILLING AND EXPLORATION

DRILLING & SAMPLING SYMBOLS:

SS: Split Spoon - 13/8" I.D., 2" O.D., unless otherwise noted
ST: Thin-Walled Tube - 2" O.D., unless otherwise noted
R: Ring Barrel Sampler - 2.42" I.D., 3" O.D. unless otherwise noted
PA: Power Auger
HA: Hand Auger
DB: Diamond Bit = 4", N, B
AS: Auger Sample
HS: Hollow Stem Auger

PS: Piston Sample
WS: Wash Sample
FT: Fish Tail Bit
RB: Rock Bit
BS: Bulk Sample
PM: Pressure Meter
WB: Wash Bore

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. split spoon, except where noted.

WATER LEVEL MEASUREMENT SYMBOLS:

WL : Water Level
WCI: Wet Cave in
DCI: Dry Cave in
AB : After Boring

WS : While Sampling
WD : While Drilling
BCR: Before Casing Removal
ACR: After Casting Removal

Water levels indicated on the boring logs are the levels measured in the borings at the time indicated. In pervious soils, the indicated levels may reflect the location of ground water. In low permeability soils, the accurate determination of ground water levels is not possible with only short term observations.

DESCRIPTIVE SOIL CLASSIFICATION

Soil Classification is based on the Unified Soil Classification system and the ASTM Designations D-2488. Coarse Grained Soils have move than 50% of their dry weight retained on a #200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are described as : clays, if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse grained soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their consistency. Example: Lean clay with sand, trace gravel, stiff (CL); silty sand, trace gravel, medium dense (SM).

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Consistency
< 500	Very Soft
500 - 1,000	Soft
1,001 - 2,000	Medium
2,001 - 4,000	Stiff
4,001 - 8,000	Very Stiff
8,001 - 16,000	Very Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS:

N-Blows/ft	Relative Density
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80	Very Dense
80 +	Extremely Dense

PHYSICAL PROPERTIES OF BEDROCK

DEGREE OF WEATHERING:

Slight	Slight decomposition of parent material on joints. May be color change.
Moderate	Some decomposition and color change throughout.
High	Rock highly decomposed, may be extremely broken.

HARDNESS AND DEGREE OF CEMENTATION:

Limestone and Dolomite:

Hard	Difficult to scratch with knife.
Moderately	Can be scratched easily with knife.
Hard	Cannot be scratched with fingernail.
Soft	Can be scratched with fingernail.

Shale, Siltstone and Claystone:

Hard	Can be scratched easily with knife, cannot be scratched with fingernail.
Moderately Hard	Can be scratched with fingernail.
Soft	Can be easily dented but not molded with fingers.

Sandstone and Conglomerate:

Well Cemented	Capable of scratching a knife blade.
Cemented	Can be scratched with knife.
Poorly Cemented	Can be broken apart easily with fingers.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests					Soil Classification: Group Symbol	Soil Classification: Group Name
Coarse - Grained Soils more than 50% retained on No. 200 sieve	Gravels more than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines	Cu≥4 and 1<Cc≤3 [E]		GW	Well-graded gravel [F]
			Cu<4 and/or 1>Cc>3 [E]		GP	Poorly-graded gravel [F]
		Gravels with Fines more than 12% fines	Fines classify as ML or MH		GM	Silty gravel [G,H]
			Fines Classify as CL or CH		GC	Clayey Gravel [F,G,H]
	Sands 50% or more coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	Cu≥6 and 1<Cc≤3 [E]		SW	Well-graded sand [I]
			Cu<6 and/or 1>Cc>3 [E]		SP	Poorly-graded sand [I]
		Sands with Fines more than 12% fines	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid Limit less than 50	inorganic	PI>7 and plots on or above "A" Line		CL	Lean clay [K,L,M]
			PI<4 or plots below "A" Line		ML	Silt [K,L,M]
		organic	Liquid Limit - oven dried / Liquid Limit - not dried	<0.75	OL	Organic clay [K,L,M,N] / Organic silt [K,L,M,O]
	Silts and Clays Liquid Limit 50 or more	inorganic	PI plots on or above "A" Line		CH	Fat clay [K,L,M]
			PI plots below "A" Line		MH	Elastic Silt [K,L,M]
		organic	Liquid Limit - oven dried / Liquid Limit - not dried	<0.75	OH	Organic clay [K,L,M,P] / Organic silt [K,L,M,O]
Highly organic soils		Primarily organic matter, dark in color, and organic odor			PT	Peat

[A]Based on the material passing the 3-in. (75-mm) sieve

[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C]Gravels with 5 to 12% fines required dual symbols:
GW-GM well graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly-graded gravel with silt
GP-GC poorly-graded gravel with clay

[D]Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to

[G]If fines classify as CL-ML, use dual symbol GC-CM, or SC-SM.

[H]If fines are organic, add "with organic fines" to group name

[I]If soil contains >15% gravel, add "with gravel" to group name

[J]If Atterberg limits plots shaded area, soil is a CL-ML, Silty clay

[K]if soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

[L]If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

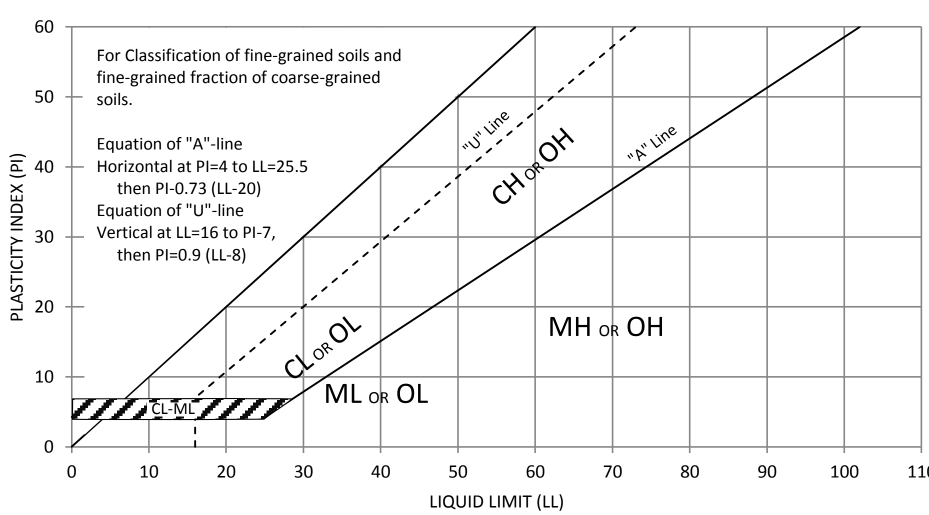
[M]If soil contains ≥30% plus No. 200 predominantly gravel, add "gravelly" to group name.

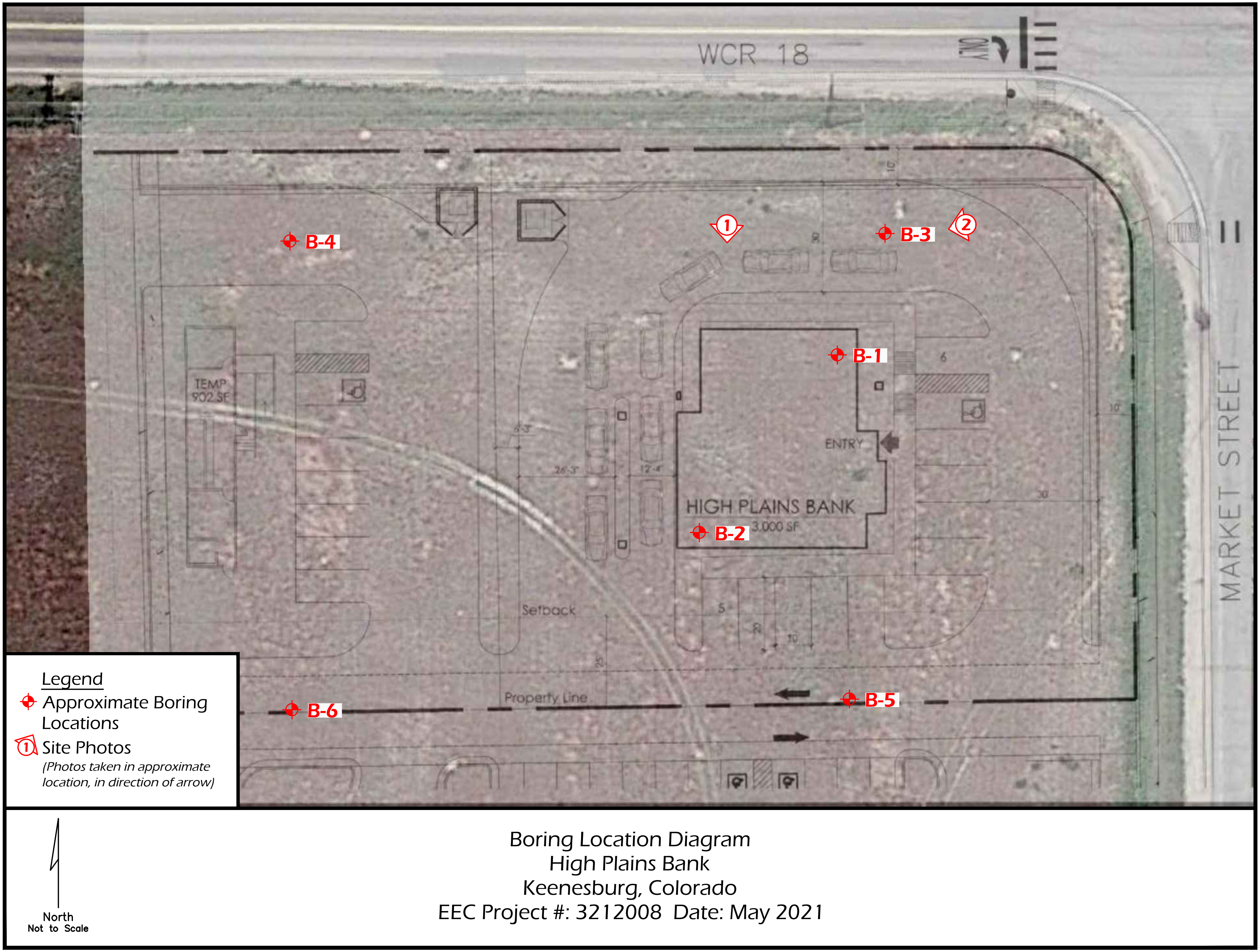
[N]PI≥4 and plots on or above "A" line.

[O]PI≤4 or plots below "A" line.

[P]PI plots on or above "A" line.

[Q]PI plots below "A" line.





Boring Location Diagram
High Plains Bank
Keenesburg, Colorado
EEC Project #: 3212008 Date: May 2021

EARTH ENGINEERING CONSULTANTS, LLC

HIGH PLAINS BANKS
KEENESBURG, COLORADO
EEC PROJECT NO. 3212008
MAY 2021

HIGH PLAINS BANK
KEENESBURG, COLORADO

PROJECT NO: 3212008	LOG OF BORING B-1		DATE: MAY 2021	
RIG TYPE: CME55	*SHEET 1 OF 1*		WATER DEPTH	
FOREMAN: JK	START DATE	5/21/2021	WHILE DRILLING	None
AUGER TYPE: 4" CFA	FINISH DATE	5/21/2021		
SPT HAMMER: AUTOMATIC	SURFACE ELEV	N/A		

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	% SWELL
SPARSE VEGETATION											
		1									
		2									
LEAN CLAY with SAND (CL)											
brown	CS	3	18	9000+	13.4	102.1					
very stiff											
		4									(% @ 500 psf)
	CS	5	14	7000	12.9	113.0	38	20	77.1	5000 psf	6.9%
		6									
		7									
		8									
		9									
CLAYSTONE											
brown/ gray/ rust	SS	10	42	9000+	10.8						
soft, highly weathered with interbedded sandstone											
BOTTOM OF BORING DEPTH 10.5'		11									
		12									
		13									
		14									
		15									
		16									
		17									
		18									
		19									
		20									
		21									
		22									
		23									
		24									
		25									

HIGH PLAINS BANK

KEENESBURG, COLORADO

PROJECT NO: 3212008	**LOG OF BORING B-2**		**DATE: MAY 2021**
RIG TYPE: CME55	*SHEET 1 OF 1*		**WATER DEPTH**
FOREMAN: JK	**START DATE**	**5/21/2021**	**WHILE DRILLING** None
AUGER TYPE: 4" CFA	**FINISH DATE**	**5/21/2021**	
SPT HAMMER: AUTOMATIC	**SURFACE ELEV**	**N/A**	

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % SWELL
SPARSE VEGETATION											
		1									
		2									
LEAN CLAY with SAND (CL)			**Water Soluble Sulfates =0.40%**								(% @ 150 psf)
brown	CS	3	**20**	**6500**	**9.8**	**115.6**					**10.5%**
very stiff											
		4									
	SS	**5**	**15**	**9000+**	**15.9**	**113.0**					
		6									
		7									
		8									
		9									
CLAYSTONE											
brown/ gray/ rust	SS	**10**	**33**	**9000+**	**16.2**						
soft, highly weathered with interbedded sandstone											
BOTTOM OF BORING DEPTH 10.5'		11									
		12									
		13									
		14									
		15									
		16									
		17									
		18									
		19									
		20									
		21									
		22									
		23									
		24									
		25									

HIGH PLAINS BANK
KEENESBURG, COLORADO

PROJECT NO: 3212008	LOG OF BORING B-3		DATE: MAY 2021	
RIG TYPE: CME55	*SHEET 1 OF 1*		WATER DEPTH	
FOREMAN: JK	START DATE	5/21/2021	WHILE DRILLING	None
AUGER TYPE: 4" CFA	FINISH DATE	5/21/2021		
SPT HAMMER: AUTOMATIC	SURFACE ELEV	N/A		

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % SWELL
SPARSE VEGETATION											
		1									
		2									
LEAN CLAY (CL)											(% @ 150 psf)
light brown to brown	CS	3	32	9000+	10.8	117.6	34	18	90.9		10.4%
very stiff											
		4									
	CS	5	13	9000+	12.5	113.0					
		6									
		7									
		8									
		9									
	CS	10	11	6000	19.4	109.4					
BOTTOM OF BORING DEPTH 10'											
		11									
		12									
		13									
		14									
		15									
		16									
		17									
		18									
		19									
		20									
		21									
		22									
		23									
		24									
		25									

HIGH PLAINS BANK
KEENESBURG, COLORADO

PROJECT NO: 3212008	LOG OF BORING B-4 *SHEET 1 OF 1*	DATE: MAY 2021
RIG TYPE: CME55		WATER DEPTH
FOREMAN: JK	START DATE: 5/21/2021	WHILE DRILLING: None
AUGER TYPE: 4" CFA	FINISH DATE: 5/21/2021	
SPT HAMMER: AUTOMATIC	SURFACE ELEV: N/A	

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	% SWELL
SPARSE VEGETATION											
		1									
		2									
LEAN CLAY (CL) light brown to brown very stiff to stiff	CS	3	20	5000	9.0	94.8					
		4									
	CS	**5**	13	2500	9.5	113.0					
		6									
		7									
		8									
		9									
CLAYSTONE brown/ gray/ rust soft, highly weathered with interbedded sandstone	SS	**10**	34	9000+	13.4						
BOTTOM OF BORING DEPTH 10.5'		11									
		12									
		13									
		14									
		15									
		16									
		17									
		18									
		19									
		20									
		21									
		22									
		23									
		24									
		25									

HIGH PLAINS BANK
KEENESBURG, COLORADO

PROJECT NO: 3212008	LOG OF BORING B-5		DATE: MAY 2021	
RIG TYPE: CME55	*SHEET 1 OF 2*		WATER DEPTH	
FOREMAN: JK	START DATE	5/21/2021	WHILE DRILLING	24'
AUGER TYPE: 4" CFA	FINISH DATE	5/21/2021		
SPT HAMMER: AUTOMATIC	SURFACE ELEV	N/A		

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % SWELL
SPARSE VEGETATION											
		1									
		2									
LEAN CLAY (CL)											(% @ 150 psf)
light brown to brown	CS	3	12	9000+	9.1	109.1				2800 psf	6.5%
very stiff											
		4									
	CS	5	16	8000	11.1	113.0					
		6									
		7									
		8									
		9									
	CS	10	34	8500	14.8	112.1					
CLAYSTONE											
brown/ gray/ rust		11									
soft, highly weathered											
with interbedded sandstone		12									
		13									
		14									
	SS	15	37	6000	19.6						
		16									
		17									
		18									
		19									
											(% @ 1000 psf)
	CS	20	40	9000+	16.4	113.7				6600 psf	3.6%
		21									
		22									
		23									
		24									
			Water Soluble Sulfates = 0.06%								
	SS	25	22	9000+	17.0						

Continued on Sheet 2 of 2

HIGH PLAINS BANK

KEENESBURG, COLORADO

PROJECT NO: 3212008	**LOG OF BORING B-5**		**DATE: MAY 2021**	
RIG TYPE: CME55	*SHEET 2 OF 2*		**WATER DEPTH**	
FOREMAN: JK	**START DATE**	**5/21/2021**	**WHILE DRILLING**	**24'**
AUGER TYPE: 4" CFA	**FINISH DATE**	**5/21/2021**		
SPT HAMMER: AUTOMATIC	**SURFACE ELEV**	**N/A**		

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % SWELL
Continued from Sheet 1 of 2		26									
CLAYSTONE		27									
brown/ gray/ rust											
soft, highly weathered		28									
with interbedded sandstone											
		29									
	CS	**30**	**38**	**9000+**	**21.4**	**105.3**					
		31									
		32									
		33									
		34									
	SS	**35**	**50**	**9000+**	**18.1**						
BOTTOM OF BORING DEPTH 35.5'		36									
		37									
		38									
		39									
		40									
		41									
		42									
		43									
		44									
		45									
		46									
		47									
		48									
		49									
		50									

HIGH PLAINS BANK

KEENESBURG, COLORADO

PROJECT NO: 3212008	**LOG OF BORING B-6**		**DATE: MAY 2021**	
RIG TYPE: CME55	*SHEET 1 OF 2*		**WATER DEPTH**	
FOREMAN: JK	**START DATE**	**5/21/2021**	**WHILE DRILLING**	**None**
AUGER TYPE: 4" CFA	**FINISH DATE**	**5/21/2021**		
SPT HAMMER: AUTOMATIC	**SURFACE ELEV**	**N/A**		

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % SWELL
SPARSE VEGETATION											
		1									
		2									
LEAN CLAY with SAND (CL)			**Water Soluble Sulfates = 0.08%**								
light brown to brown	CS	3	**17**	**9000+**	**9.0**	**100.5**					
very stiff											
		4									**(% @ 500 psf)**
	CS	**5**	**13**	**8000**	**10.2**	**117.4**	**37**	**21**	**79.7**	**5000 psf**	**5.3%**
		6									
		7									
		8									
		9									
	SS	**10**	**34**	**9000+**	**15.0**						
CLAYSTONE		11									
brown/ gray/ rust											
soft, highly weathered		12									
with interbedded sandstone											
		13									
		14									**(% @ 1000 psf)**
	CS	**15**	**40**	**9000+**	**16.4**	**112.1**				**3500 psf**	**1.5%**
		16									
		17									
		18									
		19									
	SS	**20**	**32**	**9000+**	**19.1**						
		21									
		22									
		23									
		24									**(% @ 1000 psf)**
	CS	**25**	**30**	**9000+**	**20.6**	**109.2**				**8000 psf**	**5.7%**

Continued on Sheet 2 of 2

HIGH PLAINS BANK

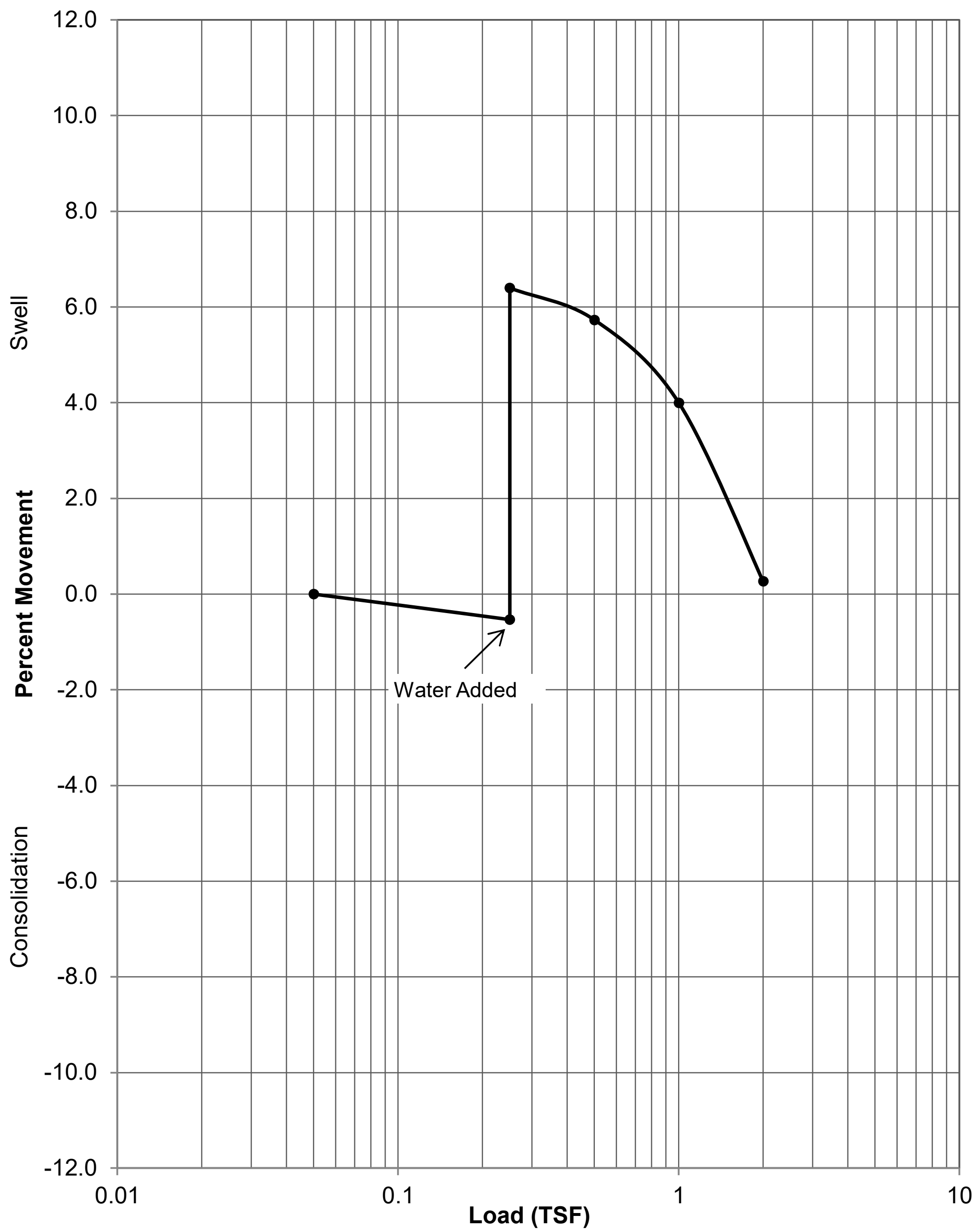
KEENESBURG, COLORADO

PROJECT NO: 3212008	LOG OF BORING B-6		DATE: MAY 2021	
RIG TYPE: CME55	*SHEET 2 OF 2*		WATER DEPTH	
FOREMAN: JK	START DATE	5/21/2021	WHILE DRILLING	None
AUGER TYPE: 4" CFA	FINISH DATE	5/21/2021		
SPT HAMMER: AUTOMATIC	SURFACE ELEV	N/A		

SOIL DESCRIPTION	TYPE	D (FEET)	N (BLOWS/FT)	QU (PSF)	MC (%)	DD (PCF)	A-LIMITS LL	A-LIMITS PI	-200 (%)	SWELL PRESSURE	SWELL % SWELL
Continued from Sheet 1 of 2		26									
CLAYSTONE		27									
brown/ gray/ rust											
soft, highly weathered		28									
with interbedded sandstone											
		29									
	SS	**30**	**39**	**9000+**	**18.6**						
		31									
		32									
		33									
		34									
	CS	**35**	**48**	**9000+**	**18.3**	**113.6**					
BOTTOM OF BORING DEPTH 35'											
		36									
		37									
		38									
		39									
		40									
		41									
		42									
		43									
		44									
		45									
		46									
		47									
		48									
		49									
		50									

SWELL / CONSOLIDATION TEST RESULTS

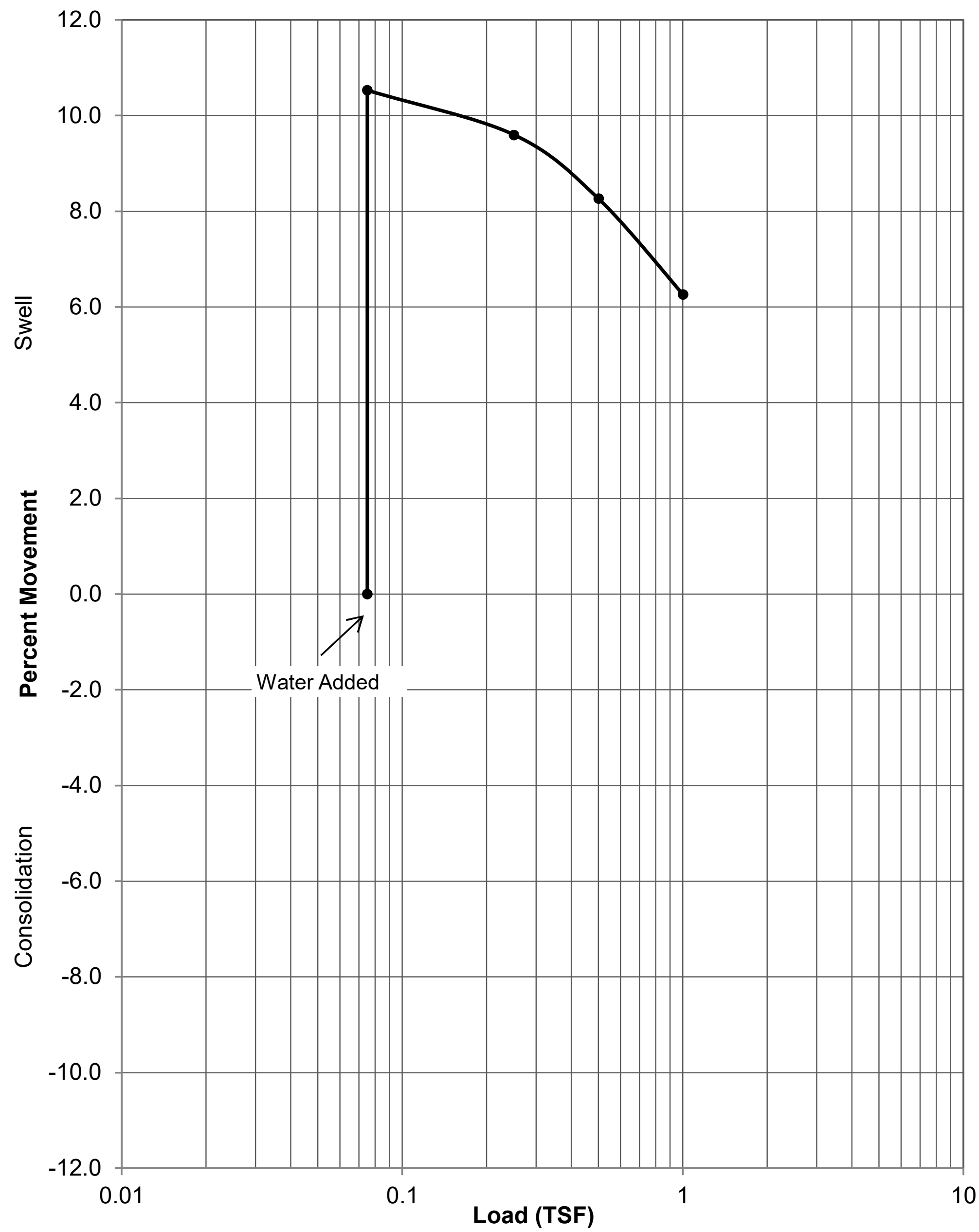
Material Description: Brown Lean Clay with Sand		
Sample Location: Boring 1, Sample 2, Depth 4'		
Liquid Limit: 38	Plasticity Index: 20	% Passing #200: 77.1%
Beginning Moisture: 12.9%	Dry Density: 113 pcf	Ending Moisture: 18.2%
Swell Pressure: 5000 psf	% Swell @ 500: 6.9%	



Project: High Plains Bank
Location: Keenesburg, Colorado
Project #: 3212008
Date: May 2021

SWELL / CONSOLIDATION TEST RESULTS

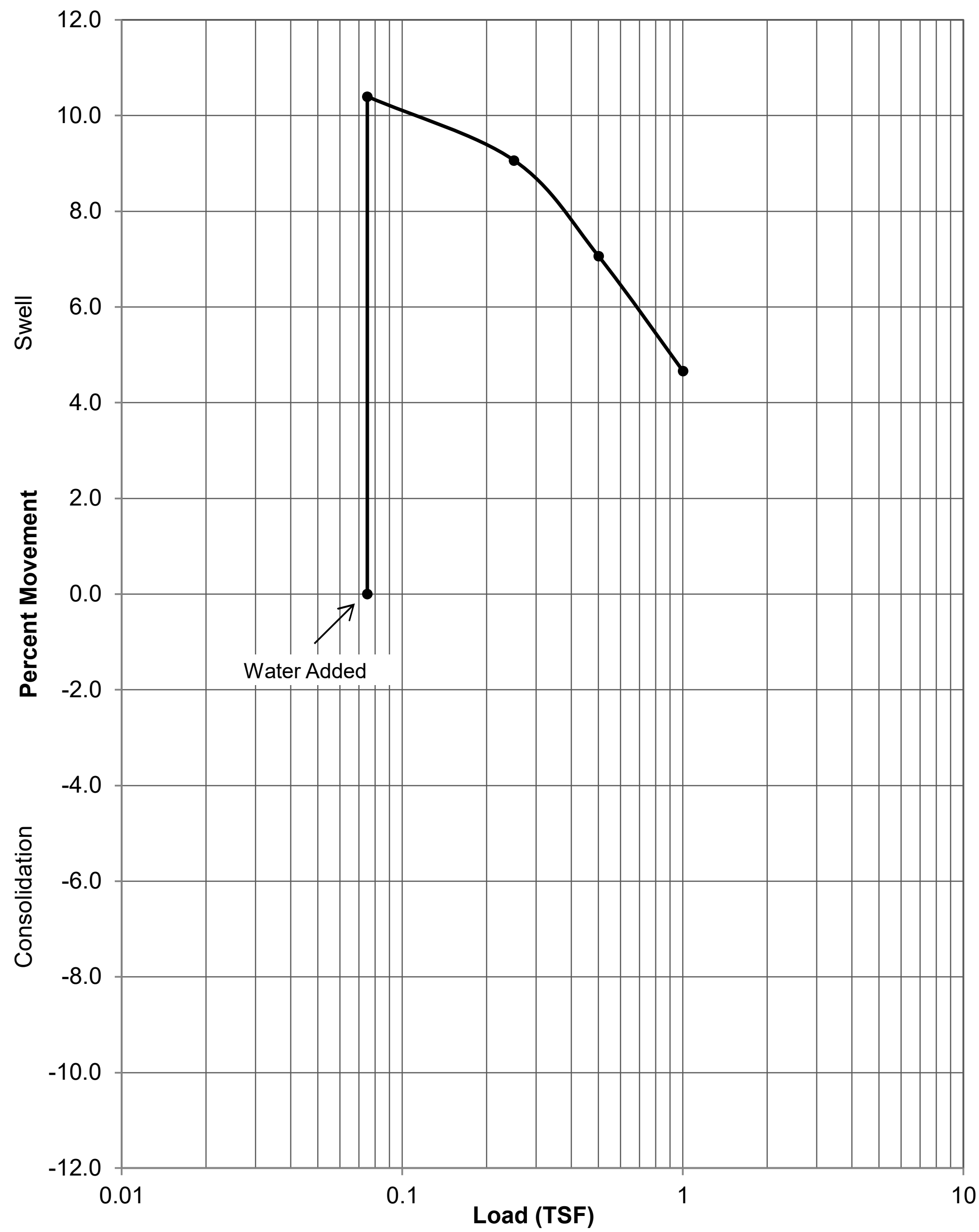
Material Description:	Brown Lean Clay with Sand		
Sample Location:	Boring 2, Sample 1, Depth 2'		
Liquid Limit:	Plasticity Index:	% Passing #200:	
Beginning Moisture: 9.8%	Dry Density: 119.1 pcf	Ending Moisture: 20.0%	
Swell Pressure:		% Swell @ 150:	10.5%



Project: High Plains Bank
Location: Keenesburg, Colorado
Project #: 3212008
Date: May 2021

SWELL / CONSOLIDATION TEST RESULTS

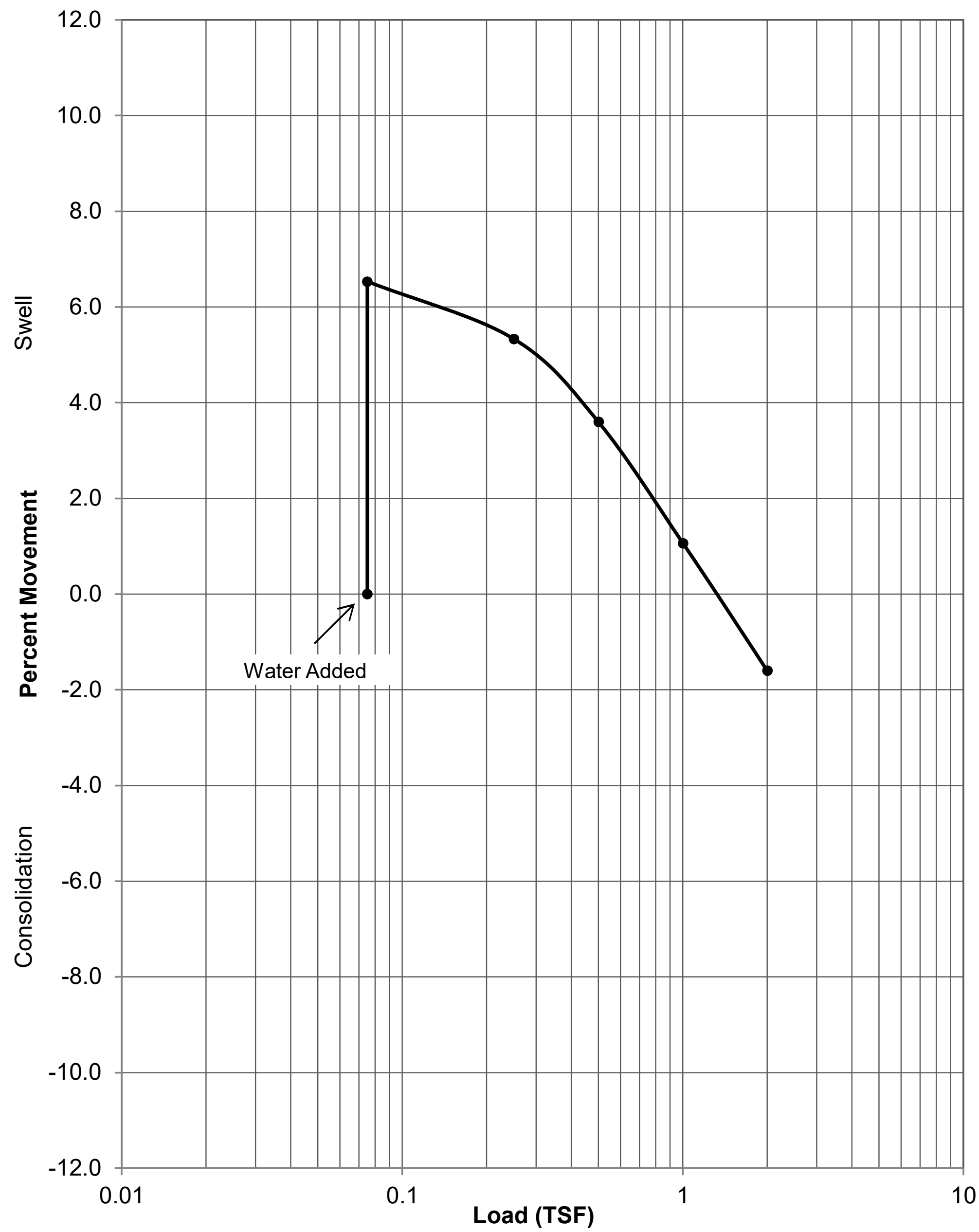
Material Description: Light Brown Lean Clay with Sand		
Sample Location: Boring 3, Sample 1, Depth 2'		
Liquid Limit: 34	Plasticity Index: 18	% Passing #200: 90.9%
Beginning Moisture: 10.8%	Dry Density: 121.1 pcf	Ending Moisture: 19.1%
Swell Pressure:	% Swell @ 150: 10.4%	



Project: High Plains Bank
Location: Keenesburg, Colorado
Project #: 3212008
Date: May 2021

SWELL / CONSOLIDATION TEST RESULTS

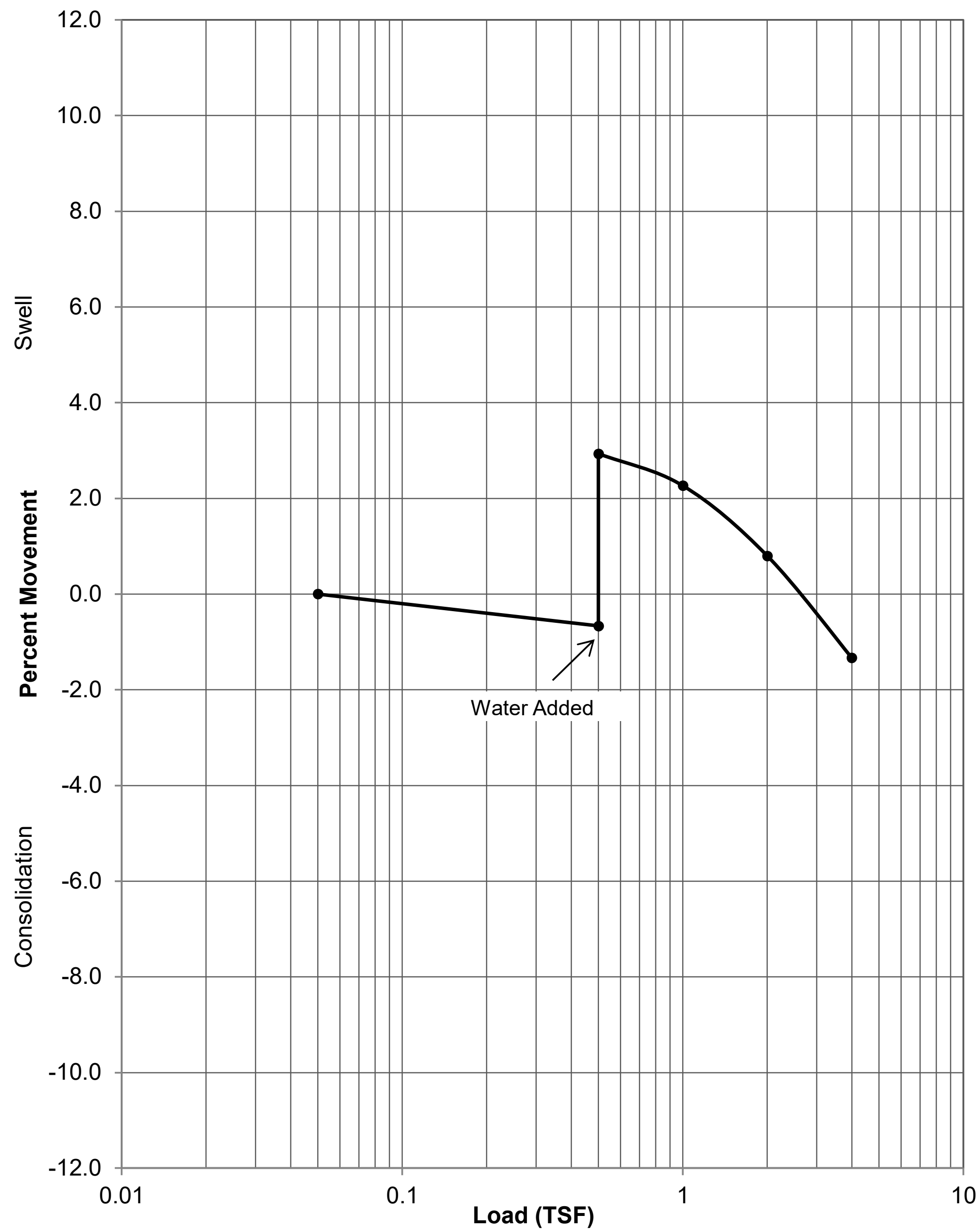
Material Description: Light Brown Lean Clay with Sand		
Sample Location: Boring 5, Sample 1, Depth 2'		
Liquid Limit:	Plasticity Index:	% Passing #200:
Beginning Moisture: 9.1%	Dry Density: 109.1 pcf	Ending Moisture: 22.3%
Swell Pressure: 2800 psf	% Swell @ 150: 6.5%	



Project: High Plains Bank
Location: Keenesburg, Colorado
Project #: 3212008
Date: May 2021

SWELL / CONSOLIDATION TEST RESULTS

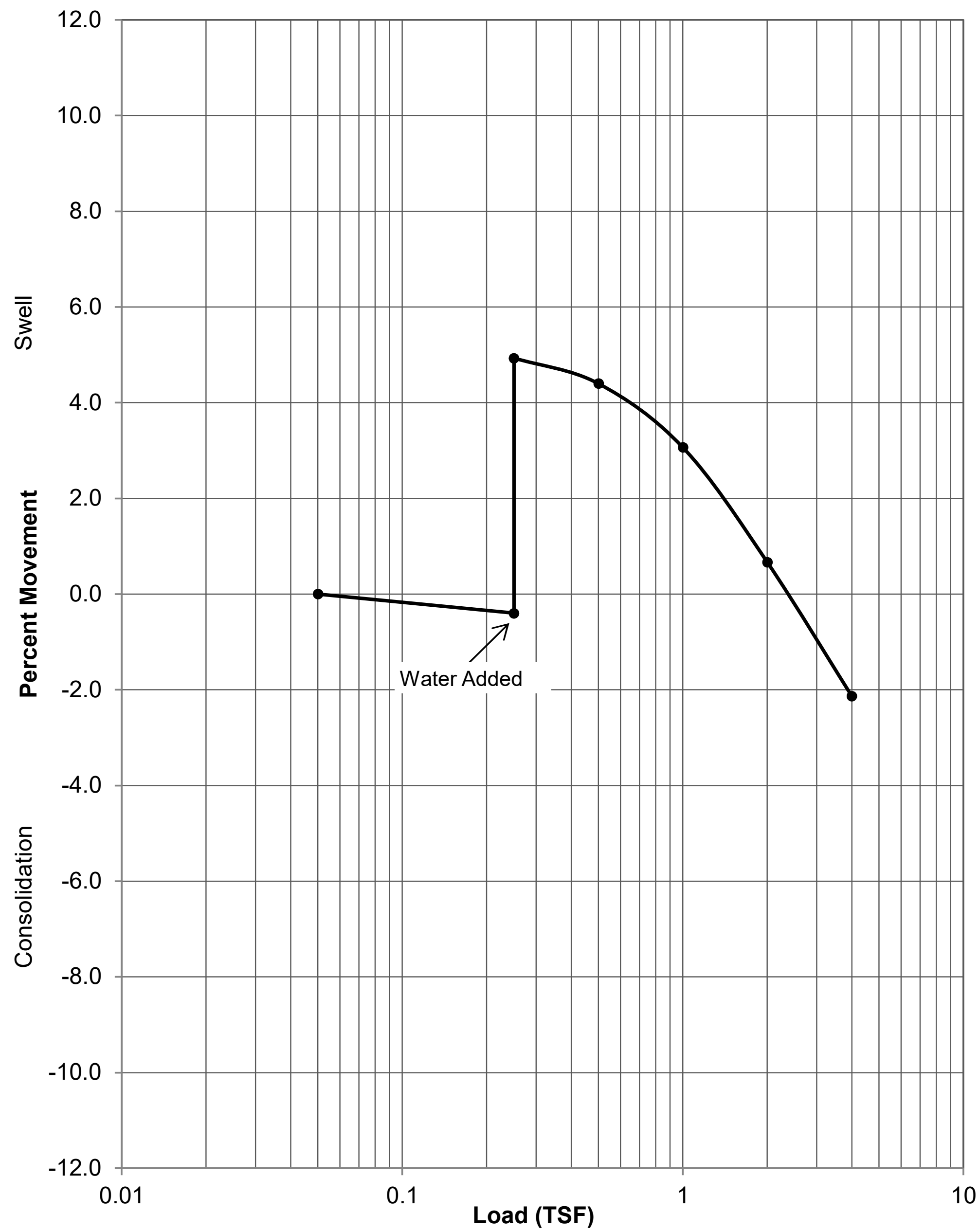
Material Description: Claystone			
Sample Location: Boring 5, Sample 5, Depth 19'			
Liquid Limit:	Plasticity Index:		% Passing #200:
Beginning Moisture: 16.4%	Dry Density: 115.7 pcf		Ending Moisture: 19.0%
Swell Pressure: 6600 psf		% Swell @ 1000: 3.6%	



Project: High Plains Bank
Location: Keenesburg, Colorado
Project #: 3212008
Date: May 2021

SWELL / CONSOLIDATION TEST RESULTS

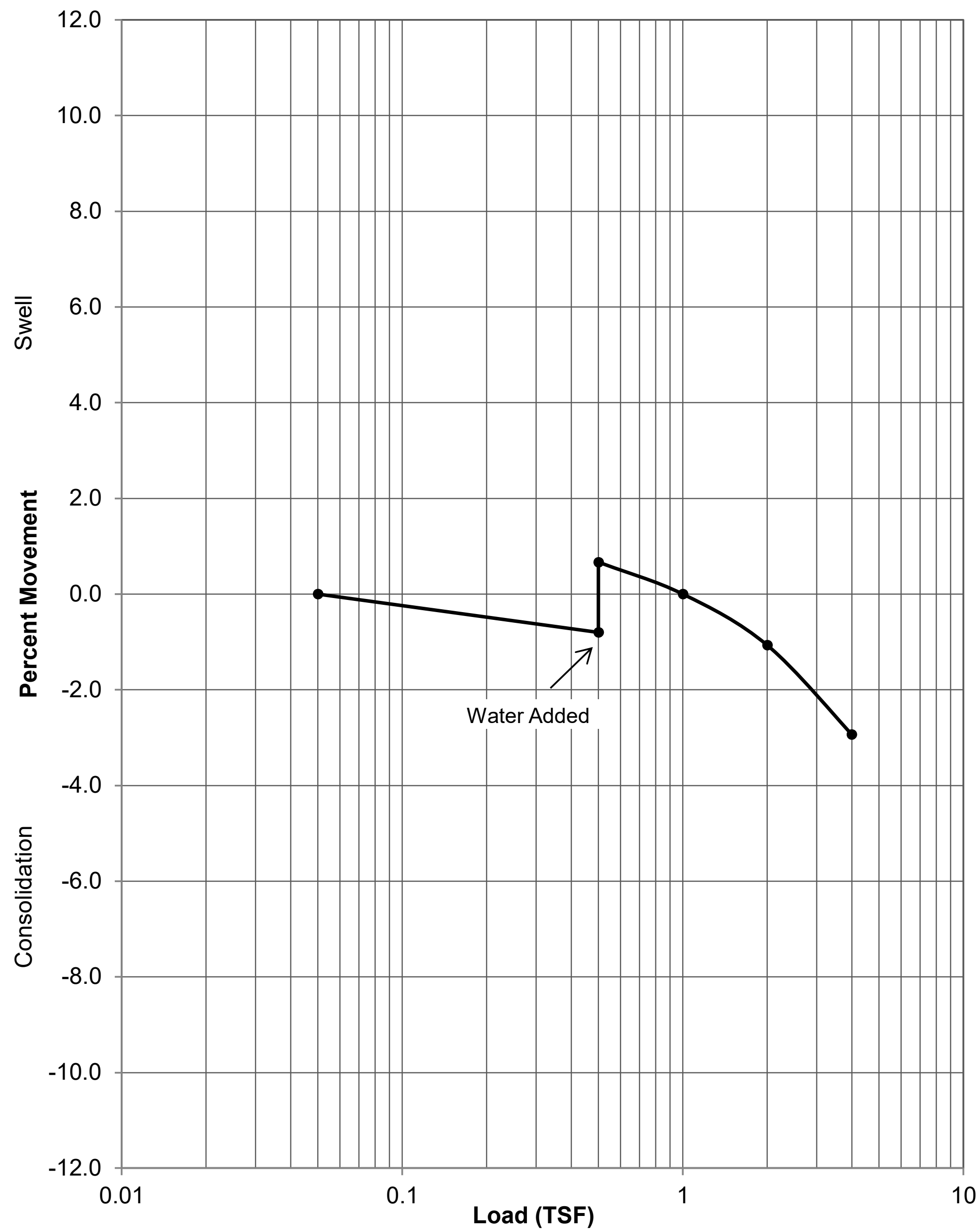
Material Description: Brown Lean Clay with Sand		
Sample Location: Boring 6, Sample 2, Depth 4'		
Liquid Limit: 37	Plasticity Index: 21	% Passing #200: 79.7%
Beginning Moisture: 10.2%	Dry Density: 117.4 pcf	Ending Moisture: 16.2%
Swell Pressure: 5000 psf	% Swell @ 500: 5.3%	



Project: High Plains Bank
Location: Keenesburg, Colorado
Project #: 3212008
Date: May 2021

SWELL / CONSOLIDATION TEST RESULTS

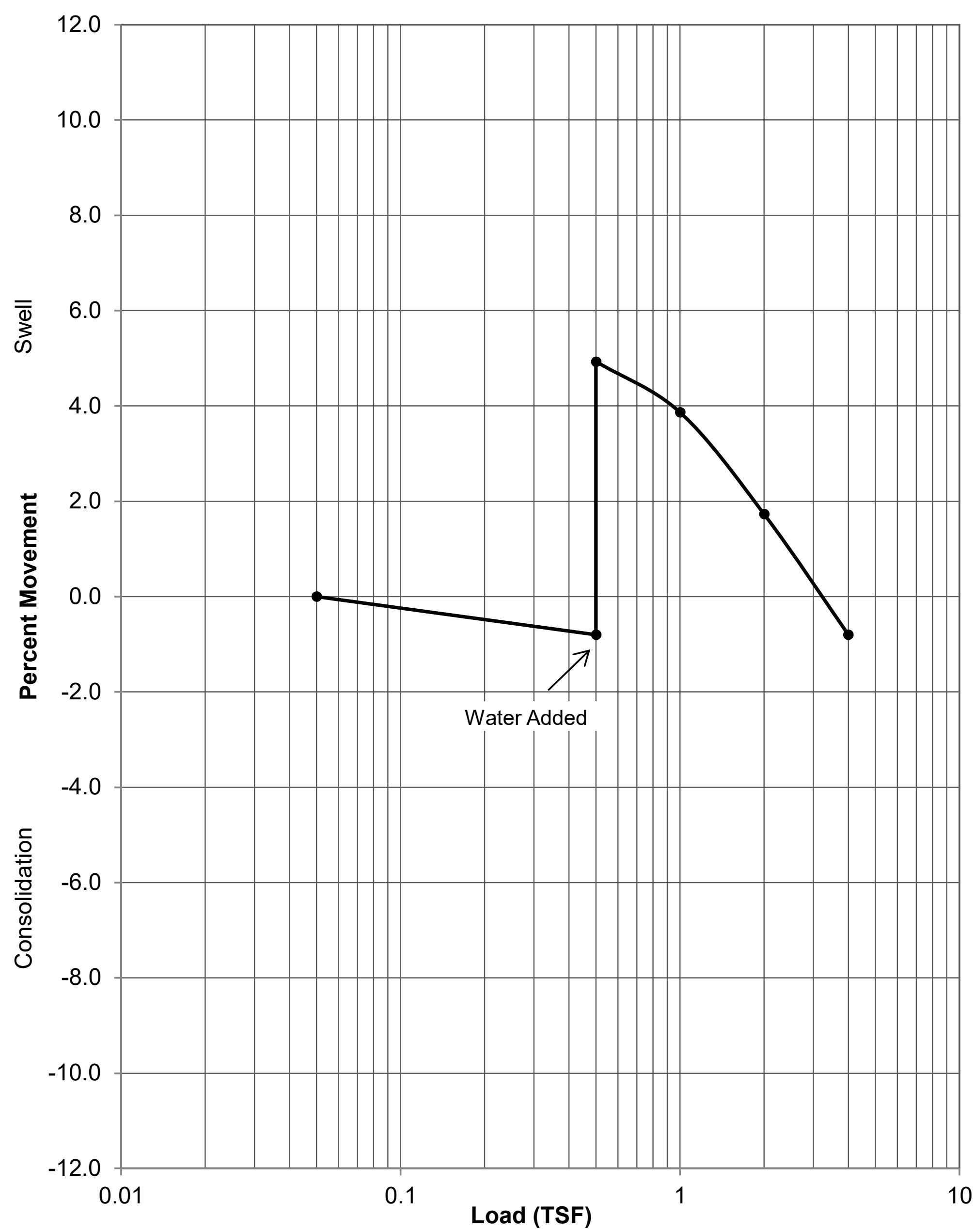
Material Description: Claystone		
Sample Location: Boring 6, Sample 4, Depth 14'		
Liquid Limit:	Plasticity Index:	% Passing #200:
Beginning Moisture: 16.4%	Dry Density: 112.3 pcf	Ending Moisture: 18.8%
Swell Pressure: 3500 psf	% Swell @ 1000: 1.5%	



Project: High Plains Bank
Location: Keenesburg, Colorado
Project #: 3212008
Date: May 2021

SWELL / CONSOLIDATION TEST RESULTS

Material Description: Claystone			
Sample Location: Boring 6, Sample 6, Depth 24'			
Liquid Limit:	Plasticity Index:		% Passing #200:
Beginning Moisture: 20.6%	Dry Density: 106.3 pcf		Ending Moisture: 23.8%
Swell Pressure: 8000 psf		% Swell @ 1000: 5.7%	



Project: High Plains Bank

Location: Keenesburg, Colorado

Project #: 3212008

Date: May 2021

EEC

APPENDIX B

WEC Drainage Calculations

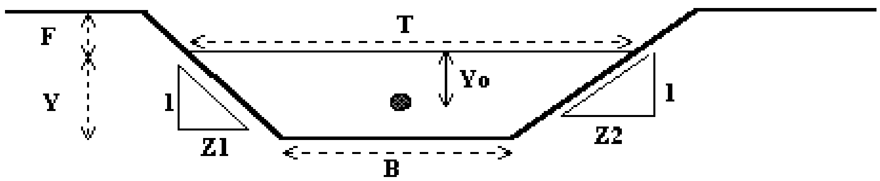
Developed Runoff Table - Market Street Business Park Subdivision							
BASIN	Impervious	C-YR	I	A	CIA(YR-DEVELOPED)	cfs	DESIGN POINT
L2							
C_2 (UDFCD 2018)	56.29	0.46	2.88	1.01	1.35	cfs	9
C_5	56.29	0.49	3.83	1.01	1.91	cfs	
C_{10}	56.29	0.55	4.74	1.01	2.63	cfs	
C_{100}	56.29	0.71	8.94	1.01	6.43	cfs	

APPENDIX C

Channel Capacity / Market Street Subdivsion Drainage Plan

Normal Flow Analysis - Trapezoidal Channel

Project: Market Street Business Park Subdivision
Channel ID: Swale RG2

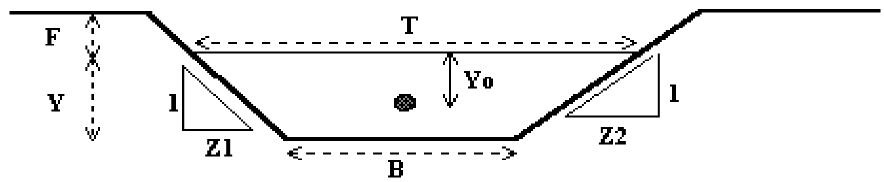


Design Information (Input)			
Channel Invert Slope	So =	0.0160	ft/ft
Manning's n	n =	0.025	
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Freeboard Height	F =	0.00	ft
Design Water Depth	Y =	**0.75**	ft

Normal Flow Condtion (Calculated)			
Discharge	**Q =**	**16.80**	cfs
Froude Number	**Fr =**	**1.15**	
Flow Velocity	**V =**	**4.48**	fps
Flow Area	A =	3.75	sq ft
Top Width	T =	8.00	ft
Wetted Perimeter	P =	8.18	ft
Hydraulic Radius	R =	0.46	ft
Hydraulic Depth	D =	0.47	ft
Specific Energy	Es =	1.06	ft
Centroid of Flow Area	Yo =	0.30	ft
Specific Force	Fs =	0.22	kip

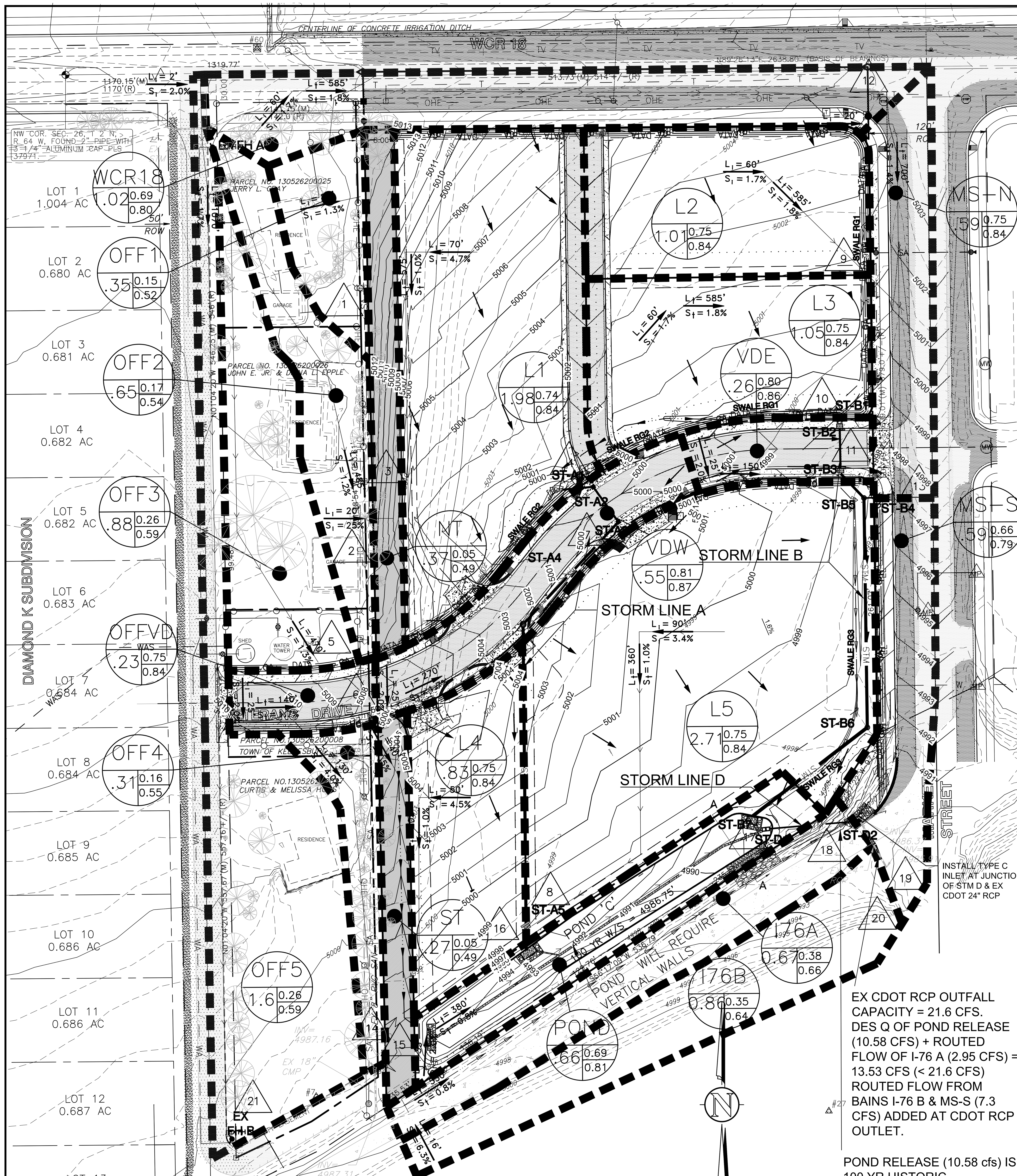
Critical Flow Analysis - Trapezoidal Channel

Project:	**Market Street Business Park Subdivision**
Channel ID:	**Swale RG2**



Design Information (Input)			
Bottom Width	B =	2.00	ft
Left Side Slope	Z1 =	4.00	ft/ft
Right Side Slope	Z2 =	4.00	ft/ft
Design Discharge	Q =	**15.60**	cfs

Critical Flow Condition (Calculated)			
Critical Flow Depth	**Y =**	**0.78**	ft
Critical Flow Area	A =	3.95	sq ft
Critical Top Width	T =	8.20	ft
Critical Hydraulic Depth	D =	0.48	ft
Critical Flow Velocity	V =	3.95	fps
Froude Number	**Fr =**	**1.00**	
Critical Wetted Perimeter	P =	8.39	ft
Critical Hydraulic Radius	R =	0.47	ft
Critical (min) Specific Energy	Esc =	1.02	ft
Centroid on the Critical Flow Area	Yoc =	0.23	ft
Critical (min) Specific Force	Fsc =	0.18	kip



EX CDOT RCP OUTFALL CAPACITY = 21.6 CFS. DES Q OF POND RELEASE (10.58 CFS) + ROUTED FLOW OF I-76 A (2.95 CFS) = 13.53 CFS (< 21.6 CFS) ROUTED FLOW FROM BAINS I-76 B & MS-S (7.3 CFS) ADDED AT CDOT RCP OUTLET.

POND RELEASE (10.58 cfs) IS 100 YR HISTORIC RATE OF BASINS (OFF 1-4, WCR18, & MS), ZERO RELEASE USED FOR BASIN H

POND VOLUME:

REQUIRED MODIFIED FAA VOLUME	-	76,370 CF
PROVIDED VOLUME	-	94,170 CF

60 30 0 60 120
FULL SCALE: 1" = 60'
HALF SCALE: 1" = 120'

DEVELOPED DRAINAGE LEGEND

B1 Sub-basin Designation
3.2 Area in Acres
XX C5
XX C100
PROPOSED DRAINAGE PATTERN
DEVELOPED BASIN
DESIGN POINT
Existing Drainage Pattern

L - INITIAL LENGTH
S - INTIAL SLOPE
L - TRAVEL LENGTH
S - TRAVEL SLOPE
* AVERAGE SLOPE INCLUDES ROOF SLOPE OF 8.33%

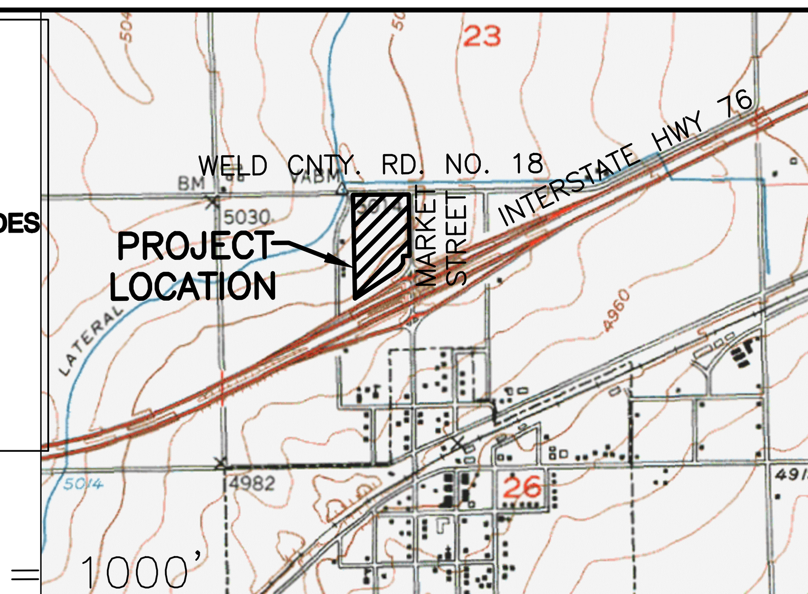
L_i = Li
S_i = Si
L_t = Lt
S_t = St

DEVELOPED DRAINAGE TABLE

Developed Runoff Table - Market Street Business Park Subdivision							
BASIN	Impervious	C-YR	I	A	CIA(YR-DEVELOPED)	cfs	DESIGN POINT
L1							
C_2 (UDFCD 2018)	86.72	0.72	2.91	1.98	4.13	cfs	4
C_5	86.72	0.74	3.87	1.98	5.68	cfs	
C_{10}	86.72	0.77	4.78	1.98	7.29	cfs	
C_{100}	86.72	0.84	9.02	1.98	14.93	cfs	
L2							
C_2 (UDFCD 2018)	87.93	0.73	2.91	1.01	2.14	cfs	9
C_5	87.93	0.75	3.87	1.01	2.94	cfs	
C_{10}	87.93	0.78	4.78	1.01	3.77	cfs	
C_{100}	87.93	0.84	9.02	1.01	7.67	cfs	
L3							
C_2 (UDFCD 2018)	88.00	0.73	2.91	1.05	2.22	cfs	10
C_5	88.00	0.75	3.87	1.05	3.04	cfs	
C_{10}	88.00	0.78	4.78	1.05	3.90	cfs	
C_{100}	88.00	0.84	9.02	1.05	7.93	cfs	
L4							
C_2 (UDFCD 2018)	87.43	0.72	2.91	0.83	1.74	cfs	16
C_5	87.43	0.75	3.87	0.83	2.39	cfs	
C_{10}	87.43	0.78	4.78	0.83	3.07	cfs	
C_{100}	87.43	0.84	9.02	0.83	6.26	cfs	
L5							
C_2 (UDFCD 2018)	87.23	0.72	2.81	2.71	5.49	cfs	8
C_5	87.23	0.75	3.73	2.71	7.55	cfs	
C_{10}	87.23	0.77	4.62	2.71	9.69	cfs	
C_{100}	87.23	0.84	8.71	2.71	19.78	cfs	
POND							
C_2 (UDFCD 2018)	79.89	0.66	2.46	0.66	1.07	cfs	17
C_5	79.89	0.69	3.27	0.66	1.47	cfs	
C_{10}	79.89	0.72	4.04	0.66	1.91	cfs	
C_{100}	79.89	0.81	7.63	0.66	4.04	cfs	
NT							
C_2 (UDFCD 2018)	2.00	0.01	2.84	0.37	0.01	cfs	3
C_5	2.00	0.05	3.77	0.37	0.07	cfs	
C_{10}	2.00	0.15	4.66	0.37	0.26	cfs	
C_{100}	2.00	0.49	8.79	0.37	1.58	cfs	
ST							
C_2 (UDFCD 2018)	2.00	0.01	2.60	0.27	0.01	cfs	15
C_5	2.00	0.05	3.45	0.27	0.05	cfs	
C_{10}	2.00	0.15	4.27	0.27	0.17	cfs	
C_{100}	2.00	0.49	8.05	0.27	1.05	cfs	
VDW							
C_2 (UDFCD 2018)	95.45	0.79	2.91	0.55	1.27	cfs	7
C_5	95.45	0.81	3.87	0.55	1.73	cfs	
C_{10}	95.45	0.84	4.78	0.55	2.21	cfs	
C_{100}	95.45	0.87	9.02	0.55	4.34	cfs	
VDE							
C_2 (UDFCD 2018)	93.86	0.78	2.91	0.26	0.59	cfs	11
C_5	93.86	0.80	3.87	0.26	0.81	cfs	
C_{10}	93.86	0.82	4.78	0.26	1.03	cfs	
C_{100}	93.86	0.86	9.02	0.26	2.04	cfs	
WCR 18							
C_2 (UDFCD 2018)	79.90	0.66	2.52	1.02	1.71	cfs	12
C_5	79.90	0.69	3.35	1.02	2.34	cfs	
C_{10}	79.90	0.71	4.14	1.02	3.01	cfs	
C_{100}	79.90	0.80	7.81	1.02	6.40	cfs	
MS-N							
C_2 (UDFCD 2018)	87.82	0.73	2.79	0.59	1.21	cfs	13
C_5	87.82	0.75	3.71	0.59	1.65	cfs	
C_{10}	87.82	0.78	4.59	0.59	2.12	cfs	
C_{100}	87.82	0.84	8.65	0.59	4.31	cfs	
MS-S							
C_2 (UDFCD 2018)	76.32	0.63	2.65	0.59	0.99	cfs	19
C_5	76.32	0.66	3.52	0.59	1.36	cfs	
C_{10}	76.32	0.70	4.36	0.59	1.79	cfs	
C_{100}	76.32	0.79	8.22	0.59	3.84	cfs	

*** FOR BASINS OFF 1-5, OFF VD, & I-76 A&B SEE SHEETS C4.00 & C4.01**

PORTIONS OR ALL OF SWALES RG1, RG2, AND RG3 TO REMAIN UNTIL FINAL LOT DEVELOPMENT CAPTURES AND DIRECTS INDIVIDUAL LOT RUNOFF TO STORM LINES A, B, OR POND 'C' AS APPROVED UNDER EACH LOT'S INDIVIDUAL STORM PLAN



1" = 1000'
PART of NE 1/4 S26, T2N, R64W, 6th PM
SHOWN VICINITY MAP TAKEN FROM USGS QUAD – KEENESBURG 40104–A5

NOTES

THIS PLAN IS INTENDED AS THE FINAL DRAINAGE PLAN FOR MARKET STREET BUSINESS PARK SUBDIVISION.

ALL IMPROVEMENTS ARE PROPOSED UNLESS NOTED AS EXISTING.

IT IS THE OWNER AND/OR THE CONTRACTOR'S RESPONSIBILITY TO ATTAIN ALL APPROPRIATE PERMITS AND REVIEW APPROVALS FROM THE STATE OF COLORADO AND TOWN OF KEENESBURG RESPECTIVELY.

SEE "AS BUILT/BOUNDARY SURVEY" COMPLETED BY AMERICAN WEST LAND SURVEY – DATED MAY 24, 2006 AND UPDATED TOPOGRAPHY AND IMPROVEMENTS SURVEY DATED AUGUST 07, 2019.

SEE COVER SHEET FOR PROJECT BENCHMARK AND BASIS OF BEARING.

SITE BENCHMARK WAS ESTABLISHED BEING A 3" BRASS CAP IN CONCRETE LYING FIVE FEET WEST OF A CONCRETE IRRIGATION DITCH NEAR THE INTERSECTION OF COUNTY ROAD 18 AND NORTH CEDAR STREET, AND THIRTY FEET NORTH OF THE CENTERLINE OF COUNTY ROAD 18. STAMPED "NATIONAL GEODETIC SURVEY ACD 1" HAVING AN ELEVATION OF 5015.39 FEET (NAVD 1988)

ANY REFERENCE TO EASEMENTS, SURVEY POINTS, OR EXISTING UTILITIES AND FEATURES ARE BASED SOLELY FROM SURVEY INFORMATION PROVIDED BY OTHERS – SPECIFICALLY PER SAME SURVEY NOTED ABOVE.

NOT ALL UNCC UTILITY LOCATES HAVE BEEN PERFORMED. IT IS THE CONTRACTOR'S RESPONSIBILITY TO VERIFY ALL UTILITIES ARE LOCATED AND SURVEY PROVIDED TO THE OWNER AND ENGINEER PRIOR TO CONSTRUCTION DRAWING RELEASE.

BUILDING SETBACKS FRONT/REAR = 25', SIDES = 10' PER ZONE DISTRICT HIGHWAY COMMERICAL (CH).

EACH LOT DEVELOPER RESPONSIBLE TO CAPTURE THE DEVELOPED RUNOFF AND RELEASE INTO DESIGNED STORM PIPING ADJACENT TO EACH LOT SO ALL RELEASES OCCUR AT FOREBAY LOCATIONS.

SYMBOL LEGEND

45 DEG BEND
22.5 DEG BEND
RESTRAINED PLUG
RESTRAINED TEE
WATER METER
EXISTING ASPHALT
RESTRAINED CROSS
FIRE HYDRANT
RESTRAINED WATER VALVE
PIPE CROSSOVER
MANHOLE
PROPOSED ASPHALT PAVING

LINETYPE LEGEND

LOT / PROPERTY LINE
RIGHT OF WAY LINE
SETBACK
EASEMENT
TO BE ABANDONED LOT LINE
EXISTING BUILDING, CURB
EDGE of ASPHALT
CHAINLINK FENCE
WIRE FENCE
POND WQ W/S
SWALE
EXISTING SWALE
EXISTING OVERHEAD ELEC
EXISTING ELECTICAL LINE
EXISTING STORM LINE
EXISTING SANITARY LINE
EXISTING WATER LINE
EXISTING GAS LINE
EXISTING FIBER OPTIC LINE
EXISTING TELEPHONE LINE
PROPOSED SANITARY LINE
PROPOSED SANITARY SERVICE
PROPOSED STORM LINE
PROPOSED WATER LINE
PROPOSED WATER SERVICE
PROPOSED GAS LINE
PROPOSED ELECTRIC LINE
PROPOSED TELEPHONE LINE

127 S. DENVER AVE
FT. LUPTON, CO 80621
www.westerneci.com
email@westerneci.com
(720) 685-9951
FAX (720) 294-1330
Western Engineering Consultants, inc LLC

No.	REVISION	DATE	BY
0	PRELIM/FINAL PLAT SUBMITTAL	08/06/19	CFC
1	UPDATED DRAINAGE-TOWN SUBMITTAL	08/16/19	CFC
2	RESUBMITTAL PER TOWN COMMENTS	03/27/20	CFC
3	KUM & GO LOI REQUESTS	06/09/20	CFC
4	RESUBMITTAL PER TOWN COMMENTS	07/22/20	CFC

KEENE LAND, LLC
CONTACT: RICK ROBERTSON
8537 WCR 51
KEENESBURG, CO 80643
(303)961-0031

FINAL DRAINAGE PLAN
MARKET STREET BUSINESS PARK SUBDIVISION
TOWN of KEENESBURG, WELD COUNTY, COLORADO

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CHADWIN F. COX
FOR 33802 APPROVAL 07/22/20
ONLY VALID FOR CONSTRUCTION IF SEAL & ORIGINAL SIGNATURE ARE ON EACH SHEET

INITIAL PLAN RELEASE: 08/06/19
DESIGNED BY: CFC
DRAWN BY: CFC
CHECKED BY: CFC
PROJECT NO. 01-0187.003.00
DOC CON # C4.02-FNLDRNG
SHT C4.02

T:\0187_003_00-KEENE LAND-MARKET BUS PARK\Dwg\CDs\0187_003-WECI-CDS-4.00.dwg, C4.02-FINAL DRNG, 7/23/2020 7:09:35 PM, DWG To PDF.pc3, WEC 24*36, WEC 24*36