

VALUE ENGINEERING REPORT

I-520 Widening & Interchange Improvements

NH000-0520-01(017)

PI No. 210700

Richmond County

December 2, 2008

OWNER AND DESIGN TEAM:



Georgia Department of Transportation
600 North Peachtree Street
Atlanta, GA 30338

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VALUE ENGINEERING STUDY

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EXECUTIVE SUMMARY

Executive Summary

VALUE ENGINEERING STUDY

I-520 Widening and Interchange Improvements Richmond County

Introduction

This report summarizes the results of a value engineering (VE) study conducted on the proposed design for the I-520 Widening and Interchange Improvement project in Richmond, County, Georgia. The roadway part of this project consists of widening and reconstructing the outside Interstate shoulders to accommodate a partial lane in order to maintain two lanes of through traffic in each direction during the construction of the additional median lane, shoulder, and concrete barrier in the existing depressed median. Widening the Interstate will also require the widening of the two I-520 structures over Deans Bridge Road. The Interchange improvements involve the removal of two loop ramps in each of the Gordon Highway and Deans Bridge Road Interchanges. The four existing loop ramps will be replaced with standard diamond type off ramps in order to minimize / eliminate the poor existing Interstate weaving distance between the current cloverleaf loop ramp gore areas. In addition, the remaining two loop ramps in the I-520 / Deans Bridge Road Interchange will be reconstructed.

Adding the two median lanes to I-520 will result in a six-lane section that ties directly to the existing six-lane sections to the north and south of this project. The additional lanes will improve capacity and safety through the area. Gordon Highway will remain essentially as is while Deans Bridge Road will have minor lane modifications made through the interchange area. Major contract work items include bridge widening and reconstruction, roadway embankment, pavement, drainage, noise walls, retaining walls, traffic signals, curb and gutter, and sidewalk. The total estimated project cost including right-of-way (R/W) is \$23.3 million. The design is currently in the concept stage. The study was conducted November 4-7, 2008, at the Georgia DOT Central Office in Atlanta, using a four person VE team.

This report presents the Team's recommendations and all back-up information, for consideration by the decision-makers. This **Executive Summary** includes a brief description of each recommendation. The **Study Identification** section contains information about the project and the team. The **Recommendations** section presents a more detailed description and support information about each recommendation. Lastly, the **Appendix** includes a complete record of the Team's activities and findings. The reader is encouraged to review all sections of the report in order to obtain a complete understanding of the VE process.

Considerations

The project being evaluated under this study has an estimated construction cost of \$22.6 million (not including R/W). Project funding will come from Federal and State sources. The Project

Concept Report has been approved. The Environmental Assessment is almost complete. A public hearing has been held and there is great support for the project. Right-of-way acquisition is scheduled for 2009 and construction is scheduled for December 2009.

Results Obtained

The VE team focused their efforts on the high cost items of the project. Through the use of functional analysis and “brain storming” techniques, the team generated 40 ideas with 24 being identified for additional evaluation as possible recommendations or design suggestions. The VE team developed seven independent recommendations, four alternative recommendation, and two design suggestions. The implementation of the independent recommendations has the potential to reduce the project cost by approximately \$ 2.8 million. A detailed write-up of each recommendation is contained in the respective portion of this report. A summary of the recommendations and design suggestions follows.

Recommendation Highlights

Idea A-2: Reduce the width / thickness of the proposed outside asphalt shoulder widening to minimize construction staging and expedite this phase of work.

The current design will reconstruct the existing full-width outside asphalt paved shoulder to a 12-foot wide shoulder with the same pavement design as the mainline between Sta. 99+95.24 and Sta. 229+83.00. This concept also requires the reconstruction of the existing outside grass shoulder and slopes. This work will provide adequate room for staging traffic during Stage 2 so that two lanes can remain open to traffic in each direction during reconstruction of the median.

It is recommended to mill / overlay the existing full width asphalt shoulders and reconstruct only four feet of the existing shoulder that is adjacent to the mainline. This section provides an adequate pavement width to convey two lane traffic during the median construction stage. The purpose of the roadway portion of the project is to provide capacity improvements to I-520 which is being accomplished by adding additional lanes in the existing depressed median. Widening and strengthening the outside shoulder and slopes are not required to provide capacity for the mainline. Shoulder improvements serve only to facilitate construction staging. A significant time and cost savings is achieved by reducing the reconstruction of the outside shoulder to the minimum required for staging of traffic.

The total potential savings if accepted is \$1,348,000.

Idea B-2: Reduce the width / thickness of the proposed outside concrete shoulder widening to minimize construction staging and expedite this phase of work.

The current design will reconstruct the existing full-width outside concrete paved shoulder to a 12-foot wide shoulder with the same pavement design as the mainline between Sta. 229+83.00 and Sta. 283+00.00. This concept would also reconstruct the existing grass shoulder and slopes. This work will provide adequate room for staging traffic during Stage 2 so that two lanes can remain open to traffic in each direction during reconstruction of the median.

It is recommended to reconstruct the existing outside concrete shoulder adjacent to the mainline with 8-inch roller compacted concrete to provide an adequate pavement section to convey traffic during construction staging. This section provides an adequate pavement width to convey two lane traffic during the median construction stage. The purpose of the roadway portion of the project is to provide capacity improvements to I-520 which is being accomplished by adding additional lanes in the existing depressed median. Widening and strengthening the outside shoulder and slopes are not required to provide capacity for the mainline. Shoulder improvements serve only to facilitate construction staging. A significant time and cost savings is achieved by reducing the reconstruction of the outside shoulder to the minimum required for staging of traffic. Roller compacted concrete has been successfully used on I-985 for construction staging and final shoulder installation.

The total potential savings if accepted is \$757,000.

Idea B-2.1: Reduce the 12-inch thickness of the median concrete shoulder pavement by using eight-inch roller compacted concrete.

The current median concrete shoulder design uses the same pavement section as the mainline pavement. The concrete shoulder section consists of 12-inch GAB, 4-inch intermediate asphalt layer, and 12-inch thick PCC for the median shoulder area.

It is recommended that a review be made of the concrete shoulder pavement design to develop a more reasonable section for the median shoulders along side the existing concrete pavement section south of the Deans Road Bridge. This idea assumes the use of the same 8-inch thick, roller compacted concrete section as the outside shoulder address in Idea B-2. This shoulder type was recently used on I-285 and I-985 projects. A benefit of roller compacted concrete is that it can be placed directly on compacted sub-grade. This reduces construction costs and also shortens the construction duration.

The total potential savings if accepted is \$325,000.

Idea A-5: Modify / reduce the typical section for the median asphalt shoulder on the Interstate mainline.

The current design provides a 6.75-foot inside asphalt shoulders with the same pavement section design as the mainline between Sta. 99+95.24 and Sta. 229+83.00. The current asphalt pavement design is 1.25-inch 12.5 mm PEM, 4-inch 19mm, 6-inch 25mm, and 12-inch GAB.

It is recommended that the proposed 6.75-foot inside asphalt shoulders section be revised to provide a more standard full-depth asphalt shoulder design. The recommended design would provide a 1.5-inch 12.5mm PEM, 2-inch 19mm, 3-inch 25mm, and 8-inch GAB. The purpose of the roadway portion of the project is improving capacity on I-520. Capacity improvements are being provided by adding additional lanes in the existing depressed median. The additional pavement thickness in the inside shoulder does not address the purpose of the project and may be removed to produce significant cost savings.

The total potential savings if accepted is \$392,000.

Idea B-3: Construct all the new Interchange ramps with PCC pavement and eight-inch roller compacted concrete shoulders.

The current design proposes to construct three ramps (I-520 SB off ramp to Deans Road, WB Deans Road loop on ramp to I-520, and Deans Road EB loop on ramp to I-520) using PCC pavement and shoulders and three ramps (I-520 SB off ramp to Deans Road, I-520 NB off ramp to Gordon Highway, and I-520 SB off ramp to Gordon Highway) using asphalt pavement and shoulders.

It is recommended that all four new Interchange ramps and the two reconstructed existing loop ramps be constructed using PCC Pavement and eight-inch roller compacted concrete shoulders. Constructing these ramps using PCC pavement would be consistent with the State's policy for

constructing new Interstate Interchange ramps. Using PCC pavement would prevent shoving and rutting in the ramp lanes if they were constructed using asphalt pavement. Constructing all ramps with PCC pavement would result in a small cost increase, however, combined with the roller compacted concrete for the shoulders would minimize the cost increase and reduce the time needed to complete the work.

The total potential increase if accepted is \$169,000.

Idea F-1: Reduce the width of the outside I-520 Bridge widening by reducing the width of the outside shoulder from 14 feet to 12 feet.

The current design will widen the existing I-520 bridges over SR 4 to accommodate the four existing lanes plus the additional new inside lane. The bridge widening will accommodate the six mainline lanes plus two 14-foot shoulders.

It is recommended that the bridge widening be changed to accommodate the six mainline lanes, a 14-foot median shoulder and a 12-foot outside shoulder. This concept would reduce the widening of each bridge by 2 feet. The outside shoulder width can be reduced to 12 feet because the outside lane is really a ramp and only requires a 12-foot shoulder. This concept would reduce the cost of the project and has the concurrence of the State Bridge Engineer.

The total potential savings if accepted is \$95,000.

Idea S-1: Reduce the amount of retaining walls on the project.

The original design uses gravity-type, concrete retaining walls along the right side of US-1 beginning at station 2025+18 and ending at station 2027+30. Ramp 2-4 is introduced in this section and the right side of the Ramp 2-4 baseline is controlled by typical Section # 13 showing a 16-foot shoulder. Additional R/W and easements for the construction and maintenance of the side slopes must be purchased.

It is recommended that this retaining wall be eliminated by revising Typical Section # 13 to reduce the proposed shoulder from 16 feet to 12 feet. This concept used the minimum shoulder width and would reduce the amount of easement needed for construction and maintenance of slopes. This concept would save cost without sacrificing function.

The total potential savings if accepted is \$51,000.

Idea B-6: ALTERNATIVE to B-2 & B-2.1 Reduce the 12-inch thickness of the eight-foot median and 12-foot outside concrete shoulders by using roller compacted concrete.

The current design will reconstruct the existing full-width concrete median and outside shoulders with the same pavement design as the concrete mainline. This work will provide adequate room for staging traffic during Stage 2 so that two lanes can remain open to traffic in each direction during reconstruction of the median.

It is recommended that the current 12-inch concrete shoulder design be changed to an 8-inch thick, roller compacted concrete shoulder. The need and purpose of the project is to provide safety and capacity improvements to I-520 and improve the existing interchanges within the project limits. Capacity improvements along I-520 are provided by adding an additional lane in each direction by reconstructing the existing depressed median. Shoulder improvements serve to facilitating construction staging and provide safety after construction is complete. This concept would significantly reduce construction time and construction cost. It has been used successfully on I-285 and I-985 projects.

The total potential savings if accepted is \$875,000.

Idea A-13: ALTERNATIVE to A-2, B-2 Modify the staging plan by eliminating the outside shoulder replacement / widening by using / maintaining the existing asphalt shoulder (mill and resurface).

The current design requires the removal / widening of the outside asphalt shoulders. The reconstructed 12-foot outside shoulder will be used for construction staging and ultimately serve as the standard outside shoulder for the Interstate.

It is recommended that the outside shoulder reconstruction be revised to include only the milling and resurfacing (as necessary) of the existing paved shoulder. The existing paved shoulder has some load carrying capacity and may be adequate to serve as a partial staging lane by milling and resurfacing as, or if, the shoulders deteriorate during construction. Milling and resurfacing as much as 2 times during the course of construction would result in significant cost savings. This concept would also eliminate the outside area widening and grading work.

The total potential savings if accepted is \$2,555,000.

Idea A-3: ALTERNATIVE to Idea B-3 Construct the three new PCC paved ramps at the Deans Road Interchange with asphalt pavement and shoulders.

The current design proposes to construct the I-520 SB off ramp to Deans Road, the WB Deans Road loop entrance ramp to I-520, and the Deans Road EB entrance ramp to I-520 using PCC pavement and shoulders. The other three new ramps will be constructed using asphalt pavement and shoulders.

It is recommended that the three ramps (I-520 SB off ramp to Deans Road, the WB Deans Road loop entrance ramp to I-520, and the Deans Road EB entrance ramp to I-520) that are to be paved with PCC pavement / shoulders be constructed using asphalt pavement and shoulders. Constructing the three PCC ramps with asphalt pavement and shoulders would be consistent with the construction and material used to build the other three ramps included in this contract. Using asphalt would accelerate construction and reduce the cost of the project. The asphalt ramps would provide the same function as the currently designed PCC ramps.

The total potential savings if accepted is \$401,000.

Idea B-7: ALTERNATIVE to Idea B-3 Construct eight-inch roller compacted concrete shoulders on the three new PCC paved ramps in the Deans Road Intersection.

The current design proposes to construct the I-520 SB off ramp to Deans Road, the WB Deans Road loop entrance ramp to I-520, and the Deans Road EB entrance ramp to I-520 using PCC pavement and shoulders. The other three new ramps will be constructed using asphalt pavement and shoulders.

It is recommended that the three Interchange ramps proposed for construction using PCC pavement and shoulders be constructed with eight-inch roller compacted concrete shoulders. Using eight-inch Roller compacted concrete shoulders would accelerate construction and reduce project cost.

The total potential savings if accepted is \$223,000.

Design Suggestions

The VE team also developed various Design Suggestions for further consideration during the design of the project. The Design Suggestions are:

- It is suggested that consideration be given to including an Incentive / Disincentive clause in the contract to cover the staging phase to reconstruct / widen the outside shoulder that will serve as a temporary lane. Having an Incentive / Disincentive clause for this phase will help expedite this work stage thereby reducing the time needed for the single lane night-time operation to prepare the temporary two-lane roadway section needed to widen the mainline in the median.
- It is suggested that a review be made of the concrete pavement design to develop a more applicable section including consideration of roller compacted concrete. The concrete pavement section, being proposed is 28 inches thick and is shown to be used on the shoulders also. This project presents an ideal situation for the use of roller compacted concrete for shoulders and perhaps, even for the short new interior lane as a test / experimental section.

I-520 Widening & Interchange Improvements
SUMMARY OF POTENTIAL COST SAVINGS

| ITEM No. | CREATIVE IDEA DESCRIPTION | ORIGINAL INITIAL COST | PROPOSED INITIAL COST | INITIAL COST SAVINGS | FUTURE SAVINGS | TOTAL LIFE CYCLE SAVINGS | SAVINGS POTENTIAL* (%) |
|--------------------------------|--|-----------------------|-----------------------|----------------------|----------------|--------------------------|------------------------|
| RECOMMENDATIONS | | | | | | | |
| A-2 | Reduce the width / thickness of the proposed outside asphalt shoulder widening and expedite this phase of work. | \$1,348,000 | \$0 | \$1,348,000 | N/A | \$1,348,000 | 100% |
| B-2 | Reduce the width / thickness of the proposed outside concrete shoulder widening and expedite this phase of work. | \$1,149,000 | \$392,000 | \$757,000 | N/A | \$757,000 | 100% |
| B-2.1 | Reduce the 12-inch thickness of the median concrete shoulders by using eight-inch roller compacted concrete. | \$600,000 | \$275,000 | \$325,000 | N/A | \$325,000 | 100% |
| A-5 | Modify the median asphalt shoulder section on the Interstate mainline. | \$968,000 | \$576,000 | \$392,000 | N/A | \$392,000 | 100% |
| B-3 | Construct all new Interchange ramps with PCC pavement with eight-inch, roller compacted concrete shoulders. | \$1,675,000 | \$1,844,000 | (\$169,000) | N/A | (\$169,000) | 100% |
| F-1 | Reduce the outside bridge widening by reducing the width of the shoulder from 14 feet to 12 feet. | \$1,505,000 | \$1,410,000 | \$95,000 | N/A | \$95,000 | 100% |
| S-1 | Reduce the amount of retaining walls on the project. | \$51,000 | \$0 | \$51,000 | N/A | \$51,000 | 100% |
| Total Potential Savings | | | | | | \$2,799,000 | |

| ITEM No. | CREATIVE IDEA DESCRIPTION | ORIGINAL INITIAL COST | PROPOSED INITIAL COST | INITIAL COST SAVINGS | FUTURE SAVINGS | TOTAL LIFE CYCLE SAVINGS | SAVINGS POTENTIAL* (%) |
|----------|---|-----------------------|-----------------------|----------------------|----------------|--------------------------|------------------------|
| | ALTERNATIVE RECOMMENDATIONS | | | | | | |
| B-6 | <u>ALTERNATIVE to Idea B-3</u> Reduce the 12-inch thickness of the eight-foot median shoulder and 12-foot outside concrete shoulders by using roller compacted concrete. | \$1,650,000 | \$775,000 | \$875,000 | N/A | | |
| A-13 | <u>ALTERNATIVE to Idea A-2, B-2</u> Modify the staging plan by eliminating the outside shoulder replacement / widening and using / maintaining the existing shoulders | \$3,075,000 | \$520,000 | \$2,555,000 | N/A | | |
| A-3 | <u>ALTERNATIVE to Idea B-3</u> Construct the three new PCC ramps at the Deans Bridge Road Interchange with asphalt pavement and shoulders. | \$871,000 | \$470,000 | \$401,000 | N/A | | |
| B-7 | <u>ALTERNATIVE to Idea B-3</u> Construct eight-inch roller compacted concrete shoulders on the three new PCC paved ramps in the Deans Road Intersection. | \$421,000 | \$198,000 | \$223,00 | N/A | | |
| | | | | | | | |
| | DESIGN SUGGESTIONS | | | | | | |
| E-4 | Include an Incentive / Disincentive Clause for the shoulder widening / replacement phase to expedite the work and minimize time. | N/A | N/A | N/A | N/A | N/A | N/A |

| ITEM No. | CREATIVE IDEA DESCRIPTION | ORIGINAL INITIAL COST | PROPOSED INITIAL COST | INITIAL COST SAVINGS | FUTURE SAVINGS | TOTAL LIFE CYCLE SAVINGS | SAVINGS POTENTIAL* (%) |
|--|--|-----------------------|-----------------------|----------------------|----------------|--------------------------|------------------------|
| C-1 | Reduce / modify the pavement design for the project. Consider the use of roller compacted concrete on the mainline pavement. | N/A | N/A | N/A | N/A | N/A | N/A |
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| * Note: Savings Potential represents how much of an individual item, exclusive of any overlapping dependent items, can be implemented. | | | | | | | |

STUDY IDENTIFICATION

Study Identification

| | |
|---|---------------------------------|
| Project: I-520 Widening & Interchange Improvements | Date: November 4-7, 2008 |
| Location: Richmond County, Georgia | |

VE Team Members

| Name: | Title: | Organization: | Telephone: |
|-------------------|---------------------|------------------------|--------------|
| Keith Borkenhagen | VE Team Facilitator | MACTEC | 623-556-1875 |
| George Obaranec | Roadway Design | MACTEC | 770-421-3346 |
| Steven Gains | Construction | Wolverton & Associates | 770-447-8999 |
| Greg Grant | Structures | Wolverton & Associates | 770-447-8999 |

Project Description

This project will provide Interstate widening and Interchange improvements to the section of I-520 between Gordon Highway and Deans Bridge Road in Richmond County, Georgia. The roadway part consists of widening and reconstructing the outside Interstate shoulders to accommodate a partial lane in order to maintain two lanes of through traffic in each direction during the construction of the additional lane, shoulder, and median barrier in the existing depressed median. Widening the Interstate will also require widening the two I-520 structures over Deans Bridge Road. The Interchange improvements involve the removal of two loop ramps in the Gordon Highway and Deans Bridge Road Interchanges. The four existing loop ramps will be replaced with standard diamond off ramps in order to minimize / eliminate the poor Interstate weaving distance between the current cloverleaf loop ramp gore areas. In addition, the remaining two loop ramps in the Deans Bridge Road Interchange will be reconstructed.

Adding the two median lanes will result in a six-lane section that ties directly to the existing six-lane sections to the north and south of this project. The additional lanes will improve capacity and safety through the area. Gordon Highway will remain essentially as it is while Deans Bridge Road will have minor lane modifications made through the interchange area. Major contract work items include bridge widening and reconstruction, roadway embankment, pavement, noise walls, drainage, retaining walls, traffic signals, curb and gutter, and sidewalk. The total estimated project cost including right-of-way (R/W) is \$23.3 million.

Project Constraints

The VE team was given the following constraints for this project:

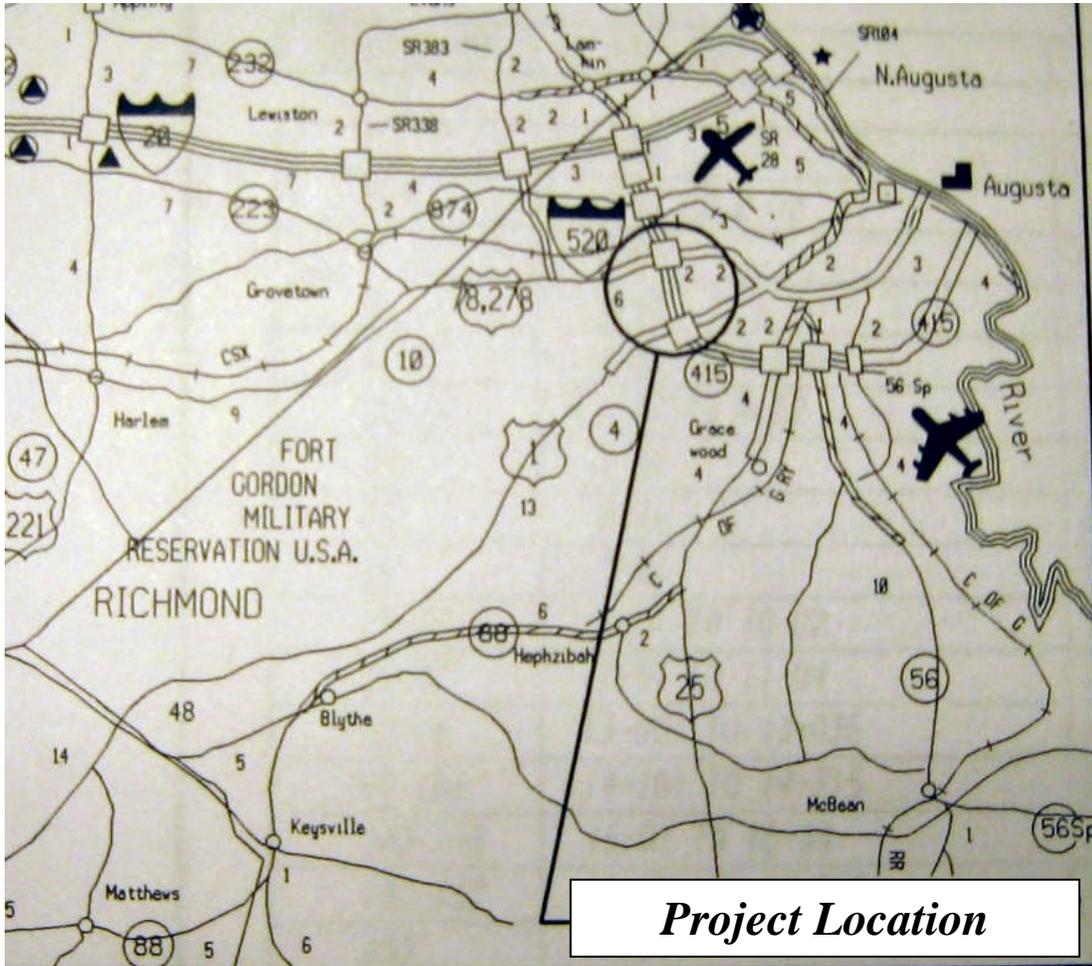
- Four lanes of Interstate traffic, 2 in each direction, would have to remain open during the main construction phase of adding the inside lane, shoulder, and barrier in the median.
- Changes could not be made to the project noise barriers. The barriers had to remain in-place in the areas designated.
- The design team had already modified the south western end of Deans Bridge Road to provide 11-foot lanes in order to significantly reduce the amount of R/W required in that area.

Project Briefing

Prior to beginning work, the VE team was briefed on the design status of the project. The following items were discussed:

- This project will widen I-520 by constructing an additional lane in the median in each direction. The new six-lane section will match the six-lane section to the north and south of the project.
- The project is phased to widen / reconstruct the existing paved outside shoulders first to provide adequate roadway width to maintain two-lane traffic in both directions during the longer median stage that will add the new lane, shoulders, and median barrier.
- Traffic can be reduced to a single lane during the shoulder work in order to accomplish the work. Lane closures will be allowed at night.
- New dual exit ramps are being built to eliminate four loop ramps in the two Interchanges. The loop ramps are being removed to reduce / eliminate weaving problems on the Interstate. This will also improve safety.
- Two additional loop ramps are being reconstructed in the Deans Bridge Road Interchange due to their extremely poor condition.
- R/W needs have been reduced through the use of 11-foot lanes on the south west end of Deans Bridge Road.
- Existing traffic signals are not being upgraded on the crossroads. New traffic signals will be added at the ends of the new diamond ramps.
- The existing bridges have adequate vertical clearances.
- No work will be done on the Gordon Highway Bridge over the Interstate.
- The Interchange revisions have been approved. The Environmental Assessment is almost complete. Public hearings have been held. R/W acquisition is scheduled for 2009. Construction is scheduled for December 2009.
- There is no change in the existing drainage concept. The widening will simply tie to the existing drainage system.
- No sidewalks will be constructed on Gordon Highway (none currently exist). Sidewalks will be provided through the Deans Bridge Road Interchange.

Project Sketch Map



RECOMMENDATIONS

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|---|
| Idea No.: A-2 | Sheet No.: 1 of 4 | CREATIVE IDEA: Modify the mainline outside asphalt shoulder for improved construction staging. |
|-------------------------|-----------------------------|---|

Comp By: S.W.G. Date: 11-6-08 Checked By: K.B. Date: 11/17/08

Original Concept: Construct 12-foot outside asphalt shoulders with the same pavement design as the mainline between Sta. 99+95.24 and Sta. 229+83.00 and to reconstruct the existing outside grass shoulder and slopes. The full depth asphalt shoulder (original concept) is being provided for staging traffic during Stage 2 to allow two lanes to remain open to traffic in each direction during reconstruction of the median. The staging typical section provides for two 12-foot lanes during Stage 2 construction. A temporary barrier is placed at an offset of 7.5 feet from the existing inside edge of pavement to allow for median construction.

Proposed Change: It is recommended to mill / overlay the existing full width outside asphalt shoulders and to reconstruct only four feet of the existing shoulder adjacent to the mainline. This concept provides an adequate pavement section to convey traffic during construction staging. The final roadway surface course should also be placed on the full width (existing) outside shoulder. The staging typical section would be revised to provide two 11-foot lanes during Stage 2 construction. The temporary barrier would be placed at an offset of 1.5 feet from the existing edge of pavement to allow for median construction.

Justification: The need and purpose of the project is to provide safety and capacity improvements to I-520 and improve the existing interchanges within the project limits. Capacity improvements along I-520 are provided by adding an additional lane in each direction by reconstructing the existing depressed median. Proposed improvements to the outside shoulder and slopes are not required to provide capacity for the mainline. Shoulder improvements serve only to facilitate construction staging. A significant cost savings is achieved by reducing the reconstruction of the outside shoulder to the minimum required for staging of traffic. The removal of required improvements to the existing grass shoulders and slopes prevents the necessity of sliver fills, excess embankment and reduces erosion control measures.

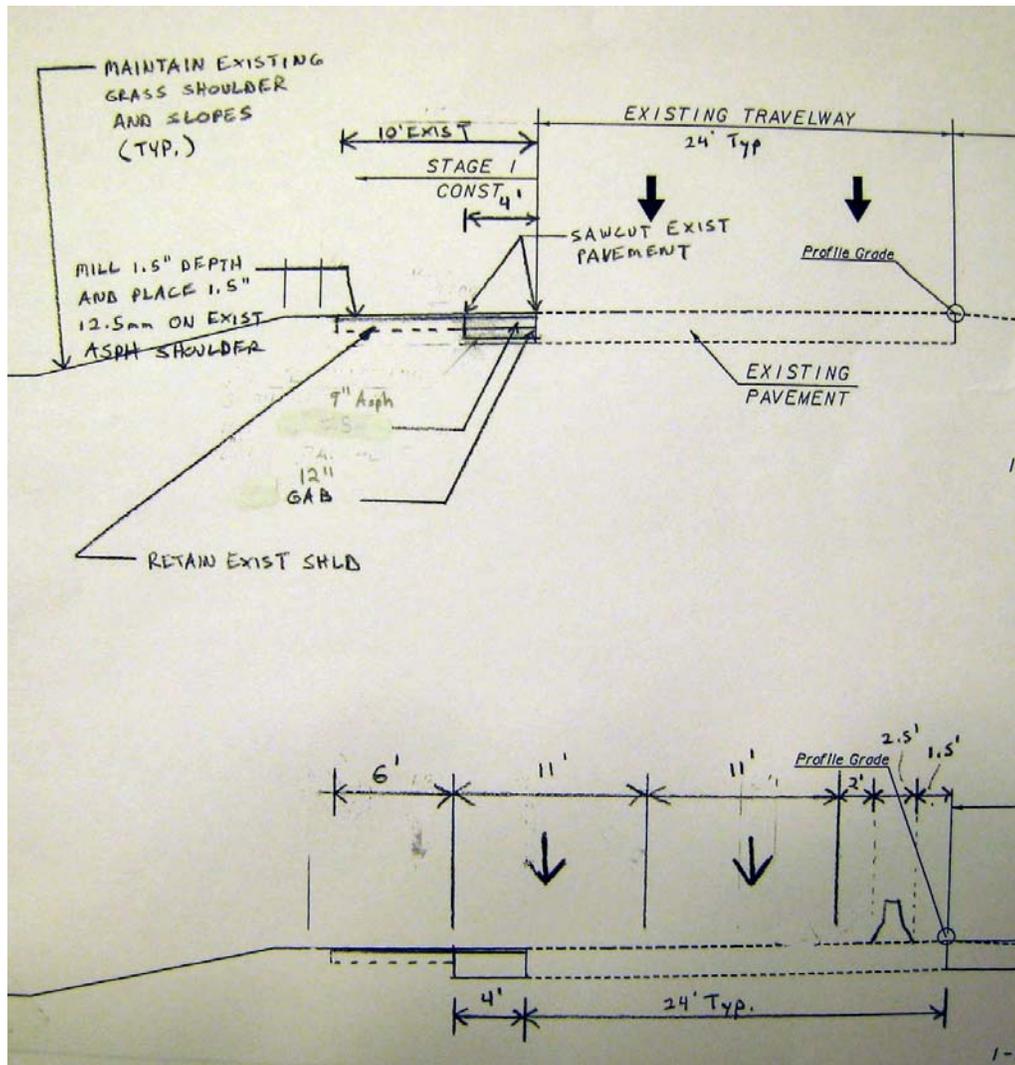
| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|--------------------|
| INITIAL COST - Original | \$1,348,000 | | |
| - Proposed | \$0 | | |
| - Savings | \$1,348,000 | | \$1,348,000 |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | \$1,348,000 |

SKETCH

Project: I-520 Widening and Interchange Improvements

Idea No.: A-2
CLIENT: GDOT
Sheet 2 of 4

Proposed Design



CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: A-2
CLIENT: GDOT
Sheet 4 of 4

General Assumptions

Left Side

Sta. 112+00 to 132+00, Sta. 140+50 to 210+00, Sta. 223+50 to 230+00

Right Side

Sta. 110+00 to 132+00, Sta. 140+50 to 190+00, Sta. 223+50 to 230+00

Total Length = 17,400 lf

Earthwork (Assume 4 sy savings per cross section)

Volume = (17,400 lf)(4 cy)(1 yd/3 lf) = 23,200 cy

Pavement Removal (Assume 1 sy savings per cross section)

Volume = (17,400 lf)(1 cy)(1 yd/3 lf) = 5,800 cy

GAB (12" Thickness) – 8' Width Savings

Wt = (8 lf)(17,400 lf)(1sy/9sf)(1320#/1sy)(1tn/2000#) = 10,208 tons

Asphalt 12.5mm PEM

Wt = (8 lf)(17,400 lf)(1sy/9sf)(165#/1sy)(1tn/2000#) = 1,276 tons

Asphalt 19mm

Wt = (8 lf)(17,400 lf)(1sy/9sf)(440#/1sy)(1tn/2000#) = 3,402 tons

Asphalt 25mm

Wt = (8 lf)(17,400 lf)(1sy/9sf)(550#/1sy)(1tn/2000#) = 4,253 tons

Traffic Control

Assume 5% overall savings

Erosion Control

Assume 10% overall savings

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|--|
| Idea No.: B-2 | Sheet No.: 1 of 4 | CREATIVE IDEA: Modify the mainline outside concrete shoulder for improved construction staging. |
|-------------------------|-----------------------------|--|

Comp By: S.W.G. Date: 11-6-08 Checked By: K.B. Date: 11/17/08

Original Concept: Construct 12-foot outside concrete shoulders with the same pavement design as the mainline between Sta. 229+83.00 and Sta. 283+00.00 and to reconstruct the existing grass shoulder and slopes. The full depth concrete shoulder (original concept) is provided for staging traffic during Stage 2 to allow two lanes to remain open to traffic in each direction during reconstruction of the median. The staging typical section provides for two 12-foot lanes during Stage 2 construction. A temporary barrier is placed at an offset of 7.5 feet from the existing inside edge of pavement to allow for concrete pavement operations during median construction.

Proposed Change: It is recommended to reconstruct the existing outside concrete shoulder adjacent to the mainline with 8-inch roller compacted concrete to provide an adequate pavement section to convey traffic during construction staging. This allows the existing grass shoulders and slopes to remain undisturbed. The staging typical section would be revised to provide two 11-foot lanes during Stage 2 construction. A temporary barrier would be placed at an offset of 7.5 feet from the existing edge of pavement to allow for concrete pavement operations during median construction.

Justification: The need and purpose of the project is to provide safety and capacity improvements to I-520 and improve the existing interchanges within the project limits. Capacity improvements along I-520 are provided by adding an additional lane in each direction by reconstructing the existing depressed median. Proposed improvements to the outside shoulder and slopes are not required to provide capacity for the mainline. Shoulder improvements serve only to facilitate construction staging. A significant cost savings is achieved by reducing the reconstruction of the outside shoulder to that required for staging of traffic. Roller compacted concrete (7.5" thickness) has been successfully implemented for project IM-NH-985-1(322)01 on I-985 for construction staging and final shoulder installation. The removal of required improvements to the existing grass shoulders and slopes prevents the necessity of sliver fills, excess embankment and reduces erosion control measures.

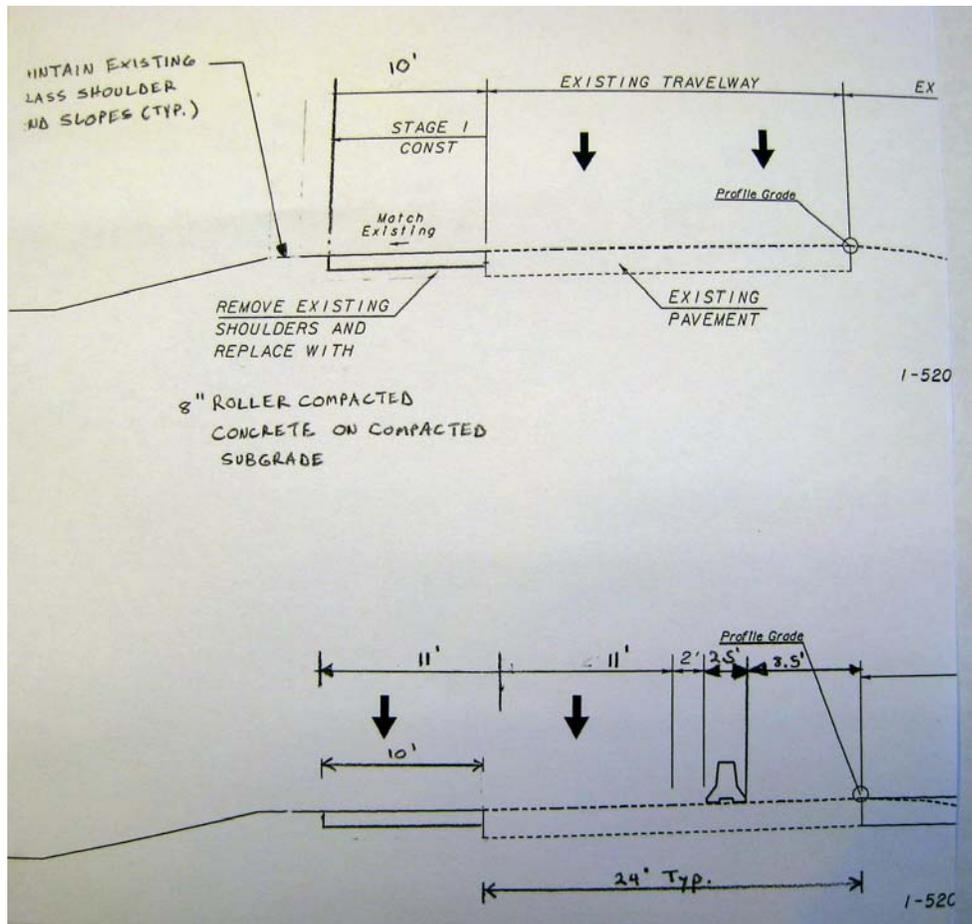
| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|------------------|
| INITIAL COST - Original | \$1,149,000 | | |
| - Proposed | \$392,000 | | |
| - Savings | \$757,000 | | \$757,000 |
| FUTURE COST – Savings | | \$0 | \$757,000 |
| TOTAL PRESENT WORTH SAVINGS | | | \$757,000 |

SKETCH

Project: I-520 Widening and Interchange Improvements

Idea No.: B-2
CLIENT: GDOT
Sheet 2 of 4

Proposed Design



CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: B-2
CLIENT: GDOT
Sheet 4 of 4

General Assumptions

Left Side

Sta. 230+00 to 247+50, Sta. 253+00 to 283+00

Right Side

Sta. 230+00 to 245+00, Sta. 253+50 to 283+00

Total Length = 9,250

Earthwork (Assume 4 sy savings per cross section)

Volume = (9,250 lf)(4 cy)(1 yd/3 lf) = 12,333 cy

GAB (12" Thickness) – 12' Width Savings

Area = (9,250 lf)(12 lf)(1sy/9 sf) = 12,333 sy

PCC (12" Thickness) – 12' Width Savings

Area = (9,250 lf)(12 lf)(1sy/9 sf) = 12,333 sy

Asphalt 19mm

Area = (9,250 lf)(12 lf)(1sy/9 sf) = 12,333 sy

Erosion Control

Assume 5% overall savings

Traffic Control

Assume 2.5% overall savings

Roller Compacted Concrete

Area = (9,250 lf)(10 lf)(1sy/9 sf) = 10,278 sy

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|---------------------------|-----------------------------|--|
| Idea No.: B-2.1 | Sheet No.: 1 of 4 | CREATIVE IDEA: Reduce the thickness of the median concrete shoulder pavement and to review the pavement design for the project. |
|---------------------------|-----------------------------|--|

Comp By: G.A.O. Date: 11-6-08 Checked By: K.B. Date: 11/17/08

Original Concept:

The current design uses the existing concrete pavement section of 12-inch GAB, 4-inch intermediate asphalt layer, and 12-inch thick PCC for the median shoulder area.

Proposed Change:

It is recommended that a review be made of the concrete pavement design to develop a more applicable section for the median concrete shoulder work along side the existing concrete pavement section south of the Deans Road bridge. It is recommended that an 8-inch thick, roller compacted concrete section be used for the median shoulders which would match the section recommended for the outside shoulder addressed in Idea B-2.

Justification:

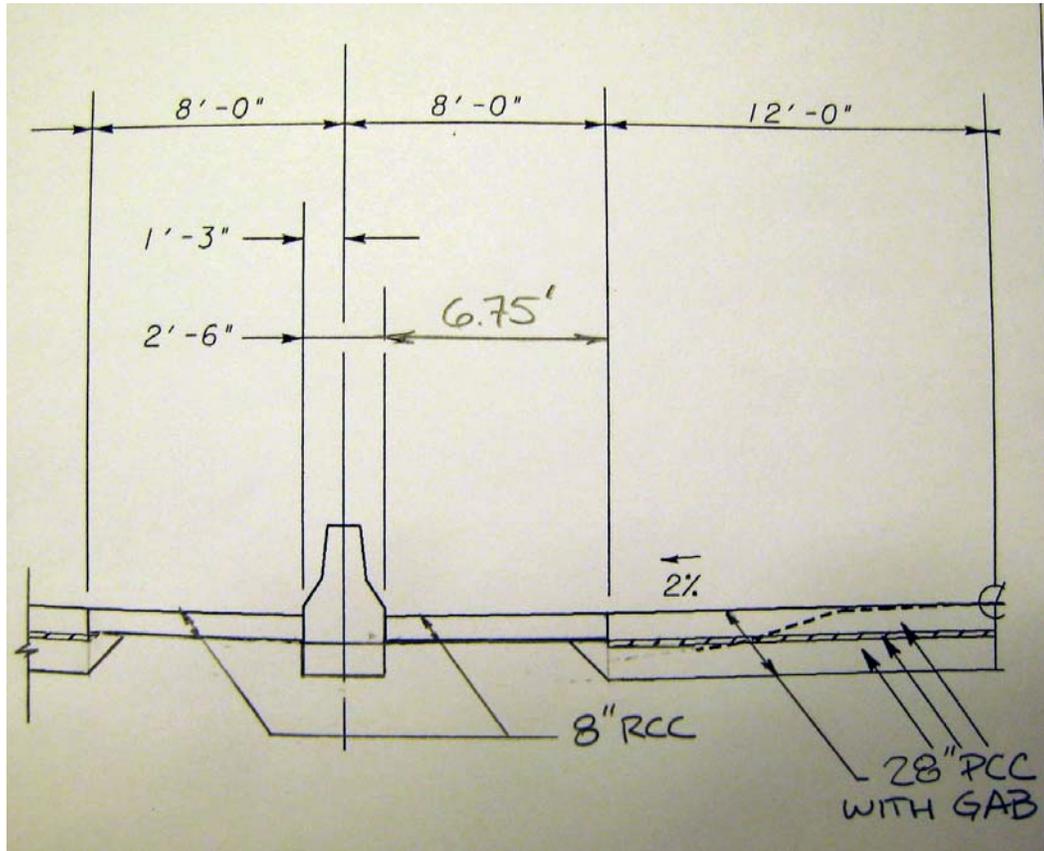
The current design for the median concrete shoulder appears excessive. This design appears to be a general, “default section” for Interstate improvements, however, a more appropriate project specific design could improve constructability and reduce cost. The VE concept provides for a 8-inch roller compacted concrete section. This shoulder type was recently used on I-285 and I-985 projects. An added benefit of roller compacted concrete as used on the I-285 and I-985 projects is that it can be placed directly on compacted sub-grade. This reduces construction costs and also shortens the construction duration.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|---------------------|--------------------|-------------------|
| INITIAL COST - Original | \$600,000 | | |
| - Proposed | \$275,000 | | |
| - Savings | \$325,000 | | \$325,000 |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | \$325,000 |

SKETCH

Project: I-520 Widening and Interchange Improvements

Idea No.: B-2.1
CLIENT: GDOT
Sheet 2 of 4



CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: B-2.1
CLIENT: GDOT
Sheet 4 of 4

Station 235+00 (end of bridge) to station 283+00 (end of project) = 4,800 feet

average width; $(8 - 1.25) \times 2$ directions = 13.5 feet

$$(4,800 \times 13.5) / 9 = 7,200 \text{ SY}$$

4 in intermediate asphalt layer

$$(4 / 12 \text{ ft} \times 4800 \text{ ft} \times 13.5 \text{ ft}) \times 150 \text{ \#/CF} \times (1 \text{ ton} / 2000 \text{ \#}) = 1,620 \text{ tons}$$

GAB cost

$$18.67 \text{ \$/ton} = 12.60 \text{ \$ / SY, 12 in thick}$$

Cost of RCC ; \$165 / CY ; 8 inch thick;

$$165 \text{ \$/CY} (8 \text{ in} / 36 \text{ in/yd}) = \$36.67 / \text{SY, 8 inch thick, USE } \$ 36.70$$

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|--|
| Idea No.: A-5 | Sheet No.: 1 of 4 | CREATIVE IDEA: Modify / reduce the typical section for the median asphalt shoulder on the Interstate mainline. |
|-------------------------|-----------------------------|--|

Comp By: S.W.G. Date: 11-6-08 Checked By: K.B. Date: 11/17/08

Original Concept:

The current design provides a 6.75-foot inside asphalt shoulders with the same pavement section design as the mainline between Sta. 99+95.24 and Sta. 229+83.00. The original asphalt pavement design is 1.25-inch 12.5 mm PEM, 4-inch 19mm, 6-inch 25mm, and 12-inch GAB.

Proposed Change:

It is recommended that the proposed 6.75-foot inside asphalt shoulders section be revised to provide a more standard full-depth asphalt shoulder design. The recommended design would provide a 1.5-inch 12.5mm PEM, 2-inch 19mm, 3-inch 25mm, and 8-inch GAB.

Justification:

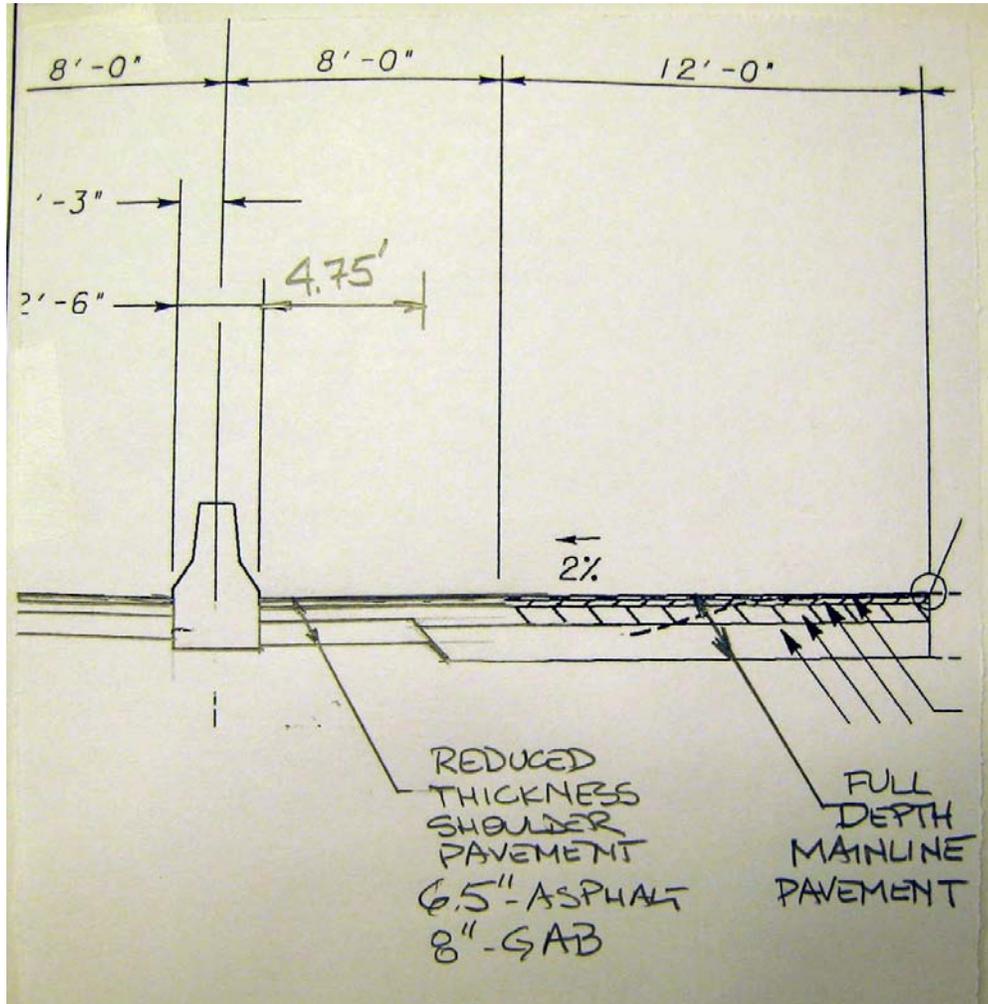
The need and purpose of the project is to provide safety and capacity improvements to I-520 and improve the existing interchanges within the project limits. Capacity improvements along I-520 are provided by adding an additional lane in each direction by reconstructing the existing depressed median. The additional pavement thickness in the inside shoulder does not address the need and purpose of the project and may be removed to produce significant cost savings.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|------------------|
| INITIAL COST - Original | \$968,000 | | |
| - Proposed | \$576,000 | | |
| - Savings | \$392,000 | | \$392,000 |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | \$392,000 |

SKETCH

Project: I-520 Widening and Interchange Improvements

Idea No.: A-5
CLIENT: GDOT
Sheet 2 of 4



CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: A-5
CLIENT: GDOT
Sheet 4 of 4

Length of Modification

99+95.24 to Sta. 229+83.00 => 12,988 lf (each side)

Total Length = (2)(12,988) = 25,976 lf

Original Concept

GAB (12" Thickness)

Wt = (4.75 lf)(25,976 lf)(1sy/9sf)(1320#/1sy)(1tn/2000#) = 9,048 tons

Asphalt 12.5mm PEM

Wt = (4.75 lf)(25,976 lf)(1sy/9sf)(135#/1sy)(1tn/2000#) = 925 tons

Asphalt 19mm

Wt = (4.75 lf)(25,976 lf)(1sy/9sf)(440#/1sy)(1tn/2000#) = 3,016 tons

Asphalt 25mm

Wt = (4.75 lf)(25,976 lf)(1sy/9sf)(660#/1sy)(1tn/2000#) = 4,524 tons

Proposed Change

GAB (8" Thickness)

Wt = (4.75 lf)(25,976 lf)(1sy/9sf)(880#/1sy)(1tn/2000#) = 6,032 tons

Asphalt 12.5mm PEM

Wt = (4.75 lf)(25,976 lf)(1sy/9sf)(165#/1sy)(1tn/2000#) = 1,131 tons

Asphalt 19mm

Wt = (4.75 lf)(25,976 lf)(1sy/9sf)(220#/1sy)(1tn/2000#) = 1,508 tons

Asphalt 25mm

Wt = (4.75 lf)(25,976 lf)(1sy/9sf)(330#/1sy)(1tn/2000#) = 2,262 tons

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|---|
| Idea No.: B-3 | Sheet No.: 1 of 5 | CREATIVE IDEA: Construct all the new Interchange ramps with PCC pavement and eight-inch roller compacted concrete shoulders. |
|-------------------------|-----------------------------|---|

Comp By: G.O. Date: 11-5-08 Checked By: K.B. Date: 11/17/08

Original Concept:

The current design proposes to construct the I-520 SB off ramp to Deans Road, the WB Deans Road loop entrance ramp to I-520, and the Deans Road EB entrance ramp to I-520 using PCC pavement and shoulders. The other three new ramps (I-520 SB off ramp to Deans Road, I-520 NB off ramp to Gordon Highway, and I-520 SB off ramp to Gordon Highway) will be constructed using asphalt pavement and shoulders.

Proposed Change:

It is recommended that the four new Interchange ramps and two reconstructed existing loop ramps be constructed using PCC Pavement and eight-inch Roller Compacted Concrete Shoulders.

Justification:

Constructing these ramps using PCC pavement would be consistent with the State’s policy for the construction of new Interstate Interchange ramps. Using PCC concrete pavement would prevent shoving and rutting in the ramp lanes if the lanes were constructed from asphalt pavement. The use of PCC concrete for the ramps would match the PCC concrete pavement found on the Interstate mainline south of Deans Road.

Constructing these ramps with PCC pavement would result is a small increase in the project cost. However, constructing the shoulders with Roller Compacted Concrete would minimize the cost increase and reduce the time needed to complete the work.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|--------------------|
| INITIAL COST - Original | \$1,675,000 | | |
| - Proposed | \$1,844,000 | | |
| - Savings | (\$169,000) | | (\$169,000) |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | (\$169,000) |

COST WORKSHEET

| Project: I-520 Widening and Interchange Improvements | | | | | Idea No.: B-3 CLIENT: GDOT Sheet 2 of 5 | | |
|--|------|-------------------|-----------|-------------|---|-----------|-------------|
| CONSTRUCTION ELEMENT | | ORIGINAL ESTIMATE | | | NEW ESTIMATE | | |
| Item | Unit | No. Units | Cost/Unit | Total Cost | No. Units | Cost/Unit | Total Cost |
| Existing PCC Ramps: | | | | | | | |
| NB I-520 Off Ramp to Deans Rd | | | | | | | |
| PCC Ramp Shoulders | SY | 2,447 | \$46.11 | \$112,831 | | | |
| Asphalt Intermediate Layer | SY | 2,447 | \$19.80 | \$48,451 | | | |
| 12" Aggregate Base Course | SY | 2,447 | \$12.32 | \$30,147 | | | |
| Roller Compacted Concrete | SY | | | | 2,447 | \$36.70 | \$89,805 |
| WB I-520 Entrance Loop Ramp | | | | | | | |
| PCC Ramp Shoulders | SY | 1,364 | \$46.11 | \$62,894 | | | |
| Asphalt Intermediate Layer | SY | 1,364 | \$19.80 | \$27,007 | | | |
| 12" Aggregate Base Course | SY | 1,364 | \$12.32 | \$16,804 | | | |
| Roller Compacted Concrete | SY | | | | 1,364 | \$36.70 | \$50,059 |
| EB I-520 Entrance Loop Ramp | | | | | | | |
| PCC Ramp Shoulders | SY | 1,364 | \$46.11 | \$62,894 | | | |
| Asphalt Intermediate Layer | SY | 1,364 | \$19.80 | \$27,007 | | | |
| 12" Aggregate Base Course | SY | 1,364 | \$12.32 | \$16,804 | | | |
| Roller Compacted Concrete | SY | | | | 1,364 | \$36.70 | \$50,059 |
| Existing Asphalt Ramps | | | | | | | |
| SB I-520 Off Ramp to Deans Rd | | | | | | | |
| Asphalt Ramp & Shoulder | SY | 10,945 | \$37.21 | \$407,263 | | | |
| PCC Ramp Pavement | SY | | | | 7,867 | \$46.11 | \$362,747 |
| Asphalt Intermediate Layer | SY | | | | 7,867 | \$19.80 | \$155,767 |
| Roller Compacted Concrete | SY | | | | 3,078 | \$36.70 | \$112,963 |
| 12" Aggregate Base Course | SY | 3,078 | \$12.32 | \$114,532 | | | |
| NB I-520 Off Ramp to Gordon | | | | | | | |
| Asphalt Ramp & Shoulder | SY | 6,021 | \$37.21 | \$224,041 | | | |
| PCC Ramp Pavement | SY | | | | 3,653 | \$46.11 | \$168,440 |
| Asphalt Intermediate Layer | SY | | | | 3,653 | \$19.80 | \$72,329 |
| Roller Compacted Concrete | SY | | | | 2,368 | \$36.70 | \$86,906 |
| 12" Aggregate Base Course | SY | 2,368 | \$12.32 | \$29,174 | | | |
| Sub Totals | | | | | | | |
| | | | | \$1,178,849 | | | \$1,149,075 |

CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: B-3
CLIENT: GDOT
Sheet 4 of 5

Gordon Highway – New Asphalt I-520 SB Off Ramps

2 Full Lanes Station 1099+00 to 1121+00 = 2,200 ft $2 \times 2,200 \times 12 = 52,800 / 9 = 5,867$ SY

2 Turn Lanes Sta. 1113+40 to 1121+00 = 760 ft $2 \times 760 \times 12 = 18,240 / 9 = 2,027$ SY

Total Roadway Area = 5,867 + 2,027 = 7,924 SY

Outside Shoulder Sta. 1099+00 to 1121+00 = 2,200 ft $2,200 \times 10 = 22,000 / 9 = 2,444$ SY

Inside Shoulder Sta. 1113+40 to 1120+80 = 740 ft $740 \times 4 = 2,960 / 9 = 329$ SY

Total Shoulder Area 2,444 + 329 = 2,773 SY

Grand Total for Ramp 7,924 + 2,773 = 10,697 SY

Gordon Highway - New Asphalt I-520 NB Off Ramp:

1 Full Lane Sta. 1402+50 to 1419+30 = 1,680 ft $1,680 \times 12 = 20,160 / 9 = 2,240$ SF

2 Turn Lanes Sta. 1414+00 to 1419+30 = 530 ft $2 \times 530 \times 12 = 12,720 / 9 = 1,413$ SF

Total Roadway Area 2,240 + 1,413 = 3,653 SF

Outside Shoulder Sta. 1402+50 to 1419+30 = 1,680 ft $1,680 \times 10 = 16,800 / 9 = 1,866$ SF

Inside Shoulder Sta. 1408+00 to 1419+30 = 1,130 ft $1,130 \times 4 = 4,520 / 9 = 502$ SF

Total Shoulder Area 1,866 + 502 = 2,368 SY

Grand Total for Ramp 3,653 + 2,368 = 6,021 SY

Deans Road - Reconstructed Concrete WB Entrance Loop Ramp

1 Full Lane Sta. 2501+80 to 2511+00 = 920 ft $920 \times 16 = 14,720 / 9 = 1,636$ SY

Outside Shoulder 820 ft x 10 ft = 8,200 / 9 = 911 SY

Inside Shoulder 1020 ft x 4 ft = 4080 / 9 = 453 SY

Total Shoulder Area 911 + 453 = 1,364 SY

Grand Total for Ramp 1,636 + 1,364 = 3,000 SY

Deans Road - Reconstructed Concrete EB Entrance Loop Ramp

1 Full Lane 920 ft x 16 ft = 14,720 / 9 = 1,636 SY

Outside Shoulder 820 ft x 10 ft = 8,200 / 9 = 911 SY

Inside Shoulder 1020 ft x 4 ft = 4080 / 9 = 453 SY

Total Shoulder Area 911 + 453 = 1,364 SY

Grand Total for Ramp 1,636 + 1,364 = 3,000 SY

Deans Road – Construct New Concrete I-520 NB Off Ramp

1 Full Lane Sta. 2601+00 to 2618+10 = 1,710 ft $1,710 \times 12 = 20,520 / 9 = 2,280$ SY

2 Turn Lanes Sta. 2612+80 to 2618+10 = 530 ft $2 \times 530 \times 12 = 12,720 / 9 = 1,413$ SY

Total Roadway Area 2,280 + 1,413 = 3,693 SY

Outside Shoulder Sta. 2601+00 to 2618+10 = 1,700 ft $1,710 \times 10 = 17,100 / 9 = 1,900$ SY

Inside Shoulder Sta. 2605+80 to 2618+10 = 1,230 ft $1,230 \times 4 = 4,920 / 9 = 547$ SY

Total Shoulder Area 1,900 + 547 = 2,447 SY

Grand Total for Ramp 3,693 + 2,447 = 6,140 SY

CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: B-3
CLIENT: GDOT
Sheet 5 of 5

Deans Road – Construct New Asphalt I-520 SB Off Ramp

2 Full Lanes Sta. 2092+00 to 2114+50 = 2,250 ft $2 \times 2,250 \times 12 = 54,000 / 9 = 6,000$ SY

2 Turn Lanes Sta. 2107+50 to 2114+50 = 700 ft $2 \times 700 \times 12 = 16,800 / 9 = 1,867$ SY

Total Roadway Area 6,000 + 1,867 = 7,867 SY

Outside Shoulder Sta. 2092+00 to 2115+15 = 2,350 ft $2,350 \times 10 = 23,500 / 9 = 2,611$ SY

Inside Shoulder Sta. 2104+00 to 2114+40 = 1,050 ft $1,050 \times 4 = 4,200 / 9 = 467$ SY

Total Shoulder Area 2,611 + 467 = 3,078 SY

Grand Total for Ramp 7,867 + 3,078 = 10,945 SY

COST FACTORS:

12" PCC Pavement \$41.11

4" Asphalt Intermediate Layer \$19.80

Full Depth Asphalt Pavement \$37.21

12" Aggregate Base \$12.32

Rolled Concrete Shoulder \$36.70

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|--|
| Idea No.: F-1 | Sheet No.: 1 of 3 | CREATIVE IDEA: Reduce the I-520 bridge widening by reducing the width of the shoulder from 14 feet to 12 feet. |
|-------------------------|-----------------------------|--|

Comp By: G.C.G. Date: 11-05-08 Checked By: K.B. Date: 11/17/08

Original Concept:

The current design will widen the existing I-520 bridges over SR 4 (US 1) to accommodate the four existing lanes plus the additional new inside lane. This will be done by closing in the median of the existing parallel bridges and also widening on the outside. The inside shoulder created is the remainder of subtracting the additional 12-foot lanes (one each direction) and median barrier out of the existing 40 foot depressed median. The proposed outside shoulder is 14-foot on each side.

Proposed Change:

It is recommended that the same median widening concept be used, but that the outside widening concept is reduced 2 feet by only widen the outside shoulder to 12 feet.

Justification:

The VE concept would reduce the proposed bridge widening by 4 feet. This change would reduce the cost of the project and has the concurrence of the State Bridge Engineer.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|-----------------|
| INITIAL COST - Original | \$1,505,000 | | |
| - Proposed | \$1,410,000 | | |
| - Savings | \$95,000 | | \$95,000 |
| FUTURE COST – Savings | | \$0 | \$0 |
| TOTAL PRESENT WORTH SAVINGS | | | \$95,000 |

CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: F-1
CLIENT: GDOT
Sheet 3 of 3

The original concept considers the outside shoulder to be an outside shoulder on an Interstate lane. With that approach, a 14-foot shoulder width is correct. However, given that a ramp is the outer most lane on the bridge, it seems reasonable to control the outside shoulder width based on the appropriate shoulder width for the interstate ramp. On typical section sheet 5-206 of the preliminary plans, the paved right shoulder for ramp 2-2 is 10 feet (as is the same condition for Ramp 2-5 on plan sheet 5-207).

According to the Georgia DOT Bridge Design Manual, Section 2.9.1.3, “a general rule of thumb [for width of bridge] is to use the paved width of the typical section”. The section also encourages getting concurrence from the Office of Bridge Design. Upon consulting Paul Liles, P.E., State Bridge Engineer, the minimum acceptable width based on GDOT policy and the advice of the State Bridge Engineer.

Using a 10-foot right shoulder seems too narrow and a 14 foot shoulder seems excessive. Mr. Liles agreed that given the circumstances, the 12-foot right shoulder seems appropriate.

This will result in a savings of 4 feet in the bridge cross section (2 feet each side).

New Estimate:

191.5 ft long x 51.33 ft wide = 9,830.33 sq. ft.

Original Estimate:

191.5 x Width = 12,062 sq ft

Width = 62.99 ft

Actual width widened per original concept = 10.65 ft x 2 sides + 30.04 ft median = 51.34 ft

So Original Concept Estimate is incorrect. Use a relative adjustment to present savings...

12,062 sq feet - 2 sides x 2 ft per side x 191.5 ft long = 11,296 sq ft.

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|--|
| Idea No.: S-1 | Sheet No.: 1 of 4 | CREATIVE IDEA: Reduce to use of retaining walls wherever possible. |
|-------------------------|-----------------------------|--|

Comp By: G.C.G. Date: 11-05-08 Checked By: K.B. Date: 11/17/08

Original Concept: The original design uses two gravity-type, concrete retaining walls. The first wall, (Wall 1) is located along the right side of US-1/SR 4 (Deans Bridge Road) beginning at station 2025+18 and ending at station 2027+30. Through this station range, Ramp 2-4 is introduced and the right side of the Ramp 2-4 baseline is controlled by Typical Section # 13 on sheet 5-207. Wall 1 is comprised of approximately 85 cubic yards of Class B concrete. The wall has a maximum height of 5 feet. Additional R/W and easement for construction and maintenance of slope is to be purchased.

The second wall, (Wall 2) is located along the right side of Ramp 2-6 beginning at station 2611+50 and ending at station 2613+50. Through this station range, the 2:1 side slope for the improvements made to the existing ramp begin to extend beyond an existing drainage ditch. Wall 2 is comprised of approximately 130 cubic yards of Class B concrete. The wall has a maximum height of 8 feet. Additional R/W and easement for construction and maintenance of slope is to be purchased.

Proposed Change: It is recommended that Wall 1 be eliminated by revising Typical Section # 13 to reduce the proposed shoulder from 16 feet (as measured from the gutter line) to 12 feet. This proposed change used the minimum shoulder width verses the desired shoulder width. Easement is being purchased for construction and maintenance of slopes so no negative costs associated with the slopes running out further.

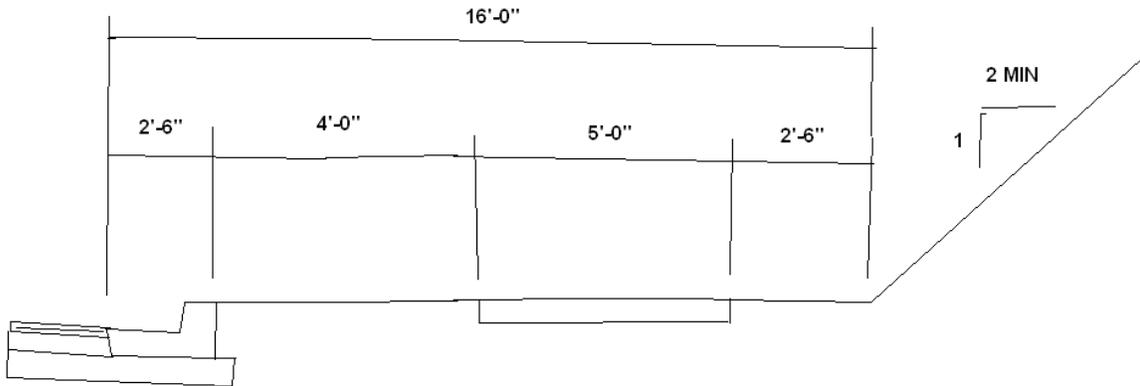
Justification: This concept would save cost without sacrificing function.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|-----------------|
| INITIAL COST - Original | \$51,000 | | |
| - Proposed | \$0 | | |
| - Savings | \$51,000 | | \$51,000 |
| FUTURE COST – Savings | | \$0 | \$0 |
| TOTAL PRESENT WORTH SAVINGS | | | \$51,000 |

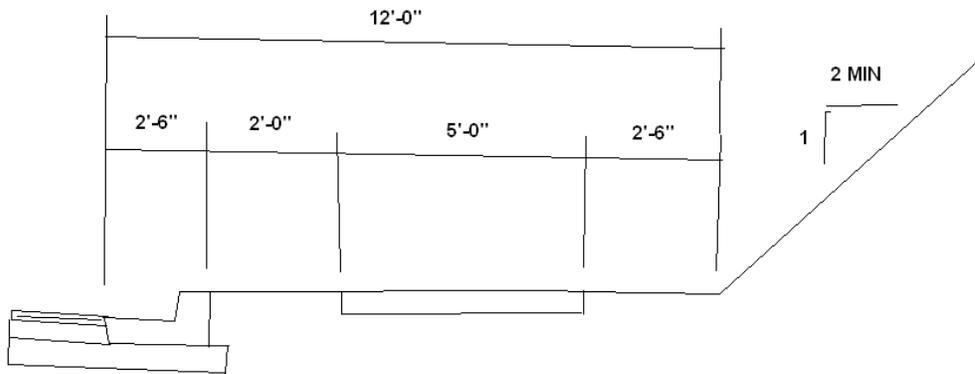
SKETCH

Project: I-520 Widening and Interchange Improvements

Idea No.: S-1
CLIENT: GDOT
Sheet 2 of 4



Original Concept - Ramp Typical Section #13 at Shoulder (16 ft)



Proposed Concept - Ramp Typical Section #13 at Shoulder (12 ft)

CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: S-1
 CLIENT: GDOT
 Sheet 4 of 4

Original Concept:

Volume Calculations:

| Wall 1 | | | | | | | | | | | | |
|---------|-------------|----------------|-------------|--------------|-----------------|-----------------|----------------|-----------------|-----------------|-------------------|---------------|------|
| Station | Top of Wall | Bottom of Wall | Height (ft) | Length (ft) | Avg Height (ft) | Base Width (ft) | Top Width (ft) | Section 1 (ft2) | Section 2 (ft2) | Section 1+2 (ft2) | Volume (ft3) | |
| 202518 | 473 | 472 | 1 | | | | | | | | | |
| 202550 | 473 | 469 | 4 | 32 | 2.5 | 1.92 | 0.67 | 1.67 | 2.29 | 3.96 | 126.67 | |
| 202600 | 473 | 468 | 5 | 50 | 4.5 | 2.92 | 0.67 | 3.00 | 8.62 | 11.63 | 581.25 | |
| 202650 | 472 | 467 | 5 | 50 | 5 | 3.17 | 0.67 | 3.33 | 10.83 | 14.17 | 708.33 | |
| 202700 | 470 | 465 | 5 | 50 | 5 | 3.17 | 0.67 | 3.33 | 10.83 | 14.17 | 708.33 | |
| 202730 | 470 | 469 | 1 | 30 | 3 | 2.17 | 0.67 | 2.00 | 3.50 | 5.50 | 165.00 | |
| | | | | Length (ft)= | 212 | | | | | | Volume (ft3)= | 2290 |
| | | | | | | | | | | | Volume (yd3)= | 85 |

| Wall 2 | | | | | | | | | | | | |
|---------|-------------|----------------|-------------|--------------|-----------------|-----------------|----------------|-----------------|-----------------|-------------------|---------------|------|
| Station | Top of Wall | Bottom of Wall | Height (ft) | Length (ft) | Avg Height (ft) | Base Width (ft) | Top Width (ft) | Section 1 (ft2) | Section 2 (ft2) | Section 1+2 (ft2) | Volume (ft3) | |
| 261150 | 396 | 395 | 1 | | | | | | | | | |
| 261200 | 396 | 392 | 4 | 50 | 2.5 | 1.92 | 0.67 | 1.67 | 2.29 | 3.96 | 197.92 | |
| 261250 | 395 | 387 | 8 | 50 | 6 | 3.67 | 0.67 | 4.00 | 16.00 | 20.00 | 1000.00 | |
| 261300 | 393 | 385 | 8 | 50 | 8 | 4.67 | 0.67 | 5.33 | 29.33 | 34.67 | 1733.33 | |
| 261350 | 393 | 392 | 1 | 50 | 4.5 | 2.92 | 0.67 | 3.00 | 8.62 | 11.63 | 581.25 | |
| | | | | Length (ft)= | 200 | | | | | | Volume (ft3)= | 3513 |
| | | | | | | | | | | | Volume (yd3)= | 130 |

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|---|
| Idea No.: B-6 | Sheet No.: 1 of 4 | CREATIVE IDEA: <u>ALTERNATIVE to B-2 & B-2.1</u> Reduce the 12” thickness of the 8-foot median and 12-foot outside concrete shoulders by using roller compacted concrete. |
|-------------------------|-----------------------------|---|

Comp By: G.A.O. Date: 11-6-08 Checked By: K.B. Date: 11/17/08

Original Concept:

The current design for the 8-foot inside and 12-foot outside concrete shoulder is the same as for the mainline concrete pavement. The current shoulder section consists of 12-inch GAB, 4 inch intermediate asphalt layer, and 12 inch thick PCC for both inside and outside shoulders.

Proposed Change:

It is recommended that the current concrete shoulder design be changed to an 8-inch thick, roller compacted concrete shoulder.

Justification:

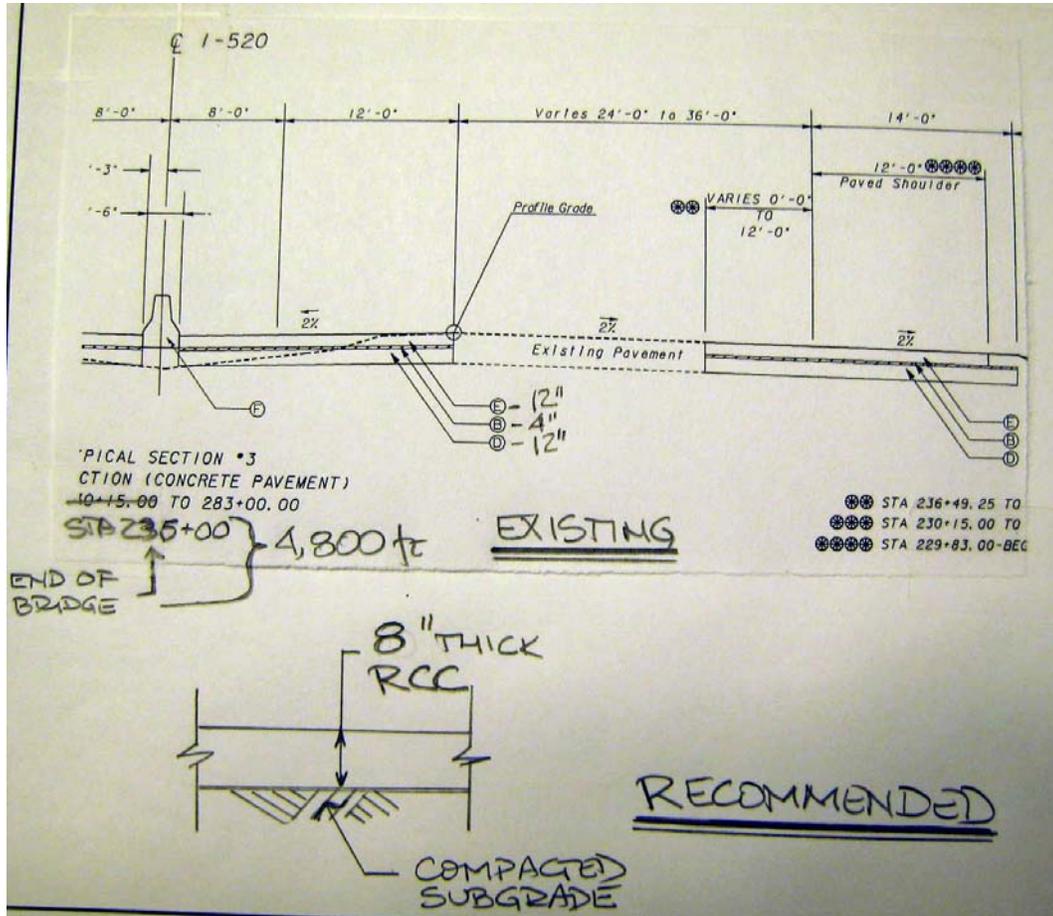
The need and purpose of the project is to provide safety and capacity improvements to I-520 and improve the existing interchanges within the project limits. Capacity improvements along I-520 are provided by adding an additional lane in each direction by reconstructing the existing depressed median. Shoulder improvements serve to facilitating construction staging and provide safety after construction is complete. This concept would significantly reduce construction time and construction cost. It has been used successfully on I-285 and I-985 projects.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|------------------|
| INITIAL COST - Original | \$1,650,000 | | |
| - Proposed | \$775,000 | | |
| - Savings | \$875,000 | | \$875,000 |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | \$875,000 |

SKETCH

Project: I-520 Widening and Interchange Improvements

Idea No.: B-6
 CLIENT: GDOT
 Sheet 2 of 4



CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: B-6
CLIENT: GDOT
Sheet 4 of 4

Sta. 235+00 (end of bridge) to sta. 283+00 (end of project) = 4,800 feet

average width; $[(8 - 1.25) + 12] \times 2$ directions = 37.5 feet

$$(4,800 \times 37.5) / 9 = 20,000 \text{ SY}$$

4 in intermediate asphalt layer

$$(4 / 12 \text{ ft} \times 4800 \text{ ft} \times 37.5 \text{ ft}) 150 \text{ \#/CF} (1 \text{ ton} / 2000 \text{ \#}) = 4,500 \text{ tons}$$

GAB cost

$$18.67 \text{ \$/ton} = 12.60 \text{ \$ / SY, 12 in thick}$$

Cost of RCC ; \$165 / CY ; 8 inch thick;

$$165 \text{ \$/CY} (8 \text{ in} / 36\text{in/yd}) = 36.67 \text{ / SY, 8 inch thick, USE \$ 36.70}$$

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|--------------------------|-----------------------------|---|
| Idea No.: A-13 | Sheet No.: 1 of 4 | CREATIVE IDEA: <u>ALTERNATIVE to A-2, B-2</u> Modify the staging plan by eliminating the outside shoulder replacement / widening by using / maintaining the existing shoulder (mill and resurface). |
|--------------------------|-----------------------------|---|

Comp By: G.A.O. Date: 11-6-08 Checked By: K.B. Date: 11/17/08

Original Concept:

The current design requires the removal / widening of the outside shoulders. The reconstructed 12-foot outside shoulder will be used for construction staging and ultimately serve as the standard outside shoulder for the Interstate.

Proposed Change:

It is recommended that the outside shoulder reconstruction be revised to include only the milling and resurfacing (as necessary) of the existing paved shoulder.

Justification:

The existing paved shoulder has some load carrying capacity, although, without specific pavement make-up information it is difficult to determine how suitable the shoulder pavement is for use during construction. Rather than assuming the worst condition and totally reconstructing the outside shoulders with full depth pavement, assume that there is some structural capacity in the existing shoulder pavement and provide for milling and resurfacing as, or if, the shoulders deteriorate during construction.

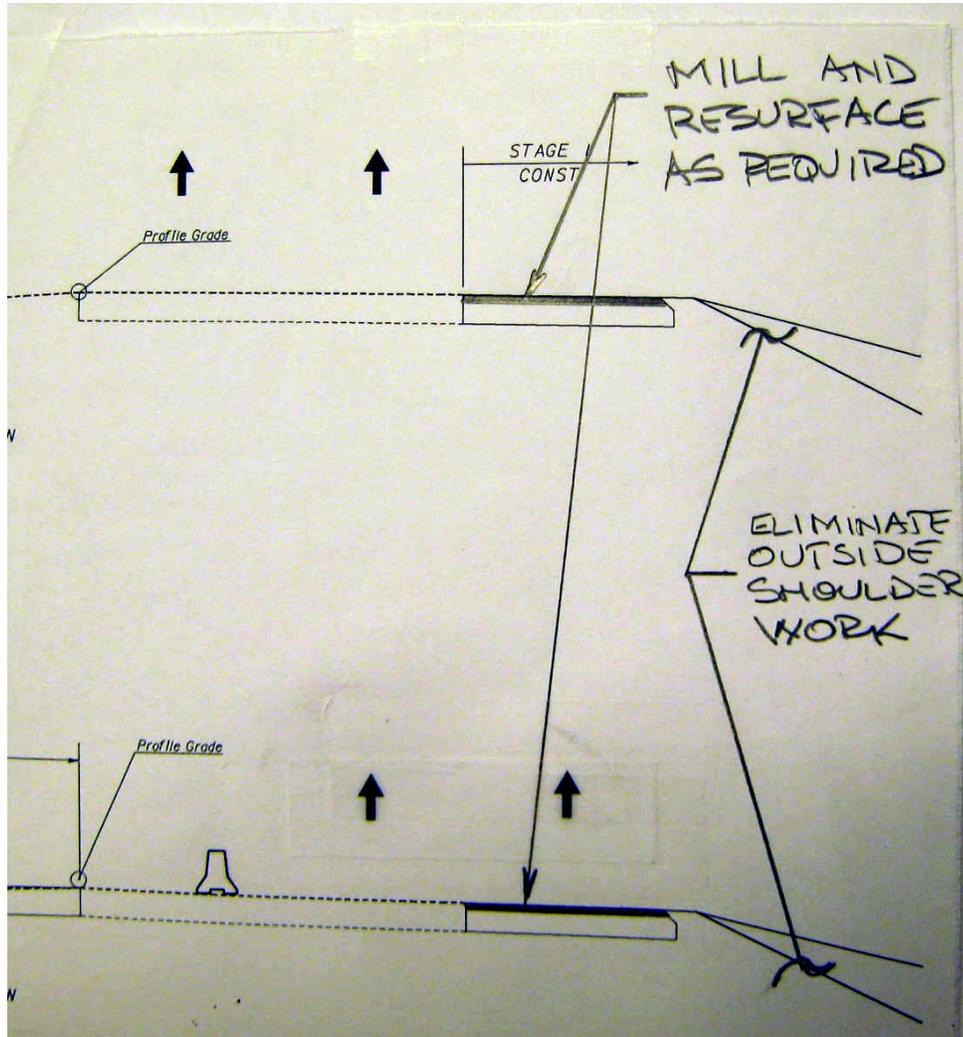
With milling and resurfacing 2 times during the course of construction, significant cost savings can be realized. An important benefit of this concept is the elimination of any outside area widening and grading work. This will reduce the earthwork, erosion control and maintenance of traffic elements while providing the project function in a more efficient manner with reduced construction duration.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|--------------------|
| INITIAL COST - Original | \$3,075,000 | | |
| - Proposed | \$520,000 | | |
| - Savings | \$2,555,000 | | \$2,555,000 |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | \$2,555,000 |

SKETCH

Project: I-520 Widening and Interchange Improvements

Idea No.: A-13
CLIENT: GDOT
Sheet 2 of 4



CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: A-13
CLIENT: GDOT
Sheet 4 of 4

This will occur along the mainline, not at the interchange areas.

Sta. 133+00 to sta. 221+00 and sta. 247+00 to sta. 283+00 = 8,800 + 3600 = 12,400 ft

average width; $12 + 12 = 24$ feet

$$(12,400 \times 24) = 297,600 \text{ SF} = 33,067 \text{ SY}$$

Asphalt; $(12,400 \times 24 \times 11.25 / 12) \text{ CF} \times (150 \# / \text{CF}) \times (1 \text{ ton} / 2000 \#) = 20,925 \text{ tons}$

Grading complete ; assume 25% reduction

$$1,550,000 \times 0.25 = \$387,500$$

Erosion control; assume 25% reduction

$$1,072,000 \times 0.25 = \$268,000$$

Additional milling and resurfacing, assume 2 times during the duration of the project for outside shoulders; 2 in thick

$$\{(12,400 \times 24 \times 2 / 12) \text{CF} \times (150 \# / \text{CF}) \times (1 \text{ ton} / 2000 \#)\} 2 = 3,720 \text{ tons}$$

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|--|
| Idea No.: A-3 | Sheet No.: 1 of 4 | CREATIVE IDEA: <u>ALTERNATIVE to Idea B-3</u> Construct the three new PCC paved ramps at the Deans Road Interchange with asphalt pavement and shoulders. |
|-------------------------|-----------------------------|--|

Comp By: G.O. Date: 11-5--08 Checked By: K.B. Date: 11/17/08

Original Concept:

The current design proposes to construct the I-520 SB off ramp to Deans Road, the WB Deans Road loop entrance ramp to I-520, and the Deans Road EB entrance ramp to I-520 using PCC pavement and shoulders. The other three new ramps (I-520 SB off ramp to Deans Road, I-520 NB off ramp to Gordon Highway, and I-520 SB off ramp to Gordon Highway) will be constructed using asphalt pavement and shoulders.

Proposed Change:

It is recommended that the three ramps (I-520 SB off ramp to Deans Road, the WB Deans Road loop entrance ramp to I-520, and the Deans Road EB entrance ramp to I-520) that are paved with PCC pavement and shoulders be constructed using Asphalt Concrete pavement and shoulders.

Justification:

Constructing these (PCC Concrete) ramps with asphalt pavement and shoulders would be consistent with the construction and material used to build the other three ramps included in this contract. Constructing them with asphalt would accelerate their completion and reduce the cost of the project. The asphalt ramps would provide the same function as the currently designed PCC Concrete ramps.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|------------------|
| INITIAL COST - Original | \$871,000 | | |
| - Proposed | \$470,000 | | |
| - Savings | \$401,000 | | \$401,000 |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | \$401,000 |

CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: A-3
CLIENT: GDOT
Sheet 3 of 4

Gordon Highway – New Asphalt I-520 SB Off Ramps

2 Full Lanes Station 1099+00 to 1121+00 = 2,200 ft $2 \times 2,200 \times 12 = 52,800 / 9 = 5,867$ SY

2 Turn Lanes Sta. 1113+40 to 1121+00 = 760 ft $2 \times 760 \times 12 = 18,240 / 9 = 2,027$ SY

Total Roadway Area = 5,867 + 2,027 = 7,924 SY

Outside Shoulder Sta. 1099+00 to 1121+00 = 2,200 ft $2,200 \times 10 = 22,000 / 9 = 2,444$ SY

Inside Shoulder Sta. 1113+40 to 1120+80 = 740 ft $740 \times 4 = 2,960 / 9 = 329$ SY

Total Shoulder Area 2,444 + 329 = 2,773 SY

Grand Total for Ramp 7,924 + 2,773 = 10,697 SY

Gordon Highway - New Asphalt I-520 NB Off Ramp:

1 Full Lane Sta. 1402+50 to 1419+30 = 1,680 ft $1,680 \times 12 = 20,160 / 9 = 2,240$ SF

2 Turn Lanes Sta. 1414+00 to 1419+30 = 530 ft $2 \times 530 \times 12 = 12,720 / 9 = 1,413$ SF

Total Roadway Area 2,240 + 1,413 = 3,653 SF

Outside Shoulder Sta. 1402+50 to 1419+30 = 1,680 ft $1,680 \times 10 = 16,800 / 9 = 1,866$ SF

Inside Shoulder Sta. 1408+00 to 1419+30 = 1,130 ft $1,130 \times 4 = 4,520 / 9 = 502$ SF

Total Shoulder Area 1,866 + 502 = 2,368 SY

Grand Total for Ramp 3,653 + 2,368 = 6,021 SY

Deans Road - Reconstructed Concrete WB Entrance Loop Ramp

1 Full Lane Sta. 2501+80 to 2511+00 = 920 ft $920 \times 16 = 14,720 / 9 = 1,636$ SY

Outside Shoulder 820 ft x 10 ft = 8,200 / 9 = 911 SY

Inside Shoulder 1020 ft x 4 ft = 4080 / 9 = 453 SY

Total Shoulder Area 911 + 453 = 1,364 SY

Grand Total for Ramp 1,636 + 1,364 = 3,000 SY

Deans Road - Reconstructed Concrete EB Entrance Loop Ramp

1 Full Lane 920 ft x 16 ft = 14,720 / 9 = 1,636 SY

Outside Shoulder 820 ft x 10 ft = 8,200 / 9 = 911 SY

Inside Shoulder 1020 ft x 4 ft = 4080 / 9 = 453 SY

Total Shoulder Area 911 + 453 = 1,364 SY

Grand Total for Ramp 1,636 + 1,364 = 3,000 SY

Deans Road – Construct New Concrete I-520 NB Off Ramp

1 Full Lane Sta. 2601+00 to 2618+10 = 1,710 ft $1,710 \times 12 = 20,520 / 9 = 2,280$ SY

2 Turn Lanes Sta. 2612+80 to 2618+10 = 530 ft $2 \times 530 \times 12 = 12,720 / 9 = 1,413$ SY

Total Roadway Area 2,280 + 1,413 = 3,693 SY

Outside Shoulder Sta. 2601+00 to 2618+10 = 1,700 ft $1,710 \times 10 = 17,100 / 9 = 1,900$ SY

Inside Shoulder Sta. 2605+80 to 2618+10 = 1,230 ft $1,230 \times 4 = 4,920 / 9 = 547$ SY

Total Shoulder Area 1,900 + 547 = 2,447 SY

Grand Total for Ramp 3,693 + 2,447 = 6,140 SY

CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: A-3
CLIENT: GDOT
Sheet 4 of 4

Deans Road – Construct New Asphalt I-520 SB Off Ramp

2 Full Lanes Sta. 2092+00 to 2114+50 = 2,250 ft $2 \times 2,250 \times 12 = 54,000 / 9 = 6,000$ SY

2 Turn Lanes Sta. 2107+50 to 2114+50 = 700 ft $2 \times 700 \times 12 = 16,800 / 9 = 1,867$ SY

Total Roadway Area 6,000 + 1,867 = 7,867 SY

Outside Shoulder Sta. 2092+00 to 2115+15 = 2,350 ft $2,350 \times 10 = 23,500 / 9 = 2,611$ SY

Inside Shoulder Sta. 2104+00 to 2114+40 = 1,050 ft $1,050 \times 4 = 4,200 / 9 = 467$ SY

Total Shoulder Area 2,611 + 467 = 3,078 SY

Grand Total for Ramp 7,867 + 3,078 = 10,945 SY

COST FACTORS:

12" PCC Pavement \$41.11

4" Asphalt Intermediate Layer \$19.80

Full Depth Asphalt Pavement \$37.21

12" Aggregate Base \$12.32

Rolled Concrete Shoulder \$36.70

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|---|
| Idea No.: B-7 | Sheet No.: 1 of 4 | CREATIVE IDEA: <u>ALTERNATIVE to Idea B-3</u> Construct 8" roller compacted concrete shoulders on the three new PCC paved ramps in the Deans Road Intersection. |
|-------------------------|-----------------------------|---|

Comp By: G.O. Date: 11-5-08 Checked By: K.B. Date: 11/17/08

Original Concept:

The current design proposes to construct the I-520 SB off ramp to Deans Road, the WB Deans Road loop entrance ramp to I-520, and the Deans Road EB entrance ramp to I-520 using PCC pavement and shoulders. The other three new ramps (I-520 SB off ramp to Deans Road, I-520 NB off ramp to Gordon Highway, and I-520 SB off ramp to Gordon Highway) will be constructed using asphalt pavement and shoulders.

Proposed Change:

It is recommended that the three Interchange ramps proposed for construction using PCC pavement and PCC shoulders be constructed with eight-inch Roller Compacted Concrete Shoulders.

Justification:

Using eight-inch Roller Compacted Concrete Shoulders would accelerate the construction of these ramps and reduce the project's cost.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------|-------------|------------------|
| INITIAL COST - Original | \$421,000 | | |
| - Proposed | \$198,000 | | |
| - Savings | \$223,000 | | \$223,000 |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | \$223,000 |

CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: B-7A
 CLIENT: GDOT
 Sheet 3 of 4

Gordon Highway – New Asphalt I-520 SB Off Ramps

2 Full Lanes Station 1099+00 to 1121+00 = 2,200 ft $2 \times 2,200 \times 12 = 52,800 / 9 = 5,867$ SY

2 Turn Lanes Sta. 1113+40 to 1121+00 = 760 ft $2 \times 760 \times 12 = 18,240 / 9 = 2,027$ SY

Total Roadway Area = 5,867 + 2,027 = 7,924 SY

Outside Shoulder Sta. 1099+00 to 1121+00 = 2,200 ft $2,200 \times 10 = 22,000 / 9 = 2,444$ SY

Inside Shoulder Sta. 1113+40 to 1120+80 = 740 ft $740 \times 4 = 2,960 / 9 = 329$ SY

Total Shoulder Area 2,444 + 329 = 2,773 SY

Grand Total for Ramp 7,924 + 2,773 = 10,697 SY

Gordon Highway - New Asphalt I-520 NB Off Ramp:

1 Full Lane Sta. 1402+50 to 1419+30 = 1,680 ft $1,680 \times 12 = 20,160 / 9 = 2,240$ SF

2 Turn Lanes Sta. 1414+00 to 1419+30 = 530 ft $2 \times 530 \times 12 = 12,720 / 9 = 1,413$ SF

Total Roadway Area 2,240 + 1,413 = 3,653 SF

Outside Shoulder Sta. 1402+50 to 1419+30 = 1,680 ft $1,680 \times 10 = 16,800 / 9 = 1,866$ SF

Inside Shoulder Sta. 1408+00 to 1419+30 = 1,130 ft $1,130 \times 4 = 4,520 / 9 = 502$ SF

Total Shoulder Area 1,866 + 502 = 2,368 SY

Grand Total for Ramp 3,653 + 2,368 = 6,021 SY

Deans Road - Reconstructed Concrete WB Entrance Loop Ramp

1 Full Lane Sta. 2501+80 to 2511+00 = 920 ft $920 \times 16 = 14,720 / 9 = 1,636$ SY

Outside Shoulder 820 ft x 10 ft = 8,200 / 9 = 911 SY

Inside Shoulder 1020 ft x 4 ft = 4080 / 9 = 453 SY

Total Shoulder Area 911 + 453 = 1,364 SY

Grand Total for Ramp 1,636 + 1,364 = 3,000 SY

Deans Road - Reconstructed Concrete EB Entrance Loop Ramp

1 Full Lane 920 ft x 16 ft = 14,720 / 9 = 1,636 SY

Outside Shoulder 820 ft x 10 ft = 8,200 / 9 = 911 SY

Inside Shoulder 1020 ft x 4 ft = 4080 / 9 = 453 SY

Total Shoulder Area 911 + 453 = 1,364 SY

Grand Total for Ramp 1,636 + 1,364 = 3,000 SY

Deans Road – Construct New Concrete I-520 NB Off Ramp

1 Full Lane Sta. 2601+00 to 2618+10 = 1,710 ft $1,710 \times 12 = 20,520 / 9 = 2,280$ SY

2 Turn Lanes Sta. 2612+80 to 2618+10 = 530 ft $2 \times 530 \times 12 = 12,720 / 9 = 1,413$ SY

Total Roadway Area 2,280 + 1,413 = 3,693 SY

Outside Shoulder Sta. 2601+00 to 2618+10 = 1,700 ft $1,710 \times 10 = 17,100 / 9 = 1,900$ SY

Inside Shoulder Sta. 2605+80 to 2618+10 = 1,230 ft $1,230 \times 4 = 4,920 / 9 = 547$ SY

Total Shoulder Area 1,900 + 547 = 2,447 SY

Grand Total for Ramp 3,693 + 2,447 = 6,140 SY

CALCULATIONS

Project: I-520 Widening and Interchange Improvements

Idea No.: B-7A
CLIENT: GDOT
Sheet 4 of 4

Deans Road – Construct New Asphalt I-520 SB Off Ramp

2 Full Lanes Sta. 2092+00 to 2114+50 = 2,250 ft $2 \times 2,250 \times 12 = 54,000 / 9 = 6,000$ SY

2 Turn Lanes Sta. 2107+50 to 2114+50 = 700 ft $2 \times 700 \times 12 = 16,800 / 9 = 1,867$ SY

Total Roadway Area 6,000 + 1,867 = 7,867 SY

Outside Shoulder Sta. 2092+00 to 2115+15 = 2,350 ft $2,350 \times 10 = 23,500 / 9 = 2,611$ SY

Inside Shoulder Sta. 2104+00 to 2114+40 = 1,050 ft $1,050 \times 4 = 4,200 / 9 = 467$ SY

Total Shoulder Area 2,611 + 467 = 3,078 SY

Grand Total for Ramp 7,867 + 3,078 = 10,945 SY

COST FACTORS:

12" PCC Pavement \$41.11

4" Asphalt Intermediate Layer \$19.80

Full Depth Asphalt Pavement \$37.21

12" Aggregate Base \$12.32

Rolled Concrete Shoulder \$36.70

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|---|
| IDEA No.: E-4 | Sheet No.: 1 of 1 | CREATIVE IDEA: <u>Design Suggestion</u> Consider Using an Incentive / Disincentive Clause for the Work Phase involved in Constructing the Temporary Outside Lane. |
|-------------------------|-----------------------------|---|

Comp By: G.O. Date: 11-6-08 Checked By: K.B. Date: 11-17-08

Original Concept:

This project will widen I-520 and reconfigure the Interchanges at Gordon Highway and Deans Road. The construction will be accomplished while maintaining current Interstate traffic through the construction area. Constructing this project will require a critical staging phase to reconstruct / widen the outside shoulder that will serve as a temporary lane during the construction of the new median lane.

Proposed Change:

It is suggested that consideration be given to including an Incentive / Disincentive clause in the contract to cover the staging phase to reconstruct / widen the outside shoulder that will serve as a temporary lane.

Justification:

The staging phase to reconstruct / widen the outside shoulder is time critical to the progress of construction on the project. The construction of this stage will likely require nighttime lane closures which could impact traffic on the Interstate. It is imperative to complete this work in as little time as possible to reduce lane closure impacts to the traveling public and improve safety to traveling public and contractor forces. Requiring that this phase be completed in a “specified” short number of days and including an Incentive / Disincentive clause to manage the contractor’s performance would assure that this phase is completed on time.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|-------------------|-------------|--------------------------|
| INITIAL COST – Original | Design Suggestion | | |
| - Proposed | | | |
| - Savings | | | |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | Design Suggestion |

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-520 Widening and Interchange Improvements

| | | |
|-------------------------|-----------------------------|---|
| IDEA No.: C-1 | Sheet No.: 1 of 1 | CREATIVE IDEA: <u>Design Suggestion</u> Reduce / modify the concrete pavement design for the project. To consider using roller compacted concrete for the new mainline section south of Deans Road. |
|-------------------------|-----------------------------|---|

Comp By: G.A.O. Date: 11-06-08 Checked By: K.B. Date: 11/17/08

Original Concept: Uses an existing concrete pavement section of 12 inch GAB, 4 inch intermediate asphalt layer and 12 inch thick PCC for new concrete pavement and shoulders.

Proposed Change: It is suggested that a review be made of the concrete pavement design to develop a more applicable section including consideration of roller compacted concrete.

Justification: The existing concrete pavement section seems excessive. This section could be the general, “default section” for Interstate improvements, however, a more project specific pavement section should be considered. Reducing the current 28-inch deep pavement will save construction costs, materials costs and reduce the earthwork (spoil) on a projected waste project.

Roller compacted concrete was used successfully on I-285 and I-985 projects. An added benefit of roller compacted concrete is that it can be placed directly on compacted sub-grade. This reduces construction costs and also shortens the construction duration. Roller compacted concrete’s use for mainline pavement should be assessed on this project. It could serve as a good test section for the concept.

Another item that can be evaluated during the concrete pavement design is the intermediate asphalt layer. While this layer is required as an intermediate transition / bonding layer, alternate materials and / or reduced thicknesses can be considered.

During the continued preliminary and final design phases, a thorough pavement evaluation / design should be required for the specific concrete pavement design for this project.

| LIFE CYCLE COST SUMMARY | CAPITAL COST | FUTURE COST | TOTAL COST |
|------------------------------------|--------------------------|-------------|--------------------------|
| INITIAL COST - Original | Design Suggestion | | |
| - Proposed | | | |
| - Savings | | | |
| FUTURE COST – Savings | | | |
| TOTAL PRESENT WORTH SAVINGS | | | Design Suggestion |

APPENDIX

Sources

Key Positions

| Name: | Position: | Telephone: |
|---------------|---|-------------------|
| Brian Summers | GDOT – Engineering Services, Value Engineering Coordinator | 404-631-1770 |
| Ron Wishon | GDOT – Engineering Services, Assistant Project Review Engineer | 404-631-1753 |

Personal Contacts

| Name: | Telephone: | Notes: |
|--------------|-------------------|--|
| Al Jubran | | Pavement Design Issues, Depth of Concrete Pavement for Interstate Mainline |
| Paul Liles | | Bridge Shoulder Widths |
| | | |
| | | |

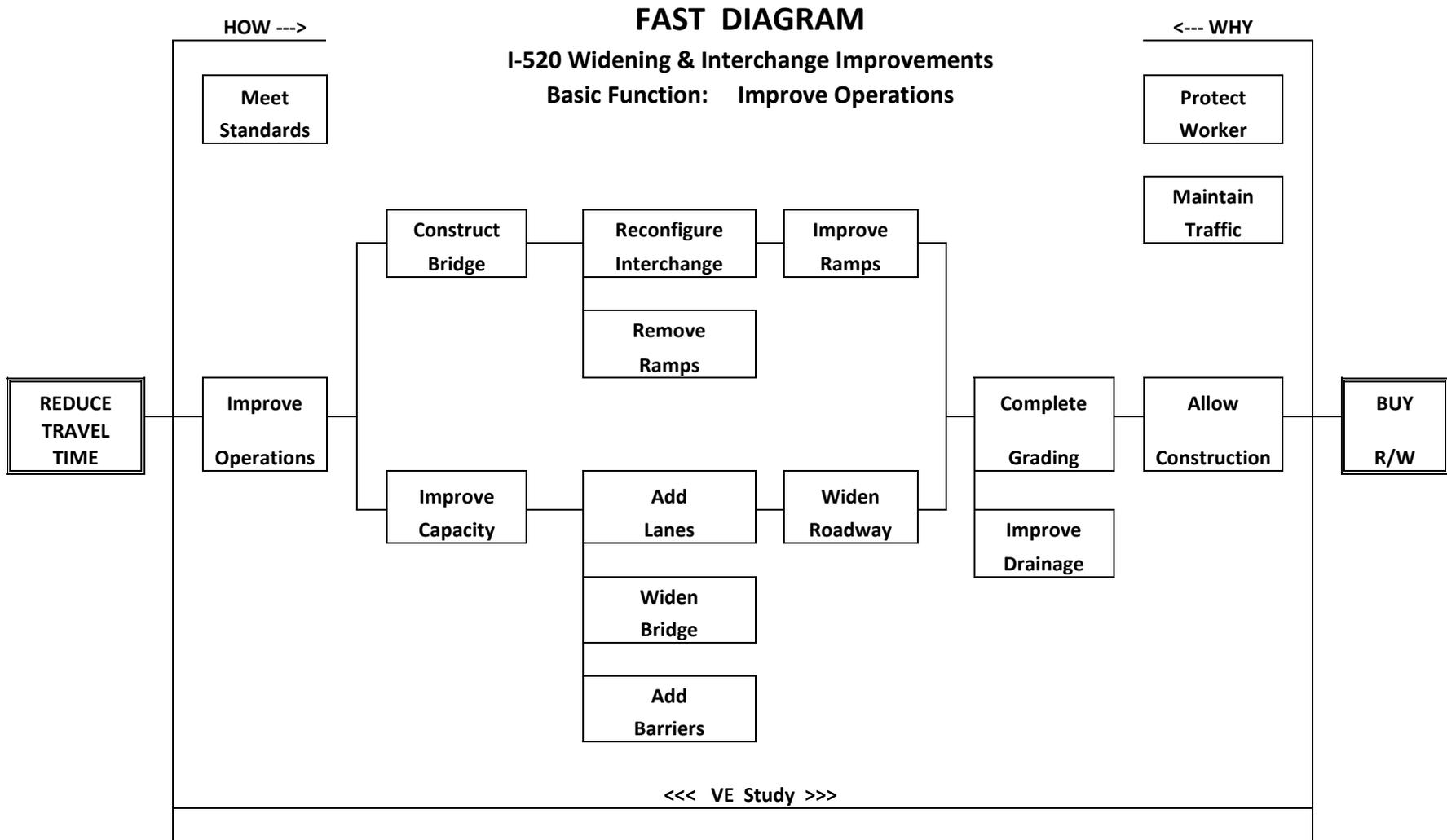
Documents/Abstracts

| Reference: | Reference: |
|-----------------------------------|-------------------------------|
| Preliminary Plans | State Standard Specifications |
| Preliminary Cross Sections | State Average Unit Bid Prices |
| Preliminary Erosion Control Plans | AASHTO Design Guide |
| Preliminary R/W Plans | State Design Manual |
| 200 Scale Layout | |
| Project Preliminary Cost Estimate | |
| Project Concept Report | |
| | |

I-520 Widening & Interchange Improvements

Cost Model / Distribution

| Item | Description | \$ Amount | % of Total Project |
|---|-------------------------------|--------------|--------------------|
| A | Asphalt – Superpave | \$7,340,000 | 32.7% |
| B | Plain PCC Pavement | \$2,061,000 | 9.2% |
| C | Aggregate Base Course | \$1,966,000 | 8.8% |
| D | Signing and Markings | \$1,844,000 | 8.2% |
| E | Grading Complete | \$1,550,000 | 6.9% |
| F | Bridge | \$1,447,000 | 6.4% |
| G | Erosion Control | \$1,072,000 | 4.8% |
| H | Temporary Barrier 1 & 2 | \$1,001,000 | 4.4% |
| 80% Line | | | |
| I | Drainage | \$951,000 | 4.2% |
| J | Concrete Barrier | \$711,000 | 3.2% |
| K | R/W | \$700,000 | 3.1% |
| L | Traffic Signals | \$427,000 | 1.9% |
| M | Pavement Reinforcement Straps | \$284,000 | 1.3% |
| N | Curb & Gutter | \$226,000 | 1.0% |
| O | Miscellaneous | \$191,000 | 0.9% |
| P | Concrete Median | \$172,000 | 0.7% |
| Q | Guardrail | \$164,000 | 0.7% |
| R | Concrete Sidewalk | \$129,000 | 0.6% |
| S | Retaining Wall | \$124,000 | 0.6% |
| T | Utilities | \$100,000 | 0.4% |
| Sub Total | | \$22,460,000 | 100.0% |
| | E & C at 4% | \$870,000 | |
| TOTAL | | \$23,330,000 | |
| NOTE: The 4% Engineering and Contingency Item is Used as Mark-up on the Recommendation Cost Worksheet | | | |



INFORMATION PHASE – FUNCTION ANALYSIS

Project: I-520 Widening & Interchange Improvements

Function: Improve Operation

| ITEM No. | DESCRIPTION | FUNCTION | | INITIAL DOLLARS | | |
|----------|------------------------------|--------------|------------|-----------------|------------|------------|
| | | Verb | Noun | Cost | % of Total | Worth/Save |
| A | Asphalt - Superpave | Increase | Capacity | \$7,340,000 | 32.7% | Yes |
| | | Improve | Operation | | | |
| | | Improve | Safety | | | |
| | | Increase | Storage | | | |
| | | Facilitate | Staging | | | |
| | | Accommodate | Staging | | | |
| | | | | | | |
| B | Plain PCC Pavement | Improve | Safety | \$2,061,000 | 9.2% | Yes |
| | | Meet | Standard | | | |
| | | Add | Lanes | | | |
| | | Rehabilitate | Existing | | | |
| | | Match | Existing | | | |
| C | Aggregate Base Course | Support | Pavement | \$1,966,000 | 8.8% | Yes |
| | | Support | Shoulders | | | |
| | | Facilitate | Staging | | | |
| | | Support | Temp. Lane | | | |
| | | | | | | |

INFORMATION PHASE – FUNCTION ANALYSIS

Project: I-520 Widening & Interchange Improvements

Function: Improve Operation

| ITEM No. | DESCRIPTION | FUNCTION | | INITIAL DOLLARS | | |
|----------|------------------------------|-------------|---------------|-----------------|------------|------------|
| | | Verb | Noun | Cost | % of Total | Worth/Save |
| D | Signing & Marking | Inform | Motorist | \$1,844,000 | 8.2% | Yes |
| | | Facilitate | Staging | | | |
| | | Improve | Safety | | | |
| E | Grading Complete | Support | Pavement | \$1,550,000 | 6.9% | Yes |
| | | Support | Ramps | | | |
| | | Support | Shoulder | | | |
| | | Achieve | Grade | | | |
| | | Widen | Roadway | | | |
| | | Remove | Roadway | | | |
| F | Bridge | Increase | Capacity | \$1,447,000 | 6.4% | Yes |
| | | Add | Lane | | | |
| | | Accommodate | Ramps | | | |
| | | Maintain | Clearance | | | |
| | | Achieve | Typical Sect. | | | |

INFORMATION PHASE – FUNCTION ANALYSIS

Project: I-520 Widening & Interchange Improvements

Function: Improve Operation

| ITEM No. | DESCRIPTION | FUNCTION | | INITIAL DOLLARS | | |
|----------|--------------------------------------|-------------|--------------|-----------------|------------|------------|
| | | Verb | Noun | Cost | % of Total | Worth/Save |
| G | Erosion Control | Prevent | Erosion | \$1,072,000 | 4.8% | No |
| H | Temporary Barrier (1 & 2) | Allow | Staging | \$1,001,000 | 4.4% | Yes |
| | | Separate | Traffic | | | |
| | | Improve | Safety | | | |
| | | Allow | Construction | | | |
| | | Protect | Workers | | | |
| | | Define | Lane Widths | | | |
| I | Drainage | Convey | Storm Water | \$951,000 | 4.2% | Yes |
| | | Accommodate | Runoff | | | |
| | | Extend | Existing | | | |
| | | Accommodate | Stream | | | |
| J | Concrete Barrier | Separate | Roadway | \$711,000 | 3.2% | Yes |
| | | Improve | Safety | | | |
| | | Prevent | Crossovers | | | |
| | | Accommodate | Drains | | | |

INFORMATION PHASE – FUNCTION ANALYSIS

Project: I-520 Widening & Interchange Improvements

Function: Improve Operation

| ITEM No. | DESCRIPTION | FUNCTION | | INITIAL DOLLARS | | |
|----------|------------------------------------|--------------|---------------|-----------------|------------|------------|
| | | Verb | Noun | Cost | % of Total | Worth/Save |
| K | R/W | Store | Project | \$700,000 | 3.1% | Yes |
| | | Allow | Construction | | | |
| L | Traffic Signals | Improve | Capacity | \$427,000 | 1.9% | Yes |
| | | Relieve | Congestion | | | |
| | | Improve | Safety | | | |
| | | Allow | Turns | | | |
| | | Interconnect | Signals | | | |
| M | Pavement Reinforcing Straps | Control | Cracking | \$284,000 | 1.3% | No |
| N | Curb & Gutter | Delineate | Roadway | \$226,000 | 1.0% | Yes |
| | | Channelize | Runoff | | | |
| | | Establish | Urban Section | | | |
| | | Direct | Runoff | | | |
| O | Miscellaneous | Allow | Construction | \$191,000 | 0.9% | No |

INFORMATION PHASE – FUNCTION ANALYSIS

Project: I-520 Widening & Interchange Improvements

Function: Improve Operation

| ITEM No. | DESCRIPTION | FUNCTION | | INITIAL DOLLARS | | |
|----------|--------------------------|----------|------------|-----------------|------------|------------|
| | | Verb | Noun | Cost | % of Total | Worth/Save |
| P | Concrete Median | Restrict | Access | \$172,000 | 0.7% | Yes |
| | | Separate | Roadway | | | |
| | | Control | Turns | | | |
| | | Control | Drainage | | | |
| Q | Guardrail | Improve | Safety | \$164,000 | 0.7% | Yes |
| | | Protect | Structures | | | |
| R | Concrete Sidewalk | Allow | Access | \$129,000 | 0.6% | Yes |
| | | Connect | Existing | | | |
| S | Retaining Walls | Separate | Grades | \$124,000 | 0.6% | Yes |
| | | Retain | Fill | | | |
| | | Save | R/W | | | |
| T | Utilities | Replace | Existing | \$100,000 | 0.4% | No |
| | | Continue | Service | | | |

| CREATIVE PHASE Creative Idea Listing | | JUDGMENT PHASE Idea Evaluation | |
|---|--|--|--------------------|
| No. | CREATIVE IDEA | COMMENTS | IDEA RATING |
| A | Asphalt - Superpave | | |
| A-1 | To Modify the Roadway Typical Section | See A-2, Addressed in Other Ideas | X |
| A-2 | To Reduce the 12-foot Temporary Lane to 3 ½ feet | Reduce Cost, Reduce Time, Simplify Const. | ✓ |
| A-3 | To use Asphalt Pavement in-lieu-of Concrete Pavement on the Ramps | Reduce Cost, Reduce Time | ✓ |
| A-4 | To Review / Adjust the Construction Staging Concept | See A-2, Addressed in other ideas | X |
| A5- | To Evaluate the Inside Shoulder & Lane Typical | Possible Cost and Time Savings | ✓ |
| A-6 | To Change the Crown on the Final Roadway to all Drain in One direction | Use Excess Excavation | ✓ |
| A-7 | To Modify / Adjust the Final Full Width Layer to Better Accommodate Drainage | Not Cost Effective, Current Surface Adequate | X |
| A-8 | To Use a Surface Mix that Produces Less Spray | Not Cost Effective, Current Surface Adequate | X |
| A-9 | To Review the Number & Length of Ramp Lanes | Maximize LOS, Possible Cost Reduction | ✓ |
| A-10 | To Evaluate the Triple Left Turn on the Ramp | Safety Concerns, Capacity Concerns | ✓ |
| A-11 | To Reverse the Loops on the North Interchange | Will Not Accommodate Traffic Levels | X |
| A-12 | To use Asphalt for Ramp Shoulders | Rolled Compacted Concrete Better Choice | ✓ |
| ✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team | | | |

| CREATIVE PHASE Creative Idea Listing | | JUDGMENT PHASE Idea Evaluation | |
|---|---|--|--------------------|
| No. | CREATIVE IDEA | COMMENTS | IDEA RATING |
| A-13 | To Ride on Existing Shoulders and Mill & Repair as Necessary | Reduce Construction Time, Possible Safety Issues | ✓ |
| B | Plain PCC Pavement | | |
| B-1 | To Use Asphalt Pavement in-lieu-of Concrete Pavement on the Ramps | See A-3 | X |
| B-2 | To Reduce / Modify Widening of Temporary Lanes | Reduce Cost, Reduce Time | ✓ |
| B-3 | To Construct all of the Ramps with PCC Pavement | Meets State Interstate Ramp Policy | ✓ |
| B-4 | To use Asphalt Shoulders on all Ramps | Heavy Truck Traffic, Rolled Concrete Better | X |
| B-5 | To Review / Modify the full Concrete Shoulder for the Temporary lane build-out. | Reduce Cost, Reduce Time, Simplify Construction | ✓ |
| B-6 | To use Roller Compacted Concrete Shoulders in the Concrete Section of I-520 | Reduce Cost, Reduce Time, Simplify Construction | ✓ |
| B-7 | To use Roller Compacted Concrete Shoulders on the Interchange Ramps | Reduce Cost, Reduce Time, Simplify Construction | ✓ |
| ✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team | | | |

| CREATIVE PHASE Creative Idea Listing | | JUDGMENT PHASE Idea Evaluation | |
|---|---|---|--------------------|
| No. | CREATIVE IDEA | COMMENTS | IDEA RATING |
| C | Aggregate Base Course | | |
| C-1 | To check the depth of the Aggregate Base Course under the Concrete Pavement. | Reduce Cost, Simplify Construction | ✓ |
| C-2 | To Eliminate and use Rolled Concrete Shoulders | Reduce Cost, Simplify Construction | X |
| | | | |
| D | Signing and Markings | | |
| D-1 | Reuse Old Signs | Already in Plans | X |
| | | | |
| E | Grading Complete | | |
| E-1o | To use the Excess Material (waste job) to Build-up the new inside lane and reverse its crown | Possible Drainage Concerns, Design Change | X |
| E-2 | To Address possible Impacts to Stream due to widening the Ramp | Adequately Addressed in Plans | X |
| E-3 | To Modify Staging Lane Build-out to Eliminate Sliver Fills Along the edge of the shoulder | Reduce Erosion, See A-2, B-2 | X |
| E-4 | To Consider an Incentive / Disincentive clause for the Construction Stage to widen the outside shoulder | Accelerate Construction Phase | ✓ |
| ✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team | | | |

| CREATIVE PHASE Creative Idea Listing | | JUDGMENT PHASE Idea Evaluation | |
|---|--|--|--------------------|
| No. | CREATIVE IDEA | COMMENTS | IDEA RATING |
| F | Bridge | | |
| F-1 | To Revise the Width of the Bridge Widening | Reduce Cost | ✓ |
| F-2 | To Change the Type of Interchange to Take the Ramps off the Bridge | Not Practicable, Design Change | X |
| F-3 | To Check the Type / Depth of the Girders | Improve Vertical Clearance | ✓ |
| | | | |
| G | Erosion Control | | |
| G-1 | To Minimize the Outside Widening Needed for the Temporary Shoulder | See A-2, B-2 | X |
| | | | |
| H | Temporary Barrier | | |
| H-1 | To Change the Construction Staging to Reduce Amount | See A-2, B-2 | X |
| H-2 | To Limit the Length of Area open for Construction | Possible Cost Savings, Limit Contractor's Work | ✓ |
| | | | |
| ✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team | | | |

| CREATIVE PHASE Creative Idea Listing | | JUDGMENT PHASE Idea Evaluation | |
|---|--|--|--------------------|
| No. | CREATIVE IDEA | COMMENTS | IDEA RATING |
| I | Drainage | | |
| I-1 | The Review / Check the Box Culvert Extension | Reduce Impacts | ✓ |
| | | | |
| J | Concrete Barrier | | |
| J-1 | To Consider other types of barriers | Not Practicable in Narrow Area | X |
| | | | |
| N | Curb & Gutter | | |
| N-1 | To verify / Identify locations on Ramps | Eliminate Where Possible, Reduce Cost | ✓ |
| | | | |
| Q | Guardrail | | |
| Q-1 | To Eliminate the Widening for the Temporary Lane and Eliminate the need to shift the guardrail | See A-2, B-2 | ✓ |
| Q-2 | To Check the Location where the new Diamond Ramps and loop ramps come together | Maintain Physical Separation, Improve Safety | ✓ |
| Q-3 | Check if needed on new Ramps or if Slopes could be Widened | Eliminate if Possible, Reduce cost | ✓ |
| ✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team | | | |

