

## REPORT

# Yukon Government Rural Land Development

## Grizzly Valley Road Preliminary Assessment



**August 2015**

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# REPORT

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## 1 Introduction and Background

The Grizzly Valley Subdivision located approximately 40 km north of downtown Whitehorse on the North Klondike Highway and was developed to meet market demand for developable rural lots in the Whitehorse area. Construction took place in two phases over the 2011 and 2012 seasons. Since then, portions of the subdivision road have been damaged by erosion and settlement. These issues were temporarily addressed in the fall of 2014 when Yukon Government, Department of Rural Land Development (YG-RLD) invited Associated Engineering (B.C.) Ltd. (AE) to conduct a site tour and provide feedback on the damage observed. This initial investigation resulted in temporary measures being implemented to repair erosion damage to large embankment fill areas and a full closure of the northern access of the subdivision out of concern for public safety due to failure of the road sub grade.

YG-RLD retained Associated Engineering (B.C.) Ltd. in summer of 2015 to complete a preliminary site assessment and report outlining the concerns identified in the subdivision and recommend remedial actions. AE teamed with Tetra Tech EBA (TT EBA) to provide geotechnical expertise and knowledge of the original planning, design and construction of the project. TT EBA participated in the 2015 site investigations and provided a report focused on construction materials, assessment of embankment stability, and drainage considerations. The report can be found in its entirety in Appendix A.

This report documents the findings of the site assessment including observations and recommendations provided by Tetra Tech EBA. The recommended action items are identified along with the priority in which they should be addressed. A Class D cost estimate has been prepared outlining expected capital costs. As built drawings of the subdivision road are located in Appendix B as stationing from these drawings is used throughout this report to refer to locations.

## 2 Geotechnical Conditions

The geotechnical conditions of the Grizzly Valley Subdivision were provided by Tetra Tech EBA in their assessment report and can be summarized as follows: glacial deposits of fair quality gravel and sand, sand and silt till, and finer grained silts and sands. Surficial bedrock was located in the vicinity of the north subdivision access where the road travels through a natural drainage course between two ponds. The road sub grade was constructed with native soils, the sub base with select granular material, and manufactured Granular A gravel for the base course. The traveled road surface has a bituminous surface treatment (BST).

## 3 Site Assessment

An initial site assessment was conducted on June 18, 2015 by Steven Bartsch and Michael Abbott of AE and Myles Plaunt of TT EBA. A follow up site visit was conducted by Mr. Plaunt and Mr. Abbott on July 9, 2015. The entire subdivision road was assessed to evaluate erosion and settlement issues and propose next steps to repair the deteriorating sections of the road. The following issues were documented in various locations of the subdivision; the pictures shown are typical to the issue to be addressed.

### 3.1 EMBANKMENT INSTABILITY

All large embankment fills, generally those greater than 6 m in height, in the subdivision showed signs of instability. This can be attributed to material placed in excessively thick lifts during construction, relatively steep side slopes of approximately 1.5 horizontal to 1 vertical, minimal compactive effort and lack of vegetation growth on side slopes. Tension cracking on embankment side slopes and BST road surface were observed at the following locations: from Sta 0+800 to Sta 1+100, Sta 2+060 to Sta 2+300, Sta 5+200 to Sta 5+320, Sta 5+900 to Sta 6+600.



**Picture 3-1 Tension cracking extending up the fill embankment and into the BST surface at 0+850 on the right hand side.**

### 3.2 SUB GRADE FAILURE

The sub grade failure near the north entrance was localized to approximately 100 metres of the roadway. This section of road was built on wet ground unsuitable for the road embankment constructed and has subsequently failed. Pondered water was observed at the toe of the embankment.

The stretch of road from approximately Sta 6+750 to Sta 7+100 was constructed on the historic drainage channel of a pond located on the south side of the road at 7+100. The water level of this pond has increased since the fall 2014 site visit based on observations from the 2015 site visit. Shrubs and trees previously not exposed to standing water on the edge of the pond appeared to be dying. This section of road was bounded by bedrock on either side. No significant damage to the road was observed along this section, however there is potential for future degradation if the water level continues to rise and drain along the toe of the road embankment.



Picture 3-2 Localized failure of the road subgrade at 6+670.

### **3.3 SCOURING OF SIDE AND BACK SLOPES**

Large erosion rills have developed and led to damage of the BST road surface, guide rails and ditches. Relatively steep side and back slopes of approximately 1.5H:1V, constructed using native soils susceptible to erosion, have contributed significantly to the erosion. No measures to direct and control runoff were installed along the embankments. Ditches and slopes showed little sign of revegetation since original construction and no root mass was present to stabilize the slope. Poor compaction of road sub-base, observed by TT EBA field staff during original construction, may have contributed to extensive scouring as the material on the surface of the road side slopes would be unconsolidated. The embankments on the inside of superelevated corners were eroded significantly more than the outside embankments on the same corner due to the additional catchment area from the road surface.



**Picture 3-3 Located at approx. 0+500 on the right hand side of road.**



**Figure 3-4 Major erosion around guard rail posts and scouring on side slope on inside of corner above wildlife crossing at approx. 2+160. Picture from fall 2014.**

### 3.4 DITCH EROSION AND DEPOSITION

The topography of the Grizzly Valley Subdivision has resulted in long relatively steep ditch runs. No erosion protection measures were installed during original construction. As noted by TT EBA in their assessment, all ditches in excess of 3% were scoured with material deposited downstream in areas with a relief in grade. The extent of damage ranged from minor to severe.



Picture 3-5 Ditch scour and downstream deposition around 0+800 on the left hand side.



Figure 3-6 Major scour in ditch around 6+400 on the left hand side.

### **3.5 TRANSITION FROM CUT TO FILL**

Areas where the road embankment transitioned from cut to fill often resulted in an increase in grade in the ditch. These locations experienced the most severe damage from scouring.



**Picture 3-7 Major scouring located in a transition from cut to fill on the right hand side of road 5+140.**

### 3.6 DITCH BLOCKS

Ditch blocks were not installed during original construction to direct water into culverts and reduce water velocity in ditches. Lack of infrastructure to reduce velocities or volumes of water have contributed to scouring of the ditch bottom and resulted in a number of culverts being ineffective where runoff water bypasses the inlet or has resulted in transport of material which has partially or completely blocked the inlet.



**Picture 3-8 Deposition of fine grained material in the ditch bottom has plugged the culvert inlet at 6+050 on the LHS.**

### 3.7 GUIDERAILS

The guiderails throughout the subdivision were consistently installed too close to the top of embankment slopes. Typical installation would have one metre from the back of the guiderail posts to the top of the road embankment slope to provide a solid foundation. Poor compaction around the concrete abutments at the end of each guiderail was noticed and water had infiltrated and eroded the road subbase.



**Figure 3-9 Guiderail installed in the embankment slope at 2+100 on the left hand side. Also note the scouring in the ditch bottom.**



**Picture 3-10 Erosion around concrete guiderail abutments.**

### 3.8 ROAD SIGNS

All road signs were installed incorrectly. The post anchors extended far above the ground surface and no breakaway was installed. This has resulted in posts breaking at station 1+390, 4+780. The sign at 1+480 is missing.



Picture 3-11 Typical sign post installation, long anchor and no breakaway.

### 3.9 INCONSISTENT SLOPE CONSTRUCTION

Slope angles varied in large fill areas, on the majority of corners, the slope on the inside of the embankment appeared to be at a steeper angle than the outside of the embankment. Most large embankment fills had a rough bench part way up the slope where the angle was adjusted during construction. This did not appear to be a significant contributing factor to the damage of the roadway. The general angle of slope construction of 1.5H:1V was too steep for embankment construction using native soils. Due to the characteristics of the native soil, they are prone to erosion when constructed at such an angle without erosion protection measures in place.

## **4 Recommendations**

Based on observations from the site investigation, it was evident extensive repairs will be required in a timely manner in order to prevent further erosion and degradation of the road structure and improve public safety of road users is maintained in the Grizzly Valley Subdivision. We recommend the following remedial actions should be taken by Yukon Government.

### **4.1 SUB GRADE FAILURE REPAIR**

The barricade at the north access point to the subdivision should be reinstalled. The concrete lock blocks at the north entrance on the Klondike Highway were found to be out of place during the July 9<sup>th</sup> site visit allowing public access to this portion of the road. To our knowledge, the lots between the Highway access point and Sta 4+900 have not yet sold and therefore no landowners are prevented from accessing property with these barricades in place. We recommend the following action:

- Reinstall concrete barricades at the north subdivision access and ensure the road is secure from public vehicle access.
- Further geotechnical investigation of the subgrade soils between 6+650 and 6+750. Tetra Tech EBA suggested drilling two test holes through the road embankment in the area to assess the soil characteristics and investigate the possibility of ice-rich permafrost presence.
- Reconstruct road between Sta 6+650 and 6+750 based on the findings of the geotechnical investigation.
- Monitor the retained water level at 7+100 for increasing water volume. If the road is acting like a dam a permanent drainage solution may be required for this historic flow path.

### **4.2 EMBANKMENT RECONSTRUCTION**

Reconstruction of the four large road embankments fills as a high priority to stabilize the slopes and mitigate further damage. Reconstruction should take place in the following order:

- The wildlife crossing from Sta 2+060 to Sta 2+300. The granular fill dumped on this slope in fall of 2014 as a temporary erosion protection measure has failed in multiple locations. A concrete jersey barrier was also installed in fall of 2014 in place of the compromised guiderail, however erosion of the embankment has since undermined the barrier and compromised its integrity.
- The embankment from Sta 0+800 to Sta 1+100. This embankment has eroded the least of the four embankments under consideration but is located on what is currently the only access to the subdivision and is therefore in a critical location.
- The wildlife crossing from Sta 5+200 to Sta 5+320 and embankment from Sta 5+900 to Sta 6+600 are of equal importance to reconstruct. Both of these sections are located within the section of road that should be barricaded from public access and are therefore a lower priority once this section of road is closed.

- Material for embankment reconstruction could be partially sourced from within areas of the subdivision road right of way. There was some stockpiled material leftover from original construction located at approximately Sta 3+500. Additional material could be sourced from the cut slopes within the subdivision. This would reduce the cost of hauling material and provide an opportunity to reshape and reduce the angle of back slopes in large cut areas reducing erosion potential of these slopes.

Construction methodology should follow the recommendations provided by Tetra Tech EBA in their assessment found in Appendix A. In general, the embankments should be reconstructed to a 2H:1V slope by importing fill material and benching into the existing side slope starting at the toe. Material similar to the original subbase should be placed, moisture conditioned and compacted in lifts of a maximum of 300 mm depth. Removal and re-installation of guiderails will be required.

To increase the success of embankment reconstruction, measures to direct and control runoff water should be installed along the length of the reconstructed embankments. These control measures should be located on the inside of superelevated corners and on both sides of the road where a crowned surface is present. Possible solutions include:

- Install a PWF wooden curb along the base of the guiderails by fastening lumber to the guiderail on its vertical access embedded into the road shoulder after the guiderail has been reinstalled. At regular intervals, there should be a gap in the curb to allow water to flow onto the embankment slope.
- Alternatively, concrete jersey barrier curb could be installed along these embankments in replacement of the guiderails. These barriers would serve as a safety barrier and a curb to direct runoff water. A barrier with a gap in the base should be installed at regular intervals to allow water to flow onto the embankment slope.
- At the locations where there is a gap in the curb allowing water to discharge onto the embankment slope, armoured channels should be constructed to prevent erosion of the slope. These channels should be lined with geotextile anchored to the embankment slope with riprap placed on top.

### **4.3 DITCH AND CULVERT REMEDIATION**

Culvert remediation work should be conducted in conjunction with ditch line remediation as their function complements each other. Damage to ditches from erosion of fine grained material was an extensive problem throughout the subdivision where grades exceed 3%, as outlined in Tetra Tech EBA's assessment report.

#### **4.3.1 Ditches**

No erosion protection measures were installed in ditches during original construction to reduce runoff water velocities and prevent transportation of fine grained material. The following remediation work should be conducted to reinstate ditches:

- Reshape and compact ditch side and back slopes in the following locations on both sides of the road: Sta 0+100 to Sta 1+360, Sta 1+900 to Sta 2+300 and 4+860 to 6+650. Reconstruction methodology should follow Section 4.3.1 of Tetra Tech EBA's Assessment Report.
- Ditch check dams should be constructed at regular intervals along the above mentioned ditches once the ditches are reshaped. Reconstruction methodology should follow Section 4.3.2 of Tetra Tech EBA's Assessment Report.

#### **4.3.2 Culverts**

The following work to specific culverts should be conducted:

- Ditch check dams should be constructed on the downstream side of culvert inlets in the following locations to channel water through the culvert: Sta 0+370, Sta 0+740 and Sta 6+050.
- Ditch check dams should be constructed with material similar to the road subgrade. The subgrade should be scarified and compacted prior to construction of the check dam. The check dam should span the ditch from side to back slope at a height of 900 mm. The slopes of the check dam are to be constructed at an angle of 2H:1V. The width of the crest of the check dam is to be one metre. Rip rap is to be installed around the culvert inlet, ditch bottom and slopes, and over the entire check dam.
- Sediment deposited inside the culvert and surrounding the inlet and outlet should be removed at the following locations: Sta 4+620 and Sta 6+500.
- The culvert at 6+050 should have the sediment removed that is blocking the inlet. Sediment built up inside the culvert should be flushed out. The flume on outlet end of the culvert should be extended further from the toe of the slope, as per original design, and armoured with rip rap at the discharge point.

#### **4.4 RE-VEGETATION**

Re-vegetation of side and back slopes is recommended to mitigate erosion and transportation of fine grained material. Re-vegetation should be done in conjunction with ditch and culvert remediation work to maximize the effectiveness. Methods of re-vegetation for road side and back slopes are discussed in section 4.3.4 of Tetra Tech EBA's assessment report. In areas requiring embankment reconstruction, re-vegetation should be conducted following the embankment reconstruction work. Re-vegetation should be conducted in the following locations: Sta 0+000 to Sta 1+460, Sta 1+900 to Sta 2+500, Sta 4+530 to Sta 4+770 and Sta 5+130 to Sta 6+750.

#### **4.5 MINOR REPAIRS**

There were a few areas of the subdivision where minor embankment repairs should be conducted to prevent further damage to the road surface. The same construction methodology as recommended in Section 4.2 should be applied using equipment sized appropriate to the height of the embankment. These repairs are low priority and are located in the following areas:

- Rebuild the road embankment on the right hand side of the road at 2+400 where a small slough has occurred.
- Rebuild the road embankment on the east side of the intersection between the Phase I and Phase II roads at Sta 3+250. The road side slope has eroded and is undermining the asphalt.
- Rebuild the road embankment on the right hand side of the road at 6+960 where a small slough has occurred.

#### **4.6 ROAD SIGN REINSTALLATION**

The reinstallation of road signs throughout the subdivision is the lowest priority of the repair work to be done. All road signs were installed incorrectly and should be removed and replaced with proper anchor posts and breakaway mechanisms. Some road signs will be required to be removed and replaced during embankment reconstruction, at such time, these signs should be reinstalled with proper anchors and breakaway mechanisms. The sign posts at 1+390, 4+780 were broken and should be replaced. The sign at 1+480 is missing and should be replaced.

#### **4.7 OPERATION AND MAINTENANCE**

Based on the damage observed to the subdivision road, an ongoing monitoring and maintenance program should be established. We recommend an annual engineering assessment of the subdivision road to monitor the remedial work completed and to identify any new issues that may arise. We anticipate maintenance work will be required to remove built up sediment in culverts and at the inlet and outlets. Minor erosion may occur in new areas.

#### **4.8 NEXT STEPS**

The following steps should be taken by YG-RLD moving forward with repair of the Grizzly Valley Subdivision Road.

- Review and accept recommendations in this report.
- Plan for and allocate internal budgetary resources within YG-RLD.
- Obtain detailed survey information of the areas identified in need of repair in fall of 2015.
- Undertake further geotechnical investigation in fall of 2015 as recommended.
- Undertake engineering design throughout winter of 2015/2016.
- Tender the project early in 2016 for construction in spring/summer of 2016.

## 5 Cost

A Class D cost estimate was produced based on the above recommendations. We expect the total repair cost to be approximately \$1.5 million; however, we have prioritized our recommendations and associated costs to address the issues of highest priority first within the project budget. Table 5-1 below provides a breakdown of the Class D cost estimate including design and capital costs of the recommended tasks.

**Table 5-1 Class D cost estimate and priority of work.**

<b>Task</b>	<b>Cost</b>	<b>Priority</b>
Sub-Grade Failure Repair	\$ 211,000	Medium
Embankment Reconstruction <ul style="list-style-type: none"> <li>• Sta 2+060 to Sta 2+300</li> <li>• Sta 0+800 to Sta 1+100</li> </ul>	\$ 317,000	High
Embankment Reconstruction <ul style="list-style-type: none"> <li>• Sta 5+200 to Sta 5+320</li> <li>• Sta 5+900 to Sta 6+600</li> </ul>	\$ 584,000	Medium
Ditch and Culvert Remediation	\$ 358,000	High
Re-vegetation	\$ 120,000	High
Minor Repairs	\$ 10,000	Low
Road Sign Reinstallation	\$ 8,000	Low
Operation and Maintenance	\$13,000	Medium

The following assumptions were made in determining this cost estimate:

- Material for embankment reconstruction can be sourced from within the Grizzly Valley Subdivision or within reasonable distance of the site.
- Embankment reconstruction around the Wildlife crossings can be conducted without modifying or extending the multi-plate culverts.
- Guiderail posts and metal W beam can be reused.
- Road sub-base material will be suitable for reuse in the area of sub-grade failure requiring reconstruction.
- Engineering fees for design of reconstruction work not included.

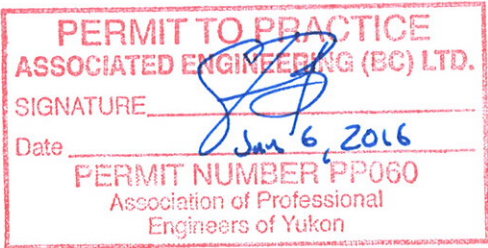
## 6 Closure

We are pleased to submit this report to assist the Yukon Government in moving forward with repairs to the Grizzly Valley Subdivision road. We believe this report outlines the next steps to be taken to move forward with the design and construction process. Associated Engineering would be pleased to continue providing our services to Yukon Government in the near future.

Please do not hesitate to contact our office with any comments, questions or concerns at (867) 456-2711.

Michael Abbott, E.I.T.  
Civil Engineer

Steven Bartsch, P.Eng.  
Yukon Area Manager





# REPORT



## **Appendix A – Tetra Tech EBA Geotechnical Assessment**



November 26, 2015

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ISSUED FOR USE  
FILE: W14103622-01  
Via Email: bartschs@ae.ca

**Attention:** Mr. Steven Bartsch, P.Eng.  
Yukon Area Manager

**Subject:** Grizzly Valley Roadway Assessment  
North Klondike Highway Near Lake Laberge

## 1.0 INTRODUCTION

### 1.1 General

Tetra Tech EBA Inc. (Tetra Tech EBA) was retained by Associated Engineering (B.C.) Ltd. (AE) to complete an assessment of the ongoing surface erosion damage and associated slope instability throughout the Grizzly Valley Subdivision. This letter presents a summary of the conditions noted during site reconnaissance, an assessment of the damage as of July 2015 and recommendations for repair of the problem areas noted.

Authorization to proceed was received via a Subconsultant Agreement dated June 6, 2015. For additional information regarding the use of this report, please refer to Tetra Tech EBA's General Conditions included in Appendix A.

### 1.2 Background

Tetra Tech EBA formerly known as EBA Engineering Consultants Ltd. completed a predesign level geotechnical evaluation of the Grizzly Valley area in 2005. This evaluation included a shallow testpitting program completed throughout the south half of the site (10 testpits were excavated to an average depth of 4.0 m). As part of this project, terrain mapping was also completed and it included the entire study area.

The Grizzly Valley Subdivision was constructed during the 2011 and 2012 construction seasons. The general contractor was Cobalt Construction of Whitehorse, YT. The project was managed by YG Community Services with assistance from Yukon Engineering Services (part-time inspection services) and Tetra Tech EBA (additional geotechnical services including the drilling of the two wildlife access multiplate locations and the large cut area at Sta 5+500 along with quality control (QC) testing during construction).

In the fall of 2014, AE was asked to participate in a site observation trip to provide insight into the significant erosional damage noted throughout all the large embankment fill areas and the subgrade failure noted near Sta 6+660. On June 18, 2015 and July 9, 2015, additional site visits were completed by AE and Tetra Tech EBA to assess current damage and to discuss possible remediation methods.

## 2.0 GEOTECHNICAL AND TERRAIN CONDITIONS

In general, the Grizzly Valley Subdivision area is underlain with glacial deposits including fairly good quality gravel and sand; sand and silt till; and finer grained silts and sands. At the north entrance into the site, there is bedrock at surface and the roadway runs between ponds located on both sides of the road. Embankment fills were constructed from a variety of native soils, while select granular materials were used for sub-base construction. Approved Granular A basecourse gravel was imported for the surface course.

Terrain was the biggest challenge for design with slopes that vary from less than 5% to 70% in along the edges of specific glaciofluvial terraces.

## 3.0 OBSERVATIONS

Erosion damage throughout the subdivision has been well documented by AE and Tetra Tech EBA. Along with the subgrade failure noted at Sta 6+600, erosion and sediment transport was noted along all ditch lines that had grades in excess of 3%, and embankment instability was noted along both sides of all large fills, including the section from Sta 0+500 to Sta 1+000; Sta 2+060 to Sta 2+300; Sta 5+200 to Sta 5+340; and Sta 6+100 to Sta 6+600. Along many of the high backslopes, surface sloughs and varying degrees of erosional damage were also observed.

Representative photos of erosion damage observed throughout the subdivision are presented below.



**Photo 1:** July 9, 2015 - Subgrade Failure at Sta 6+670



**Photo 2:** July 9, 2015 – Ditch Scour at Sta 6+320 (greater than 3 m at some locations)



**Photo 3:** July 9, 2015 – RHS Embankment Instability North Of Sta 6+100



**Photo 4:** July 9, 2015 – Surficial Erosion Along High Backslopes at Sta 5+550 – Ditches Carrying Sediment



**Photo 5:** July 9, 2015 – Sta 5+280 RHS – Wash-outs Along Guard Rail



**Photo 6:** July 9, 2015 – Sta 2+060 to Sta 2+300 – RHS – Washouts Extending Under Guardrail & Barrier Curb



**Photo 7:** June 18, 2015 – Sta 2+150 – LHS – Ditch Line Scour Down-gradient of Transition to Large Fill Area

### 3.1 Additional Observations

The embankment sideslopes and backslopes were measured with an inclinometer during the July 9, 2015 site reconnaissance trip and it was determined that most slopes were constructed to 1.5 horizontal:1.0 vertical (approximate and quite variable).

Since the site reconnaissance trips were completed, the undersigned has observed the following while travelling to various 2015 projects along the Alaska Highway, the Klondike Highway and the Campbell Highway, as well as throughout various country residential subdivisions in Whitehorse:

- Sideslopes and backslopes constructed at 1.5H:1V are very common along Yukon highways where the cut/fill slopes are high. In areas where the slopes have revegetated, the stability appears marginally acceptable. However, where backslopes lack vegetation and are established in silt or sand till soils, surface sloughing and scour is very common;
- Sideslopes and backslopes constructed in Whitehorse area country residential subdivisions are often gentler (at least 2H:1V) and it has been noted that along with increased slope stability, natural revegetation seems to occur faster; and
- Backslopes that are located throughout forest fire burn areas are especially susceptible to erosion as there is little to no root mat up gradient of the backslopes (Fox Lake burn area).

### 3.2 Other Information

Information from other sources was reviewed while developing recommendations for this project, including:

- Alberta Transportation Documents BMP#2; BMP#7; BMP#8 and BMP#11, all of which discuss specific check dam configurations to be used as velocity dissipaters along ditch lines;
- Ohio Department of Transportation Geotechnical Bulletin GB2 which discusses Special Benching and SideHill Embankment Fills; and,
- Montana Department of Transportation Permanent Erosion & Sediment Control Design Guidelines, which discusses revegetation along sideslopes and backslopes, check dam spacing and construction, ditch profiles, and lined ditches.

## 4.0 RECOMMENDATIONS

Recommendations presented below deal with the roadway embankment reconstruction in the vicinity of Sta 6+650 to Sta 6+750; embankment fill sideslope reconstruction; ditch line remediation and backslope revegetation.

### 4.1 Sta 6+650 to Sta 6+750 Subgrade Failure

This section of roadway is considered unsafe (refer to Photo 1 showing large longitudinal cracks). The north entrance off the Klondike Highway was blocked off but it is now open so the public has access to this area. Unfortunately, there is no site-specific geotechnical information for this location but it appears that the construction process and weight of embankment fill has caused subgrade failure. Ideally, it would be appropriate to drill two testholes through the embankment fill into the underlying soils to assess soil strength and the possible presence of ice-rich permafrost but since this is likely considered a public safety issue, the following reconstruction recommendations apply:

- The embankment soils must be excavated down to the native soil surface. During subexcavation, the better quality sub-base and basecourse soils should be separated and stockpiled for reuse.
- Once the subgrade surface is exposed, some exploratory testpitting should be performed to ensure that ice-rich permafrost does not exist at or near the original subgrade elevation.
- Assuming that there is no permafrost, and the shear strength of the subgrade is adequate to support the slope, it is recommended that geotextile be placed over the exposed subgrade area. The geotextile should have a one metre overlap and should extend beyond the toe-of-slope on each side of the embankment. There will likely be groundwater in the base of the excavation so contractors should be prepared to pump water into the adjacent pond (to the northwest), or other approved location, during reconstruction.
- On top of the geotextile, a 500 mm thick lift of coarse clear stone (75 mm to 200 mm) can be placed and track-packed (to properly seat the rock).
- A geotextile silt barrier should be placed over the rock and subsequent sub-base and basecourse construction can be completed by placing lifts (maximum lift thickness 300 mm) and compacting to 95% of standard proctor maximum dry density for lifts below 1 m of design grades (hopefully the stockpiled materials are suitable for sub-base construction). It is recommended that 98% of standard proctor maximum dry density be achieved in the final metre to facilitate BST surfacing.
- It should be noted that the culvert at Sta 6+660 is badly damaged and will require replacement as well.

## 4.2 Embankment Reconstruction in Large Fill Areas

The following recommendations apply to the large fill areas where the two wildlife crossing culverts are located; the fill area extending from Sta 0+500 to Sta 1+000; and the large fill extending from Sta 5+600 to Sta 6+500. All embankment sideslopes, as well as the edges of the traffic surface show signs of failure in these areas. Recommendations for remediation include:

- There is evidence that some embankment fill was placed with excessively thick lifts (as noted on various daily report forms prepared by Tetra Tech EBA technical staff during construction) so it is not unusual to be seeing sideslope instability and evidence of failure along the driving surface for the three large fill areas identified in this section.
- In order to mitigate the ongoing erosional problems noted, it is suggested that the embankment sideslopes be reconstructed with 2H:1V sideslopes (both sides of the embankment).
- Sliver fills are difficult to construct properly, so benching (creating a stair step surface) will be required in order to relax the constructed 1.5H:1V slopes to 2H:1V. This will inhibit the development of a contiguous shear plane along the interface between the existing embankment soils and the sliver fill. By benching, some of the loose, uncompacted soil will be excavated and used in the engineered sliver fill, ensuring improved compaction along the face of the embankment.
- Since the toe of slope will be located beyond the existing toe, the subgrade will have to be stabilized prior to placing the sliver fill. During site reconnaissance, some areas were quite wet and soft so scarification and regrading may be required to achieve moisture contents that will ensure stability.
- It is recommended that benches that are cut into the existing slope have backslopes of 1H:1H in order to minimize sloughing during reconstruction. If each bench is 1 m in vertical height, three lifts can be placed and

compacted per bench. The width of each bench must allow equipment travel so keep in mind that each bench will be narrower at the top than at its base (because of the 1H:1V backslope).

- Ideally, the sliver fills should be constructed of similar soils to those used during the original embankment construction so that the resistance to shear failure remains consistent throughout the entire embankment.
- Benches should be constructed horizontally or should match the grade line of the existing roadway.
- Each lift must be compacted to 95% of standard proctor maximum dry density for all material placed below 1.0 m of final road elevations. Material placed in the top metre must be compacted to 98% of standard proctor maximum dry density.
- It is likely that all guardrails will have to be removed during embankment reconstruction. However, since there are numerous washouts around the guardrail supports, removal would have been required anyway. Guardrails, especially along the inside of super-elevated curves, may not be acceptable for large fills on long slopes. Problems with washouts have been noted at other locations as well (for example, the long slope north of the bridge in Pelly Crossing where PWF has been placed between the supports to prevent water scour during rainfall events). A common solution used along numerous highway corridors are “F” shape pre-cast barrier curb (solid with no water slots). This is being used on the RHS of the fill at Sta 2+100 for public safety reasons but should be considered along the three large fills requiring remediation.

### 4.3 Ditch Reconstruction

Ditch scour and sediment transport is a very common problem throughout the sections of roadway with grades exceeding 3%. No check dams were installed during the original construction so erosion problems along ditches are prevalent.

#### 4.3.1 Ditch Profile

Since there has been a lot of sediment transport, most of the ditches should be cleaned out and recompacted prior to placing check dams. This work is often performed by a Grade-All, which is a rubber tired excavator that is capable of travel along BST surfaced roads. However, the use of this type of equipment often results in a bowl shaped ditch profile which can easily erode and undercut the roadway embankment. The optimum ditch shape for the soils throughout the Grizzly Valley Subdivision is V-shaped with sideslopes and backslopes cut as shallow as possible.

#### 4.3.2 Check Dams

Without properly spaced check dams, sediment transport and scouring will be ongoing. Four check dam options used by Alberta Transportation are presented for consideration, including:

##### 4.3.2.1 Straw Bale Check Dams

Straw bale check dams are considered a good temporary solution for minimizing sediment transport and decreasing flow velocities from storm runoff. They are considered appropriate in shallow ditches where grades are less than 5%. Although they are considered to be temporary, the main advantages are that they are economical and readily available to most areas along with being biodegradable.

They are obviously not as robust as sand bags, rock or gabion check dams and they may require maintenance after large storm events. As well, placement is usually by hand and this system is prone to failure if not properly anchored.

Proper execution includes:

- At each check dam location, excavate a trench that is 150 mm deep and 2 bales wide;
- Place the two rows of bales perpendicular to flow and stagger the seams;
- Bales should extend up along the embankment sideslopes and the backslope of the ditch;
- Twine or wire should not be in contact with the soil;
- Using stakes, anchor the bales into the underlying soils; and
- Backfill and compact up tight to the bales on the upstream and downstream side.

Suggested spacing is:

- 3% slopes – check dam every 40 m
- 4% slopes – check dam every 35 m
- 5% or greater slopes – check dam every 25 m with frequent inspection (especially after heavy rainfall events)

#### **4.3.2.2 Sand Bag Check Dams**

Sand bags can be used to construct small dams across the ditches. This will limit sediment transport and reduce flow velocities. This is considered a good temporary solution where there are sand/silt soils (prevalent throughout the study area) and are more effective than straw bale check dams

The main disadvantages are that hand placement is required and care must be taken to avoid ripping the bags.

Proper execution involves:

- Structure should extend from the embankment sideslope, across the ditch and up the backslope, ensuring that a center flow channel is established;
- Sand bag check dams should not exceed 0.8 m in height so that large volumes of water aren't impounded on the upstream side;
- Since the sand bags are placed to form a dam structure, the upstream slope should be 1.5H:1V and the downstream side should be 2.5H:1V

Suggested spacing is:

- 3% slopes – check dam every 40 m
- 4% slopes – check dam every 35 m
- 5% or greater slopes – check dam every 25 m with frequent inspection (especially after heavy rainfall events)

#### 4.3.2.3 Rock Check Dams

Rock check dams are considered to be a fairly permanent solution using readily available granular materials. They are appropriate in areas with slopes of 5% to 8%, but are most effective in areas where flow velocities are likely to be less than 1.5 m/s and are generally cheaper than using rip rap or gabion structures. If flow velocities are higher, they may be susceptible to failure if water undermines or outflanks the structure.

Proper execution involves:

- Excavate a key trench to a depth of 0.15 m at each check dam location;
- Place geotextile along the base of the excavation;
- Construction should extend from the embankment sideslope, across the ditch and up the backslope, ensuring that a center flow channel is established;
- Maximum height should be 0.8 m to minimize potential for impounding large volumes of water;
- Upstream slope should be constructed to 2H:1V and downstream slope should be constructed to 3H:1V
- Rock check dams should be constructed of free draining material. The mean rock diameter (D50) should be between 75 mm and 150 mm. If higher flow velocities are anticipated larger stone sizes can be considered.

Suggested spacing is:

- Less than 5% slopes – check dam every 35 m
- 5% or greater slopes – geotechnical input should be requested to assess site specific conditions

#### 4.3.2.4 Gabion Check Dams

Single gabion drop structures for ditch channels are suitable for steep grades ranging from 4 to 10% but are considered to be expensive and labour intensive. If considered, site-specific assessments would be required since this is considered to be a permanent option.

#### 4.3.3 Cut/Fill Transition Areas

Ditches that flow towards large fill areas are very problematic because of steep grade changes resulting in increased water velocities during storm events. In these areas, a broad V-shaped ditch lined with geotextile cloth and armoured with angular rip-rap should be established. The geotextile must be properly anchored at the crest and rip-rap should be 300 mm in size. Some maintenance should be anticipated as the rip-rap will eventually become silted-in, decreasing the velocity dissipation potential.

#### 4.3.4 Slope Soil Stabilization

Erosion (along both sideslopes and steep backslopes) has been noted, with rills and erosion gullies resulting in sediment transport into the ditches. Revegetation of slopes by hydroseeding or reseeding are considered the best methods of remediation. However, Hydroseeding or reseeding of the long, steep slopes noted throughout the subdivision may be challenging due to:

- Equipment access difficulties;
- Lack of organic matter to promote regrowth;

- Cold soil temperatures (typical throughout the Yukon) which inhibits decomposition of available organic matter and causes the soils to be deficient in available nitrogen (natural fertilizer); and
- A lack of proper slope preparation during the original subdivision construction.

It may be impossible (or at least cost prohibitive) to revegetate entire slopes but it has been proven that if the bottom third of long slopes is treated, that is an adequate filter zone minimizing the amount of sediment reaching the ditches will be established. Proper slope preparation will be required, including:

- Regrading to repair existing rills and erosion gullies;
- Track-walking of the surface to establish cleat tracks that will serve as catchment for seed, fertilizer and surface water. This is accomplished by walking tracked equipment up and/or down the slope. Not only does this form cleat tracks for catchment, it loosens the surface to promote root growth.
- Track-walking steep slopes can be difficult or dangerous but if it is decided that only the bottom third of some of the longer slopes is prepared, the bottom of a tracked excavator cleanup bucket can be modified by welding cleats across the bucket and the slope can be stamped with the bucket to establish a similar cleat pattern.

Other treatment options (individually or in combination) to be considered include:

- Erosion control blankets with seeding
- Compost blanket with seeding
- Topsoil treatment with seeding

## 5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Associated Engineering (B.C.) Ltd. and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than the Associated Engineering (B.C.) Ltd, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. For further information regarding the use of this report, see Tetra Tech EBA's General Conditions that are presented in Appendix A of this report.

## 6.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,  
Tetra Tech EBA Inc.

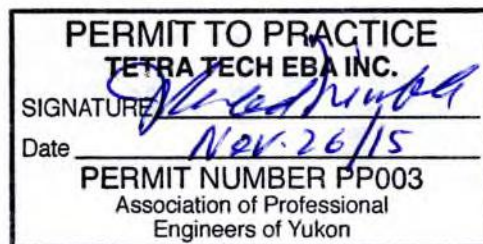


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Richard.Trimble@tetrattech.com

/chr

Attachments: Figure 1: Grizzly Subdivision Site Plan  
Appendix A: Tetra Tech EBA's General Conditions – Geotechnical

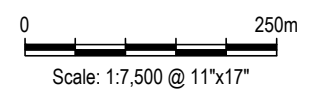
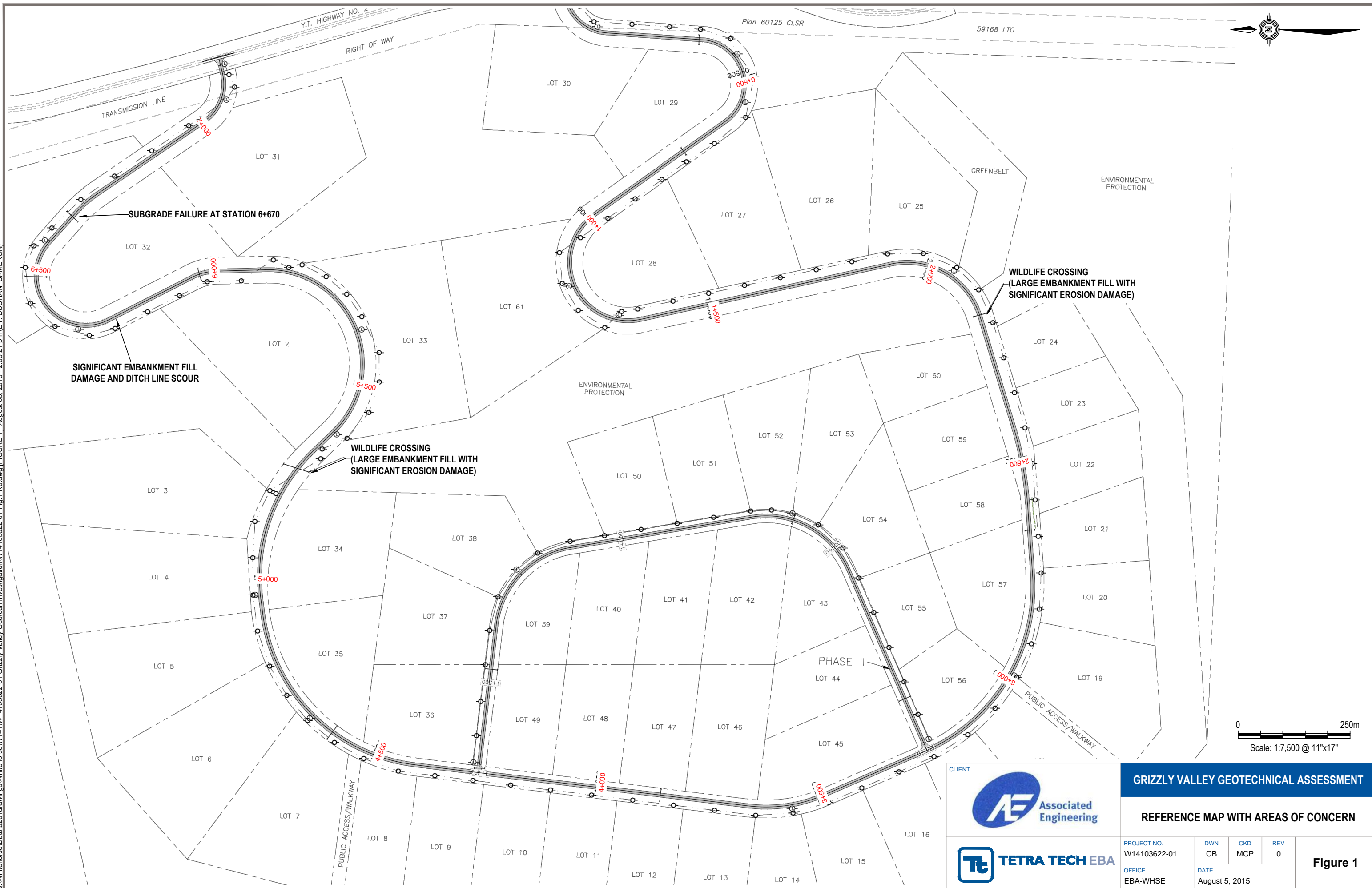



# FIGURES

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Figure 1      Grizzly Valley Site Plan

Q:\Whitehorse\Drawings\Whitehorse\141\14103622-01 Grizzly Valley Geotech Investigation\14103622-01 Fig.1-RO.dwg [FIGURE 1] August 05, 2015 - 2:08:21 pm (BY: BUCHAN, CAMERON)



CLIENT		<b>GRIZZLY VALLEY GEOTECHNICAL ASSESSMENT</b>			
		<b>REFERENCE MAP WITH AREAS OF CONCERN</b>			
PROJECT NO.	DWN	CKD	REV	<b>Figure 1</b>	
W14103622-01	CB	MCP	0		
OFFICE	DATE				
EBA-WHSE	August 5, 2015				



# APPENDIX A

## TETRA TECH EBA'S GENERAL CONDITIONS - GEOTECHNICAL

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# GENERAL CONDITIONS

---

## GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

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### 1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA's Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA's Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

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### 2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA's instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

### 3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

### 4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

### 5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

### 6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

## 7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

## 8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

## 9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

## 10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

## 11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

## 12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

## 13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

## 14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.



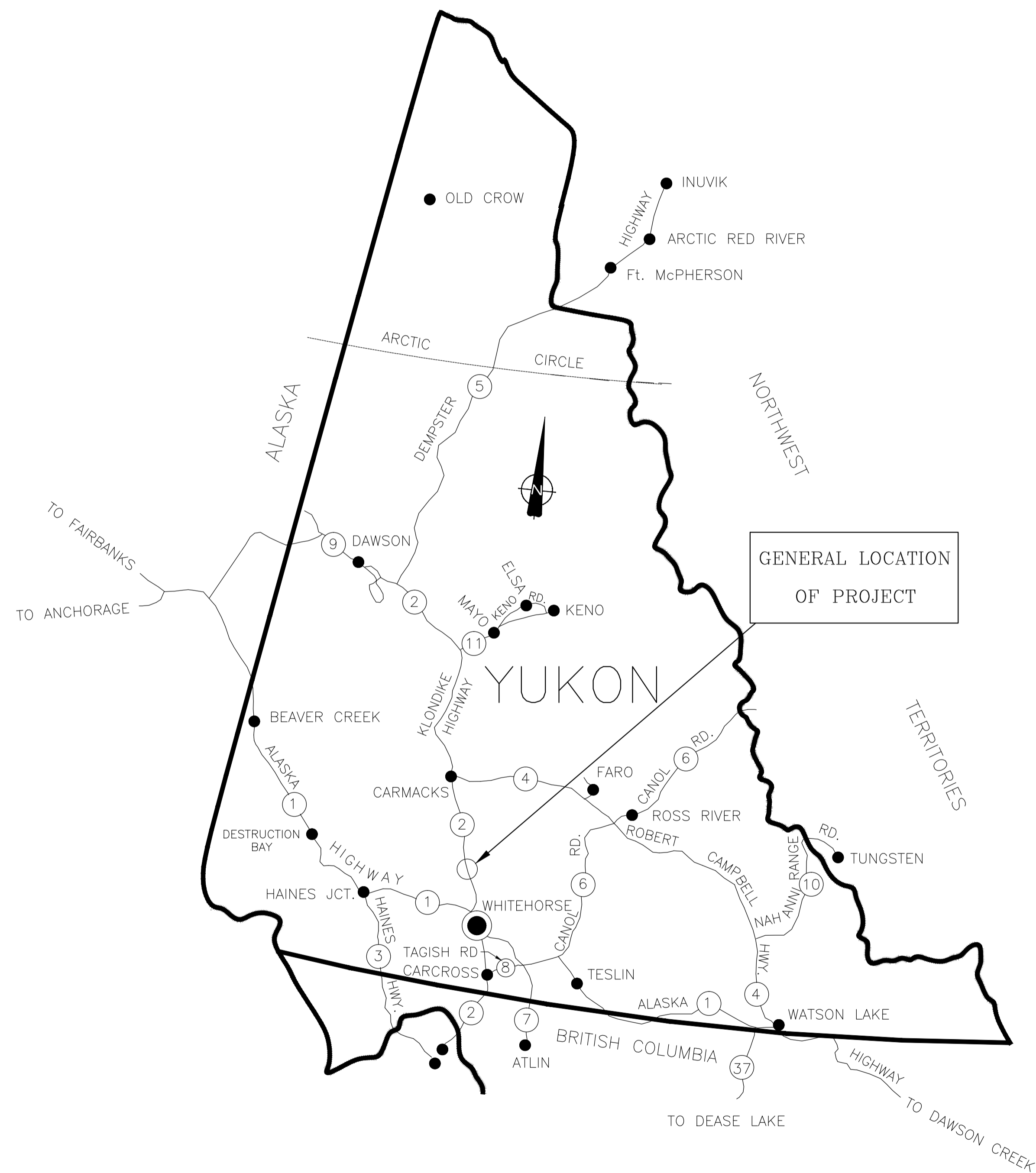
# REPORT



## Appendix B – As Built Drawings

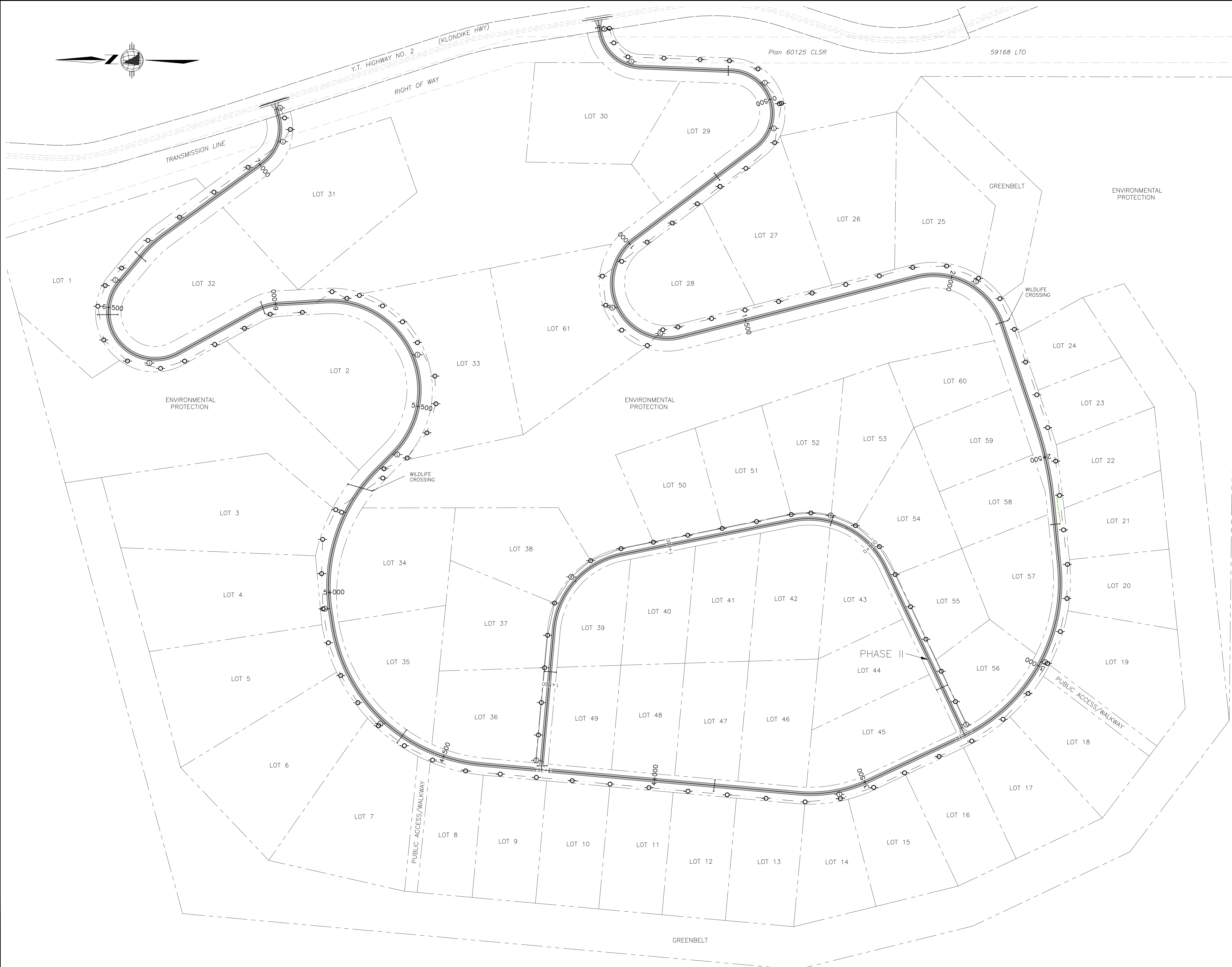
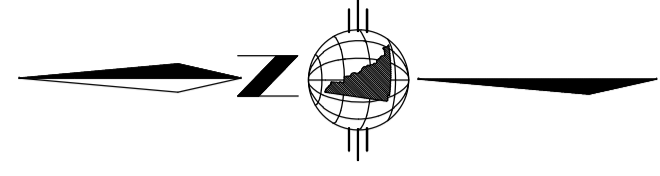


# ASBUILT DRAWINGS FOR GRIZZLY VALLEY SUBDIVISION YUKON 2013



SHEET 02 of 32	SITE PLAN
SHEET 03 of 32	0+000 to 0+300
SHEET 04 of 32	0+300 to 0+600
SHEET 05 of 32	0+600 to 0+900
SHEET 06 of 32	0+900 to 1+200
SHEET 07 of 32	1+200 to 1+500
SHEET 08 of 32	1+500 to 1+800
SHEET 09 of 32	1+800 to 2+100
SHEET 10 of 32	2+100 to 2+400
SHEET 11 of 32	2+400 to 2+700
SHEET 12 of 32	2+700 to 3+000
SHEET 13 of 32	3+000 to 3+300
SHEET 14 of 32	3+300 to 3+600
SHEET 15 of 32	3+600 to 3+900
SHEET 16 of 32	3+900 to 4+200
SHEET 17 of 32	4+200 to 4+500
SHEET 18 of 32	4+500 to 4+800
SHEET 19 of 32	4+800 to 5+100
SHEET 20 of 32	5+100 to 5+400
SHEET 21 of 32	5+400 to 5+700
SHEET 22 of 32	5+700 to 6+000
SHEET 23 of 32	6+000 to 6+300
SHEET 24 of 32	6+300 to 6+600
SHEET 25 of 32	6+600 to 6+900
SHEET 26 of 32	6+900 to 7+120
SHEET 27 of 32	PHASE II 0+000 to 0+300
SHEET 28 of 32	PHASE II 0+300 to 0+600
SHEET 29 of 32	PHASE II 0+600 to 0+900
SHEET 30 of 32	PHASE II 0+900 to 1+200
SHEET 31 of 32	PHASE II 1+200 to 1+500
SHEET 32 of 32	PHASE II 1+500 to 1+702

Signage location data added by YG Community Services.  
July 30th, 2013.



NOTES:

- LEGEND:
- INSTALLED UTILITY POLE
  - INSTALLED LIGHT STANDARD
  - OVERHEAD UTILITY LINE
  - INSTALLED CULVERT
  - PAVEMENT AREA
  - BST AREA
  - LEGAL BOUNDARIES
  - TRANSMISSION LINE
  - RIGHT OF WAY
  - KLONDIKE HIGHWAY SHOULDERS
  - KLONDIKE HIGHWAY CENTRELINE
  - KLONDIKE HIGHWAY RIGHT OF WAY



REVISIONS:

NO.	DATE	ENG.	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:

**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:

**OVERALL  
SITE PLAN**

DATE: APRIL 2013      SCALE: 1:4000 on A1  
DRAWN: R. Colberg

Professional Engineers Seal

DESIGN: J. Quoitte  
CHECKED:  
APPROVED: C. Benedek  
DRAWING NO. E08064 ASB      SHEET 2 of 32

NOTES:

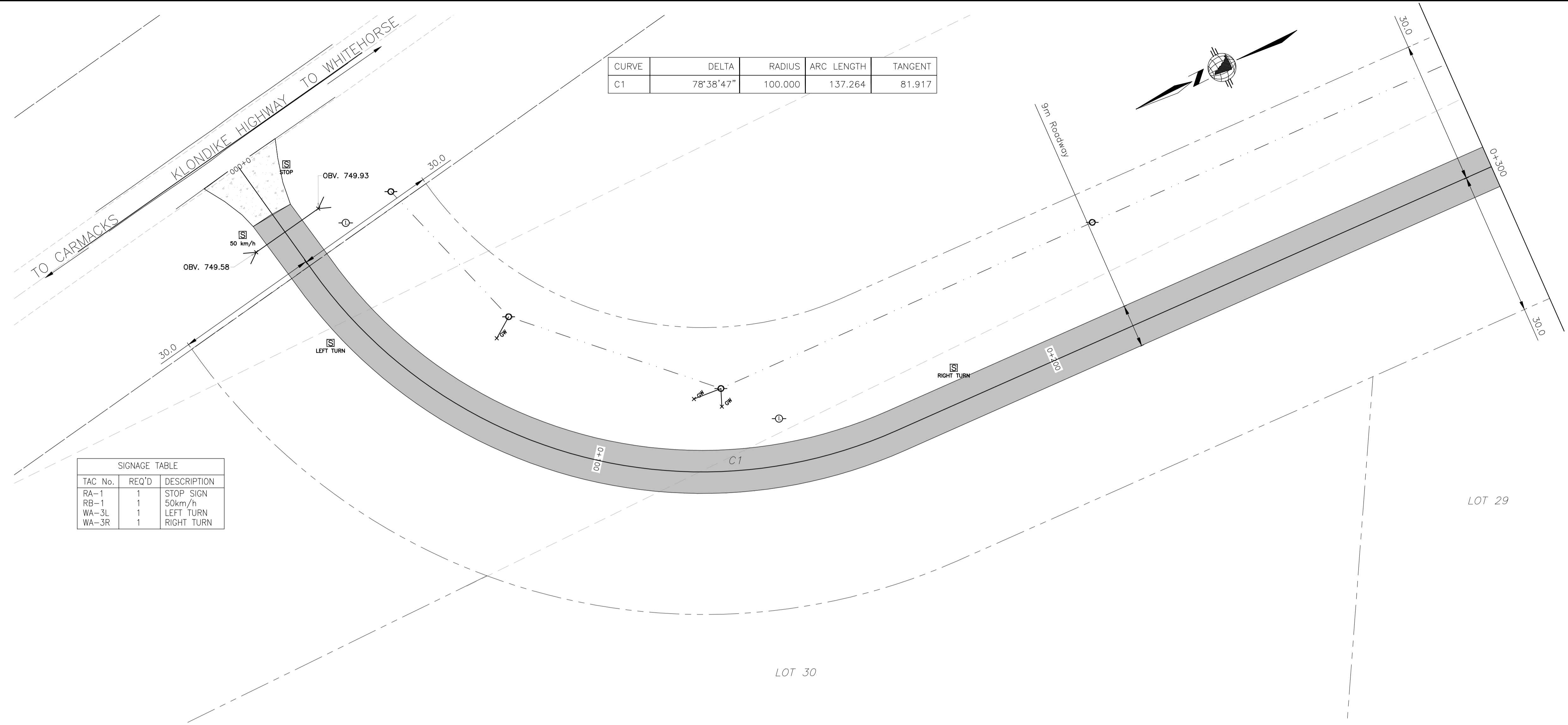
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- ASBUILT CENTERLINE
- ASBUILT SHOULDER
- INSTALLED GUARDRAIL
- INSTALLED CULVERT
- INSTALLED SIGN
- INSTALLED UTILITY POLE
- OVERHEAD UTILITY LINE
- LEGAL BOUNDARIES
- TRANSMISSION LINE
- RIGHT OF WAY
- KLONDIKE HIGHWAY SHOULDERS
- KLONDIKE HIGHWAY CENTRELINE
- KLONDIKE HIGHWAY RIGHT OF WAY

PAVEMENT AREA

BST AREA

CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C1	78°38'47"	100.000	137.264	81.917



TAC No.	REQ'D	DESCRIPTION
RA-1	1	STOP SIGN
RB-1	1	50km/h
WA-3L	1	LEFT TURN
WA-3R	1	RIGHT TURN



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:

**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

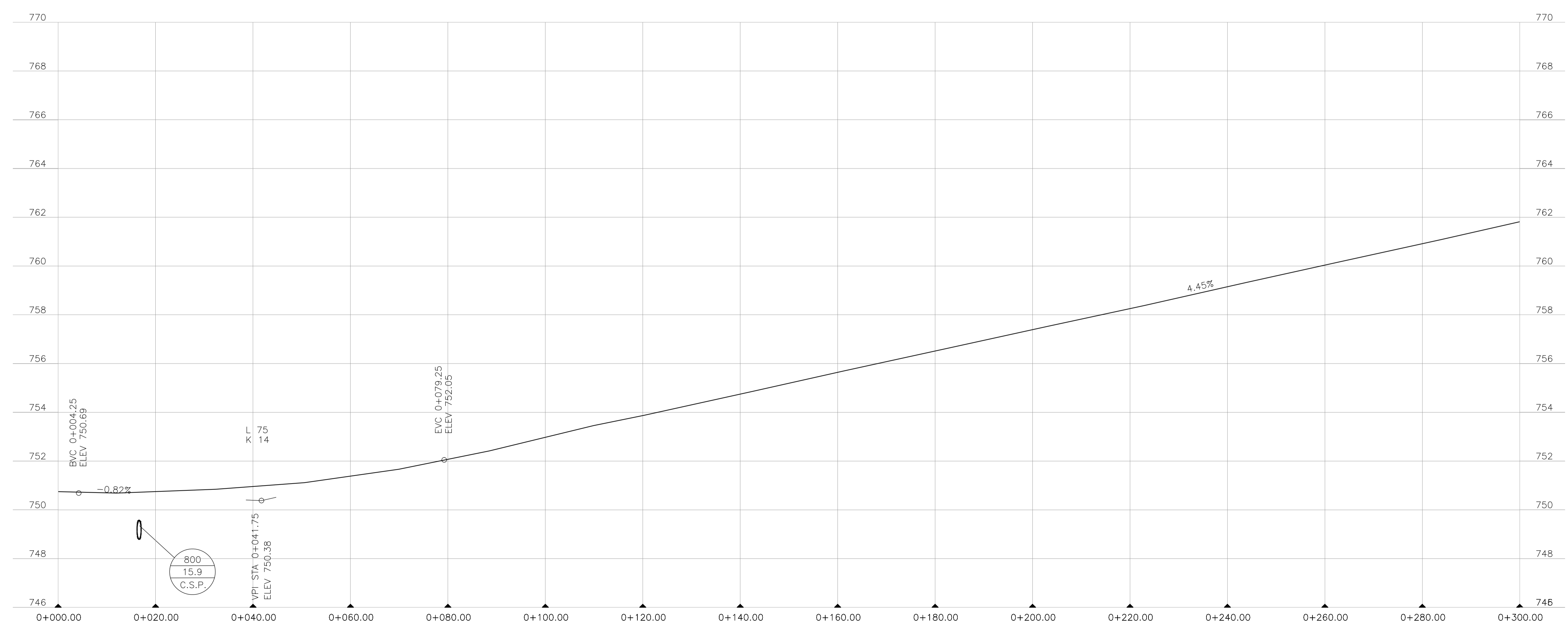
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km 0+000 to km 0+300

DATE: FEB	HORIZONTAL SCALE: 1:500
DRAWN: R. Colberg	VERTICAL SCALE: 1:100

*Professional Engineers Seal*

DESIGN: J. Quoitte  
CHECKED:  
APPROVED:  
DRAWING NO. E08064\_PP SHEET 3 of 32



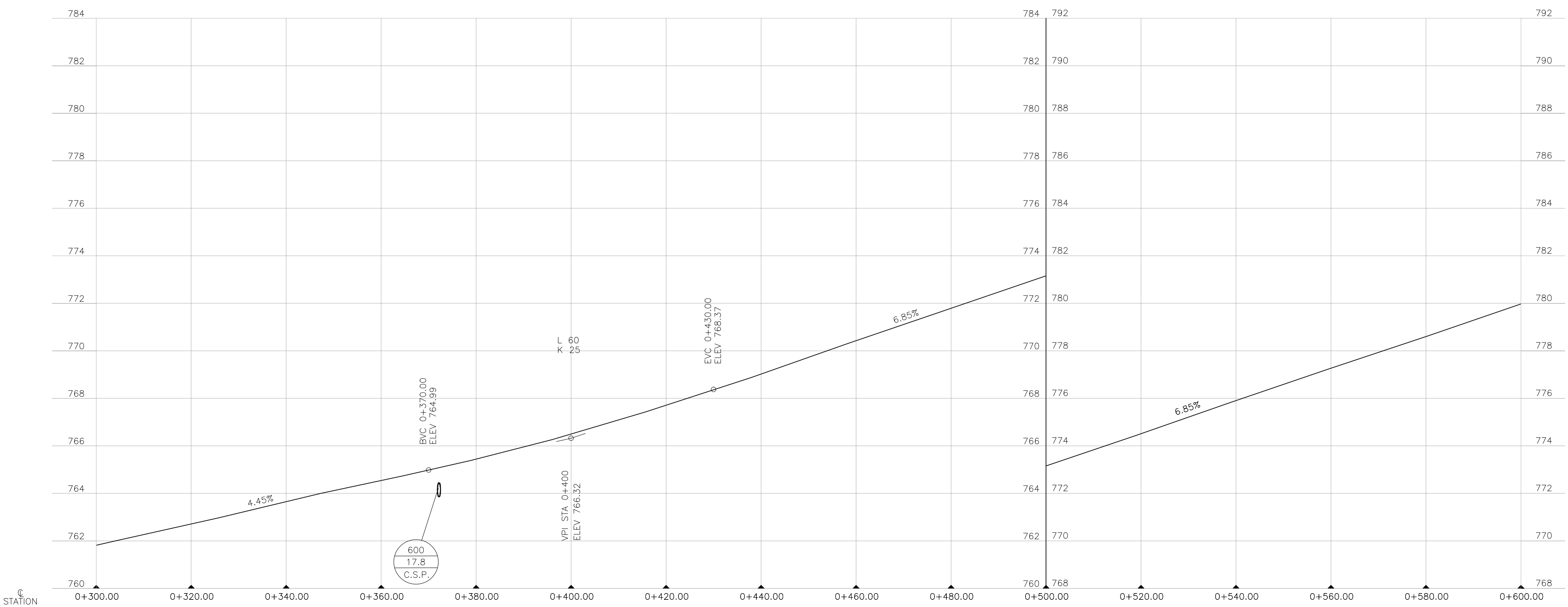
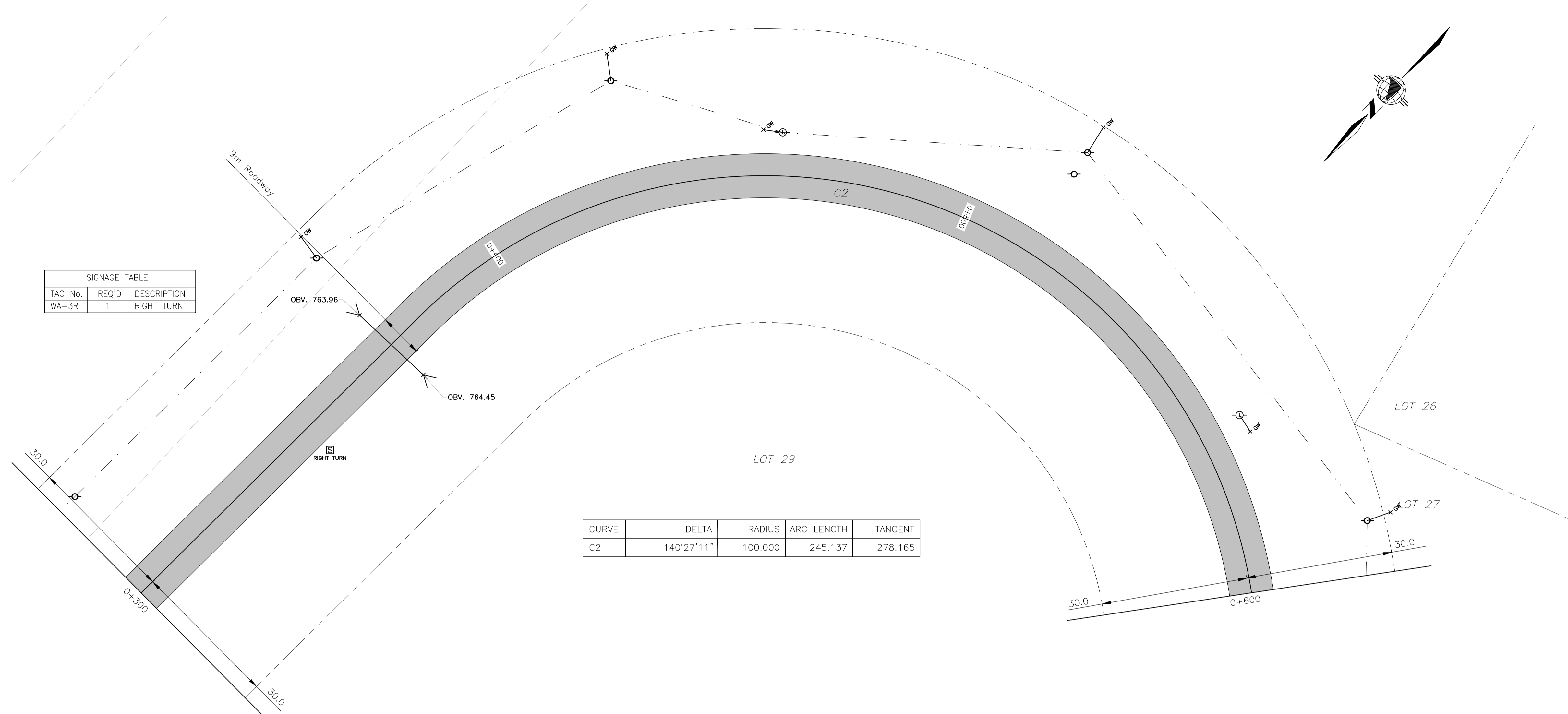
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ASBUILT SHOULDER	---
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INSTALLED CULVERT	---/---/---
INSTALLED SIGN	[S] SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---o---
GUY WIRE	---x---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled Pattern]
BST AREA	[Grey Shaded Area]
FALSE GRADE DITCH	~ ~ ~

SIGNAGE TABLE

TAC No.	REQ'D	DESCRIPTION
WA-3R	1	RIGHT TURN

CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C2	140°27'11"	100.000	245.137	278.165



REVISIONS:

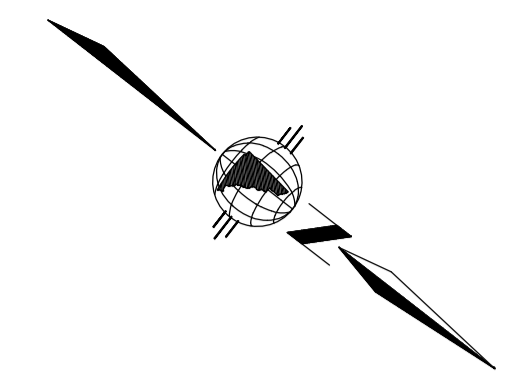
NO.	DATE	BY	SUBJECT
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02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

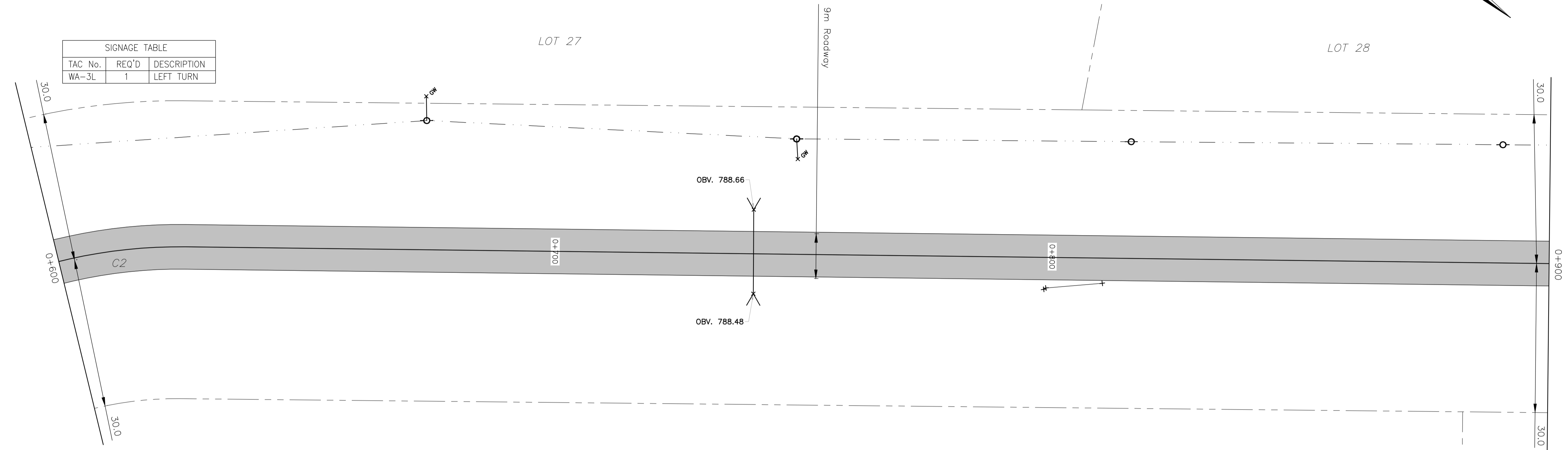
DRAWING TITLE:  
**PLAN PROFILE  
km 0+300 to km 0+600**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Quaille  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 4 of 32



SIGNAGE TABLE		
TAC No.	REQ'D	DESCRIPTION
WA-3L	1	LEFT TURN



CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C2	140°27'11"	100.000	245.137	278.165

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---x---x---x---
INSTALLED CULVERT	---/---\---
INSTALLED SIGN	[S] SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---o---
GUY WIRE	---x---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled Pattern]
BST AREA	[Solid Grey]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

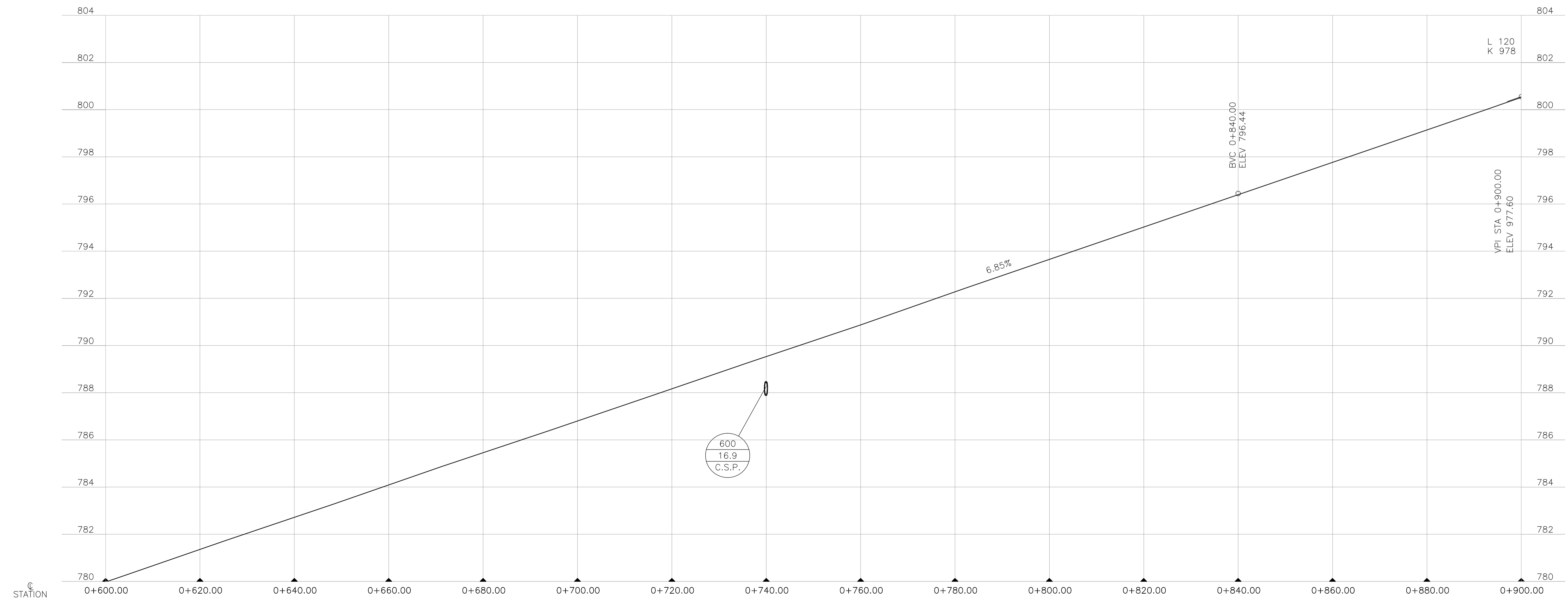
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 0+600 to km 0+900**

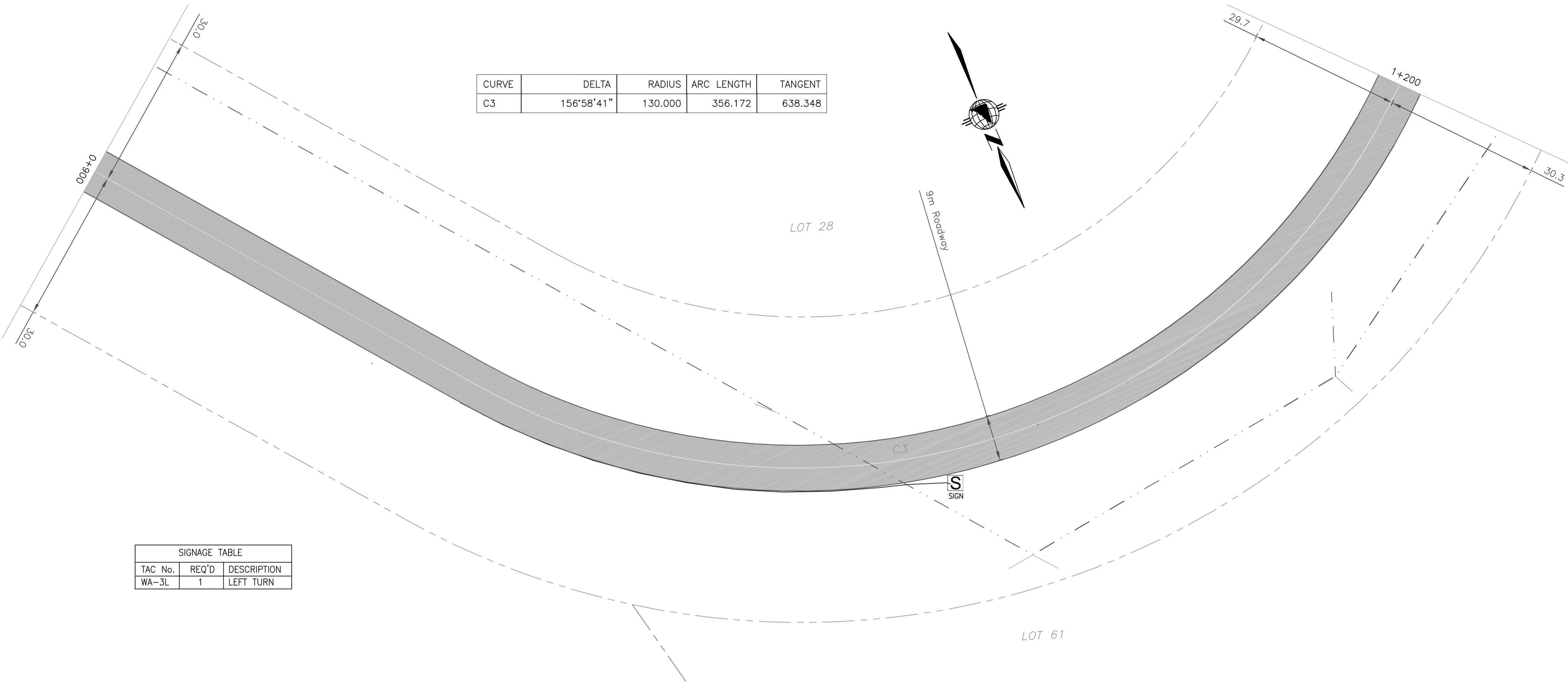
DATE: APRIL 2013	HORIZONTAL SCALE: 1:500
DRAWN: R. Colberg	VERTICAL SCALE: 1:100

Professional Engineers Seal

DESIGN: J. Quaille  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB SHEET 5 of 32



CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C3	156°58'41"	130.000	356.172	638.348

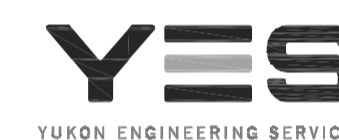


SIGNAGE TABLE

TAC No.	REQ'D	DESCRIPTION
WA-3L	1	LEFT TURN

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---
INSTALLED CULVERT	
INSTALLED SIGN	
INSTALLED UTILITY POLE	
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

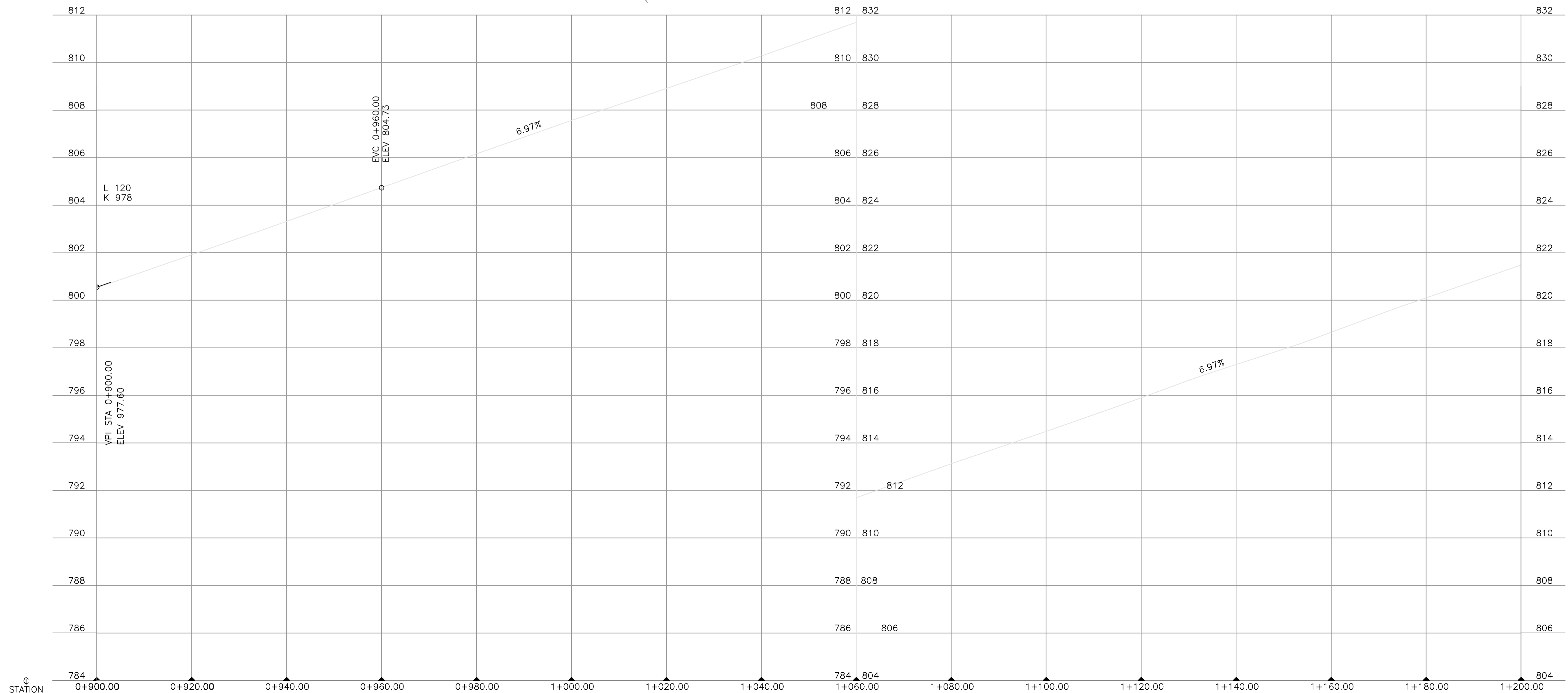
NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 0+900 to km 1+200**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Quailie  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 6 of 32



STATION



LEGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	× × × × ×
INSTALLED CULVERT	⌢
INSTALLED SIGN	S SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	--- x
GUY WIRE	--- x
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled Pattern]
BST AREA	[Grey Shaded Area]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

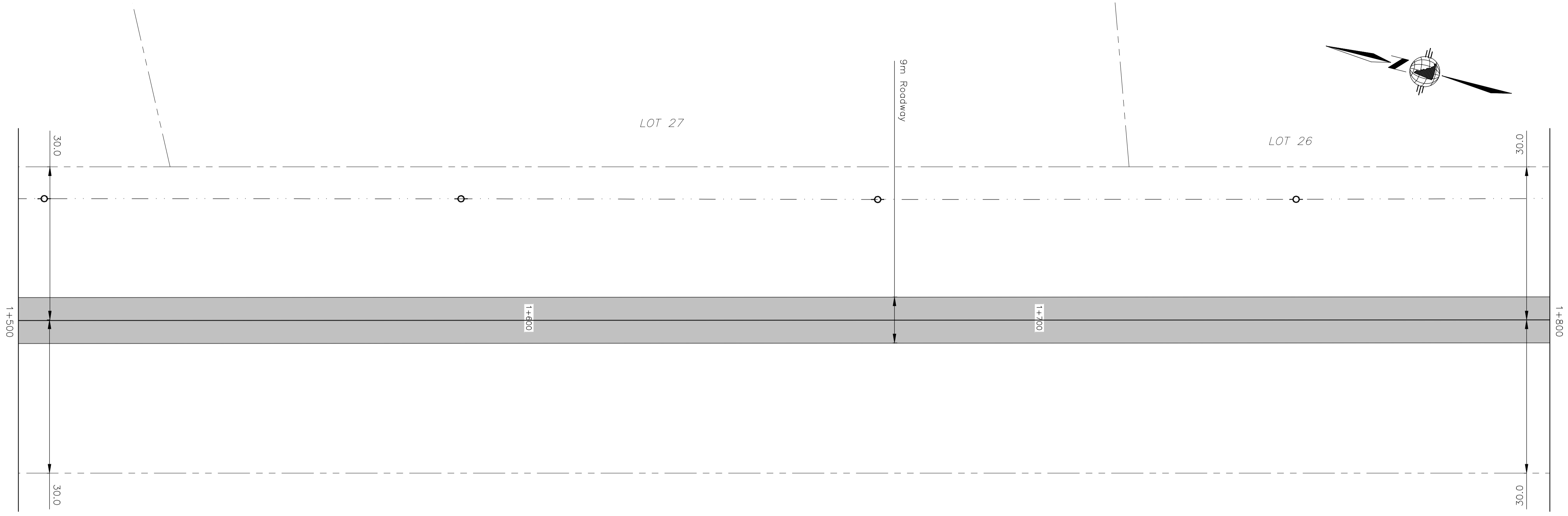
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 1+500 to km 1+800**

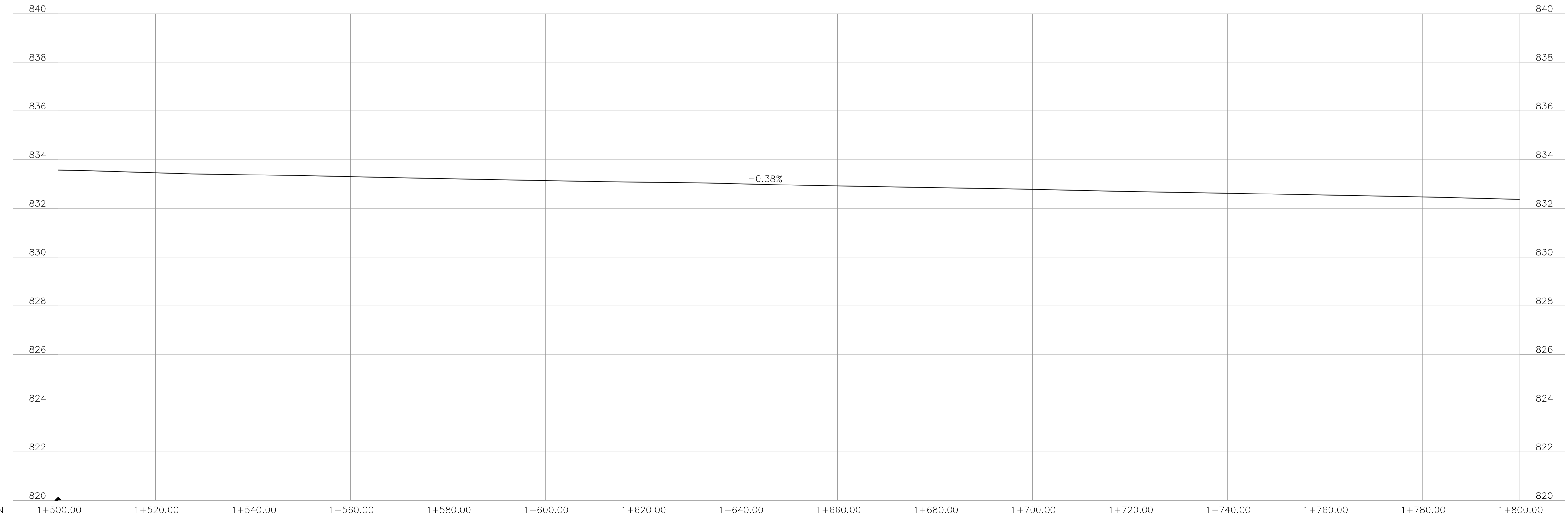
DATE: APRIL 2013	HORIZONTAL SCALE: 1:500
DRAWN: R. Colberg	VERTICAL SCALE: 1:100

Professional Engineers Seal

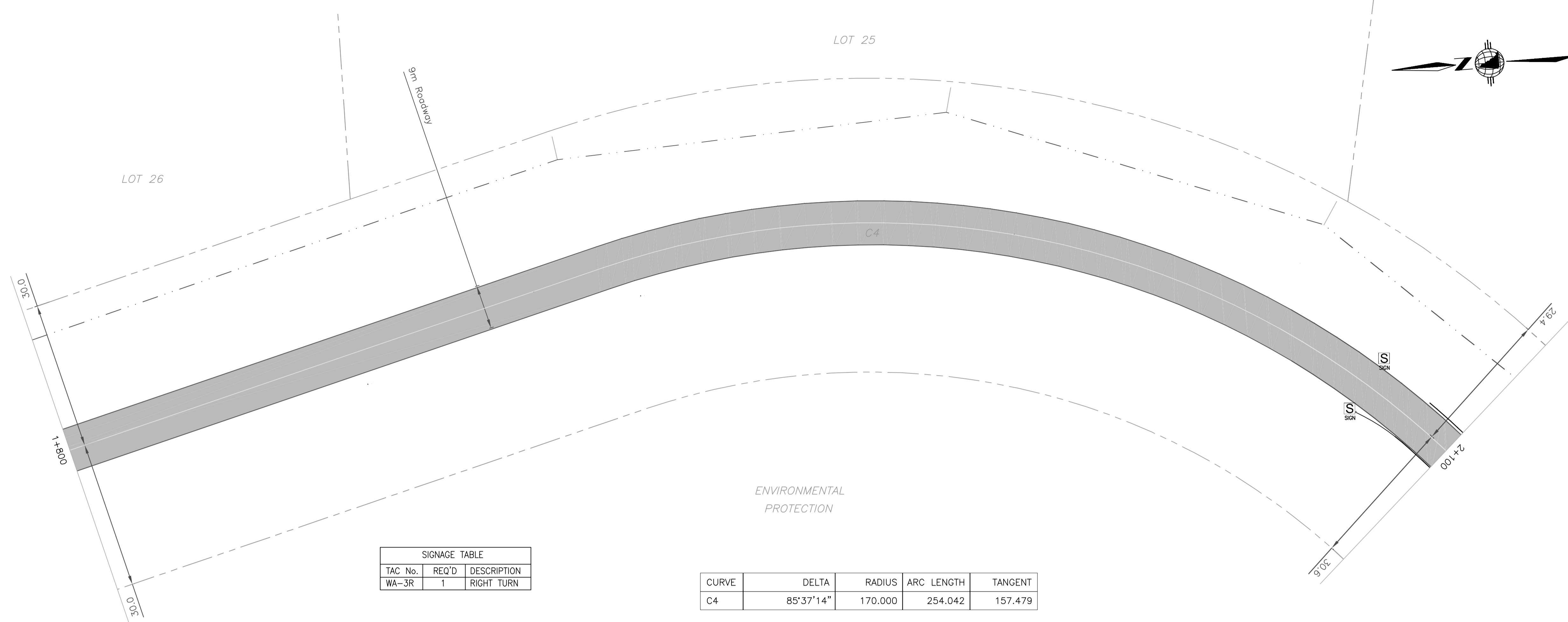
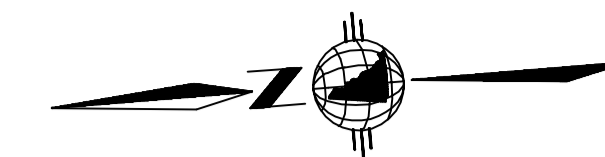
DESIGN: J. Quaille
CHECKED:
APPROVED: C. BENEDEK
DRAWING NO. E08064 ASB
SHEET 8 of 32



ENVIRONMENTAL  
PROTECTION



STATION 1+500.00 1+520.00 1+540.00 1+560.00 1+580.00 1+600.00 1+620.00 1+640.00 1+660.00 1+680.00 1+700.00 1+720.00 1+740.00 1+760.00 1+780.00 1+800.00

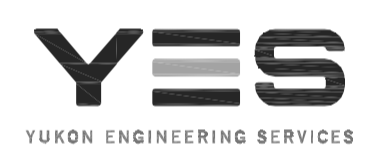


SIGNAGE TABLE		
TAC No.	REQ'D	DESCRIPTION
WA-3R	1	RIGHT TURN

CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C4	85°37'14"	170.000	254.042	157.479

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---
INSTALLED CULVERT	
INSTALLED SIGN	
INSTALLED UTILITY POLE	
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

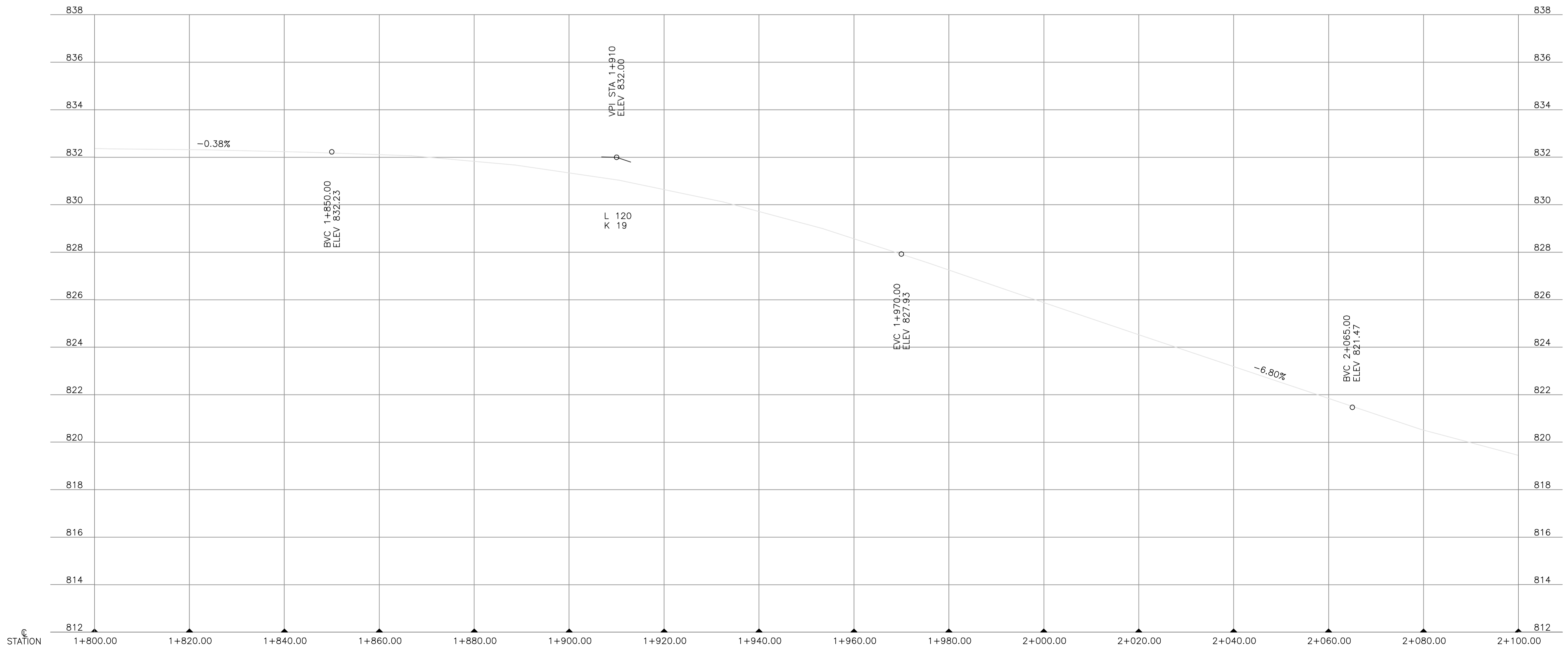
NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

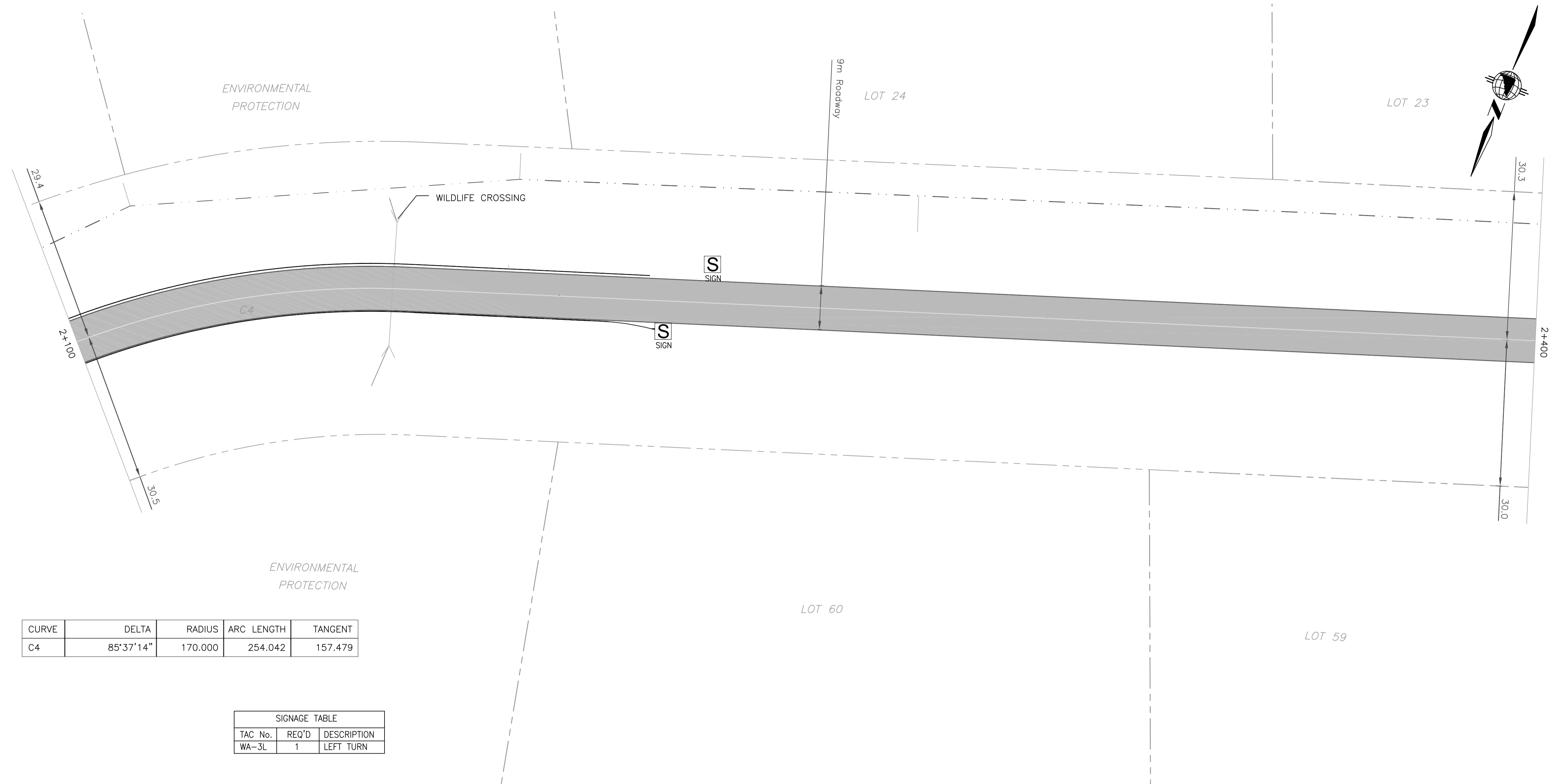
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 1+800 to km 2+100**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Quailie  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 9 of 32



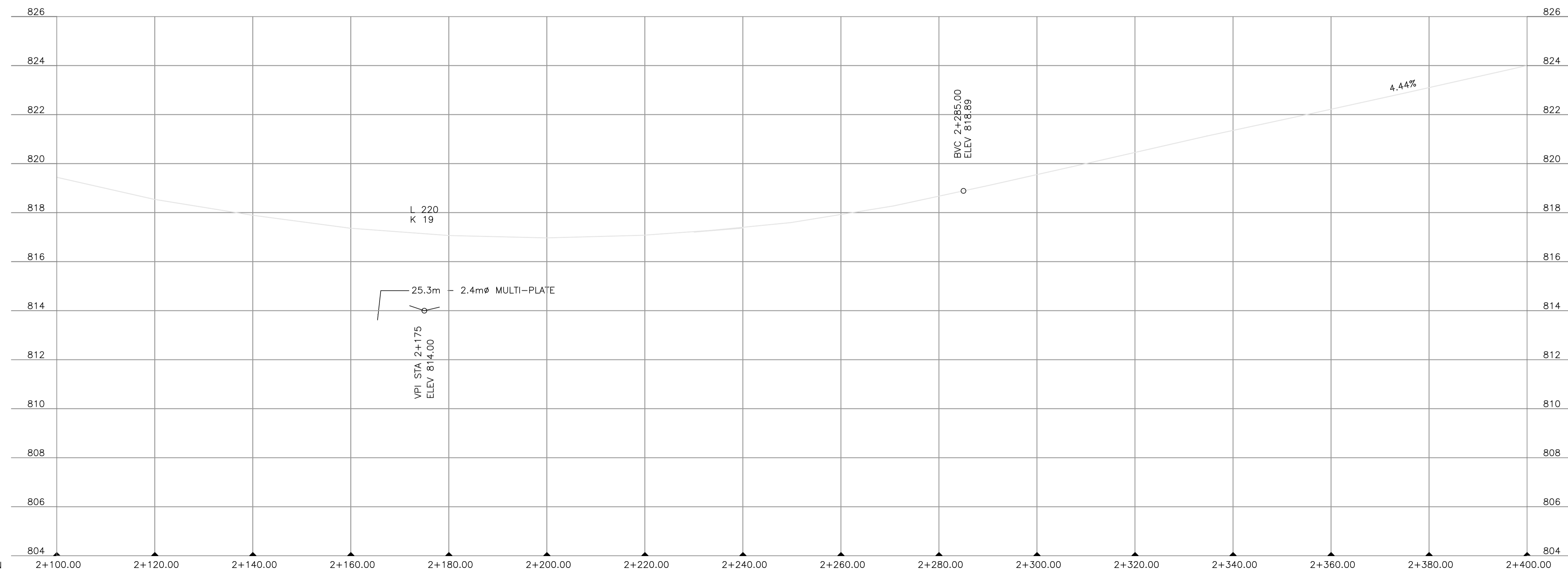


CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C4	85°37'14"	170.000	254.042	157.479

SIGNAGE TABLE		
TAC No.	REQ'D	DESCRIPTION
WA-3L	1	LEFT TURN

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---
INSTALLED CULVERT	
INSTALLED SIGN	
INSTALLED UTILITY POLE	
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

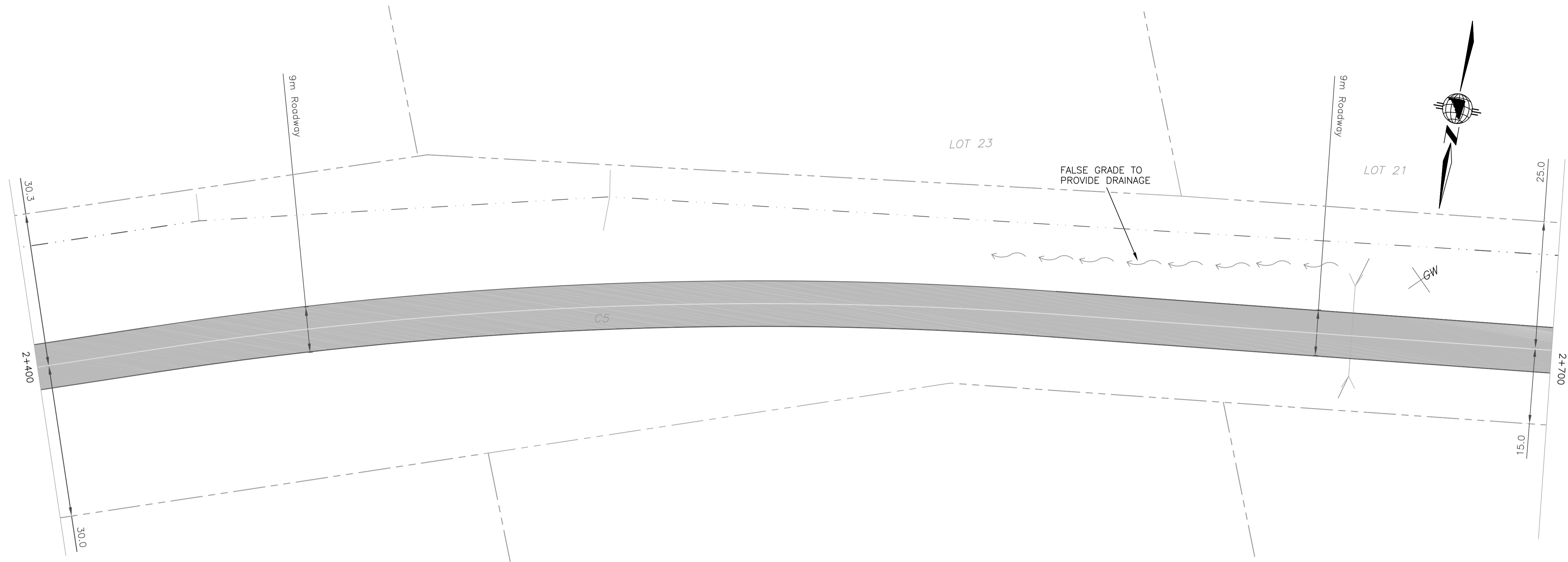
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 2+100 to km 2+400**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal

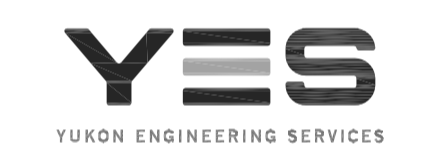
DESIGN: J. Quailie  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 10 of 32



CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C5	12°36'24"	800.000	176.024	88.369

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---
INSTALLED CULVERT	
INSTALLED SIGN	
INSTALLED UTILITY POLE	
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 2+400 to km 2+700**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

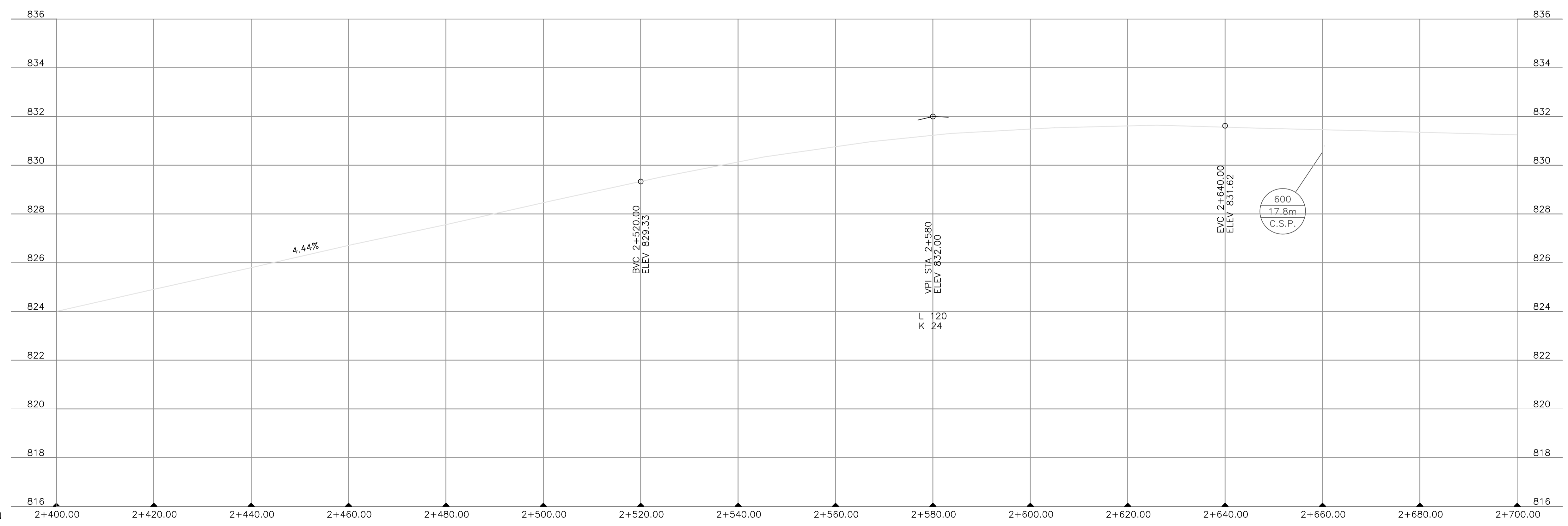
Professional Engineers Seal

DESIGN: J. Quailie

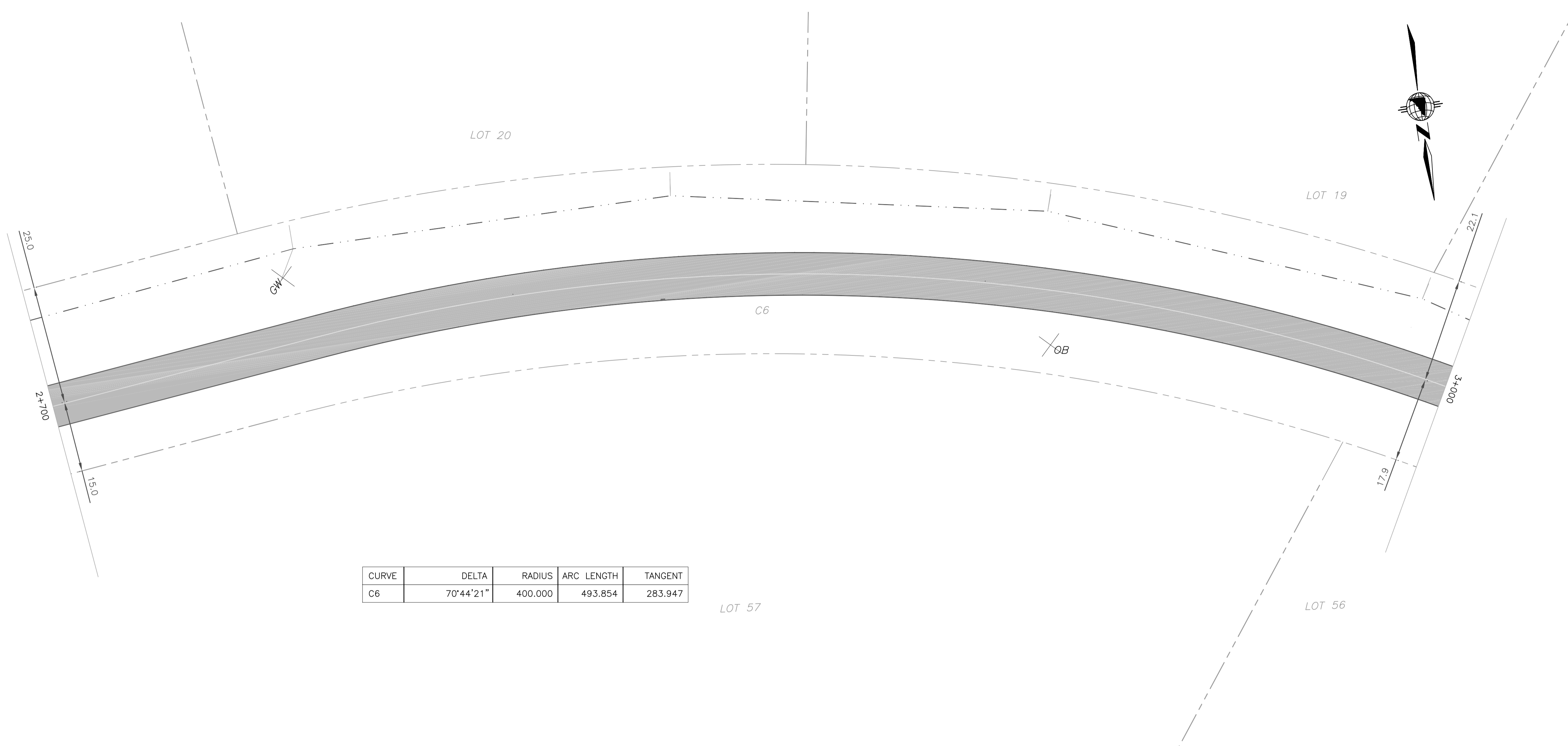
CHECKED:

APPROVED: C. BENEDEK

DRAWING NO. E08064 ASB      SHEET 11 of 32



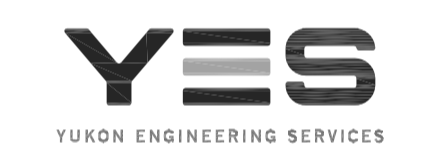
STATION



CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C6	70°44'21"	400.000	493.854	283.947

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---
INSTALLED CULVERT	
INSTALLED SIGN	
INSTALLED UTILITY POLE	
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 2+700 to km 3+000**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

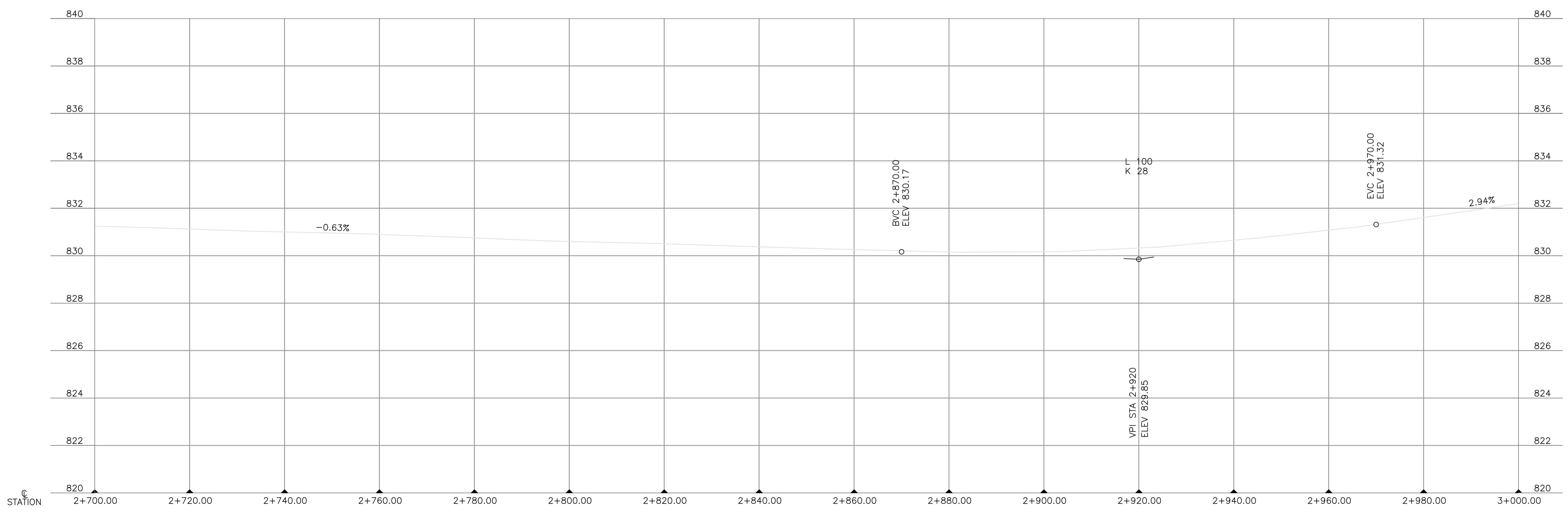
Professional Engineers Seal

DESIGN: J. Quailie

CHECKED:

APPROVED: C. BENEDEK

DRAWING NO. E08064 ASB      SHEET 12 of 32



LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	× × × × × ×
INSTALLED CULVERT	⌢
INSTALLED SIGN	S SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled Pattern]
BST AREA	[Grey Fill]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

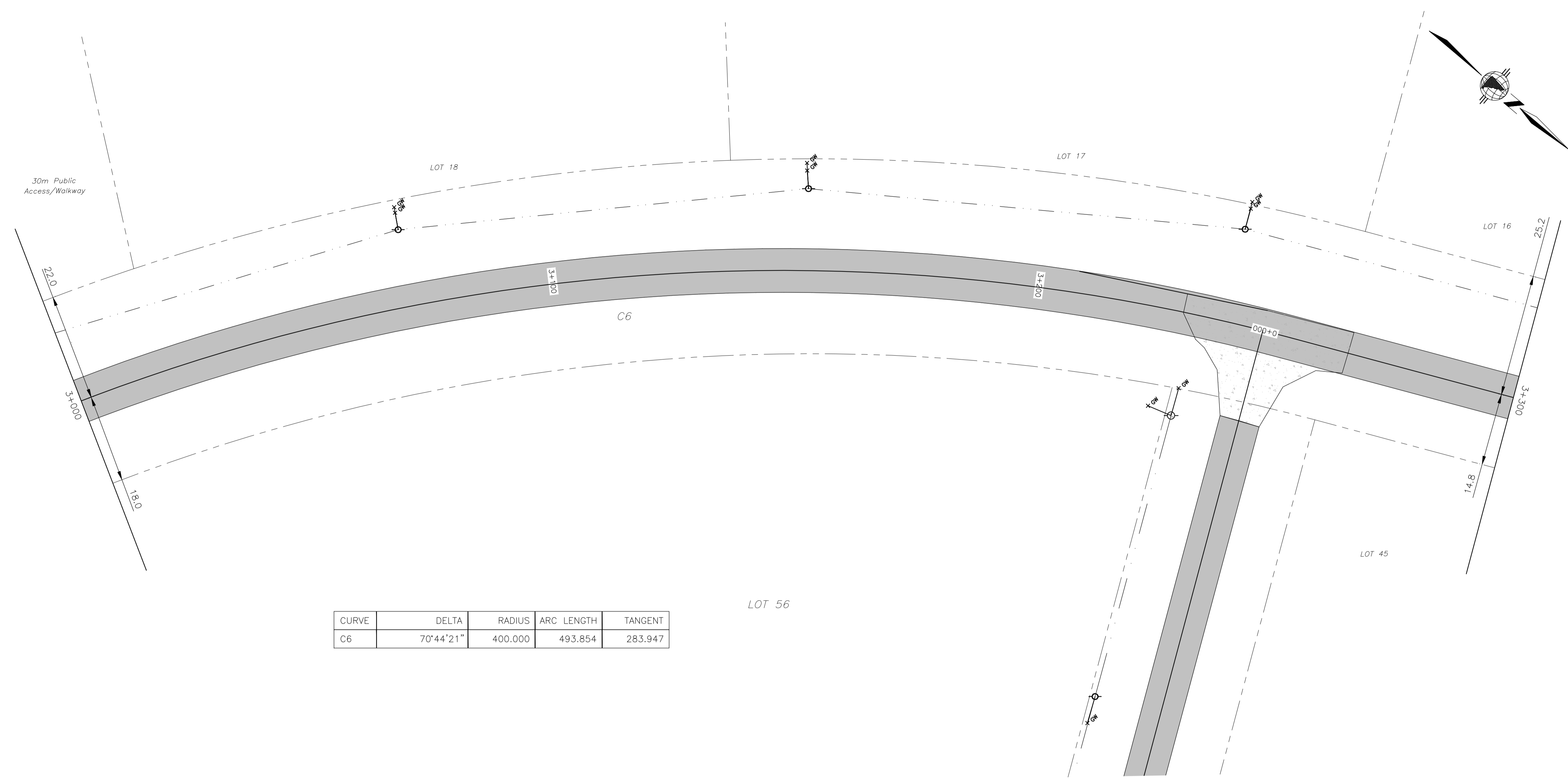
NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

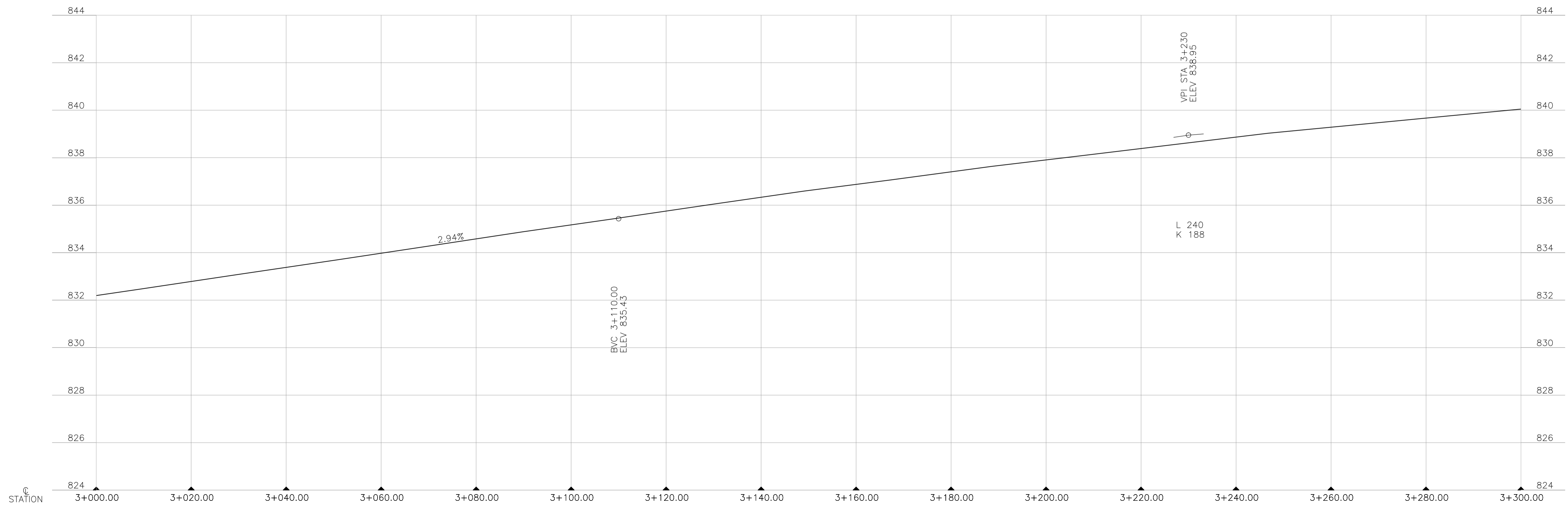
DRAWING TITLE:  
**PLAN PROFILE  
km 3+000 to km 3+300**

DATE: APRIL 2013 HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg VERTICAL SCALE: 1:100

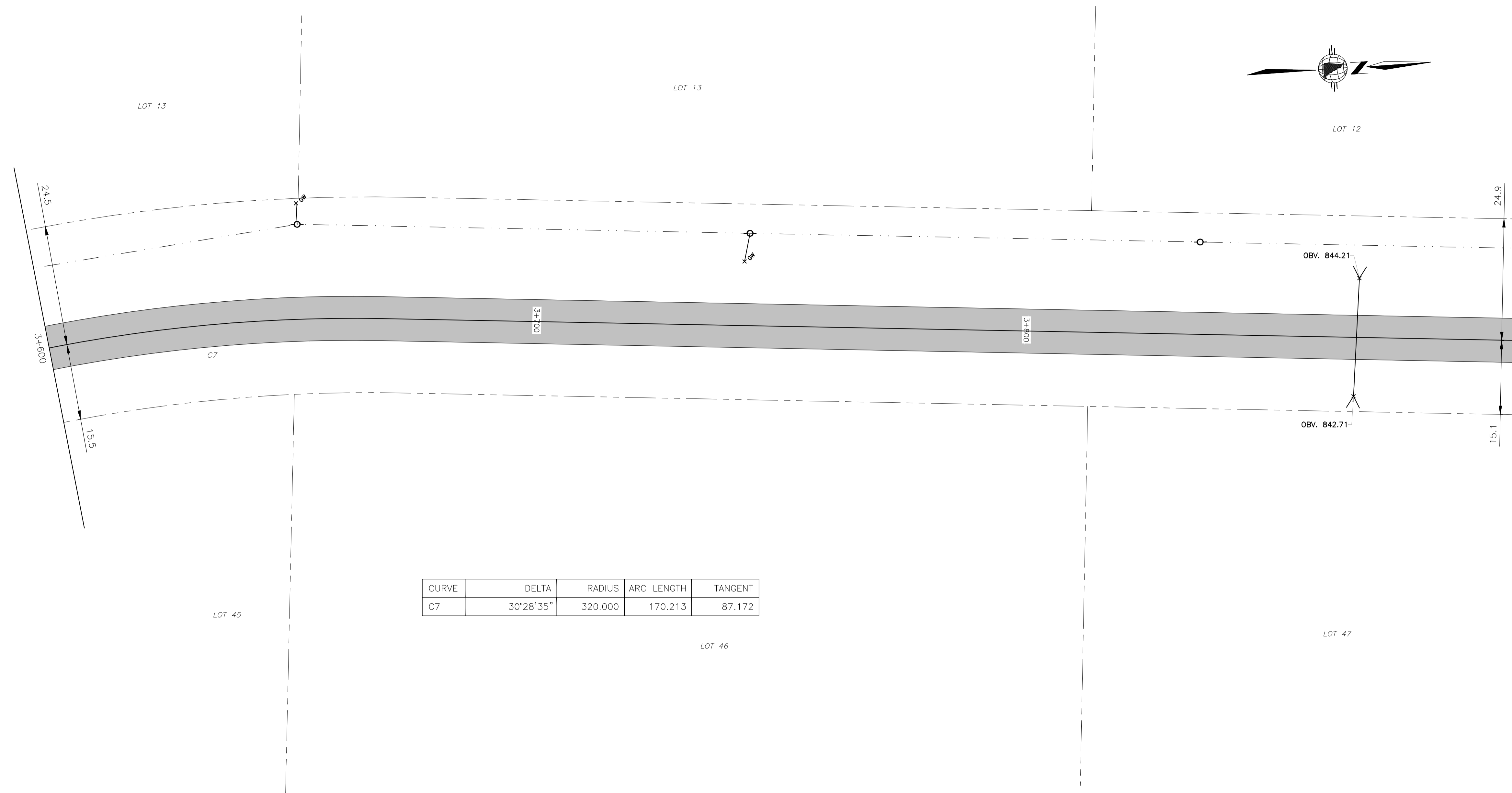
Professional Engineers Seal  
DESIGN: J. Quaille  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB SHEET 13 of 32



CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C6	70°44'21"	400.000	493.854	283.947







CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C7	30°28'35"	320.000	170.213	87.172

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	✕-✕-✕-✕-✕-✕
INSTALLED CULVERT	⌈     ⌋
INSTALLED SIGN	Ⓢ SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled Pattern]
BST AREA	[Solid Grey]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

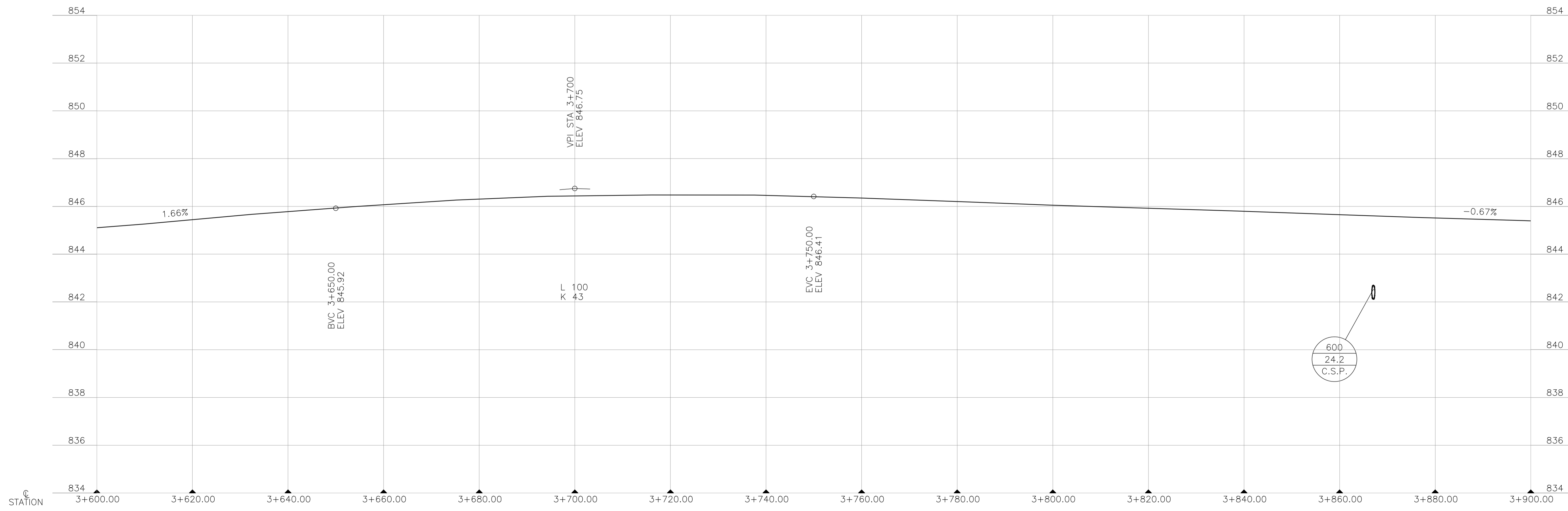
NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

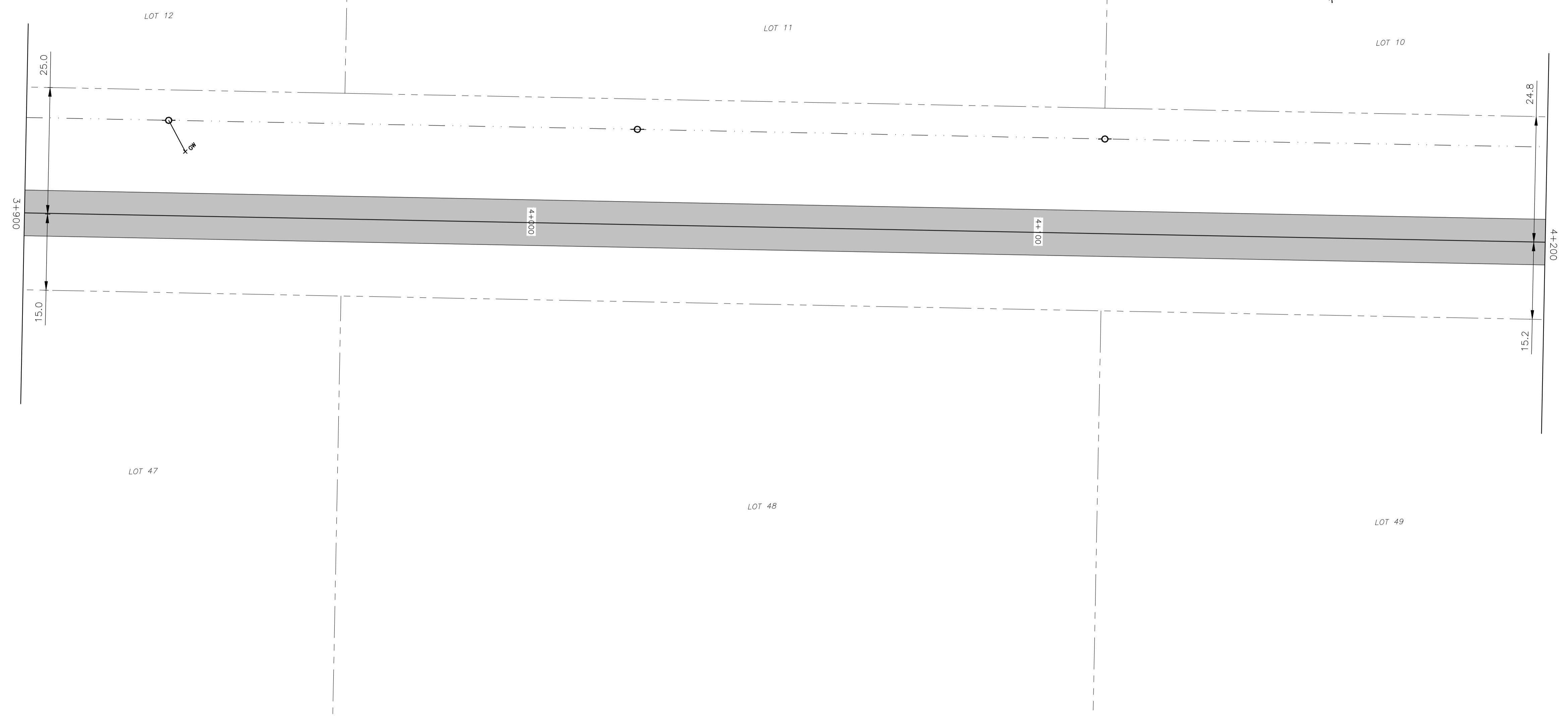
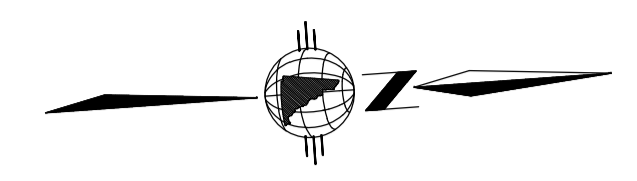
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 3+600 to km 3+900**

DATE: APRIL 2013     HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg     VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Quaille  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB     SHEET 15 of 32





**LEGEND:**

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	× × × × ×
INSTALLED CULVERT	⌢
INSTALLED SIGN	⊞ SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	--- X
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled Pattern]
BST AREA	[Grey Shaded Area]
FALSE GRADE DITCH	~ ~ ~



**REVISIONS:**

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

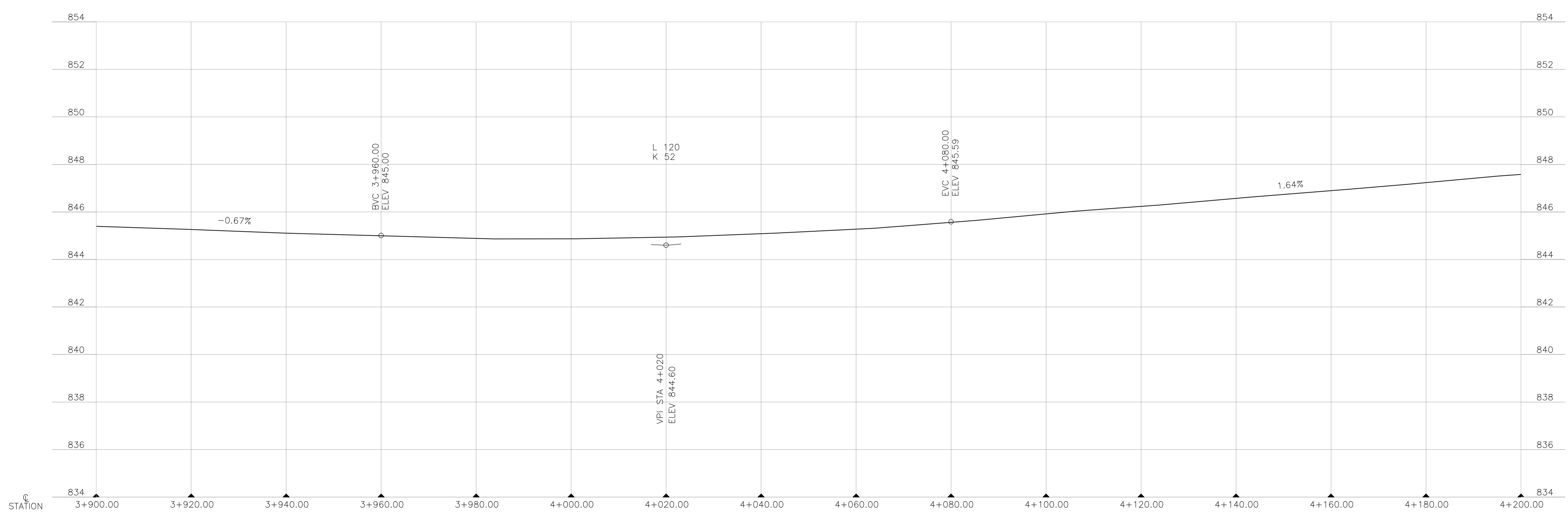
**PROJECT:**  
GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON

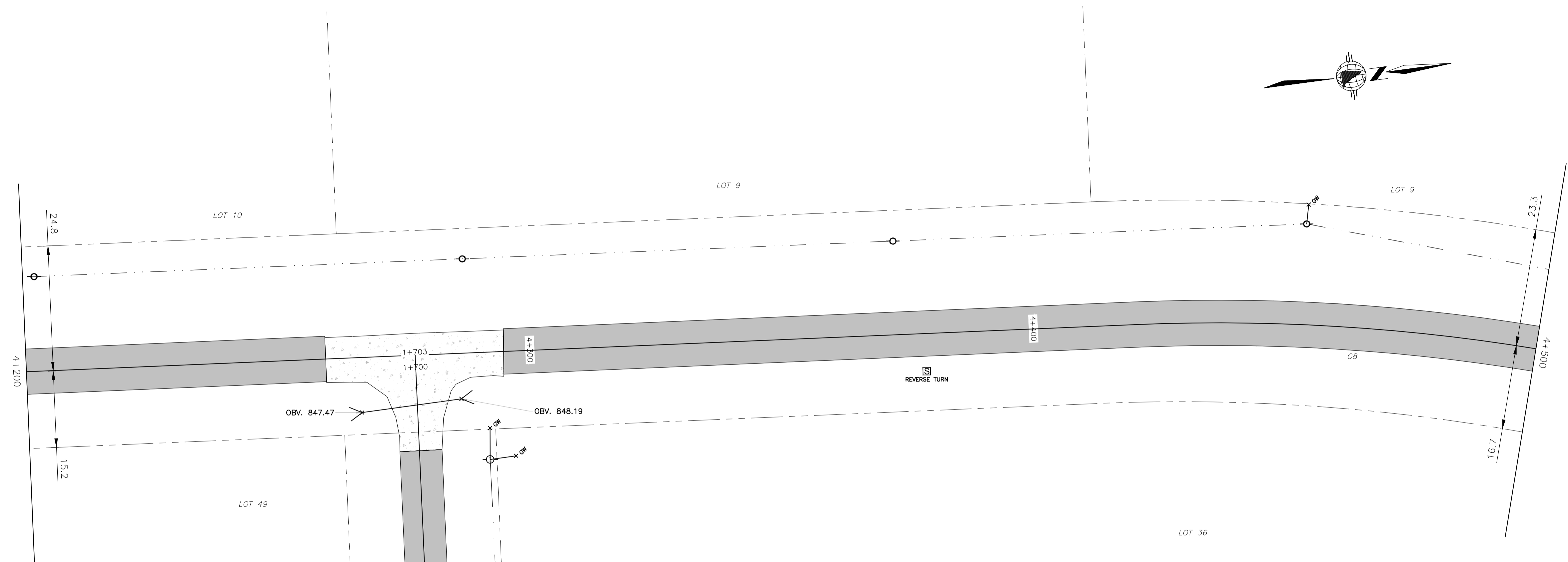
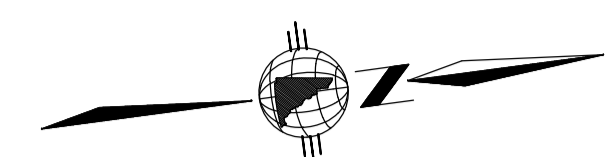
**DRAWING TITLE:**  
PLAN PROFILE  
km 3+900 to km 4+200

DATE: APRIL 2013	HORIZONTAL SCALE: 1:500
DRAWN: R. Colberg	VERTICAL SCALE: 1:100

*Professional Engineers Seal*

DESIGN: J. Quaille  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB SHEET 16 of 32





CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C8	75°32'59"	390.000	514.252	302.242

SIGNAGE TABLE		
TAC No.	REQ'D	DESCRIPTION
WA-4R	1	REVERSE TURN

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	x-x-x-x-x
INSTALLED CULVERT	Y Y
INSTALLED SIGN	SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---
GUY WIRE	x
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Pattern]
BST AREA	[Shaded]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 4+200 to km 4+500**

DATE: APRIL 2013	HORIZONTAL SCALE: 1:500
DRAWN: R. Colberg	VERTICAL SCALE: 1:100

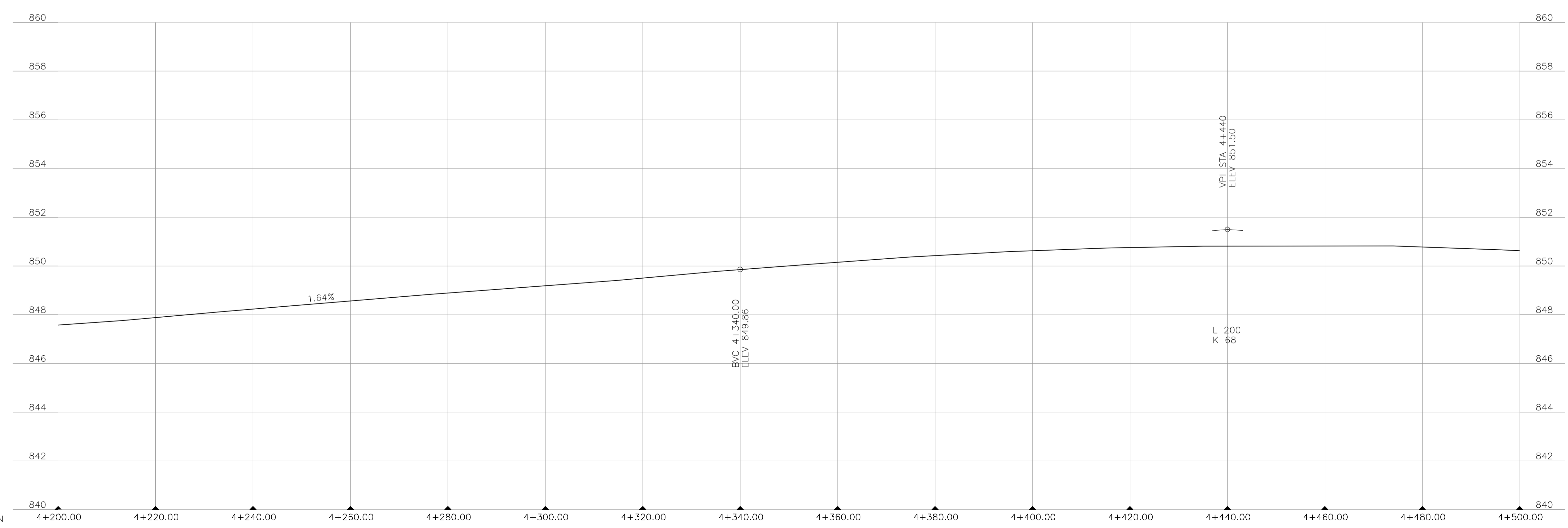
Professional Engineers Seal

DESIGN: J. Quaille

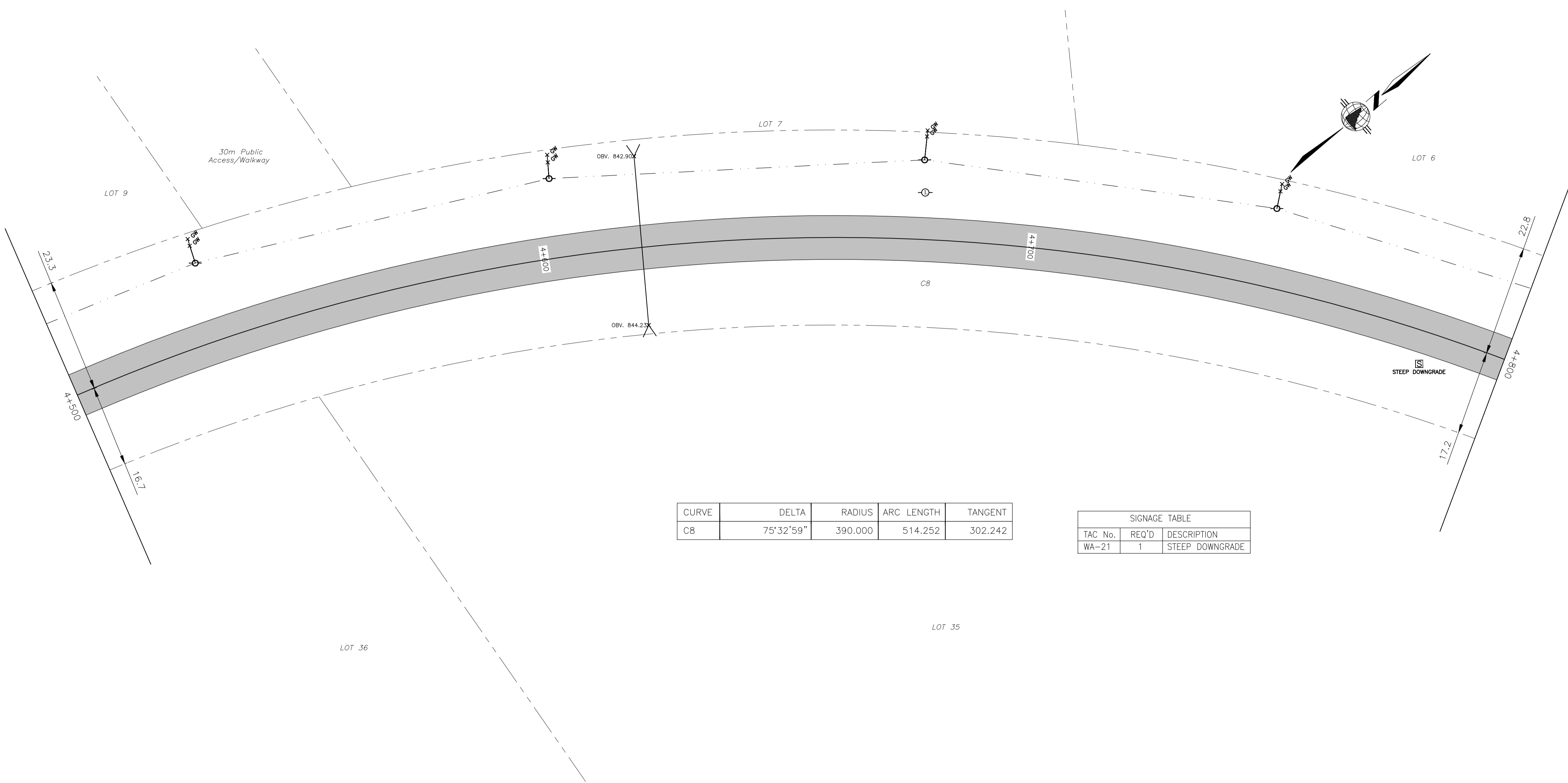
CHECKED:

APPROVED: C. BENEDEK

DRAWING NO. E08064 ASB SHEET 17 of 32



STATION



CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C8	75°32'59"	390.000	514.252	302.242

SIGNAGE TABLE		
TAC No.	REQ'D	DESCRIPTION
WA-21	1	STEEP DOWNGRADE

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	✕✕✕✕✕
INSTALLED CULVERT	⌢
INSTALLED SIGN	Ⓢ
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	—○—
GUY WIRE	—x—
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled Pattern]
BST AREA	[Solid Grey]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 4+500 to km 4+800**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

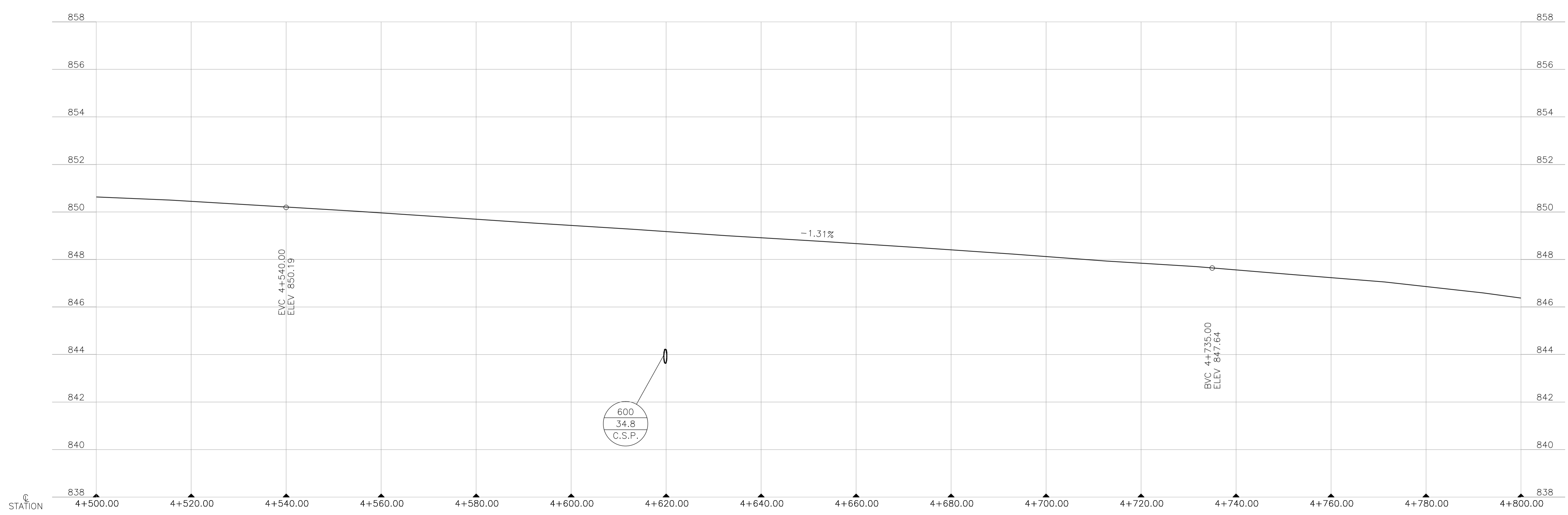
Professional Engineers Seal

DESIGN: J. Quaille

CHECKED:

APPROVED: C. BENEDEK

DRAWING NO. E08064 ASB      SHEET 18 of 32



LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	× × × × ×
INSTALLED CULVERT	⌢
INSTALLED SIGN	S SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	○—○
GUY WIRE	—○
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Pattern]
BST AREA	[Grey Box]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 4+800 to km 5+100**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

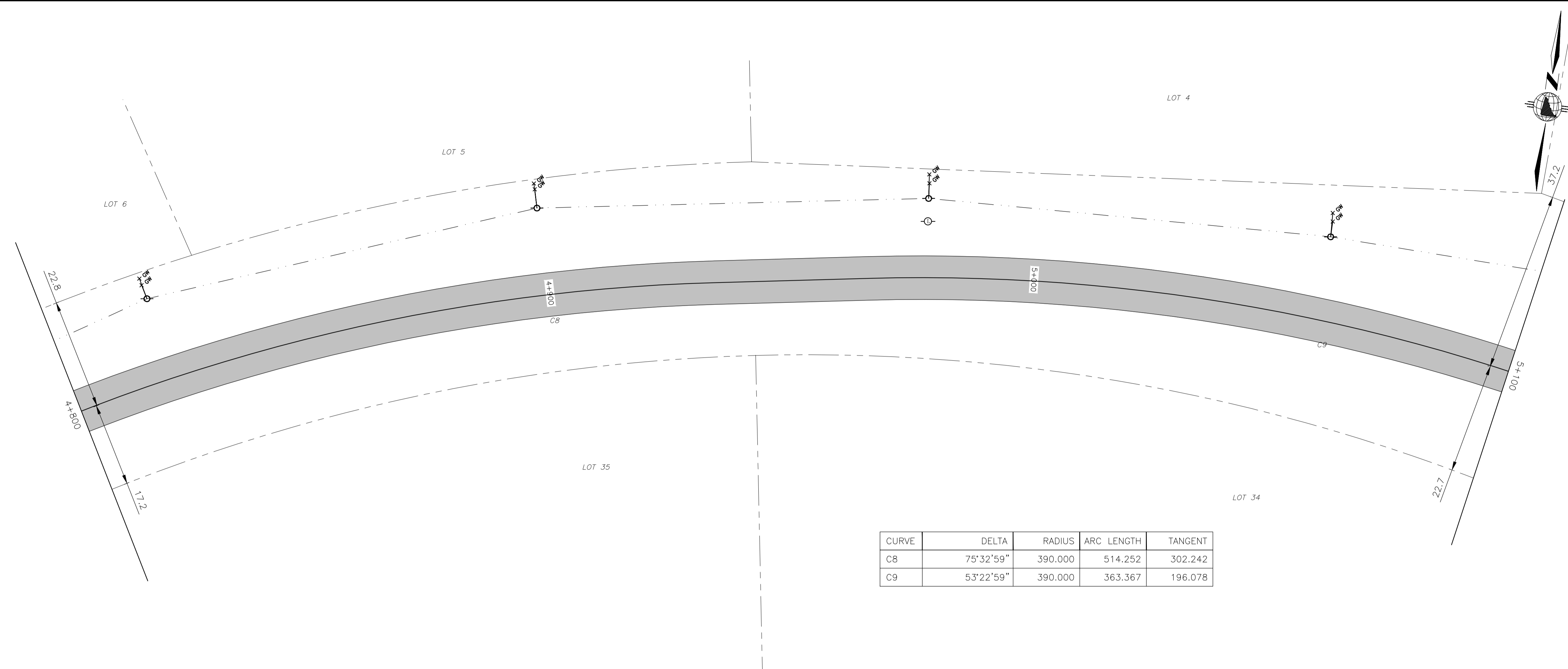
Professional Engineers Seal

DESIGN: J. Quaille

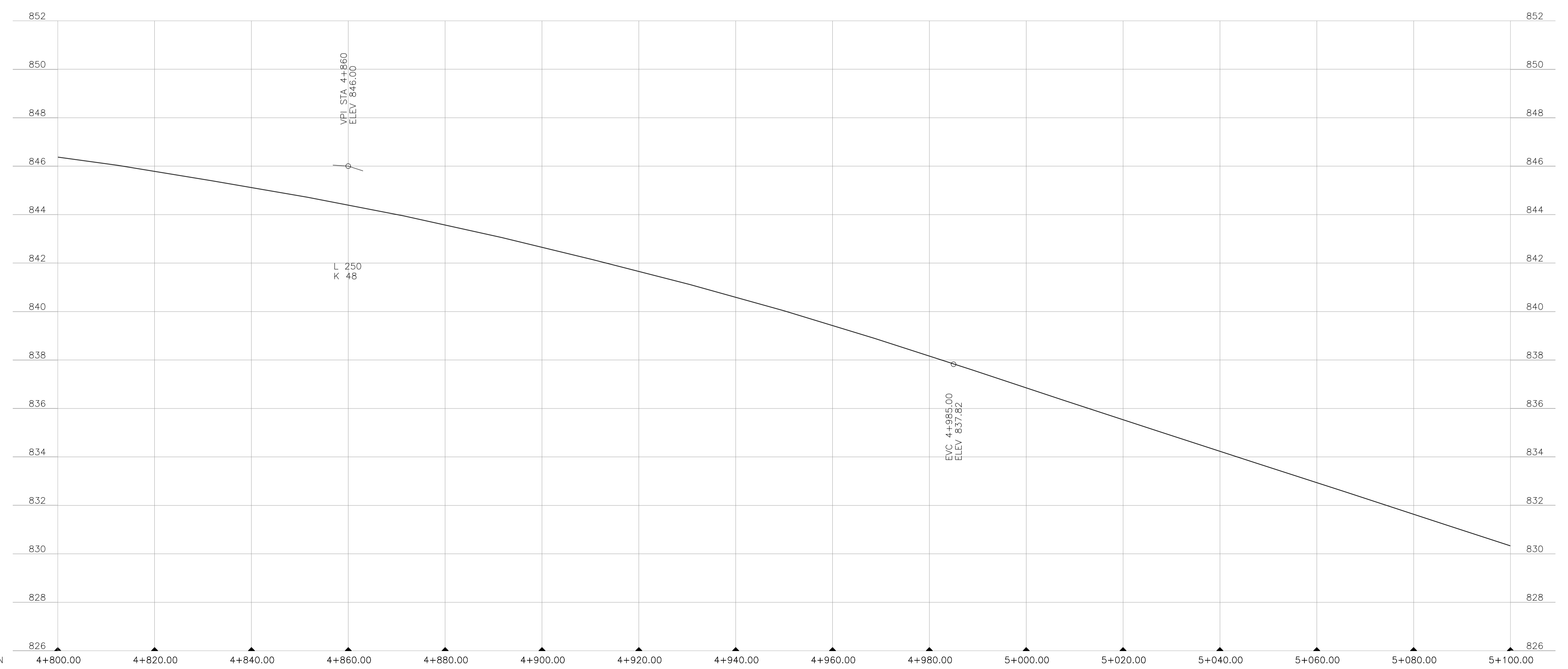
CHECKED:

APPROVED: C. BENEDEK

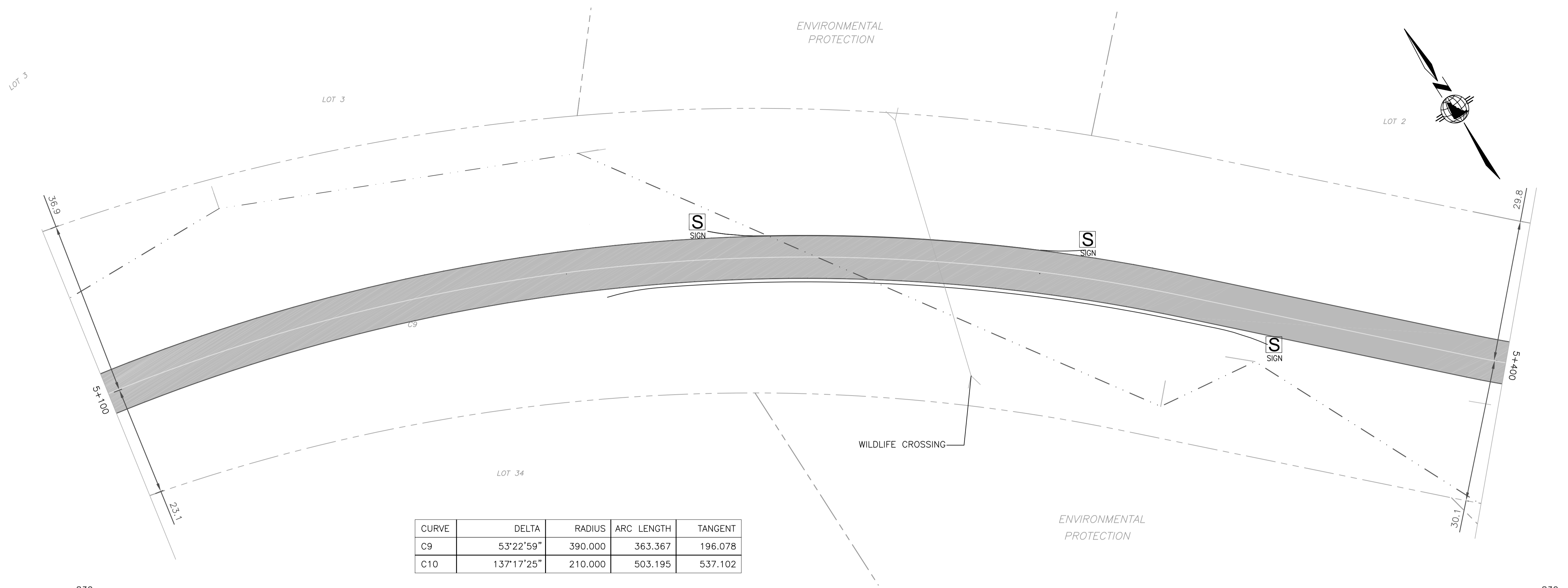
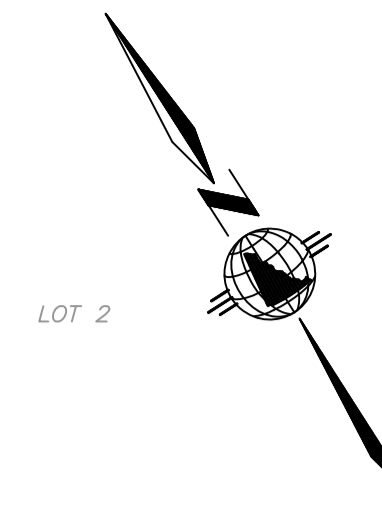
DRAWING NO. E08064 ASB      SHEET 19 of 32



CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C8	75°32'59"	390.000	514.252	302.242
C9	53°22'59"	390.000	363.367	196.078



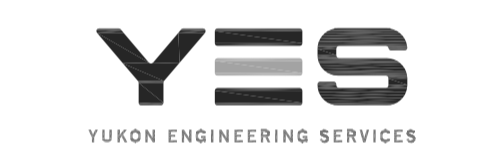
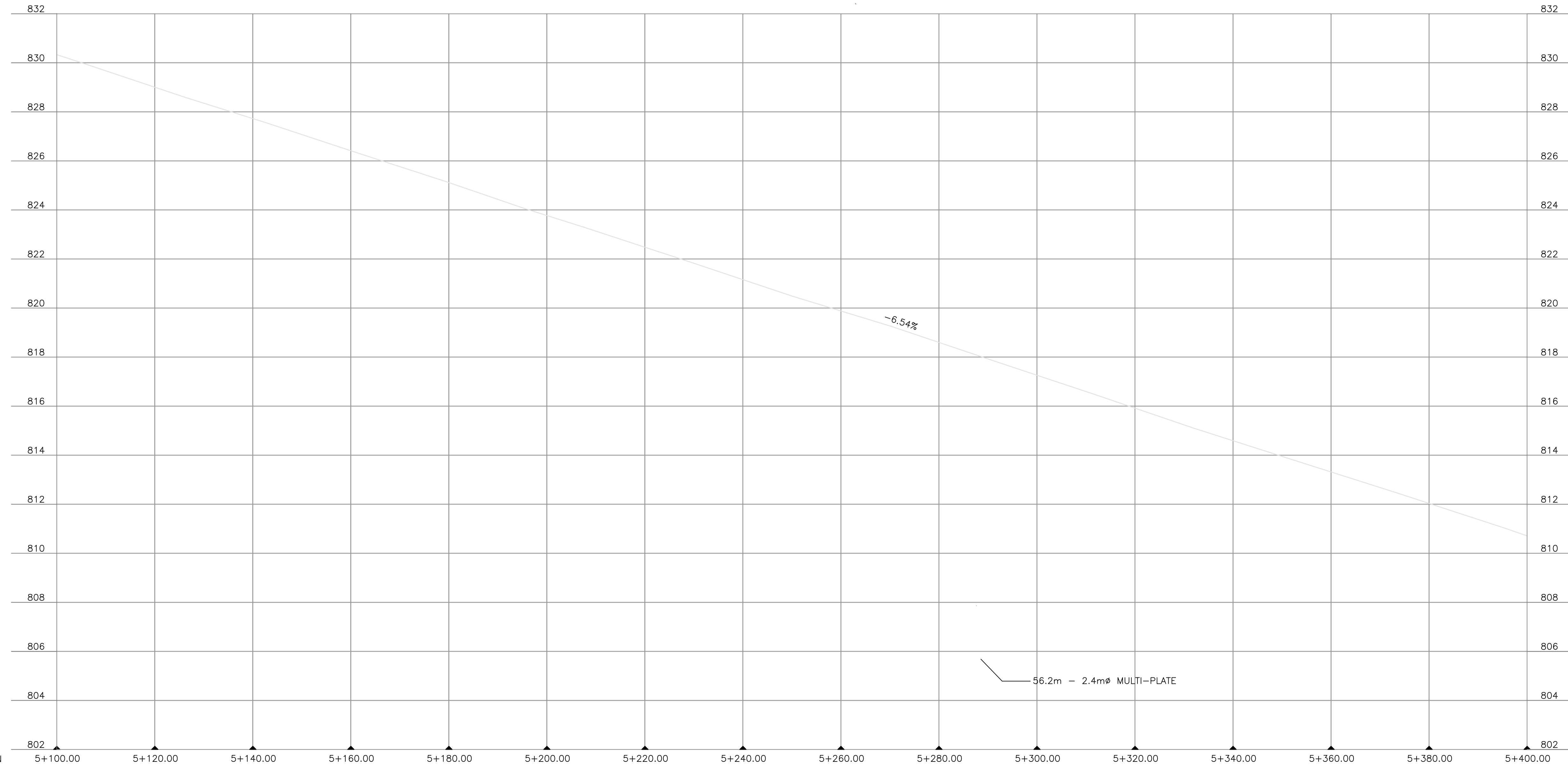
STATION      4+800.00      4+820.00      4+840.00      4+860.00      4+880.00      4+900.00      4+920.00      4+940.00      4+960.00      4+980.00      5+000.00      5+020.00      5+040.00      5+060.00      5+080.00      5+100.00



CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C9	53°22'59"	390.000	363.367	196.078
C10	137°17'25"	210.000	503.195	537.102

LEGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---
INSTALLED CULVERT	---
INSTALLED SIGN	S SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled pattern]
BST AREA	[Solid grey fill]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

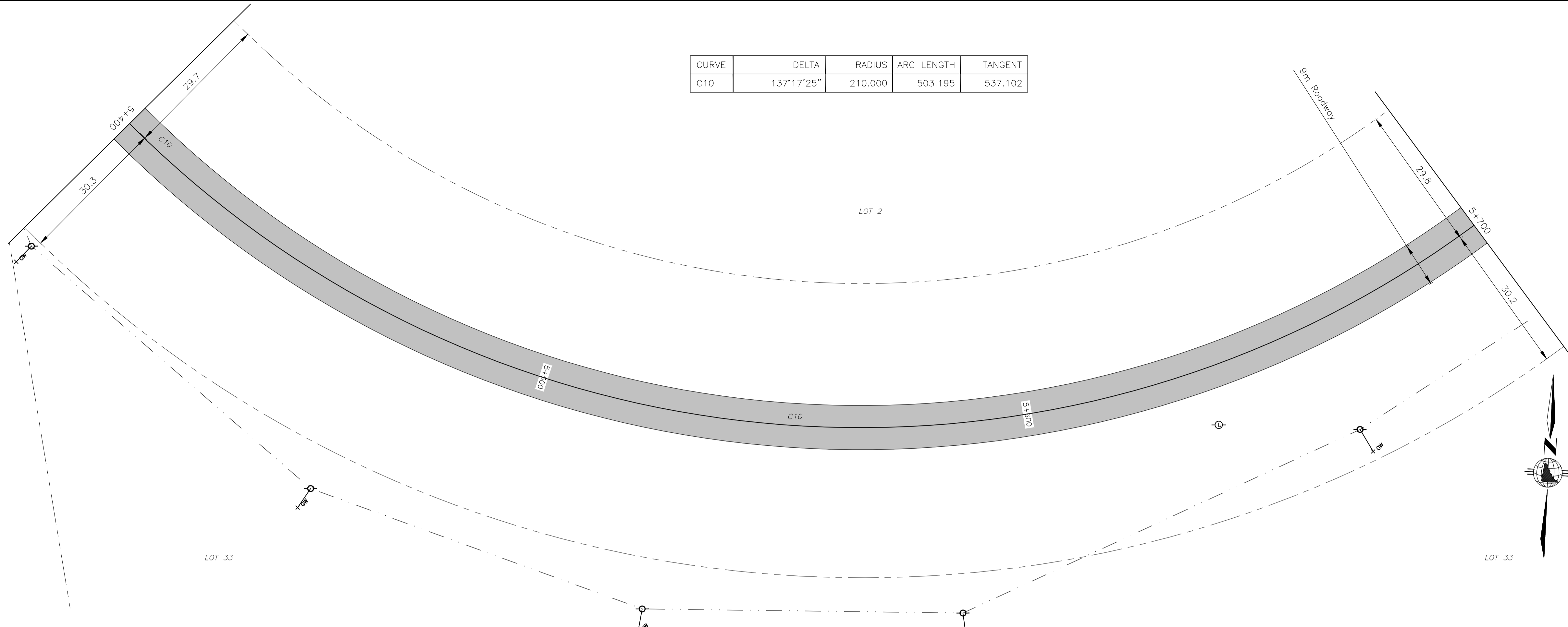
DRAWING TITLE:  
**PLAN PROFILE  
km 5+100 to km 5+400**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal

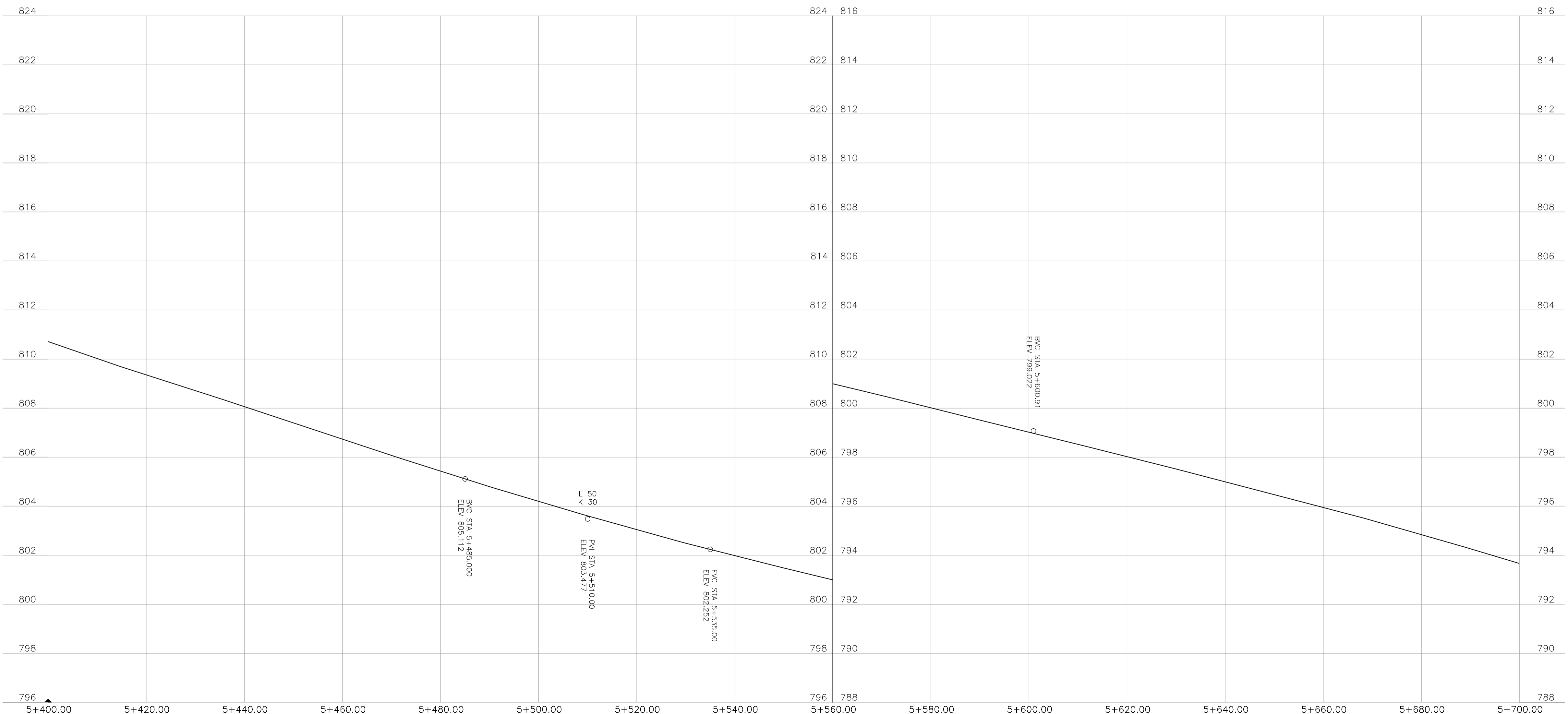
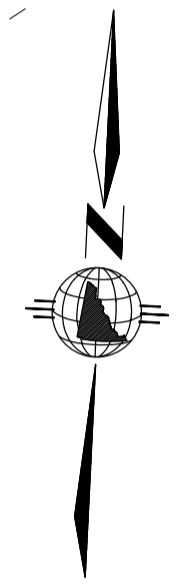
DESIGN: J. Quailie  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 20 of 32

CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C10	137°17'25"	210.000	503.195	537.102



LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	✕-✕-✕-✕-✕-✕
INSTALLED CULVERT	⌢
INSTALLED SIGN	S SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---○---
GUY WIRE	---○---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Pattern]
BST AREA	[Grey Box]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

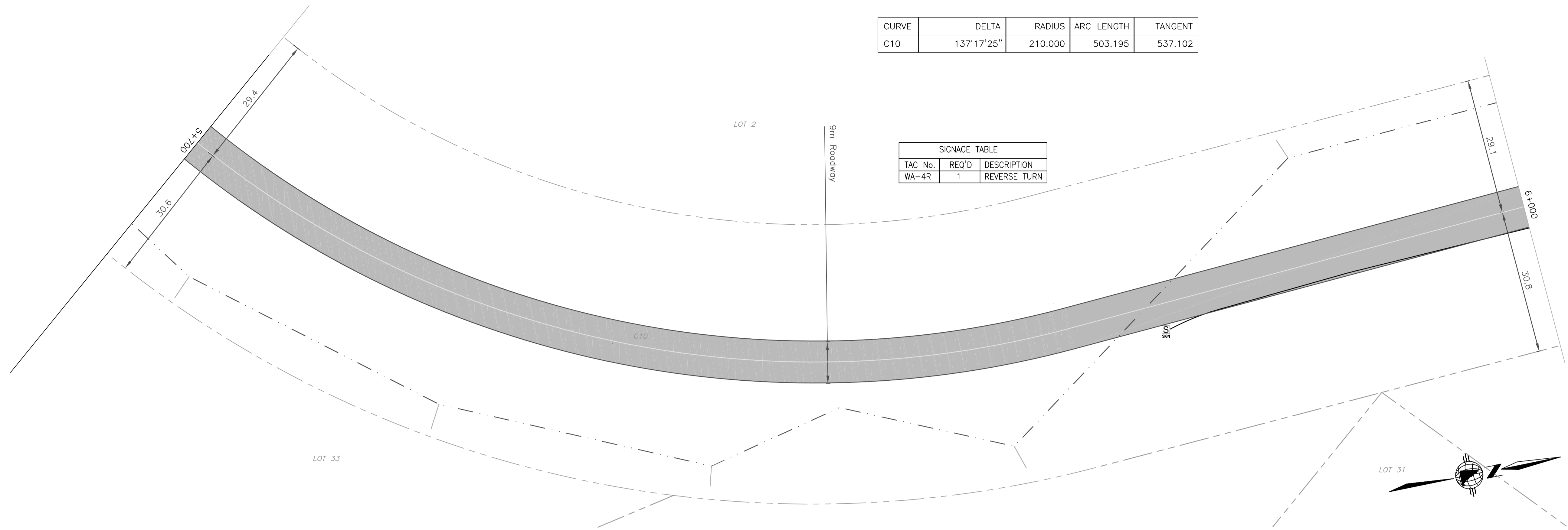
DRAWING TITLE:  
**PLAN PROFILE  
km 5+400 to km 5+700**

DATE: APRIL 2013	HORIZONTAL SCALE: 1:500
DRAWN: R. Colberg	VERTICAL SCALE: 1:100

Professional Engineers Seal

DESIGN: J. Quaille  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB SHEET 21 of 32

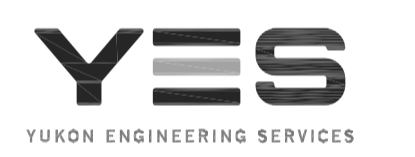
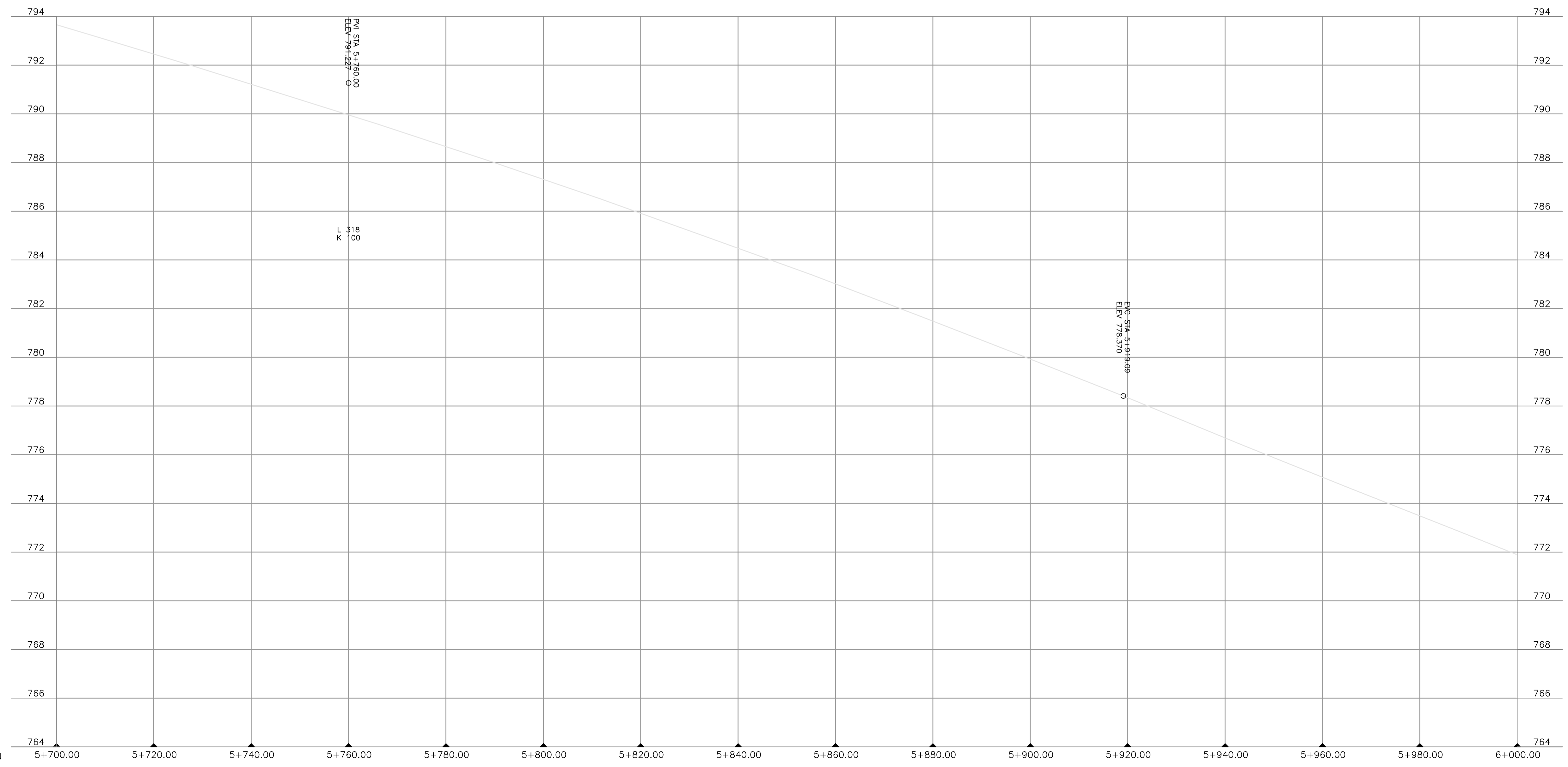
CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C10	137°17'25"	210.000	503.195	537.102



SIGNAGE TABLE		
TAC No.	REQ'D	DESCRIPTION
WA-4R	1	REVERSE TURN

LEGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---
INSTALLED CULVERT	
INSTALLED SIGN	
INSTALLED UTILITY POLE	
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

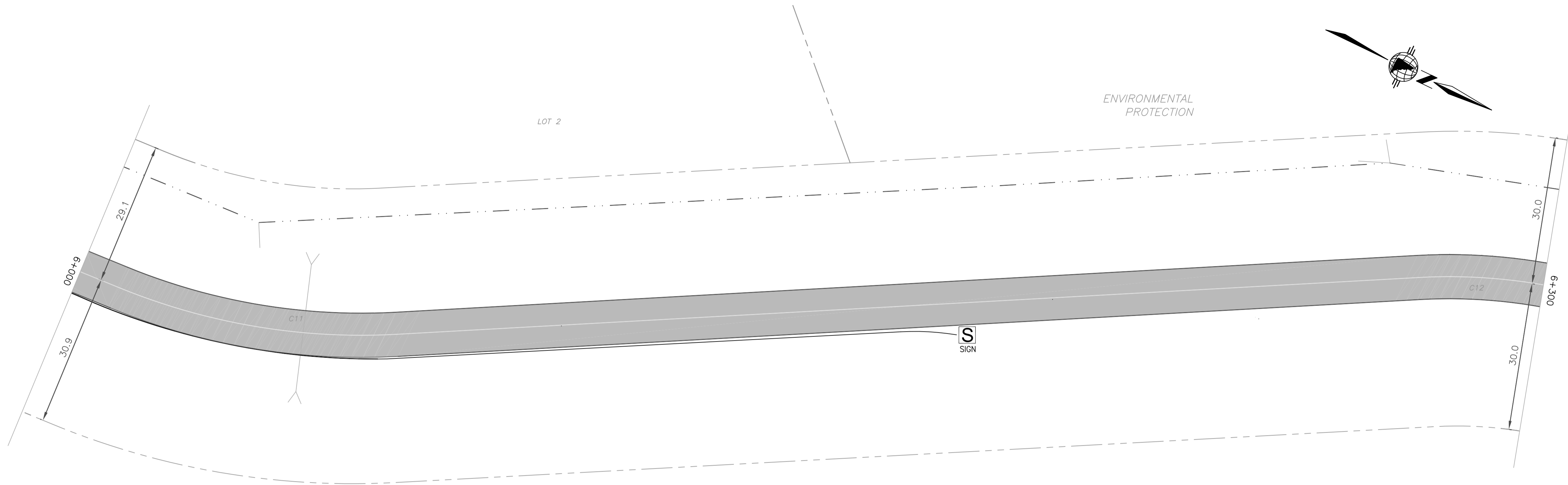
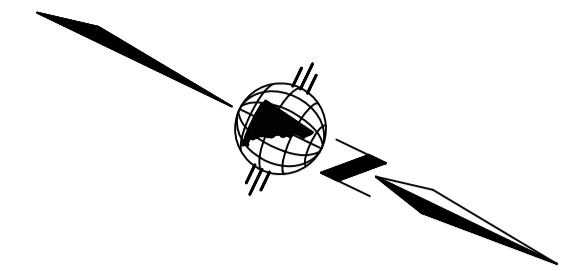
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 5+700 to km 6+000**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal

DESIGN: J. Quailie  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 22 of 32

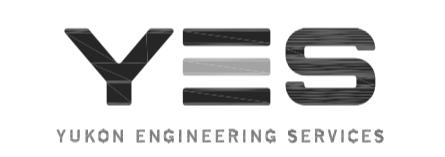


CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C11	25°37'51"	130.000	58.155	29.572
C12	158°27'08"	110.000	304.207	578.075

TAC No.	REQ'D	DESCRIPTION
WA-3R	1	RIGHT TURN

LEGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---
INSTALLED CULVERT	
INSTALLED SIGN	
INSTALLED UTILITY POLE	
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 6+000 to km 6+300**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

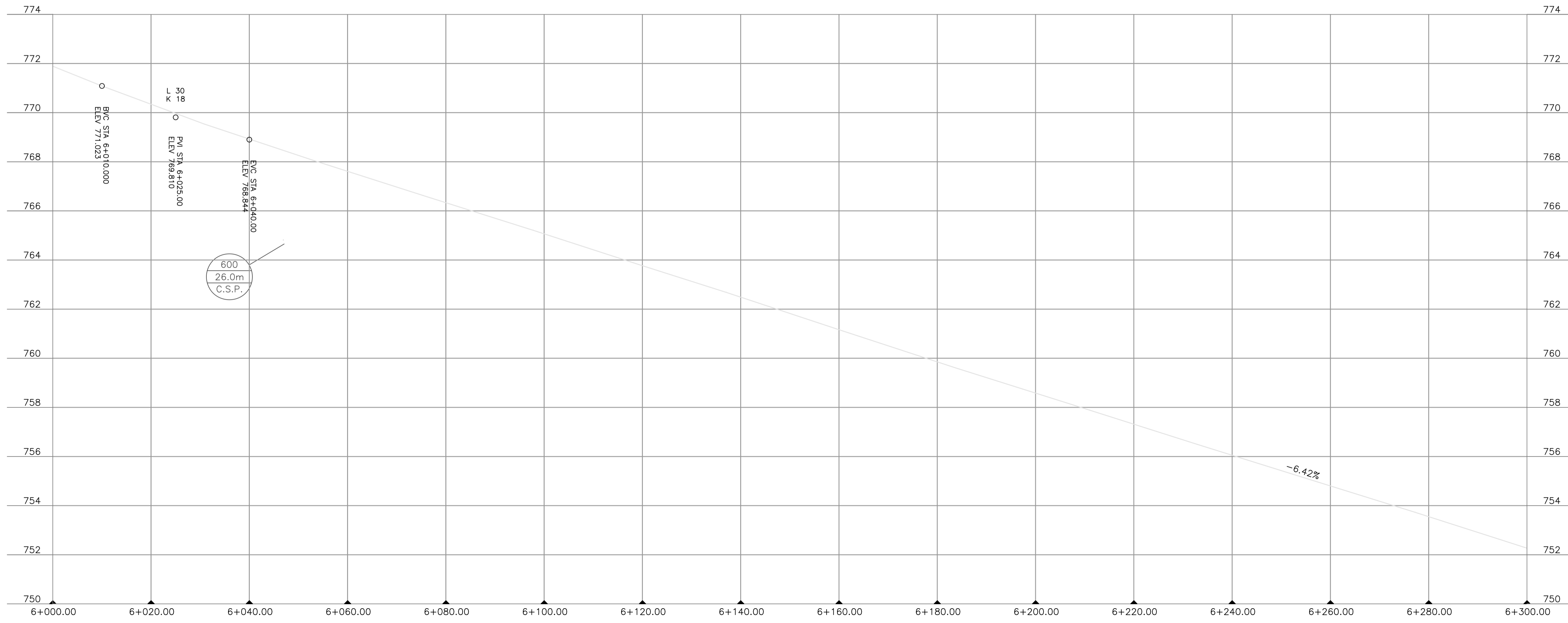
Professional Engineers Seal

DESIGN: J. Quailie

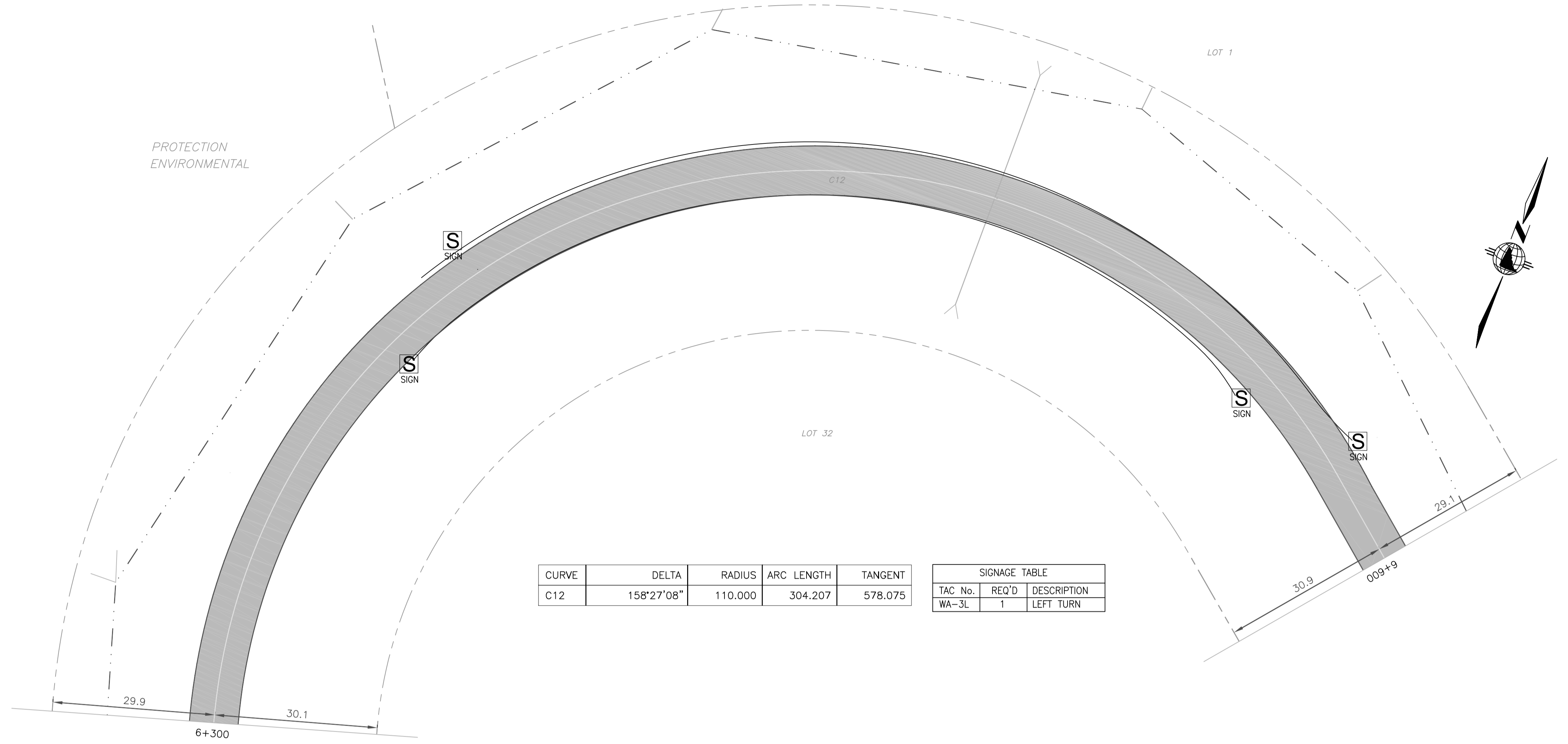
CHECKED:

APPROVED: C. BENEDEK

DRAWING NO. E08064 ASB      SHEET 23 of 32



STATION

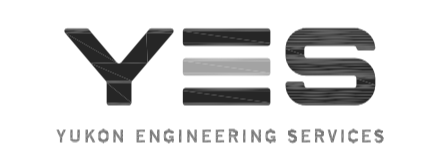


CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C12	158°27'08"	110.000	304.207	578.075

SIGNAGE TABLE		
TAC No.	REQ'D	DESCRIPTION
WA-3L	1	LEFT TURN

LEGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---
INSTALLED CULVERT	
INSTALLED SIGN	
INSTALLED UTILITY POLE	
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

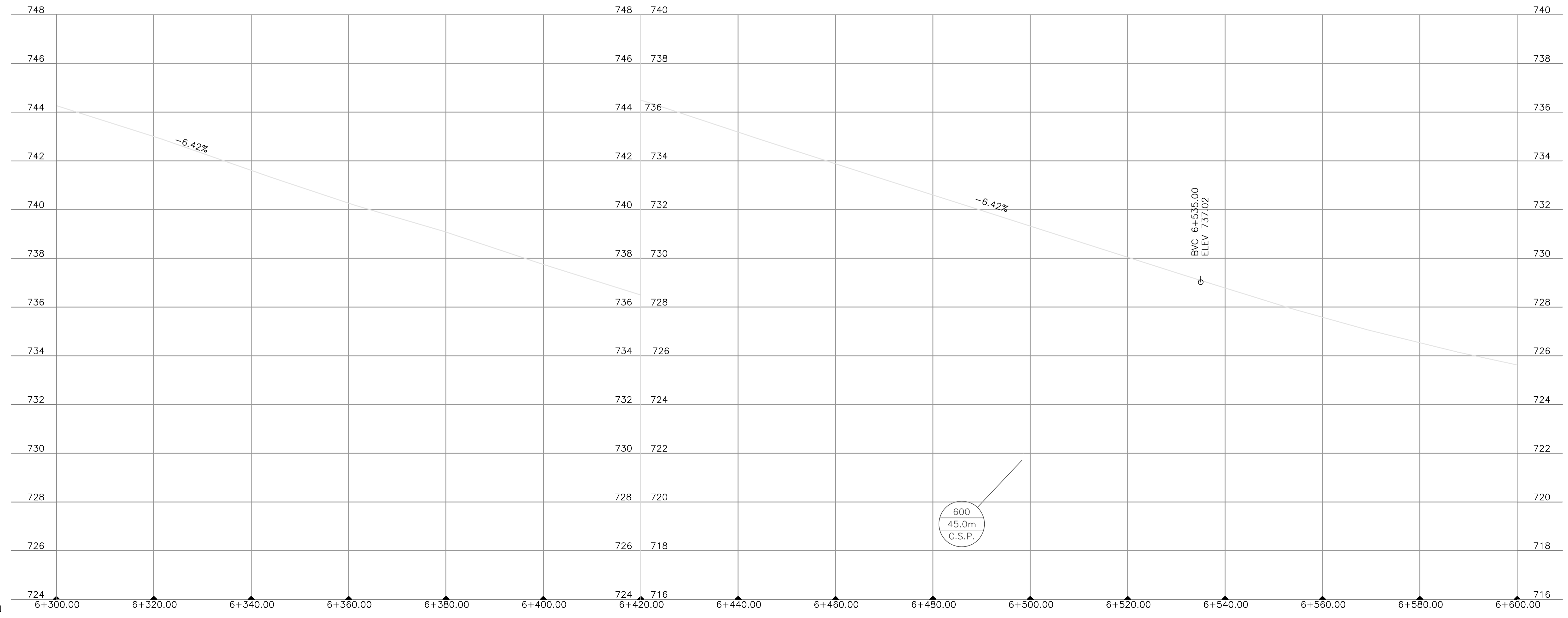
NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

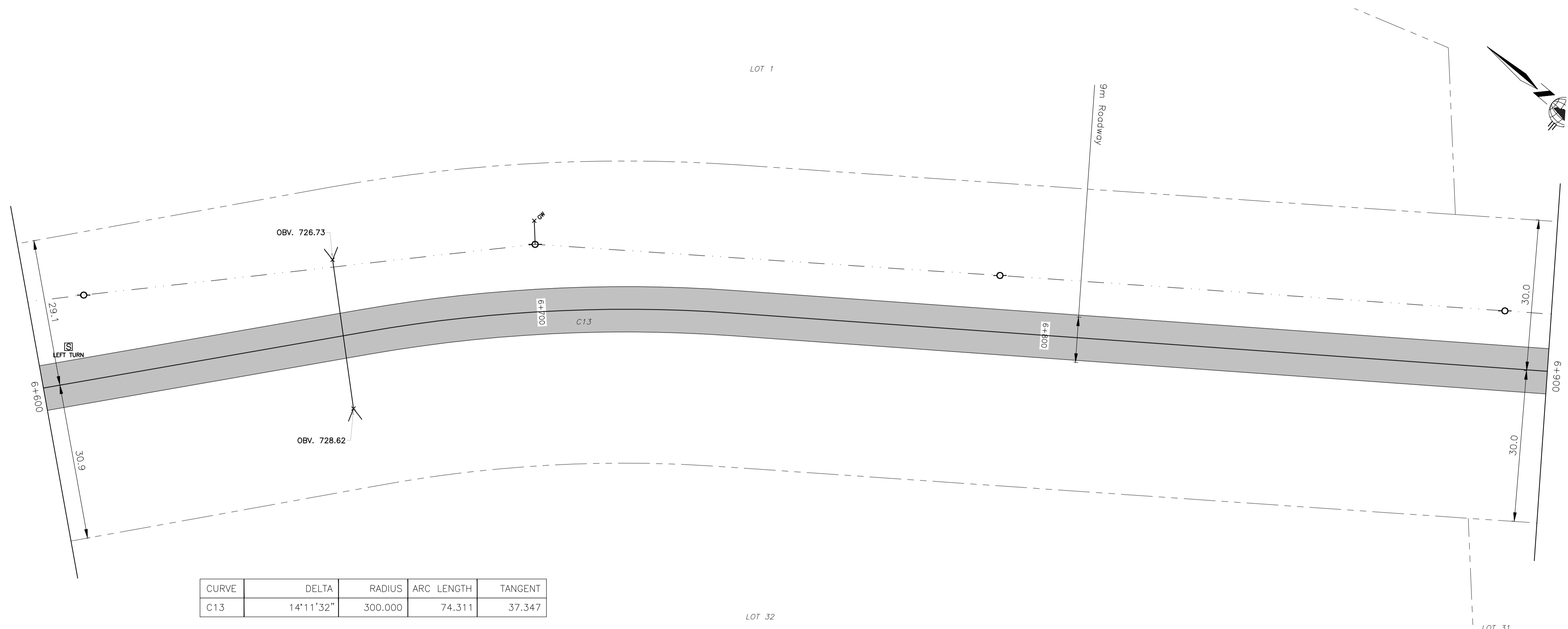
DRAWING TITLE:  
**PLAN PROFILE  
km 6+300 to km 6+600**

DATE: APRIL 2013 HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg VERTICAL SCALE: 1:100

DESIGN: J. Qualle  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB SHEET 24 of 32



STATION



CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C13	14°11'32"	300.000	74.311	37.347

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	✕-✕-✕-✕-✕-✕
INSTALLED CULVERT	⌢
INSTALLED SIGN	Ⓢ
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled Pattern]
BST AREA	[Grey Shaded Area]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

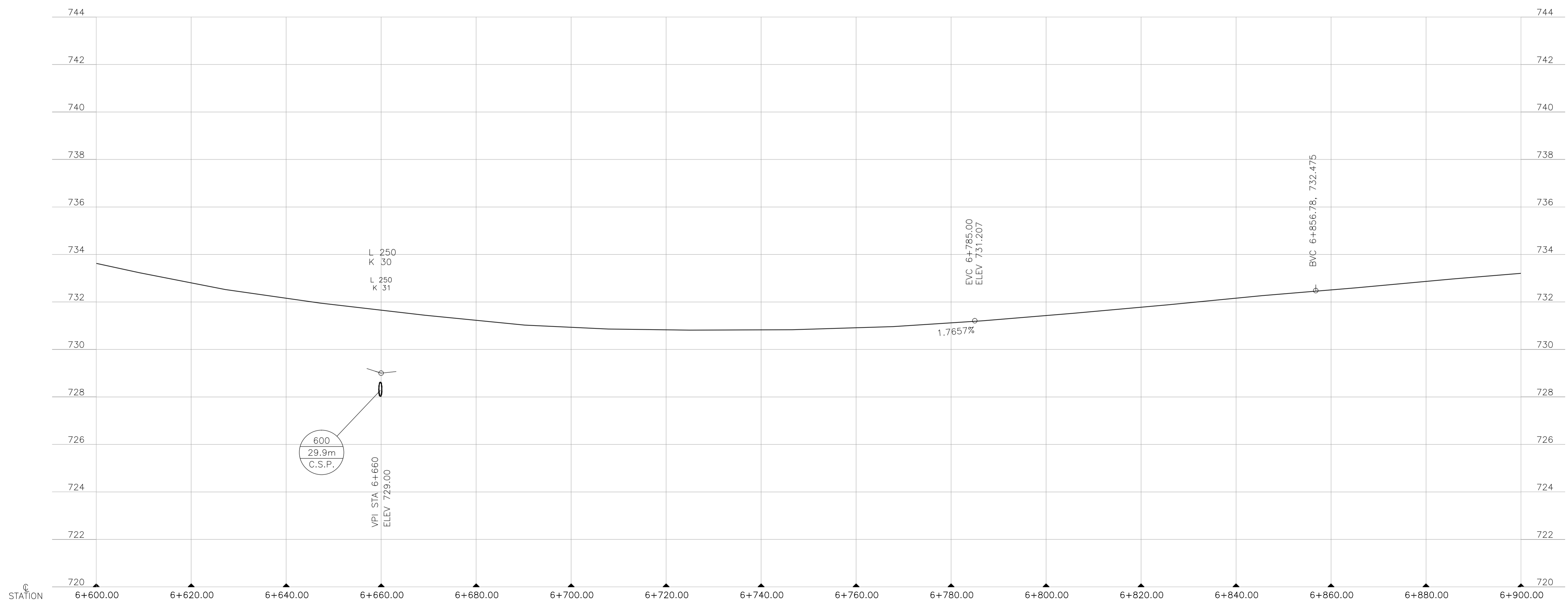
NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

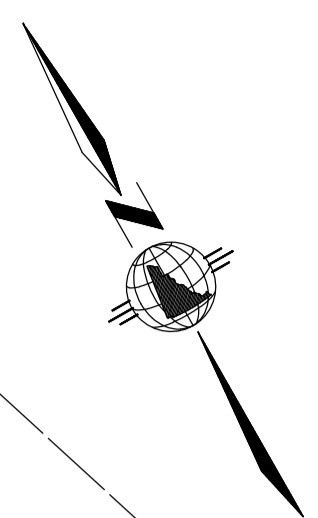
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 6+600 to km 6+900**

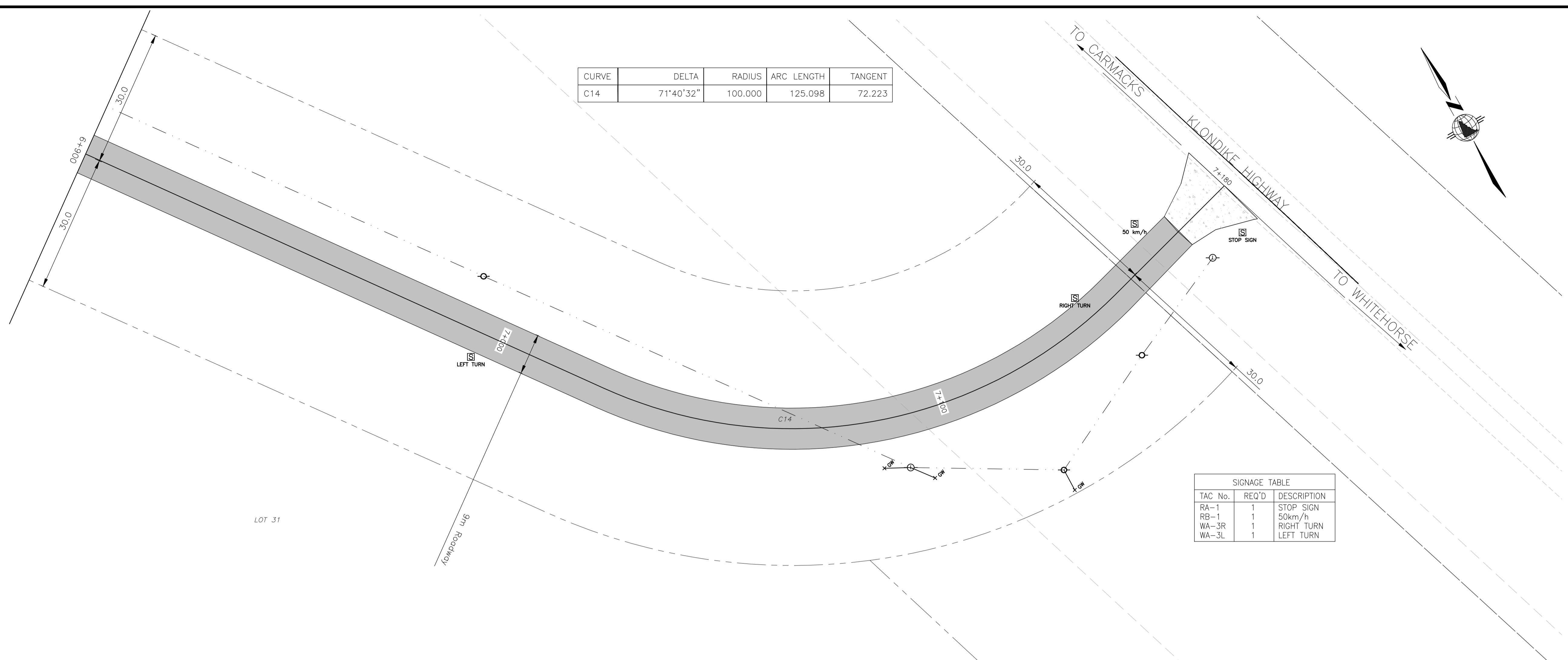
DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Quaille  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 25 of 32





CURVE	DELTA	RADIUS	ARC LENGTH	TANGENT
C14	71°40'32"	100.000	125.098	72.223



TAC No.	REQ'D	DESCRIPTION
RA-1	1	STOP SIGN
RB-1	1	50km/h
WA-3R	1	RIGHT TURN
WA-3L	1	LEFT TURN

LEGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	---x---x---x---
INSTALLED CULVERT	---v---v---
INSTALLED SIGN	[S] SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---o---
GUY WIRE	---x---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Stippled Pattern]
BST AREA	[Grey Shaded Area]
FALSE GRADE DITCH	---v---v---



REVISIONS:

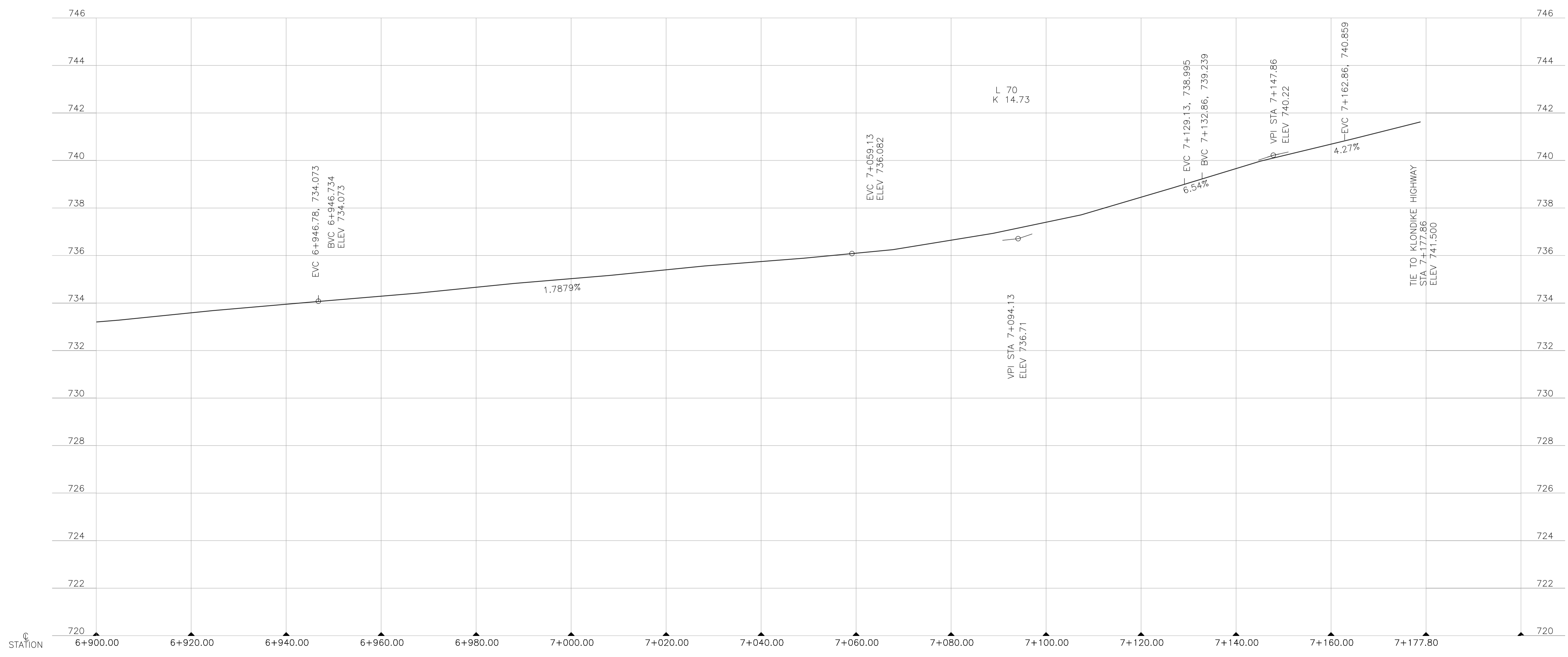
NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

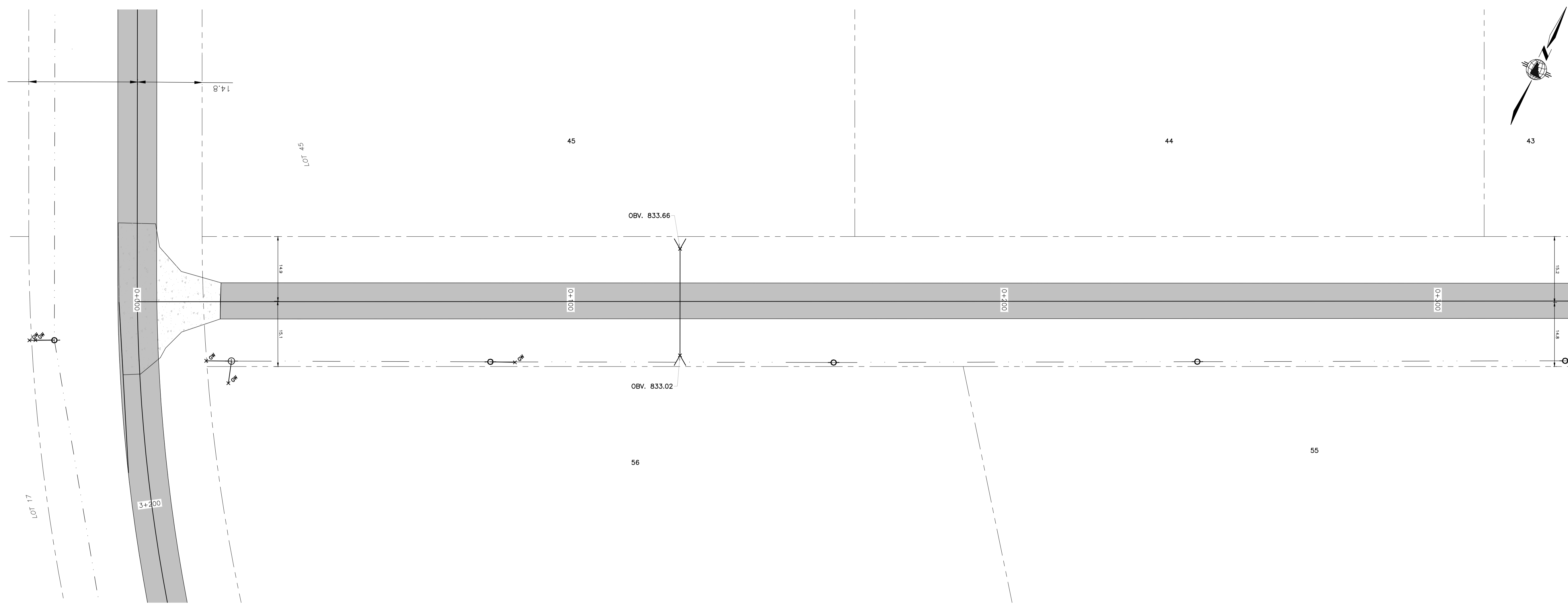
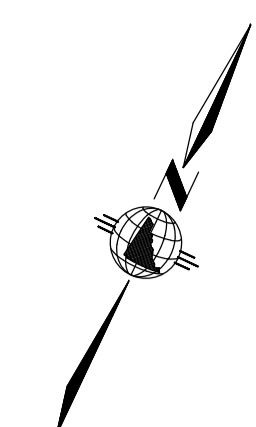
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PLAN PROFILE  
km 6+900 to km 7+161.20**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Quaille  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 26 of 32





LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	x-x-x-x-x
INSTALLED CULVERT	Y-Y
INSTALLED SIGN	SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Pattern]
BST AREA	[Grey Box]
FALSE GRADE DITCH	~ ~ ~



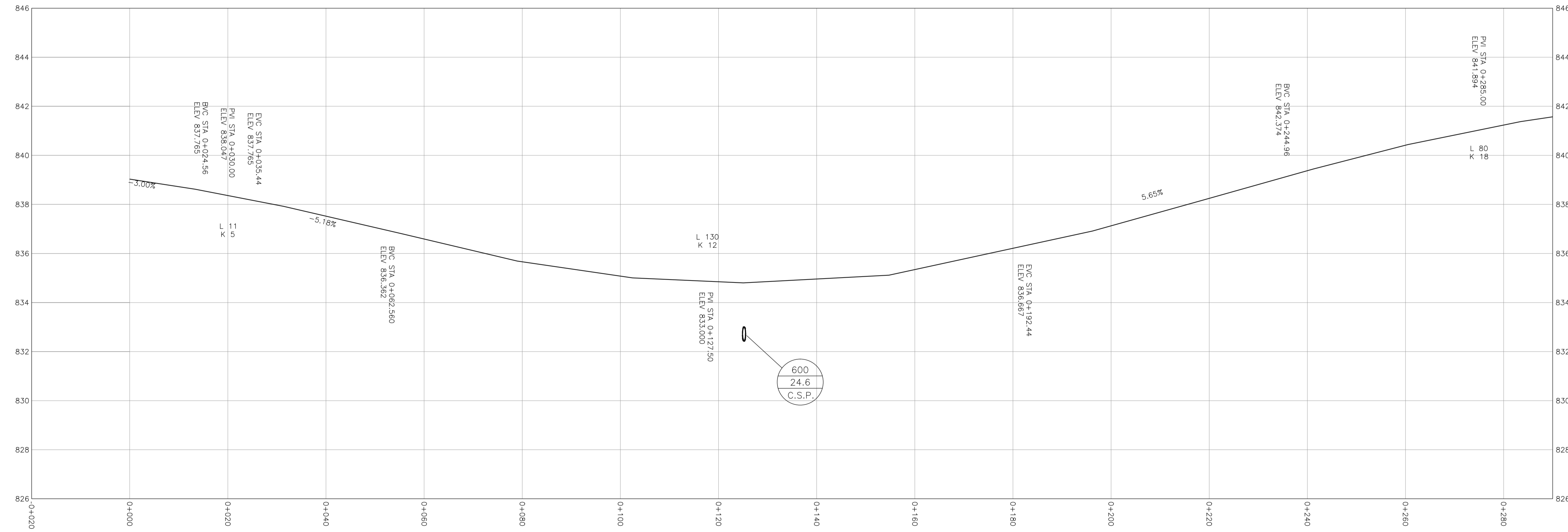
REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PHASE II  
PLAN/PROFILE  
0+000 to 0+300**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100



Professional Engineers Seal  
DESIGN: J. Qualle  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 27 of 32

LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	x-x-x-x-x
INSTALLED CULVERT	--- ---
INSTALLED SIGN	
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---o---
GUY WIRE	---x---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

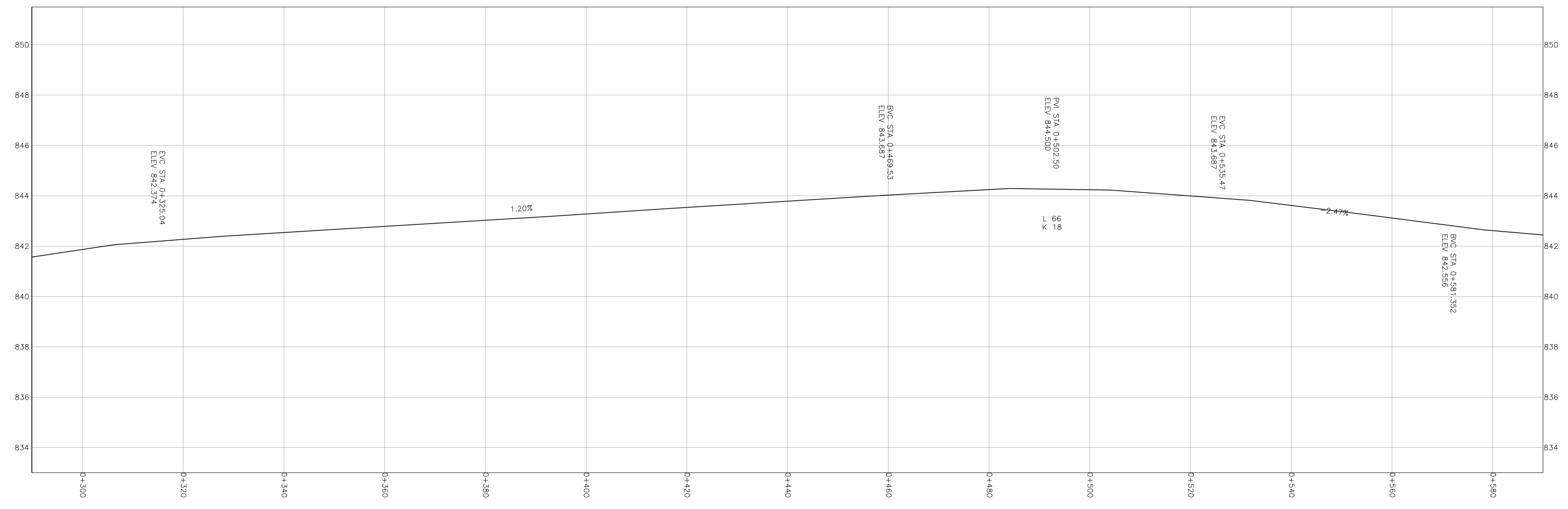
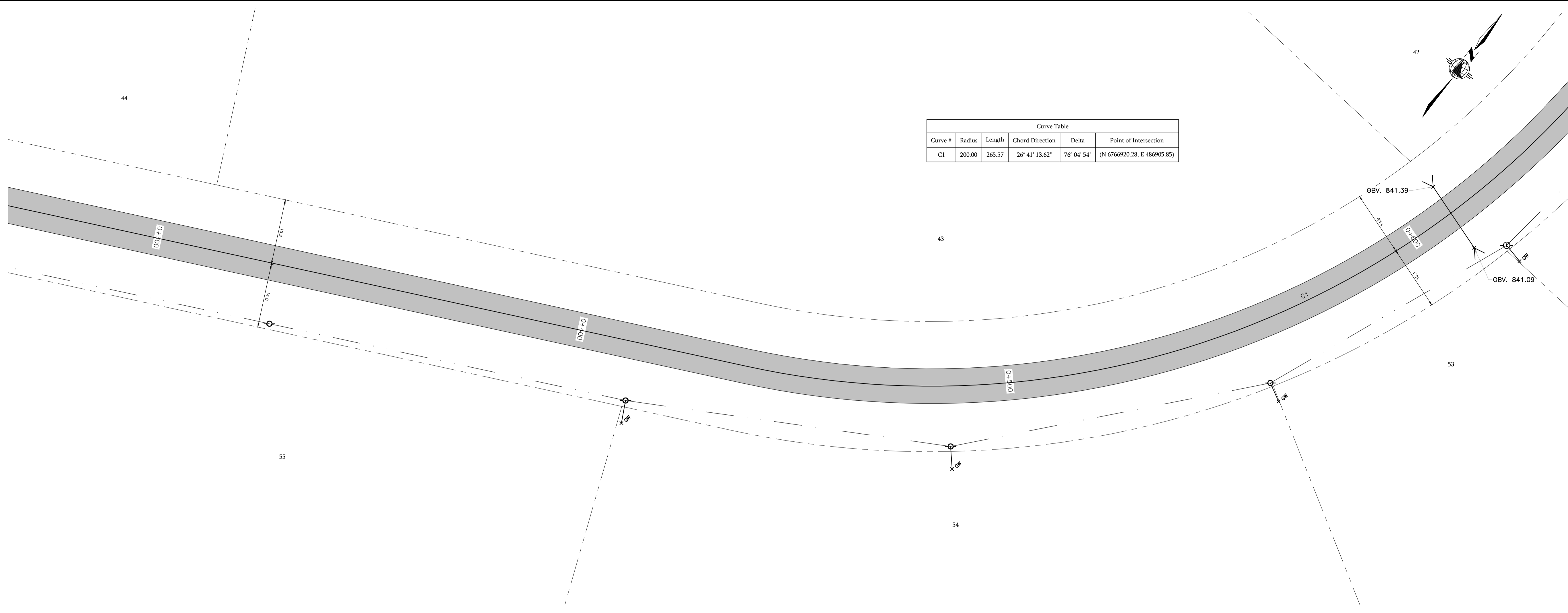
DRAWING TITLE:  
**PHASE II  
PLAN/PROFILE  
0+300 to 0+600**

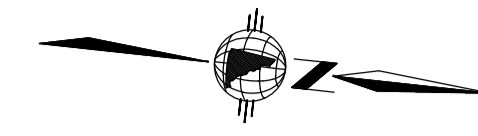
DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Qualle  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 28 of 32

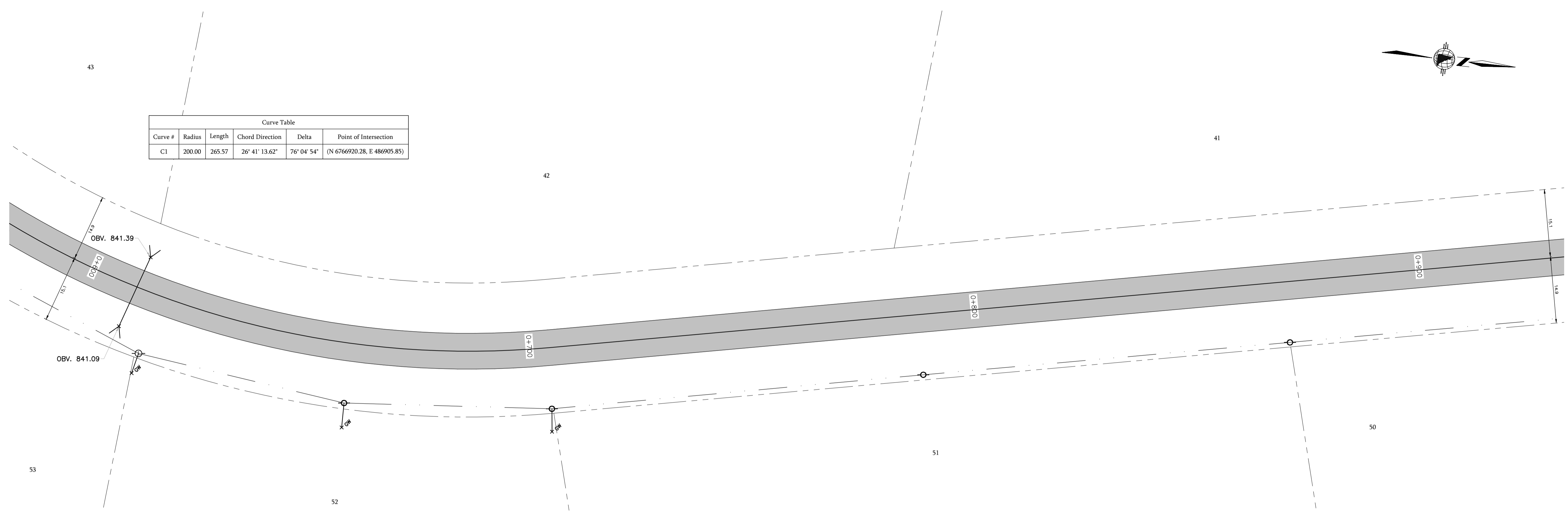
Curve Table

Curve #	Radius	Length	Chord Direction	Delta	Point of Intersection
C1	200.00	265.57	26° 41' 13.62"	76° 04' 54"	(N 6766920.28, E 486905.85)





Curve Table					
Curve #	Radius	Length	Chord Direction	Delta	Point of Intersection
C1	200.00	265.57	26° 41' 13.62"	76° 04' 54"	(N 6766920.28, E 486905.85)



LEDGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	X-X-X-X-X
INSTALLED CULVERT	--->---
INSTALLED SIGN	
INSTALLED UTILITY POLE	
OVERHEAD UTILITY LINE	---X---
GUY WIRE	---X---
LEGAL BOUNDARIES	---
TRANSMISSION LINE	---
RIGHT OF WAY	---
KLONDIKE HIGHWAY	---
SHOULDERS	---
KLONDIKE HIGHWAY	---
CENTRELINE	---
KLONDIKE HIGHWAY	---
RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

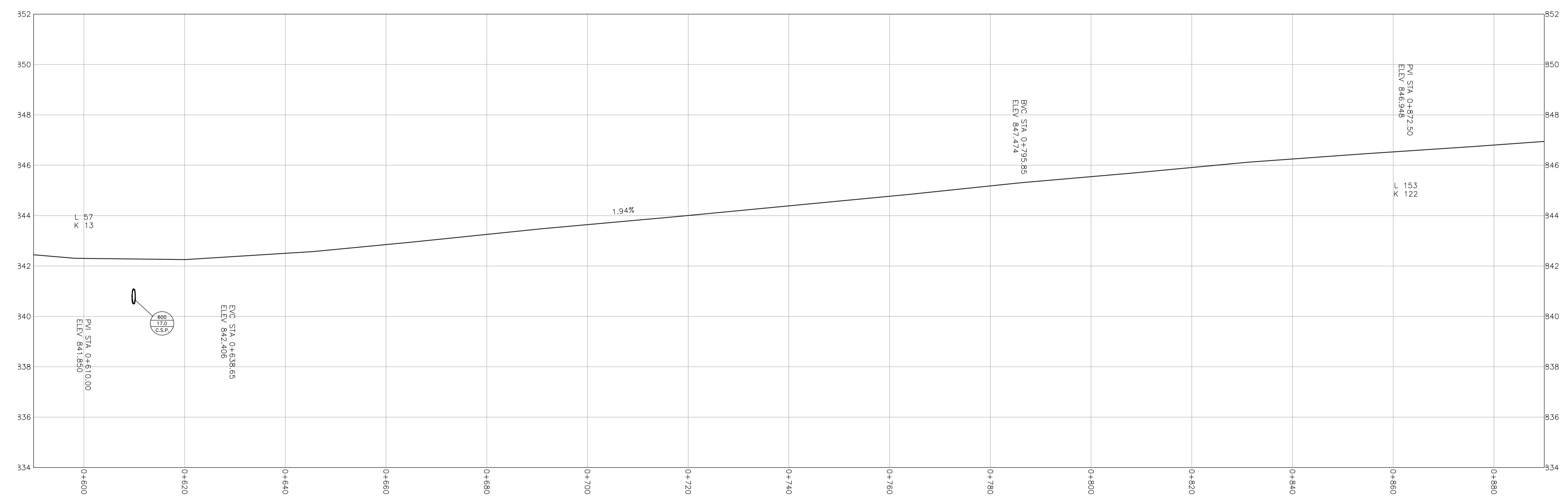
NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

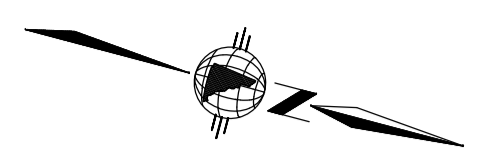
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PHASE II  
PLAN/PROFILE  
0+600 to 0+900**

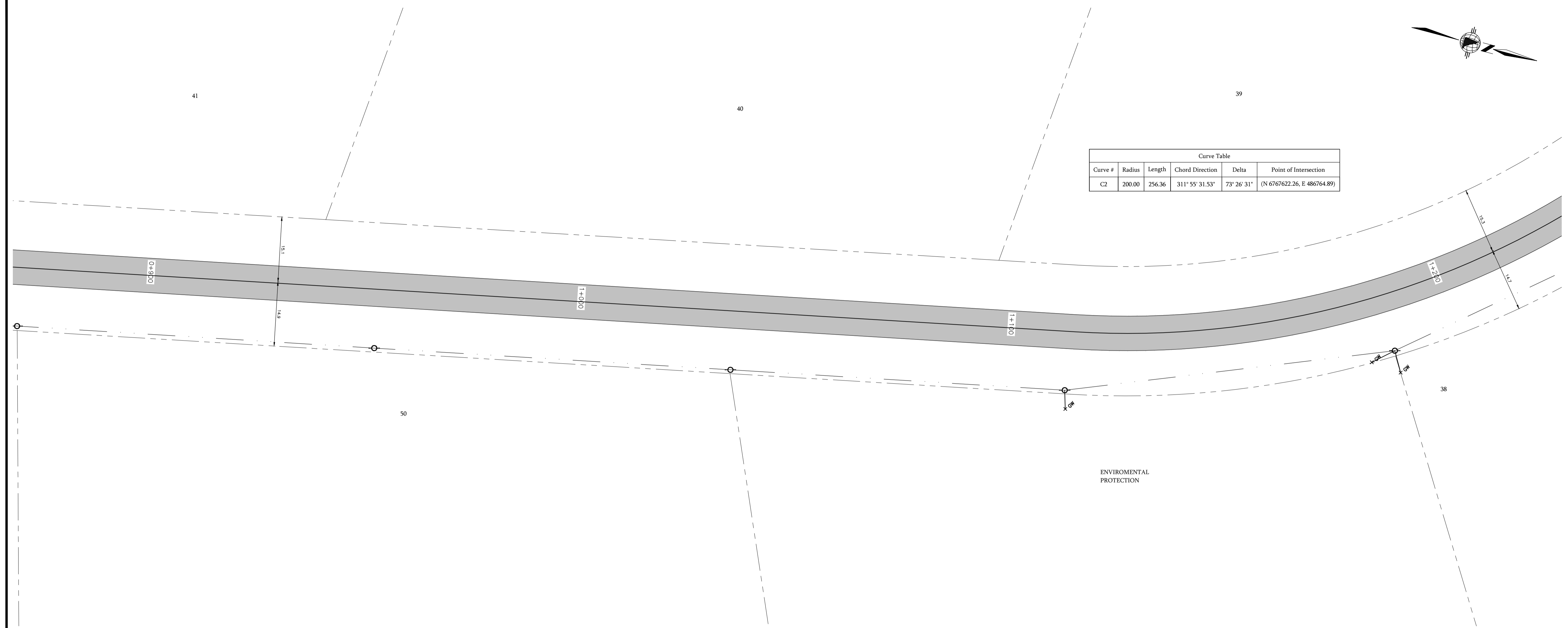
DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Qualle  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 29 of 32





Curve Table					
Curve #	Radius	Length	Chord Direction	Delta	Point of Intersection
C2	200.00	256.36	311° 55' 31.53"	73° 26' 31"	(N 6767622.26, E 486764.89)



LEGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	X-X-X-X-X
INSTALLED CULVERT	Y-Y
INSTALLED SIGN	SIGN
INSTALLED UTILITY POLE	○
OVERHEAD UTILITY LINE	---
GUY WIRE	X
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	[Pattern]
BST AREA	[Grey Box]
FALSE GRADE DITCH	~ ~ ~



REVISIONS:

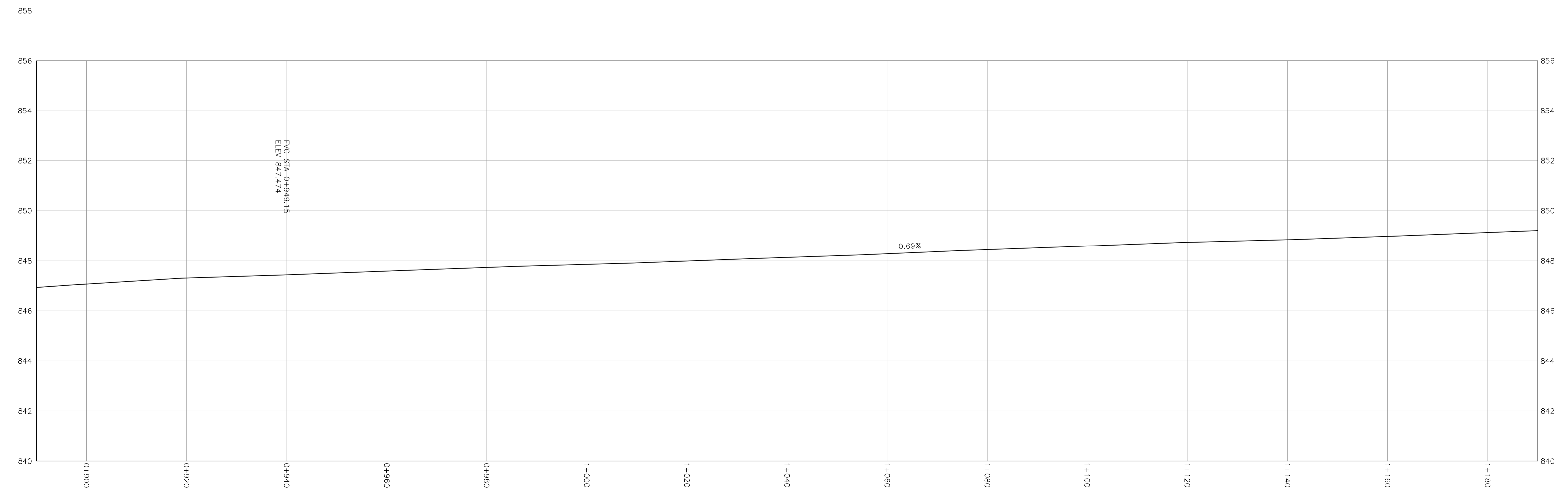
NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PHASE II  
PLAN/PROFILE  
0+900 to 1+200**

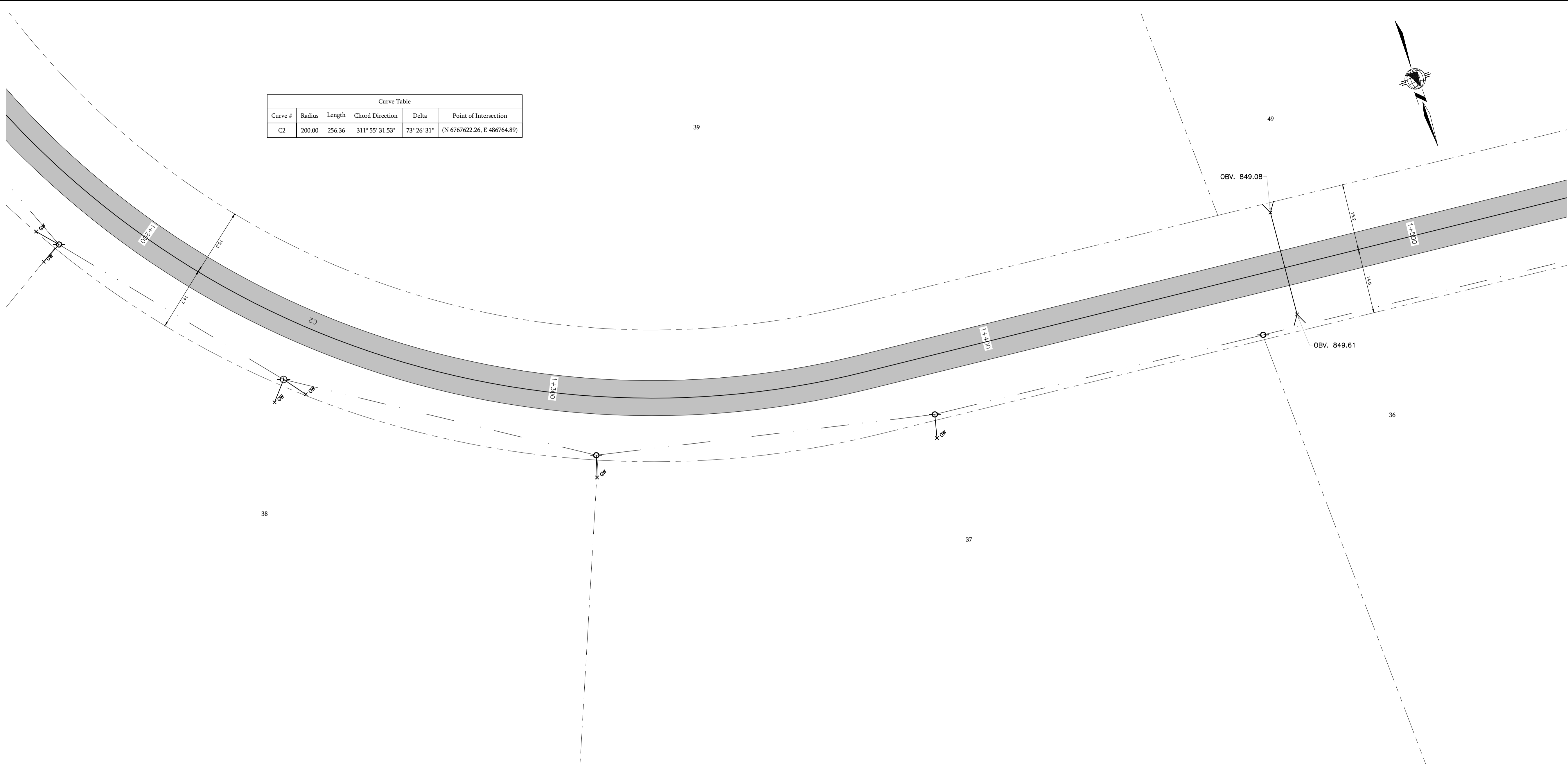
DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Quaille  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 30 of 32





Curve Table				
Curve #	Radius	Length	Chord Direction	Delta
C2	200.00	256.36	311° 55' 31.53"	73° 26' 31"
(N 67° 67' 62.26" E 486764.89)				



LEGEND:

DESIGN CENTERLINE	---
ASBUILT CENTERLINE	---
ASBUILT SHOULDER	---
INSTALLED GUARDRAIL	x-x-x-x-x
INSTALLED CULVERT	--->---
INSTALLED SIGN	
INSTALLED UTILITY POLE	o
OVERHEAD UTILITY LINE	---
GUY WIRE	---
LEGAL BOUNDARIES	---
TRANSMISSION LINE RIGHT OF WAY	---
KLONDIKE HIGHWAY SHOULDERS	---
KLONDIKE HIGHWAY CENTRELINE	---
KLONDIKE HIGHWAY RIGHT OF WAY	---
PAVEMENT AREA	
BST AREA	
FALSE GRADE DITCH	



REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

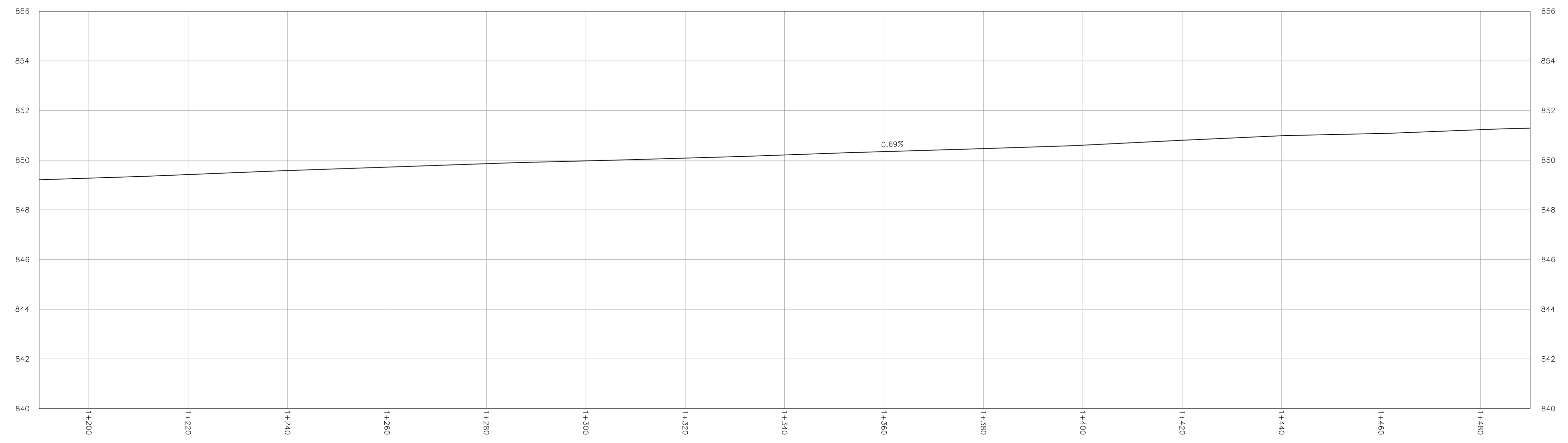
PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

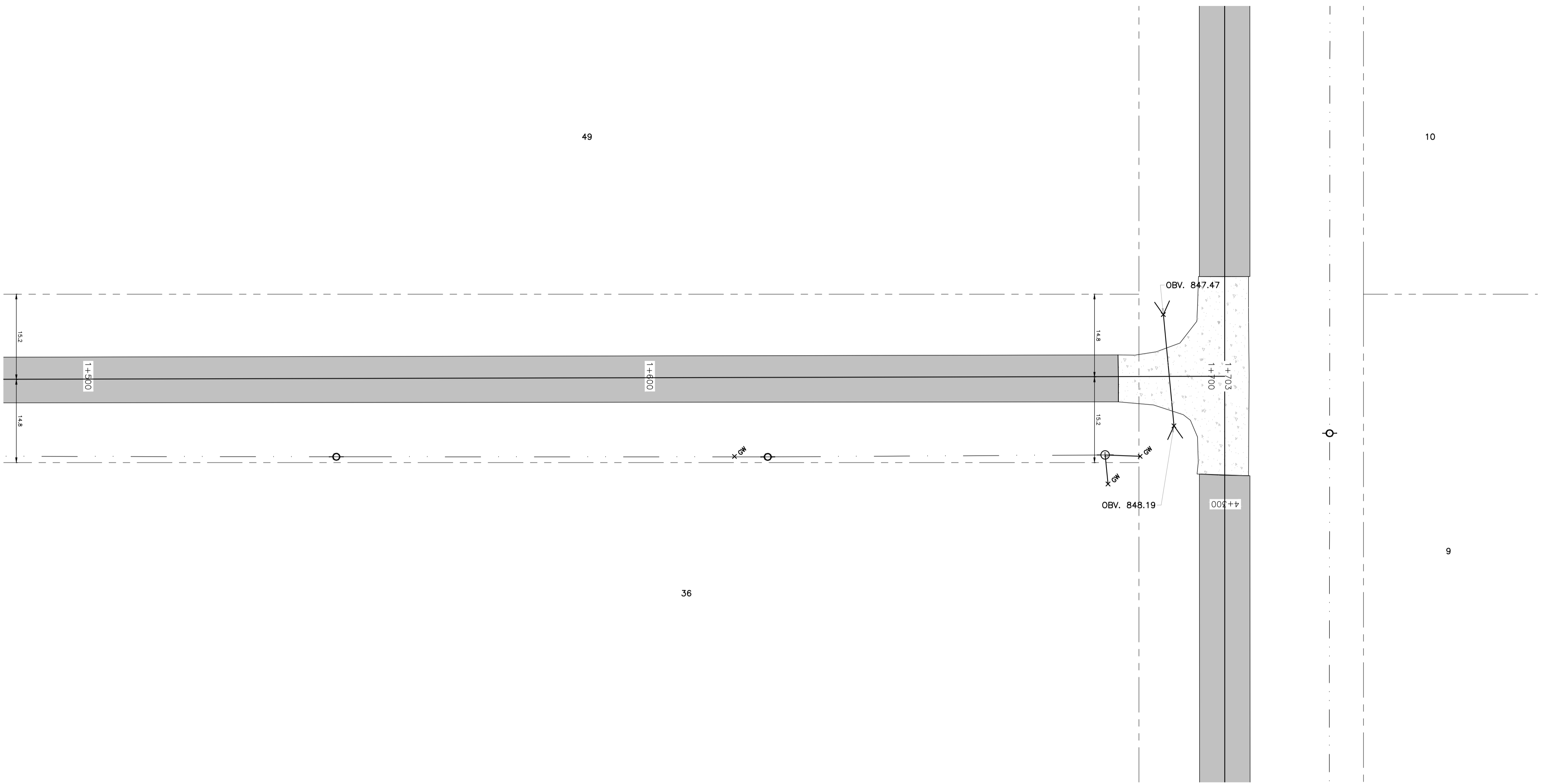
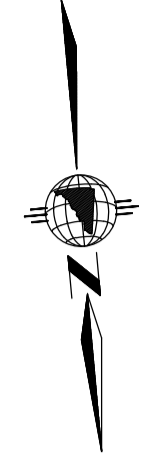
DRAWING TITLE:  
**PHASE II  
PLAN/PROFILE  
1+200 to 1+500**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal

DESIGN: J. Qualle  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 31 of 32





REVISIONS:

NO.	DATE	BY	SUBJECT
01	11/03/09	JTQ	ISSUED FOR REVIEW
02	04/11/09	MJB	ISSUED FOR REVIEW
03	04/17/13	CB	ISSUED FOR ASBUILT

PROJECT:  
**GRIZZLY VALLEY  
SUBDIVISION  
WHITEHORSE, YUKON**

DRAWING TITLE:  
**PHASE II  
PLAN/PROFILE  
1+500 to 1+702**

DATE: APRIL 2013      HORIZONTAL SCALE: 1:500  
DRAWN: R. Colberg      VERTICAL SCALE: 1:100

Professional Engineers Seal  
DESIGN: J. Qualle  
CHECKED:  
APPROVED: C. BENEDEK  
DRAWING NO. E08064 ASB      SHEET 32 of 32