Appendix F
Mineola Hill Technical Memo

Over the course of the Improve I-70 Study, the SIU 6 Study Team has evaluated various build alternatives through the Mineola Hill segment of I-70. Located within the Mineola Hill portions of SIU 6 are three unique environmental constraints (Graham Cave State Park, Graham Farmstead, and Graham Rock) located within close proximity to the existing interstate highway. Two of the properties, the state park and farmstead have been identified as 4(f) resources. The SIU 6 study team's overall approach was to identify a series of avoidance alternatives that satisfied the identified purpose and need and, failing that, develop mitigation alternatives. The SIU 6 team has identified two basic avoidance alternatives, the On-Existing and Far North alternatives, neither of which would directly impact any of the existing 4(f) resources.

Those avoidance alternatives were presented to the Study Management Subcommittee on Mineola Hill, as well as to FHWA for their review. A series of questions arose from those meetings that required additional analysis. This technical memorandum is intended to address those issues and provide the background material to enable MoDOT and FHWA to come to a resolution as to the preferred alternative through Mineola Hill.

A. Two Mineola Hill Avoidance Alternatives

The SIU 6 Study Team has evaluated over a dozen different alternatives through Mineola Hill including two off-alignment corridors that would relocate the highway north of Graham Cave State Park. Those alternatives have been screened down to two avoidance alternatives, an alternative along the Far North Corridor and an alternative along existing I-70.

1. Expand Existing with Off-Alignment Frontage Road

This alternative improves mainline I-70 by expanding on the existing alignment. Unlike other On-Existing alternatives, this alternative would not have parallel frontage roads. Instead it would utilize a single southern frontage road along an improved State Route J and N through the town of Mineola before rejoining and running parallel to I-70 for the remainder of the segment. There would be no northern frontage road through the Mineola Hill area. Three variations of this alternative are being considered, each has different vertical grades, retaining walls and guard rail. **Exhibits F-1, F-2** and **F-3** show these concepts.

2. Far North Relocation with Split Frontage

This alternative would utilize the Far North corridor to relocate the highway through Mineola Hill and the Loutre Valley. It would build a split frontage road system that features a new parallel frontage road running north of the mainline and utilizes a portion of existing I-70 to provide a frontage road south of mainline I-70. The Far North relocation alternative would follow the desired Improve I-70 design criteria that would utilize a maximum vertical grade of 3 percent and 6:1 slopes.

The screening process leading to the On-Existing alternative included detailed evaluations of differing vertical grades, side slopes and retaining wall lengths and sizes attempting to optimize the preferred alternative. The three variations remaining are described in more detail below.

B. Selecting Avoidance Alternative

The first step in the environmental decision-making process was to apply the typical roadway section developed during the first tier study through Mineola Hill. It was determined that the On-Existing first tier alternative could not reasonably be constructed without undue impact to the environment primarily from the 6:1 side slopes and the frontage roads on both sides. From there, the study team evaluated a series of modifications to that alternative that would avoid direct impact to the identified resources. It was determined in all cases that there would be no frontage roads directly adjacent to the interstate and that guardrail with steeper side slopes and retaining walls would be required. Vertical alignment variations are the most defining difference.

The three remaining alternatives being evaluated on the existing alignment include:

- ***On-Existing Alternative A (3/5%)*** – This revised On-Existing alignment includes no parallel frontage roads, a combination of 3 and 5 percent profile grade, use of 2:1 foreslope with guard rails and retaining walls. The study team proposed the immediate construction of the future fourth east bound lane. This lane would provide needed room for a cross over maintenance of traffic plan that would be required in this area during construction. This additional lane would act as a truck climbing lane that would mitigate some of the concerns of a long or steep profile grade shown in some of these options. (**Exhibit F-1**)
- ***On-Existing Alternative B (3/4%)*** – This variation of the On-Existing alternative uses the same criteria as Alternative A, except for the profile grade. This alternative would use a 4 percent grade from the Loutre River Bridge to Graham Rock and a 3 percent profile grade from the rock to the crest of Mineola Hill. (**Exhibit F-2**)
- ***On-Existing Alternative C (4%)*** – This variation of an On-Existing alternative would utilize a 4 percent profile grade, 2:1 foreslopes with guardrails and a fourth eastbound climbing lane. Unlike all of the other alternatives developed during this process, this alternative assumes that Graham Rock has no historic, cultural, or environmental justice issues associated with it. As such the study team was free to consider removing the rock were it necessary to construct the alternative. (**Exhibit F-3**)

1. Key Issues

The key issues being discussed at this point of the study are in regards to a series of engineering issues related to the remaining alternatives, three On-Existing and the Far North.

a. Vertical Grades

The desired criteria established for the I-70 corridor provides for a maximum vertical grade of three percent. The typical criterion for interstate highways, as provided by FHWA, is a maximum grade of four percent.

- ***On Existing Alternative A*** – This alternative would meet the 3% grade requirement from Graham Rock to the crest of the hill near Danville but would carry a substandard grade of 5% from the Loutre River Bridge to the rock. The total length

of grade that would be greater than 3% is approximately 1440 feet. The total length of grade that would be greater than 4% is 730 feet.

- ***On Existing Alternative B*** – This alternative also would meet the desired 3% grade from Graham Rock to the crest of the hill but would carry a grade of four percent from the Loutre River Bridge to the rock. The total length of grade greater than 3% is 880 feet. The total length of grade greater than 4% is 0 feet.
- ***On Existing Alternative C*** – This alternative assumes that the total length, 4,775 feet, would follow a 4% grade from the river to the crest of the hill.
- ***Far North Alternative*** – This alternative would carry a maximum 3% grade throughout the valley.

b. Slope/Guardrail

The recommended side slope of 6:1 cannot be included in any of the On-Existing alternatives in Mineola without impacting the identified environmental resources. All three alternatives would require a 2:1 slope with guard rails throughout the majority of the length of roadway. The Far North alternative would carry a 6:1 side slope throughout its length.

c. Retaining Walls

Extensive use of retaining walls on both the north and south sides of I-70 will be required to avoid impacting the environmental resources through Mineola for all three of the On-Existing alternatives.

- ***On Existing Alternative A*** – This alternative would require the longest overall length of retaining wall but the shortest overall height. The approximate total length of retaining walls would be approximately 5,080 feet. The maximum height of those retaining walls would be 18 feet high.
- ***On Existing Alternative B*** – This alternative would require a total retaining wall length of approximately 3,845 feet. The maximum height of those retaining walls would be 25 feet high.
- ***On Existing Alternative C*** - This alternative would require a total retaining wall length of approximately 3,000 feet. The maximum height of those retaining walls would be 25 feet high.
- ***Far North Alternative*** – This alternative would not require any retaining walls.

d. Loutre River Bridge

The height of the new Loutre River Bridge is also a concern because of the direct impact to the Loutre River floodplain.

- ***On Existing Alternative A and B*** – Neither Alternative A or B would require the existing bridge to be raised to accommodate the change in grade.
- ***On Existing Alternative C*** – This alternative would require the bridge to be raised an average of seven feet above existing levels.
- ***Far North Alternative*** - This alternative would allow the new bridge to be placed in accordance with the design of the facility at a standard height.

e. Maximum Cut Section

All of the alternatives would require a substantial amount of cut between Graham Rock and the Danville interchange to make the required grades. The total amount of cut has a direct impact on the overall cost of the improvement, as well as the ability to maintain traffic during

construction. For example, it was determined that a 3% grade throughout would require a maximum cut of approximately 65 feet.

- ***On Existing Alternative A*** – The maximum cut expected with this alternative is approximately 35 feet.
- ***On Existing Alternative B*** – The maximum cut expected with this alternative is approximately 35 feet.
- ***On Existing Alternative C*** – The maximum cut expected with this alternative is approximately 28 feet.
- ***Far North Alternative*** - Cut heights will be determined during design.

f. Traffic Safety

A final issue through Mineola Hill is the tradeoff each of the four alternatives has related to traffic safety. This section of I-70 has been identified as a high accident area because of the existing 5 and 6% slopes and the location of the rest areas. Several improvements have been incorporated into all the alternatives through Mineola, including the removal of the rest areas, the additional fifth and sixth through lanes, retaining walls and guard rails, as well as an additional seventh lane in the eastbound direction to provide a truck climbing lane. The only real difference from an accident perspective between the final Mineola alternatives is the respective vertical grades being proposed.

A brief description of the existing crash characteristics might help frame the overall discussion through this section of I-70.

- Between 1995 and 2000, there were an average of 44 accidents per year between the rest area exit ramp east of the Loutre River and the rest area exit ramp west of the river in both the eastbound and westbound directions (approximately 10,600 feet). 54% of those accidents were in the westbound direction and the remaining 46% were in the eastbound direction.
- In the westbound direction, between the rest area exit ramp and the Loutre River there were a total of 16 accidents per year (approximately 6,250 feet). 77% of those accidents occurred between the exit ramp and Graham Rock and the remaining 23% occurred between Graham Rock and the river.
- In the eastbound direction, between the Loutre River and the westbound rest area there were a total of 14 accidents per year. 19% of those accidents occurred between the river and Graham Rock and the remaining 81% occurred between Graham Rock and the rest area.

In order to calculate total crash reductions associated with grade improvements in the Mineola Hill area east of the Loutre River, an advanced regression equation for estimating changes in crash rates for transportation projects was used. The crash rate-predictor regression equation was then applied to the existing and forecasted situations in the Mineola Hill area to determine the effects of grade improvements upon the total number of crashes to determine crash savings, if any. This analysis and conclusions apply to the section between the Loutre River and the westbound rest area.

- ***On Existing Alternative A*** – Alternative A resulted in a 13.2 percent reduction in crashes in the year 2030 for a total annual reduction of between 12 and 13 traffic crashes.
- ***On Existing Alternative B*** – Alternative B resulted in a 14.0 percent reduction in crashes in the year 2030 for a total annual reduction of between 13 and 14 traffic crashes.

- ***On Existing Alternative C*** – Alternative C resulted in a 10.3 percent reduction in crashes in the year 2030 for a total reduction of between 9 and 10 traffic crashes. This alternative has the lowest overall reduction in traffic crashes even though the maximum grade is 4% or less. The primary reason is that the majority of the length studied for Alternatives A and B was at 3% and only a small section was greater than 4%, while the entire length of Alternative C was at 4% grade.
- ***Far North Alternative*** – This alternative would expect to have the highest overall reduction in traffic crashes since it maintains a 3% grade or less throughout the entire Loutre River valley. It was estimated that this alternative would result in a 14.6% reduction in traffic crashes for a total reduction of between 13 and 14 crashes in the year 2030.

Table F-1: Year 2030 Crash Reductions in the Mineola Hill Area

Grade	Crash Rate (per HMVMT)	6-yr. Avg. Total Crashes	Total Crash Reduction	Percent Reduction
No Build (5%)	163.59	92.8	-	
Far North (3%)	138.17	79.3	13.5	14.6%
On-Existing A (3/5%)	140.22	80.5	12.27	13.2%
On-Existing B (3/4%)	139.00	79.8	12.97	14.0%
On-Existing C (4%)	145.09	83.2	9.5	10.3%

Source: Wilbur Smith Associates

2. Conclusions

The table below documents the study team findings regarding key issues for each of the alternatives.

Table F-2: Mineola Hill Summary Table

Alternative	Vertical Grade Length			Sideslopes	Retaining Walls		Loutre Bridge - Additional Height	Max. Cut - Height	Total Crash Reduction
	at 3%	>3%	>4%		Max Height	Max Length			
No Build (5%)	---	---	---	2:1	---	---	---	---	---
Far North (3%)	---	0 ft.	0 ft.	6:1	---	0 ft.	---	---	14.6%
On-Existing A (3/5%)	3570 ft.	1440 ft.	730 ft.	2:1	18 ft.	5080 ft.	0.0	35 ft.	13.2%
On-Existing B (3/4%)	5840 ft.	880 ft.	0 ft.	2:1	25 ft.	3845 ft.	0.0	35 ft.	14.0%
On-Existing C (4%)	0 ft.	4775 ft.	0 ft.	2:1	25 ft.	3000 ft.	7.0 ft.	28 ft.	10.3%

Source: Wilbur Smith Associates

Based on the analysis, the study team has determined:

- All three On-Existing alternatives, as well as the Far North alternative, can be constructed without directly impacting the known Section 4(f) resources (Graham Cave State Park and Graham Farmstead).
- Alternatives A, B and the Far North can be constructed without directly impacting Graham Rock. At this point, Graham Rock has been identified as not eligible for inclusion in the National Register.
- Alternative A cannot be constructed without a design exception to provide for a 1,440 foot section of five percent vertical grades…in other words, maintaining the existing grade that is there today between the bridge and Graham Rock. This alternative would require approximately 5,080 feet of retaining wall with a maximum height of 18 feet. The height of the Loutre River Bridge would not need to be increased.

- Alternative B can be constructed without a design exception but would require 3,845 feet of retaining wall with a maximum height of 25 feet. The height of the Loutre River Bridge would not need to be increased.
- Alternative C can also be constructed without a design exception but would require the removal of Graham Rock, as well as the construction of approximately 3,000 feet of retaining wall with a maximum eight of 25 feet. The height of the Loutre River Bridge would need to be increased by approximately 7 feet.
- All four alternatives, including the Far North, would result in a reduction of traffic crashes above what is expected if I-70 is not improved. The removal of the rest areas, along with additional lanes and lower grades could substantially improve traveler safety. It is important to note, however, that the difference in traffic crash savings between any of the Mineola alternatives is negligible with a total difference of just over one accident per year between Alternatives A, B and the Far North. Alternative C would actually perform the worst, because of the long section of four percent grade, with four more accidents per year than the Far North Alternative and three more per year than Alternatives A and B.

The intent of the NEPA environmental-decision making process, as it relates to this study, is develop a sufficient number of alternatives and to explore all possible environmental implications of those alternatives to adequately determine a final preferred alternative. The screening process utilized through Mineola was intended to accomplish that need, while at the same time optimizing the specific engineering design of that alternative.

However, it is not uncommon that minor changes to any preferred alternative will occur during the final design as more refined information is obtained, as long as those changes do not result in a substantial departure from the preferred and the conclusions of the environmental decision-making process are not compromised. Small changes to vertical and/or side slope grades, retaining walls, maximum cuts, or bridge heights could potentially occur during the final design and it is not critical that precise grades are identified at this level of analysis.