# West Susitna Access Reconnaissance Study
# West Susitna Access to Resource Development

## *Transportation Analysis Report*

# *Appendix A:*
# *Preliminary Design Criteria Report*

# WEST SUSITNA ACCESS RECONNAISSANCE STUDY

## PRELIMINARY DESIGN CRITERIA TECHNICAL MEMORANDUM

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**Alaska Department of Transportation and Public Facilities**

Prepared by

*HDR Alaska*
Anchorage, Alaska

Submitted by:


_____ ____
Michael R Tooley Date
Senior Transportation Engineer

Approved by:

_____ ____
Date
Department of Transportation and Public Facilities

The State of Alaska, Department of Transportation and Public Facilities, Division of Program Development (Roads to Resources Initiative), is evaluating one or more potential transportation corridors and river crossing(s) to provide surface access to resource development opportunities west of the Susitna River in Southcentral Alaska.

The West Susitna Access objective is to identify feasible access route options to connect resources (mineral, timber, coal, recreation opportunities, oil, and gas) identified in the Alaska Range and its southeast foothills to the road or marine transportation system. This *Preliminary Design Criteria* presents the standards proposed to be used as the basis for evaluation of the road transportation access prepared during the reconnaissance phase for the West Susitna Access. These criteria will be revised as more information is discovered during the preliminary reconnaissance and design stages.

The *Preliminary Design Criteria* will be applicable to all access routes analyzed. The project Study Area includes areas west of the Parks Highway between Knik Arm and Petersville, south of Denali National Park and Preserve, and north of Cook Inlet (see Figure 1, Study Area, below).

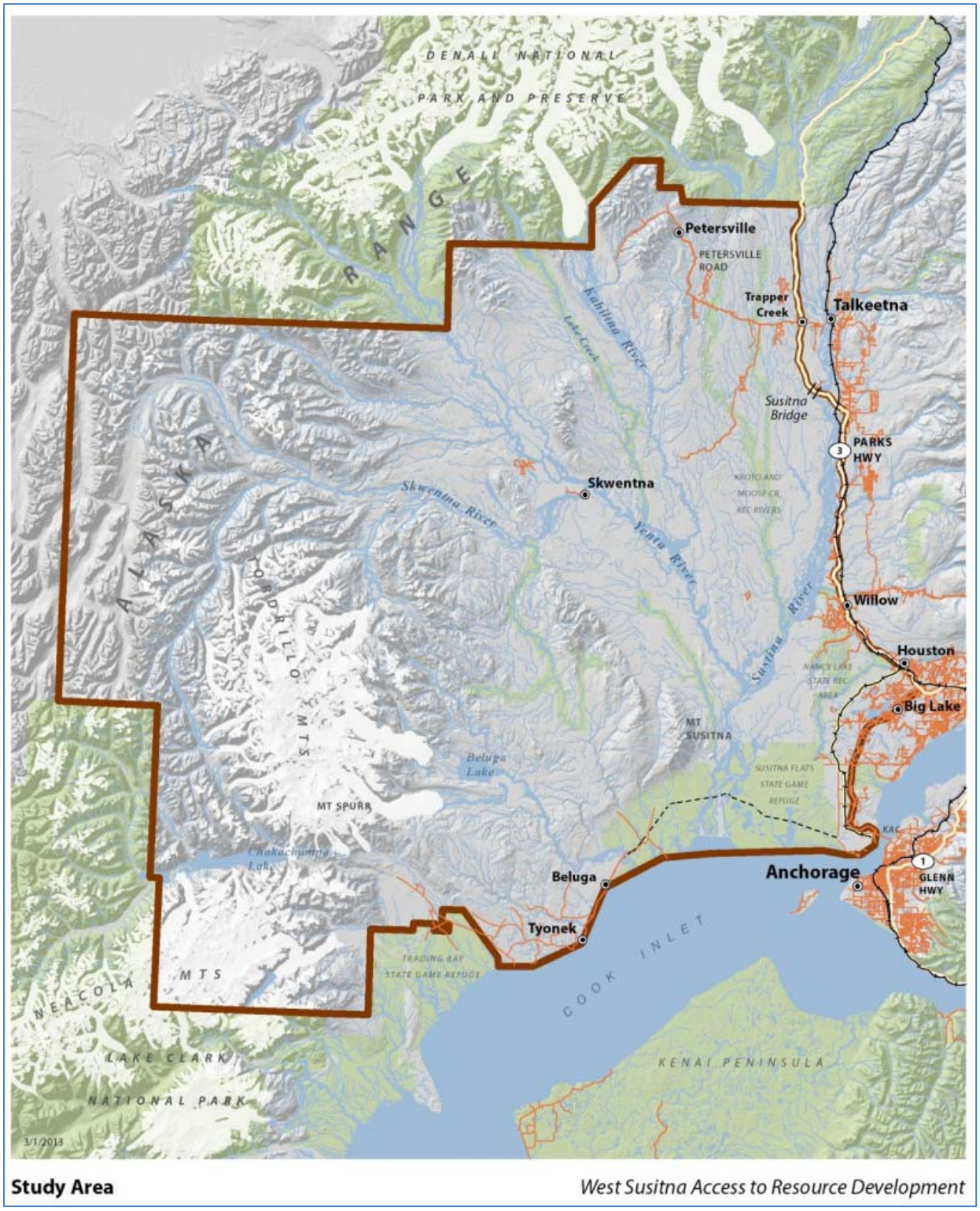



**Figure 1. Study Area**

## Assumptions

Over the course of the development of this reconnaissance study, it was determined that the West Susitna access road would be utilized by both the resource development industry for resource exploration/transport as well as open to the public. This *Preliminary Design Criteria Technical Memorandum* reflects the design criteria associated with those dual functions. It is also possible a toll road or fee might be associated with the road, but that is not a part of the analysis in this memorandum.

Development for resource recovery typically advances in three stages: the investigation and discovery, the site development, and then extraction and processing of the finished product. Depending on the resource, it generally progresses as follows:

1. *Initial Phase*. For initial site investigation access, a pioneer road concept is proposed – a low-volume, two-way single-lane gravel access road. Vehicles will be four-wheel drive (4WD) crew cab pickups and single unit support trucks for exploratory purposes only. Such traffic can use single lane roads with intervisible turnouts.
2. *Construction Phase*. During resource site construction, the road may continue to be a two-way single-lane road if minimal heavy equipment is needed for site development. It may also need to expand to a two-lane facility between the material source and resource site.
3. *Production Phase*. If all the resource development work is on-site with a pipe or line transmission facility, or the finish product is being hauled out, a two-way single-lane facility may be sufficient. It is anticipated transporting raw product or concentrate to a production facility or to tidewater will be required; thus, a two-lane facility will need to eventually be provided.

Initially, the preliminary design criteria considered for the West Susitna access road was based on an initial phased concept of a single-lane gravel road. Upon proof of product and start of production, this initial work could then be expanded into the production phase. Additional initial assumptions included:

- Initial traffic volumes for resource exploration efforts would be under 100 vehicles per day (VPD). This traffic volume is the maximum suggested for two-way single-lane gravel roads driven by professionals who are often in contact with each other by radio. It is an appropriate assumption during initial roadway construction and resource exploration efforts.
- Resource development traffic volumes would remain under 400 VPD. This would result in a minimal two-way two-lane gravel road for planning and estimating purposes.
- Vehicle traffic would enter and exit the route using the George A. Parks Highway (or other roadways such as the Point MacKenzie Road, Petersville Road, and/or Oil Well Road, depending on the corridors chosen), and therefore must conform to State legal size, length, and weight restrictions (17 AAC 25).
- Preliminary discussions considered that initial access would be limited to construction and industry traffic, and would not be conditionally opened to the public until a later date. However, as this study has progressed, design considerations are for the road to be open to the public from the beginning, with traffic volumes still below 400 VPD. Depending on

resource development needs and public interest in accessing Study Area lands, traffic volumes could be more than 400 VPD. With the uncertainty of resource development needs and level of public interest, it is difficult at this time to know with certainty traffic volumes.

- Material is readily available and is easily obtained along the corridor for use.

## Reference Design Standards

The preliminary design criteria for the West Susitna Access were based on the American Association of State Highway and Transportation Officials (AASHTO) Geometric Design of Highways and Streets, 2004 (PGDHS), as supplemented by the current edition of the Department's Highway Preconstruction Manual (PCM). Additional guidance was provided from the applicable sections of the AASHTO Guidelines for Geometric Design of Very Low-Volume Local Roads, 2001 (GDVLVLR), the U.S. Forest Service Roadway Preconstruction Handbook, 2011 (FS-RPH); and engineering judgment. References and sources are noted within the text.

## Functional Classification

Anticipating the myriad of uses and vehicles that the West Susitna access road could see (e.g., resource recovery, public access for recreation, etc.), a 24-foot-wide, two-lane gravel access road (2'-10'-10'-2') was considered for the facility, with the idea that the ultimate facility may be significantly wider based on further investigations or interest in the Study Area. The suggested functional classification of an access road into the West Susitna basin would be a two-lane gravel **Rural Resource Recovery Road**.[1] At this time, the corridor would be considered a very low-volume local road. The PGDHS defines a very low-volume local road as one with an average annual daily traffic volume of 400 VPD or less.

The dimensions of a Rural Resource Recovery Road would more than meet the roadway dimensions and needs required for a **Rural Local Road**[2] or **Rural Minor Access Road**.[3] Table 3 highlights the design criteria for all three road classifications, indicating that the Rural Resource Recovery Road would more than satisfy the need for the other roadway uses. The Rural Local Road classification is included here to highlight that this type of roadway could serve as pioneer access for initial exploratory investigations for natural resources.[4] With minimal traffic, such an initial phase access would be classified as a **Rural Local Road** with the understanding that it will eventually function as and become a **Rural Resource Recovery Road**. However, Rural Local Road dimensions do not satisfy the design criteria needs (e.g., total roadway width) required for public access, per the Rural Minor Access Road classification. Therefore, the Rural Resource Recovery Road is the most reasonable functional classification for the West Susitna access route corridors. Also, design criteria appropriate for a Rural Resource Recovery Road in many areas are not significantly different from those for

[1] PGDHS, page 414
[2] PGDHS, page 416
[3] GDVLVLR, page 6
[4] In terms of initial "pioneer access", the PGDHS goes on to recommend the GDVLVLR guidelines (page 52) in lieu of the PGDHS for geometric design, which goes even further stating that two-way single-lane gravel roads serve less than 50 VPD (100 VPD if radio connected). The GDVLVLR also suggests using the FS-RPH as an additional resource for single-lane roads.

recreational roads.[5] Oftentimes, resource development roads are ultimately used for other (e.g., recreational) purposes, assuming the volumes are still below 400 VPD. The Rural Resource Recovery Road classification for West Susitna access takes into account these varying usages.

## Design Vehicle

In terms of resources exploration, development, and extraction, as would be expected, the design vehicle evolves through each anticipated project phase.

1. *Initial Phase*. Vehicles such as 4WD crew cab pickups and single unit (SU) flatbed trucks, drill rigs, fuel tankers, etc., would make up the majority of the expected traffic in the investigative period.
2. *Construction Phase*. Trucks for hauling gravels and building materials would probably be tractors with double (bellydump) trailers (WB-120).
3. *Production Phase*. The majority of the anticipated traffic would be heavy haul vehicles. This would cover a wide range of transportation needs, including moving heavy mining equipment and hauling large amounts of extract or product from product origin to process plants, or to tidewater for shipping Outside. These vehicles may or may not be street-legal.


**Photo 1: Klondike Highway Truck**

**Photo 2: Red Dog Truck**

If the access corridor connects to the existing highway network, vehicles using the new corridor will need to be consistent with the State requirements governing the existing highways (17 AAC 25).

However, given other similar developments around the State, it is not unreasonable to expect that a more robust type of design vehicle could be utilized – like the 10-axle, 200,000-pound double trailer similar to the trucks proposed for use over the Klondike Highway in Southeast, or the 13-axle, 260,000-pound double haul trailers used at the Red Dog mine in Western Alaska.

[5] PGDHS, page 414

For public access, it is anticipated that the primary vehicle will be a 4WD pickup or suburban class vehicle, possibly towing an ATV, boat, or camping trailer.

## Design Speed

A two-way single-lane gravel road is designed to operate at low speeds, typically no more and usually less than 30 MPH. The lower speeds also allow for smaller radius curves that will permit the initial phase road to better conform to the terrain and reduce the amount of earthwork.

Users of the two-lane gravel roadway can function at higher operating speeds, subject to the control of the terrain features[6].

**Table 1. Proposed Design Speeds**

| TERRAIN | DESIGN SPEED (MPH) |
|---|---|
| Level | 40 |
| Rolling | 30 |
| Mountainous | 20 |

The proposed design speed for the production phase should be increased to match the speed at which the majority of the professional drivers are comfortable traveling, while adapting to visual and physical cues such as sight distance, lane width, and road alignment. This may entail a design speed in level terrain of up to 50 MPH wherever possible.

## Typical Section

Because the size of equipment that travels on haul roads varies significantly, vehicle size rather than vehicle type or gross vehicle weight are best used to define road width requirements. In the past, it was recommended that each lane of travel should provide clearance on each side of the vehicle equal to one-half of the width of the widest vehicle in use (AASHO 1965).

During the initial phase, the typical section of the 30 MPH two-way single-lane access roadway for 4WD pickups and service vehicles would consist of one 12-foot travel lane, with 2-foot shoulders on each side for a total width of 16 feet[7].

In the production phase, the ultimate build-out of the higher speed two-lane resource recovery road typical section width would be a function of the intended design vehicle. This could vary from the 16-foot-wide single-lane for an oil or gas pipeline or aerial poleline service road, to 32 feet for the two-way Klondike Highway or 30 feet for the one-way Red Dog mine road. The GDVLVLR recommends a 22.5-foot-wide resource recovery roadway.

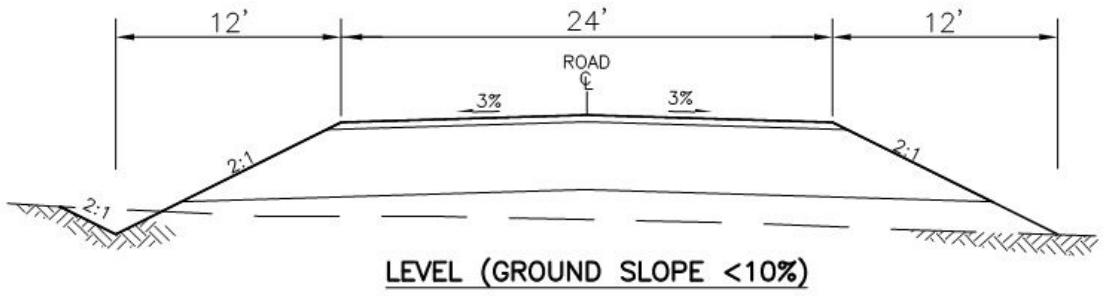
The GDVLVLR also suggests that a public minor access road be 18 feet wide.

Anticipating the varying uses and vehicles that this new access road could see, it is proposed that the production phase width should be at least 22.5 feet wide.

[6] PGDHS, page 415
[7] FS-RPH, page 20

For purposes of this Study, as shown on Figure 2, a 24-foot-wide two-lane gravel access road (2'-10'-10'-2') will be the considered facility, with the idea that the ultimate facility may be significantly wider.

**Figure 2. West Susitna Access Typical Cross Section**




## Bridges

Bridges will be estimated initially as two-lane structures. For long bridges in excess of 200 feet, the width may be reduced for economy. Once a design vehicle and any special restricted usage is identified, design criteria will be per the current edition of the AASHTO Load and Resistance Factor Design Bridge Design Specifications (LRFD).

## Grades

The maximum grade for a pioneer road is 18 percent for 4WD and high clearance vehicles[8].

The grade for a resource recovery road varies with design speed and surrounding terrain. From the PGDHS, the following is interpolated[9]:

**Table 2. Terrain Grades**

| TERRAIN | DESIGN SPEED | GRADE |
|---|---|---|
| Level | 40 | 7 |
| Rolling | 30 | 10 |
| Mountainous | 20 | 16 |

For 50 MPH, the maximum grade decreases to 6 percent on the flat topography[10]. Further reductions may be required to address the use of even heavier haul vehicles. AASHTO cautions that “sections of adverse grades should not be so long that they slow a loaded truck to crawl

[8] FS-RPH, page 56
[9] PGDHS, page 409
[10] PGDHS, page 382

speed… In many instances, failure to use flatter grades may result in additional expenses for transportation during the life of the road far in excess of any savings in construction cost."[11]

## Curve Radius

The minimum curve radius matches the design speed and friction factor of the road surface with superelevation to the design vehicle to comfortably negotiate the curve. The PGDHS recommends a curve radius of 485 feet for a design speed of 40 MPH, and 833 feet for 50 MPH for a high type facility, but the GDVLVLR calculates a minimum curve radius of 185 feet for 30 MPH, and 380 feet for 40 MPH for lower volume roadways with a high percentage of truck traffic[12]. In climates that commonly receive snow and ice, 6 percent superelevation is considered the maximum[13].

## Sight Distance

The GDVLVLR recommends doubling the two-lane stopping sight distance for single-lane roads[14]. At 40 MPH, the stopping sight distance for the two-way two-lane roadway is 250 feet[15].

K value is the rate of change of grade on a vertical curve (the distance in feet required to achieve a 1% change in grade); it is used to make sure the crest vertical curve is shallow enough to allow drivers to see what is on the other side in time to stop their vehicle, or that a sag vertical curve is flat enough for their headlights to illuminate a possible obstruction ahead of them. K values are based on the stopping sight distance; for a 40 MPH design speed, the crest K value is 29[16]. The GDVLVLR does not provide specific guidance on sag vertical curves, but the FS-RPH formula recommends a computed sag K value of 35 at 40 MPH[17].

## Sideslopes

According to AASHTO, sideslopes are "designed to ensure roadway stability and to provide a reasonable opportunity for recovery for an out-of-control vehicle"[18]. Slopes are divided into "recoverable" (≥4H:1V), "traversable" (>3:1 and <4:1), and "non-traversable" (≤3:1). The initial phase pioneer road would incorporate 2:1 slopes.

The production phase road design would analyze 4:1 sideslopes, where practical, to provide a reasonable recovery area prior to a more cost-effective 2:1 slope[19]. On more significant fills, a 2:1 fill slope protected by guardrail (subject to geotechnical investigation), would be incorporated into the design to reduce earthwork quantities, as well as to reduce impacts to area resources.

[11] PGDHS, page 415
[12] GDVLVLR, page 28
[13] FS-RPH, page 40
[14] GDVLVLR, page 52
[15] GDVLVLR, page 39
[16] GDVLVLR, page 39
[17] FS-RPH, page 43 ($k = v^2 / 46.5$)
[18] PGDHS, page 330
[19] PGDHS, pages 413 and 387

## Clear Zones

The clear zone is the portion of the roadside that is free of obstructions and sufficiently flat to enable an errant vehicle to encroach without overturning. Shoulders are part of the roadside clear zone. Providing roadside clear zones, flatter slopes, or traffic barriers is generally inconsistent with the economic decision to build and maintain an unpaved surface[20]. However, the GDVLVLR design guidelines for new construction states that a clear recovery area of 6 feet or more should be considered if cost, terrain, right-of-way, and social/environmental impacts are not an issue[21]. If the impacts are considered large, clear zones from 0 to 6 feet may be used.

## Turnouts

The U.S. Forest Service operates many unpaved two-way single-lane roads, and their design criteria recommends turnouts be provided at regular intervals to allow opposing vehicles to pass one another safely. The location of the turnouts should consider topography and horizontal and vertical alignment. Turnouts should be intervisible, with a maximum spacing of 1,000 feet[22]. In some cases where sight distances are impractical, roadways should be widened at crests. The recommended turnout width is 120 feet long by 10 feet in width with 50 foot transitions at each end (based on a 120-foot design vehicle length)[23].

## Access

The purpose of this road is to encourage development of and provide new access to State lands. At this time, controlled-access restrictions may not be warranted; though it is recommended that all access to the new roadways be in accordance with the Department's current edition of the Driveway Regulations. On a corridor planning level, controlled-access may make sense, especially closer to the already-developed areas where the proposed access routes would connect to existing roadways.

## Summary

The West Susitna Access reconnaissance study proposes to look at the development of possibly several resource recovery road corridors to the west of the Parks Highway. The proposed access route(s) would provide the opportunity for both resource exploration/recovery and public access to lands. In terms of resource exploration, the intent is to initially provide access for investigative services. Once a site has been identified to advance, then the production phase would be initiated and work on the resource could begin.

Table 3 highlights the design criteria based on the functional uses of the proposed access road. At this time, it is assumed the **Rural Resource Recovery Road** classification would more than meet the needs of the varying proposed uses and development phases of resource development.

[20] GDVLVLR, page 50
[21] GDVLVLR, page 48
[22] FS-RPH, page 22
[23] FS-RPH, page 24

**Table 3. Preliminary Design Criteria**

| ELEMENT | INITIAL PHASE | PRODUCTION PHASE | PUBLIC ACCESS CONSIDERATION |
|---|---|---|---|
| Functional Classification | Rural Local Road | **Rural Resource Recovery Road** | Rural Minor Access Roads |
| Traffic Volume | < 100 AADT | **< 400 AADT** | < 400 AADT |
| Number of Lanes | One lane with turnouts | **Two lanes** | Two lanes |
| Design Vehicle | Single Unit Vehicle | **WB-120 Trucks** | Single Unit Vehicle with Trailer |
| Design Speed | 30 MPH | **20 – 40 MPH depending on terrain** | 20 – 40 MPH depending on terrain |
| Surfacing | Unpaved | **Unpaved** | Unpaved |
| Traveled Way Width | 12 feet (one lane) | **10 feet (two lanes)** | 18 feet |
| Shoulder Width | 2 feet | **2 feet** | — |
| Bridge Width | Two lanes | **Two lanes** | Two lanes |
| Maximum Grade | 18% | **7-16% depending on terrain** | 7-16% depending on terrain |
| Curve Radius | 185 feet @ 30 MPH | **380 feet @ 40 MPH** | 380 feet @ 40 MPH |
| Stopping Sight Distance | 270 feet @ 30 MPH | **250 feet @ 40 MPH** | 250 feet @ 40 MPH |
| Vertical Curves | Crest K = 9 @ 30 MPH<br>Sag K = 19 @ 30 MPH | **Crest K = 29 @ 40 MPH**<br>**Sag K = 35 @ 40 MPH** | Crest K = 29 @ 40 MPH<br>Sag K = 35 @ 40 MPH |
| Clear Zone | 0 to 6 feet | **0 to 6 feet or more up to 10 feet** | 0 to 6 feet |
| Sideslopes | Foreslopes – 2:1<br>Backslopes – 2:1 | **Foreslopes – 4:1**<br>**Backslopes – 2:1** | Foreslopes – 2:1<br>Backslopes – 2:1 |
| Turnouts | Intervisible, with 1,000-foot spacing | **Not applicable** | Not applicable |