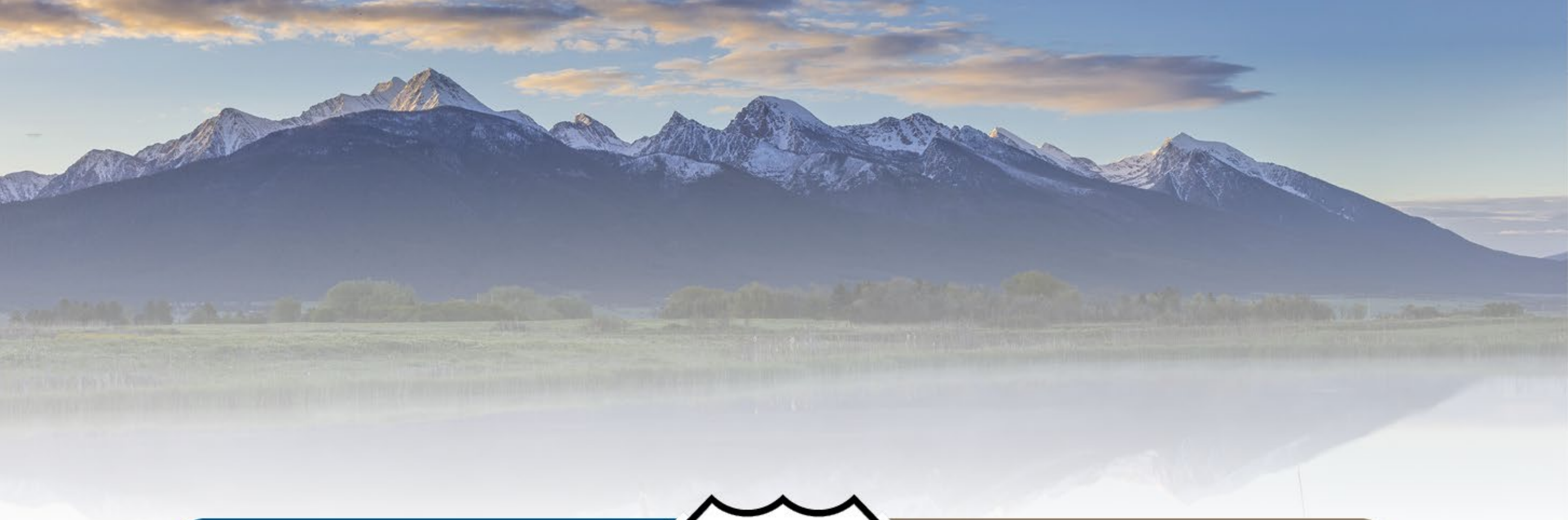
APPENDIX 2:

Summary of Relevant Conditions Technical Memorandum

NINEPIPE CORRIDOR 93 FEASIBILITY STUDY



NINEPIPE CORRIDOR 93 FEASIBILITY STUDY

Summary of Relevant Conditions

Technical Memorandum

March 21, 2022

Prepared for:
Montana Department of Transportation

MONTANA
Department of Transportation

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Acronyms and Abbreviations

AADT	Annual Average Daily Traffic
ALCO	Aquatic Lands Conservation Ordinance
cfs	cubic feet per second
CPT	Cone Penetrometer Testing
CSKT	Confederated Salish and Kootenai Tribes
CWA	Clean Water Act
DNRC	Department of Natural Resources and Conservation
EO	Executive Order
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIIP	Flathead Indian Irrigation Project
FIRM	Flood Insurance Rate Map
HCM	Highway Capacity Manual
HSA	Hollow-Stem Auger
LOS	Level of Service
MDT	Montana Department of Transportation
MFWP	Montana Fish, Wildlife & Parks
mph	miles per hour
MWAM	Montana Wetland Assessment Method
NCDE	Northern Continental Divide Ecosystem
NFIP	National Flood Insurance Program
NHS	National Highway System
NRHP	National Register of Historic Places
PDO	Property Damage Only
PJD	Preliminary Jurisdictional Determination
ROD	Record of Decision
RP	Reference Point
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Office
TPO	Tribal Preservation Office
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
VMT	Vehicle Miles Traveled
vpd	vehicles per day
WOTUS	Waters of the United States
WPA	Waterfowl Production Area

Summary of Relevant Conditions

1.0. INTRODUCTION

The Montana Department of Transportation (MDT) is developing a feasibility study for the Ninepipe segment of US Highway 93 (US 93) between Reference Points (RP) 40.0 (Gunlock Road) and 44.5 (Brooke Lane) as illustrated in **Figure 1**.

Multiple constraints occur within the Ninepipe corridor that will need to be considered when determining a future reconstruction project.

The intent of the *US 93 Ninepipe Corridor Feasibility Study* is to analyze the feasibility of the preferred alternative previously identified in the 2008 Supplemental Environmental Impact Statement (SEIS)[1]. The purpose of the action proposed in the SEIS was to improve traffic operations and the connectivity and safety of the transportation system. The preferred alternative was determined to best meet the purpose and need of the proposed action while minimizing costs and impacts to the area's natural resources. The study is a collaborative process between MDT, the Federal Highway Administration (FHWA), the Confederated Salish and Kootenai Tribes (CSKT), resource agencies, and the public to identify potential constraints and determine the viability of the preferred alternative as outlined in the SEIS.

The purpose of this document is to review relevant resources within the study area and identify any changed conditions that have occurred since the evaluations conducted during the 2008 SEIS. Updated analysis of traffic and safety conditions was conducted to help determine if any conditions have changed that might influence development of the preferred alternative. Additionally, a summary of land use and ownership, wetlands, floodplains and streams, wildlife, cultural resources, and geological and soils conditions is provided, with detailed information included in supporting appendices. Comparison between updated information gathered for the feasibility study and conditions reported in the 2008 SEIS is important to confirm previous findings and to identify changed conditions that may influence either the need or feasibility of future corridor improvements.

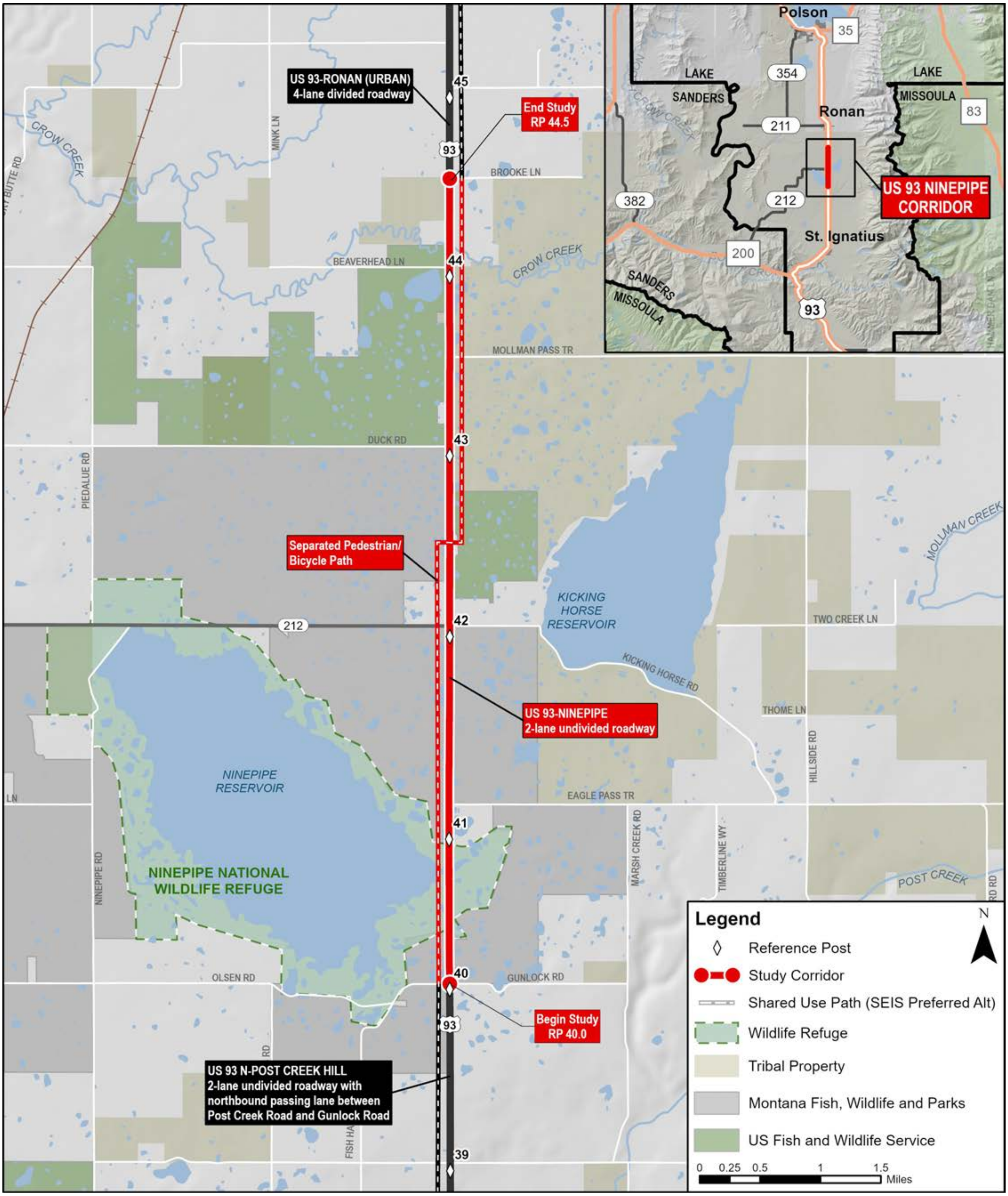

Figure 1: Study Area

2.0. BACKGROUND AND PREVIOUS EVALUATION

In 1996, MDT completed a *Final Environmental Impact Statement (FEIS) and Section 4(f) Evaluation* for the portion of US 93 between Evaro and Polson, MT[2]. The Record of Decision (ROD) did not provide specific design details so FHWA, MDT, and the CSKT agreed to prepare a supplemental environmental study of the Ninepipe/Ronan section (RP 37.1 to 48.3) to further explore possible alternate alignments and perform a detailed study on the effects of highway improvements on wetlands and wildlife in the corridor. In 2008, MDT, FHWA, and CSKT completed a *Supplemental Environmental Impact Statement (SEIS) and a Section 4(f) Evaluation* for the Ninepipe/Ronan section[1].

The SEIS noted that US 93 is important to local, regional, and nationwide transportation. With poor existing operations, projected increases in traffic volumes, multiple safety concerns, and a lack of dedicated pedestrian and bicycle facilities, MDT and the CSKT supported improvements to address safety and mobility in the US 93 corridor. At the same time, MDT and the CSKT strived to minimize impacts to sensitive elements within the Ninepipe segment, including cultural and historic features, wetlands and waterways, wildlife and habitat, and other environmental resources.

The SEIS/ROD identified Alternative Rural 3 as the preferred alternative for the corridor. The configuration consists of a two-lane roadway, widened shoulders, wildlife crossing structures, and a separated bicycle/pedestrian path within the Ninepipe segment connecting to a divided four-lane segment north of Brooke Lane and a northbound passing lane segment south of Gunlock Road, as shown in **Figure 1**. The SEIS noted "the preferred alternative was crafted to gain both safety and capacity improvements and, with the implementation of proposed mitigation, will not result in significant additional impacts to natural resources."

3.0. TRAFFIC OPERATIONS AND SAFETY

US 93 is a National Highway System (NHS) route that is important to the local, state, and nationwide transportation system. US 93 provides linkage between other highway routes and Interstate 90. US 93 serves as an access route to Flathead Lake and Glacier National Park, two popular destinations in northwest Montana.

Considering the importance of US 93 to the transportation network, the corridor experiences high traffic volumes and poor levels of service. The roadway consists of one travel lane in each direction and shoulders of varying width. The SEIS determined that reconstruction of the corridor is needed to improve safety, provide multimodal accommodations, and to ensure that the corridor can operate efficiently under existing and projected traffic conditions. For this study, updated traffic and safety conditions were evaluated to help determine if new information might influence development of the preferred alternative.

Appendix A provides additional information about the traffic and safety conditions for the study corridor.

3.1. Methods

EXISTING CONDITIONS

For the SEIS, traffic counts were conducted in 2000 during normal weekday conditions (April and May) and during summer weekend conditions (July and August). These counts were used to develop design year traffic volumes for the SEIS along the rural portions of the US 93 corridor. Design volumes and corridor operations were evaluated for the years 2000, 2004, and 2024 based on the collected volumes as well as count data from the permanent counter on US 93 just south of Ravalli.

An updated analysis was completed using existing MDT count data as well as supplemental data collected for this feasibility study. Two MDT short-term count sites are located within the study area, including one south of MT 212 and one north of MT 212. Additionally, data collection cameras were placed at three locations in August 2021 to document peak summer conditions. Pneumatic tubes were placed at two locations across US 93 for the same duration to determine vehicle speed trends on the corridor.

PROJECTED CONDITIONS

Future design volumes in the SEIS were derived using a growth rate of 2.8 percent. This value was based on historic traffic patterns seen at that time and were used to project conditions for the design year of 2024.

For this feasibility study, an updated review of the most recent 20 years of traffic data was conducted to determine historic growth rates for the study corridor. Three growth rates were selected to model low, moderate, and high growth scenarios. These growth rates were applied to existing traffic data to evaluate projected conditions out to the year 2045.

NON-MOTORIZED TRANSPORTATION

The SEIS analysis used planning models developed by the Florida Department of Transportation for a point quality of service analysis, specifically focused on pedestrians and bicyclists.

The updated analysis of relevant conditions did not include a pedestrian- or bicyclist-specific study to determine the existing multi-modal quality of service.

SAFETY

The SEIS safety analysis was conducted using crash data for the 9-year period from 1995 through 2003. The analysis considered crash type, crash location, and roadway surface condition at the time of the crash. For the rural portion of US 93, two segments were analyzed: the segment between Saint Ignatius and Montana Highway 212 (MT 212) and the segment between MT 212 and Ronan.

For this feasibility study, MDT provided crash data for the study corridor for the five-year period between January 1, 2015, and December 31, 2019. The crash data included location, time period, type, severity, environmental factors, driver demographics, and vehicle details associated with each crash.

3.2. Key Findings and Changed Conditions

EXISTING CONDITIONS

The SEIS relied on traffic data and analysis conducted for US 93 between Evaro and Polson. The evaluation distinguished between urban and rural context and divided the corridor into two segments: Saint Ignatius to MT 212 and MT 212 to Ronan. The data showed traffic volumes in the year 2000 between 7,500 vehicles per day (vpd) south of MT 212 and 8,750 vpd to the north.

For the feasibility study, 2020 annual average daily traffic (AADT) ranged from approximately 7,000 vehicles per day (vpd) south of MT 212 to just over 8,500 vpd to the north, slightly less than those documented in 2000 for the SEIS. Summer ADT volumes were approximately 35 percent higher when unadjusted for seasonal variation.

An operational analysis was conducted for the study corridor to determine highway level of service (LOS) based on roadway volume and theoretical capacity. The MDT *Traffic Engineering Manual*[3] lists a target LOS of B for an NHS Non-Interstate route with rolling/level terrain. At LOS B, passing demand and passing capacity are balanced with some platoons of vehicles. While there may be some reduction in travel speed, the reductions are relatively small. A previous agreement, approved during development of the SEIS, allowed for some exceptions to the normal MDT policy to balance improved traffic operations with potential negative impacts.

Based on the operational analysis, the highway currently operates at LOS D during an average day and during a summer weekday. A roadway operating at LOS D is characterized by a high percentage of vehicles traveling in platoons. Passing demand is high but passing capacity approaches zero so drivers will spend a lot of time following slower vehicles. The corridor was shown to operate at a similar level during the evaluation for the SEIS.

PROJECTED CONDITIONS

The SEIS identified a future growth rate of 2.8 percent per year for rural portions of US 93 based on historic traffic patterns at that time.

For the feasibility study, AADT data for the previous 20 years were used to evaluate historic growth rates for the study corridor. When averaged over this period, annual traffic growth has been negligible due to reduced traffic volumes between 2008 and 2014. More recently, traffic volumes have grown to values close to those experienced in the early 2000s.

Based on the heavily variable historic volumes and seasonal variation, three growth rates were identified to evaluate low, moderate, and high growth scenarios. The low growth scenario applies an annual growth rate of 1.0 percent per year representing slow growth over the next 25 years. For the moderate growth scenario, the average growth rate experienced from the past 10 years (2.22 percent) was used. This scenario represents conditions if traffic were to increase at rates similar to the past decade. The high growth rate of 2.8 percent matches the projections identified in the SEIS. Based on these growth scenarios, daily traffic volumes are projected to range from approximately 9,000 to 14,000 vpd on the south end and between 11,000 and 17,000 vpd on the north end. Peak summer weekday traffic volumes are projected to be approximately 3,000 to 6,000 vpd higher than those during a typical day.

Table 1: Projected Daily Traffic Volumes

Count Location	Existing Daily Traffic	2045 Projected Traffic (vpd)		
		Low Growth (1.0%)	Moderate Growth (2.22%)	High Growth (2.8%)
2021 Summer Weekday				
South of MT 212	9,695	12,310	16,421	18,810
North of MT 212	11,264	14,302	19,079	21,854
North of Beaverhead Ln	11,838	15,031	20,051	22,967
2020 Average Annual Daily Traffic				
South of MT 212 (24-3-004)	7,082	9,080	12,260	14,125
North of MT 212 (24-3-027)	8,544	10,960	14,790	17,040

Similar to the analysis of the existing corridor operations, an operational analysis was conducted using the projected traffic volume scenarios. The operations were evaluated for the summer PM peak hour (worst condition) and the design hour based on 2020 AADT volumes. The projected corridor operations show that the corridor will experience degrading operations. Under low growth conditions, the corridor is projected to operate at LOS D. Under moderate and high growth projections, the LOS is shown to decrease to LOS E under all scenarios except south of MT 212 with moderate growth. This evaluation shows slightly better performance than the SEIS which projected the corridor operating at LOS E by the year 2016.

NON-MOTORIZED TRANSPORTATION

The SEIS documented minimal pedestrian and bicycle activity along the rural portions of the corridor. A model was completed which indicated failing service ratings for both pedestrian and bicycle quality of service based on the lack of separated facilities. Additionally, the speed and volume of traffic were also considered. For US 93, the impact of the high speed along the rural section and narrow shoulders on the existing roadway resulted in the low rated quality of service F.

There are no dedicated facilities for pedestrians and bicyclists along the study corridor. The existing roadway corridor has shoulders of varying width but are typically approximately six feet wide on each side. Minimal non-motorized activity was documented during the summer 2021 data collection effort with only two bicyclists counted during the 48-hour period. The existing highway facility is currently not well suited to accommodate non-motorists due to high speeds, high traffic volumes, and lack of dedicated facilities.

SAFETY

According to the MDT crash database, a total of 84 crashes occurred within the study area during the 2015 to 2019 analysis period. Most crashes involved a single vehicle, with the most common crash type being wild-animal crashes, followed by fixed-object. The most common multiple vehicle crash type was rear-end, followed by right angle and sideswipe opposite direction. **Figure 2** presents the distribution of crash types within the study area.

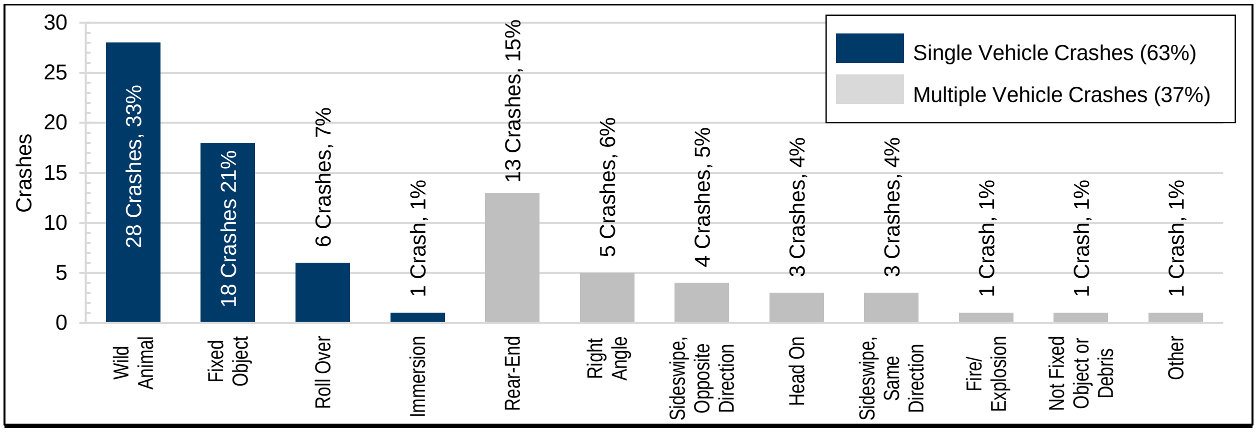

Figure 2: Crash Type (2015-2019)

Crash data were also reviewed based on reported location of the crashes in the study area as shown in **Figure 3**, which presents a heat map representing the relative density of crashes. A review of crash locations revealed clusters at the intersections with Eagle Pass Trail, MT 212, and Beaverhead Lane. At those intersections, nearly half were wild animal or fixed object crashes unrelated to the intersections.

Fatal and suspected serious injury crash locations are also identified on **Figure 3**. Crashes are detailed below from least to most severe.

- Most (59 crashes, 70 percent of total) resulted in property damage only (PDO).
- Approximately 24 percent (20 crashes) were reported as possible injury, suspected minor injury, or unknown.
- The remaining five crashes (6 percent of total) were considered severe and resulted in suspected serious injury or fatality.

Recent crash data were compared to information provided in the SEIS. A summary comparison between the SEIS and updated data is provided in **Table 2**.

Table 2: Crash Data Comparison

Comparison Metric	2008 SEIS[i]	Updated Crash Data[ii]
Crash Severity	5% Fatal	1% Fatal (6% severe)
Crash Rate	2.8 crashes per mile per year	4.3 crashes per mile per year
	0.98 crashes per million vehicle miles of travel	1.44 crashes per million vehicle miles of travel
Crash Type	6% Head On	3.6% Head On
Severity Rate	2.86	2.27
Noted Contributor	33% at or related to intersections/driveways	17% at or related to intersections/driveways

[i] Data includes rural segments of US 93 between Evaro and Polson (1995-2003)
[ii] Source: MDT Traffic and Safety Bureau (2015-2019) for Ninepipe corridor (RP 40.3 to RP 44.2)

As shown in the table, the crash rate for the Ninepipe corridor is higher based on updated crash data compared to the SEIS. However, the severity rate, percent of fatalities, and rate of head on and intersection crashes is lower with the updated crash data.

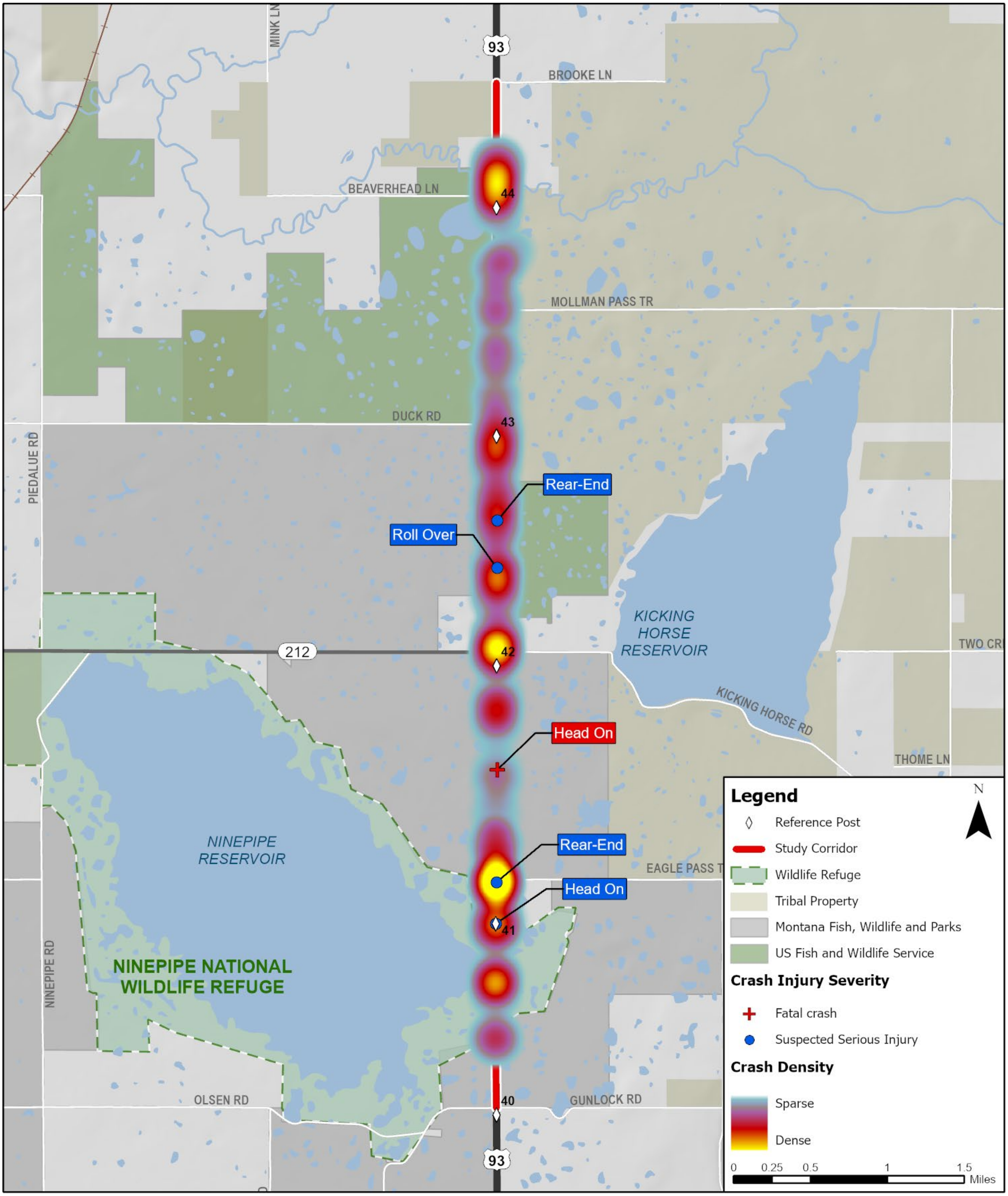

Figure 3: Crash Location Map (2015-2019)

4.0. LAND USE AND OWNERSHIP

It is important to evaluate adjacent land use, ownership, and roadway right-of-way boundaries to aid in determining impacts that may potentially result from construction activities. Additionally, some access modifications may be required for adjacent properties or intersecting roads along the study corridor. **Appendix B** provides a list of landowners and right-of-way plan sheets developed for this study.

4.1. Methods

The SEIS analysis of land use within the vicinity of the study corridor involved a review of existing and proposed Tribal and local government plans, policies, and regulations. In 2003, an inventory of the land parcels within the corridor was conducted to determine the primary land use in the study area. Upon completion of the inventory, Tribal and local government officials were contacted to confirm the results.

An updated land use inventory was completed for this feasibility study. The land use by parcel was determined from Montana Cadastral data[4], with parcels categorized as residential, commercial/industrial/ institutional, and other or unknown. Consistent with the SEIS, "other" lands included recreational land, parks, or open space. Farmland was classified as residential while unknown meant the current use was unknown or not listed. The corridor was also evaluated to determine existing right-of-way widths and property boundaries based on available highway right-of-way monumentation.

4.2. Key Findings and Changed Conditions

The SEIS and the feasibility study analysis found that approximately half of parcels immediately adjacent to the study corridor are categorized as residential / agricultural properties. Most remaining parcels are commercial / industrial / institutional uses. A small number of parcels are classified as other or unknown which includes the Ninepipe National Wildlife Refuge. The land use inventory is shown in **Table 3**.

Table 3: Inventory of Land Uses by Parcel Comparison

Source	Residential / Agricultural	Commercial / Industrial / Institutional	Other or Unknown
2008 SEIS Inventory	16	10	2
2021 Inventory	18	12	2

Source: 2008 SEIS; Montana Cadastral, December 2021

As presented in **Figure 4** most of the study corridor is surrounded by public lands, with ownership varying between Tribal property, Montana Fish, Wildlife and Parks (MFWP) property, and United States Fish and Wildlife Service (USFWS) property. These public lands are managed to support and preserve wildlife in the area. Additionally, 12 private landowners own one or more parcels adjacent to the study corridor.

The SEIS specified a minimum desirable right-of-way width of 160 feet for the Ninepipe segment to accommodate the preferred alternative including a two-lane roadway, widened shoulders, and a separated bicycle/pedestrian path. MDT generally owns the minimum width throughout the corridor although some areas of MDT-owned right-of-way are narrower. South of Eagle Pass Trail adjacent to the Ninepipes Lodge, the right-of-way width is 100 feet. North of Eagle Pass Trail, the right-of-way width is 130 feet. At the northern end of the study area south of Brooke Lane, the right-of-way width is 140 feet.

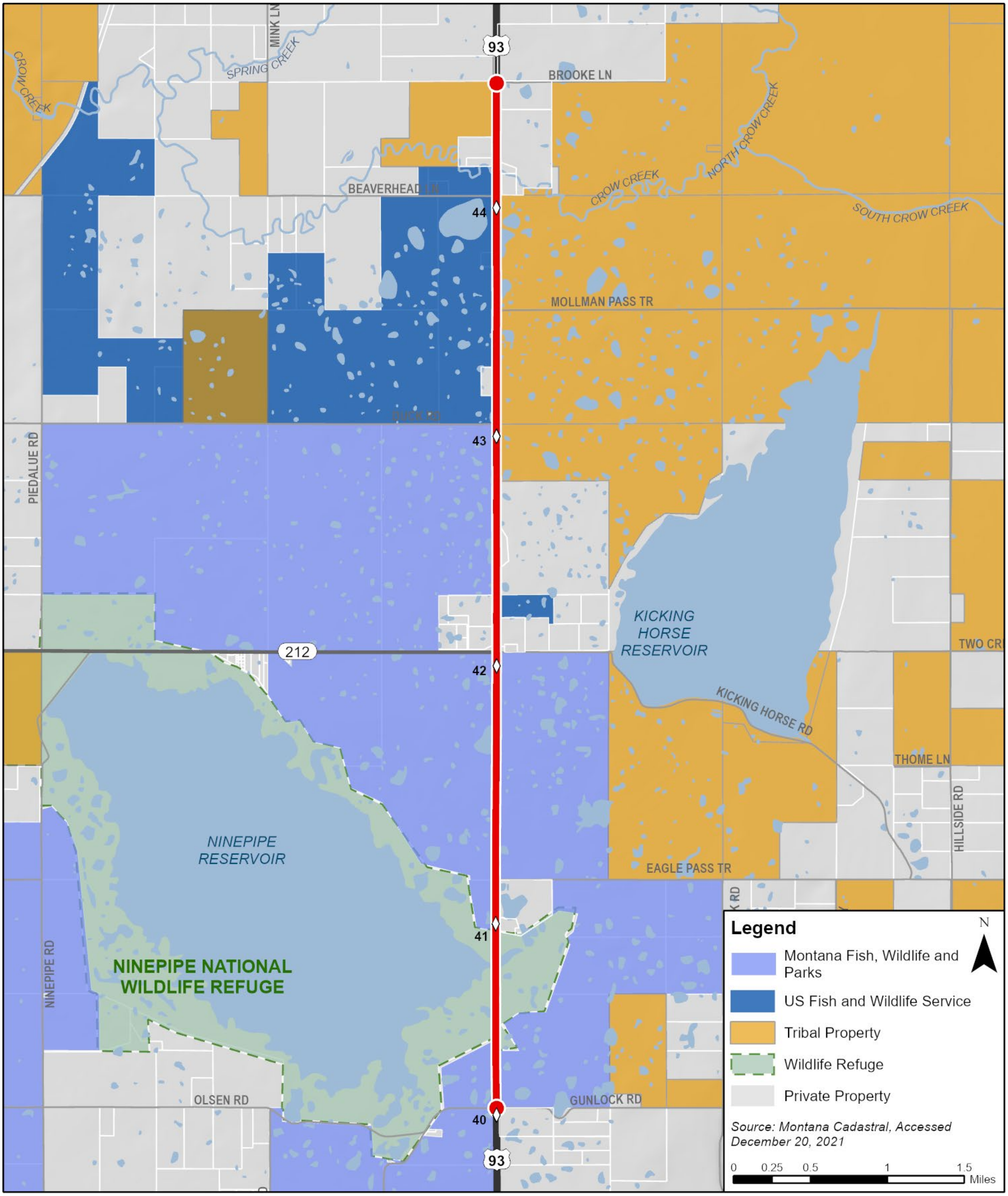

Figure 4: Existing Land Ownership

5.0. WETLANDS

All waters of the United States (WOTUS), including wetlands, are regulated by the United States Army Corps of Engineers (USACE) under the Clean Water Act (CWA) Section 404. Additionally, wetlands on the Flathead Indian Reservation are also regulated by the CSKT under the Aquatic Lands Conservation Ordinance (ALCO) 87A. Wetlands are further protected under Executive Order (EO) 11990, which requires federal agencies to minimize the loss or degradation of wetlands and enhance their natural value. The policy of the U.S. Department of Transportation, as stated in Order DOT 5660.1A, is that transportation projects should be planned, constructed, and operated to ensure the protection, preservation, and enhancement of the nation's wetlands to the fullest extent practicable. For wetlands with no connection to a Water of the US, permanent wetland impacts will be mitigated in accordance with FHWA "no net loss" guidance and EO 11990. Additionally, CWA Section 401 and CSKT mitigation requirements will be assessed during the feasibility evaluation for this study.

For this study, it is important to understand any changed conditions since completion of the 2008 SEIS in terms of wetland boundaries, classification and functional assessments, and preliminary jurisdictional status to quantify potential impacts and identify anticipated mitigation requirements associated with a future improvement project. **Appendix C** provides additional information about the wetlands analysis conducted for this study.

5.1. Methods

DELINEATION

The 2008 SEIS generally considered the 1996 FEIS findings to be correct and primarily focused on using updated information to define the wetland boundaries more accurately relative to potential impacts resulting from proposed construction alternatives. The 1996 FEIS analysis used methods described in the 1987 *Corps of Engineers Wetlands Delineation Manual*[5] to determine wetland boundaries. Revised boundaries were completed in 2002.

While re-evaluating wetland boundaries for this feasibility study, USACE wetland determination criteria were used as documented in the 1987 *Wetland Delineation Manual*, as well as regional guidance presented in the *Western Mountains, Valleys, and Coast Region*[6]. To verify previously delineated boundaries, an Arrow GPS receiver and iPad Collector map with the 2002 wetland delineation layer depicted over a current aerial photograph was used. The mapped boundaries of each wetland within the road right-of-way were walked to determine whether conditions on the ground were accurately represented, with adjustments noted to reflect actual site conditions. Field data were collected in upland and wetland conditions to confirm the locations of the wetland boundaries.

CLASSIFICATION AND FUNCTIONAL ASSESSMENT

Each wetland in the corridor was classified using the *Classification of Wetlands and Deepwater Habitats of the United States*[7]. Wetland functions were rated using the *Montana Wetland Assessment Method*[8] (MWAM). This method categorizes wetlands into a hierarchy ranging from category I wetlands, which exhibit outstanding features to category IV wetlands which exhibit minimal attributes. The 2008 SEIS used the 1999 version of MWAM to assess the functions and values of existing wetlands within the corridor. The functional rating conducted for this feasibility study used the 2008 MWAM rating system, which is the most current version at the time of this study.

PRELIMINARY JURISDICTIONAL REVIEW

In 2008, wetland status was determined based on surface or wetland connection to any WOTUS and "significant nexus" reflected by linkage between or effect on interstate/foreign commerce. For this feasibility study, National Wetland Inventory maps, observations in the field, and aerial photo interpretation were used to document hydrologic connections between wetlands within the project corridor and WOTUS outside the corridor in sufficient detail to support a preliminary USACE jurisdictional determination. The analysis used the current definition of WOTUS consistent with the pre-2015 regulatory regime[9].

5.2. Key Findings and Changed Conditions

DELINEATION

In the 2008 SEIS, 82 wetlands were delineated within the Ninepipe corridor from RP 40.0 to RP 44.6 totaling 109.92 acres. For the purposes of the wetland evaluation, limits were extended to RP 44.6 to include wetland areas up to Brooke Lane using the RPs originally listed in the 2008 SEIS.

In 2021, 85 wetlands were delineated totaling 110.58 acres, reflecting three newly identified wetlands listed below.

- Wetland H40G at RP 42.0 – 0.041 acre
- Wetland I9C at RP 43.2 to 43.3 – 0.034 acre
- Wetland I16C at RP 44.0 – 0.012 acre

Compared to the delineation presented in the 2008 SEIS, minor changes were noted where new wetlands had formed in roadside ditches and where existing wetland boundaries were modified to reflect updated conditions. Of the 82 previously identified wetlands, minor changes were noted for 26 wetlands, and boundaries for 56 wetlands remained unchanged.

CLASSIFICATION AND FUNCTIONAL ASSESSMENT

A change from the 1999 to 2008 MWAM rating systems relating to the threshold for percent of possible points awarded affected Wetlands H40D, H40E, and H40F. These wetlands changed from Category III to Category IV, which is the lowest quality wetland under the MWAM rating system. No changes to other wetlands were identified.

PRELIMINARY JURISDICTIONAL REVIEW

Preliminary jurisdictional status for wetlands listed in the 2008 SEIS was confirmed. Preliminary jurisdictional status for newly identified wetlands is listed below.

- Wetland H40G at RP 42.0 – non-jurisdictional
- Wetland I9C at RP 43.2 to 43.3 – non-jurisdictional
- Wetland I16C at RP 44.0 – jurisdictional

6.0. FLOODPLAINS AND STREAMS

Federal and state laws, regulations, executive orders, policies, and guidelines require transportation officials to identify, evaluate, and minimize impacts to floodplains and streams. As noted in the SEIS, all projects with federal sponsorship must comply with *Executive Order 11988 – Floodplain Management*, which requires federal agencies to reduce the risk of flood loss, minimize the impact of floods on human safety, and restore and preserve the natural and beneficial values served by the floodplains. At the state level, MFWP administers the *Montana Stream Preservation Act* for activities that disturb the bed or bank of a stream, and the Montana Department of Natural Resources and Conservation (DNRC) administers the *Montana Floodplain and Floodway Management Act* which covers all new construction within a floodplain. At the Tribal government level, the CSKT Shoreline Protection Office administers ALCO 87A, which regulates construction activities in aquatic lands of the Flathead Indian Reservation including lakes, rivers, streams, mudflats, wetlands, sloughs, potholes, and ponds. WOTUS (including streams and some irrigation canals) are subject to regulation under the CWA Section 404 permit administered by the USACE.

The US 93 Ninepipe study corridor is located in the Mission Valley within the Lower Flathead Subbasin (HUC 17010212). The study area is located in both the Mission Creek and Crow Creek watersheds, both of which originate in the Mission Mountains Tribal Wilderness and drain west to the Flathead River downstream of Flathead Lake. For this study, it is important to understand any changed conditions since completion of the 2008 SEIS to identify potential implications for design and construction of wildlife crossing structures and anticipated mitigation requirements and permitting needs associated with a future improvement project.

6.1. Methods

The SEIS evaluation of floodplains and streams involved literature review and coordination with local agency representatives. Reviewed literature included *Federal Emergency Management Agency (FEMA) Flood Study for Lake County*[10], a preliminary hydraulics report prepared for the SEIS, and local, state, and federal regulations and applicable information.

For this feasibility study, information obtained from FEMA's National Flood Hazard Layer[11] online database was used to document changed conditions. The most recent Flood Insurance Rate Map (FIRM)[12] for Lake County and incorporated areas was also reviewed.

6.2. Key Findings and Changed Conditions

FLOODPLAINS

The SEIS noted that the most severe flooding in Lake County occurs in the spring and early summer due to snowmelt and rainfall runoff. The Ninepipe segment of US 93 passes through two separate floodplains:

- Ninepipe Reservoir: Approximately 350 feet of US 93 roadway crosses the 100-year floodplain associated with the reservoir.
- Crow Creek: Approximately 550 feet of US 93 roadway crosses the 100-year floodplain associated with Crow Creek.

As noted in the SEIS, Lake County is participating in the National Flood Insurance Program (NFIP) and has adopted standards for floodplain management, including requiring a floodplain permit for any encroachment or crossing of a designated floodplain. However, CSKT is not participating in the NFIP, and the Flathead Indian Reservation is not subject to federal floodplain development regulations. Since no specific criteria have been developed by CSKT, federal standards would likely be applied at stream crossings within the study corridor.

Based on the updated mapping conducted by FEMA in 2013 and shown in **Figure 5**, the Ninepipe segment of US 93 passes through the following floodplains:

- Ninepipe Reservoir: Approximately 140 feet of US 93 roadway crosses Zone A - 1% annual chance flood (100-year floodplain) of the reservoir.
- Crow Creek: Approximately 645 feet of US 93 roadway crosses Zone A - 1% annual chance flood (100-year floodplain) associated with Crow Creek.

The Flathead Indian Reservation remains unmapped.

STREAMS

The SEIS notes that Crow Creek flows through the project corridor between RP 44.1 and 44.2 and is conveyed under US 93 at approximately RP 44.2 through two 10x14-foot culverts, which may not be adequate to convey high water flows. The 100-year flood flow in Crow Creek at the US 93 crossing was estimated to be 1,020 cubic feet per second (cfs). The SEIS reported that Crow Creek has previously overtopped the US 93 roadway due to inadequate conveyance capacity. Updated conveyance analysis was not conducted for the feasibility study.

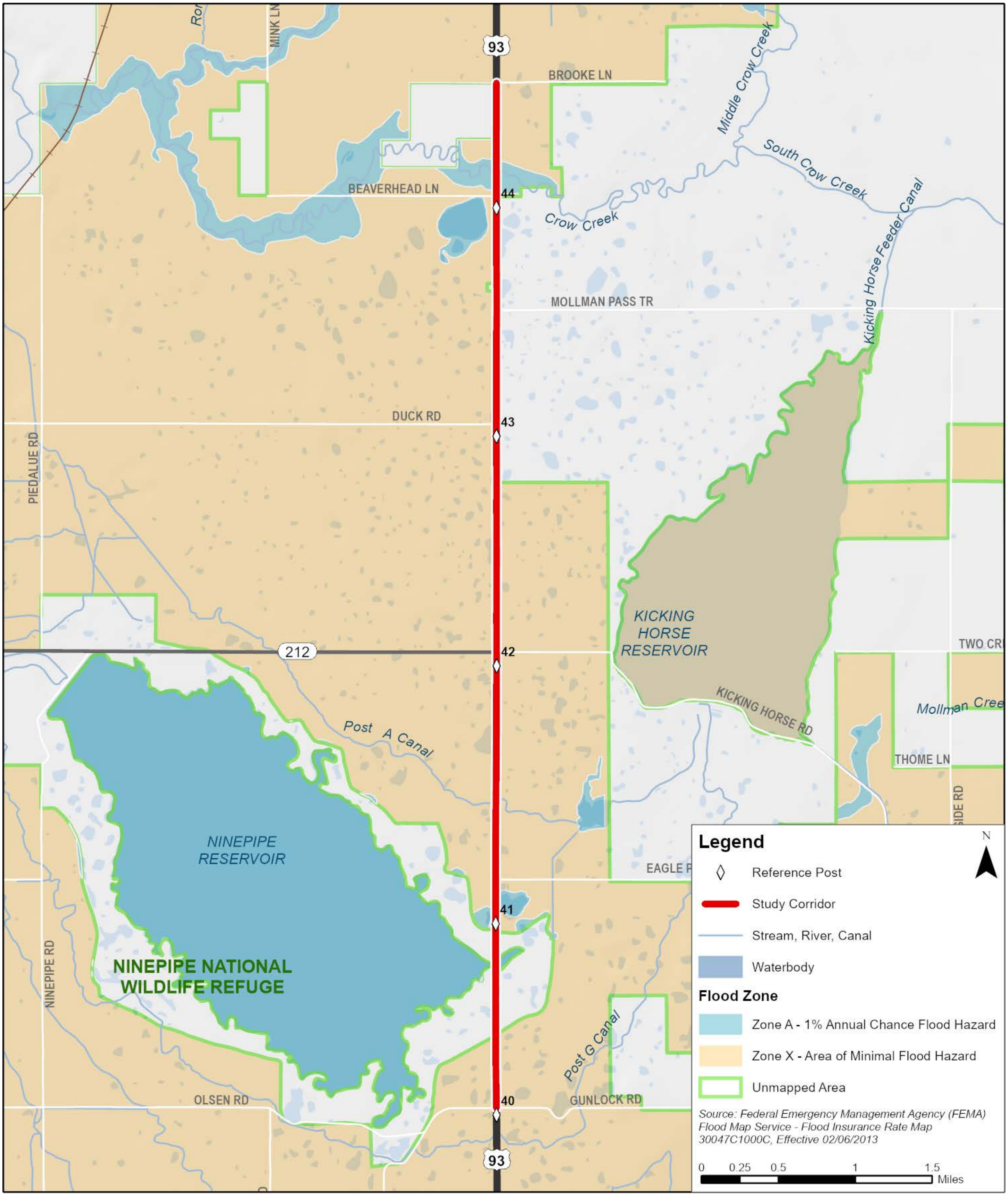

Figure 5: Floodplains and Streams

7.0. WILDLIFE

As noted in the SEIS, the Ninepipe area supports an abundance of wildlife due to the diversity of habitats in the vicinity and protected land status associated with the Ninepipe National Wildlife Refuge. The refuge includes a 1,672-acre reservoir and nearly 400 acres of surrounding grasslands. Additional grassland areas surrounding the refuge include nearly 3,500 acres of state Wildlife Management Areas, approximately 3,000 acres of Tribal lands, many of which are dedicated to wildlife and wildlife habitat uses, and 2,000 acres of USFWS conservation easements and Waterfowl Production Areas (WPAs). The proximity of Flathead Lake, the Pablo National Wildlife Refuge, and the Mission Mountain Range also contribute to the abundance of wildlife in the project area.

The abundant wildlife species are highly valued by the CSKT for their cultural significance. Understanding wildlife presence, habitat use, and movement characteristics are important for this feasibility study in order to accommodate wildlife movements, minimize potential impacts from future improvements to the US 93 corridor, and understand the feasibility and appropriate location of the proposed crossing structures included in the SEIS. **Appendix D** provides additional information about the wildlife analysis conducted for this study.

7.1. Methods

For the 2008 SEIS, wildlife presence and habitat use were determined through field investigations, review of previously developed reports and studies, and interviews with federal, Tribal, local, and university biologists representing the USFWS, CSKT, the Owl Research Institute, and the University of Montana Cooperative Wildlife Research Unit.

For this feasibility study, information from a literature review was supplemented by updated crash and carcass data, multiple resource agency meetings, and individual discussions with Tribal, state, and federal wildlife agency representatives.

7.2. Key Findings and Changed Conditions

BIRDS

The SEIS noted numerous birds within the Ninepipe area, including 188 different bird species observed on the Ninepipe and Pablo National Wildlife Refuges. The most abundant bird group was waterfowl, with the highest numbers occurring in the spring and fall during peak migration periods. Waterfowl nesting occurs generally from April until July, and it was noted that the Ninepipe area was known to have some of the highest nest success rates in North America for the upland nesting duck. **Table 4** lists some of the most common bird species noted to occur within or near the study corridor.

Table 4: Birds Occurring Within Study Area

Bird Group	Species
Ducks	Redhead, ruddy duck, canvasback, lesser scaup, ring-necked duck, mallard, pintail, wigeon, green-winged teal, blue-winged teal, cinnamon teal, northern shoveler
Other Waterfowl and Waterbirds	Canada goose, snow goose, merganser, goldeneye, bufflehead, swan, trumpeter swan, western grebe, great blue heron, cormorant, American bittern, sora rails, Wilson's phalarope, Forster's tern loon
Shorebirds	Long-billed curlew, American avocet, black-necked stilt, common snipe, spotted sandpiper, killdeer
Raptors	Rough-legged hawk, northern harrier, red-tailed hawk, Swainson's Hawk, short-eared owl, great gray owl, barred owl, barn owl, western screech owl, saw whet owl, pygmy owl, great-horned owl, long-eared owl, bald eagle
Passerine	Swallow, magpie, horned lark, marsh wren, American robin, common yellowthroat, house sparrow, western meadowlark, sparrow, yellow-headed and red-winged blackbirds

Source: 2008 SEIS.

The study area is notable for the numerous species and numbers of birds it supports. The Ninepipe National Wildlife Refuge is included in an Audubon Society Important Bird Area (IBA). The IBA consists of the national wildlife refuge, and the Montana Fish Wildlife and Parks Ninepipe Wildlife Management Area that surrounds the refuge. Ninepipe Reservoir supports breeding colonies of western grebes, red-necked grebes, double-crested cormorants, great blue herons, California gulls, Ring-billed gulls, and yellow-headed blackbirds. At least 11 species of ducks nest here, as well as small numbers of American bitterns and Caspian terns. Thousands of waterfowl, mostly Canada geese and mallards, congregate in ice-free areas on the reservoir during some winters, and Bald Eagles also are relatively common during the winter.[13]

Spring migration peaks from late March to early May when as many as 100,000 birds may be observed. Fall populations often peak to more than 200,000 birds in early October to late November. Waterfowl nest from April until July.[14]

The SEIS reported high levels of mortality for nongame birds, upland gamebirds, and waterfowl for the segment of roadway that crosses the core pothole area in the Ninepipe segment. The CSKT have confirmed large numbers of birds are killed on the highway, although no updated data are available.

MAMMALS

The SEIS identified a variety of mammals occurring within the Ninepipe area, including grizzly bears, whitetail deer, muskrats, badgers, beavers, striped skunks, raccoons, weasels, mink, river otters, ground squirrels, coyotes, red fox, field mice, shrews, and montane and meadow voles. Additionally, transient species likely to travel through without actively breeding in the area included black bear, bobcats, and porcupine.

The area was noted to provide foraging opportunities for grizzly bears including eggs, small mammals, aquatic vegetation tubers, aquatic insects, and mollusks. Surrounding grasslands provide foraging habitat for deer, skunks, weasels, coyotes, red fox, mice, and voles. Riparian wetlands were assumed to support beavers, muskrats, mink, deer, and various other species, with additional species likely using riparian areas as cover during movement. Species of bat likely to occur within the area include the little brown bat, big brown bat, Yuma myotis, and western small-footed myotis.

AMPHIBIANS AND REPTILES

The SEIS summarized amphibian and reptile occurrence based on a 1998 study conducted by Werner et al,[15] which involved a field survey of multiple sites including locations within the Ninepipe area. Based on this study, common reptile species included western terrestrial garter snakes, western painted turtle, and the western garter snake. Snakes are expected in grasslands near water, roadside ditches, and streams. Painted turtles are abundant in the area. They occur in ponds and lakes and migrate to upland areas to lay their eggs. The SEIS noted movements greater than several hundred meters are not uncommon.

Incidental observations noted the presence of two spotted frogs in the Ninepipe segment. No evidence of breeding was noted. Other amphibian species that may occur in the area include long toed salamanders, pacific tree frogs, and western toads. These species breed in temporary or permanent ponds.

A study completed in 2006 contains the most recent data on turtles in the Ninepipe vicinity[16]. A total of 1,040 turtles were killed in the Ninepipe segment in that period. The study showed hot spots for turtle mortality at Kettle Ponds 1 and 2 (RP 41.8/42.5) and south of the Beaverhead Lane turnout (RP 44.1). All three of these areas also appear to have important nesting areas on and adjacent to the road banks. Hydrology of the ponds was a more important influence on turtle movements than distance to the highway. For example, at Beaverhead Lane, when the pond on the east side of the highway began to dry out turtles moved to the permanent pond on the west side of the highway. Although a complete survey of turtle carcasses was not performed for this study, at least 50 carcasses were observed on the road shoulders between Kettle Ponds 1 and 2, indicating that there are still large numbers of turtles being killed there and in other areas along the Ninepipe segment. The CSKT have noted that many people are concerned and stop to try to help turtles, creating a danger on the highway.

SPECIES OF CONCERN

The SEIS reported five wildlife species of concern that may occur in the Ninepipe area, including the common loon, Caspian tern, Forster's tern, trumpeter swan, and bald eagle. Of these, documented occurrence has been recorded for Forster's tern loon (with nesting reporting within 0.25 mile of the corridor) and bald eagle (with wintering individuals observed near RP 41.5). The SEIS noted wintering bald eagles are found throughout the valley in the early part of the winter season. After freezing conditions occur, eagles congregate in areas with open water, such as Post Creek, Ninepipe Reservoir, and Flathead Lake, to prey on waterfowl, particularly coots. Around mid-February when the calving season starts, eagles are distributed throughout the valley, foraging on after-birth.

THREATENED AND ENDANGERED SPECIES

Several threatened and endangered species were mentioned in the SEIS. **Table 5** lists the only one determined likely to occupy the Ninepipe area.

Table 5: Threatened and Endangered Species – Ninepipe Area

Species	Federal Status (2008)	Occurrence In Study Area
Grizzly Bear	**Listed as Threatened**	Grizzly bears range into the Ninepipe area in the spring through late fall. The species utilizes the area for foraging (eggs, small mammals, succulent aquatic vegetation and tubers). The area also seems to provide an escape area for young dispersing males or females with cubs evading aggressive male bears. Grizzly bears likely access the study area from the Mission Mountains by way of the Post Creek riparian area and the Crow Creek riparian area.

Source: 2008 SEIS.

The SEIS noted the US 93 corridor is located on the western front of the Northern Continental Divide Ecosystem (NCDE) grizzly bear recovery area, which roughly corresponds with the northern Rocky Mountain Range. From this recovery area, grizzly bears range into the Ninepipe area in the spring through late fall and occasionally cross US 93.

Grizzlies forage on sedges and grasses and hunt for rodents on Ninepipe National Wildlife Refuge and surrounding lands.[17] Grizzlies use the area around Kicking Horse Reservoir and the shelterbelts west of the highway. They also travel along the Post G canal that crosses Eagle Pass trail, and cross US 93 along Post A canal. The canal maintenance roads provide cover with trees along the roads.

As of 2021, at least 37 female bears whose home range includes the bear management unit located immediately east of the Ninepipe segment are monitored using GPS collars. Of these, 22 GPS-collared female grizzly bears have home ranges on the west slopes or east and west slopes of the Mission Range. The data from these collared bears showed that bears frequent the Post Creek riparian corridor, the foothills habitat east of Kicking Horse Reservoir, and the Ninepipe National Wildlife Refuge.[18]

WILDLIFE MOVEMENT CORRIDORS AND MORTALITY

The SEIS noted that although US 93 is a barrier to most species, wildlife still frequently cross the corridor. Mammals typically cross at locations where vegetation and topography provide adequate cover for secure movement between suitable habitats. However, white-tailed deer often cross in random patterns, as indicated in carcass data from 1998-2005 presented in the SEIS and in more recent carcass data provided by MDT for the period 2015-2019 (**Table 6** and **Figure 6**). Crash data from 2015 to 2019 indicate animal strikes were distributed throughout the corridor. During the five-year analysis period, 28 total wild animal crashes occurred along the corridor. No species information was provided with the crash data. Based on discussion with wildlife agency representatives, carcass data likely are not representative of wildlife mortality in the Ninepipe segment.

Table 6: Carcass Data

Location	Carcass Data (1998-2005)	Carcass Data (2015-2019)
RP 40.0 to 40.5	6 deer	1 whitetail deer
RP 41.2 to 41.8	10 deer	1 whitetail deer
RP 42.2 to 42.9	4 deer	none
RP 43.0 to 43.9	6 deer	3 whitetail deer
RP 44.0 to 44.8	4 deer, 1 coyote	2 whitetail deer

Source: 2008 SEIS and MDT 2021.

Since 2020, the CSKT have started documenting animal carcasses using electronic records that are updated in real time. The data indicate that white-tailed deer cross the highway at random locations, and they represent the majority of wildlife killed in the Ninepipe segment. Resource agency representatives noted black bear collisions are rare in the Ninepipe segment.

Within the Ninepipe segment, the SEIS noted wildlife crossings are centered around the core pothole area from RP 39.4 to 44.1, with high levels of mortality for nongame birds, upland gamebirds, waterfowl, small mammals, amphibians, and reptiles. Painted turtles were the most commonly struck species based on surveys conducted between Gunlock Road (RP 40.0) and Beaverhead Lane (RP 44.0) from July to September 2002 and from May to September 2003 and 2004. After reptiles, which primarily represented turtles, birds were the second most commonly struck wildlife recorded from 2002 to 2004. Commonly struck birds included swallows, blackbirds, and grouse/pheasants.

Grizzly bears are known to cross the highway in the Crow Creek vicinity, including the riparian corridor at RP 44.2 and adjacent areas. The SEIS noted that while its value is limited by the proximity of homes, lack of vegetative connectivity, and lack of dry land passage for wildlife underneath the US 93 crossing over Crow Creek, grizzly bears were suspected to use this corridor to travel from the Mission Mountains to the Moiese Hills west of Charlo. The SEIS reported that three grizzly bears had been struck and killed in the Ninepipe area, one of which was killed near the Ninepipe Reservoir and two in the Post Creek vicinity in 2001 and 2002.

Since 2008, Tribal biologists have continued monitoring bear movements and have documented hot spots for grizzly presence in the Ninepipe segment. Based on GPS collar data, high use has been documented in the Crow Creek riparian area east of US 93 and in the area between Ninepipe and Kicking Horse reservoirs on both sides of the highway. The CSKT have indicated other areas within the Ninepipe segment probably are not preferred crossing corridors, although bears may feed on carcasses in those areas.

A total of 45 highway crossings by nine different bears were documented in the Ninepipe vicinity from 2007 to 2019.[19] Although grizzlies were observed crossing throughout the Ninepipe vicinity, there appeared to be a concentration of crossings close to where US 93 crosses Crow Creek. Most of those crossings involved females with cubs (28 crossings by 3 individuals) or females with yearlings (11 crossings by 2 individual mothers). Timing of crossings was estimated as the midpoint between successive locations and most crossings appeared to occur at night, dawn, or dusk hours when traffic volumes are likely lower and when light conditions reduce motorists' visibility.

The US Highway 93 Evaro to Polson consultation between the USFWS and FHWA was reinitiated in 2012 because incidental take of grizzly bears that occurred under the 2005 Biological Opinion had been exceeded due to grizzly bear-vehicle collisions. Subsequently, the USFWS 2020 Biological Opinion noted that grizzly bear occurrences have been increasingly documented outside the NCDE recovery zone line, suggesting that the grizzly bear population is expanding since completion of the SEIS.[20]

From 2004 to 2019, there were 61 vehicle-caused grizzly bear mortalities in the NCDE including a 10-mile buffer. Within the NCDE, grizzly bear mortalities from vehicle collisions have increased significantly since 2000 and have notably accelerated since 2010.[21] From 1990 to 2019 the number of mortalities or incidents that occurred per mile of road on US 93 was roughly 10 times higher within the Evaro to Polson corridor compared to other highways in the NCDE.[22] The NCDE Monitoring Team and CSKT documented 11 grizzly bear mortalities during eight different incidents in the Ninepipe vicinity during 1998 to 2021. Two grizzly bear-vehicle collisions have occurred since 2020. One was hit by an ambulance in 2020 and one (a cub) was hit near the Post A irrigation canal.

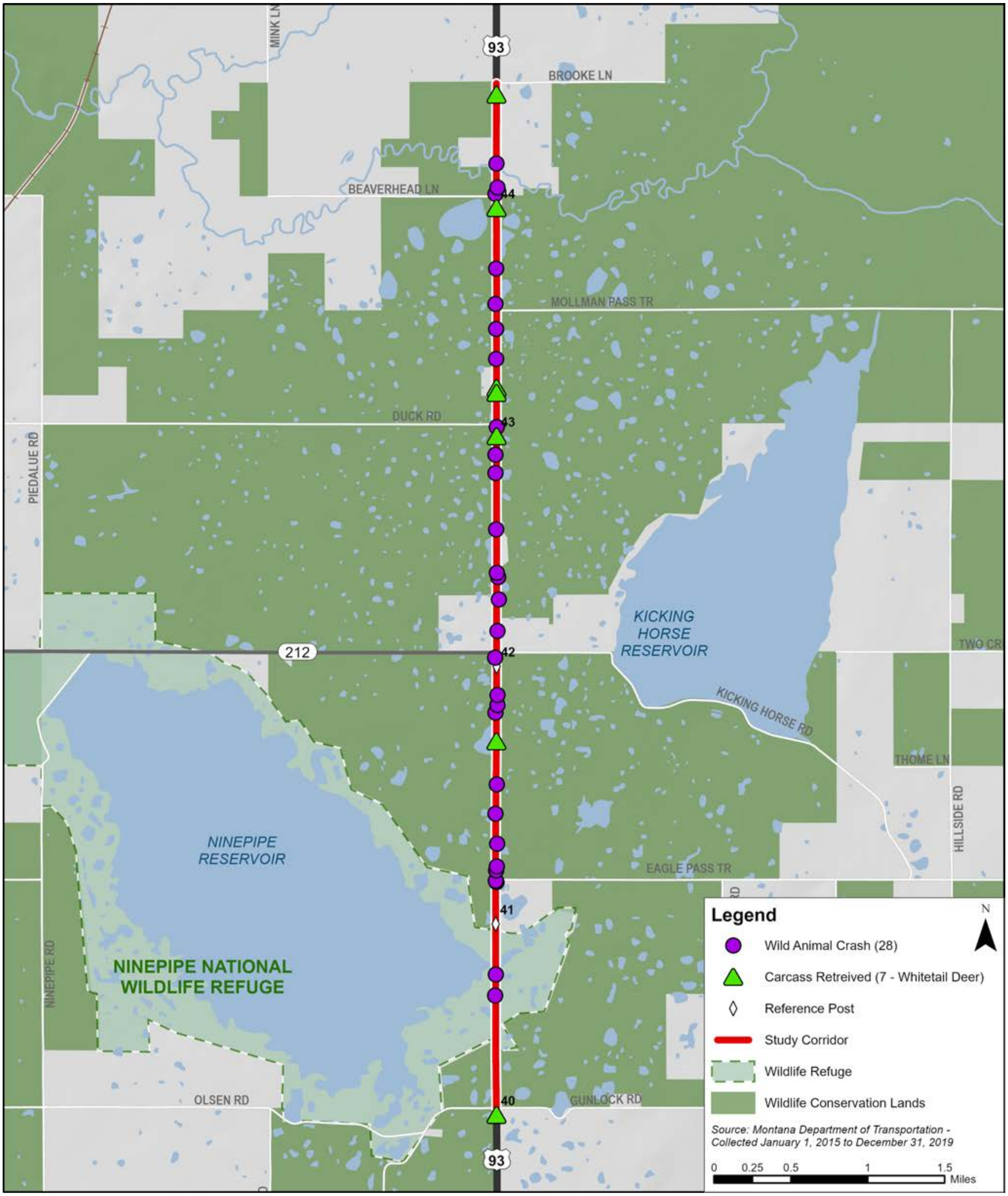

Figure 6: Wild Animal Crash and Carcass Data (2015-2019)

8.0. CULTURAL RESOURCES

The Mission Valley holds exceptional cultural value to the CSKT. As noted in the 2008 SEIS, archaeological evidence and oral tradition suggest that Tribal groups have inhabited the region for 12,000 years, and their continuous interaction with the land has resulted in specific cultural values, traditions, practices, and resources that persist today. Traditional cultural resources comprise an ethnographic landscape that mirrors the systems of meanings, ideologies, beliefs, values, and worldviews shared by a group of people who have inhabited a particular place over a long period of time. The ethnographic landscape contains resources that may be in physical form, such as archaeological sites, as well as resources that may occur in less apparent form, such as geological landforms, cultural plants, and animals. The Salish and Kootenai Cultural Committees, and the CSKT Tribal Preservation Office (TPO) are the primary repositories of traditional cultural knowledge and information, and the authoritative voice on the cultural significance of all these resources.

Federal laws, regulations, executive orders, policies, and guidelines require transportation officials to identify, evaluate, and protect cultural resources. For this feasibility study, it will be important to understand cultural resources occurring within the Ninepipe segment and ultimately to assess how potential future improvements to the US 93 corridor may affect culturally significant features and sites.

8.1. Methods

The 2008 SEIS used various methods to identify cultural resources within the US 93 corridor, including landscape analysis, archival and document research, records search, vehicle and pedestrian field surveys, Tribal elder interviews, and consultation with the CSKT TPO.

A cultural resource study of the US 93 corridor from Evaro to Polson, MT, was conducted by the CSKT TPO under a contract with MDT in 2004[23]. The study was conducted in response to CSKT concerns that tribal cultural resources were not adequately addressed during US 93 cultural resource studies conducted in the 1980s and 1990s.

Investigations conducted for this feasibility study included a records search of the Montana State Historic Preservation Office (SHPO) and review of major studies, decisions, and agreements relating to cultural resources within the Ninepipe corridor.

Additional coordination with the TPO and Culture Committees is planned for Spring 2022.

8.2. Key Findings and Changed Conditions

The cultural resources investigation conducted for this feasibility study identified three previously identified resources within the Ninepipe segment of US 93, including two vernacular resources and one ethnographic resource. Vernacular resources include properties that are listed or eligible for listing on the National Register of Historic Places (NRHP) based on age, significance, and integrity. Ethnographic cultural resources include plants and animals that have special cultural values as well as traditional cultural places such as archaeological, sacred, and cultural sites, features, and trails, and CSKT living cultural landscapes (including camas fields, streams, forests, prairies, and wetlands).

VERNACULAR RESOURCES

Flathead Indian Irrigation Project (FIIP) (24LA0091): The FIIP is a large and complex system that contains thousands of associated structures and over 1,300 miles of canals. US 93 crosses or parallels multiple primary and lateral canals of the FIIP. The only site number and site form for the FIIP does not document the canal features in the vicinity of Ninepipe segment.

Stagecoach Route (No Site Number): The 2008 SEIS discussed a historic stagecoach route present within the Ninepipe segment that roughly follows the US 93 corridor through the Mission Valley. The route, currently visible as a dirt road, follows the southwest edge of the Ninepipe Reservoir before crossing US 93 and continuing in a northeast direction through USFWS management lands. The SEIS noted that portions of the old road are still visible in the Ninepipe area, and the remains of an old collapsed wooden bridge are visible at a canal crossing along the historic route. No site form is available, and a formal site number has not been issued for the route. According to the SEIS, the property was determined eligible for listing on the NRHP under an agreement between MDT and the SHPO, however, no record of this agreement was identified during the 2021 records search.

ETHNOGRAPHIC RESOURCES

Ninepipe Cultural Property (SKP-LA-284): The Ninepipe cultural site encompasses the entire Ninepipe segment adjacent to US 93. It is documented by the CSKT TPO as a traditional cultural property due to its unique qualities as an environmentally rich area of kettle lakes and glacial wetlands[23]. The rich geological history of the area adds to its cultural significance. The site covers an area centered on US 93 extending from the Crow Creek crossing of US 93 south nearly 5 miles to the southern end of Ninepipe Reservoir. The site area encompasses innumerable small kettle lakes, streams, and Ninepipe and Kicking Horse Reservoirs. The Mollman Pass Trail is located near the northern portion of the site. The site offers an extremely diverse and rich wetland setting with abundant riparian vegetation and small ponds that offer habitat to a variety of large and small mammals, reptiles, birds, native fish, and an abundance of economic cultural plants. The area was also used as a recreational site by tribal members for horse racing and informal family gatherings.

9.0. GEOLOGY AND SOILS

It is important to understand geological, soils, and groundwater conditions to determine if constructability challenges exist within the Ninepipe segment related to slope stability, liquefaction risk from seismic activity, settlement issues, and artesian conditions. On a separate project in the Post Creek Hill segment of US 93 immediately south of the Ninepipe area, MDT encountered artesian groundwater conditions along with challenges associated with soft soils. These conditions created difficulties during fieldwork and during design to achieve acceptable structure performance under the seismic design event. **Appendix E** provides additional information about the geotechnical analysis conducted for this study.

9.1. Methods

To support the SEIS analysis, a site reconnaissance was conducted in the fall of 2002 to review geological and soils conditions in the corridor. The project team also conducted a review of published maps and literature, a review of files in the MDT Geotechnical Section, and an interview with the MDT Engineering Services Supervisor in the Missoula District.

For the feasibility study, cone penetrometer testing (CPT) was performed to evaluate the general strength and compressibility of the soils. The CPT soundings were performed instead of more standard hollow-stem auger (HSA) borings to enable measurement of groundwater pressure and minimize soil disturbance. Additionally, potential artesian groundwater pressure was measured using vibrating wire piezometers. A total of 14 CPT soundings were performed at wildlife crossing structure locations proposed in the SEIS and at other locations of interest. Two wire piezometer readings were also conducted at the northern and southern ends of the Ninepipe segment.

9.2. Key Findings and Changed Conditions

SOILS

As displayed in **Figure 7**, the geologic units within the vicinity of the study corridor include shallow alluvium, glacial till, and coarse- and fine-grained lake deposits. The SEIS noted that depth to bedrock varies from 200 to 300 feet, with soils generally composed of sands and gravels overlain by coarse- and fine-grained lake deposits (generally gravels, silts, and clays), which are further overlain in some locations by shallow alluvium (mostly sands and gravels).

At the time of the SEIS, deep sands and gravels were assumed to be approximately 100 feet or less in thickness beneath the study corridor, and the overlying lake sediments were assumed to be approximately 100 feet or more in thickness. Shallow alluvium was noted to occur from the US 93/MT 212 intersection north to the end of the study corridor. Between this location, lake sediments were noted immediately beneath the surface soils, with a thickness of approximately 50 feet.

In general, CPT soundings conducted in 2021 encountered similar soils which consisted primarily of relatively soft clays, silts, sands. Dense bearing layers were encountered in seven of the eight structure-related soundings at depths ranging from 50 to 80 feet, with the depth increasing as the project extends north towards Crow Creek. In sounding CPT-8, a dense bearing stratum was not encountered to the termination depth of 160 feet.

SEISMIC RISK AND LIQUEFACTION

The corridor is mapped as Earthquake Zone 2b, indicating earthquake motions equaling 20 to 30 percent of the acceleration of gravity have a 10 percent probability of occurring during any given 50-year period. Such motions are sufficiently strong to result in slight to moderate damage in ordinary well-built structures. The Mission fault is located along the west base of the Mission Mountain Range approximately 4.25 miles east of the US 93 corridor. The SEIS noted that certain soils including loose, saturated, sandy alluvial material are susceptible to liquefaction, indicating they can lose strength and temporarily behave like liquids during an earthquake. Roadways and structures supported by susceptible soils can sustain damage during an earthquake if not properly mitigated. The SEIS noted liquefaction could be a concern in alluvial deposits associated with Crow Creek. Analysis conducted in 2021 confirmed that minor liquefaction can be expected in all locations analyzed.

GROUNDWATER

The SEIS noted that depth to groundwater varies throughout the corridor, with groundwater likely at shallow depths (less 100 feet) in the Crow Creek area and possibly elsewhere in the vicinity. The groundwater surface was calculated to be between 10 and 15 feet below the ground surface in the CPT soundings. The two piezometers installed to monitor long-term conditions also showed groundwater levels below the ground surface, and evidence of artesian conditions was not observed.

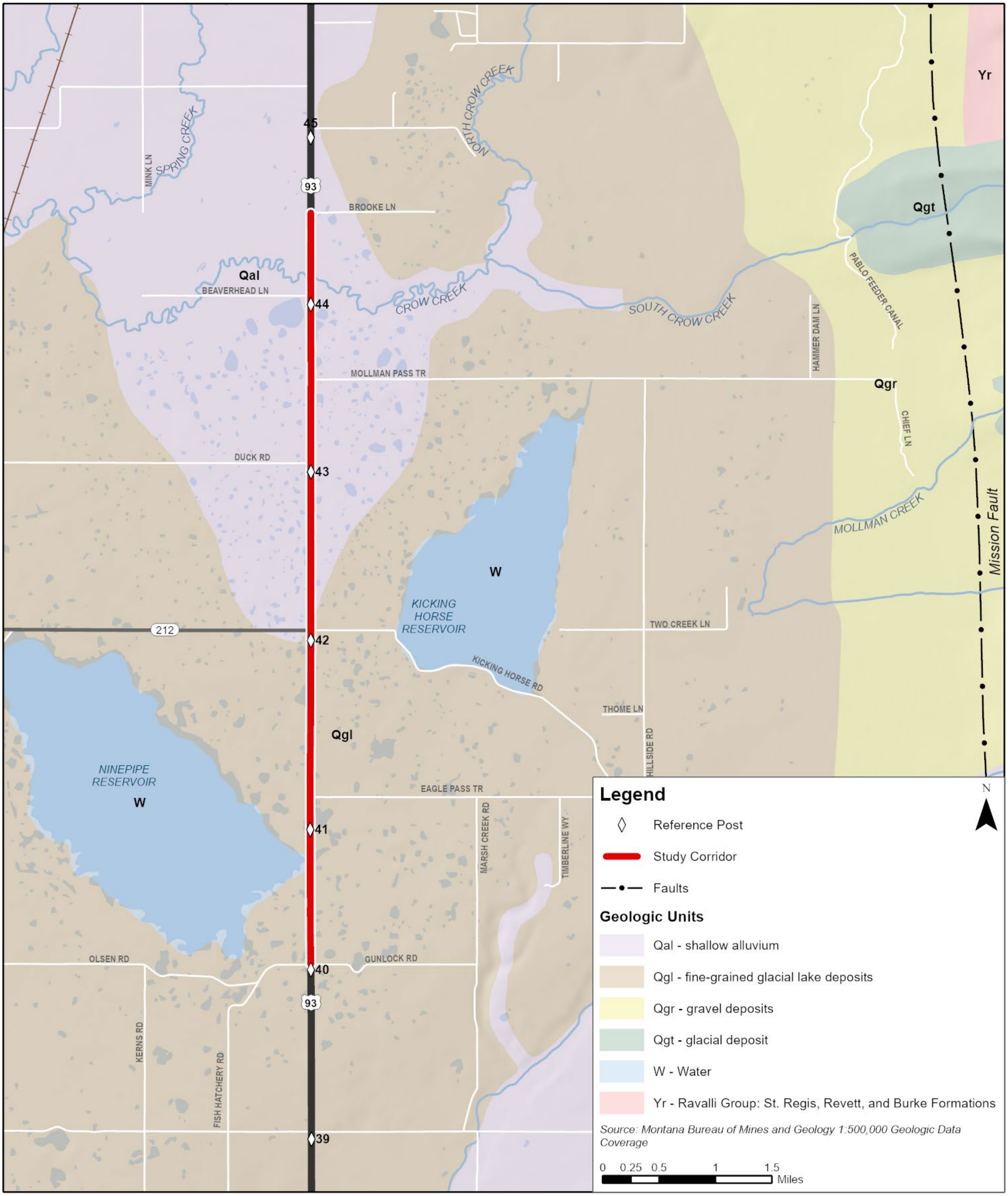

Figure 7: Geologic Units Immediately Beneath the Soil Layer

10.0. SUMMARY OF KEY FINDINGS AND CHANGED CONDITIONS

The following sections summarize key findings and conditions that have changed since the time of the 2008 SEIS. This information will be used to support the feasibility analysis, including development of costs and identification of impacts and constructability challenges associated with proposed improvements to the US 93 corridor.

Traffic and Safety

- 2020 AADT volumes are similar to those documented for the year 2000 in the SEIS, with substantial variation from year to year.
- Peak summer traffic volumes are approximately 35 percent higher than those during an average day throughout the year.
- The corridor operates similarly to 2008 conditions. Traffic analyses concluded that the corridor currently operates at LOS of D, below recommended levels. The corridor is projected to continue to operate at LOS D or deteriorate to LOS E depending on future traffic growth.
- The existing highway facility is not well suited to accommodate non-motorists due to high speeds, high traffic volumes, and lack of dedicated facilities.
- Crash rates have increased in comparison to the SEIS findings, however, the severity of crashes has decreased.
- The most common crash type is wild animal crashes, followed by fixed object and rear-end.

Land Use

- The majority of the study corridor is surrounded by public lands, which are managed to support and preserve wildlife.
- Twelve private landowners own parcels adjacent to the study corridor.
- The updated land use inventory shows similar usage as found in the 2008 SEIS inventory.
- The recommended right-of-way width along the corridor is 160 feet for the preferred alternative. Generally, this minimum width is available, with narrower areas near Eagle Pass Trail and Brooke Lane.

Wetlands

- Three new wetlands totaling approximately 0.09 acre were delineated at RP 42.0, RP 43.2, and RP 44.0.
- Of the 82 wetlands previously identified in the 2008 SEIS, minor changes were noted for 26 wetlands while boundaries for 56 wetlands remained unchanged.
- Three wetlands were reclassified from Category III to Category IV as a result of changes to the scoring methodology.
- No changes to preliminary jurisdictional status were made to previously identified wetlands.

Floodplains and Streams

- At the Ninepipe Reservoir, approximately 200 feet of US 93 roadway crosses the 100-year floodplain (a reduction of 150 feet since documented in the SEIS).
- At Crow Creek, approximately 675 feet of US 93 roadway crosses the 100-year floodplain (an increase of 125 feet since documented in the SEIS).
- Crow Creek flows through the Ninepipe segment between RP 44.1 and 44.2. Existing culverts may be inadequate to convey high water flows.

Wildlife

- Numerous birds occur within the Ninepipe area, including ducks and other waterfowl (the most abundant group), shorebirds, raptors, and passerine.
- The Ninepipe area supports a variety of mammals, including grizzly bears (listed as Threatened), whitetail deer, muskrats, badgers, beavers, striped skunks, raccoons, weasels, mink, river otters,

ground squirrels, coyotes, red fox, field mice, shrews, and montane and meadow voles, and multiple bat species.

- Common reptile species include western terrestrial garter snakes, western painted turtle, and the western garter snake.
- Amphibians potentially occurring within the area include spotted frogs, long toed salamanders, pacific tree frogs, and western toads.
- Documented occurrence has been recorded for two species of concern, including Forster's tern loon (with nesting reporting within 0.25 mile of the corridor) and bald eagle (with wintering individuals observed near RP 41.5).
- Deer cross throughout the US 93 corridor and are most represented in carcass data. For other species, concentrated wildlife movement occurs near the core pothole area from RP 39.4 to 44.1 and in the Crow Creek riparian corridor at RP 44.2. Large numbers of birds and turtles are struck within the Ninepipe segment, particularly near the core pothole area.
- Since completion of the 2008 SEIS, grizzly bear occurrences have been increasingly documented outside the NCDE recovery zone line, suggesting that the grizzly bear population is expanding. Grizzly bears are active the Ninepipe segment, with high use documented in the Crow Creek riparian area east of US 93 and in the area between Ninepipe and Kicking Horse reservoirs on both sides of the highway. Grizzly bear mortalities from vehicle collisions have increased significantly since 2000 and have notably accelerated since 2010.

Cultural Resources

- Three previously identified cultural resources occur within Ninepipe segment of the US 93 corridor.
- The Flathead Indian Irrigation Project (24LA0091) includes multiple canals crossing or paralleling US 93.
- The Stagecoach Route (No Site Number) follows the southwest edge of the Ninepipe Reservoir before crossing US 93 and continuing in a northeast direction through USFWS management lands.
- The Ninepipe Cultural Property (SKP-LA-284) encompasses the entire Ninepipe segment adjacent to US 93 and is considered a traditional cultural property due to its unique qualities as an environmentally rich area of kettle lakes and glacial wetlands.

Geology and Soils

- Soils in the study area consist primarily of relatively soft clays, silts, and sands. Dense bearing layers were encountered in seven of the eight structure-related soundings at depths ranging from 50 to 80 feet, with the depth increasing as the project extends north towards Crow Creek. In sounding CPT-8, a dense bearing stratum was not encountered to the termination depth of 160 feet.
- Minor liquefaction can be expected in all locations analyzed.
- The groundwater surface was calculated to be between 10 and 15 feet below the ground surface. Evidence of artesian conditions was not observed.

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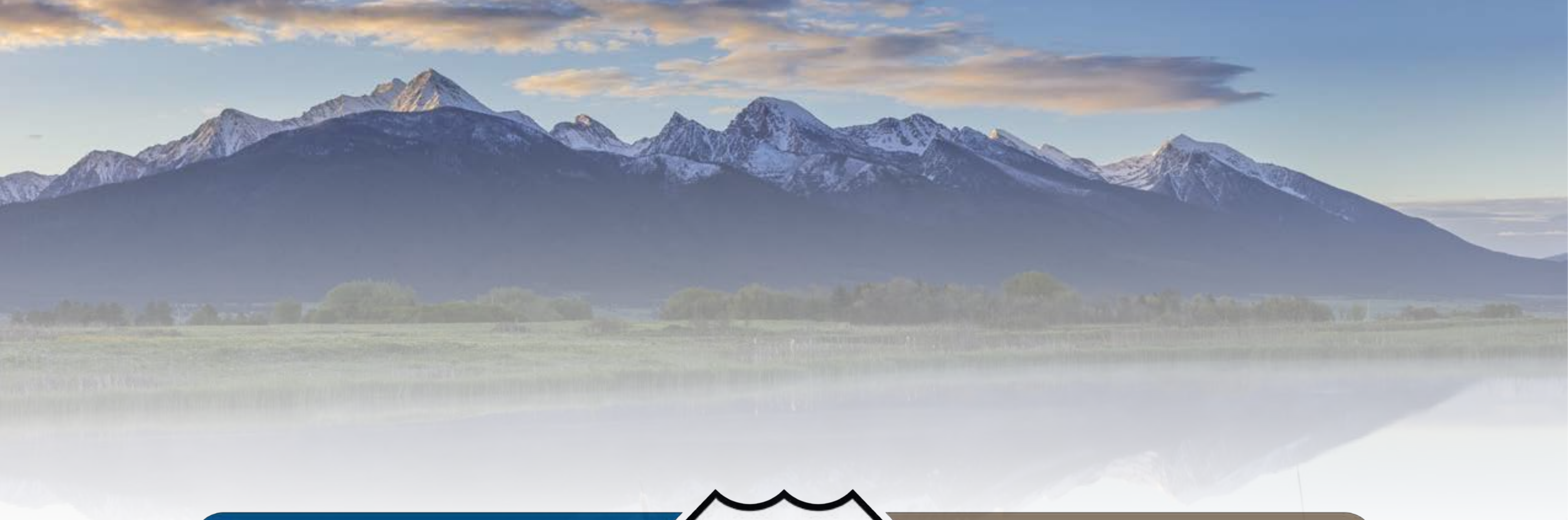

NINEPIPE CORRIDOR 93 FEASIBILITY STUDY

APPENDIX A:

Traffic and Safety Review Technical Memorandum

CIVIL ENGINEERING | TRANSPORTATION | PLANNING | SURVEYING

ROBERT PECCIA & ASSOCIATES

Technical Memorandum

HELENA, MT
KALISPELL, MT
BOZEMAN, MT

TO: Montana Department of Transportation
Statewide and Urban Planning Section

FROM: Robert Peccia and Associates
Scott Randall, PE, PTOE
Transportation Planning and Operations Manager

DATE: February 01, 2022

SUBJECT: US 93 Ninepipe Corridor Feasibility Study
Traffic and Safety Review Memo

ATTACHMENTS:

1. Traffic Data
2. Existing Conditions Operations
3. Projected Conditions Operations

1. INTRODUCTION

The Montana Department of Transportation (MDT) is developing a feasibility study of the Ninepipe segment of US Highway 93 (US 93) between Reference Points (RP) 40.0 at Gunlock Road and 44.5 at Brooke Lane. The intent of the *US 93 Ninepipe Corridor Feasibility Study* is to analyze the feasibility of the preferred alternative previously identified in the 2008 *Supplemental Environmental Impact Statement* (SEIS)[1]. The study will be a collaborative process between MDT, the Federal Highway Administration (FHWA), the Confederated Salish and Kootenai Tribes (CSKT), resource agencies, and the public to identify potential constraints and determine the viability of the preferred alternative as outlined in the SEIS. A study area map is shown in **Figure 1**.

The purpose of this memorandum is to review and update traffic and safety conditions within the study area. Historic traffic trends, existing traffic conditions, and crash history are analyzed and discussed in detail. The information in this memorandum is to be used to help determine if any conditions have changed or if there is new information related to traffic and safety that might influence development of the preferred alternative since identification in the SEIS.

[1] Montana Department of Transportation, *Final Supplemental Environmental Impact Statement and Section 4(f) Evaluation*, 2008, available at: https://www.mdt.mt.gov/pubinvolve/docs/eis_ea/eis_ninepipe.pdf

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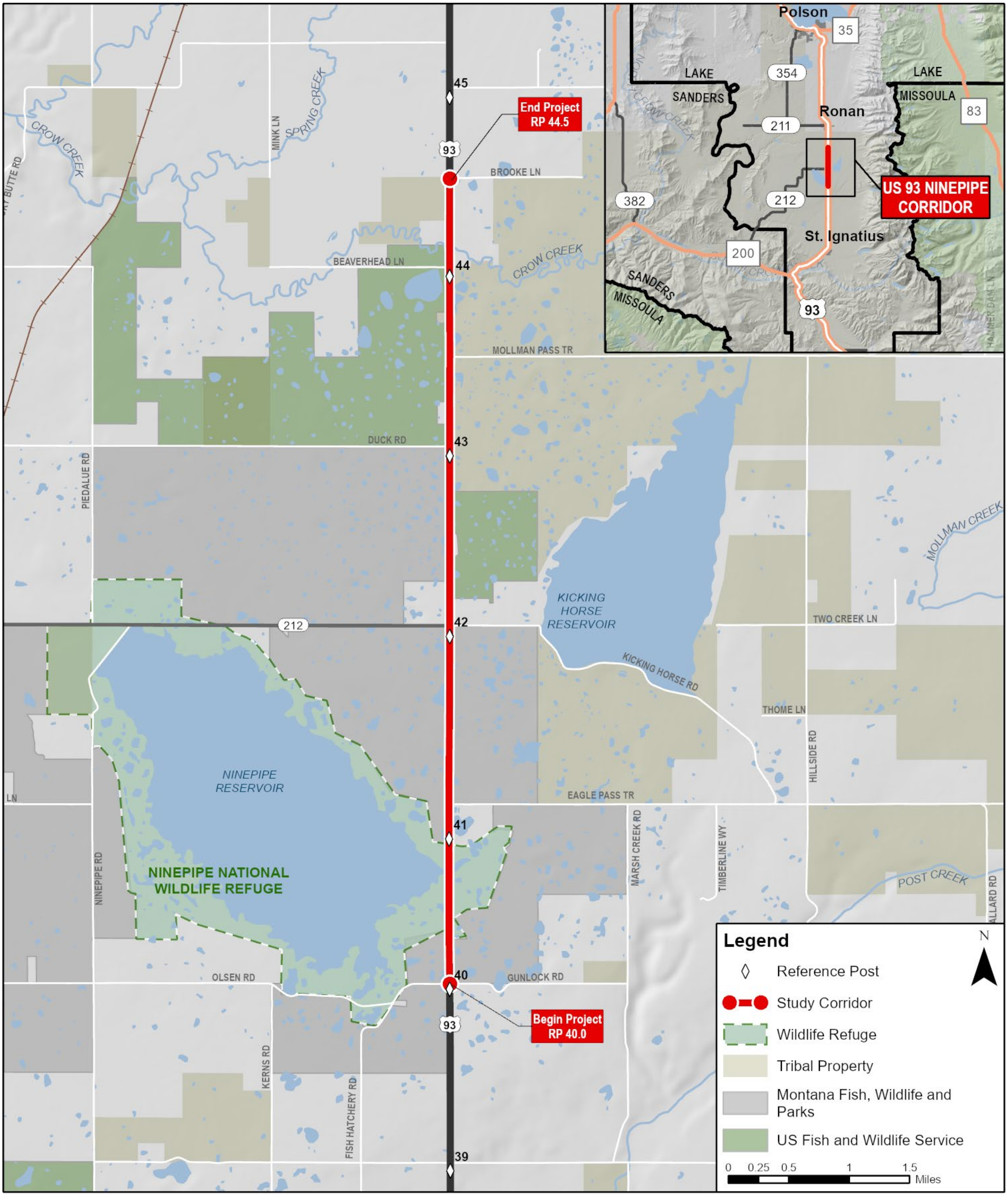

FIGURE 1: STUDY AREA

2. TRAFFIC CONDITIONS

US 93 is a National Highway System (NHS) Non-Interstate route that is important to the local, state, and nationwide transportation system. US 93 provides linkage between other highway routes and Interstate 90. US 93 serves as an access route to Flathead Lake and Glacier National Park, two popular destinations in northwest Montana.

Considering the importance of US 93 to the transportation network, the corridor experiences high traffic volumes and poor levels of service. The roadway consists of one travel lane in each direction and shoulders of varying width. Previous environmental documentation determined reconstruction of the corridor is needed to improve safety, provide multimodal accommodations, and to ensure that the corridor can operate efficiently under current and projected traffic conditions. The following sections provide a detailed review of traffic conditions for the study corridor.

2.1. Data Collection

Traffic volumes along the study corridor are typically collected annually as part of the Montana Department of Transportation (MDT) traffic data collection program. Two short-term collection sites are located along the study corridor, one on each side of MT Highway 212 (MT 212). The traffic data is used to determine average annual daily traffic (AADT) volumes which are adjusted for seasonal variation and represent conditions on an average day throughout the year. For both count sites, traffic data was last collected in 2018 with estimates made for current 2020 conditions. As of this writing, AADT counts are unavailable for 2021.

To supplement information provided by MDT, additional data were collected at five locations along the study corridor during the summer of 2021. At three of the locations, *Miovision* cameras were used to capture traffic volumes during a typical summer weekday. The cameras also collected data for vehicle classification types including passenger vehicles, buses, single-unit trucks, articulated trucks, and bicycles. At the remaining two data collection sites, pneumatic road tubes were used to capture vehicle speeds. The collected data was combined with other available information to document existing traffic conditions for the corridor.

2.2. Existing Traffic Volumes

Existing traffic volumes along the study corridor were established based on MDT's yearly traffic counts and supplemented with data collected in the summer of 2021. There are two annual MDT count sites, one on each side of MT 212, and three locations where supplemental data were collected, Beaverhead Lane, north of MT 212, and south of MT 212. The supplemental data was collected over a 48-hour period and averaged to represent a typical summer weekday. According to the data from 2020, AADT ranges from approximately 7,000 vehicles per day (vpd) south of MT 212 to just over 8,500 vpd to the north. Summer ADT volumes were approximately 35 percent higher in 2021 when compared to the average day in 2020. Daily traffic data for the study corridor is provided in **Table 1**.

Table 1: Existing Daily Traffic Volumes

Count Location	South of MT 212	North of MT 212	North of Beaverhead Ln
2021 ADT (Summer Weekday)[i]	**9,695**	**11,264**	**11,838**
Northbound	*4,811*	*5,602*	*5,954*
Southbound	*4,884*	*5,662*	*5,885*
2020 Average Annual Daily Traffic[ii]	**7,082**	**8,544**	**--**

[i] Data collected August 2021, unadjusted for seasonal variation.
[ii] Data provided by MDT, adjusted for seasonal variation to represent average annual traffic volume.

Traffic volumes were also evaluated for variation throughout the day to identify peak hour travel periods. Each of the three supplemental count sites were found to have similar time-of-day trends. Peak hours were identified as 7:30-8:30 AM, 11:30 AM -12:30 PM (Midday), and 4:30-5:30 PM. When looking at travel direction, the sites showed a small northbound peak between 6:30 AM and 8:00 AM, a second northbound peak at approximately 3:45 PM, and a southbound peak around 5:00 PM. The northbound

AM peak and southbound PM peak are indicative of commuter traffic traveling to and from work on the north end of the corridor. **Figure 2** shows the daily distribution of traffic recorded at the three count sites.

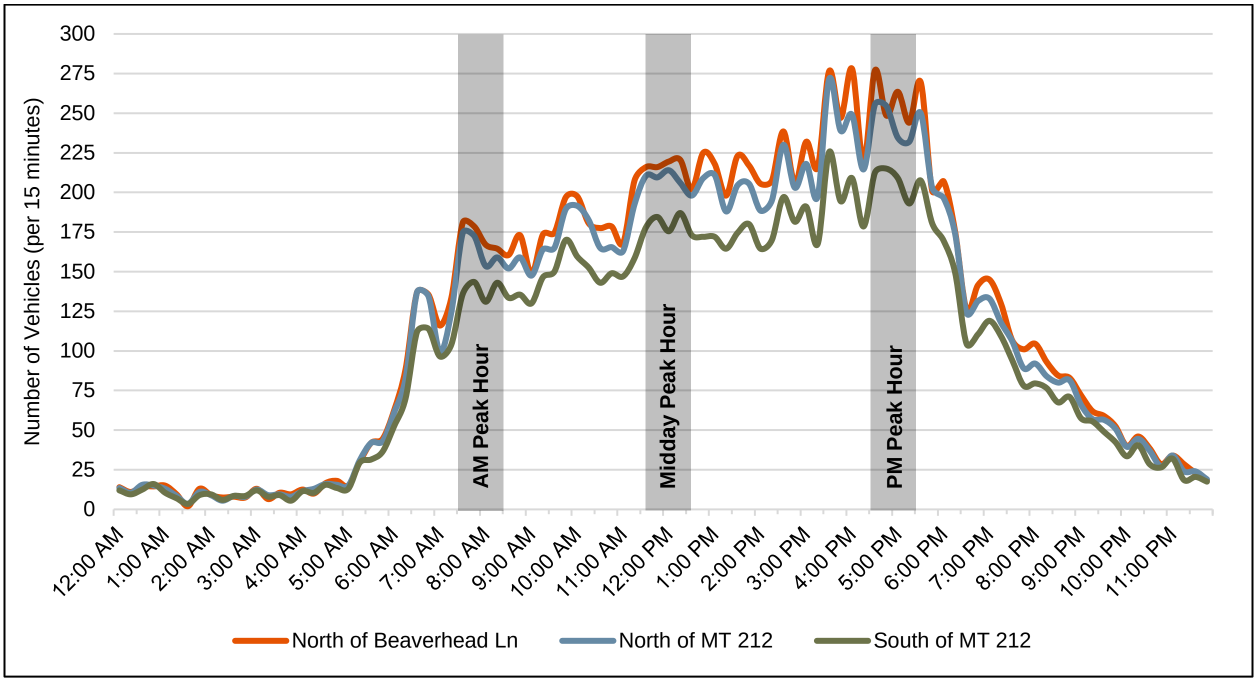

FIGURE 2: DAILY TRAFFIC VOLUME DISTRIBUTION (2021 SUMMER WEEKDAY)

2.2.1. Vehicle Classification

Vehicle classification information was collected as part of the data collected in August 2021. The vehicle classification was determined at three sites using the *Miovision* traffic data. For this evaluation, vehicles classified as single-unit trucks, articulated trucks, and buses were considered heavy vehicles. According to the data, heavy vehicle traffic accounted for approximately 7 to 8 percent of the total daily traffic during the summer weekday time period as shown in **Table 2**. According to MDT's AADT traffic count sites, business/commercial truck traffic accounted for approximately 6 to 7 percent of traffic along the corridor in 2020.

TABLE 2: HEAVY VEHICLE TRAFFIC (SUMMER WEEKDAY)

Count Location	South of MT 212	North of MT 212	North of Beaverhead Ln
Heavy Vehicles (% of traffic)	**760 (7.8%)**	**869 (7.7%)**	**851 (7.2%)**
Southbound	*372 (7.6%)*	*433 (7.6%)*	*419 (7.0%)*
Northbound	*388 (8.1%)*	*436 (7.8%)*	*432 (7.3%)*

2.2.2. Vehicle Speeds

Vehicle speed data were collected at two locations, north and south of MT 212. The locations were selected to ensure that traffic would be flowing in a steady manner. The speed limit within the study corridor is 70 mph during the day and 65 mph at night for passenger vehicles and 60/55 mph during the day/night for trucks.

The speed data was evaluated for average vehicle speed, 85th percentile speed, and 10-mph pace. The 85th percentile speed is the speed at which 85 percent of vehicles are traveling at or below, or the maximum speed that is expected 85 percent of the time. The 10-mph pace is the 10-mph range that includes the highest percent of vehicles. **Table 3** presents the speed data at both sites.

TABLE 3: SPEED DATA

Location	Direction of Travel	Speed Limit (mph)	Average Speed (mph)	85th percentile Speed (mph)	10-mph Pace (mph)
South of MT 212	Northbound	70.0	66.0	72.3	62.5 – 72.4
	Southbound	70.0	62.3	67.5	57.8 – 67.7
North of MT 212	Northbound	70.0	63.8	69.3	60.0 – 69.9
	Southbound	70.0	64.2	69.5	59.9 – 69.8

From the collected speed data, it was determined that traffic is generally traveling at or near the speed limit. The 85th percentile speeds are all within ±5 mph of the posted limits. The northbound direction generally has higher speeds than southbound, with the location south of MT 212 exhibiting the highest 85th percentile speed of 72.3 mph. All other sites and directions of travel had a 10-mph pace that was less than the posted speed limit.

2.2.3. Alternative Transportation Modes

There are no dedicated facilities for pedestrians and bicyclists along the study corridor. The existing roadway corridor has shoulders of varying width but are typically approximately six feet wide on each side. Minimal non-motorized activity was documented during the summer 2021 data collection effort with only two bicyclists counted during the 48-hour period. The existing highway facility is not well suited to accommodate non-motorists due to high speeds, high traffic volumes, and lack of dedicated facilities.

2.3. PROJECTED TRAFFIC VOLUMES

The selection of an appropriate growth rate for the corridor is important for forecasting future conditions. To help identify an appropriate growth rate, historic traffic conditions were evaluated. Historic growth rates for the study corridor can help project future conditions as past growth may be indicative of future growth. Since traffic volumes can vary greatly over short periods of time, an analysis of multiple years of historic data was conducted to more accurately project future conditions. AADT data for the past 20 years (2001 through 2020) are shown in **Figure 3**.

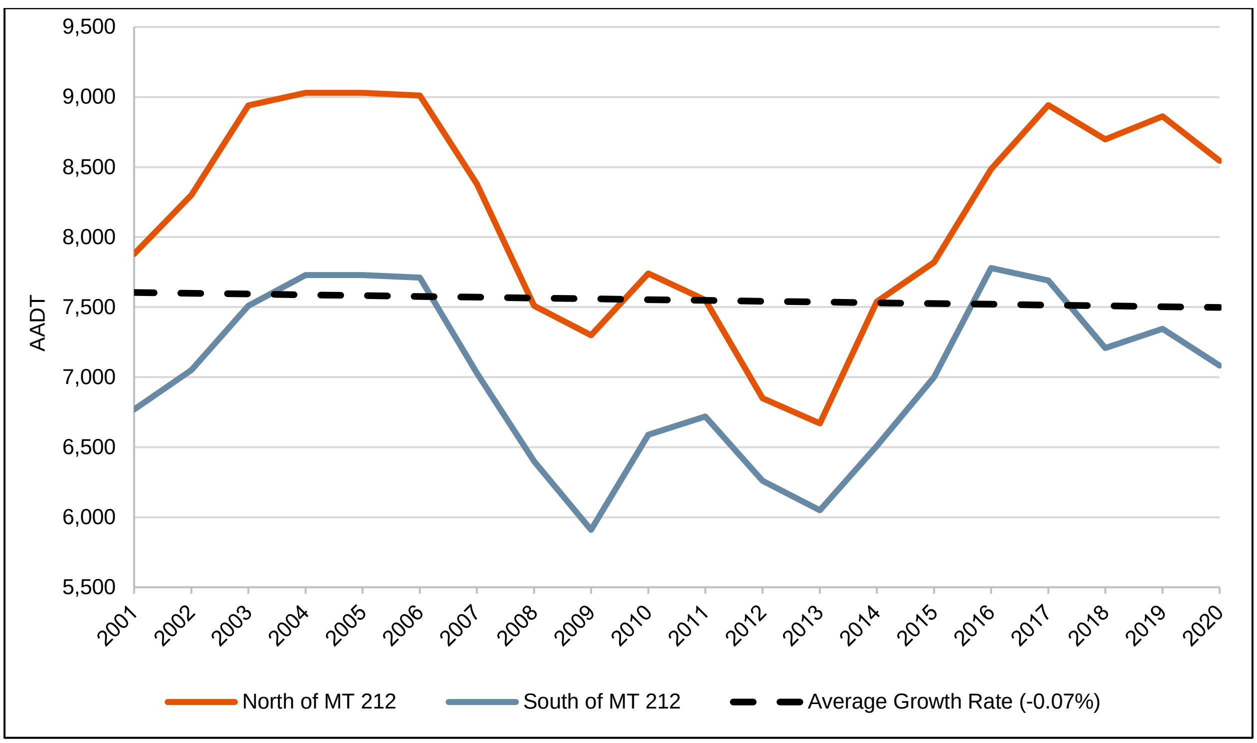

FIGURE 3: HISTORIC AVERAGE ANNUAL DAILY TRAFFIC

Figure 3 shows a sharp increase in traffic between 2001 and 2003, a plateau in volumes between 2003 and 2006, and then a sharp decline in traffic from 2006 to 2009. Between 2009 and 2013, traffic volumes were much lower than previous years. After 2013, traffic volumes increased quickly, reaching pre-construction volumes by 2017. Since 2017, volumes have tapered off and experienced some declines in recent years. The decline in traffic in 2020 may be attributed to the COVID-19 pandemic.

This depression in traffic volumes during the mid-2000s may be attributed to construction on various segments of US 93 during this timeframe. MDT performed about 15 construction projects on US 93 between Missoula and Kalispell from 2006 to 2013. These projects included regular maintenance, safety improvements, and major reconstruction. The reconstruction projects that included expanding the roadway to add capacity likely had the most impact on traffic volumes and travel patterns. Those projects are listed below:

- 2006: Minesinger Trail-MT 35 (RP 55.2 – 57.3)
- 2006: Vic White Coyote Rd-S Ravalli (RP 19.7 – 26.4)
- 2008: South of Ravalli-Medicine Tree (RP 26.4 – 31.3)
- 2009: Spring Creek Rd-Minesinger Trl (RP 48.3 – 55.5)
- 2009: Medicine Tree-Vic Red Horn Rd (RP 31.2 – 36.6)
- 2010: Mcclure Rd-N of Arlee Couplet (RP 12.5 – 18.2)
- 2010: Evaro-Mcclure Road (RP 6.1 – 12.5)

The AADT data for the previous 20 years were used to evaluate historic growth rates for the study corridor. The growth rates were calculated for 20-, 10-, and 5-year periods. As seen in the table and previous figure, volumes along the corridor vary considerably over the past 20 years. When averaged across the past 20 years, annual traffic growth has been negligible due to reduced traffic volumes between 2008 and 2014. More recently, traffic volumes have grown to values close to those experienced in the early 2000s. The existing AADT and historic growth rates are shown in **Table 4**.

TABLE 4: HISTORIC ANNUAL DAILY TRAFFIC GROWTH RATES

AADT Count Location		2020 AADT	Time Period		
			Past 20 Years (2001-2020)	Past 10 Years (2011-2020)	Past 5 Years (2016-2020)
24-3-004	**South of MT 212**	7,082	-0.04%	1.69%	-1.85%
24-3-027	**North of MT 212**	8,544	-0.10%	2.67%	0.04%
Corridor Average		**7,813**	**-0.07%**	**2.22%**	**-0.84%**

The information was also compared to traffic projections made in the SEIS. The SEIS provided additional data that were collected as part of the EIS process in the year 2000. For the SEIS, data were collected at an assortment of locations including rural ADT and urban turning movement counts. The count sites do not match those used by MDT but are in locations that are roughly equivalent and can be reasonably compared. Based on this information, the SEIS identified a future growth rate of 2.8 percent per year for rural portions of US 93. This value was based on historic traffic patterns seen at the time of its writing.

2.3.1. Projected Growth Summary

Since traffic volumes can vary greatly over short periods of time, an analysis of multiple growth scenarios was conducted to help project future corridor operations. Based on the heavily variable historic volumes and seasonal variation, three growth rates were identified to evaluate low, moderate, and high growth scenarios. The low growth scenario targets an annual growth rate of 1.0 percent per year. This represents slow growth over the next 25 years. For the moderate growth scenario, the average growth rate experienced from the past 10 years (2.22 percent) was used. This scenario represents conditions if traffic were to increase at rates similar to the past decade. The high growth rate of 2.8 percent matches the projections identified in the SEIS. These growth rates were applied to existing traffic volumes as shown in **Table 5**. As show in the table, daily traffic volumes are projected to range from approximately 9,000 to 14,000 vpd on the south end and between 11,000 and 17,000 vpd on the north end. Peak summer weekday traffic volumes are projected to be approximately 3,000 to 6,000 vpd higher than those during a typical day.

TABLE 5: PROJECTED DAILY TRAFFIC VOLUMES

Count Location	Existing Daily Traffic	2045 Projected Traffic (vpd)		
		Low Growth (1.0%)	Moderate Growth (2.22%)	High Growth (2.8%)
2021 Summer Weekday				
South of MT 212	9,695	12,310	16,421	18,810
North of MT 212	11,264	14,302	19,079	21,854
North of Beaverhead Ln	11,838	15,031	20,051	22,967
2020 Average Annual Daily Traffic				
South of MT 212 (24-3-004)	7,082	9,080	12,260	14,125
North of MT 212 (24-3-027)	8,544	10,960	14,790	17,040

2.4. CORRIDOR OPERATIONS

The traffic operations of the study corridor were evaluated based on procedures outlined in the *Highway Capacity Manual (HCM)*[2]. The operational characteristics are defined in terms of roadway capacity and level of service (LOS). Capacity is the theoretical maximum traffic flow obtainable on the roadway using all available lanes. Individual roadway capacity varies greatly and is calculated based on available lanes, passing opportunities, access points, and speed limits. The maximum number of vehicles that could theoretically be accommodated on a roadway (i.e., physical capacity) is generally greater than the number typically acceptable to driver perception.

Roadway LOS is intended to provide a comparison value to represent the driver's perception of the roadway performance. The LOS is based on a combination of factors, all of which play a part in the driver's perception of how the roadway is performing. When drivers experience delays or congestion due to reduced travel speeds, lack of passing opportunities, heavy vehicles in the traffic stream, and steep roadway grades, the roadway LOS deteriorates. The following provides a description of each LOS as defined by the HCM:

- LOS A: Represents free-flow conditions. Motorists experience high operating speeds and little difficulty in passing. Platoons of three or more vehicles are rare.
- LOS B: Passing demand and passing capacity are balanced. The degree of platooning becomes noticeable. Some speed reductions are present but are still relatively small.
- LOS C: Most vehicles are traveling in platoons. Speeds are noticeably curtailed.
- LOS D: Platooning increases significantly. Passing demand is high but passing capacity approaches zero. A high percentage of vehicles traveling in platoons, and the time spent following is quite noticeable.
- LOS E: Demand is approaching capacity. Passing is virtually impossible, and the time spent following is more than 80 percent. Speeds are seriously curtailed.
- LOS F: Exists whenever demand flow in one or both directions exceeds the capacity of the segment. Operating conditions are unstable, and heavy congestion exists.

2.4.1. Existing Corridor Operations

An operational analysis was conducted using *Highway Capacity Software* for two-lane highways. The analysis was conducted using 2021 data collected during a summer weekday in addition to conditions during an average day in 2020. The results of the analysis are shown in **Table 6**.

[2] Transportation Research Board, *Highway Capacity Manual 6th Edition: A Guide for Multimodal Mobility Analysis*, 2016.

TABLE 6: EXISTING CORRIDOR OPERATIONS ANALYSIS

Site	Existing Daily Traffic	Analysis Volume (veh/h)	Time Spent Following	Volume to Capacity	Level of Service
2021 Summer Weekday					
South of MT 212	**9,695**	**--**	**69.6%**	**0.28**	**D**
AM Peak		*554*	*64.6%*	*0.20*	*C*
Midday Peak		*726*	*63.6%*	*0.22*	*C*
PM Peak		*830*	*69.6%*	*0.28*	*D*
North of MT 212	**11,264**	**--**	**72.1%**	**0.33**	**D**
AM Peak		*676*	*65.7%*	*0.26*	*D*
Midday Peak		*857*	*67.0%*	*0.27*	*D*
PM Peak		*1,005*	*72.1%*	*0.33*	*D*
2020 Average Annual Daily Traffic					
South of MT 212	7,082	708	66.4%	0.25	**D**
North of MT 212	8,544	940	72.9%	0.33	**D**

The MDT *Traffic Engineering Manual*[3] lists a target design year LOS of B for a rural NHS Non-Interstate route with rolling/level terrain. In negotiating the *Memorandum of Agreement-US 93 Evaro to Polson*, (MOA) MDT in consultation with FHWA and CSKT approved an exception to the target design LOS for the proposed project[4]. The agreement determined no specific LOS requirements for the project, instead, the requirements summarized below would be goals for achievement. It was also agreed that alternatives considered would not be screened out based solely on operational performance and ability to meet LOS targets if the alternative nearly achieves these goals.

- Achieve at least LOS B through the first half of the 20-year design period and at least LOS C through the second half of the design period.
- No portion of the corridor should closely approach LOS D for normal weekday traffic during the design period.
- At least LOS C should be achieved through the entire 20-year design period for summer weekend traffic.

Based on the analysis in **Table 6,** the Ninepipe segment of US 93 currently operates below the target LOS for this facility, typically at a level of D during the summer weekday analysis periods as well as under average daily traffic conditions.

2.4.2. Projected Corridor Operations

Similar to the analysis of the existing corridor operations, an operational analysis was conducted using the projected traffic volume scenarios discussed in **Section 2.3.1**. The operations were evaluated for the summer PM peak hour (worst condition) and the design hour based on 2020 AADT volumes. The results of the analysis are shown in **Table 7**.

[3] Montana Department of Transportation, *Traffic Engineering Manual*, Chapter 30: Highway Capacity, November 2007, Revised August 2009, available at: https://mdt.mt.gov/publications/manuals.aspx
[4] Montana Department of Transportation, *Final Supplemental Environmental Impact Statement and Section 4(f) Evaluation*, 2008, page 2-14, available at: https://www.mdt.mt.gov/pubinvolve/docs/eis_ea/eis_ninepipe.pdf

TABLE 7: PROJECTED CORRIDOR OPERATIONS ANALYSIS (2045)

Site	Low Growth (1.0%)		Moderate Growth (2.22%)		High Growth (2.8%)	
	Volume to Capacity	Level of Service	Volume to Capacity	Level of Service	Volume to Capacity	Level of Service
Summer Weekday (PM Peak Hour)						
South of MT 212	0.35	D	0.47	E	0.54	E
North of MT 212	0.42	D	0.56	E	0.65	E
Average Annual Daily Traffic (Design Hour)						
South of MT 212	0.32	D	0.43	D	0.50	E
North of MT 212	0.43	D	0.58	E	0.66	E

The projected corridor operations show that the corridor will experience degrading operations. Under low growth conditions, the corridor is projected to operate at a LOS D. Under moderate and high growth projections, the LOS is shown to decrease to an E under all scenarios except south of MT 212 with moderate growth. Under these conditions, the corridor will not meet recommended LOS targets or the goals defined in the MOA.

3. SAFETY CONDITIONS

MDT provided crash data for the study area including the type, location, and severity of each crash. Crash data were provided for the five-year period between January 1, 2015, and December 31, 2019. The crash reports are a summation of information from the scene of the crash provided by responding officers. As a result, some of the information contained in the crash reports may be subjective. The following sections provide an analysis of available crash data to help identify crash trends and contributing factors. According to the MDT crash database, a total of 84 crashes occurred within the study area during the analysis period. The following sections provide a detailed analysis of the crash data.

3.1. CRASH TYPE

Crash types were grouped into two categories: single and multiple vehicle crashes. The majority of crashes involved a single vehicle, which accounts for almost two-thirds of all crashes. The most common single-vehicle type was wild animal crashes (28 crashes), followed by fixed-object (18 crashes). There were also six rollover crashes. The most common multiple vehicle crash type was rear-end (13 crashes), followed by right angle (5 crashes) and sideswipe opposite direction (4 crashes). **Figure 4** presents the distribution of crash types within the study area.

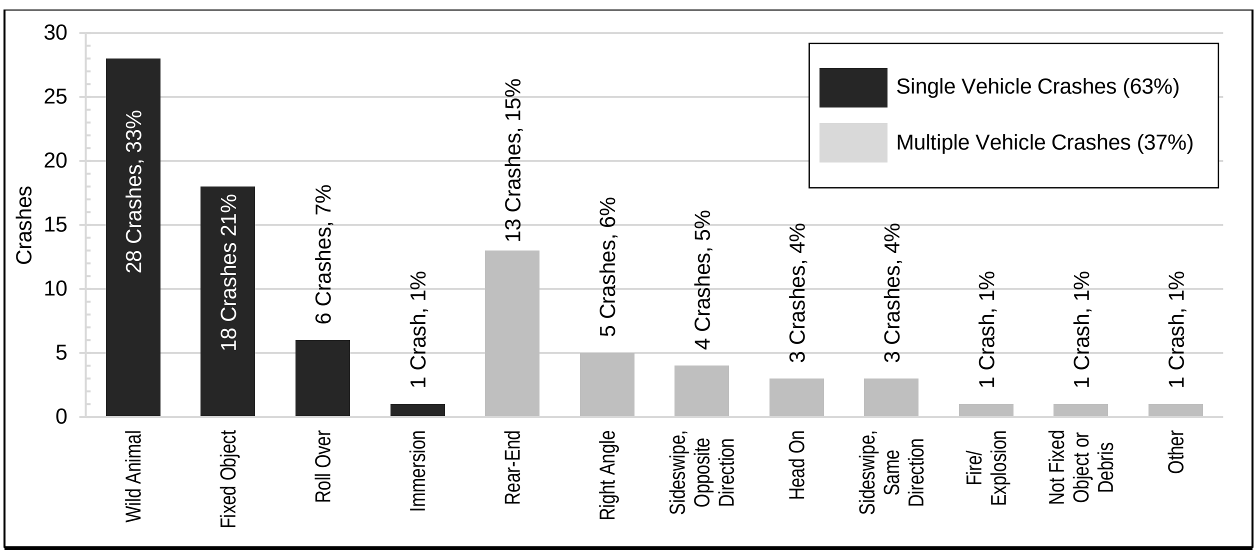

FIGURE 4: CRASH TYPE

3.2. CRASH SEVERITY

Crashes can be categorized by the severity of the harm to people and property. From the least to most severe, crash severity categories include property damage only (PDO), possible injury, suspected minor injury, suspected serious injury, and fatality. The most severe injury incurred defines the severity for the crash. For example, if a crash results in a fatality and an injury, the crash would be reported as a fatal crash.

The majority of crashes, 70 percent, resulted in PDO. Another 24 percent (20 crashes) were reported as possible injury, suspected minor injury, or unknown. The remaining five crashes were considered severe and resulted in suspected serious injury or fatality. **Figure 5** graphically presents the crash severity data.

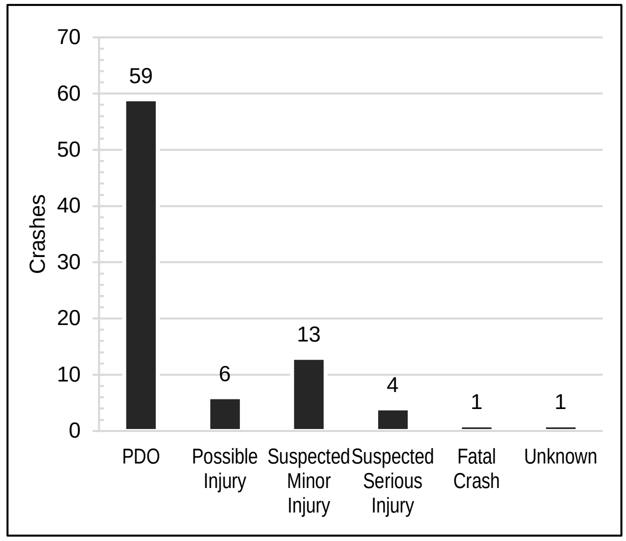

FIGURE 5: CRASH SEVERITY

The one fatal crash resulted in three total fatalities and was the result of a head-on collision. The crash was reported as an impaired driver crash and occurred while the roadway was dry and in the daylight. The four suspected serious injury crashes resulted in eight total injuries. The crash types included two rear-ends, one roll over, and one head on. All four crashes occurred outside of daylight conditions (dark, dusk, or dawn) and with dry roadway conditions. Two of the four suspected serious injury crashes involved an impaired driver. The location and type of severe crashes is shown later in **Figure 7**.

3.3. CRASH PERIOD

Crash data for the study area were evaluated based on the year, time of day, day of week, and month of year that the crashes occurred. An average of approximately 17 crashes occurred each year during the five-year analysis period. The highest number of crashes occurred in 2018 when 22 crashes (26 percent) were reported. Crashes were most common during the summer months (July through September, 38 percent) when traffic volumes are typically higher, and in December when over 14 percent of crashes occurred. With regards to time of day, peaks occurred around 5:00 PM when commuter traffic is highest, and between 8:00 and 11:00 PM when road conditions are dark. **Figure 6** presents crash period data over the analysis period.

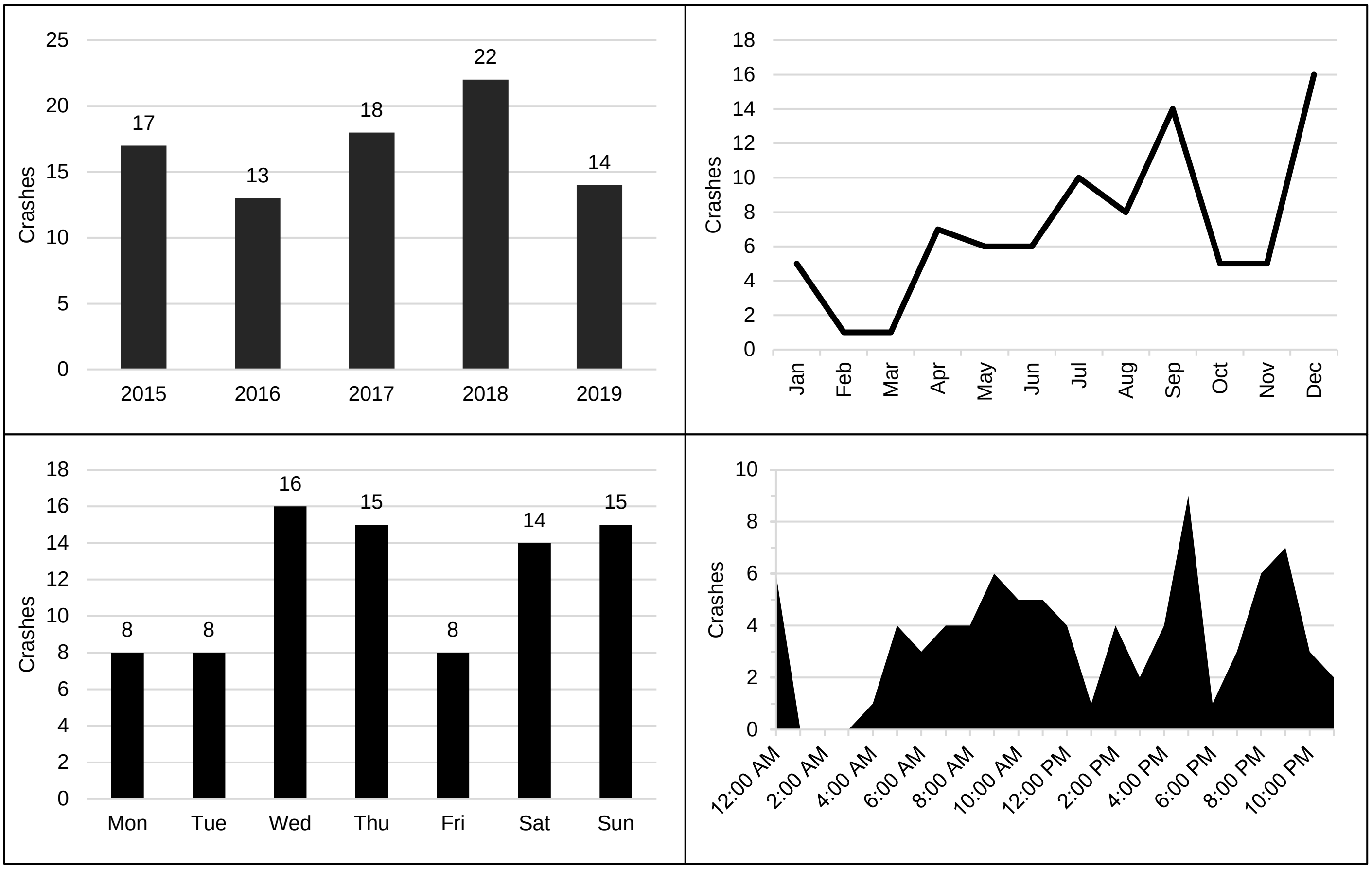

FIGURE 6: TEMPORAL CRASH STATISTICS

3.4. ENVIRONMENTAL FACTORS

Crash data were reviewed to evaluate trends related to environmental factors such as weather, roadway conditions, and light conditions. The road condition was reported as dry for 81 percent of crashes. Inclement roadway conditions (snow, slush, ice, wet, or frost) were reported in 18 percent. With respect to weather conditions, clear or cloudy conditions were reported in 85 percent of crashes. Crashes were most likely to occur during daylight (60 percent). The remaining crashes occurred under dark-not lighted conditions (33 percent) or during dusk/dawn (11 percent). **Table 8** tabulates the environmental conditions during reported crashes.

TABLE 8: ENVIRONMENTAL CONDITIONS

Weather Condition	Road Condition						
Lighting Condition	Dry	Wet	Snow	Ice/Frost	Slush	Unknown	Total
Clear	**44**	**—**	**—**	**1**	**—**	**—**	**45**
Daylight	*22*	—	—	*1*	—	—	*23*
Dawn	*4*	—	—	—	—	—	*4*
Dusk	*4*	—	—	—	—	—	*4*
Dark-Not Lighted	*14*	—	—	—	—	—	*14*
Cloudy	**20**	**3**	**1**	**1**	**1**	**—**	**26**
Daylight	*10*	*1*	*1*	*1*	*1*	—	*14*
Dusk	*1*	—	—	—	—	—	*1*
Dark-Not Lighted	*9*	*2*	—	—	—	—	*11*
Rain	**—**	**1**	**—**	**—**	**—**	**—**	**1**
Daylight	—	*1*	—	—	—	—	*1*
Snow	**—**	**—**	**1**	**5**	**—**	**—**	**6**
Daylight	—	—	*1*	*5*	—	—	*6*
Fog, Smog, Smoke	**4**	**—**	**—**	**1**	**—**	**—**	**5**
Daylight	*1*	—	—	*1*	—	—	*2*
Dark-Not Lighted	*3*	—	—	—	—	—	*3*
Unknown	**—**	**—**	**—**	**—**	**—**	**1**	**1**
Unknown	—	—	—	—	—	*1*	*1*
Total	**68**	**4**	**2**	**8**	**1**	**1**	**84**

3.5. CRASH LOCATION

Crash data were reviewed to determine the reported location of the crashes in the study area. Crash location data are included in the form of latitude and longitude coordinates for each crash. The crashes are plotted in **Figure 7** based on their reported coordinates. The figure shows a heat map which represents the relative density of crashes. The fatal and the suspected serious injury crash locations are also specifically identified. In addition to spatial location, crashes are categorized by their relation to a junction such as along the roadway or at an intersection. Of the 84 total crashes, 84 percent (71 crashes) were non-junction related. The remain 14 crashes occurred at, or were related to, a driveway or intersection. Note that some crashes may have physically occurred at an intersection but were coded as non-junction if they were not specifically related to the intersection. An example of this is a wild animal crash occurring near an intersection.

A review of crash locations revealed clusters at the intersections with Eagle Pass Trail, MT 212, and Beaverhead Lane. Ten crashes were reported in the vicinity of Eagle Pass Trail. Four of the crashes were wild animal crashes. Five of the crashes were of the type typical at intersections: two sideswipe, opposite direction; one sideswipe, same direction; and two rear-end crashes, one of which resulted in a suspected serious injury. The final crash was a fixed-object crash with no contributing circumstances listed.

Eight crashes were reported near the intersection with MT 212, two of which were wild animal crashes. The remaining six crashes included: two rear-end, three right angle, and one sideswipe opposite direction crash. No severe crashes were reported at this location.

There were ten reported crashes at the intersection with Beaverhead Lane. Three of the crashes were wild animal crashes, and three were fixed object crashes. None of the fixed object crashes have associated contributing factors listed and each were listed as non-junction related. The remaining crashes include a right-angle, a rear-end, a sideswipe same direction, and a fire/explosion crash. None of the crashes occurring at the intersection resulted in severe injuries.

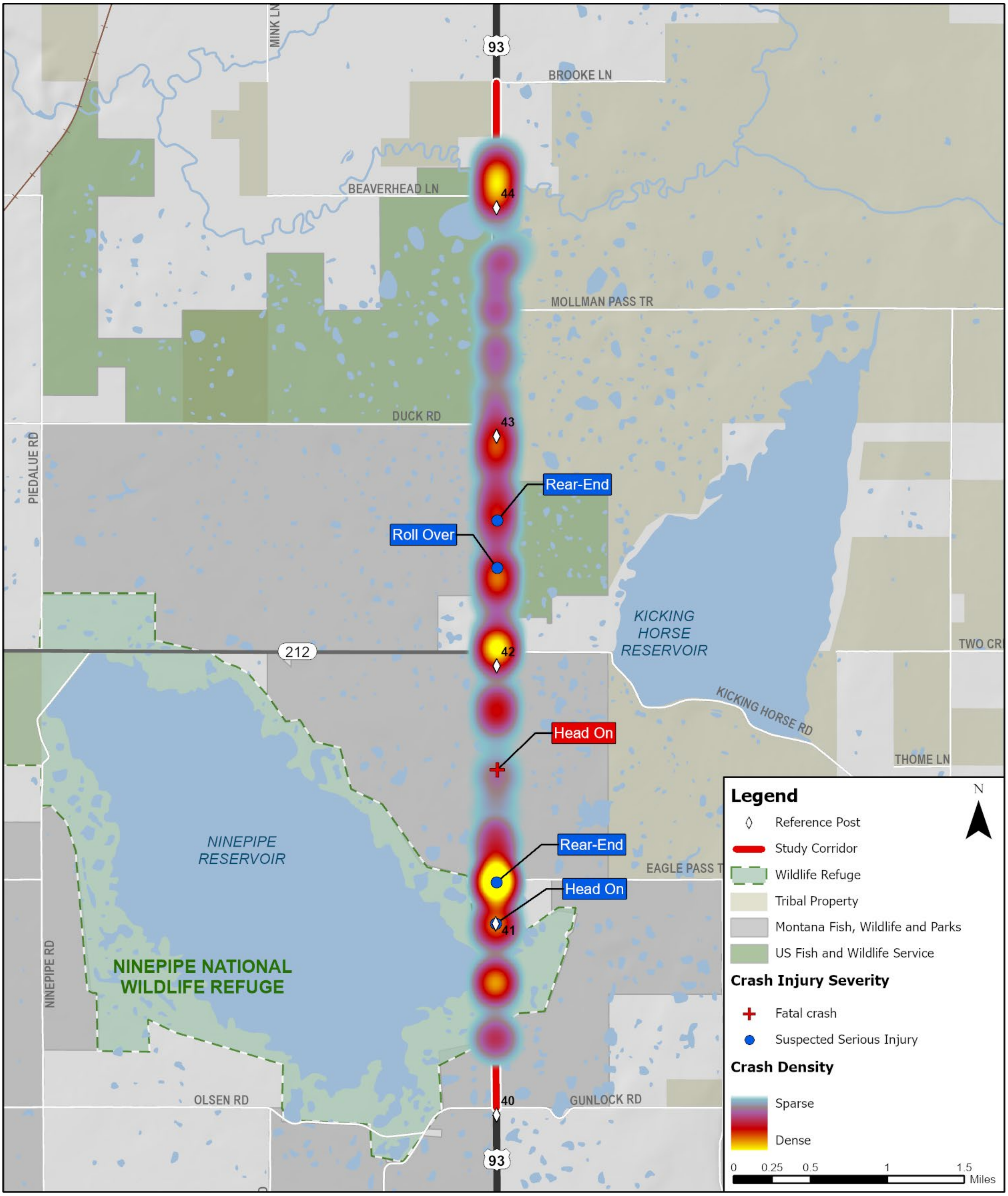

FIGURE 7: CRASH LOCATION MAP (2015-2019)

4. SUMMARY OF TRAFFIC AND SAFETY CONDITIONS

This *Traffic and Safety Memo* provides an evaluation of available and collected data for the Ninepipe corridor. The corridor is located along US 93 between RP 40.0 and RP 44.5. The segment is surrounded by a mix of Tribal, public, and private lands and has historically been considered for updates as outlined in past environmental documentation. The existing roadway consists of one travel lane in each direction and typical shoulder widths of approximately six feet.

Traffic data for the corridor were collected in August of 2021. The data was used to supplement available information provided by MDT. During an average day, traffic volumes along the corridor range from 7,000 to 8,500 vpd on the south and north sides of MT 212, respectively. Peak summer volumes were recorded as approximately 35 percent higher than those during an average day. Throughout the year, heavy vehicles account for between 6 and 8 percent of daily traffic. Under existing conditions, the corridor typically operates at a LOS D during the analysis periods which is lower than the recommended target LOS of B.

Traffic conditions were projected out to the future year of 2045. The projections were made based on evaluation of historic traffic growth and past documentation. Growth rates were selected to evaluate conditions under low, moderate, and high growth scenarios which ranged between 1.0 and 2.8 percent annual growth. Based on the evaluation, projected conditions show worsening conditions with future LOS between D and E.

A thorough safety evaluation was also conducted to identify potential crash clusters and trends. Crash data was reviewed for the most recent five-year period. There were a total of 84 reported crashes along the corridor during this period. Of those reported crashes, one crash resulted in three fatalities and four resulted in suspected serious injuries. The majority of the crashes (85 percent) were reported as non-junction related. Nearly two-thirds of all crashes involved a single vehicle, with the most common crash types being wild animal and fixed object. Additional investigation showed some concentration of crashes at the intersections with Eagle Pass Trail, MT 212, and Beaverhead Lane.

NINEPIPE CORRIDOR 93 FEASIBILITY STUDY

Traffic Data

Robert Peccia & Associates
3147 Saddle Drive

Helena, Montana, United States 59601
406-447-5000 srandall@rpa-hln.com

Count Name: North of Beaverhead Dr
Site Code: 1
Start Date: 08/24/2021

Direction (Southbound)

Start Time	Lights	Buses	Single-Unit Trucks	Articulated Trucks	Bicycles on Road	Total
08/24/2021 12:00 AM	21	0	0	0	0	21
1:00 AM	12	0	0	2	0	14
2:00 AM	13	0	0	1	0	14
3:00 AM	9	0	2	4	0	15
4:00 AM	24	0	0	5	0	29
5:00 AM	51	0	1	3	0	55
6:00 AM	144	0	6	14	0	164
7:00 AM	229	0	9	11	0	249
8:00 AM	269	1	3	14	0	287
9:00 AM	326	0	11	21	0	358
10:00 AM	368	4	11	17	0	400
11:00 AM	379	0	22	25	0	426
12:00 PM	416	4	12	20	0	452
1:00 PM	376	1	21	19	0	417
2:00 PM	393	0	13	16	0	422
3:00 PM	446	1	22	13	0	482
4:00 PM	446	1	14	14	0	475
5:00 PM	558	0	9	17	0	584
6:00 PM	341	2	3	15	0	361
7:00 PM	216	0	2	14	0	232
8:00 PM	184	0	1	7	0	192
9:00 PM	91	0	1	4	0	96
10:00 PM	64	0	0	5	0	69
11:00 PM	58	1	0	1	0	60
08/25/2021 12:00 AM	27	0	0	1	0	28
1:00 AM	17	0	0	1	0	18
2:00 AM	15	0	0	2	0	17
3:00 AM	15	0	0	6	0	21
4:00 AM	23	0	1	4	0	28
5:00 AM	43	0	1	1	0	45
6:00 AM	144	1	1	5	0	151
7:00 AM	233	3	4	8	0	248
8:00 AM	298	2	18	9	0	327
9:00 AM	325	3	14	15	0	357
10:00 AM	356	1	6	22	0	385
11:00 AM	400	6	12	17	0	435
12:00 PM	409	1	12	18	0	440
1:00 PM	389	0	14	18	0	421
2:00 PM	414	0	20	16	0	450
3:00 PM	483	1	24	19	0	527
4:00 PM	525	2	16	19	1	563
5:00 PM	526	0	7	7	0	540
6:00 PM	350	1	1	5	0	357
7:00 PM	216	0	4	7	0	227
8:00 PM	174	0	6	6	0	186
9:00 PM	136	0	1	3	0	140
10:00 PM	68	0	1	5	0	74
11:00 PM	48	0	0	0	0	48
Total	11068	36	326	476	1	11907
Total %	93.0	0.3	2.7	4.0	0.0	100.0
AM Times	11:00 AM	7:00 AM	9:00 AM	9:00 AM	9:00 AM	11:00 AM
AM Peaks	400	3	14	21	0	435
PM Times	4:00 PM	12:00 PM	3:00 PM	12:00 PM	4:00 PM	4:00 PM
PM Peaks	525	4	22	20	1	563

Robert Peccia & Associates
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Helena, Montana, United States 59601
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Direction (Northbound)

Start Time	Lights	Buses	Single-Unit Trucks	Articulated Trucks	Bicycles on Road	Total
08/24/2021 12:00 AM	19	0	2	1	0	22
1:00 AM	18	0	0	4	0	22
2:00 AM	9	0	1	6	0	16
3:00 AM	15	0	2	8	0	25
4:00 AM	20	0	4	2	0	26
5:00 AM	63	0	4	9	0	76
6:00 AM	258	0	13	9	0	280
7:00 AM	301	1	9	20	0	331
8:00 AM	309	0	10	16	0	335
9:00 AM	262	1	26	27	1	317
10:00 AM	298	0	15	23	0	336
11:00 AM	321	0	14	22	0	357
12:00 PM	379	3	21	27	0	430
1:00 PM	392	1	7	18	0	418
2:00 PM	407	2	9	19	0	437
3:00 PM	475	3	13	13	0	504
4:00 PM	456	0	13	12	0	481
5:00 PM	386	1	6	6	0	399
6:00 PM	255	1	10	3	0	269
7:00 PM	235	0	1	6	0	242
8:00 PM	173	0	2	5	0	180
9:00 PM	127	0	0	2	0	129
10:00 PM	94	0	1	2	0	97
11:00 PM	52	0	0	3	0	55
08/25/2021 12:00 AM	35	0	0	2	0	37
1:00 AM	20	0	0	5	0	25
2:00 AM	13	0	0	4	0	17
3:00 AM	10	0	2	6	0	18
4:00 AM	28	0	1	2	0	31
5:00 AM	72	0	4	11	0	87
6:00 AM	239	0	5	8	0	252
7:00 AM	354	4	13	19	0	390
8:00 AM	355	0	11	15	0	381
9:00 AM	309	0	25	21	0	355
10:00 AM	311	0	17	19	0	347
11:00 AM	372	1	6	18	0	397
12:00 PM	377	4	17	14	0	412
1:00 PM	427	0	14	15	0	456
2:00 PM	386	1	8	10	0	405
3:00 PM	414	0	7	9	0	430
4:00 PM	494	5	12	15	0	526
5:00 PM	419	1	10	3	0	433
6:00 PM	301	1	4	7	0	313
7:00 PM	252	0	9	3	0	264
8:00 PM	165	1	1	5	0	172
9:00 PM	124	0	0	2	0	126
10:00 PM	61	0	2	3	0	66
11:00 PM	43	0	2	0	0	45
Total	10905	31	353	479	1	11769
Total %	92.7	0.3	3.0	4.1	0.0	100.0
AM Times	11:00 AM	7:00 AM	9:00 AM	9:00 AM	9:00 AM	11:00 AM
AM Peaks	372	4	25	27	1	397
PM Times	4:00 PM	12:00 PM	3:00 PM	12:00 PM	4:00 PM	4:00 PM
PM Peaks	494	3	13	27	0	526

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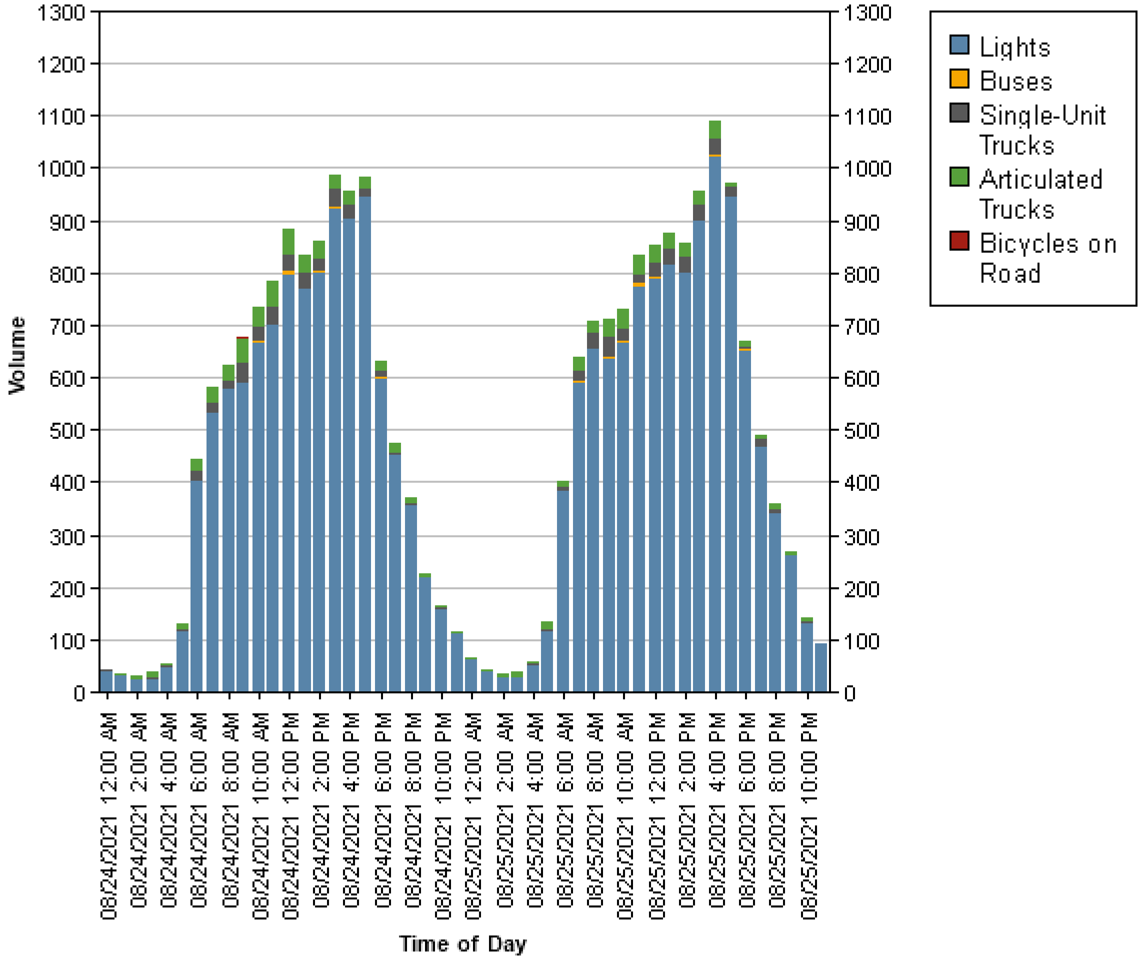
Count Name: North of Beaverhead Dr
Site Code: 1
Start Date: 08/24/2021
Page No: 3



Robert Peccia & Associates
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Helena, Montana, United States 59601
406-447-5000 srandall@rpa-hln.com

Count Name: North of MT 212
Site Code: 2
Start Date: 08/24/2021

Direction (Southbound)

Start Time	Lights	Buses	Single-Unit Trucks	Articulated Trucks	Bicycles on Road	Total
08/24/2021 12:00 AM	22	0	0	0	0	22
1:00 AM	7	0	1	2	0	10
2:00 AM	12	0	0	1	0	13
3:00 AM	11	0	0	5	0	16
4:00 AM	21	0	1	3	0	25
5:00 AM	54	0	0	4	0	58
6:00 AM	139	0	6	14	0	159
7:00 AM	217	0	11	8	0	236
8:00 AM	250	1	3	16	0	270
9:00 AM	299	0	15	16	0	330
10:00 AM	348	3	21	17	0	389
11:00 AM	361	0	20	25	0	406
12:00 PM	386	0	21	17	0	424
1:00 PM	365	1	22	19	0	407
2:00 PM	370	0	16	14	0	400
3:00 PM	424	0	22	14	0	460
4:00 PM	435	1	14	12	0	462
5:00 PM	518	0	10	16	0	544
6:00 PM	319	2	5	15	0	341
7:00 PM	196	0	2	14	0	212
8:00 PM	170	0	4	6	0	180
9:00 PM	91	0	1	4	0	96
10:00 PM	58	0	0	4	0	62
11:00 PM	53	1	2	1	0	57
08/25/2021 12:00 AM	26	0	0	1	0	27
1:00 AM	14	0	0	1	0	15
2:00 AM	17	0	0	2	0	19
3:00 AM	15	0	3	4	0	22
4:00 AM	26	0	2	1	0	29
5:00 AM	40	0	1	0	0	41
6:00 AM	133	0	1	5	0	139
7:00 AM	222	3	3	9	0	237
8:00 AM	276	2	20	10	0	308
9:00 AM	306	0	19	14	0	339
10:00 AM	339	1	8	23	0	371
11:00 AM	378	0	15	21	0	414
12:00 PM	389	0	20	16	0	425
1:00 PM	370	0	15	19	0	404
2:00 PM	391	0	19	18	0	428
3:00 PM	461	0	25	18	0	504
4:00 PM	480	3	17	16	0	516
5:00 PM	499	0	8	8	0	515
6:00 PM	341	1	1	5	0	348
7:00 PM	193	0	6	7	0	206
8:00 PM	174	0	5	6	0	185
9:00 PM	127	0	3	1	0	131
10:00 PM	71	1	2	1	0	75
11:00 PM	45	0	2	0	0	47
Total	10459	20	392	453	0	11324
Total %	92.4	0.2	3.5	4.0	0.0	100.0
AM Times	11:00 AM	7:00 AM	9:00 AM	11:00 AM	9:00 AM	11:00 AM
AM Peaks	378	3	15	25	0	414
PM Times	4:00 PM	4:00 PM	12:00 PM	12:00 PM	5:00 PM	4:00 PM
PM Peaks	480	3	21	17	0	516

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Count Name: North of MT 212
Site Code: 2
Start Date: 08/24/2021

Direction (Northbound)

Start Time	Lights	Buses	Single-Unit Trucks	Articulated Trucks	Bicycles on Road	Total
08/24/2021 12:00 AM	20	0	1	1	0	22
1:00 AM	17	0	2	3	0	22
2:00 AM	7	0	0	6	0	13
3:00 AM	14	0	2	8	0	24
4:00 AM	21	0	2	5	0	28
5:00 AM	62	0	3	12	0	77
6:00 AM	253	0	9	13	0	275
7:00 AM	280	1	13	14	0	308
8:00 AM	288	0	7	16	0	311
9:00 AM	260	1	28	25	1	315
10:00 AM	280	0	12	27	0	319
11:00 AM	308	0	14	22	0	344
12:00 PM	370	3	21	21	0	415
1:00 PM	364	0	9	16	0	389
2:00 PM	395	0	12	18	0	425
3:00 PM	454	0	12	11	0	477
4:00 PM	443	2	10	12	0	467
5:00 PM	349	2	5	6	0	362
6:00 PM	262	1	11	3	0	277
7:00 PM	209	1	7	7	0	224
8:00 PM	155	0	1	6	0	162
9:00 PM	112	0	0	3	0	115
10:00 PM	90	0	1	3	0	94
11:00 PM	49	0	4	1	0	54
08/25/2021 12:00 AM	35	0	0	3	0	38
1:00 AM	19	0	1	5	0	25
2:00 AM	13	0	1	3	0	17
3:00 AM	8	0	2	6	0	16
4:00 AM	27	0	0	3	0	30
5:00 AM	73	0	2	11	0	86
6:00 AM	242	0	6	9	0	257
7:00 AM	328	2	10	21	0	361
8:00 AM	329	0	12	17	0	358
9:00 AM	303	0	23	22	0	348
10:00 AM	294	0	17	19	0	330
11:00 AM	357	1	8	21	0	387
12:00 PM	357	2	17	14	0	390
1:00 PM	389	0	13	16	0	418
2:00 PM	362	1	10	7	0	380
3:00 PM	386	0	13	12	0	411
4:00 PM	471	5	8	18	0	502
5:00 PM	402	1	12	2	1	418
6:00 PM	275	1	3	7	0	286
7:00 PM	239	0	7	4	0	250
8:00 PM	142	1	0	5	0	148
9:00 PM	115	0	1	3	0	119
10:00 PM	58	0	0	7	0	65
11:00 PM	43	0	0	1	0	44
Total	10329	25	352	495	2	11203
Total %	92.2	0.2	3.1	4.4	0.0	100.0
AM Times	11:00 AM	7:00 AM	9:00 AM	11:00 AM	9:00 AM	11:00 AM
AM Peaks	357	2	28	22	1	387
PM Times	4:00 PM	4:00 PM	12:00 PM	12:00 PM	5:00 PM	4:00 PM
PM Peaks	471	5	21	21	1	502

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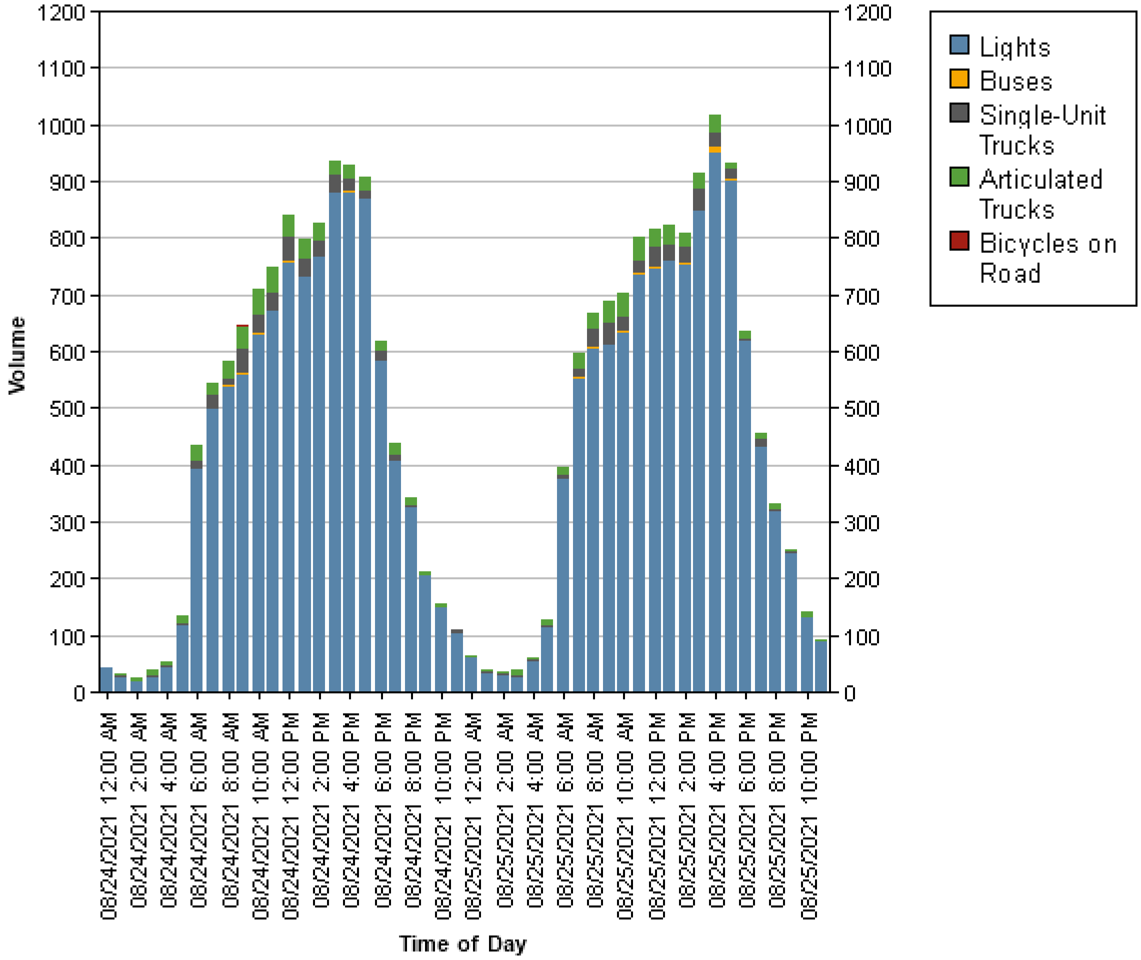
406-447-5000 srandall@rpa-hln.com

Count Name: North of MT 212
Site Code: 2
Start Date: 08/24/2021
Page No: 3



Robert Peccia & Associates
3147 Saddle Drive

Helena, Montana, United States 59601
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Count Name: South of MT 212
Site Code: 3
Start Date: 08/24/2021

Direction (Southbound)

Start Time	Lights	Buses	Single-Unit Trucks	Articulated Trucks	Bicycles on Road	Total
08/24/2021 12:00 AM	18	0	0	0	0	18
1:00 AM	5	0	0	1	0	6
2:00 AM	13	0	0	1	0	14
3:00 AM	8	0	0	5	0	13
4:00 AM	19	0	0	6	0	25
5:00 AM	45	0	2	2	0	49
6:00 AM	120	0	4	14	0	138
7:00 AM	191	0	6	4	0	201
8:00 AM	229	1	1	11	0	242
9:00 AM	281	0	10	18	0	309
10:00 AM	290	2	18	13	0	323
11:00 AM	304	0	16	18	0	338
12:00 PM	342	0	19	13	0	374
1:00 PM	309	2	18	12	0	341
2:00 PM	337	3	17	11	0	368
3:00 PM	340	0	15	9	0	364
4:00 PM	374	1	13	11	0	399
5:00 PM	432	0	6	15	0	453
6:00 PM	265	2	4	15	0	286
7:00 PM	170	0	3	13	0	186
8:00 PM	152	0	3	8	0	163
9:00 PM	82	0	1	3	0	86
10:00 PM	49	0	0	3	0	52
11:00 PM	49	0	0	1	0	50
08/25/2021 12:00 AM	22	0	0	1	0	23
1:00 AM	11	0	0	1	0	12
2:00 AM	18	0	0	1	0	19
3:00 AM	12	0	0	7	0	19
4:00 AM	20	0	1	3	0	24
5:00 AM	35	0	1	1	0	37
6:00 AM	117	0	3	4	0	124
7:00 AM	193	3	6	5	0	207
8:00 AM	252	2	16	9	0	279
9:00 AM	271	0	17	12	0	300
10:00 AM	306	0	6	18	0	330
11:00 AM	325	0	19	19	0	363
12:00 PM	333	0	14	13	0	360
1:00 PM	321	0	12	18	0	351
2:00 PM	342	0	15	17	0	374
3:00 PM	376	0	21	15	0	412
4:00 PM	390	2	10	15	1	418
5:00 PM	436	0	10	9	0	455
6:00 PM	306	1	2	5	0	314
7:00 PM	174	0	4	8	0	186
8:00 PM	142	0	7	6	0	155
9:00 PM	101	0	1	3	0	105
10:00 PM	56	0	1	5	0	62
11:00 PM	40	0	1	0	0	41
Total	9023	19	323	402	1	9768
Total %	92.4	0.2	3.3	4.1	0.0	100.0
AM Times	11:00 AM	7:00 AM	9:00 AM	9:00 AM	9:00 AM	11:00 AM
AM Peaks	325	3	17	18	0	363
PM Times	4:00 PM	4:00 PM	12:00 PM	1:00 PM	4:00 PM	4:00 PM
PM Peaks	390	2	19	18	1	418

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Direction (Northbound)

Start Time	Lights	Buses	Single-Unit Trucks	Articulated Trucks	Bicycles on Road	Total
08/24/2021 12:00 AM	18	0	1	2	0	21
1:00 AM	13	0	1	4	0	18
2:00 AM	16	0	0	0	0	16
3:00 AM	13	0	2	8	0	23
4:00 AM	19	0	3	4	0	26
5:00 AM	44	0	3	13	0	60
6:00 AM	210	0	9	11	0	230
7:00 AM	228	1	9	17	0	255
8:00 AM	234	0	6	14	0	254
9:00 AM	228	1	25	24	1	279
10:00 AM	240	0	16	18	0	274
11:00 AM	261	0	12	20	0	293
12:00 PM	309	3	18	18	0	348
1:00 PM	318	0	9	15	0	342
2:00 PM	337	0	12	15	0	364
3:00 PM	405	0	9	8	0	422
4:00 PM	365	0	10	10	0	385
5:00 PM	302	1	4	4	0	311
6:00 PM	219	1	7	1	0	228
7:00 PM	192	1	5	5	0	203
8:00 PM	139	0	1	4	0	144
9:00 PM	101	0	4	2	0	107
10:00 PM	83	0	0	2	0	85
11:00 PM	42	0	1	4	0	47
08/25/2021 12:00 AM	36	0	0	2	0	38
1:00 AM	19	0	2	3	0	24
2:00 AM	12	0	0	4	0	16
3:00 AM	7	0	2	5	0	14
4:00 AM	24	0	1	2	0	27
5:00 AM	60	0	5	10	0	75
6:00 AM	189	0	8	8	0	205
7:00 AM	269	2	7	19	0	297
8:00 AM	282	0	12	17	0	311
9:00 AM	263	0	25	17	0	305
10:00 AM	248	0	17	16	0	281
11:00 AM	314	1	9	18	0	342
12:00 PM	302	2	18	11	0	333
1:00 PM	321	0	13	14	0	348
2:00 PM	305	1	7	7	0	320
3:00 PM	343	0	9	7	0	359
4:00 PM	401	3	10	14	0	428
5:00 PM	346	1	12	2	0	361
6:00 PM	233	0	2	5	0	240
7:00 PM	213	0	8	5	0	226
8:00 PM	122	1	0	4	0	127
9:00 PM	109	0	0	2	0	111
10:00 PM	53	0	0	6	0	59
11:00 PM	38	0	0	1	0	39
Total	8845	19	334	422	1	9621
Total %	91.9	0.2	3.5	4.4	0.0	100.0
AM Times	11:00 AM	7:00 AM	9:00 AM	9:00 AM	9:00 AM	11:00 AM
AM Peaks	314	2	25	24	1	342
PM Times	4:00 PM	4:00 PM	12:00 PM	1:00 PM	4:00 PM	4:00 PM
PM Peaks	401	3	18	14	0	428

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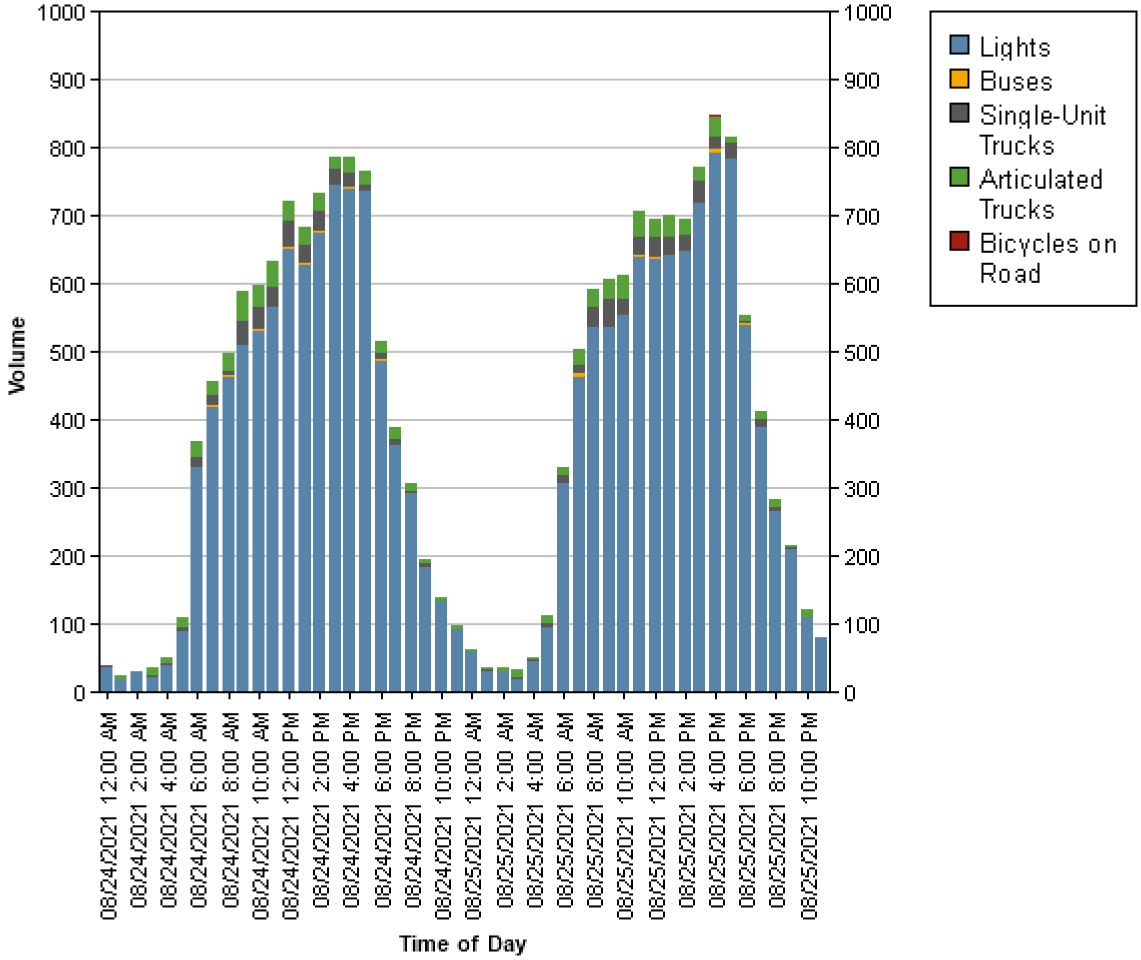
Count Name: South of MT 212
Site Code: 3
Start Date: 08/24/2021
Page No: 3



Per-Vehicle Summary Report: US 93 Ninepipe (Duck Rd NB)

Station ID : US 93 Ninepipe (Duck Rd NB)
Info Line 1 : Northbound
Info Line 2 : North of HWY 212
GPS Lat/Lon :
DB File : Duck Road (NB).DB

Last Connected Device Type : RoadRunner3
Version Number : 1.34
Serial Number : 19238
Number of Lanes : 1
Posted Speed Limit : 70.0 mph

Lane Configuration

#	Dir.	Information	Vehicle Sensors	Sensor Spacing	Loop Length
1.		North	Axle-Axle	5.0 ft	

Average Daily Traffic (ADT)

	Weekday			Weekend		**Total ADT**	
Cars :	5153	(91%)	Cars :		Cars :	**5153**	(91%)
Trucks :	489	(9%)	Trucks :		Trucks :	**489**	(9%)
Total :	5642		Total :		Total :	**5642**	

Speed Totals

50 % :	64.2 mph	Top Speed :	90.5 mph	Average Truck Speed :	62.6 mph
85 % :	69.3 mph	Low Speed :	20.3 mph	Average Car Speed :	63.9 mph
Avg :	63.8 mph	10mph Pace Speed:	60.0 - 69.9 (66.7%)		

Peak Hour Totals

AM Peak Hour (Volume)
Weekday : 07:30 - 08:30 (Avg 379)
Weekend :

AM Peak Hour (Speed)
04:00 - 05:00 (66.3 mph)

PM Peak Hour (Volume)
Weekday : 16:00 - 17:00 (Avg 485)
Weekend :

PM Peak Hour (Speed)
19:15 - 20:15 (67.5 mph)

Grand Totals

Total Cars :	10306 (5153 ADT)	Average Length :	13.6 ft	Average Headway :	15.3 sec
Total Trucks :	978 (489 ADT)	Average Axles :	2.2	Average Gap :	15.1 sec
Total Volume :	11284 (5642 ADT)				

Per-Vehicle Summary Report: US 93 Ninepipe (Duck Rd SB)

Station ID : US 93 Ninepipe (Duck Rd SB)
Info Line 1 : Southbound
Info Line 2 : North of HWY 212
GPS Lat/Lon :
DB File : Duck Road (SB).DB

Last Connected Device Type : RoadRunner3
Version Number : 1.34
Serial Number : 19237
Number of Lanes : 1
Posted Speed Limit : 70.0 mph

Lane Configuration

#	Dir.	Information	Vehicle Sensors	Sensor Spacing	Loop Length
1.		South	Axle-Axle	5.0 ft	

Average Daily Traffic (ADT)

	Weekday			Weekend		Total ADT	
Cars :	5224	(91%)	Cars :		Cars :	**5224**	(91%)
Trucks :	486	(9%)	Trucks :		Trucks :	**486**	(9%)
Total :	5710		Total :		Total :	**5710**	

Speed Totals

50 % :	64.7 mph	Top Speed :	97.1 mph	Average Truck Speed :	62.1 mph
85 % :	69.5 mph	Low Speed :	25.7 mph	Average Car Speed :	64.4 mph
Avg :	64.2 mph	10mph Pace Speed:	59.9 - 69.8 (69.3%)		

Peak Hour Totals

AM Peak Hour (Volume)
Weekday : 11:00 - 12:00 (Avg 415)
Weekend :

AM Peak Hour (Speed)
01:15 - 02:15 (69.0 mph)

PM Peak Hour (Volume)
Weekday : 16:45 - 17:45 (Avg 545)
Weekend :

PM Peak Hour (Speed)
19:15 - 20:15 (66.2 mph)

Grand Totals

Total Cars :	10448 (5224 ADT)	Average Length :	13.5 ft	Average Headway :	15.1 sec
Total Trucks :	973 (486 ADT)	Average Axles :	2.2	Average Gap :	15.0 sec
Total Volume :	11421 (5710 ADT)				

Per-Vehicle Summary Report: US 93 Ninepipe (Eagle Pass NB

Station ID : US 93 Ninepipe (Eagle Pass NB)
Info Line 1 : Northbound
Info Line 2 : South of HWY 212
GPS Lat/Lon :
DB File : US 93 Ninepipe (Eagle Pass NB).DB

Last Connected Device Type : RoadRunner3
Version Number : 1.34
Serial Number : 21416
Number of Lanes : 1
Posted Speed Limit : 70.0 mph

Lane Configuration

#	Dir.	Information	Vehicle Sensors	Sensor Spacing	Loop Length
1.		North	Axle-Axle	5.0 ft	

Average Daily Traffic (ADT)

	Weekday			Weekend		**Total ADT**	
Cars :	4240	(90%)	Cars :		Cars :	**4240**	(90%)
Trucks :	467	(10%)	Trucks :		Trucks :	**467**	(10%)
Total :	4707		Total :		Total :	**4707**	

Speed Totals

50 % :	66.5 mph	Top Speed :	99.4 mph	Average Truck Speed :	64.9 mph
85 % :	72.3 mph	Low Speed :	15.0 mph	Average Car Speed :	66.1 mph
Avg :	66.0 mph	10mph Pace Speed:	62.5 - 72.4 (60.2%)		

Peak Hour Totals

AM Peak Hour (Volume)
Weekday : 11:00 - 12:00 (Avg 313)
Weekend :

AM Peak Hour (Speed)
04:15 - 05:15 (69.8 mph)

PM Peak Hour (Volume)
Weekday : 16:00 - 17:00 (Avg 415)
Weekend :

PM Peak Hour (Speed)
19:30 - 20:30 (69.6 mph)

Grand Totals

Total Cars :	8480 (4240 ADT)	Average Length :	14.3 ft	Average Headway :	18.3 sec
Total Trucks :	935 (467 ADT)	Average Axles :	2.3	Average Gap :	18.2 sec
Total Volume :	9415 (4707 ADT)				

Per-Vehicle Summary Report: US 93 Ninepipe (Eagle Pass SB

Station ID : US 93 Ninepipe (Eagle Pass SB)
Info Line 1 : Southbound
Info Line 2 : South of HWY 212
GPS Lat/Lon :
DB File : US 93 Ninepipe (Eagle Pass SB).DB

Last Connected Device Type : RoadRunner3
Version Number : 1.34
Serial Number : 21417
Number of Lanes : 1
Posted Speed Limit : 70.0 mph

Lane Configuration

#	Dir.	Information	Vehicle Sensors	Sensor Spacing	Loop Length
1.		South	Axle-Axle	5.0 ft	

Average Daily Traffic (ADT)

	Weekday		Weekend		Total ADT	
Cars :	4343	(91%)			**4343**	(91%)
Trucks :	395	(9%)			**395**	(9%)
Total :	4738				**4738**	

Speed Totals

50 % : 62.6 mph
85 % : 67.5 mph
Avg : 62.3 mph

Top Speed : 95.6 mph
Low Speed : 5.4 mph
10mph Pace Speed: 57.8 - 67.7 (69.2%)

Average Truck Speed : 61.1 mph
Average Car Speed : 62.3 mph

Peak Hour Totals

AM Peak Hour (Volume)
Weekday : 11:00 - 12:00 (Avg 344)
Weekend :

AM Peak Hour (Speed)
01:15 - 02:15 (66.6 mph)

PM Peak Hour (Volume)
Weekday : 16:45 - 17:45 (Avg 421)
Weekend :

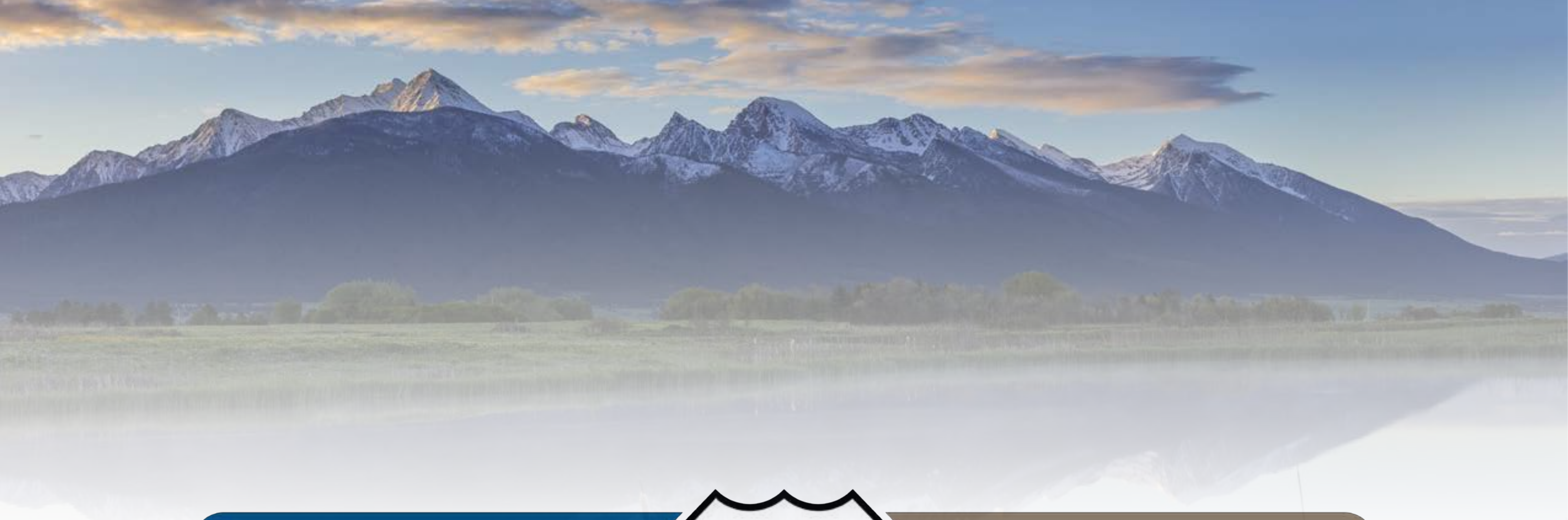
PM Peak Hour (Speed)
19:15 - 20:15 (64.3 mph)

Grand Totals

Total Cars : 8687 (4343 ADT)
Total Trucks : 790 (395 ADT)
Total Volume : 9477 (4738 ADT)

Average Length : 13.5 ft
Average Axles : 2.2

Average Headway : 18.2 sec
Average Gap : 18.1 sec



NINEPIPE CORRIDOR 93 FEASIBILITY STUDY

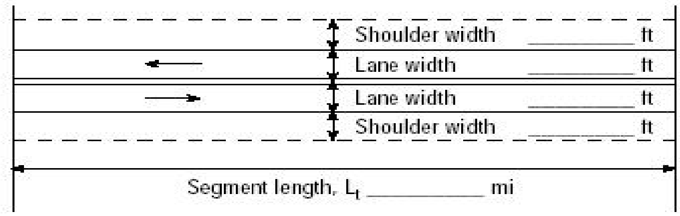
Existing Conditions Operations

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd to MT 212*
Date Performed	*12/1/2021*	Jurisdiction	
Analysis Time Period	*Average Annual*	Analysis Year	*2021*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*375*veh/h
Opposing direction vol., V_o	*333*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Grade Length mi Up/down	
Peak-hour factor, PHF	*0.88*
No-passing zone	*70%*
% Trucks and Buses , P_T	*6* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.3*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}$=1/ (1+ P_T (E_T -1)+P_R (E_R -1))	*0.982*	*0.982*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) v_i=V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*434*	*385*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.8 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*59.1 mi/h*
		Percent free flow speed, PFFS	*86.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*	*0.994*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) v_i=V_i/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*426*	*381*
Base percent time-spent-following[4], $BPTSF_d$(%)=100(1-$e^{av_d^b}$)	*43.9*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*42.7*	
Percent time-spent-following, $PTSF_d$(%)=$BPTSF_d$+$f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$ + $v_{o,PTSF}$)	*66.4*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.25*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*426.1*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*4.47*
Bicycle level of service (Exhibit 15-4)	*D*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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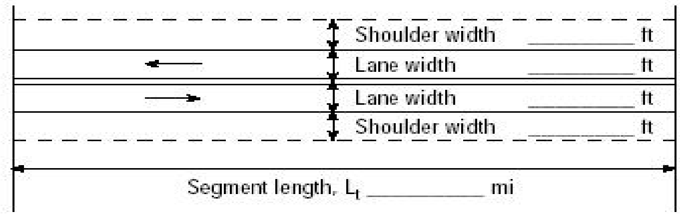
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 to Brooke Ln*
Date Performed	*12/1/2021*	Jurisdiction	
Analysis Time Period	*Average Annual*	Analysis Year	*2021*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.88*
No-passing zone	*43%*
% Trucks and Buses , P_T	*6* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7*/mi

Analysis direction vol., V_d	*498*veh/h
Opposing direction vol., V_o	*442*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))$	*0.994*	*0.988*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*569*	*508*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
		Base free-flow speed[4], BFFS	*70.0 mi/h*
		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Mean speed of sample[3], S_{FM}		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Total demand flow rate, both directions, *v*		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*58.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.9 mi/h*	Percent free flow speed, PFFS	*85.0 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i$/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*566*	*502*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*55.9*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*32.1*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF} / v_{d,PTSF} + v_{o,PTSF})$	*72.9*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.33*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*85.0*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*565.9*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*4.61*
Bicycle level of service (Exhibit 15-4)	*E*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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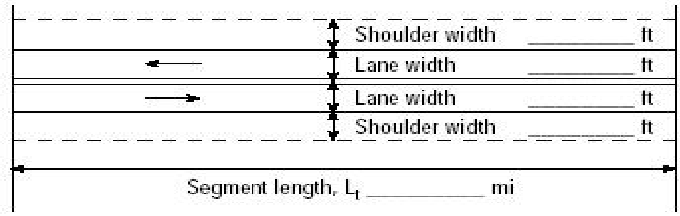
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2021*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



Analysis direction vol., V_d *388*veh/h

Opposing direction vol., V_o *288*veh/h

Shoulder width ft *6.0*

Lane Width ft *12.0*

Segment Length mi *2.5*

☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.87*

No-passing zone *43%*

% Trucks and Buses , P_T *1* %

% Recreational vehicles, P_R *4%*

Access points *mi* *8*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.3*	*1.4*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.997*	*0.996*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*447*	*332*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*59.2 mi/h*
		Percent free flow speed, PFFS	*87.1 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*0.999*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}{}^* f_{g,PTSF})$	*446*	*331*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*44.4*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*37.1*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}{}^*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*65.7*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.26*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*87.1*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*446.0*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.02*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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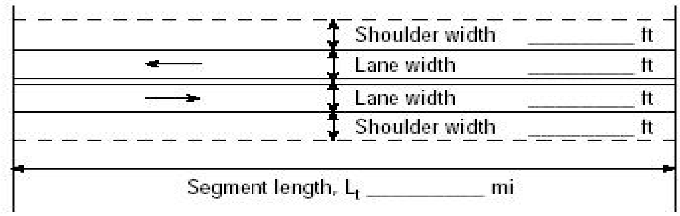
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*MID Peak*	Analysis Year	*2021*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*440*veh/h
Opposing direction vol., V_o	*417*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.97*
No-passing zone	*42%*
% Trucks and Buses , P_T	*2* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.2*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.996*	*0.994*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*455*	*432*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0* mi/h
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0* mi/h
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0* mi/h
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.2* mi/h	Free-flow speed, FFS $(FSS=BFFS-f_{LS}-f_A)$	*68.0* mi/h
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*58.9* mi/h
		Percent free flow speed, PFFS	*86.6* %

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}{}^* f_{g,PTSF})$	*454*	*430*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*47.7*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*37.6*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*67.0*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.27*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.6*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*453.6*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.28*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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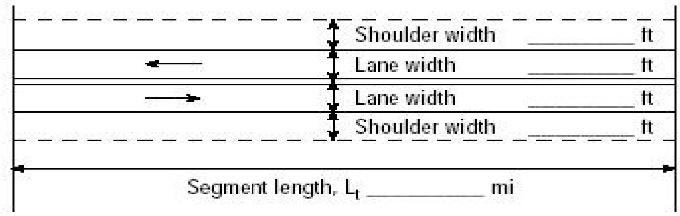
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2021*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*537*veh/h
Opposing direction vol., V_o	*468*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.95*
No-passing zone	*42%*
% Trucks and Buses , P_T	*1* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.999*	*0.998*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*566*	*494*

Free-Flow Speed from Field Measurement

Mean speed of sample[3], S_{FM}	
Total demand flow rate, both directions, *v*	
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$	
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.0 mi/h*

Estimated Free-Flow Speed

Base free-flow speed[4], BFFS	*70.0 mi/h*
Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*57.8 mi/h*
Percent free flow speed, PFFS	*85.0 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}^* f_{g,PTSF})$	*565*	*493*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*55.0*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*32.0*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*72.1*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.33*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*85.0*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*565.3*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.14*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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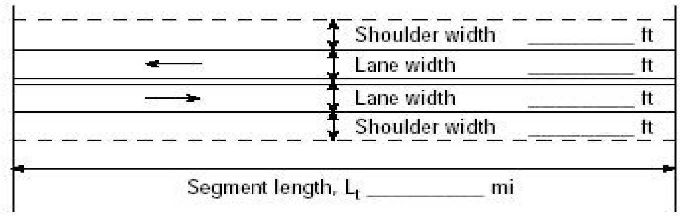
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2021*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



Analysis direction vol., V_d *306*veh/h

Opposing direction vol., V_o *248*veh/h

Shoulder width ft *6.0*

Lane Width ft *12.0*

Segment Length mi *2.0*

☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.90*

No-passing zone *70%*

% Trucks and Buses , P_T *2* %

% Recreational vehicles, P_R *4%*

Access points *mi* *7*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.4*	*1.4*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.992*	*0.992*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF* f_{g,ATS} * f_{HV,ATS})$	*343*	*278*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*3.5 mi/h*	Free-flow speed, FFS $(FSS=BFFS-f_{LS}-f_A)$	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*59.9 mi/h*
		Percent free flow speed, PFFS	*87.8 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.998*	*0.998*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*341*	*276*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*35.8*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*52.1*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*64.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.20*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*87.8*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*340.0*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.13*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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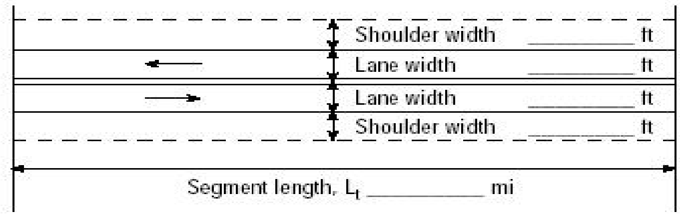
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*MID Peak*	Analysis Year	*2021*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*368*veh/h
Opposing direction vol., V_o	*358*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Grade Length mi Up/down	
Peak-hour factor, PHF	*0.97*
No-passing zone	*55%*
% Trucks and Buses , P_T	*2* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.3*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}$=1/ (1+ P_T (E_T-1)+P_R (E_R-1))	*0.994*	*0.994*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) v_i=V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*382*	*371*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
		Base free-flow speed[4], BFFS	*70.0 mi/h*
		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Mean speed of sample[3], S_{FM}		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Total demand flow rate, both directions, *v*		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*59.6 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.8 mi/h*	Percent free flow speed, PFFS	*87.4 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*0.998*	*0.998*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) v_i=V_i/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*380*	*370*
Base percent time-spent-following[4], $BPTSF_d$(%)=100(1-$e^{av_d^b}$)	*40.9*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*44.9*	
Percent time-spent-following, $PTSF_d$(%)=$BPTSF_d$+$f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$ + $v_{o,PTSF}$)	*63.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*C*
Volume to capacity ratio, *v/c*	*0.22*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*87.4*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*379.4*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.19*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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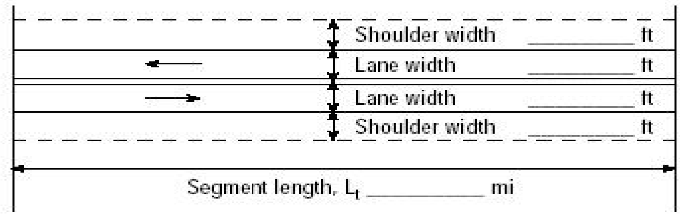
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2021*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.92*
No-passing zone	*55%*
% Trucks and Buses , P_T	*1 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	7/mi

Analysis direction vol., V_d	*436*veh/h
Opposing direction vol., V_o	*394*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.2*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.998*	*0.997*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*475*	*430*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.5 mi/h*	Free-flow speed, FFS $(FSS=BFFS-f_{LS}-f_A)$	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*58.8 mi/h*
		Percent free flow speed, PFFS	*86.1 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}^* f_{g,PTSF})$	*474*	*428*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*49.2*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*38.9*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*69.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.28*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.1*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*473.9*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.05*
Bicycle level of service (Exhibit 15-4)	*C*
Notes	

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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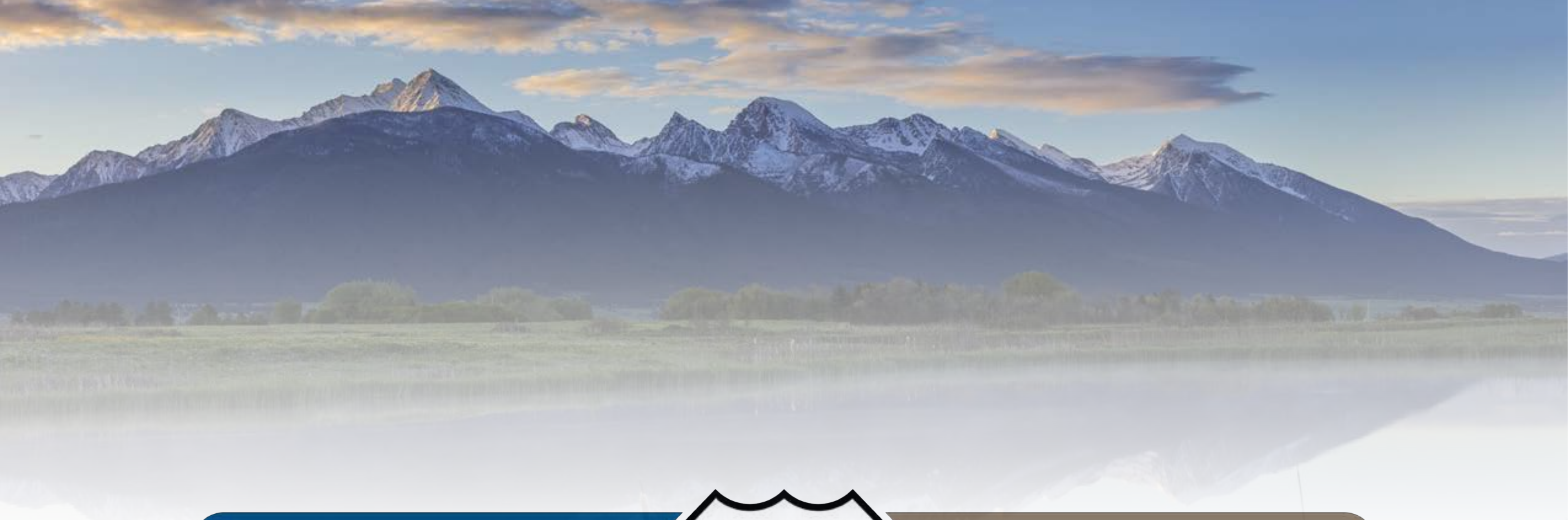


NINEPIPE CORRIDOR 93 FEASIBILITY STUDY

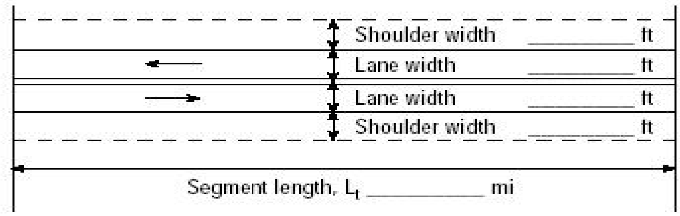
Projected Conditions Operations

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd to MT 212*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*Average Annual*	Analysis Year	*2045 (1%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.88*
No-passing zone	*70%*
% Trucks and Buses , P_T	*6 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7/mi*

Analysis direction vol., V_d	*481*veh/h
Opposing direction vol., V_o	*427*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.2*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.988*	*0.988*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*553*	*491*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
		Base free-flow speed[4], BFFS	*70.0 mi/h*
		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Mean speed of sample[3], S_{FM}		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Total demand flow rate, both directions, *v*		Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776($v/f_{HV,ATS}$)		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*57.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.3 mi/h*	Percent free flow speed, PFFS	*84.7 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}^* f_{g,PTSF})$	*547*	*485*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*54.4*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*36.6*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*73.8*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.32*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*84.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*546.6*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*4.59*
Bicycle level of service (Exhibit 15-4)	*E*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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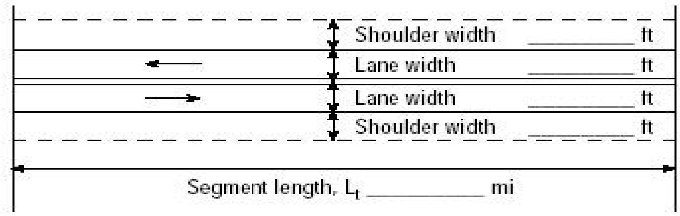
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd to MT 212*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*Average Annual*	Analysis Year	*2045 (2.2%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.88*
No-passing zone	*70%*
% Trucks and Buses , P_T	*6* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7*/mi

Analysis direction vol., V_d	*650*veh/h
Opposing direction vol., V_o	*576*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))$	*0.994*	*0.994*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i / (PHF^* f_{g,ATS} * f_{HV,ATS})$	*743*	*658*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/ f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS} + v_{o,ATS}) - f_{np,ATS}$	*55.7 mi/h*
		Percent free flow speed, PFFS	*81.6 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}{}^* f_{g,PTSF})$	*739*	*655*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*65.2*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*26.7*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF} {}^*(v_{d,PTSF} / v_{d,PTSF} + v_{o,PTSF})$	*79.4*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.43*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*81.6*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*738.6*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*4.75*
Bicycle level of service (Exhibit 15-4)	*E*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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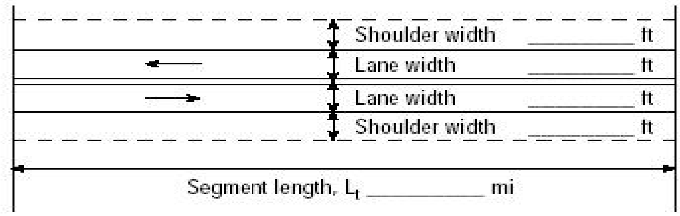
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd to MT 212*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*Average Annual*	Analysis Year	*2045 (2.8%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.88*
No-passing zone	*70%*
% Trucks and Buses, P_T	*6* %
% Recreational vehicles, P_R	*4*%
Access points *mi*	*7*/mi

Analysis direction vol., V_d	*749*veh/h
Opposing direction vol., V_o	*664*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}$=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*1.000*	*0.994*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*851*	*759*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0* *mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0* *mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8* *mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.4* *mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3* *mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*54.4* *mi/h*
		Percent free flow speed, PFFS	*79.6* *%*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ $P_T(E_T-1)+P_R(E_R-1)$)	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i$/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*851*	*755*
Base percent time-spent-following[4], $BPTSF_d$(%)=100($1-e^{av_d^b}$)	*70.6*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*23.4*	
Percent time-spent-following, $PTSF_d$(%)=$BPTSF_d$+$f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$ + $v_{o,PTSF}$)	*83.0*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*E*
Volume to capacity ratio, *v/c*	*0.50*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*79.6*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*851.1*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*4.82*
Bicycle level of service (Exhibit 15-4)	*E*
Notes	

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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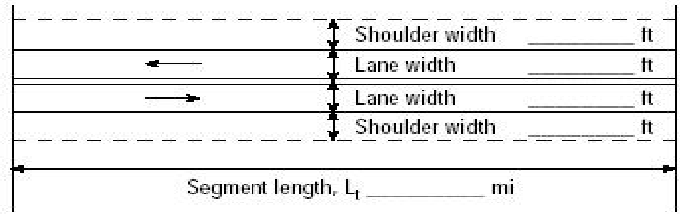
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 to Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*Average Annual*	Analysis Year	*2045(1%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF	*0.88*
No-passing zone	*43%*
% Trucks and Buses , P_T	*6* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Analysis direction vol., V_d	*639*veh/h
Opposing direction vol., V_o	*566*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}$=1/ (1+ P_T (E_T -1)+P_R (E_R -1))	*0.994*	*0.994*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) v_i=V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*731*	*647*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.4 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*55.9 mi/h*
		Percent free flow speed, PFFS	*82.2 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) v_i=V_i/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*726*	*643*
Base percent time-spent-following[4], $BPTSF_d$(%)=100(1-$e^{av_d^b}$)	*65.1*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*24.5*	
Percent time-spent-following, $PTSF_d$(%)=$BPTSF_d$+$f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$ + $v_{o,PTSF}$)	*78.1*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.43*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*82.2*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*726.1*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*4.74*
Bicycle level of service (Exhibit 15-4)	*E*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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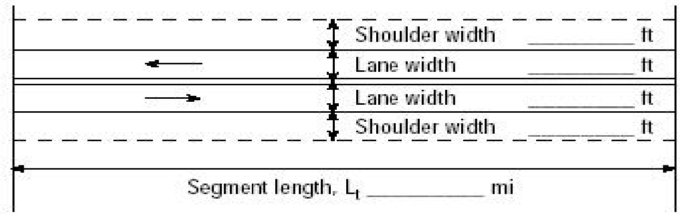
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 to Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*Average Annual*	Analysis Year	*2045(2.2%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.88*
No-passing zone	*43%*
% Trucks and Buses , P_T	*6* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Analysis direction vol., V_d	*862*veh/h
Opposing direction vol., V_o	*765*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}$=1/ (1+ P_T (E_T -1)+P_R (E_R -1))	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*980*	*869*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.0 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*52.7 mi/h*
		Percent free flow speed, PFFS	*77.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i$/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*980*	*869*
Base percent time-spent-following[4], $BPTSF_d$(%)=100(1-$e^{av_d^b}$)	*75.8*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*17.9*	
Percent time-spent-following, $PTSF_d$(%)=$BPTSF_d$+$f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$ + $v_{o,PTSF}$)	*85.3*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*E*
Volume to capacity ratio, *v/c*	*0.58*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*77.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*979.5*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*4.89*
Bicycle level of service (Exhibit 15-4)	*E*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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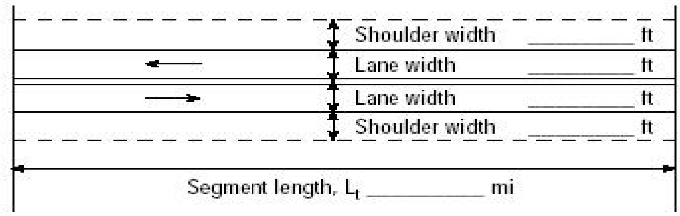
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 to Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*Average Annual*	Analysis Year	*2045 (2.8%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*993*veh/h
Opposing direction vol., V_o	*881*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.88*
No-passing zone	*43%*
% Trucks and Buses , P_T	*6 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}$=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*1128*	*1001*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*0.8 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*50.6 mi/h*
		Percent free flow speed, PFFS	*74.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i$/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*1128*	*1001*
Base percent time-spent-following[4], $BPTSF_d$(%)=100(1-$e^{av_d^b}$)	*81.0*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*14.4*	
Percent time-spent-following, $PTSF_d$(%)=$BPTSF_d$+$f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$ + $v_{o,PTSF}$)	*88.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*E*
Volume to capacity ratio, *v/c*	*0.66*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*74.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*1128.4*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*4.96*
Bicycle level of service (Exhibit 15-4)	*E*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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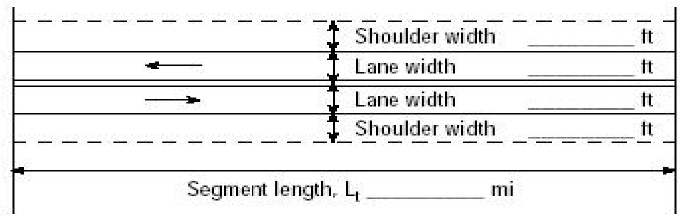
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2045 (1%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*492*veh/h
Opposing direction vol., V_o	*365*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.87*
No-passing zone	*43%*
% Trucks and Buses , P_T	*1* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.3*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.999*	*0.997*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*566*	*421*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0* *mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0* *mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0* *mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.3* *mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0* *mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*58.1* *mi/h*
		Percent free flow speed, PFFS	*85.4* *%*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}{}^* f_{g,PTSF})$	*566*	*420*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*53.9*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*31.9*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*72.2*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.33*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*85.4*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*565.5*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.14*
Bicycle level of service (Exhibit 15-4)	*C*
Notes	

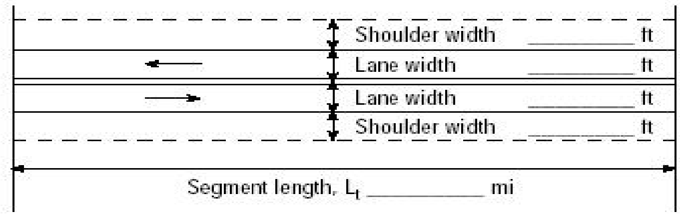
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2045 (2.2%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.87*

No-passing zone *43%*

% Trucks and Buses , P_T *1* %

% Recreational vehicles, P_R *4%*

Access points *mi* *8*/mi

Analysis direction vol., V_d *654*veh/h

Opposing direction vol., V_o *485*veh/h

Shoulder width ft *6.0*

Lane Width ft *12.0*

Segment Length mi *2.5*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.999*	*0.999*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*752*	*558*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.7 mi/h*	Free-flow speed, FFS $(FSS=BFFS-f_{LS}-f_A)$	*68.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*56.1 mi/h*
		Percent free flow speed, PFFS	*82.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*752*	*557*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*65.4*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*25.0*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*79.8*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.44*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*82.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*751.7*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.29*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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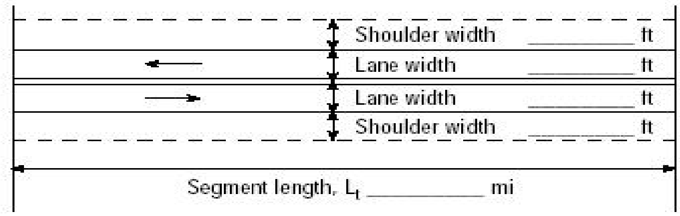
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2045 (2.8%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



Analysis direction vol., V_d *752*veh/h

Opposing direction vol., V_o *558*veh/h

Shoulder width ft *6.0*

Lane Width ft *12.0*

Segment Length mi *2.5*

☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Peak-hour factor, PHF *0.87*

No-passing zone *43%*

% Trucks and Buses , P_T *1* %

% Recreational vehicles, P_R *4%*

Access points *mi* *8*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*0.999*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*864*	*642*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.4 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*54.9 mi/h*
		Percent free flow speed, PFFS	*80.7 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*864*	*641*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*69.6*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*21.7*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*82.1*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*E*
Volume to capacity ratio, *v/c*	*0.51*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*80.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*864.4*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.36*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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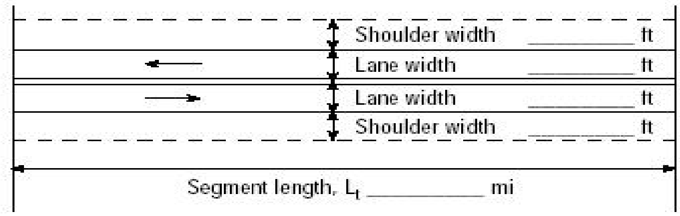
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*MID Peak*	Analysis Year	*2045 (1%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.97*
No-passing zone	*42%*
% Trucks and Buses, P_T	*2* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Analysis direction vol., V_d	*558*veh/h
Opposing direction vol., V_o	*529*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))$	*0.998*	*0.996*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*576*	*548*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/ f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.7 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS} + v_{o,ATS}) - f_{np,ATS}$	*57.5 mi/h*
		Percent free flow speed, PFFS	*84.6 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*575*	*545*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*56.4*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*31.3*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF} / v_{d,PTSF} + v_{o,PTSF})$	*72.5*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.34*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*84.6*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*575.3*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.40*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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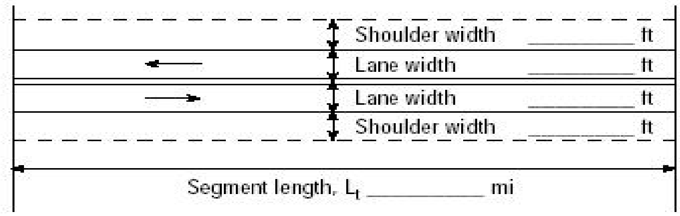
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		**Site Information**	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*MID Peak*	Analysis Year	*2045 (2.2%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*741*veh/h
Opposing direction vol., V_o	*702*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.97*
No-passing zone	*42%*
% Trucks and Buses , P_T	*2* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.998*	*0.998*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*765*	*725*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/ f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.2 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*55.2 mi/h*
		Percent free flow speed, PFFS	*81.2 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}^* f_{g,PTSF})$	*764*	*724*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*66.9*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*22.7*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF} *(v_{d,PTSF} / v_{d,PTSF}+v_{o,PTSF})$	*78.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.45*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*81.2*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*763.9*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.54*
Bicycle level of service (Exhibit 15-4)	*D*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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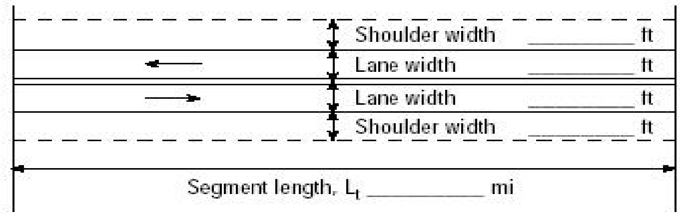
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*MID Peak*	Analysis Year	*2045 (2.8%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Analysis direction vol., V_d	*853*veh/h
Opposing direction vol., V_o	*808*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*
Peak-hour factor, PHF	*0.97*
No-passing zone	*42%*
% Trucks and Buses , P_T	*2* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*0.998*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*879*	*835*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.0 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*53.7 mi/h*
		Percent free flow speed, PFFS	*79.0 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}{}^* f_{g,PTSF})$	*879*	*833*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*72.6*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*19.7*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}{}^*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*82.7*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*E*
Volume to capacity ratio, *v/c*	*0.52*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*79.0*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*879.4*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.62*
Bicycle level of service (Exhibit 15-4)	*D*

Notes

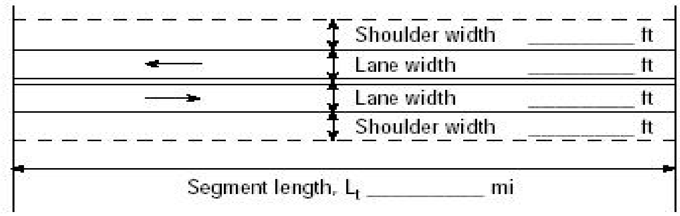
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2045 (1%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.95*
No-passing zone	*42%*
% Trucks and Buses , P_T	*1* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Analysis direction vol., V_d	*682*veh/h
Opposing direction vol., V_o	*594*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.999*	*0.999*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*719*	*626*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.5 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*56.1 mi/h*
		Percent free flow speed, PFFS	*82.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i$/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*718*	*625*
Base percent time-spent-following[4], $BPTSF_d$(%)=100($1-e^{av_d^b}$)	*63.4*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*24.9*	
Percent time-spent-following, $PTSF_d$(%)=$BPTSF_d$+$f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$ + $v_{o,PTSF}$)	*76.7*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.42*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*82.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*717.9*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.26*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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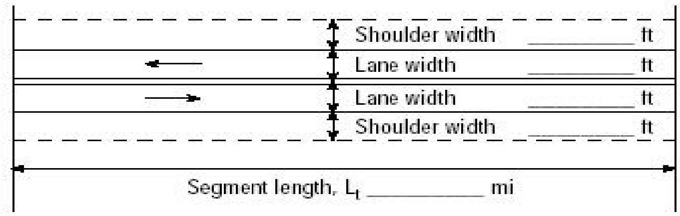
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2045 (2.2%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*906*veh/h
Opposing direction vol., V_o	*788*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.95*
No-passing zone	*42%*
% Trucks and Buses , P_T	*1 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/\ (1+ P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*0.999*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*954*	*830*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/\ f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.0 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS} + v_{o,ATS}) - f_{np,ATS}$	*53.2 mi/h*
		Percent free flow speed, PFFS	*78.2 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/\ (1+ P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*954*	*829*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*75.0*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*18.6*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF} / v_{d,PTSF} + v_{o,PTSF})$	*85.0*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*E*
Volume to capacity ratio, *v/c*	*0.56*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*78.2*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*953.7*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.41*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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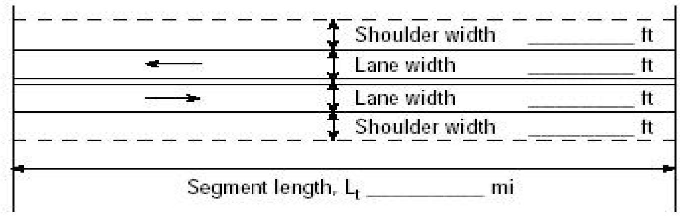
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*MT 212 - Brooke Ln*
Date Performed	*12/2/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2045 (2.8%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi	Up/down
Peak-hour factor, PHF	*0.95*
No-passing zone	*42%*
% Trucks and Buses , P_T	*1* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*8*/mi

Analysis direction vol., V_d	*1042*veh/h
Opposing direction vol., V_o	*907*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.5*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}$=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) v_i=V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*1097*	*955*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*2.0 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*0.9 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.0 mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*51.2 mi/h*
		Percent free flow speed, PFFS	*75.3 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) v_i=V_i/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*1097*	*955*
Base percent time-spent-following[4], $BPTSF_d$(%)=100(1-$e^{av_d^b}$)	*79.8*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*15.2*	
Percent time-spent-following, $PTSF_d$(%)=$BPTSF_d$+$f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$ + $v_{o,PTSF}$)	*87.9*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*E*
Volume to capacity ratio, *v/c*	*0.65*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*75.3*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*1096.8*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.48*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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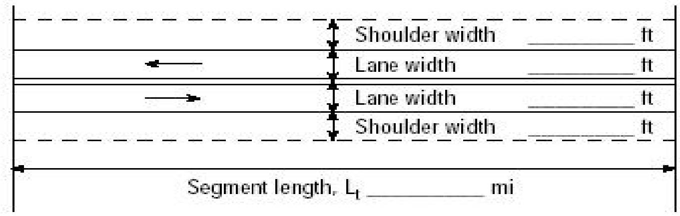
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		**Site Information**	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2045 (1%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*389*veh/h
Opposing direction vol., V_o	*314*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.90*
No-passing zone	*70%*
% Trucks and Buses, P_T	*2* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.3*	*1.4*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.994*	*0.992*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*435*	*352*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*3.0 mi/h*	Free-flow speed, FFS $(FSS=BFFS-f_{LS}-f_A)$	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*59.1 mi/h*
		Percent free flow speed, PFFS	*86.6 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*0.998*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*432*	*350*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*44.1*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*42.7*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*67.7*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.25*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*86.6*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*432.2*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.26*
Bicycle level of service (Exhibit 15-4)	*C*
Notes	

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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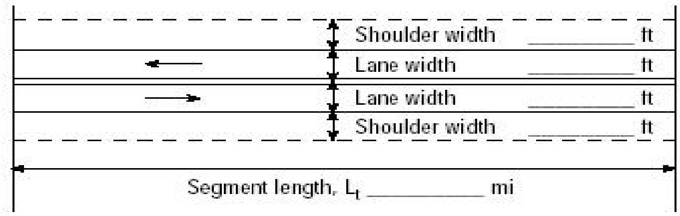
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2045 (2.2%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*516*veh/h
Opposing direction vol., V_o	*417*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.90*
No-passing zone	*70%*
% Trucks and Buses , P_T	*2* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}$=1/ (1+ P_T (E_T -1)+P_R (E_R -1))	*0.998*	*0.996*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) v_i=V_i / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*574*	*465*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(*v*/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.4 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*57.7 mi/h*
		Percent free flow speed, PFFS	*84.6 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, f_{HV}=1/ (1+ P_T(E_T-1)+P_R(E_R-1))	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) v_i=V_i/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*573*	*463*
Base percent time-spent-following[4], $BPTSF_d$(%)=100(1-$e^{av_d^b}$)	*54.5*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*35.6*	
Percent time-spent-following, $PTSF_d$(%)=$BPTSF_d$+$f_{np,PTSF}$ *($v_{d,PTSF}$ / $v_{d,PTSF}$ + $v_{o,PTSF}$)	*74.2*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.34*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*84.6*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*573.3*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.40*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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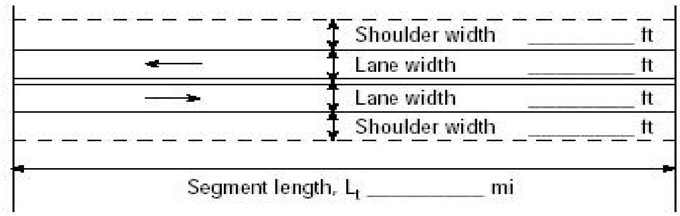
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*AM Peak*	Analysis Year	*2045 (2.8%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Analysis direction vol., V_d	*594*veh/h
Opposing direction vol., V_o	*480*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Peak-hour factor, PHF	*0.90*
No-passing zone	*70%*
% Trucks and Buses , P_T	*2 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.998*	*0.996*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*661*	*535*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.1 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*56.9 mi/h*
		Percent free flow speed, PFFS	*83.3 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}^* f_{g,PTSF})$	*660*	*533*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*60.3*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*31.6*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*77.8*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.39*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*83.3*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*660.0*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.47*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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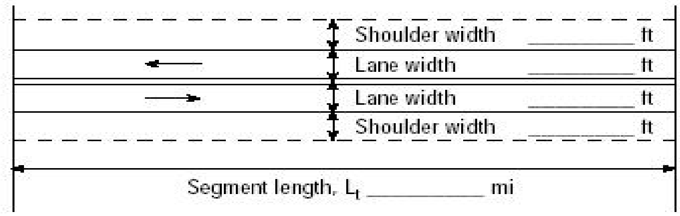
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*MID Peak*	Analysis Year	*2045 (1%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Analysis direction vol., V_d	*467*veh/h
Opposing direction vol., V_o	*454*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Peak-hour factor, PHF	*0.97*
No-passing zone	*55%*
% Trucks and Buses , P_T	*2 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.2*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.996*	*0.996*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*483*	*470*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*2.3 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*58.6 mi/h*
		Percent free flow speed, PFFS	*85.8 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*481*	*468*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*50.1*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*38.4*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*69.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.28*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*85.8*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*481.4*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.31*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

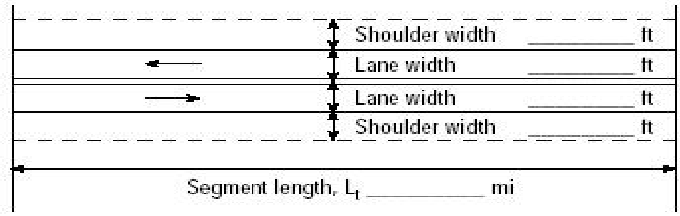
1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*MID Peak*	Analysis Year	*2045 (2.2%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Grade Length mi Up/down

Analysis direction vol., V_d	*620*veh/h
Opposing direction vol., V_o	*603*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Peak-hour factor, PHF	*0.97*
No-passing zone	*55%*
% Trucks and Buses , P_T	*2* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.998*	*0.998*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*640*	*623*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, FFS=S_{FM}+0.00776(v/ $f_{HV,ATS}$)		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.6 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
		Average travel speed, ATS_d=FFS-0.00776($v_{d,ATS}$ + $v_{o,ATS}$) - $f_{np,ATS}$	*56.9 mi/h*
		Percent free flow speed, PFFS	*83.3 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i$/(PHF*$f_{HV,PTSF}$* $f_{g,PTSF}$)	*639*	*622*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*59.9*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*29.5*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*74.8*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.38*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*83.3*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*639.2*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.45*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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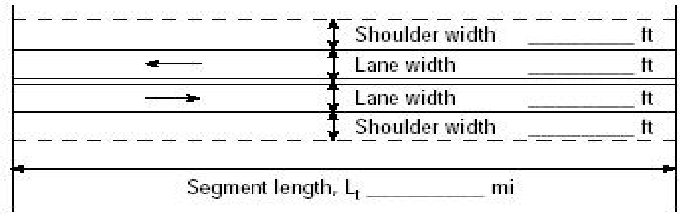
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*MID Peak*	Analysis Year	*2045 (2.8%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*713*veh/h
Opposing direction vol., V_o	*694*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.97*
No-passing zone	*55%*
% Trucks and Buses , P_T	*2 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.998*	*0.998*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*737*	*717*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.4 mi/h*	Free-flow speed, FFS $(FSS=BFFS-f_{LS}-f_A)$	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*55.6 mi/h*
		Percent free flow speed, PFFS	*81.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}{}^* f_{g,PTSF})$	*735*	*715*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*66.2*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*24.8*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}{}^*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*78.8*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.43*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*81.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*735.1*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.52*
Bicycle level of service (Exhibit 15-4)	*D*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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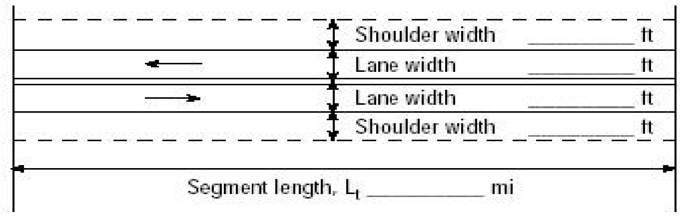
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		Site Information	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2045 (1%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*553*veh/h
Opposing direction vol., V_o	*500*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.92*
No-passing zone	*55%*
% Trucks and Buses, P_T	*1 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.2*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.999*	*0.998*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF^* f_{g,ATS} * f_{HV,ATS})$	*602*	*545*

Free-Flow Speed from Field Measurement		Estimated Free-Flow Speed	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.9 mi/h*	Free-flow speed, FFS $(FSS=BFFS-f_{LS}-f_A)$	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*57.4 mi/h*
		Percent free flow speed, PFFS	*84.2 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF^*f_{HV,PTSF}{}^* f_{g,PTSF})$	*601*	*543*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*57.8*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*32.3*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*74.8*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*D*
Volume to capacity ratio, *v/c*	*0.35*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*84.2*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*601.1*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.17*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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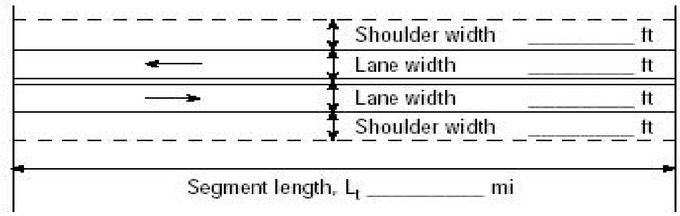
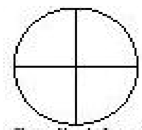
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2045 (2.2%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data





Show North Arrow

☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*734*veh/h
Opposing direction vol., V_o	*664*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.92*
No-passing zone	*55%*
% Trucks and Buses , P_T	*1* %
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7*/mi

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.1*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*0.999*	*0.999*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i$ / (PHF* $f_{g,ATS}$ * $f_{HV,ATS}$)	*799*	*722*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.3 mi/h*	Free-flow speed, FFS (FSS=BFFS-f_{LS}-f_A)	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*55.1 mi/h*
		Percent free flow speed, PFFS	*80.7 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*798*	*722*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*68.3*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*23.6*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*80.7*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*E*
Volume to capacity ratio, *v/c*	*0.47*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*80.7*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*797.8*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.32*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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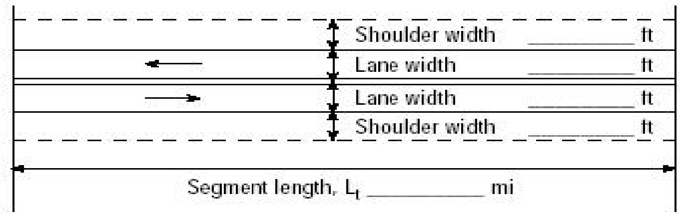
DIRECTIONAL TWO-LANE HIGHWAY SEGMENT WORKSHEET

General Information		***Site Information***	
Analyst	*Hailee Cross*	Highway / Direction of Travel	*US 93*
Agency or Company	*RPA*	From/To	*Gunlock Rd - MT 212*
Date Performed	*11/30/2021*	Jurisdiction	
Analysis Time Period	*PM Peak*	Analysis Year	*2045 (2.8%)*

Project Description: *US 93 Ninepipe Corridor Study*

Input Data



☑ Class I highway ☐ Class II highway ☐ Class III highway

Terrain ☑ Level ☐ Rolling

Analysis direction vol., V_d	*845*veh/h
Opposing direction vol., V_o	*764*veh/h
Shoulder width ft	*6.0*
Lane Width ft	*12.0*
Segment Length mi	*2.0*
Grade Length mi	Up/down
Peak-hour factor, PHF	*0.92*
No-passing zone	*55%*
% Trucks and Buses , P_T	*1 %*
% Recreational vehicles, P_R	*4%*
Access points *mi*	*7/mi*

Average Travel Speed

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T (Exhibit 15-11 or 15-12)	*1.0*	*1.1*
Passenger-car equivalents for RVs, E_R (Exhibit 15-11 or 15-13)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV,ATS}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*0.999*
Grade adjustment factor[1], $f_{g,ATS}$ (Exhibit 15-9)	*1.00*	*1.00*
Demand flow rate[2], v_i (pc/h) $v_i=V_i/(PHF*f_{g,ATS}*f_{HV,ATS})$	*918*	*831*

Free-Flow Speed from Field Measurement		**Estimated Free-Flow Speed**	
Mean speed of sample[3], S_{FM}		Base free-flow speed[4], BFFS	*70.0 mi/h*
Total demand flow rate, both directions, *v*		Adj. for lane and shoulder width,[4] f_{LS}(Exhibit 15-7)	*0.0 mi/h*
Free-flow speed, $FFS=S_{FM}+0.00776(v/f_{HV,ATS})$		Adj. for access points[4], f_A (Exhibit 15-8)	*1.8 mi/h*
Adj. for no-passing zones, $f_{np,ATS}$ (Exhibit 15-15)	*1.1 mi/h*	Free-flow speed, FFS $(FSS=BFFS-f_{LS}-f_A)$	*68.3 mi/h*
		Average travel speed, $ATS_d=FFS-0.00776(v_{d,ATS}+v_{o,ATS})-f_{np,ATS}$	*53.5 mi/h*
		Percent free flow speed, PFFS	*78.5 %*

Percent Time-Spent-Following

	Analysis Direction (d)	Opposing Direction (o)
Passenger-car equivalents for trucks, E_T(Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Passenger-car equivalents for RVs, E_R (Exhibit 15-18 or 15-19)	*1.0*	*1.0*
Heavy-vehicle adjustment factor, $f_{HV}=1/(1+P_T(E_T-1)+P_R(E_R-1))$	*1.000*	*1.000*
Grade adjustment factor[1], $f_{g,PTSF}$ (Exhibit 15-16 or Ex 15-17)	*1.00*	*1.00*
Directional flow rate[2], v_i(pc/h) $v_i=V_i/(PHF*f_{HV,PTSF}*f_{g,PTSF})$	*918*	*830*
Base percent time-spent-following[4], $BPTSF_d(\%)=100(1-e^{av_d^b})$	*73.9*	
Adj. for no-passing zone, $f_{np,PTSF}$ (Exhibit 15-21)	*20.3*	
Percent time-spent-following, $PTSF_d(\%)=BPTSF_d+f_{np,PTSF}*(v_{d,PTSF}/v_{d,PTSF}+v_{o,PTSF})$	*84.6*	

Level of Service and Other Performance Measures

Level of service, LOS (Exhibit 15-3)	*E*
Volume to capacity ratio, *v/c*	*0.54*

Capacity, $C_{d,ATS}$ (Equation 15-12) veh/h	*1700*
Capacity, $C_{d,PTSF}$ (Equation 15-13) veh/h	*1700*
Percent Free-Flow Speed $PFFS_d$(Equation 15-11 - Class III only)	*78.5*
Bicycle Level of Service	
Directional demand flow rate in outside lane, v_{OL} (Eq. 15-24) veh/h	*918.5*
Effective width, Wv (Eq. 15-29) ft	*24.00*
Effective speed factor, S_t (Eq. 15-30)	*5.19*
Bicycle level of service score, BLOS (Eq. 15-31)	*3.39*
Bicycle level of service (Exhibit 15-4)	*C*

Notes

1. Note that the adjustment factor for level terrain is 1.00,as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If v_i(v_d or v_o) >=1,700 pc/h, terminate analysis--the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only
5. Exhibit 15-20 provides coefficients a and b for Equation 15-10.
6. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

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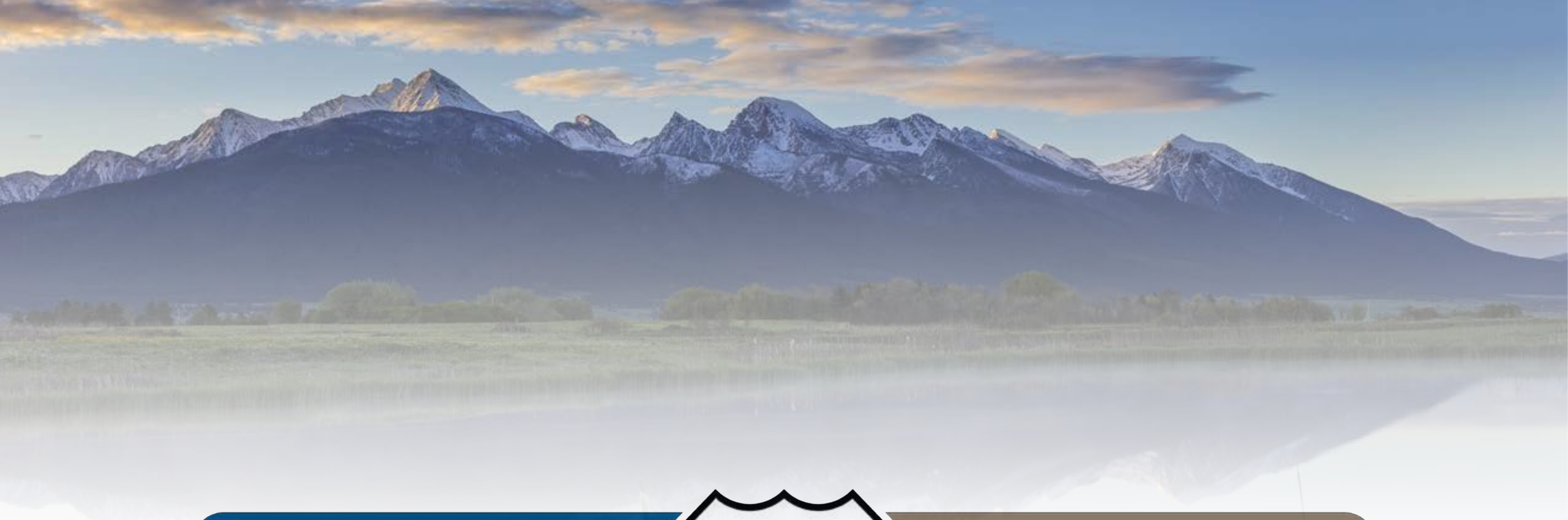
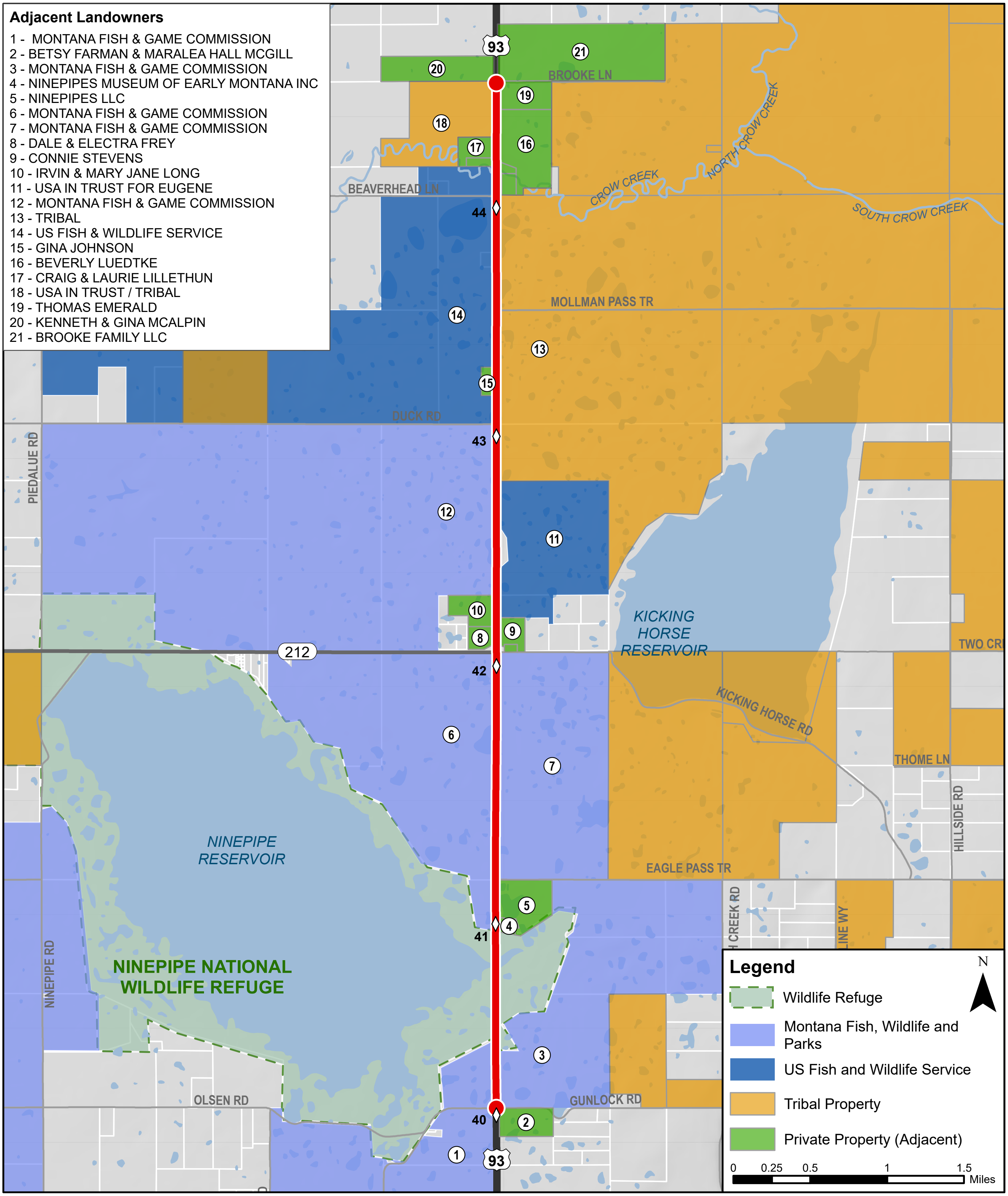


NINEPIPE CORRIDOR 93 FEASIBILITY STUDY

APPENDIX B:

Ownership Summary and Existing Right-of-Way


Adjacent Landowners
1 - MONTANA FISH & GAME COMMISSION
2 - BETSY FARMAN & MARALEA HALL MCGILL
3 - MONTANA FISH & GAME COMMISSION
4 - NINEPIPES MUSEUM OF EARLY MONTANA INC
5 - NINEPIPES LLC
6 - MONTANA FISH & GAME COMMISSION
7 - MONTANA FISH & GAME COMMISSION
8 - DALE & ELECTRA FREY
9 - CONNIE STEVENS
10 - IRVIN & MARY JANE LONG
11 - USA IN TRUST FOR EUGENE
12 - MONTANA FISH & GAME COMMISSION
13 - TRIBAL
14 - US FISH & WILDLIFE SERVICE
15 - GINA JOHNSON
16 - BEVERLY LUEDTKE
17 - CRAIG & LAURIE LILLETHUN
18 - USA IN TRUST / TRIBAL
19 - THOMAS EMERALD
20 - KENNETH & GINA MCALPIN
21 - BROOKE FAMILY LLC
93
BROOKE LN
NORTH CROW CREEK
CROW CREEK
SOUTH CROW CREEK
BEAVERHEAD LN
44
MOLLMAN PASS TR
DUCK RD
43
PIEDALUE RD
KICKING HORSE RESERVOIR
TWO CR
212
42
KICKING HORSE RD
THOME LN
HILLSIDE RD
NINEPIPE RESERVOIR
EAGLE PASS TR
41
NINEPIPE NATIONAL WILDLIFE REFUGE
NINEPIPE RD
OLSEN RD
GUNLOCK RD
40
93
Legend
Wildlife Refuge
Montana Fish, Wildlife and Parks
US Fish and Wildlife Service
Tribal Property
Private Property (Adjacent)
N
0 0.25 0.5 1 1.5 Miles

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		2	12

PROJECT NUMBER

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

MDT MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION TOP OF CUT DITCH BOTTOM
TOE OF FILL

FHWA/DOT APPROVAL

MAP REVISED

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		3	12
PROJECT NUMBER			

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

MDT MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION TOE OF FILL
FHWA/DOT APPROVAL
MAP REVISED

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		4	12
PROJECT NUMBER			

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

MDT MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION / TOE OF FILL
TOP OF CUT
DITCH BOTTOM

FHWA/DOT APPROVAL ____________

MAP REVISED ____________

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		5	12
PROJECT NUMBER			

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

MDT MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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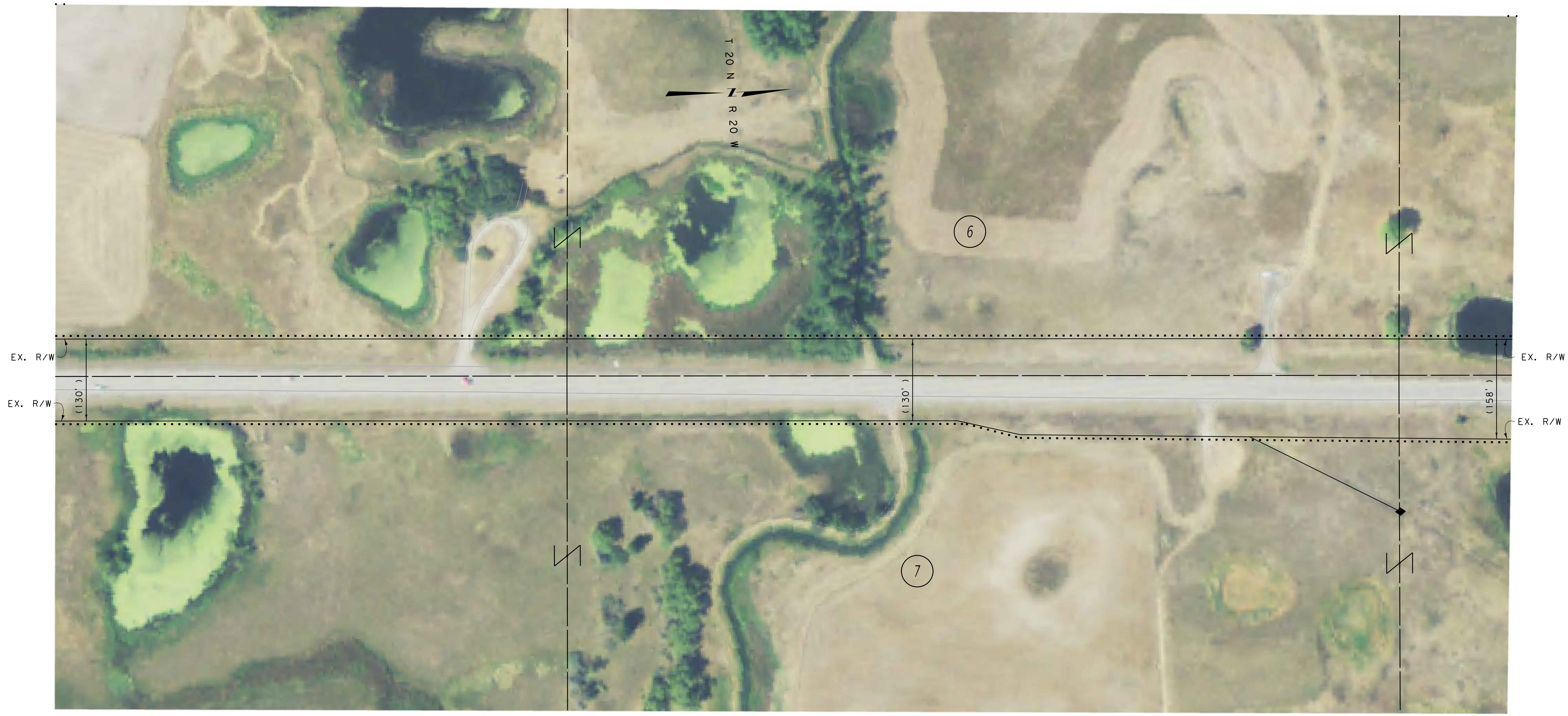

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BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION TOE OF FILL
TOP OF CUT
DITCH BOTTOM

FHWA/DOT APPROVAL ____

MAP REVISED ____

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		6	12
PROJECT NUMBER			

MDT MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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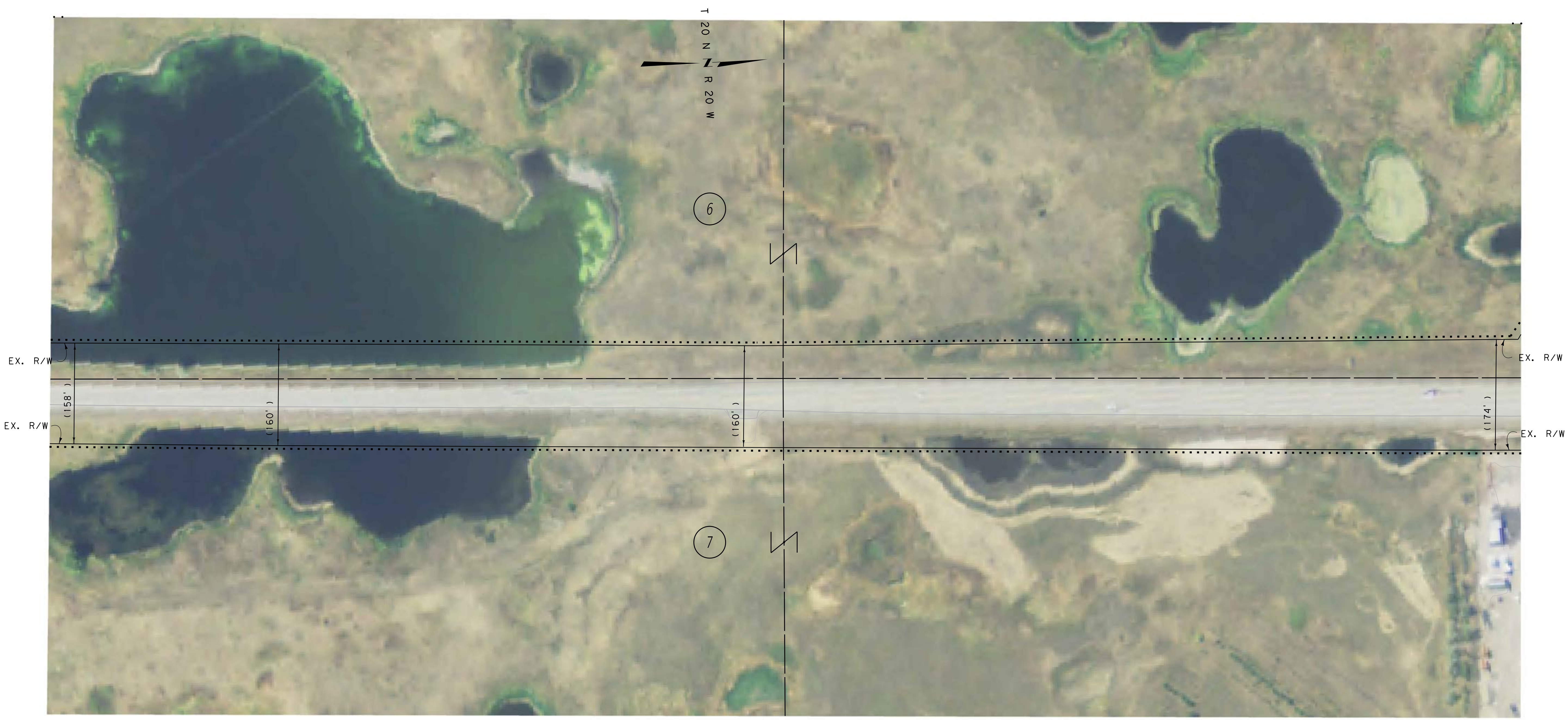

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BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION TOE OF FILL
TOP OF CUT
DITCH BOTTOM

FHWA/DOT APPROVAL

MAP REVISED

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		7	12
PROJECT NUMBER			

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION TOE OF FILL
TOP OF CUT
DITCH BOTTOM

FHWA/DOT APPROVAL ____________

MAP REVISED____________

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

MDT MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		8	12
PROJECT NUMBER			

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

RDROW

BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION TOE OF FILL
TOP OF CUT
DITCH BOTTOM

FHWA/DOT APPROVAL ____________

MAP REVISED ____________

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		9	12
PROJECT NUMBER			

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

MDT MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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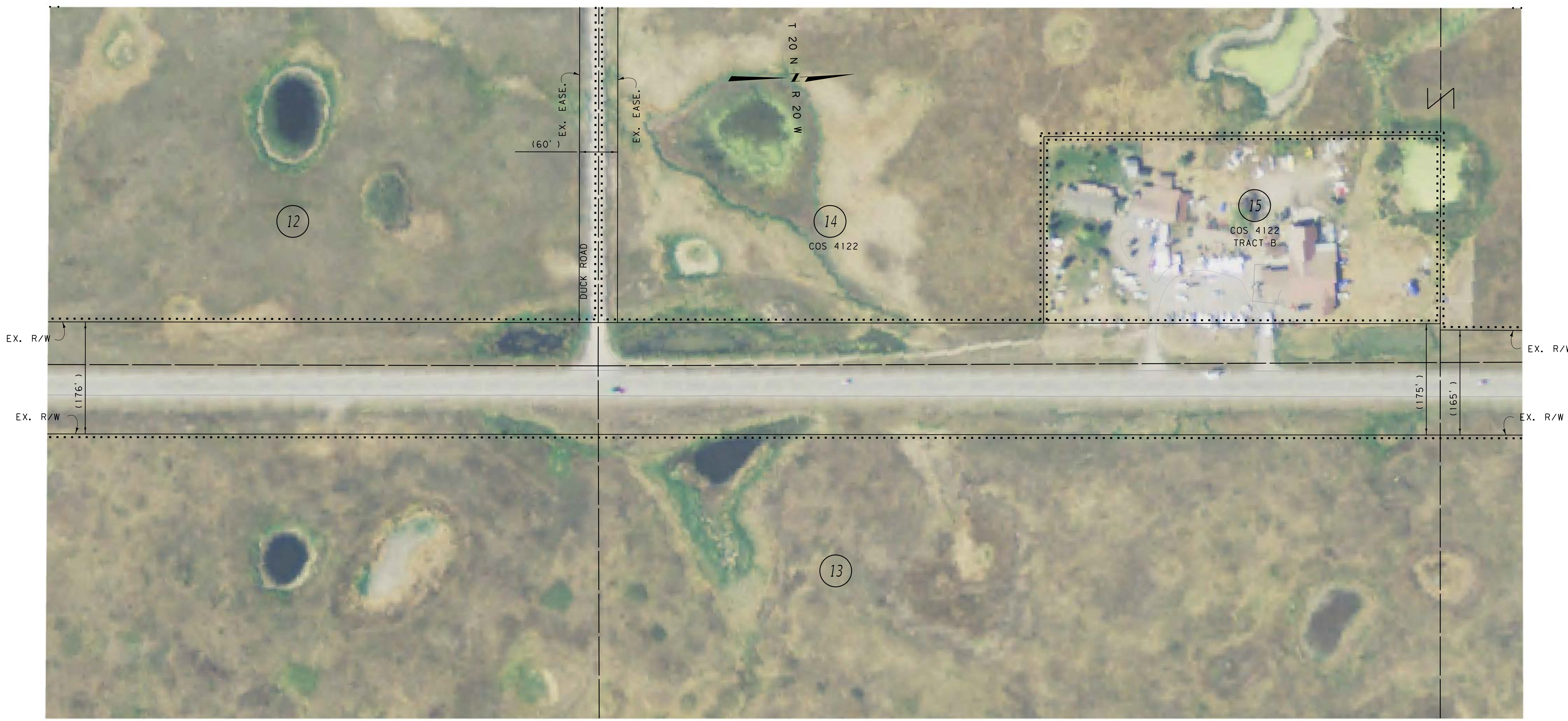

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BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION TOP OF CUT DITCH BOTTOM TOE OF FILL

FHWA/DOT APPROVAL

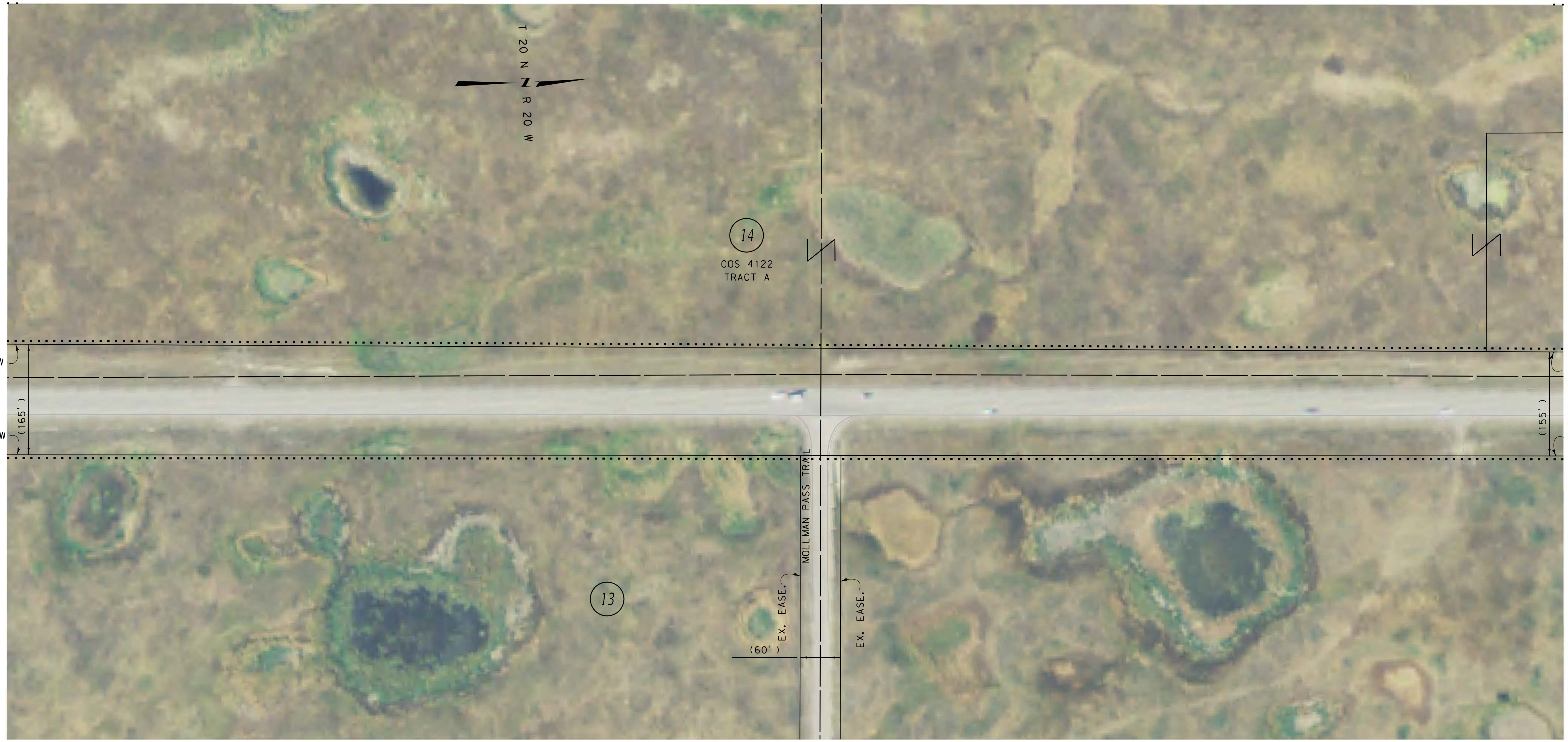
MAP REVISED

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		10	12
PROJECT NUMBER			

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.



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MONTANA CADD

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FHWA/DOT APPROVAL ____________

MAP REVISED ____________

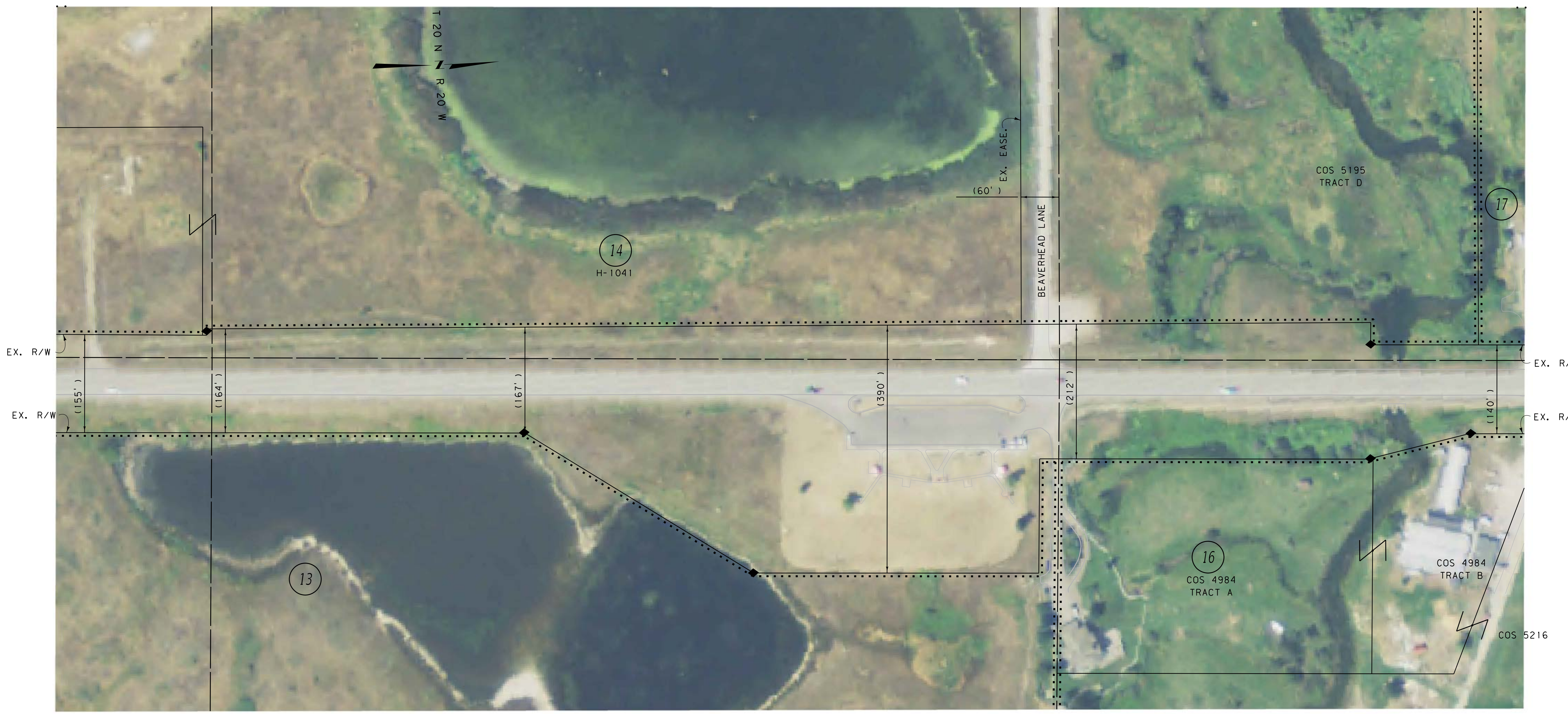
MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		11	12

PROJECT NUMBER



BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION / TOE OF FILL
TOP OF CUT / DITCH BOTTOM

FHWA/DOT APPROVAL

MAP REVISED

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

MDT MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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SEE SHEET NO.1 FOR OWNERSHIP NAMES, ADDRESSES, AREAS, ETC.

STATE	RIGHT OF WAY ID.	SHEET NO.	TOTAL SHEETS
MONTANA		12	12
PROJECT NUMBER			

MDT MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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BACKSLOPE LIMITS INCLUDE ROUNDING
CONSTRUCTION LIMITS: CUT SECTION TOE OF FILL
TOP OF CUT
DITCH BOTTOM

FHWA/DOT APPROVAL

MAP REVISED

MONTANA
DEPARTMENT OF TRANSPORTATION

RIGHT OF WAY PLAN
LAKE COUNTY

NINEPIPE CORRIDOR 93 FEASIBILITY STUDY

APPENDIX C:

Wetlands Technical Memorandum

HERRERA

TECHNICAL MEMORANDUM

Date: January 6, 2022

To: Sarah Nicolai, Scott Randall; Robert Peccia and Associates

From: Susan Wall

Subject: Analysis of Relevant Conditions for Wetlands in the Ninepipe Study Corridor

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CONTENTS

APPENDICES

TABLES

INTRODUCTION

This memorandum was prepared to confirm and update wetland boundaries and functions in the Ninepipes Feasibility Study corridor (Ninepipe study corridor).

Background

The US 93 Evaro to Polson Final Environmental Impact Statement (FEIS) (FHWA and MDT 1996) included wetland boundary locations along US 93, including the Ninepipe segment that is the subject of the feasibility study. Boundary determinations for the 1996 analysis were based on the methods described in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987).

During preparation of the US 93 Ninepipe/Ronan Final Supplemental Environmental Impact Statement (SEIS) (FHWA, MDT and CSKT 2008), wetland boundaries were re-evaluated using spatial data that became available after the wetland assessment for the US 93 Evaro to Polson FEIS was completed. The revised boundaries were completed in 2002.

Objectives

The objectives of the wetland reconnaissance were to:

- Re-evaluate and update wetland boundaries delineated in 2002.
- Review functional assessments and determine if any rating updates are warranted under the 2008 Montana Wetland Assessment Method (MWAM) (Berglund 2008) compared to the 1999 MWAM that was used for the SEIS.
- Provide preliminary jurisdictional review to support Clean Water Act permitting.

METHODS

For the purpose of referencing individual wetlands, each wetland within the study corridor was assigned a wetland identifier code composed of a combination of letters and numbers using the naming convention used in the US 93 Evaro to Polson FEIS.

Delineation

While re-evaluating wetland boundaries, the U.S. Army Corps of Engineers (USACE) wetland determination criteria as documented in the 1987 Wetland Delineation Manual (Environmental Laboratory 1987), and regional guidance presented in the Western Mountains Valleys and Coast (USACE 2010) were used to verify previously delineated boundaries. The mapped boundaries of each wetland within the road right-of-way were walked to determine whether the boundaries accurately represented conditions on the ground using an Arrow GPS receiver and iPad Collector map with the 2002 wetland delineation layer depicted over a current aerial photograph. If the boundary appeared to be inaccurate, a revised boundary line was mapped using GPS. Paired wetland and upland sample plots were documented in select locations using USACE routine delineation forms.

Classification and Functional Assessment

Wetlands were classified using the Classification of Wetlands and Deepwater Habitats of the United States (FGDC 2013), a descriptive classification with 28 subclasses, based on physical wetland attributes (i.e., vegetation, soils, and water regime). Wetlands were also grouped into four types, using the categories developed for the SEIS. These include the following types:

- Riparian zone wetlands located in the floodplains of streams, outside of the stream channel.
- Pothole wetlands characteristic of glacial features. Pothole wetlands were grouped based on water regime.
  - Group 1 potholes are inundated by precipitation, surface water runoff, and/or ground water inflow for all of the year.
  - Group 2 potholes are usually saturated at or near the soil surface for all or most of the year and inundated for portions of the year.
  - Group 3 potholes are depression areas that are inundated periodically, but with much longer lengths of time between inundation.
- Irrigation feature wetlands including feeder canals, lateral canals, and features resulting from seepage of the irrigation system.
- Roadside ditch wetlands that are present because of runoff from the roadway collecting and ponding in the ditches or interception of ground water from excavation of the ditches.

The functional assessment analysis used the 2008 Montana Wetland Assessment Method (Berglund and McEldowney 2008). The criteria presented in the 1999 version of MWAM, which was in place at the time of the 2002 delineations, was compared to the criteria in the 2008 version. The criteria are largely the same, but minor differences that could result in changes in the ratings were noted and conditions that could affect those criteria were verified in the field.

Preliminary Jurisdictional Review

Hydrologic connections between wetlands within the study corridor and Waters of the U.S. outside the corridor were documented in sufficient detail to support a preliminary USACE jurisdictional determination using National Wetland Inventory maps, observations in the field and aerial photo interpretation.. For this memorandum, the current definition of Waters of the U.S. consistent with the pre-2015 regulatory regime (EPA 2021) was used. Under this interpretation, the term Waters of the U.S. means:

- All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
- All interstate waters including interstate wetlands;
- All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:
  - Which are or could be used by interstate or foreign travelers for recreational or other purposes; or
  - From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
  - Which are used or could be used for industrial purposes by industries in interstate commerce;
- All impoundments of waters otherwise defined as Waters of the U.S. under this definition;
- Tributaries of waters identified above;
- The territorial sea;
- Wetlands adjacent to waters (other than waters that are themselves wetlands) identified above; waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet the criteria of this definition) are not Waters of the U.S.

Waters of the U.S. do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with EPA. This interpretation remains in effect until further notice (EPA 2021).

RESULTS

This section provides general descriptions of the current state of wetlands in the Ninepipe study corridor.

Delineation

Table 1 and the figures in Appendix A present the results of the field reconnaissance. There were no major changes in wetland boundaries compared to the delineation presented in the SEIS. Minor changes were noted where new wetlands had formed in roadside ditches and where existing wetland boundaries were modified to reflect current conditions as noted on Figures A-1 through A-21 in Appendix A. Wetland data sheets are provided in Appendix B.

Functional Assessment

The 1999 and 2008 versions of the MWAM were compared and the following differences that could affect wetland ratings were noted:

- 13. Structural diversity - in the 1999 version structural diversity was rated low if less than or equal to one vegetation class. In 2008 it is rated low if vegetation is a monoculture, but moderate if vegetation is not a monoculture. In many of the roadside ditch wetlands the vegetation is a mix of cattails, reed canarygrass and other herbaceous species so would be rated moderate. This factor affects Category 14C. General Wildlife Habitat, and Category 14J. Production Export/Food Chain Support, but not to an extent that would change the rating of any of the assessment areas in the corridor.

- 14A. Habitat for Federally Listed or Proposed Threatened or Endangered Plants or Animals – this rating is based on documentation of species presence and use of the habitat (primary, secondary or incidental). In the 1999 version documented/incidental was rated 0.5L; in the 2008 version documented/incidental is 0.3L. Suspected/incidental was 0.3L in 1999, in 2008 it is 0.1L. Many of the wetlands received the suspected/incidental rating of 0.3L in the assessment for the SEIS. Grizzly bears have been documented in and around the study corridor. Their use of the habitat may still be considered incidental therefore their presence would be documented/incidental and the rating would remain 0.3L under the 2008 method.

- 14B. Habitat for Plants or Animals Rated S1, S2, or S3 by the Montana Natural Heritage Program – in 1999 ratings were the same for S1, S2, and S3 species across all categories of habitats; in 2008 ratings for S2 and S3 species were less than for S1 species for primary and secondary habitats but are the same for incidental habitats. However, this change did not affect the ratings for any of the wetlands in the Ninepipe study corridor.

- 14D. General Fish/Aquatic Habitat – criterion for shading/thermal cover was adjusted in the 2008 version. The only features that could be affected by this change are Ninepipe Reservoir, Crow Creek and an irrigation ditch. The preliminary determination is that this would not change the ratings for these wetlands.

- 14L. Recreation/Education Potential – was based on ownership (public or private) and disturbance at the assessment area in 1999. In the 2008 version this criterion is based solely on ownership and access (permission required or not required). The 1999 version included these points in the overall rating, whereas in the 2008 version they are "bonus points." This factor affected the percentage of possible points for each assessment area to a small degree but did not change the ratings.

- Scoring: In the 1999 version a Category IV rating is given if percent of possible score is less than 30, and the wetland is rated low for uniqueness, and the vegetation wetland component is less than one acre. Under the 2008 system the criteria are the same except the threshold for percent of possible points is 35 percent. This change affected one assessment area located outside the right-of-way (H40D-F) that went from Category III to Category IV.

A table showing updated ratings and percentage of possible points is provided in Appendix C.

Preliminary Jurisdictional Review

Wetlands in the study area were assessed in accordance with the current interpretation of the Clean Water Act and definition of Waters of the U.S., which uses the same definition as was used during preparation of the SEIS. However, final jurisdictional determinations have not been verified by the USACE.

Wetlands in the US 93 Ninepipe study corridor that appear non-jurisdictional consist of isolated wetlands, which are generally pothole wetlands. The following guidelines were used in this assessment to determine if a wetland appeared to be isolated and non-jurisdictional:

- No apparent surface or wetland connection with any Water of the U.S. and not directly adjacent to any Water of the U.S.

- No actual link between the water body and interstate or foreign commerce based on the above definition of Waters of the U.S.

- Individually and/or in the aggregate, the use, degradation, or destruction of the isolated water would have no substantial effect on interstate or foreign commerce, i.e., the wetland does not have a "significant nexus" to navigable waters.

Based on this review, jurisdictional and non-jurisdictional wetlands in the Ninepipe study corridor are identified in Table 1. Area comparisons between the 2002 and 2021 delineations are based on the acreage of wetlands presented in the SEIS. Those areas represent wetlands within the proposed right-of-way for the alternative with the greatest impact, a two-lane divided highway. Wetland areas within the construction limits for the preferred alternative, a one-lane undivided highway, will likely be less, and will be calculated and presented in a forthcoming memorandum documenting potential impacts and mitigation.

The USACE requires that unavoidable losses of over 0.10 acre of jurisdictional wetlands (Waters of the U.S.) be compensated at a minimum ratio of 1:1 (USACE 2005), and any unavoidable stream impacts over 300 lineal feet may require mitigation under the Montana Stream Mitigation Procedure (USACE 2013). In addition, the CSKT Tribal Natural Resources Department, Environmental Protection Division administers the Clean Water Act (CWA) 401 program, which regulates discharges into Waters of the U.S. (CSKT 2020; CSKT 2021).

The CSKT Aquatic Lands Conservation Ordinance 87A regulates "construction or installation of projects upon aquatic lands whenever such projects may cause erosion, sedimentation, or other disturbances adversely affecting the quality of Reservation waters and aquatic lands (CSKT 1986)." The ordinance applies to all wetlands, regardless of USACE jurisdiction. The CSKT Memorandum of Agreement for U.S. Highway 93 Evaro to Polson (MDT, FHWA, and CSKT 2000) requires unavoidable impacts on all wetlands to be compensated at a greater than 1:1 ratio by preserving, restoring, creating, or enhancing wetlands (Price 2003).

Once preliminary construction and right-of-way limits are determined, the crediting system presented in the SEIS will be used to calculate an estimate of wetland mitigation credits needed. The estimate will assume that MDT would seek to compensate for all unavoidable wetland impacts if a project moves forward from the feasibility study. Compensatory mitigation would be planned in coordination with FHWA, CSKT, USACE, US Fish and Wildlife Service, and Montana Fish Wildlife and Parks.

Table 1. Classification, Functional Ratings and Preliminary Jurisdictional Review for Wetlands in the Ninepipe Study Corridor

Wetland ID	Reference Post	Wetland Type	USFWS Classification[a]	MWAM Rating[b]	Comparison to 2002 Wetlands	Preliminary Jurisdictional Status	Wetland Size 2002[c] (acres)	Wetland Size 2021 [c] (acres)
H28A	40.1 to 40.2	Group 1 pothole	PEM, PAB, PUB	II	Revised boundary based on vegetation and topography	Non-jurisdictional	2.50322	2.46901
H29A	40.4	Group 1 pothole	PEM, PUB	II	Extended the boundary to the south based on vegetation and hydrology indicators and sample plots	Non-jurisdictional	2.20975	2.54641
H30A	40.4 to 41	Ninepipe Reservoir	PEM, PUB	II	Minor boundary adjustments based on vegetation	Jurisdictional; connected to Kicking Horse Reservoir via Ninepipe Feeder Canal. Kicking Horse Reservoir is connected to SouthCrow Creek via South Crow Creek Feeder Canal	20.40485	20.38986
H30B	40.4 to 40.8	Ninepipe Reservoir	PEM, PUB	II	Minor boundary adjustments based on vegetation		19.60873	19.61160
H31A	40.8 to 41	Group 1 pothole	PEM, PUB	II	No change	Non-jurisdictional	1.13229	1.13229
H31B	41.1	Group 1 pothole	PEM, PUB	II	No change	Non-jurisdictional	0.70653	0.70653
H32A	41.1	Group 3 pothole	PEM	III	No change	Non-jurisdictional	0.01337	0.01337
H32B	41.1	Group 3 pothole	PEM	III	No change	Non-jurisdictional	0.06428	0.06428
H32C	41.1	Group 3 pothole	PEM	III	Extended the boundary to the north and connected to H32D based on vegetation and sample plots	Non-jurisdictional	0.03452	0.11852

Table 1 (continued). Classification, Functional Ratings and Preliminary Jurisdictional Review for Wetlands in the Ninepipe Study Corridor								
Wetland ID	**Reference Post**	**Wetland Type**	**USFWS Classification[a]**	**MWAM Rating[b]**	**Comparison to 2002 Wetlands**	**Preliminary Jurisdictional Status**	**Wetland Size 2002 [c] (acres)**	**Wetland Size 2021 [c] (acres)**
H32D	41.2	Group 3 pothole	PEM	III	Connected to H32C	Non-jurisdictional	0.00559	Combined with H32C
H33A	41.1	Group 2 pothole	PEM	III	Extended boundary based on vegetation, topography and sample plot	Non-jurisdictional	0.09957	0.17764
H33B	41.2	Group 1 pothole	PEM, PSS, PFO	II	No change	Non-jurisdictional	1.95766	1.95766
H33C	41.2	Group 3 pothole	PEM	III	Mapped in different location in 2002, delineated new H33C boundary and documented sample plots	Non-jurisdictional	0.06866	0.03402
H34A	41.3	Group 1 pothole	PEM, PUB	II	No change	Non-jurisdictional	0.66767	0.66767
H34B	41.3	Group 2 pothole	PEM	III	No change	Non-jurisdictional	0.16688	0.16688
H34C	41.3 to 41.4	Group 1 pothole	PEM, PSS, PUB	II	No change	Non-jurisdictional	3.49943	3.49943
H34D	41.4	Group 1 pothole	PEM, PSS, PUB	II	No change	Non-jurisdictional	0.75764	0.75764
H35A	41.4	Irrigation feature	PEM, PFO, PAB, PUB	III	No change	Jurisdictional; connected to Kicking Horse Reservoir via Ninepipe Feeder Canal.	0.06042	0.06042
H35B	41.4	Irrigation feature	PEM, PFO, PAB, PUB	III	Minor revised boundary based on vegetation		0.28137	0.28181

Table 1 (continued). Classification, Functional Ratings and Preliminary Jurisdictional Review for Wetlands in the Ninepipe Study Corridor								
Wetland ID	Reference Post	Wetland Type	USFWS Classification[a]	MWAM Rating[b]	Comparison to 2002 Wetlands	Preliminary Jurisdictional Status	Wetland Size 2002 [c] (acres)	Wetland Size 2021 [c] (acres)
H36A	41.5	Roadside ditch	PEM	III	Revised boundary based on vegetation and included small wetland south of culvert under access road.	Non-jurisdictional	0.01573	0.01619
H37A	41.6 to 41.8	Group 1 pothole, Kettle Pond 1	PEM, PUB	II	Revised boundary based on vegetation and topography	Non-jurisdictional	6.03967	5.87034
H37B	41.6 to 41.8	Group 1 pothole, Kettle Pond 1	PEM, PUB	II	Revised boundary based on vegetation and topography	Non-jurisdictional	4.10116	3.99211
H38A	41.9	Group 2 pothole	PEM	IV	No change	Non-jurisdictional	0.0884	0.08840
H39A	41.9	Group 1 pothole	PEM, PUB	III	Minor revised boundary based on vegetation	Non-jurisdictional	0.58566	0.63971
H39B	41.9 to 42	Group 1 pothole	PEM, PUB	III	Extended boundary at north end to include H40D based on vegetation	Non-jurisdictional	1.52459	1.62238
H40A	42	Group 1 pothole	PEM, PUB	III	Revised boundary based on vegetation and topography	Non-jurisdictional	2.12109	2.19477
H40B	42	Group 2 pothole	PEM, PUB	III	No change	Non-jurisdictional	0.23807	0.23807
H40C	42	Group 1 pothole	PEM, PUB	III	No change	Non-jurisdictional	0.41517	0.41517
H40D	42	Roadside ditch	PEM	IV	Included in H39B	Non-jurisdictional	0.01133	0.01133

Table 1 (continued). Classification, Functional Ratings and Preliminary Jurisdictional Review for Wetlands in the Ninepipe Study Corridor								
Wetland ID	**Reference Post**	**Wetland Type**	**USFWS Classification[a]**	**MWAM Rating[b]**	**Comparison to 2002 Wetlands**	**Preliminary Jurisdictional Status**	**Wetland Size 2002 [c] (acres)**	**Wetland Size 2021 [c] (acres)**
H40E	42.1	Group 3 pothole	PEM	IV	No change	Non-jurisdictional	0.18001	0.18001
H40F	42.1	Group 3 pothole	PEM	IV	No change	Non-jurisdictional	0.09002	0.09002
H40G	42	Roadside ditch	PEM	III	New wetland boundary based on vegetation and sample plots	Non-jurisdictional	NA	0.04117
I1A	42.1	Irrigation feature	PEM	IV	No change	Non-jurisdictional	0.00588	0.00588
I1B	42.1	Irrigation feature	PEM	IV	No change	Non-jurisdictional	0.01695	0.01695
I2A	42.2	Group 2 pothole	PEM	IV	No change	Non-jurisdictional	0.05938	0.05938
I3A	42.	Group 2 pothole	PEM	III	Minor revised boundary based on vegetation	Non-jurisdictional	0.26424	0.27399
I3B	42.4	Group 1 pothole	PEM	III	Minor revised boundary based on vegetation	Non-jurisdictional	0.21736	0.20697
I3C	42.3 to 42.4	Group 1 pothole	PEM, PUB	II	No change	Non-jurisdictional	0.48449	0.48449
I3D	42.4	Group 1 pothole	PEM, PUB	II	No change	Non-jurisdictional	0.97556	0.97556
I3E	42.8	Group 2 pothole	PEM	III	No change	Non-jurisdictional	0.26817	0.26817
I4A	42.5 to 42.6	Group 1 pothole, Kettle Pond 2	PEM, PUB	II	Revised boundary based on vegetation and topography	Non-jurisdictional	4.92892	4.80714

Table 1 (continued). Classification, Functional Ratings and Preliminary Jurisdictional Review for Wetlands in the Ninepipe Study Corridor

Wetland ID	Reference Post	Wetland Type	USFWS Classification[a]	MWAM Rating[b]	Comparison to 2002 Wetlands	Preliminary Jurisdictional Status	Wetland Size 2002 [c] (acres)	Wetland Size 2021 [c] (acres)
I4B	42.5 to 42.6	Group 1 pothole, Kettle Pond 2	PEM, PUB	II	Revised boundary based on vegetation and topography	Non-jurisdictional	2.29216	2.17995
I5A	42.7	Group 2 pothole	PEM	III	No change	Non-jurisdictional	0.14384	0.14384
I5B	42.5 to 42.7	Group 1 pothole	PEM	III	No change	Non-jurisdictional	1.10293	1.10293
I6A	42.7	Group 1 pothole	PEM	III	No change	Non-jurisdictional	0.24714	0.24714
I6B	42.7	Group 1 pothole	PEM	III	No change	Non-jurisdictional	0.0926	0.09260
I6C	42.8	Group 3 pothole	PEM	III	No change	Non-jurisdictional	0.06639	0.06639
I6D	42.8 to 42.8	Group 1 pothole	PEM, PUB	II	No change	Non-jurisdictional	1.79388	1.79388
I6E	42.8	Group 3 pothole	PEM	III	No change	Non-jurisdictional	0.04854	0.04854
I7A	42.8 to 42.9	Group 1 pothole	PEM, PUB	II	No change	Non-jurisdictional	0.58398	0.58398
I7B	42.9	Group 1 pothole	PEM, PUB	II	No change	Non-jurisdictional	1.38754	1.38754
I7C	43	Group 2 pothole	PEM	III	No change	Non-jurisdictional	0.26951	0.26951
I8A	43	Group 1 pothole	PEM	II	No change	Non-jurisdictional	0.29716	0.29716
I8B	43.1 to 43.2	Group 1 pothole	PEM	II	No change	Non-jurisdictional	0.52839	0.52839
I8C	43.1 to 43.2	Group 1 pothole	PEM	II	No change	Non-jurisdictional	1.42782	1.42782

Table 1 (continued). Classification, Functional Ratings and Preliminary Jurisdictional Review for Wetlands in the Ninepipe Study Corridor

Wetland ID	Reference Post	Wetland Type	USFWS Classification[a]	MWAM Rating[b]	Comparison to 2002 Wetlands	Preliminary Jurisdictional Status	Wetland Size 2002 [c] (acres)	Wetland Size 2021 [c] (acres)
I8D	43.2	Group 1 pothole	PEM	II	No change	Non-jurisdictional	1.14414	1.14414
I9A	43.3	Group 1 pothole	PEM	III	Revised boundary based on vegetation	Non-jurisdictional	0.80398	0.92127
I9B	43.3	Group 2 pothole	PEM	III	No change	Non-jurisdictional	0.11494	0.11494
I9C	43.2 to 43.3	Roadside ditch	PEM	III	New wetlands connected to I9A via culvert- boundary based on vegetation and sample plots	Non-jurisdictional	NA	0.03437
I10A	43.4	Group 1 pothole	PEM, PUB	III	No change	Non-jurisdictional	0.29926	0.29926
I11A	43.4	Roadside ditch	PEM	IV	No change	Non-jurisdictional	0.01247	0.01247
I11B	43.4	Roadside ditch	PEM	IV	No change	Non-jurisdictional	0.01344	0.01344
I11C	43.4	Roadside ditch	PEM	IV	No change	Non-jurisdictional	0.01004	0.01004
I11D	43.4	Roadside ditch	PEM	IV	No change	Non-jurisdictional	0.00876	0.00876
I12A	43.4	Group 1 pothole	PEM, PUB	III	No change	Non-jurisdictional	0.24374	0.24374
I12B	43.5	Group 1 pothole	PEM, PUB	III	No change	Non-jurisdictional	0.25769	0.25769
I12C	43.5	Group 2 pothole	PEM, PUB	III	No change	Non-jurisdictional	0.04198	0.04198
I13A	43.4	Group 1 pothole	PEM, PUB	III	No change	Non-jurisdictional	0.05629	0.05629
I13B	43.4 to 43.5	Group 1 pothole	PEM, PUB	III	No change	Non-jurisdictional	1.49601	1.49601
I13C	43.5	Group 3 pothole	PEM, PUB	III	No change	Non-jurisdictional	0.03957	0.03957

Table 1 (continued). Classification, Functional Ratings and Preliminary Jurisdictional Review for Wetlands in the Ninepipe Study Corridor

Wetland ID	Reference Post	Wetland Type	USFWS Classification[a]	MWAM Rating[b]	Comparison to 2002 Wetlands	Preliminary Jurisdictional Status	Wetland Size 2002 [c] (acres)	Wetland Size 2021 [c] (acres)
I13D	43.5	Group 2 pothole	PEM, PUB	III	Revised boundary based on vegetation – connected to I13E and I13F	Non-jurisdictional	0.23906	0.57310
I13E	43.5	Group 2 pothole	PEM, PUB	III	Connected to I13D	Non-jurisdictional	0.06259	Combined with I13D
I13F	43.5	Group 2 pothole	PEM, PUB	III	Connected to I13D	Non-jurisdictional	0.08148	Combined with I13D
I14A	43.6 to 43.7	Group 2 pothole	PEM	III	No change	Non-jurisdictional	1.22509	1.22509
I14B	43.6	Group 1 pothole	PEM	III	Revised boundary based on vegetation	Non-jurisdictional	0.35929	0.38848
I14C	43.6 to 43.8	Group 1 pothole	PEM	III	Revised boundary based on vegetation	Non-jurisdictional	2.17349	2.29691
I15A	43.8 to 44	Group 1 pothole (Wildlife Mitigation Area)	PEM, PUB	II	No change	Non-jurisdictional	6.00501	6.00501
I16A	44 to 44.2	Riparian zone (Crow Creek)	PEM, PSS, PAB, PUB	II	Revised boundary based on vegetation and topography	Jurisdictional; surface water connection to Crow Creek	3.64476	3.62914
I16B	44 to 44.2	Riparian zone (Crow Creek)	PEM, PSS, PAB, PUB	II	No change	Jurisdictional; surface water connection to Crow Creek	1.99276	1.99276
I16C	44	Roadside ditch	PEM	III	New wetland boundary based on vegetation	Jurisdictional; surface water connection to Crow Creek	NA	0.01174

Table 1 (continued). Classification, Functional Ratings and Preliminary Jurisdictional Review for Wetlands in the Ninepipe Study Corridor

Wetland ID	Reference Post	Wetland Type	USFWS Classification[a]	MWAM Rating[b]	Comparison to 2002 Wetlands	Preliminary Jurisdictional Status	Wetland Size 2002 [c] (acres)	Wetland Size 2021 [c] (acres)
I17A	44.2 to 44.3	Roadside ditch	PAB	IV	No change	Jurisdictional; surface water connection to Crow Creek	0.13741	0.13741
I17B	44.3	Roadside ditch	PAB	IV	No change	Jurisdictional; surface water connection to Crow Creek	0.04221	0.04221
I17C	44.4 to 44.5	Roadside ditch	PAB	IV	No change	Jurisdictional; surface water connection to Crow Creek	0.33806	0.33806
I17D	44.5 to 44.6	Roadside ditch	PAB	IV	No change	Jurisdictional; surface water connection to Crow Creek	0.20664	0.20664
I19A	44.2 to 44.6	Roadside ditch	PAB	IV	No change	Jurisdictional; surface water connection to Crow Creek	1.57677	1.57677
Total (acres)							**109.92154**	**110.57865**

a USFWS vegetation classes: PEM – palustrine emergent; PSS – palustrine scrub shrub; PAB – palustrine aquatic bed; PUB – palustrine unconsolidated bottom

b Category I is the highest functional rating a wetland can receive; Category IV is the lowest

c The size of the wetland is the area of the wetland generally within the proposed right-of-way for the widest alternative (Rural 9) presented in the SEIS, a two lane divided roadway. Many of the wetlands in the study corridor are entirely within this limit and others, such as wetlands associated with streams and the Ninepipe Reservoir extend beyond this limit. For the latter case, the acreage presented does not represent the size of the entire system.

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APPENDIX A

Wetland Figures

Legend

- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

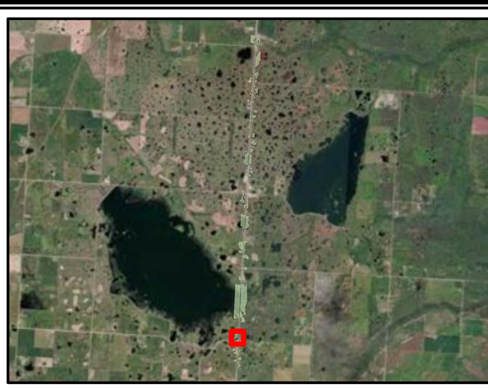

Figure A-1
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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Legend

- Wetland Sample Plots
- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

Figure A-2
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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Legend

- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

Figure A-3
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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Legend

- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

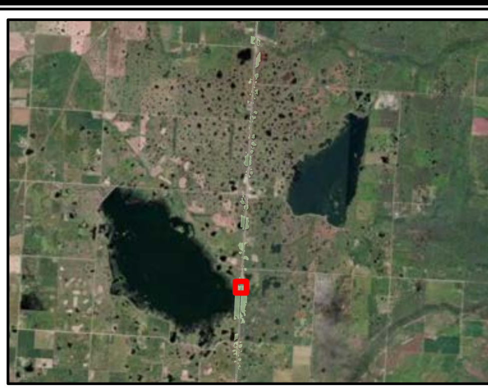

Figure A-4
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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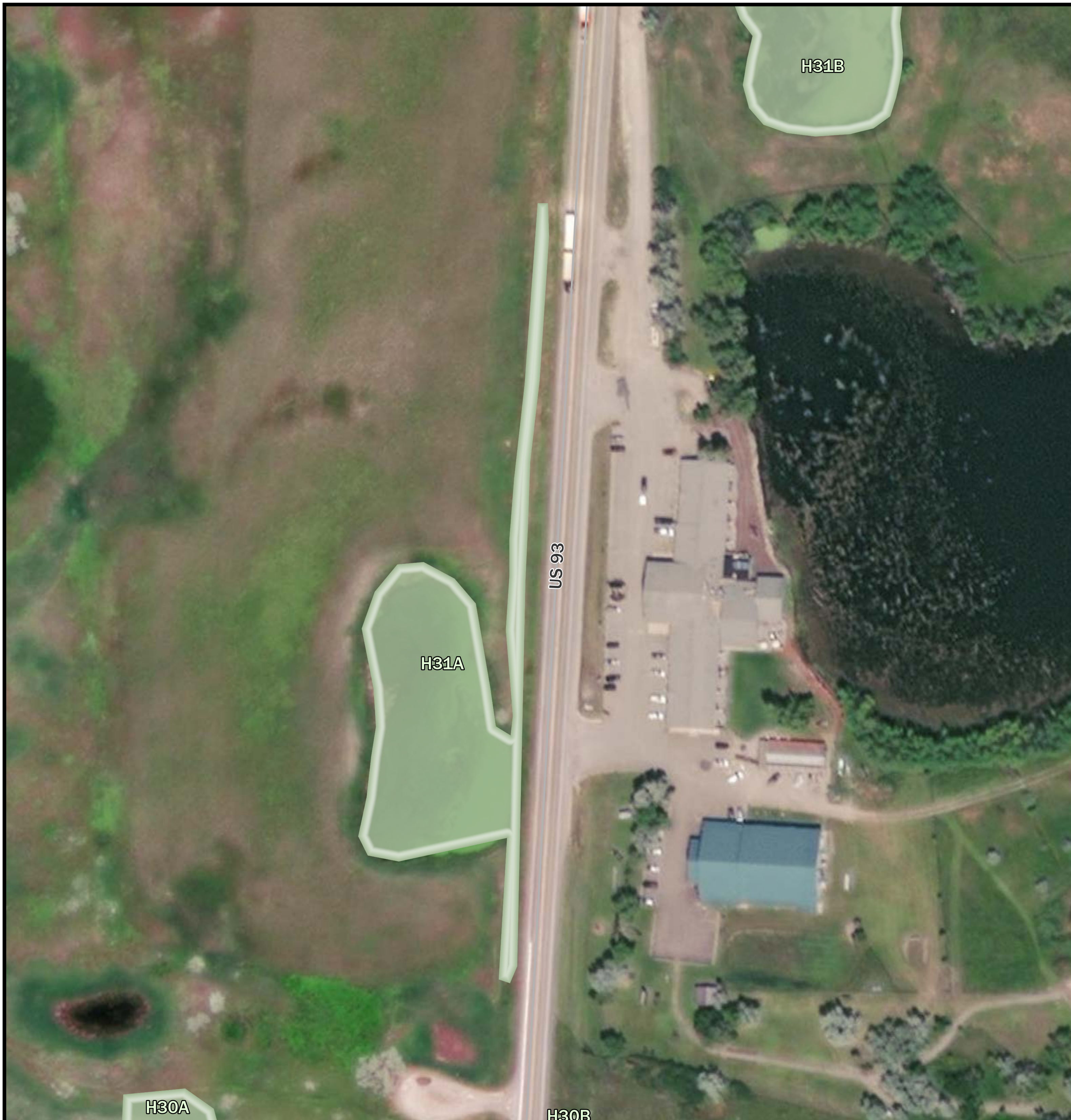

Legend

2021 Wetland Boundary

2002 Wetland Boundary

Road

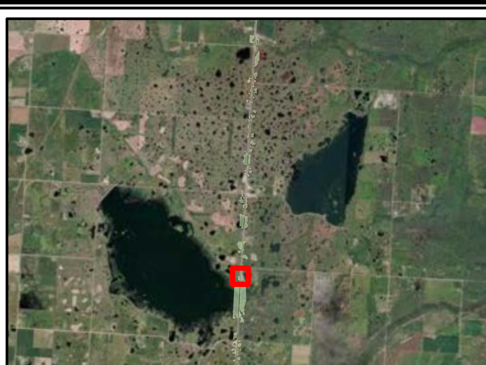

Figure A-5
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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Legend

- Wetland Sample Plots
- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

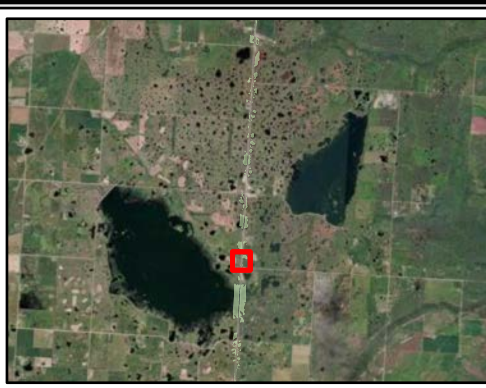

Figure A-6
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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Legend

- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

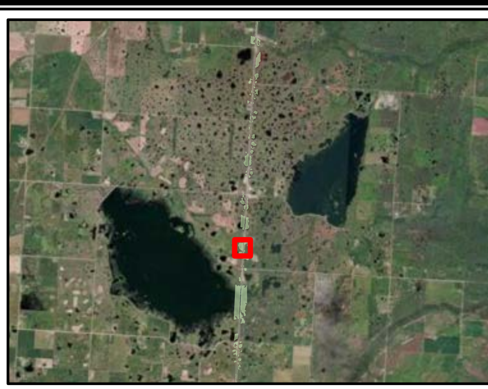

Figure A-7
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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Legend

- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

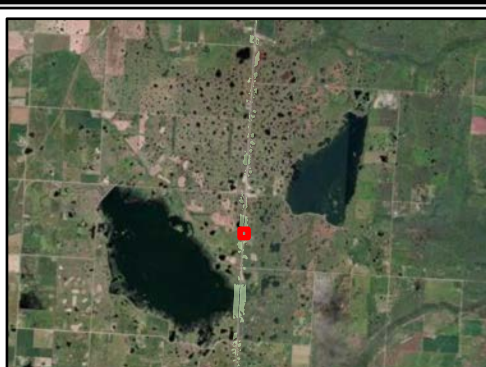

Figure A-8
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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Legend

2021 Wetland Boundary

2002 Wetland Boundary

Road

Figure A-9
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

0 100 200 Feet

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Legend

- Wetland Sample Plots
- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

Figure A-10
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

0 100 200 Feet

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Legend

2021 Wetland Boundary

2002 Wetland Boundary

Road

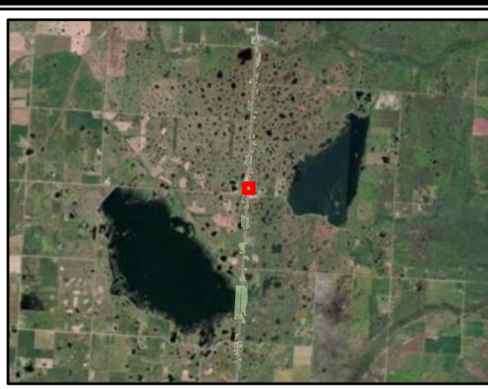

Figure A-11
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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Legend

- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

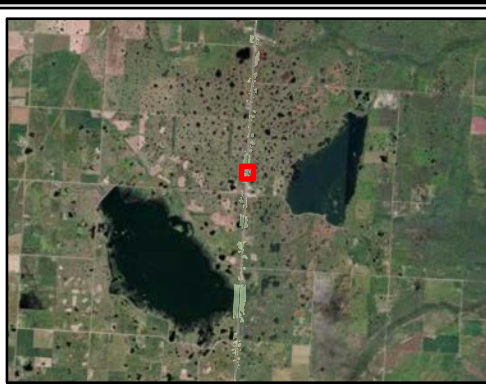

Figure A-12
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

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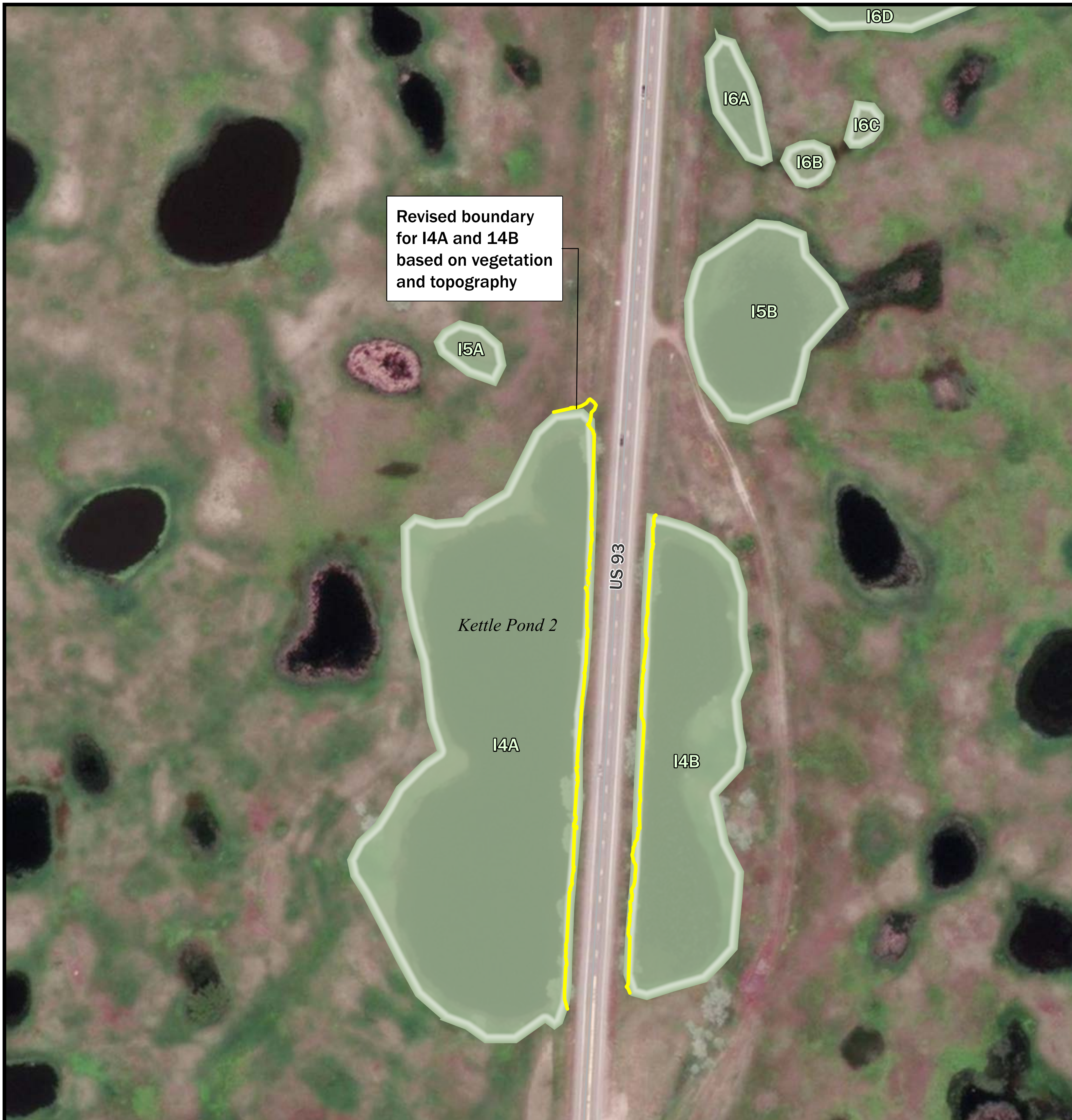

Legend

2021 Wetland Boundary

2002 Wetland Boundary

Road

Figure A-13
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

0 100 200 Feet

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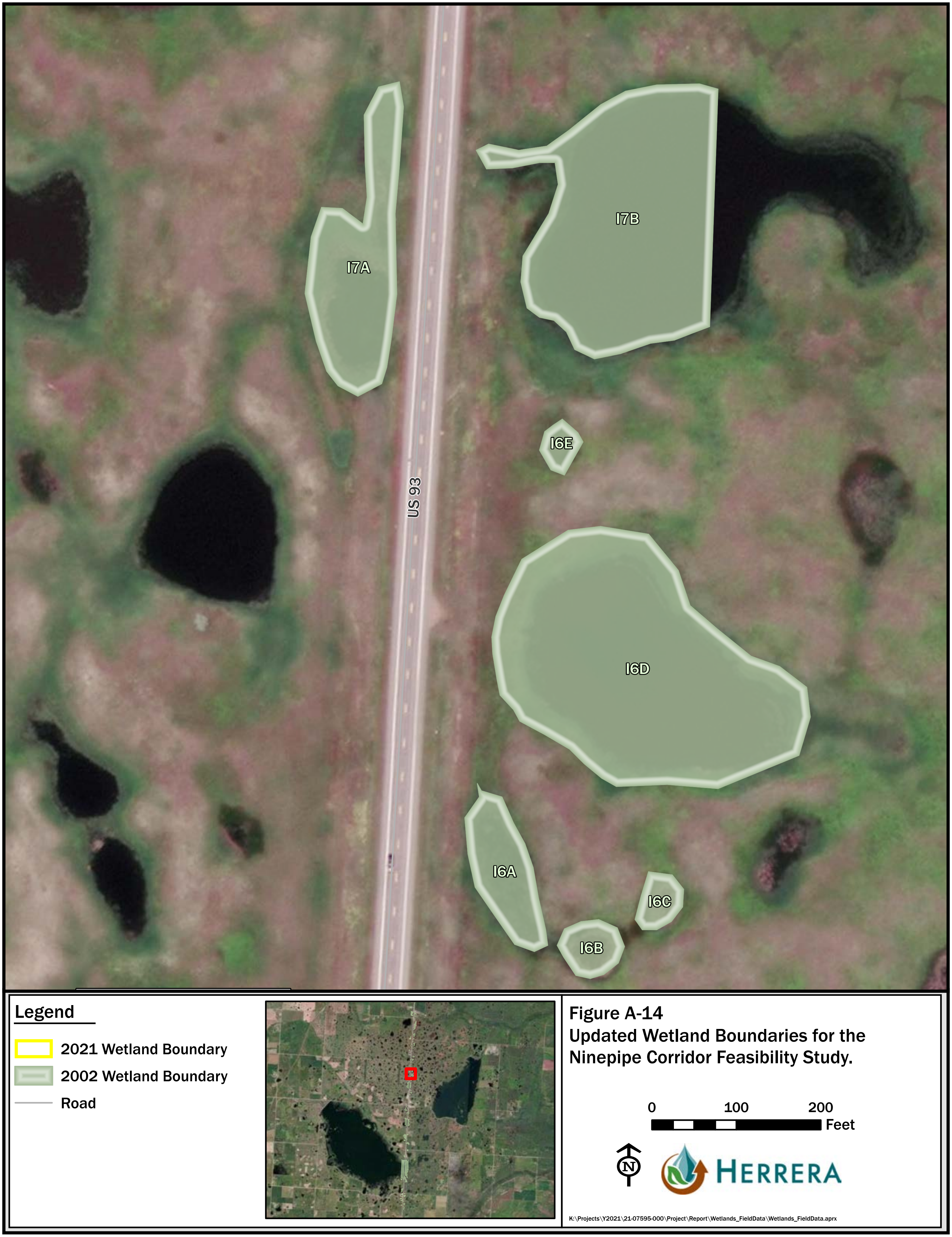

Figure A-14
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

Legend

2021 Wetland Boundary
2002 Wetland Boundary
Road

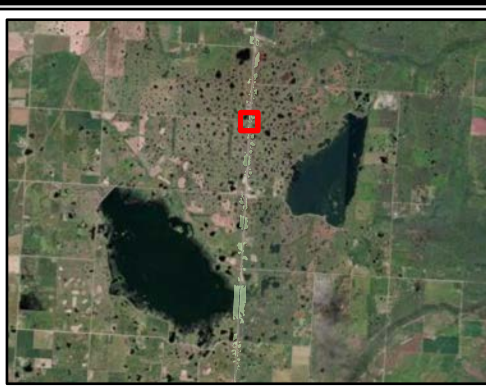

Figure A-15
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

0 100 200
Feet

N

HERRERA

K:\Projects\Y2021\21-07595-000\Project\Report\Wetlands_FieldData\Wetlands_FieldData.aprx

Legend

- Wetland Sample Plots
- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

Figure A-16
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

0 100 200 Feet

N

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Legend

2021 Wetland Boundary

2002 Wetland Boundary

Road

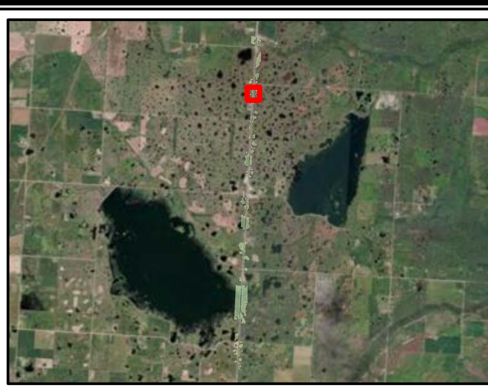

Figure A-17
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

0 100 200 Feet

N

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Legend

- 2021 Wetland Boundary
- 2002 Wetland Boundary
- Road

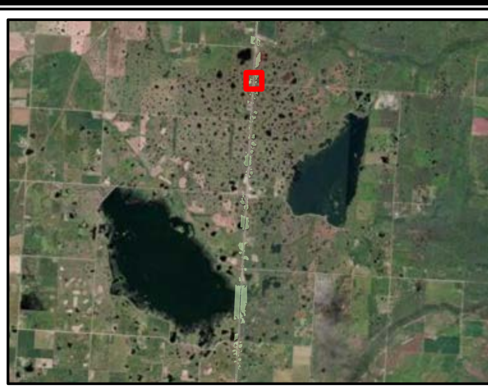

Figure A-18
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

0 100 200 Feet

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Legend

2021 Wetland Boundary

2002 Wetland Boundary

Road

Figure A-19
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

0 100 200
Feet

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Figure A-20
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

Legend

2021 Wetland Boundary

2002 Wetland Boundary

Road

Figure A-21
Updated Wetland Boundaries for the Ninepipe Corridor Feasibility Study.

0 100 200 Feet

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APPENDIX B

Wetland Data Sheets

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **H29A1UP**

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** S 23 T 20N R 20W

Landform (hillslope, terrace, etc.): Hillside **Local relief (concave, convex, none):** convex **Slope:** 0.0 % / 0.0 °

Subregion (LRR): E **Lat.:** 47.47429 **Long.:** -114.09704 **Datum:** WGS84

Soil Map Unit Name: Post silty clay loam **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ◉ No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ○ No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Hydric Soil Present?	Yes ○ No ◉	
Wetland Hydrology Present?	Yes ○ No ◉	

Remarks: During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species? Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
	0	= Total Cover	
Sapling/Shrub Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
	0	= Total Cover	
Herb Stratum (Plot size: 3m rad)			
1. Thinopyrum pycnanthum	80	☑ 80.0%	FACW
2. Thlaspi arvense	20	☑ 20.0%	UPL
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
6.	0	☐ 0.0%	
7.	0	☐ 0.0%	
8.	0	☐ 0.0%	
9.	0	☐ 0.0%	
10.	0	☐ 0.0%	
11.	0	☐ 0.0%	
	100	= Total Cover	
Woody Vine Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
	0	= Total Cover	

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	2	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	50.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	80	x 2 =	160
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	20	x 5 =	100
Column Totals:	100 (A)		260 (B)

Prevalence Index = B/A = 2.600

Hydrophytic Vegetation Indicators:

- ☐ **1 - Rapid Test for Hydrophytic Vegetation**
- ☐ **2 - Dominance Test is > 50%**
- ☑ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes ○ No ◉

Remarks:

No hydrophytic vegetation indicators are met

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H29A1UP

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 3/3	100					Loam	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ○ No ◉

Remarks:

No evidence of hydric soil.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☐ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

No evidence of wetland hydrology

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **H29A1WET**

Investigator(s): S. Wall; T. Cross **Section, Township, Range: S** 23 **T** 20N **R** 20W

Landform (hillslope, terrace, etc.): pothole and roadside ditch **Local relief (concave, convex, none):** concave **Slope:** 0.0 **% /** 0.0 **°**

Subregion (LRR): E **Lat.:** 47.47429 **Long.:** -114.09704 **Datum:** WGS84

Soil Map Unit Name: post silty clay loam **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ☑ No ☐ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ☑ No ☐

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ☑ No ☐	**Is the Sampled Area within a Wetland?** Yes ☑ No ☐
Hydric Soil Present?	Yes ☑ No ☐	
Wetland Hydrology Present?	Yes ☑ No ☐	

Remarks:
New wetland South of H29A. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0	= Total Cover		
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size: 3m rad)				
1. Typha latifolia	25	☑	25.0%	OBL
2. Agrostis stolonifera	55	☑	55.0%	FAC
3. Bromus inermis	20	☑	20.0%	UPL
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
	100	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
	0	= Total Cover		

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	2	(A)
Total Number of Dominant Species Across All Strata:	3	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	66.7%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	25	x 1 =	25
FACW species	0	x 2 =	0
FAC species	55	x 3 =	165
FACU species	0	x 4 =	0
UPL species	20	x 5 =	100
Column Totals:	100 (A)		290 (B)

Prevalence Index = B/A = 2.900

Hydrophytic Vegetation Indicators:

- ☐ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☑ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes ☑ No ☐

Remarks:
Hydrophytic veg is present.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H29A1WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR	5/2	90	7.5Y/R	5/6	10	C	M	Clay Loam	depletions also present

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

hydric soil indicators present.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☑ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

Wetland hydrology indicated.

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **H33A1UP**

Investigator(s): S. Wall; T. Cross **Section, Township, Range: S** 23 **T** 20N **R** 20W

Landform (hillslope, terrace, etc.): Flat **Local relief (concave, convex, none):** none **Slope:** 0.0 **%** / 0.0 **°**

Subregion (LRR): E **Lat.:** 47.443114 **Long.:** -114.096732 **Datum:** WGS84

Soil Map Unit Name: post silt loam **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (●) No ( )

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●) No ( )	**Is the Sampled Area within a Wetland?** Yes ( ) No (●)
Hydric Soil Present?	Yes ( ) No (●)	
Wetland Hydrology Present?	Yes ( ) No (●)	

Remarks:
Hydrophytic vegetation present, but no hydric soil or wetland hydrology indicators. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0	= Total Cover		
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size: 3m rad)				
1. Lactuca serriola	20	☐	16.7%	FACU
2. Bromus inermis	40	☑	33.3%	UPL
3. Poa pratensis	30	☑	25.0%	FAC
4. Elymus trachycaulus	30	☑	25.0%	FAC
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
	120	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
	0	= Total Cover		

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	2	(A)
Total Number of Dominant Species Across All Strata:	3	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	66.7%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	60	x 3 =	180
FACU species	20	x 4 =	80
UPL species	40	x 5 =	200
Column Totals:	120 (A)		460 (B)

Prevalence Index = B/A = 3.833

Hydrophytic Vegetation Indicators:

- ☐ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☐ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks:
wetland vegetation present

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H33A1UP

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-4	10YR	2/2							Clay Loam	
4-16	7.5YR	4/2							Clay	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: compacted clay

Depth (inches): 4

Hydric Soil Present? Yes ○ No ◉

Remarks:

No evidence of hydric soil.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☐ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

No evidence of wetland hydrology

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **H33A1WET**

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** **S** 23 **T** 20N **R** 20W

Landform (hillslope, terrace, etc.): ditch connected **Local relief (concave, convex, none):** concave **Slope:** 1.0 **%** / 0.6 **°**

Subregion (LRR): E **Lat.:** 47.443106 **Long.:** -114.096818 **Datum:** WGS84

Soil Map Unit Name: post silt loam **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (●) No ( )

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●) No ( )	**Is the Sampled Area within a Wetland?** Yes (●) No ( )
Hydric Soil Present?	Yes (●) No ( )	
Wetland Hydrology Present?	Yes (●) No ( )	

Remarks:
All 3 wetland parameters are met. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species? Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
	0	= Total Cover	
Sapling/Shrub Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
	0	= Total Cover	
Herb Stratum (Plot size: 3mx1m)			
1. Typha latifolia	30	☑ 30.0%	OBL
2. Eleocharis palustris	70	☑ 70.0%	OBL
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
6.	0	☐ 0.0%	
7.	0	☐ 0.0%	
8.	0	☐ 0.0%	
9.	0	☐ 0.0%	
10.	0	☐ 0.0%	
11.	0	☐ 0.0%	
	100	= Total Cover	
Woody Vine Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
	0	= Total Cover	

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	2	(A)
Total Number of Dominant Species Across All Strata:	2	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	100.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	100	x 1 =	100
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	100 (A)		100 (B)

Prevalence Index = B/A = 1.000

Hydrophytic Vegetation Indicators:

- ☑ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☑ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks:
Hydrophytic veg is present.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H33A1WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Color (moist)		Redox %	Type[1]	Loc[2]	Texture	Remarks
0-9	10R	4/1	95	7.5YR	6/6	3	C	M	Clay Loam	depletion is present

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- [ ] Histosol (A1)
- [ ] Histic Epipedon (A2)
- [ ] Black Histic (A3)
- [ ] Hydrogen Sulfide (A4)
- [ ] Depleted Below Dark Surface (A11)
- [ ] Thick Dark Surface (A12)
- [ ] Sandy Muck Mineral (S1)
- [ ] Sandy Gleyed Matrix (S4)
- [ ] Sandy Redox (S5)
- [ ] Stripped Matrix (S6)
- [ ] Loamy Mucky Mineral (F1) (except in MLRA 1)
- [ ] Loamy Gleyed Matrix (F2)
- [x] Depleted Matrix (F3)
- [ ] Redox Dark Surface (F6)
- [ ] Depleted Dark Surface (F7)
- [ ] Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- [ ] 2 cm Muck (A10)
- [ ] Red Parent Material (TF2)
- [ ] Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes (●) No ( )

Remarks:

hydric soil present

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- [ ] Surface Water (A1)
- [ ] High Water Table (A2)
- [ ] Saturation (A3)
- [ ] Water Marks (B1)
- [ ] Sediment Deposits (B2)
- [ ] Drift deposits (B3)
- [ ] Algal Mat or Crust (B4)
- [ ] Iron Deposits (B5)
- [ ] Surface Soil Cracks (B6)
- [ ] Inundation Visible on Aerial Imagery (B7)
- [ ] Sparsely Vegetated Concave Surface (B8)
- [ ] Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- [ ] Salt Crust (B11)
- [ ] Aquatic Invertebrates (B13)
- [ ] Hydrogen Sulfide Odor (C1)
- [ ] Oxidized Rhizospheres on Living Roots (C3)
- [ ] Presence of Reduced Iron (C4)
- [ ] Recent Iron Reduction in Tilled Soils (C6)
- [ ] Stunted or Stressed Plants (D1) (LRR A)
- [ ] Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- [ ] Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- [x] Drainage Patterns (B10)
- [ ] Dry Season Water Table (C2)
- [ ] Saturation Visible on Aerial Imagery (C9)
- [ ] Geomorphic Position (D2)
- [ ] Shallow Aquitard (D3)
- [x] FAC-neutral Test (D5)
- [ ] Raised Ant Mounds (D6) (LRR A)
- [ ] Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ( )	No (●)	Depth (inches):
Water Table Present?	Yes ( )	No (●)	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ( )	No (●)	Depth (inches):

Wetland Hydrology Present? Yes (●) No ( )

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

wetland hydrology indicated

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **H33C1UP**

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** **S** 35 **T** 20N **R** 20W

Landform (hillslope, terrace, etc.): Flat **Local relief (concave, convex, none):** none **Slope:** 0.0 **%** / 0.0 **°**

Subregion (LRR): E **Lat.:** 47.443309 **Long.:** -114.097217 **Datum:** WGS84

Soil Map Unit Name: post silt loam **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ◉ No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ○ No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Hydric Soil Present?	Yes ○ No ◉	
Wetland Hydrology Present?	Yes ○ No ◉	

Remarks:
No wetland indicators present. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species? Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
	0	= Total Cover	
Sapling/Shrub Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
	0	= Total Cover	
Herb Stratum (Plot size: 3m rad)			
1. Bromus inermis	85	☑ 89.5%	UPL
2. Thinopyrum pycnanthum	10	☐ 10.5%	FACW
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
6.	0	☐ 0.0%	
7.	0	☐ 0.0%	
8.	0	☐ 0.0%	
9.	0	☐ 0.0%	
10.	0	☐ 0.0%	
11.	0	☐ 0.0%	
	95	= Total Cover	
Woody Vine Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
	0	= Total Cover	

% Bare Ground in Herb Stratum: 5

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	0	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	0.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	10	x 2 =	20
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	85	x 5 =	425
Column Totals:	95 (A)		445 (B)

Prevalence Index = B/A = 4.684

Hydrophytic Vegetation Indicators:

- ☐ **1 - Rapid Test for Hydrophytic Vegetation**
- ☐ **2 - Dominance Test is > 50%**
- ☐ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes ○ No ◉

Remarks:
no evidence of wetland vegatation

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H33C1UP

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Color (moist)		Redox %	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR	2/2	100						Clay Loam	
6-7	7.5R	4/2	100						Clay	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: compacted clay

Depth (inches): 6

Hydric Soil Present? Yes ○ No ◉

Remarks:

No evidence of hydric soil.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☐ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

No evidence of wetland hydrology

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** H33C1WET

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** S 35 T 20N R 20W

Landform (hillslope, terrace, etc.): roadside depression **Local relief (concave, convex, none):** concave **Slope:** 0.0 % / 0.0 °

Subregion (LRR): E **Lat.:** 47.443291 **Long.:** -114.097162 **Datum:** WGS84

Soil Map Unit Name: post silt loam **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (●) No ( )

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●) No ( )	**Is the Sampled Area within a Wetland?** Yes (●) No ( )
Hydric Soil Present?	Yes (●) No ( )	
Wetland Hydrology Present?	Yes (●) No ( )	

Remarks:
All 3 wetland parameters are met. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0	= Total Cover		
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size: 3mx1m)				
1. Phalaris arundinacea	80	☑	84.2%	FACW
2. Typha latifolia	15	☐	15.8%	OBL
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
	95	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
	0	= Total Cover		

% Bare Ground in Herb Stratum: 5

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	100.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	15	x 1 =	15
FACW species	80	x 2 =	160
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	95 (A)		175 (B)

Prevalence Index = B/A = 1.842

Hydrophytic Vegetation Indicators:

- ☑ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☑ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks:
wetland vegetation present

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H33C1WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc[2]	Texture	Remarks
0-2	10YR	2/1	100						Clay loam	
2-8	10YR	4/2	95	7.5YR	5/6	5	C	M	Clay	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- [ ] Histosol (A1)
- [ ] Histic Epipedon (A2)
- [ ] Black Histic (A3)
- [ ] Hydrogen Sulfide (A4)
- [ ] Depleted Below Dark Surface (A11)
- [ ] Thick Dark Surface (A12)
- [ ] Sandy Muck Mineral (S1)
- [ ] Sandy Gleyed Matrix (S4)
- [ ] Sandy Redox (S5)
- [ ] Stripped Matrix (S6)
- [ ] Loamy Mucky Mineral (F1) (except in MLRA 1)
- [ ] Loamy Gleyed Matrix (F2)
- [x] Depleted Matrix (F3)
- [ ] Redox Dark Surface (F6)
- [ ] Depleted Dark Surface (F7)
- [ ] Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- [ ] 2 cm Muck (A10)
- [ ] Red Parent Material (TF2)
- [ ] Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes (●) No ( )

Remarks:

hydric soil present

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- [ ] Surface Water (A1)
- [ ] High Water Table (A2)
- [ ] Saturation (A3)
- [ ] Water Marks (B1)
- [ ] Sediment Deposits (B2)
- [ ] Drift deposits (B3)
- [ ] Algal Mat or Crust (B4)
- [ ] Iron Deposits (B5)
- [ ] Surface Soil Cracks (B6)
- [ ] Inundation Visible on Aerial Imagery (B7)
- [ ] Sparsely Vegetated Concave Surface (B8)
- [ ] Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- [ ] Salt Crust (B11)
- [ ] Aquatic Invertebrates (B13)
- [ ] Hydrogen Sulfide Odor (C1)
- [ ] Oxidized Rhizospheres on Living Roots (C3)
- [ ] Presence of Reduced Iron (C4)
- [ ] Recent Iron Reduction in Tilled Soils (C6)
- [ ] Stunted or Stressed Plants (D1) (LRR A)
- [ ] Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- [ ] Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- [x] Drainage Patterns (B10)
- [ ] Dry Season Water Table (C2)
- [ ] Saturation Visible on Aerial Imagery (C9)
- [x] Geomorphic Position (D2)
- [ ] Shallow Aquitard (D3)
- [x] FAC-neutral Test (D5)
- [ ] Raised Ant Mounds (D6) (LRR A)
- [ ] Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ( )	No (●)	Depth (inches):
Water Table Present?	Yes ( )	No (●)	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ( )	No (●)	Depth (inches):

Wetland Hydrology Present? Yes (●) No ( )

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

wetland hydrology indicated

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **H33C2UP**

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** **S** 23 **T** 20N **R** 20W

Landform (hillslope, terrace, etc.): Swale **Local relief (concave, convex, none):** concave **Slope:** 0.0 **%** / 0.0 **°**

Subregion (LRR): E **Lat.:** 47.47429 **Long.:** -114.09704 **Datum:** WGS84

Soil Map Unit Name: **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (●) No ( )

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●) No ( )	**Is the Sampled Area within a Wetland?** Yes ( ) No (●)
Hydric Soil Present?	Yes ( ) No (●)	
Wetland Hydrology Present?	Yes ( ) No (●)	

Remarks:

This area was delineated as a wetland in 2002 but is no longer a wetland. A new wetland was delineated south of this location labeled H33C2. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0	= Total Cover		
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size: 3m rad)				
1. Elymus trachycaulus	95	☑	95.0%	FAC
2. unkknown forb	5	☐	5.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
	100	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
	0	= Total Cover		

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	100.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	95	x 3 =	285
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	95 (A)		285 (B)

Prevalence Index = B/A = 3.000

Hydrophytic Vegetation Indicators:

- ☐ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☑ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks:

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H33C2UP

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Color (moist)		Redox %	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR	2/1	100						Clay Loam	
10-12	10YR	4/2	100						Clay	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: compacted clay

Depth (inches): 10

Hydric Soil Present? Yes ○ No ●

Remarks:

No evidence of hydric soil.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☐ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ●	Depth (inches):
Water Table Present?	Yes ○	No ●	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ●	Depth (inches):

Wetland Hydrology Present? Yes ○ No ●

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

No evidence of wetland hydrology

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** H33C2WET

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** **S** 23 **T** 20N **R** 20W

Landform (hillslope, terrace, etc.): Roadside Swale **Local relief (concave, convex, none):** concave **Slope:** 0.0 **%** / 0.0 **°**

Subregion (LRR): E **Lat.:** 47.47429 **Long.:** -114.09704 **Datum:** WGS84

Soil Map Unit Name: **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (●) No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (●) No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●) No ○	**Is the Sampled Area within a Wetland?** Yes (●) No ○
Hydric Soil Present?	Yes (●) No ○	
Wetland Hydrology Present?	Yes (●) No ○	

Remarks:
All 3 wetland parameters are met.During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species? Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
	0	= Total Cover	
Sapling/Shrub Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
	0	= Total Cover	
Herb Stratum (Plot size: 3m rad)			
1. Phalaris arundinacea	90	☑ 90.0%	FACW
2. Typha latifolia	10	☐ 10.0%	OBL
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
6.	0	☐ 0.0%	
7.	0	☐ 0.0%	
8.	0	☐ 0.0%	
9.	0	☐ 0.0%	
10.	0	☐ 0.0%	
11.	0	☐ 0.0%	
	100	= Total Cover	
Woody Vine Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
	0	= Total Cover	

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	100.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	10	x 1 =	10
FACW species	90	x 2 =	180
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	100 (A)		190 (B)

Prevalence Index = B/A = 1.900

Hydrophytic Vegetation Indicators:

- ☑ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☑ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes (●) No ○

Remarks:
Hydrophytic veg is present.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H33C2WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Color (moist)		Redox %	Type[1]	Loc[2]	Texture	Remarks
0-9	10YR	2/1	100						Loam	
9-12	10YR	5/2	100						Clay	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☑ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: clay

Depth (inches): 12

Hydric Soil Present? Yes ◉ No ○

Remarks:

Could not dig past compacted clay layer. Wetland hydrology is presumed to be present based on presence of hydrophytic vegetation and wetland hydrology indicators.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☐ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

wetland hydrology indicated

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **H40GUP**

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** S 23 T 20N R 20W

Landform (hillslope, terrace, etc.): Flat **Local relief (concave, convex, none):** none **Slope:** 0.0 % / 0.0 °

Subregion (LRR): E **Lat.:** 47.456602 **Long.:** -114.097184 **Datum:** WGS84

Soil Map Unit Name: post-ronan water complex **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (•) No ( ) **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (•) No ( )

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (•) No ( )	**Is the Sampled Area within a Wetland?** Yes ( ) No (•)
Hydric Soil Present?	Yes ( ) No (•)	
Wetland Hydrology Present?	Yes ( ) No (•)	

Remarks:
No wetland indicators are present. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size: 3 m)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
	0	= Total Cover		
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size: 3m rad)				
1. Lactuca serriola	20	☐	16.7%	FACU
2. Bromus inermis	40	☑	33.3%	UPL
3. Poa pratensis	30	☑	25.0%	FAC
4. Elymus trachycaulus	30	☑	25.0%	FAC
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
	120	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
	0	= Total Cover		

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 66.7% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	60	x 3 =	180
FACU species	20	x 4 =	80
UPL species	40	x 5 =	200
Column Totals:	120 (A)		460 (B)

Prevalence Index = B/A = 3.833

Hydrophytic Vegetation Indicators:

- ☐ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☐ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes (•) No ( )

Remarks:

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H40GUP

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Color (moist)		Redox %	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR	2/2	100						Clay Loam	
4-16	7.5R	4/2	100						Clay	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: compacted clay

Depth (inches): 4

Hydric Soil Present? Yes ○ No ◉

Remarks:

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☐ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **H40GWET**

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** **S** 23 **T** 20N **R** 20W

Landform (hillslope, terrace, etc.): ditch **Local relief (concave, convex, none):** concave **Slope:** 0.0 **% /** 0.0 **°**

Subregion (LRR): E **Lat.:** 47.47429 **Long.:** -114.09704 **Datum:** WGS84

Soil Map Unit Name: post-ronan water complex **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ◉ No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ◉ No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Hydric Soil Present?	Yes ◉ No ○	
Wetland Hydrology Present?	Yes ◉ No ○	

Remarks:
All three wetland indicators present. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species? Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size: 3m x 1m)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
	0	= Total Cover	
Sapling/Shrub Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
	0	= Total Cover	
Herb Stratum (Plot size: 3m rad)			
1. Agrostis stolonifera	100	☑ 100.0%	FAC
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
6.	0	☐ 0.0%	
7.	0	☐ 0.0%	
8.	0	☐ 0.0%	
9.	0	☐ 0.0%	
10.	0	☐ 0.0%	
11.	0	☐ 0.0%	
	100	= Total Cover	
Woody Vine Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
	0	= Total Cover	

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	100.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	100	x 3 =	300
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	100	(A)	300 (B)

Prevalence Index = B/A = 3.000

Hydrophytic Vegetation Indicators:

- ☐ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☑ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks:
cattails to the north and south present

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: H40GWET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-4	10YR	3/2	100						Loam	
4-10	10YR	4/1	90	7.5YR	5/4	10	C	M	Clay Loam	
10-12	7.5YR	5/2	100						sand	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☑ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

hydric soil present

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☑ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

wetland hydrology indicated

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **I9CUPL**

Investigator(s): S. Wall; T. Cross **Section, Township, Range: S** 23 **T** 20N **R** 20W

Landform (hillslope, terrace, etc.): slope **Local relief (concave, convex, none):** convex **Slope:** 10.0 **%** / 5.7 **°**

Subregion (LRR): E **Lat.:** 47.47429 **Long.:** -114.09704 **Datum:** WGS84

Soil Map Unit Name: Post-Ronan-Water Complex **NWI classification:** None

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ◉ No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ○ No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Hydric Soil Present?	Yes ○ No ◉	
Wetland Hydrology Present?	Yes ○ No ◉	

Remarks:
No wetland indicators are met. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

	Absolute % Cover	Dominant Species? Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
	0	**= Total Cover**	
Sapling/Shrub Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
	0	**= Total Cover**	
Herb Stratum (Plot size: 3m)			
1. Bromus inermis	95	☑ 95.0%	UPL
2. Pascopyrum smithii	5	☐ 5.0%	FACU
3.	0	☐ 0.0%	
4.	0	☐ 0.0%	
5.	0	☐ 0.0%	
6.	0	☐ 0.0%	
7.	0	☐ 0.0%	
8.	0	☐ 0.0%	
9.	0	☐ 0.0%	
10.	0	☐ 0.0%	
11.	0	☐ 0.0%	
	100	**= Total Cover**	
Woody Vine Stratum (Plot size:)			
1.	0	☐ 0.0%	
2.	0	☐ 0.0%	
	0	**= Total Cover**	

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	0	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	0.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	5	x 4 =	20
UPL species	95	x 5 =	475
Column Totals:	100 (A)		495 (B)

Prevalence Index = B/A = 4.950

Hydrophytic Vegetation Indicators:

- ☐ **1 - Rapid Test for Hydrophytic Vegetation**
- ☐ **2 - Dominance Test is > 50%**
- ☐ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes ○ No ◉

Remarks:
No hydric vegetation indicators are met.

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: I9CUPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-10	7.5YR	4/1	100						Clay Loam	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: Compacted Clay

Depth (inches): 10

Hydric Soil Present? Yes ○ No ●

Remarks:

No hydric soil indicators met.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☐ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ●	Depth (inches):
Water Table Present?	Yes ○	No ●	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ●	Depth (inches):

Wetland Hydrology Present? Yes ○ No ●

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

No evidence of wetland hydrology

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** **I9CWET**

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** S 23 T 20N R 20W

Landform (hillslope, terrace, etc.): Swale **Local relief (concave, convex, none):** concave **Slope:** 0.0 % / 0.0 °

Subregion (LRR): E **Lat.:** 47.47429 **Long.:** -114.09704 **Datum:** WGS84

Soil Map Unit Name: Post-Ronan-Water Complex **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (●) No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (●) No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●) No ○	**Is the Sampled Area within a Wetland?** Yes (●) No ○
Hydric Soil Present?	Yes (●) No ○	
Wetland Hydrology Present?	Yes (●) No ○	

Remarks:
All three wetland indicators present. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

Tree Stratum (Plot size: 3 m)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.		☐	0.0%	
2.		☐	0.0%	
3.		☐	0.0%	
4.	0	☐	0.0%	
	0	= Total Cover		
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size: 3mx1m)				
1. Typha latifolia	20	☑	28.6%	OBL
2. Hordeum jubatum	30	☑	42.9%	FAC
3. Alopecurus aequalis	20	☑	28.6%	OBL
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
	70	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
	0	= Total Cover		

% Bare Ground in Herb Stratum: 0

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	3	(A)
Total Number of Dominant Species Across All Strata:	3	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	100.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	40	x 1 =	40
FACW species	0	x 2 =	0
FAC species	30	x 3 =	90
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	70 (A)		130 (B)

Prevalence Index = B/A = 1.857

Hydrophytic Vegetation Indicators:

- ☐ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☑ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes (●) No ○

Remarks:
Hydrophytic vegetation is present

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: I9CWET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-5	10YR	4/1	100						Loam	With Gravel
5-12	7.5YR	6/1	70	7.5R	7/6	30	C	M	Clay	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) (except in MLRA 1)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

Hydric soil indicator F3 is met.

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres on Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (LRR A)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- ☐ Drainage Patterns (B10)
- ☐ Dry Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☑ FAC-neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (LRR A)
- ☐ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ○	No ◉	Depth (inches):
Water Table Present?	Yes ○	No ◉	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ○	No ◉	Depth (inches):

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

Soil moist but not saturated.

WETLAND DETERMINATION DATA FORM - Western Mountains, Valleys, and Coast Region

Project/Site: Ninepipe Feasibility Study **City/County:** Lake County **Sampling Date:** 18-Aug-21

Applicant/Owner: Montana Department of Transportation **State:** MT **Sampling Point:** NEWWL

Investigator(s): S. Wall; T. Cross **Section, Township, Range:** S 23 T 20N R 20W

Landform (hillslope, terrace, etc.): roadside ditch **Local relief (concave, convex, none):** concave **Slope:** 0.0 % / 0.0 °

Subregion (LRR): E **Lat.:** 47.485904 **Long.:** -114.097070 **Datum:** WGS84

Soil Map Unit Name: post-ronan-water complex **NWI classification:**

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (●) No ( )

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●) No ( )	**Is the Sampled Area within a Wetland?** Yes (●) No ( )
Hydric Soil Present?	Yes (●) No ( )	
Wetland Hydrology Present?	Yes (●) No ( )	

Remarks:
South of Beaverhead Drive. All three wetland indicators present. During the field work the study area was classified as being in severe drought (D2) by the US Drought Monitor Index.

VEGETATION - Use scientific names of plants.

Stratum / Species	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
Tree Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
= Total Cover	0			
Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
= Total Cover	0			
Herb Stratum (Plot size: 3mx1m)				
1. Agrostis stolonifera	30	☑	50.0%	FAC
2. Alopecurus pratensis	20	☑	33.3%	FAC
3. Typha latifolia	10	☐	16.7%	OBL
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
= Total Cover	60			
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
= Total Cover	0			

% Bare Ground in Herb Stratum: 40

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	2	(A)
Total Number of Dominant Species Across All Strata:	2	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	100.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	10	x 1 =	10
FACW species	0	x 2 =	0
FAC species	50	x 3 =	150
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	60 (A)		160 (B)

Prevalence Index = B/A = 2.667

Hydrophytic Vegetation Indicators:

- ☑ **1 - Rapid Test for Hydrophytic Vegetation**
- ☑ **2 - Dominance Test is > 50%**
- ☑ **3 - Prevalence Index is ≤3.0** [1]
- ☐ **4 - Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **5 - Wetland Non-Vascular Plants** [1]
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Hydrophytic Vegetation Present? Yes (●) No ( )

Remarks:
wetland vegetation present

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: NEWWL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR	3/1							clay loam	
3-5	7.5YR	6/3							Clay	
5-9	10YR	3/1							clay loam	
9-16	7.5YR	6/2		7.5YR	6/6	20	C	M	Clay	

[1]Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- [ ] Histosol (A1)
- [ ] Histic Epipedon (A2)
- [ ] Black Histic (A3)
- [ ] Hydrogen Sulfide (A4)
- [x] Depleted Below Dark Surface (A11)
- [ ] Thick Dark Surface (A12)
- [ ] Sandy Muck Mineral (S1)
- [ ] Sandy Gleyed Matrix (S4)
- [ ] Sandy Redox (S5)
- [ ] Stripped Matrix (S6)
- [ ] Loamy Mucky Mineral (F1) (except in MLRA 1)
- [ ] Loamy Gleyed Matrix (F2)
- [ ] Depleted Matrix (F3)
- [ ] Redox Dark Surface (F6)
- [ ] Depleted Dark Surface (F7)
- [ ] Redox depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- [ ] 2 cm Muck (A10)
- [ ] Red Parent Material (TF2)
- [ ] Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes (●) No ( )

Remarks:

hydric soil present

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- [ ] Surface Water (A1)
- [ ] High Water Table (A2)
- [ ] Saturation (A3)
- [ ] Water Marks (B1)
- [ ] Sediment Deposits (B2)
- [ ] Drift deposits (B3)
- [ ] Algal Mat or Crust (B4)
- [ ] Iron Deposits (B5)
- [ ] Surface Soil Cracks (B6)
- [ ] Inundation Visible on Aerial Imagery (B7)
- [ ] Sparsely Vegetated Concave Surface (B8)
- [ ] Water-Stained Leaves (B9) (except MLRA 1, 2, 4A, and 4B)
- [ ] Salt Crust (B11)
- [ ] Aquatic Invertebrates (B13)
- [ ] Hydrogen Sulfide Odor (C1)
- [ ] Oxidized Rhizospheres on Living Roots (C3)
- [ ] Presence of Reduced Iron (C4)
- [ ] Recent Iron Reduction in Tilled Soils (C6)
- [ ] Stunted or Stressed Plants (D1) (LRR A)
- [ ] Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- [ ] Water-Stained Leaves (B9) (MLRA 1, 2, 4A, and 4B)
- [ ] Drainage Patterns (B10)
- [ ] Dry Season Water Table (C2)
- [ ] Saturation Visible on Aerial Imagery (C9)
- [x] Geomorphic Position (D2)
- [ ] Shallow Aquitard (D3)
- [x] FAC-neutral Test (D5)
- [ ] Raised Ant Mounds (D6) (LRR A)
- [ ] Frost Heave Hummocks (D7)

Field Observations:

	Yes	No	Depth (inches):
Surface Water Present?	( )	(●)	
Water Table Present?	( )	(●)	
Saturation Present? (includes capillary fringe)	( )	(●)	

Wetland Hydrology Present? Yes (●) No ( )

Describe Recorded Data (stream gauge, monitor well, aerial photos, previous inspections), if available:

Remarks:

wetland hydrology indicated

APPENDIX C

Functional Assessment Ratings Comparison

	Ninepipe Segment Comparison of 1999 and 2008 Functional Ratings.																											
	H 28A		**H 28A**		**H 29A**		**H 29A**		**H 30 A, B**		**H 30 A, B**		**H 31 A, B**		**H 31 A, B**		**H 32 A, B, C H33 A**		**H 32 A, B, C H33 A**		**H33 B**		**H33 B**		**H34 A**		**H34 A**	
Listed/Proposed T&E Species Habitat	0.3	L	0.20	L	0.3	L	0	L	0.8	M	0.7	M	0.7	M	0.7		0	L	0	L	0.3	L	0.3		0.3	L	0.30	
MNHP Species Habitat	0.1	L	0.20	L	0.1	L	0	L	0.6	M	0.6	M	0.1	L	0.2	L	0	L	0	L	0.1	L	0.2	L	0.1	L	0.20	L
General Wildlife Habitat	0.9	H	0.9	H	0.9	H	0.9		1	E	1		0.9	H	0.9		0.3	L	0.3		0.9	H	0.9		0.9	H	0.90	
General Fish/Aquatic Habitat	NA	NA	NA	NA	NA	NA	NA		0.6	M	0.6	M	NA	NA			NA	NA			NA	NA			NA	NA		
Flood Attenuation	NA	NA	NA	NA	NA	NA	NA		NA	NA			NA	NA			NA	NA			NA	NA			NA	NA		
Short and Long-Term Surface Water Storage	1	H	1	H	0.8	H	0.8		1	H	1		0.8	H	0.8		0.3	L	0.3		0.8	H	0.8		0.8	H	0.80	
Sediment, Nutrient, Toxicant Removal	0.7	M	0.7	M	1	H	1		0.7	M	0.7		0.7	M	0.7		1	H	1		1	H	1		1	H	1.00	
Sediment/Shoreline Stabilization	NA	NA	NA	NA	NA	NA	NA		1	H	1		NA	NA			NA	NA			NA	NA			NA	NA		
Production Export/Food Chain Support	0.3	L	0.40	M	0.6	M	0.6		0.7	M	0.7		0.6	M	0.6		0.5	M	0.5		0.8	H	0.8		0.6	M	0.60	
Ground Water Discharge/Recharge	NA	NA	NA	NA	NA	NA	NA		NA	NA			NA	NA			NA	NA			NA	NA			NA	NA		
Uniqueness	0.3	L	0.3	L	0.4	M	0.4		0.4	M	0.4		0.4	M	0.4		0.2	L	0.2		0.5	M	0.5		0.4	M	0.40	
Recreation/Education Potential	1	H	0.20	H	1	H	0.2	H	1	H	0.2	H	1	H	0.2	H	0.1	L	0.2	H	1	H	0.2	H	1	H	0.2	H
Actual Points	4.6		3.90		5.1		3.9		7.9		6.9		4.6		4.5		2.4		2.5		5.4		4.7		5.1		4.4	
Possible Points	8		7.00		8		7		10		9		8		7		8		7		8		7		8		7.00	
% of Possible Score Achieved	58%		56%		64%		56%		79%		77%		58%		64%		30%		36%		68%		67%		64%		0.63	
Overall Category	II		II		II		II		II		II		II		II		III		III		II		II		II		II	

Note: shaded columns show 1999 MWAM ratings, unshaded columns show 2008 ratings.

changed rating

no change in final score

change in final score

	Ninepipe Segment Comparison of 1999 and 2008 Functional Ratings.																											
	H 34 C, D		H 34 C, D		H35 A, B		H35 A, B		H37 A, B		H37 A, B		H38 A		H38 A		H 39 A, B H40 A, B, C		H 39 A, B H40 A, B, C		H40 D, E, F		H40 D, E, F		I1 A, B I2 A		I1 A, B I2 A	
Listed/Proposed T&E Species Habitat	0.3	L	0.3		0.3	L	0.30		0.3	L	0.30		0.3	L	0.3		0.3	L	0.30		0	L	0	L	0	L	0	L
MNHP Species Habitat	0.1	L	0.2	L	0.1	L	0.20	L	0.1	L	0.20	L	0.1	L	0.20	L	0.1	L	0.20	L	0	L	0	L	0	L	0	L
General Wildlife Habitat	0.9	H	0.9		0.7	M	0.70		0.9	H	0.90		0.5	M	0.5		0.7	M	0.70		0.3	L	0.30		0.3	L	0.30	
General Fish/Aquatic Habitat	NA	NA			0.4	L	0.40		NA	NA			NA	NA			NA	NA			NA	NA			NA	NA		
Flood Attenuation	NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA		
Short and Long-Term Surface Water Storage	0.8	H	0.8		0.3	L	0.30		0.4	M	0.40		0.1	L	0.1		0.8	H	0.80		0.3	L	0.30		0.3	L	0.30	
Sediment, Nutrient, Toxicant Removal	1	H	1		0.4	M	0.40		0.7	M	0.70		NA	NA			1	H	1.00		1	H	1.00		1	H	1.00	
Sediment/Shoreline Stabilization	NA	NA			0.7	M	0.70		NA	NA			NA	NA			NA	NA			NA	NA			NA	NA		
Production Export/Food Chain Support	0.7	M	0.7		0.8	H	0.80		0.6	M	0.60		0.1	L	0.1		0.6	M	0.60		0.5	M	0.50		0.2	L	0.20	
Ground Water Discharge/Recharge	NA	NA			0.1	L	0.10		NA	NA			0.1	L	0.1		NA	NA			NA	NA			NA	NA		
Uniqueness	0.4	M	0.4		0.2	L	0.20		0.4	M	0.40		0.3	L	0.3		0.4	M	0.40		0.2	L	0.20		0.2	L	0.20	
Recreation/Education Potential	1	H	0.2	H	0.1	L	0.05	L	1	H	0.2	H	0.5	M	0.2	H	1	H	0.2	H	0.1	L	0.05	L	0.1	L	0.05	L
Actual Points	5.2		4.5		4.1		4.15		4.4		3.70		2		1.8		4.9		4.20		2.4		2.4		2.1		2.05	
Possible Points	8		7		11		10		8		7		8		7		8		7		8		7		8		7	
% of Possible Score Achieved	65%		64%		37%		42%		55%		53%		25%		26%		61%		60%		30%		34%		26%		29%	
Overall Category	II		II		III		III		II		II		IV		IV		III		III		III		IV		IV		IV	

<u>Note</u>: shaded columns show 1999 MWAM ratings, unshaded columns show 2008 ratings.

changed rating

no change in final score

change in final score

	Ninepipe Segment Comparison of 1999 and 2008 Functional Ratings.																											
	I3 A, B, E		**I3 A, B, E**		**I3 C, D**		**I3 C, D**		**I4 A, B**		**I4 A, B**		**I5 A, B I6 A, B, C, E I7 C**		**I5 A, B I6 A, B, C, E I7 C**		**I6 D, I7 A, B**		**I6 D, I7 A, B**		**I8 A, B, C, D**		**I8 A, B, C, D**		**I 9 A, B**		**I 9 A, B**	
Listed/Proposed T&E Species Habitat	0.3	L	0.30		0.3	L	0.30		0.3	L	0.30		0.3	L	0.30		0.3	L	0.3		0.3	L	0.30		0.3	L	0.30	
MNHP Species Habitat	0.1	L	0.20	L	0.1	L	0.20	L	0.1	L	0.20	L	0.1	L	0.20	L	0.1	L	0.20	L	0.1	L	0.2	L	0.1	L	0.20	L
General Wildlife Habitat	0.5	M	0.50		0.9	H	0.90		0.9	H	0.90		0.5	M	0.50		0.9	H	0.9		0.9	H	0.9		0.5	M	0.50	
General Fish/Aquatic Habitat	NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA		
Flood Attenuation	NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA		
Short and Long-Term Surface Water Storage	0.3	L	0.30		0.8	H	0.80		0.8	H	0.80		0.3	L	0.30		0.4	M	0.4		0.3	L	0.3		0.3	L	0.30	
Sediment, Nutrient, Toxicant Removal	1	H	1.00		0.7	M	0.70		0.7	M	0.70		1	H	1.00		0.7	M	0.7		1	H	1		1	H	1.00	
Sediment/Shoreline Stabilization	NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA		
Production Export/Food Chain Support	0.5	M	0.50		0.3	L	0.30		0.3	L	0.30		0.5	M	0.50		0.6	M	0.6		0.5	M	0.5		0.3	L	0.30	
Ground Water Discharge/Recharge	NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA			NA	NA		
Uniqueness	0.4	M	0.40		0.4	M	0.40		0.4	M	0.40		0.4	M	0.40		0.4	M	0.4		0.3	L	0.3		0.3	L	0.30	
Recreation/Education Potential	1	H	0.20	H	1	H	0.20	H	1	H	0.20	H	0.1	L	0.05	L	1	H	0.2	H	0.5	M	0.2	H	0.5	M	0.20	H
Actual Points	4.1		3.40		4.5		3.80		4.5		3.80		4.1		3.25		4.4		3.7		3.9		3.70		3.3		3.10	
Possible Points	8		7		8		7		8		7		8		7		8		7		8		7		8		7	
% of Possible Score Achieved	51%		49%		55%		0.543		56%		54%		51%		46%		55%		53%		48%		53%		41%		44%	
Overall Category	III		III		II		II		II		II		III		III		II		II		II		II		III		III	

Note: shaded columns show 1999 MWAM ratings, unshaded columns show 2008 ratings.

changed rating

no change in final score

change in final score

	Ninepipe Segment Comparison of 1999 and 2008 Functional Ratings.																											
	I10 A, I 13 B		I10 A, I 13 B		I11 A, B, C, D		I11 A, B, C, D		I12 A, B, C I13 A, C, D, E, F		I12 A, B, C I13 A, C, D, E, F		I14 A, B, C		I14 A, B, C		I15 A		I15 A		I16 A, B		I16 A, B		I17 A, B, C, D, E I18 A, B, C, D I19 A, B I20 A, B, C		I17 A, B, C, D, E I18 A, B, C, D I19 A, B I20 A, B, C	
Listed/Proposed T&E Species Habitat	0.3	L	0.30		0	L	0.00		0.3	L	0.30		0.3	L	0.30		0.3	L	0.30		0.7	M	0.70		0	L	0	
MNHP Species Habitat	0.1	L	0.2	L	0	L	0.00		0.1	L	0.20	L	0.1	L	0.20	L	0.1	L	0.20	L	0.6	M	0.60		0	L	0	
General Wildlife Habitat	0.8	H	0.8		0.1	L	0.10		0.5	M	0.50		0.5	M	0.50		0.9	H	0.90		0.7	M	0.70		0.3	L	0.3	
General Fish/Aquatic Habitat	NA	NA			NA	N			NA	NA			NA	NA			NA	NA			0.8	H	0.80		NA	NA		
Flood Attenuation	NA	NA			NA	N			NA	NA			NA	NA			NA	NA			0.4	M	0.40		NA	NA		
Short and Long-Term Surface Water Storage	0.6	M	0.6		0.2	L	0.20		0.6	M	0.60		0.6	M	0.60		0.8	H	0.80		1	H	1.00		0.3	L	0.3	
Sediment, Nutrient, Toxicant Removal	1	H	1		0.8	H	0.80		1	H	1.00		0.8	H	0.80		0.7	M	0.70		0.9	H	0.90		1	H	1	
Sediment/Shoreline Stabilization	NA	NA			NA	N			NA	NA			NA	NA			NA	NA			1	H	1.00		NA	NA		
Production Export/Food Chain Support	0.5	M	0.5		0.1	L	0.10		0.5	M	0.50		0.5	M	0.50		0.6	M	0.60		0.8	H	0.80		0.2	L	0.2	
Ground Water Discharge/Recharge	NA	NA			NA	N			NA	NA			NA	NA			NA	NA			1	H	1.00		NA	NA		
Uniqueness	0.4	M	0.4		0.1	L	0.10		0.3	L	0.30		0.4	M	0.40		0.4	M	0.40		0.3	L	0.30		0.1	L	0.1	
Recreation/Education Potential	1	H	0.2	H	0.1	L	0.05	L	0.1	L	0.05	L	0.5	M	0.20	H	1	H	0.20	H	1	H	0.20	H	0.1	L	0.05	L
Actual Points	4.7		4.00		1.4		1.35		3.4		3.45		3.7		3.50		4.8		4.10		9.2		8.40		2		1.95	
Possible Points	8		7		8		7		8		7		8		7		8		7		12		11		8		7	
% of Possible Score Achieved	60%		57%		17%		19%		43%		49%		46%		50%		60%		0.586		77%		76%		25%		0.279	
Overall Category	III		III		IV		IV		III		III		III		III		II		II		II		II		IV		IV	

Note: shaded columns show 1999 MWAM ratings, unshaded columns show 2008 ratings.

changed rating

no change in final score

change in final score

NINEPIPE CORRIDOR 93 FEASIBILITY STUDY

APPENDIX D:

Wildlife Technical Memorandum

HERRERA

TECHNICAL MEMORANDUM

Date: January 31, 2022

To: Sarah Nicolai and Scott Randall, Robert Peccia and Associates

From: Susan Wall

Subject: Analysis of Relevant Conditions for Wildlife in the Ninepipe Segment

CONTENTS

TABLES

FIGURES

INTRODUCTION

This memorandum was prepared to evaluate the wildlife crossing locations and proposed structure types presented as the preferred alternative in the *US Highway 93 Ninepipe/Ronan Improvement Project Final Supplemental Environmental Impact Statement and Section 4(f) Evaluation* (SEIS). The primary functional objectives that guided identification of the wildlife crossing structure options included: 1) improvement of hydrologic connectivity in wetlands and in streams and their associated floodplains, 2) improvement of wetland and riparian functions, and 3) improvement of wildlife habitat connectivity and wildlife passage (FHWA, MDT and CSKT 2008).

This memo provides a summary of relevant conditions for wildlife using the most recent available studies and data on wildlife presence and injury/mortality in the Ninepipe segment of the corridor (reference post [RP] 40.0 to 44.5). Wildlife information was discussed in the first resource agency meeting for the Ninepipe Feasibility Study on September 21, 2021, and a Microsoft Teams meeting was held on December 2, 2021, with experts from state, federal and tribal wildlife agencies. The purpose of these meetings was to gather information to help determine if the wildlife crossings identified in the SEIS preferred alternative are feasible.

The information presented in this memorandum is intended to inform the feasibility analysis that will evaluate the crossing structures for constructability challenges, impacts on wetlands and cultural resources, roadway alignment, and right-of-way impacts.

BACKGROUND

The SEIS identified a series of wildlife crossing structures within the Ninepipe segment including:

- North of Gunlock Road to Ninepipe Reservoir (approximately RP 40 to 40.8)
    - Two 12-foot by 22-foot culverts
    - Two 10-foot by 12-foot culverts
    - One 660-ft multiple-span bridge with minimum clearance of 10 – 13 feet.
- Kettle Pond 1 (approximately RP 41.7)
    - Two 4-foot by 6-foot culverts
    - Two 59-foot single-span bridges with minimum clearance of 10 – 13 feet.
- Kettle Pond 2 (approximately RP 42.5)
    - Two 4-foot by 6-foot culverts
    - Two 59-foot single-span bridges with minimum clearance of 10 – 13 feet.
- Crow Creek (approximately RP 44.2)
    - One 121-foot multiple-span bridge with minimum clearance of 10 – 13 feet.
    - One 150-foot multiple-span bridge with minimum clearance of 10 – 13 feet.

Existing Ninepipe reservoir bridge, and Kettle Pond 2 facing south

Generally, the wide range of structure types and locations in the corridor is expected to facilitate movement by many species including turtles, deer, some small to large mammals, and grizzly bear (FHWA, MDT and CSKT 2008). The benefits of all the structures would take time to realize as wildlife learn how to negotiate the structures and become accustomed to using them.

Wildlife Presence and Injury/Mortality in the Ninepipe Segment

Grizzly Bears

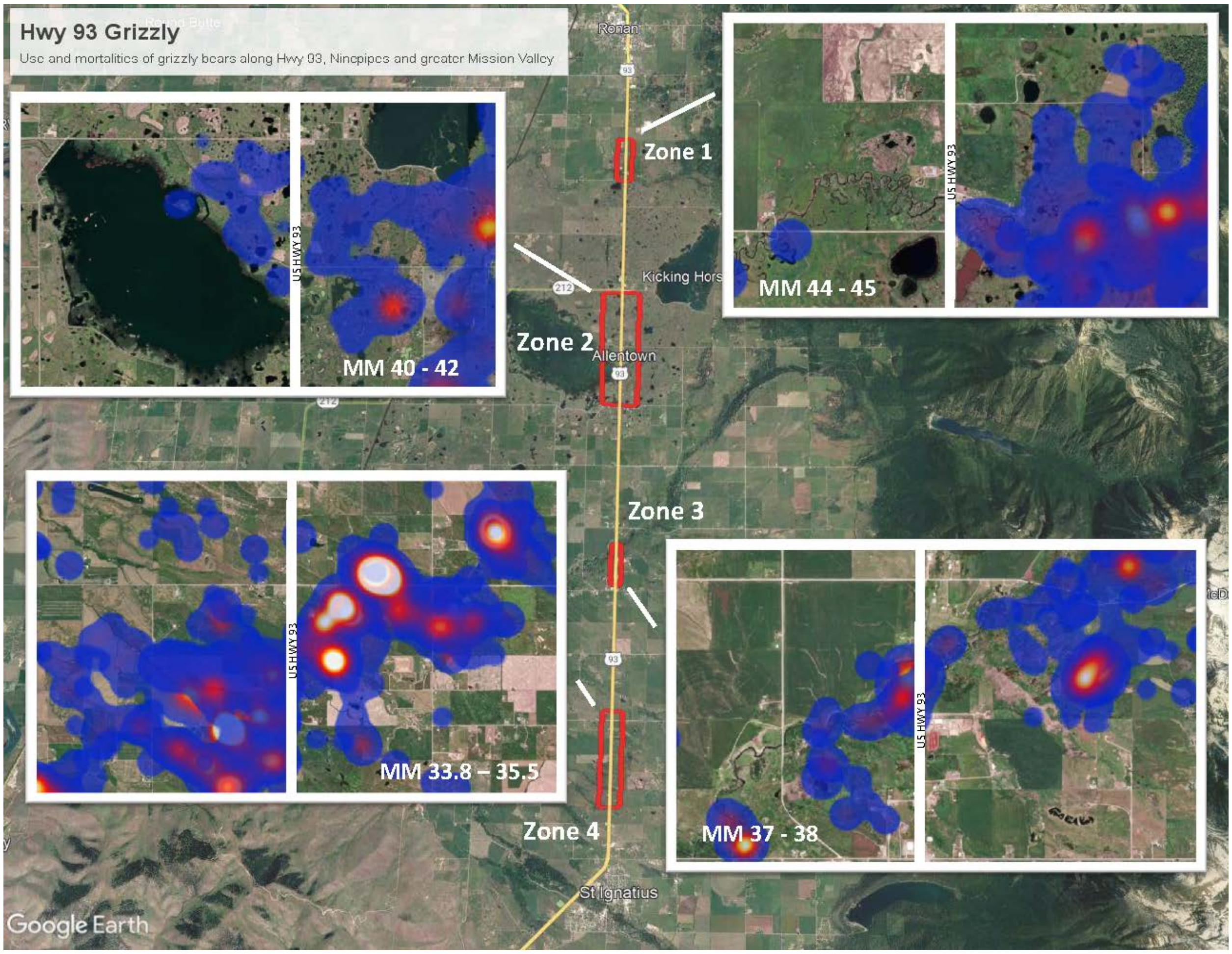
Presence

At the ecosystem level, the population of grizzly bears in the Northern Continental Divide Ecosystem (NCDE) is increasing. The NCDE recovery zone includes all of Glacier National Park, as well as portions of the Flathead, Helena-Lewis and Clark, Kootenai, and Lolo National Forests (including four Wilderness Areas), and the Flathead and Blackfeet Indian Reservations (USFWS 2018). Female grizzly bears with young have dispersed well beyond the NCDE recovery zone, occupying an estimated area of roughly twice the size of the recovery zone. (Costello et al. 2016).

The NCDE is divided into Bear Management Units (BMUs) to facilitate both the assessment of projects and recovery objectives. The Mission Mountain BMU is immediately east of the Ninepipe segment. Grizzly bear movements in the Mission Range BMU are monitored using GPS collared bears. Currently at least 37 female bears that have occupied home ranges that include the Mission Range BMU are fitted with collars. Of these, there are 22 GPS-collared female grizzly bears with home ranges on the west slopes or east and west slopes of the Mission Range. The data from these collared bears showed that bears frequently used the Post Creek riparian corridor, the foothills habitat east of Kicking Horse Reservoir, and the Ninepipe National Wildlife Refuge (CSKT 2014 as cited in USFWS 2020).

Tribal biologists have continued monitoring bear movements and have documented hot spots for grizzly presence in the Ninepipe segment as shown on the "heat map" (Figure 1). The map was generated using ArcGIS to calculate estimates of grizzly bear using location data from multiple bears collared over the past 7-8 years. There were at least five different bears (not maternally related or from the same family groups) whose data contributed to the map. The blue color represents where bears were (or could have been with 95% confidence based on collar GPS locations), red indicates areas with higher use and multiple data points in one location (hot travel corridors), and the white spots are areas where bears spent more time, accruing many logged data locations. Each of the blue shapes indicates that somewhere within that circle there was at least one GPS collar location. The larger the shape, the more location points taken in that area (personal communication, Kari Eneus, Confederated Salish & Kootenai Tribes Wildlife Management Program, December 13, 2021).

Zones 1 and 2 of the map encompass areas within the Ninepipe segment. The map shows high use of the Crow Creek riparian area east of Hwy 93, and in the area between Ninepipe and Kicking Horse reservoirs on both sides of the highway. The area between Zone 1 and Zone 2 on the heat map is probably not a preferred corridor for bears to cross the highway, although they may feed on roadkill in that area.



Source: CSKT Wildlife Management Program

Figure 1. Grizzly Bear Zone Map for the Ninepipe Vicinity

The CSKT and the NCDE Monitoring Team documented 45 highway crossings by nine different individuals in the Ninepipe vicinity from 2007 to 2019 (Figure 2). Exact locations of highway crossings by GPS-collared bears cannot be determined, but they are approximated by drawing a straight line between the last locations on one side of the highway and the first location on the other side of the highway. They observed grizzlies crossing throughout the Ninepipe vicinity, but there appeared to be a concentration of crossings close to where Hwy 93 crosses Crow Creek. Most of those crossings involved females with cubs (28 crossing by 3 individuals) or females with yearlings (11 crossings by 2 individual mothers). Timing of crossings was estimated as the midpoint between successive locations and most crossing appeared to occur at night, dawn, or dusk hours when traffic volumes are likely lower and when light conditions reduce motorists' visibility.

Grizzlies forage on sedges and grasses and hunt for rodents on Ninepipe National Wildlife Refuge and surrounding lands (USFWS 2021). Grizzlies use the area around Kicking Horse Reservoir and the shelterbelts west of the highway. They also travel along the Post G canal that crosses Eagle Pass trail, and cross Hwy 93 along Post A canal (see Figure 4 for canal locations). The canal maintenance roads provide cover with trees along the roads.

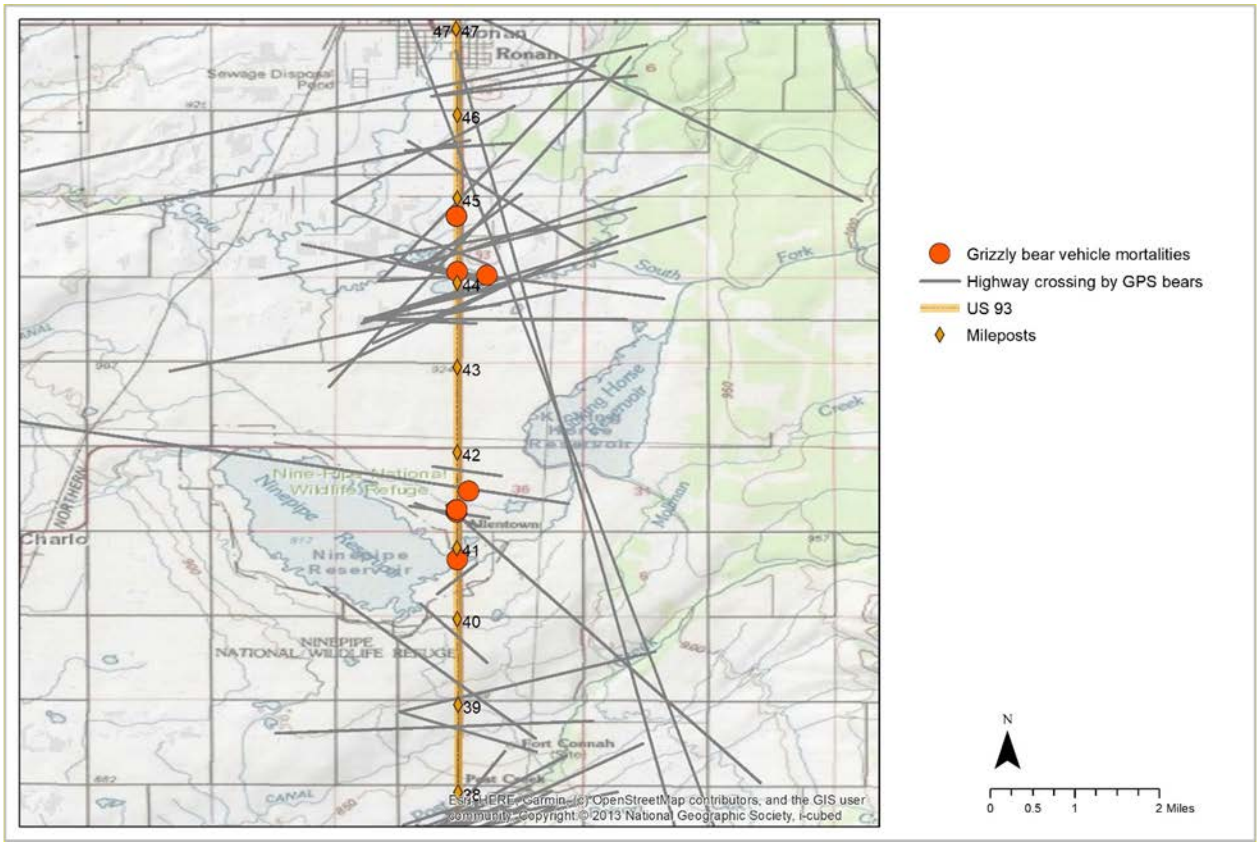
Post A Canal and adjacent woody cover south of the canal

Injury and Mortality

The US Highway 93 Evaro to Polson consultation between the U.S. Fish and Wildlife Service (USFWS) and the Federal Highway Administration (FHWA) was reinitiated in 2012 because incidental take of grizzly bears that occurred under the 2005 Biological Opinion (BO) had been exceeded due to grizzly bear-vehicle collisions. From 2004 to 2019, there were 61 vehicle-caused grizzly bear mortalities in the NCDE including a 10-mile buffer. Within the NCDE, grizzly bear mortalities from vehicle collisions have increased significantly since 2000 (USFWS 2020) and have notably accelerated since 2010 (McGrath personal communication October 19, 2021).

This trend is evident in data collected by CSKT and the NCDE Grizzly Bear Monitoring Team (NCDE Monitoring Team) for Hwy 93. Since publication of the SEIS in 2008, traffic on Hwy 93 has increased and the grizzly bear population has expanded, leading to a sharp increase in vehicle collisions and bear mortality on Hwy 93 North. From 1990 to 2019 the number of mortalities or incidents that occurred per mile of road on Hwy 93 was roughly 10 times higher within the Hwy 93 Evaro to Polson corridor compared to other highways in the NCDE (Costello et al. 2020).

The NCDE Monitoring Team and CSKT documented 11 grizzly bear mortalities during eight different incidents in the Ninepipe vicinity from 1998 to 2021 (Figure 2 and Table 1).



Source: Costello, 2021

Figure 2. Documented Vehicle-caused Mortalities of Grizzly Bears (1998–2021) and Approximate Locations of Documented Highway Crossings by GPS-collared Grizzly Bears (2007–2019) Within the Ninepipe Vicinity, Mileposts 38 to 47, US Highway 93, Montana.

Two grizzly bear-vehicle collisions have occurred since publication of the BO in 2020. One was hit by an ambulance in 2020 and one (a cub) was hit near the Post A irrigation canal. Numerous collisions have occurred near that canal (Whisper Camel-Means, personal communication, wildlife agency meeting, December 2, 2021).

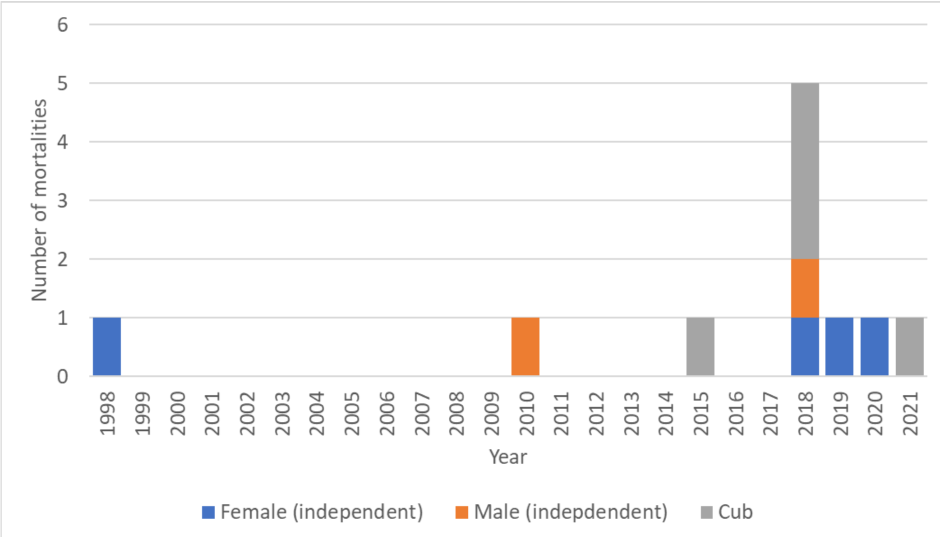
Table 1. Grizzly Bear Mortality in the Ninepipe Segment

Year	Discovery or report date	Hwy 93 reference post	Location description	Sex	Age
1998	Unknown	41.5	Canal across US93, access/canal road.	Female	2-year-old female
2010	June 21	40	Gunlock Road	Male	Adult
2010	May 5	41.3	Canal across US93, access/canal road.	Male	Yearling male (between one and two years of age)
2018	August 24	44.1	Crow Creek	Male	Adult
2018	July 27	44.75	Vicinity Crow Creek/Bev's Bloomers	Female	Adult
2018	July 27	44.75	Vicinity Crow Creek/Bev's Bloomers	Female	Cub-of-the-year (first year of life)
2018	July 27	44.75	Vicinity Crow Creek/Bev's Bloomers	Male	Cub-of-the-year
2018	July 27	44.75	Vicinity Crow Creek/Bev's Bloomers	Male	Cub-of-the-year[a]
2019	September 24	41.3	West side of highway north of Ninepipe Lodge	Female	Adult
2020	September 4	40.9	Ninepipe bridge	Female	Adult
2021	July 27	41.5	Montana Fish Wildlife and Parks pond pullout, south of Post A irrigation canal	unknown	Cub-of-the-year

Source: Whisper Camel-Means unpublished data

[a] this cub was euthanized due to loss of mother and no location to send it

The number of grizzly bears killed in vehicle collisions has increased over time, especially since 2015 (Figure 3).



Source: Costello 2021

Figure 3. Number of Grizzly Bears Killed by Vehicle Collisions (1998–2021), by Sex and Age Category, Ninepipe Vicinity, Mileposts 38 to 47, US Highway 93, Montana

Medium to Large Mammals

White-tailed deer represent most of all reported large mammal wildlife-vehicle collisions along Hwy 93 North (Hardy et al. 2007; Huijser et al. 2016a). Current observations in the Ninepipe segment confirm that large numbers of whitetail deer are involved in vehicle collisions. Black bear collisions are rare in the Ninepipe segment (Whisper Camel-Means, personal communication, wildlife agency meeting December 2, 2021).

Since 2020 the Tribes have started documenting roadkill using electronic records that are updated by game wardens and biologists in real time. The data indicates that white-tailed deer cross the highway at random locations and confirms that they are the majority of wildlife killed in the Ninepipe segment (Figure 4).

There is an informal understanding between Montana Department of Transportation (MDT) and the Tribes that carcasses of deer and sensitive wildlife, such as grizzly bear, mountain lion, bobcat, and elk are collected by the Tribes. MDT collects animals that are a danger to the travelling public because they are in the roadway or on the road shoulder. There is not enough information about these species to identify hot spots for highway crossings (Whisper Camel-Means, personal communication, wildlife agency meeting December 2, 2021).

Legend

- Great Horned Owl
- Grizzly Bear
- Whitetail Deer
- Racoon
- Badger
- Alive Animal

Data source: Survey 123 Roadkill Study, 2020-2021. Whisper Camel-Means unpublished data.

Figure 4.
Wildlife Mortality in the Ninepipe Segment, 2020 and 2021

N

0 0.25 0.5 1 Miles

HERRERA

Esri Imagery (2021)

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Turtles

MDT sponsored a study titled *Potential Effects of Highway Mortality and Habitat Fragmentation on a Population of Painted Turtles in Montana* (Griffin and Pletcher 2006) that focused on the Ninepipe segment. This study, conducted from 2002 to 2004, contains the most recent data on turtles in the Ninepipe vicinity. A total of 1,040 turtles were killed in the Ninepipe segment in that period. The study showed hot spots for turtle mortality at Kettle Ponds 1 and 2 (RP 41.8/42.5) and south of the Beaverhead Lane turnout (RP 44.1). All three of these areas also appear to have important nesting areas on and adjacent to the road banks (Griffin and Pletcher 2006).

Hydrology of the ponds was a more important influence on turtle movements than distance to the highway. For example, at Beaverhead Lane, when the pond on the east side of the highway began to dry out turtles moved to the permanent pond on the west side of the highway (Griffin and Pletcher 2006).

There continue to be large numbers of turtles killed at the kettle ponds, as observed during the 2021 wetland survey. There are many people who are concerned, and people stop to try to help turtles, creating a danger on the highway (wildlife agency meeting, December 2, 2021).

Other Wildlife

The SEIS reported high levels of mortality for nongame birds, upland gamebirds, waterfowl, small mammals, amphibians, and reptiles for the segment of roadway that crosses the core pothole area in the Ninepipe segment (MDT, FHWA and CSKT 2008). The Tribes are concerned about all wildlife but do not have data, other than the information presented above, to help inform the study. Although large numbers of birds are killed on the highway, bird mortality has not been as much of a focus as grizzly bears and large mammals.

The study area is notable for the numerous species and numbers of birds it supports. The Ninepipe National Wildlife Refuge is included in an Audubon Society Important Bird Area (IBA). The IBA consists of the national wildlife refuge, and the Montana Fish Wildlife and Parks Ninepipe Wildlife Management Area that surrounds the refuge. Ninepipe Reservoir supports breeding colonies of western grebes, red-necked grebes, double-crested cormorants, great blue herons, California gulls, Ring-billed gulls, and yellow-headed blackbirds and at least 11 species of ducks, as well as small numbers of American bitterns and Caspian terns. Thousands of waterfowl, mostly Canada geese and mallards, congregate in ice-free areas on the reservoir during some winters, and Bald Eagles also are relatively common during the winter (Audubon 2021).

Spring migration peaks from late March to early May when as many as 100,000 birds may be observed. Fall populations often peak to more than 200,000 birds in early October to late November. Waterfowl nest from April until July (USGS 2021). A pair of swans with cignets crossed the highway several times at the kettle ponds and also at Beaverhead Lane (wildlife agency meeting, December 2, 2021).

USE OF EXISTING CROSSING STRUCTURES IN ADJACENT AREAS

The BO (USFWS 2020) documented grizzly bear use of crossing structures in the action area for the BO, which encompasses the Mission and Flathead River-Pablo Reservoir subwatersheds. Of the eighteen crossing structures of various types and dimensions that were constructed, there have been 35 grizzly bear crossings documented in five of the structures from 2009 to 2017. All structures that were used by grizzly bears were large culverts that were 17 to 24 feet wide and ranged in height from 13 to 24 feet (Huijser et al. 2016a; W. Camel-Means, CSKT Wildlife Management Program, personal communication, May 29, 2018, as cited in USFWS 2020).

The study cited in the BO, Huijser et al. (2016a), documented wildlife-vehicle collisions and wildlife use of crossing structures. It showed that white-tailed deer used bridges, overpasses, and large culverts (approximately 24 feet wide by 13 feet high) more than expected, and rarely used small culverts. Black bears used a wider variety of structures than expected including bridges, large culverts and small culverts. There were 32 crossings by elk, mostly on the wildlife overpass, and only 3 crossings by moose on the wildlife overpass.

The study showed great variability in wildlife use of underpasses regardless of the presence and length of wildlife fences, and that presence of long or short sections of fence were not the primary factors influencing use of the structures. Rather, large mammal use of underpasses was heavily influenced by other factors. These factors likely include the location of the structure in relation to the surrounding habitat, wildlife population density, and wildlife movements. However, subsequent research presented by Huijser et al. (2016b) showed that wing fencing would likely decrease wildlife vehicle collisions and increase the use of the existing crossing structures.

No current studies exist regarding use of culverts by turtles, but documents cited in the turtle mortality study (Griffin and Pletcher 2006) showed that turtles used 9- by 9-foot, inundated, partially submerged box culverts; 3-foot cylindrical culverts when wet with earthen substrates; and 6-foot by 6-foot dry box culverts. Turtles prefer larger diameter culverts that allow for natural light on either end of the culvert (Griffin and Pletcher 2006).

EVALUATION OF PROPOSED CROSSING STRUCTURES

Grizzly Bears and Large Mammals

The Ninepipe Reservoir bridge and both Crow Creek bridges appear to be in appropriate crossing locations for grizzlies because they are located in major drainages, they are in high quality habitat, and they correspond with locations where there has been concentrated use and mortalities (USFWS 2020). They are open-span bridges, which are a type of crossing structure preferred by single grizzly bears and somewhat by family groups (i.e., adult female with young), although family groups prefer overpasses (Ford et al. 2017:715 as cited in USFWS 2020). The length of the proposed bridges in the SEIS seems adequate (USFWS 2020) but the proposed vertical clearance (10 to 13 feet) is less than the recommended 15 feet (Clevenger and Huijser 2011 as cited in USFWS 2020). However, all structures would have a minimum of 150 yards of wing fencing to guide wildlife to the structure (USFWS 2020) (see discussion of fencing in the section below). As proposed, the structures would likely provide occasional use by predominately male grizzly bears, and some use by family groups. They would be more likely to be used by grizzly bears if vertical clearance exceeded 15 feet and wing fencing of at least 0.4 miles was used on each side to help funnel bears to the structures (USFWS 2020). The more open the structures and the more natural they appear the more attractive they would be to grizzly bears (wildlife agency meeting December 2, 2021).

As long as there is adequate land available on each side of the water bodies for animals to pass in the dry, the structures would likely to be used by a variety of other small and large mammals as well (wildlife agency meeting December 2, 2021). Under the preferred alternative, the bridge opening at Ninepipe Reservoir would span more than 100 percent of the floodplain width and the openings at Crow Creek would span 48 percent of the floodplain width. This would provide some opportunity for terrestrial passage through wetland and upland areas (SEIS Table 5.11-1).

Additional accommodations for grizzly bears and other wildlife could be considered at the Post A canal where grizzly bears have been documented crossing the highway and vehicle collisions have occurred.

Turtles

Culverts and fencing systems have been shown to be effective in reducing turtle road mortality (Dodd et al. 2004, Aresco 2005 as cited in Griffin and Pletcher 2006). Painted turtles do not burrow and may show reluctance to enter dark areas., therefore light boxes or oversized culverts are recommended (Griffin and Pletcher 2006). The bridges and over-sized culverts proposed at the kettle ponds would benefit turtles.

Dry land culverts should be flat bottom with an earthen substrate to facilitate turtle terrestrial movements through them. Wing or directional fencing is recommended to funnel turtles to the culverts in the vicinity of the crossing structures and nesting areas that occur on and adjacent to the road bank in the high priority areas (Griffin and Pletcher 2006).

Birds

The proposed bridges at Ninepipe Reservoir, the Kettle Ponds, and Crow Creek would benefit waterfowl that could swim or walk through the crossing structures. This would help alleviate waterfowl collisions that occur when leading young to new areas.

There is concern that eight-foot fences that have been suggested in the past might cause a collision hazard for flying waterfowl. Fence markers, such as those used for sage grouse, and markings on power lines for trumpeter swans, could be explored to reduce waterfowl strikes on the fencing (wildlife agency meeting December 2, 2021).

Bird densities and behaviors that vary from year to year make a big difference in effectiveness of any mitigation measures. For example, pheasants, a species that Montana Fish Wildlife and Parks is working to increase in the Ninepipe area, will fly over fences to access grit on roads (wildlife agency meeting December 2, 2021).

FENCING

The 2001 biological assessment (BA) (Herrera 2001) stated that wing fencing would be added at crossing structures if research demonstrated the need for it. Fencing was eliminated in the final SEIS largely because of concern on the part of several businesses and residents that require access to the highway as well as concerns about aesthetics and potential harm to waterfowl or other species (MDT, FHWA and CSKT 2008).

A subsequent literature review and field studies presented by Huijser et al. (2016b) showed that wildlife fencing can improve wildlife use of crossing structures. There is anecdotal evidence from grizzly bear GPS collar data that some grizzly bears were crossing Hwy 93 at-grade between existing crossing structures (personal communication, Mike McGrath, December 8, 2021). Additionally, several grizzly bear-vehicle collisions occurred near existing crossing structures. The updated 2017 BA proposes a minimum of 150 yards of wing fencing for the large mammal crossing structures, including those in the Ninepipe segment (Respec 2017).

Results from the Huijser et al. (2016a) study showed that large wild mammal carcasses were on average 17.79 percent lower in the fenced road sections and wildlife crashes were 50.62 percent lower on average. Wildlife-vehicle collisions (average of the carcass and crash data) were reduced by 33.52 percent. While the fences did result in a reduction of wildlife-vehicle collisions, their effectiveness was relatively low compared to other studies that showed a 79-97 percent reduction (Reed et al. 1982, Ward 1982, Woods 1990, Clevenger et al. 2001, Dodd et al. 2007b as cited in Huijser et al. 2016a).

There was a higher-than-expected concentration of large wild mammal carcasses at fence ends and within the first 0.1-mile past fence ends. Based on literature cited in the study, mitigated road sections that were at least about 3.1-miles (5 km) long were almost always at least 80 percent effective in reducing collisions with large mammals. Despite their effectiveness, implementing wildlife fences can be challenging due to the need to provide gates or wildlife barriers at access points. They are typically 8 feet high, affecting aesthetics. As mentioned above they can also create a barrier for waterfowl (Huijser et al. 2016a).

Fences modified with barriers for turtles would be beneficial at the identified turtle mortality “hot spots.” Barrier fences would be beneficial in conjunction with turtle passage structures to help direct turtles to the structures since they naturally avoid areas with low light. The integration of an appropriate barrier design into a turtle passage structure is essential to ensure turtles are guided into the passage structure and prevented from accessing the road (Sievert and Yorks 2015).

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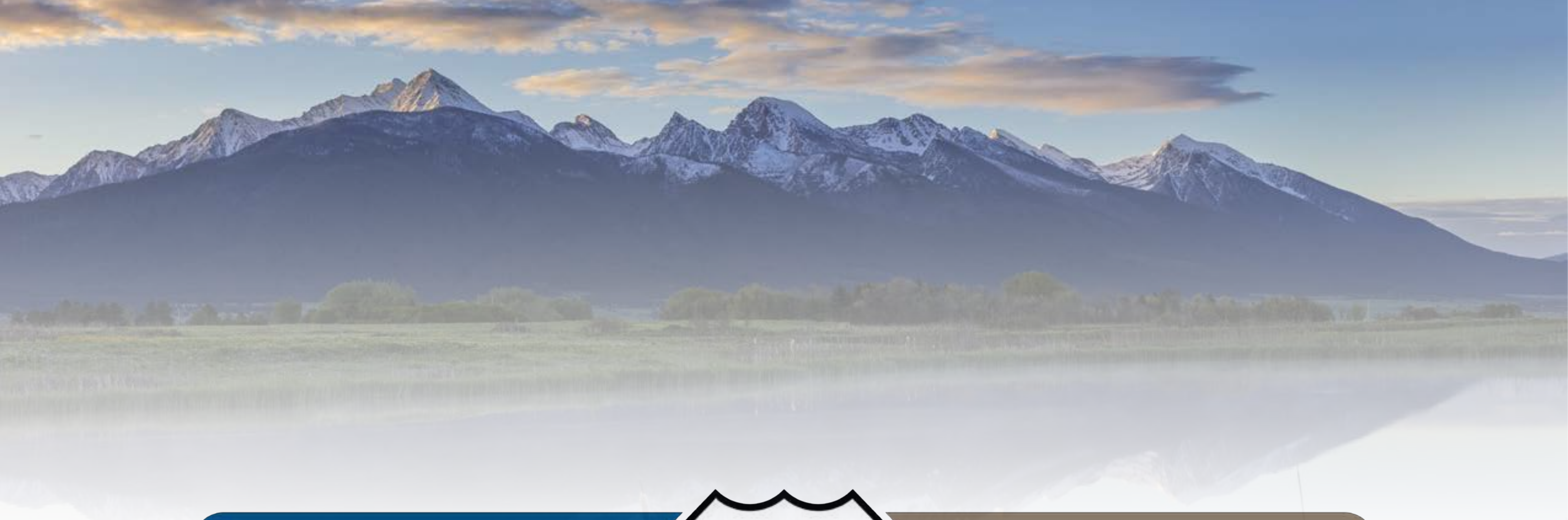

NINEPIPE CORRIDOR 93 FEASIBILITY STUDY

APPENDIX E:

Preliminary Geotechnical Analysis Technical Memorandum

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Memorandum

To: Scott Randall, PE, PTOE
Robert Peccia & Associates, Inc

From: Brett Warren, PE
Cory Rice, PE

Re: Preliminary Geotechnical Analysis
Geotechnical Feasibility Study
Ninepipe Section US-93
Lake County, Montana
SK Geotechnical Project 21-4041S

Date: January 4, 2022

The purpose of this Preliminary Geotechnical Analysis Memorandum is to provide a brief summary of the field work and analysis completed to date for the above-referenced study. We look forward to meeting with Montana Department of Transportation (MDT) and members of the study team to discuss the results of our preliminary analysis.

Study Background

The MDT Planning Division and Missoula District have identified a need for a feasibility study on US-93 from RP 40.3 to 44.2, referred to as the Ninepipe section. This study will analyze the overall feasibility of the preferred alternative selected in the SEIS, completed in 2008. The SEIS noted seven bridges and eight large-diameter wildlife crossing structures are required along this portion of the alignment. These structures will be grouped into four distinct locations. The SEIS also indicates a pedestrian underpass structure may be placed to minimize wetland and right-of-way impacts. At this time, the pedestrian path alignment and location of any underpass is still being evaluated.

Previous work at the Post Creek Hill segment, just south of this study, encountered artesian groundwater conditions along with several soil-related issues. These artesian conditions created difficulties during the fieldwork and also created design challenges when balancing the needs of a long wildlife crossing (as required in the SEIS), and the difficulty and expense of designing and constructing a multi-span structure which achieves acceptable performance under the seismic design event. The geotechnical design challenges at Post Creek and requirements included in the SEIS at the Ninepipe section have created the need to evaluate the feasibility of the proposed structures.

Cone Penetrometer Testing and Results

To evaluate subsurface conditions, cone penetrometer testing (CPT) was performed to evaluate the general strength and compressibility of the soils as well as to measure potential artesian groundwater conditions. The CPT soundings were performed in lieu of more standard hollow-stem auger (HSA) for the feasibility phase of the study because CPT soundings can be performed to greater depths and performed more quickly than HSA borings. Additionally, the hole left by the CPT rod can be plugged more easily than an HSA hole, should artesian conditions be encountered.

A total of 14 CPT tests were performed along the alignment and are shown on the attached CPT location sketch. Two vibrating wire piezometers were installed to measure potential artesian groundwater pressure. CPT soundings CPT-1 through CPT-8 were performed at the four primary structure locations in pairs of two. CPT soundings CPT-9 through CPT-12 were performed at possible underpass locations or other areas of interest, and CPT-13 and CPT-14 were performed at the piezometer installation locations. Summary sheets for each of the 14 CPT soundings are attached to this memo.

In general, the CPT soundings encountered similar soils which consisted primarily of relatively soft clays, silts, sands. Dense bearing layers were encountered in seven of the eight structure-related soundings at depths ranging from 50 to 80 feet, with the depth increasing as the project extends north towards Crow Creek. In sounding CPT-8, a dense bearing stratum was not encountered to the termination depth of 160 feet. The groundwater surface was calculated to be between 10 and 15 feet below the ground surface in the CPT soundings. The two piezometers installed to monitor long-term conditions also show groundwater levels below the ground surface, and evidence of artesian conditions were not observed.

Preliminary Analysis

Using the CPT soil data, preliminary analyses were performed, including liquefaction potential, pile capacity, and embankment settlement. These calculations were performed using general assumptions about the project using experience and engineering judgement. If a project is nominated as a result of this study, these assumptions can be updated and the alculations refined. The results of the calculations are summarized in Table 1, attached to this memo.

Liquefaction. Preliminary liquefaction analysis was performed using the software package LiqIT v.4.7.7.5 as well as the “Simplified Performance-based Liquefication Analysis Tool SPLiq”, and the results are attached to this memo. The analysis shows minor liquefaction can be expected at all locations, with liquefaction settlement ranging from less than 1/4 inch to about 3 inches. Lateral spread ranging from less than 1 inch to over 15 inches was calculated. Based on these results liquefaction mitigation should be anticipated for the 660-foot long Ninepipe bridge and the two bridges at the Crow Creek Area. Mitigation may also be needed at the kettle pond structures to reduce slope instability. Slope stability analysis will also be performed after preliminary cross-sections can be provided. It is anticipated the culverts at the two kettle ponds will be able to tolerate the anticipated level of liquefaction settlement and lateral spread.

Preliminary Foundation Recommendations. Preliminary pile capacity calculations were performed at the four primary structure locations using the wave equation software package GRLWEAP™, and the results are attached to this memo. Based on the results of the CPT soundings and analysis driven pipe pile are the likely preferred foundation alternative. Drilled shafts can also be considered during project design, but for the feasibility analysis 16-inch closed ended pipe pile can be used at the bridge end bents, and 24-inch closed-ended pipe pile can be used at the intermediate bents.

The nominal pile capacities and the resulting estimated pile lengths are shown in Table 1. Calculations show that a 16-inch pile can achieve 400- to 500-kip nominal capacities at depths ranging from about 60 to 80 feet. The Crow Creek bridges are the exception where a 16-inch pile would need to be extended to 90 to 100 feet. Calculations also show the 24-inch pile can achieve nominal capacities between 500 to 650 kips at depths ranging from 65 to 95 feet.

It should be anticipated that 2 to 3 feet of subexcavation and foundation material will be required for the large culverts located at the two kettle pond locations. Subexcavation and foundation material will also be required for other culverts along the project, including the potential pedestrian underpass.

Embankment Settlement. Settlement of the bridge approach embankment was analyzed using Settle3 from RocScience, and a portion of the results are attached to this memo. Because the design and layout of the roadways has not yet begun, it was assumed the approach embankments at the Ninepipe and Crow Creek bridges will be about 10 feet above existing roadway grade. The need for grade raises at the two kettle ponds will be minimal and the settlement analysis was performed assuming a 2-foot grade raise. Any potential grade raises at the pedestrian underpass can be analyzed after the location and grade have been determined.

The calculations show between 3 to 7 inches of total settlement can be expected at the Ninepipe and Crow Creek bridge, and about 1 to 2 inches of settlement can be expected at the kettle pond locations. It will likely be necessary to surcharge the embankments at the Ninepipe and Crow Creek locations, and calculations indicate the surcharge will need to remain in place for about 3 to 9 months. The settlement and surcharge calculations will need to be further evaluated as design proceeds.

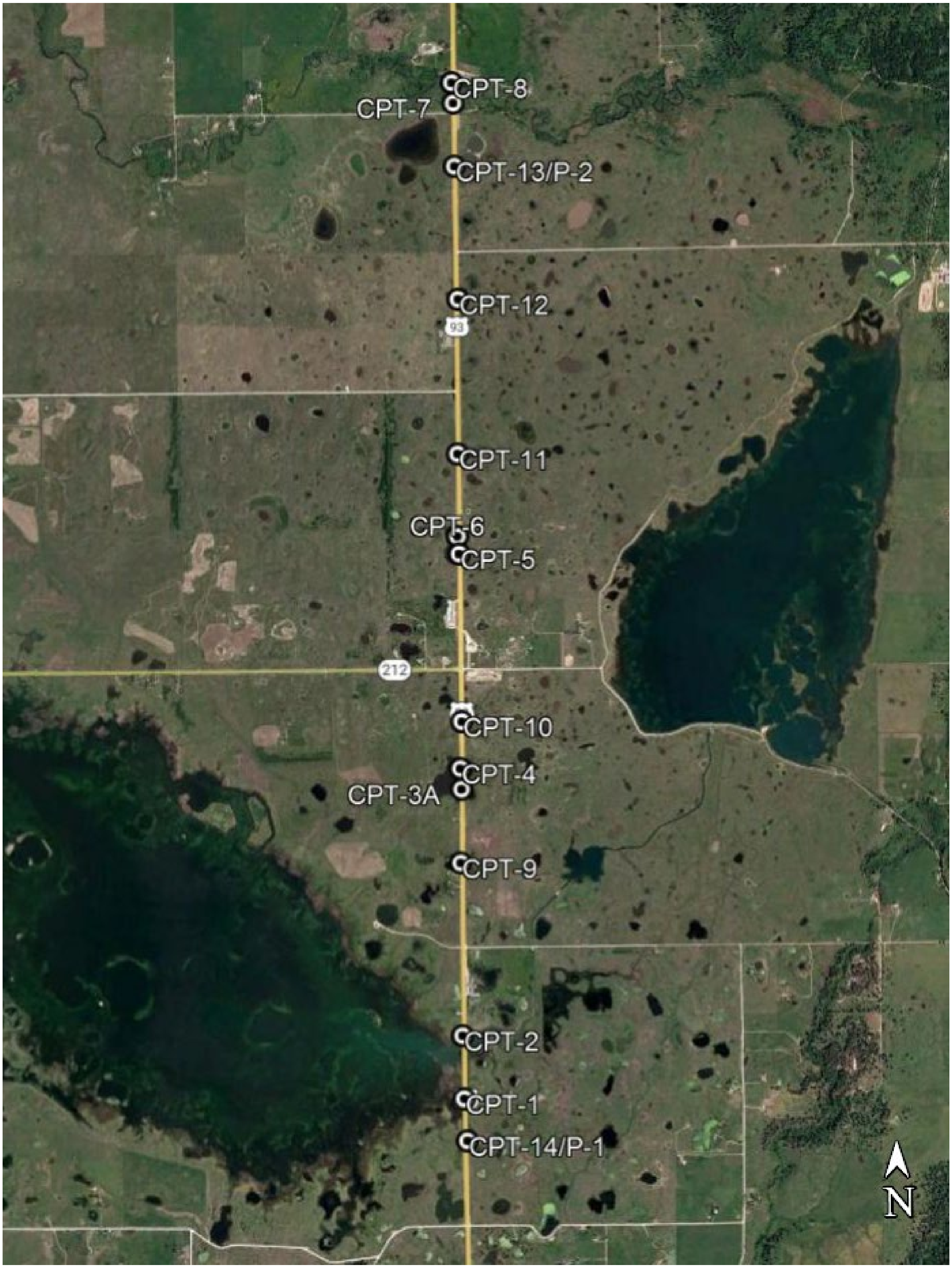
Attachments:
Summary of Preliminary Analysis Table
CPT Overview Sketch
CPT Location Sketch
CPT Summary Pages (14)
Liquefaction Analysis (16)
GRLWEAP Analysis (16)
Embankment Settlement Analysis (4)

Table 1. Summary of Preliminary Geotechnical Analysis and Recommendations

<table>
<tr><th>Structure Location</th><th>Structure Types[a.]</th><th>Assumed Raise in Grade (feet)</th><th>Liquefaction Mitigation Required</th><th>Recommended Foundation Type</th><th>Estimated Length (feet)</th><th>Maximum Estimated Approach Embankment Settlement (inches)</th><th>Surcharge Required</th><th>Estimated Waiting Period (months)</th></tr>
<tr><td rowspan="2">Ninepipe Reservoir</td><td rowspan="2">One 660-foot Four-Span Bridge</td><td rowspan="2">10</td><td rowspan="2">Likely</td><td>Bridge Ends, 500-kip nominal, 16”x0.50” Pipe</td><td>70 -80</td><td rowspan="2">3</td><td rowspan="2">Yes</td><td rowspan="2">3-6</td></tr>
<tr><td>Intermediate Bents, 650-kip nominal, 24”x0.50” Pipe[a]</td><td>70 -80</td></tr>
<tr><td rowspan="2">Kettle Pond 1</td><td>Two 60-foot Single-Span Bridges</td><td><2</td><td>Possible</td><td>Bridge Ends, 500-kip nominal, 16” x 0.50” Pipe</td><td>60 -70</td><td rowspan="2">1</td><td>No</td><td rowspan="2">n/a</td></tr>
<tr><td>Two 4’ x 6’ Culverts</td><td><2</td><td>No</td><td>2 Feet of Foundation Material</td><td>N/A</td><td>No</td></tr>
<tr><td rowspan="2">Kettle Pond 2</td><td>Two 60-foot Single-Span Bridges</td><td><2</td><td>Possible</td><td>Bridge Ends, 400-kip nominal, 16” x 0.50” Pipe</td><td>65 - 75</td><td rowspan="2">2</td><td>No</td><td rowspan="2">n/a</td></tr>
<tr><td>Two 4’ x 6’ Culverts</td><td><2</td><td>No</td><td>3 Feet of Foundation Material</td><td>N/A</td><td>No</td></tr>
<tr><td>Crow Creek</td><td>One 120-Foot Single Span Bridge and One 150-foot Single Span Bridge</td><td>10</td><td>Likely</td><td>Bridge Ends, 500-kip nominal, 16”x0.50” Pipe</td><td>90 -100</td><td>7</td><td>Yes</td><td>6-9</td></tr>
</table>

a. Structure types listed in this table are the preferred alternatives listed in the 2008 Final SEIS.

b. Large diameter pile or drilled shafts may be needed to resist lateral spread if liquefaction is not mitigated at intermediate bent locations.



SK GEOTECHNICAL	**CPT OVERVIEW SKETCH** **Geotechnical Feasibility Study** **Ninepipe Section, US-93** **South of Ronan, Montana**	Drawn by: SK Geo/Google	Date 11/23/21	
		Project: 21-4041S		
		Scale: n/a		FIGURE
		Sheet 1 of 2		1

Nine Pipe Reservoir

Kettle Pond 1

Kettle Pond 2

Crow Creek Area

SK GEOTECHNICAL

CPT LOCATION SKETCH
Geotechnical Feasibility Study
Ninepipe Section, US-93
South of Ronan, Montana

Drawn by:	SK Geo/Google	Date	11/23/21
Project:	21-4041S		
Scale:	n/a		FIGURE
Sheet	2 of 2		1

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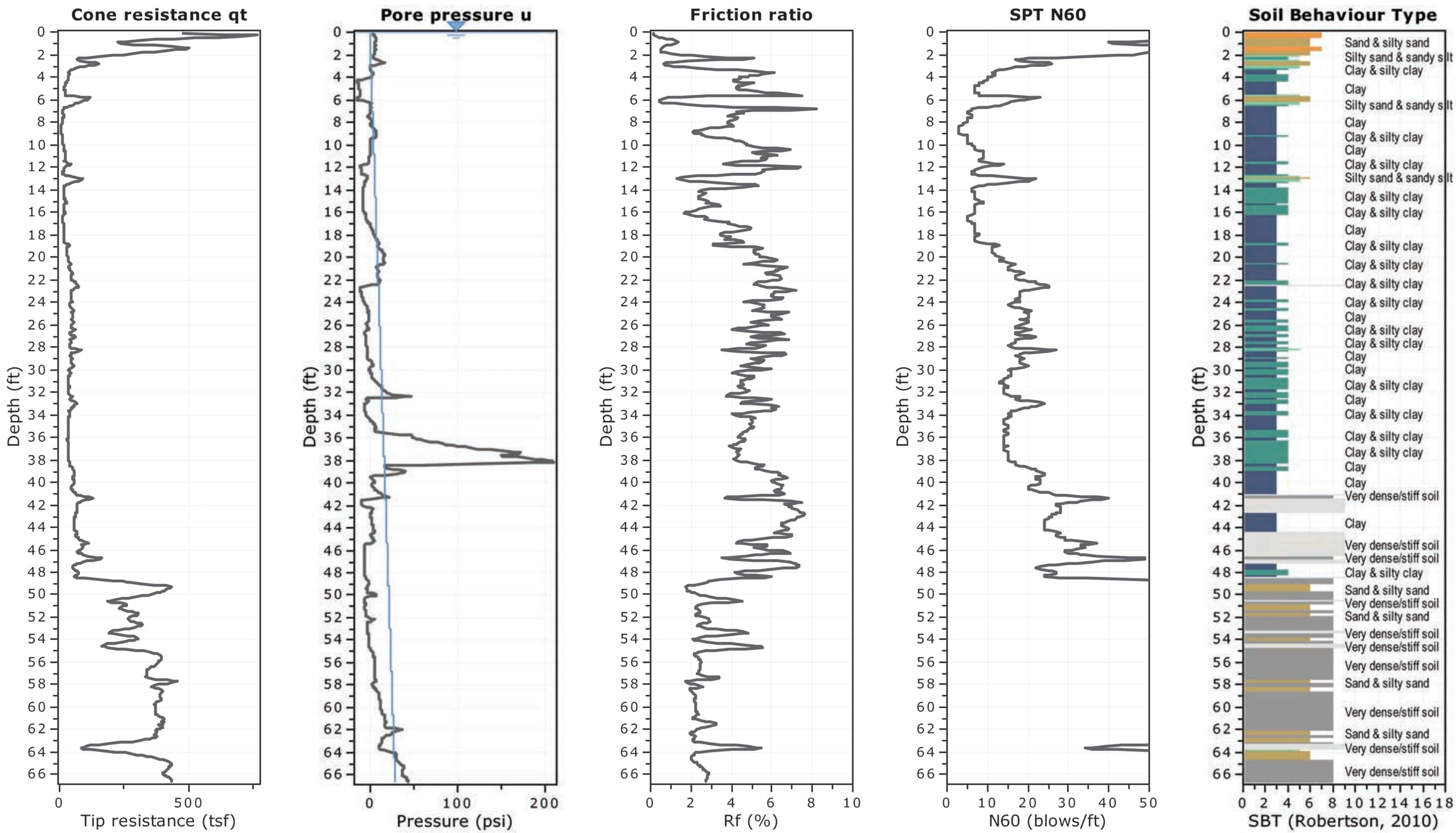
CPT: CPT-1
Total depth: 66.60 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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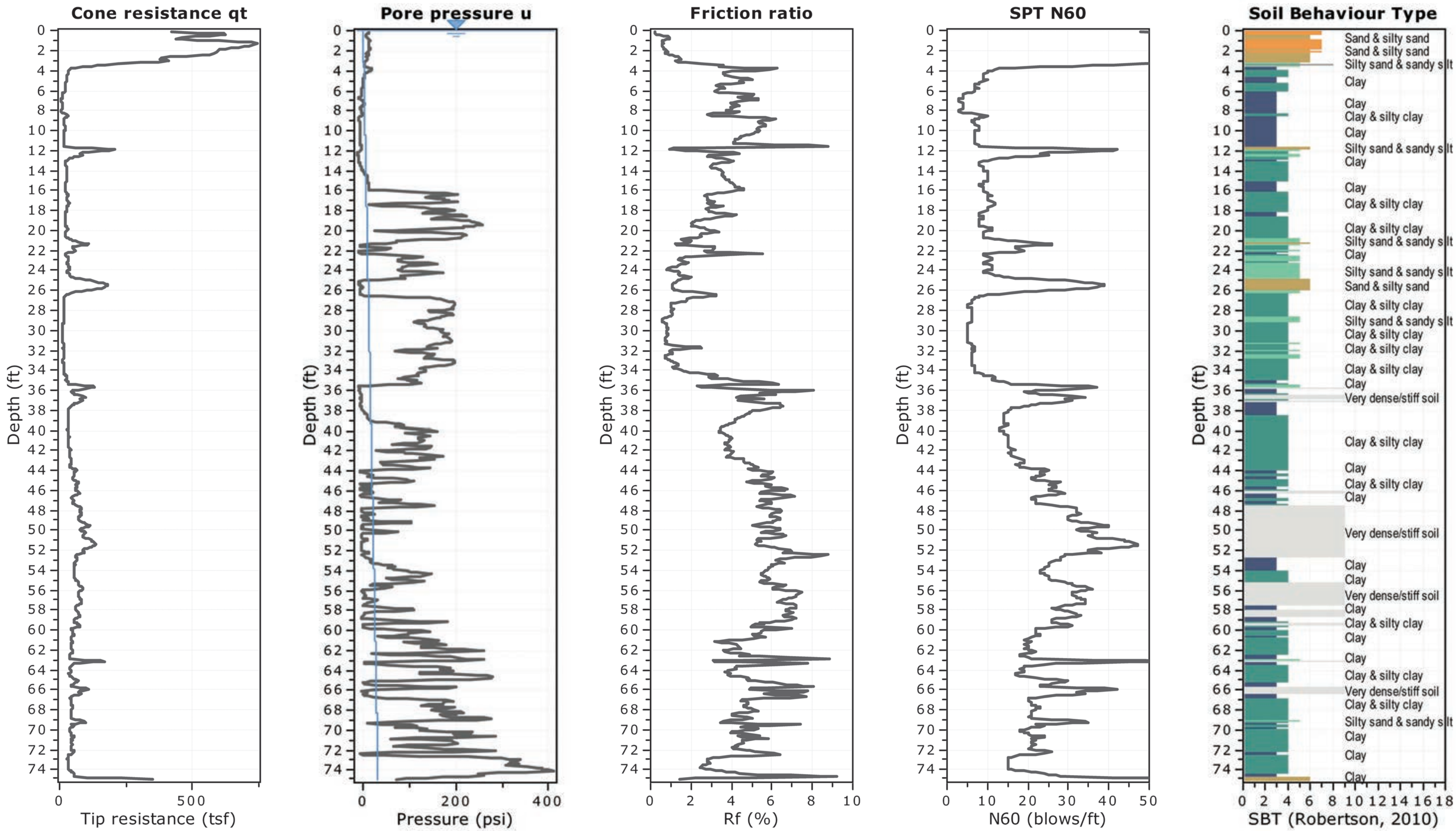
CPT: CPT-2

Total depth: 74.97 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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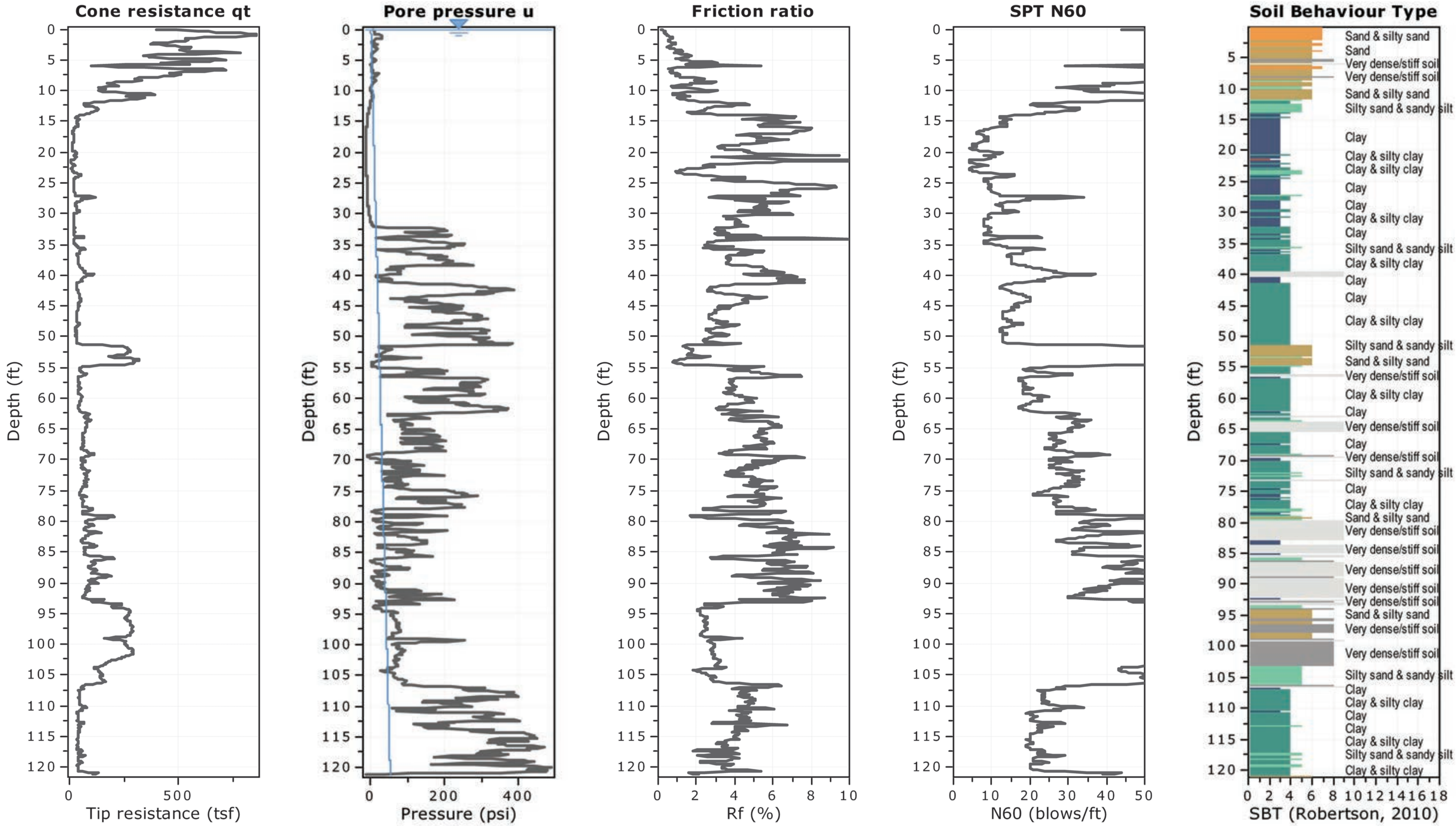
CPT: CPT-3A
Total depth: 121.14 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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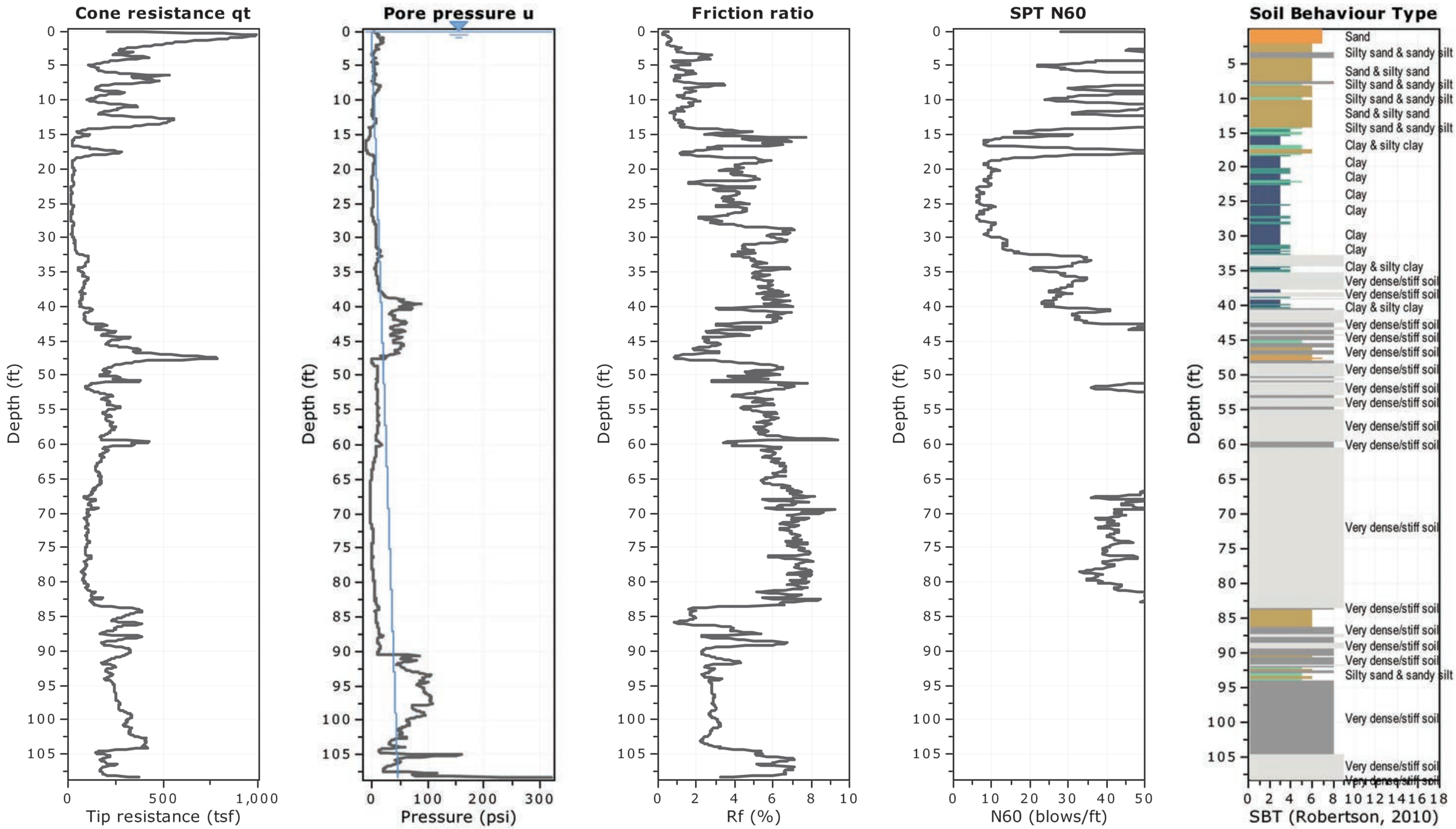
CPT: CPT4
Total depth: 108.35 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



CPT: CPT-5

Total depth: 160.51 ft, Date: 11/9/2021
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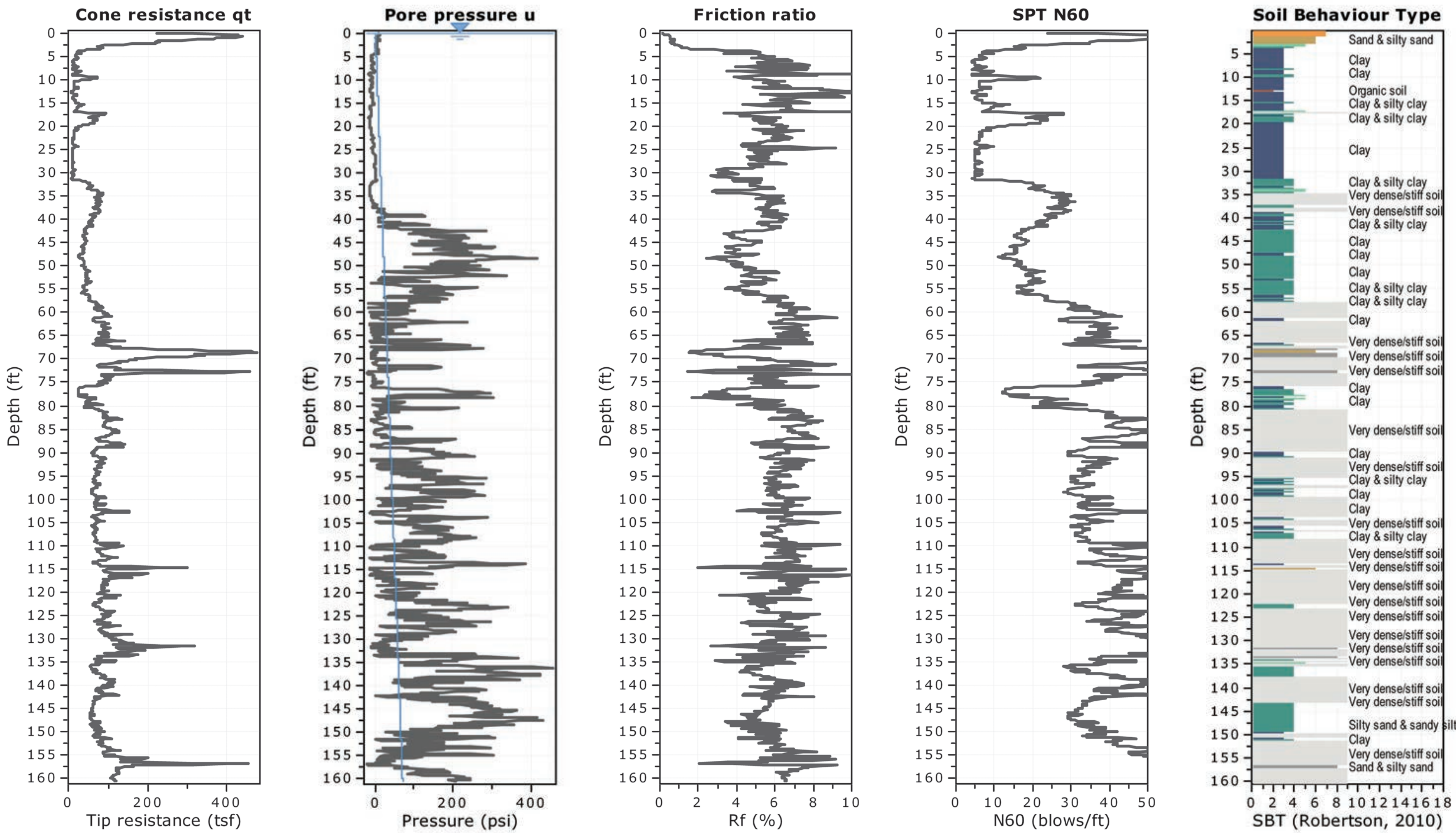
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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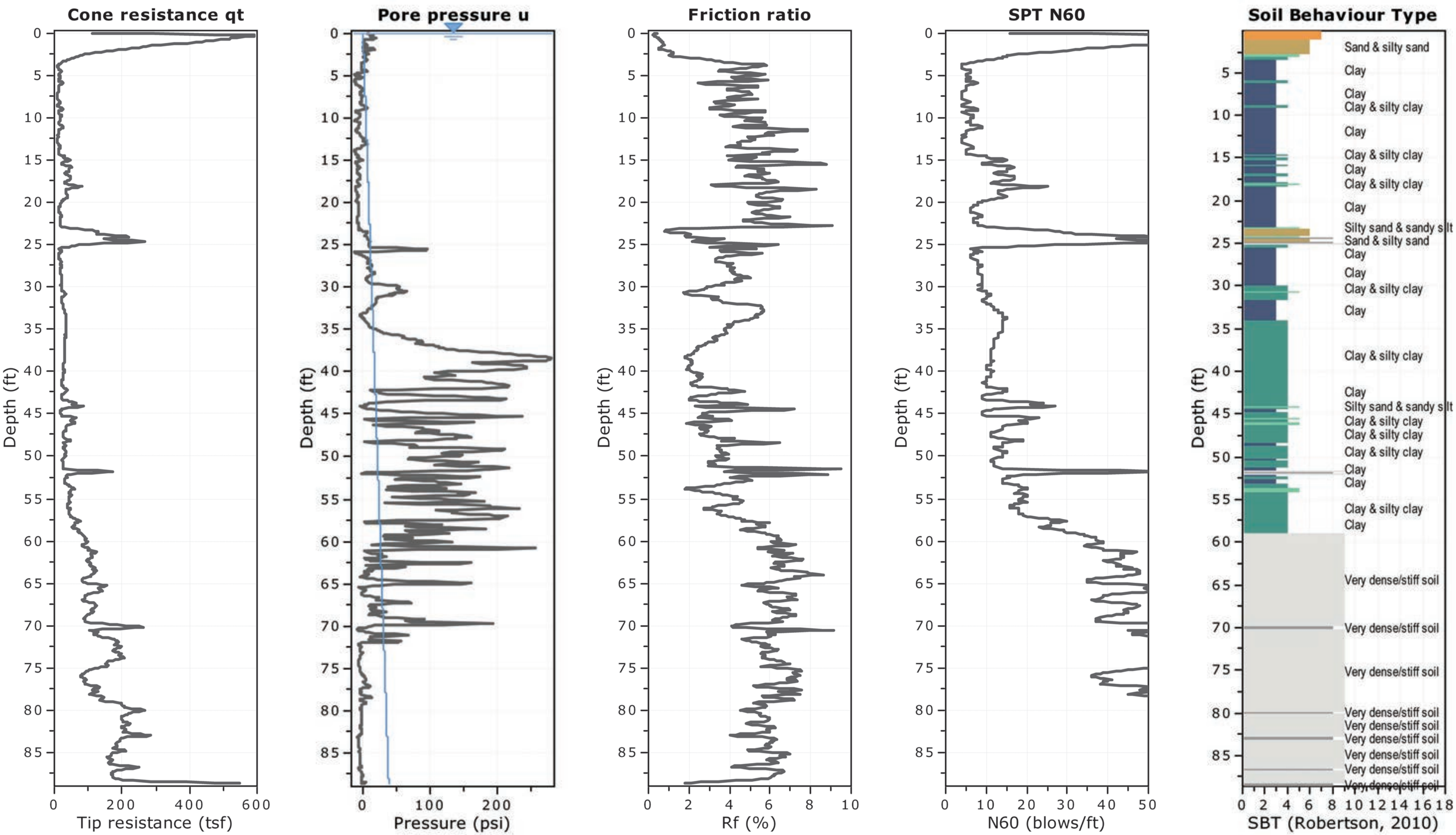
CPT: CPT-6
Total depth: 88.58 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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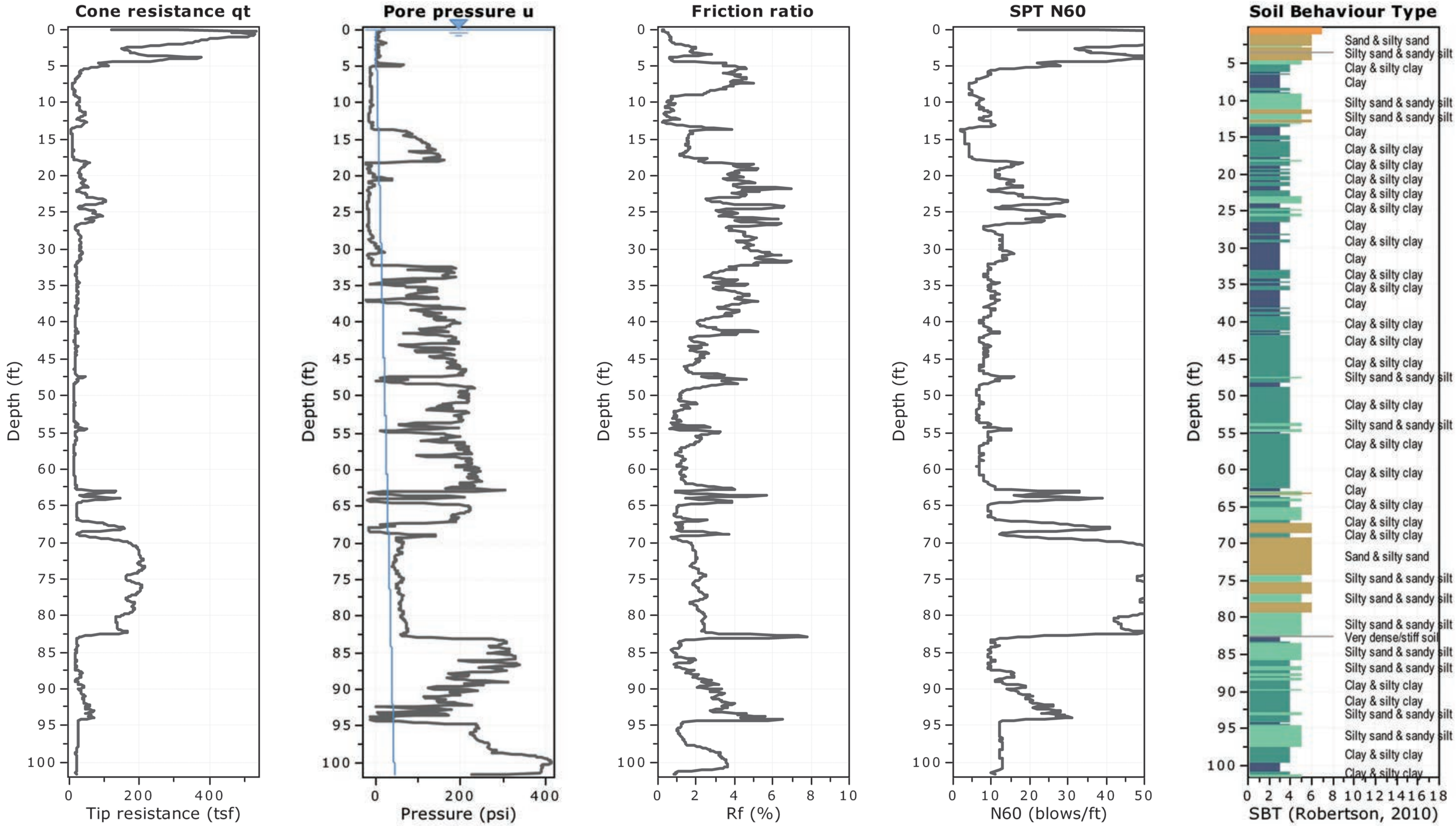
CPT: CPT-7
Total depth: 101.62 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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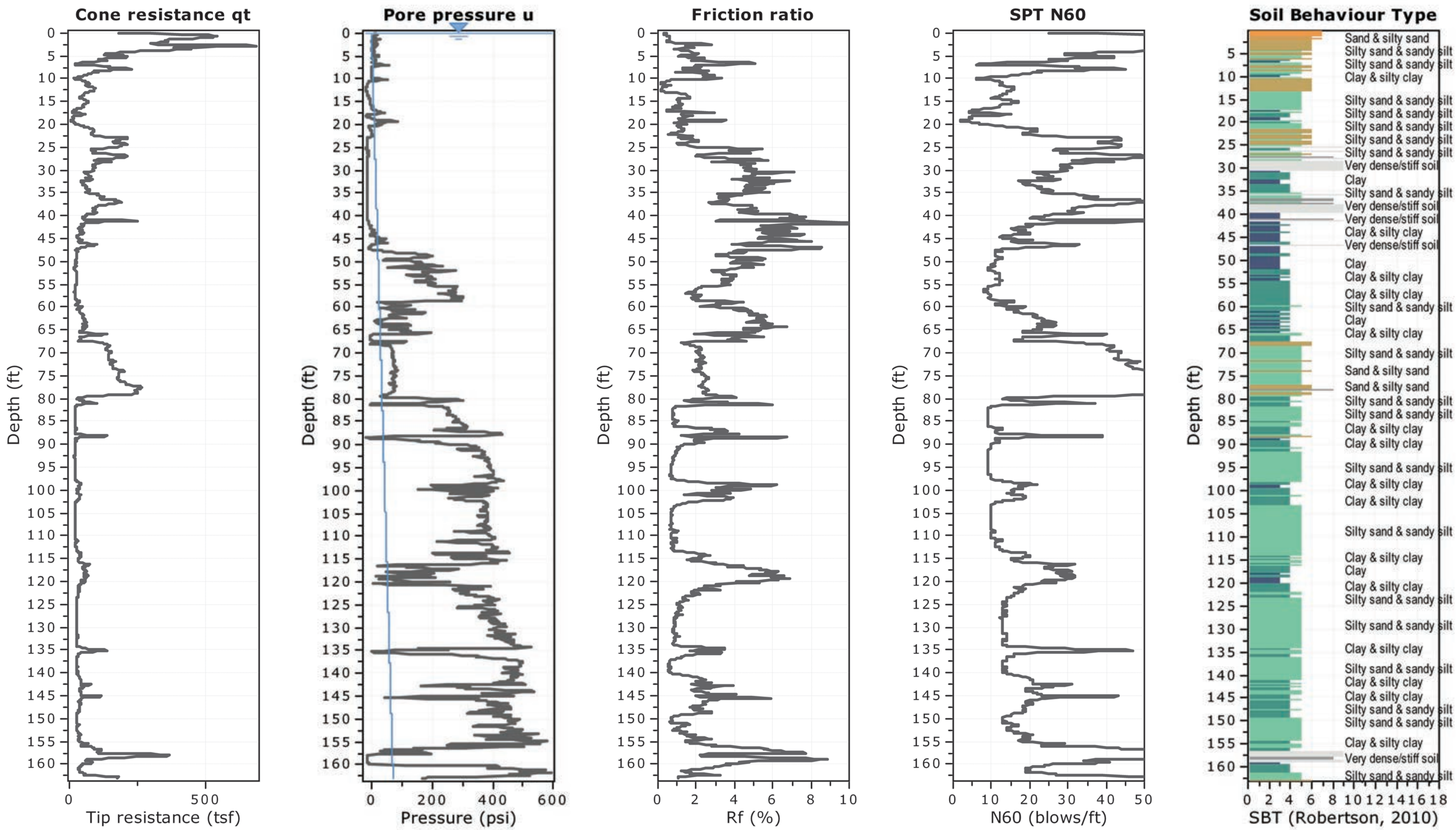
CPT: CPT-8
Total depth: 163.06 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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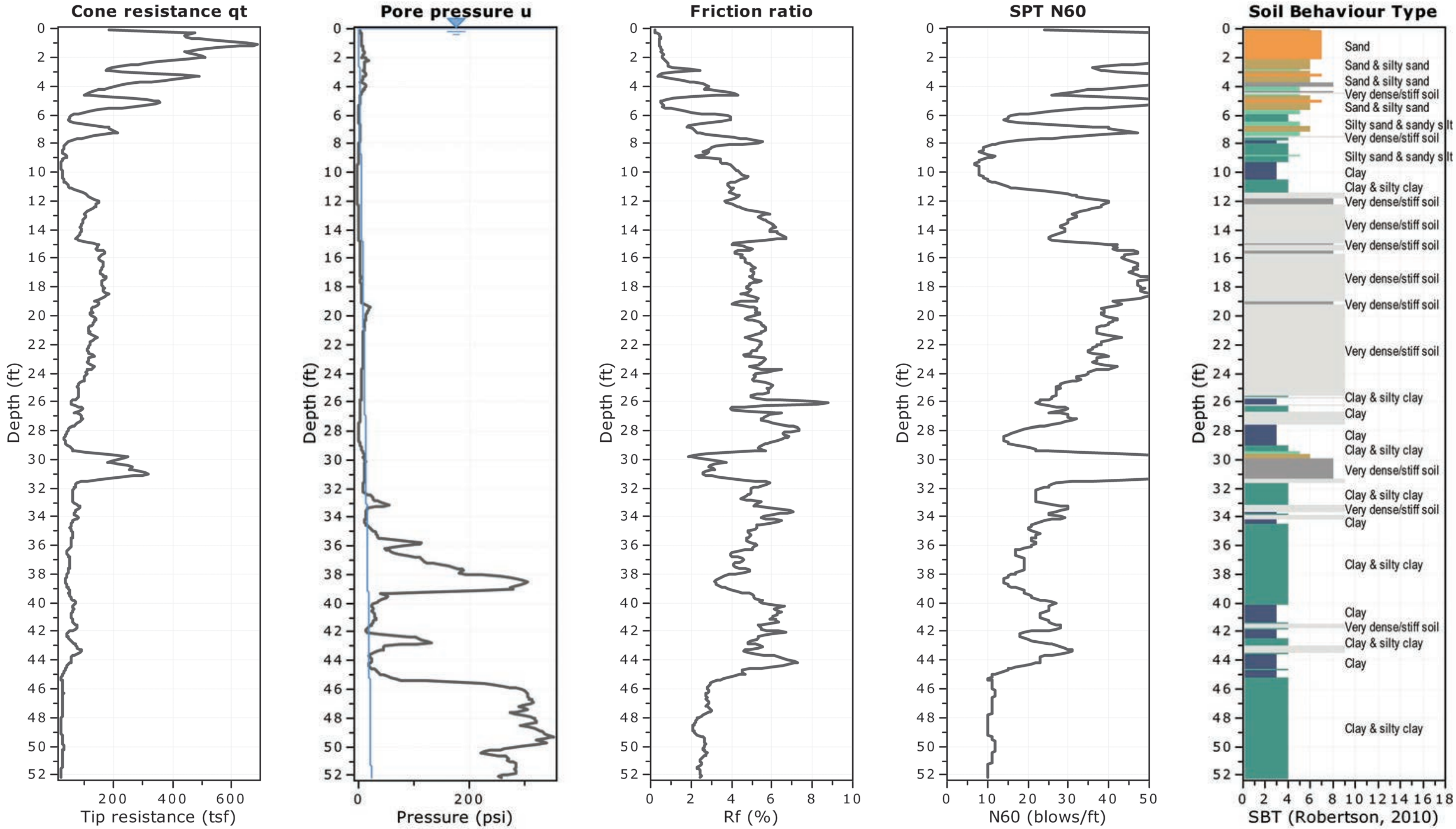
CPT: CPT-9

Total depth: 52.17 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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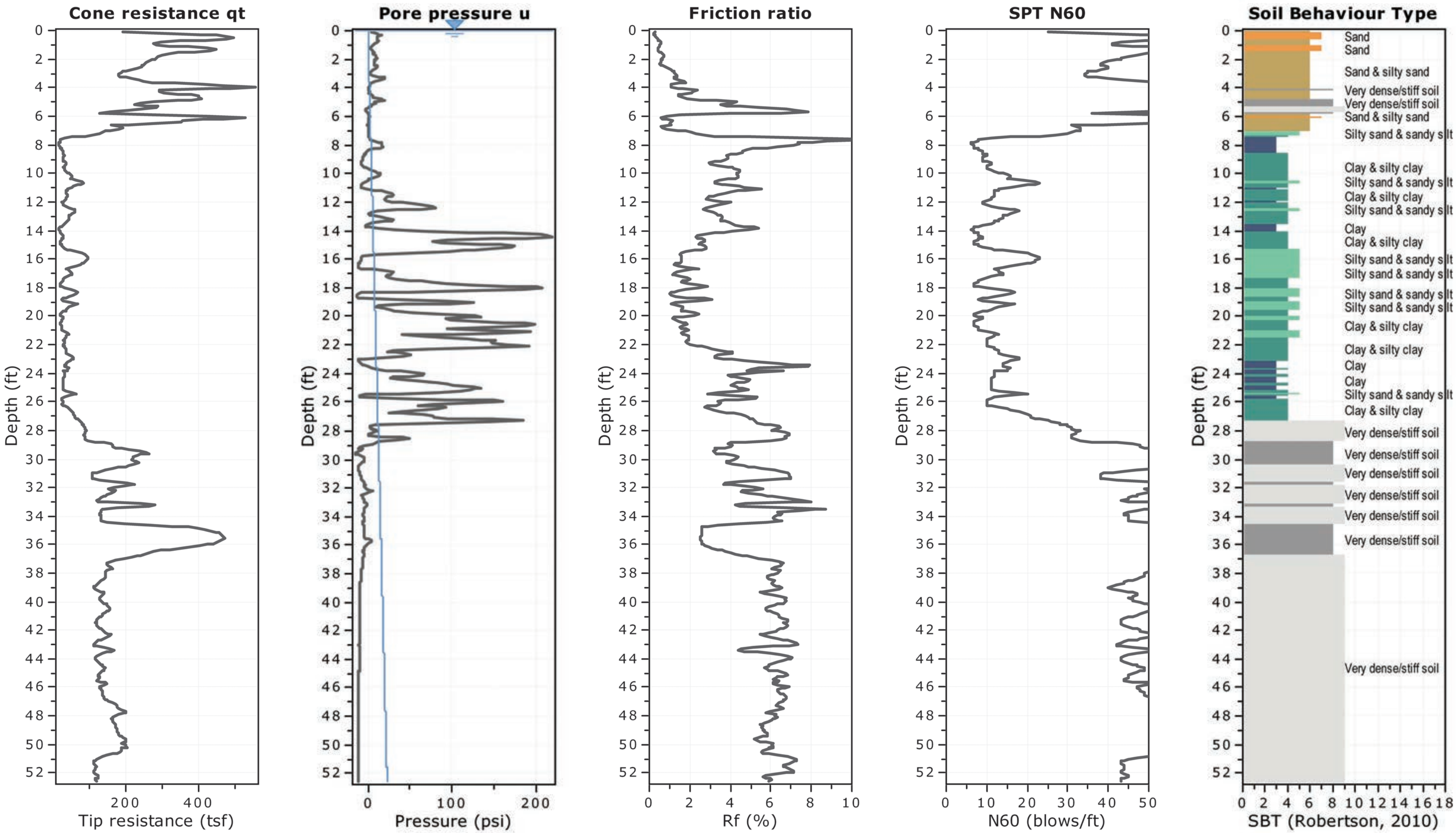
CPT: CPT-10
Total depth: 52.58 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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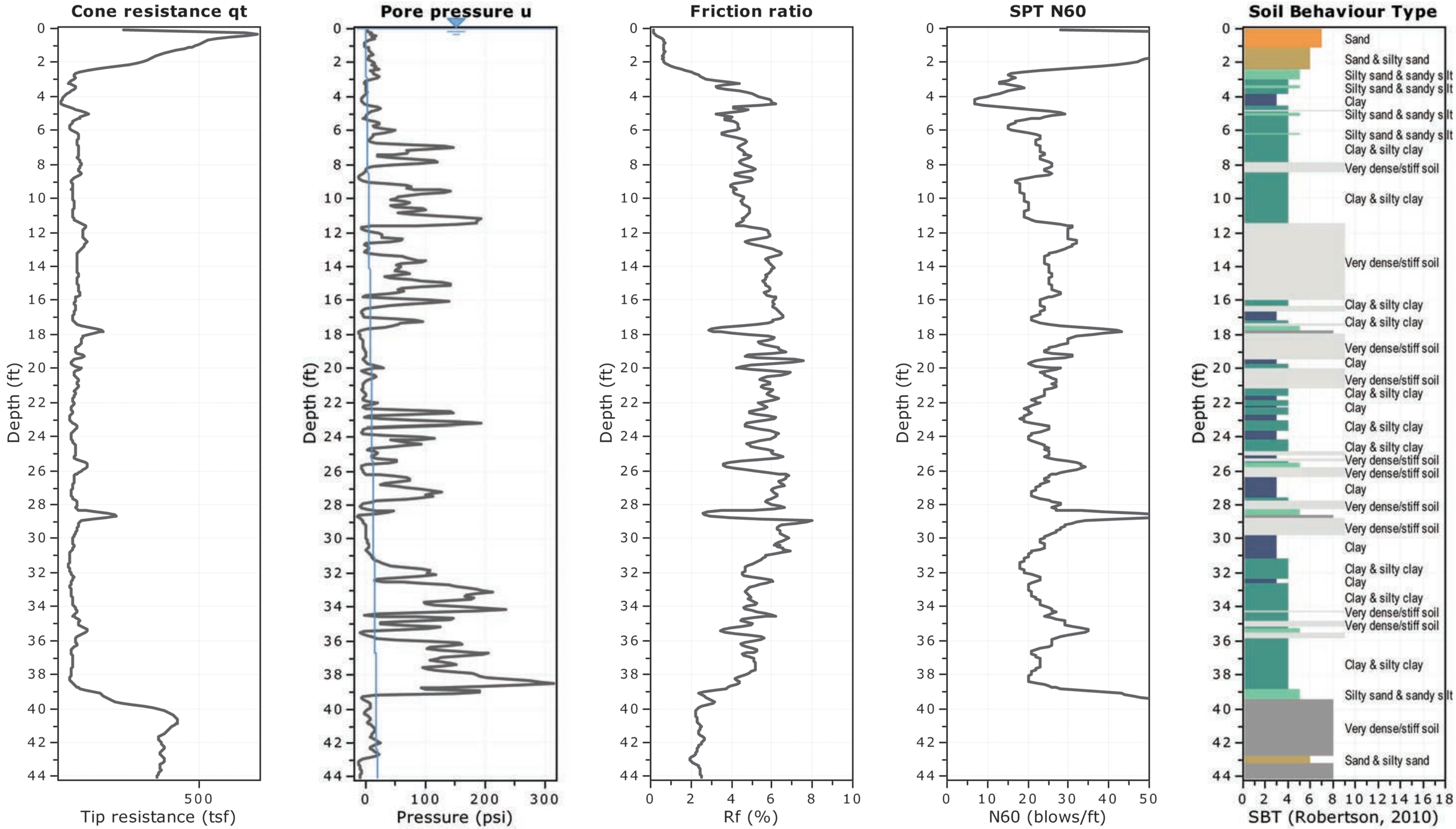
CPT: CPT-11
Total depth: 44.05 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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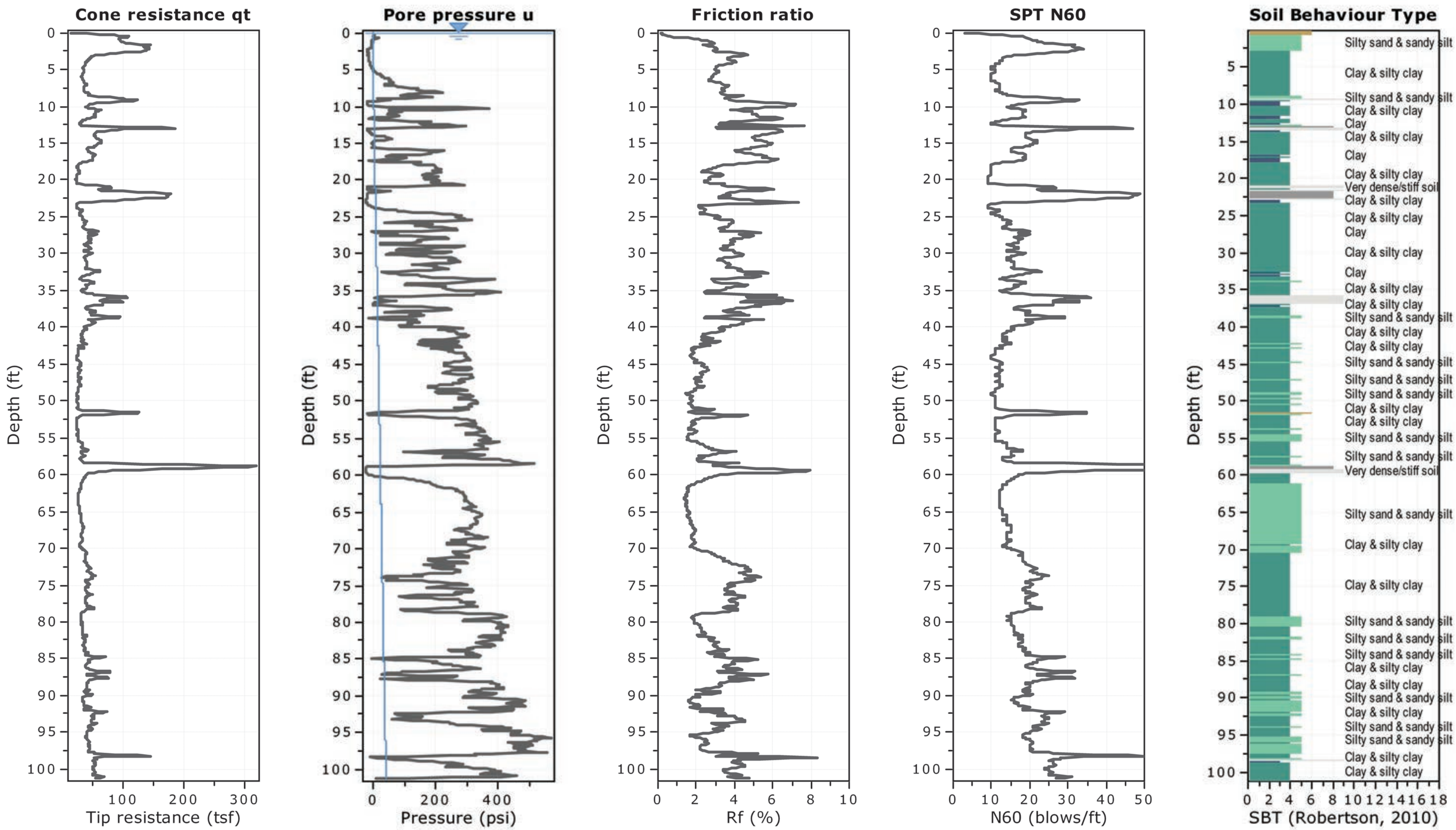
CPT: CPT-12
Total depth: 101.21 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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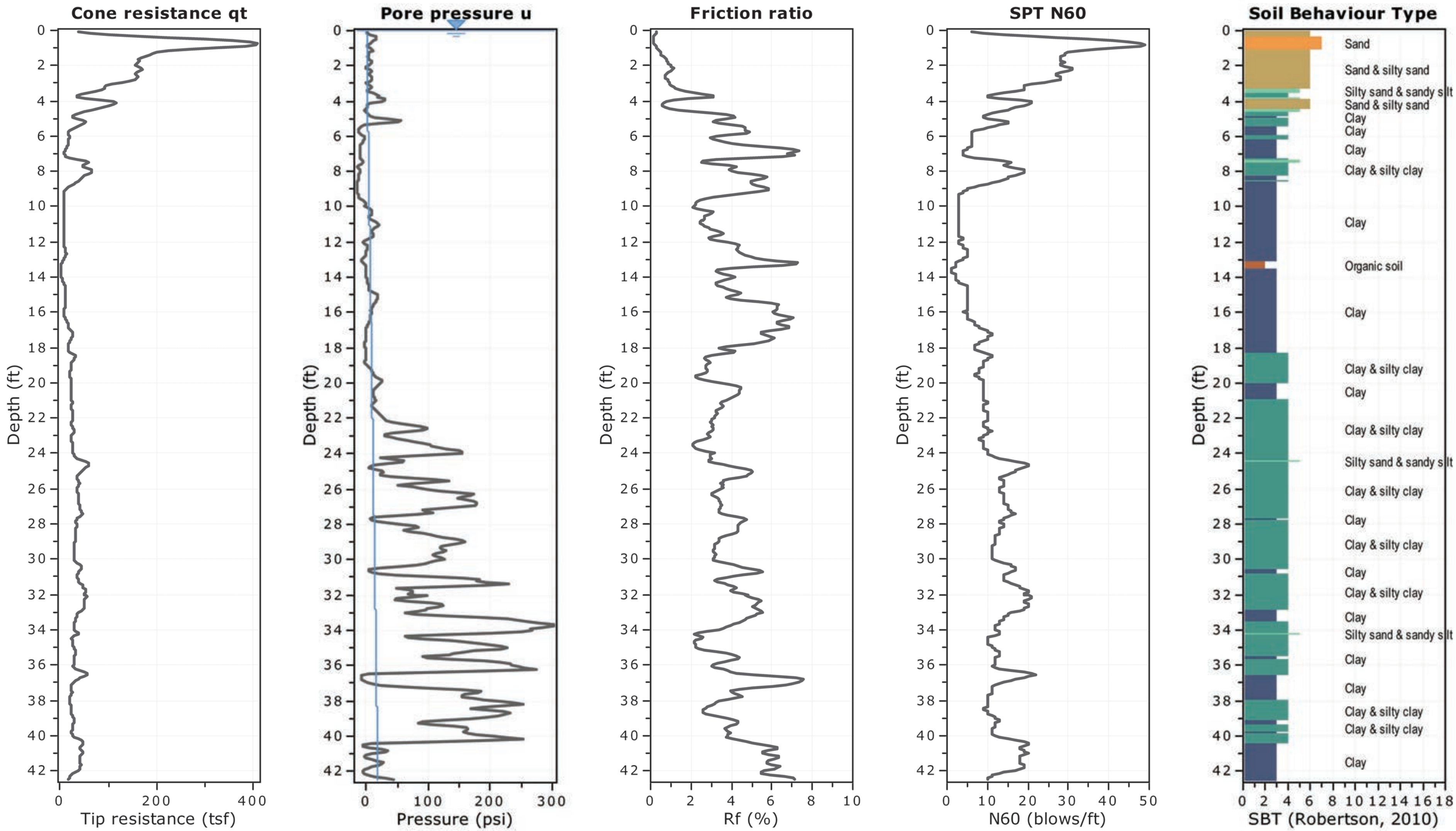
CPT: CPT-13
Total depth: 42.49 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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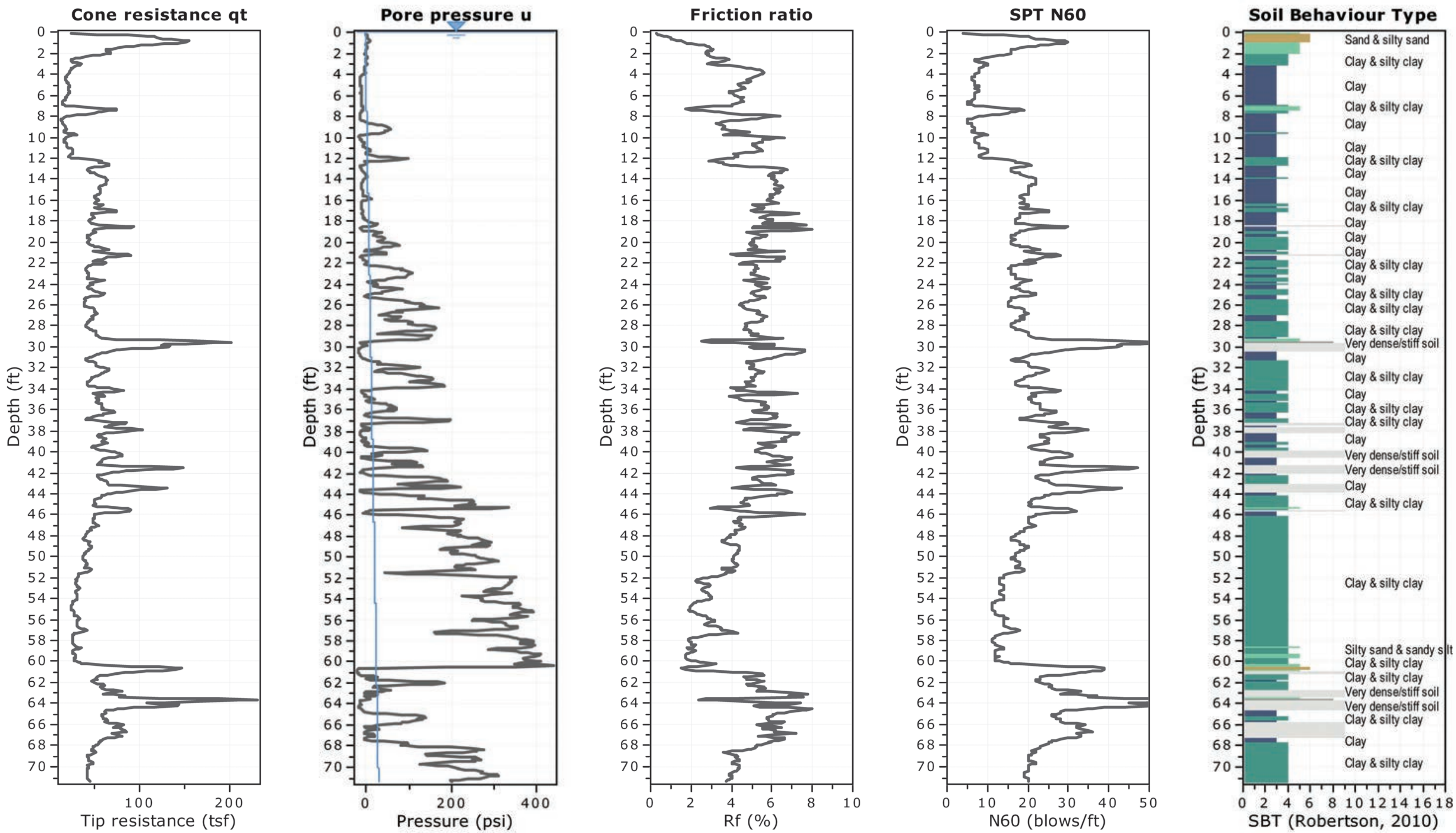
CPT: CPT-14
Total depth: 71.44 ft, Date: 11/9/2021
Surface Elevation: 0.00 ft
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



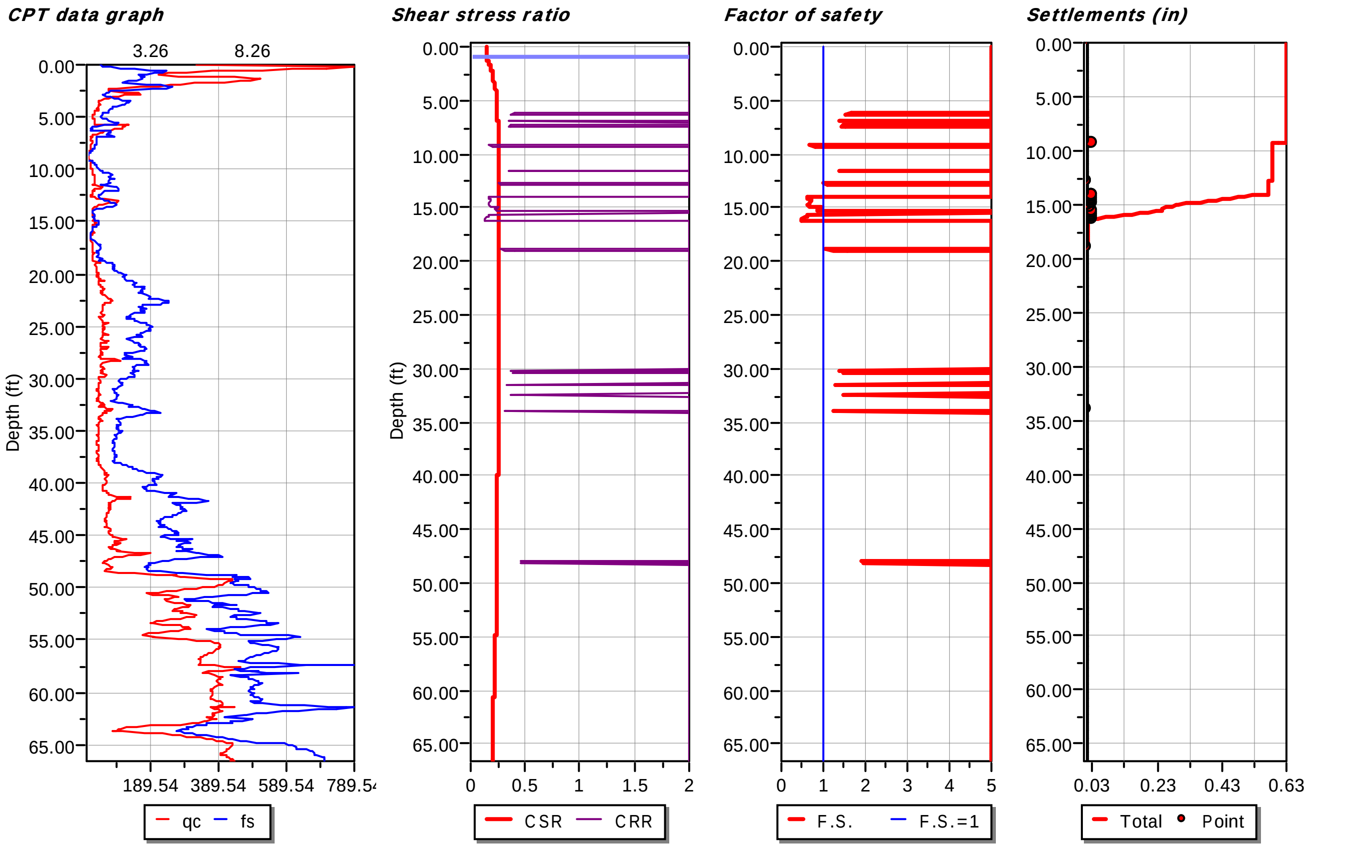
LIQUEFACTION ANALYSIS REPORT

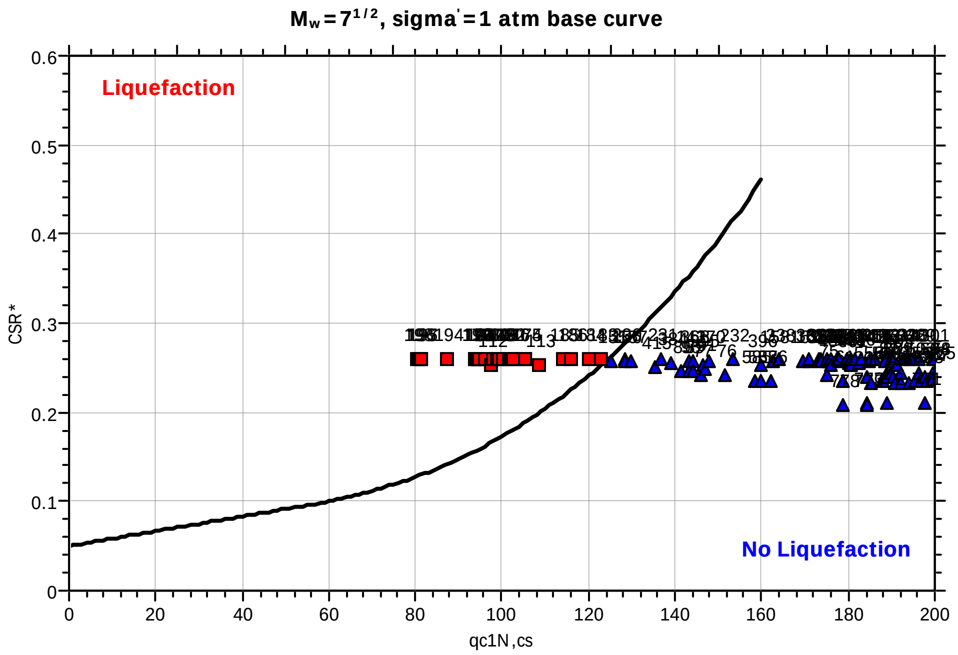
Project title : Ninepipes Feasibility

Project subtitle : CPT-1

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	6.49
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.31 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





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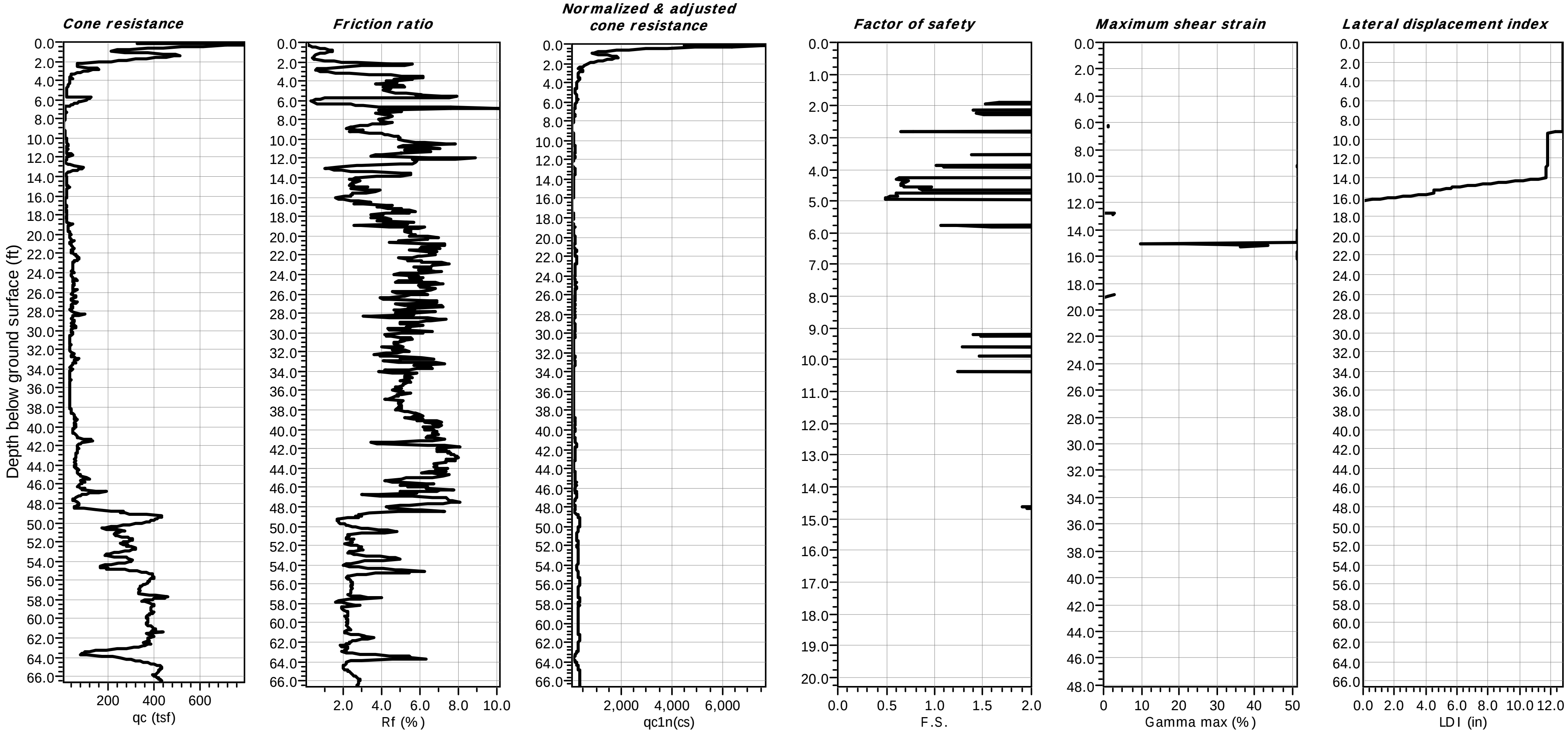
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1]

Geometric parameters: Level ground (or gently sloping) with free face
Total lateral displacement estimation: 5.05 in



q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

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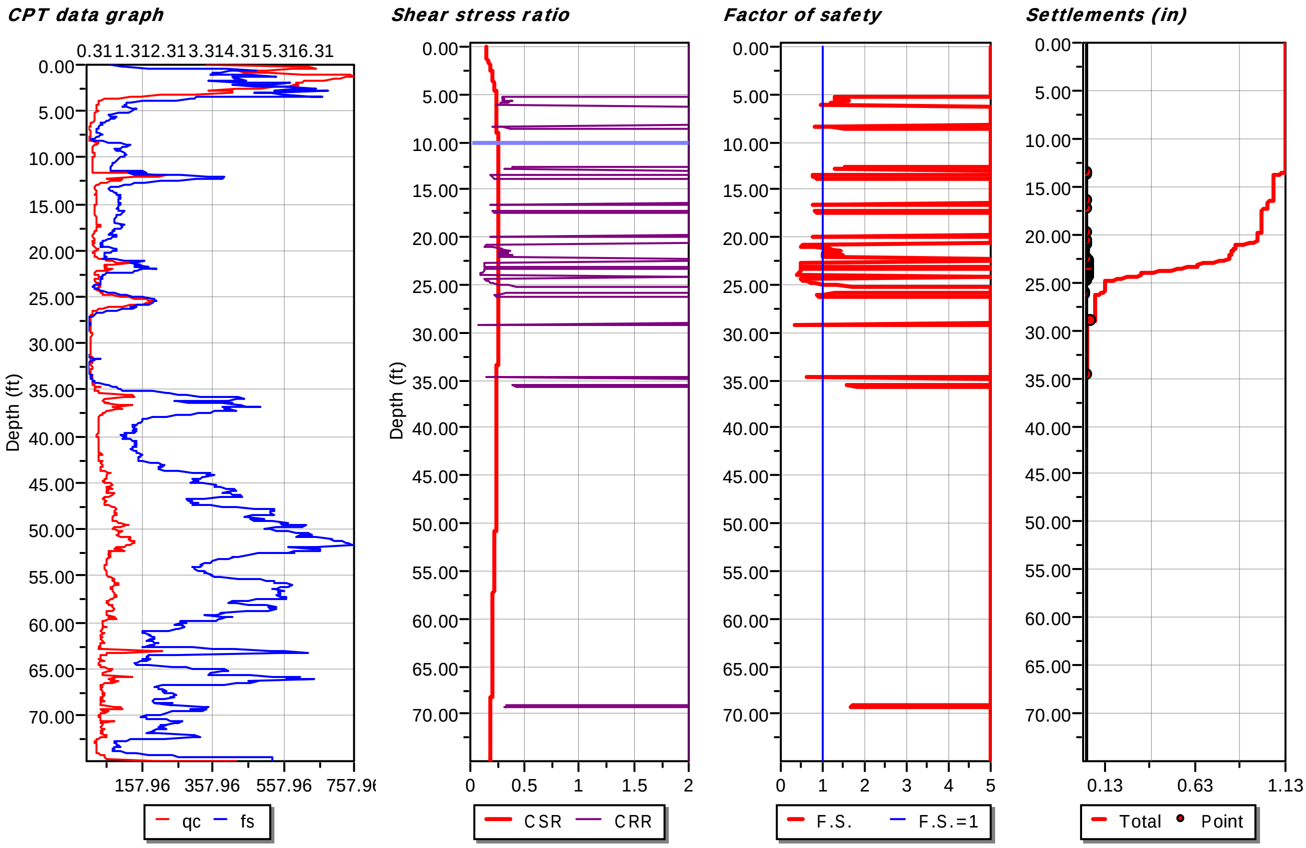
LIQUEFACTION ANALYSIS REPORT

Project title : Ninepipes Feasibility Study

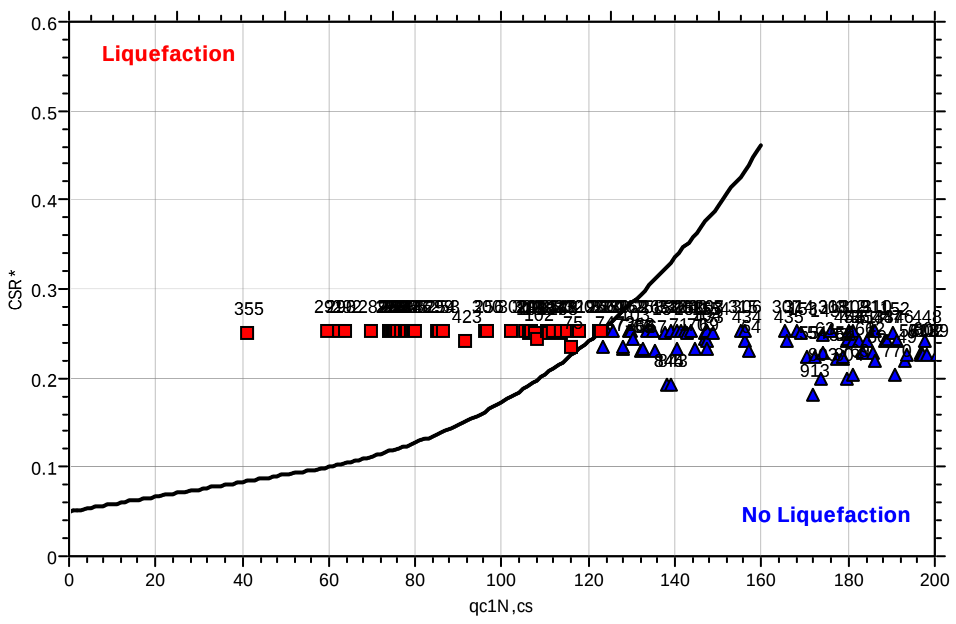
Project subtitle : CPT-02

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	10.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	6.42
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.31 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00



$M_w = 7^{1/2}$, sigma' = 1 atm base curve



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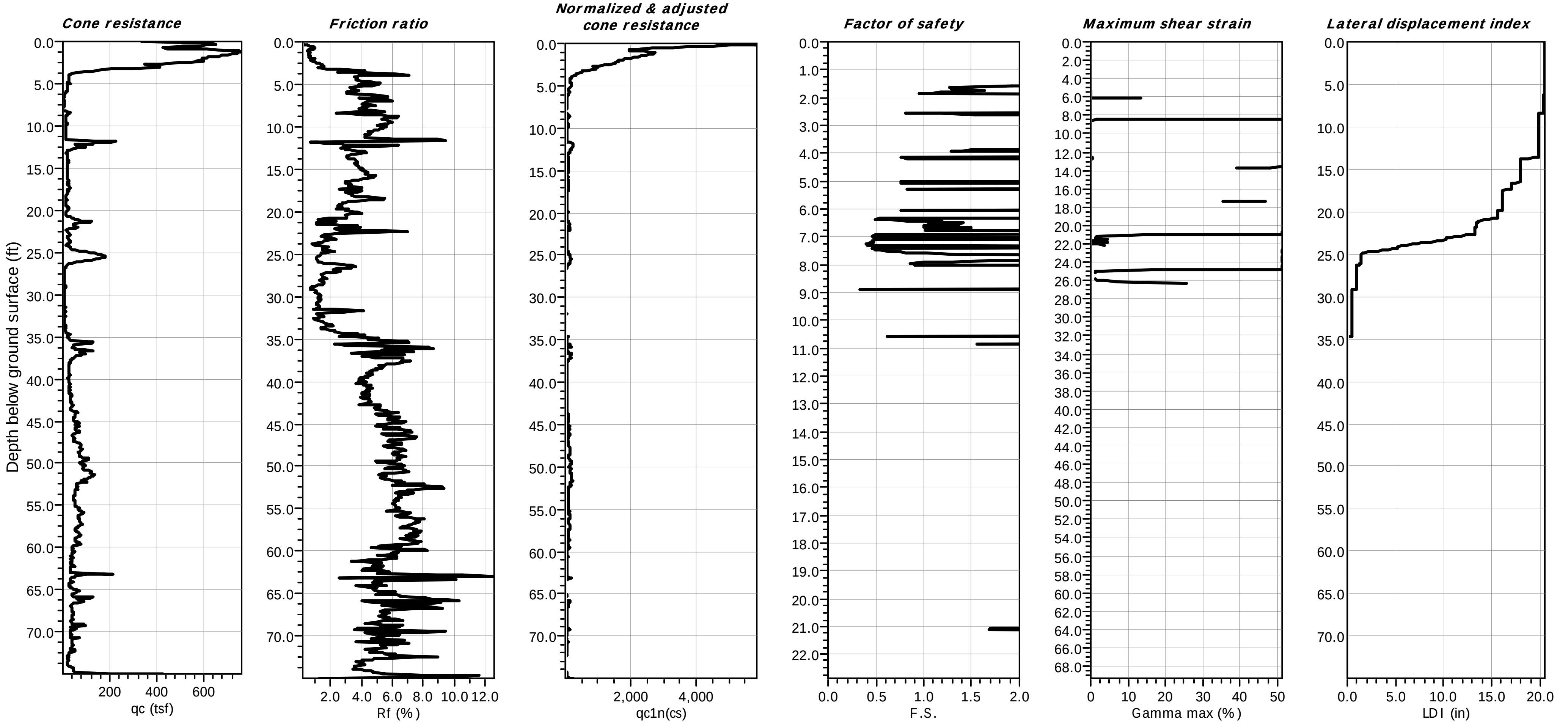
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1]

Geometric parameters: Level ground (or gently sloping) with free face
Total lateral displacement estimation: 8.10 in



q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

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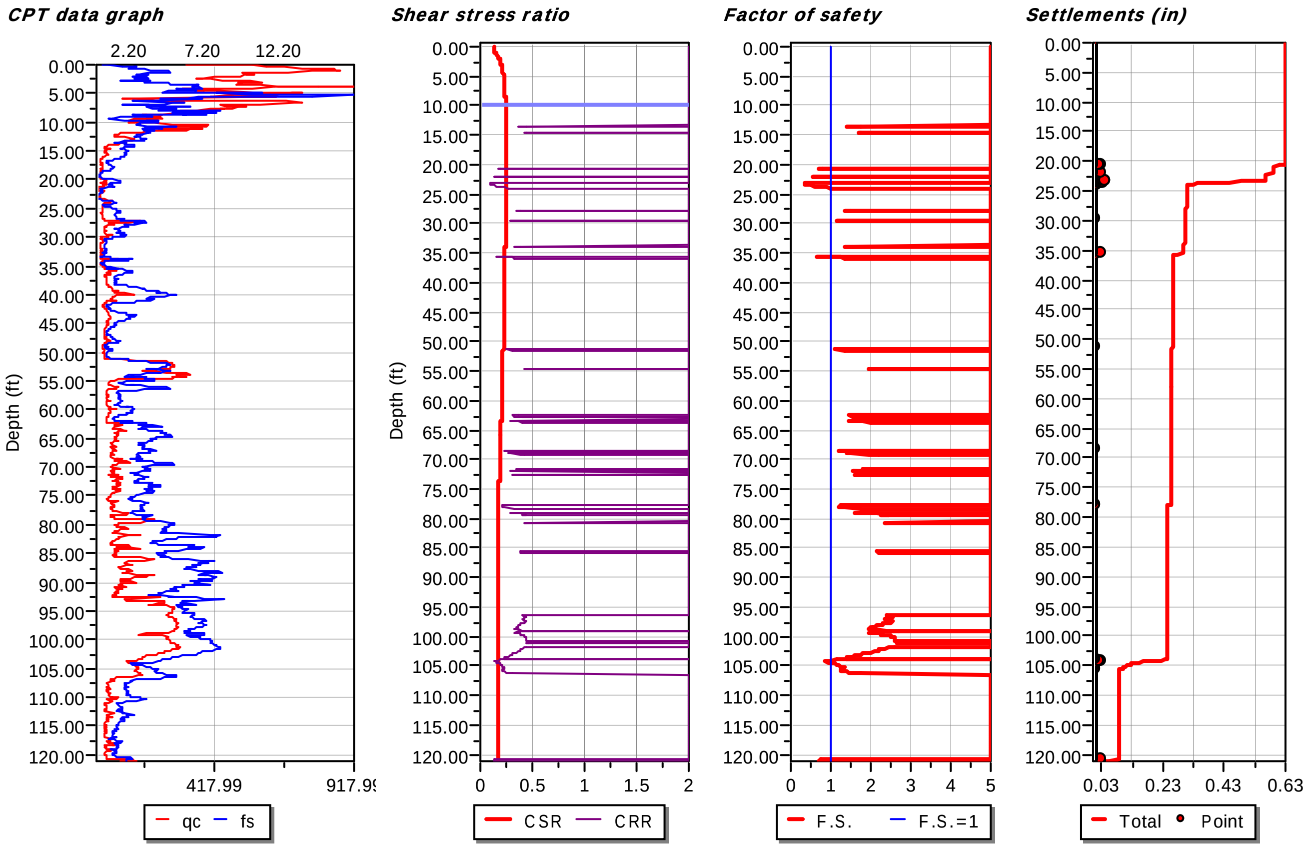
LIQUEFACTION ANALYSIS REPORT

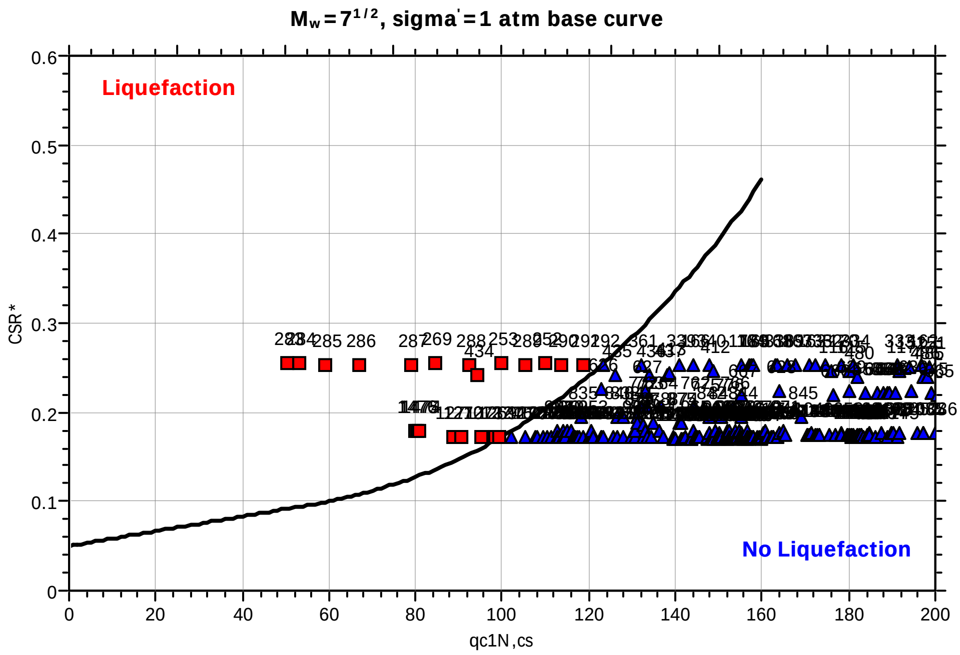
Project title : Ninepipes Feasibility Study

Project subtitle : CPT-3A

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	10.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	6.43
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.31 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





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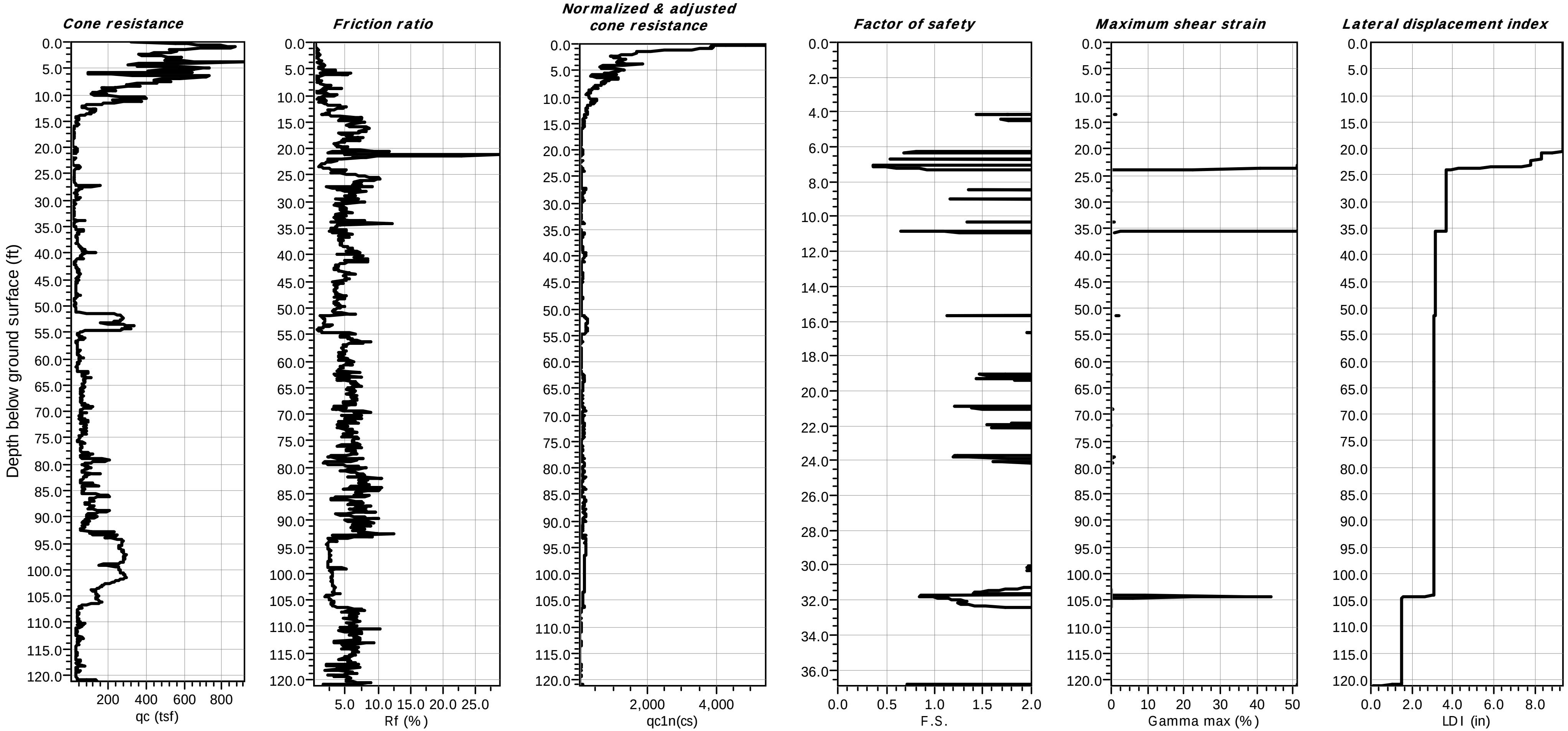
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1]

Geometric parameters: Level ground (or gently sloping) with free face
Total lateral displacement estimation: 3.70 in



q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

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LIQUEFACTION ANALYSIS REPORT

Project title : Ninepipes Feasibility

Project subtitle : CPT-04

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	6.43
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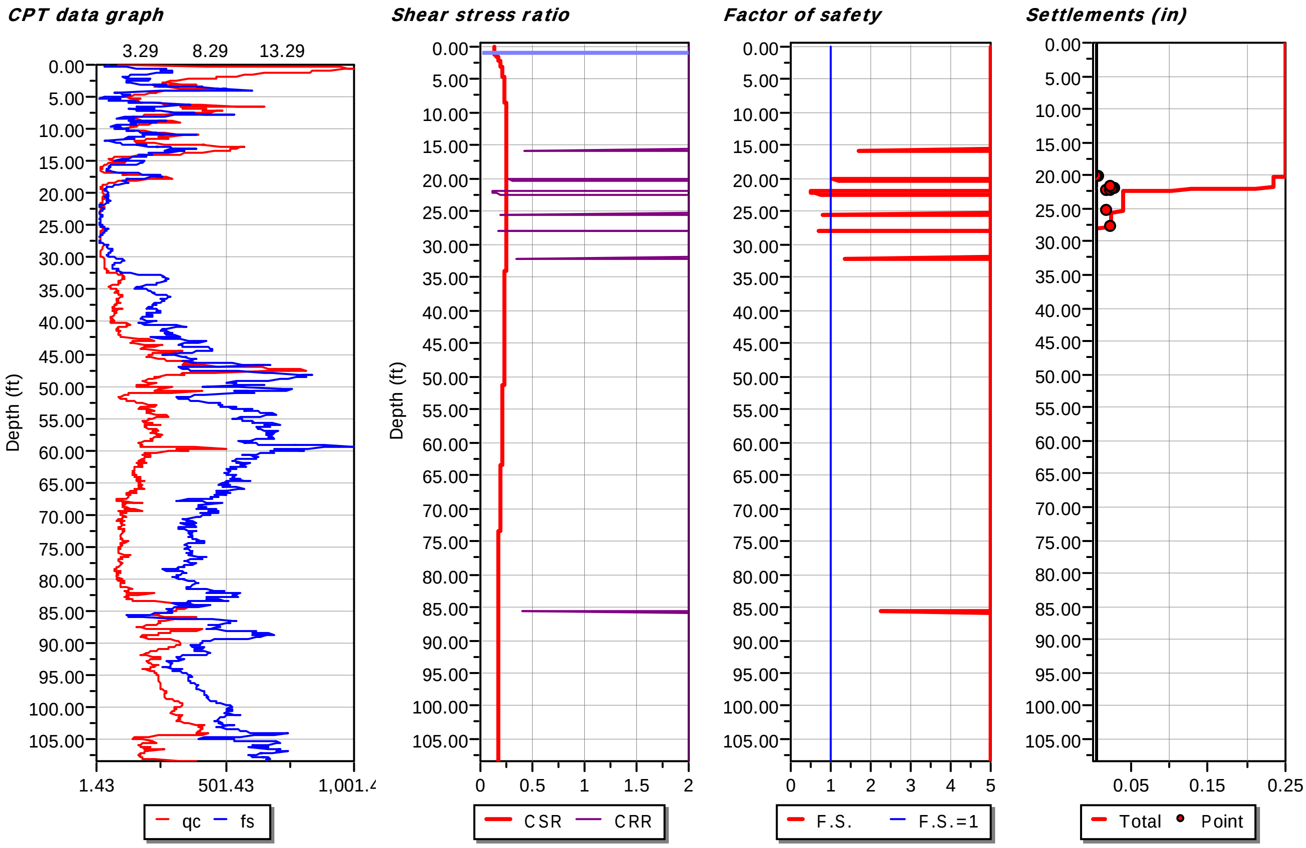
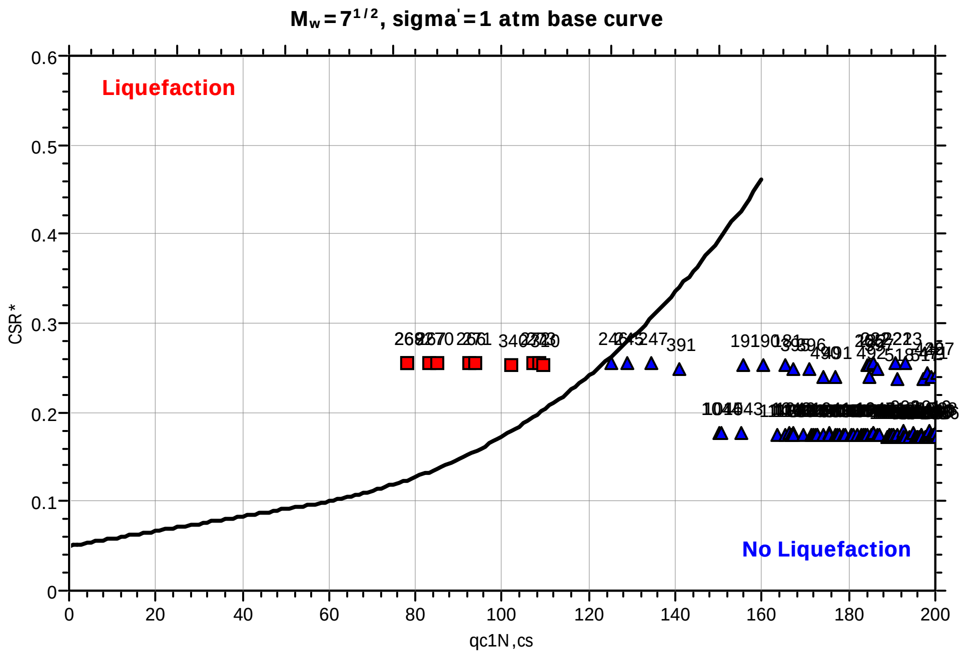
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





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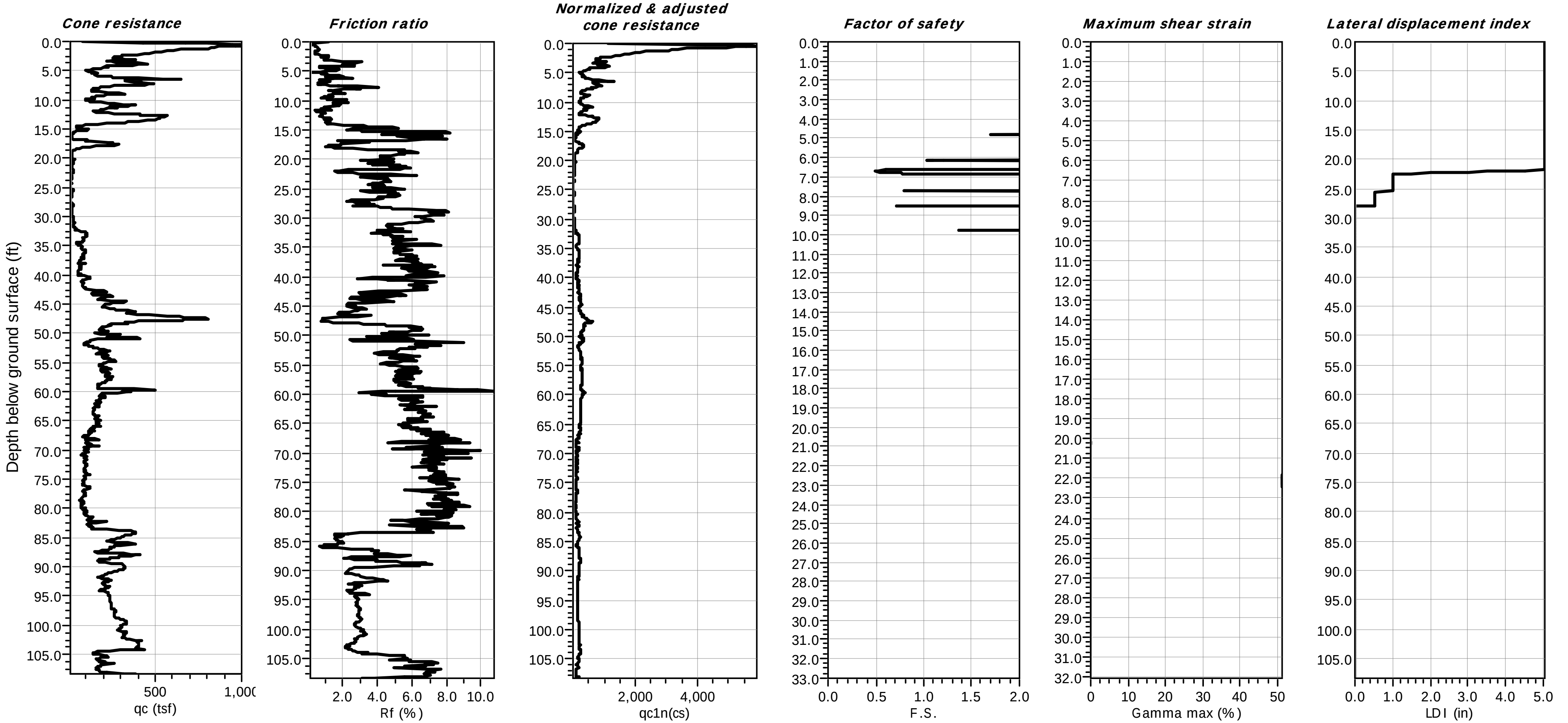
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1]

Geometric parameters: Level ground (or gently sloping) with free face
Total lateral displacement estimation: 1.99 in



q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

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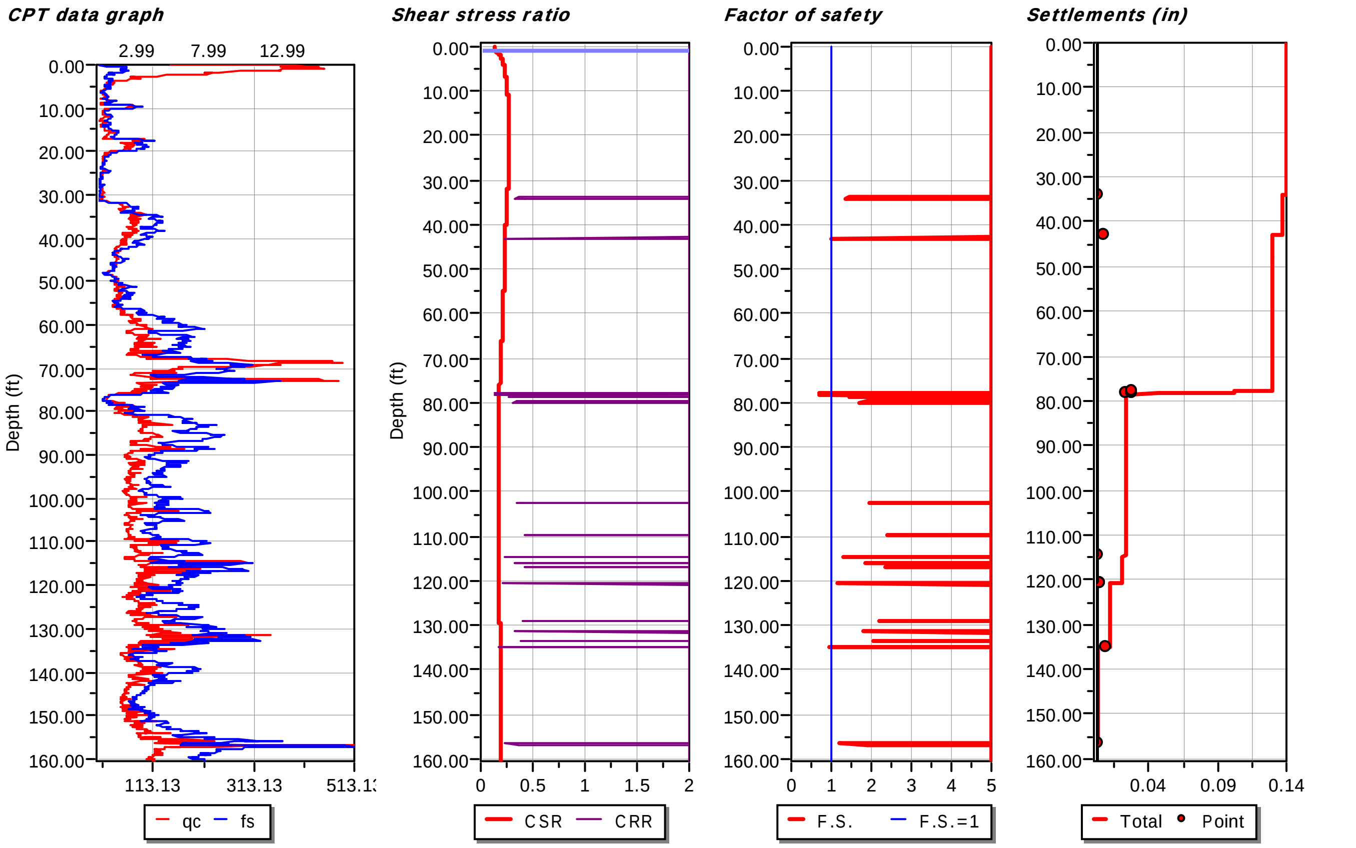
LIQUEFACTION ANALYSIS REPORT

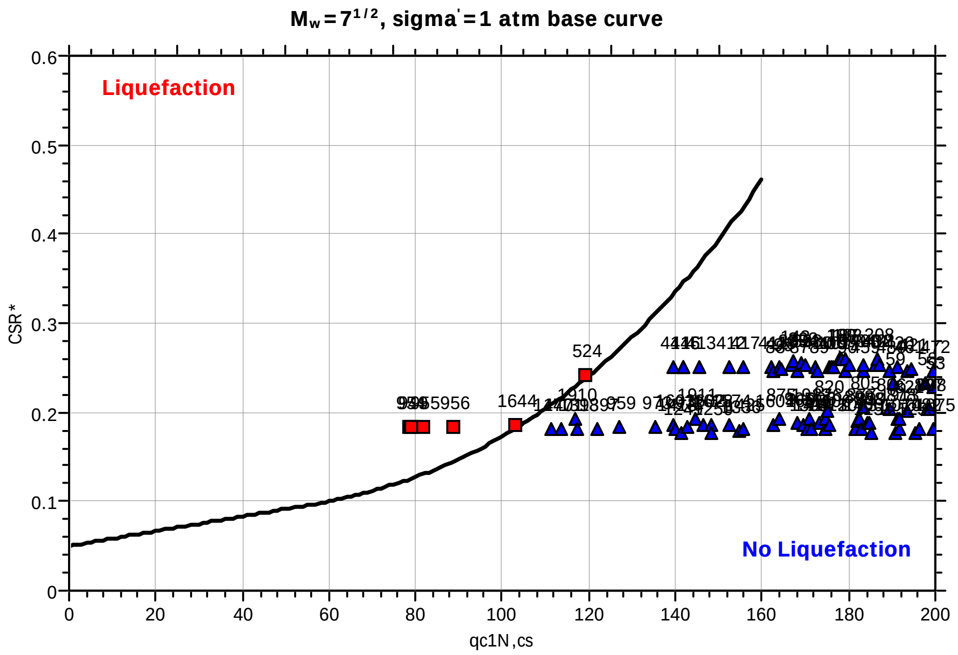
Project title : Ninepipes Feasibility

Project subtitle : CPT-5

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	6.49
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.31 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





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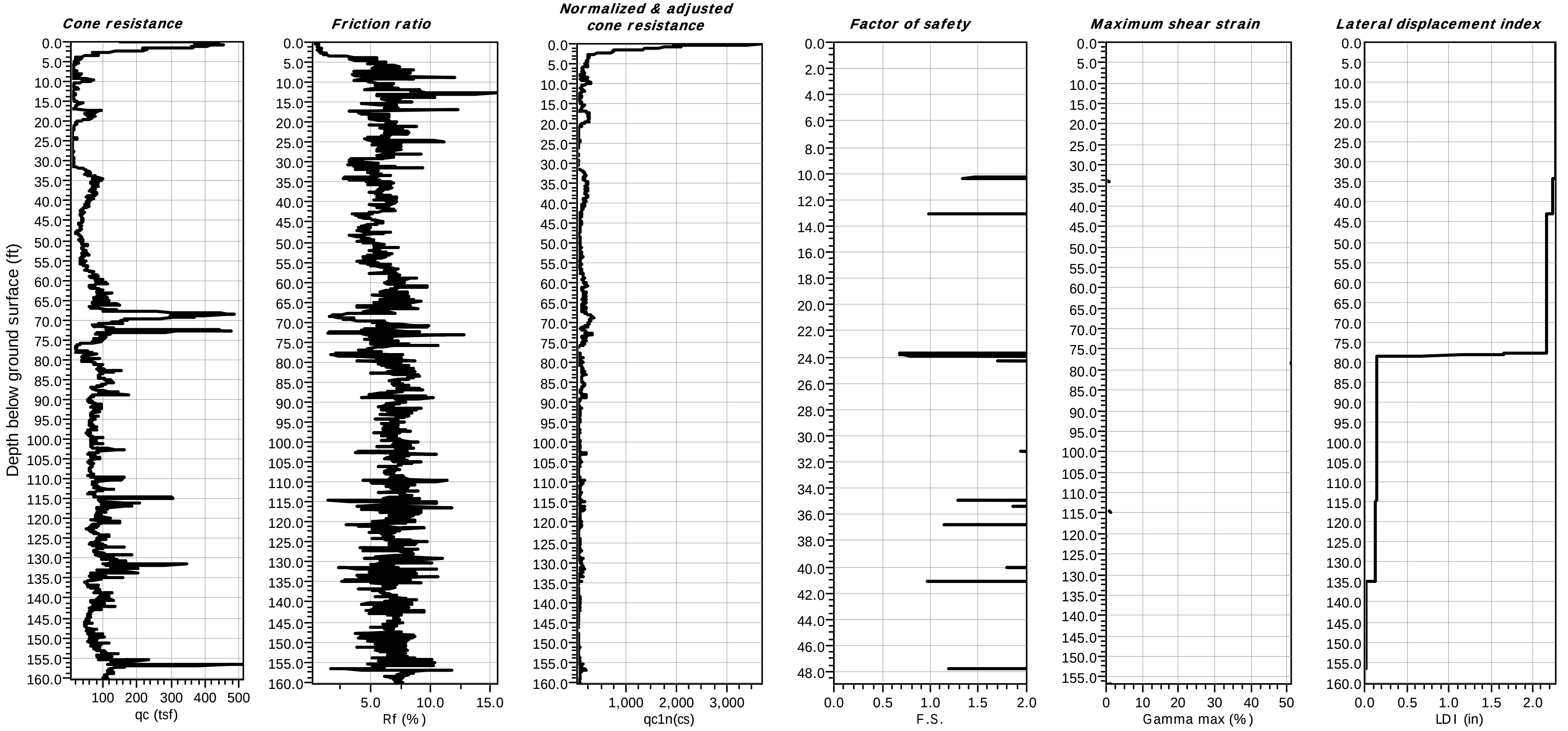
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1]

Geometric parameters: Level ground (or gently sloping) with free face
Total lateral displacement estimation: 0.89 in



q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

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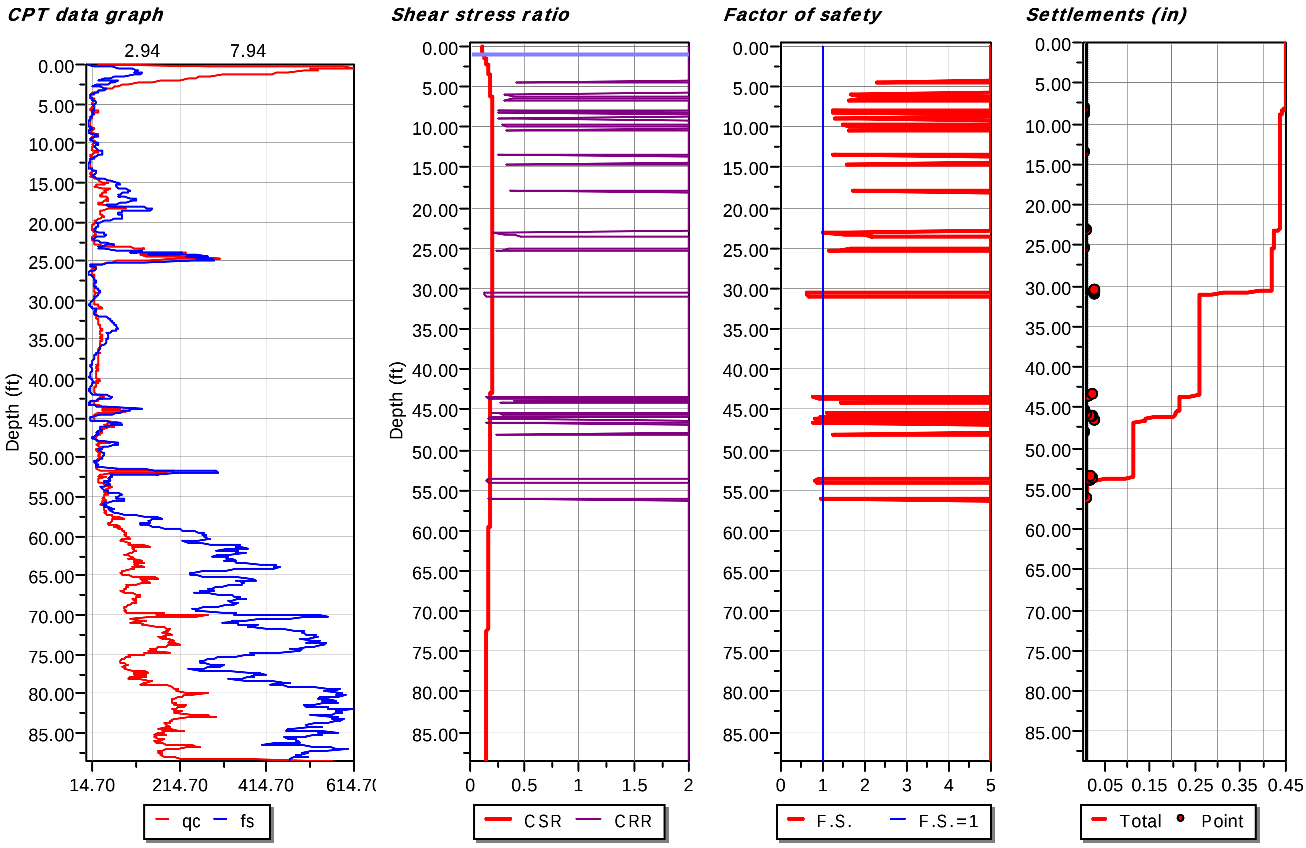
LIQUEFACTION ANALYSIS REPORT

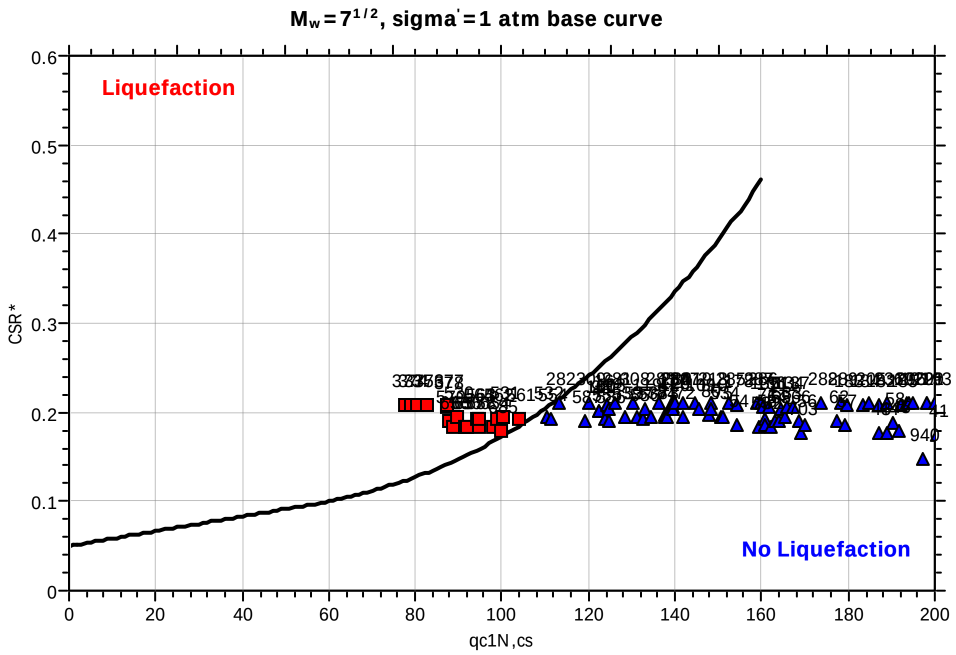
Project title : Ninepipes Feasibility

Project subtitle : CPT-6

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	6.49
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.25 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





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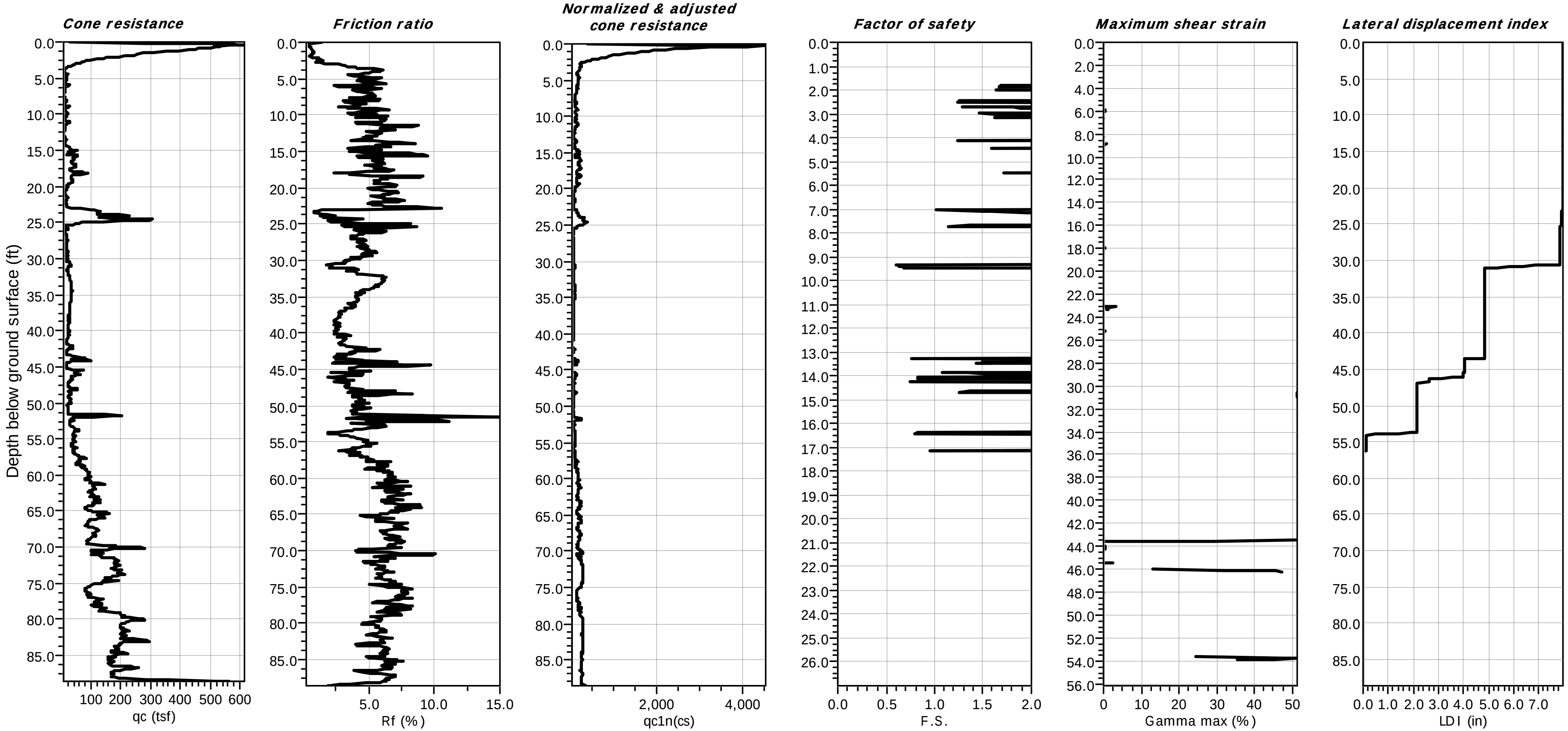
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1]

Geometric parameters: Level ground (or gently sloping) with free face
Total lateral displacement estimation: 3.14 in



q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

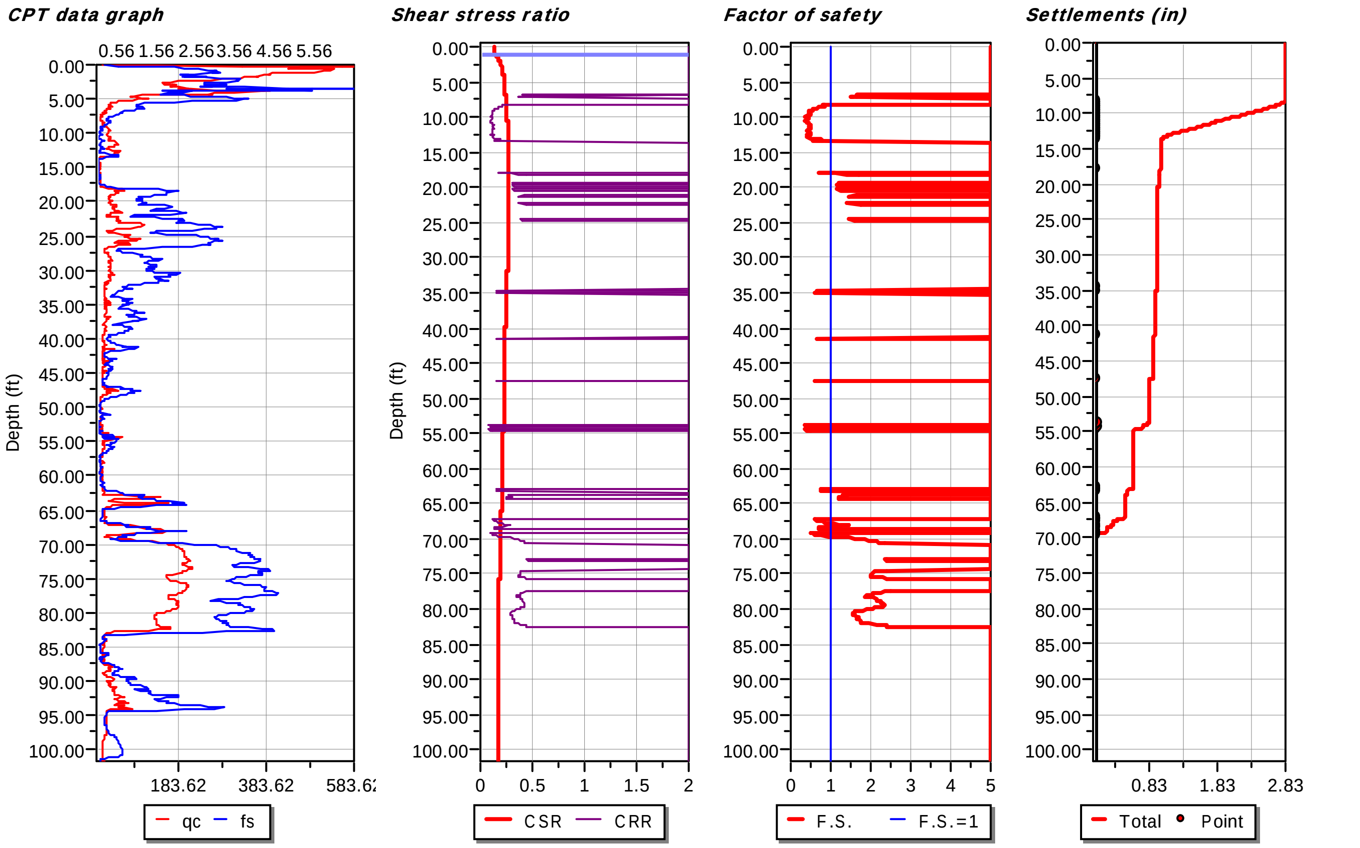
LIQUEFACTION ANALYSIS REPORT

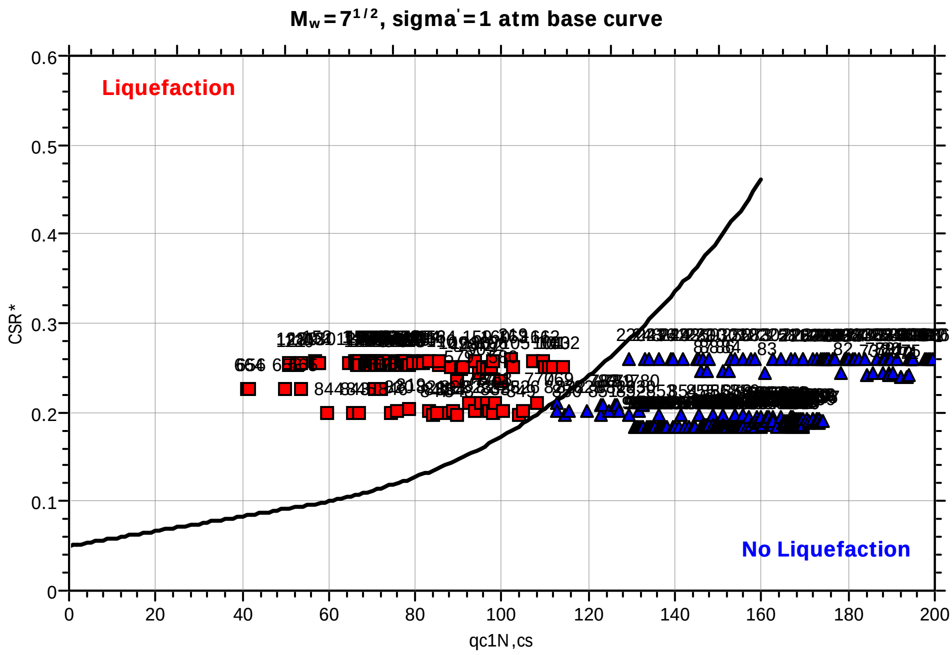
Project title : Ninepipes Feasibility

Project subtitle : CPT-7

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	6.49
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.31 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





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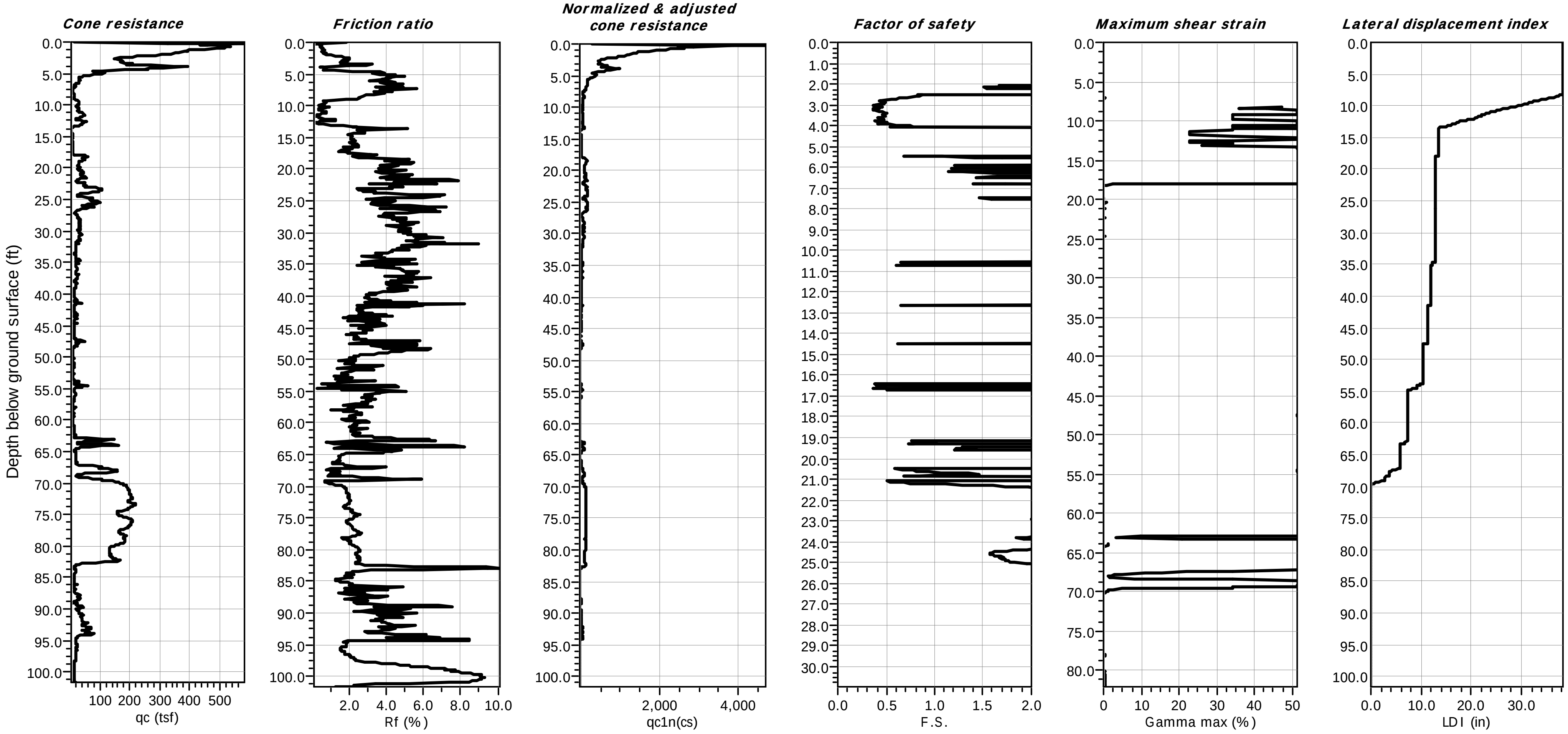
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1]

Geometric parameters: Level ground (or gently sloping) with free face
Total lateral displacement estimation: 15.14 in



q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

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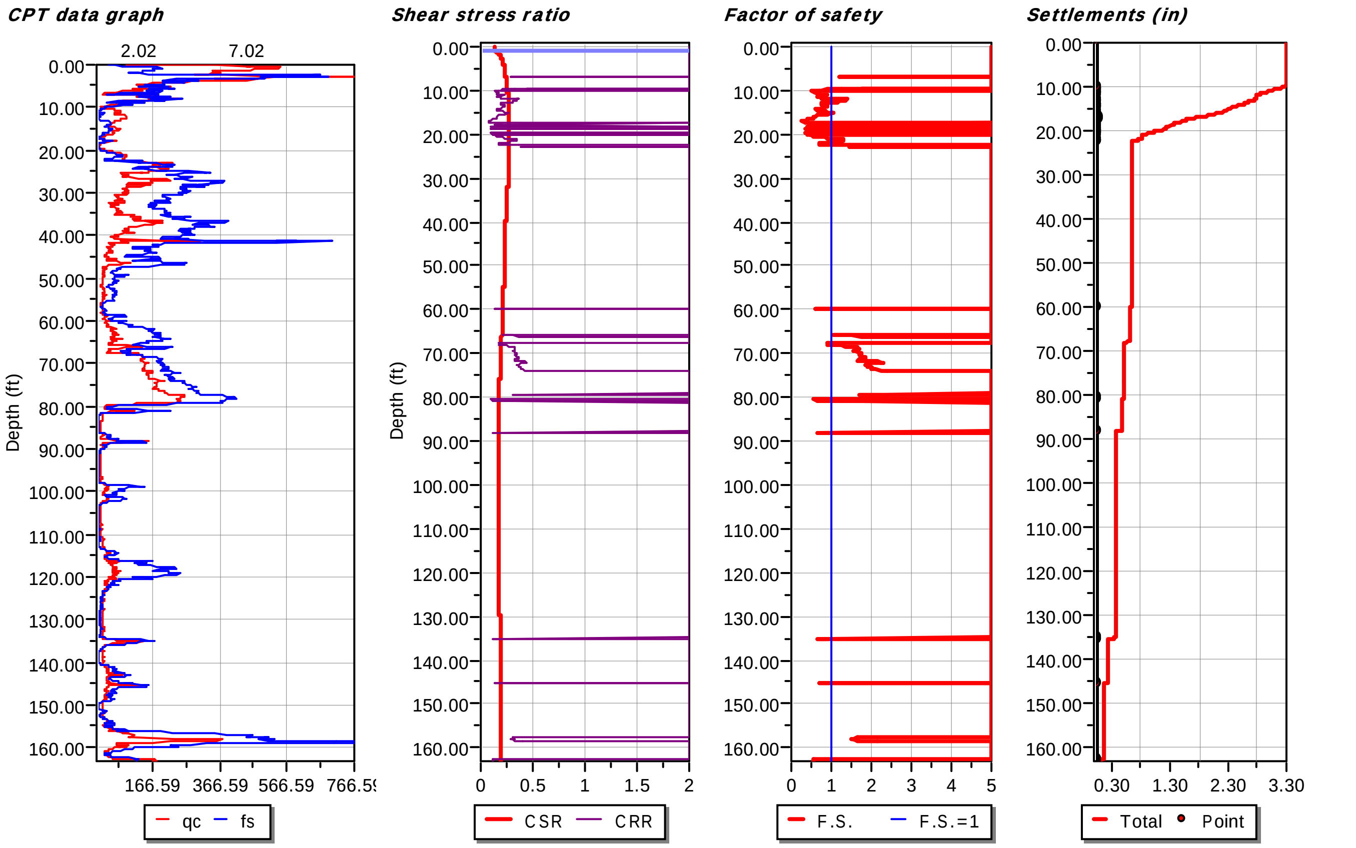
LIQUEFACTION ANALYSIS REPORT

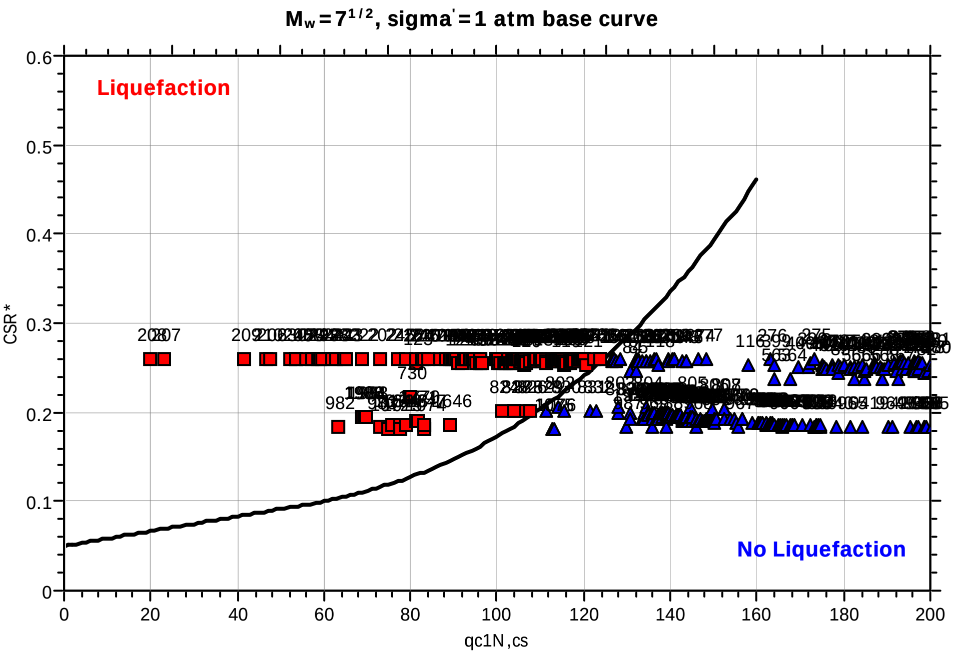
Project title : Ninepipes Feasibility

Project subtitle : CPT-08

Input parameters and analysis data

In-situ data type:	Cone Penetration Test	Depth to water table:	1.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	6.49
Analysis method:	Robertson (1998)	Peak ground accelaration:	0.31 g
Fines correction method:	Robertson (1998)	User defined F.S.:	1.00





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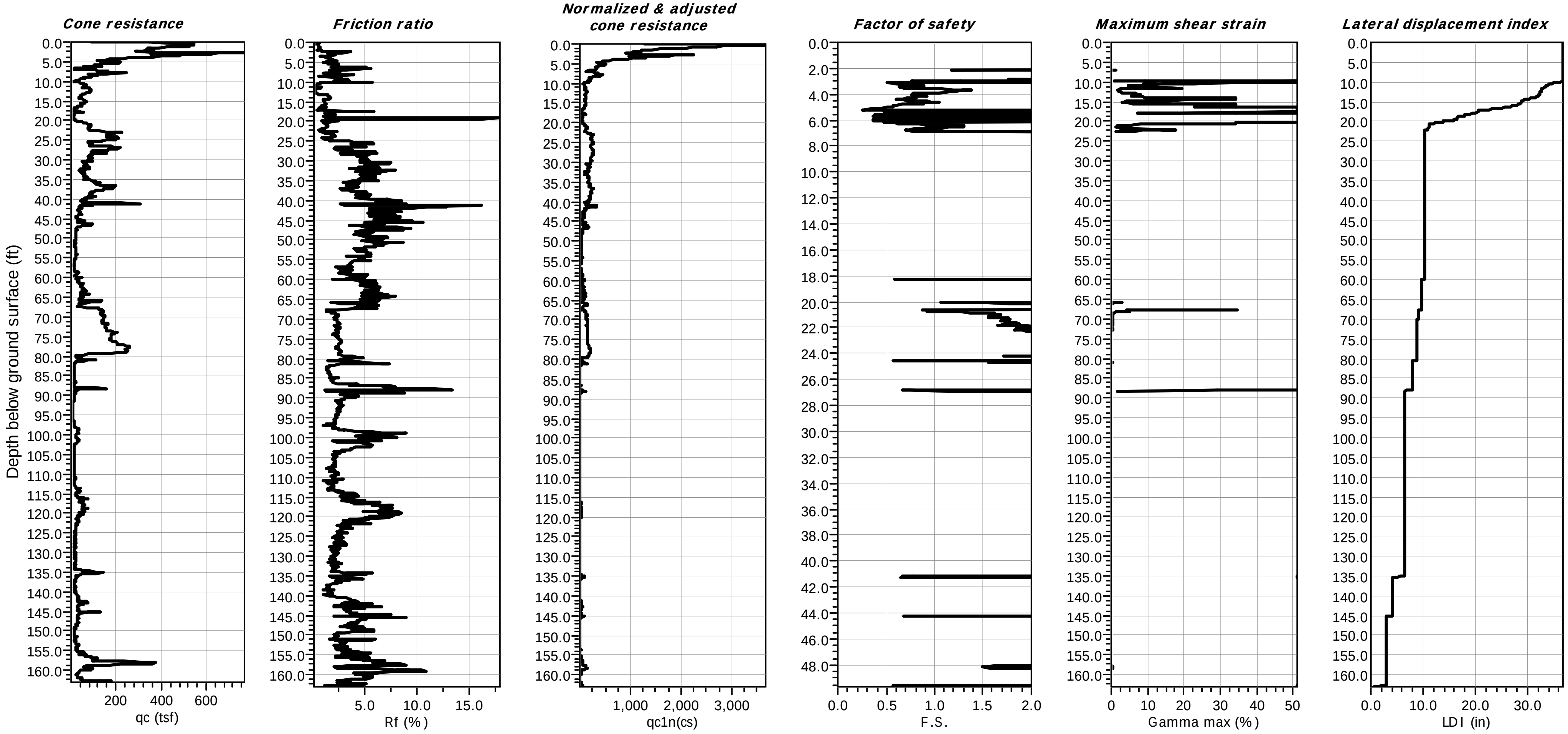
LATERAL DISPLACEMENTS ESTIMATION DUE TO SOIL LIQUEFACTION[1]

Geometric parameters: Level ground (or gently sloping) with free face
Total lateral displacement estimation: 14.58 in



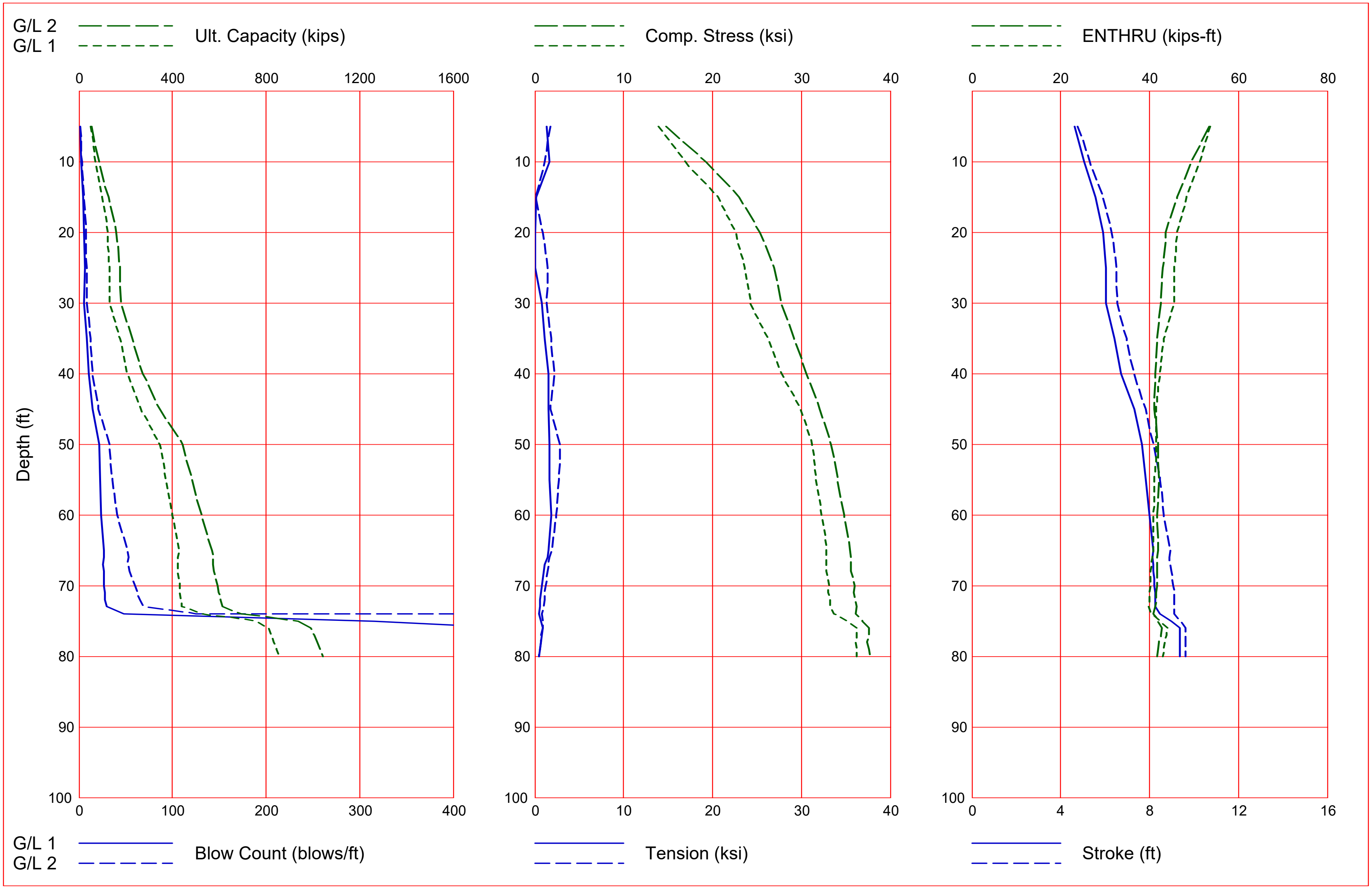
q_c: Measured cone resistance
R_f: Friction ratio
q_{cNcs}: Normalized & adjusted cone resistance

F.S.: Factor of safety
Gamma max: Maximum cyclic shear strain
LDI: Lateral displacement index

[1] This method was developed using the NCEER methods (SPT and CPT) and other methods will produce slightly different results

SK Geotechnical Corp
CPT-2, Ninepipe Res, 16" Pipe, I-36
Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Nov 19 2021
GRLWEAP Version 2010
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	49.3	27.2	22.0	1.7	13.907	-1.316	4.65	53.6
10.0	72.1	35.9	36.1	2.7	16.875	-1.696	5.06	51.2
15.0	99.5	53.2	46.3	4.1	20.593	-0.188	5.56	48.4
20.0	125.2	64.5	60.7	5.7	22.631	0.000	5.91	46.2
25.0	132.6	84.7	48.0	6.1	23.611	0.000	6.03	45.5
30.0	130.6	100.2	30.4	5.8	24.243	-0.806	6.03	45.5
35.0	174.4	106.0	68.5	8.5	26.272	-1.125	6.42	43.2
40.0	207.0	135.6	71.4	10.5	27.755	-1.555	6.73	42.3
45.0	266.4	154.8	111.6	14.4	29.958	-1.569	7.32	41.4
50.0	344.6	197.1	147.4	21.9	31.150	-1.617	7.66	41.4
55.0	370.1	243.2	126.9	22.6	31.666	-1.654	7.83	41.0
60.0	398.6	294.1	104.5	23.8	32.240	-1.878	7.98	40.8
65.0	427.6	318.4	109.2	26.8	32.834	-1.525	8.17	40.8
66.0	425.1	324.4	100.6	27.3	32.770	-1.485	8.14	40.6
67.0	421.5	332.7	88.9	26.3	32.753	-1.165	8.15	40.4
68.0	423.9	336.6	87.3	26.4	32.817	-1.014	8.18	40.3
69.0	426.9	340.4	86.5	26.8	33.005	-0.933	8.20	40.2
70.0	429.9	345.0	84.8	27.2	33.103	-0.750	8.23	40.2
71.0	432.3	348.5	83.8	27.6	33.026	-0.645	8.25	40.0
72.0	433.5	352.2	81.4	27.9	33.185	-0.579	8.27	39.9
73.0	441.4	355.5	85.9	29.6	33.213	-0.572	8.27	39.8
74.0	520.9	357.8	163.1	47.8	33.623	-0.442	8.49	40.5
75.0	760.5	364.2	396.3	315.5	35.161	-0.719	8.97	42.3
76.0	812.2	374.9	437.3	461.6	36.254	-0.956	9.37	44.0
77.0	822.9	385.6	437.3	532.5	36.164	-0.759	9.37	43.8
78.0	833.9	396.6	437.3	637.3	36.156	-0.649	9.35	43.4
79.0	844.6	407.3	437.3	782.7	36.255	-0.615	9.35	43.2
80.0	855.4	418.1	437.3	999.3	36.212	-0.465	9.35	43.0

Total Continuous Driving Time 106.00 minutes; Total Number of Blows 4211 (starting at penetration 5.0 ft)

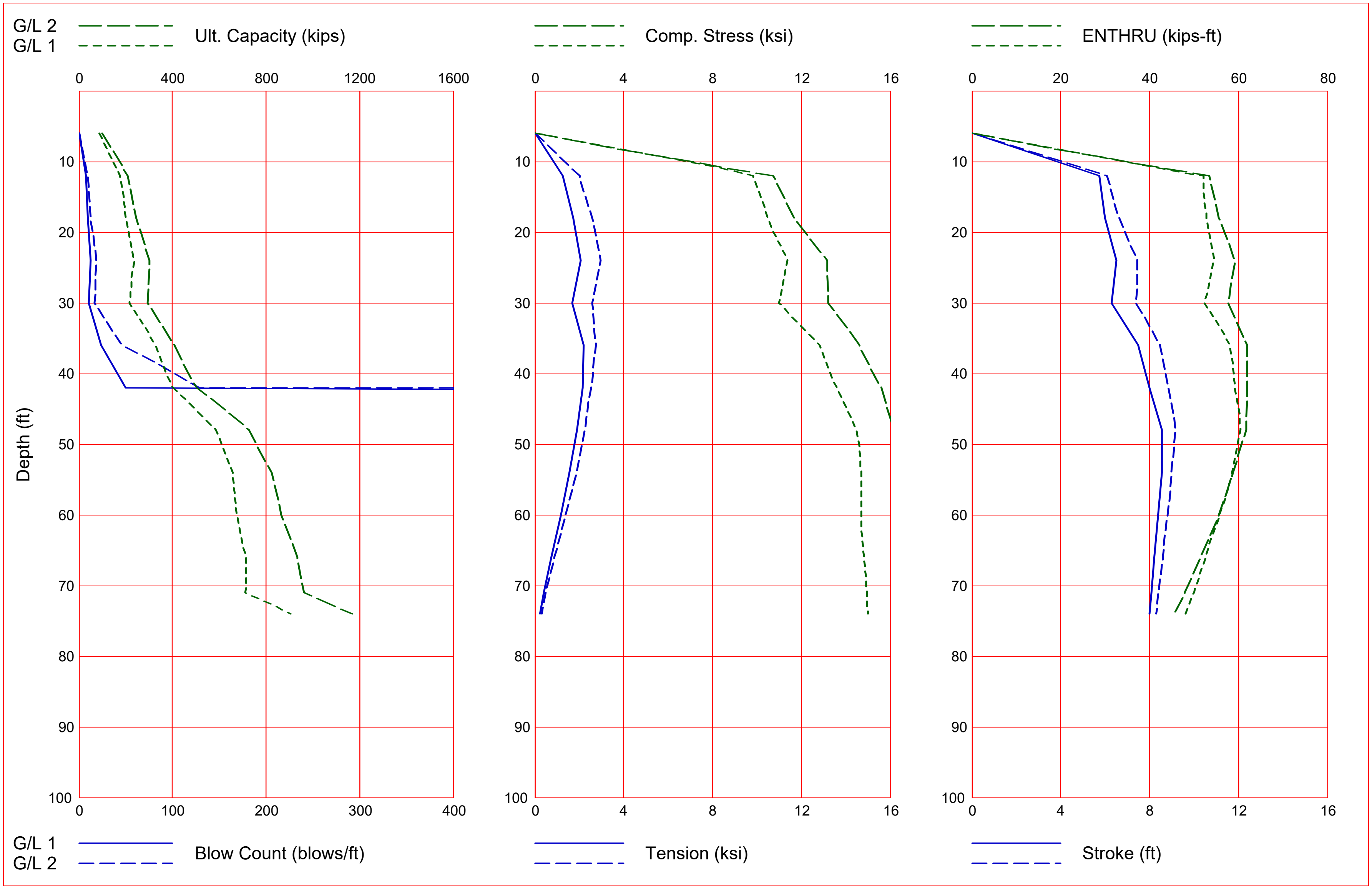
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	56.2	34.2	22.0	1.8	14.805	-1.801	4.77	53.5
10.0	87.8	51.6	36.1	3.4	19.264	-1.075	5.33	49.3
15.0	125.7	79.4	46.3	5.6	22.970	0.000	5.93	46.1
20.0	159.7	98.9	60.7	7.8	25.379	-0.954	6.28	43.7
25.0	177.1	129.1	48.0	8.8	26.901	-1.484	6.49	42.9
30.0	180.9	150.5	30.4	8.8	27.639	-1.380	6.54	42.6
35.0	227.8	159.3	68.5	12.3	29.144	-1.820	6.98	41.8
40.0	272.2	200.8	71.4	15.1	30.597	-2.237	7.33	41.2
45.0	346.4	234.9	111.6	20.4	32.068	-1.767	7.81	41.0
50.0	443.7	296.3	147.4	33.3	33.382	-2.868	8.17	41.9
55.0	484.9	358.0	126.9	36.4	34.127	-2.697	8.46	42.1
60.0	525.4	420.9	104.5	41.1	34.840	-2.357	8.66	41.8
65.0	569.6	460.4	109.2	51.9	35.467	-1.902	8.92	41.9
66.0	572.4	471.8	100.6	53.2	35.586	-1.689	8.89	41.6
67.0	572.2	483.4	88.9	52.3	35.625	-1.513	8.93	41.6
68.0	578.4	491.1	87.3	54.5	35.569	-1.423	8.98	41.6
69.0	585.3	498.8	86.5	57.1	35.904	-1.357	9.02	41.6
70.0	592.7	507.9	84.8	60.0	36.030	-1.187	9.07	41.6
71.0	598.8	515.0	83.8	62.7	35.892	-1.104	9.10	41.5
72.0	603.6	522.2	81.4	65.1	36.141	-1.098	9.13	41.4
73.0	614.6	528.7	85.9	69.3	36.262	-0.987	9.13	41.2
74.0	696.3	533.2	163.1	124.9	36.087	-0.849	9.13	40.9
75.0	938.0	541.7	396.3	9999.0	36.879	-0.896	9.41	42.0
76.0	991.8	554.5	437.3	9999.0	37.630	-0.877	9.62	42.8
77.0	1004.8	567.5	437.3	9999.0	37.579	-0.693	9.63	42.6
78.0	1017.8	580.5	437.3	9999.0	37.433	-0.644	9.62	42.2
79.0	1030.8	593.5	437.3	9999.0	37.644	-0.609	9.61	41.9
80.0	1043.8	606.4	437.3	9999.0	37.705	-0.441	9.63	41.7

Refusal occurred; no driving time output possible

SK Geotechnical Corp
CPT-2, 24" Pipe, I-36
Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Nov 19 2021
GRLWEAP Version 2010
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
6.0	87.7	43.8	43.9	-1.0	0.000	0.000	0.00	0.0
12.0	176.7	62.2	114.5	8.0	9.834	-1.278	5.73	52.2
18.0	198.6	90.4	108.2	9.5	10.482	-1.730	5.98	52.7
24.0	237.8	120.4	117.3	12.4	11.362	-2.087	6.50	54.6
30.0	218.7	150.4	68.3	10.7	10.995	-1.678	6.31	52.4
36.0	324.2	167.6	156.5	23.9	12.841	-2.194	7.48	58.1
42.0	401.3	213.2	188.1	50.1	13.576	-2.139	7.99	59.3
48.0	587.1	264.2	322.9	9999.0	14.489	-1.887	8.56	60.4
54.0	658.3	356.1	302.2	9999.0	14.711	-1.573	8.56	58.6
60.0	676.3	441.2	235.1	9999.0	14.703	-1.186	8.37	55.7
66.0	713.2	486.8	226.5	9999.0	14.822	-0.744	8.21	52.6
71.0	711.5	522.9	188.6	9999.0	14.966	-0.414	8.08	50.0
74.0	903.7	536.7	367.0	9999.0	15.003	-0.253	8.00	48.2

Refusal occurred; no driving time output possible

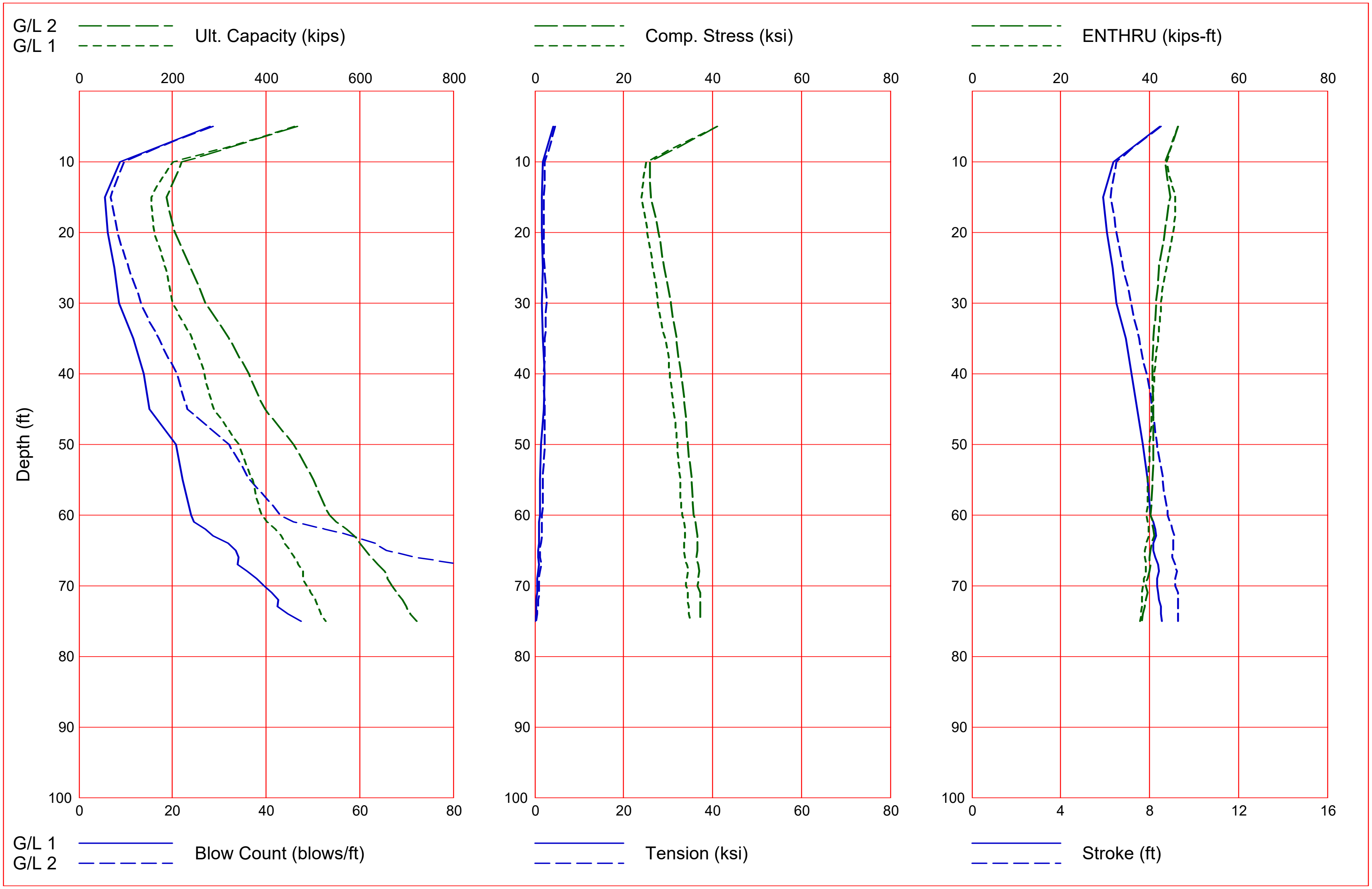
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
6.0	101.1	57.1	43.9	-1.0	0.000	0.000	0.00	0.0
12.0	208.1	93.6	114.5	10.0	10.749	-2.030	6.07	53.5
18.0	246.0	137.8	108.2	13.0	11.680	-2.560	6.62	55.6
24.0	301.2	183.8	117.3	18.8	13.149	-2.952	7.44	59.2
30.0	294.1	225.8	68.3	17.2	13.187	-2.598	7.40	57.7
36.0	408.3	251.8	156.5	46.3	14.608	-2.759	8.48	62.0
42.0	503.8	315.7	188.1	128.9	15.597	-2.558	8.85	62.0
48.0	728.7	405.7	322.9	9999.0	16.145	-2.250	9.15	61.7
54.0	822.8	520.6	302.2	9999.0	16.165	-1.897	8.99	58.8
60.0	866.6	631.5	235.1	9999.0	16.279	-1.396	8.81	55.5
66.0	934.3	707.8	226.5	9999.0	16.612	-0.879	8.60	51.6
71.0	961.2	772.6	188.6	9999.0	16.650	-0.511	8.40	47.8
74.0	1166.9	799.9	367.0	9999.0	16.660	-0.309	8.30	45.5

Refusal occurred; no driving time output possible

SK Geotechnical Corp
CPT-3A, Kettle Pond 1, 16" Pipe, I-36
Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Nov 19 2021
GRLWEAP Version 2010
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	460.0	32.2	427.8	28.1	40.995	-4.229	8.48	46.5
10.0	201.9	85.3	116.6	8.8	25.036	-1.830	6.36	43.9
15.0	154.1	126.6	27.4	5.5	24.007	-1.681	5.92	45.7
20.0	161.9	138.3	23.7	6.1	25.228	-1.589	6.09	45.3
25.0	185.5	148.8	36.7	7.5	26.594	-1.796	6.35	43.8
30.0	202.3	164.0	38.3	8.7	27.631	-1.580	6.52	42.6
35.0	241.1	175.0	66.1	11.7	29.249	-1.736	6.93	41.9
40.0	268.3	193.9	74.3	13.8	30.304	-2.165	7.20	41.1
45.0	288.1	216.8	71.3	15.1	31.274	-1.936	7.44	40.5
50.0	340.3	230.4	110.0	20.7	32.006	-1.337	7.68	40.1
55.0	371.3	270.0	101.3	22.2	32.777	-1.163	7.91	39.6
60.0	389.8	291.1	98.7	24.0	33.186	-1.194	8.06	39.4
61.0	401.1	295.1	106.0	24.6	33.554	-0.997	8.16	39.5
62.0	420.8	298.0	122.8	27.0	33.842	-0.982	8.24	39.7
63.0	432.7	302.5	130.3	28.7	33.832	-0.936	8.30	39.7
64.0	440.4	309.9	130.4	31.8	33.701	-0.952	8.18	39.1
65.0	450.1	320.3	129.9	33.6	33.659	-0.794	8.19	38.9
66.0	460.2	330.0	130.1	34.1	33.797	-0.817	8.25	39.0
67.0	468.9	337.1	131.9	34.0	34.227	-0.887	8.37	39.1
68.0	478.3	342.7	135.6	35.9	34.424	-0.770	8.42	39.1
69.0	479.4	348.9	130.5	37.9	34.173	-0.626	8.36	38.7
70.0	486.4	358.6	127.8	39.6	34.120	-0.578	8.35	38.5
71.0	496.2	368.3	128.0	41.3	34.353	-0.468	8.39	38.3
72.0	505.4	377.0	128.4	42.7	34.403	-0.388	8.42	38.2
73.0	511.8	385.4	126.3	42.4	34.561	-0.422	8.53	38.3
74.0	516.9	394.2	122.7	44.7	34.769	-0.316	8.51	38.1
75.0	528.6	403.1	125.5	47.4	34.861	-0.183	8.56	37.9

Total Continuous Driving Time 30.00 minutes; Total Number of Blows 1266 (starting at penetration 5.0 ft)

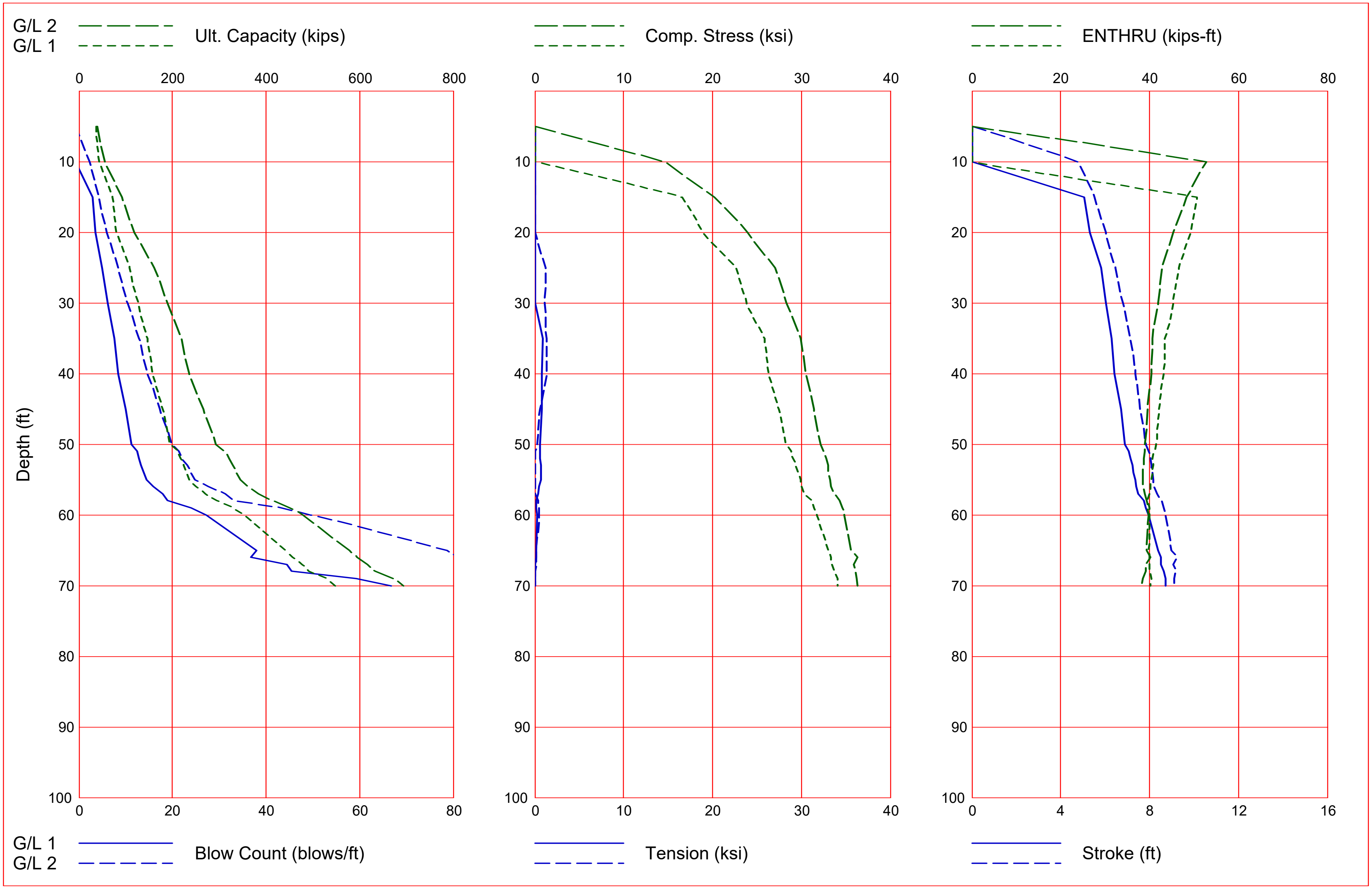
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	466.4	38.6	427.8	28.7	41.031	-4.517	8.50	46.5
10.0	218.9	102.3	116.6	9.6	25.911	-2.257	6.50	43.6
15.0	186.6	159.2	27.4	6.8	26.203	-2.029	6.24	44.6
20.0	206.2	182.5	23.7	8.2	27.776	-2.095	6.49	43.5
25.0	238.6	201.9	36.7	10.7	29.140	-2.161	6.82	42.1
30.0	270.4	232.2	38.3	13.2	30.607	-2.610	7.18	41.4
35.0	320.2	254.2	66.1	17.2	31.899	-2.343	7.55	40.8
40.0	364.0	289.7	74.3	20.9	32.947	-1.986	7.86	40.7
45.0	397.8	326.5	71.3	23.2	33.887	-2.248	8.14	40.8
50.0	458.0	348.0	110.0	32.1	34.399	-2.310	8.35	40.8
55.0	501.2	399.9	101.3	36.5	35.281	-1.787	8.60	40.7
60.0	534.8	436.1	98.7	43.1	35.688	-1.672	8.81	40.3
61.0	549.4	443.4	106.0	45.8	36.170	-1.681	8.92	40.7
62.0	572.4	449.6	122.8	52.6	36.457	-1.589	9.02	40.9
63.0	588.7	458.5	130.3	58.2	36.487	-1.603	9.09	41.0
64.0	601.1	470.7	130.4	63.3	36.487	-1.459	9.05	40.5
65.0	613.3	483.4	129.9	65.8	36.569	-1.272	9.06	40.3
66.0	625.6	495.4	130.1	72.1	36.414	-1.273	9.04	39.9
67.0	639.0	507.2	131.9	81.5	36.771	-1.320	9.17	40.3
68.0	653.7	518.0	135.6	92.0	37.019	-1.186	9.22	40.1
69.0	659.2	528.7	130.5	90.0	36.832	-1.011	9.15	39.5
70.0	668.5	540.7	127.8	95.0	36.626	-0.989	9.14	39.1
71.0	680.0	552.1	128.0	99.8	37.174	-0.885	9.26	39.5
72.0	691.1	562.7	128.4	108.7	37.251	-0.695	9.29	39.2
73.0	700.2	573.9	126.3	132.8	37.176	-0.682	9.30	39.0
74.0	708.8	586.1	122.7	132.9	37.183	-0.615	9.27	38.5
75.0	723.0	597.5	125.5	151.3	37.386	-0.412	9.30	38.3

Total Continuous Driving Time 59.00 minutes; Total Number of Blows 2359 (starting at penetration 5.0 ft)

SK Geotechnical Corp
CPT-6, Kettle Pond 2, 16" Pipe, I-36
Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Nov 19 2021
GRLWEAP Version 2010
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	36.6	10.0	26.6	-1.0	0.000	0.000	0.00	0.0
10.0	43.9	18.4	25.4	-1.0	0.000	0.000	0.00	0.0
15.0	71.4	27.9	43.5	3.0	16.540	0.000	5.07	50.6
20.0	79.5	45.8	33.7	3.6	18.936	0.000	5.31	49.1
25.0	108.3	67.4	40.8	5.0	22.633	0.000	5.83	46.6
30.0	127.4	79.3	48.1	6.2	23.815	0.000	6.04	45.4
35.0	146.9	91.4	55.5	7.5	25.863	-0.948	6.31	43.5
40.0	157.7	103.6	54.1	8.4	26.267	-0.836	6.42	43.1
45.0	179.7	118.8	60.9	10.0	27.497	-0.841	6.70	42.1
50.0	195.2	133.3	61.9	11.2	28.274	-0.559	6.89	41.4
51.0	210.8	135.3	75.5	12.4	28.859	-0.596	7.05	41.0
52.0	217.7	139.6	78.1	12.9	29.114	-0.589	7.14	40.7
53.0	224.2	144.6	79.6	13.3	29.400	-0.693	7.24	40.9
54.0	230.7	147.8	82.9	13.9	29.644	-0.733	7.29	40.6
55.0	235.8	151.4	84.3	14.4	29.913	-0.683	7.34	40.5
56.0	250.1	154.7	95.3	15.9	30.039	-0.508	7.42	40.2
57.0	269.5	158.9	110.6	17.9	30.299	-0.358	7.50	39.9
58.0	294.2	164.2	129.9	19.0	31.167	-0.107	7.73	39.6
59.0	329.3	171.8	157.5	24.1	31.378	-0.140	7.84	39.9
60.0	355.5	182.7	172.8	27.2	31.719	-0.268	7.96	40.0
65.0	442.6	236.7	205.9	37.9	33.034	-0.138	8.37	39.7
66.0	457.4	247.5	209.9	36.8	33.384	-0.168	8.50	39.9
67.0	476.8	258.4	218.4	44.5	33.423	-0.083	8.52	40.0
68.0	491.5	269.2	222.3	45.4	33.787	-0.094	8.63	40.1
69.0	530.2	279.9	250.3	59.3	34.068	0.000	8.71	40.4
70.0	547.8	290.9	257.0	66.8	34.078	0.000	8.72	40.2

Total Continuous Driving Time 19.00 minutes; Total Number of Blows 809 (starting at penetration 5.0 ft)

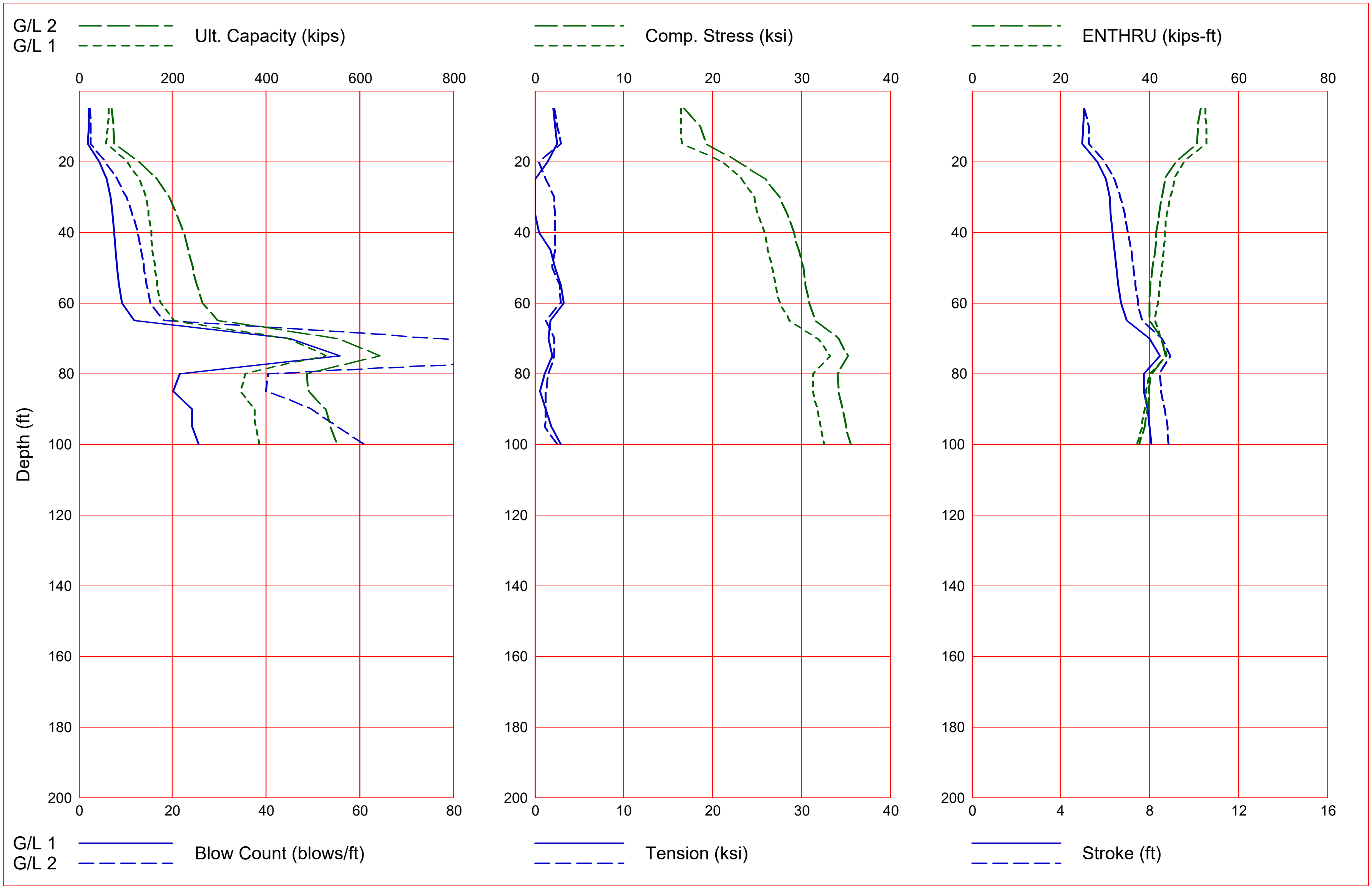
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	40.5	13.9	26.6	-1.0	0.000	0.000	0.00	0.0
10.0	56.1	30.7	25.4	2.3	14.713	0.000	4.80	52.8
15.0	93.1	49.6	43.5	4.3	20.217	0.000	5.54	48.3
20.0	119.2	85.5	33.7	6.0	23.922	0.000	6.03	45.4
25.0	160.7	119.9	40.8	8.4	27.057	-1.197	6.48	42.8
30.0	189.1	141.0	48.1	10.5	28.302	-1.090	6.79	41.9
35.0	219.6	164.0	55.5	12.8	29.903	-1.332	7.16	40.7
40.0	236.9	182.9	54.1	14.7	30.484	-1.298	7.36	40.4
45.0	267.2	206.3	60.9	17.4	31.373	-0.565	7.59	39.6
50.0	292.4	230.5	61.9	19.9	32.175	-0.220	7.82	39.0
51.0	310.2	234.7	75.5	21.4	32.490	0.000	7.94	38.9
52.0	321.0	242.9	78.1	22.0	32.794	0.000	8.04	38.7
53.0	329.2	249.6	79.6	23.1	33.018	0.000	8.08	38.7
54.0	338.2	255.3	82.9	24.1	33.011	0.000	8.13	38.5
55.0	345.4	261.1	84.3	24.8	33.258	0.000	8.19	38.6
56.0	362.4	267.1	95.3	27.7	33.380	0.000	8.21	38.4
57.0	383.8	273.2	110.6	31.2	33.667	0.000	8.33	38.9
58.0	412.0	282.1	129.9	33.1	34.329	-0.421	8.55	39.3
59.0	451.5	294.0	157.5	43.3	34.631	-0.452	8.64	39.6
60.0	479.8	307.0	172.8	49.6	34.879	-0.468	8.73	39.7
65.0	577.8	371.9	205.9	78.7	35.587	-0.191	9.00	39.4
66.0	594.8	384.9	209.9	81.1	36.358	-0.201	9.25	40.2
67.0	616.3	397.9	218.4	97.1	35.843	-0.139	9.07	39.2
68.0	633.2	410.8	222.3	112.4	36.107	-0.052	9.18	39.2
69.0	674.2	423.8	250.3	146.0	36.201	0.000	9.13	38.6
70.0	693.8	436.8	257.0	179.7	36.285	0.000	9.12	38.2

Total Continuous Driving Time 39.00 minutes; Total Number of Blows 1600 (starting at penetration 5.0 ft)

SK Geotechnical Corp
CPT-7, Crow Creek, 16" Pipe, I-36
Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Nov 19 2021
GRLWEAP Version 2010
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000



SK Geotechnical Corp
CPT-7, Crow Creek, 16" Pipe, I-36

Nov 19 2021
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	64.2	24.7	39.5	2.2	16.428	-2.102	5.05	52.5
10.0	60.9	36.0	24.9	2.1	16.497	-2.244	5.02	52.7
15.0	58.2	41.3	16.9	2.0	16.594	-2.490	4.99	52.7
20.0	105.2	51.5	53.8	4.3	21.041	-1.468	5.67	47.7
25.0	129.6	73.2	56.3	5.9	23.296	0.000	6.03	45.5
30.0	143.8	93.5	50.3	6.8	24.649	0.000	6.20	44.7
35.0	148.5	104.8	43.7	7.2	25.125	0.000	6.23	43.8
40.0	154.1	114.6	39.6	7.6	25.893	-0.455	6.33	43.4
45.0	156.7	123.2	33.5	7.8	26.197	-1.719	6.40	43.1
50.0	162.3	131.9	30.3	8.3	26.736	-2.314	6.51	42.7
55.0	167.8	137.3	30.5	8.7	27.114	-2.978	6.59	42.4
60.0	175.9	144.0	31.9	9.3	27.612	-3.243	6.70	41.9
65.0	203.0	157.2	45.8	11.8	28.631	-1.785	6.98	41.3
70.0	447.5	177.4	270.1	45.1	31.809	-1.590	7.98	42.5
75.0	527.7	228.9	298.8	55.7	33.240	-1.971	8.47	43.8
80.0	355.4	276.7	78.7	21.6	31.306	-1.070	7.76	39.9
85.0	344.8	304.5	40.3	20.2	31.326	-0.561	7.74	39.1
90.0	376.1	313.9	62.1	24.2	31.863	-1.244	7.91	38.9
95.0	377.0	331.3	45.7	24.2	32.135	-1.855	8.00	38.3
100.0	385.1	340.5	44.6	25.6	32.633	-2.948	8.08	37.2

Total Continuous Driving Time 33.00 minutes; Total Number of Blows 1433 (starting at penetration 5.0 ft)

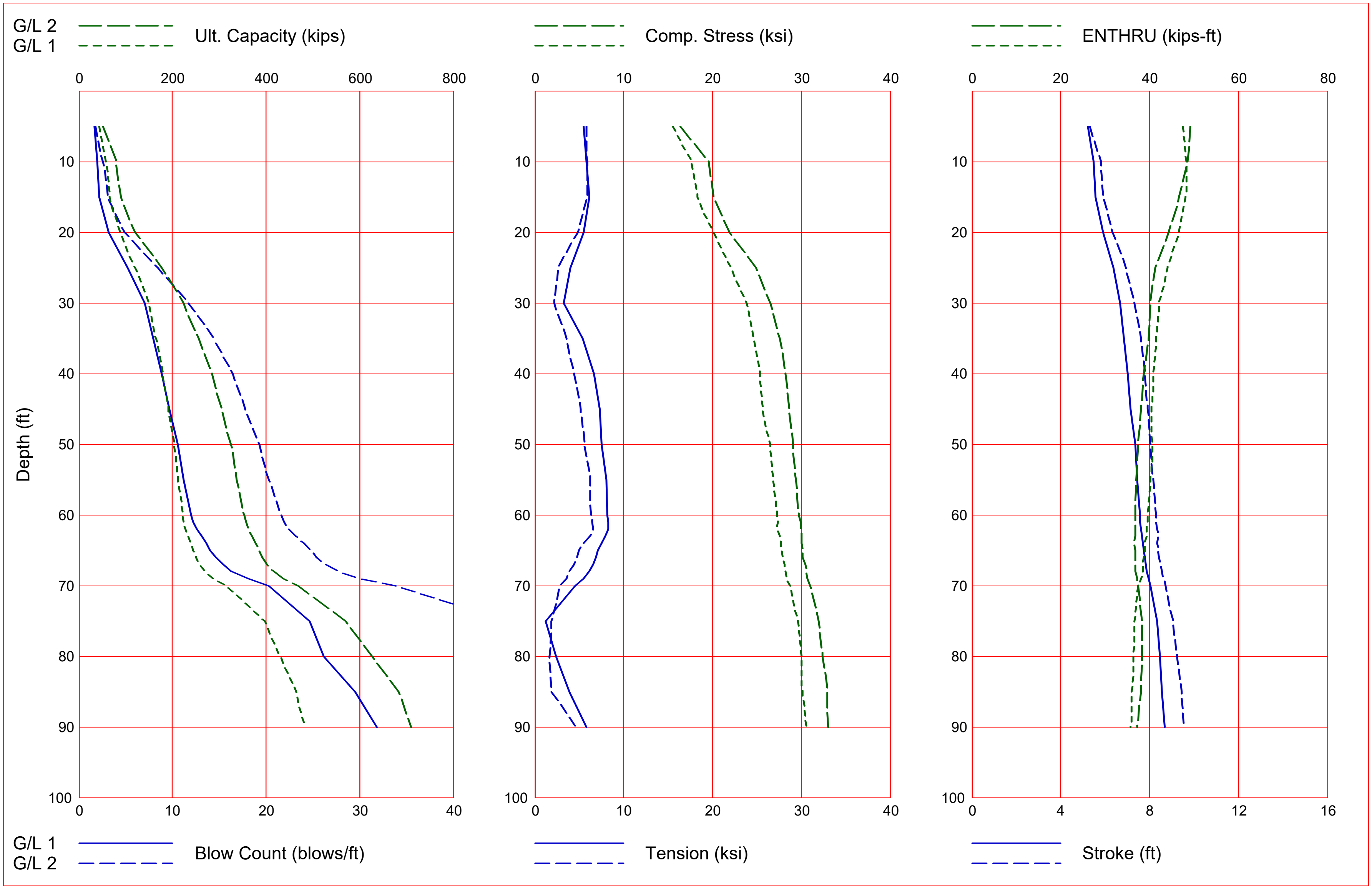
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	69.6	30.2	39.5	2.3	16.808	-2.199	5.06	51.5
10.0	74.8	49.9	24.9	2.6	18.652	-2.530	5.26	50.9
15.0	75.0	58.1	16.9	2.6	19.204	-2.908	5.29	50.7
20.0	127.8	74.0	53.8	5.6	22.854	-0.470	5.96	45.9
25.0	167.4	111.0	56.3	8.3	26.010	-1.192	6.40	43.4
30.0	193.4	143.1	50.3	10.2	27.603	-2.168	6.67	42.7
35.0	209.5	165.8	43.7	11.5	28.444	-2.300	6.87	42.1
40.0	224.5	185.0	39.6	12.7	29.195	-2.337	7.03	41.5
45.0	233.1	199.6	33.5	13.3	29.713	-2.256	7.19	41.3
50.0	243.7	213.4	30.3	13.9	30.202	-1.942	7.28	40.7
55.0	252.1	221.6	30.5	14.5	30.450	-2.774	7.37	40.2
60.0	263.4	231.5	31.9	15.3	30.856	-2.913	7.47	39.9
65.0	297.2	251.4	45.8	18.1	31.567	-1.190	7.67	39.9
70.0	549.7	279.6	270.1	76.6	34.141	-2.176	8.56	42.8
75.0	642.2	343.4	298.8	130.6	35.270	-2.168	8.95	43.7
80.0	487.0	408.4	78.7	40.5	34.050	-1.505	8.48	40.5
85.0	491.4	451.0	40.3	40.0	34.208	-1.203	8.53	39.7
90.0	527.1	464.9	62.1	49.8	34.665	-1.274	8.69	39.5
95.0	538.5	492.7	45.7	55.2	35.065	-1.146	8.80	38.9
100.0	551.8	507.2	44.6	61.0	35.572	-2.468	8.87	37.6

Total Continuous Driving Time 67.00 minutes; Total Number of Blows 2762 (starting at penetration 5.0 ft)

SK Geotechnical Corp
CPT-7, Crow Creek, 24" Pipe, I-36
Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Nov 19 2021
GRLWEAP Version 2010
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	44.3	37.1	7.2	1.7	15.549	-5.507	5.23	47.4
10.0	58.6	54.0	4.6	2.0	17.615	-5.801	5.47	48.4
15.0	65.0	61.9	3.1	2.2	18.313	-6.104	5.57	48.1
20.0	87.1	77.2	9.9	3.2	20.056	-5.440	5.91	46.7
25.0	120.2	109.9	10.3	5.2	22.150	-3.991	6.38	44.0
30.0	149.5	140.2	9.2	7.0	23.850	-3.229	6.68	42.2
35.0	165.2	157.2	8.0	7.9	24.589	-5.363	6.86	41.4
40.0	179.1	171.9	7.3	8.9	25.294	-6.715	7.02	40.8
45.0	190.9	184.8	6.1	9.7	25.704	-7.326	7.15	40.5
50.0	203.5	197.9	5.6	10.6	26.549	-7.522	7.36	40.6
55.0	211.6	206.1	5.6	11.2	26.847	-8.100	7.45	40.2
60.0	221.9	216.1	5.9	12.0	27.253	-8.204	7.56	39.6
61.0	224.3	217.6	6.7	12.2	27.318	-8.312	7.58	39.6
62.0	228.8	219.7	9.1	12.6	27.289	-8.290	7.61	39.4
63.0	234.0	223.7	10.3	13.1	27.608	-7.990	7.66	39.3
64.0	239.7	230.5	9.2	13.6	27.723	-7.479	7.70	39.0
65.0	244.3	235.9	8.4	14.0	27.741	-7.086	7.74	38.9
66.0	249.8	238.5	11.4	14.6	27.929	-6.835	7.78	38.8
67.0	257.6	241.2	16.4	15.4	28.102	-6.538	7.83	38.6
68.0	268.0	248.7	19.3	16.3	28.242	-6.105	7.89	38.4
69.0	287.3	256.7	30.6	18.1	28.366	-5.506	7.97	38.0
70.0	315.7	266.2	49.6	20.3	28.767	-4.560	8.05	37.5
75.0	398.3	343.4	54.8	24.7	29.573	-1.264	8.34	36.6
80.0	429.6	415.1	14.4	26.2	30.023	-2.379	8.46	36.4
85.0	464.2	456.7	7.4	29.5	30.184	-3.877	8.54	35.9
90.0	482.4	471.0	11.4	31.8	30.555	-5.823	8.68	35.7

Total Continuous Driving Time 25.00 minutes; Total Number of Blows 1048 (starting at penetration 5.0 ft)

SK Geotechnical Corp
CPT-7, Crow Creek, 24" Pipe, I-36

Nov 19 2021
GRLWEAP Version 2010

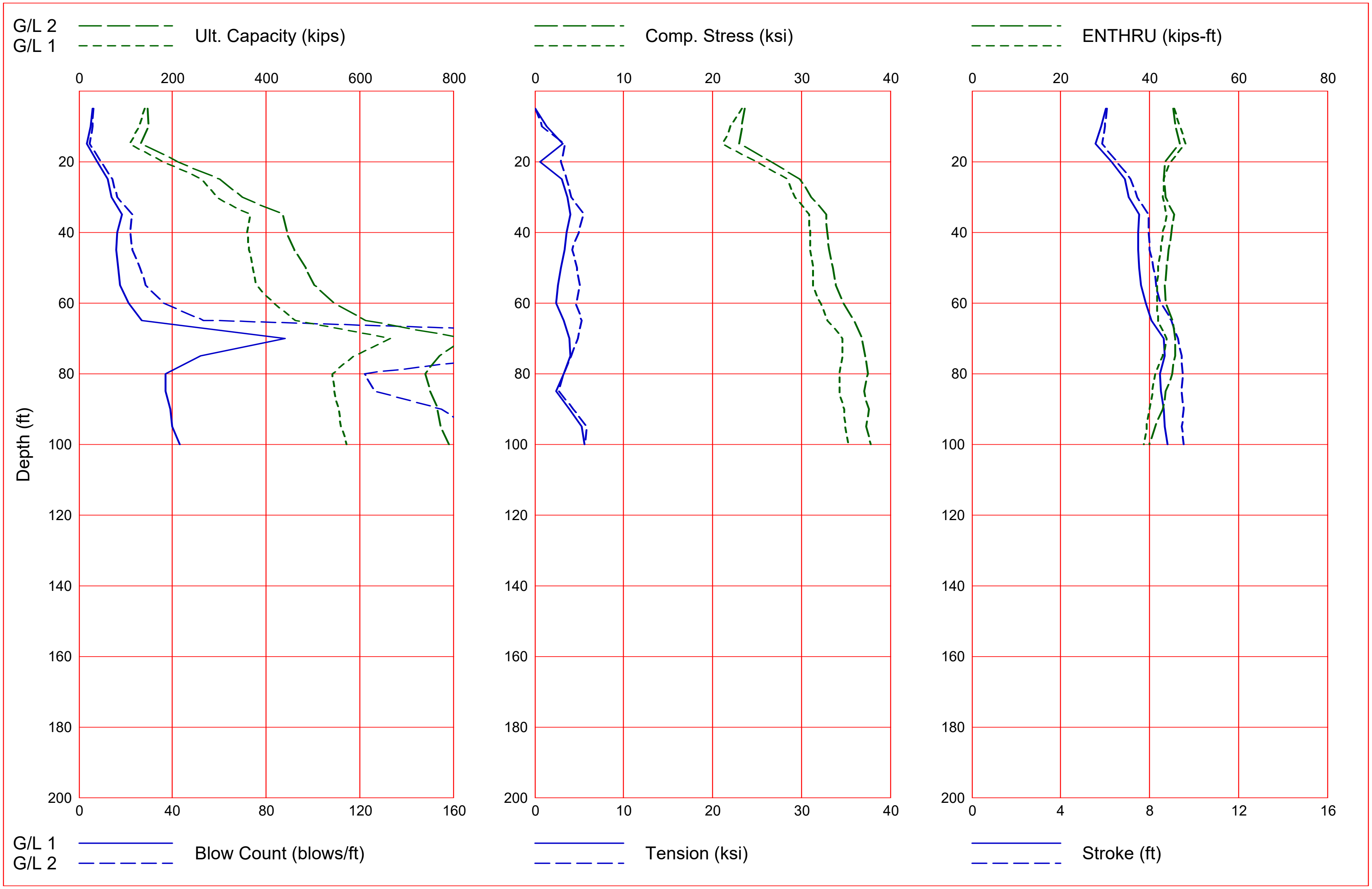
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	52.5	45.2	7.2	1.8	16.425	-5.785	5.30	49.1
10.0	79.5	74.9	4.6	2.6	19.595	-5.869	5.82	48.5
15.0	90.3	87.2	3.1	3.1	20.136	-5.948	5.92	46.6
20.0	120.9	111.0	9.9	4.9	21.938	-4.896	6.32	44.2
25.0	176.9	166.6	10.3	8.5	24.908	-2.630	6.92	41.3
30.0	223.9	214.6	9.2	11.7	26.516	-2.234	7.30	40.2
35.0	256.8	248.8	8.0	14.4	27.567	-3.617	7.61	39.7
40.0	284.7	277.5	7.3	16.5	28.216	-4.402	7.79	38.7
45.0	305.6	299.4	6.1	17.8	28.643	-5.203	7.92	38.0
50.0	325.7	320.1	5.6	19.3	29.032	-5.547	8.04	37.4
55.0	338.0	332.4	5.6	20.3	29.353	-6.233	8.16	37.0
60.0	353.2	347.3	5.9	21.6	29.750	-6.380	8.28	36.8
61.0	356.5	349.8	6.7	21.9	29.923	-6.476	8.30	36.8
62.0	362.0	352.9	9.1	22.4	29.935	-6.536	8.34	36.9
63.0	369.2	358.8	10.3	23.1	30.012	-6.209	8.38	36.9
64.0	378.3	369.1	9.2	24.1	30.068	-5.452	8.35	36.6
65.0	385.6	377.2	8.4	24.8	30.153	-4.951	8.40	36.7
66.0	392.3	380.9	11.4	25.4	30.139	-4.726	8.44	36.7
67.0	401.4	385.0	16.4	26.4	30.432	-4.448	8.49	36.8
68.0	415.6	396.3	19.3	27.7	30.578	-3.901	8.55	36.9
69.0	437.1	406.4	30.6	29.9	30.705	-3.540	8.63	37.2
70.0	469.0	419.4	49.6	33.9	31.037	-2.818	8.74	37.5
75.0	570.1	515.2	54.8	45.5	31.942	-1.862	9.08	38.3
80.0	627.1	612.6	14.4	54.9	32.368	-1.629	9.25	38.2
85.0	684.0	676.6	7.4	70.2	32.858	-1.872	9.43	38.0
90.0	708.9	697.5	11.4	77.0	33.048	-4.655	9.53	37.3

Total Continuous Driving Time 51.00 minutes; Total Number of Blows 2039 (starting at penetration 5.0 ft)

SK Geotechnical Corp
CPT-1, Crow Creek, 16" Pipe, I-36
Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Nov 19 2021
GRLWEAP Version 2010
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	140.4	33.0	107.5	5.9	23.289	0.000	6.05	45.5
10.0	128.5	66.7	61.8	5.1	22.023	-1.332	5.83	46.9
15.0	107.5	81.5	26.1	3.6	21.162	-3.118	5.56	48.0
20.0	180.9	94.4	86.5	7.7	24.872	-0.609	6.31	44.6
25.0	261.4	132.6	128.7	12.3	28.417	-2.991	6.91	43.1
30.0	294.7	183.6	111.1	13.9	29.279	-3.643	7.06	43.0
35.0	366.3	225.7	140.5	18.3	30.922	-4.049	7.55	43.9
40.0	360.1	274.7	85.4	16.6	30.980	-3.602	7.48	43.0
45.0	363.3	311.3	52.0	16.1	30.957	-3.334	7.47	42.5
50.0	371.0	328.1	43.0	16.9	31.266	-2.887	7.53	42.0
55.0	379.8	337.6	42.2	17.7	31.357	-2.580	7.60	41.6
60.0	415.6	347.6	68.0	21.2	32.208	-2.389	7.81	41.7
65.0	463.7	367.7	96.0	27.0	32.908	-3.249	8.10	41.9
70.0	664.8	407.1	257.7	87.9	34.630	-3.863	8.63	43.8
75.0	588.4	451.5	136.9	51.9	34.633	-3.957	8.67	43.0
80.0	540.9	494.3	46.6	36.9	34.307	-3.302	8.47	41.2
85.0	545.5	505.3	40.2	37.2	34.338	-2.448	8.52	40.6
90.0	555.1	517.7	37.4	39.1	34.801	-3.897	8.62	40.1
95.0	560.3	522.2	38.1	39.9	34.946	-5.261	8.70	39.4
100.0	573.1	530.1	43.0	43.0	35.382	-5.594	8.80	38.7

Total Continuous Driving Time 60.00 minutes; Total Number of Blows 2466 (starting at penetration 5.0 ft)

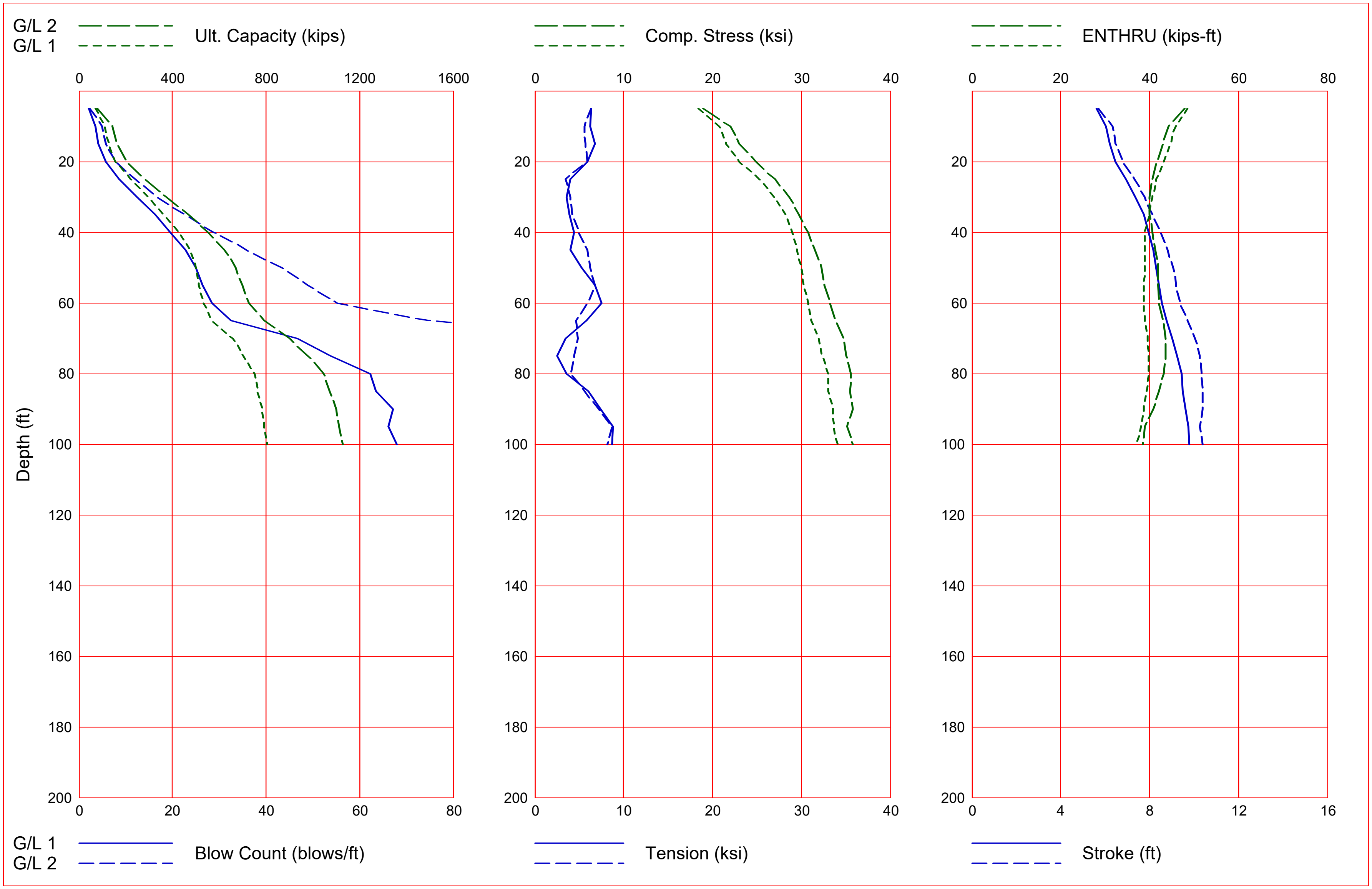
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	147.0	39.6	107.5	6.2	23.577	0.000	6.10	45.4
10.0	149.4	87.6	61.8	5.9	23.271	-0.815	6.01	45.8
15.0	132.6	106.6	26.1	4.7	23.033	-3.335	5.87	46.9
20.0	211.0	124.5	86.5	9.5	26.636	-2.888	6.49	43.5
25.0	301.7	173.0	128.7	14.3	29.851	-3.596	7.15	43.2
30.0	348.6	237.5	111.1	16.4	31.088	-4.087	7.43	43.6
35.0	435.5	294.9	140.5	23.0	32.774	-5.493	7.96	45.5
40.0	444.3	358.9	85.4	22.1	32.921	-4.969	7.96	44.8
45.0	460.2	408.3	52.0	22.7	33.088	-4.162	8.01	44.2
50.0	484.8	441.8	43.0	26.0	33.599	-4.761	8.16	43.8
55.0	503.1	460.9	42.2	28.6	33.897	-5.119	8.28	43.4
60.0	545.4	477.4	68.0	36.2	34.716	-4.667	8.50	43.7
65.0	612.5	516.5	96.0	53.1	35.880	-5.311	8.99	45.1
70.0	826.9	569.2	257.7	298.6	36.895	-4.813	9.30	45.8
75.0	771.0	634.1	136.9	186.9	37.120	-4.090	9.45	45.7
80.0	740.0	693.4	46.6	122.3	37.515	-3.306	9.51	45.1
85.0	750.0	709.8	40.2	126.2	37.116	-2.696	9.46	43.7
90.0	765.9	728.5	37.4	155.0	37.651	-4.293	9.53	42.9
95.0	773.3	735.2	38.1	166.1	37.321	-5.830	9.47	41.2
100.0	790.7	747.7	43.0	193.5	37.801	-5.728	9.53	40.0

Total Continuous Driving Time 182.00 minutes; Total Number of Blows 7087 (starting at penetration 5.0 ft)

SK Geotechnical Corp
CPT-1, Crow Creek, 24" Pipe, I-36
Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Nov 19 2021
GRLWEAP Version 2010
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	69.2	49.5	19.7	2.1	18.379	-6.322	5.61	48.5
10.0	111.4	100.1	11.3	3.6	20.712	-6.225	6.05	45.8
15.0	127.0	122.2	4.8	4.1	21.544	-6.742	6.20	44.7
20.0	157.5	141.6	15.9	5.7	22.984	-5.928	6.47	43.1
25.0	222.6	199.0	23.6	8.7	25.229	-3.970	6.95	41.5
30.0	295.8	275.5	20.4	12.4	26.984	-3.543	7.36	40.6
35.0	364.4	338.6	25.8	16.4	28.171	-3.918	7.76	39.9
40.0	427.8	412.1	15.7	19.6	28.945	-4.467	7.96	39.0
45.0	476.6	467.0	9.5	22.7	29.451	-4.051	8.16	39.0
50.0	500.0	492.2	7.9	25.1	29.998	-5.333	8.31	38.9
55.0	514.2	506.5	7.7	26.5	30.257	-6.793	8.42	38.8
60.0	534.0	521.5	12.5	28.4	30.766	-7.548	8.56	38.8
65.0	569.3	551.6	17.6	32.6	31.138	-5.797	8.77	39.0
70.0	658.0	610.7	47.3	46.6	31.989	-3.480	9.02	39.5
75.0	702.5	677.3	25.1	53.7	32.407	-2.523	9.24	39.8
80.0	750.1	741.6	8.6	62.3	33.021	-3.534	9.43	39.8
85.0	765.4	758.0	7.4	63.4	33.053	-6.076	9.51	39.3
90.0	783.5	776.7	6.9	67.1	33.573	-7.412	9.63	38.7
95.0	790.5	783.5	7.0	66.1	33.631	-8.803	9.74	38.0
100.0	803.1	795.2	7.9	68.0	34.067	-8.711	9.80	37.0

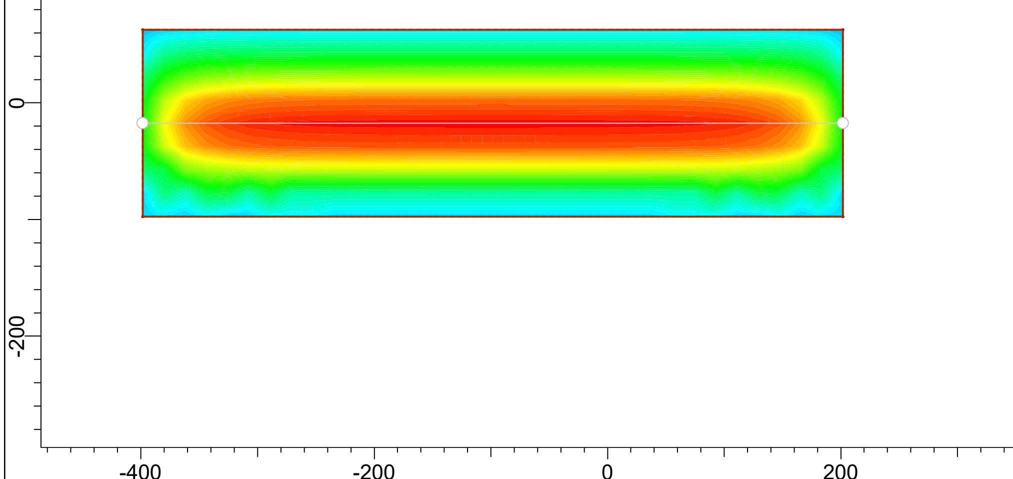
Total Continuous Driving Time 76.00 minutes; Total Number of Blows 3001 (starting at penetration 5.0 ft)

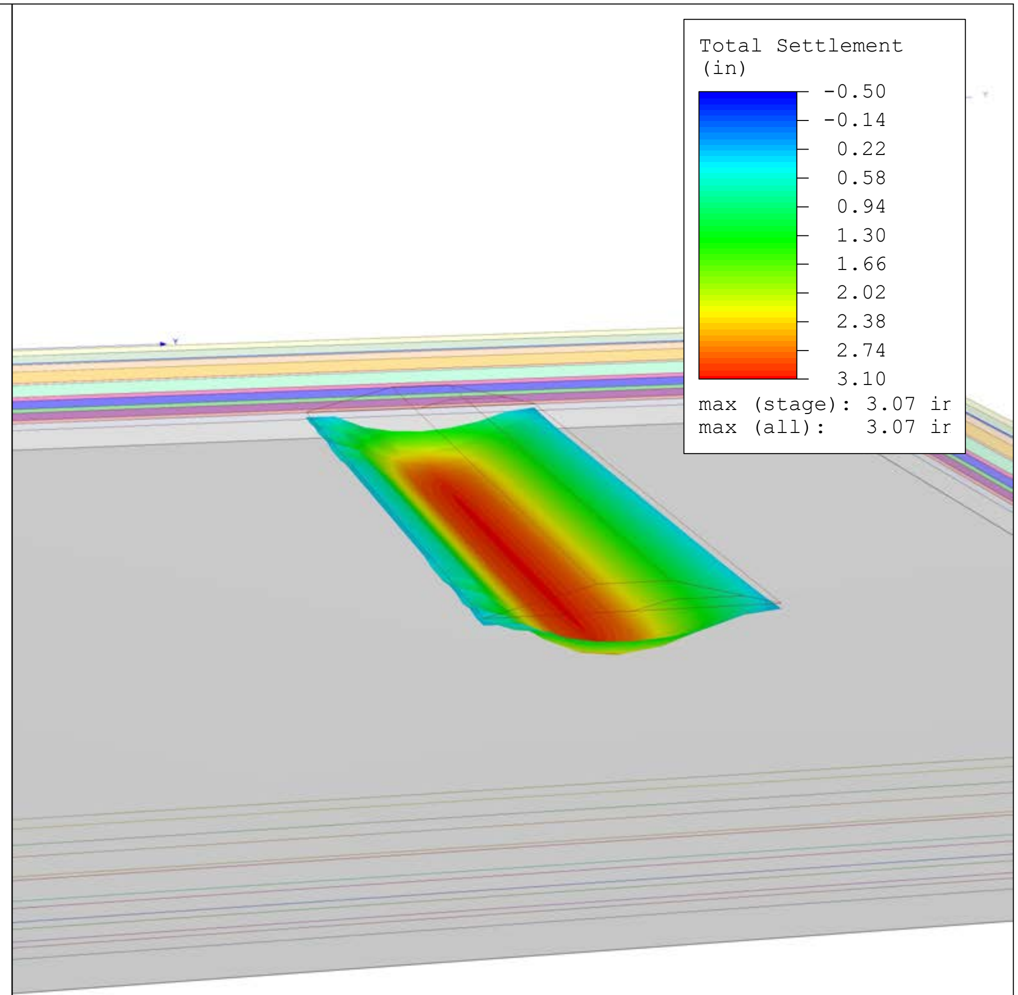
Gain/Loss 2 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.0	79.1	59.4	19.7	2.3	18.943	-6.299	5.71	47.9
10.0	142.8	131.5	11.3	4.9	22.036	-5.564	6.33	44.2
15.0	164.7	159.9	4.8	5.8	22.963	-5.657	6.48	42.9
20.0	202.6	186.7	15.9	7.8	24.862	-5.907	6.80	41.7
25.0	283.1	259.5	23.6	12.0	27.014	-3.493	7.32	40.7
30.0	376.7	356.3	20.4	16.7	28.632	-4.029	7.78	39.9
35.0	468.3	442.5	25.8	22.5	29.694	-4.247	8.13	39.9
40.0	554.1	538.4	15.7	28.9	30.802	-4.982	8.50	40.7
45.0	622.0	612.5	9.5	35.8	31.556	-5.876	8.80	41.3
50.0	670.7	662.8	7.9	43.5	32.284	-6.270	9.07	42.0
55.0	699.2	691.5	7.7	49.0	32.637	-6.773	9.20	41.9
60.0	728.6	716.1	12.5	55.1	33.175	-5.889	9.38	42.1
65.0	792.5	774.9	17.6	74.8	33.902	-4.622	9.72	43.0
70.0	901.2	853.9	47.3	123.8	34.707	-4.855	10.03	43.7
75.0	976.4	951.3	25.1	190.7	35.092	-4.421	10.24	43.7
80.0	1048.8	1040.2	8.6	239.6	35.568	-4.035	10.35	43.2
85.0	1072.2	1064.8	7.4	234.5	35.488	-5.576	10.40	42.2
90.0	1099.8	1092.9	6.9	254.0	35.788	-7.157	10.41	40.9
95.0	1109.9	1103.0	7.0	250.5	35.194	-8.707	10.26	38.9
100.0	1129.6	1121.7	7.9	256.3	35.741	-8.176	10.38	38.4

Total Continuous Driving Time 237.00 minutes; Total Number of Blows 8895 (starting at penetration 5.0 ft)

Material Name	Unit Weight (tons/ft3)	Es (tons/ft2)	Eur (tons/ft2)	Material Type	Cc	Cr	OCR	e0
1- Very Dense Stiff Soil	0.067	1633.8	1633.8	-	-	-	-	-
2- Clay and Silty Clay	0.057	-	-	Non-Linear	0.09	0.009	3.8	0.5
3- Clay and Silty Clay	0.06	-	-	Non-Linear	0.09	0.009	3.1	0.5
4- Silty Sand and Sandy Silt	0.058	506	506	-	-	-	-	-
5- Sand and Silty Sand	0.062	890.4	890.4	-	-	-	-	-
6- Clay and Silty Clay	0.052	-	-	Non-Linear	0.09	0.009	1.2	0.5
7- Clay and Silty Clay	0.064	-	-	Non-Linear	0.09	0.009	2.8	0.5
8- Clay	0.061	-	-	Non-Linear	0.22	0.022	1.6	0.85
9- Clay	0.064	-	-	Non-Linear	0.22	0.022	2.3	0.85
10- Clay	0.066	-	-	Non-Linear	0.22	0.022	3.1	0.85
11- Clay	0.064	-	-	Non-Linear	0.22	0.022	1.9	0.85
12- Clay	0.065	-	-	Non-Linear	0.22	0.022	2.1	0.85
13- Clay	0.062	-	-	Non-Linear	0.22	0.022	1.2	0.85



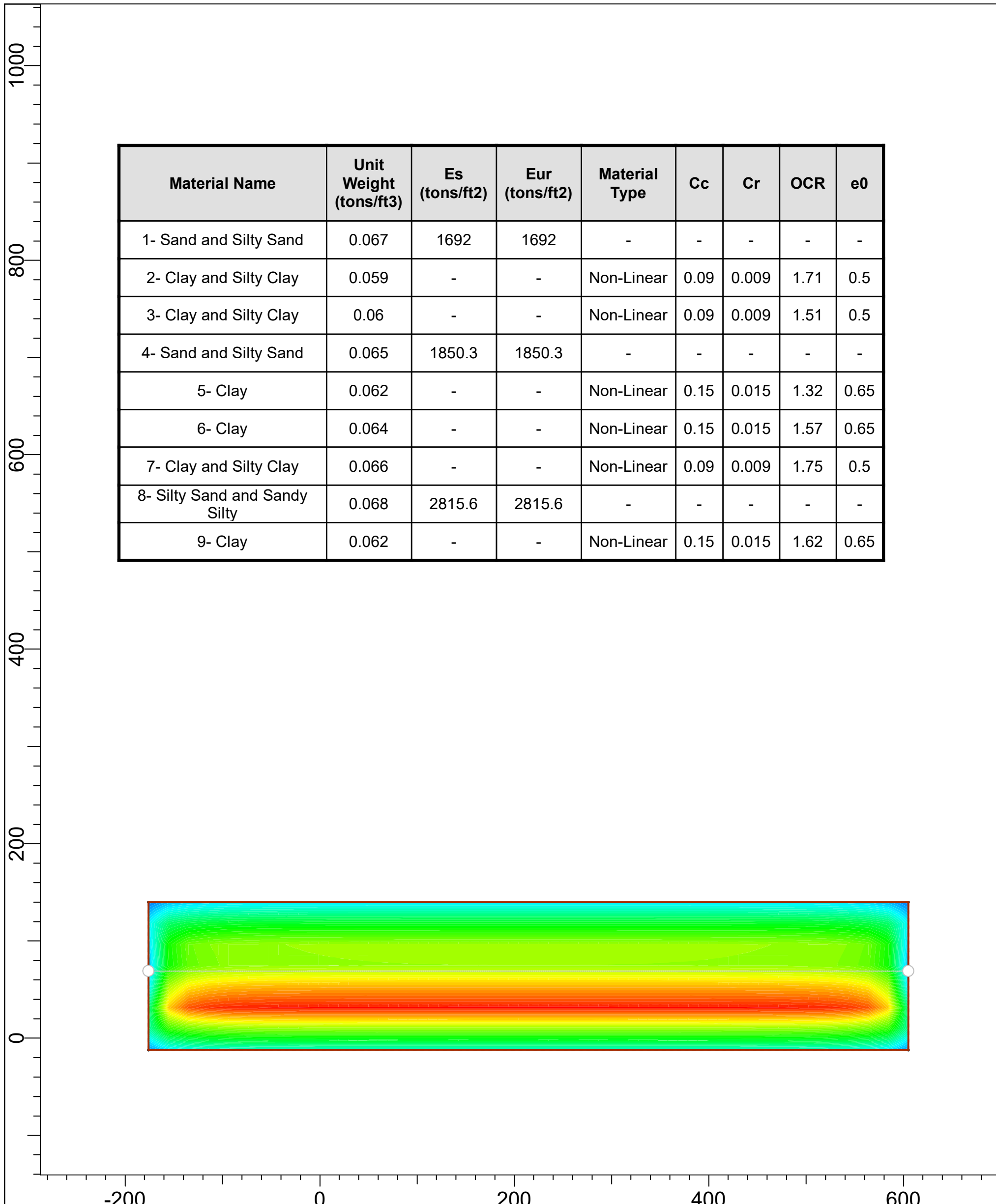


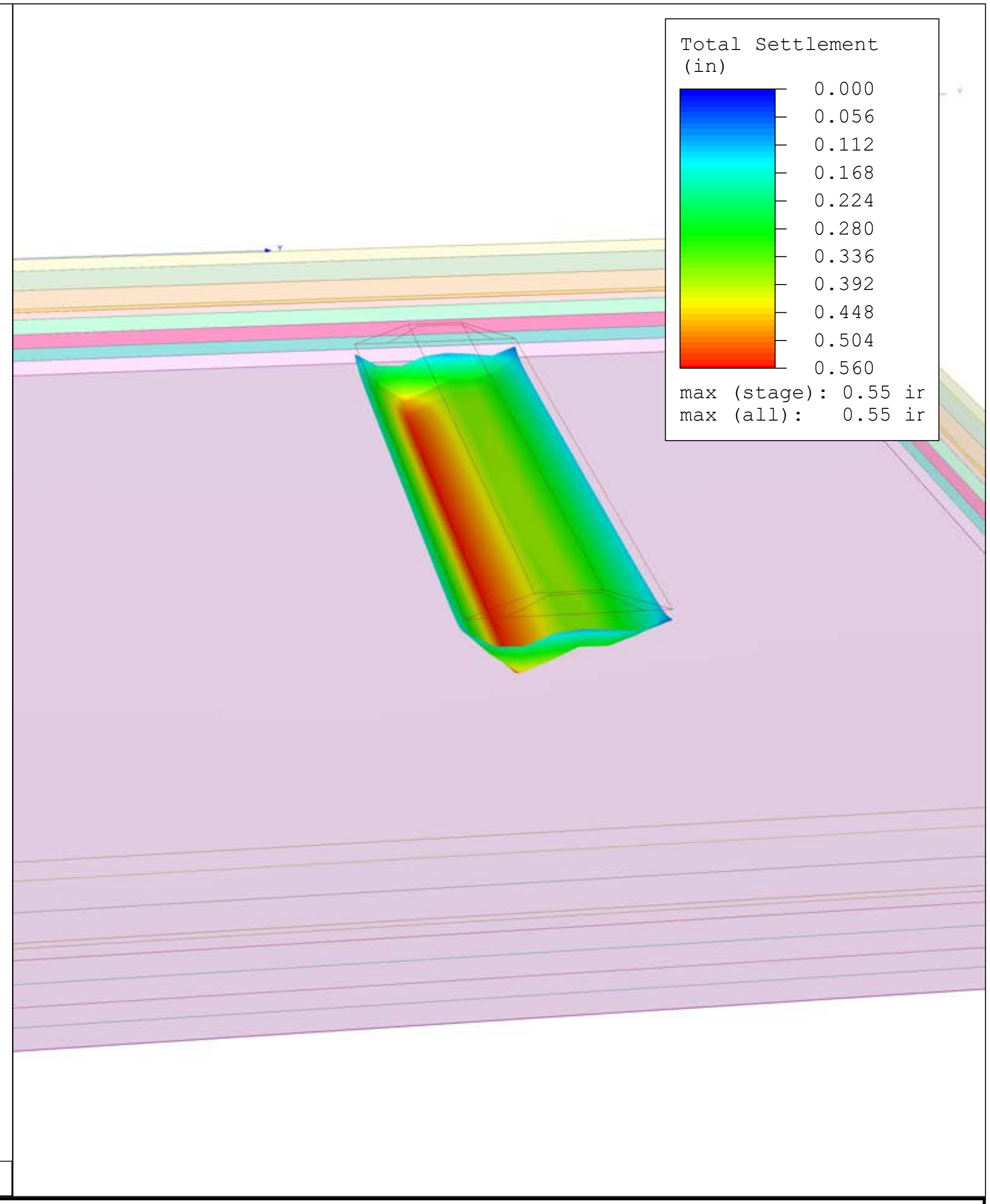
SK GEOTECHNICAL

SETTLE3 5.010

Project	21-4041S Ninepipe Feasibility Study
Location	Ninepipe Reservoir - North Approach
Drawn By / Checked By	Samuel A. Michalak / Cory G. Rice, PE
Company	SK Geotechnical
Date	11/24/2021
Cone Penetration Test ID	CPT-2

Material Name	Unit Weight (tons/ft3)	Es (tons/ft2)	Eur (tons/ft2)	Material Type	Cc	Cr	OCR	e0
1- Sand and Silty Sand	0.067	1692	1692	-	-	-	-	-
2- Clay and Silty Clay	0.059	-	-	Non-Linear	0.09	0.009	1.71	0.5
3- Clay and Silty Clay	0.06	-	-	Non-Linear	0.09	0.009	1.51	0.5
4- Sand and Silty Sand	0.065	1850.3	1850.3	-	-	-	-	-
5- Clay	0.062	-	-	Non-Linear	0.15	0.015	1.32	0.65
6- Clay	0.064	-	-	Non-Linear	0.15	0.015	1.57	0.65
7- Clay and Silty Clay	0.066	-	-	Non-Linear	0.09	0.009	1.75	0.5
8- Silty Sand and Sandy Silty	0.068	2815.6	2815.6	-	-	-	-	-
9- Clay	0.062	-	-	Non-Linear	0.15	0.015	1.62	0.65



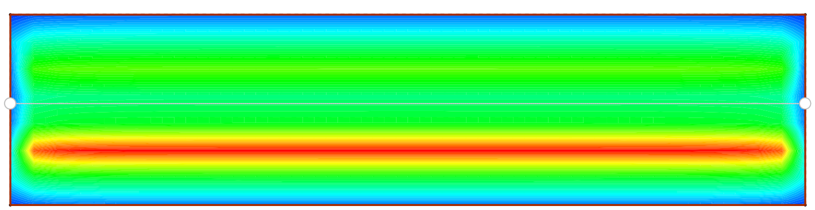


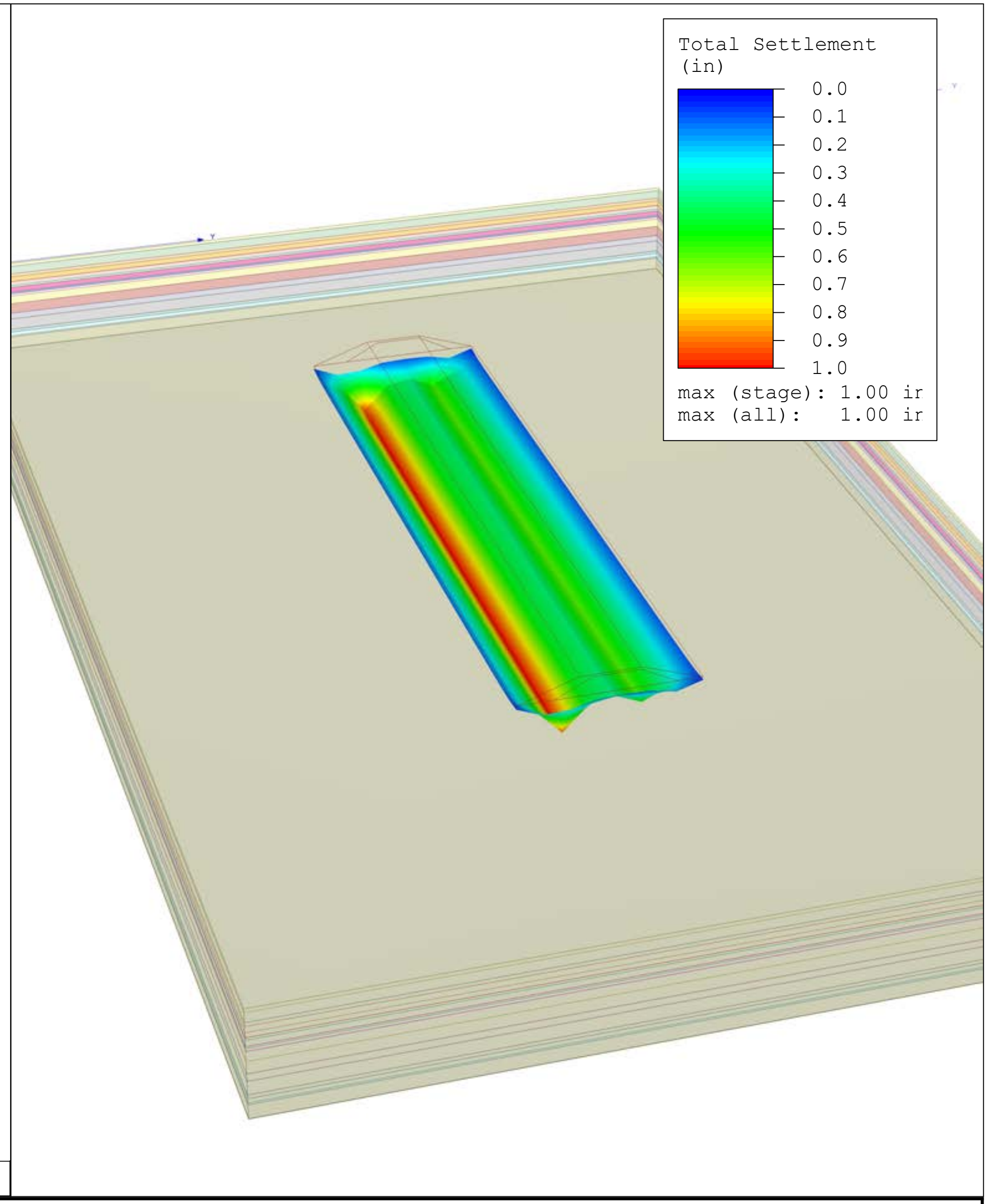
Project	21-4041S Ninepipe Feasibility Study
Location	Kettle Pond 1 - South Approach
Drawn By / Checked By	Samuel A. Michalak / Cory G. Rice, PE
Company	SK Geotechnical
Date	11/24/2021
Cone Penetration Test ID	CPT-3A

SK GEOTECHNICAL

SETTLE3 5.010

Material Name	Unit Weight (tons/ft3)	Es (tons/ft2)	Eur (tons/ft2)	Material Type	Cc	Cr	OCR	e0
1- Sand	0.063	890.5	890.5	-	-	-	-	-
2- Clay and Silty Clay	0.056	-	-	Non-Linear	0.09	0.009	3.23	0.5
3- Clay	0.056	-	-	Non-Linear	0.22	0.022	1.85	0.85
4- Clay and Silty Clay	0.61	-	-	Non-Linear	0.09	0.009	3.71	0.5
5- Clay	0.059	-	-	Non-Linear	0.22	0.022	1.69	0.85
6- Silty Sand and Sandy Silt	0.064	1300	1300	-	-	-	-	-
7- Clay	0.058	-	-	Non-Linear	0.22	0.022	1.38	0.85
8- Clay and Silty Clay	0.057	-	-	Non-Linear	0.09	0.009	1.23	0.5
9- Clay	0.06	-	-	Non-Linear	0.15	0.015	1.47	0.65
10- Clay and Silty Clay	0.058	-	-	Non-Linear	0.09	0.009	1.27	0.5
11- Clay and Silty Clay	0.06	-	-	Non-Linear	0.09	0.009	1.2	0.5
12- Clay	0.061	-	-	Non-Linear	0.15	0.015	1.38	0.65
13- Clay	0.067	-	-	Non-Linear	0.15	0.015	2.71	0.65
14- Very Dense/Stiff Soil	0.068	-	-	Non-Linear	0.09	0.009	3.49	0.5
15- Very Dense/Stiff Soil	0.068	-	-	Non-Linear	0.09	0.009	3.85	0.5
16- Clay	0.067	-	-	Non-Linear	0.15	0.015	1.89	0.65
17- Very Dense/Stiff Soil	0.068	-	-	Non-Linear	0.09	0.009	3.79	0.5

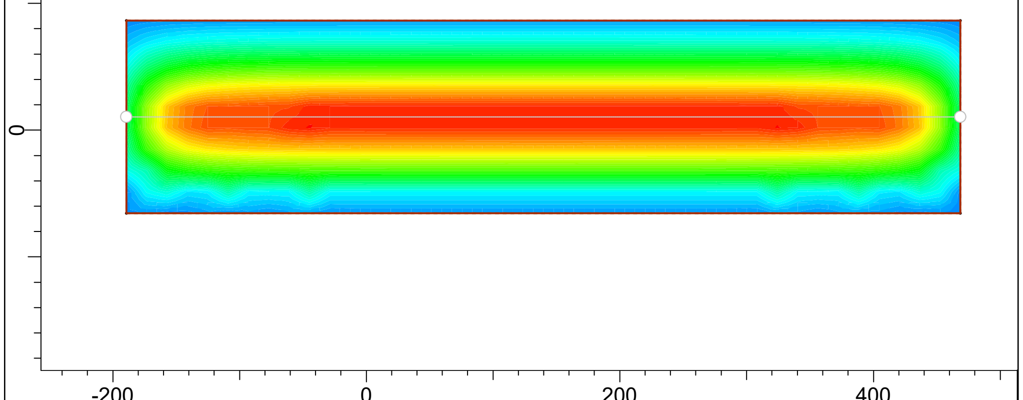


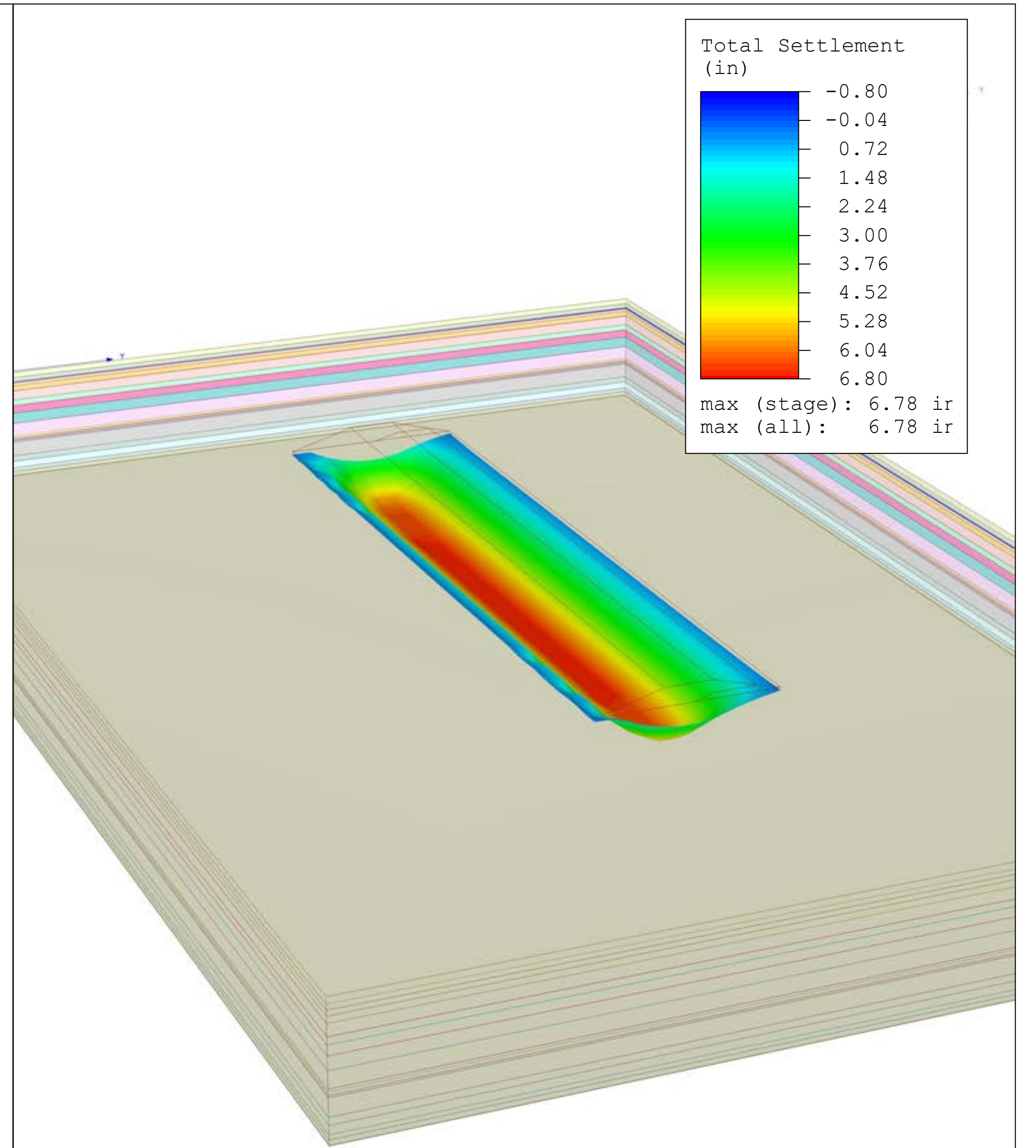


Project	21-4041S Ninepipe Feasibility Study		
Location	Kettle Pond 2 - North Approach		
Drawn By / Checked By	Samuel A. Michalak / Cory G. Rice, PE	*Company*	SK Geotechnical
Date	11/24/2021	*Cone Penetration Test ID*	CPT-6

SETTLE3 5.010

Material Name	Unit Weight (kips/ft3)	Es (ksf)	Eur (ksf)	Material Type	Cc	Cr	OCR	e0
1- Sand and Silty Sand	0.13	1114.7	1114.7	-	-	-	-	-
2- Clay and Silty Clay	0.116	-	-	Non-Linear	0.09	0.009	5	0.5
3- Sand and Silty Sand	0.106	261.8	261.8	-	-	-	-	-
4- Clay and Silty Clay	0.102	-	-	Non-Linear	0.09	0.009	1.2	0.5
5- Clay and Silty Clay	0.124	-	-	Non-Linear	0.09	0.009	3.2	0.5
6- Clay	0.12	-	-	Non-Linear	0.15	0.015	1.6	0.65
7- Clay	0.114	-	-	Non-Linear	0.15	0.015	1.2	0.65
8- Clay	0.11	-	-	Non-Linear	0.22	0.022	1.2	0.85
9- Clay	0.106	-	-	Non-Linear	0.22	0.022	1.2	0.85
10- Clay and Silty Clay	0.122	-	-	Non-Linear	0.09	0.009	1.2	0.5
11- Clay and Silty Clay	0.108	-	-	Non-Linear	0.09	0.009	1.2	0.5
12- Silty Sand and Sandy Silt	0.122	1131.3	1131.3	-	-	-	-	-
13- Silty Sand and Sandy Silt	0.13	1871.2	1871.2	-	-	-	-	-
14- Clay and Silty Clay	0.112	-	-	Non-Linear	0.09	0.009	1.2	0.5
15- Clay	0.12	-	-	Non-Linear	0.15	0.015	1.2	0.65
16- Clay	0.114	-	-	Non-Linear	0.15	0.015	1.2	0.65
17- Clay	0.114	-	-	Non-Linear	0.15	0.015	1.2	0.65





SK GEOTECHNICAL	*Project* 21-4041S Ninepipe Feasibility Study		
	Location Crow Creek Crossing - South Approach		
	Drawn By / Checked By Samuel A. Michalak / Cory G. Rice, PE	*Company* SK Geotechnical	
SETTLE3 5.010	*Date* 11/24/2021	*Cone Penetration Test ID* CPT-7	