Part II: Alternatives

A. Introduction

Alternate actions for the proposed reconstruction of US 2 between Columbia Heights and Hungry Horse are discussed in this part. The alternatives considered for this proposal include two- lane and four-lane road designs, options to maximize the efficiency of the existing facility, and "no-action". Alternatives were discussed at public meetings held in October, 1989 and in June, 1990. Part VI of the EIS contains summaries of the comments received at these meetings.

The following text describes the existing and projected design year traffic conditions of the project area which are one of the primary considerations used in the development of reasonable alternatives. This section **also** describes the process and decisions that led to the selection of the preferred alternative.

B. Existing and Projected Traffic Characteristics

1. SOURCE OF TRAFFIC DATA

Traffic on US 2 at locations in and near the project corridor has been monitored for more than 40 years using continuously-recording permanent counters and portable counters. A permanent automatic traffic recorder (ATR) on US 2 **was installed** between Hungry Horse and Martin City in 1982. The ATR (Station A-60) recorded hourly traffic volumes at this location through 1985. ATR Station A-60 **was moved** to MP 139.5 (near the House of Mystery) prior to reconstructing US 2 between Hungry Horse and Coram.

The permanent counter is located between Monte Vista Drive and Berne Road in an area typical of rural conditions in the corridor. Land use in the vicinity of the counter is primarily agricultural with scattered residences. The House of Mystery is the only highway commercial business located near the permanent counter. The density of approaches and development is notably less in this area than in Columbia Heights.

Short-term traffic volume data is collected using portable traffic counters at other locations in and near the project corridor each year. These count locations include:

- Station 4A-1 on FAS 206
- Station 4A-3 on US 2 west of the South Fork bridge
- Station 4A-4 on US 2 at former ATR Station A-60
- Station 4A-13 on US 2 west of junction with FAS 206

FIGURE II-1 shows the locations of the portable counters and ATR Station A-60. Data from the permanent counter allows annual traffic volumes and variations in traffic **to be quantified**. Periodic counts provide information about specific use characteristics of US 2 and adjoining routes. **FIGURE II-1** also presents **recent** traffic volumes for all count locations in the project area.

Please note that new traffic data for the project area became available after the publication of the Draft EIS. The data showed that the 1992 annual average daily traffic (AADT) at Station A-60 was 5,720, an increase of 11.8% over the 1991 AADT. The 1992 AADT also represents a traffic increase of more than 14% from the 1990 AADT at this station. Traffic volume increases were recorded for other count locations on US 2 in the project area.

Changes made since the Draft EIS are shown in bold-faced text.

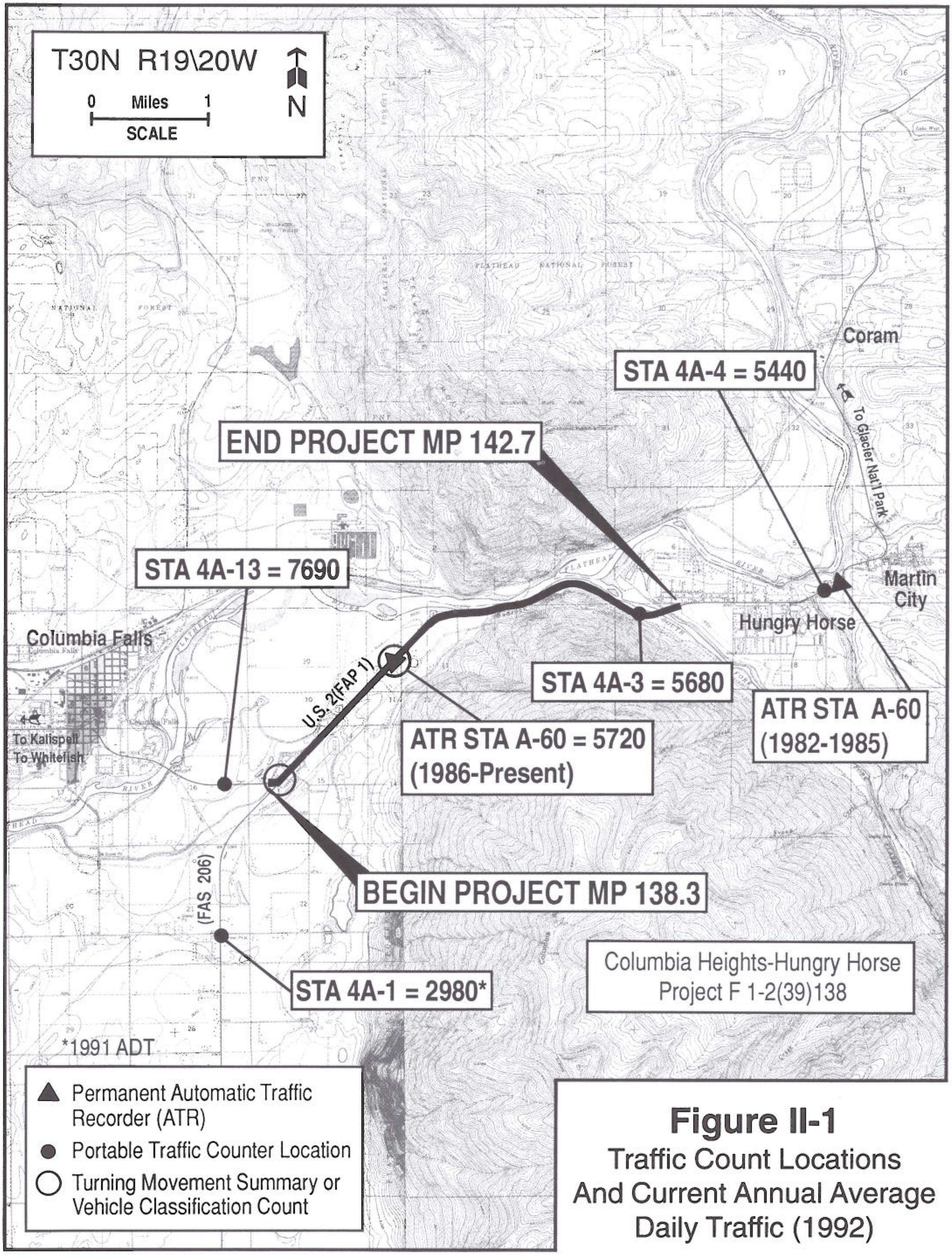


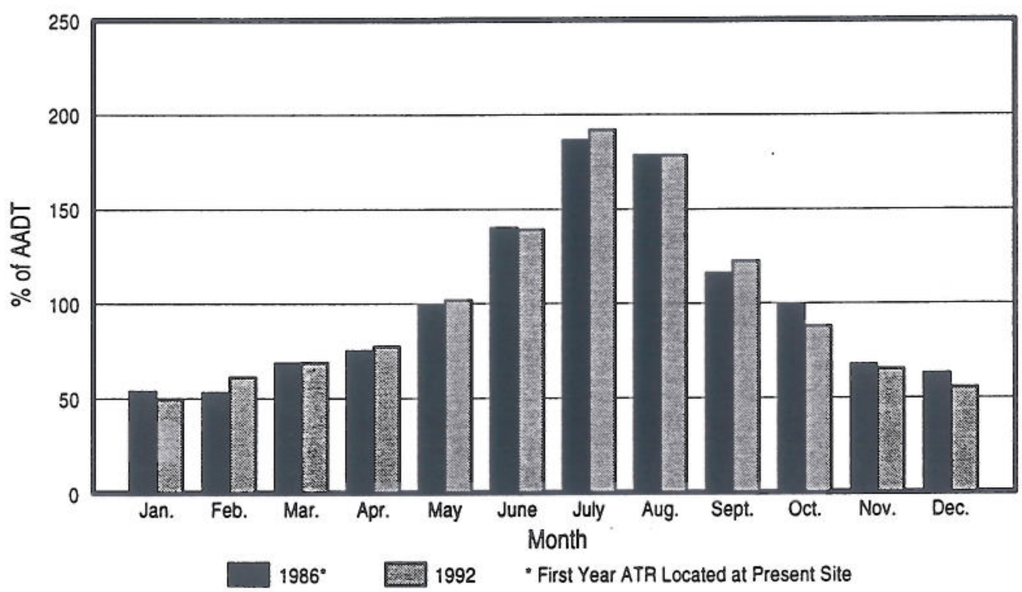
Figure II-1
Traffic Count Locations
And Current Annual Average
Daily Traffic (1992)

2. VARIATIONS IN TRAFFIC

Traffic volume information from the ATR can identify monthly, daily, and hourly variations in traffic volumes. The following narrative describes these variations **in traffic volumes within the corridor.**

Monthly Variations in Traffic - **FIGURE II-2** shows the variation in traffic at Station A-60 by month **for 1992.** The highest traffic of the year occurs in July. Conversely, the least travel occurs in January. **During 1992, the average daily traffic volume for the month of July was nearly double that of the average annual daily traffic volume at ATR Station A-60. During January, the average daily traffic volume for the month was only about half of the annual average daily traffic volume at this recording station.**

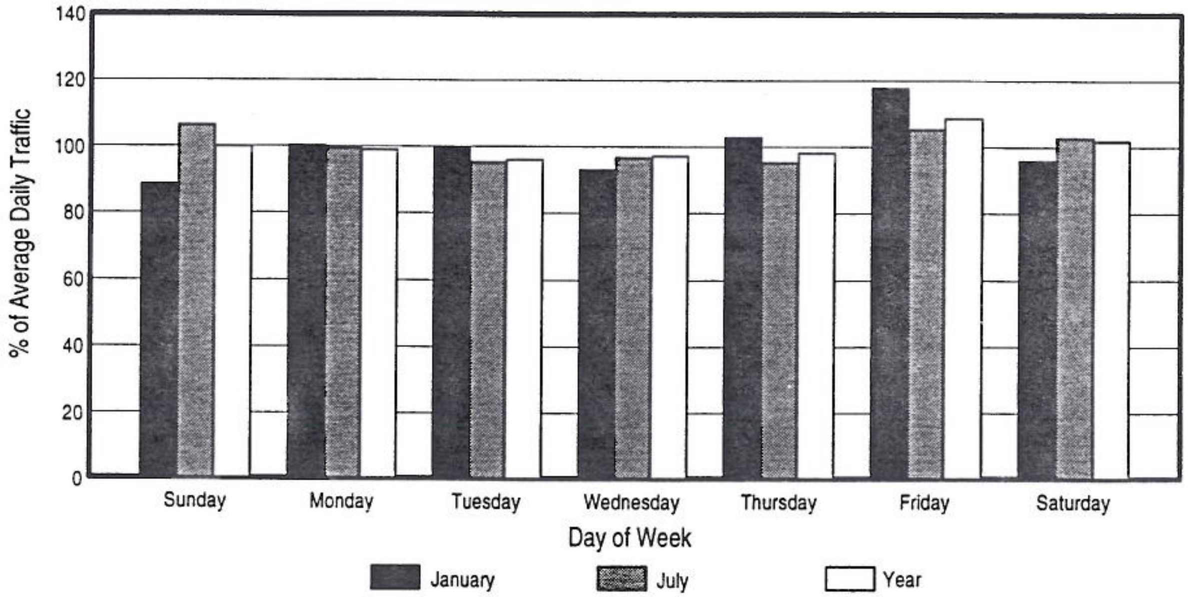
Figure II-2 - Monthly Variations in Traffic at Counter Sta. A-60



Daily Variations in Traffic - **FIGURE II-3** presents daily variations in traffic at Station A-60. The figure clearly shows Fridays as being the highest travel day of the week. **During 1992, the average daily traffic volumes on Friday was about 9% higher than the average traffic volume for all weekdays.** The lowest travel day of the week **typically occurs** on Tuesdays. **The highest daily traffic volume at the ATR during 1992 was 12,253 recorded on August 1. The lowest daily traffic volume during 1992 was 1,257 recorded on December 27.**

The highest traffic volumes during peak summer months **(June, July, and August) typically** occurs on Fridays, Saturdays, and Sundays. High weekend traffic reflects the recreational use of this route. Traffic during January, **the month with the least travel,** is highest on weekdays and lowest on weekends. **These higher weekday traffic volumes suggests use by commuters.**

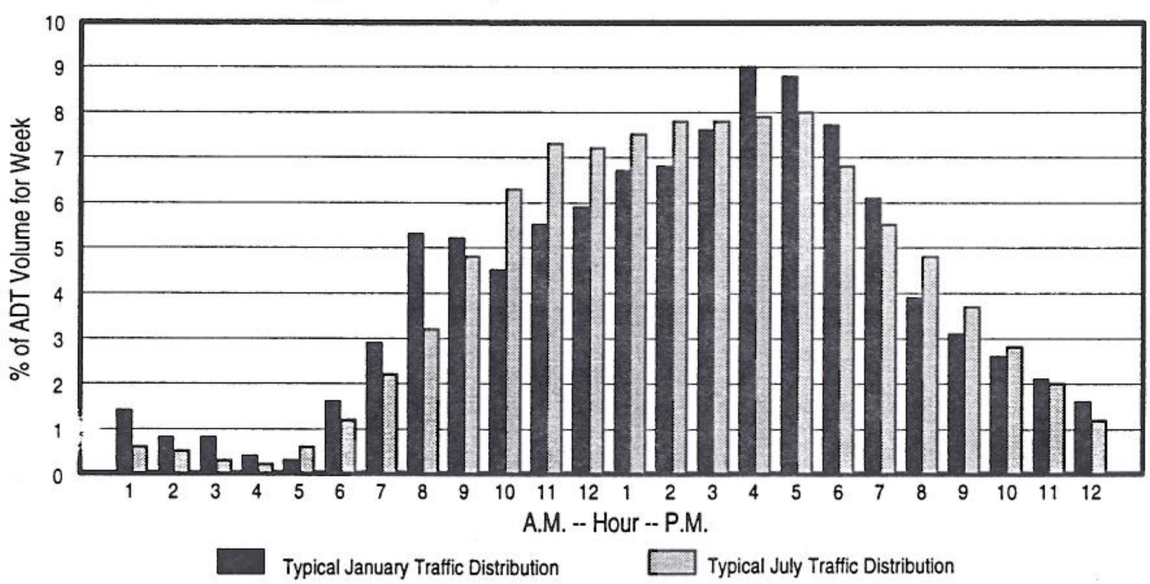
Figure II-3 - Typical Daily Variations in Traffic For ATR Sta. A-60



* First Year ATR Located at Present Site

Hourly Variations in Traffic - **FIGURE II-4** shows the typical variations in daily traffic by hour at ATR Station A-60. The graph presents data for a week-long period during the high and low travel months of the year. January traffic shows well defined peaks from 8:00 to 9:00 a.m. and from 4:00 to 6:00 p.m. Peak travel hours during July occur from about 10:00 a.m. to 6:00 p.m. **The highest hourly volume recorded in 1992 was 1,046 and occurred between 4:00 and 5:00 p.m. on July 5.**

Figure II-4 - Typical Hourly Variations in Traffic For ATR Sta. A-60*



Based on Detailed Analysis of Hourly Traffic Volume Data For One Week Each In January & July, 1989.

3. COMPOSITION OF TRAFFIC

Several times each year, information **is collected** on vehicle classifications and turning movements in Columbia Heights. An analysis of classification data (more than 51,000 vehicle observations) gathered over four years helped determine the typical composition of traffic in the project area. **TABLE II-1** contains the results of the traffic composition analysis. **To verify current vehicle classification statistics for the corridor, a count taken during April, 1993 is also presented in the table. The new data suggests that the traffic stream may consist of slightly higher percentages of passenger cars, pickups, and vans than in past years. It should be noted that the 1993 data is based on less than 5,000 vehicle observations. Therefore, the vehicle classification data based on more than 51,000 observations over four different years is believed to best represent the composition of traffic in the corridor.**

Please note that the vehicle classifications presented below correspond to the manual count summary sheets. The classifications for RV's, trucks, and buses represent the combined percentages for all vehicles considered in the more general vehicle groups.

The proportion of recreational vehicles is larger during the summer than **the averages shown below.** A vehicle classification count performed in July, 1989 showed that RV's comprised 13.4% of all vehicles seen during the study period. During the peak travel months of 1989, RV's accounted for about 8.7% of the vehicles on US 2 in the project corridor (1).

TABLE II-1
VEHICLE CLASSIFICATION SUMMARY

Vehicle Type	% of Vehicles Observed	
	1986-1989	April, 1993
Passenger Cars	52.8	**59.1**
Pickups & Vans	34.8	**29.7**
Motorcycles	0.8	**0.3**
RV's	4.3	**5.0**
Single Unit Trucks	4.4	**3.2**
Tractor Semi-trailer	1.5	**1.9**
Truck Full Trailer	0.8	**0.4**
3 Unit Combination	0.1	**0.2**
Buses	0.5	**0.2**

4. DIRECTIONAL DISTRIBUTION AND TURNING MOVEMENTS

Directional Distribution - Directional distribution studies **were performed** 12 times at the ATR location during the 1986 through 1989 period. These studies showed that the directional distribution of traffic varies markedly by season. During peak summer months, eastbound traffic dominates (about 55% of the traffic). Traffic flows during the rest of the year were evenly split by direction or became predominantly westbound (52% - 55% of the observed traffic).

Turning Movements - Turning movement data **was collected** at the intersection of US 2/FAS 206 on four occasions during 1988 and once in 1989. The intersection's configuration requires eastbound traffic on US 2 to stop. Motorists on US 2 must turn left to continue to Hungry Horse or turn right to proceed on FAS 206. Approaching traffic on FAS 206 must turn left toward Columbia Falls or continue straight ahead to Hungry Horse. A left turn lane and a right turn ramp facilitate turning movements from and to FAS 206.

Through traffic between Columbia Falls and Hungry Horse dominates all vehicle movements at the intersection. About 20% of the westbound traffic and 25% of the eastbound traffic left US 2 during the 1988 and 1989 counts. **Turning movement data collected during April, 1993 verified this trend.** These movements remained relatively constant throughout the year.

Studies show that the amount of traffic leaving FAS 206 and proceeding eastbound on US 2 increased during peak summer months. Left turns from FAS 206 onto US 2 (toward Columbia Falls) were the primary movement during the remainder of the year.

5. TRAFFIC PROJECTIONS FOR THE CORRIDOR

Historical traffic data from the ATR installed in the corridor (1986-present) and from the ATR when it was located between Hungry Horse and Martin City (1982-85) show that annual average daily traffic volumes in 1992 are more than 60 percent higher than those recorded in 1982. This increase represents a simple increase in average annual daily traffic volumes of about 5.2% per year during the past eleven years. The traffic volume data recorded at the ATR provides essential information for projecting future traffic volumes in the corridor.

Traffic for Station A-60 can be projected through the use of regression analysis to analyze the linear relationship between historical traffic volume data points for the count location. One type of regression analysis, the method of least squares, **was used** to develop a mathematical representation of the best trend line for estimating future traffic volumes. The results of the "least squares" computations for the permanent counter and historical data points are presented in **FIGURE II-5** and **TABLE II-2. The standard deviation from the mean for these data points is 435 vehicles.**

Figure II-5 - Estimated Average Daily Traffic Through Year 2010

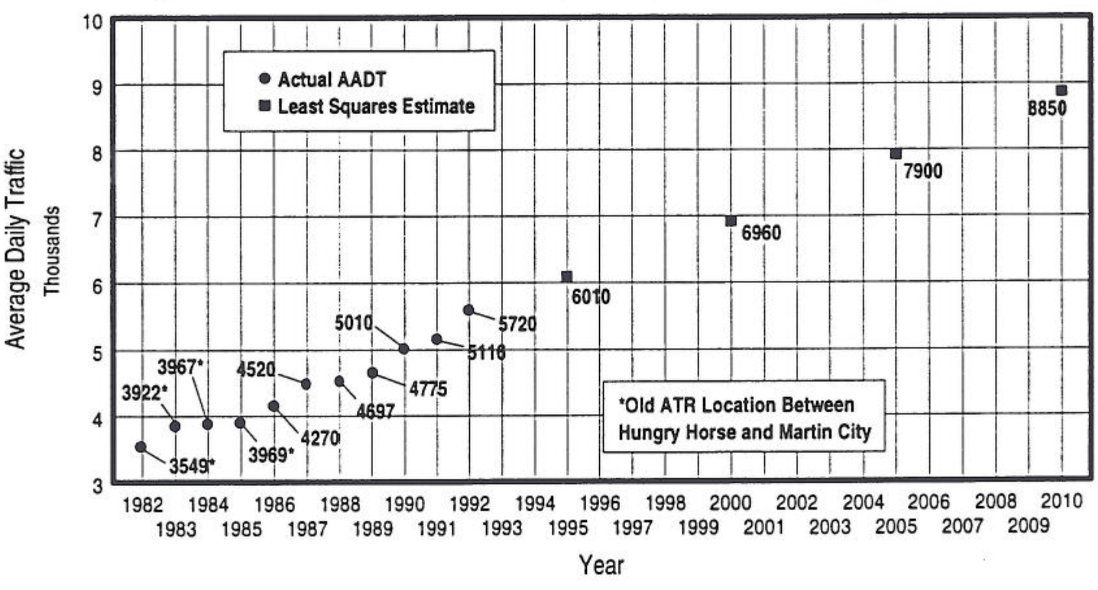


FIGURE II-6 shows design year traffic volumes for other count locations in and near the project corridor. Regression analysis, based on historical traffic volume data, was used to project future traffic volumes at other individual count locations in and near the corridor.

Note that the future traffic volumes for the count stations presented in the Draft EIS were estimated by applying a projected overall growth rate, similar to the rate determined for the ATR, to current traffic volumes. For the Final EIS, the method of least squares (used to project future traffic volumes at the ATR) was used to project traffic at other count locations in the project area. This ensures consistency between projections for each station since the methodology considers the historical variations in traffic volumes at each count location.

TABLE II-2
AVERAGE DAILY TRAFFIC PROJECTIONS FOR ATR STATION A-60

1989	1990	1991	1992	1995	2000	2005	2010
4775*	5010*	5116*	5720*	6010	6960	7900	8850

* Actual Annual Average Daily Traffic (AADT) for Station A-60.

6. DESIGN HOURLY VOLUME

Highway designs must accommodate the traffic expected to use the facility at some time in the future, commonly 20 years. A design hourly volume (DHV), often the 30th highest hourly volume of the year (30HV), represents the most important traffic volume considered by highway designers. The DHV provides guidance for road designers about the necessary geometric features needed for the new facility.

AASHTO indicates that it is the accepted engineering practice to use the 30HV for the design of highway improvements for rural roads (2). This design value typically varies little from year to year in spite of significant changes in ADT that may occur. Many other transportation agencies across the country adhere to the strict usage of the 30HV for highway design purposes.

The traffic data for ATR Station A-60 shows that the 30HV during **1992 was 945 (3). This hourly volume represented 16.5% of the annual average daily traffic volume at this count location.**

An important design calculation relates the peak hourly traffic volumes to the ADT. This ratio, known as the K-factor, most often compares the 30HV of the year to the ADT. The K-factor for the most recent year **(1992) at Station A-60 was 0.165**. Computations show that the average K-factor for the past five years at this station was **0.1708. This value was used to evaluate the current level of service provided by the alternatives under consideration.**

The method of least squares was also used to determine the K-factor for the design year at Station A-60. Based on **eleven** years of data, this analysis determined that the K-factor for the design year is **0.1714**. By applying the average K-factor to the projected design year traffic volume at Station A-60, the calculated 30HV value is **1517. This value was used to evaluate the future level of service provided by the alternatives under consideration for the proposed action.**

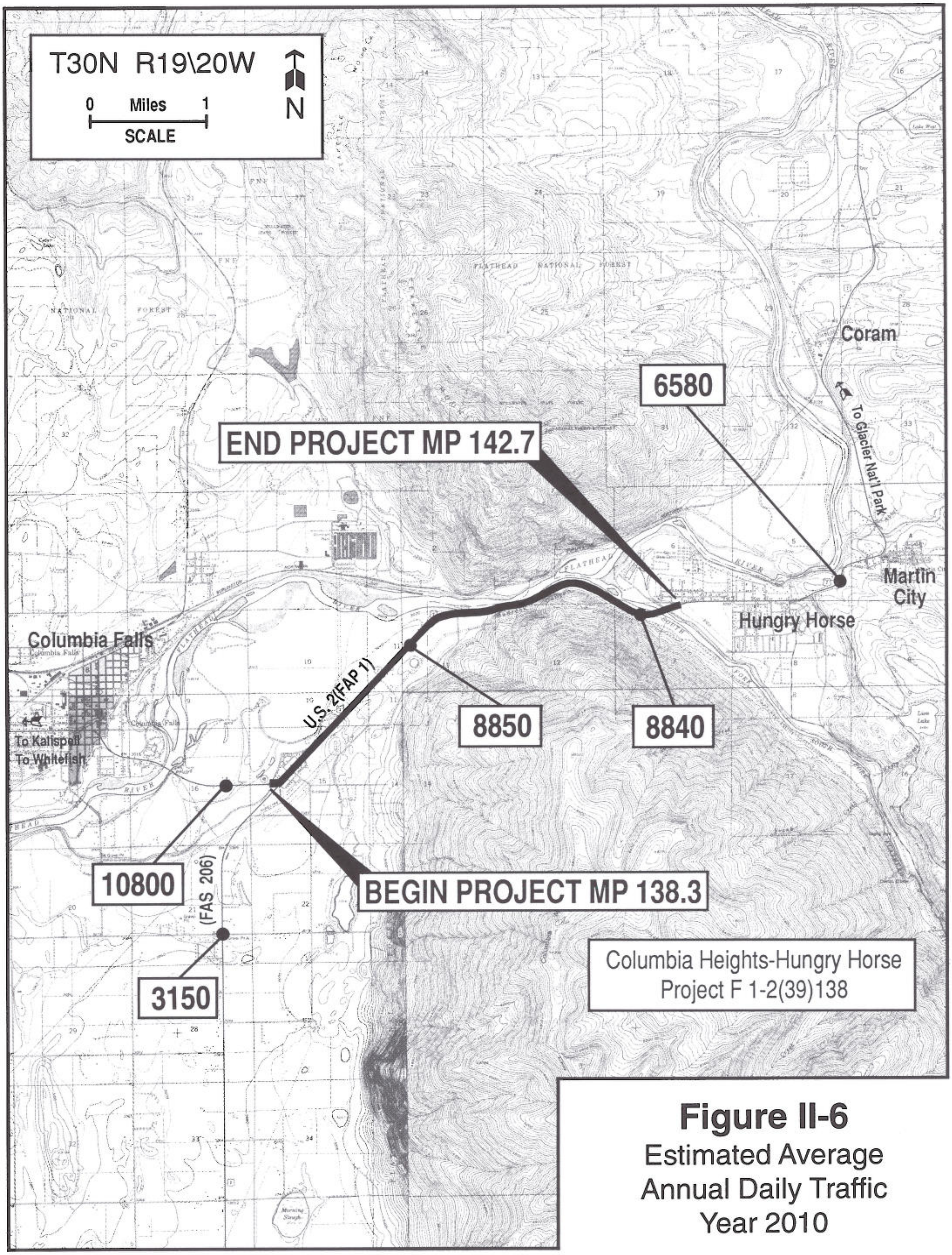


Figure II-6
Estimated Average
Annual Daily Traffic
Year 2010

C. Alternatives Initially Considered

The alternatives initially considered for the proposed action included no-action, transportation system management (TSM) actions, mass transit, alternate locations for the highway, and specific road design options. The alternatives considered were based on road designs for other US 2 reconstruction projects in the vicinity, accepted highway design standards for rural arterials, and design suggestions included with comments received during scoping activities.

1. NO-ACTION ALTERNATIVE

Environmental regulations require that no action be evaluated as a reasonable alternative for the proposed action. The no-action alternative would not change the 24-foot-wide, two-lane highway or the two-lane bridge that exist within the project corridor. This alternative includes short-term minor restoration activities (safety and maintenance improvements) that are needed to continue the use of the existing facilities.

2. TRANSPORTATION SYSTEM MANAGEMENT (TSM) ALTERNATIVE

The TSM alternative includes limited construction activities which maximize the efficiency of the existing system. TSM options cover a variety of physical, operational, regulatory and managerial actions that can be quickly and cheaply designed and implemented to improve the use and performance of transportation facilities. This alternative is usually relevant for major projects proposed in urbanized areas with populations exceeding 200,000. However, the concept of achieving maximum use of existing facilities received consideration for this proposed action.

The underlying transportation deficiency in this section of the US 2 corridor is the existing roadway's inability to safely and efficiently accommodate present traffic volumes during peak travel periods. Increases in traffic volumes will cause the existing facility to operate at an unacceptable level of service more frequently through the foreseeable future. Strategies that would maximize use of the existing facility or increase its capacity include:

- adding capacity to the facility by providing new lanes,
- controlling access or adding two-way left turn lanes,
- encouraging travelers to ride-share, and
- encouraging travel at less congested times.

3. MASS TRANSIT

Mass transit options received initial consideration as an alternative for this project. Such an alternative assumes that the present roadway would remain in place to serve existing land uses but mass transit systems (bus or rail services) would be provided to handle as much existing and projected traffic as possible. The provision of mass transit systems could help alleviate congestion on the existing facility by reducing the number of vehicle trips within the project area. In addition to reducing the number of vehicle trips in the project area, a mass transit alternative would avoid the environmental impacts associated with constructing a new road.

4. ALTERNATE ROUTES

This alternative includes measures that would reduce the travel demands on US 2 by promoting shifts of existing and future traffic to other routes. Two alternate routes, shown on FIGURE II-7, could be used instead of US 2 to travel from Columbia Falls to West Glacier.

One alternate route follows Federal Aid Secondary Route 486 (FAS 486) from Columbia Falls and

extends to the north for some 9.6 miles to the junction of the Blankenship Bridge Road. The route then continues north for 13 miles via Forest Highway 61, located along the west side of the North Fork of the Flathead River, to the Camas Creek Entrance of Glacier National Park. The route then extends southeasterly for 13 miles from the Camas Creek Entrance to US 2 at West Glacier. The total length of this alternate route is approximately 36 miles. About 25 of the 36 total miles on this route are paved. The Camas Creek Road in Glacier National Park is closed during the winter.

The other alternate route also follows FAS 486 from Columbia Falls to the Blankenship Bridge Road. The route then extends easterly along Blankenship Bridge Road for some 6 miles before joining US 2 south of West Glacier. Approximately 10 miles of the 15.6 mile-long route are paved.

5. BUILD ALTERNATIVES

Location Alternatives - The alternatives considered for the proposed action also include improving US 2 within its existing highway corridor and reconstructing the highway on a new location. The environmental impacts of the proposed action will vary depending upon the location of the highway in the project area. **A road built on a new location in an area previously unaffected by construction is likely to produce greater environmental impacts than a project that reconstructed the road within its existing corridor.**

Inherent with the consideration of **some** location alternatives **identified below** is the modification or replacement of the existing bridge over the South Fork of the Flathead. **If the proposed highway is built on a new location or its alignment within the existing highway corridor** changes, a new bridge **must be provided.** If the highway were improved following the existing alignment, the bridge could be modified or reconstructed in-place.

The location alternatives considered for the proposed action included:

- Construct the Road on an Entirely New Route
- Reconstruct the Road Following the Existing Horizontal and Vertical Alignment
- Improve the Alignment Within the Existing Highway Corridor
- Other Location Alternatives

These location alternatives are discussed in the following paragraphs.

CONSTRUCT THE ROAD ON AN ENTIRELY NEW ROUTE

This location alternative would construct US 2 along an entirely new route between Columbia Heights and Hungry Horse. Such an alternative would require that the highway be reconstructed on the north side of the Flathead River or some distance south of the existing highway. A new route located north of the Flathead River would cross the steep terrain of Teakettle Mountain, encounter an existing railroad line, and would likely require more than one new crossing of the Flathead River. A new route to the south of the existing highway corridor, would pass through the steep terrain of Columbia Mountain and require a new bridge across the South Fork of the Flathead River.

RECONSTRUCT THE ROAD FOLLOWING THE EXISTING ALIGNMENT

This alternative would construct a new highway along the same alignment as the existing facility. The alternative would provide a wider roadway, but it would not change the hori-

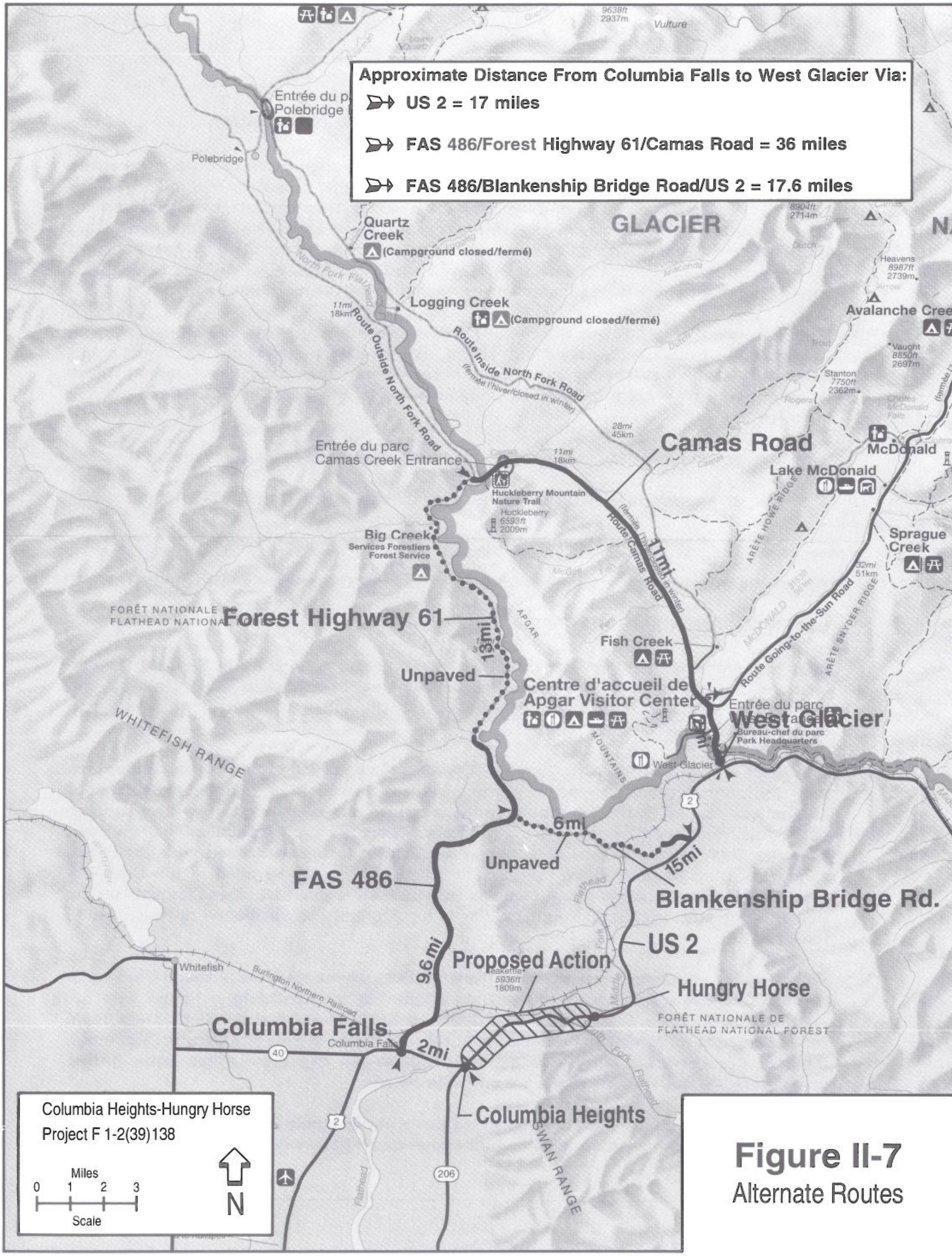


Figure II-7
Alternate Routes

zontal and vertical curves that presently exist in the corridor.

IMPROVE THE ALIGNMENT WITHIN THE EXISTING HIGHWAY CORRIDOR

This alternative would modify the horizontal and vertical alignments of US 2 to meet the geometric standards for a 60 mph design speed. The alternative would produce minor changes in the location of the highway. The work required to reconstruct the highway would generally happen within the existing highway corridor, however, variations from the existing alignment would occur where vertical and horizontal curves are modified to meet the sight distance requirements for the selected design speed. New right-of-way would be required where alignment shifts vary substantially from that of the existing highway.

Reconstruction of US 2 would generally follow the existing centerline from Columbia Heights to the House of Mystery. Minor variations from the existing alignment would occur between the House of Mystery and Hungry Horse where curves would be flattened. Three location options for US 2 in Badrock Canyon were identified for the EIS. These options included:

- an alignment to avoid or minimize the placement of fill in the Flathead River;
- an alignment to avoid or minimize impacts on Berne Memorial Park; and
- an alignment to minimize the impacts to the river and the park.

The alignment variations considered for US 2 in Badrock Canyon are shown in FIGURE II-8.

OTHER LOCATION ALTERNATIVES

Scoping comments identified several other location options for US 2 in Badrock Canyon including the construction of a tunnel, the development of US 2 as a tiered roadway, and building US 2 on piers in the Flathead River. Additional discussion of these location alternatives follows.

Construct a Tunnel in Badrock Canyon - The idea of constructing a two-lane or four-lane tunnel through Badrock Canyon initially received consideration during the development of alternatives for the Draft EIS. Incorporating a tunnel was mentioned in written scoping comments on alternatives and in followup letters received before the publication of the Draft EIS. The Draft EIS addressed a tunnel as an alternative that had been considered but eliminated from consideration. Reasons for eliminating a tunnel cited in the Draft EIS included high construction costs, complex construction requirements, and impacts on the use of Berne Memorial Park. No cost estimate for a tunnel was developed or presented in the Draft EIS.

Following the circulation and review of the Draft EIS, comments were received from some members of the public indicating that an alternative incorporating a tunnel was not sufficiently addressed in the document. Comments also stated that such an option could reduce impacts to Berne Memorial Park and other features of Badrock Canyon. Therefore, the incorporation of a tunnel as a design option for this project has been further investigated. These investigations are on file in Helena.

Public comments on the Draft EIS suggested that a one-half mile-long tunnel could be built to accommodate the eastbound lanes of the four-lane highway designs. This would allow

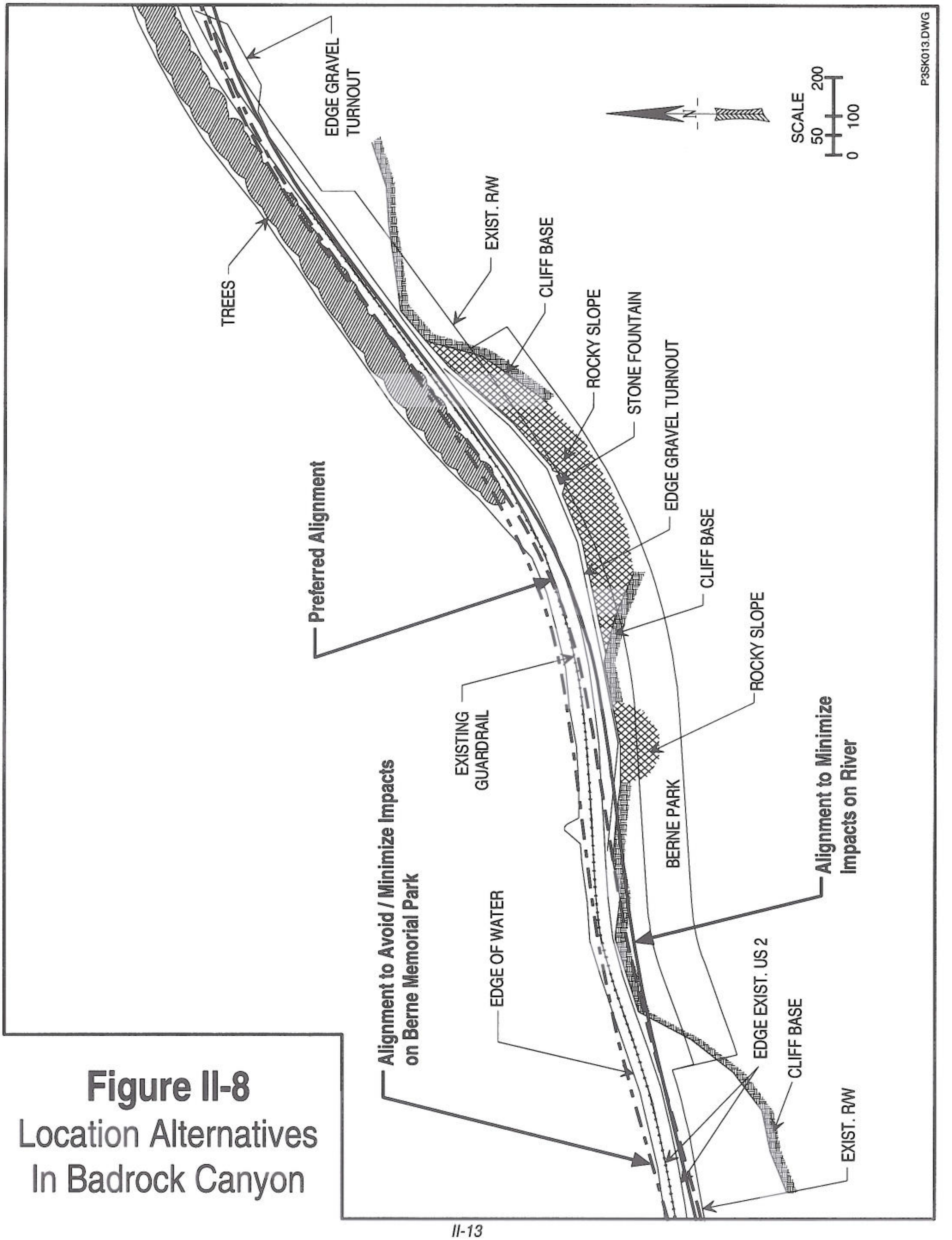


Figure II-8
Location Alternatives
In Badrock Canyon

the westbound lanes of US 2 to be reconstructed following an alignment similar to that of the existing highway.

Due to the terrain of the project area, it is likely that a tunnel to serve eastbound traffic would have to be longer than one-half mile as suggested by public comments. Investigations of potential alignments for a tunnel, suggest that the minimum length for such a facility would be closer to 3,750 feet. The maximum length of a tunnel, if the facility was constructed directly through Columbia Mountain, would be about 6,300 feet. FIGURE II-9 shows potential locations for a tunnel.

The following assumptions were made about including a tunnel in Badrock Canyon:

- **The minimum length for a tunnel was assumed to be 3,750 feet, not 2,640 feet as suggested by public comments on the Draft EIS.**

- **The tunnel would be two-lanes wide and designed to accommodate the eastbound lanes of a four-lane facility. The tunnel would require a ventilation system to exhaust vehicle emissions.**

- **Hard-rock boring would be the excavation technique used for the facility. Tunneling could not be accomplished from the surface due to the limestone, dolomite, and argillite formations of Columbia Mountain. In general, hard-rock tunneling is less costly than using soft-earth methods.**

- **Costs for constructing the tunnel were estimated on a cost per lineal-foot basis. Overall construction cost totals for applicable tunnel projects in other states were used to estimate all costs associated with a tunnel (construction materials, labor, ventilation system, etc.) in Badrock Canyon.**

- **The costs estimated for a tunnel through Badrock Canyon strictly apply to the tunnel and do not include the costs of reconstructing the westbound travel lanes.**

- **Accommodating four travel lanes of US 2 in a tunnel would likely be accomplished by constructing separate, but parallel tunnels for the eastbound and westbound travel lanes.**

Highway agencies in California, Colorado, Minnesota, and Washington were contacted to obtain information on the construction, design, and costs of tunneling associated with recent projects. The cost information provided by other highway agencies was reviewed to determine an appropriate estimate for providing a tunnel with US 2 reconstruction between Columbia Heights and Hungry Horse. Based on this information, the low estimate was $12,400/lineal foot and the high estimate was $18,200/lineal foot for tunnels capable of housing two travel lanes.

Some public comments received on the Draft EIS recommended that a portion of a 230-kV electric transmission line proposed for reconstruction by the Bonneville Power Administration (BPA), be placed within the highway tunnel. This would eliminate the support towers for the lines that exist in the cliffs above US 2 in Badrock Canyon.

Contacts with the BPA indicated that is technically feasible to place the 230-kV electrical transmission lines underground or in a tunnel. Such an alternative would also require that "mini" substations be constructed at either end of the buried section of transmission line

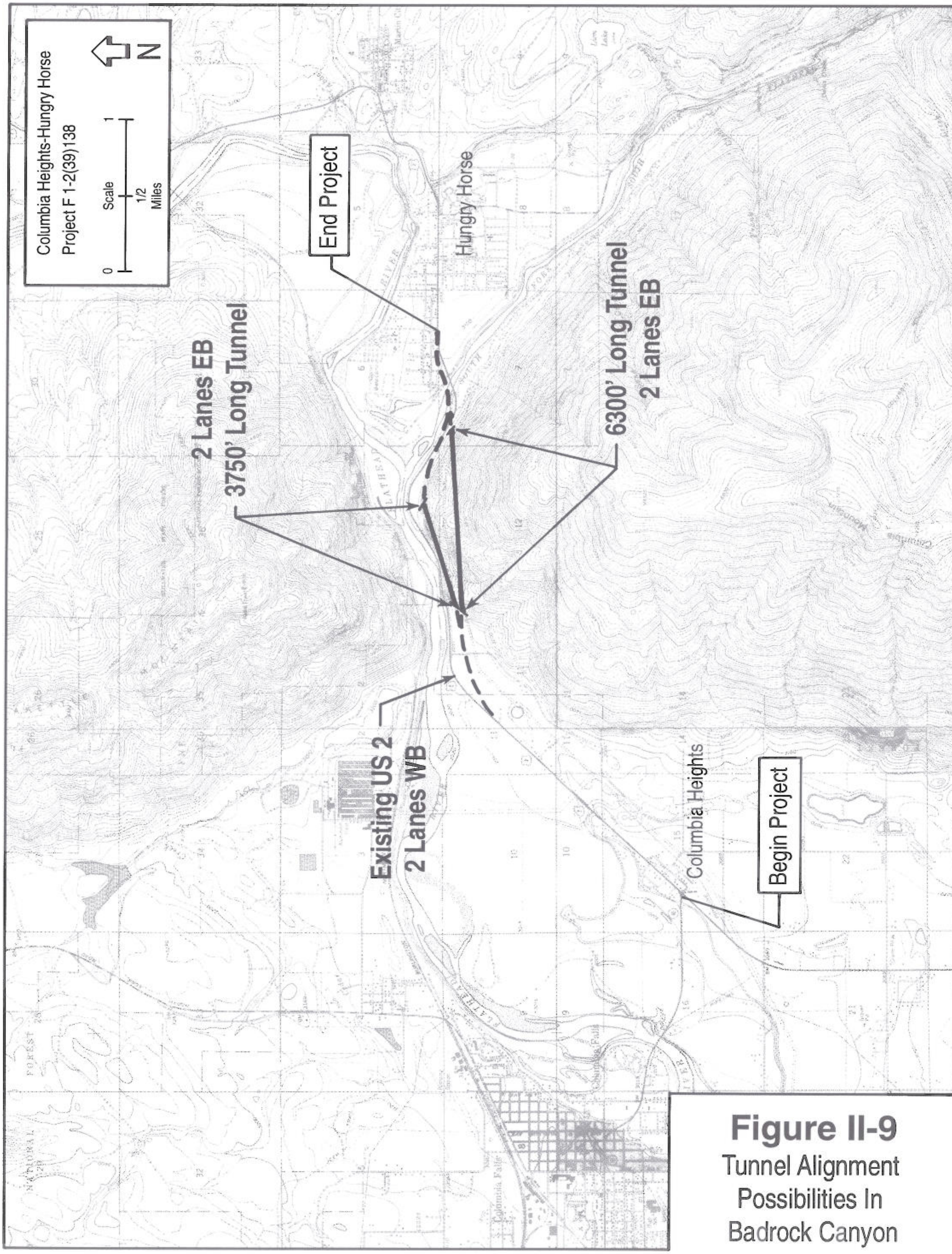


Figure II-9
Tunnel Alignment Possibilities In Badrock Canyon

to convert the electrical energy to voltages that can be readily transmitted. Based on "very rough" estimates provided by BPA, the minimum cost of placing the lines underground or in a tunnel through Badrock Canyon would be $4.5 million.

In September, 1993, the BPA approved an Environmental Assessment and Finding of No Significant Impact (FONSI) which examined alternatives for rebuilding and relocating the Hungry Horse-Columbia Falls electrical transmission line and associated environmental impacts. The BPA's Environmental Assessment for the reconstruction project indicated that placing the transmission lines underground or within a tunnel for US 2 (should one be provided) was eliminated from consideration due to the excessive costs of such actions. Since the BPA's proposed project would not place the electrical transmission lines underground or in a tunnel, further consideration in this EIS is unnecessary.

Develop US 2 as a Grade-Separated Roadway in Badrock Canyon - Several comments received from the public during scoping activities suggested that if four-lanes are required for US 2, the new highway should be built as grade-separated roadway through Badrock Canyon. This would require that a structure be built to support two of the traffic lanes for US 2.

Close US 2 - A public comment made during scoping for the proposed action suggested that US 2 be closed entirely. Closure of the route would eliminate the need for a large amount of public funds to be spent and would minimize the likelihood of further environmental impacts due to road construction. The closure of the route would disrupt traffic flows on this element of the National Highway System.

Design Alternatives - Design alternatives refer to the various lane configurations and other features that would be developed with the proposed highway. The design alternatives initially identified for the proposed action were developed after reviewing the designs used for reconstruction projects on other nearby segments of US 2 and discussing design options with the FHWA and the public. Several four-lane road design configurations (an 88-foot wide four-lane and a 64-foot wide four-lane with 6-foot shoulders and a 4-foot median) were obvious since adjacent portions of US 2 were recently reconstructed as four-lane facilities. The terrain in Badrock Canyon, the proximity of the Flathead River, the presence of an important local park, cost considerations, and public expectations require that two-lane road configurations also be examined for this proposal.

Guidelines recommended by AASHTO and design standards contained in the *Geometric Design Standards* (1992) identify most of the features that must be included with the proposed development of this rural principal arterial highway. These sources also identify the size of traffic lanes, shoulders, or medians that are included with such highways.

APPENDIX 1 presents the design elements and controls that apply to two-lane and four-lane rural arterials. Based on these guidelines, four road design alternatives listed below were developed for the proposed action. These design alternatives were considered in addition to the designs used for adjacent reconstruction projects on US 2. These alternatives have been assigned numbers for convenient reference.

ALTERNATIVE 1: FOUR-LANE ROAD WITH MEDIAN/LEFT TURN LANE

The width of the roadway surface for this alternative would range from 78 feet in areas where a median/left turn lane is provided to 64 feet wide in other rural portions of the corridor. The typical features of the undivided four-lane sections of the alternative would consist of four 12-foot lanes and two 8-foot shoulders. A 14-foot median/left turn lane would be provided in appropriate locations.

ALTERNATIVE 2: FOUR-LANE ROAD WITHOUT MEDIAN/LEFT TURN LANE

This design would have a 64-foot-wide roadway surface that consists of four 12-foot lanes and two 8-foot shoulders. A median/left turn lane would not be included with this design.

ALTERNATIVE 3: TWO-LANE ROAD WITH MEDIAN/LEFT TURN LANE

The alternative would have a surface width ranging from 58 feet wide in areas where a median/left turn lane is provided to 44 feet wide in rural areas. The design would include two 12-foot lanes and two 10-foot shoulders. If necessary, a 14-foot median/left turn lane would be provided as necessary at major approaches in the corridor.

ALTERNATIVE 4: TWO-LANE ROAD WITHOUT MEDIAN/LEFT TURN LANE

This alternative would provide a 44-foot wide roadway surface consisting of two 12-foot lanes and two 10-foot shoulders. No median or left turn provisions would be considered in this design.

<u>Design Modifications Considered for US 2 in Badrock Canyon</u> - Due to steep terrain, the presence of a roadside park, and the proximity of the Flathead River in Badrock Canyon, building US 2 on some locations would require the placement of fill in and along the river. The extent of fill placed in the river channel would depend mainly on the location of the new road and the design of slopes adjacent to the road. Ratios are commonly used to describe the steepness of slopes and provide a means for comparing the horizontal dimension to the vertical dimension of the slope. Therefore, an embankment constructed to a 2:1 slope would have one foot of vertical rise for every two feet of horizontal distance. The use of embankments with 1.5:1 or 2:1 slopes faced with rock (riprap) is a typical design used for roadside areas next to surface waters.

Several other design approaches are possible to reduce or eliminate the placement of fill materials in the river. These approaches include:

- Using Steepened Embankments (1:1 Slopes)
- Using Vertical Retaining Walls
- Using Structures to Support Part of Road (Cantilevered or Bridge Support System)

These measures are discussed individually in the paragraphs below.

STEEPENED EMBANKMENTS

Reinforcement can be used to mechanically stabilize the embankments allowing for the construction of steeper fill slopes (up to 1:1). Geogrids, made of polymers, are placed between lifts of backfill material to create a structurally stable mass. The steepened embankment slopes can be designed to blend with existing ground contours and vegetated for erosion control and improved aesthetics. Riprap or a gabion mat (Reno mat) could be installed as a measure to control erosion where embankments encounter water.

FIGURE II-10 illustrates the typical components of a steepened slope employing geogrid material between successive lifts of backfill.

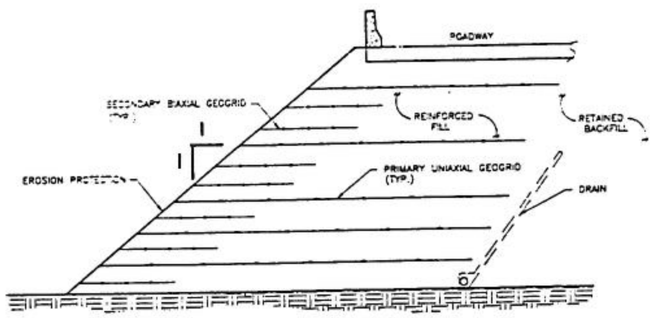


Figure II-10
Steepened Embankment

VERTICAL RETAINING WALLS

Several types of vertical walls to retain embankments and support the road are possible including: mechanically stabilizing the backfill and using gabion facing (see FIGURE II-11a) or precast facing panels (see FIGURE II-11b), gravity gabion walls (see FIGURE II-11c), and conventional cast-in-place reinforced concrete walls (see FIGURE II-11d). Retaining walls that employ reinforcing mesh to mechanically stabilize backfill placed behind the wall are commonly referred to as "reinforced earth", "retained earth" or "mechanically stabilized embankment" (MSE) walls.

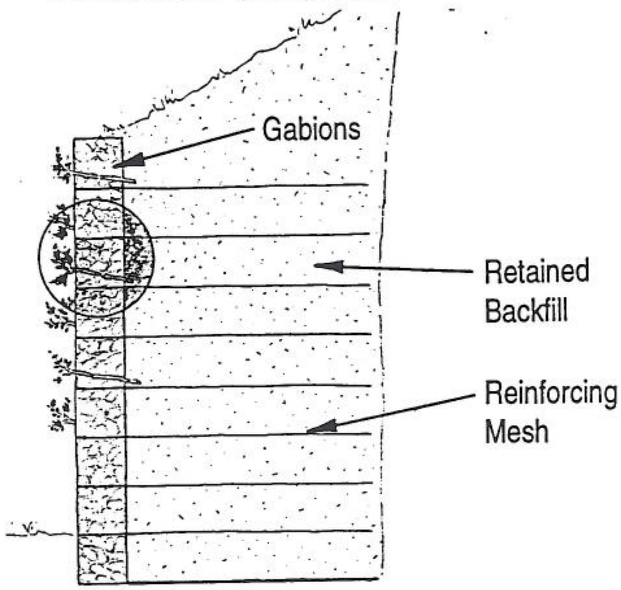


Figure II-11a
Vertical Retaining Wall
With Gabion Facing

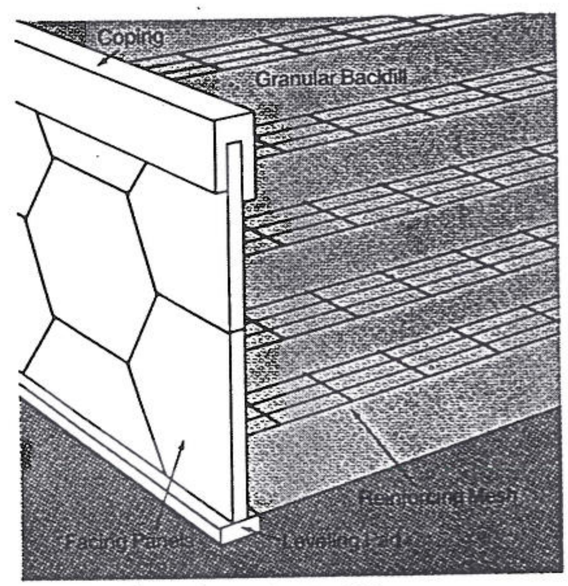
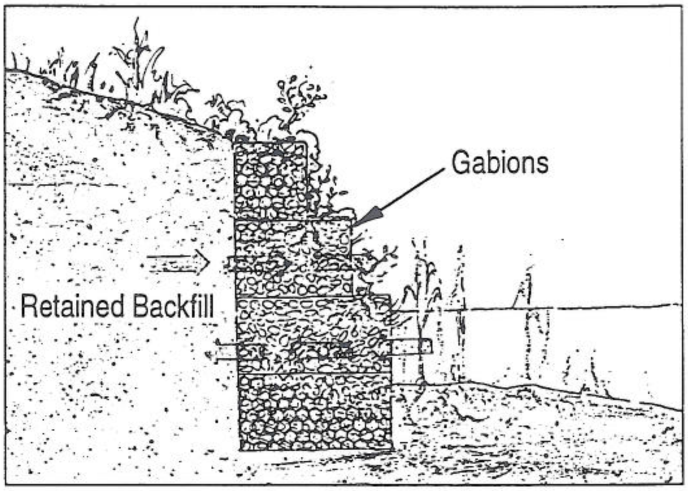


Figure II-11b
Vertical Retaining Wall
With Precast Facing Panels

Gravity type retaining walls rely upon the mass of the wall itself to hold retain backfilled material and typically do not include measures to reinforce the backfill. Such walls may be constructed of gabions, cast-in-place concrete, or metal or concrete cribs. FIGURE II-11 (c and d) show typical examples of gravity walls.

Figure II-11c

Gravity Gabion Wall



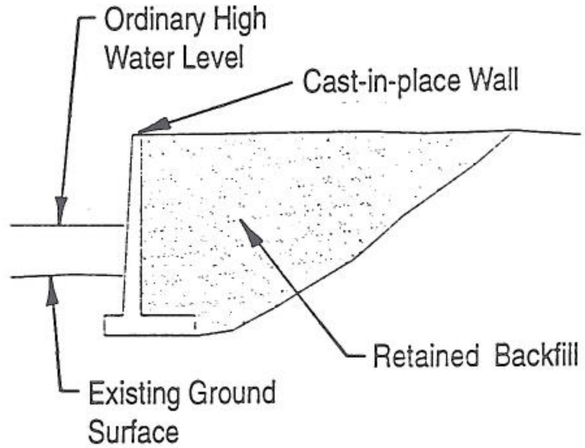


Figure II-11d

Cast-in-place, Reinforced Concrete Retaining Wall

STRUCTURES

Fill embankments that would extend into the river channel could be replaced by a structure to support the roadway. This could be accomplished by employing piers to support a bridge superstructure and deck or by using cantilevered support structures, like the project at Goatlick on US 2 (see FIGURE II-12). Shafts would be drilled along the river bank to accommodate the construction of reinforced concrete piers supporting the roadway.

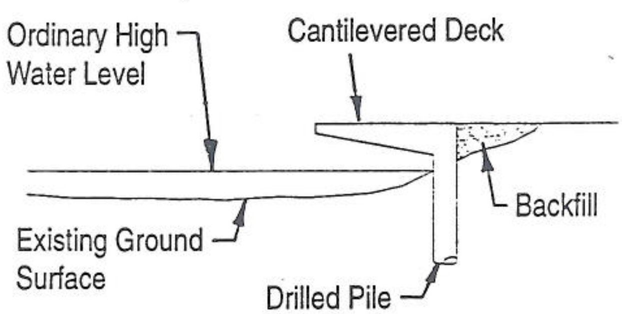


Figure II-12

Bridge Structure - Cantilevered Type

A total of ten design alternates for US 2 in Badrock Canyon were initially considered. These design alternates employed steepened embankments, vertical retaining walls, structures, or combinations of these elements. The alternates identified below address specific design modifications that could be implemented between Project Stations 590+00 and 620+00, the area directly opposite Berne

Memorial Park.

<u>Alternate 1</u> - Use embankments and riprap-faced fill slopes as proposed in the Draft EIS.

<u>Alternate 2</u> - Use steepened embankments only in areas where the fill would be placed below the ordinary high water mark. Riprap fill slopes as originally proposed in the Draft EIS would be used elsewhere.

<u>Alternate 3</u> - Use a vertical retaining wall only in area where the fill would be placed below the ordinary high water mark. Riprap fill slopes as originally proposed in the Draft EIS would be used elsewhere.

<u>Alternate 4</u> - Use steepened embankments along the entire length through Badrock Canyon.

<u>Alternate 5</u> - Use a vertical retaining wall in the area where steepened embankments would encroach on the ordinary high water mark and use steepened embankments through the remainder of the area.

<u>Alternate 6</u> - Use vertical retaining walls along the entire length through Badrock Canyon.

<u>Alternate 7</u> - Use a 350-foot long structure in areas where the placement of fill would encroach on the ordinary high water mark. Construct a vertical retaining wall at each end of the structure and use steepened embankments along the remainder of the road segment.

<u>Alternate 8</u> - Use a 350 foot-long bridge structure in places where a vertical retaining wall would encroach on the river and use vertical retaining walls along all the remainder of the road segment.

<u>Alternate 9</u> - Use a 750 foot-long structure and steepened embankments along the remainder of the road segment.

<u>Alternate 10</u> - Use a 750 foot-long structure and vertical retaining walls along all other segments of this road section.

Some of the alternates reduce the encroachment on the river channel, while others eliminate it entirely. Best engineering judgement was used to identify reasonable design alternates for this area. For example, although it is technically feasible to design and build a structure to support all of the roadway through the Canyon, the primary benefits of such a design alternate (reducing the encroachment and impacts on riparian vegetation) may be accomplished by other less expensive designs. The alternates identified for this study are those that provide notable reductions in the encroachment and that are reasonable to consider implementing with the proposed action.

Similar design measures were considered to reduce the minor encroachment on the Flathead River west of Fisherman's Rock included with the reconstruction proposals in the Draft EIS.

A complete report identifying the design alternates considered for US 2 in Badrock Canyon is on file in Helena.

D. Alternatives Eliminated from Consideration

1. TSM ALTERNATIVE

TSM alternatives were eliminated from consideration for this proposed action because many of the measures do not address **the** fundamental geometric deficiencies (substandard horizontal and vertical curves) of the existing facility **and its inability to provide an acceptable level of service throughout the foreseeable future.** Added capacity is needed throughout the corridor, not just in spot locations. Increasing the number of lanes to add capacity without improving other design features or geometrics would not be prudent.

During the most heavily traveled months, much of the traffic in the corridor is comprised of visitors **traveling through** the area. It is unrealistic to assume that transit, prearranged ride-sharing, or rescheduling visits for less congested times would meet the unique needs and itineraries of these facility users.

For the above reasons, **the TSM alternative is not** a reasonable alternative and **was** eliminated from further consideration.

2. MASS TRANSIT

No mass transit services, other than those offered by interstate passenger carriers, **presently exists** in the project area. **The mass transit alternative for the proposed action was eliminated from consideration because current and future land use densities in the project area would not provide sufficient ridership for a mass transit alternative.** Sufficient numbers of people who cannot provide their own transportation do not **reside in or near the project area for transit services to be economically implemented in** the corridor. The primary use of US 2 is for travel to destinations outside of the project area. Implementation of mass transit to serve only the corridor would not address the needs of most facility users.

Further, this alternative is not responsive to the project purpose and need as current safety and substandard geometric conditions would remain.

3. ALTERNATE ROUTES

The alternate routes identified previously in this Part are most responsive to the travel desires of motorists with destinations outside of the project area. Since the length of the alternate routes and the related travel times are much greater than if US 2 were used, it is unlikely that residents of the project area would elect to use such routes. Similarly, facility users wishing to travel on the shortest and most efficient travel route through the area would use US 2 instead of alternate routes.

The alternate route employing FAS 486, Forest Highway 61, and Camas Road in Glacier Park would require motorists traveling between Columbia Falls and West Glacier to drive 36 miles instead of 17 miles if US 2 were used. The distance of the route between Columbia Falls and West Glacier via FAS 486 and Blankenship Bridge Road is similar to that following US 2 between these points. However, using both routes would require that motorists travel over paved and unpaved roads that are designed to lower standards than that of US 2. Portions of the alternate routes have narrower road surfaces, sharp curves, and sight distance limitations.

The alternate routes are also not maintained to the same standards as US 2. The level of winter maintenance activities devoted to Forest Highway 61 and the Blankenship Bridge Road is considerably less than for US 2. Camas Road in Glacier National Park is closed during the winter months.

Because of the differences in mileage and travel conditions on alternate routes, it is unlikely that substantial reductions in traffic on US 2 could be realized. This alternative is not responsive to project purposes and needs because substandard geometric conditions would remain in the project corridor. Alternate routes would not effectively link or provide design continuity between previously reconstructed portions of US 2. For these reasons, this alternative was eliminated from further consideration in the EIS.

4. LOCATION ALTERNATIVES ELIMINATED FROM CONSIDERATION

Construction on an Entirely New Route - Constructing the highway on an alternate route is not a reasonable alternative because the environmental impacts of developing a new highway corridor would far exceed those associated with improving the existing alignment. Steep mountain terrain and/or sensitive wildlife habitat **on Teakettle and Columbia Mountains** would be encountered by **substantially** shifting the corridor to the north or south.

If the road's location were shifted to the north side of the Flathead River, two new crossings of the river would be required between Columbia Heights and Hungry Horse. Unless Hungry Horse were bypassed, a long bridge spanning the Middle Fork of the Flathead River would be required to provide access to the community. This crossing would lie within the floodplain of the Middle Fork of the Flathead River and would likely affect features associated with the Middle Fork Recreational River segment. Conflicts with Burlington Northern Railroad facilities would also occur if the road were to be constructed on the north side of the river.

If a new route were developed, the existing **section of US 2** would have to remain in service for businesses and local residents that currently use the facility. **Continued expenditures of labor and funds would be necessary to keep the old route in service.**

Reconstruction Following the Existing Horizontal and Vertical Alignment - This location alternative was eliminated from consideration because the existing alignment has both horizontal and vertical curves that do not meet the criteria for a 60 mph design. **Constructing a wider roadway and perpetuating substandard curves is not prudent.**

<u>Alignment Options in Badrock Canyon</u> - **Two of the three alignment options identified for US 2 in Badrock Canyon were eliminated from consideration due to their potential impacts on the features of the Canyon and/or their high costs. Building a new road on an alignment to avoid or minimize the placement of fill in the Flathead River was eliminated because it would affect nearly all features of Berne Memorial Park and require that excavation of the eastern and western rock outcrops at the park. The spring and the parking area at the park would be completely eliminated with an alignment to avoid the river.**

Likewise, building on an alignment to avoid the park was dropped from consideratin because it would require extensive amounts of construction in the Flathead River. To totally avoid the park, the new road would have to be cantilevered above the river or built on piers in the river for at least 2,300 feet. Constructing US 2 on this alignment would remove substantial amounts of riparian vegetation and affect wetlands located in the floodplain. The total costs of building US 2 on such an alignment are estimated to be about $29.6 million, at least two times higher than other build alternatives being considered for the proposed action.

<u>Incorporating a Tunnel in Badrock Canyon</u> - **Based on the investigations of recent highway projects that included tunnels and the assumptions about building a tunnel in Badrock Canyon discussed earlier in this Part, the construction costs for a 3,750 foot-long tunnel are estimated to range from $46.5 million to $68.3 million. The costs for building tunnels to accommodate four travel lanes of**

US 2 are estimated to range from $93.0 million to $136.6 million.

US 2 is part of the Interim National Highway System (NHS) designated under the provisions of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). Excluding the Interstate System, the NHS consists of some 2,100 miles of principal arterial roads in Montana. Estimates place Montana's total apportionment of federal funds for the NHS at about $36.2 million for 1993 and successive years covered by the legislation. The federal share of NHS-eligible projects is 86.58 percent. The State must provide the remainder of the funds for such projects. The estimated cost of a tunnel in Badrock Canyon is extraordinary, given the limited financial resources available to the State of Montana.

To appreciate the magnitude of a tunnel's cost, such a facility would require a commitment of funds equal nearly two years of Montana's total apportionment for the NHS. In another perspective, the costs of building a tunnel in Badrock Canyon would be roughly equal to the costs of completely reconstructing between 70 and 102 miles of typical rural two-lane road in Montana.

Applying these same correlations to the development of tunnels to accommodate both eastbound and westbound traffic, a commitment equal to more than three and one-half years of the total federal funding apportionment for the entire NHS would be necessary. The cost of twin tunnels would be roughly equivalent to the cost of totally reconstructing 140 to 204 miles of typical rural two-lane road in Montana.

Some members of the public, aware of the high costs of tunnels, suggested that tolls be charged for users of the tunnel as a means of paying for the facility. Calculations show that about 1.04 million eastbound vehicles passed through the project corridor during 1992. This figure is projected to increase to about 1.61 million vehicles annually by the design year. Assuming a toll of 50 cents per vehicle was established for the use of the tunnel, some $522,000 would be generated each year based on current traffic volumes. With the projected traffic volume increases in the corridor, the annual revenue from the toll would be expected to increase to more than $800,000 by the design year. If the tunnel in Badrock Canyon cost $46.5 million and a toll for using the facility generated an average of $650,000 each year through the design year, only $11.7 million (about 25% of the initial construction cost) would be generated from a toll by the year 2010.

Several comments on the Draft EIS stated that providing a tunnel would be a way to avoid impacts to Berne Memorial Park and the Flathead River in Badrock Canyon. While a tunnel may reduce impacts by limiting the extent of construction in the vicinity of these features, there are concerns about other potential impacts resulting from such an action. It is conceivable that boring through a portion of Columbia Mountain could disrupt the flow of water at the spring in Berne Memorial Park. Note that this concern is raised without the benefit of detailed hydrogeological investigations about this water source.

Park users approaching from the west would be forced to drive to Hungry Horse and travel back to the park, unless an access road to the park is provided for eastbound motorists. A connecting road between the eastbound and westbound travel lanes or a separate one-way access route to the park for eastbound traffic would be needed to provide convenient access for all potential users of the park. A park access road would have to be provided at a location before motorists entered the tunnel or after they left the tunnel. Construction of such a road could itself be the source of major environmental impacts given the terrain and sensitive features of the Canyon.

Substandard geometric conditions are present along the existing alignment that would be used by westbound traffic. Modifying the existing alignment to address these substandard conditions may impact the rock outcrops at the park, affect other features of the park, or encroach on the Flathead

River or associated riparian areas.

For the reasons discussed above, including a tunnel with the reconstruction of US 2 through Badrock Canyon was eliminated from consideration. Clearly, the major funding commitment required to build a tunnel in Badrock Canyon is unreasonable in light of equally important needs for reconstructing other segments of the National Highway System in Montana.

Develop US 2 as a Grade-Separated Roadway in Badrock Canyon - The construction of a grade-separated roadway in Badrock Canyon was identified by the public as a measure that should be incorporated with the four-lane road designs in Badrock Canyon. This measure was suggested as a way to minimize or avoid impacts on the Flathead River and Berne Memorial Park by reducing the extent of road widening near these features. A structure would be used to elevate two travel lanes of the facility while the other travel lanes would be constructed beneath the structure.

This alternative would eliminate the use of the roadside park for motorists on the elevated section of the facility and would obstruct views for park users. The costs of building a grade-separated facility in Badrock Canyon would be considerably more expensive than those of a conventional highway due to the length of the structure, the structure's complex design which would incorporate multiple horizontal curves, and the structure's maintenance requirements. For these reasons, this alternative was eliminated from consideration.

Close US 2 - An alternative to close US 2 was eliminated from further consideration because it would disrupt traffic on an important segment of the state and national highway system. The highway is the only continuous east-west route in northern Montana and is one of the few such routes in the northern United States. US 2 is part of the recently designated Interim National Highway System created by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). This designation attests to the important role the facility plays in the State and national surface transportation network.

5. ROAD DESIGNS ELIMINATED FROM CONSIDERATION

Design Alternatives Eliminated from Consideration - Design standards for two-lane rural arterials with traffic characteristics similar to those on US 2 indicate that the minimum two-lane road should have two 12-foot lanes and two 10-foot shoulders for a total width of 44 feet. Therefore, road designs with typical sections less than the accepted minimum width of 44-feet are not reasonable alternatives for the proposed action and were eliminated from further consideration.

The 88-foot four-lane that exists immediately west of the project area included a 20-foot-wide median/left turn lane. AASHTO indicates that flush median widths of between 10 and 16 feet provide the optimum design for two-way left turn lanes (4). The operational and safety benefits provided by a 20-foot wide median/left turn lane were not substantially greater than those offered by an alternative which incorporates a 14-foot wide median/left turn lane. However, the costs and impacts (particularly in Columbia Heights and in Badrock Canyon) associated with construction of an 88-foot wide section would be substantially greater than the other four-lane designs considered in the EIS.

The 64-foot-wide four-lane that exists to the east of the project area included four 12-foot-wide travel lanes, a 4-foot wide painted median, and 6-foot wide shoulders. Providing shoulders less than 8 feet wide on a roadway with traffic volumes like that present on this portion of US 2 is not consistent with guidelines presented in AASHTO's *A Policy on Geometric Design of Highways and Streets* (5).

The two-lane highway designs, identified as Alternatives 3 and 4, are not reasonable alternatives for the proposed action because they fail to meet critical aspects **of the purpose and need** described in Part I of the EIS. These two-lane alternatives were eliminated from consideration because the designs will not meet future operational requirements for the facility. **Even though Alternatives 3 and 4 are not reasonable alternatives for the proposed action, the** costs, benefits, operational characteristics, and environmental impacts of **these alternatives are discussed** in the EIS due to public expectations and to document that detailed analyses were completed for **each alternative.**

<u>Design Modifications in Badrock Canyon Eliminated from Consideration</u> - Design modifications for US 2 in Badrock Canyon were evaluated in a separate report (6). The purpose of this report was to identify design measures (slope treatments) that would reduce the encroachment on the Flathead River in Badrock Canyon. The report evaluated a total of ten design alternates for US 2 in Badrock Canyon using steepened embankments, vertical retaining walls, or structures and combinations of these features. The design alternates considered for US 2 in Badrock Canyon are identified below in TABLE II-3.

TABLE II-3
COMPARISON OF ALTERNATE DESIGN MEASURES FOR US 2 IN BADROCK CANYON

	Design Alternate	Estimated Additional Cost	% Reduction of Encroachment
1.	Riprap Fill Slopes (Draft EIS Proposal)	N/A	N/A
2.	Steepened Embankments and Riprap Fill Slopes	$472,000	37%
3.	Vertical Retaining Wall and Riprap Fill Slopes	$420,000	78%
4.	Steepened Embankments for Entire Length	$665,700	37%
5.	Vertical Retaining Walls and Steepened Embankments	$606,900	78%
6.	Vertical Retaining Wall for Entire Length	$650,500	78%
7.	350' Long Structure, Vertical Retaining Walls, and Steepened Embankments	$2,192,200	100%
8.	350' Long Structure and Vertical Retaining Walls	$2,226,000	100%
9.	750' Long Structure, Vertical Retaining Walls, and Steepened Embankments	$4,069,800	100%
10.	750' Long Structure and Vertical Retaining Walls	$3,994,600	100%

TABLE II-3 presents estimates of the additional cost to the project if the design alternates were constructed instead of the riprap-faced embankments (Design Alternate 1) proposed in the Draft EIS. The table also compares the volume of fill that would be placed below the ordinary high water (encroachment) for the design alternates with the amount required by the riprap-faced embankments (Design Alternate 1) proposed in the Draft EIS. For example, the amount of fill

material that would be placed below the ordinary high water mark with Design Alternate 2 would be 37% less than that of the design proposed in the Draft EIS. A 100% reduction means that the measure would eliminate the encroachment entirely.

The report examining these design alternates considered hydraulic and floodplain effects, the impact on riparian vegetation, and the effects on visual resources, in addition to the cost and extent of the encroachment. These findings of the report are summarized below.

Each of the design alternates considered would reduce the amount of encroachment on the river as compared to the alternative proposed in the Draft EIS. Reducing the encroachment also decreases the potential for adverse hydraulic and floodplain effects. The alternates that eliminated the encroachment would have the least hydraulic and floodplain impacts.

Of the alternates considered, the construction of riprap-faced embankments as proposed in the Draft EIS (identified as Design Alternate 1 above) would impact riparian vegetation in Badrock Canyon to the greatest extent. This alternate would eliminate most riparian vegetation for more than 1,100 feet along the riverbank. Similar impacts would occur with Alternates 2 and 3 since the use of steepened embankments or a retaining wall would be included only where fill would be placed below the ordinary high water mark, an area where little vegetation presently exists.

Alternates with steepened embankments through the area of encroachment (Alternates 4, 5, 7, and 9) would reduce impacts to riparian vegetation. At best, the construction of steepened embankments would leave narrow (15-20 feet wide), isolated bands of vegetation through this area. The option would also remove most vegetation for about 550 feet along a portion of the riverbank.

Design alternates with a vertical retaining wall (Alternates 6, 8, and 10) would produce the least impact on the riparian vegetation that exists opposite Berne Memorial Park. A vertical retaining wall would leave isolated, but wider (20-30 feet) bands of vegetation and would remove most vegetation for about 400 feet of the bank area.

The structures associated with Alternates 7, 8, 9, and 10 span areas where open water exists or where little riparian vegetation exists.

The primary visual impact associated with any of the design alternates is the alteration of the riverbank area opposite Berne Memorial Park. As indicated above, each alternate would remove varying amounts of the riparian vegetation that exists in the area and most would include some construction in the Flathead River. Alternates incorporating vertical retaining walls would produce the least impact on the vegetation between the new roadway and the river.

Alternate 1 would remove the most vegetation and require the most construction in the river of the alternates examined. The resulting riverbank area would appear similar to the existing riverbank west of Fisherman's Rock where fill was placed with previous road construction. This area has steep banks with exposed rocks and little vegetation.

The report concluded that design alternates employing riprap-faced embankments (Alternates 1, 2, 3) and steepened embankments (Alternates 4 and 5) should be eliminated from further consideration due to the extent of encroachment and the impact on riparian vegetation. Alternates that incorporated structures and steepened embankments (Alternate 7 and 9) were also eliminated because their costs were substantially higher than other options and because of their adverse impacts on riparian vegetation.

Evaluations show that Design Alternates 6, 8, and 10 would minimize or eliminate the encroachment

in Badrock Canyon. This was not considered to be a substantial concern in this instance because calculations indicate that adverse hydraulic and floodplain effects are not likely to occur with the construction of any alternate. These alternates would impact riparian vegetation the least of the options considered and to the same extent. Although Alternates 8 and 10 would completely eliminate the encroachment, the costs of these options are 3.5 and 6 times higher than the cost of Alternate 6. Therefore, Alternates 8 and 10 were eliminated from consideration due to their higher costs.

Alternate 6, construction of a vertical retaining wall along the Flathead River, was ultimately recommended as the preferred slope design modification for US 2 in this part of Badrock Canyon.

E. Reasonable Alternatives

1. BUILD ALTERNATIVES

Reasonable Location Alternatives - The only reasonable location alternative for the proposed action is to **Improve the Alignment Within the Existing Highway Corridor**. This alternative would modify the horizontal and vertical alignments of US 2 to meet geometric standards for a 60 mph design. The flattening of **substandard** horizontal curves near the House of Mystery and in Badrock Canyon and the construction of a bridge on a new location would cause shifts from the existing alignment. Additional right-of-way would be needed due to the **wider roadway surface provided by** the build alternatives and **changes to the alignment of the highway.**

The new roadway would be constructed on an alignment through Badrock Canyon designed to minimize the impacts on the Flathead River and associated riparian areas and to Berne Memorial Park.

Reasonable Design Alternatives - **Alternative 1 (Four-Lane Road with Median/Left Turn Lane) and Alternative 2 (Four-Lane Road without Median/Left Turn Lane) were identified as reasonable design alternatives and will be evaluated further in the EIS. Although Alternatives 3 and 4 are not considered to be reasonable build alternatives, the costs and impacts associated with these alternatives will be presented throughout the EIS and compared with the reasonable alternatives advanced in this document.**

Since the project corridor adjoins four-lane highways, all build alternatives would require transitions **to and from adjacent sections of US 2** at the beginning and end of this proposed action. An 88-foot four-lane highway, consisting of four 12-foot driving lanes, a 20-foot median, and two 10-foot shoulders, exists on US 2 immediately west of the project corridor. A 66-foot undivided four-lane highway was constructed through Hungry Horse at the east end of the corridor.

In Columbia Heights, an 82-foot wide four-lane road consisting of four 12-foot driving lanes, a 14-foot continuous, two-way left turn lane, and two 10-foot shoulders is proposed for **the transition area with** all build alternatives. A four-lane bridge across the South Fork and a four-lane highway into Hungry Horse would be provided with all build alternatives. **The undivided four-lane road across the bridge would be 66-feet wide to match the existing pavement section in Hungry Horse.** Therefore, the variation in the design of the build alternatives would occur between Columbia Heights and the new South Fork bridge.

The build alternatives for US 2 would also include a vertical retaining wall through Badrock Canyon. Due to cost and aesthetic considerations, a vertical retaining wall using mechanical stabilization combined with precast concrete facing panels or gabion facing is preferred over a conventional cast-in-place, reinforced concrete or a gravity gabion wall. The build alternatives would also eliminate the minor river encroachment to the west of Fisherman's Rock included with the design proposals contained in the Draft EIS. This encroachment would be eliminated through minor

modifications to the horizontal or vertical alignment of the new road or by constructing a steepened embankment using reinforced soil techniques.

Note that **efforts to acquire some right-of-way and other lands required by the build alternatives have been initiated in advance of the proposed action. These advance acquisition efforts were limited** to a parcel of land surrounding the House of Mystery, a parcel of land opposite the House of Mystery and west of Berne Road, and to private lands in Badrock Canyon. The acquisition of these parcels is being pursued as mitigation for the proposed action's effects on Berne Memorial Park and as a means of controlling incompatible development in a sensitive portion of the project corridor.

Further discussions of these proposals are contained in Parts IV and V of the EIS. A Categorical Exclusion examining the impacts of the advanced acquisition of land for this proposed action was approved by FHWA on September 4, 1990. **To date, a parcel of land adjacent to the House of Mystery and a parcel opposite the House of Mystery and west of Berne Road have been purchased. Attempts to acquire private lands in Badrock Canyon have been unsuccessful.**

Schematic layouts of the build alternatives for this proposed action are shown in **FIGURE II-13**. Drawings of typical roadway cross-sections for each alternative are compared with that of the existing highway in **FIGURE II-14**.

2. NO-ACTION

No action is a reasonable alternative that must be evaluated further in the EIS. This alternative is identified as ALTERNATIVE 5 in this document.

The no-action alternative would not change the 24-foot-wide, two-lane highway that exists within the project corridor. The alternative would include the safety and maintenance improvements necessary to continue operating the existing facility. This alternative would not include construction of a new bridge over the South Fork.

This alternative is compared to the **build alternatives** in **FIGURE II-13**.

F. Estimated Costs of Alternatives

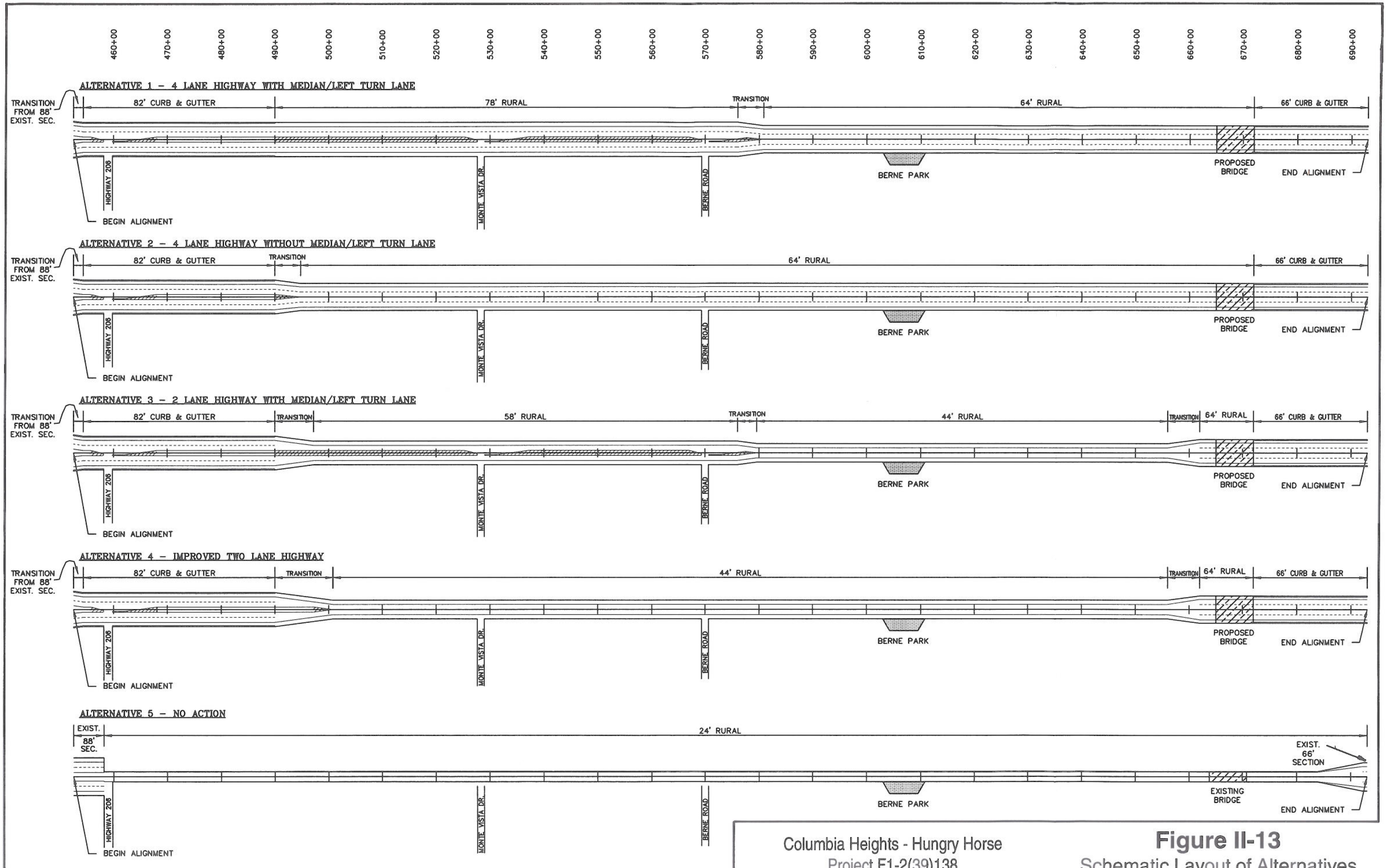
The following sections briefly describe the costs associated with each alternative evaluated in the EIS. The discussions summarize construction costs, annual maintenance costs, and life-cycle pavement maintenance costs for the alternatives. Detailed materials about the determination of these costs are contained in APPENDIX 2.

1. CONSTRUCTION COSTS

Detailed preliminary layouts for the build alternatives, based on the typical cross-sections shown in **FIGURE II-14** and on **the** geometric standards for a 60 mph highway design, were used to estimate the construction costs of each highway design. The layouts helped quantify the physical features, work items, construction limits, and right-of-way requirements associated with each alternative.

The following table summarizes all construction, right-of-way, and utility relocation costs for the build alternatives. The **construction costs** shown in **TABLE II-4** also contain estimates for **mobilization, traffic control,** engineering costs and contingencies associated with the proposed action.

Note that the cost estimates presented in the Draft EIS were updated to better reflect recent tabulations of items and work associated with road construction and current real estate values in



Columbia Heights - Hungry Horse
Project F1-2(39)138

Figure II-13
Schematic Layout of Alternatives

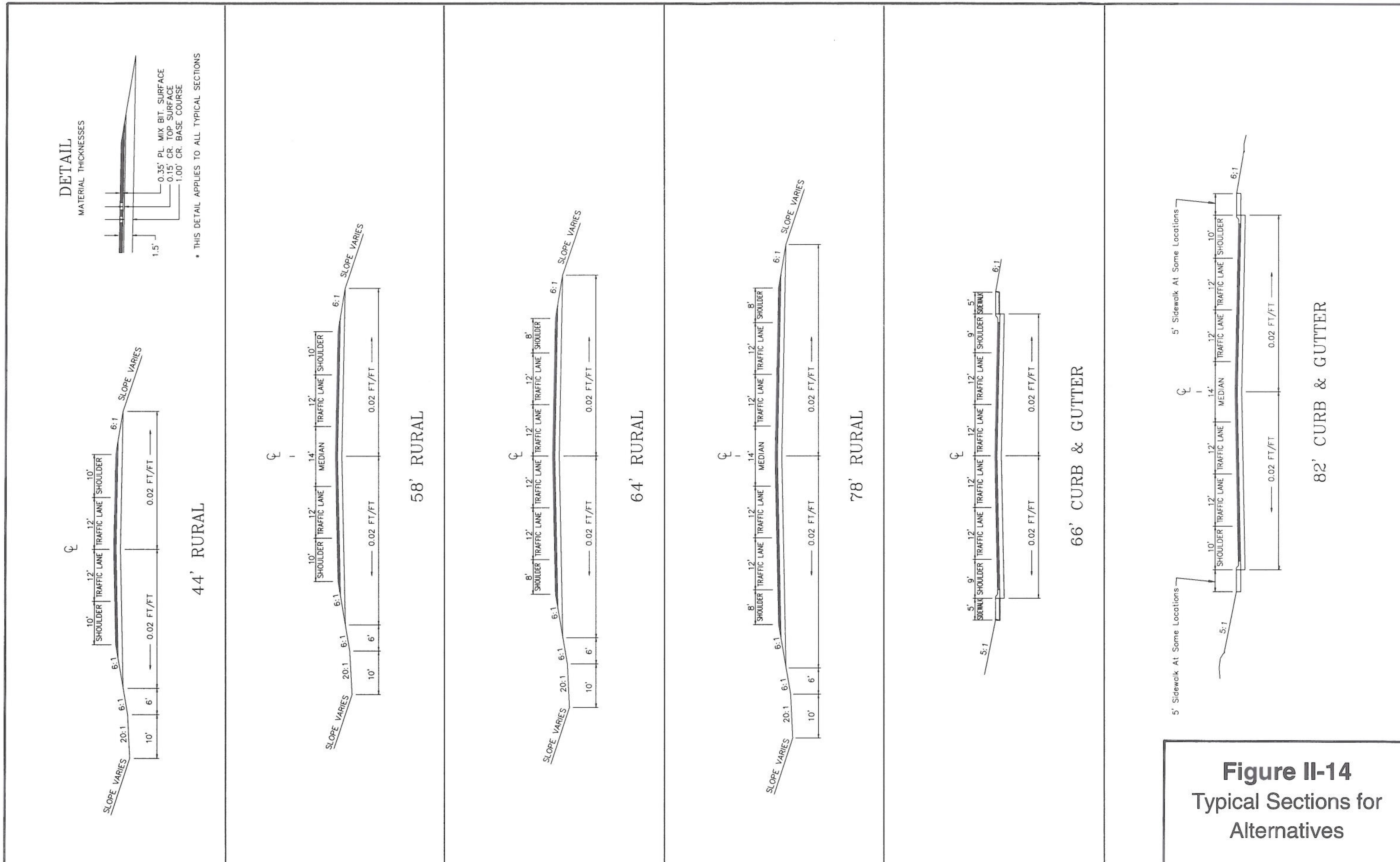


Figure II-14
Typical Sections for Alternatives

the project corridor. The construction cost estimates for the build alternatives shown in TABLE II-4 were prepared according to procedures outlined in the *Montana Road Design Manual* (MDT, April 1994).

TABLE II-4
TOTAL CONSTRUCTION COSTS OF BUILD ALTERNATIVES

Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Road Construction	$5,002,800	$4,777,400	$4,348,400	$4,383,600
Bridge Construction	4,020,300	4,020,300	4,020,300	4,020,300
SUBTOTAL	9,023,100	8,797,700	8,368,700	8,403,900
10% Mobilization	902,300	879,800	836,900	840,400
SUBTOTAL	9,925,400	9,677,500	9,205,600	9,244,300
5% Traffic Control	496,300	483,900	460,300	462,200
10% Construction Engineering	992,500	967,700	920,600	924,400
15% Contingency	1,488,800	1,451,700	1,380,900	1,386,600
SUBTOTAL	12,903,000	12,580,900	11,967,400	12,017,500
Right-of-Way Costs	880,200	786,400	714,000	706,600
Utility Costs	680,900	680,900	680,900	680,900
Total Cost	**$14,464,100**	**$14,048,200**	**$13,362,300**	**$13,405,000**

It is apparent from **TABLE II-4** that the total construction costs for the build alternatives do not vary substantially. The construction costs are similar for the following reasons:

- the build alternatives follow the same alignment;
- all build alternatives have similar designs through Columbia Heights and into Hungry Horse;
- a new four-lane bridge is common to each alternative; and
- the width of alternatives varies by only 20 feet and have similar roadside slope areas.

2. ANNUAL MAINTENANCE COSTS

Records kept by the **Maintenance Operations and Services Bureau** were reviewed to determine the costs various maintenance activities on the existing highway **during Fiscal Years 91, 92, and 93.** The records provided the actual costs for general road maintenance and winter maintenance activities on US 2 in **and near** the project corridor. **These costs are presented on a lane-mile (ln-mi) basis for comparing alternatives. TABLE II-5** presents annual maintenance cost estimates for each alternative.

Please note that the costs per lane-mile presented for road maintenance and winter maintenance

include an overhead factor of approximately 40% to account for salary additives and other indirect expenses incurred by the agency.

TABLE II-5 ESTIMATED ANNUAL MAINTENANCE COSTS BY ALTERNATIVE						
Alt.	LN-MI	Road Maintenance $/LN-MI*	Winter Maintenance $/LN-MI	Road Maintenance Cost/Year*	Winter Maintenance Cost/Year	Total Maintenance Cost/Year
1	20.63	$1,420	$1,095	$29,290	$22,590	$51,880
2	19.00	$1,420	$1,095	$26,980	$20,800	$47,780
3	14.58	$1,420	$1,095	$20,700	$15,970	$36,670
4	13.22	$1,420	$1,095	$18,770	$14,480	$33,250
5	11.80	$1,420	$1,460	$16,760	$17,230	$33,990

*** Does not include cost of winter maintenance activities.**

3. LIFE-CYCLE PAVEMENT MAINTENANCE COSTS

Decreasing appropriations for road maintenance combined with inflation and rising costs for pavement rehabilitation have resulted in conditions where pavements often wear out faster than they can be repaired. Research indicates that roads deteriorate relatively slowly during the early years of their design life, but the rate of deterioration increases as they near the end of their design life. Proper maintenance and rehabilitation has been shown to lengthen the life of pavements, however, reconstruction will eventually be needed.

TABLE II-6 presents the estimated costs of preventative pavement maintenance activities for the build alternatives and for rehabilitating the pavement surface of the existing highway over a twenty year period. The costs shown for the no-action alternative are for activities necessary to maintain the pavement in a condition similar to that which currently exists. No widening or shoulder improvements would be incorporated into the projects.

TABLE II-6 PAVEMENT MAINTENANCE AND REHABILITATION COST ESTIMATES BY ALTERNATIVE	
Alternative Considered	Adjusted Cost of Pavement Maintenance
1	$604,300
2	$522,800
3	$501,100
4	$438,800
5 (No-Action)	$415,500

G. Evaluation of the Operation and Benefits of Each Alternative

This section discusses how each alternative is expected to operate through the design year 2010. The primary measure of each alternatives operation is its ability to accommodate future traffic volumes in an acceptable manner. The traffic safety benefits provided by the build alternatives are also examined in the narrative. Finally, the overall benefits **of** each alternative are compared with its estimated cost to provide an indication of the cost-effectiveness of each design option.

1. LEVEL OF SERVICE (LOS) COMPARISON

Levels of service (LOS) are the different operating conditions which occur on a highway or specific segment of the highway when accommodating various traffic volumes. Factors affecting LOS include speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and indirectly, safety. LOS analyses provide a qualitative measurement of operational conditions within the traffic stream and their perception by motorists and/or passengers **(7)**.

Levels of service for different types of facilities are based on factors describing the quality of operation on the facility. For two-lane highways, average travel speed (mph) and the time delay (%) are the primary measures of effectiveness. Density, in passenger cars per mile per lane, is the primary measure of effectiveness for multi-lane highways. The operating conditions of a traffic facility are measured on the basis of six levels of service, designated as LOS A through LOS F by the *Highway Capacity Manual* (HCM) **(8)**. LOS A represents the best operating conditions and LOS F the worst.

The characteristics of service levels on rural highways under uninterrupted traffic flows are generally described in **TABLE III-7** . Specific definitions for these for two-lane and multi-lane rural highway service levels are contained in APPENDIX 3.

TABLE II-7
GENERAL LEVEL OF SERVICE DESCRIPTIONS

LOS A	Free flow operation with low volumes and densities. Drivers can maintain their desired speed with little or no delay and are unaffected by other vehicles. Minor disruptions in traffic flows are easily absorbed without causing delays or lines of cars.
LOS B	Stable traffic flows, but operating speeds begin to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speeds.
LOS C	Stable traffic flows, but speeds and maneuverability are more controlled by higher traffic volumes. Congestion caused by turning traffic and slower vehicles causes substantial deterioration in service.
LOS D	Traffic is approaching unstable flow, travel speeds are tolerable but considerably reduced by operating conditions. Drivers have little freedom to maneuver within the traffic stream.
LOS E	Describes operations at or near capacity and unstable flows. Travel speeds have been reduced to the point where momentary stoppages could occur. Massive platooning occurs when slower vehicles or interruptions are encountered. Traffic volumes are approaching the capacity of the facility, and there are no usual gaps in traffic.
LOS F	Corresponds to forced flow conditions. Travel speeds are low and stoppages may occur for short or long periods. These conditions are usually caused by vehicles backed up behind downstream restrictions.

AASHTO's *A Policy on Geometric Design of Highways and Streets* states that a LOS B should be maintained on a rural arterial highways throughout its design life **(9)**. This criteria is one of the primary considerations in the evaluation of the design alternatives for the proposed action. Future development of projects on the National Highway System (which includes US 2) must be done in accordance with AASHTO policies.

LOS analyses were performed to address several questions about the current and future operation of each alternative and to identify the most appropriate facility (from a highway capacity standpoint) for this proposed action. The major questions posed for the analyses were:

- What level of service does the existing facility currently provide?
- If the existing facility is not improved, what level of service will it provide in the design year?
- Will the two-lane alternatives (Alternatives 3 and 4) provide an acceptable level of service under current and design year traffic conditions?
- What level of service will be provided by the four-lane alternatives (Alternatives 1 and 2) under current and design year traffic conditions?
- If the two-lane alternatives will not operate effectively in the design year, are there features that can be incorporated into the alternatives that will substantially improve their operation?

For each alternative, the **current** LOS was calculated **using traffic volumes experienced during the 30th highest hour of the year (30HV) recorded at ATR Station A-60. The 30HV, also referred to as the design hourly volume (DHV), is commonly used as a design value for rural roads because as a percentage of the ADT, this hourly volume varies little from year to year even though substantial changes in total daily traffic may occur. In the project corridor, the 30HV occurs during the summer months. A corresponding future value for 30HV was calculated for use in evaluating the LOS provided by project alternatives** in the design year (2010).

The findings of the LOS analyses for the alternatives are described below. **FIGURE II-15** presents a schematic summary of the LOS evaluations for each alternative considered. LOS calculations and other pertinent materials are on file in Helena.

The detailed LOS calculations initially completed for the EIS were based on available traffic information for the permanent traffic counter through 1990. Traffic data for 1991 became available during the development of the Draft EIS. Traffic information for 1991 was used to forecast the future traffic volumes for the corridor and was presented in the Draft EIS. The LOS calculations and other traffic-sensitive analyses were not revised for the Draft EIS because 1991 volumes in the corridor were higher than those in 1990. Likewise, 1992 and 1993 traffic information became available after the Draft EIS was circulated for review. The new data shows that traffic volumes for 1992 and 1993 were substantially above those of 1990 and 1991.

Checks were made to determine if the use of more recent traffic data would change the results of the LOS analyses presented in the Draft EIS. The LOS analyses performed with new traffic data reaffirmed the results and conclusions of the analyses described on the following pages. Therefore, the LOS analyses were not completely revised using the more recent traffic volume data.

Results of the LOS Analyses for the Existing Highway - The LOS for the existing 24-foot-wide two-lane roadway was calculated to be LOS E for **current traffic** conditions. This indicates that the facility currently

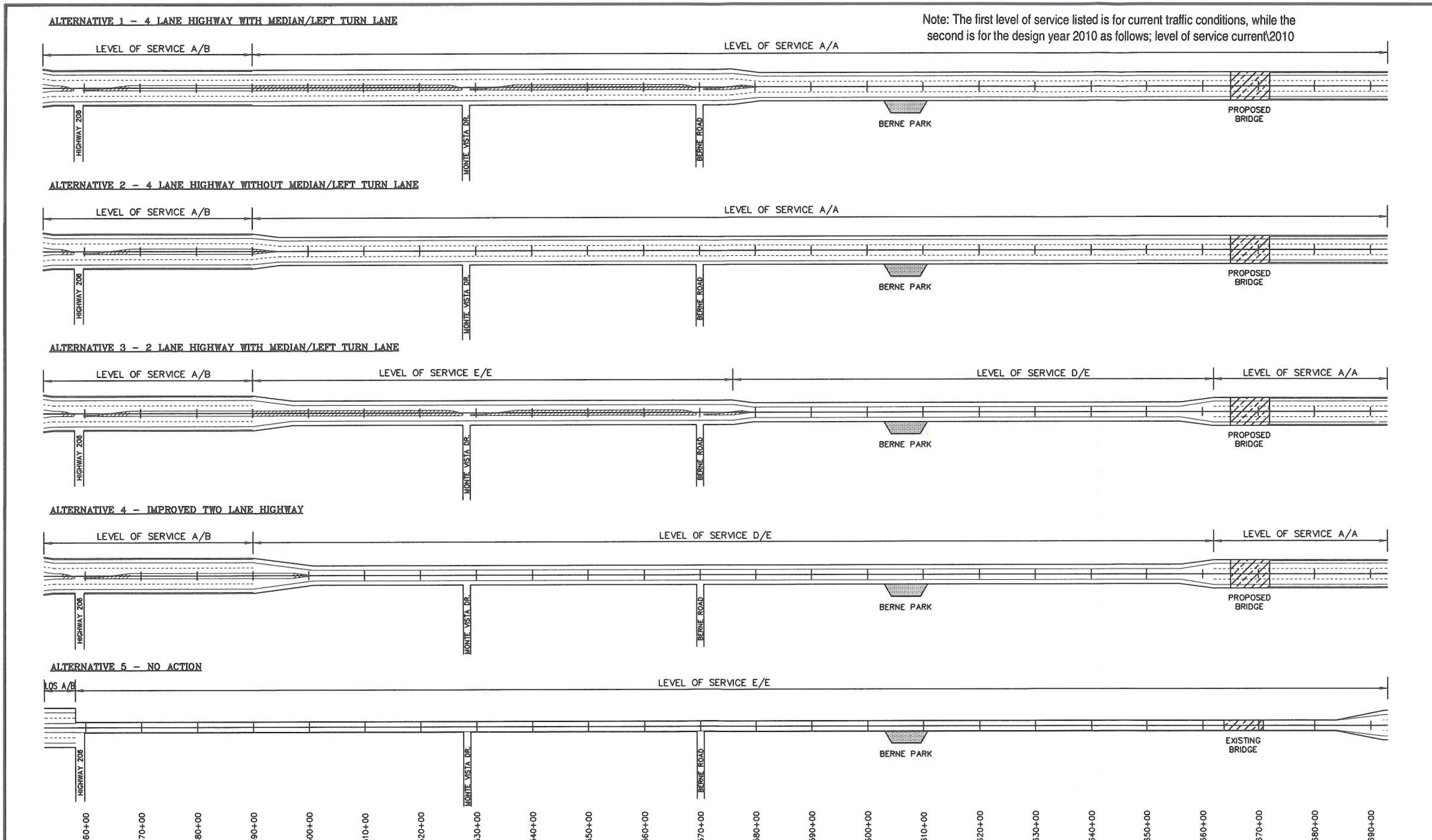


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Figure II-15
Levels of Service For Each Alternative

operates at or near its capacity. Calculations also show that the facility would operate at LOS F in the design year.

Results of the LOS Analyses for Two-Lane Alternatives - The following sections summarize the results of the **LOS** analyses for Alternatives 3 and 4.

> **ALTERNATIVE 3** -- The alternative would operate at LOS E under **current** and design year traffic conditions. The presence of a continuous, two-way left turn lane or a median with isolated left turn bays would adversely affect capacity by eliminating passing.
>
> **ALTERNATIVE 4** -- This alternative would operate at a LOS D under **current** conditions and at LOS E in the design year. Capacity would improve somewhat over the existing facility because of the wider shoulders and the alignment improvements that would provide more passing opportunities.

Results of the LOS Analyses for Four-Lane Alternatives - The following paragraph summarizes the **LOS** analyses conducted for the four-lane alternatives (Alternatives 1 and 2).

> **ALTERNATIVES 1 AND 2** -- The capacity calculations indicated that these four-lane alternatives would operate at LOS A for **current** and design year traffic conditions in all portions of the corridor.

Consideration of Left Turn Lanes - All build alternatives would provide a continuous, two-way left turn lane in Columbia Heights. This design feature is desirable due to the number and density of approaches to residences and businesses in this part of the project corridor.

Alternatives 1 and 3 also would provide a median with isolated left turn lanes at justified locations in the corridor. Such a design feature may be appropriate when left turn volumes at a specific approach exceeds 25 vehicles per hour **(10)**. The accident history, primarily the number of rear-end collisions recorded at an approach or in a short road segment, may also suggest the need for left turn provisions. Analyses did not identify any locations between Columbia Heights and Hungry Horse where left turn volumes exceed 25 vehicles per hour or where high numbers of rear-end collisions have been recorded.

Although left turn lanes can not be warranted solely by turning volumes or by accident histories at approaches east of Columbia Heights, isolated left turn lanes would provide operational benefits where they are used. Such a design feature would also provide traffic safety benefits by separating turning and through traffic.

Measures to Increase the Capacity of Two-Lane Alternatives - The HCM describes several design modifications that may be used to improve the level of service for two-lane highways **(11)**. These modifications include:

- use of alternating passing lanes,
- use of climbing lanes,
- use of turnouts, and
- use of short four-lane sections.

The following sections discuss the use of these measures to improve the level of service of the two-lane alternatives evaluated for the proposed action. Although these options were not fully developed as project alternatives, LOS analyses allowed the effects of their use on the **operation** of the two-lane alternatives

to be examined.

Alternating Passing Lanes - This option would provide three travel lanes for sections of US 2 between Columbia Heights and the South Fork Bridge. The third lane would be assigned to traffic in one direction to increase the availability of passing and break up vehicle platoons. Similar opportunities would be provided for both east and westbound traffic, however, permissive passing would not be allowed for the one-lane direction to minimize conflicts between opposing traffic.

The HCM indicates that the second lane would provide more efficient passing and reduce left turn conflicts, but its operation would not approach that of a four-lane highway, even in the preferred direction **(12)**.

The recommended length for a passing lane is 1 to 2 miles **(11)**. The logical locations for adding another eastbound travel lane would be between Berne Memorial Park and the South Fork bridge. Likewise, a second westbound travel lane would be most desirable east of Columbia Heights. These locations would allow for the dissipation of vehicle queues before entering Columbia Heights or Hungry Horse. An analysis of this configuration shows that passing opportunities for eastbound and westbound traffic would be available over 60% of the corridor.

This measure would produce LOS A in the direction of travel with two travel lanes, but the single lane in the opposing direction would continue to operate at LOS E because passing would be prohibited. The overall corridor would operate at LOS D under current conditions and LOS E in the design year.

Climbing Lanes - The grades within the project corridor are not sufficient to warrant consideration of climbing lanes.

Turnouts - Turnouts have been used successfully to improve the traffic flows on two-lane highways in a variety of terrain conditions. According to the HCM, "turnouts are short segments of a third lane added to one side of the highway or the other which permit slow vehicles at the head of platoons to pull off the main roadway, allowing faster vehicles to pass" **(13)**. Turnouts longer than 600 feet are generally not designed because they could be mistaken for a passing lane.

The HCM also references the results of a study by the California Department of Transportation about turnouts that showed **(13)**:

- turnouts do not substitute for passing or climbing lanes,
- turnouts are used by only 10% of platoon leaders, and
- large trucks tend to avoid turnouts.

The addition of turnouts to the two-lane alternatives would improve the operation of the road in the vicinity of the turnouts by allowing for the redistribution of traffic within the platoon. Unfortunately, this effect would be localized and would not improve the overall LOS.

Short Four-Lane Sections - Short four-lane sections may also be constructed along a two-lane highway to eliminate delays due to slow moving vehicles, break up platoons, or provide additional passing opportunities. AASHTO suggests that four-lane sections be sufficiently long (1.0 to 1.5 miles) to dissipate vehicle queues **(14)**. Sections of four-lane highway longer than 2 miles may cause drivers to forget that the facility is predominantly a two-lane road.

The most appropriate location for a short four-lane section in the project area would be from Columbia Heights to the Berne Road area. This section would be about 1.7 miles in length. An analysis of this option showed that passing opportunities for east and westbound traffic could be increased to 80% within the corridor.

The LOS analysis for this two-lane design option showed that the four lane sections would operate at LOS A while the remaining two lane segment would continue to operate at LOS E. The overall corridor would operate at LOS D under current conditions but deteriorate to LOS E by the design year.

Alternate Design Hourly Volumes - Scoping comments received during the preparation of the EIS suggested that DHV other than the 30HV should be examined for this corridor because of its seasonal fluctuations in traffic. The comments also suggested that a more cost-effective design may be achieved if a lower DHV was used. Use of the 30HV as the appropriate road design standard is a nationally accepted practice of state highway agencies and the FHWA. The 30HV is the only DHV that can be supported for the design of facilities of this type. However, a review of the level of service effects of using alternate DHVs was performed for informational purposes. The results are described below.

Data showing the total two-way traffic volumes for the top 870 hours of 1990 at ATR Station A-60 near the House of Mystery was reviewed **for the EIS**. Various hourly volumes, representing the 200th, 400th, and 870th highest hours of 1990, were selected as alternate design values for evaluating the LOS of the undivided, two-lane highway (Alternative 4) considered in the EIS. The 200th highest hourly volume (200HV) represented a two-way volume of 761 vehicles per hour, or 15.2% of the AADT, the 400th highest hourly volume (400HV) represented a two-way volume of 672 vehicles per hour, or 13.4% of the AADT. A traffic volume of 500 vehicles per hour was approximately equal to the 870th highest hourly volume (870HV) was identified from count data. The 870HV represented 10.0% of the AADT. Corresponding DHVs for the design year, based on these percentages and a projected AADT were calculated for use in the LOS analysis.

The LOS was calculated for the Alternative 4 using these DHVs. The results of the analyses did not vary substantially from the analyses based on the 30HV. The calculations showed that a two-lane design based on the 200HV would function at LOS D under 1990 traffic conditions and at LOS E in the design year 2010. Similarly, analyses based on the 400HV showed that the two-lane designs would function at LOS D for 1990 conditions and at LOS E in the design year. The analyses using the 870HV showed that a two-lane road would operate at LOS C in 1990 but deteriorate to LOS E by the design year.

These analyses indicate that, even using these lower design values, a two-lane alternative would not provide the desired level of service (LOS B) during the design life of the project.

2. EFFECTS OF RECONSTRUCTION ON TRAFFIC SAFETY

All build alternatives **would** increase traffic safety to varying degrees through the use of wider paved shoulders, improved horizontal and vertical alignments, and less severe roadside slopes. Limited access control for the proposed highway **would** provide safety benefits by combining or eliminating unnecessary approaches. The median/left turn lane proposed with several alternatives **would** reduce conflicts between turning and through traffic. Right-of-way clearing may provide minor traffic safety benefits during the winter by reducing the extent of shaded areas in Badrock Canyon.

No attempt was made to predict the accident rates for the alternatives presented in this EIS because each contains a variety of design features rather than a uniform design throughout the entire project area. Roadside environments and traffic facilities like those proposed do not exist, so similar accident information is not available for **evaluating** the proposed alternatives. Instead, a more general assessment, described below, was used to identify the likely effects of the proposed reconstruction project.

Effects of Reconstruction on Accident Rates - A before and after study of recent projects was performed to help quantify the traffic safety benefits of major highway reconstruction on Montana's Primary Road System. Major reconstruction projects were those that included road widening, improvements to horizontal and vertical alignments, and the addition of other features designed to improve the operation of the facility. Overlay and widening projects were not considered in the study. **The** study primarily examined accident rates before and after reconstruction. The study reviewed accident rates for six two-lane to four-lane reconstruction and for eight major upgrades of two-lane facilities covering about 77 miles of the Primary Road System. A copy of the study is on file in Helena.

The study did not attempt to predict accident characteristics for particular road designs used on the Primary Road System because the **roadside environments and use of these facilities varies greatly between projects**. Before and after statistics for the same road segments were compared since the reconstruction activities would be the primary change in the conditions of each project area. Highway reconstruction **was** assumed to be the most influential factor for any changes in the accident rates for each project. Computerized accident data for a three-year period immediately preceding each construction project and for at least two years following construction were reviewed. The major **findings** of the study **are discussed** below.

Overall, accident rates decreased by an average of nearly 45% following reconstruction. Accident rates for two-lane to four-lane projects decreased by an average of 37.5% following reconstruction. Accident rates were reduced by an average of 52.3% for projects that substantially upgraded two-lane facilities.

Three recent projects on US 2 adjacent to or near the project area were included in **the** accident study. The LaSalle Road to Columbia Falls section and Hungry Horse to Coram section of US 2 were reconstructed from two-lanes to four-lanes in separate projects in the mid-1980's. The segment between Coram and West Glacier was also reconstructed as an improved two-lane facility during the same time period. Records show that accident rates for these segments decreased by 48%, 28%, and 52%, respectively, following reconstruction.

Expected Traffic Safety Benefits - Based on the **study**, it is realistic to expect the current rate of 3.67 ACC/MVMT to be reduced by about 40% following the proposed highway reconstruction between Columbia Heights and Hungry Horse.

3. BENEFIT-COST COMPARISON

An analysis was performed for each alternative to evaluate the economic effects of highway improvements on US 2. This analysis compares the benefits from reduced highway user costs to the facility costs required to produce the benefits. Highway user benefits considered in the analysis are vehicle travel time savings, fuel cost savings, and accident reduction savings. Facility cost components addressed in the analysis were design and engineering costs, right-of-way costs, construction costs, and operation and maintenance costs during the service life of the project.

The objective of benefit-cost analysis of highway improvements is to help select an efficient transportation investment for the project area. Efficiency, in this instance, refers to obtaining the maximum service from a transportation investment. The benefit-cost analysis provides an economic measure of the relative differences between the proposed alternatives. It is primarily of use to decision makers in the selection of an appropriate action for the proposal.

Results of the Benefit-Cost Analysis - TABLE II-8 contains the results of the economic analyses for the alternatives under consideration. The ultimate product of the analysis was a benefit-cost ratio for each alternative. The ratio compares the estimated annual costs with estimated benefits to provide an indication of the cost-effectiveness of each alternative. It must be emphasized that values have been placed on benefits which are difficult to assess. Caution should be used in the interpretation of the benefit-cost ratios because of their approximate nature. Small differences between ratios should not be considered as substantial due to the approximate nature of the analysis.

TABLE II-8 shows the annualized costs, annual benefits from reduced highway user costs, and the benefit-cost ratio for each alternative. All benefits and costs are expressed in constant dollars and based on **1992** prices.

Copies of the background materials and the methodology used for this analysis are on file in Helena.

TABLE II-8
BENEFIT-COST COMPARISON BY ALTERNATIVE

Alternative	Annual Benefit	Annual Cost	Benefit-Cost Ratio
1	**$1,106,400**	**$1,030,700**	**1.07**
2	**$1,106,400**	**$993,500**	**1.11**
3	**$613,300**	**$931,500**	**0.66**
4	**$613,300**	**$925,800**	**0.66**
5	0*	0*	1.00*

* *Costs and benefits presented in this analysis are compared to the cost and benefits of Alternative 5 (No-Action). By definition, the benefit-cost ratio of Alternative 5 equals 1.00.*

H. Preferred Alternative

Alternative 1, a four-lane highway, has been selected as the preferred alternative for the proposed action. This decision was based on the consideration of all evaluations contained in the **Final EIS**. All comments on the Draft EIS and from the public hearing **were fully evaluated prior to the selection of the preferred alternative.**

The preferred alternative would provide **four travel lanes and a center median/left turn lane** from the project's beginning in Columbia Heights to Berne Road, west of Badrock Canyon. The width of the roadway would be 82 feet through Columbia Heights and 78 feet **in the area** between Columbia Heights and Berne Road where no curbs or gutters would be installed. The center median/left turn lane would be eliminated between Berne Road and Hungry Horse reducing the typical width of the four-lane roadway to 64 feet.

Approximately 2,100 lineal feet of vertical retaining wall, using mechanically-stabilized backfill placed behind the wall, would be included with the highway reconstruction along the Flathead River in Badrock Canyon. PHOTO PLATE 3 depicts the riparian area along the Flathead River in Badrock Canyon where a vertical retaining wall is proposed. The photographs on the plate show the area as it currently exists and the area's likely appearance with the provision of a vertical retaining wall.

APPENDIX 4 contains a preliminary design layout for the preferred alternative. These drawings illustrate many of the design features of the project such as the proposed alignment, probable right-of-way limits, and where various typical sections would be used in the corridor. These plan drawings provide a basis for evaluating potential impacts and are not intended to serve as the final design for the project.

Photo Plate 3 - Proposed Retaining Wall in Badrock Canyon

Photo 1 - View of the existing riparian area east of Fisherman's Rock where a verticle retaining wall along the Flathead River is proposed.

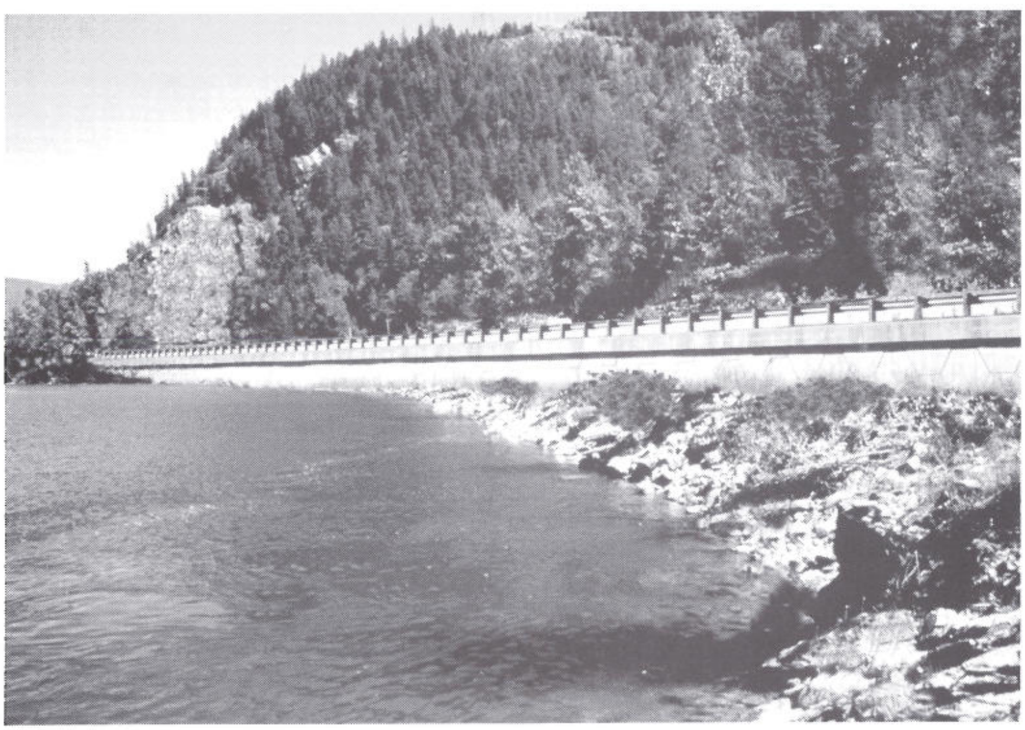

Photo 2 - Simulated view of the riparian area with the provision of a vertical reinforced earth type retaining wall. Precast concrete panels would be used as a facing material with such a design.

Level of service calculations show that the existing two-lane highway already experiences operational problems during peak hours and predicts that the facility would operate at capacity by the completion of this proposed highway reconstruction. The operational efficiency of the existing facility could not be substantially increased by implementing TSM activities or mass transit options for the corridor. Analyses showed that a new two-lane road would initially function better than the existing facility but its operation would deteriorate to an unacceptable level as traffic volumes increase and passing opportunities and travel speeds decrease during **the foreseeable future.**

The operation of the two-lane alternatives considered in the EIS could be improved somewhat by **adding** left turn lanes, alternating passing lanes, turnouts, **or by incorporating** a short four-lane section. Although analyses **showed** that some localized operational benefits could be realized in the corridor, a two-lane facility incorporating such modifications would operate at LOS D under current traffic conditions and deteriorate to LOS E by the design year. This LOS would not be consistent with the stated purpose of this proposed action and would not address identified needs within the corridor.

A four-lane highway is the next logical progression in selecting a geometric design for the corridor that provides sufficient passing opportunities, maintains travel speeds, and accommodates the volume of traffic projected to occur over the next twenty years. The analyses performed for the EIS indicate that both four-lane alternatives (Alternatives 1 and 2) would provide an acceptable LOS in the design year and meet all design standards for rural arterials with traffic characteristics like those of the project corridor.

Alternative 1 was preferred over Alternative 2 because the median/left turn lane proposed for the area between Columbia Heights and Berne Road would eliminate conflicts between left turning and through traffic on US 2. This portion of the project corridor contains most of the existing roadside development and has a strong potential for new commercial and residential land uses in the future. The design of Alternative 2 would not accommodate traffic to these adjacent land uses as well as the preferred alternative.

The difference in cost between all build alternatives is not substantial. However, the operational benefits provided by a four-lane design far exceeds those of the two-lane options. The preferred alternative attempts to provide a facility that balances functional requirements with economics and environmental effects. The typical section of the preferred design is only 20 feet wider than the undivided two-lane option through the most sensitive area of the corridor. **Because the build alternatives follow the same horizontal alignment**, construction limits for the four-lane design are typically 10 feet wider on both sides of the highway than those of the undivided two-lane design. Due to the need to improve the alignment of US 2 through Badrock Canyon, the primary impacts of the proposed action (rock excavation, river encroachment, effects on Berne Memorial Park, and loss of riparian vegetation) are essentially the same for all build alternatives. The extent of these impacts is only incrementally greater for the preferred alternative than for the two-lane options considered.

Due to the uncertain funding for future highway projects, the proposed action may be in service well beyond the twenty years considered by the EIS. In light of this possibility, the construction of a lesser facility that would experience severe operational problems or be at capacity before the design year would not be prudent. The purposes and needs of this project would not be met if reconstruction was required within the next twenty years. Obviously, the reconstruction of a lesser facility would again cause substantial disruption to the environment of the project corridor and **require major expenditures for the design and construction of a new facility.**

I. Comparison of Alternatives

TABLE II-9 compares the features and operation of each **build** alternative. The characteristics of the alternatives that can be directly compared, such as the LOS, right-of-way requirements, and costs are included in the table. A table comparing the impacts of each alternative is included in Part IV.

TABLE II-9
COLUMBIA HEIGHTS-HUNGRY HORSE EIS
COMPARISON OF ALTERNATIVES

ITEM/CONSIDERATION	ALTERNATIVE 1 (Preferred)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5 (No-Action)
1. DESIGN FEATURES					
• Width of typical pavement section	82'- Urban 78'- Rural w/median/left turn 64' - Rural	82'- Urban 64' - Rural	82'- Urban 58'- Rural w/median/left turn 44' - Rural	82'- Urban 64' - Rural	24' Urban/Rural
• Number of driving lanes	4		2		2
• Width of driving lanes	12'		12'		11'
• Width of shoulders	10'- Urban/8'- Rural		10'- Urban/10'- Rural		1'- 2'
• Incorporates median/left turn lanes?	Yes, from Columbia Heights to east of Berne Road	Yes, Columbia Heights only	Yes, from Columbia Heights to east of Berne Road	Yes, Columbia Heights only	No
• Width of median/left turn lanes	14' where median would be provided				Not Applicable
• Minimum width of design section	64'		44'		24'
• Incorporates curbs, gutters, and sidewalks where appropriate?	Yes, curbs and gutters, sidewalks and a piped storm drainage system would be provided in Columbia Heights. Curbs and gutters and sidewalks would be provided from the new South Fork bridge to Hungry Horse to connect with existing features.				No
• Type of bicyclist facilities	Build alternatives would provide 8'-10' wide shoulders for bicyclist use.				1'-2' shoulders
• Number of lane-miles	20.63	19.00	14.58	13.22	11.80
• Other design features	Build alternative would include a new four-lane bridge over the South Fork of the Flathead River west of Hungry Horse, a reconfigured intersection where US 2 joins FAS 206, and a retaining wall along the Flathead River in Badrock Canyon.				None
2. RIGHT-OF-WAY CONSIDERATIONS					
• Acres of additional right-of-way needed	48.76	45.87	41.78	40.84	None
• Existing right-of-way to be abandoned	11.50	11.50	12.94	12.96	None

TABLE II-9 (Cont.)
COLUMBIA HEIGHTS-HUNGRY HORSE EIS
COMPARISON OF ALTERNATIVES

ITEM/CONSIDERATION	ALTERNATIVE 1 (Preferred)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5 (No-Action)
• Final right-of-way impact	37.26	34.37	28.84	27.88	None
• Utility relocations required?	Yes	Yes	Yes	Yes	No
• Minimum width of right-of-way corridor (typical)	140'				80'
• Maximum width of right-of-way corridor (typical)	220'		210'		110'-190'
3. OPERATIONAL CONSIDERATIONS					
• Current (1992) AADT	5,720 vehicles per day at ATR Station A-60				
• Projected design year AADT (2010)	8,850 vehicles per day at ATR Station A-60				
• Design hourly volume (30HV) -- 1992	945 vehicles				
• Design hourly volume (30HV) -- 2010	1517 vehicles				
• Current Level of Service (LOS)	LOS A	LOS A	LOS D-E	LOS D	LOS E
• Design year Level of Service	LOS A-B	LOS A-B	LOS E	LOS E	LOS F
• Current accident rate (1990)	Not Applicable				3.67 ACC/MVMT
• Estimated % reduction in accident rate with alternative	40% Reduction in accident rate may be possible through reconstruction of the corridor.				Not Applicable
4. PROJECT COST ESTIMATES					
• Estimated construction cost	$9,023,100	$8,797,700	$8,368,700	$8,403,900	Not Applicable
• Estimated cost of utility relocations	680,900	680,900	680,900	680,900	Not Applicable
• Estimated right-of-way costs	880,200	786,400	714,000	706,500	Not Applicable
• Estimated cost of mobilization, traffic control, construction engineering, and contingencies	3,879,900	3,783,200	3,598,700	3,613,700	Not Applicable
• Total Cost of Project	$14,464,100	$14,048,200	$13,362,300	$13,405,000	Not Applicable
• Estimated Annual Maintenance Costs	$51,800	$47,780	$36,670	$33,250	$33,990

TABLE II-9 (Cont.)
COLUMBIA HEIGHTS-HUNGRY HORSE EIS
COMPARISON OF ALTERNATIVES

ITEM/CONSIDERATION	ALTERNATIVE 1 (Preferred)	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4	ALTERNATIVE 5 (No-Action)
• Adjusted cost of pavement maintenance over project life	$423,300	$382,700	$352,700	$313,800	$379,200
• Estimated annual benefit	$1,106,400	$1,106,400	$613,300	$613,300	Not Applicable
• Estimated annual cost	$1,030,700	$993,500	$931,500	$925,800	Not Applicable
• Benefit-Cost Ratio	1.07	1.11	0.66	0.66	1.00

References for Part II

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2. American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets, 1990*, Washington D.C., page 494.

3. Montana Department of Transportation, Traffic Operations Section, *Montana Automatic Counters, 1992.*

4. AASHTO, Page 369.

5. AASHTO, Page 499.

6. Robert Peccia & Associates, "Investigation of Design Alternates in Badrock Canyon for the Columbia Heights-Hungry Horse EIS", July, 1993.

7. Khisty, C. Jotin, *Transportation Engineering - An Introduction*, Prentice-Hall, Englewood Cliffs, NJ, 1990, Page 210.

8. Transportation Research Board, National Research Council, *Highway Capacity Manual, Special Report 209*, (HCM), Washington D.C.,1985, page 7-6.

9. AASHTO, Page 495.

10. MDOH Traffic Unit, "Approach Standards for Rural Highways", 1983, page 22.

11. HCM, pages 8-18 through 8-21.

12. HCM, page 7-19.

13. HCM, page 8-20.

14. HCM, page 8-21.