EXHIBIT 4
DATE 2-13-13
HB 392

PRELIMINARY ALIGNMENT REVIEW

FOR

Makoshika State Park
Radio Hill Road Reconstruction

Glendive, Montana

MORRISON MAIERLE, INC.

Engineers, Scientists, Surveyors & Planners Since 1945

PRELIMINARY ALIGNMENT REVIEW

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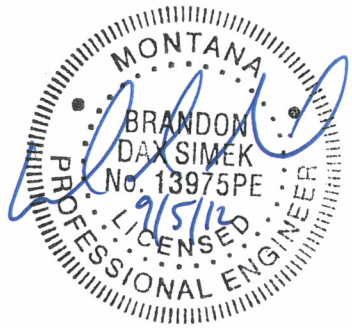

PRELIMINARY ALIGNMENT REVIEW

FOR

MAKOSHIKA STATE PARK
RADIO HILL ROAD RECONSTRUCTION

GLENDIVE, MONTANA

INTRODUCTION

On April 19, 2012, the Montana Fish, Wildlife and Parks Department (MT FWP) contracted with Morrison Maierle, Inc. (MMI) to conduct a preliminary design study for the reconstruction of Radio Hill Road. The intent of this study is to address ongoing road failure issues, and consider alternate alignments along a portion of Radio Hill Road in Makoshika State Park, located just outside of Glendive, Montana. Terracon Consultants, Inc. (Terracon) was subcontracted by MMI to drill boreholes in the failed areas and prepare a Geotechnical analysis and report to assist in the alternatives analysis and recommendations.

The work completed for this study provides for the conceptual design of the road reconstruction improvements and does not constitute the final engineering design and plans necessary for the construction of the improvements.

EXISTING SITE CONDITIONS

The project area for this study is generally located along Radio Hill Road approximately 2.5 miles from the visitor center building at the entrance to Makoshika State Park, as shown on Figure 1. The area is located in the "badlands" of Eastern Montana. This rugged area is largely comprised of soils that are classified as loamy fine sands and silty clay loams. These soils are generally highly erodible and exhibit poor engineering properties, which are exacerbated under wet conditions.

A detention basin, built in 2001, is located on the interior curve that has experienced the most significant subgrade failure. Additionally, an asphalt roadside swale was installed along the south side of the road to intercept stormwater runoff and route it over to the basin.

In addition to the poor site soil conditions and drainage issues, the study area also includes significant elevation gain. The current road alignment in the study area generally exceeds the preferred maximum grade of ten percent, with a stretch of the road exceeding seventeen percent.

MORRISON MAIERLE, INC.
An Employee-Owned Company

Engineers
Surveyors
Scientists
Planners

315 N. 25th Street
Suite 102
Billings MT 59101

Phone: (406) 656-6000
Fax: (406) 237-1201

DRAWN BY: KDK
CHK'D. BY:
APPR. BY: BDS
DATE: 07/11/12

MAKOSHIKA STATE PARK

GLENDIVE MONTANA

VICINITY MAP

PROJECT NO.
0210.032

FIGURE NUMBER
FIG. 1

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BACKGROUND INFORMATION

In 2001, MT FWP contracted for the design and construction of stormwater improvements and sink hole repairs along the stretch of road that is the subject of this report. The stormwater improvements included the installation of a roadside inlet that collected water and directed the runoff to a detention basin that was constructed on the inside of the curve that failed. Additionally, an outlet was installed in the detention basin that passed underneath the road and released the flow downgradient of the failed area.

The stormwater improvements project also included the installation of a geogrid material in the general area of the failure in an attempt to stabilize the ground. The geogrid was installed in several layers with approximately three feet of material between the layers in the "sink hole" areas that were identified at the time.

Surficial cracks within the asphalt road began appearing along the curve that is adjacent to the detention basin during May 2011. It is important to note that this area experienced precipitation amounts that were much greater than average over the months of March through June of that year. By mid-summer, the cracking worsened and the road began to show signs of settlement, which is evidence of sub-base failure, as shown in Photo 1.

Photo 1 – Surficial cracking and evidence of sub-base failure. (Photo courtesy of MT FWP).

By September 2011 the cracks had expanded further and the road and adjacent slope had failed. In October 2011, a large portion of the adjacent slope failed and took a portion of the road with it, as shown in Photo 2. The road was then closed and a contractor was selected to construct a temporary, alternate route. The alternate route filled in the existing detention facility and moved the curve inward approximately 50 feet. To maintain storm drainage, a continuous length of 18-inch HDPE intercepted the flow from the existing roadside inlet and conveyed the runoff downslope of the failed section. This work was completed in November 2011.

Photo 2 – Failure of roadway and adjacent slope. (Photo courtesy of MT FWP).

The detention pond, constructed in 2001, was designed to be seeded, but had no additional lining that would prevent the infiltration of runoff into the underlying soils. It is suspected that this detention pond, combined with the extraordinary amount of precipitation in the spring of 2011, contributed to the saturation of the surrounding soils and ultimately the failure of the adjacent slope and roadway.

GEOTECHNICAL STABILITY ANALYSIS

As previously mentioned, Terracon conducted a field investigation from May 9, 2012 to May 11, 2012. A follow-up visit occurred on June 21, 2012 to further evaluate the slope and observe the progression of the failed areas. During the field investigation, three borings were drilled at the failure site to depths varying from 51 feet to 60 feet below existing ground elevations. The subsurface profile consisted of fat clay and silty to clayey sand soils with underlying layers of weathered sandstone and shale bedrock. Groundwater was not observed during the drilling of the boreholes.

The Terracon instability analysis makes several recommendations, which MMI has incorporated into the alternative alignment analysis and recommendations discussed in the following sections. The Geotechnical Engineering Report is included in its entirety in Appendix A.

ALTERNATIVE ALIGNMENTS

MMI identified three potential alignments that attempt to mitigate the slope instability or provide for an alternative route through the area. Due to the substantial constraints of the existing landscape, Montana Dept. of Transportation (MDT) design criteria guidelines are not met in the following alternative alignments – specifically maximum road grades and curve radii. MDT standards suggest a maximum grade of ten percent and minimum curve radius of 220 feet for a rural road with a 30 mph speed limit.

It should be noted that two other road route alternatives, in addition to the three alternatives discussed below, located to the east and west of the existing alignment, were also evaluated. However, due to the existing topographical constraints, both of these routes were dismissed from further consideration. These routes would have to be located along the bottom of the existing drainages or cut in along the adjacent hillsides, and neither route was realistic or feasible.

Lower Routes

The lower routes were eliminated from more detailed consideration as it would be very problematic to design a road around the large amount of stormwater that these basins drain. Using aerial photos and quad maps of the areas outside the survey limits, it was determined that the bottoms of the existing drainages were not wide enough to accommodate both a channel large enough to convey storm runoff and a road section.

Hillside Routes

The hillside routes were eliminated due to constructability issues and cost. As previously mentioned, the native soils in this area exhibit engineering properties that are not conducive to providing a sound platform for road construction. Significant hillside stabilization would need to be implemented in addition to a large quantity of imported structural fill material for a solid road base.

Feasible Alternatives

The estimated costs listed with the following Alternatives took into account the remoteness of the project and as such, higher prices were included for excavation and hauling, and road materials. The estimated costs include construction costs, design costs, and a twenty percent contingency due to the large unknowns related to the potential slide areas. A breakdown of the cost estimates is included in Appendix B of this report.

Alternative No. 1

The first alternative improves the current temporary alignment and stabilizes the adjacent potential problem areas, as shown in Figure 2. During the topographical survey of the area, two to three additional slope areas along the escarpment and adjacent hillside were noted that had significant potential to calve off, much like the failure that occurred on the curve. One such area is shown in Photo 3.

Photo 3 – Potential, future failure area shown in upper middle of picture.

While the tighter geometry provides certain challenges, it is advantageous in that the alignment distances the road from the unstable slide area. The curve would be redesigned to provide as large of a radius as possible to accommodate motorhomes and vehicles towing trailers, while at the same time maximizing the separation distance from the slide area.

The length of paved road constructed under this alternative is approximately 825 feet with 690 feet of new asphalt roadside swale. The asphalt road would be 24 feet wide providing two 12 foot driving lanes. A new inlet would also be installed to convey stormwater away from the site. Rather than direct water to a detention facility, the runoff would be piped to the west and discharged into the existing drainage.

Design Considerations

In order to achieve a long-term solution, the adjacent areas that are currently exhibiting signs of failure will need to be stabilized. This stabilization will likely involve a combination of stone or concrete columns, soil nailing/pinning, and surficial anchoring with netting. Figures 1 and 2, shown below, illustrate the mechanics of soil nailing and micropiles. According to the Geotechnical Engineering Report, these stabilization methods include:

- Providing a series of post-tensioned, multi-strand anchors with reaction blocks across the slope face; the anchors would be drilled into bedrock sufficiently to develop necessary tensile resistance.
- Installing drilled shafts or micropiles to provide reinforcing across the slide surface.
- Dismantling the slide zone and constructing a buttress through the slide surface with a reinforced soil embankment constructed of on-site sand soils to rebuild the slope.

LEGEND

POTENTIAL SLIDE AREA

MORRISON MAIERLE, INC.
An Employee-Owned Company
Engineers
Surveyors
Scientists
Planners
315 N. 25th Street
Suite 102
Billings MT 59101
Phone: (406) 656-6000
Fax: (406) 237-1201

DRAWN BY: KDK
CHK'D. BY:
APPR. BY: BDS
DATE: 7/17/12

MAKOSHIKA STATE PARK
GLENDIVE MONTANA

ALTERNATIVE NO. 1

PROJECT NO.
0210.032

FIGURE NUMBER
FIG. 2

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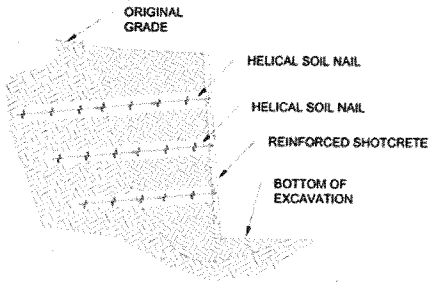

Fig. 1 – Example of Soil Nailing

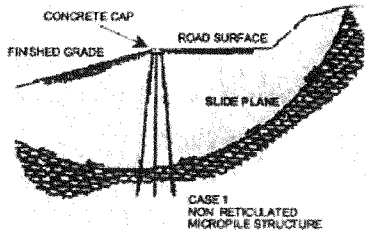

Fig. 2 – Example of Micropiles

Other stabilization methods, such as the use of geogrid, are not considered to be viable options as it was previously attempted and failed.

Stormwater improvements will also be required to prevent future saturation of the native soils. Improvements would include asphalt roadside swales, and inlets and storm pipe where necessary to limit the amount of runoff flowing onto the adjacent hillsides.

An alternative storm drainage alignment was considered whereby the roadside drainage ditch on the south side of the road would be extended and directly discharged into the drainage located to the east, rather than installing an inlet and pipe, as shown in Figure 2. This alternative was eliminated from further consideration due to constructability concerns with the steep slopes and highly erodible soils in the outfall area.

Due to the steep grades, tight curve radius and close proximity to the existing drainage, the installation of steel guardrail along the outside of the curve should be considered. The estimated cost of this alternative includes guardrail installation.

Estimated Cost

The estimated cost for Alternative No. 1 is $1,007,100.

Alternative No. 2

Alternative No. 2 involves re-establishing the original alignment and addressing the adjacent potential problem areas, as illustrated in Figure 3. This potential route is very similar to Alternative No. 1; however, returning to the original road location improves the drivability of this section of road by slightly decreasing the roadway slope and also marginally increasing the curve radius of the curve from 72 feet to 80 feet.

The length of road constructed under this alternative is approximately 940 feet with 830 feet of new asphalt roadside swale. Again, the asphalt road would be 24 feet wide providing two 12 foot driving lanes. A new inlet would also be installed to convey stormwater away from the site. Rather than direct water to a detention facility, the runoff would be piped to the west and discharged into the existing drainage.

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Planners
315 N. 25th Street
Suite 102
Billings MT 59101
Phone: (406) 656-6000
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ALTERNATIVE NO. 2

PROJECT NO.
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FIGURE NUMBER
FIG. 3

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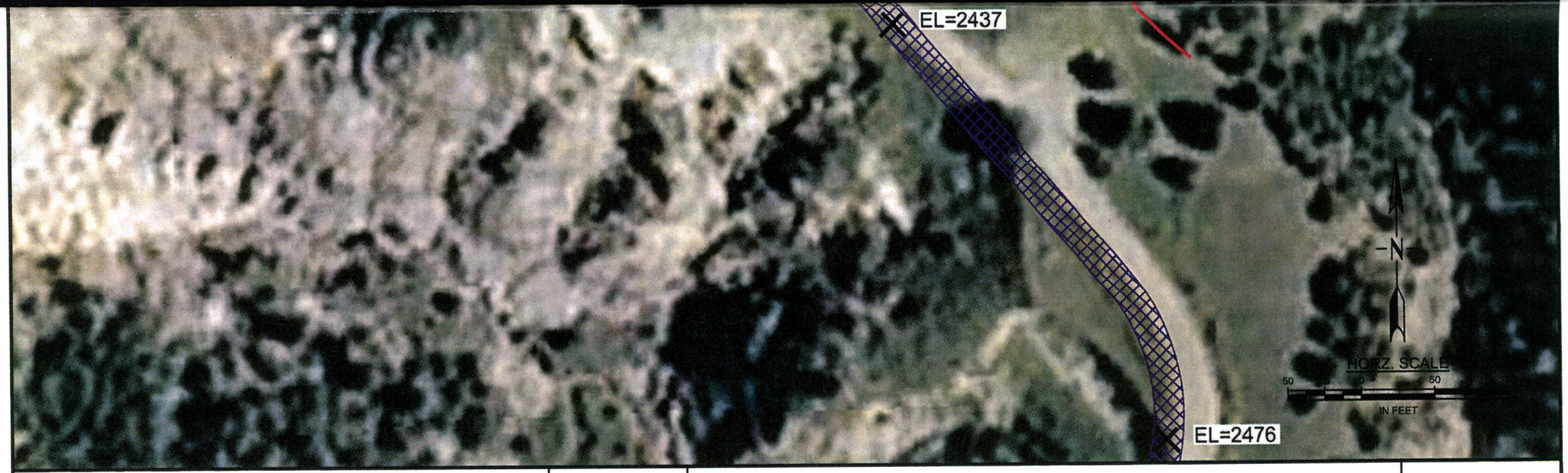
EL=2277
EL=2335
APPROXIMATE CUT LIMIT
ON 17% GRADE
APPROXIMATE CUT LIMIT
ON 17% GRADE
APPROXIMATE CUT LIMIT
ON 11% GRADE
EL=2398
EXISTING
ESCARPMENT



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ALTERNATIVE NO. 3

PROJECT NO.
0210.032

FIGURE NUMBER
FIG. 4

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While the curve radius is less than recommended by MDT for a low-volume mountainous road, the surrounding topography precludes more desirable design options. Additionally, the challenges of meeting the design criteria, including the curve radius and steep grades, will be tempered by an appropriate speed limit and the installation of guardrail along the outside of the curve. Although the cost of the preferred alternative is relatively expensive for the construction of such a small length of road that has a low volume of traffic, there are no other economically viable routes that can bypass this problematic area to let visitors travel further into the Park's interior.

CONCLUSION

MMI and Terracon analyzed several potential alternative alignments through the study area, and using sound, accepted engineering practices, recommend the best alternative to provide an economical, long-term solution.

The recommendations set forth in this preliminary design study should be used as the basis of design for future improvements to Radio Hill Road.