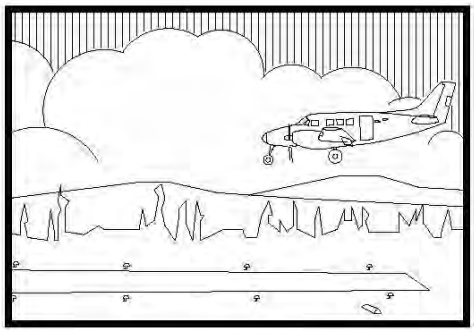
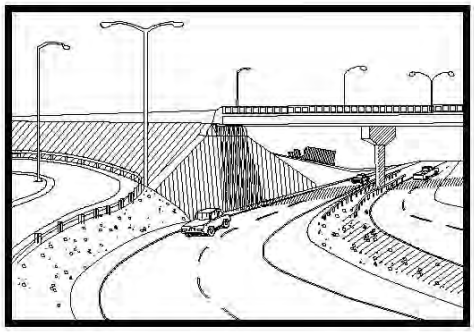
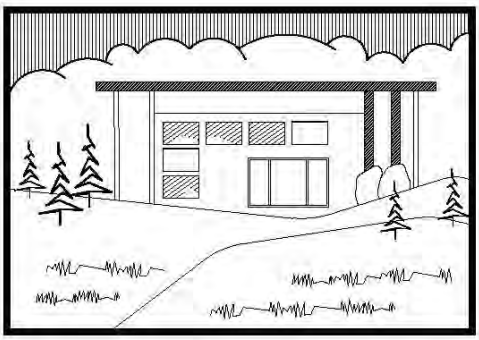
DESIGN STUDY REPORT

DALTON HIGHWAY MP 0-9 RECONSTRUCTION

Z609110000/0652016

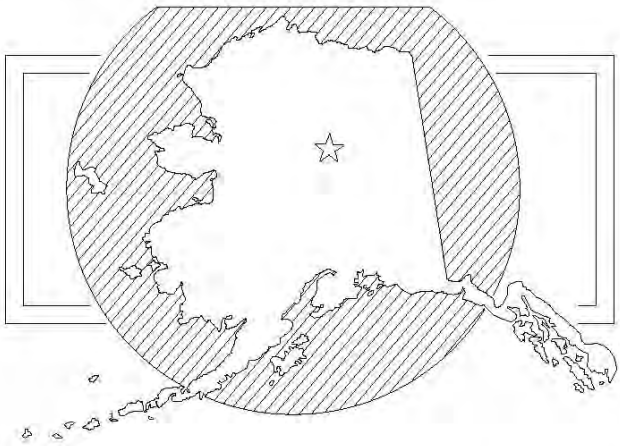






STATE OF ALASKA

Department of Transportation and Public Facilities



NORTHERN REGION

August 2016

DESIGN APPROVAL

DALTON HIGHWAY MP 0-9 RECONSTRUCTION

PROJECT NO. Z609110000/0652016

Requested by:

Barry L. Hooper, P.E. — Date 8/5/16
PD&E Group Chief
Northern Region

Design Approval Granted:

Sarah E. Schacher, P.E. — Date 8/9/2016
Preconstruction Engineer
Northern Region

Distribution: NR Design Directive 16-02 Distribution

DESIGN STUDY REPORT
FOR

DALTON HIGHWAY MP 0-9 RECONSTRUCTION

PROJECT NO. Z609110000/0652016

PREPARED BY: Andrew B. Wells, P.E.

ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
NORTHERN REGION DESIGN AND ENGINEERING SERVICES
AUGUST, 2016

DALTON HIGHWAY MP 0-9 RECONSTRUCTION
PROJECT NO. Z609110000/0652016

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INTRODUCTION/HISTORY

The Alaska Department of Transportation and Public Facilities (DOT&PF), in cooperation with the Federal Highway Administration (FHWA) proposes to reconstruct the first nine miles of the James W. Dalton Highway (known simply as the Dalton Highway).

The Dalton Highway is classified as a rural principal arterial and is part of the National Highway System (NHS) extending from north of Fairbanks to Deadhorse. The Dalton Highway provides the only vehicle access route across Northern Alaska and serves as a critical supply route between commercial and industrial centers. The original roadway was built between 1971 and 1974 as a private haul route to support the Trans-Alaska Pipeline System (TAPS) and was constructed to the former State of Alaska Department of Highways secondary road standards. It was opened to the public in 1994 and currently supports heavy truck and tourism traffic. DOT&PF anticipates an increase in future traffic with continued industrial development, regional tourism, and renewed interest in the Alaska natural gas pipeline. This reconstruction project will upgrade this existing TAPS access route to arterial standards, improving safety and service.

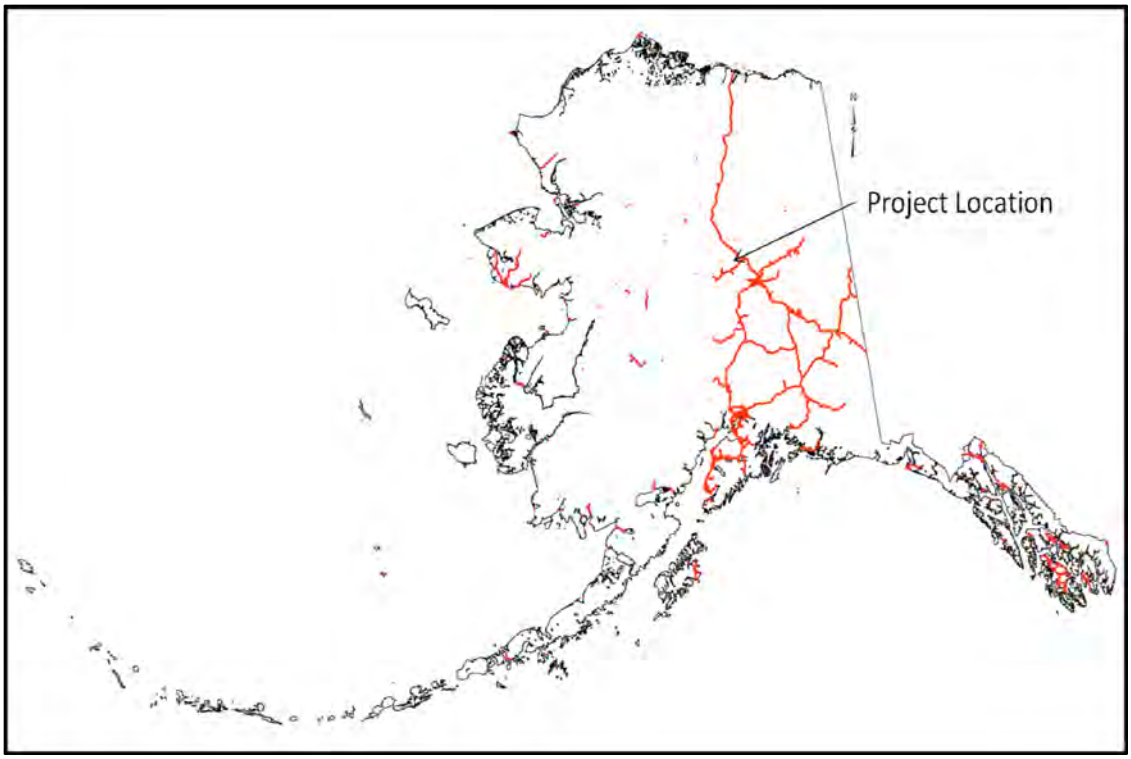


Figure 1

PROJECT DESCRIPTION

The project is located within T8N, R7W, Section 12 and T8N, R6W, Sections 7, 16, 17, 18, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 35, and 36; and T8N, R5W Section 29, 30, 31 Fairbanks Meridian, USGS Quad Maps Livengood C-4 and C-5. The section of the Dalton to be reconstructed begins at Latitude 65°29'21.32"N, Longitude -148°39'17.05"W and ends at Latitude 65°32'22.23"N, Longitude -148°53'4.61"W. See Figure 2 for a location overview.

There is need for the project corridor to be updated to current safety standards as more than a third of the existing alignment has substandard grades and curves that need correction. The geometry of the roadway makes truck travel difficult due to steep grades and sharp curves, which are considerable for a route with trucks comprising 60% of its total traffic volume. The existing geometry also makes maintenance efforts difficult. Due to the surrounding mountainous terrain of this segment of the existing Dalton Highway, a realignment of the first 7.5 miles of the highway to the nearby valley bottom is the most practicable option for reconstructing this roadway in conformance with current design standards.

The proposed realignment portion of the project departs from the Elliott highway and travels down the West Fork Tolovana River Valley and Lost Creek Valley, staying near the valley bottom until rising again to tie back into MP6.5 of the existing Dalton Highway, in which the road continues to climb until reaching the end of the project, near the summit of 9 Mile Hill. The proposed road varies in elevation from 450' to 1450'.

Proposed improvements for this project are described in detail throughout this report. These improvements include: corrections to horizontal and vertical geometry, road widening, installation of a new bridge at the Lost Creek crossing, new culverts, new signage, constructing vehicle pullouts, removal of the existing culverts at Lost Creek, and existing highway abandonment including retaining portions to provide access to adjacent land facilities.

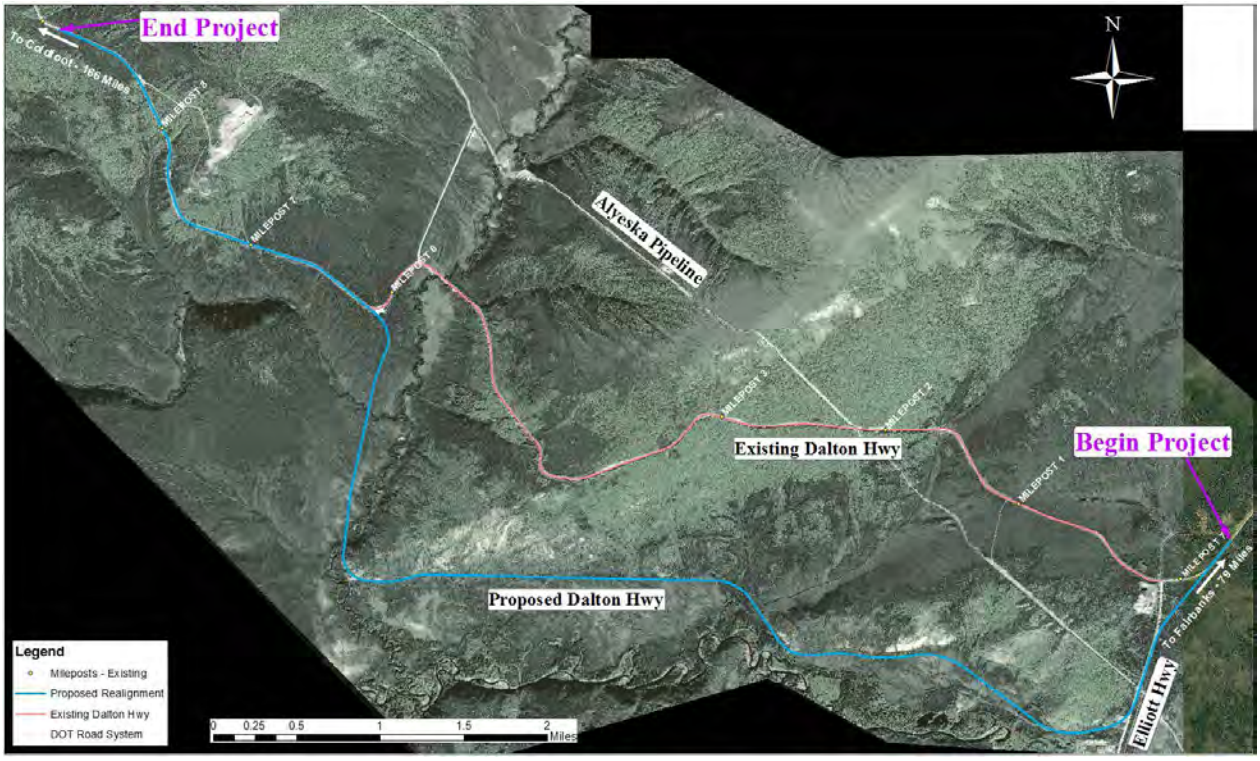


Figure 2

DESIGN STANDARDS

The source of the general standards upon which this project's design is based is as follows:

Agency	Standard
Alaska Department of Transportation and Public Facilities (DOT&PF)	• Highway Preconstruction Manual (PCM) • Alaska Sign Design Specifications (ASDS), 2015 • Alaska Highway Drainage Manual, 2006 • Alaska Traffic Manual, 2016 (ATM)
American Association of State Highway and Transportation Officials (AASHTO)	• A Policy on Geometric Design of Highways and Streets, 2001 (Green Book) • Roadside Design Guide, 2011 • LRFD Bridge Design Specifications, 2014 Edition, with latest interim specifications • Guide Specifications for LRFD Seismic Bridge Design, 2011 Edition, with latest interim specifications

The Design Criteria for this project are included in Appendix A. A design speed of 50 mph was selected for consistency with the PCM and local conditions and for adherence to the May 27, 1997 Pre-Construction Engineer's Design Directive adopting Design Speeds on the Dalton Highway.

DESIGN EXCEPTIONS AND DESIGN WAIVERS

A design exception for the Grade criteria (Maximum Allowable) was requested and approved on May 26, 2016 for two grades on the existing alignment near MP 8.5. See Appendix G.

DESIGN ALTERNATIVES

Slope Treatments and Clear Zone

The Roadside Safety Analysis Program Version 3.0 (RSAP V3.0) was used to evaluate several fill slope alternatives at varying embankment heights to determine whether or not it is cost effective to provide protection from steep slopes within the clear zone. This comparison was based upon the rollover hazard specifically, as that is the only hazard directly dependent on changes in cross-slopes; treatments for other hazards present in the 14' clear-zone or runout path will be evaluated using RSAP V3.0 on a case by case basis as the design progresses. The "no-build" baseline condition used in the analysis was a 2:1 foreslope initiated at the edge of shoulder and continuing until catching with the existing ground. This 2:1 fill foreslope is the maximum as recommended by the Northern Region Materials Section (NRMS). The steep slope hazard protections used for comparisons were either:

a) provide a recoverable slope within the clear zone,
b) provide a traversable slope with clear runout or
c) provide guardrail at the edge of the shoulder.

See Appendix D for more details on the inputs and assumptions used in this analysis.

Surfacing: Gravel VS Pavement

Two surfacing alternatives were compared for this project: pavement and gravel. The beginning of the project is currently paved and the end is gravel. Benefits of pavement over gravel include reduced maintenance costs, smoother driving surface if embankment is stable, improved delineation and major reduction in traffic-generated dust; drawbacks include a significantly higher upfront cost and sensitivity to embankment movement. The benefits and drawbacks of gravel are essentially the opposite of those from pavement, respectively.

PREFERRED DESIGN ALTERNATIVE

Slope Treatments and Clear Zone

The results of the RSAP V3.0 analysis indicate that for embankment heights up to 8', providing a traversable (3:1) foreslope with clear runout is a cost effective treatment. For embankment heights 8' and above slope treatments are not cost effective and the "No-Build" alternative of 2:1 foreslopes initiated at the shoulder will be used. Other design considerations, such as incorporating geotechnical or drainage related features, may result in exceptions to these preferred slopes. Guardrail was not cost-effective at any expected embankment height. See Appendix D for further details regarding this cost effective analysis.

Surfacing: Gravel VS Pavement

Gravel was chosen as the preferred alternative for surfacing for several reasons:

1. As this reconstruction project will result in substantial changes to the roadway embankment, including road widening where the alignment follows the existing Dalton and Elliott highways, and over 7 miles of the final embankment constructed on previously undisturbed ground, there is a the high potential for roadway settlement in amounts well beyond the capacities of pavements and maintaining a paved surface is much more costly than gravel while the embankment stabilizes. This is the primary reason for choosing gravel over pavement.
2. Gravel has a significantly less upfront cost than pavement.
3. Pavement aggregates are very limited in this region which would result in a higher than typical material costs for initial construction and continued maintenance.

3R ANALYSIS

Not applicable. This is a reconstruction project.

TRAFFIC ANALYSIS

No specific traffic analysis was performed for this project. The approved project design criteria with traffic data is included in Appendix A. The 2010 traffic counts show an average daily

traffic (ADT) of 330 vehicles through the project corridor, with an estimated annual traffic growth rate of 2%, resulting in an estimated ADT of 600 vehicles in 2040 and a design hourly volume (DHV) of 16%. The traffic mix is estimated to include 60% trucks, as measured from the traffic class counter on the Dalton Highway at the Yukon River Bridge.

The project corridor has six recorded crashes during the 5-year reporting period from 2007-2011; the 5-year crash data is included in Appendix C.

HORIZONTAL/VERTICAL ALIGNMENT

The Dalton Highway was originally designed to secondary road standards in the early 1970s, and as a result, a large number of horizontal and vertical alignment geometry components do not meet the current design standards. This proposed reconstruction project, with the approximately seven miles of realignment, results in a final roadway with only two grades that will not meet the maximum allowable design standard per the accepted design criteria; details regarding these two grades can be found in the approved Design Exception memo in Appendix G.

TYPICAL SECTIONS

The typical sections may vary throughout the project depending on subgrade conditions and final geotechnical recommendations; examples of these variations include slope flattening, the use of thermal berms, insulation, geotextile(s) and/or ACE. The expected predominate section will consist of the material layers and slope geometries as shown in the typical sections in Appendix H and as described below.

A 36’ wide top was selected to be consistent with new construction and other projects in the vicinity. Generally, embankment foreslopes in fill sections will be 3:1 (H:V) for embankment heights up to 8’, and 2:1 for embankment heights 8’ and greater, as discussed previously in the Design Alternatives section regarding Slope Treatments and Clear Zone. Cut slopes will generally consist of an 8’ wide 3:1 foreslope connecting to an 8’ wide, -25:1 (-4%) flat bottom ditch and a 1.5:1 backslope. Exceptions to the cut section ditch widths and backslopes are expected and will follow the final geotechnical recommendations from the NRMS. The 30’ wide left ditch and right ditch daylighting to catch, as shown in Typical Section 3, will be used between the stations indicated and will provide a scenic overview of the approaching valley for southbound users.

PAVEMENT DESIGN

Paving is not proposed for this reconstruction project.

The preferred gravel top structure of the proposed typical section is similar to that of the Dalton Highway 9 Mile Hill North and Dalton Highway MP 11-18 Reconstruction projects, both of which are exposed to essentially the same traffic loadings, and of which the structural sections of both projects were evaluated considering several published California Bearing Ration (CBR) design models. Refer to documentation from those projects for details on the evaluation and corresponding typical section details.

PRELIMINARY BRIDGE LAYOUT

A bridge is planned for the new realignment crossing at Lost Creek. With an estimated design flow (Q50) of 1940cfs and designation as fish bearing, a culvert is not a practical or economic feature for this crossing. The proposed bridge is a 144 foot single span prestressed concrete decked bulb-tee girder bridge with a width of 36 feet to match the typical section of 2-12 foot lanes with 6 foot shoulders, for a total width of 36 feet. See Appendix F for the preliminary bridge plans and culvert/bridge cost comparison.

RIGHT-OF-WAY REQUIREMENTS

New ROW will be acquired for a large portion of this project due to the significant length of realignment. There are also several sections along the existing alignment that will require widening the existing ROW to accommodate the proposed design. The realigned portion of this project has a targeted width of 300 feet, whereas reconstruction sections occurring on the existing alignment have a target width of 200 feet.

The proposed ROW passes through land owned by the State of Alaska Department of Natural Resources (DNR). A permanent easement application will be required and will be submitted in conjunction with a Mineral Closing Order, which will prevent future mining claims within the Easement area. The process of closing the existing mining claims will be dealt with during the acquisitions process.

In addition, the proposed ROW overlaps a segment of the Hunter Creek – Livengood RS2477 Trail. The trail crosses over the proposed alignment several times before departing a final time near MP 2.5, where access to the trail will be provided via a pullout and new trailhead.

MAINTENANCE CONSIDERATIONS

This section of road is maintained by DOT&PF staff from the Livengood maintenance camp. The camp maintains the Dalton Highway from milepost 0 to 28 and the Elliott Highway from milepost 28 to 110.

This project will result in an overall increase in lane miles requiring maintenance. The existing road totals approximately 26 lane miles which includes a portion of the Elliott Highway. The post-project lane miles will be approximately 40, an increase of 14 lanes miles. It is important to note, however, that over 6 of these lane miles make up the section of the existing Dalton Highway to remain in service and will continue to be maintained, but at a lower priority than the new highway open to through traffic.

Proposed project elements expected to result in increased maintenance efforts include:

- Increase in Lane Miles to plow, grade, resurface and provide dust control for.
- Addition of a bridge crossing at Lost Creek.
- Increase in vegetated foreslopes, ditches and backslopes.

Proposed project elements expected to result in reduced maintenance efforts include:

- Upgraded drainage design including new culverts.

- Less severe road geometry resulting in reduced and easier maintenance and less accidents requiring M&O assistance.
- Incorporated geotechnical designs resulting in reduced future road settlement.
- Removal of the series of culverts (designated as a bridge) at Lost Creek on the existing Dalton Highway. These culverts have washed out in the past, requiring M&O to close the road for extended periods of time to repair.
- Availability of the Lost Creek Material Site at MP 6.5.

Typical maintenance activities for the proposed gravel road will include blading, drainage maintenance, gravel resurfacing and dust control.

MATERIAL SOURCES

The primary source of aggregate needed for the project, with the exception of crushed aggregates, is estimated to be available from the currently proposed project excavation, resulting in no anticipated need for imported materials for use as Select Materials in embankment construction. The proposed cut in the hill leading up to the intersection with the existing Dalton Highway at MP 6.5 will generate the quantity of useable excavation necessary to pioneer a road to facilitation project construction. Crushed aggregates and aggregates required to pass quality requirements are not expected to be available from project excavation in the quantities necessary to meet the project demands and the limited quantities that may be available will also likely require selective mining.

The following material sources are anticipated to be listed as available sources:

MS 65-3-013-2 - Near MP 19 on the Dalton Highway and named “19 Mile Quarry”. This is currently the closest material site identified to have the potential for providing a sufficient quantity of crushed aggregates to meet the project needs and is being explored for expansion by the NRMS. This is also the closest material site with the potential for providing riprap and

MS 65-3-020-2 – Near MP 6.5 on the Dalton Highway and named “Lost Creek Site”. The application for this site has been put on hold due to an Archeological discovery within the site boundaries. The application process is expected to resume when the site becomes available for permitting following the satisfaction of the Section 106 Memorandum of Agreement with the Alaska State Historic Preservation Officer (SHPO) which is expected to take place in the summer of 2016. Extensive drilling has been performed on this site throughout the years and indicates a substantial quantity of Select Material Type C is available with limited quantities of higher grade select materials being available with selective mining and/or processing efforts. The project corridor and corresponding proposed ROW bisects the current boundary defined parcel for this material site and will require modification of the current Draft Material Sales Agreement on file prior to processing for approval with DNR.

UTILITY RELOCATION & COORDINATION

There are three utility permittees within the existing Right of Way that are expected to be impacted by the project:

- Alascom, Inc. (AT&T),

- GCI Fiber Communication, Co., Inc. (GCI) and
- Alyeska Pipeline Service Company (Alyeska).

Utilities permitted on the Dalton Highway are not entitled to relocation benefits and any costs associated with relocation or adjustments due to project activities will be borne by the respective utility company. A notice to vacate will be required for this project and will be submitted by the DOT&PF Utilities section to applicable companies prior to construction. Utilities permitted on the Elliott Highway are, however, entitled to relocation benefits. The exact boundary of the Elliott and Dalton highway will need to be determined by the DOT&PF Utilities Section as well as the new boundary due to the proposed reconfiguration of the Dalton/Elliott intersection.

AT&T has a buried fiber optic cable (FOC) running on the right side of the Elliott Hwy until it crosses the highway via a bore just East of the Rosebud Creek culvert (1200 feet prior to the existing Dalton/Elliott intersection). The FOC then travels along the left side of the road until another bored crossing under the Elliott Hwy at the Dalton/Elliott intersection, after which the FOC follows the Dalton Hwy to beyond the project limits, changing several times between the right and left side of the roadway via bored crossings.

GCI has buried FOC that begins near the Alyeska Pipeline crossing on the Elliott Hwy and runs south to the Livengood Airport, with cables running on both sides of the highway.

Alyeska Pipeline has a 48” petroleum pipeline with two crossings within project limits. The first crossing is under the existing Dalton Hwy at approximately MP 2.2. The second crossing is under the existing Elliott Hwy ~3600 feet from the intersection with the existing Dalton Hwy. Neither utility crossing will be directly impacted by the proposed design with the exception of changes to access for this utility. Accommodations will be made to maintain access to three Alyeska containment sites impacted by the proposed design. The removal of the culverts at Lost Creek and reestablishment of the creek channel will also aid in the protection of the adjacent containment site. The Department will coordinate with Alyeska prior to construction activities to ensure on-site representatives can be made available during construction.

ACCESS CONTROL FEATURES

There are no existing or proposed access control restrictions beyond the driveway permitting process. Existing approach geometry will be modified as necessary to maintain access to the reconstructed facility.

PEDESTRIAN/BICYCLE (ADA) PROVISIONS

There are no special provisions being incorporated into the proposed project design to accommodate pedestrian/bicycle traffic, however the six foot wide shoulders will accommodate these users allowing a safer opportunity to traverse the Highway.

SAFETY IMPROVEMENTS

As discussed throughout various sections in this report, as well as in further detail in the approved Design Exception memo in Appendix G, this project brings nearly all of the roadway characteristics of the existing highway up to current design standards, of which most updates result in increased safety as that is within the primary scope of this reconstruction project. A brief summary of these safety improvements are as follows:

- Realign roadway to provide vertical and horizontal geometry that meets current design standards for the 50 MPH design speed (excluding two grades per the Design Exception in Appendix G)
- Lane and Shoulder widening.
- Provide turnouts for driver rest and for installing/removing snow chains.
- Providing Clear Zone or hazard protection where cost effective.
- Installation of new signs as necessary.
- Mitigation for aufeis and related roadway overtopping.
- Providing wider ditches for increased snow storage.

INTELLIGENT TRANSPORTATION SYSTEM FEATURES

Not applicable. There are no intelligent transportation system features within the project limits.

DRAINAGE

The proposed alignment crosses five drainages: Rosebud Creek, West Fork Tolovana Tributary #1, West Fork Tolovana Tributary #2, Lost Creek and Lost Creek Tributary #2. All of these drainages eventually flow into the Tolovana River well outside the project corridor.

HDR, Inc., is under contract to provide a Hydraulic and Hydrologic (H&H) analysis for crossings requiring culverts 48” or larger in diameter, with the exception of the bridge crossing at Lost Creek, which will be completed by the Alaska DOT&PF Bridge Design section.

With coordination between the Department and the Alaska Department of Fish and Game (ADF&G), two of the six crossings listed above were identified as fish habitat streams and will require fish passage designs. These two fish passage crossings are at Lost Creek and Lost Creek Tributary #2. The crossing to Lost Creek, as discussed previously, is proposed to be a 144’ single span pre-stressed concrete decked bulb-tee girder bridge. The crossing at Lost Creek Tributary #2 is currently estimated to require a 9’ circular culvert with a 40% embedment depth for stream simulation, complying with fish passage requirements.

The existing 60” culvert at Rosebud creek is in poor condition and will require replacement with a new, longer culvert to extend past the toe of the new embankment.

Further details of these drainage crossings can be found on file in HDR’s Dalton Highway MP 0-9 Reconstruction Preliminary H&H report dated April 22, 2016; this report will be updated and finalized as the project design progresses.

Existing culverts under 48" in diameter that are present on the portions of the existing alignment proposed for reconstruction will require replacement, and new culverts will be installed on the realigned portions of the projects; all of these installations will be designed in-house following the guidelines of the AHPM and the Alaska Highway Drainage Manual (AHDM).
HDR, Inc., is also under contract to provide design and design recommendations as applicable for the following: aufeis mitigation, snow drifting mitigation, special ditch treatments, scour protection and design for culvert removal and channel restoration of Lost Creek at the existing Dalton Highway crossing.

HDR's Draft General Project Recommendations and Winter Field Observations report dated March 31, 2016, which is on file, provides an initial assessment and recommendations for those drainage issues listed above. In summary:

- Snow Drifting, as also noted by local M&O, is not anticipated to be a maintenance or safety issue;
- Aufeis has been found and is expected to continue to be present at several locations along the project corridor; mitigation will be incorporated into the final design;
- General scour mitigation for both ditching and watercourse crossings will be designed after final project geometry and culvert crossings are known;
- Removal of the culverts at the Lost Creek crossing on the existing Dalton Highway and corresponding channel restoration could provide an opportunity to earn Wetland mitigation credits.

SOIL CONDITIONS

Extensive geotechnical drilling and investigation, including resistivity analysis and mapping, has been performed throughout the project corridor. During the 2014 & 2015 seasons, a total of 217 test holes were drilled along and in the vicinity of the proposed alignment. In addition, test holes and data near the end of the project corridor and within Lost Creek material site (MS 65-3-020-2) are available from previous geotechnical investigations performed in 1990, 1991 and 2008.

The expected soil conditions along the alignment are highly variable, from ice rich silt to bedrock likely requiring blasting. Preliminary guidance from the NRMS indicates 43 subdivided regions along the proposed alignment, with divisions based upon changes in subgrade conditions and corresponding embankment recommendations.

Two particularly notable regions consisting of thaw-unstable ice-rich silts with characteristics indicative of potential for substantial settlement are from approximate stations 223+00 to 241+00 and 358+00 to 372+50. Thermal modeling is being performed on these two regions as well as several other regions with ice present, although these other regions are considered less severe with respect to potential settlement. Air Circulation Embankment (ACE) is being considered as a thaw mitigation alternative for the two regions noted above but its use is contingent upon the results of the thermal modeling and ACE material availability. Insulated embankments and/or insulated thermal berms are also being considered for permafrost protection, both in lieu of and in conjunction with ACE. In addition, these thaw sensitive areas will not be grubbed prior to embankment construction. Winter work may be required for initial embankment construction and/or construction access roads over these thaw unstable areas to prevent irreversible permafrost degradation.

Other notable regions throughout the alignment include areas of large quantities of excavation that are expected to produce Select Material Type C or better materials for use as newly constructed embankment fill. The three largest of these regions and their approximate excavation quantities are as follows:

- 300+00 to 309+00 – 134,000CY
- 325+00 to 352+00 – 300,000CY
- 405+00 to 430+00 – 831,000CY

The aforementioned information within this section is intended to provide a current general overview of expected soil conditions; this is subject to change and, with the exception of the approximate excavation quantities, is based primarily upon interim information provided by the NRMS. Final geotechnical recommendations will be made available under separate title when complete.

EROSION AND SEDIMENT CONTROL

An Erosion and Sediment Control Plan (ESCP) will be required and will be prepared in accordance with Section 1120.7 of the PCM. As the estimated area of disturbed ground within the project corridor is currently estimated to be 175 acres, which exceeds five acres, a Storm Water Pollution Prevention Plan (SWPPP) will be required and will be prepared by the construction Contractor. Ground disturbance due to Material Site development and use has not yet been estimated due to ongoing geotechnical investigations and refinements to the project design. The ESCP will aid in the preparation of the SWPPP and provide specific Department expectations regarding Erosion and Sediment Control.

The anticipated primary pollutant is sediment from surface erosion in areas disturbed by construction related activities. Areas expected to pose erosion/sediment problems are relatively large, homogenously steep slopes consisting of exposed materials with high fines content. A proposed remedy for erosion and sediment control on some of these slopes is the re-use of stockpiled grubbed materials with high organics content as a top-dressing in order to expedite permanent erosion control via establishing permanent vegetation.

Establishing vegetation via seeding with mulch is expected to be the predominate Best Management Practice (BMP) for providing permanent stabilization and erosion control of the disturbed ground throughout the project. Additional permanent BMP's, although not yet designed, may include:

- inlet and outlet protection at smaller (36" diameter and smaller) culverts via either installation of aggregates or manufactured products;
- riprap protection at larger culverts (48" diameter and larger), at the proposed bridge crossing at Lost Creek, and at the re-established drainage channels on the abandoned existing Dalton Highway;
- ditch bottom protection in select areas as necessary; and
- other products and/or methods as determined practical throughout refinement of the project design.

ENVIRONMENTAL COMMITMENTS

The FHWA approved the Categorical Exclusion Documentation Form (CE) for this project on July 20, 2015. A brief summary of the unique environmental commitments, as identified in the CE are as follows:

- As an outcome of the Section 106 process, a total of approximately 2.5 miles of the Dalton Highway's first 6.5 miles will be preserved in place in order for the project to be considered as having no adverse effect to the treated-as-eligible Dalton Highway.
- Satisfying the requirements of the Section 106 MOA signed 6/4/2015 regarding data recovery of the eligible archeological site LIV-456 located within the Lost Creek Material Site boundary. This work is scheduled to be completed in 2016.

As identified in the CE the following permits and authorizations will be required for this project:

1. United States Army Corps of Engineers (USACE), Section 404/10.
2. Alaska Department of Fish & Game (ADF&G) Fish Habitat Permit (Title 16.05.871 and Title 16.05.841).
3. ADEC Non-Domestic Wastewater Plan Approval.
4. ADEC 401.
5. ADEC Alaska Pollution Discharge Elimination System (APDES).

WORK ZONE TRAFFIC CONTROL

This project may be considered a Category 2 Significant Project per the Alaska HPM as it is an arterial and full road closures over an hour in duration, with no practical alternate route, may occur during construction of the project. While a large portion of the work proposed under this reconstruction project is expected to take place off of the existing alignment without any impacts to traffic, there are portions of proposed work that take place on the existing alignment, and depending on circumstances during construction, road closures with duration of greater than one hour may be required. Road closures of up to 12 hours are not uncommon on Dalton Highway construction projects. For closures of this duration ample advanced public notice will be given. The Contractor, in coordination with the Department, will be required to develop and submit Traffic Control Plans for approval prior to implementation.

VALUE ENGINEERING

Per department policy, this project, with a total estimated value greater than $40 million, must be considered for a VE analysis. A VE analysis is still being considered for this project.

COST ESTIMATE

The estimated costs for this project are as follows:

Design	$4,395,000
Utilities	$300,000
Right of Way	$500,000
Construction* *(Includes 15.0% CENG)*	$36,681,557
Total Cost of Project	$41,876,557

*****This construction estimate is still subject to fluctuation pending further geotechnical analysis.

APPENDIX A

DESIGN CRITERIA
AND
DESIGN DESIGNATION

ALASKA DOT&PF PRECONSTRUCTION MANUAL
Chapter 11 - Design
PROJECT DESIGN CRITERIA

Project Name:	Dalton Highway MP 0-9 Reconstruction			
☑ New Construction/Reconstruction	☐ 3R	☐ PM	☐ Other:	
Project Number:	Z609110000/0652016		☑ NHS	☐ Non NHS
Functional Classification:	Rural Principal Arterial			
Design Year:	2040	**Present ADT:**	330 (2010)	
Design Year ADT:	600	**Mid Design Period ADT:**	490 (2020)	
DHV:	95	**Directional Split:**	45-55	
Percent Trucks:	60%	**Equivalent Axle Loading:**	1,046,044	
Pavement Design Year:	N/A	**Design Vehicle:**	WB-67	
Terrain:	Mountainous	**Number of Roadways:**	1	
Design Speed:	50 mph (GB page 448; consistent with adjacent projects 64899 and 62196 and posted speed limit)			
Width of Traveled Way:	24' (Green Book, Exhibit 7-3; Consistent with adjacent projects 64899 and 62196)			
Width of Shoulders:	**Outside:**	6' (Green Book Exhibit 7-3)	**Inside:**	N/A
Cross Slope:	3% (HPCM Section 1130.1.2)			
Superelevation Rate:	6% (Green Book Exhibit 3-22)			
Minimum Radius of Curvature:	835' (Green Book Exhibit 3-14)			
Min. K-Value for Vert. Curves:	**Sag:**	96 (GB Exhibit 3-79)	**Crest:**	84 (GB Exhibit 3-76)
Maximum Allowable Grade:	7% + 1% for up to 500' (Green Book Exhibit 7-2; Green Book page 242)			
Minimum Allowable Grade:	0% (Green Book page 242)			
Stopping Sight Distance:	425' (Green Book Exhibit 3-1; varies with upgrades and downgrades)			
Lateral Offset to Obstruction:	1.5'			
Vertical Clearance:	20.5' (HPCM Table 1130-1)			
Bridge Width:	36' (Full width of approach roadway, Green Book page 451)			
Bridge Structural Capacity:	HL-93			
Passing Sight Distance:	1,835' (Green Book Exhibit 3-7)			
Surface Treatment:	**T/W:**	Crushed Agg Surface Coarse	**Shoulders:**	Crushed Agg Surface Coarse
Side Slope Ratios:	**Foreslopes:**	Varies	**Backslopes:**	Varies
Degree of Access Control:	Driveway permit process			
Median Treatment:	N/A			
Illumination:	N/A			
Curb Usage and Type:	N/A			
Bicycle Provisions:	Shoulders			
Pedestrian Provisions:	Shoulders			
Misc. Criteria:	N/A			

Proposed - Designer/Consultant: _____ **Date:** 5/9/16

Endorsed - Engineering Manager: _____ **Date:** 5/9/2016

Approved - Preconstruction Engineer: _____ **Date:** 5/26/2016

Shaded criteria are commonly referred to as the *FWHA 13 controlling criteria*. For NHS routes only, these criteria must meet the minimums established in the Green Book (*AASHTO A Policy on Geometric Design of Highways and Streets*). For all other routes, these criteria must meet the minimums established in the *Alaska Highway Preconstruction Manual*. Otherwise a Design Exception must be approved.

Design Criteria marked with a " # " do not meet minimums and must have a Design Exception(s) and/or Design Waiver(s) approved. See the Design Study Report for Design Exception/Design Waiver approval(s) and approved design criteria values.

MEMORANDUM

State of Alaska

Department of Transportation & Public Facilities

TO: Janet Brown, P.E.,
Preconstruction Engineer
Design/Engineering

DATE: December 8, 2011

FILE NO: I:\Traffic Data\DESIGN\11\Dalton_60911.doc

TELEPHONE NO: 451-5150

FROM: Ethan Birkholz
Chief, Planning and Support
Northern Region

SUBJECT: Dalton Hwy MP 0-9 Reconstruction Pro No. STP-0652(16)/60911 Design Designation

Please approve the attached design designation by signing the endorsement below which enables your staff to proceed.

Any questions should be directed to Jennifer Eason at 451-2257.

Janet Brown 12/27/11

Janet Brown, P.E., Preconstruction Engineer — Date

JCE/sgv

cc: Sarah Schacher, P.E., Engineering Manager, Northern Region

Attachment

Please circulate and return to Traffic Data & Forecasting Manager	
Planning Manager	MLC
Planning Chief	
FMATS **urban only**	
Traffic & Safety	APG
Any changes, additions, or questions, Please write on this sheet	

DESIGN DESIGNATION

Northern Region Planning

Traffic Data & Forecasting

ROUTE NAME: Dalton Hwy
STATE ROUTE NO: 150000
CDS MILEAGE: 0-9
FUNCTIONAL CLASS: Rural Principal Arterial

	YEAR	ADT	%	
ADT	2010	330		
	2020	490		
	2040	600		
DHV	2020		16%	80
	2040			95
D				45-55
T			**60%**	**Total**
			19.0	Class 5
			6.4	Class 6
			1.0	Class 8
			17.0	Class 9
			12.5	Class 10
			4.1	Class 13
ESAL'S (Design Lane)	To Be Provided by Design			

MEMORANDUM

State of Alaska

Department of Transportation & Public Facilities
Northern Region Preconstruction

TO: Ethan Birkholz
Planning Chief
Northern Region

DATE: November 22, 2011

FILE NO: V:\Hwy\60911 Dalton 0-9\08 - Support\06 - Traffic

THRU: Janet Brown, P.E.
Preconstruction Engineer
Northern Region

TELEPHONE NO: (907) 451-5361
FAX NUMBER: (907) 451-5126

FROM: Sarah E. Schacher P.E.
Engineering Manager
Northern Region

SUBJECT: Dalton Highway MP 0-9
Reconstruction
Project No. STP-0652(16)/60911
Design Designation Request

Please provide a Design Designation for the **Dalton Highway MP 0-9 Reconstruction**

- ☒ Present AADT
- ☒ Design Year AADT (**2040**)
- ☒ Mid-Design Period AADT (**2020**)
- ☒ Design Hourly Volume
- ☒ Directional Split
- ☒ Percent Trucks
- ☒ Design Functional Classification
- ☐ Intersection Turning Movement Counts
- ☐ Other

This project intends to reconstruct the Dalton from mile 0-9. The reconstruction will improve the roadway to meet new construction standards.

Please complete the attached Traffic Data Request Form.

Attachment: As Stated

DSA/smb

Traffic Data Request Form

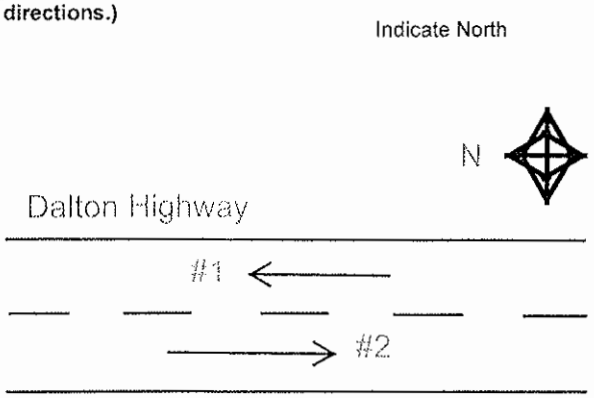
TDR Form-1-10/20/03

Alaska Department of Transportation & Public Facilities

Requested By: Sarah E. Schacher, P.E.	**Design Project Number:** 60911	**Date Requested:** 11/22/11
Base Year: 2010 **Base Year Total AADT:** 330 **AADT Growth Rate** **Forward (%/yr):** 2 **End Year:** 2040 **Back Cast (%/yr):** **Begin Year:** 2010	**Common Route Name:** ~~Dalton~~ Elliott Highway **Functional Class:** **Urban/Rural:** Principal Arterial **Historic M.P. Interval:** 0-9	**CDS Route Name:** Route 150000 Dalton Highway **CDS M.P. Interval:** 0-9

Truck Category	Load Factor (ESALs per Truck)	% of Total AADT in Truck Category
2-axle		
3-axle	See	
4-axle	attached	
5-axle		
≥ 6-axle		

Lane Configuration Sketch:
(Designer: Provide sketch of lane layout. Number each lane and show directions.)



Percent of Base Year Total AADT for Each Numbered Lane in Configuration Sketch:

Lane # 1	% 45
Lane # 2	% 55
Lane #	%
Lane #	%
Lane #	%
Lane #	%

Comments:

Data Provided By:	Provider's Signature:	Date Provided:
Scott Vockrick		11/28/11

Figure 6-1. Traffic Data Request (TDR) Form

Highway Log Report

CDS Route: 150000 Dalton Highway (Internal Dup # 0)

Milepoint: 0.000 **to** 12.000

General Direction: North

Features Selected:

Cross Streets | Mileposts | Bridges/Culverts | Railroads Crossings | Buildings/Landmarks

Attributes Selected

Functional Classification: Rural Other Principal Arterial

Milepoint	Side	Feature CDS	Feature
0.000	Left	153000	Elliott Highway
0.000	Right	153000	Elliott Highway
0.121	-	-	Boundary Change
1.005	Right	-	Milepost 1
2.029	Right	-	Milepost 2
2.199	Under	-	Pipeline Crossing
3.024	Right	-	Milepost 3
4.009	Right	-	Milepost 4
5.004	Right	-	Milepost 5
5.732	Right	-	Pipeline Road 391.8
5.989	Right	-	Milepost 6
6.984	Right	-	Milepost 7
7.988	Right	-	Milepost 8
8.287	Right	-	Pipeline Road
9.024	Right	-	Milepost 9
10.063	Right	-	Milepost 10
11.091	Right	-	Milepost 11

ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES TWVRM13

11/28/11 **SUMMARY DATA - ADT** 11:31:44.4

STATION ID **30114000** **NORTH-SOUTH** ROUTE **150000** MILEPOINT **0.050**

DALTON HIGHWAY NORTH OF ELLIOTT HIGHWAY

		PERCENT OF ANNUAL AVERAGE DAILY TRAFFIC						
YEAR	AADT	MON	TUE	WED	THR	FRI	SAT	SUN
2000	115	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	200	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2006	206	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2007	275	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	269	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2009	300	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	329	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PF1 - INQUIRY PF2 - HELP PF3 - QUIT PF4 - TDS MENU
PF5 - SELECTION PF10-NEXT STATION

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

Computations

For Dalton Hwy MP 0-9 Recon / 60911 Design Designation

Item No. _____
DATE 11/28/11
Project No. 60911
Project Name Dalton Recon
Calc. by Scott K.
Checked by _____

Year	ADT
2010	330
2020	490
2040	600

Annual growth rate of 2% used (per previous design designation)

20 yr factor: 1.48
30 yr factor: 1.81

DHV- 16%
2020: 80
2040: 95

Directional Split 45-53

% Trucks: 60% from class counter on Dalton @ Yukon Bridge - 2010

Class	# Axles	%	Load Factor
5	2	19.0	0.50
6	3	6.4	0.85
7	4	—	—
8	4	1.0	1.20
9	5	17.0	1.55
10	6	12.5	2.24
11	6	—	—
12	6	—	—
13	7+	4.1	2.24

APPENDIX B

ENVIRONMENTAL DOCUMENT

VIII. Environmental Documentation Approval Signatures

Prepared by: _____ Date: 6/24/15
[Sign] Environmental Impact Analyst

Robert A. Effinger
[Print Name] Environmental Impact Analyst

Reviewed by: _____ Date: 6/24/2015
[Sign] Engineering Manager

Sarah E. Schacher
[Print Name] Engineering Manager

Approved by: _____ Date: 6-25-15
[Sign] Regional Environmental Manager

Brett Nelson
[Print Name] Regional Environmental Manager

Assigned CE
Approved by: _____ Date: _____
[Sign] DOT&PF Statewide NEPA Manager

_____
[Print Name] DOT&PF Statewide NEPA Manager

Non-Assigned CE
Approved by: _____ Date: 7/20/2015
[Sign] FHWA Area Engineer

Austin Armstrong
[Print Name] FHWA Area Engineer

Dalton Highway MP 6-9 Reconstruction
60911/0652(016)

APPENDIX C

CRASH HISTORY

Dalton Highway MP 0-9 2007-2011 5-year crash data

CASE ID	STREET 1	STREET 2	MILE 1	DATE	DISTANCE	TIME	DAY	NUM VEHS	FATALITIES	MAJ INJURIES	MIN INJURIES	ACC SEVERITY	TRAF CONTROL	TYPE	ROAD CHAR	ROAD SURF	LIGHTING	VEH 1 DIR	VEH 1 SEC EVENT	VEH 1 ACT	VEH 1 HUMAN CIRCUM 1	VEH 1 HUMAN CIRCUM 2	VEH 1 VEH CIRCUM	VEH 1 RDWY CIRCUM	DRVR 1 ALC/DRUGS	EVENT LOC	RD JCT
200806452	150000	MILE 8	7.988	8/3/2008	0	19:10	Sunday	1	0	0	1	Minor injury	No Controls	Ran off Road	Curve lvl	Dry	Daylight	South	Overturn	Out of Control	Driver Inexperience	Uncoded	None veh1circ	None veh1rdwy	None Alc_Drugs	Shoulder eventloc	13
200807022	150000	MP 5.5	5.504	8/19/2008	0	12:40	Tuesday	1	0	1	0	Major injury	No Controls	Ran off Road	Curve grd	Dry	Daylight	South	Uncoded	Out of Control	Fell asleep	Unsafe Speed	Oversized Veh	None veh1rdwy	None Alc_Drugs	Roadway	Not a junction
200807278	150000	MP 4	4.009	8/26/2008	0	8:35	Tuesday	1	0	0	1	Minor injury	No Controls	Sign	Curve hlcrst	Sand/mud/dirt/ oil/gravel	Daylight	North	Uncoded	Skidding	Unsafe Speed	Uncoded	None veh1circ	Road Surface Condition	None Alc_Drugs	Roadside	Not a junction
200906415	150000	MILEPOST 5	5.004	5/14/2009	0	8:00	Thursday	1	0	0	0	Property damage	No Controls	Overturn	7	Dry	Daylight	South	Uncoded	Out of Control	Uncoded	Uncoded	Uncoded	Debris	5	Shoulder eventloc	13
200964496	150000	MILE 2	2.029	8/14/2009	0	22:40	Friday	1	0	0	1	Minor injury	No Controls	Ran off Road	7	Dry	Twilight	North	Uncoded	Skidding	Uncoded	Uncoded	Uncoded	Other veh1rdwy	5	Shoulder eventloc	Not a junction
200911867	150000	TOP 18	0	10/18/2009	0	14:30	Sunday	1	0	0	0	Property damage	Unknown trafcont	Ditch	7	Ice	Daylight	North	Uncoded	Skidding	Uncoded	Uncoded	Uncoded	Other veh1rdwy	5	Roadway	13

APPENDIX D

RSAP V3.0 ANALYSIS

Dalton Hwy MP 0-9 Reconstruction

RSAP V3.0 Analysis for Rollover hazard due to foreslope treatments in clear zone.

The purpose of this analysis is to determine whether providing protection from the hazard presented by steep slopes within the clear zone is cost effective for this project, and if so, which of the alternative slope treatments is the most cost effective. This analysis was not performed for the actual conditions of the project as this would far exceed the computational capabilities of RSAP V3.0 and it is not necessary to meet the intentions of the analysis; rather, a "worst-case" situation, with respect to crash-prediction effects within this program, was used. The "worst-case" situation uses individual geometric characteristics specific to this project (length of curve, grade, etc.) however they occur simultaneously for this "worst-case" situation. The only geometric characteristic varied through the analysis is the height of grade. As a result, the hazard treatment, or lack thereof, determined to be most cost effective at a given embankment height in this "worst-case" situation will also serve as such for less severe conditions, as the probability of crashes and the resulting costs will only decrease.

Non slope-related hazards within the clear zone were not considered in this analysis.

General assumptions and constants:

- 12' Lanes, 6' Shoulders, -3% crown.
- Use DSR Est. cost for Fill @ $6.50/CY – Uniform Cost – No Change for Qty Magnitude.
- Only fill and Guardrail/End Treatment costs used.
- Cross Sections and Guardrail symmetric about centerline.
- 1500' sample section used for analysis.
- 1300 LF of W-Beam Guardrail with End Treatments (W-Beam @ $50/LF & Ends @ $6,000 ea.).
- Embankment constructed on flat EG (for volume computations and RSAP Cross Sections).
- Where alternatives exceed the maximum 200' analysis width, other alternatives are changed to constant slopes rather than "flat" on the bottom.
- Traffic values from the Design Designation were used. See the sample RSAP V3.0 printout at the end of this report for those values.

Assumptions and constants in "worst-case" geometry

- Shortest proposed curve of radius 835' and length of 550'. Shortest curve length and to the left equals largest horizontal curve adjustment factor.
- Grade at -7% for largest grade adjustment factor.

Fill foreslopes for comparisons:

- 2:1 from shoulder – Considered the "do-nothing" alternative;
- 3:1 from shoulder;
- 4:1 from shoulder;

- 4:1 to 8’ from shoulder, then 2:1 (Barnroof);
- 2’ shoulder widening with W-Beam Guardrail, then 2:1.

The results of the analysis indicate that providing a traversable 3:1 slope within the clear zone is cost effective to an embankment height of up to 8’, and for embankment heights 8’ and greater it was not cost effective to provide protection from the rollover hazard presented by steep slopes within the clear zone. Guardrail was not cost effective at any embankment height.

The following sample printouts show the constant inputs used within the RSAP V3.0 analyses and example results; the embankment height for this example is 7’.

RSAP PROJECT INFORMATION

BASIC INFORMATION

Today's date (i.e., run date)	6/28/2016	
Title	Dalton Hwy MP 0-9 Reconstruction. Z609110000/0652016	
Units	USCU	(only USCU units at this time)
Design Life	25	YRS
Construction Year	2018	
Rate of Return	4	%

CRASH COSTS

Use GDP values during life?	N	
Expand to current year by GDP?	Y	http://www.gpoaccess.gov/usbudget/fy09/hist.html
GDP Deflator to construction year	1.07	**Crash Cost Timeline**

Base year for crash cost data	2015	2018	2030.5	2043	Cost Used
Value of Statistical Life	$ 9,400,000	$ 9,704,980	$ 9,704,980	$ 9,704,980	$9,704,980

Reference for VSL: Guidance on Treatment of the Economic Value of a Statistical Life (VSL) in U.S. Department ofTransportation Analyses- 2015 Adjustment

http://www.dot.gov/office-policy/transportation-policy/guidance-treatment-econo

RSAP Root Directory: C:\Program Files\RSAPv3

Notes:

Dalton Hwy MP 0-9 Reconstruction. Z609110000/0652016

TRAFFIC INFORMATION

CONSTRUCTION YEAR ADT:	387	vehicles/day
TRAFFIC GROWTH	2.0	% growth/yr
WHICH ADT TO USE?	Mid-Life	
MID-LIFE ADT:	496	vehicles/day
END OF LIFE ADT:	635	vehicles/day
ADT USED BY RSAP	496	vehicles/day
PERCENT TRUCKS	60	%

VEHICLE MIX

				TYPICAL CHARACTERISTICS						Trajectory Information			
RSAP VEHICLES	FHWA CLASS	PERCENT	RSAP TYPE	WEIGHT	LENGTH	WIDTH	C.G. Long.	C.G. Hgt	Crash Cost Adj.	Trajectory Grid Name	Redirection Grid Name	Encr Multiplier	Mix Multiplier
		%		lbs	ft	ft	ft	ft					
Motorcycles	1	0	M	600	7.00	1.50	3.00	2.60	0.56	TrajectoryGrid1	RedirectionCars	1	0
Passenger Cars	2	0	C	3,300	15.00	5.40	6.00	2.00	1.00	TrajectoryGrid2	RedirectionCars	1	-0.75
PickupTruck	3	40	PU	5,000	19.75	6.50	8.50	2.30	1.00	TrajectoryGrid2	RedirectionCars	1	-0.25
Light Tractor Trailer	8-9	18	LTT	16,000	48.00	8.50	12.00	4.8	3.52	TrajectoryGrid3	RedirectionTrucks	0.3	0
Average Tractor Trailer	8-13	12.5	ATT	22,250	48.00	8.50	20.00	4.8	3.52	TrajectoryGrid3	RedirectionTrucks	0.3	0.6
Heavy Tractor Trailer	8-13	4.1	HTT	37,500	48.00	8.50	20.00	6	3.52	TrajectoryGrid3	RedirectionTrucks	0.3	0
Light Single Unit Truck	5	19	LSUT	6,800	35.00	7.77	12.50	3.4	3.52	TrajectoryGrid4	RedirectionTrucks	0.3	0
Average Single Unit Truck	6	6.4	ASUT	12,000	35.00	7.77	12.50	3.4	3.52	TrajectoryGrid4	RedirectionTrucks	0.3	0.4
Heavy Single Unit Truck	7	0	HSUT	22,000	35.00	7.77	12.50	4.2	3.52	TrajectoryGrid4	RedirectionTrucks	0.3	0
	Total	100.00											0.00

Click **here** for the on-line link to the FHWA classification system.

Dalton Hwy MP 0-9 Reconstruction. Z609110000/0652016

WHOLE ROADWAY CHARACTERISTICS

PERCENT OF TRAFFIC IN PRIMARY DIRECTION:	45	%
PERCENT OF TRAFFIC ENCROACHING RIGHT:	50	%
HIGHWAY TYPE:	U	
TERRAIN:	M	
POSTED SPEED LIMIT:	50	mi/hr
USER ENROACHMENT ADJUSTMENT:	1	

PROJECT LIMITS	
Min Sta	15+00.00 ft
Max Sta	30+00.00 ft
Max Offset	200.00 ft

ROAD SEGMENT DATA				EXPECTED EQUIVALENT PASSENGER VEHICLE ENCROACHMENTS					
				TOTAL		PRIMARY DIRECTION		OPPOSING DIRECTION	
SEG	START STA	END STA	SEGMENT LENGTH	BASE ENCR RATE	MODIFIED ENCR RATE	PRIMARY RIGHT ENCR	PRIMARY LEFT ENCR	OPPOSING RIGHT ENCR	OPPOSING LEFT ENCR
			ft	encr/yr	encr/yr	0.2250	0.2250	0.2750	0.2750
1	15+00.	17+00.	200.00	0.0237	0.1109	0.0344	0.0344	0.0210	0.0210
2	17+00.	22+50.	550.00	0.0652	0.9153	0.3787	0.1894	0.1157	0.2315
3	22+50.	30+00.	750.00	0.0889	0.4160	0.1291	0.1291	0.0789	0.0789

Dalton Hwy MP 0-9 Reconstruction. Z609110000/0652016

WHOLE ROADWAY CHARACTERISTICS

PERCENT OF TRAFFIC IN PRIMARY DIRECTION:	45	%
PERCENT OF TRAFFIC ENCROACHING RIGHT:	50	%
HIGHWAY TYPE:	U	
TERRAIN:	M	
POSTED SPEED LIMIT:	50	mi/hr
USER ENROACHMENT ADJUSTMENT:	1	

PROJECT LIMITS	
Min Sta	15+00.00 ft
Max Sta	30+00.00 ft
Max Offset	200.00 ft

ROAD CHARACTERISTICS TABLE

NUMBER OF ROAD SEGMENTS:			3	ROAD CHARACTERISTICS BY SEGMENT									
			WHOLE ROAD CHARACTERISTICS				PRIMARY DIRECTION			NON-DIRECTIONAL CHARACTERISTICS			
SEG	STATIONS		ADT	SPEED LIMIT	TERRAIN	TOTAL NUMBER OF LANES	PRIM DIR GRADE	PRIM DIR CURVE RADIUS	LNS IN PRIM DIR	LANE WIDTH	ACCESS DENSITY	RUMBLE STRIPS	SHLDR WIDTH
			RSAP DEFAULTS										
			496	50	M	2	0	T	1	12	0	FALSE	6
	START	END	veh / day	mi / hr	F / M / R		%	ft		ft	points/mi	TRUE/FALSE	ft
1	15+00.	17+00.	496	50	M	2	-7	T	1	12	0	FALSE	6
2	17+00.	22+50.	496	50	M	2	-7	-835	1	12	0	FALSE	6
3	22+50.	30+00.	496	50	M	2	-7	T	1	12	0	FALSE	6

Dalton Hwy MP 0-9 Reconstruction. Z609110000/0652016

WHOLE ROADWAY CHARACTERISTICS

PERCENT OF TRAFFIC IN PRIMARY DIRECTION:	45	%
PERCENT OF TRAFFIC ENCROACHING RIGHT:	50	%
HIGHWAY TYPE:	U	
TERRAIN:	M	
POSTED SPEED LIMIT:	50	mi/hr
USER ENROACHMENT ADJUSTMENT:	1	

PROJECT LIMITS	
Min Sta	15+00.00 ft
Max Sta	30+00.00 ft
Max Offset	200.00 ft

ENCROACHMENT ADJUSTMENTS										
SEG	PRIM DIR ADJ			OPPOSING DIR ADJ			NON-DIRECTIONAL ADJUSTMENTS			
	GRADE	HORIZ'L CURVE RADIUS	NUMBER OF LANES	GRADE	HORIZ'L CURVE RADIUS	NUMBER OF LANES	SPEED LIMIT	LANE WIDTH	ACCESS DENSITY	USER
1	2.00	1.00	1.00	1.00	1.00	1.00	1.42	1.00	1.00	1.00
2	2.00	4.00	1.00	1.00	2.00	1.00	1.42	1.00	1.00	1.00
3	2.00	1.00	1.00	1.00	1.00	1.00	1.42	1.00	1.00	1.00

Dalton Hwy MP 0-9 Reconstruction. Z609110000/0652016

Based on Analysis Run on 6/17/2016 4:19:28 PM

RSAP 3.0.1 (release 150507) running in Excel Version 14.0 on Windows (32-bit) NT 6.01

Settings Summary and Trajectory Score Report

Encroachment Settings		Trajectory Selection Settings		
Primary Right Encroachment:	TRUE	Default Settings were modified:	FALSE	
Primary Left Encroachment:	TRUE	**Criterion**	**Score**	**Weight**
Opossing Right Encroachment:	TRUE	Highway Cross-Section	0.70	3.00
Opposing Left Encroachment:	TRUE	Horizontal Curve	0.70	2.00
		Highway Grade	0.70	1.00
Minimum No. of Trajectories		Speed Limit	0.70	1.00
per encroachment location:	10			
Maximum No. of Trajectories				
per encroachment location:	200			
Distance between encr. Locations:	25			

Trajectory Score for each Encroachment Grouping

Score>0.9	→	Considered a good score.
0.9<Score<0.8	→	Considered an acceptable score.
0.8<Score<0.7	→	Considered a poor score.
0.7>Score	→	Considered an unacceptable score.

Seg.	Alt.	Vehicle Type	Encr. Type	No. of Trajectories	Min. Traj. Score	Avg. Traj. Score
1	1	PU	PR	10	0.77	0.81
1	1	LTT	PR	10	0.75	0.77
1	1	ATT	PR	10	0.75	0.77
1	1	HTT	PR	10	0.75	0.77
1	1	LSUT	PR	10	0.76	0.79
1	1	ASUT	PR	10	0.76	0.79
1	2	PU	PR	10	0.77	0.80
1	2	LTT	PR	10	0.74	0.77
1	2	ATT	PR	10	0.74	0.77
1	2	HTT	PR	10	0.74	0.77
1	2	LSUT	PR	10	0.76	0.79
1	2	ASUT	PR	10	0.76	0.79
1	3	PU	PR	10	0.77	0.80
1	3	LTT	PR	10	0.74	0.77
1	3	ATT	PR	10	0.74	0.77
1	3	HTT	PR	10	0.74	0.77
1	3	LSUT	PR	10	0.76	0.79
1	3	ASUT	PR	10	0.76	0.79

DETAILED COLLISION AND COST SUMMARY

Dalton Hwy MP 0-9 Reconstruction. Z609110000/0652016

Based on Analysis Run on 6/28/2016 4:37:34 PM

RSAP 3.0.1 (release 150507) running in Excel Version 14.0 on Windows (32-bit) NT 6.01

Analysis Time = 572.5469 sec.

			AADT	496 vpd			PT	60.00
	FEATURE		EXPECTED ANNUAL CRASHES				ANNUAL COST OF CRAS	
Segment	Feature Number	Feature Type	Encroachment and Vehicle Type	Total Feature Crashes	Penetrated or Vaulted	Rolled Over after Redirection	Annual Feature Crash Cost	Feature Maintenance Cost
		ALTERNATIVE 1						
1	1	Rollover	PR - PU	0.0013	0.0000	$ -	$ 85	$ -
1	1	Rollover	PR - LTT	0.0002	0.0000	$ -	$ 123	$ -
1	1	Rollover	PR - LSUT	0.0002	0.0000	$ -	$ 134	$ -
1	1	Rollover	PR - HTT	0.0000	0.0000	$ -	$ 28	$ -
1	1	Rollover	PR - ATT	0.0001	0.0000	$ -	$ 85	$ -
1	1	Rollover	PR - ASUT	0.0001	0.0000	$ -	$ 45	$ -
1	1	Rollover	PL - PU	0.0010	0.0000	$ -	$ 64	$ -
1	1	Rollover	PL - LTT	0.0001	0.0000	$ -	$ 86	$ -
1	1	Rollover	PL - LSUT	0.0001	0.0000	$ -	$ 95	$ -
1	1	Rollover	PL - HTT	0.0000	0.0000	$ -	$ 20	$ -
1	1	Rollover	PL - ATT	0.0001	0.0000	$ -	$ 60	$ -
1	1	Rollover	PL - ASUT	0.0000	0.0000	$ -	$ 32	$ -
1	1	Rollover	OR - PU	0.0003	0.0000	$ -	$ 21	$ -
1	1	Rollover	OR - LTT	0.0000	0.0000	$ -	$ 37	$ -
1	1	Rollover	OR - LSUT	0.0000	0.0000	$ -	$ 32	$ -
1	1	Rollover	OR - HTT	0.0000	0.0000	$ -	$ 8	$ -
1	1	Rollover	OR - ATT	0.0000	0.0000	$ -	$ 26	$ -
1	1	Rollover	OR - ASUT	0.0000	0.0000	$ -	$ 11	$ -
1	1	Rollover	OL - PU	0.0002	0.0000	$ -	$ 19	$ -
1	1	Rollover	OL - LTT	0.0000	0.0000	$ -	$ 28	$ -
1	1	Rollover	OL - LSUT	0.0000	0.0000	$ -	$ 27	$ -
1	1	Rollover	OL - HTT	0.0000	0.0000	$ -	$ 6	$ -
1	1	Rollover	OL - ATT	0.0000	0.0000	$ -	$ 20	$ -
1	1	Rollover	OL - ASUT	0.0000	0.0000	$ -	$ 9	$ -
2	1	Rollover	PR - PU	0.0182	0.0000	$ -	$ 2,577	$ -
2	1	Rollover	PR - LTT	0.0025	0.0000	$ -	$ 2,675	$ -
2	1	Rollover	PR - LSUT	0.0027	0.0000	$ -	$ 2,709	$ -
2	1	Rollover	PR - HTT	0.0006	0.0000	$ -	$ 609	$ -
2	1	Rollover	PR - ATT	0.0017	0.0000	$ -	$ 1,858	$ -
2	1	Rollover	PR - ASUT	0.0009	0.0000	$ -	$ 912	$ -
2	1	Rollover	PL - PU	0.0055	0.0000	$ -	$ 413	$ -
2	1	Rollover	PL - LTT	0.0007	0.0000	$ -	$ 529	$ -
2	1	Rollover	PL - LSUT	0.0007	0.0000	$ -	$ 638	$ -
2	1	Rollover	PL - HTT	0.0002	0.0000	$ -	$ 121	$ -
2	1	Rollover	PL - ATT	0.0005	0.0000	$ -	$ 368	$ -
2	1	Rollover	PL - ASUT	0.0003	0.0000	$ -	$ 215	$ -
2	1	Rollover	OR - PU	0.0016	0.0000	$ -	$ 200	$ -
2	1	Rollover	OR - LTT	0.0002	0.0000	$ -	$ 176	$ -
2	1	Rollover	OR - LSUT	0.0002	0.0000	$ -	$ 184	$ -
2	1	Rollover	OR - HTT	0.0001	0.0000	$ -	$ 40	$ -
2	1	Rollover	OR - ATT	0.0002	0.0000	$ -	$ 122	$ -
2	1	Rollover	OR - ASUT	0.0001	0.0000	$ -	$ 62	$ -
2	1	Rollover	OL - PU	0.0036	0.0000	$ -	$ 389	$ -

SEGMENT AND ALTERNATIVE COST SUMMARY

Dalton Hwy MP 0-9 Reconstruction. Z609110000/0652016

Based on Analysis Run on 6/28/2016 4:37:34 PM

RSAP 3.0.1 (release 150507) running in Excel Version 14.0 on Windows (32-bit) NT 6.01

							Rate of Return	4	%	
	AADT	496	vpd	PT	60.00 %		Design Life	25	yrs	
ANNUAL SEGMENT SUMMARY							A/P	0.0640		
Segment	Crashes	Crash Costs	Maintenance Cost	Repair Costs	Crash Rate (crashes/MVMT)	Alternative	Annualized Construction Cost	Expected Annual Maintenance Cost	Expected Annual Repair Cost	Expected Annual Crash Cost
		Alternative # 1				1	$ 39,925		$ 0	$ 21,790
1	0.00	$ 1,101		$ 0	2	2	$ 39,645		$ 0	$ 22,862
2	0.04	$ 16,559		$ 0	7	3	$ 39,472		$ 0	$ 21,477
3	0.02	$ 4,130		$ 0	2	4	$ 49,695	$ 1,100	$ 749	$ 84,828
		Alternative # 2				5	$ 39,019	$ 0	$ 0	$ 24,892
1	0.00	$ 1,154		$ 0	2					
2	0.04	$ 17,381		$ 0	8					
3	0.02	$ 4,327		$ 0	2					
		Alternative # 3								
1	0.00	$ 1,129		$ 0	2					
2	0.04	$ 16,112		$ 0	7					
3	0.02	$ 4,235		$ 0	2					
		Alternative # 4								
1	0.02	$ 5,314		$ 12	11					
2	0.58	$ 62,400		$ 561	99					
3	0.20	$ 17,114		$ 177	24					
		Alternative # 5								
1	0.01	$ 1,453		$ 0	2					
2	0.05	$ 17,992		$ 0	8					
3	0.02	$ 5,447		$ 0	2					

EQUIVALENT ANNUAL INCREMENTAL BENEFIT-COST

alton Hwy MP 0-9 Reconstruction. Z609110000/06520

Based on Analysis Run on 6/28/2016 4:37:34 PM

RSAP 3.0.1 (release 150507) running in Excel Version 14.0 on Windows (32-bit) NT 6.01

			Decision Point Benefit-Cost Ratio:			
			Alternative Choice			
			5	3	2	1
With Respect to Alternative	Alternative No.	ALTERNATIVE NAMES	2:1 From Shoulder	All 3:1	Barnroof to 2:1 @ 14' from EOTW (CZ)	All 4:1
	5	2:1 From Shoulder	1.00	**7.53**	3.24	3.42
	3	All 3:1		0.00	-8.00	-0.69
	2	Barnroof to 2:1 @ 14' from EOTW (CZ)			0.00	3.83
	1	All 4:1				0.00
	4	Guardrail (2' Widening)				

Best Benefit-Cost Choice is: **All 3:1**

APPENDIX E

PRELIMINARY PLAN AND PROFILE SHEETS

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	1	19

← To Fairbanks

10+00 15+00 20+00 25+00 30+00 35+00 40

"05_N" 10+00.00 BP

S 38°41'22" W ~ 3249.03'

MATCH "05_N" 40+00 LINE

Proposed ROW

Replace Existing Culvert & extend under realigned roadway

590 580 500 590 600

STATE OF ALASKA 49TH
####
REGISTERED PROFESSIONAL ENGINEER

VPI = 10+00.00
ELEV = 584.30

VPC 15+92.94
ELEV = 550.78

VPT 34+46.24
ELEV = 534.33

3.8787%

PROFILE GRADE

EXISTING GROUND

VPI 25+19.59
ELEV = 498.39
LVC = 1853.29'

PROFILE GRADE
EXISTING GROUND

584.30 584.3 | 578.65 578.1 | 572.99 571.9 | 567.34 565.7 | 561.68 559.8 | 556.03 553.8 | 550.38 548.0 | 545.02 542.7 | 540.17 538.5 | 535.84 535.1 | 532.02 531.3 | 528.72 527.4 | 525.93 511.6 | 523.66 503.1 | 521.90 491.9 | 520.65 502.7 | 519.92 503.4 | 519.70 503.8 | 520.00 502.6 | 520.81 505.8 | 522.14 509.9 | 523.98 513.4 | 526.34 518.1 | 529.21 521.9 | 532.59 525.9 | 536.41 530.2 | 540.29 532.9 | 544.17 537.0 | 548.05 542.3 | 551.93 547.0 | 555.81 550.2

10+00 15+00 20+00 25+00 30+00 35+00 40+00

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STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	2	19

MATCH "05_N" 40+00 LINE

MATCH "05_N" 70+00 LINE

"05_N"46+65.40 PI
Δ = 20°31'20"
D = 2°29'28"
T = 416.37'
L = 823.82'
R = 2300.00'
S = 4.3%

"05_N"42+49.03 PC

"05_N"50+72.85 PT

S 18°10'02" W ~ 1925.61'

Existing Alyeska Pipeline Underground Crossing

STATE OF ALASKA 49TH
####
####
REGISTERED PROFESSIONAL ENGINEER

PROFILE GRADE

EXISTING GROUND

3.8787%

-2.1642%

-5.0765%

VPI 45+71.43
ELEV = 577.97
LVC = 900.00'

VPI 62+23.77
ELEV = 542.21
LVC = 933.84'

VPC 41+21.43
ELEV = 560.52

VPT 50+21.43
ELEV = 568.23

VPC 57+56.85
ELEV = 552.32

VPT 66+90.69
ELEV = 518.51

570 560 550 540 530 520 510 500 490

555.81 550.2 | 559.68 551.1 | 563.36 555.3 | 566.37 556.5 | 568.72 560.4 | 570.39 563.0 | 571.39 565.2 | 571.72 563.4 | 571.38 564.5 | 570.36 565.2 | 568.68 564.3 | 566.53 563.1 | 564.37 561.4 | 562.20 559.4 | 560.04 556.6 | 557.87 553.9 | 555.71 551.5 | 553.55 549.6 | 551.35 547.4 | 548.90 545.2 | 546.13 542.6 | 543.05 539.5 | 539.66 535.9 | 535.96 531.6 | 531.95 527.2 | 527.62 523.2 | 522.98 519.7 | 518.03 514.8 | 512.96 510.0 | 507.88 504.8 | 502.80 499.9

40+00 45+00 50+00 55+00 60+00 65+00 70+00

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STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	3	19

"05_N"76+75.06 PI
Δ = 58°49'52"
D = 4°46'29"
T = 676.59'
L = 1232.16'
R = 1200.00'
S = 5.6%

"05_N"98+26.12 PI
Δ = 49°54'36"
D = 2°44'53"
T = 970.26'
L = 1816.23'
R = 2085.00'
S = 4.3%

To Manley →

S 76°59'54" W ~ 625.24'

"05_N"82+30.62 PT

"05_N"88+55.86 PC

Existing RS 2477 Trail

"05_N"69+98.46 PC

MATCH "05_N" 70+00 LINE

MATCH "05_N" 100+00 LINE

STATE OF ALASKA
49 TH
####
####
REGISTERED PROFESSIONAL ENGINEER

-5.0765%

VPC 76+91.54
ELEV = 467.70

VPI 80+46.89
ELEV = 449.66
LVC = 710.71'

VPT 84+02.24
ELEV = 449.62

-0.0120%

VPC 98+63.53
ELEV = 449.44

VPI 99+63.53
ELEV = 449.43
LVC = 200.00'

PROFILE GRADE

EXISTING GROUND

PROFILE GRADE
EXISTING GROUND

502.80 499.9	497.73 494.3	492.65 487.9	487.58 480.5	482.50 480.8	477.42 482.7	472.35 474.6	467.27 466.1	462.61 473.4	458.67 479.9	455.43 474.0	452.91 444.9	451.10 443.0	450.00 444.5	449.62 443.9	449.61 441.2	449.59 439.0	449.58 438.8	449.57 438.3	449.56 439.2	449.55 439.3	449.53 439.6	449.52 438.8	449.51 437.2	449.50 439.8	449.49 440.4	449.47 443.4	449.46 440.8	449.45 438.5	449.45 439.5	449.60 438.1
70+00					75+00					80+00									85+00											90+00									95+00									100+00

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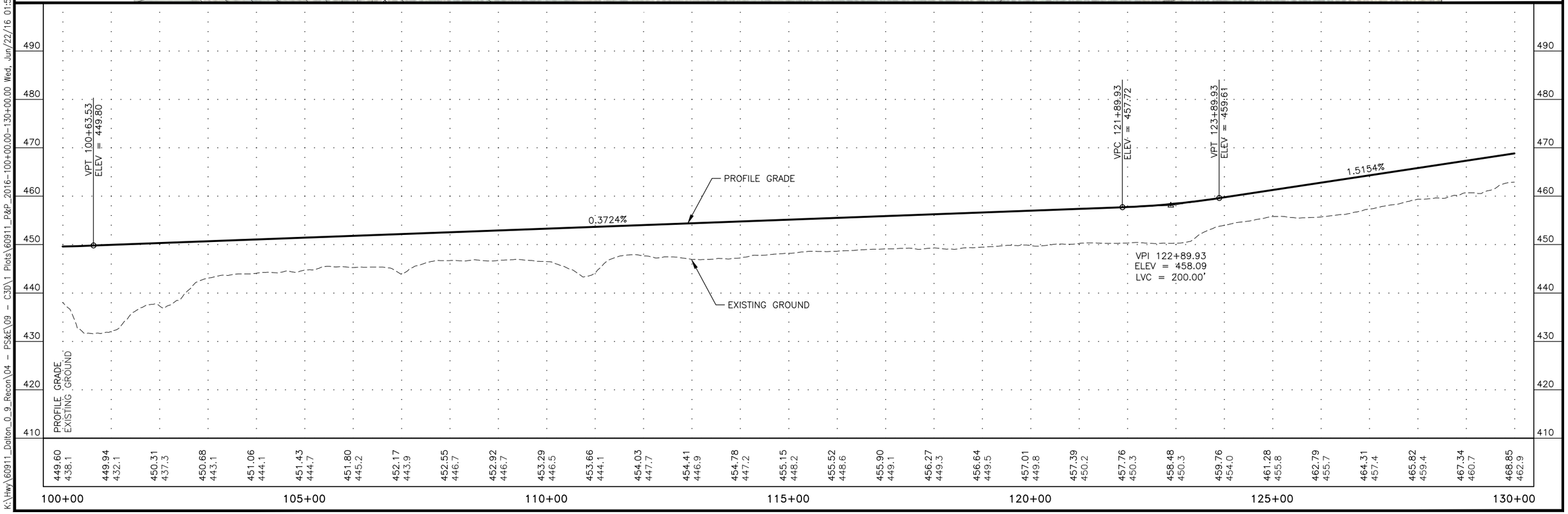
STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	4	19



STATE OF ALASKA
49 TH
####
REGISTERED PROFESSIONAL ENGINEER

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STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	5	19

MATCH "05_N" 130+00 LINE

MATCH "05_N" 160+00 LINE

"05_N"142+92.17 PI
Δ = 44°37'28"
D = 2°44'53"
T = 855.64'
L = 1623.89'
R = 2085.00'
S = 4.3%

"05_N"134+36.53 PC

"05_N"150+60.41 PT

"05_N"153+95.87 PC

S 82°17'01" W ~ 335.45'

STATE OF ALASKA
49 TH
REGISTERED PROFESSIONAL ENGINEER

VPI 137+46.77
ELEV = 480.17
LVC = 486.82'

VPI 150+46.23
ELEV = 483.42
LVC = 1561.72'

PROFILE GRADE
EXISTING GROUND

1.5154%

0.2499%

-0.4691%

VPC 135+03.36
ELEV = 476.48

VPT 139+90.18
ELEV = 480.78

VPC 142+65.37
ELEV = 481.47

VPT 158+27.09
ELEV = 479.75

PROFILE GRADE
EXISTING GROUND

468.85 462.9 | 470.37 464.7 | 471.88 466.4 | 473.40 467.2 | 474.92 468.4 | 476.43 469.7 | 477.82 470.8 | 478.96 473.5 | 479.83 474.1 | 480.45 474.0 | 480.80 473.2 | 481.05 472.4 | 481.30 471.6 | 481.55 470.8 | 481.76 471.0 | 481.93 471.4 | 482.04 471.7 | 482.12 472.3 | 482.14 473.5 | 482.12 476.7 | 482.06 476.4 | 481.95 474.5 | 481.79 466.6 | 481.59 459.4 | 481.34 460.2 | 481.04 459.8 | 480.70 459.7 | 480.31 464.7 | 479.88 468.7 | 479.41 466.2 | 478.94 466.4

130+00 135+00 140+00 145+00 150+00 155+00 160+00

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STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	6	19

"05_N"160+31.43 PI
Δ = 15°47'02"
D = 1°14'59"
T = 635.57'
L = 1263.08'
R = 4585.00'
S = 2.7%

MATCH "05_N" 160+00 LINE

MATCH "05_N" 190+00 LINE

N 81°55'57" W ~ 305.13'

S 86°12'48" W ~ 622.37'

"05_N"166+58.95 PT

"05_N"169+64.08 PC

"05_N"177+54.42 PT

"05_N"183+76.79 PC

"05_N"173+60.67 PI
Δ = 11°51'15"
D = 1°30'00"
T = 396.58'
L = 790.34'
R = 3820.00'
S = 3.0%

160+00 165+00 170+00 175+00 180+00 185+00 190+00

500 600 700

STATE OF ALASKA
49TH
####
REGISTERED PROFESSIONAL ENGINEER

VPC 165+89.32
ELEV = 476.18

VPT 167+89.32
ELEV = 475.90

PROFILE GRADE

−0.4691%

0.1957%

VPI 166+89.32
ELEV = 475.71
LVC = 200.00'

EXISTING GROUND

PROFILE GRADE
EXISTING GROUND

510 500 490 480 470 460 450 440 430

160+00	165+00	170+00	175+00	180+00	185+00	190+00
478.94 / 466.4	478.47 / 466.7	478.00 / 466.3	477.54 / 464.0	477.07 / 462.3	476.60 / 463.7	476.13 / 464.1
475.86 / 463.9	475.93 / 464.2	476.12 / 465.3	476.32 / 467.9	476.51 / 467.5	476.71 / 467.7	476.90 / 468.2
477.10 / 467.8	477.30 / 468.6	477.49 / 468.4	477.69 / 468.2	477.88 / 468.3	478.08 / 468.0	478.27 / 468.1
478.47 / 469.0	478.67 / 469.4	478.86 / 469.5	479.06 / 469.9	479.25 / 470.3	479.45 / 471.0	479.64 / 471.5
479.84 / 470.8	480.04 / 474.6	480.23 / 502.2				

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STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	7	19

"05_N"190+63.45 PI
Δ = 59°33'29"
D = 4°46'29"
T = 686.66'
L = 1247.38'
R = 1200.00'
S = 5.6%

MATCH "05_N" 190+00 LINE

MATCH "05_N" 220+00 LINE

Construct Pullout
& RS 2477 Trailhead

"05_N"196+24.17 PT

N 34°13'43" W ~ 1512.86'

"05_N"211+37.03 PC

"05_N"218+06.95 PI
Δ = 54°31'33"
D = 4°24'27"

STATE OF ALASKA
49TH
####
####
REGISTERED PROFESSIONAL ENGINEER

VPI 216+96.23
ELEV = 526.99
LVC = 900.00'

VPC 207+21.11
ELEV = 490.41

VPT 212+21.11
ELEV = 505.33

4.558%

PROFILE GRADE

1.4094%

VPI 209+71.11
ELEV = 493.94
LVC = 500.00'

VPC 212+46.23
ELEV = 506.48

VPI 201+22.01
ELEV = 481.97

VPC 195+37.62
ELEV = 479.83

VPI 193+71.83
ELEV = 480.96
LVC = 292.21'

0.1957%

-0.6785%

VPI 198+29.82
ELEV = 477.85
LVC = 584.39'

EXISTING GROUND

PROFILE GRADE
EXISTING GROUND

VPC 192+25.73
ELEV = 480.67

VPT 195+17.94
ELEV = 479.97

530 520 510 500 490 480 470 460 450

480.23 502.2 | 480.43 540.3 | 480.62 491.2 | 480.74 467.3 | 480.56 469.0 | 480.08 469.7 | 479.48 468.9 | 479.20 469.7 | 479.28 467.8 | 479.72 469.5 | 480.52 470.8 | 481.67 472.6 | 483.07 473.1 | 484.48 476.8 | 485.89 475.4 | 487.30 478.7 | 488.71 483.4 | 490.12 486.1 | 491.72 487.0 | 493.94 488.0 | 496.79 491.6 | 500.27 492.9 | 504.38 494.5 | 508.80 498.8 | 512.41 508.0 | 515.12 512.7 | 516.92 519.4 | 517.81 521.6 | 517.80 518.9 | 516.88 517.7 | 515.04 513.2

190+00 195+00 200+00 205+00 210+00 215+00 220+00

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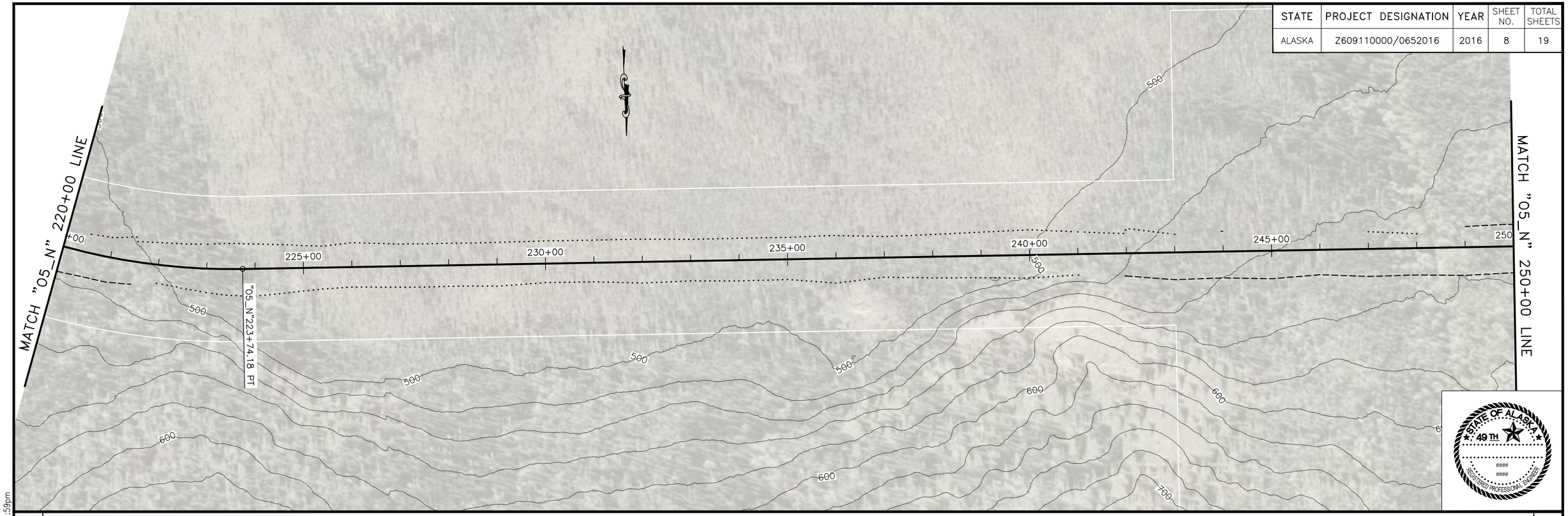
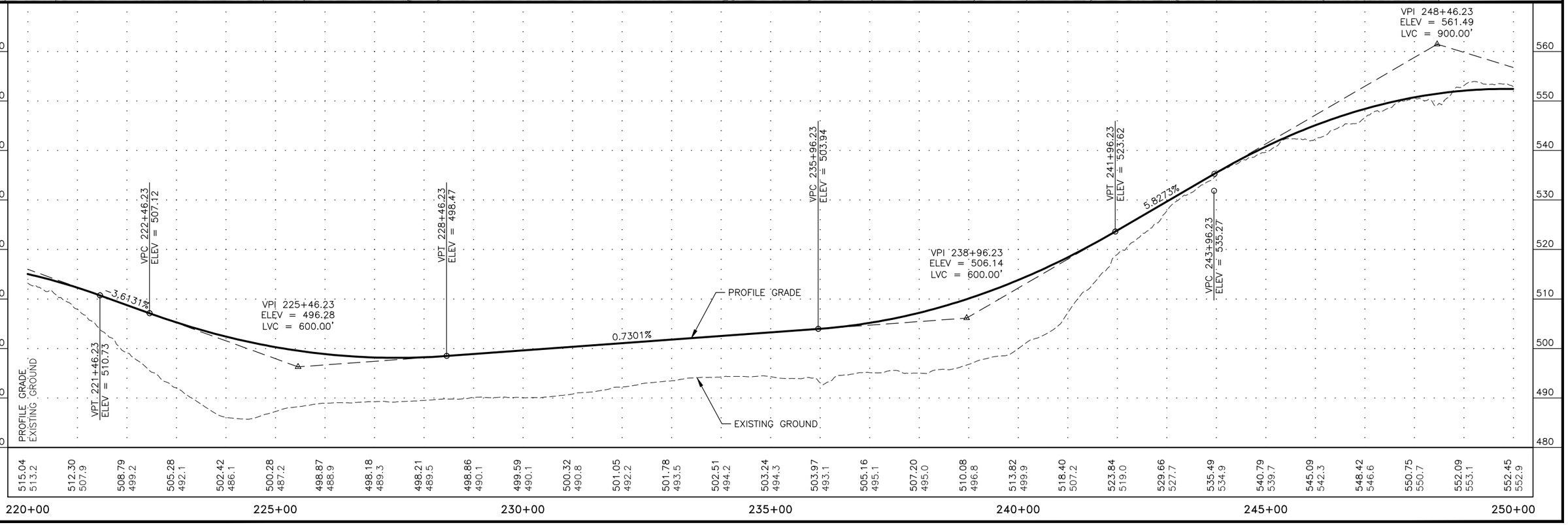
STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	8	19





STATE OF ALASKA
49TH
REGISTERED PROFESSIONAL ENGINEER
####
####

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STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	9	19

MATCH "05_N" 250+00 LINE

MATCH "05_N" 280+00 LINE

N 88°45'16" W ~ 9095.58'

STATE OF ALASKA 49TH
####
####
REGISTERED PROFESSIONAL ENGINEER

VPT 252+96.23
ELEV = 547.71

VPC 257+16.23
ELEV = 534.84

VPT 262+16.23
ELEV = 530.04

-3.0640%

1.1447%

PROFILE GRADE

EXISTING GROUND

VPI 259+66.23
ELEV = 527.18
LVC = 500.00'

PROFILE GRADE
EXISTING GROUND

552.45 552.9	551.82 553.1	550.20 552.1	547.59 549.6	544.53 544.4	541.46 541.1	538.40 533.8	535.34 526.9	532.57 526.9	530.63 524.6	529.53 521.1	529.28 521.2	529.86 522.6	531.00 524.0	532.14 525.6	533.29 527.7	534.43 531.4	535.58 531.1	536.72 530.1	537.87 531.8	539.01 531.6	540.16 530.9	541.30 532.2	542.45 533.8	543.59 545.7	544.73 550.9	545.88 553.8	547.02 553.8	548.17 554.4	549.31 550.5	550.46 546.3

250+00 255+00 260+00 265+00 270+00 275+00 280+00

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STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	10	19

MATCH "05_N" 280+00 LINE

MATCH "05_N" 310+00 LINE

+00 285+00 290+00 295+00 300+00 305+00 310

600 600 600 600 600 600 700 700 700

STATE OF ALASKA 49TH REGISTERED PROFESSIONAL ENGINEER #### ####

610 600 590 580 570 560 550 540 530

VPC 286+96.23
ELEV = 558.43

VPT 287+96.23
ELEV = 559.26

PROFILE GRADE

0.5249%

1.1447%

VPI 287+46.23
ELEV = 559.00
LVC = 100.00'

EXISTING GROUND

PROFILE GRADE
EXISTING GROUND

550.46 546.3 | 551.60 546.8 | 552.75 547.1 | 553.89 547.9 | 555.04 545.2 | 556.18 545.2 | 557.33 543.9 | 558.47 542.8 | 559.28 545.6 | 559.81 546.7 | 560.33 551.1 | 560.86 556.4 | 561.38 555.1 | 561.91 558.7 | 562.43 564.2 | 562.96 564.7 | 563.48 565.1 | 564.01 565.7 | 564.53 569.7 | 565.06 568.1 | 565.58 566.1 | 566.11 573.9 | 566.63 587.6 | 567.16 598.2 | 567.68 603.5 | 568.21 612.3 | 568.73 609.3 | 569.26 586.8 | 569.78 571.7 | 570.31 565.4 | 570.83 566.6

280+00 285+00 290+00 295+00 300+00 305+00 310+00

K:\Hwy\60911_Dalton_0_9_Recon\04 - PS&E\09 - C3D\1 Plots\60911_P&P_2016-280+00.00-310+00.00 Wed, Jun/22/16 02:00pm

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	11	19

"05_N"317+47.03 PI
Δ = 15°47'08"
D = 2°51'53"
T = 277.27'
L = 551.02'
R = 2000.00'
S = 4.3%

"05_N"325+73.90 PI
Δ = 8°33'23"
D = 2°51'53"
T = 149.61'
L = 298.67'
R = 2000.00'
S = 4.3%

MATCH "05_N" 310+00 LINE

MATCH "05_N" 340+00 LINE

S 75°59'36" W ~ 403.49'

S 84°00'59" W ~ 602.20'

"05_N"314+69.77 PC

"05_N"320+20.79 PT

"05_N"324+24.28 PC

"05_N"327+22.95 PT

"05_N"333+25.15 PC

310+00 315+00 320+00 325+00 330+00 335+00 340+00

600 600 600 600 700 700 700 700 700

STATE OF ALASKA
49 TH
REGISTERED PROFESSIONAL ENGINEER

PROFILE GRADE

EXISTING GROUND

0.5249%

VPC 332+60.77
ELEV = 582.70

PROFILE GRADE
EXISTING GROUND

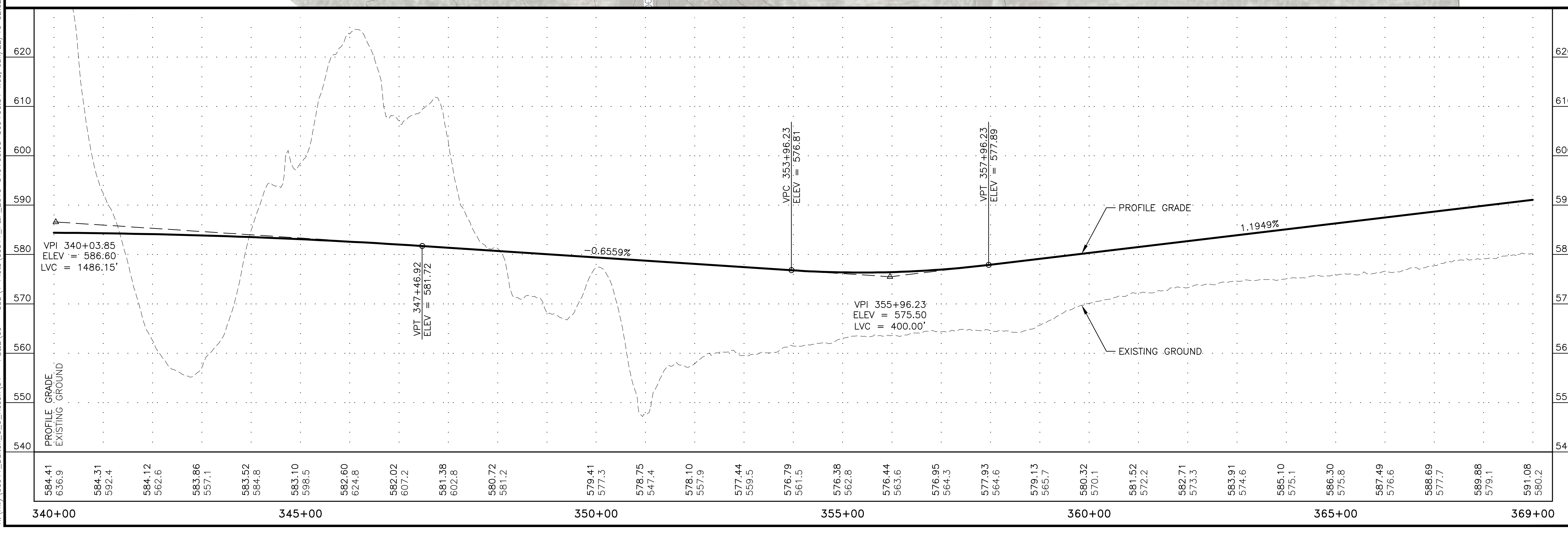
620 610 600 590 580 570 560 550 540

570.83 566.6 | 571.36 568.0 | 571.88 569.2 | 572.41 569.0 | 572.93 569.2 | 573.46 570.6 | 573.98 572.9 | 574.51 576.0 | 575.03 579.5 | 575.55 582.4 | 576.08 583.2 | 576.60 590.5 | 577.13 589.5 | 577.65 583.6 | 578.18 578.9 | 578.70 579.0 | 579.23 584.3 | 579.75 583.0 | 580.28 575.1 | 580.80 562.4 | 581.33 555.1 | 581.85 548.7 | 582.38 547.1 | 582.90 547.5 | 583.35 542.3 | 583.73 543.4 | 584.02 544.3 | 584.24 548.1 | 584.37 564.6 | 584.43 605.8 | 584.41 636.9

0.046785%

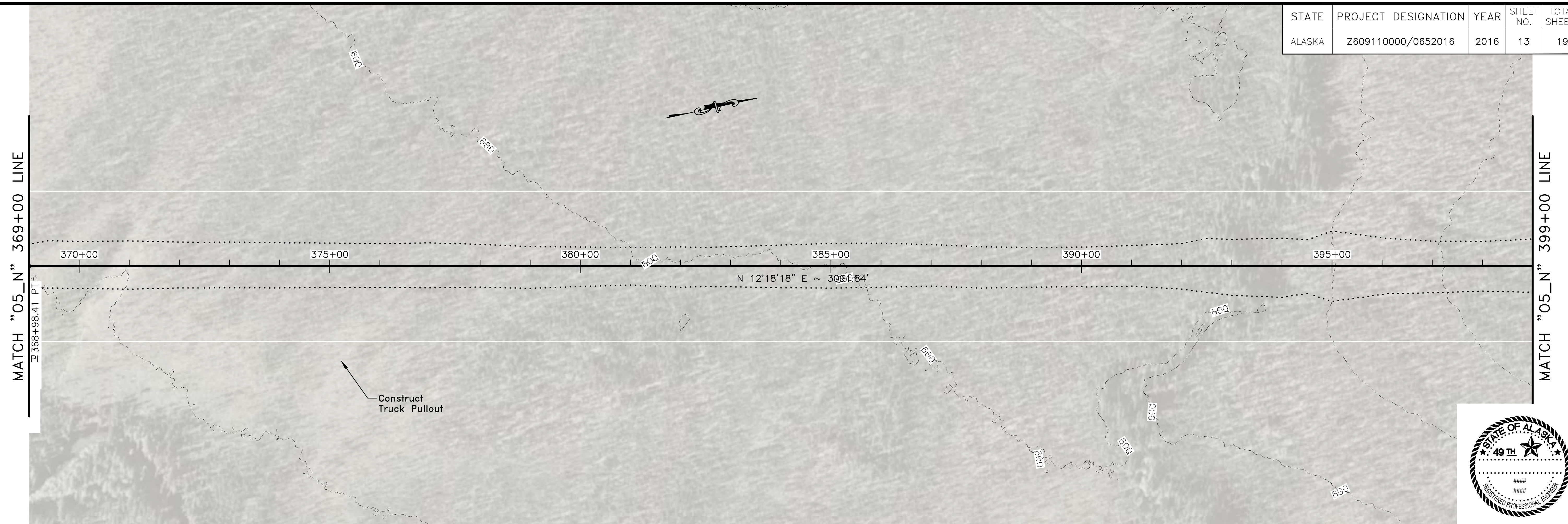
310+00 315+00 320+00 325+00 330+00 335+00 340+00

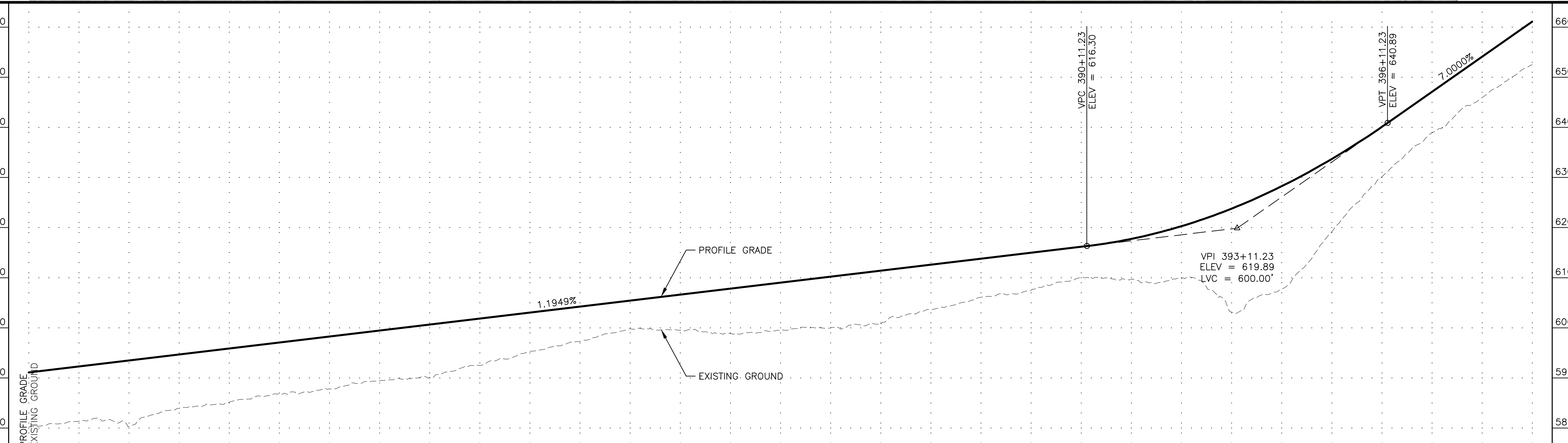
STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	12	19



K:\Hwy\60911_Dalton_0_9_Recon\04 - PS&E\09 - C3D\1 Plots\60911_P&P_2016-340+00.00-369+00.34 Wed, Jun/22/16 02:02pm

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	13	19





591.08	592.27	593.47	594.66	595.86	597.05	598.25	599.44	600.64	601.83	603.03	604.22	605.42	606.61	607.81	609.00	610.20	611.39	612.59	613.78	614.98	616.17	617.75	620.28	623.79	628.26	633.70	640.11	647.10	654.10	661.10
580.2	581.3	580.3	583.9	585.1	586.8	587.8	589.4	590.1	592.5	595.3	597.3	599.8	599.5	598.9	599.5	600.0	600.7	603.6	606.1	607.5	610.1	609.6	609.9	603.1	607.8	619.2	630.1	638.9	646.0	652.5

369+00 370+00 375+00 380+00 385+00 390+00 395+00 399+00

K:\Hwy\60911_Dalton_0_9_Recon\04 - PS&E\09 - C3D\1 Plots\60911_P&P_2016-369+00.34-399+00.34 Wed, Jun/22/16 02:02pm

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	14	19

MATCH "05_N" 399+00 LINE

MATCH "05_N" 429+00 LINE

"05_N"399+90.25 PC

"05_N"404+27.10 PI
Δ = 9°59'11"
D = 1°08'45"
T = 436.84'
L = 871.47'
R = 5000.00'
S = 2.2%

"05_N"408+61.73 PT

N 22°17'29" E ~ 448.89'

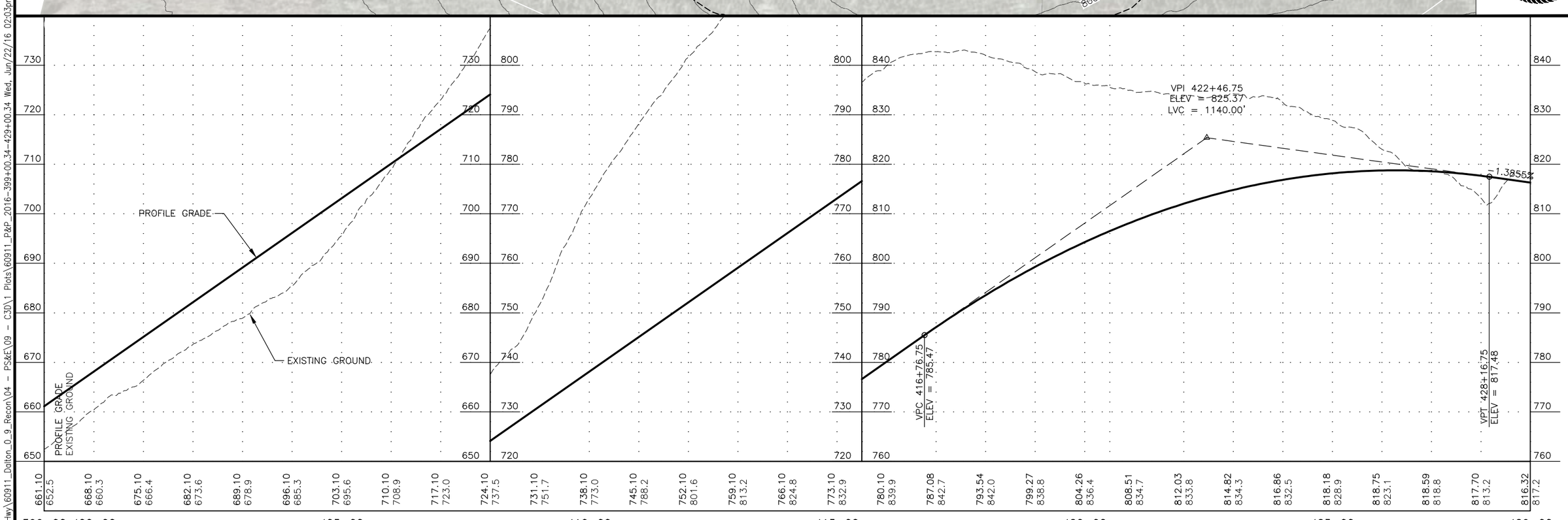
"05_N"413+10.62 PC

"05_N"420+56.89 PI
Δ = 73°27'59"
D = 5°43'46"
T = 746.28'
L = 1282.23'
R = 1000.00'
S = 5.9%

"05_N"425+92.84 PT

400+00 405+00 410+00 415+00 420+00 425+00

600 700 800



STATE OF ALASKA
49TH
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K:\Hwy\60911_Dalton_0_9_Recon\04 - PS&E\09 - C3D\1 Plots\60911_P&P_2016-399+00.34-429+00.34 Wed, Jun/22/16 02:03pm

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	15	19

MATCH "05_N" 429+00 LINE

MATCH "05_N" 459+00 LINE

430+00 435+00 440+00 445+00 450+00 455+00

800

N 51°10'30" W ~ 2191.68'

N 72°48'24" W ~ 559.51'

"05_N"447+84.52 PC

"05_N"453+41.40 PT

"05_N"450+66.31 PI
Δ = 21°37'54"
D = 3°53'04"
T = 281.79'
L = 556.88'
R = 1475.00'
S = 5.2%

STATE OF ALASKA
49TH
REGISTERED PROFESSIONAL ENGINEER

860 850 840 830 820 810 800 790 780

PROFILE GRADE
EXISTING GROUND

VPC 430+95.30
ELEV = 813.62

VPT 433+95.30
ELEV = 810.92

VPC 444+46.23
ELEV = 806.61

VPT 448+46.23
ELEV = 812.21

VPC 453+88.73
ELEV = 829.62

VPT 457+88.73
ELEV = 838.76

VPI 455+88.73
ELEV = 836.04
LVC = 400.00'

-1.3855%

-0.4104%

3.2092%

1.3615%

VPI 432+45.30
ELEV = 811.54
LVC = 300.00'

VPI 446+46.23
ELEV = 805.79
LVC = 400.00'

PROFILE GRADE

EXISTING GROUND

816.32 817.2 | 814.94 813.7 | 813.55 811.8 | 812.35 810.6 | 811.46 810.0 | 810.91 810.3 | 810.49 809.4 | 810.08 808.9 | 809.67 809.2 | 809.26 808.6 | 808.85 807.8 | 808.44 807.0 | 808.03 806.7 | 807.62 805.9 | 807.21 804.2 | 806.80 802.9 | 806.52 802.2 | 807.05 803.1 | 808.48 804.1 | 810.82 805.4 | 813.94 808.0 | 817.14 811.8 | 820.35 815.9 | 823.56 820.2 | 826.77 824.2 | 829.98 827.3 | 832.90 829.9 | 835.37 832.0 | 837.37 833.3 | 838.91 834.8 | 840.28 836.5

429+00 430+00 435+00 440+00 445+00 450+00 455+00 459+00

K:\Hwy\60911_Dalton_0_9_Recon\04 - PS&E\09 - C3D\1 Plots\60911_P&P_2016-429+00.34-459+00.34 Wed, Jun/22/16 02:04pm

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	16	19

MATCH "05_N" 459+00 LINE

MATCH "05_N" 489+00 LINE

"05_N"459+00.91 PI

"05_N"465+95.41 PI

"05_N"472+35.88 PI

"05_N"480+85.35 PI

460+00 465+00 470+00 475+00 480+00 485+00

N 72°38'03" W ~ 694.50'

N 72°05'07" W ~ 640.47'

N 70°54'15" W ~ 849.47'

N 72°11'43" W ~ 1022.11'

BM

NO DEBRIS REMOVED

0.0' DEBRIS

0.0' DEBRIS CHISELED

0.0' DEBRIS

0.0' DEBRIS

DEBRIS REMOVED

0.0' DEBRIS

STATE OF ALASKA 49TH

REGISTERED PROFESSIONAL ENGINEER

PROFILE GRADE

EXISTING GROUND

PROFILE GRADE
EXISTING GROUND

1.361S%

VPC 462+96.23
ELEV = 845.67

VPI 464+96.23
ELEV = 848.39
LVC = 400.00'

VPT 466+96.23
ELEV = 858.29

4.950S%

VPC 475+46.26
ELEV = 900.38

VPI 477+46.26
ELEV = 910.28
LVC = 400.00'

VPT 479+46.26
ELEV = 924.28

7.000%

VPI 485+41.88
ELEV = 965.97
LVC = 237.24'

4.178A%

VPC 484+23.26
ELEV = 957.67

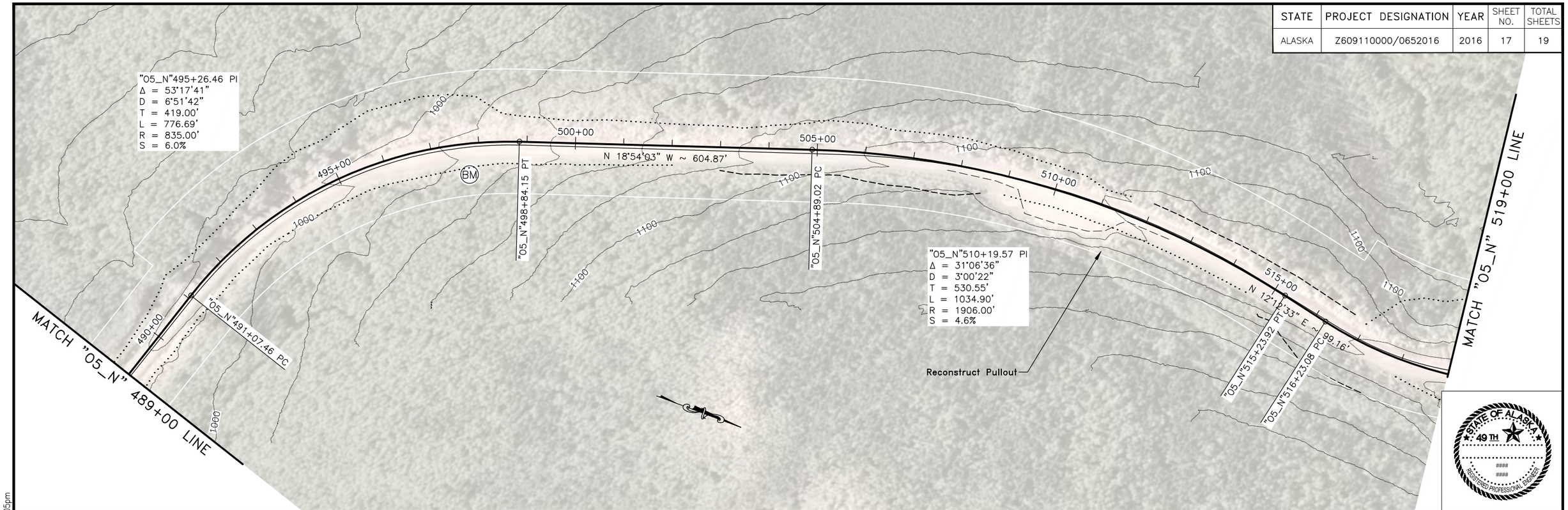
VPT 486+60.50
ELEV = 970.93

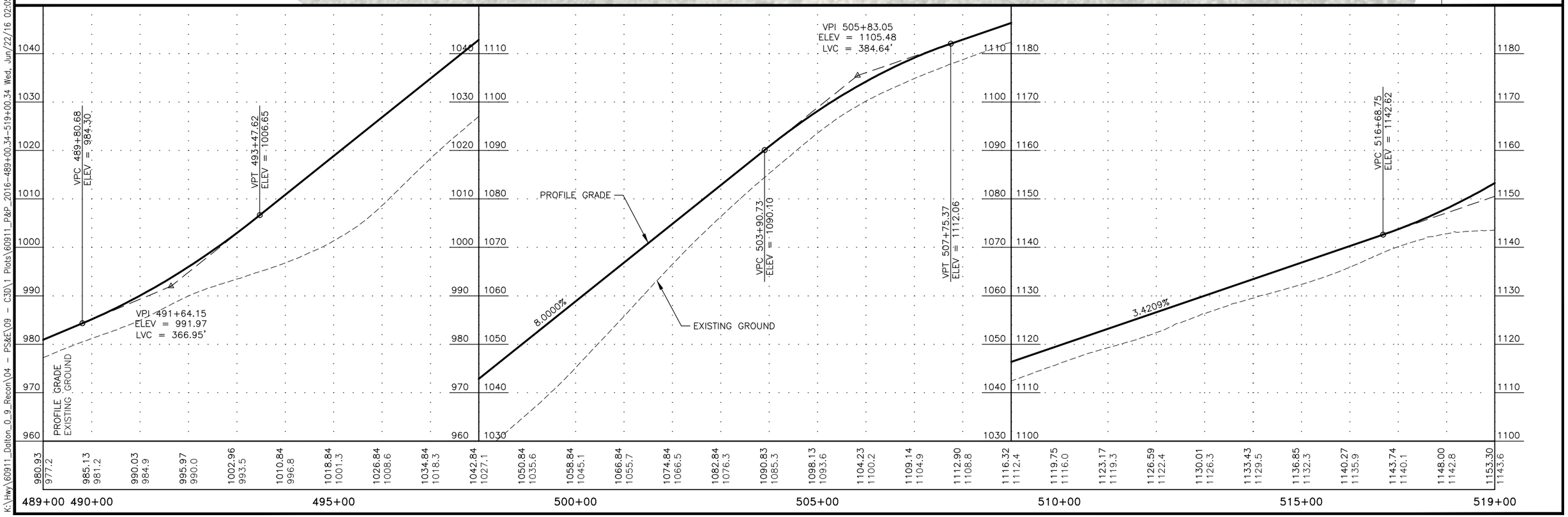
840.28 836.5 | 841.64 838.1 | 843.00 838.9 | 844.36 840.5 | 845.72 842.7 | 847.57 845.2 | 850.31 848.1 | 853.95 851.8 | 858.48 856.1 | 863.43 860.7 | 868.38 865.3 | 873.33 870.2 | 878.28 875.6 | 883.23 880.9 | 888.18 885.8 | 893.13 890.6 | 898.09 895.5 | 903.11 900.8 | 908.59 906.3 | 914.59 912.0 | 921.09 917.7 | 928.04 923.4 | 935.04 930.4 | 942.04 938.6 | 949.04 944.9 | 956.04 951.5 | 962.69 957.9 | 968.18 964.1 | 972.58 968.5 | 976.75 972.9 | 980.93 977.2

459+00 460+00 465+00 470+00 475+00 480+00 485+00 489+00

K:\Hwy\60911_Dalton_0_9_Recon\04 - PS&E\09 - C3D\1 Plots\60911_P&P_2016-459+00.34-489+00.34 Wed, Jun/22/16 02:05pm

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	17	19





STATE OF ALASKA
49TH
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REGISTERED PROFESSIONAL ENGINEER

K:\Hwy\60911_Dalton_0_9_Recon\04 - PS&E\09 - C3D\1 Plots\60911_P&P_2016-489+00.34-519+00.34 Wed, Jun/22/16 02:05pm

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	18	19

MATCH "05_N" 519+00 LINE

MATCH "05_N" 549+00 LINE

"05_N"519+20.90 PI
Δ = 39°15'34"
D = 6°51'42"
T = 297.82'
L = 572.15'
R = 835.00'
S = 6.0%

"05_N"521+95.23 PT

"05_N"528+72.34 PC

"05_N"530+02.17 PI
Δ = 2°07'30"
D = 0°49'07"
T = 129.83'
L = 259.63'
R = 7000.00'
S = 3.0%

"05_N"531+31.97 PT

"05_N"539+78.74 PC

"05_N"544+40.70 PI
Δ = 20°44'39"
D = 2°16'12"
T = 461.97'
L = 913.82'
R = 2524.00'
S = 3.8%

N 27°03'01" W ~ 677.11'

N 24°55'30" W ~ 846.76'

520+00 525+00 530+00 535+00 540+00 545+00

1100 1200 1300 1400

BM

STATE OF ALASKA
49TH
####
####
REGISTERED PROFESSIONAL ENGINEER

VPI 519+38.52
ELEV = 1151.85
LVC = 539.55'

VPT 522+08.29
ELEV = 1176.13

PROFILE GRADE

9.0000%

EXISTING GROUND

VPI 545+72.13
ELEV = 1388.88
LVC = 429.17'

3.9478%

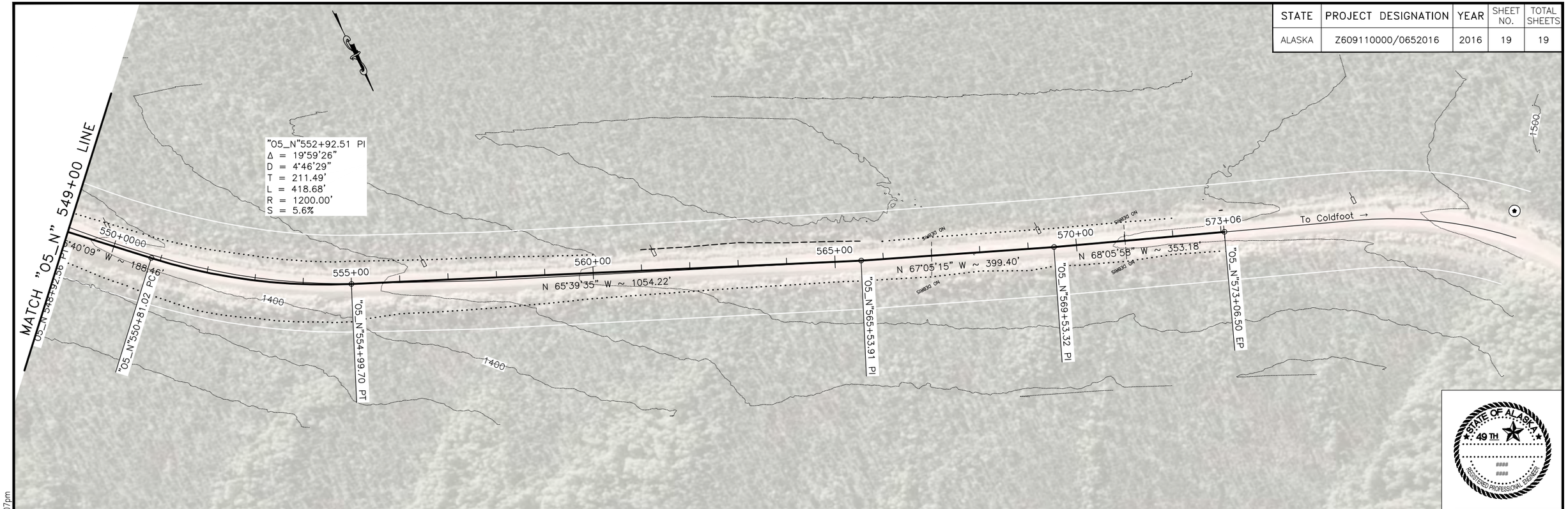
VPC 543+57.55
ELEV = 1369.56

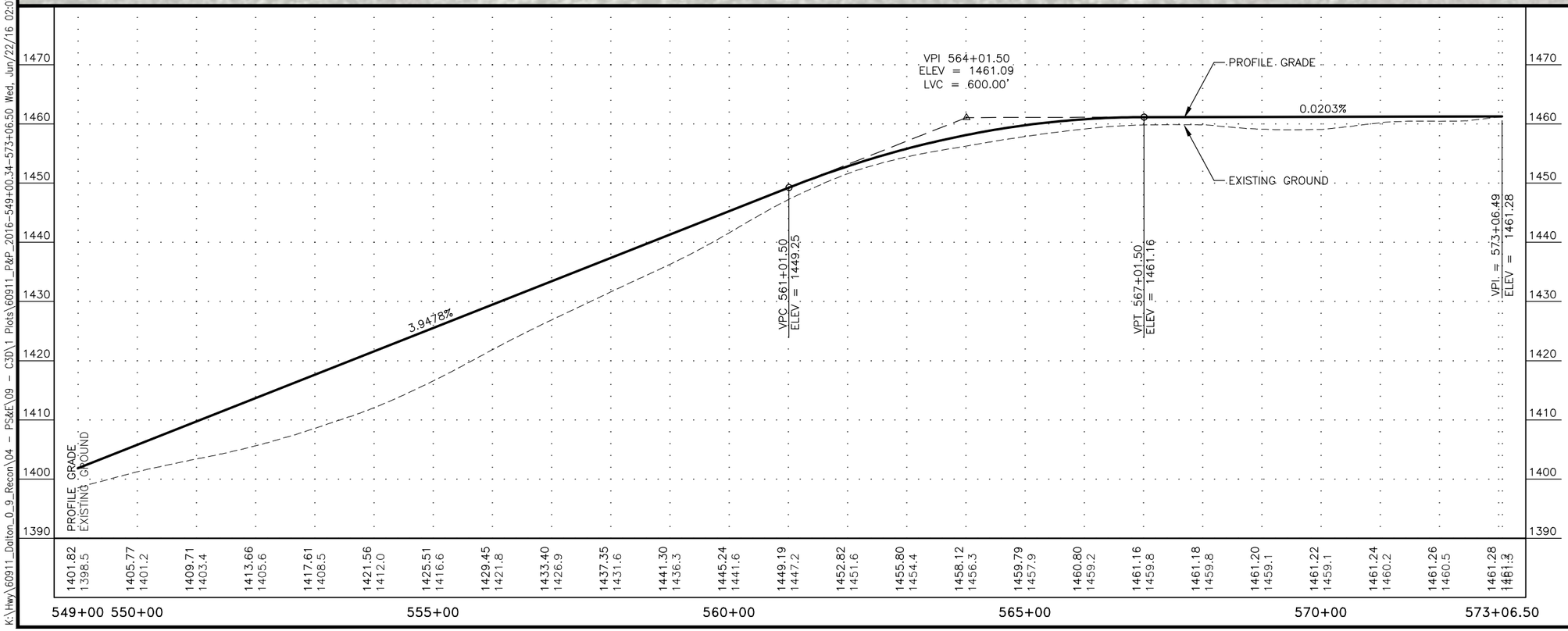
VPT 547+86.71
ELEV = 1397.35

519+00 525+00 530+00 535+00 540+00 545+00 549+00

K:\Hwy\60911_Dalton_0_9_Recon\04 - PS&E\09 - C3D\1 Plots\60911_P&P_2016-519+00.34-549+00.34 Wed, Jun/22/16 02:06pm

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	Z609110000/0652016	2016	19	19





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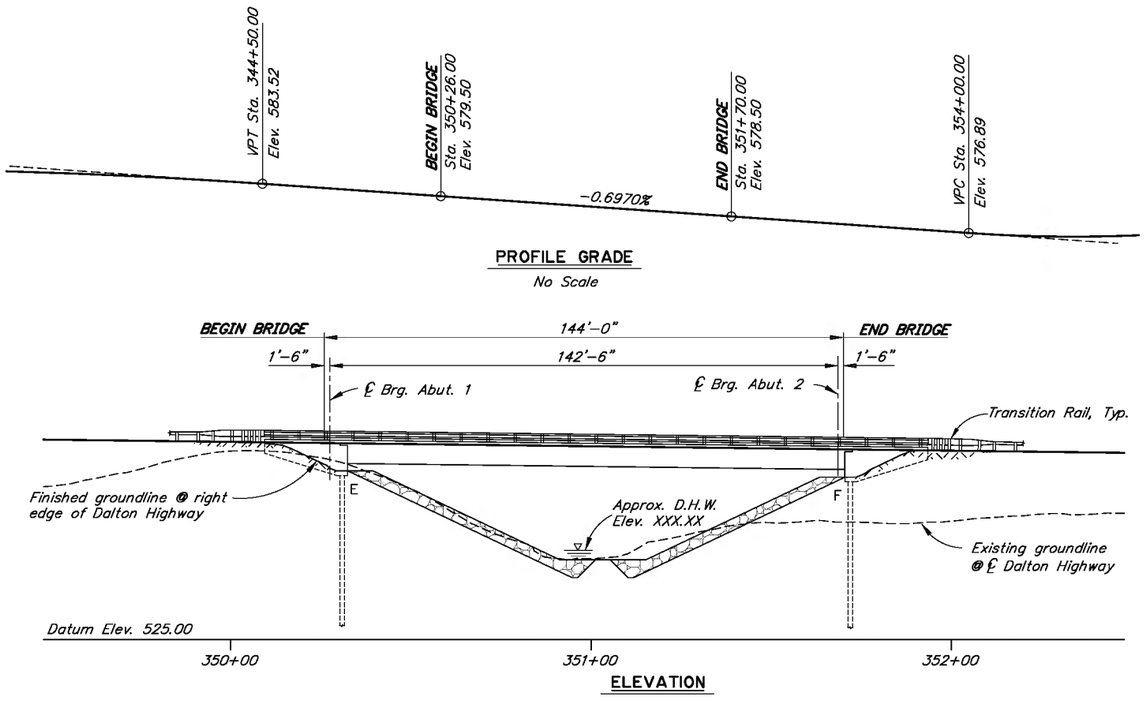
APPENDIX F

PRELIMINARY BRIDGE PLANS AND COST ANALYSIS

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA		2015		

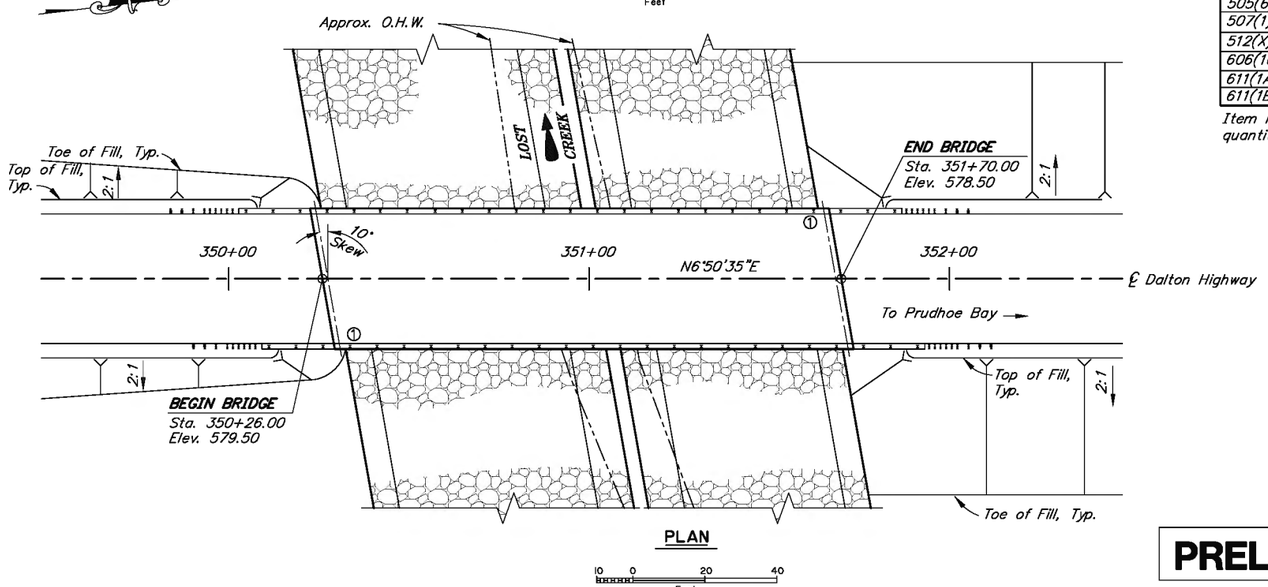


PROFILE GRADE

No Scale

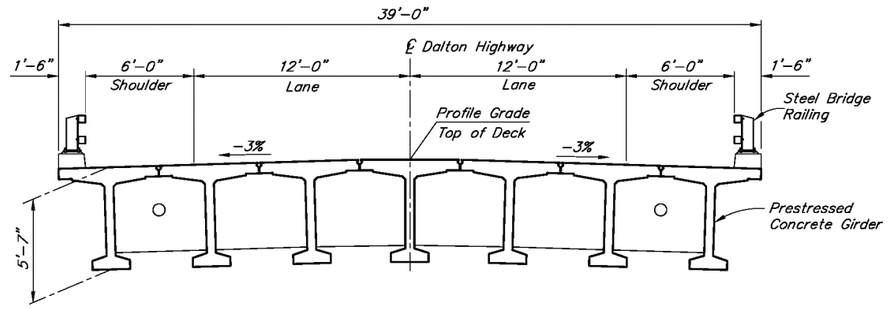
ELEVATION

10 0 20 40 Feet



PLAN

10 0 20 40 Feet



TYPICAL SECTION

12 0 4 8 In. Feet

BRIDGE BASIS OF ESTIMATE

ITEM NO.	ITEM	PAY UNIT	ESTIMATING UNIT	SUBST.	SUPERST.	TOTAL
205(3)	Structural Fill	LS	CY			
501(1)	Class A Concrete	LS	CY			
501(5)	Precast Concrete Member (142'-6" Decked Bulb-Tee)	EA	EA			
503(1)	Reinforcing Steel	LS	LBS			
503(2)	Epoxy-Coated Reinforcing Steel	LS	LBS			
505(5)	Furnish Structural Steel Piles (HP14x117)	LF	LF			
505(6)	Drive Structural Steel Piles (HP14x117)	EA	EA			
507(1)	Steel Bridge Railing	LF	LF			
512(X)	Temporary Work Structure	SF	SF			
606(16)	Transition Rail	EA	EA			
611(1A)	Riprap, Class I	CY	CY			
611(1B)	Riprap, Class III	CY	CY			

Item numbers are for reference only. Quantities shown are not necessarily the pay quantities nor the total quantity of the particular item.

BRIDGE DRAWING INDEX

TITLE	DWG. NO.
GENERAL LAYOUT	1
SITE PLAN	2

PRELIMINARY PLAN **OPTION 1**

① *Approximate location of Bridge Number Plate.*

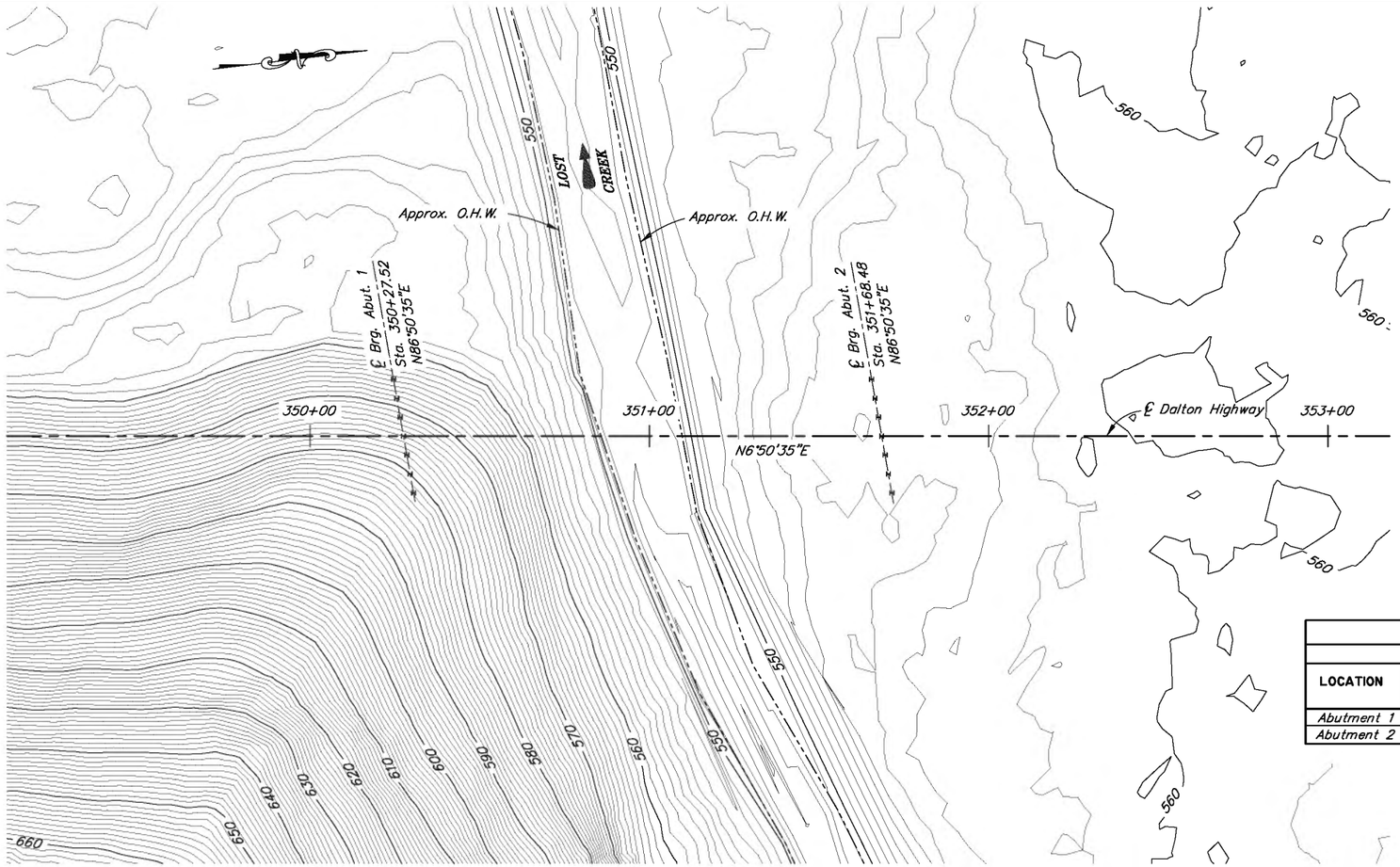
DESIGNED BY: *Elmer Marx*	CHECKED: *ENG*	LAYOUT BY: *Elmer Marx*	CHECKED BY: *ENG*
DRAWN BY: *Sam Sollie*	CHECKED: *Elmer Marx*	SPECIFICATIONS BY: *Elmer Marx*	P S & E COMPARED: *ENG*
QUANTITIES BY: *Elmer Marx*	CHECKED: *ENG*	APPROVAL RECOMMENDED BY: *Richard Pratt*	

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES
BRIDGE SECTION

LOST CREEK BRIDGE
DALTON HIGHWAY
GENERAL LAYOUT

BRIDGE NO. 2322
DWG. NO. 1

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	60911	2015		



SITE PLAN

10 0 20 40
Feet

GENERAL NOTES

DESIGN: ..... AASHTO LRFD Bridge Design Specifications, 2014 Edition, with latest interim specifications.
Seismic design per AASHTO Guide Specifications for LRFD Seismic Bridge Design, 2011 Edition, with latest interim specifications.

LIVE LOAD: HL-93

DEAD LOAD: ..... Includes 50 psf for all wearing surfacing.

SEISMIC PARAMETERS: ..... PGA = 0.25
Ss = 0.59
S1 = 0.18
Site Class = D
Liquefaction Potential = Moderate
AASHTO 7% probability of exceedance in 75 years.

REINFORCEMENT: ..... ASTM A706, Grade 60, Fy = 60,000 psi
Space reinforcement evenly unless otherwise noted.
Use ASTM A970 Headed bars, Class HA.

PRESTRESSED CONCRETE: ..... See "GIRDERS" Dwg.

CONCRETE: ..... Class A Concrete unless otherwise, f'c = 4000 psi.
Provide rubbed finish on all vertical surfaces.

STRUCTURAL STEEL: ..... ASTM A709, Grade 36T3, Fy = 36,000 psi,
Galvanize all structural steel in accordance with AASHTO M111 unless shown otherwise.

STRUCTURAL STEEL PILING: ..... H-Piles – ASTM A709, Grade 50T3, Fy = 50,000 psi.
Pile Tip reinforcing is required.

PILE DATA TABLE

LOCATION	PILE TYPE	DRIVING CRITERIA: MINIMUM PENETRATION (ft)	DRIVING CRITERIA: ESTIMATED PILE TIP ELEVATION (ft)	DRIVING CRITERIA: DRIVING RESISTANCE (K)	DESIGN DATA: STRENGTH I FACTORED LOAD (K)	DESIGN DATA: NOMINAL RESISTANCE (K)	DESIGN DATA: RESISTANCE FACTOR, ϕ
Abutment 1	HP14x117						
Abutment 2	HP14x117						

BRIDGE SHEET ABBREVIATIONS:

℄	= centerline	f.f.	= front/air face
ℙ	= plate	Hwy.	= highway
&	= and	H.J.	= high strength
@	= at	Int.	= interior
ø	= diameter	Jt.	= joint
±	= approximate	ksf	= 1000 pounds per square foot
Abut.	= abutment	LB	= pound
Approx.	= approximate	LF	= linear foot
b.f.	= back/dirt face	LS	= lump sum
bot.	= bottom	Lt.	= left
Br.	= bridge	max.	= maximum
btwn.	= between	min.	= minimum.
Brg.	= Bearings	N/A	= not applicable
C.I.P.	= cast in place	n.f.	= near face
C.G.	= center of gravity	No.	= number
Clr.	= clear, clearance	o.c.	= on center
CMP	= corrugated metal pipe	PVC	= point of vertical curve
CY	= cubic yard	PVI	= point of vertical intersection
dia.	= diameter	PVT	= point of vertical tangent
Dwg.	= drawing	R/W	= right of way
E	= expansion	Rt.	= right
(E)	= existing	Rd.	= road
EA	= each	spcs.	= space, spaces
Elev.	= elevation	Sta.	= station
e.a.	= each face	Std.	= standard
e.w.	= each way	SF	= square feet
Ext.	= exterior	Symm.	= symmetric
F	= fixed	Typ.	= typical

PRELIMINARY PLAN **OPTION 1**

DESIGNED BY: Elmer Marx	CHECKED: Engineer	HYDRAULICS BY: Michael Knapp	CHECKED BY: Engineer	STATE OF ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES BRIDGE SECTION		LOST CREEK BRIDGE DALTON HIGHWAY SITE PLAN
DRAWN BY: Sam Sallie	CHECKED: Elmer Marx	FOUNDATIONS REVIEWED BY: Engineer				BRIDGE NO. 2322 DWG. NO. 2
QUANTITIES BY: Elmer Marx	CHECKED: Engineer					

STATE OF ALASKA
DEPARTMENT OF TRANSPORTATION
AND
PUBLIC FACILITIES

Computations

Item No. _____

DATE 8/2016
Project No. Z60911000
Project Name DALTON D-9
Calc. by D. Wells
Checked by _____

For Cost Comp: Culvert Vs. Bridge @ LOST CREEK
BASED ON SIMILAR ANALYSIS of LIVENGOOD CR. BRIDGE → 2011

ASSUMPTIONS-

Bridge life → 75 yrs
Culvert Life → 37.5 yrs
INFLATION of 2.5% Annually
Full cost Culvert Repl. @ end of life
Maint. Cost Not included

Culvert Cost: EST. Present Const. Cost → $1,149,859

Replacement cost in Present Dollars

$F = P(1+i)^n$

$= \$1,149,859(1+0.025)^{37.5}$

$= \$2,902,616$

Total Culvert Cost for 75 yr life (IN PRESENT $) : $1,149,859 + $2,902,616

$= \$4,052,475$

Bridge Cost (ON FILE) (est) : $3,905,982

Difference : $146,493

Conclusion: IN PRESENT DOLLARS, A CULVERT (FISH PASSAGE) crossing @ LOST CREEK will cost $146,493 more than the proposed Bulb-tee girder bridge over the Bridge 75 year design life. Furthermore, the cost for the Bridge temp work structure will be considerably less than used for the Bridge estimate, further increasing the estimated cost difference between the culvert & Bridge.

25D-120 (5/84)

Dalton 0-9 - Lost Creek crossing - Fish Passage Pipe Cost Est. for Bridge/Culvert Comp
D. Wells - 2016

Assumptions:
18.5' Dia plate pipe or arch pipe with equivalent capacity
Dalton MP 401-414 bids used for culvert cost estimate
same guardrail L.O.N. for bridge vs. SPP (same length for comparison)
same contingency factor (25%) as bridge
LF cost for SPP includes temp work structure
Mob&Demob not included in pipe cost (added at end) & assumed at 7%

	Unit	Unit Price	Qty	Amount
18.5' SPP or Arch	LF	$ 4,000	130	$ 520,000
Fish Passage Substrate	CY	$ 500	300	$ 150,000
W-Beam Guardrail	LF	$ 50	368	$ 18,400
Riprap Class III	CY	$ 100	250	$ 25,000
				$ -
			subtotal	**$ 713,400**
			7% Mob & Demob	$ 49,938
			subtotal	**$ 763,338**
			25% Contingency	$ 190,835
			subtotal	**$ 954,173**
			ICAP 4.79%	$ 45,705
			subtotal	**$ 999,877**
			CENG15%	$ 149,982
			Culvert Total (present cost)	**$ 1,149,859**

present value for replacement at 37.5 years, i=2.5%	$	2,902,616
total present value	**$**	**4,052,475**
Bridge Replacement cost (present dollars)	$	3,905,982
Difference (Culvert cost minus bridge cost in present dollars)	**$**	**146,493**

APPENDIX G

DESIGN EXCEPTION

ALASKA DOT&PF PRECONSTRUCTION
DESIGN EXCEPTION/DESIGN WAIVER FORM

Type of Request: (select one or both)

☒ Design Exception (FHWA controlling design criteria only)

☐ Design Waiver (all other design criteria)

PROJECT INFORMATION:

Project Name: Dalton Hwy MP 0-9 Reconstruction

Project Number: Z632130000/0652016

☒ NHS ☐ Non NHS

Functional Classification: Rural Principal Arterial

Design Year: 2040

Present ADT: 330 (2010)

Design Year ADT: 600

Mid Design Period ADT: 490 (2020)

DHV: 95 (2040)

Directional Split: 45-55

Percent Trucks: 60%

Equivalent Axle Loading: 1,046,044

Pavement Design Year: N/A

Design Vehicle: WB-67

Terrain: Mountainous

Number of Roadways: 1

*Design Speed: 50 MPH

Posted Speed: 50 MPH

Operational Speed: 50 MPH

* *If requesting a design exception for design speed, use the recommended not reduced design speed here. Further, any design which uses a design speed below the posted or regulatory speed limit should not be approved (Source: FHWA Supplement, Section 8.,b. Application of Design Standards, Uniform Federal Accessibility Standards, and Bridges located here: http://www.fhwa.dot.gov/design/0625sup.cfm). FHWA also recommends evaluating specific geometric element(s) and treating those as design exceptions instead of design speed.*

PROJECT INFORMATION:

1. ***Design Exception requested for the following design criteria. Mark the criteria to be discussed:***

- ☐ Design Speed
- ☐ Lane Width
- ☐ Shoulder Width
- ☐ Cross Slope
- ☐ Superelevation Rate
- ☐ Horizontal Alignment (minimum radius of curvature)
- ☐ Vertical Alignment (minimum sag and/or crest K values)
- ☒ Grade (minimum and/or maximum allowable grades)
- ☐ Stopping Sight Distance
- ☐ Lateral Offset to Obstruction
- ☐ Vertical Clearance
- ☐ Bridge Width
- ☐ Bridge Structural Capacity

2. Provide a synopsis of the project scope (including purpose and need), the situation you are encountering, and the problem you are attempting to mitigate.

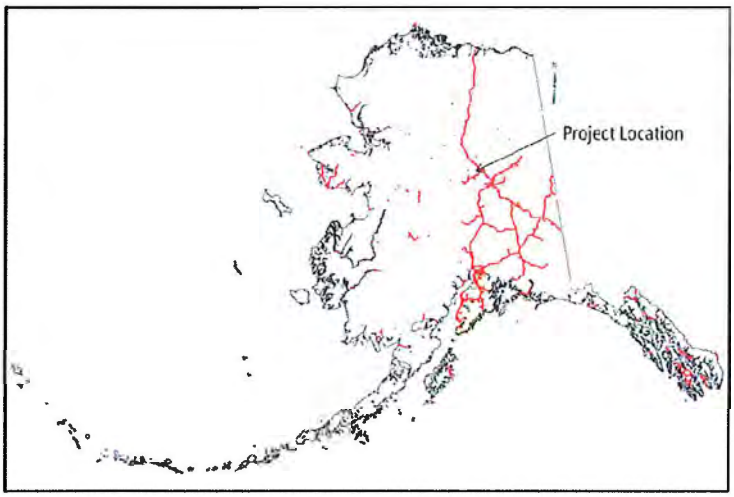


Figure 1 – General Location Map

Purpose & Need: The purpose of this project is to improve the safety and performance of the Dalton Highway from its beginning (junction with Elliott Highway) to milepost 9. The Dalton Highway is part of the National Highway System and provides the only vehicle access across Interior Alaska from Fairbanks to Deadhorse. It serves as a critical supply route between commercial and industrial centers. DOT&PF also anticipates an increase in future traffic with continued industrial development, regional tourism, and renewed interest in the Alaska natural gas pipeline.

There is need for the project corridor to be updated to current safety standards since more than a third of the existing alignment has substandard grades and curves that need correction. The geometry of the roadway makes truck travel difficult due to steep grades and sharp curves, which are considerable for a route with trucks comprising 60% of its total traffic volume. Due to the surrounding mountainous terrain of this segment of the existing Dalton Highway, a realignment of the first 7.5 miles of the highway to the nearby valley bottom is the most practicable option for reconstructing this roadway in conformance with current design standards.

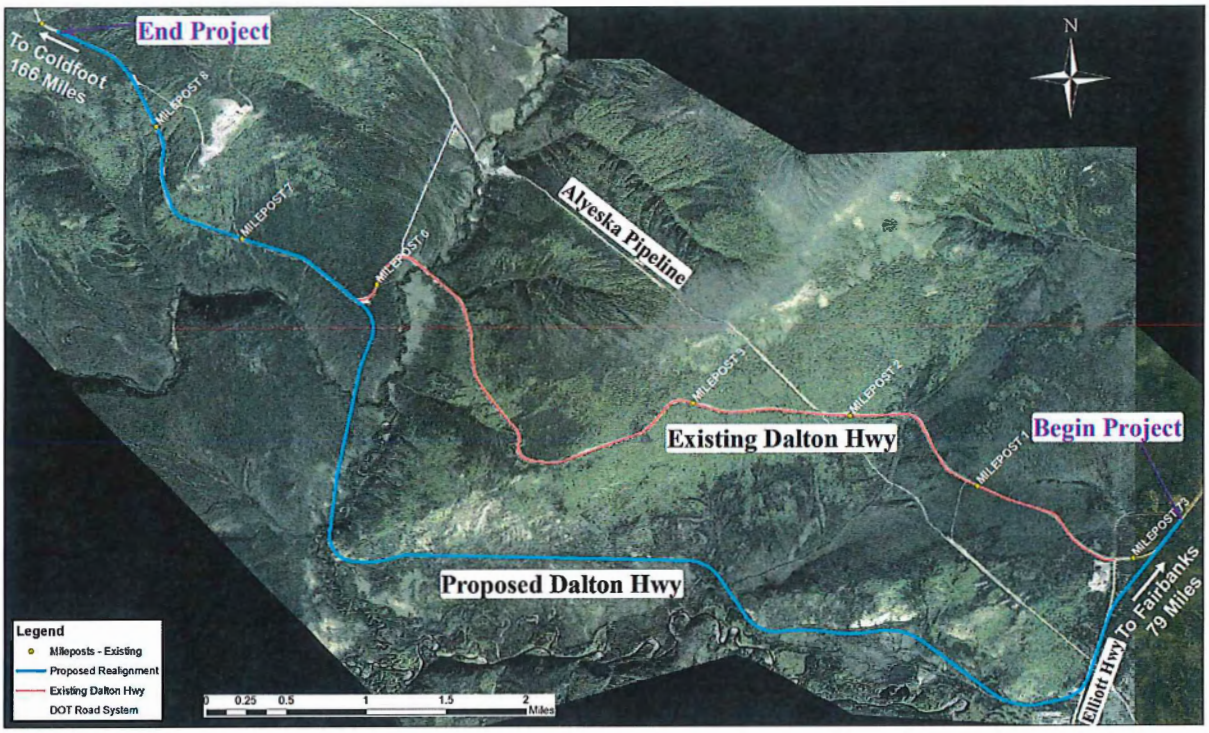


Figure 2 – Project realignment overview

Situation: The proposed realignment ties back in to the existing Dalton Highway at approximately Milepost 6.5 and predominately follow the existing Dalton Hwy until the EOP near MP 9. From approximate station "O5" 495+00 to "O5" 547+00, the existing highway is comprised of two consecutive steep hills, both with average grades of 9.7%, separated by a short "Bench" (lower grade section of approximately 3.3%; see figure 3). Geotechnical exploration indicates the presence of massive ice underneath the first hill and "bench" and beginning again after the second hill, limiting the use of cuts for the reconstruction of this section. Furthermore, in the limited sections where a cut may be considered, a large portion of the material encountered during excavation is expected to exhibit plastic characteristics, making it unsuitable for a temporary driving surface and not preferred for reuse in the proposed embankment.

Problem: Reconstructing the grades near the end of this project to meet the approved design criteria maximum grade of 7% is cost prohibitive due to the surrounding terrain and geotechnical considerations.

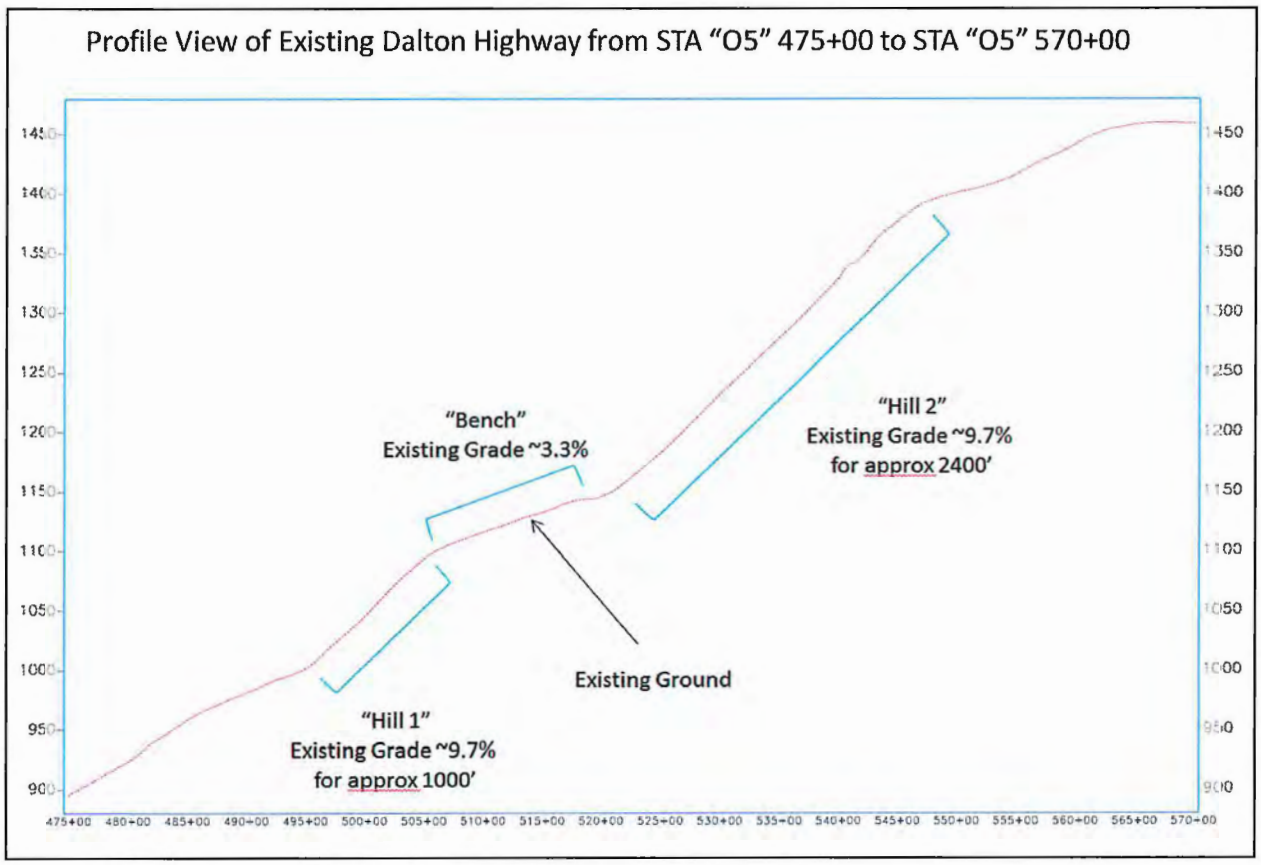


Figure 3 - Profile view showing existing grades

3. Provide a concise written description of the proposed Design Exception(s)/Design Waiver(s). It is required to be specific in stating which design standard(s) is being requested to be excepted or waived and the location (either the entire project length or a station range). State the standard and proposed values of the design criteria exception/waiver citing AASHTO, Department, or other standards. Include the date of the design standard references cited. Whenever possible, reference AASHTO guidelines to support your design decisions.

Proposed Design Exceptions/Design Waivers Summary			
Criteria	**Standard**	**Proposed**	**Location** *(entire project or station range)*
Grade: Maximum Allowable	7.0% (up to 8.0% for 500')	8%	"O5" 492+54 to 504+75 (1221')
Grade: Maximum Allowable	7.0% (up to 8.0% for 500')	9%	"O5" 520+14 to 545+27 (2513')

Table 1

A Design exception to the Maximum Allowable Grade Criteria is requested in two locations within the project limits, as shown in Table 1. The project design standards for maximum grade are as specified in The American Association of State Highway and Transportation Officials' (AASHTO) A Policy on Geometric Design of Highways and Streets, for the project design speed of 50MPH in Mountainous terrain.

4. Discuss the terrain in the area of the project and the proposed Design Exception(s)/Design Waiver(s).

The project is in mountainous terrain. The proposed realignment portion of the project departs from the Elliott highway and travels down the West Fork Tolovana River Valley and Lost Creek Valley, staying near the valley bottom until rising again to tie back into MP6.5 of the existing Dalton Highway, in which the road continues to climb until reaching the end of the project, near the summit of 9 Mile hill. The proposed road varies in elevation from 450' to 1450'. The existing terrain in the area of the requested Design Exception is very steep, with the existing road consisting of two sections with average grades of approximately 9.7%, separated by a short section with an average grade of approximately 3.3%. The surrounding terrain, coupled with other issues in this area (such as the presence of massive ice), does not allow for a practicable horizontal alignment alternative to correct these steep, substandard grades.

5. Discuss the traffic characteristics in the area of the project and the proposed Design Exception(s)/Design Waiver(s).

The Dalton Highway is a low volume road with a high percentage of commercial truck traffic. Present (2010) AADT is 330, with trucks accounting for approximately 60% of this total daily volume. The number of tourists using this facility each year is continuing to increase.

6. Discuss the crash history of the project and the proposed Design Exception(s)/Design Waiver(s). State if any anomalies are present within the project limits.

The project corridor has five reported crashes during the 5-year reporting period from 2007 to 2011. All but one of these crashes occurred on the section of the Dalton Hwy proposed to be abandoned. In addition, an accident involving a tanker truck and resulting in a large fuel spill occurred in 2006 at approximately MP 7, per the DEC. It is important to note that due to its remote location, it is not uncommon for crashes to go unreported on the Dalton Highway.

7. Discuss the degree to which a standard is being reduced, whether the exception/waiver will affect other standards, and are there any additional features being introduced, e.g., signing or delineation that would mitigate the deviation and the proposed Design Exception(s)/Design Waiver(s). Also, discuss if multiple Design Exceptions/Waivers are being requested in the same segment and if they will influence each other.

The maximum allowable grade per this project's design criteria is 7% (8% up to 500'). The proposed consecutive grades are 8% and 9% for lengths of approximately 1200' and 2500', respectively, which exceeds the maximum allowable grade by 1% and 2% respectively. This exception to the maximum allowable grade will not affect other design standards. These two consecutive steep grades are related in that they are separated by a short "bench", as described previously. Having two steep grades separated by this "flatter" section was preferred over a single, longer grade of 7% by several members of the trucking community. In addition to the project proposed safety improvements, such as road widening and clear zone considerations, this section of road will be signed to adequately forewarn of these grades that exceed the maximum allowable grade or 7%. Pullouts will also be designed in the flatter section just south of these grades to provide a safe and convenient location for installing and removing chains.

8. Explain why the proposed Design Exception(s)/Design Waiver(s) is needed. (Provide supporting information as to why the minimum design criteria cannot be met. Substantiate reasons with facts, historical data, cost estimates, etc.)

The need for this proposed Design Exception has been determined following an extensive analysis of profile alternatives in this section of road, and included considerations beyond sheer cost such as:

- Discussions with and input from:
    - Maintenance and Operations (M&O),
    - Members of the trucking community and contacts from the Haul Road Safety Group,
    - Northern Region Materials Section,
- The considerable proposed safety improvements to existing conditions,
- The overall project needs for materials and the project balance of cut and fill, and
- The steep (-9.4%) grade immediately beyond the project limits, locally designated as "9 Mile Hill", which also received an approved design exception.

Following the determination that the quantity of fill required to bring this section of road up to the current project design standards was disproportionately large with respect to the rest of the project, contact was initiated with the trucking community, particularly contacts from the Haul Road Safety Group (HRSG) and the Maintenance and Operations (M&O) section of the State of Alaska Department of Transportation and Public Facilities; both of these groups consist of regular users and persons intimately familiar with this section of road.

In separate meetings, both groups were presented with multiple profile alternatives with grades ranging from 7% to 9% on "hill 1" and 7% to 9.75% on the "hill 2" (illustrated in the Cost Comparison subsection). Corresponding cost data was also presented with the profile alternatives to ensure economic consideration was given. The HRSG believed that grades over 9% were considerably more difficult to navigate than those under 9%. They also pointed out that the "Bench" (section between the hills with a shallow slope, as seen in Figure 2) was beneficial for navigating these hills; in fact, they preferred steeper sections of road separated by this "bench" over a continuous 7% grade without the "bench". In the end, the HSRG representatives settled on the option of an 8% grade on hill one and 9% grade on hill 2 as the most practicable and acceptable alternative. The outcome of the meeting with M&O was that 8% was their ideal maximum grade, but they did not raise opposition to the 8% & 9% alternative; their concerns were more directed to road width and stability in this section with respect to safety improvements, rather than the grades.

While the proposed Design Exception results in two grades that exceed the maximum allowable design grades, it is important to recognize the considerable improvements to the existing grades in this section, as well as the all of the safety improvements proposed by the current design, not only in this section, but for the corridor in its entirety.

Geometric Deficiency Comparison Between the Existing Dalton Alignment and the Proposed Realignment

	Existing Dalton Highway (MP 0 -9)		Proposed Realignment (MP 0-9)	
	Total Number	Number that do not meet design criteria	Total Number	Number that do not meet design criteria
Vertical Curves	66	41	33	0
Grades (Segments)	67	27	34	2
Horizontal Curves	30	9	21	0

Table 2

Table 2 summarizes the primary geometric deficiencies of the existing and proposed alignments. All nine of the existing substandard horizontal curves have radii less than 650' (the design minimum is 835') and there are existing grades up to 13%. Within this project corridor the current design eliminates all but two of these substandard geometric components, and those two remaining are still considerable improvements to the existing conditions. From a purely numerical standpoint based upon the table above, the realignment corrects over 97% of the geometric deficiencies present from the existing alignment. For perspective, it would take an estimated 19.4% increase in the cost of the project (over $7M) to bring the <3% of remaining geometric deficiencies discussed above to the current design standards. Other safety improvements, in addition to those related to the horizontal and vertical alignment, include: road widening, slopes being

designed with consideration for recommended Clear Zones and improving and/or updating general design treatments for hazard mitigation (drainage, drifting, etc.).

This reconstruction project has a strong focus on earthwork, and the balance thereof. Excavation alone accounts for over a third of the current total estimated construction cost. The current design (which incorporates this design exception) is also fairly balanced between cuts and fills, with all of the fill needs (except crushed aggregates) coming from the planned excavation. There is a relatively small estimated amount of excess excavated material that is suitable for fill and therefore any substantial increase to the needed fill volume will offset this balance and will require importing the material from outside of project limits, which compounds the increase in the project cost as compared to reusing planned excavation. Maintaining a maximum 7% grade for this section of road would result in an estimate increase of ~665,000 CY of fill volume required for the project. For scale, constructing these grades at the 7% maximum would result in 6.6% of the total project length requiring ~35.5% of the total non-crushed fill needs (665,000CY of 1.87 Million CY total).

Finally, it is important to understand that the end of this project ties into the beginning of the Dalton Highway 9 Mile Hill North project (AKSAS#64899) which was designed to a finish grade of -9.4% for ~2500' (downhill traveling northbound). While constructing a 7% (or less) grade would certainly be ideal, the value gained is disproportionately small compared to the expenditure required, and even more so when nearby conditions are considered.

Cost Comparison

As noted previously, cost was a consideration when the profile alternatives were analyzed.

Nine separate profile alternatives were used for this cost comparison, as shown in the figures and table below. The typical section used for comparison purposes is as follows:

- 6-inches of surface course
- 18-inches of base Course
- Two 12-ft lanes
- Two 6-ft shoulders
- 3% cross slope
- 4:1 foreslopes for 8-ft from the shoulder edge (14-ft from the Edge of Traveled Way) then:
    - 4:1 to catch for an embankment height up to 5-ft,
    - 2:1 to catch for an embankment height from 5-ft to 10-ft, and
    - 1.5:1 to catch for an embankment heights greater than 10-ft.

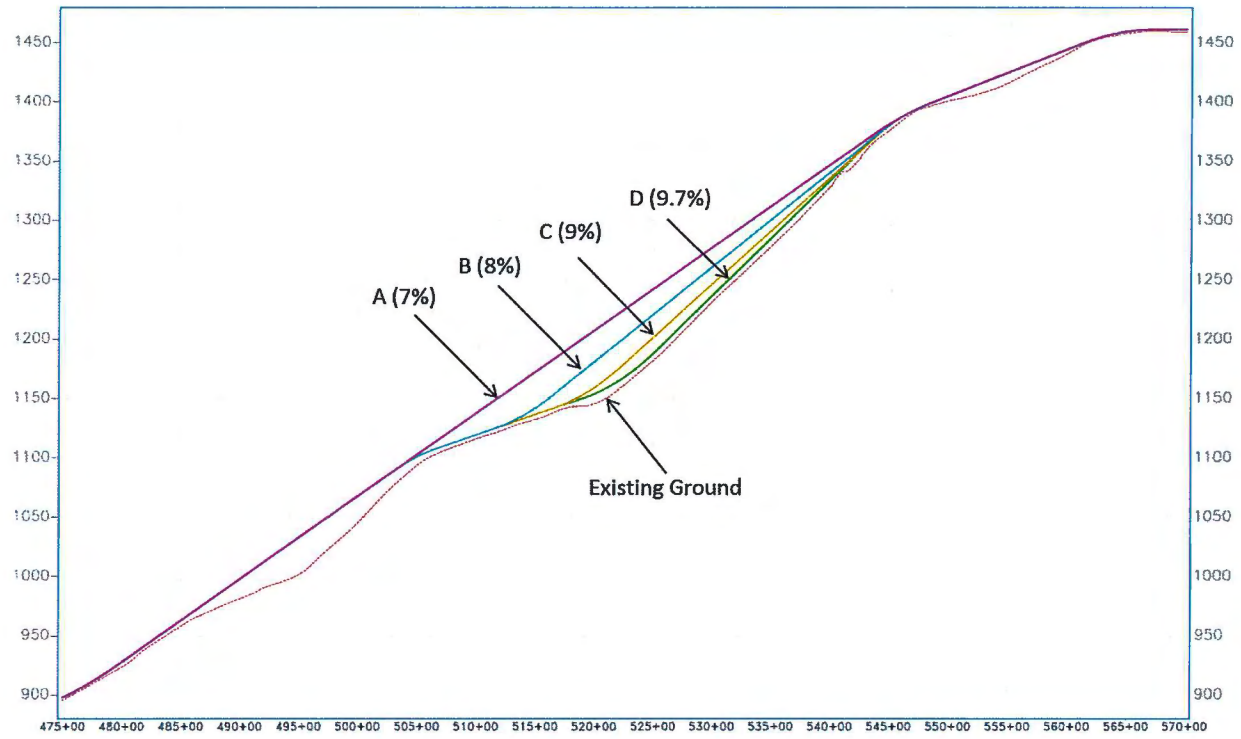


Figure 4 – Profiles alternatives A, B, C & D (units are in feet)

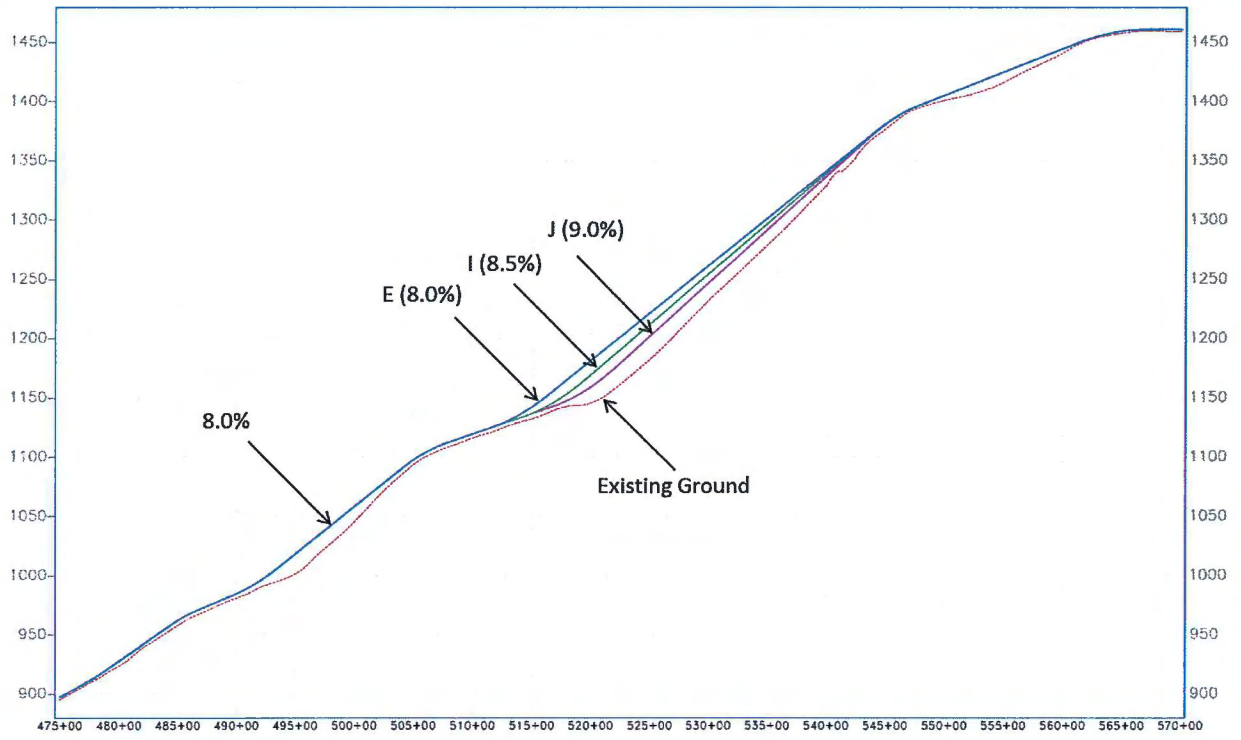


Figure 5 - – Profiles alternatives E, I & J (units are in feet)

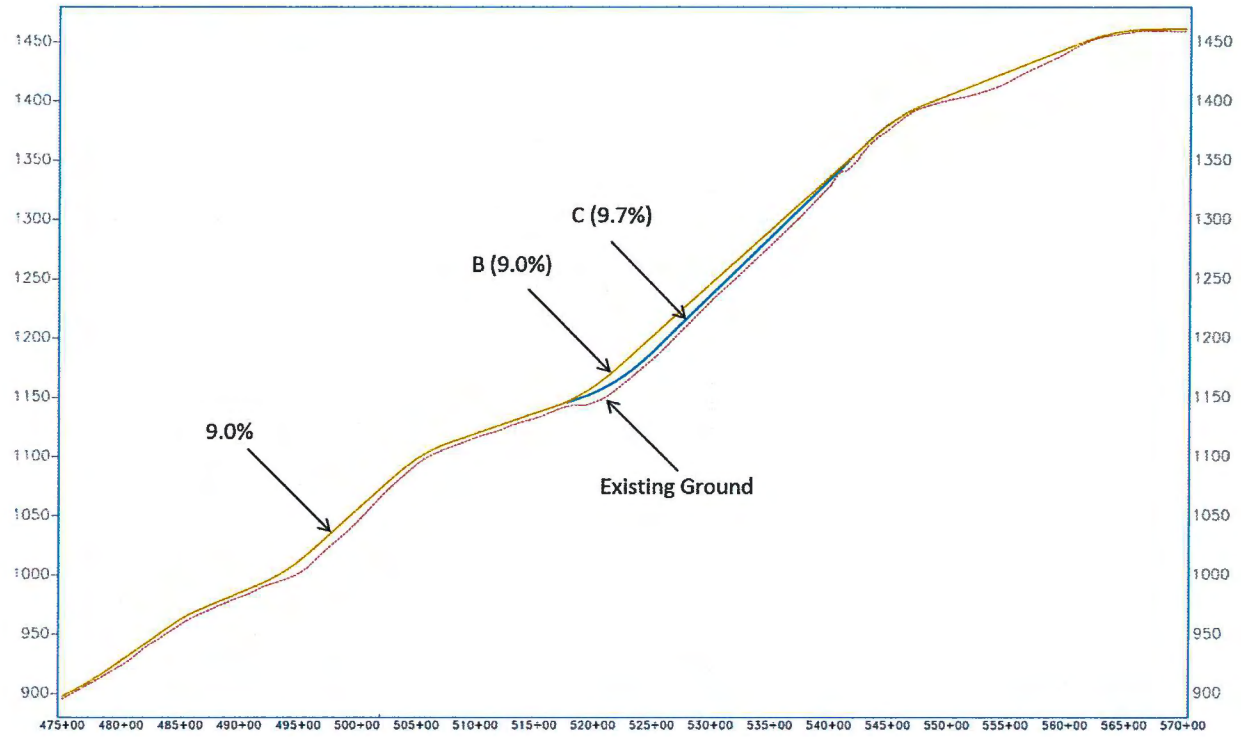


Figure 6 - – Profiles alternatives B & C (units are in feet)

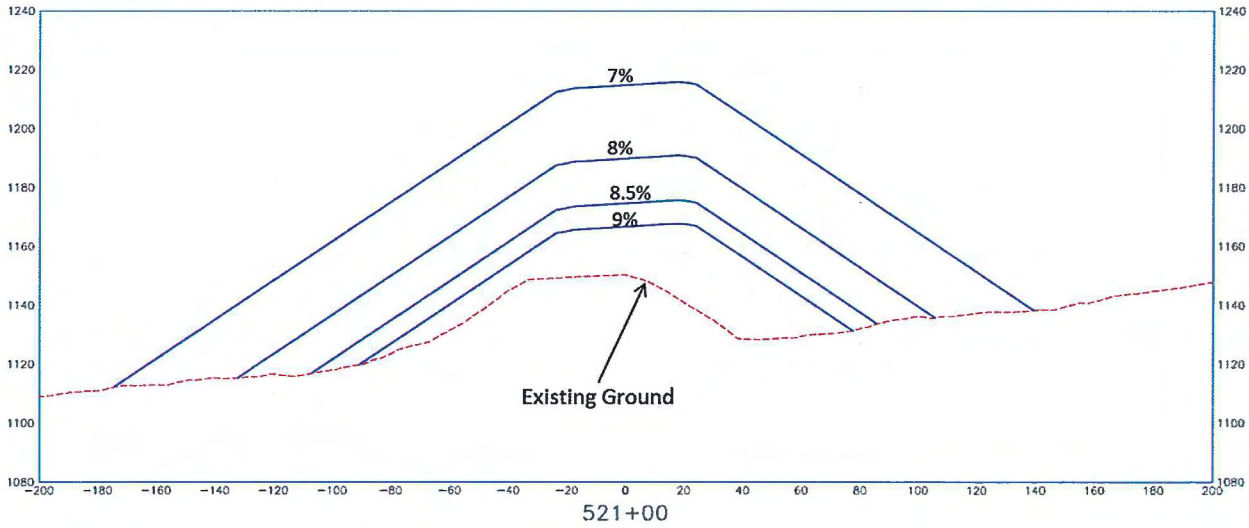


Figure 7 – Example cross section showing various grades (units are in feet)

			Values from EOP Comparison Section: STA 484+00 to STA 565+00			
Profile	Hill 1 (% Grade)	Hill 2 (% Grade)	Fill Qty (CY)	Total Fill Cost (@9$/CY)	Fill $/Mile	Total Project Fill $/Mile [1]
A	7.0%	7.0%	866,349	$ 7,797,141	$ 5,082,580.80	$ 993,793.21
B	7.0%	8.0%	468,620	$ 4,217,580	$ 2,749,237.33	$ 993,793.21
C	7.0%	9.0%	278,834	$ 2,509,506	$ 1,635,826.13	$ 993,793.21
D	7.0%	9.75%	223,157	$ 2,008,413	$ 1,309,187.73	$ 993,793.21
E	8.0%	8.0%	397,595	$ 3,578,355	$ 2,332,557.33	$ 993,793.21
F	9.0%	9.0%	186,576	$ 1,679,184	$ 1,094,579.20	$ 993,793.21
G	9.0%	9.75%	129,246	$ 1,163,214	$ 758,243.20	$ 993,793.21
I	8.0%	9.0%	201,749	$ 1,815,741	$ 1,183,594.13	$ 993,793.21
J	8.0%	8.5%	281,448	$ 2,533,032	$ 1,651,161.60	$ 993,793.21

1 This cost assumes $9/CY for cost of hauling & placing Fill.
Quantity excludes the estimated fill quantity for this comparison section.

2 Based upon working DSR Draft Estimate, using the "I" Profile. Inludes Borrow, Subbase F & Unclassified Excavation.

Table 3- Profile Alternative volume and cost comparison

The risks of encountering highly thaw susceptible permafrost coupled with the poor quality of material in this area, as discussed earlier in this report, has led to the decision not to consider profile cuts in this section of the project; the Northern Region Materials section concurs with this decision.

After careful consideration of the nine profile alternatives, Profile "I" was chosen as the preferred alternative. Profile alternatives with grades over 9% were eliminated fairly quickly, and the estimated fill volumes and costs of the remaining profile alternatives were compared to the project as a whole, for both a fill-cost per mile and earthwork-cost per mile basis. Although the estimated cost to construct Profile "I" is still higher than the project averages, it was considered reasonable. Alternative "F" was also considered reasonable, however the increase in fill required to achieve an 8% grade on the first hill was deemed relatively small. Right-Of-Way (ROW) and wetland impacts were also considered in this comparison, though not shown in the table above. Profile "A" would require an estimated additional 7.6 acres of ROW acquisition; wetland impacts were negligible. Also, the comparison above (Table 3) does not account for an increase in the fill unit cost that would be expected if the material were imported and paid as borrow.

9. Discuss the cost of the project and the proposed Design Exception(s)/Design Waiver(s). Provide information that reflects the cost with and without the Design Exception(s)/Design Waiver(s). Attach detailed cost estimates.

Project Construction Cost Summary	
To Standards	**With approved Design Exceptions/ Design Waivers**
$43,495,612	$36,420,293

Table 4

Reconstructing the two steep grades discussed in this report to the maximum allowable grade of 7% would cost an estimated $7,075,319 more than reconstructing these grades to the proposed design exception grades of 8% and 9% for "hill 1" and "hill 2", respectively. This increase in cost was calculated as shown below:

Fill Quantity needed to meet Standards (CY)	866,349
Less excess unclassified excavation from current quantity computations that could be used as fill for this section(CY)	-78,673
Less Excavation being used for fill in the current design volume calculations (incorporating profle alternative "I")	-200,554
Equals quantity of borrow needed as fill for this section to meet design standards (CY)	587,122
Engineer's Estimated Unit Price ($/CY) for Pit-Run Borrow ($9/CY plus $0.50/CY for royalties plus $0.50/CY for M.S. development & misc. extra costs)	$ 10.00
Total increase to construction contract cost.	$ 5,871,220
Total increase to Construction cost (with 15% CENG and 4.79% ICAP)	**$ 7,075,319**

Table 5

Proposed **Designer/Consultant:** _____ **Date:** 5/9/16

Endorsed **Engineering Manager:** _____ **Date:** 5/9/2016

Approved **Preconstruction Engineer:** _____ **Date:** 5/26/2016

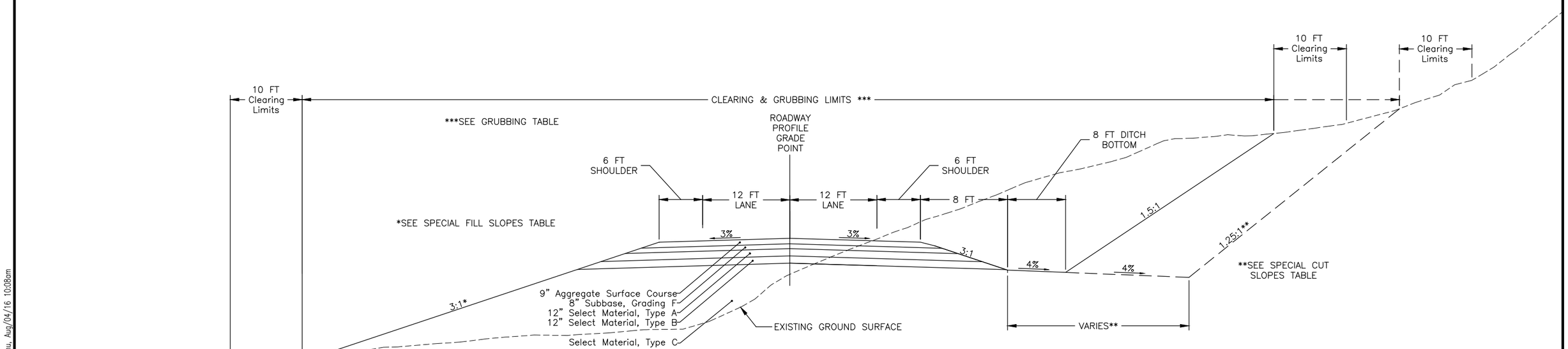
Concur – FHWA: _____ **Date:** _____

FHWA concurrence required for high profile projects only.

APPENDIX H

TYPICAL SECTIONS

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	####	####	####	####

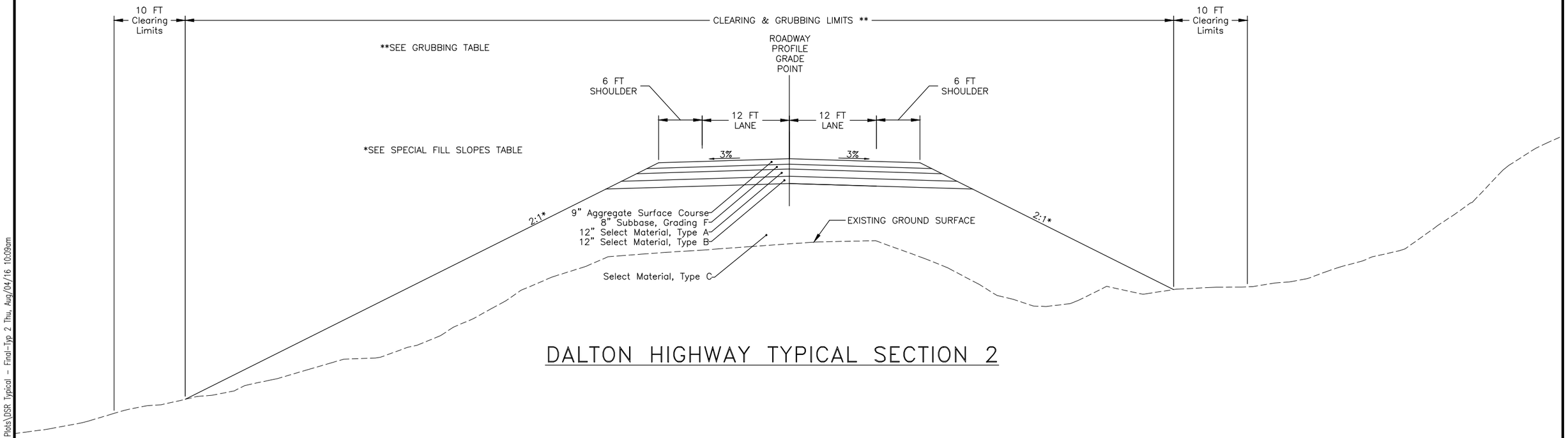


DALTON HIGHWAY TYPICAL SECTION 1

####

STATE OF ALASKA
49 TH
####
####
REGISTERED PROFESSIONAL ENGINEER

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	####	####	####	####

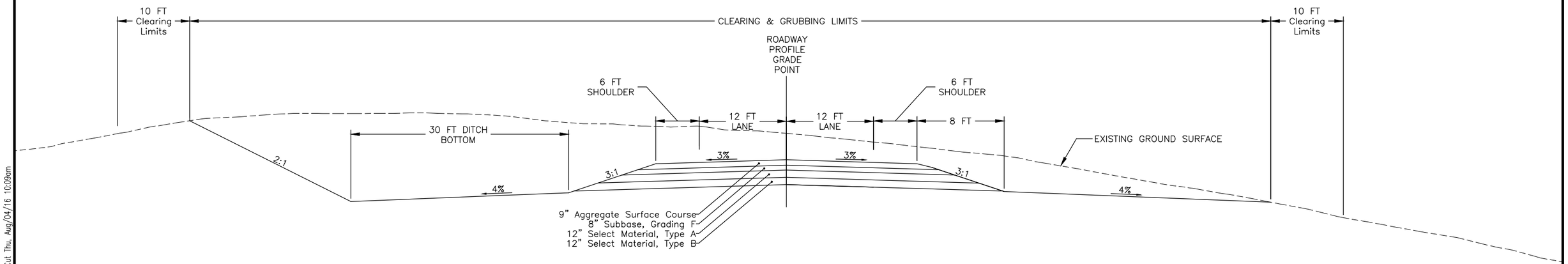


DALTON HIGHWAY TYPICAL SECTION 2

####

STATE OF ALASKA
49 TH
####
####
REGISTERED PROFESSIONAL ENGINEER

STATE	PROJECT DESIGNATION	YEAR	SHEET NO.	TOTAL SHEETS
ALASKA	####	####	####	####



DALTON HIGHWAY TYPICAL SECTION 3

STATION "05_N"406+00 TO STATION "05_N"426+00

####

STATE OF ALASKA
49 TH
####
####
REGISTERED PROFESSIONAL ENGINEER

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