



Final WFLHD Geotechnical Engineering Report No. 05-21

**Charles M Russell Refuge Repairs
Fergus, Petroleum and Phillips Counties, MT**

May 26, 2021

Terracon Project No. C4205037

Prepared for:

DJ&A PC
Missoula, MT

Prepared by:

Terracon Consultants, Inc.
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May 26, 2021

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Attn: Mr. Paul Druyvestein, P.E.
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Re: Final WFLHD Geotechnical Engineering Report No. 05-21 Report
Charles M Russell Refuge Repairs
Charles M Russell Refuge
Fergus, Petroleum and Phillips Counties, MT
Contract No. DTFH7015D00003, Task Order No. 69056720F000090
Terracon Project No. C4205037

Dear Mr. Druyvestein:

We have completed the Final WFLHD Geotechnical Engineering Report No. 05-21 services for the project referenced above. This study was performed in general accordance with the Statement of Work (SOW) dated June 11, 2020 and subsequent signed Professional Services Agreement dated October 23, 2020. This report presents the findings of the subsurface exploration, including laboratory testing completed by Western Federal Lands Highway Division finalized on March 3, 2021, and provides geotechnical design recommendations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

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Environmental



Facilities



Geotechnical



Materials

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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the **GeoReport** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
PHOTOGRAPHY LOG
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS
SUPPORTING INFORMATION

Note: Refer to each individual Attachment for a listing of contents.

Final WFLHD Geotechnical Engineering Report No. 05-21 Report

Charles M Russell Refuge Repairs Charles M Russell Refuge Fergus, Petroleum and Phillips Counties, MT Terracon Project No. C4205037 May 26, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Charles M Russell Refuge Repairs project to include design modifications at five sites throughout the Charles M Russell Refuge in Fergus, Petroleum and Phillips Counties, MT. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Foundation design and construction
- Lateral earth pressures
- Seismic site classification per AASHTO LRFD Bridge Design Specifications, 8th Edition

The geotechnical engineering Scope of Services for this project, based on the Statement of Work (SOW) dated June 11, 2020 along with the approved Final Exploration Plan submittal dated August 28, 2020, included the advancement of a total of 15 test borings for the five sites explored. The five sites included within our geotechnical scope and evaluated within this report are as follows:

■ Site 1 – Siparyann Creek	■ Site 2 – Rock Creek
■ Site 3 – Sevenmile	■ Site 4 - Nichols
■ Site 6 – Sand Creek	

Thirteen of the borings, conducted at Sites 1, 2, 3, and 4, were extended to 26.5 feet below existing grade. Based on the 30% preliminary design, these sites included primarily surface improvements such as site grade raising, riprap erosion control installations, construction of concrete ford, and culvert replacements. For Site 6, Sand Creek Crossing, two borings were extended to 43.0 and 54.0 feet below existing grade as the site improvement will include the installation of a precast concrete bridge adjacent a former timber bridge structure to replace the current concrete ford used for crossing at this location.

Maps showing the sites and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions has been replicated from the Statement of Work (SOW) documents provided by DJ&A, along with additional description derived from our site visits in association with the project scoping phase and preliminary geotechnical field explorations, and our review of publicly available geologic and topographic maps.

Item	Description
<p>Parcel Information</p>	<p>The proposed project improvements are located at several locations both north and south of the Missouri River in the CMR Refuge.</p> <p>Sites 1 through 4 are located north of the river on Route 201, which is a maintained jeep trail, beyond the end of Route 101, a maintained gravel surfaced road. Site 1 is approximately 7.3 miles east of Highway 191, Site 2 is approximately 11.0 miles east of Highway 191, Site 3 is approximately 22.6 miles east of Highway 191 and Site 4 is approximately 26.1 miles east of Highway 191.</p> <p>Site 6 is located south of the Missouri River on Route 210, a maintained jeep trail east of Highway 191. Site 6 is located approximately 12.5 miles east of Highway 191 on Route 210.</p> <p>See Site Location maps</p>
<p>Existing Improvements</p>	<p>The improvements are all located along maintained jeep trails within the CMR Refuge. Existing site features primarily include culverts, concrete fords, HDPE piping, and existing timber bridge structures that have been buried by more recent alluvial sediment deposits (Site 3) or decommissioned (Site 6).</p>

Item	Description
<p>Existing Topography</p>	<p>Each of the sites is located within alluvial fans deposited by the upslope drainage systems as they feed the Missouri River. The topography at each site has limited variation along the alignment, with the general slope tending from the upslope areas of the drainage features toward the Missouri River. That is, north of the Missouri River, the general topography slopes south across the roadway alignments toward the river. South of the Missouri River, the general topography slopes north across the roadway alignment toward the river.</p> <p>The general site Elevation above Mean Sea Level (MSL), as obtained from GoogleEarth Pro for each site is listed below:</p> <ul style="list-style-type: none"> ■ Site 1 – Siparyann Creek Crossing, 2269 to 2272 feet ■ Site 2 – Rock Creek Crossing, 2273 to 2287 feet ■ Site 3 – Sevenmile Crossing, 2259 to 2262 feet ■ Site 4 – Nichols Crossing, 2259 to 2260 feet ■ Site 6 – Sand Creek Crossing, 2265 to 2270 feet
<p>Geology</p>	<p>The project scope includes several locations both north and south of the Missouri River in the CMR Refuge. The general geologic setting of the CMR Refuge is dominated by overburden sands and moderate to high plasticity clay soils, which are deposits left on the floor of Glacial Lake Musselshell during the Bull Lake Ice Age (70,000 to 130,000 years ago). These glacially derived lakebed soils are overlying bedrock of Upper Cretaceous Age, predominantly Bear Paw Shale and Judith River Formation Sandstones. As the sites approach the Missouri River, the general subsurface conditions consist of alluvial deposits, alluvial fans deposited from drainages as they feed the river and flood bank deposits of sand, silt, clay and intermittent gravel. The alluvial deposits near the Missouri River have not been documented, but are anticipated to extend over 100 feet as the Missouri River Channel has greatly incised the bedrock in the area. Outcrops of Judith River Formation sandstone, a more resistant formation, are noted along Route 101 north of the River. Many of the sites align within the Bear Paw Shale Formation that form prominent sag/slough features in which past landslide movements have resulted in the current appearance consistent with the Missouri River Breaks area. Numerous recent to active landslide features with head scarps ranging from a couple feet to over 60 feet were observed throughout the general area of observation, not necessarily impacting the project sites but indicative of the tenuous slope conditions in the geologic setting.</p>

We also collected photographs at the time of our field exploration program. Representative photos are provided in our [Photography Log](#).

PROJECT DESCRIPTION

Item	Description
Information Provided	We were provided with several documents for our review and development of the geotechnical portions of this project throughout the course of this project by DJ&A including the following: <ul style="list-style-type: none"> ○ Statement of Work (SOW) dated June 11, 2020 ○ Appendix “B” Preliminary Design dated October 31, 2018 ○ CMR Refuge Modified Design Summary dated February 2, 2019
Project Description	The overall objective of the project is to improve long-term performance of the maintained routes (Route 201 and Route 210) alignments through extreme runoff events through implementation of improved drainage features, grading, and installation of ford/bridge structures to allow for continued passage of vehicle traffic during runoff events. Description of individual design elements included in the preliminary design for each Site will be discussed separately in the report.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting, and our understanding of the project. This characterization forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. For the purposes of this report, the individual project sites will be broken out to provide brief descriptions of the subsurface conditions encountered along with the impacts to the proposed design in order to develop appropriate recommendations for the final design, economic considerations, life expectancy, and constructability. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section of this report. The methods and procedures utilized for the exploration are outlined in the **Exploration and Testing Procedures** section of this report.

The borings were observed while drilling and immediately after completion for the presence and level of groundwater. The following table provides a summary of borings in which groundwater was observed during our exploration efforts.

Site	Boring ID	Depth to Ground Water (ft) ^{1, 2}
Site 1 – Siparyann	B-01	None Encountered
Site 1 – Siparyann	B-02	15.5 (11/7/2020)
Site 1 – Siparyann	B-03	18.0 (11/7/2020)
Site 2 – Rock Creek	B-04	None Encountered
Site 2 – Rock Creek	B-05	26.0 (11/7/2020)
Site 2 – Rock Creek	B-06a	None Encountered
Site 3 – Sevenmile	B-07	None Encountered
Site 3 – Sevenmile	B-08	None Encountered
Site 3 – Sevenmile	B-09	14.5 (11/4/2020)
Site 3 – Sevenmile	B-10	24.0 (11/4/2020)
Site 4 – Nichols	B-11	24.0 (11/3/2020)
Site 4 – Nichols	B-12	17.5 (11/3/2020)
Site 4 – Nichols	B-13	12.5 (11/3/2020)
Site 6 – Sand Creek	B-14	48.5 (11/5/2020)
Site 6 – Sand Creek	B-15	12.5 (11/6/2020)

1. Below existing ground surface
2. Groundwater level measurements taken during drilling

The field investigation does not fully reflect seasonal or long-term groundwater conditions which will be influenced by precipitation, hydrologic impacts originating off-site, and other factors beyond the scope of this investigation. Therefore, groundwater levels during construction, or at other times in the life of the project, may vary from the conditions indicated on the Logs.

GEOTECHNICAL OVERVIEW

A primary concern throughout the CMR Refuge is the impact that standing water and runoff from the adjacent tributary watershed areas has on the ability to utilize the roadways within the CMR Refuge due to continued washouts and overtopping of the alignment. The predominant subgrade throughout the area consists of glacially derived, moisture-sensitive, moderate to high plasticity fat (lakebed) clay soils that become very unstable precipitation events. Any planned improvements to the areas need to consider the fat clay subgrade to be extremely sensitive to moisture and weak, such that typical construction traffic operating over prepared subgrades can create localized instabilities, especially after precipitation events. The establishment of effective surface drainage should be completed early in the construction sequence for all improvements planned, and maintained throughout and after construction to avoid potential issues associated with the moisture-sensitive clay soils. If possible, the grading should be performed during the

warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist.

Also, of consideration is the continued deposition of sediment from the drainages feeding the Missouri River at each of the sites. Planned improvements to the sites discussed has the intent of providing for improved performance of the roadway alignment, increased capacity and functionality of culverts, or fords, to allow for more water and sediment to cross the roadway while limiting the impacts on the travel path. With these improvements, it will be important to ensure that continued maintenance of the upslope drainage ditches is programmed so that the functionality of drainage improvements is maintained throughout the design life.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, subgrade preparation, subexcavations and replacements, as well as embankment fill placement. The *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects FP-14* applicable sections for earthwork will pertain for the project. Specific geotechnical considerations for pavement subgrade and structure site preparation are discussed in the corresponding sections of the following report..

Site Preparation

Prior to placing fill materials, the existing vegetation and root mat should be removed. Complete stripping of the topsoil should be performed in all areas that are to receive embankment fill. Preparation of the subgrade should be consistent with Section 204.06(b), scarification of 6 inches below subgrade and compact according to Section 204.11 of the FP-14 throughout, unless noted otherwise. The following table lists the recommended subgrade preparation methods based on stationing.

Fill Material Types

Soil Type	FP-14 Section	Placement Locations
Structural Backfill	704.04	Fill placed below concrete ford construction to provide suitable uniformity and modular value for ford concrete placement (Sites 1 and 2) For abutment backfill at precast concrete bridge structure (Site 6)
Select Borrow (Pit Run)	704.07	Grade raising fill sections for embankment construction to provide additional freeboard (Sites 1 and 3)

Soil Type	FP-14 Section	Placement Locations
Gabion Basket Fill	705.01	For gabion basket fill material used as overflow structure (Site 3)
Riprap (Class 2 & 4)	705.02	For armoring of culvert inlet and outlet, at concrete ford outfalls, and armoring of abutments for precast bridge structure (Sites 1, 2, 3, 4, and 6)
Native Clays, Gravels, and Sands	204.06	Native soils encountered may be suitable for embankment widening outside of the 1H:1V core with finished slopes at 2H:1V or flatter to match existing grade where moisture conditioning and compaction can be achieved. The predominant native soils encountered within the upper reaches of the subsurface profile consist of high plasticity, moisture-sensitive lakebed clays that may be difficult to place and compact within requirements. Native lean clays and granular materials appear suitable for reuse in embankment widening and are likely to require less effort to moisture condition and place within requirements.

Earthwork Construction Considerations

Shallow excavations for the proposed improvements are anticipated to be accomplished with conventional construction equipment. Where excavations are to be conducted within the predominantly clay soils, which are sensitive to construction disturbance, the use of equipment with a smooth bucket should be employed to limit such disturbance and provide for a “neat cut” excavation. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of foundation elements (bridge abutment, concrete ford, gabion basket materials). Construction traffic over the completed subgrades should be avoided. The construction sites should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted prior to further construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the

information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

SITE 1 – SIPARYANN CREEK CROSSING

The field exploration at the Siparyann Creek Crossing included the advancement of three borings along the 400 feet of planned grade raising from Sta. 19+00 to 23+00. Boring B-01 was located approximately at Sta. 19+70, 12 feet right of centerline on the southern end of the planned embankment raising. The segment of the site represented by Boring B-01 is approximately 3 to 4 feet lower in elevation than the segment moving upstation. Boring B-02 was located at approximately Sta. 21+50, 6 feet right of centerline near the middle of the 400 foot grade raise section. Boring B-03 was located approximately at Sta. 22+75, 4 feet right of centerline near the north end of the planned site grade raising zone. Each boring was advanced to a depth of 26.5 feet below existing grade. Boring logs conducted for the Siparyann Creek Crossing site, Borings B-01 through B-03, are attached to this report along with a site plan and exploration plan showing the layout of the borings.

The planned repairs for Siparyann Creek Crossing include removal and replacement of four 36 inch diameter existing culverts with 48 inch culverts, the addition of a 48 inch culvert near Sta. 20+25, raise grade approximately 0-3 feet along 400 feet of the section and installation of a concrete ford from Sta. 19+50 to 20+50 (this portion of the site is well suited for a concrete ford as it is positioned naturally lower than the remaining alignment through this site). The planned repairs are focused on increasing freeboard and cover over the new, larger culverts which will be able to pass more water during runoff events. The ability to pass water through the roadway section within the larger culverts and over the concrete ford, will lead to improved subgrade and roadway surfacing performance due to less potential for standing water and increased stability of the roadway section elevated away from the flat alluvial fan.

Subsurface Conditions

The site is located along the mainline alignment of Route 201 in an alluvial fan deposit create by Siparyann Creek and its associated drainage. The subsurface conditions generally consist of a nominal roadway embankment fill layer (including some oversized cobbles/boulders placed to bridge soft areas of yielding subgrade) varying from 3.5 to 7.0 feet thick overlying native alluvial deposits of moderate to high plasticity clays. The overlying fill layer appears to have been constructed with a subgrade elevation near 2264 to 2266 feet. The alluvial clay deposit extends from the overlying clayey gravel with sand fill material to the termination of exploratory borings at all locations. See the attached Boring Logs for more detailed description of the subsurface conditions.

The embankment fill material generally has a relative density of medium dense with Standard Penetration Test (SPT) recorded N-values ranging between 11 to 23 blows per foot (bpf). The natural moisture content of the clayey gravel with sand material was found to be within the range of 6.3 to 12.5 percent.

The alluvial clay generally has a soft to stiff consistency throughout the deposit, with SPT recorded N-values between 4 and 24 bpf, varying with the amount of sand and gravel within the deposit and was generally falling within the medium stiff range of blow counts. The natural moisture content of the clay material was found to be within the range of 13.5 to 33.8 percent. Liquid Limit values of 65 and 64 with Plasticity Index values of 44 and 44, respectively were determined for select samples of clay and gravelly clay soils tested at this site. Particle-size analyses conducted on select samples of clay and gravelly clay determined approximately 60 to 91 percent of the matrix consisted of material passing the number 200 sieve. Consolidation testing of a clay sample from B-01 at 10.0 feet exhibited moderately high compressibility with initial consolidation of approximately 8.3 percent strain at an overburden pressure of 8,000 pounds per square foot (psf). An additional consolidation test of a gravelly fat clay with sand sample from B-03 at 7.5 feet exhibited moderate swell potential when inundated, interpolated to be approximately 2.5 percent strain at 500 psf. Based on the testing results and manner of deposition, the clays at the site are normally consolidated such that the stress history of the soils is limited to the overburden pressure exerted on the material to date.

Groundwater was not observed in Boring B-01 at the time of our exploration, but was encountered at 15.5 feet and 18.0 feet within Borings B-02 and B-03, respectively. The field investigation does not fully reflect seasonal or long-term groundwater conditions which will be influenced by precipitation, runoff characteristics of the site, future development impacts, hydrologic impacts originating off-site, and other factors beyond the scope of this investigation or evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may vary from the conditions indicated on the Logs.

Geotechnical Consideration and Recommendations

The primary geotechnical concern at the Siparyann Creek Crossing location is the ability to allow for water passage from upslope to the downslope side of the roadway to limit the potential for washouts and overtopping of the alignment. The installation of new culverts and a concrete ford will accommodate additional water passage at this location. The compressible nature of the native soils that will provide support of the embankment fill and concrete ford should be considered in the design of these elements. Although the embankment height will not result in substantial increased pressure, a three foot high new embankment structure can be anticipated to add approximately 350 to 400 psf of stress to the subgrade. With the added stress, calculated centerline of alignment settlements (assuming an embankment geometry of 3 feet of fill with 2H:1V slopes and fill material density on the order of 135 pounds per cubic foot), using the consolidation data obtained from Boring B-01 at 10 feet, results in approximately 1.25 to 2.0

inches of settlement under primary consolidation. The edge of embankment settlement is expected to be on the order of 1/3 of the centerline settlement, or between 0.5 and 0.75 inches. Culvert installations elevations and connections should consider the potential for movement magnitudes as discussed above. Culverts are currently designed to be riprap lined at the inlet and outlet for each which is appropriate based on evidence of past undermining or piping within existing roadway prism where culverts are currently located. Use of proper keying of riprap and bedding materials prior to riprap placement should be conducted in accordance with FP-14.

The concrete ford should be designed based on an expected modulus of subgrade reaction for the predominantly fat clay soils of 75 pounds per cubic inch (pci). Preparation of the subgrade to receive embankment fill or concrete ford planking should be conducted in accordance with the **Earthwork** section to provide sufficient subgrade uniformity. Also of note, the upper portion of the existing roadway consists of clayey gravel with sand material, with varying amounts of fine within the matrix. The installation of a non-woven separation geotextile to limit migration of fines from the subgrade into the embankment fill materials may provide for additional basal stability of the embankment and increase long-term performance of the fill zone.

Regarding the need to provide sufficient bearing resistance while limiting potential for settlement of the concrete ford structure, we recommend that foundations for the ford (utilized to key into the subgrade and provide protection from erosional forces) be designed to bear on properly prepared clayey gravel with sand soils encountered near Sta. 19+70 (Boring B-01). Our analysis has considered foundation preparation of the subgrade encounter to include recompaction of the bearing surface to a minimum of 98 percent of the maximum laboratory dry density value obtained by AASHTO T99 prior to placement of foundation concrete to recover disturbance caused by excavation activities.

We have estimated nominal bearing resistance for spread footings by evaluating soil strength parameters from the explorations we performed. The bearing soils are presented in the tables as the “Soil Type” and the Soil Layer per the subsurface conditions described in this section. These design sections are intended for use in design of new foundations. It should be noted that the bearing resistances presented in the following tables are nominal resistances and should be factored (reduced) by the resistance factors of the following:

AASHTO LRFD Resistance Factors (ϕ)			
Limit State	Bearing (ϕ_{bc})	Shear Resistance to Sliding (ϕ_s)	Passive Pressure Resistance to Sliding (ϕ_{ep})
Strength	0.45	0.80	0.50
Service	1.0	N/A	N/A
Extreme Event	0.9	0.9	0.9

Based on review of the preliminary design detail for the concrete ford, we understand that it will function as an open-bottom system that is to bear on exterior strip footings at a depth of approximately 3 feet below grade, and preparation of recommendations following is based on this finding. The following table provides unfactored soil parameters for design of new spread footings at the Rock Creek Crossing concrete ford location:

Foundation Elevation (ft bgs) ¹	Soil Type	Total (Effective) Unit Weight, γ (pcf) ²	Friction Angle, ϕ (deg)	Cohesion, c (psf)	Nominal Bearing Resistance, Q_{nom} (ksf) ³	Nominal Sliding Coefficient $\tan \phi$
3.0	Clayey Gravel with Sand (GC)	120 (57.6)	24	400	11.5	0.45

1. Foundation elevation based on estimated minimum of 3 feet of footing embedment.
2. Groundwater estimated to be approximately 3 feet above base of crossing in runoff (short-term) condition; therefore, both moist and effective unit weights are presented for footing influence zone.
3. Nominal bearing resistance calculated on an assumed footing width of 1.0 feet and length of 200 feet to support concrete ford within the native clay deposit.

SITE 2 – ROCK CREEK CROSSING

The field exploration at the Rock Creek Crossing included the advancement of three borings along the planned repair area from Sta. 38+00 to 43+00. Boring B-04 was located approximately at Sta. 38+30, on centerline on the southern end of improvement area where an existing water control structure is to be removed, along with a 36 inch culvert, and installation of a 48 inch culvert is planned. Boring B-05 was located at approximately Sta. 40+00, 6 feet right of centerline near the southwest end of the existing concrete ford schedule to be replaced. Boring B-06a was located approximately at Sta. 42+50, 7 feet right of centerline near the northeast end of the existing concrete ford schedule to be replaced. Each boring was advanced to a depth of 26.5 feet below existing grade. Boring logs conducted for the Rock Creek Crossing site, Borings B-04 through B-06a, are attached to this report along with a site plan and exploration plan showing the layout of the borings.

The planned repairs for Rock Creek Crossing include removal and replacement of three 36 inch diameter existing culverts with 48 inch coated culverts, removal and replacement of dual 24 inch HDPE culverts below the existing concrete ford with dual 48 inch by 33 inch arched culverts with concrete headwalls, and replacement of the existing concrete ford with new 8 inch thick concrete ford (200 feet long by 14 feet wide). The new concrete ford structure is to be keyed into the subgrade and riprap placed at the outlet/downstream end to provide erosion control. The planned

repairs are focused increasing the capacity to pass water and providing a more stable, resistant ford design to limit potential for blow out during runoff events/overtopping.

Subsurface Conditions

The site is located along the mainline alignment of Route 201 in an alluvial fan deposit create by Rock Creek and its associated drainage. The subsurface conditions generally consist of a nominal roadway embankment fill layer (clayey gravel with sand grading to gravelly lean clay) south/west of the concrete ford, encountered within Boring B-04 and B-05, varying from 4.5 to 7.0 feet thick overlying native alluvial deposits of moderate plasticity clays. The alluvial lean clay deposit extends from the overlying fill material south/west of the existing concrete ford, and at existing grade north/east of the existing ford, to the termination of exploratory borings at all locations. See the attached Boring Logs for more detailed description of the subsurface conditions.

The embankment fill material generally has a relative density/consistency of loose to medium dense/medium stiff to stiff with Standard Penetration Test (SPT) recorded N-values ranging between 7 to 11 blows per foot (bpf). The natural moisture content of the fill material was found to be within the range of 5.4 to 8.4 percent (where granular) and 13.0 to 17.5 percent (where cohesive).

The alluvial clay generally has a soft to stiff consistency throughout the deposit, with SPT recorded N-values between 4 and 13 bpf, generally decreasing with depth. The natural moisture content of the clay material was found to be within the range of 13.6 to 33.0 percent. Liquid Limit and Plasticity Index values of 47 and 31, respectively were determined for select samples of clay tested at this site. Particle-size analyses conducted on a select sample of clay determined approximately 69 percent of the matrix consisted of fine-grained material. Consolidation testing of a clay sample from B-04 at 10.0 feet exhibited moderate compressibility with initial consolidation of approximately 2.2 percent strain at an overburden pressure of 4,000 psf, or approximately 0.5 percent strain per 1 ksf loading. Based on the testing results and manner of deposition, the clays at the site are normally consolidated such that the stress history of the soils is limited to the overburden pressure exerted on the material to date.

Groundwater was not observed in Borings B-04 or B-06a at the time of our exploration, but was encountered at 26.0 feet within Boring B-05 within a thin lens of gravel and sand. The field investigation does not fully reflect seasonal or long-term groundwater conditions which will be influenced by precipitation, runoff characteristics of the site, future development impacts, hydrologic impacts originating off-site, and other factors beyond the scope of this investigation or evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may vary from the conditions indicated on the Logs.

Geotechnical Consideration and Recommendations

The primary geotechnical concern at the Rock Creek Crossing location is the ability to allow for water passage from upslope to the downslope side of the roadway to limit the potential for washouts and overtopping of the alignment. The installation of new culverts and a replacement concrete ford that will be sloped and embedded into the subgrade will accommodate additional water passage at this location. The most likely issue associated with the site will be proper preparation, embedment (keying), and armoring of the replacement concrete ford to eliminate the risk of undermining on the outlet side which has historically led to the existing concrete ford blowing out and needing to continually be repaired. The concrete structure will be relatively light weight, accounting for approximately 100 psf dead load. With the added stress of the concrete ford which will encapsulate structural backfill on the order of 3 to 4 feet thick, calculated centerline of alignment settlements (assuming an embankment geometry of 4 feet of fill with 2H:1V slopes and fill material density on the order of 135 pounds per cubic foot), using the consolidation data obtained from Boring B-05 at 10 feet, results in approximately 0.75 to 1.25 inches of settlement under primary consolidation. The edge of embankment settlement is expected to be on the order of 1/3 of the centerline settlement, or between 0.25 and 0.50 inches. Culvert installations elevations and connections should consider the potential for movement magnitudes as discussed above. Culverts are currently designed to be riprap lined at the inlet and outlet for each which is appropriate based on evidence of past undermining or piping within existing roadway prism where culverts are currently located. Use of proper keying of riprap and bedding materials prior to riprap placement should be conducted in accordance with FP-14.

The concrete ford should be designed based on an expected modulus of subgrade reaction for the predominantly fat clay soils of 75 pounds per cubic inch (pci). Preparation of the subgrade to receive embankment fill or concrete ford planking should be conducted in accordance with the **Earthwork** section to provide sufficient subgrade uniformity. Also of note, the upper portion of the existing roadway consists of some clayey gravel with sand transitioning to sandy lean clay material, with varying amounts of fine within the matrix. The installation of a non-woven separation geotextile to limit migration of fines from the subgrade into the embankment fill materials may provide for additional basal stability of the embankment and increase long-term performance of the fill zone.

Regarding the need to provide sufficient bearing resistance while limiting potential for settlement of the concrete ford structure, we recommend that foundations for the ford (utilized to key into the subgrade and provide protection from erosional forces) be designed to bear on properly prepared native gravelly/sandy lean clay soils. Our analysis has considered foundation preparation of the subgrade encounter to include recompaction of the bearing surface to a minimum of 98 percent of the maximum laboratory dry density value obtained by AASHTO T99 prior to placement of foundation concrete to recover disturbance caused by excavation activities.

We have estimated nominal bearing resistance for spread footings by evaluating soil strength parameters from the explorations we performed. The bearing soils are presented in the tables as the “Soil Type” and the Soil Layer per the subsurface conditions described in this section. These design sections are intended for use in design of new foundations. It should be noted that the bearing resistances presented in the following tables are nominal resistances and should be factored (reduced) by the resistance factors of the following:

AASHTO LRFD Resistance Factors (ϕ)			
Limit State	Bearing (ϕ_{bc})	Shear Resistance to Sliding (ϕ_r)	Passive Pressure Resistance to Sliding (ϕ_{ep})
Strength	0.45	0.80	0.50
Service	1.0	N/A	N/A
Extreme Event	0.9	0.9	0.9

Based on review of the preliminary design detail for the concrete ford, we understand that it will function as an open-bottom system that is to bear on exterior strip footings at a depth of approximately 3 feet below grade, and preparation of recommendations following is based on this finding. The following table provides unfactored soil parameters for design of new spread footings at the Rock Creek Crossing concrete ford location:

Foundation Elevation (ft bgs) ¹	Soil Type	Total (Effective) Unit Weight, γ (pcf) ²	Friction Angle, ϕ (deg)	Cohesion, c (psf)	Nominal Bearing Resistance, Q_{nom} (ksf) ³	Nominal Sliding Coefficient $\tan \phi$
3.0	Gravelly/Sandy Lean Clay (CL)	105 (42.6)	10	1,000	9	0.18

1. Foundation elevation based on estimated minimum of 3 feet of footing embedment.
2. Groundwater estimated to be approximately 3 feet above base of crossing in runoff (short-term) condition; therefore, both moist and effective unit weights are presented for footing influence zone.
3. Nominal bearing resistance calculated on an assumed footing width of 1.0 feet and length of 200 feet to support concrete ford within the native clay deposit.

SITE 3 – SEVENMILE CROSSING

The field exploration at the Sevenmile Crossing included the advancement of four borings along the 1,400 feet of planned grade raising from Sta. 56+00 to 70+00. Boring B-07 was located approximately at Sta. 58+50, on centerline on the western end of the planned embankment raising near existing 48 and 60 inch culverts to be removed and replaced. Boring B-08 was located at approximately Sta. 60+80, 6 feet right of centerline and Boring B-09 was located approximately

at Sta. 64+00, 4 feet right of centerline. These two borings represent the middle portion of the 1,400 foot grade raise section. Boring B-10 was located approximately at Sta. 67+00, on centerline on the eastern end of the planned embankment raising. Each boring was advanced to a depth of 26.5 feet below existing grade. Boring logs conducted for the Sevenmile Crossing site, Borings B-07 through B-10, are attached to this report along with a site plan and exploration plan showing the layout of the borings.

The planned repairs for Sevenmile Crossing include removal and replacement of existing 48 and 60 inch culverts near Sta. 59+00 with a single 81 inch by 59 inch pipe arch, raising grade approximately 0-2 feet along 1,400 feet of the section, installation of a roadside ditch on the north side of the alignment, and installation of a Gabion Basket Overflow Structure from Sta. 60+50 to 61+50 where overtopping historically occurs. It is also reported that an old wooden bridge toward the east end of this Site has been filled with sediment, as the drainage creates alluvial deposition of sediments over approximately ¼ mile of the roadway. This gives an indication of the amount and widespread impacts of the sedimentation issue at the site.

The planned repairs at Sevenmile Creek are focused on increasing freeboard and cover over proposed new, larger culverts, as well as adding surface drainage features including inboard ditching to improve flow of runoff toward culverts. These improvements are designed to allow more water to pass to the downslope side of the road to during runoff events. The ability to pass water through the roadway section within the larger culverts and over the overflow structure (as needed), will lead to improved subgrade and roadway surfacing performance due to less potential for standing water and increased stability of the roadway section elevated away from the flat alluvial fan.

Subsurface Conditions

The site is located along the mainline alignment of Route 201 in an alluvial fan deposit create by Sevenmile Creek and its associated drainage. The subsurface conditions generally consist of a more recent deposits of alluvial moderate to high plasticity clays overlying older deposits of alluvial clayey gravel with sand at relatively shallow depths along the east portion of the site, and shale bedrock at shallow depths on the west portion of the site. See the attached Boring Logs for more detailed description of the subsurface conditions.

The alluvial clay varies from soft to hard consistency throughout the deposit, with SPT recorded N-values between 2 and 40 bpf, varying randomly and was generally within the medium stiff range of blow counts. The natural moisture content of the clay material was found to be within the range of 16.1 to 44.0 percent, varying randomly. Liquid Limit values of 61, 65, and 75 with Plasticity Index values of 40, 38, and 51, respectively were determined for select samples of fat clay with sand, fat clay and sandy fat clay tested at this site. Particle-size analyses conducted on select samples of clay determined approximately 69 to 92 percent of the matrix consisted of material passing the number 200 sieve. Consolidation testing of select clay samples from Borings B-07,

B-08, and B-10 at 7.5 to 15.0 feet below existing grade generally exhibited moderate compressibility, in the range of 0.75 to 1.0 percent strain per ksf loading. Limited swell potential was exhibited at 500 psf confining pressures, with swell of 1.0 to 1.8 percent recorded. Based on the testing results and manner of deposition, the clays at the site are normally consolidated such that the stress history of the soils is limited to the overburden pressure exerted on the material to date. Unconfined compressive strength testing of a sample of clay from Boring B-08 indicated an unconfined compressive strength of 4,600 psf.

The underlying older alluvial deposit of clayey gravel with sand was generally medium dense with SPT recorded N-values between 11 and 16 bpf. The natural moisture content of the clayey gravel with sand material was found to be within the range of 13.1 to 27.7 percent.

The shale bedrock of the Bear Paw Formation, was encountered in the western most boring at the site, Boring B-07, adjacent the western slope confining the edge of the alluvial fan at the location. The shale was generally medium hard to hard rock, with SPT recorded N-value between 30 and greater than 100 blows per foot. The rock was moderately fractured, highly weathered in the upper reaches and became more massive and competent with depth. Laminated bedding and very close fracture spacing were noted. Natural moisture content of the shale was between 16.4 and 24.4 percent.

Groundwater was not observed in Borings B-07 and B-08 at the time of our exploration, but was encountered at 14.5 feet and 24.0 feet within Borings B-09 and B-10, respectively. The field investigation does not fully reflect seasonal or long-term groundwater conditions which will be influenced by precipitation, runoff characteristics of the site, future development impacts, hydrologic impacts originating off-site, and other factors beyond the scope of this investigation or evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may vary from the conditions indicated on the Logs.

Geotechnical Consideration and Recommendations

The primary geotechnical concern at the Sevenmile Crossing location is the ability to allow for water passage from upslope to the downslope side of the roadway to limit the potential for washouts and overtopping of the alignment. The compressible nature of the native soils that will provide support of the embankment fill and Gabion Basket Overflow structure should be considered in the design of these elements. Although the embankment height will not result in substantial increased pressure, a two foot high new embankment structure can be anticipated to add approximately 250 to 300 psf of stress to the subgrade. With the added stress, calculated centerline of alignment settlements (assuming an embankment geometry of 2 feet of fill with 2H:1V slopes and fill material density on the order of 135 pounds per cubic foot), using the consolidation data obtained from Borings B-07 and B-08 at 7.5 feet below existing grade, results in approximately 0.5 to 1.5 inches of settlement under primary consolidation. The edge of embankment settlement is expected to be on the order of 1/3 of the centerline settlement, or

between 0.25 and 0.50 inches. Arch pipe installation elevation and connections should consider the potential for movement magnitudes as discussed above. The planned arch pipe should be designed to be riprap lined at the inlet and outlet based on evidence of past undermining or piping within existing roadway prism where culverts are currently located. Use of proper keying of riprap and bedding materials prior to riprap placement should be conducted in accordance with FP-14. Ditching currently planned for the north side of the roadway will improve water flow toward the planned arch pipe and reduce the potential for standing water/saturated subgrade along the embankment section.

The installation of a non-woven separation geotextile to limit migration of fines from the subgrade into the embankment fill materials may provide for additional basal stability of the embankment and increase long-term performance of the fill zone.

Regarding the need to provide sufficient bearing resistance for Gabion Basket Overflow Structure while limiting potential for settlement of the structure, we recommend that subgrade preparation for the gabion baskets structure be conducted as follows prior to placement of leveling course. Our analysis has considered foundation preparation of the subgrade encountered to include recompaction of the bearing surface to a minimum of 98 percent of the maximum laboratory dry density value obtained by AASHTO T99 prior to placement of Gabion Basket Leveling course to recover disturbance caused by excavation activities. The Gabion Basket should be embedded a minimum of 1B (where B is the width of the selected basket) below finished grade, below this embedment depth a nominal 12 inches of level course material should be placed to provide uniformity of bearing for the basket system. Gabion baskets should be designed to include a PVC coating of the wire mesh system for added corrosion protection based on historical data for the project vicinity.

SITE 4 – NICHOLS CROSSING

The field exploration at the Nichols Crossing included the advancement of three borings along the planned repair areas from Sta. 74+00 to 80+00. Boring B-11 was located approximately at Sta. 74+50, on centerline on the western end of the repair area near the location of a culvert that has previously blown out and is to be replaced with an 60 inch by 46 inch pipe arch culvert. Boring B-12 was located at approximately Sta. 76+30, 2 feet right of centerline and Boring B-13 was located approximately at Sta. 76+90, 6 feet right of centerline. These two borings represent the west and east ends of the existing timber bridge located at the crossing. Each boring was advanced to a depth of 26.5 feet below existing grade. Boring logs conducted for the Nichols Crossing site, Borings B-11 through B-13, are attached to this report along with a site plan and exploration plan showing the layout of the borings.

The planned repairs for Nichols Crossing include installation of a new 60 inch by 46 inch pipe arch culvert and installation of a gabion baskets keyed into creek bank filled with riprap upstream and downstream of the bridge location. This wooden bridge location collects sediment each

spring requiring continued cleaning to remove the material and maintain the integrity of the structure.

The planned repairs are focused on re-establishing a drainage path for crossing the roadway alignment to the west of the bridge and protection of the bridge structure abutments/supports from undermining. The riprap installation within gabion baskets will provide an interlocking approach, in which it will provide more resistance to allowing individual riprap materials to become dislodged and transported by large runoff events. The baskets will make the system more integral, thereby using the combined weight of the system in resistance to erosional forces as opposed to individual rocks.

Subsurface Conditions

The site is located along the mainline alignment of Route 201 in an alluvial fan deposit created by Nichols Creek and its associated drainage. The subsurface conditions generally consist of a more recent deposit of clayey sand overlying older deposits of alluvial elastic silt and lean clay deposits at relatively shallow depths along the east portion of the site, and slightly deeper on the west portion of the site. See the attached Boring Logs for more detailed description of the subsurface conditions.

The alluvial clayey sand is generally loose to dense throughout the deposit, with SPT recorded N-values between 5 and 30 bpf, varying randomly and was generally within the medium dense range of blow counts. The natural moisture content of the sand material was found to be within the range of 13.3 to 31.5 percent, varying with the amount of fines within the matrix. Liquid Limit and Plasticity Index values of 59 and 34 were determined, respectively. Particle-size analyses conducted on select samples of surficial alluvial sand determined approximately 42 percent of the matrix consisted of material passing the number 200 sieve. Unconfined compressive strength testing of a sample of clayey sand from Boring B-12 at 5.0 feet indicated an unconfined compressive strength of 10,300 psf.

A layer of elastic silt was encountered in Borings B-12 and B-13 below the clayey sand surficial deposit. The silt deposit was generally medium stiff to stiff with SPT recorded N-values between 5 and 9 bpf. The natural moisture content of the silt was found to be within the range of 29.1 to 33.1 percent. Unconfined compressive strength testing of a sample of silt from Boring B-13 at 10.0 feet indicated an unconfined compressive strength of 1,300 psf.

The lower lean clay material varied from soft to stiff, with SPT recorded N-values ranging from 4 to 11 bpf, varying with the amount of sand and gravel within the matrix. Natural moisture content of the low plasticity clay was on the order of 24.2 to 32.4 percent.

Groundwater was observed in each boring, between the depths of 12.5 and 24.0 feet below existing grade. The field investigation does not fully reflect seasonal or long-term groundwater conditions which will be influenced by precipitation, runoff characteristics of the site, future

development impacts, hydrologic impacts originating off-site, and other factors beyond the scope of this investigation or evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structures may vary from the conditions indicated on the Logs.

Geotechnical Consideration and Recommendations

The primary geotechnical concern at the Nichols Crossing location the need to protect the existing wooden bridge structure which continues to be infilled with sediments, and thus requires substantial maintenance efforts to clean out the channel to allow for water passage. The use of gabion baskets filled with riprap keyed into the channel banks has the objective of providing erosional protection of the bridge abutments as well as providing a resistant bottom for maintenance personnel to utilized in their cleaning efforts. This resistant bottom that will be created by the gabion baskets filled with riprap, will decrease the potential of over excavation and undermining of bridge abutments at this location. Gabion baskets should be designed to include a PVC coating of the wire mesh system for added corrosion protection based on historical data for the project vicinity. Gabion baskets and channel riprap to be placed along the banks are to be properly keyed into the back, and include appropriately sized bedding material for the class of riprap utilized.

SITE 6 – SAND CREEK CROSSING

Deep Foundation Analysis and Recommendations

Field exploration at the Sand Creek bridge crossing included the advancement of two borings in close proximity to the existing concrete ford location. Boring B-14 was located on centerline and approximately 15 feet north of the proposed south abutment at Sta. 157+75, and Boring B-15 was located on centerline about 15 feet north of the proposed north abutment near Sta. 158+25. Boring B-14 was advanced to a depth of 54 feet below ground surface where auger refusal was encountered on sandstone bedrock. Boring B-15 was drilled and sampled to a total depth of 43 feet below ground surface where auger refusal was also encountered on sandstone bedrock. Boring logs conducted for Borings B-14 and B-15 are attached to this report along with a site plan and exploration plan showing the layout of the borings.

The planned repairs for Sand Creek crossing include the installation of a new pre-cast bridge to replace the current concrete ford crossing that was installed, washed out, and repaired again. The proposed bridge is planned to include an overall width of 18 feet and a length of 20 feet, with the pre-cast deck sections to be simply supported on two abutments.

The primary geotechnical concern for the Sand Creek Crossing bridge crossing is to provide sufficient support for the proposed bridge structure with adequate axial and lateral resistance while limiting the potential for abutment loss due to flood-related vertical and lateral erosion along

Sand Creek. The near surface clays, while having a medium stiff upper crust, soften with depth through the depth of a conventional spread footing before becoming very stiff with depth, with the very stiff clay soils providing support for the abutments on a deep foundation system. A deep foundation alternative will provide much less settlement, greater bearing capacity, and less potential for foundation failure during flooding better than if the bridge were to be supported on shallow foundations. On that basis, we recommend that deep foundations be utilized for the Site 6 Sand Creek Crossing abutment locations to bypass the weak, compressible overburden clay soils and provide bearing within the deeper, stiffer clay layers. Support on deep foundations within the clay stratum will allow for substantially more bearing resistance to be achieved while limiting risk for differential settlement between abutment locations.

Subsurface Conditions

Subsurface conditions at the site include layers of fat clay that exhibit stiff to very stiff consistency with SPT N-values ranging from 7 to 26 blows per foot. A sample from a depth of 10 feet in Boring B-14 exhibited an unconfined compressive strength of 42 psi (6,048 psf). A similar sample from a depth of 5.0 to 7.0 feet exhibited an unconfined compressive strength of 23 psi (3,312 psf). A direct shear on sample from Boring B-15 at 15.0 to 17.0 feet resulted in friction angle of 11 degrees and cohesion of 1,040 psf.

Groundwater was observed at depths of 48.5 feet in Boring B-14 and 12.5 feet in Boring B-15.

Geotechnical Consideration and Recommendations

Our foundation analysis included a review of the Charles M. Russell Refuge Repairs 30% Design Drawings provided by DJ&A, in which the preliminary proposed foundation system included a spread footing protected by rip rap on the stream side of the abutments. During our site investigations, we noted the failure of a (now decommissioned) wooden bridge about 45 feet to the northeast along the Sand Creek channel. Our observations in the field and our review of aerial imagery of the site indicates that the failure likely occurred as a result of both lateral and vertical channel erosion of the soft clay stream banks; that failure mechanism appears to continue upstream, between, and downstream of both bridges. On that basis, and even assuming the use of rip rap to provide erosion protection to the proposed new bridge, we recommend the installation of a deep foundation system to provide a foundation system that bypasses potential erosion depths to support the bridge.

We evaluated the use of both an end-bearing steel pipe pile and a driven timber pile system. In our evaluation, we considered the potential capacity of each of the piling systems as well as the longevity of each system for the soils encountered at the site. Visual examination of the on-site soils, inclusive of the calcitic and gypsiferous rinds that appear on the exposed site soils suggests that the soils are both dispersive (highly erodible) and corrosive. So, while the use of a driven pile system is a generally standard solution for bridge foundations, our preliminary evaluation suggests that steel piles could be subject to severe corrosion, so we selected a driven wooden

pile system for use at the Sand Creek crossing bridge site. During preliminary analysis of the use of driven timber piles with the subsurface profile conditions encountered during our drilling at the bridge site, the depth of embedment for a 12-inch-butt timber pile to satisfy the Strength I requirement of 60 kips per abutment was on the order of 20 feet below the base of the conceptual abutment; or, extending to a tip elevation of 2237 feet or deeper.

Based on our review of current USGS seismic mapping products, and based on a Peak Ground Acceleration of less than 0.1g, no seismic analysis was performed for this structure.

Timber Pile Axial Capacity

The primary factor in the geotechnical design of a timber pile is determination of an appropriate shear strength for the pile-soil interface for a timber pile driven into clay soils. Although sandstone bedrock is encountered within 10 feet of the proposed pile tip depth, our analysis indicates that sufficient pile capacity can be achieved at a shallower depth relying only on skin friction to achieve sufficient capacity for a 2 to 3-pile group. The design skin friction is based upon the use of the undrained shear strength, as determined by both laboratory testing and by interpolation from Standard Penetration Test N-values.

We have utilized a resistance factor for compression resistance of a single timber pile of 0.35 in accordance with Side Resistance and End Bearing: Clay and Mixed Soils using the α -method from *Table 10.5.5.2.3-1 Resistance Factors for Driven Piles from the AASHTO LRFD Bridge Design Specifications, 8th Edition*. The results of the analysis are tabulated below:

Location	Assumed Depth To Tip of Pile (ft) ¹	Projection Above, Or Bury Depth (ft) ²	Minimum Embedment Into Clay (ft)	Approximate Total Pile Length (ft)	Factored Compressive Resistance (kips) ³
Abutments 1 and 2	20.0	3.0	20.0	23.0	30

1. Based on depth below existing grade
2. Based on 30% Design Elevation data for abutment/bent projection or bury, along with ground surface elevation at boring locations provided by DJ&A.
3. For individual timber pile factored resistances and assumes that piles will be spaced a minimum of 6 feet apart and no more than 3 piles at each abutment. Closer spacing or greater number of piles in groups will require a reduction in axial load capacity.

Timber Pile Lateral Capacity

Lateral load analysis can be conducted using the program AllPile or Lpile to calculate groundline/top of pile deflection, moment, and shear for the pile section. The results of this analysis would be used to check combined bending and axial stress in the pile section. Additional demand conditions would need to be provided in order to perform this analysis, so at this time

parameters for use in the analysis have been developed only. The nominal analysis parameters are tabulated as follows and can be used in computer programs such as AIIpile or LPILE:

Stratum	Unit Weight (pcf)	Friction Angle, ϕ	Cohesion, c (psf)	Subgrade Modulus, k (pci)	ϵ_{50}
Stiff Lean Clay with Gravel	120	0	1,000	225	0.001
Stiff to Very Stiff Lean Clay	110	0	3,250	1,100	0.005

1. Conservative parameters provided based on the variability of weathering of basalt at within contact zone

Additional interaction with our geotechnical engineer will be required during final design to ascertain axial and lateral capacities as compatible with the recommended timber pile section.

Abutment Considerations

The subsurface conditions at the bridge abutments consist of weak, compressible, and highly erodible (dispersive) clay overlying bedrock at greater depth; as such, it has been recommended that the abutments be founded on driven timber piles to transfer support of the bridge structure below the highly erodible clay zone and provide resistance in the underlying stiffer clay soils. The current recommendation for erosion protection is to install rip rap on the creek side of the abutments. However, based on the past erosion of the adjacent (now decommissioned) wooden bridge; and based on our observation of continued lateral erosion at, upstream, and downstream of both bridges; and, based on our experience with similar small bridge abutments constructed into highly erodible soils, we recommend that both bridge abutments be surrounded by a wedge of rip rap, instead of placing rip rap only on the stream side of the bridge abutment; this rip rap section should extend at least 10 feet upstream and downstream from the limits of the abutment. Employing this approach, the inboard rip rap section is buried within the approach embankment and only act when the next flood event overtops the roadway and begins to erode into the backfill, in the manner that caused the adjacent wooden bridge to fail. In this manner, when either (or both) of the approach embankments are eroded, the bridge abutment(s) remain intact and only the approach embankment needs to be replaced, without the expense of bridge replacement. A heavy duty geotextile should be installed beneath the entirety of the rip rap section, with the geotextile conforming to the “Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects FP-14”, Section 251 RIPRAP, Table 705-1 (Gradation Requirements for RipRap) of Section 705.02, and geotextile conforming to the requirements for Class 1 Non-Woven “Separation and Stabilization” geotextile in Table 714-1 of FP-14.

It is recommended that a nominal 2 feet of subexcavation by “neat cut” to limit disturbance to the native clay soils to provide a subgrade cap for the approach section. Following subexcavation, a separation/reinforcing geotextile should be provided for the subgrade prior to placement of select

borrow; this preparation should be utilized within 50 feet of the abutments. The select borrow material should be compacted according to Section 204.11 of FP-14. The subgrade cap has the intent of providing a more stable subgrade/subbase for placement of the roadway embankment section at the abutment approaches and to reduce the potential for abrupt differential performance between the abutment backfill zone and structure approach

SEISMIC CONSIDERATIONS

The project sites are located within the broad Missouri River Channel which has incised through sedimentary formations in the area. The general areas have low seismic activity and no active or dormant faults are mapped across the area of interest for this project.

The seismic design requirements for structures (or particular interest will be Site 6 precast concrete bridge structure at Sand Creek Crossing) are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance (SPT), or undrained shear strength in accordance with *Table 3.10.3.1-1 – Site Class Definitions located in the AASHTO LRFD Bridge Design Specifications, 8th Edition*. Based on the geologic setting and results of the subsurface exploration, it is our professional opinion that the **Seismic Site Classification is E**. Based on interpolation of Figures 3.10.2.1-1 through 3.10.2.1-3, a Peak Ground Acceleration of 0.023g for a 7 percent exceedance in 75 years (1000 year event), with the design acceleration for the short periods (S_s) will be on the order of 0.058g and the design acceleration of the 1-second period (S_1) will be on the order of 0.019g.

The maximum depth of exploration for Site 6, Sand Creek Crossing, was extended to 54 feet below existing grade; therefore, site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the

absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth ¹ (feet)	Location
3	26.5	Site No. 1; Siparyann Crossing
3	26.5	Site No. 2; Rock Creek Crossing
4	26.5	Site No. 3; Seven Mile Crossing
3	26.5	Site No. 4; Nichols Crossing
2	43.0 to 54.0	Site No. 6; Sand Creek Crossing

1. Below ground surface

Boring Layout and Elevations: Terracon personnel provided the boring layout for each site, based on the approved Final Exploration Plan. Layout was conducted in late October 2020, based approval for access to the CMR Refuge in mid-October 2020. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from Google Earth Pro.

Subsurface Exploration Procedures: Our exploration efforts were conducted between November 3 and 7, 2020 using a subcontracted truck-mounted drill rig operated by Boland Drilling of Great Falls, MT. We advanced the borings using continuous flight augers (hollow-stem). Drilling and sampling were directed by our Field Engineer, who selected sampling intervals, logged the borings, and coordinated the subcontracted drillers. In general, four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches (hammer efficiency rating not available from subcontracted drillers). The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs, which were scanned and sent to the FHWA COR per Task Order SOW. The samples were placed in appropriate containers and taken to our Great Falls, MT laboratory.

For the subsurface exploration efforts associated with this task order, the samples were classified and catalogued after arrival at our laboratory to assist in development of a materials testing plan prior to palletizing/packaging and shipment to Materials Lab at FHWA in Vancouver, WA. The testing of samples associated with the task order was completed based on the approved materials testing plan by the Materials Lab at FHWA in Vancouver, WA. The testing was completed and summarized by FHWA on March 3, 2021 with all results provided to Terracon for review and use in our analysis and recommendations.

Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory, as well as feedback provided by FHWA reviewers.

Laboratory Testing

The Senior Geotechnical Manager reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil and rock strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- AASHTO T265 Standard Method of Test for Laboratory Determination of Moisture Content of Soils
- AASHTO T88 Standard Method of Test for Particle Size Analysis of Soils
- AASHTO T89 Standard Method of Test for Determining the Liquid Limit of Soils
- AASHTO T90 Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils
- AASHTO T208 Standard Method of Test for Unconfined Compressive Strength of Cohesive Soils (ASTM Designation – D2166)
- AASHTO T236 Standard Method of Test for Direct Shear Test of Soils Under Consolidated Drained Conditions (ASTM Designation – D3080)

The laboratory testing program included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Rock classification was conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification was determined using the Description of Rock Properties.

PHOTOGRAPHY LOG



Site 1- Siparyann Creek Crossing; Boring B-02 looking west, note depression in roadway near planned concrete ford location Sta. 19+50 to 20+50



Site 4 – Nichols Crossing; Rig stuck attempting access from west side of site



Site 6 – Sand Creek Crossing; Boring B-14 looking south toward Sand Creek channel

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan (3 pages)

Exploration Plan (5 pages)

Note: All attachments are one page unless noted above.

SITE LOCATION WITH TOPOGRAPHIC MAP FOR SITES 1, 2, AND 6

Charles M Russell Refuge Repairs ■ Fergus, Petroleum and Phillips Counties, MT
May 26, 2021 ■ Terracon Project No. C4205037

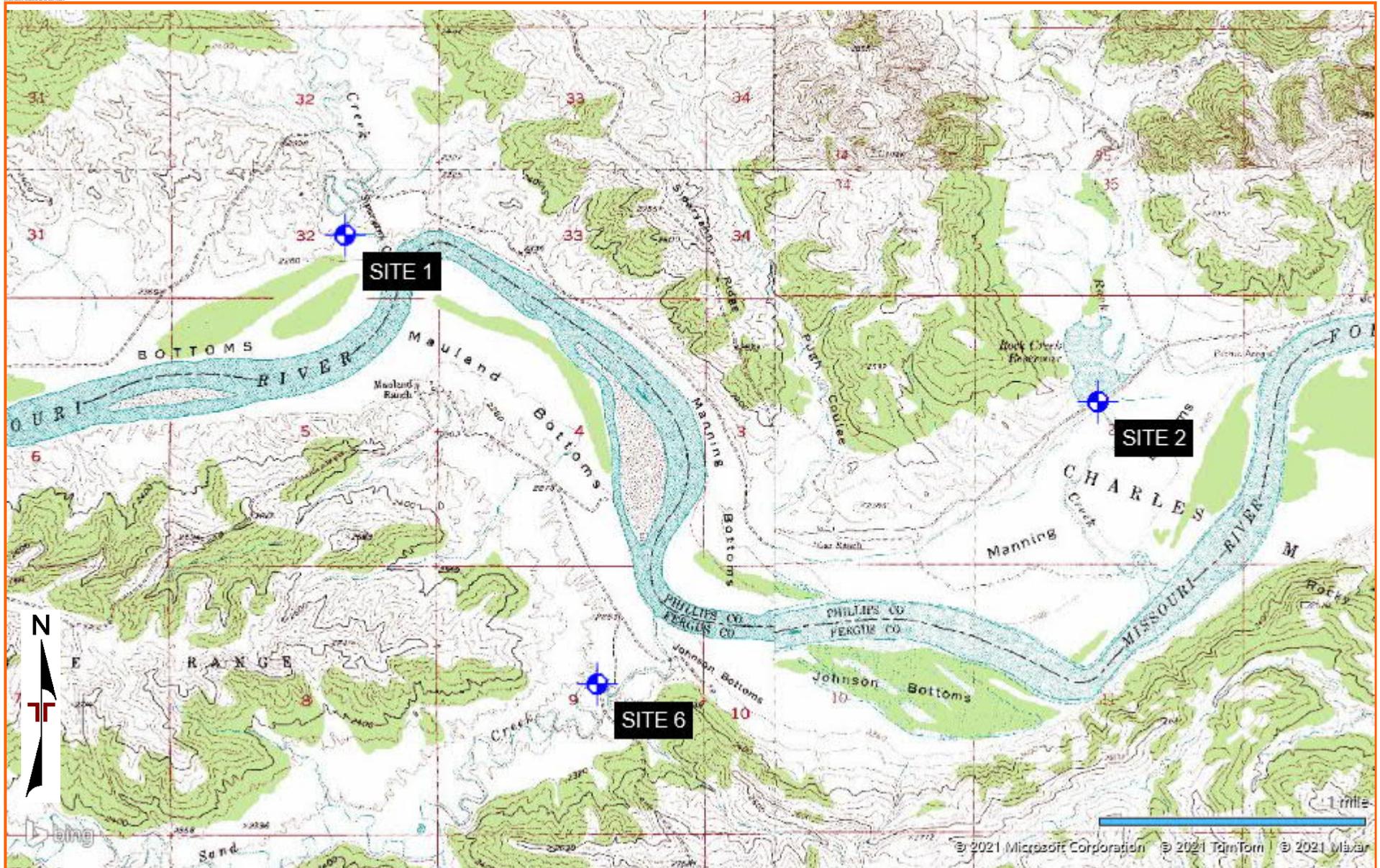


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

SITE LOCATION WITH TOPOGRAPHIC MAP SITES 3 AND 4

Charles M Russell Refuge Repairs ■ Fergus, Petroleum and Phillips Counties, MT

May 26, 2021 ■ Terracon Project No. C4205037

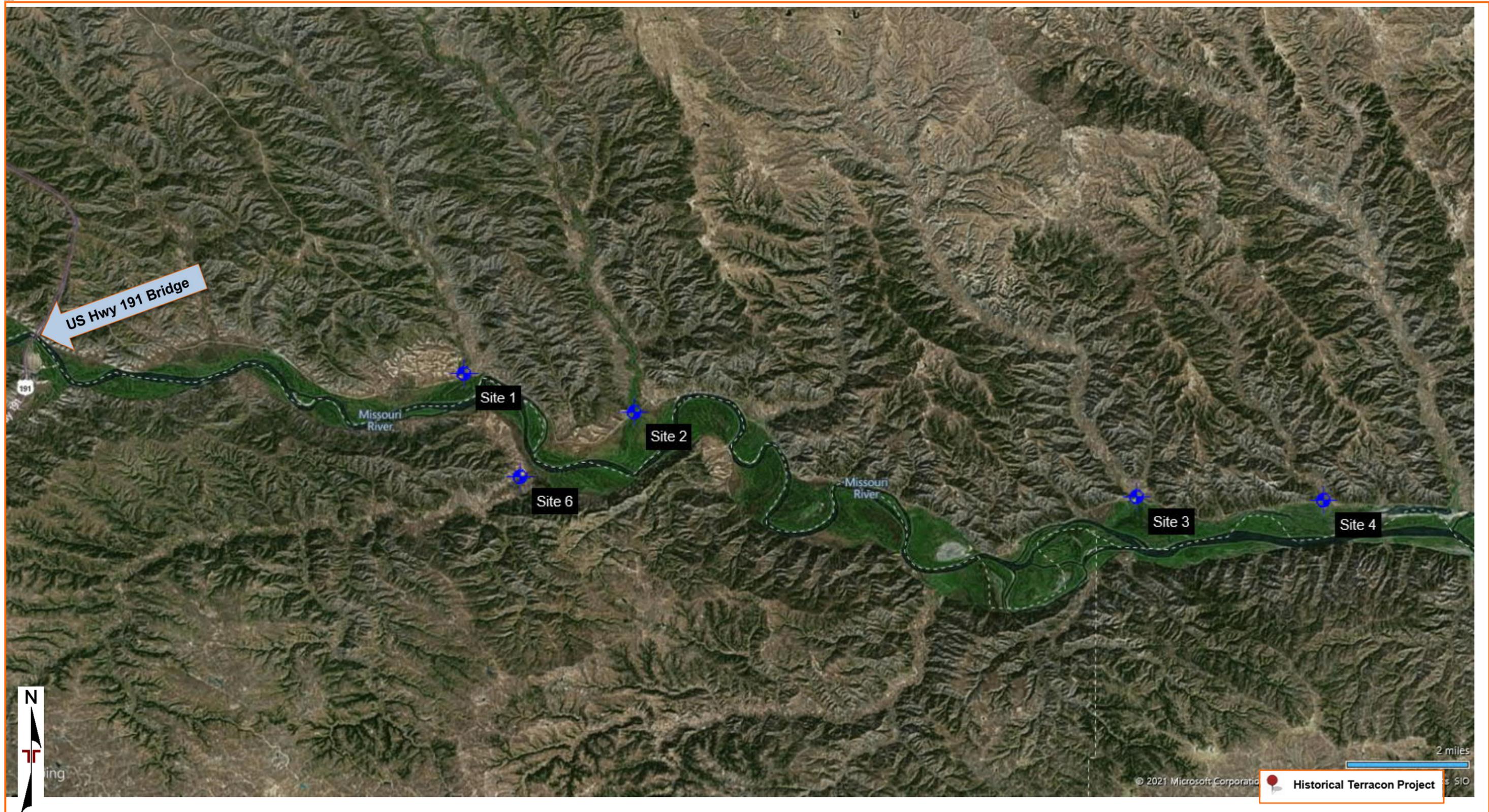


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

SITE LOCATION

Charles M Russell Refuge Repairs ■ Fergus, Petroleum and Phillips Counties, MT
May 26, 2021 ■ Terracon Project No. C4205037



EXPLORATION PLAN – SITE 1 SIPARYANN CREEK CROSSING

Charles M Russell Refuge Repairs ■ Fergus, Petroleum and Phillips Counties, MT
May 26, 2021 ■ Terracon Project No. C4205037

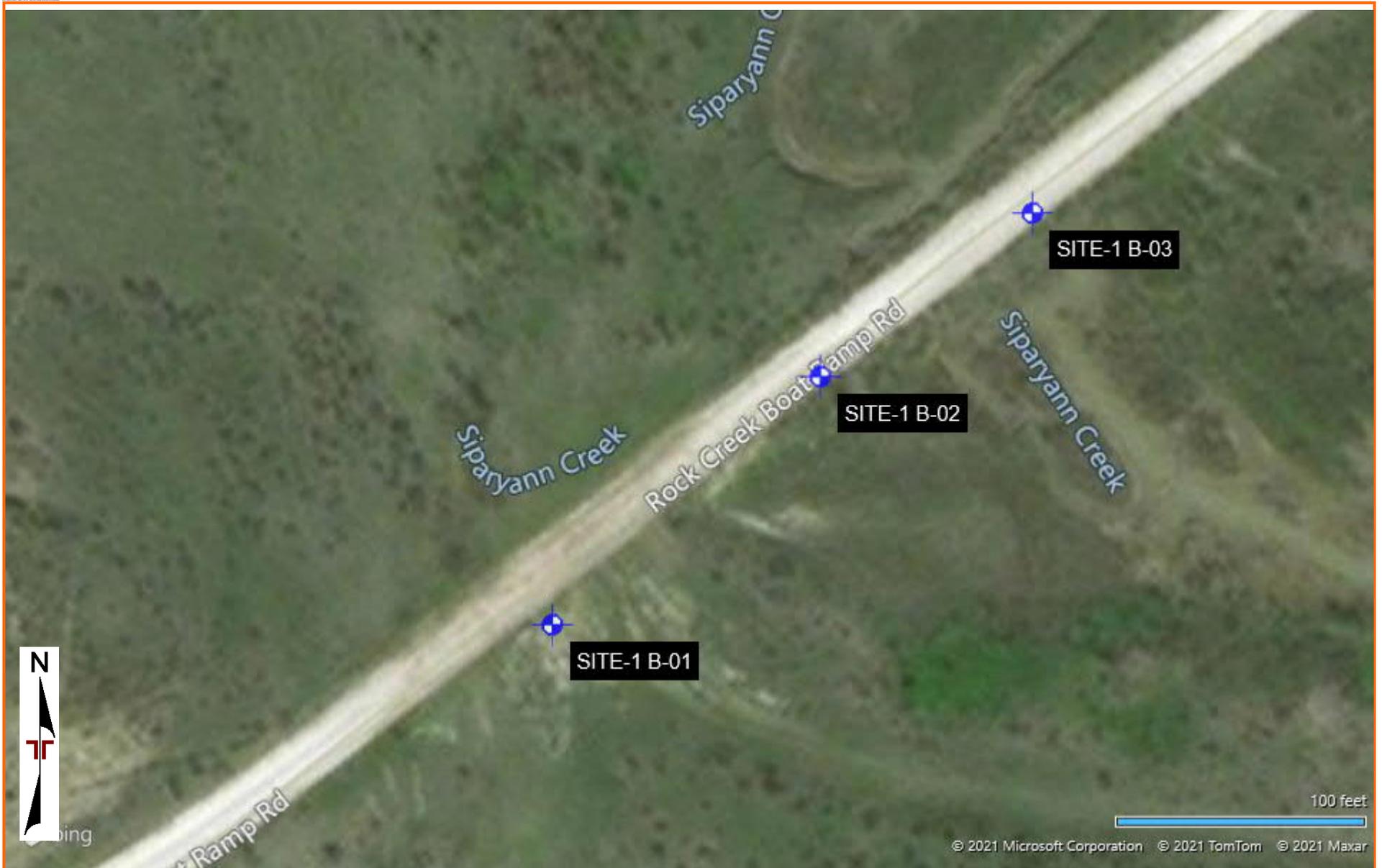


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN – SITE 2 ROCK CREEK CROSSING

Charles M Russell Refuge Repairs ■ Fergus, Petroleum and Phillips Counties, MT
May 26, 2021 ■ Terracon Project No. C4205037



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN – SITE 3 SEVENMILE CROSSING

Charles M Russell Refuge Repairs ■ Fergus, Petroleum and Phillips Counties, MT
May 26, 2021 ■ Terracon Project No. C4205037



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN – SITE 4 NICHOLS CROSSING

Charles M Russell Refuge Repairs ■ Fergus, Petroleum and Phillips Counties, MT
May 26, 2021 ■ Terracon Project No. C4205037



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN – SITE 6 SAND CREEK CROSSING

Charles M Russell Refuge Repairs ■ Fergus, Petroleum and Phillips Counties, MT
May 26, 2021 ■ Terracon Project No. C4205037

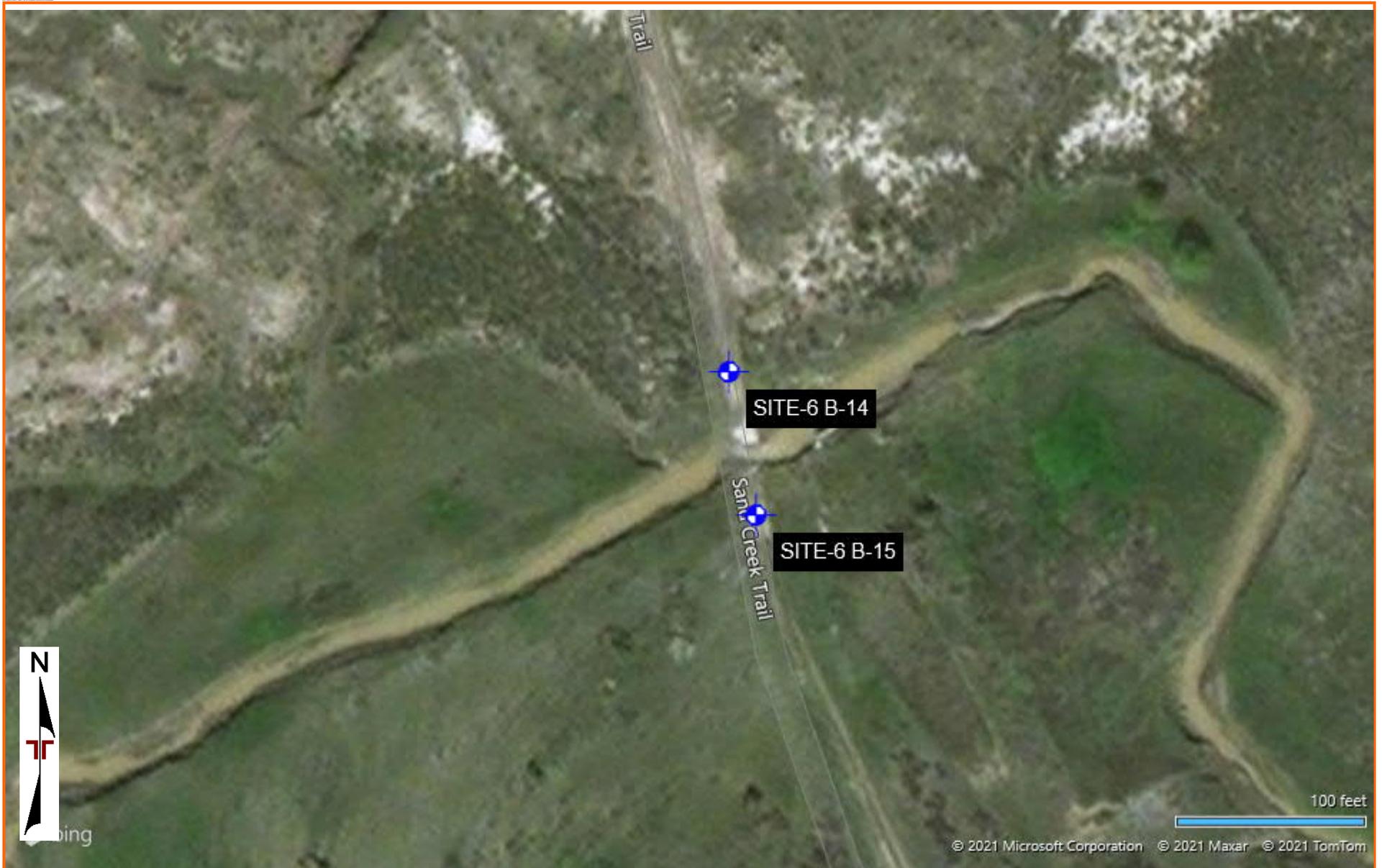


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Legend

Boring Logs (B-01 through B-15)

FHWA Laboratory Testing Summary Sheets (128 pages)

Note: All attachments are one page unless noted above.



Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1)

Project Location: Various Locations along Missouri River

SAMPLE TYPE SYMBOLS



Standard Penetration Test (2" OD)



Shelby Tube

DRILLING METHOD SYMBOLS



Hollow Stem Auger

ABBREVIATIONS

- FF - Fracture Frequency (fractures per foot)
- Fines - Percent Passing No. 200 Sieve
- LL - Liquid Limit (%)
- NP - Non-Plastic
- PL - Plastic Limit (%)
- PP - Pocket Penetrometer Reading
- Rec - Rock Core Recovery
- RQD - Rock Quality Designation
- SG - Specific Gravity
- UC - Unconfined Compressive Strength
- VWP - Vibrating Wire Piezometer
- WC - Water Content (%)



BORING LOG B-01

Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2269 ft
 Groundwater Depth: _____ Latitude: 47.62142° Longitude: -108.53507° Datum: NAD 83
 While Drilling: No Groundwater Encountered Date Started: 11/7/20 Date Completed: 11/7/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: _____ Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE										
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL							
			COBBLES AND BOULDERS. rounded 1 ft / El. 2268 ft															
			Clayey gravel with sand. medium dense, dark gray, fine grained, subrounded, moist, homogeneous				2-6-6 (14" = 78%)											
			3.5 ft / El. 2265.5 ft				4-5-5 (0" = 0%)											
2265	5		Fat CLAY. medium stiff to stiff, dark brown, medium to high plasticity, moist, lenses of silt and fine sand, calcareous nodules				1-2-4 (12" = 67%)											
							2-4-4 (14" = 78%)											
2260	10									Fines = 91% SG = 2.82 PUSH								
							1-2-4 (18" = 100%)											
2255	15																	
							2-4-6 (18" = 100%)											
2250	20																	
2245	25		Fat CLAY. very stiff, dark gray, high plasticity, moist, slickensided															
			24.5 ft / El. 2244.5 ft															
			26.5 ft / El. 2242.5 ft				4-6-12 (16" = 89%)											

Bottom of borehole at 26.5 ft.

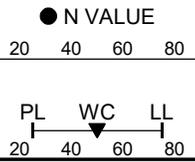


Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2271 ft
 Groundwater Depth: 15.5 ft / Elev 2255.5 ft Latitude: 47.62171° Longitude: -108.53466° Datum: NAD 83
 While Drilling: 15.5 ft / Elev 2255.5 ft Date Started: 11/7/20 Date Completed: 11/7/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C420503\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE			
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL
2270			Clayey gravel with sand. medium dense, brown, fine grained, subangular, dry to moist, homogeneous			3-4-7	(6" = 33%)				
					4-6-7	(8" = 44%)					
	5				4-6-8	(10" = 56%)					
2265											
					7 ft / El. 2264 ft						
			Gravelly fat CLAY with sand. medium stiff, dark brown, medium to high plasticity, moist, homogeneous			2-3-4	(10" = 56%)	SG = 2.79			
	10										
2260					10.5 ft / El. 2260.5 ft						
			Fat CLAY. soft to medium stiff, dark brown, medium to high plasticity, moist, lensed, calcareous nodules			1-2-2	(10" = 56%)				
	15										
2255											
			Lense of gravel and sand @ 15.5' +/-			6-10-14	(0" = 0%)				
	20										
2250											
			Fat clay. stiff, dark gray, high plasticity, moist, slickensided			1-2-3	(12" = 67%)				
	25										
2245											
			Fat clay. stiff, dark gray, high plasticity, moist, slickensided			1-3-5	(18" = 100%)				
	26.5 ft / El. 2244.5 ft										

Bottom of borehole at 26.5 ft.



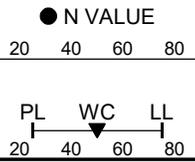


Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2272 ft
 Groundwater Depth: 18 ft / Elev 2254 ft Latitude: 47.62187° Longitude: -108.53429° Datum: NAD 83
 While Drilling: 18 ft / Elev 2254 ft Date Started: 11/7/20 Date Completed: 11/7/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE							
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL				
2270	5		Clayey gravel with sand. medium dense, brown, fine grained, subrounded, dry, homogeneous			5-7-6 (10" = 56%)									
			6 ft / El. 2266 ft			8-13-10 (8" = 44%)									
2265	10		Gravelly fat CLAY with sand. medium stiff, brown, medium to high plasticity, moist, homogeneous, calcareous nodules			3-5-6 (8" = 44%)									
			18 ft / El. 2254 ft				Fines = 60% PUSH								
2260	15		Gravelly fat CLAY. stiff, brown, medium to high plasticity, moist, blocky			1-2-4 (5" = 28%)									
2255	20					1-3-5 (12" = 67%)									
2250	25					4-8-6 (5" = 28%)									
			26.5 ft / El. 2245.5 ft			2-5-7 (12" = 67%)									

Bottom of borehole at 26.5 ft.





BORING LOG B-05

Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2279 ft
 Groundwater Depth: 26 ft / Elev 2253 ft Latitude: 47.61236° Longitude: -108.47507° Datum: NAD 83
 ∇ While Drilling: 26 ft / Elev 2253 ft Date Started: 11/7/20 Date Completed: 11/7/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE			
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL
2275	5		Gravelly lean clay. stiff to medium stiff, brown, low plasticity, dry, homogeneous			2-5-5 (8" = 44%)			●	▼	
2270	10		Sandy lean CLAY. medium stiff, dark brown, low to medium plasticity, moist, lensed, calcareous nodules			3-5-6 (8" = 44%)			●	▼	
2265	15					2-3-4 (4" = 22%)			●	▼	
2260	20					1-3-4 (8" = 44%)			●	▼	
2255	25					1-2-4 (10" = 56%)	Fines = 69% SG = 2.76 PUSH		●	▼	
	26.5					1-2-3 (16" = 89%)			●	▼	
	26.5					1-2-3 (18" = 100%)			●	▼	

7 ft / El. 2272 ft
 26.5 ft / El. 2252.5 ft
 Lense of gravel and sand @ 26.0' +/-
 Bottom of borehole at 26.5 ft.



BORING LOG B-06a

Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2273 ft
 Groundwater Depth: _____ Latitude: 47.61276° Longitude: -108.47419° Datum: NAD 83
 While Drilling: No Groundwater Encountered Date Started: 11/2/20 Date Completed: 11/2/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: _____ Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE		
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC
2270	5		Sandy lean CLAY. medium stiff, brown to dark gray, low to medium plasticity, dry to moist, homogenous to blocky, calcareous nodules		2-5-5	(8" = 44%)		●	▼	
					2-2-2	(4" = 22%)		●	▼	
					2-3-3	(6" = 33%)		●	▼	
2265	10				3-5-8	(8" = 44%)		●	▼	
					3-4-5	(10" = 56%)		●	▼	
2260	15				1-2-2	(12" = 67%)		●	▼	
2255	20				1-3-4	(18" = 100%)		●	▼	
2250	25				1-2-2	(18" = 100%)		●	▼	

26.5 ft / El. 2246.5 ft
 Bottom of borehole at 26.5 ft.



Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2261 ft
 Groundwater Depth: _____ Latitude: 47.59223° Longitude: -108.30067° Datum: NAD 83
 While Drilling: No Groundwater Encountered Date Started: 11/4/20 Date Completed: 11/4/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: _____ Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE				
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL	
2260			Fat CLAY. very stiff to stiff, dark brown, moderate to high plasticity, dry, homogeneous, calcareous nodules			3-10-12 (8" = 44%)	Fines = 72% SG = 2.78 PUSH	20	40	60	80	
	4.5 ft / El. 2256.5 ft				5-6-6 (4" = 22%)							
2255	5		Fat CLAY with sand. stiff, light yellowish green, high plasticity, moist, slickensided			3-4-6 (12" = 67%)						
	9 ft / El. 2252 ft											
2250	10		SHALE. dark gray, fine grained, moderately fractured, very close fracture spacing, laminated bedding, highly weathered, weak rock			8-12-18 (18" = 100%)						
	13 ft / El. 2248 ft											
2245	15	SHALE. dark gray, fine grained, moderately fractured, very close fracture spacing, laminated bedding, slightly weathered, strong rock				17-44-50/6" (8" = 44%)						
2240	20					16-38-50/6" (8" = 44%)						
2235	25					23-50 (4" = 22%)						

Bottom of borehole at 26.5 ft.



Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2261 ft
 Groundwater Depth: _____ Latitude: 47.5924° Longitude: -108.29929° Datum: NAD 83
 While Drilling: No Groundwater Encountered Date Started: 11/4/20 Date Completed: 11/4/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: _____ Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE				
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL	
2260			Fat CLAY. stiff to medium stiff, brown to dark gray, medium to high plasticity, moist, homogeneous				2-5-6 (10" = 56%)	Fines = 92% SG = 2.77 PUSH	20	40	60	80
	5						2-4-4 (4" = 22%)					
2255							3-3-4 (4" = 22%)					
	10						1-2-4 (16" = 89%)					
2250							1-2-3 (16" = 89%)					
2245							1-2-3 (18" = 100%)					
2240							2-3-5 (18" = 100%)					
2235												

26.5 ft / El. 2234.5 ft
 Bottom of borehole at 26.5 ft.



BORING LOG B-09

Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2259 ft
 Groundwater Depth: 14.5 ft / Elev 2244.5 ft Latitude: 47.59277° Longitude: -108.29815° Datum: NAD 83
 ∇ While Drilling: 14.5 ft / Elev 2244.5 ft Date Started: 11/4/20 Date Completed: 11/4/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE										
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL							
			Fat CLAY. medium stiff to soft, brown to dark gray, moderate to high plasticity, moist, homogeneous, calcareous nodules															
2255	5						2-4-4 (6" = 33%)											
							1-1-2 (6" = 33%)											
							1-1-1 (6" = 33%)											
2250	10		Fat CLAY with sand. medium stiff, brown, medium to high plasticity, moist, homogeneous				1-1-1 (6" = 33%)											
			9.5 ft / El. 2249.5 ft				1-2-2 (16" = 89%)											
2245	15		Clayey gravel with sand. medium dense, brown, fine grained, subrounded, moist, homogeneous				2-5-6 (10" = 56%)											
			14.5 ft / El. 2244.5 ft				2-5-6 (6" = 33%)											
2240	20						3-8-8 (4" = 22%)											
2235	25																	

Bottom of borehole at 26.5 ft.



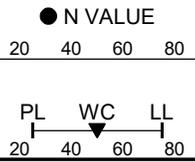
BORING LOG B-11

Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2259 ft
 Groundwater Depth: 24 ft / Elev 2235 ft Latitude: 47.59174° Longitude: -108.23363° Datum: NAD 83
 ∇ While Drilling: 24 ft / Elev 2235 ft Date Started: 11/3/20 Date Completed: 11/3/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE				
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL	
2255	5		Clayey SAND. medium dense to dense, brown, dry to moist, homogeneous, calcareous nodules			5-6-6 (8" = 44%)		●				
									5-6-8 (8" = 44%)			
									6-11-15 (12" = 67%)			
2250	10								8-12-18 (14" = 78%)			
									8-13-17 (18" = 100%)			
2245	15											
2240	20					3-5-7 (18" = 100%)						
2235	25		Lean clay with sand. stiff, brown, low plasticity, moist, lensed									
						3-5-5 (18" = 100%)						

Bottom of borehole at 26.5 ft.



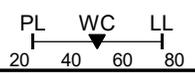
PUSH



Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2260 ft
 Groundwater Depth: 17.5 ft / Elev 2242.5 ft Latitude: 47.59183° Longitude: -108.23291° Datum: NAD 83
 ∇ While Drilling: 17.5 ft / Elev 2242.5 ft Date Started: 11/3/20 Date Completed: 11/3/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C420503\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE						
					Type	No.	Field Blow Count (Recovery)	Test Results	20	40	60	80		
2255	5		Clayey SAND. medium dense, brown, dry to moist, homogeneous, calcareous nodules			5-8-8 (14" = 78%)								
						5-7-9 (10" = 56%)								
							Fines = 42% PUSH							
2250	10		Elastic SILT with sand. medium stiff, brown to light gray, very moist to saturated			1-2-3 (12" = 67%)								
			10 ft / El. 2250 ft			1-3-5 (12" = 67%)								
2245	15		Gravelly lean clay. stiff to medium stiff, dark gray, medium plasticity, moist, blocky			2-5-6 (14" = 78%)								
			Lense of gravel @ 17.5' +/-											
2240	20					3-5-5 (16" = 89%)								
			Lense of gravel @ 20.5' +/-											
2235	25					1-2-2 (14" = 78%)								
			26.5 ft / El. 2233.5 ft											
			Bottom of borehole at 26.5 ft.											



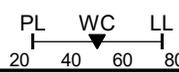


BORING LOG B-13

Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2259 ft
 Groundwater Depth: 12.5 ft / Elev 2246.5 ft Latitude: 47.59179° Longitude: -108.23259° Datum: NAD 83
 While Drilling: 12.5 ft / Elev 2246.5 ft Date Started: 11/3/20 Date Completed: 11/3/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE					
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL		
2255	5		Clayey SAND. medium dense, brown, dry to moist, homogeneous, calcareous nodules		Type	No.	6-7-5 (4" = 22%)		●	20	40	60	80
	5-8-8 (8" = 44%)						PL						
2250	10		Elastic SILT with sand. medium stiff to stiff, brown, medium plasticity, moist		Type	No.		6-7-9 (8" = 44%)	Fines = 79% PUSH	●	20	40	60
	7-8-5 (10" = 56%)						PL	WC					
2245	15		10 ft / El. 2249 ft		Type	No.			1-2-3 (18" = 100%)		●	20	40
	1-3-5 (18" = 100%)						PL	WC	LL				
2240	20				Type	No.				1-4-5 (16" = 89%)		●	20
	1-4-5 (16" = 89%)						PL	WC	LL				
2235	25		26.5 ft / El. 2232.5 ft		Type	No.						●	20
							PL	WC	LL				
Bottom of borehole at 26.5 ft.													





BORING LOG B-15

Project Name: CMR Refuge Repairs - MT FWS CMR 61520(1) Sheet: 1 of 1
 Project Location: Various Locations along Missouri River Surface Elevation: 2265 ft
 Groundwater Depth: --- Latitude: 47.59721° Longitude: -108.51487° Datum: NAD 83
 ∇ While Drilling: 12.5 ft / Elev 2252.5 ft Date Started: 11/6/20 Date Completed: 11/6/20
 At Completion: --- Driller/Company: Boland Drilling - C. Tigart Drill Mobile B-59
 After Drilling: --- Hammer Type: 140 lbs Automatic
 Notes: Logger/Company: T. Gilskey/Terracon Consultants

FHWA LOG - FHWA DATATEMPLATE.GDT - 5/28/21 13:18 - N:\PROJECTS\2020\C4205037\WORKING FILES\C4205037 CMR FHWA FORMAT.GPJ

Elevation (ft)	Depth (ft)	Graphic Log	MATERIAL DESCRIPTION	Drilling Method	SAMPLE			N VALUE									
					Type	No.	Field Blow Count (Recovery)	Test Results	PL	WC	LL						
2260	5		Sandy fat CLAY. medium stiff, dark brown, medium to high plasticity, dry, homogeneous, calcareous nodules		2-3-4 (4" = 22%)	3-4-4 (4" = 22%)	Fines = 70% PUSH	●	▼	▼							
2255	10										10.5 ft / El. 2254.5 ft	1-2-3 (16" = 89%)	1-2-3 (16" = 89%)	▼	▼	▼	
2250	15		Fat CLAY. medium stiff, brown, high plasticity, moist, lensed, highly weathered clasts Gravel and sand lense @ 12.5' +/-		21 ft / El. 2244 ft	3-4-4 (16" = 89%)	Fines = 86% Friction Angle = 11° Cohesion = 1040 psf PUSH	●	▼	▼	▼						
2245	20		Fat CLAY. stiff to very stiff, dark gray, medium to high plasticity, moist, fissured, calcareous nodules									8-12-14 (16" = 89%)	6-10-12 (18" = 100%)	●	▼	▼	
2240	25				SANDSTONE. strong rock, blueish gray, fine grained, subangular, unweathered	7-7-8 (14" = 78%)	36-50 (8" = 44%)	●	▼	▼	▼	▼					
2235	30												8-12-14 (16" = 89%)	6-10-12 (18" = 100%)	●	▼	▼
2230	35												7-7-8 (14" = 78%)	36-50 (8" = 44%)	●	▼	▼
2225	40																

Refusal at 43 ft.
 Bottom of borehole at 43 ft.



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1371-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-01	Depth: 1.0-2.5

Natural Moisture (T265) (Sample dried at 230 °F), % 11.9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:08:53 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1372-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-01	Depth: 2.5-4.0

SAMPLE COULD NOT BE LOCATED, POSSIBLY MISSING FROM SHIPPED SAMPLES - JI 12/31/2020

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:09:25 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1374-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-01	Depth: 7.5-9.0

Natural Moisture (T265) (Sample dried at 230 °F), % 28.9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:09:56 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1376-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi
Boring No./Test Pit: Site 1/B-01	State: MT
	Depth: 15.0-16.5

Natural Moisture (T265) (Sample dried at 230 °F), % 33.8

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:10:17 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1377-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-01	Depth: 20-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 26.0

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:10:34 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1378-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-01	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 28.2

Reported results apply to the sample as received

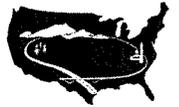
WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:10:50 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1379-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-02	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 6.3

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:11:07 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1380-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-02	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 12.5

Reported results apply to the sample as received

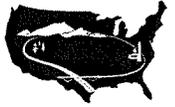
WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:11:24 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1381-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-02	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 8.2

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:11:41 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1382-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-02	Depth: 7.5-9.0

Natural Moisture (T265) (Sample dried at 230 °F), % 19.7

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:57:02 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1383-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-02	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 27.9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:57:30 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
Lab Control Number: **W-20-1385-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-02	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 30.6

Reported results apply to the sample as received

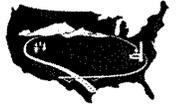
WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.21
10:57:56 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1386-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-02	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 30.6

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:58:14 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1387-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-03	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 9.9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:58:32 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
Lab Control Number: **W-20-1388-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-03	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 6.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.21
10:59:12 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1389-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-03	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 15.9

Reported results apply to the sample as received

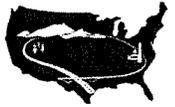
WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:58:51 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1391-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-03	Depth: 9.5-11.0

Natural Moisture (T265) (Sample dried at 230 °F), % 25.9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:59:31 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1392-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-03	Depth: 15.0-16.5

Natural Moisture (T265) (Sample dried at 230 °F), % 30.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 10:59:48 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1393-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-03	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 20.9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 13:37:22 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1394-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-03	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 23.1

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 13:37:53 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1395-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-04	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 5.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 13:38:18 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
Lab Control Number: **W-20-1396-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-04	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 8.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.21
13:39:31 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1397-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-04	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 13.6

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 13:39:55 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1398-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-04	Depth: 7.5-9.0

Natural Moisture (T265) (Sample dried at 230 °F), % 16.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 13:40:12 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1399-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-04	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 19.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 13:40:32 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
Lab Control Number: **W-20-1400-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-04	Depth: 15.0-17.0

Unit Weight Requested

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.21
13:40:54 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1401-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-04	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 29.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 13:41:13 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1402-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-04	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 24.6

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 13:41:32 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1403-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-05	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 17.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 13:41:52 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1404-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-05	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 15.1

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.21
 13:42:09 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1405-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-05	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 13.0

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.21
 13:42:30 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1408-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-12/31/2020
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-05	Depth: 15.0-16.5

Natural Moisture (T265) (Sample dried at 230 °F), % 31.0

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 15:04:30 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1409-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 to 1/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-05	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 33.0

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 15:04:56 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1410-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 to 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-05	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 27.8

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 15:05:21 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
Lab Control Number: **W-20-1411-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 to 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-06a	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 18.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.21
15:05:42 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1412-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-06a	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 15.2

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 15:06:02 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1413-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12-30-2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-06a	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 16.7

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 15:06:21 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1414-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-06a	Depth: 7.5-9.0

Natural Moisture (T265) (Sample dried at 230 °F), % 22.7

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 15:06:40 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1415-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-06a	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 27.8

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 15:11:10 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1416-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-06a	Depth: 15.0-16.5

Natural Moisture (T265) (Sample dried at 230 °F), % 30.9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 15:07:15 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
 Lab Control Number: **W-20-1417-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-06a	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 30.2

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.21
 15:07:35 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
Lab Control Number: **W-20-1418-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-06a	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 30.1

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
Date: 2021.01.21
15:10:41 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **21 Jan 2021**
Lab Control Number: **W-20-1419-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/20/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-07	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 19.4

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
Date: 2021.01.21
15:08:13 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1420-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-07	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 19.0

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 09:37:38 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1421-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-07	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 44.7

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 09:42:09 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1423-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-07	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 24.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 09:38:30 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1424-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-07	Depth: 15.0-16.5

Natural Moisture (T265) (Sample dried at 230 °F), % 16.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 09:38:49 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1425-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-07	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 18.2

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 09:39:08 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1426-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-07	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 16.8

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 09:39:25 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1427-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-08	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 29.4

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 09:39:44 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1428-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-08	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 18.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 09:40:02 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1429-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-08	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 19.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 09:40:20 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1435-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-09	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 21.8

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
Date: 2021.01.22
09:40:40 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1436-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-09	Depth:

Natural Moisture (T265) (Sample dried at 230 °F), % 26.1

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 09:58:50 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1437-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-09	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 29.4

Reported results apply to the sample as received

WALTER
F STONG

Digitally signed by
WALTER F STONG
Date: 2021.01.22
09:59:16 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1438-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No.:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-09	Depth: 7.5-9.0

Natural Moisture (T265) (Sample dried at 230 °F), % 37.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
09:59:34 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1439-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-09	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 31.0

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 09:59:55 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1440-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-09	Depth: 15.0-16.5

Natural Moisture (T265) (Sample dried at 230 °F), % 13.1

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 10:00:14 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1441-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-09	Depth: 20.0-21.5

ZIPLOCK BAGGIE WAS PUNCTURED

Natural Moisture (T265) (Sample dried at 230 °F), % 1.6

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 10:00:33 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1442-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-09	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 19.2

Reported results apply to the sample as received

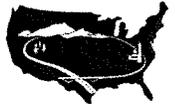
WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 10:00:53 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1443-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-10	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 25.8

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 10:01:20 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1444-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-10	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 18.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 10:01:40 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1445-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-10	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 26.7

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 10:01:57 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1446-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-10	Depth: 7.5-9.0

Natural Moisture (T265) (Sample dried at 230 °F), % 19.1

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
10:08:48 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1447-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-10	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 16.1

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 10:09:19 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1449-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-10	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 30.4

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 10:09:48 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1450-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-10	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 27.7

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 10:10:07 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1451-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-11	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 15.7

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 10:10:27 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1452-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No.:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-11	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 14.9

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
Date: 2021.01.22
10:10:48 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1453-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-11	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 17.2

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
Date: 2021.01.22
10:11:07 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1454-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-11	Depth: 7.5-9.0

Natural Moisture (T265) (Sample dried at 230 °F), % 19.1

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
Date: 2021.01.22
10:11:28 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1455-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-11	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 20.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 10:11:49 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1457-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-11	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 28.7

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 10:12:06 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1458-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-11	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 32.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 10:12:23 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1459-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-12	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 18.7

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
10:12:41 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1460-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-12	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 14.2

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 13:42:51 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1462-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-12	Depth: 7.0-8.5

Natural Moisture (T265) (Sample dried at 230 °F), % 31.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
13:43:17 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1463-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-12	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 29.1

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 13:43:36 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1464-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-12	Depth: 15.0-16.5

Natural Moisture (T265) (Sample dried at 230 °F), % 24.2

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 13:43:53 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1465-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No.:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-12	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 28.3

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 13:56:21 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1466-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-12	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 32.2

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 14:09:37 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1467-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-13	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 13.3

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 14:09:54 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1468-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-13	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 14.2

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 14:10:10 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1469-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-13	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 15.2

Reported results apply to the sample as received

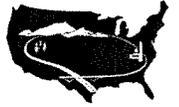
WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
14:10:29 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1470-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-13	Depth: 7.5-9.0

Natural Moisture (T265) (Sample dried at 230 °F), % 14.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 14:10:48 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1472-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-13	Depth: 15.0-16.5

Natural Moisture (T265) (Sample dried at 230 °F), % 33.1

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 14:21:34 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1473-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-13	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 31.1

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
Date: 2021.01.22
14:22:08 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1474-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 to 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-13	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 31.1

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 14:22:29 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1475-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 19.9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
14:22:49 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1476-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 17.2

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 14:23:08 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1477-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 5.0-6.5

Natural Moisture (T265) (Sample dried at 230 °F), % 19.5

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 14:23:48 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1478-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 7.5-9.0

Natural Moisture (T265) (Sample dried at 230 °F), % 22.6

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 14:24:08 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1480-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 15.0-16.5

Natural Moisture (T265) (Sample dried at 230 °F), % 21.4

Reported results apply to the sample as received

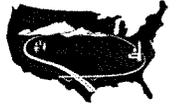
WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 14:24:28 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1483-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 30.0-31.5

Natural Moisture (T265) (Sample dried at 230 °F), % 28.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
14:24:46 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1484-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 35.0-36.5

Natural Moisture (T265) (Sample dried at 230 °F), % 36.2

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 14:25:05 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1485-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 40.0-41.5

Natural Moisture (T265) (Sample dried at 230 °F), % 30.4

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 14:25:31 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1486-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 45.0-46.5

Natural Moisture (T265) (Sample dried at 230 °F), % 28.1

Reported results apply to the sample as received

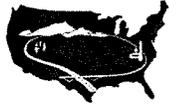
WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
15:07:07 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1488-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 0.0-1.5

Natural Moisture (T265) (Sample dried at 230 °F), % 17.5

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
Date: 2021.01.22
15:07:39 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1489-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 2.5-4.0

Natural Moisture (T265) (Sample dried at 230 °F), % 17.6

Reported results apply to the sample as received

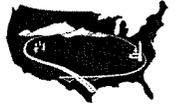
WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 15:08:00 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1491-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2021 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 26.2

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 15:08:23 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1492-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 10.0-11.5

Natural Moisture (T265) (Sample dried at 230 °F), % 28.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 15:08:42 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1494-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 20.0-21.5

Natural Moisture (T265) (Sample dried at 230 °F), % 26.9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 15:09:01 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1495-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 25.0-26.5

Natural Moisture (T265) (Sample dried at 230 °F), % 19.6

Reported results apply to the sample as received

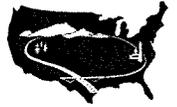
WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
15:09:20 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
Lab Control Number: **W-20-1496-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 30.0-31.5

Natural Moisture (T265) (Sample dried at 230 °F), % 33.1

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.01.22
15:09:38 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1497-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 35.0-36.5

Natural Moisture (T265) (Sample dried at 230 °F), % 24.7

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.22
 15:09:53 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **22 Jan 2021**
 Lab Control Number: **W-20-1498-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020 TO 01/05/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 40.0-41.5

Natural Moisture (T265) (Sample dried at 230 °F), % 24.0

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.22
 15:10:10 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **29 Jan 2021**
 Lab Control Number: **W-20-1400-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12/30/2020-1/22/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-04	Depth: 15.0-17.0

Unit Weight: Dry Density = 95.1 pcf
 Wet Density = 120.7 pcf (H/D Ratio: 2.13)

Natural Moisture (T265) (Sample dried at 230 °F), % 26.9

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.29
 13:57:07 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **29 Jan 2021**
 Lab Control Number: **W-20-1456-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12/30/2020-1/6/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-11	Depth: 15.0-16.5

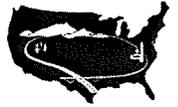
UNIT WT: Dry Density = 95.2 pcf
 Wet Density = 125.9 pcf (H/D Ratio: 2.19)

Natural Moisture (T265) (Sample dried at 230 °F), % 24.4

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.29
 13:57:42 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12/30/2020-1/22/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-12	Depth: 5.0-7.0

Sieve Analysis

Sieve Size	As Received
	% Passing
3/8"	100.0
#4	99.7
#10	98.0
#40	70.4
#100	47.7
#200	42.3

Natural Moisture (T265) (Sample dried at 140 °F), % 14.9

Atterberg Limits (T89)

Liquid Limit 59
 Plasticity Index 34

Unconfined Compression Undisturbed (T208)

Dry Density, pcf 107.9
 Moisture, % 15.1
 Diameter, in 2.86
 Length, in 5.72
 Compressive Strength, psi 72

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.29
 13:58:06 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/03/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12/30/2020-1/25/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 4/B-13	Depth: 10.0-12.0

Sieve Analysis

As Received

Sieve Size	% Passing
#4	100.0
#10	99.8
#40	95.3
#100	84.9
#200	79.1

Natural Moisture (T265) (Sample dried at 140 °F), % 27.2

Atterberg Limits (T89)

Liquid Limit	63
Plasticity Index	39

Unconfined Compression Undisturbed (T208)

Dry Density, pcf	99.1
Moisture, %	21.9
Diameter, in	2.85
Length, in	6.10
Compressive Strength, psi	9

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.29
 13:58:28 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12/30/2020-1/22/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 10.0-11.5

Sieve Analysis

Sieve Size	As Received
	% Passing
1 1/2"	100.0
1"	97.9
3/4"	97.2
1/2"	94.5
3/8"	92.4
#4	87.0
#10	78.4
#40	68.3
#100	57.6
#200	53.7

Natural Moisture (T265) (Sample dried at 140 °F), % 22.6

Atterberg Limits (T89)

Liquid Limit 70
 Plasticity Index 47

Unconfined Compression Undisturbed (T208)

Dry Density, pcf 130.4
 Moisture, % 15.5
 Diameter, in 2.80
 Length, in 6.46
 Compressive Strength, psi 42

Reported results apply to the sample as received

WALTER Digitally signed by
F STONG WALTER F STONG
 Date: 2021.01.29
 13:58:50 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **29 Jan 2021**
 Lab Control Number: **W-20-1481-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/05/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12/30/2020-1/26/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-14	Depth: 0.0-1.5

DIRECT SHEAR T 236 & UNIT WEIGHT REQUESTED (INSUFFICIENT MATERIAL RECOVERED FROM ST).

Natural Moisture (T265) (Sample dried at 230 °F), % 21.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.29
 13:59:11 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/06/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12/30/2020-1/22/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 5/B-15	Depth: 5.0-7.0

Sieve Analysis

Sieve Size	As Received
	% Passing
1/2"	100.0
3/8"	99.9
#4	99.5
#10	99.2
#40	95.5
#100	78.9
#200	69.8

Natural Moisture (T265) (Sample dried at 140 °F), % 25.1

Atterberg Limits (T89)

Liquid Limit	66
Plasticity Index	42

Unconfined Compression Undisturbed (T208)

Dry Density, pcf	118.2
Moisture, %	26.5
Diameter, in	2.86
Length, in	6.25
Compressive Strength, psi	23

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.29
 13:59:32 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **29 Jan 2021**
 Lab Control Number: **W-20-1499-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: LARGE BULK/BUCK
	Dates Tested: 12/30/2020 to 01/11/2021
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-02 & B-	Depth: 0.0-5.0

COMBINED BULK SAMPLE, STD PROCTOR T 99

Moisture-Density Relations (T99), Method C

Maximum Density, pcf	116.2
Optimum Moisture, %	14.6

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.29
 13:59:48 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **29 Jan 2021**
 Lab Control Number: **W-20-1502-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: LARGE BULK/BUCK
	Dates Tested: 12-30-20 to 01-15-21
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-08 & B-	Depth: 0.0-5.0

COMBINED BULK SAMPLE, STD PROCTOR T 99

Moisture-Density Relations (T99), Method A

Maximum Density, pcf	92.6
Optimum Moisture, %	25.4

Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.01.29
 14:00:05 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By: Terracon Consultants
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12-30-20 to 02-19-20
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-01	Depth: 10.0-11.5

T 216 CONSOL REQUESTED

Consolidation test on Site-1/B-01 from 10.0-11.5 conducted to 8,000 psf. Inundated sample on 500 psf load, allowed to swell and then continued loading until 8,000 psf. Rebounded to 1000 psf after consolidation.

Sieve Analysis

Sieve Size	As Received
	% Passing
1/2"	100.0
3/8"	99.7
#4	99.7
#10	99.6
#40	98.5
#200	90.6
20µm	72.6
10µm	65.4
5µm	56.0
2µm	43.9

Apparent Specific Gravity (T100) 2.817

Natural Moisture (T265) (Sample dried at 140 °F), % 27.8

Atterberg Limits (T89)

Liquid Limit 65
 Plasticity Index 44

Unconfined Compression Undisturbed (T208)

Moisture, % 91.9
 Diameter, in 2.85
 Length, in 4.30
 Compressive Strength, psi 18

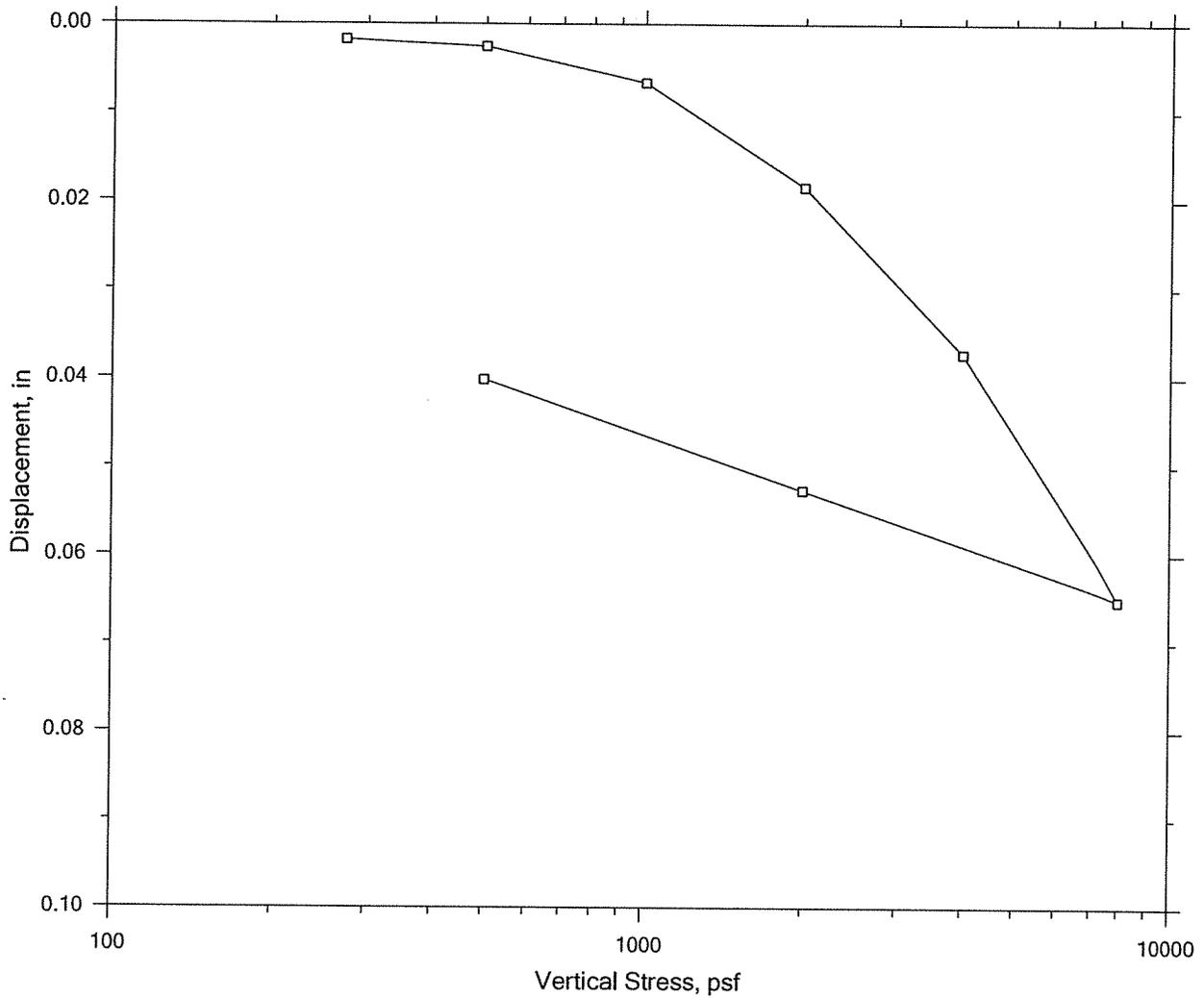
Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.03.02
 10:28:20 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report



		Before Test	After Test
Current Vertical Effective Stress: 0 psf			
Preconsolidation Stress: 0 psf			
Compression Ratio: 0			
Diameter: 2.5 in	Height: 0.778 in		
LL: 65	PL: 21		
	PI: 44		
	GS: 2.65		
Water Content, %		26.82	28.85
Dry Unit Weight, pcf		88.492	93.314
Saturation, %		81.73	98.91
Void Ratio		0.87	0.77

	Project: CMR Refuge Repairs	Location:	Project No.: MT FWS CMR Ref
	Boring No.: Site-1/B-01	Tested By: JI	Checked By: E.JL
	Sample No.: W-20-1375-SO	Test Date: 01/19/2021	Depth: 10.0-11.5'
	Test No.: 1	Sample Type: In Situ from ST	Elevation:
	Description: Dark Brown Clay, Moist		
	Remarks:		
Displacement at End of Increment			



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: ziploc
	Dates Tested: 12-30-20 to 02-19-21
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 1/B-03	Depth: 7.5-9.5

T 216 Consol Requested

Consolidation test on Site-1/B-03 from 7.5-9.5 conducted to 4,000 psf. Inundated sample on 500 psf load, allowed to swell and then continued loading until 4,000 psf. Rebounded to 500 psf after consolidation.

Insufficient material for T 208 UC testing. All other tests ordered were performed.

Sieve Analysis

Sieve Size	As Received % Passing
1"	100.0
3/4"	96.6
1/2"	94.1
3/8"	88.9
#4	79.0
#10	64.2
#40	63.0
#200	60.3
20µm	48.8
10µm	44.8
5µm	36.5
2µm	29.2

Apparent Specific Gravity (T100) 2.787

Natural Moisture (T265) (Sample dried at 140 °F), % 19.4

Atterberg Limits (T89)

Liquid Limit 64
 Plasticity Index 44

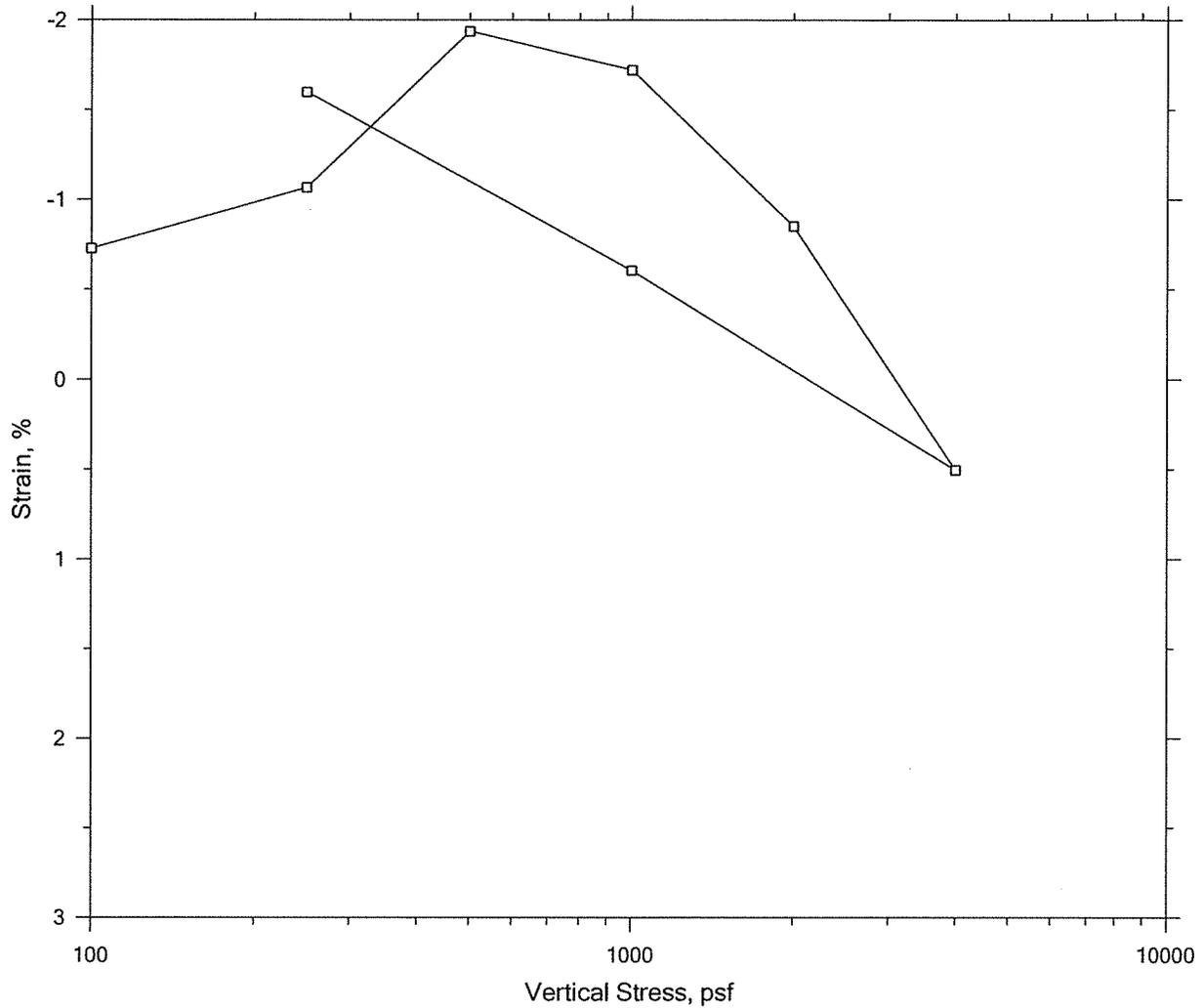
Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.03.02
 10:28:46 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report



		Before Test	After Test
Current Vertical Effective Stress: 0 psf		23.18	26.47
Preconsolidation Stress: 0 psf		99.657	98.088
Compression Ratio: 0		93.05	102.15
Diameter: 2.491 in	Height: 0.782 in	0.66	0.69
LL: 64	PL: 20		
	PI: 44		
	GS: 2.65		

	Project: CMR Refuge Repairs	Location:	Project No.: CMR 61520(1)
	Boring No.: Site-1/B-03	Tested By: JI	Checked By: EJL
	Sample No.:	Test Date: 1/27/2021	Depth: 7.5-9.5'
	Test No.: 1 (Re-Run)	Sample Type: Shelby Tube	Elevation: Unknown
	Description:		
	Remarks: Lab ID #: W-20-1390-SO		
Displacement at End of Increment			



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/07/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: shelby tube
	Dates Tested: 12-30-20 to 02-19-21
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 2/B-05	Depth: 10.0-12.0

Consolidation Test T 216 Requested: Inundated sample on 500psf load, allowed to swell and then continued loading until 4,000psf. Rebounded to 500psf after consolidation.

Sieve Analysis

	As Received	
Sieve Size	% Passing	
3/4"	100.0	
1/2"	99.5	
3/8"	98.9	
#4	98.8	
#10	98.7	
#40	98.4	
#200	68.9	
20µm	55.5	
10µm	51.3	
5µm	44.0	
2µm	36.2	

Apparent Specific Gravity (T100) 2.756

Natural Moisture (T265), % 20.0

Atterberg Limits (T89)

Liquid Limit 47
 Plasticity Index 31

Unconfined Compression Undisturbed (T208)

Dry Density, pcf 103.3
 Moisture, % 20.0
 Diameter, in 2.86
 Length, in 5.90
 Compressive Strength, psi 21

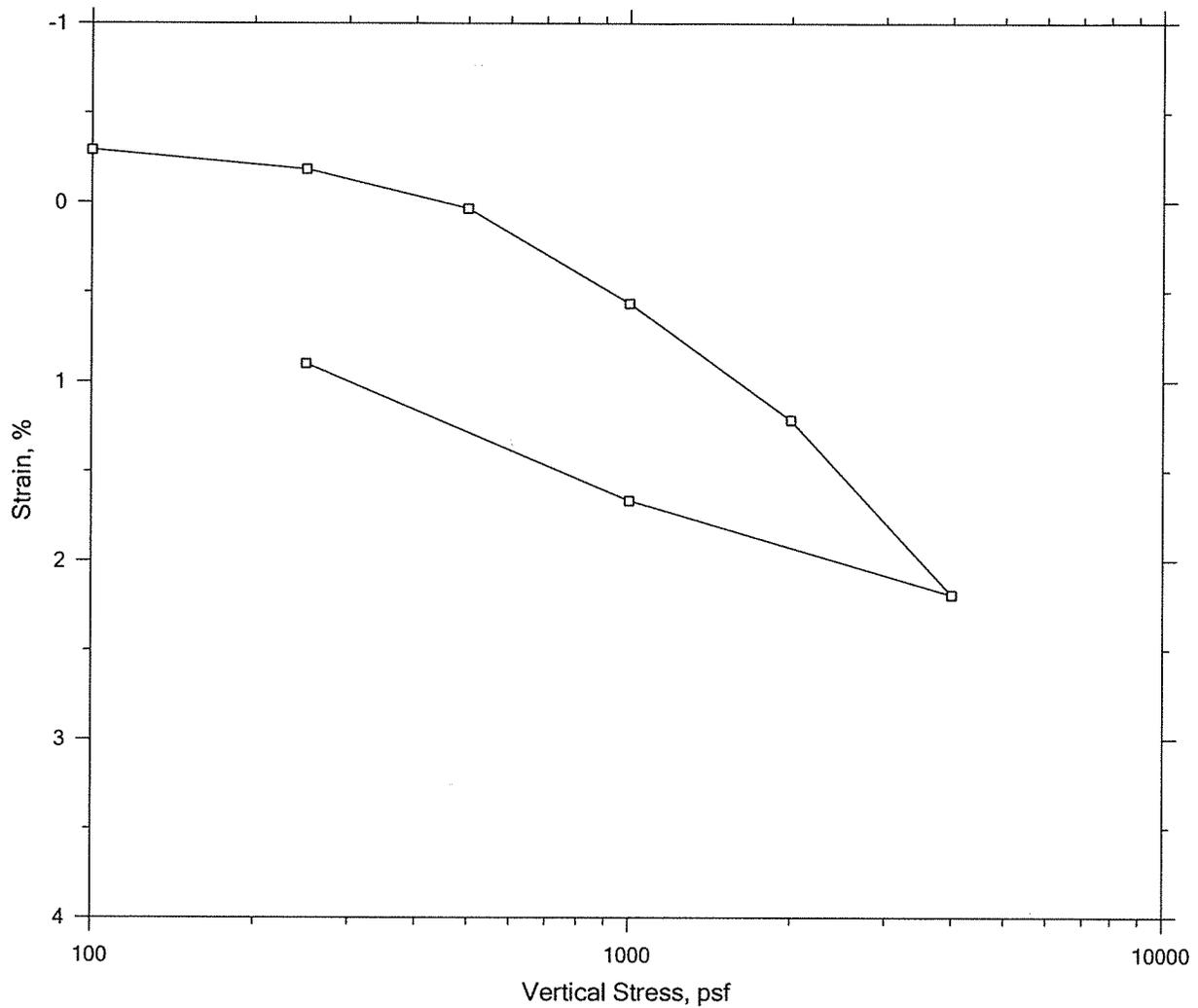
Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.03.02
 10:29:06 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report



		Before Test	After Test	
Current Vertical Effective Stress: 0 psf		Water Content, %	18.59	20.43
Preconsolidation Stress: 0 psf		Dry Unit Weight, pcf	82.396	83.144
Compression Ratio: 0		Saturation, %	48.88	54.70
Diameter: 2.491 in	Height: 0.98 in	Void Ratio	1.01	0.99
LL: 47	PL: 16	PI: 31	GS: 2.65	

	Project: CMR Refuge Repairs	Location:	Project No.: CMR 61520(1)
	Boring No.: Site-2/B-05	Tested By: JI	Checked By: E.JL
	Sample No.:	Test Date: 1/25/2021	Depth: 10.0-12.0'
	Test No.: 1	Sample Type: Shelby Tube	Elevation: Unknown
	Description:		
	Remarks: Lab ID #: W-20-1407-SO Displacement at End of Increment		



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **02 Mar 2021**
 Lab Control Number: **W-20-1422-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12-30-20 to 02-19-21
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-07	Depth: 7.5-9.5

CONSOL T 216 Requested

Consolidation test on Site-3/B-07 from 7.5-9.5 conducted to 4,000 psf. Inundated sample on 500 psf load, allowed to swell and then continued loading until 4,000 psf. Rebounded to 500 psf after consolidation.

Sieve Analysis

Sieve Size	As Received
	% Passing
3/4"	100.0
1/2"	99.8
3/8"	99.3
#4	98.7
#10	92.1
#40	88.2
#200	72.0
20µm	53.5
10µm	48.7
5µm	41.8
2µm	30.8

Apparent Specific Gravity (T100) 2.779

Natural Moisture (T265) (Sample dried at 140 °F), % 22.0

Atterberg Limits (T89)

Liquid Limit 65
 Plasticity Index 40

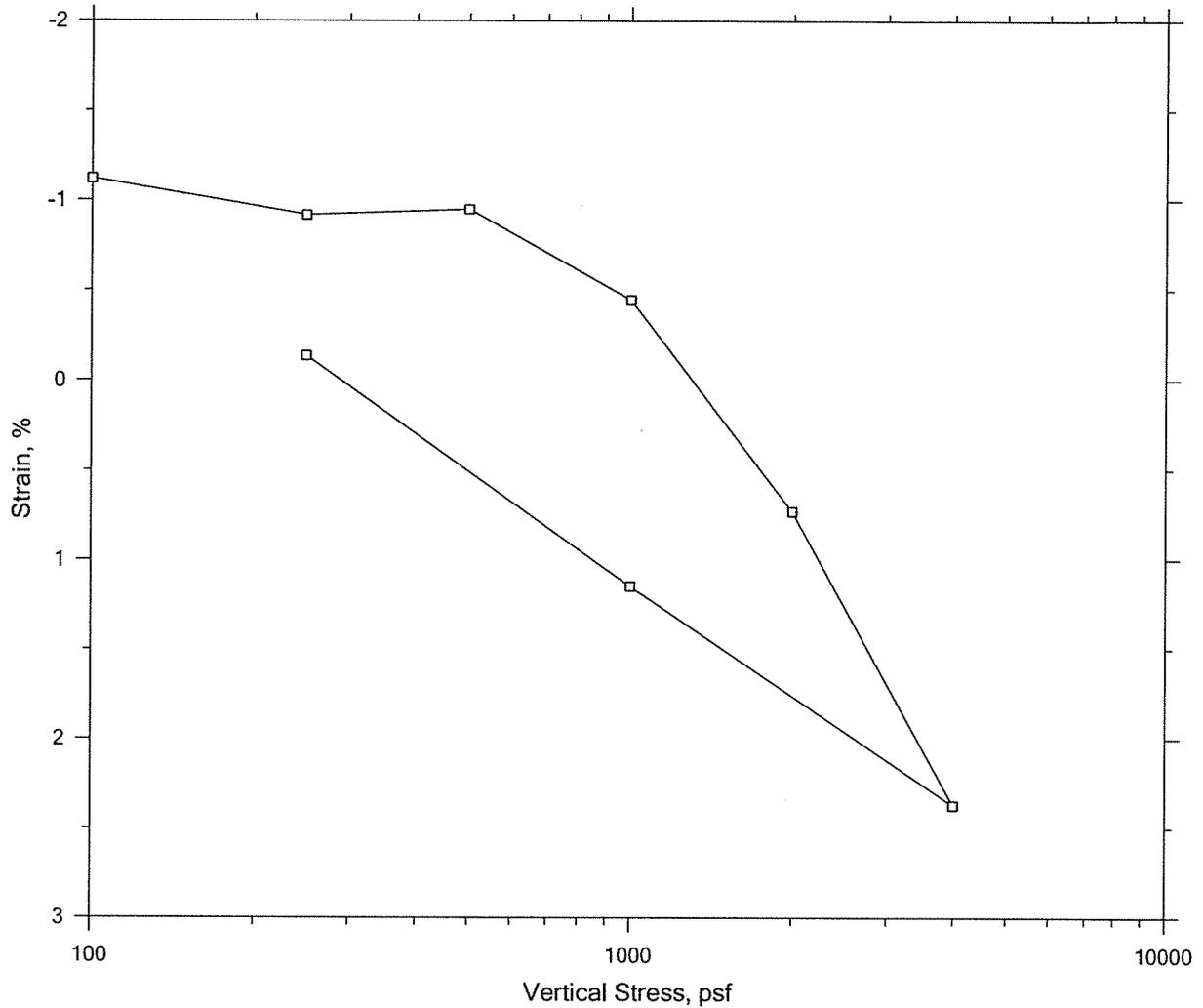
Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.03.02
 10:29:24 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer

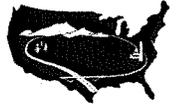
One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report



		Before Test	After Test
Current Vertical Effective Stress: 0 psf			
Preconsolidation Stress: 0 psf			
Compression Ratio: 0			
Diameter: 2.491 in	Height: 0.782 in	Water Content, %	-136.76
LL: 65	PL: 25	Dry Unit Weight, pcf	-285.77
PI: 40	GS: 2.65	Saturation, %	229.54
		Void Ratio	-1.58
			-1.58

	Project: CMR Refuge Repairs	Location:	Project No.: CMR 61520(1)
	Boring No.: Site-3/B-07	Tested By: JI	Checked By: E.JL
	Sample No.:	Test Date: 2/1/2021	Depth: 7.5-9.5'
	Test No.: 1	Sample Type: Shelby Tube	Elevation: Unknown
	Description:		
	Remarks: Lab ID #: W-20-1422-SO Displacement at End of Increment		



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12-30-20 to 02-19-21
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-08	Depth: 7.5-9.5

CONSOL T 216 REQUESTED

Consolidation test on Site-3/B-08 from 7.5-9.5 conducted to 4,000 psf, inundated at 500 psf and let swell. Finished loading to 4,000psf, then rebounded to 1,000 psf.

Sample for T208 H:D ratio was 1.92:1, which is slightly outside of the minimum of 2:1. There was little leftover material after preparing the T 216 Consol sample.

Sieve Analysis

Sieve Size	As Received % Passing
#10	100.0
#40	98.9
#200	91.6
20µm	75.8
10µm	69.2
5µm	56.8
2µm	44.0

Apparent Specific Gravity (T100) 2.774

Natural Moisture (T265) (Sample dried at 140 °F), % 24.9

Atterberg Limits (T89)

Liquid Limit 61
Plasticity Index 38

Unconfined Compression Undisturbed (T208)

Dry Density, pcf 93.1
Moisture, % 24.9
Diameter, in 2.79
Length, in 5.36
Compressive Strength, psi 32

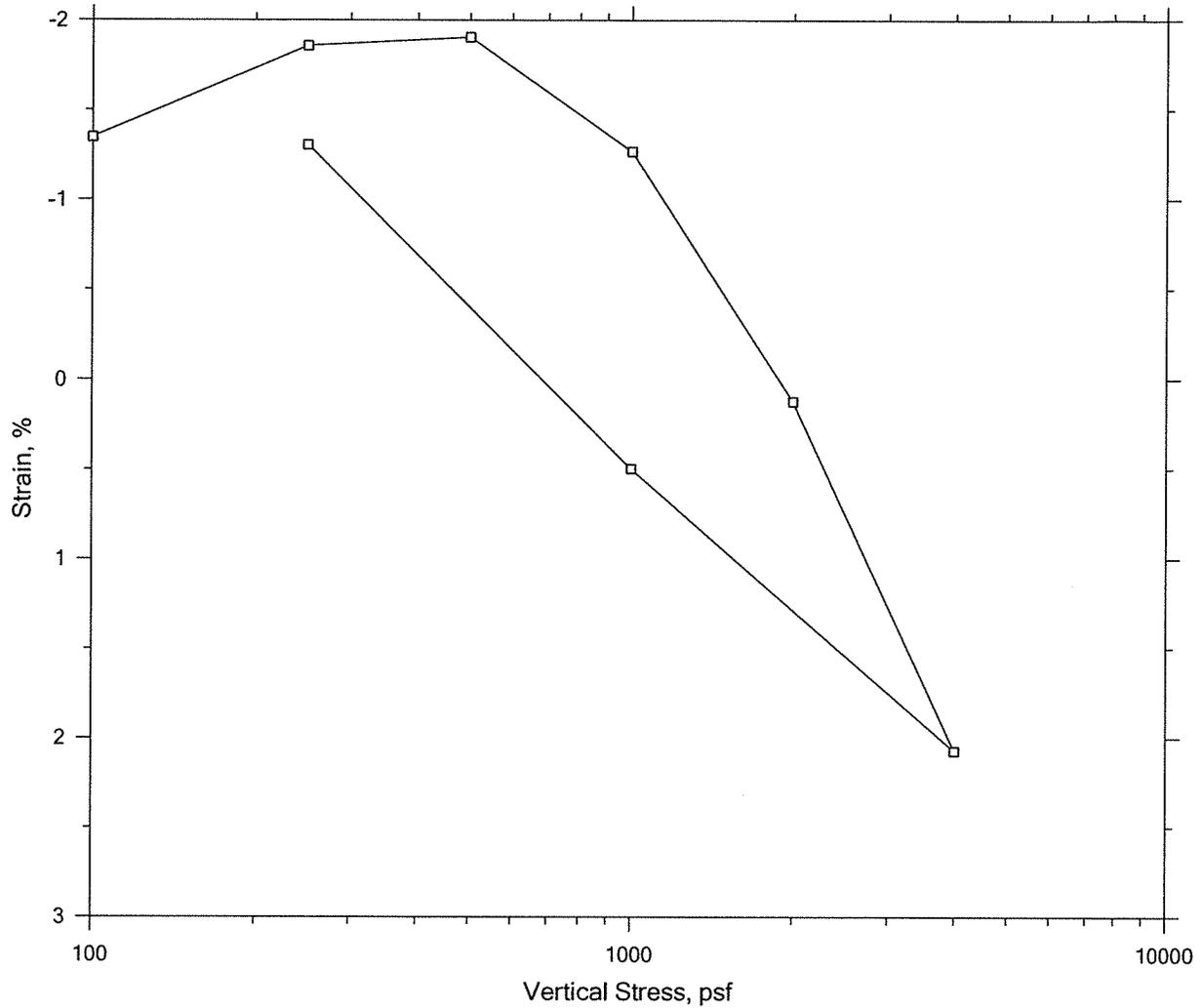
Reported results apply to the sample as received

WALTER F STONG Digitally signed by
WALTER F STONG
Date: 2021.03.02
10:29:43 -08'00'

Walt Stong, Materials Laboratory Chief
For: Megan Chatfield, Materials Engineer

One-Dimensional Consolidation by ASTM D2435 - Method B

Summary Report



		Before Test	After Test
Current Vertical Effective Stress: 0 psf		27.28	30.13
Preconsolidation Stress: 0 psf		94.948	93.725
Compression Ratio: 0		97.40	104.35
Diameter: 2.491 in Height: 0.782 in		0.74	0.77
LL: 61	PL: 23 PI: 38 GS: 2.65		

	Project: CMR Refuge Repairs	Location:	Project No.: CMR 61520(1)
	Boring No.: Site-3/B-08	Tested By: JI	Checked By: EJJ
	Sample No.:	Test Date: 2/3/2021	Depth: 7.5-9.5'
	Test No.: 1	Sample Type: Shelby Tube	Elevation: Unknown
	Description:		
	Remarks: Lab ID #: W-20-1430-SO Displacement at End of Increment		



Western Federal Lands Highway Division
 Materials Testing Laboratory
 610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **02 Mar 2021**
 Lab Control Number: **W-20-1448-SO**



Project Name: CHARLES M RUSSELL REFUGE REPAIRS	Sample No:
Project Number: MT FWS CMR 61520(1)	Sampled By:
Acct. No.: 1517306152001 510.PE.K710.30	Date Sampled: 11/04/2020
Submitted By: Terracon Consultants	Address:
Phone: 406-791-5111	
Sample of:	Date Received: 12/30/2020
Quantity Rep:	No. & Containers: SHELBY TUBE
	Dates Tested: 12-30-20 to 02-19-21
Owner:	County: Fergus & Phi State: MT
Boring No./Test Pit: Site 3/B-10	Depth: 15.0-17.0

CONSOLIDATION TEST REQUESTED

Consolidation test on Site-3/B-10 from 15.0-17.0 conducted to 8,000 psf. Inundated sample on 500 psf load, allowed to swell and then continued loading until 8,000 psf. Rebounded to 1,000 psf after consolidation.

Sieve Analysis

Sieve Size	As Received % Passing
3/4"	100.0
1/2"	97.2
3/8"	93.4
#4	88.0
#10	78.3
#40	75.9
#200	69.2
20µm	60.5
10µm	55.3
5µm	46.2
2µm	35.5

Apparent Specific Gravity (T100) 2.841

Natural Moisture (T265) (Sample dried at 140 °F), % 24.7

Atterberg Limits (T89)

Liquid Limit 75
 Plasticity Index 51

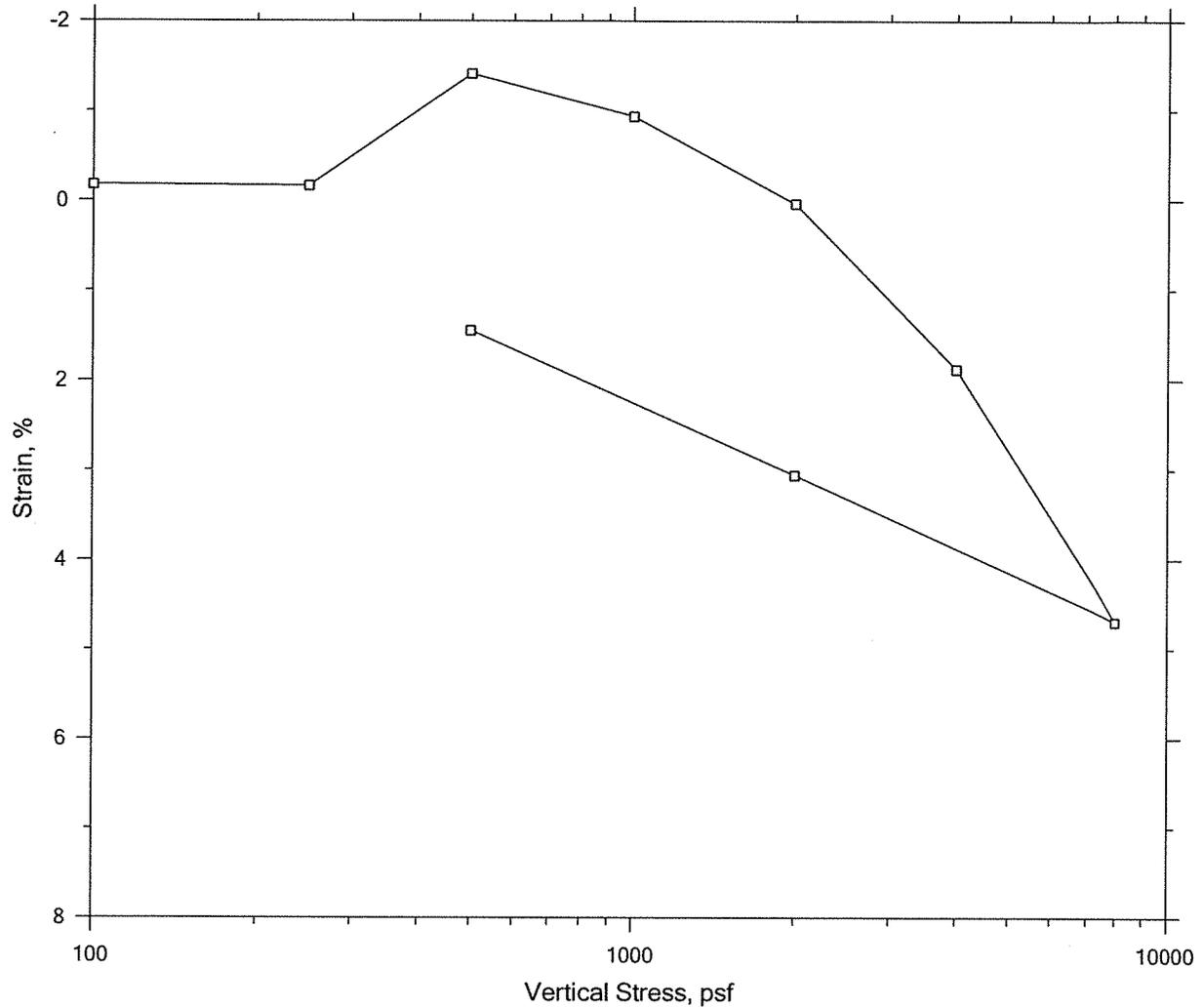
Reported results apply to the sample as received

WALTER F STONG Digitally signed by
 WALTER F STONG
 Date: 2021.03.02
 10:29:59 -08'00'

Walt Stong, Materials Laboratory Chief
 For: Megan Chatfield, Materials Engineer

One-Dimensional Consolidation by ASTM D2435 - Method B

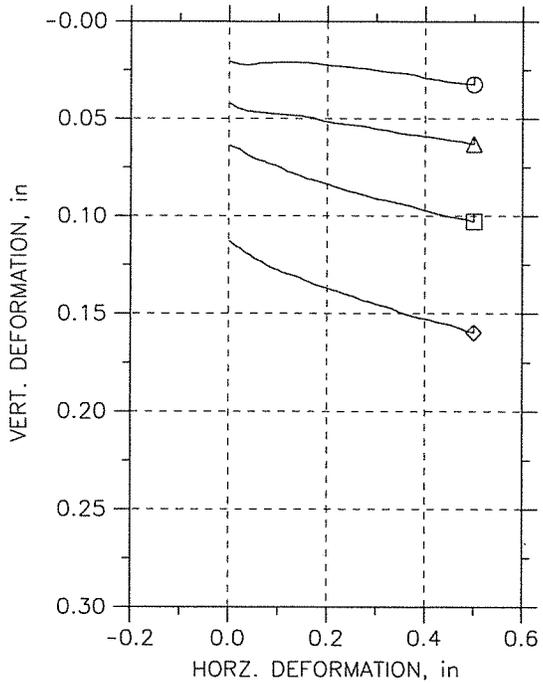
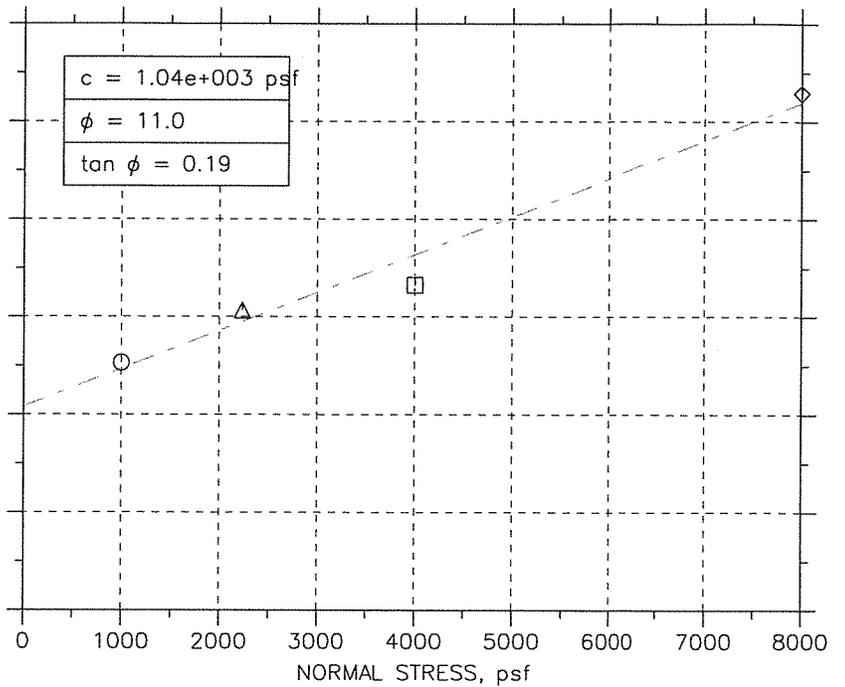
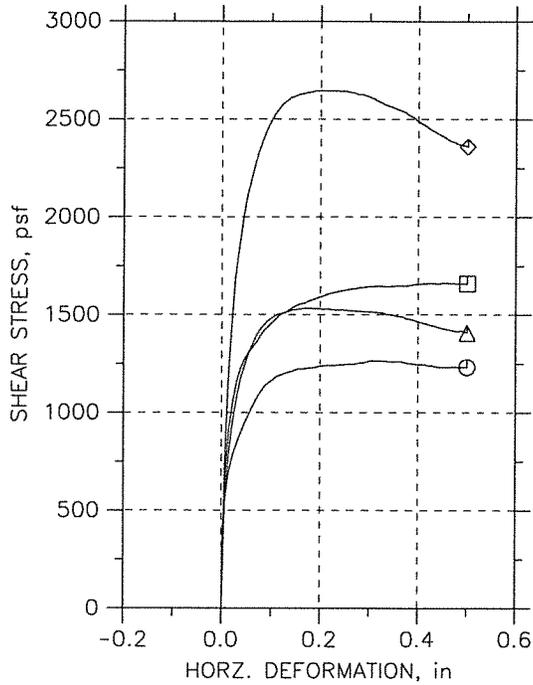
Summary Report



		Before Test	After Test	
Current Vertical Effective Stress: 0 psf		Water Content, %	27.20	29.19
Preconsolidation Stress: 0 psf		Dry Unit Weight, pcf	95.328	96.727
Compression Ratio: 0		Saturation, %	98.00	108.89
Diameter: 2.491 in	Height: 0.782 in	Void Ratio	0.74	0.71
LL: 75	PL: 24	PI: 51	GS: 2.65	

	Project: CMR Refuge Repairs	Location:	Project No.: CMR 61520(1)
	Boring No.: Site-3/B-10	Tested By: JI	Checked By: E.JL
	Sample No.:	Test Date: 2/8/2021	Depth: 15.0-17.0
	Test No.: 1	Sample Type: Shelby Tube	Elevation: Unknown
	Description:	Remarks: Lab ID #: W-20-1448-SO	
	Displacement at End of Increment		

DIRECT SHEAR TEST REPORT



Symbol	⊙	△	□	◇
Test No.	1	2	3	4
Sample No.				
Shape	Circular	Circular	Circular	Circular
Initial	Dimension, in	2.5	2.5	2.5
	Area, in ²	4.9087	4.9087	4.9087
	Height, in	1.02	1.03	1.01
	Water Content, %	22.67	20.60	19.11
	Dry Density, pcf	96.016	96.713	101.03
	Saturation, %	83.09	76.84	79.43
	Void Ratio	0.72299	0.71057	0.63755
Consol. Height, in	1.0022	0.9913	0.94972	
Consol. Void Ratio	0.69285	0.6463	0.53982	
Final	Water Content, %	36.38	34.08	33.94
	Dry Density, pcf	99.135	102.98	112.42
	Saturation, %	144.15	148.91	190.74
	Void Ratio	0.66877	0.6065	0.47156
Normal Stress, psf	997.61	2229.6	3995.9	
Max. Shear Stress, psf	1269.6	1538	1667.2	
Ult. Shear Stress, psf	1236.1	1412.4	1664.5	
Time to Failure, min	38	22.002	56.003	
Disp. Rate, in/min	0.008	0.008	0.008	
Estimated Specific Gravity	2.65	2.65	2.65	
Liquid Limit	66	66	66	
Plastic Limit	22	22	22	
Plasticity Index	44	44	44	
Description: Dark Brown Clay CL				
Remarks: Lab ID # W-20-1493-SO				

Project: CMR Refuge Repairs

Location:

Project No.: MT FWS CMR

Boring No.: Site-5/B-15

Sample Type: In Situ/ST

Description: Dark Brown Clay CL

Remarks: Lab ID # W-20-1493-SO

SUPPORTING INFORMATION

Contents:

Unified Soil Classification System
Description of Rock Properties

Note: All attachments are one page unless noted above.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
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 ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1$ or $Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	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 ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			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	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
	Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

^A Based on the material passing the 3-inch (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 require 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 $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in 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 $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

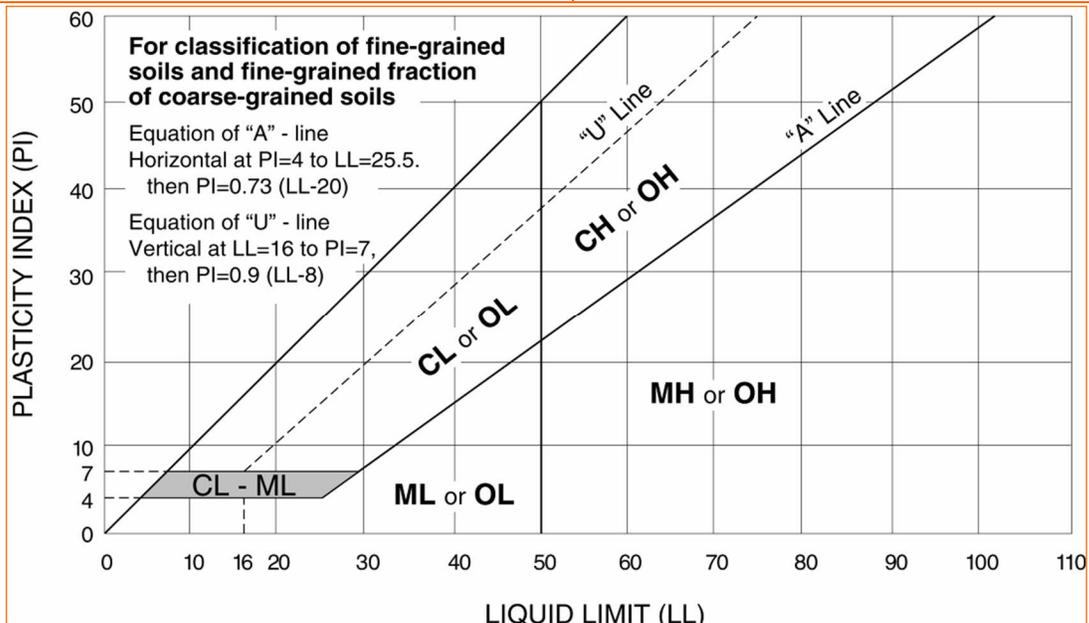
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ 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.



WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" no discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)

Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding, and Foliation Spacing in Rock ¹

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

1. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

Rock Quality Designator (RQD) ¹	
RQD, as a percentage	Diagnostic description
Exceeding 90	Excellent
90 – 75	Good
75 – 50	Fair
50 – 25	Poor
Less than 25	Very poor

Joint Openness Descriptors	
Openness	Descriptor
No Visible Separation	Tight
Less than 1/32 in.	Slightly Open
1/32 to 1/8 in.	Moderately Open
1/8 to 3/8 in.	Open
3/8 in. to 0.1 ft.	Moderately Wide
Greater than 0.1 ft.	Wide

1. RQD (given as a percentage) = length of core in pieces 4 inches and longer / length of run

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976. U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.