VALUE ENGINEERING REPORT

I-85 HOV to HOT Conversion Project
CSMSL-0009-00(295), (296), & (297)
PI No 0009295/0009296/0009297
DeKalb/Gwinnett Counties

October 8, 2009

OWNER AND DESIGN TEAM:

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EXECUTIVE SUMMARY

Executive Summary

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DeKalb/Gwinnett Counties, Georgia
October 9, 2009

Introduction

This report presents the results of a value engineering (VE) study conducted on the proposed design for the I-85 High Occupancy Vehicle (HOV) to High Occupancy Toll (HOT) lane conversion project. The project is approximately 16 miles long and begins at Chamblee Tucker Road and continues to Old Peachtree Road in DeKalb and Gwinnett Counties. The purpose of the project is to provide the most effective use of the existing HOV lanes on I-85. This project has a compressed design schedule, a critical milestone implementation date, coordinated contracting requirements, and complex construction issues.

Conversion of the HOV lane to a HOT lane will be accomplished under two contracts. The first contract will be by the GDOT and provide the civil roadway work, signage, power system connections/hookups, electronic wiring conduit/cable, and controller storage units. The second contract will be by the State Road Tollway Authority (SRTA) and will install the various tolling/monitoring hardware and base station needs for the system. Major contract work items in the GDOT civil contract include installing sign foundations, repairing the HOV lane/shoulders around the new footings, installing Type I and Type III sign structures, project signing, installing power, and installing the electronic wiring to operate the system. The total estimated project cost of the GDOT project is $23.8 million. The design is currently at approximately 60 percent and must be completed in time for a December, 2009 letting. The study was conducted September 20-24, 2009, at the GDOT General Offices 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. The VE team has included a "mark-up" calculation in the Recommendation Cost Worksheet. The mark-up calculation for this project is 10 percent and represents the cost of Engineering and Contingency (E&C). 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 VE team had several project considerations when developing their recommendations. They were; (1) median construction work was to be done during nighttime and weekend closures, (2) GDOT will construct the infrastructure/civil work for the project, (3) SRTA will install the tolling/monitoring hardware and software to operate the system, and (4) detailed tolling and electronic information was not available during the VE review and is not included as part of this Report. This project is being funded through a Federal source to demonstrate the capabilities of HOT lanes to provide travel time reliability. The project is to be completed and operational by January 30, 2011. Concurrent projects included within the overall funding will construct two new park and ride lots and purchase 36 new express buses. These projects are not included in this VE Report. The Project Concept Report has been approved. The Environmental Assessment is almost complete. No R/W is required for this project.

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 62 ideas with 34 being identified for additional evaluation as possible recommendations or design constructions. The VE team developed 12 independent recommendations, 1 alternative recommendation, and 12 design considerations. Implementation of the 12 independent recommendations has the potential to reduce the project cost by approximately $11.9 million. A detailed write-up of each recommendation and design considerations is contained in the respective portion of this report. A summary of the recommendations and design considerations follows.

Recommendation Highlights

Idea A-1: Use black and white thermoplastic pavement marking to change existing HOV lane markings as needed to convert to HOT lane entrance and exits.

The current concept would mill and resurface the existing HOV lane full width for the entire length of the project to remove/modify the existing HOV lane pavement markings.

It is recommended that the HOV lane milling and repaving be eliminated. Where the HOT lane conversion changes the existing pavement markings, either from solid to skip dash or skip dash to solid, apply new black or white thermoplastic pavement marking over the top of the existing pavement markings to make the changes. Patch the HOV lane pavement full width as required at each new sign structure footing. The asphalt surface is 3 to 5 years old, shows minimal distress, and should have an additional 8 to 10 years before requiring resurfacing. Appling new thermoplastic pavement markings over the existing pavement markings will result in a substantial cost savings.

The total potential savings if accepted is $9,425,000.

Idea A-1.1: Mill and resurface only the 3 foot wide area containing the pavement marking between HOT and general purpose lanes in the areas where the pavement markings are to change.

The current concept would mill and resurface the existing HOV lane full width for the entire length of the project to remove/modify the existing HOV lane pavement marking.

It is recommended that the full-width milling and resurfacing be eliminated. In locations where the HOT lane conversion changes the existing pavement markings, either from solid to skip dash or skip dash to solid, mill off the permeable asphalt concrete layer 3 feet wide by the length of the change, repave with permeable asphalt concrete and restripe with either solid or skip dash thermoplastic pavement marking. Milling and repaving only a 3 foot wide strip for the length of the changed pavement marking locations, repaving with permeable asphalt concrete, and applying new thermoplastic pavement markings would result in a substantial cost savings over full width milling and resurfacing.

The total potential savings if accepted is $9,325,000.

Idea B-3: Allow Northbound and Southbound right shoulder closures during daytime hours.

The Draft Project Concept Report states that traffic shall be maintained during all phases of construction. Lane and shoulder closings will be limited to nights and weekends.

It is recommended that right shoulder closings be allowed northbound and southbound during daytime hours. Allowing daytime right shoulder closures would reduce labor costs and increase labor float time by 45% that could account for unanticipated delays and weather impacts.

The total potential savings if accepted is $76,800

Idea C-2: Use Type II or V - Cantilever sign structures in-lieu-of Type I overhead sign trusses for regular signing at six locations.

The current plans use full-span Type I sign trusses for smaller signs placed over the left side lanes.

It is recommended that Type II or V, Cantaliver sign structures be used in-lieu-of Type I sign structures at six locations (not including the variable display signs) where single signs are placed over the left side of the roadway. The single sign locations can utilize a Type II or V, Cantaliver sign support rather than the full width span structure and save construction costs, expedite construction, and eliminate a hazard / obstruction on the right side of the roadway. Changing to a Type II or V, Cantaliver sign structure will require an additional structural analysis of the footing design and cantilever arm design.

The total potential savings if accepted is $240,000.

Idea C-3: Use Type II or V, Cantaliver sign structures in-lieu-of Type I overhead sign trusses for the eight variable message sign locations.

The current plans use full-span Type I sign trusses for the variable message signs.

It is recommended that Type II or V, Cantaliver sign structures be used in-lieu-of Type I sign structures for the eight variable message signs. A Type II or V, Cantaliver sign structure should be able to accommodate the variable message signs especially, if total variable electronic signs are used as recommended in Idea F-2. Using a Type II or V, Cantaliver sign structure will save construction costs, expedite construction, and eliminate a hazard / obstruction on the right side of the roadway. If required for the foundation design, the sign could be shifted to the left several feet to shorten the cantilever arm. Changing to a Type II or V, Cantaliver sign structure will require an additional structural analysis of the footing design and cantilever arm design.

The total potential savings if accepted is $310,000.

Idea D-2: Eliminate the toll tags and use only video license plate reading to identify vehicles using the HOT lanes.

The current managed HOT lane design will use electronic toll tags for toll collection purposes and video license plate reading for monitoring and enforcement.

It is recommended that video license plate reading be used for both tolling and enforcement. This concept eliminates the cost of the electronic toll tags, toll tag readers, and associated maintenance costs. It would also significantly reduce the cost of future managed HOT lanes as the system is expanded throughout the metro area. It also simplifies the registration process for motorists since they do not have to get and install the toll tag device in their vehicles. The toll industry nationwide is moving toward the use of video license plate readers only for all toll collection and enforcement.

The total potential savings if accepted is $748,000.

Idea D-4: Reduce the size of the fiber optic cable from 72 strands to 36 strands or less.

The current design uses a 72 strand fiber optic dielectric cable for the Ethernet network system.

It is recommended that a 36 strand (or smaller) fiber optic cable be used for the Ethernet network. The field Ethernet network requires only four fibers for Ring Network and drop cables to operate the HOT electronics. The 72 count fiber cable appears excessive unless additional equipment is planned to be installed that will use the excess capacity or the extra capacity is needed for some future use.

The total potential savings if accepted is $89,000.

Idea D-10: Add necessary lighting for nighttime video license plate reader operation.

The current plans do not include license plate illumination to support the automatic license plate readers.

It is recommended that illumination devices be added to the plans for the license plate readers. The plans should also include the power load requirements for the toll electronics power interconnect. License plate reader illumination is required for 24/7 operations of the toll collection system.

The total potential increase if accepted is $75,000.

Idea D-14: Add specific lightning and grounding protection to all applicable units.

The current plans show the installation of a lightning rod on each gantry. GDOT Standard Plan detail indicates ground conductor connection to the ground rod; however, there are no details of the lightning and surge protection on the plans.

It is recommended that the plans include lightning protection on all copper signal and power connections. All electronic equipment must be protected in accordance with the National Electric Code to prevent electronic equipment failure from lightning induced power and signal line surges.

The total potential increase in cost if accepted is $70,000.

Idea D-16: Construct a wireless communication network in-lieu-of hard wired communication network to support the HOT system.

The current design proposes to interconnect all Ethernet switches with single mode fiber optic cable installed in conduit. This design requires the installation of the fiber optic cable conduit under the existing Interstate highway.

It is recommended that the HOT system be constructed using wireless communications. Interconnect the field Ethernet switches to IEEE 802.16 Wireless Transceivers to the collection/back head points. The construction of a wireless field Ethernet system would save installation time and reduce the cost of the system. Continuing the use of the wireless concept on future HOT lane segments would result in addition time and cost savings.

The total potential savings if accepted is $1,100,000.

Idea F-1: Eliminate the line "HOT 3+ FREE" from the reflective/electric changeable toll message sign.

The current design for the main toll rate variable message sign includes a line showing "HOT 3+ FREE" on the rate display signs.

It is recommended that the "HOT 3+ FREE" line be eliminated from the rate display sign. The current main toll sign design is very busy and displays a lot of information (RATES and Cruise Card Logo, HOT 3+ FREE, and rates to specified destinations). This sign must be easy to read and understand so travelers can decide whether or not they want to use the HOT lane. Registered users will know that HOT 3+ users ride for free making this information unnecessary. Eliminating the "HOT 3+ FREE" line from this sign will make it less cluttered, save sign fabrication costs, and result in a smaller sign potentially saving footing costs.

The total potential savings if accepted is $25,000.

Idea F-2: Use a full face changeable electric sign for the toll message sign in-lieu-of the proposed combo reflective/electric sign.

The current toll sign design calls for using a specially fabricated signs to convey the rates to the motorists. They will include partial electronic displays for the specific rates charged to specific destinations.

It is recommended that a full matrix all electric changeable message sign be used in-lieu-of the current reflective/electric toll sign. The current toll signs are very busy and display a lot of information. Providing a complete variable message sign will allow the display of the same information and also provide the flexibility to display a different message and / or additional information. Using variable message signs will allow GDOT / SRTA to adjust the message and minimize sign clutter, especially when combined with Recommendation F-1. It will also provide more flexibility to change the displayed messages for current conditions.

Variable message signs comply with FHWA sponsored ITS National Architecture and Communications Protocol Standards. Signs have been tested and certified to meet National Standards. Full Matrix electronic signs do not need any new communications protocols for this application nor do they require any special manufacturing. They are also adaptable to new requirements that may emerge from "lessons learned" through HOT lane operations.

The total potential increase if accepted is $150,000.

Idea H-1: Use the proper size (ports/features) and number of Ethernet switches.

The current design uses 32 Type A, 8 Type F(a), and 5 Type F(6) three-layer switches. There was no network architecture, diagrams, or analysis of the requirements/communication loading provided to review.

It is recommended that the size of the field Ethernet switches be reduced where possible.

The typical ATMS field network uses hardened Layer 2 Ethernet switches. If the architecture uses corridor subnets that interface with a backbone network only F(6) switches are utilized. The large Type F(a)Ethernet switches are usually only used in the "back office." The current plans did not indicate how the F(a) and F6 switches are being used. Tailor the size of the field Ethernet switches to meet the field network requirements.

The total potential savings if accepted is $220,000.

Design Considerations

The VE team also developed the following design considerations:

- **B-1** Develop a design or identify the locations where the sign footings (narrow shoulder areas) need to be completed in one weekend. Failure to complete the work in one weekend could result in the need to close the HOV lane due to incomplete construction or temporary barrier intrusion into the HOV lane.
- **C-8** Add signing to the HOT lanes and mainline roadway to advise motorists of the traffic merge areas at the various entrance/exit points.
- **D-1** Fully coordinate the HOV to HOT lane design and construction contracts. Coordination between GDOT and SRTA is critical for the success of this project. This project has tight schedules, coordinated contracting requirements, and complex construction issues. Make sure the civil contractor has all the plans and information for the integrator contract portion of the overall contract.
- **D-5** Use the existing fiber optic capacity available from the GDOT fiber optic cable system to operate the toll system in-lieu-of installing new conduit and cable.
- **D-6** Use compressed "IP" video to reduce the bandwidth requirements and simplify the communication network for the HOT lane toll system.
- **D-7** Use smaller controller cabinets that are better suited for the small size of the field electronic equipment being housed.
- **D-9** Consolidate the GDOT/SRTA electronic hardware into a single controller cabinet located on the outside shoulder of the roadway to improve maintainability.
- **D-12** Use the conduit for the existing freeway lighting power cable for the installation of the new fiber optic cable where possible.
- **D-13** Have a "human factors expert" review the complex HOT lane signing system for user readability and understanding within acceptable time norms for freeway speeds.
- **D-17** Raise the electronic cabinets above the road surface and higher in flood prone areas to prevent flooding and loss of electronic equipment.
- **I-5** Include the power load requirements (from SRTA) at every location in the GDOT civil plans. Power interconnect design should include margins, circuit protection and grounding in accordance with NFPA 70/2008. GDOT is providing utility power interconnect, UPS, and power distribution for "others" which needs to be defined (including a safety margin).

I-85 HOV to HOT Conversion

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-1	Eliminate full width milling & resurfacing and patch disturbed pavement around footings. Restripe pavement using "black" and "white" thermoplastic pavement markings.	$9,700,000	$275,000	$9,425,000	N/A	**$9,425,000**	100%
A-1.1	Eliminate full width milling & resurfacing and patch disturbed pavement around footings. Mill/resurface a 3-foot wide area in locations of changed pavement markings and restripe.	$9,700,000	$375,000	$9,325,000	N/A	**$9,325,000**	100%
B-3	Allow daytime "right shoulder" closure to perform necessary civil and electrical work.	$76,800	$0	$76,800	N/A	**$76,800**	100%
C-2	Use Type II or V, Cantaliver sign structures in-lieu-of overhead sign trusses for regular signing at six locations.	$500,000	$260,000	$240,000	N/A	**$240,000**	100%
C-3	Use Type II or V, Cantaliver sign structures in-lieu-of overhead sign trusses for the 8 variable message sign	$660,000	$350,000	$310,000	N/A	**$310,000**	100%

I-85 HOV to HOT Conversion

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* (%)
	locations.						
D-2	Eliminate the toll tags and use only video to identify vehicles using HOT lanes.	$1,346,000	$598,000	$748,000	N/A	**$748,000**	100%
D-4	Reduce the size of the fiber optic cable from 72 strands to 36 strands or less.	$268,000	$179,000	$89,000	N/A	**$89,000**	100%
D-10	Add necessary lighting for nighttime video license plate reader operation.	Not Included	$75,000	($75,000)	N/A	**($75,000)**	100%
D-14	Add specific lightning and grounding protection to all applicable units.	Not Included	$70,000	($70,000)	N/A	**($70,000)**	100%
D-16	Construct a wireless communication network in-lieu-of hard wired communication network to support the HOT system.	$1,650,000	$550,000	$1,100,000	N/A	**$1,100,000**	100%
F-1	Eliminate the word/line “HOT 3+ Free” from the changeable message sign.	$25,000	$0	$25,000	N/A	**$25,000**	100%
F-2	Use electric changeable sign in-lieu-of the proposed reflective/electric sign.	$950,000	$1,100,000	($150,000)	N/A	**($150,000)**	100%
H-1	Use the proper (number/type of ports and proper bandwidth) network switch	$400,000	$180,000	$220,000	N/A	**$220,000**	100%

I-85 HOV to HOT Conversion

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* (%)
	size.						
	DESIGN SUGESTIONS						
B-1	Develop a design or identify the locations where the sign footings (narrow shoulder areas) need to be completed in one weekend. Failure to complete the work in one weekend could result in the need to close the HOV lane due to incomplete construction.					N/A	N/A
C-8	Add signing to the HOT lanes and mainline roadway to advise motorists of the traffic merge areas at the various entrance/exit points.					N/A	N/A
D-1	Fully coordinate the HOV to HOT lane design and construction contracts. Coordination between GDOT and SRTA is critical for the success of this project. The project has tight schedules, coordinated contracting requirements, and complex construction issues.					N/A	N/A
D-5	Use the existing fiber optic capacity available from the GDOT fiber optic cable system to operate the toll system in-lieu-of installing new conduit and cable.					N/A	N/A
D-6	Use compressed “IP” video to reduce the bandwidth requirements and simplify the communication network for the HOT lane toll system.					N/A	N/A
D-7	Use smaller controller cabinets that are better suited for the small size of the electronic equipment being housed.					N/A	N/A
D-9	Consolidate the GDOT/SRTA electronic hardware into a single controller cabinet located on the outside shoulder of the roadway for easy maintainability.					N/A	N/A
D-12	Use the conduit for the existing freeway lighting power cable for the installation of the new fiber					N/A	N/A

I-85 HOV to HOT Conversion

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* (%)
	optic cable where possible.						
D-13	Have a "human factors expert" review the complex HOT signing system for readability and associated safety standpoint.					N/A	N/A
D-17	Raise the electronic cabinets above the road surface and higher in flood prone areas to prevent flooding and loss of electronic equipment.					N/A	N/A
I-5	The power load at every location should be provided by SRTA and included in the GDOT civil plans. Power interconnect design should include margins, circuit protection and grounding in accordance with NFPA 70/2008 (National Electric Code). GDOT is providing utility power interconnect, UPS and power distribution for "others" which should be defined (including a safety margin).					N/A	N/A
	* 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-85 HOV to HOT Conversion	**Date: September 21-24, 2009**
Location: Atlanta, Georgia	

VE Team Members

Name:	Title:	Organization:	Telephone:
George Obaranec	Highway Design	MACTEC	770-421-3346
Fred Nazar	Construction	MACTEC	773-418-2955
Bruce Abernethy	ATMS Design	Street Smarts	214-406-8736
Keith Borkenhagen	VE Team Facilitator	MACTEC	623-556-1875

Project Description

This project will convert approximately 16 miles of I-85 HOV lanes into HOT lanes beginning at Chamblee Tucker Road and extending to Old Peachtree Road in DeKalb and Gwinnett Counties. Conversion of the HOV lane into a HOT lane will be accomplished under two contracts. This GDOT contract will provide the civil roadway work, signage, power system connections/hookups, electronic wiring conduit/cable, and controller storage units for the HOT conversion. A second contract by the SRTA and will install the various tolling/monitoring hardware and base station needs for the system. Major contract work items in the GDOT civil contract include installing sign foundations, repairing the HOV lane/shoulders around the new footings, installing Type I and Type III sign structures, project signing, installing power, and installing the electronic wiring to operate the system. The total estimated project cost is $23.8 million. The design is currently at approximately 60 percent and is scheduled to be completed for a December, 2009 letting.

Design Considerations

The VE team was presented with several concerns for consideration when developing their recommendations. These concerns were:

- The HOV lane must remain open during the day. Construction work was to be done during nighttime and weekend closures.
- The project must be completed and open to traffic by January 30, 2011.
- The GDOT contract will provide the civil and infrastructure work for the project. The SRTA contract will install the tolling/monitoring hardware and software to operate the system.

Design Briefing

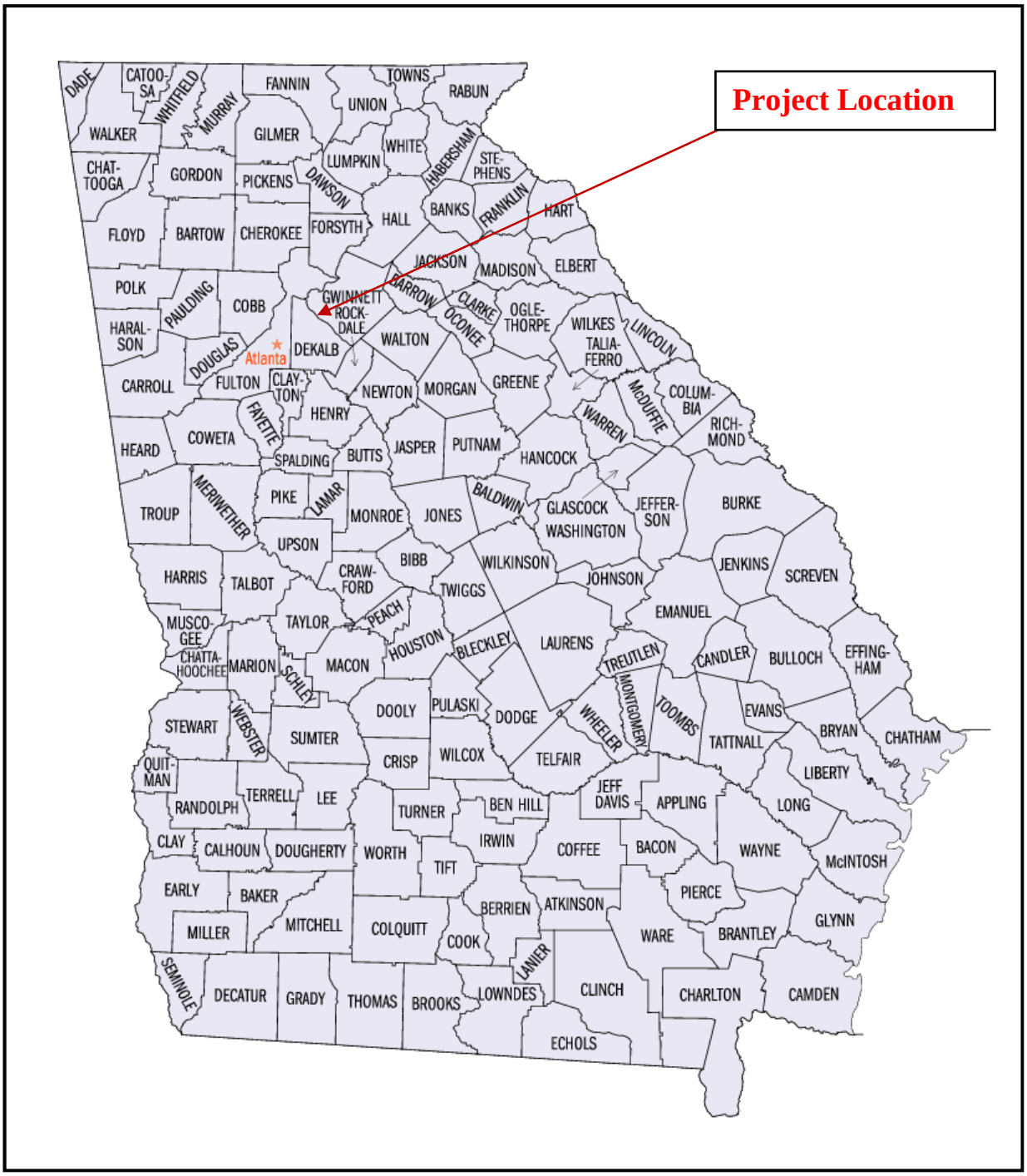
At the beginning of the study, the VE team was briefed on the project. The following items were discussed:

- The current I-85 HOV lane is being converted to a HOT lane to improve the effectiveness of the lane. Traffic projections are expected to increase 15% by 2015 and by 53% by 2030.
- The HOT lanes will be available to any toll registered driver, HOV-3+ vehicles, alternate fuel vehicles, motorcycles, and buses. All users shall have to be pre-registered.
- The HOT lanes will extend approximately 16 miles in DeKalb and Gwinnett counties.
- This project is a demonstration project to show the capabilities of the HOT lanes to provide travel time reliability. The State has received $110 million to update the lanes, enhance transit operations, install two new park and ride lots, and purchase 36 new transit buses. GDOT is receiving $12.5 million for their part of the project.
- The project has to be completed and open to traffic by January 30, 2011.
- The lane conversion will be constructed in two stages. The first (GDOT contract) stage will provide the civil and infrastructure roadway work; signage, power system connections/hookups, electronic wiring conduit/cable, and controller storage units for the HOT conversion. The second stage (STRA contract) will install the various tolling/monitoring hardware and base station needs for the system.
- There are locations along the HOV lane where the shoulders are very narrow and the construction of any sign footings will have to be completed using weekend lane closures. The HOV lane must remain in operation during the work week.
- The new sign will be constructed with high intensity sign material and will not require lighting. The main toll rate signs will also include variable message signing to display the rate changes needed to manage the lanes.
- The main power line for the freeway runs along the southbound outside shoulder.
- The District office is concerned about milling, hydroblasting, etc. off the existing HOV pavement markings because it leaves a shiny line that appears to be the lane marking at night and when raining. They would prefer the surface to be milled and resurfaced.

Project Field Review

The VE team made a field review/drive through of the proposed project. The following items were observed:

- There are many locations throughout the project with very narrow and/or almost no shoulders between the HOV lane and the median barrier wall.
- Construction of the median sign footings in these narrow shoulder areas will likely encroach into the actual HOV lane making their construction extremely time critical.
- The pavement of the HOV lane appeared to be in good to excellent condition with the north half of the project being in the best condition.
- The existing HOV striping was in good condition and clearly visible.



Project Location Map
Figure 1

Project Sketch Map

VE RECOMMENDATIONS

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
A-1	1 of 4	Use black and white thermoplastic pavement marking to change existing HOV lane markings as needed to convert to HOT lane entrance and exits.

Comp By: FN Date: 9/23/2009 Checked By: KB Date: 09/28/09

Original Concept: The current concept would mill and resurface the existing HOV lane full width for the entire length of the project to remove the existing HOV lane pavement marking.

Proposed Change: Do not mill and repave the existing HOV lanes and leave the existing HOV lane pavement marking in place. In locations where the 2-foot HOT lane conversion changes the existing pavement marking, either from solid to skip dash or skip dash to solid, apply new black or white thermoplastic pavement marking over the top of the existing pavement marking to make the changes.

Patch the existing HOV lane pavement full width as required at each new structure footing support for overhead sign type I or III.

Justification: Our understanding of the baseline concept indicates the full lane width milling and overlay is being performed to remove the pavement markings between the HOV lane and the general use lanes. During the project briefing, the VE team was told that the marks left behind from the pavement marking removal by grinding or hydroblasting "polishes" the surface of the asphalt pavement. During raining conditions and at night, these polished areas look like solid pavement markings.

The I-85 asphalt surface is 3 to 5 years old and per a visual inspection of the HOV lane asphalt pavement, the pavement shows minimal distress and we would expect a life cycle of an additional 8 to 10 years. Appling new thermoplastic pavement markings over the existing pavement markings will result in a substantial cost savings. Included on Sheet 4 of this recommendation is a manufacturers catalogue sheet for a black thermoplastic product. There are other similar products available.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$9,700,000		
- Proposed	$275,000		
- Savings	$9,425,000		$9,425,000
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$9,425,000**

COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project

Idea No.: A-1
Client: GDOT
Sheet 2 of 4

CONSTRUCTION ELEMENT		ORIGINAL ESTIMATE			NEW ESTIMATE		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
400-3604 ASPH CONC 12.5 MM SMA, GP 2 ONLY, INCL POLYMER MODIFIED	TON	37,752	$110.00	$4,152,720	0	$110.00	0
400-3624 ASPH CONC 12.5 MM PEM, GP 2 ONLY, INCL POLYER MODIFIED	TON	30,888	$90.00	$2,779,920	405	$90.00	$36,450
413-1000 BITUM TACK COAT	GAL	45,760	$2.59	$118,518	600	$2.59	$1,554
432-0206 MILL ASPH CONC PVMT, 1 ½ IN DEPTH	SY	457,600	$2.50	$1,144,000	6,000	$2.50	$15,000
653-2804 THERMOPLASTIC SOLID TRAF STRIPE, 8 IN, WHITE	LM	60	$9,126.95	$547,617	9.0	$9,126.95	$82,143
653-3804 THERMOPLASTIC SKIP TRAFFIC STRIP, 8 IN, WHITE	GLM	47,000	$1.40	$65,800	0	0	0
653-XXXX THERMOPLASTIC SKIP TRAFFIC STRIP, 8 IN, BLACK	GLM	0	0	0	47,000	$2.40	$112,800
SUBTOTAL				$8,808,575			$247,947
(10% E & C) **MARK-UP (10%)**				$880,857			$24,794
TOTAL				$9,689,432			$272,741
TOTAL ROUNDED				**$9,700,000**			**$275,000**

CALCULATIONS

Project: I-85 HOV to HOT Conversion Project	Idea No.: A-1 Client: GDOT Sheet 3 of 4

Pavement marking assumptions: Future HOT lane entrance and exit locations will be located at existing solid lane markings, which will need to changed to skip dash by using black thermoplastic pavement marking over the top of the existing solid white pavement marking to create the skip marks. Existing HOV skip dash lane markings change to HOT solid lane markings by using white thermoplastic pavement marking over the top of the existing skip dashes to create a solid.

NB
302+60 to 320+88 = 1828 LF
452+75 to 487+50 = 3475 LF
594+15 to 621+00 = 2685 LF
717+00 to 742+35 = 2535 LF
923+00 to 949+27 = 2627 LF
NB Total = 13,150 LF

SB
1139+00 to = 1828 LF
742+35 to 717+00 = 2535 LF
621+00 to 594+15 = 2685 LF
509+48 to 474+83 = 3465 LF
SB Total = 10,513 LF

NB and SB Total = 23,663 LF x 2 stripes = 47,326 GLM

Assume same quantity of existing HOV skip dashes to be converted to solid lines = 9.0 LM

Estimated amount of HOT lane patching at each sign truss foundation.
50’ in length by full lane width (12’) for NB and SB at each sign
50’x12’x2/ 9 sf/sy x 44 signs = 5866 sy; say 6000 sy

Tons of permeable asphalt concrete
6000sy x 135 lbs\sy \2000 lbs\ton = 405 tons

Gallons of bituminous tack coat
6000 sy x 0.1 gallons\sy = 600 gallons

Dobco

a business unit of The Sherwin-Williams Company

THERMOPLASTIC PAVEMENT MARKING SPECIALISTS

Black Out™

Black Thermoplastic Pavement Marking

Black Out™ is a superior black thermoplastic pavement marking material available in both Alkyd and Hydro. **Black Out™** is typically applied to the pavement at temperatures of 400°F - 440°F with no topcoat of glass beads. Some applicators prefer to replace the glass beads with ground silica, while others just eliminate the beads. **Black Out™** is shipped as a neutral material with pre-weighed amounts of black pigment. The neutral material is melted in the application equipment. The black pigment is then mixed into the color required by the applicator.

Black Out™ has various uses including "blacking-out" markings that require changing or correcting. **Black Out™** is also used as a contrast marking to accentuate white delineations on light colored pavements. Dobco's ability to formulate **Black Out™** in any binder or for use in any application makes it an extremely versatile product. Pavement colors can be matched to allow **Black Out™** to be custom formulated, leaving Dobco's **Black Out™** virtually invisible to the motorist

Black Out™ is a *Smart Choice* to correct markings and enhance delineations.

Features	Benefits
Correct Markings	• No special removal equipment required • No damage to pavement that can result with marking renewal
Enhance the Conspicuity on Light Colored Pavements	Markings will stand out on light colored pavements when black is used as a base contrast marking
Available in Alkyd or Hydro	Customers can select preferred binder system
Available for Use in Any Application	Can be formulated for extrude or spray
Can be Custom Formulated to Match Pavements	Oxidized pavement colors can be matched
Available Forms / Packaging	Granular - powdered form Solid - 50 lb pre-melted slabs

Shipping Point: Manchester, GA

Safety Information: Material Safety Data Sheet available upon request.

Product specifications and properties are available upon request.

P. O. Box 888 • 1001 Nebula Road • Manchester, Georgia 31816
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Rev 2/19/2005

Manufacturers Information

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
A-1.1	1 of 3	Mill and resurface only the 3 foot wide area containing the pavement marking between HOT and managed lanes in the areas where the pavement markings are to change.

Comp By: FN Date: 9/23/2009 Checked By: KB Date: 09/28/09

Original Concept: The current concept would mill and resurface the existing HOV lane full width for the entire length of the project to remove the existing HOV lane pavement marking.

Proposed Change: Do not mill and repave the existing HOV lanes. Leave the existing HOV lane pavement marking in place. In locations where the HOT lane conversion changes the existing pavement marking, either from solid to skip dash or skip dash to solid, mill the permeable asphalt concrete layer 3 feet in width by the length of the change, repave with permeable asphalt concrete and restripe with either solid or skip dash thermoplastic pavement marking.

Justification: Our understanding of the baseline concept indicates the full lane with milling and overlay is being performed to remove the pavement markings between the HOV lane and the general use lanes. During the project briefing, the VE team was told that the marks left behind from the pavement marking removal by grinding or hydroblasting "polishes" the surface of the asphalt pavement. During raining conditions at night, these polished areas look like solid pavement markings.

The I-85 asphalt surface is 3 to 5 years old and per a visual inspection of the HOV lane asphalt pavement, the pavement shows minimal distress and we would expect a life cycle of an additional 8 to 10 years. Milling the permeable asphalt concrete (3 foot wide strip by the length of the changed pavement marking location), repaving with permeable asphalt concrete and applying new thermoplastic pavement markings would result in a substantial cost savings over full width milling and resurfacing.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$9,700,000		
- Proposed	$375,000		
- Savings	$9,325,000		$9,325,000
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$9,325,000**

COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project

Idea No.: A-1.1
Client: GDOT
Sheet 2 of 3

CONSTRUCTION ELEMENT		ORIGINAL ESTIMATE			NEW ESTIMATE		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
400-3604 ASPH CONC 12.5 MM SMA, GP 2 ONLY, INCL POLYMER MODIFIED	TON	37,752	$110.00	$4,152,720	0	$110.00	0
400-3624 ASPH CONC 12.5 MM PEM, GP 2 ONLY, INCL POLYER MODIFIED	TON	30,888	$90.00	$2,779,920	1,470	$90.00	$132,300
413-1000 BITUM TACK COAT	GAL	45,760	$2.59	$118,518	2178	$2.590	$5,641
432-0206 MILL ASPH CONC PVMT, 1 ½ IN DEPTH	SY	457,600	$2.50	$1,144,000	21,775	$2.50	$54,437
653-2804 THERMOPLASTIC SOLID TRAF STRIPE, 8 IN, WHITE	LM	60	$9,126.95	$547,617	9.0	$9126.95	$82,143
653-3804 THERMOPLASTIC SKIP TRAFFIC STRIP, 8 IN, WHITE	GLM	47,000	$1.40	$65,800	47,000	$1.40	$65,800
SUBTOTAL				$8,808,575			$340,321
(10% E & C) **MARK-UP (10%)**				$880,857			$34,032
TOTAL				$9,700,000			$374,353
TOTAL ROUNDED				**$9,700,000**			**$375,000**

CALCULATIONS

Project: I-85 HOV to HOT Conversion Project	Idea No.: A-1.1 Client: GDOT Sheet 3 of 3

Pavement marking assumptions: Future HOT lane entrance and exit locations will be located at existing solid lane markings, which will need to changed to skip dash by using black thermoplastic pavement marking over to the top of the existing solid white pavement marking to create the skip marks. Existing HOV skip dash lane markings change to HOT solid lane markings by using white thermoplastic pavement marking over the top of the existing skip dashes to create a solid.

NB	SB
302+60 to 320+88 = 1828 LF	1139+00 to = 1828 LF
452+75 to 487+50 = 3475 LF	742+35 to 717+00 = 2535 LF
594+15 to 621+00 = 2685 LF	621+00 to 594+15 = 2685 LF
717+00 to 742+35 = 2535 LF	509+48 to 474+83 = 3465 LF
923+00 to 949+27 = 2627 LF	
NB Total = 13,150 LF	SB Total = 10,513 LF

NB and SB Total = 23,663 LF x 2 stripes = 47,326 GLM

Assume same quantity of existing HOV skip dashes to be converted to solid lines = 9.0 LM

Estimated amount of HOT lane patching at each sign truss foundation.
50’ in length by full lane width (12’) for NB and SB at each sign
50’x12’x2/ 9 sf/sy x 44 signs = 5866 sy; say 6000 sy

Tons of permeable asphalt concrete
6000sy x 135 lbs\sy \2000 lbs\ton = 405 tons

Gallons of bituminous tack coat
6000 sy x 0.1 gallons\sy = 600 gallons

Pavement marking asphalt removal and replacement
Scarification = 47,326 LF x 3 FT / 9 sf/sy = 15,775 sy
Asphalt = 15,775 sy x 135 lbs/sy / 2000 lbs/ton = 1065 tons
Bit Tack Coat = 15,775 sy x 0.1 gal/sy = 1,578 gallons

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
B-3	1 of 2	Allow Northbound and Southbound right shoulder closures during daytime hours.

Comp By: FN Date: 9/23/2009 Checked By: KB Date: 09/28/09

Original Concept:

Per the Draft Project Concept Report, page 7, traffic shall be maintained during all phases of construction. Lane and shoulder crossings will be limited to nights and weekends.

Proposed Change:

Allow Northbound and Southbound right shoulder closures during daytime hours

Justification:

By allowing day time right shoulder closures an estimated $76,800 of labor costs can be saved, allowable working hours can be increased by 45% and additional float can be added to the project schedule that could account for unanticipated delays and weather impacts.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$76,800		
- Proposed	$0		
- Savings	$76,800		$76,800
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$76,800**

CALCULATIONS

Project: I-85 HOV to HOT Conversion Project	Idea No.: B-3 Client: GDOT Sheet 2 of 2

Labor Assumption:

It is assumed labor wages for night and weekend work will be 1.5 times the daily wage rate. Estimate the average daily wage rate at $30.00/ hour. The additional cost per hour for night and weekend work will be $15.00/ hour.

Estimated Premium Cost Per Worker Per 8 Hour Shift;
8 hours x $15.00/ hour = $120 /worker/ shift.

Estimate 4 crews per day with a crew size of 4 each, 5 days a week for 8 weeks
4 crews x 4/crew x 8 hours/ day x 5 days/week x 8 weeks x $15.00/ hour = $76,800

Schedule Impact:

Although a preliminary construction was not available for review, allowing daytime right shoulder closures will provide positive impacts to schedule:

Add additional allowable working hours to complete project
Allowable working hours per week for night and weekend work only
8 hours per night x 5 nights + 48 hours per weekend = 88 hours per week.

Add daytime right shoulder closures
8 hours per day x 5 days = 40 additional hours: 40 hours/ 88 hours per week = 45% increase in allowable working hours.

Can add float to the project schedule to account for unanticipated delays and weather impacts.

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
C-2	1 of 4	Use Type II or V, Cantaliver sign structures in-lieu-of overhead sign trusses for regular signing at six locations.

Comp By: GO Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current plans use full-span structures (Type I) for smaller signs placed over the left side lanes

Proposed Change:

Use Type II or V, Cantaliver sign structure in-lieu-of Type I sign structures where single signs are placed over the left side of the roadway.

Justification:

At 6 locations, not including the variable display signs, full span Type I structures are proposed to support relatively small overhead signs over the left lanes. The current plans already include Type II or V, Cantaliver sign structures with arm spans of over 40 feet.

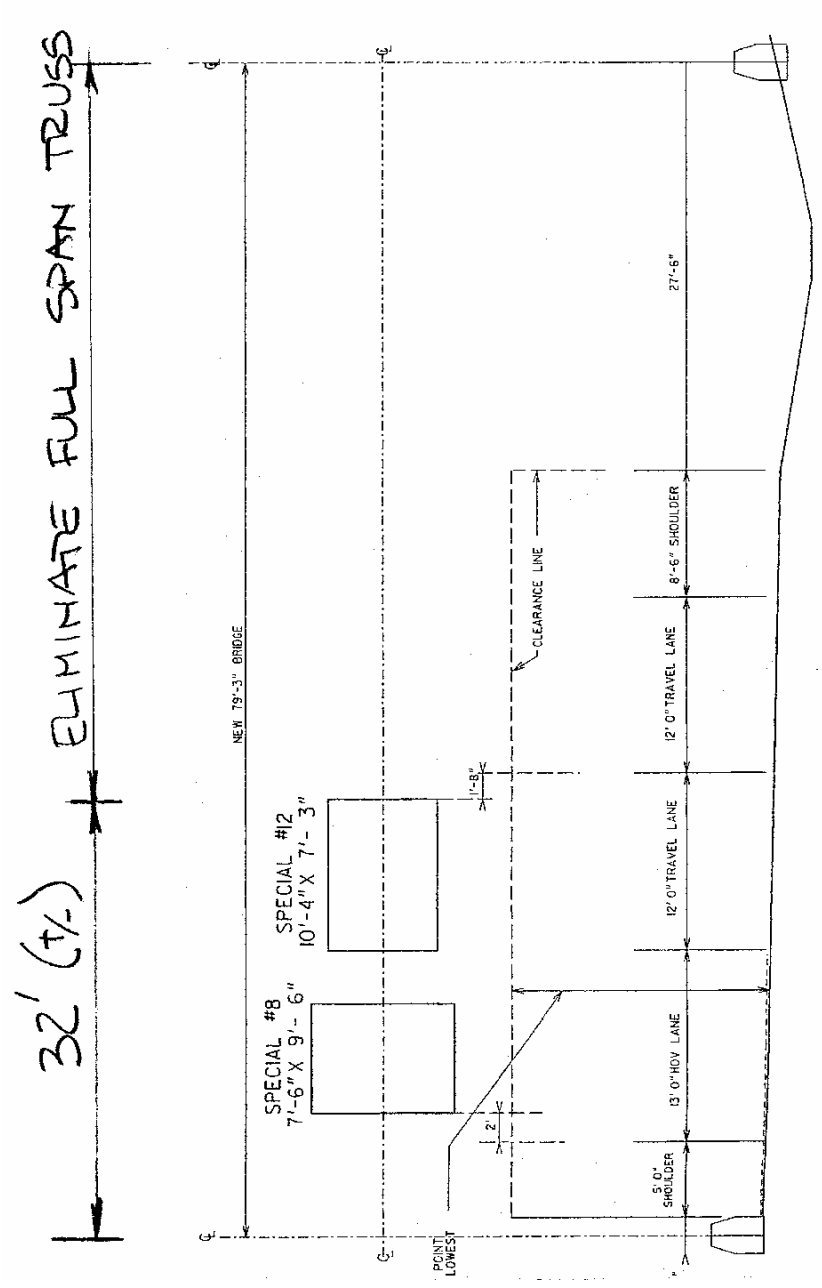
These single sign locations can utilize a Type II or V, Cantaliver sign support rather than the full width span structure. Using a Type II or V, Cantaliver sign structure will save construction costs, expedite construction, and eliminate a hazard / obstruction on the right side of the road.

Changing to a Type II or V, Cantaliver sign structure will require an additional structural analysis of the footing design, bolt patterns, and cantilever arm design.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$500,000		
- Proposed	$260,000		
- Savings	$240,000		$240,000
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$240,000**

SKETCH

Project: I-85 HOV to HOT Conversion Project	Idea No.: C-2 Client: GDOT Sheet 2 of 4



COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project					Idea No.: C-2 Client: GDOT Sheet 3 of 4		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Sign Structure Type 1	EA	6	$75,000	$450,000			
Sign Structure Type II or V, Cantaliver	EA				6	$39,000	$234,000
SUBTOTAL				$450,000			$234,000
(10% E & C) **MARK-UP (10%)**				$45,000			$23,400
TOTAL				$495,000			$257,400
TOTAL ROUNDED				**$500,000**			**$260,000**

CALCULATIONS	
Project: I-85 HOV to HOT Conversion Project	Idea No.: C-2 Client: GDOT Sheet 4 of 4

Potential sign locations

Station 421+02 NB
Station 560+00 NB
Station 988+38 SR 316
Station 995+30 SR 316
Station 1021+00 SR 316
Station 1047+00 SR 316

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA:** Use Type II or V, Cantaliver sign structures in-lieu-of overhead sign trusses for the 8 variable message sign locations.
C-3	1 of 4	

Comp By: GO Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current plans use full-span (Type I) structures for the variable message signs.

Proposed Change:

Use Type II or V, Cantaliver sign structure in-lieu-of Type I sign structures where single signs are placed over the left side of the roadway.

Justification:

At the 8 locations where variable message signs are proposed on full span trusses (Type I), cantilever sigh support structures should be able to accommodate the new signs, especially, if totally electronic variable signs are used, as recommended in idea F-2. The current plans already include Type II or V, Cantaliver sign structures with arm spans of over 40 feet.

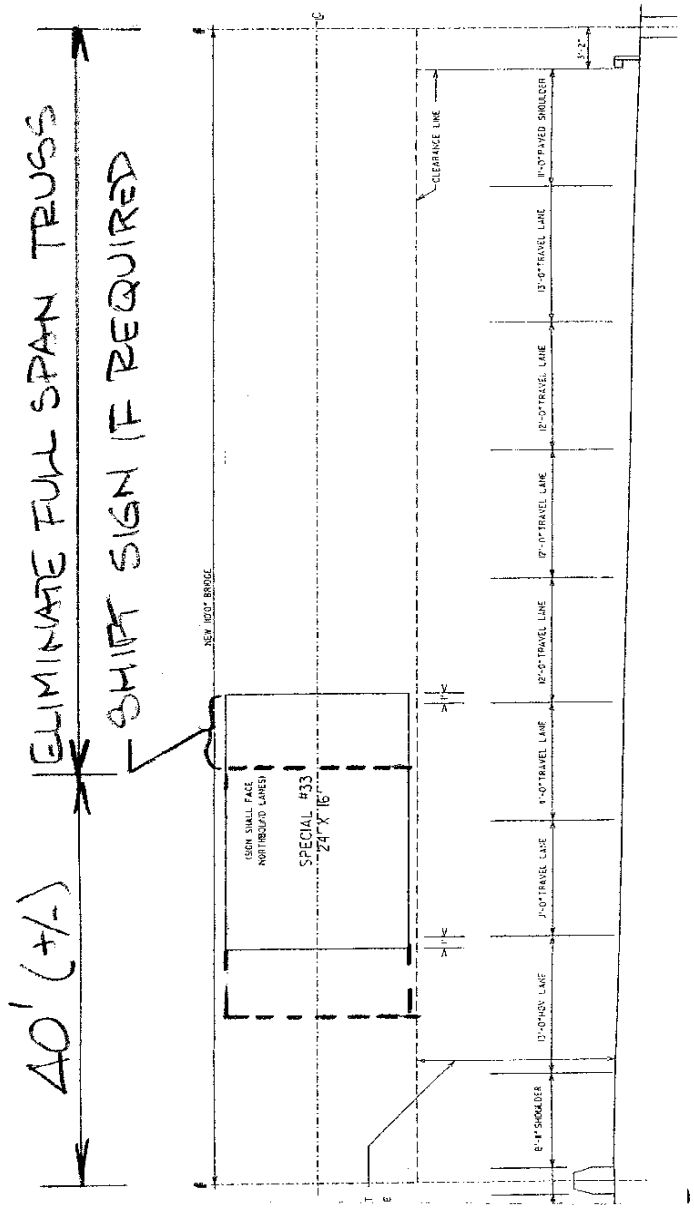
These variable message sign locations can utilize a cantilever sign support rather than the full width span structure. Using a Type II or V, Cantaliver sign structure will save construction costs, expedite construction, and eliminate a hazard / obstruction on the right side of the road. Any equipment required for power or maintenance of the sign can be mounted out of the clear zone.

Potentially, if required for the foundation design, the sign could be shifted to the left several feet to shorten the cantilever. Changing to a Type II or V, Cantaliver sign structure will require an additional structural analysis of the footing design, bolt pattern and cantilever arm design.

LIFE CYCLE COST SUMMARY	**CAPITAL COST**	**FUTURE COST**	**TOTAL COST**
INITIAL COST: - Original	$660,000		
- Proposed	$350,000		
- Savings	$310,000		$310,000
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$310,000**

SKETCH

Project: I-85 HOV to HOT Conversion Project	Idea No.: C-3 Client: GDOT Sheet 2 of 4



COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project					Idea No.: C-3 Client: GDOT Sheet 3 of 4		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Sign Structure Type 1	EA	8	$75,000	$600,000			
Sign Structure Type II or V, Cantaliver	EA				8	$39,000	$312,000
SUBTOTAL				$600,000			$312,000
(10% E & C) **MARK-UP (10%)**				$60,000			$31,200
TOTAL				$660,000			$343,200
TOTAL ROUNDED				**$660,000**			**$350,000**

CALCULATIONS

Project: I-85 HOV to HOT Conversion Project	Idea No.: C-3 Client: GDOT Sheet 4 of 4

Potential sign locations

Station 289+63 NB
Station 445+25 NB
Station 516+95 SB
Station 579+00 NB
Station 632+59 SB
Station 703+87 NB
Station 753+70 SB
Station 1150+30 SB

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
D-2	1 of 2	Eliminate the toll tags and use only video to identify vehicles using HOT lanes.

Comp By: BA Date: 9/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current design for the managed HOT lanes will use electronic toll tags for toll collection purposes and video license plate reading for monitoring and enforcement.

Proposed Change:

Use only video license plate reading for both tolling and enforcement. This concept would significantly reduce the cost of this project as well as future managed HOT lanes as the system is expanded throughout the metro area.

Justification:

The toll industry nationwide is moving toward the use of video license plate readers only for all toll collection and enforcement. This concept eliminates the cost of the electronic toll tags, toll tag readers, and associated maintenance costs. It also simplifies the registration process for motorists since they do not have to get and install the toll tag device in their vehicles.

Using only video license plate readers expands the user base and increases the likelihood of candidate vehicles choosing to use the HOT lanes. It allows for easy tolling of registered accounts while providing the necessary information to charge a toll fee and administration fee for any non-registered vehicle using the HOT lane. This concept would encourage non-registered motorists who receive a toll/administration fee bill to consider establishing an account with the toll authority.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$1,346,000		
- Proposed	$598,000		
- Savings	$748,000		$748,000
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$748,000**

COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project					Idea No.: D-2 Client: GDOT Sheet 2 of 2		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Current Design:							
Toll Tag Readers Installed	EA	68	$10,000	$680,000			
License Plate Reader cameras	EA	68	$8,000	$544,000			
VE Design							
License Plate Reader cameras	EA				68	$8,000	$544,000
SUBTOTAL				$1,224,000			$544,000
(10% E & C) **MARK-UP (10%)**				$122,400			$54,400
TOTAL				$1,346,400			$598,400
TOTAL ROUNDED				**$1,346,000**			**$598,000**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
D-4	1 of 3	Reduce the size of the fiber optic cable from 72 strands to 36 strands or less.

Comp By: BA Date: 9/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current design uses a 72 strand fiber optic dielectric cable for the Ethernet network system.

Proposed Change:

Use a 36 strand (or smaller) fiber optic cable for the Ethernet network.

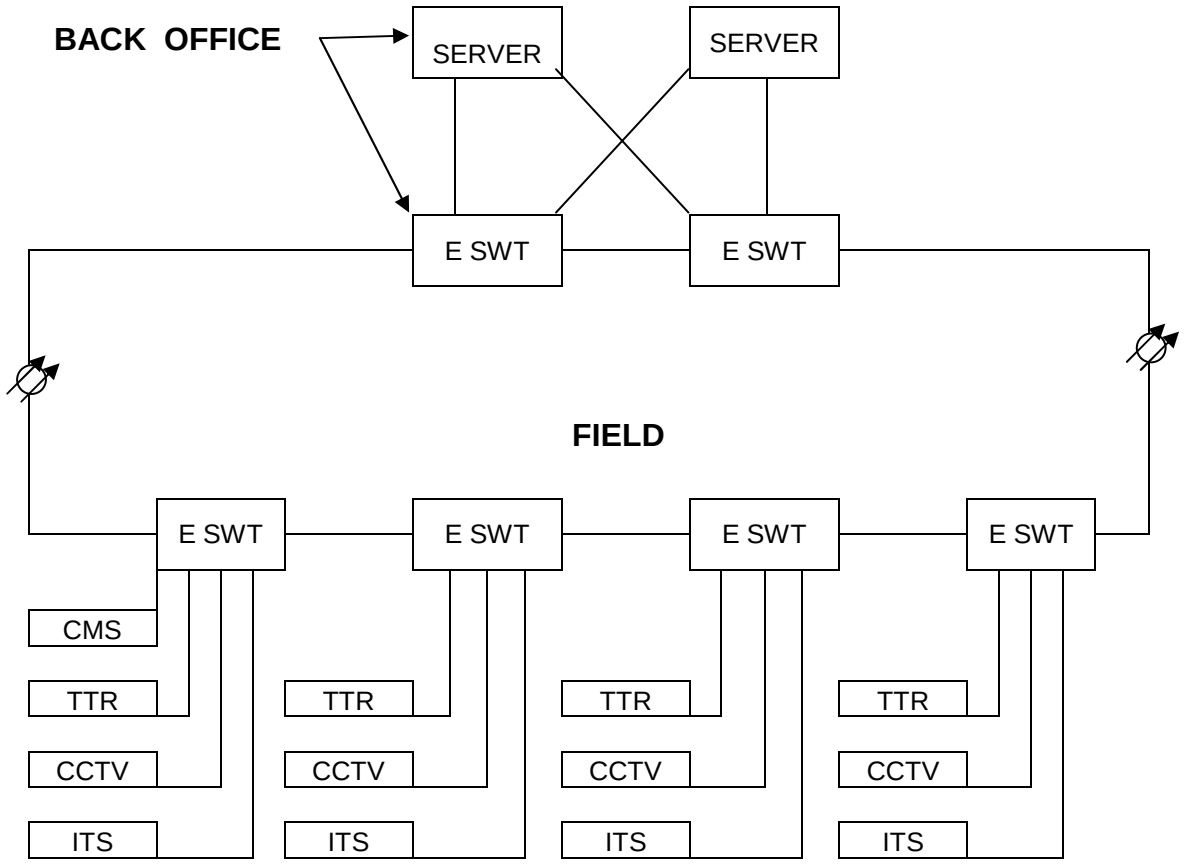
Justification:

The field Ethernet network requires only four fibers for Ring Network and drop cables to operate the HOT electronics. The 72 count fiber cable appears excessive unless additional equipment is planned to be installed that will use the excess capacity or the extra capacity is needed for some future use.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$268,000		
- Proposed	$179,000		
- Savings	$89,000		$89,000
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$89,000**

SKETCH

Project: I-85 HOV to HOT Conversion Project	Idea No.: D-4 Client: GDOT Sheet 2 of 3



NOTE: Can use wave division multiplexing (1310/1550 nm) to reduce fiber from 2 to 1.

COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project					Idea No.: D-4 Client: GDOT Sheet 3 of 3		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Current Design:							
72 Strand Fiber Optic Cable	LF	88,526	$2.75	$243,447			
VE Design:							
36 Strand Fiber Optic Cable	LF				88,526	$1.84	$162,887
SUBTOTAL				$243,447			$162,887
(10% E & C) **MARK-UP (10%)**				$24,345			$16,289
TOTAL				$267,792			$179,176
TOTAL ROUNDED				**$268,000**			**$179,000**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
D-10	1 of 2	Add necessary lighting for nighttime video license plate reader operation.

Comp By: BA Date: 9/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current plans do not include license plate illumination to support the automatic license plate readers.

Proposed Change:

Add illumination devices for the license plate readers to the plans and include their power load requirements into the power load budget for toll electronics power interconnect.

Justification:

License plate reader illumination required for 24/7 operations of the toll collection system.

Note: This idea results in a cost increase.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$0		
- Proposed	$75,000		
- Savings	($75,000)		($75,000)
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**($75,000)**

COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project					Idea No.: D-10 Client: GDOT Sheet 2 of 2		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Current Design:							
License Plate Reader Lights	EA	0	$0	$0			
VE Design:							
License Plate Reader Lights	EA				68	$1,000	$68,000
SUBTOTAL				$0			$68,000
(10% E & C) **MARK-UP (10%)**				$0			$6,800
TOTAL				$0			$74,800
TOTAL ROUNDED				**$0**			**$75,000**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
D-14	1 of 2	Add specific lightning and grounding protection to all applicable units.

Comp By: BA Date: 9/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current plans show the installation of a lightning rod on each gantry. GDOT Standard Plan detail (such as ATMS Plans – 28) indicates ground conductor connection to the ground rod. However, there are no details of the lightning and surge protection on the plans.

Proposed Change:

The plans must include lightning protection on all copper signal and power connections. Lightning protection must be installed if 10/100 Base T, CAT – 5/6 interconnect cabling is used from the electronic equipment mounted on the gantry. Include a ground from the traffic controller cabinet to other electronics installed on the gantry. All cabinets need to be grounded per NFPA-70/2008.

Justification:

All electronic equipment must be protected in accordance with the National Electric Code to prevent electronic equipment failure from lightning induced power and signal line surges.

Note: This idea results in a cost increase.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$0		
- Proposed	$70,000		
- Savings	($70,000)		($70,000)
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**($70,000)**

COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project					Idea No.: D-14 Client: GDOT Sheet 2 of 2		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Current Design:							
Lightning Surge Protectors	EA	0	$0	$0			
VE Design:							
Lightning Surge Protectors	EA				156	$400	$62,400
SUBTOTAL				$0			$62,400
(10% E & C) **MARK-UP (10%)**				$0			$6,240
TOTAL				$0			$68,640
TOTAL ROUNDED				**$0**			**$70,000**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
D-16	1 of 3	Construct a wireless communication network in-lieu-of hard wired communication network to support the HOT system.

Comp By: BA Date: 9/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current design proposes to interconnect all Ethernet switches with single mode fiber optic cable installed in conduit. This design requires the installation of the fiber optic cable conduit under the existing Interstate highway.

Proposed Change:

Interconnect the field Ethernet switches to IEEE 802.16 Wireless Transceivers to the collection/back head points.

NOTE: Cellular telephone companies are transitioning to IEEE 802.16 for Wideband G4 communications infrastructures.

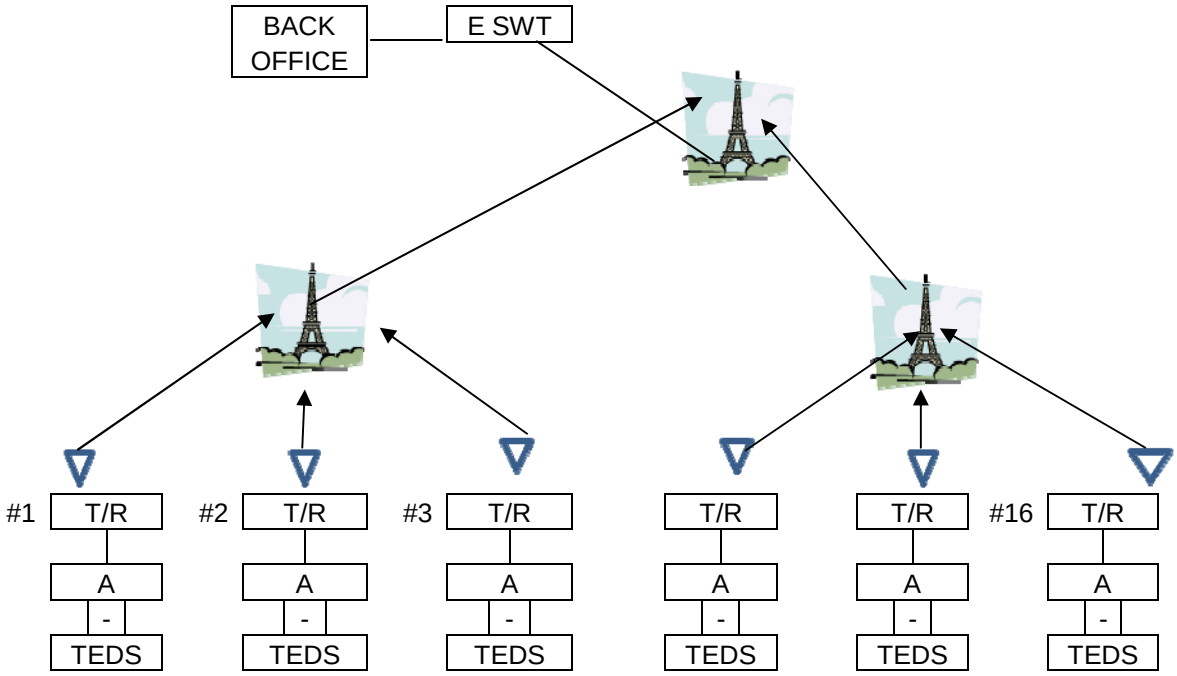
Justification:

The construction of a wireless field Ethernet system would save installation time and reduce the cost of the system. Continuing the use of the wireless concept on future HOT lane segments would result in addition time and cost savings.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$1,650,000		
- Proposed	$550,000		
- Savings	$1,100,000		$1,100,000
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$1,100,000**

SKETCH

Project: I-85 HOV to HOT Conversion Project	Idea No.: D-16 Client: GDOT Sheet 2 of 3



T/R	Wireless Transceiver
A	Type A Ethernet Switch
TEDS	Toll Electronic Devices Connected to Ethernet Switch
	Antenna (WIMAX)

NOTE: Exact wireless architecture must be developed based on terrain and existing structures for Back Haul Communications Network.

COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project					Idea No.: D-16 Client: GDOT Sheet 3 of 3		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Current Fiber Optic System:							
Conduit	LF	33,800	$11.25	$381,375			
Small Fiber	LF	88,526	$10.00	$885,260			
Small Fiber Drop	LF	8,645	$6.50	$56,193			
FO Closure	EA	52	$1,800	$93,600			
FO Closure	EA	5	$2,100	$10,500			
FO Splicing	EA	592	$54.14	$30,867			
FO Patch	EA	350	$1.09	$38,150			
VE Wireless System:							
Roadside Transceiver & Antenna	EA				32	$6,000	$192,000
Wireless Node Transceiver	EA				3	$50,000	$150,000
Node Mounting Structures	EA				3	$50,000	$150,000
SUBTOTAL				$1,495,945			$492,000
(10% E & C) **MARK-UP (10%)**				$149,595			$49,200
TOTAL				$1,645,540			$541,200
TOTAL ROUNDED				**$1,650,000**			**$550,000**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
F-1	1 of 4	Eliminate the word/line "HOT 3+ Free" from the changeable message sign.

Comp By: GO Date: 09/22/09 Checked By: KB Date: 09/28/09

Original Concept:

The current design for the main toll rate sign includes a line showing "HOT 3+ FREE" on the rate display signs.

Proposed Change:

Eliminate the "HOT 3+ FREE" line from the rate display sign.

Justification:

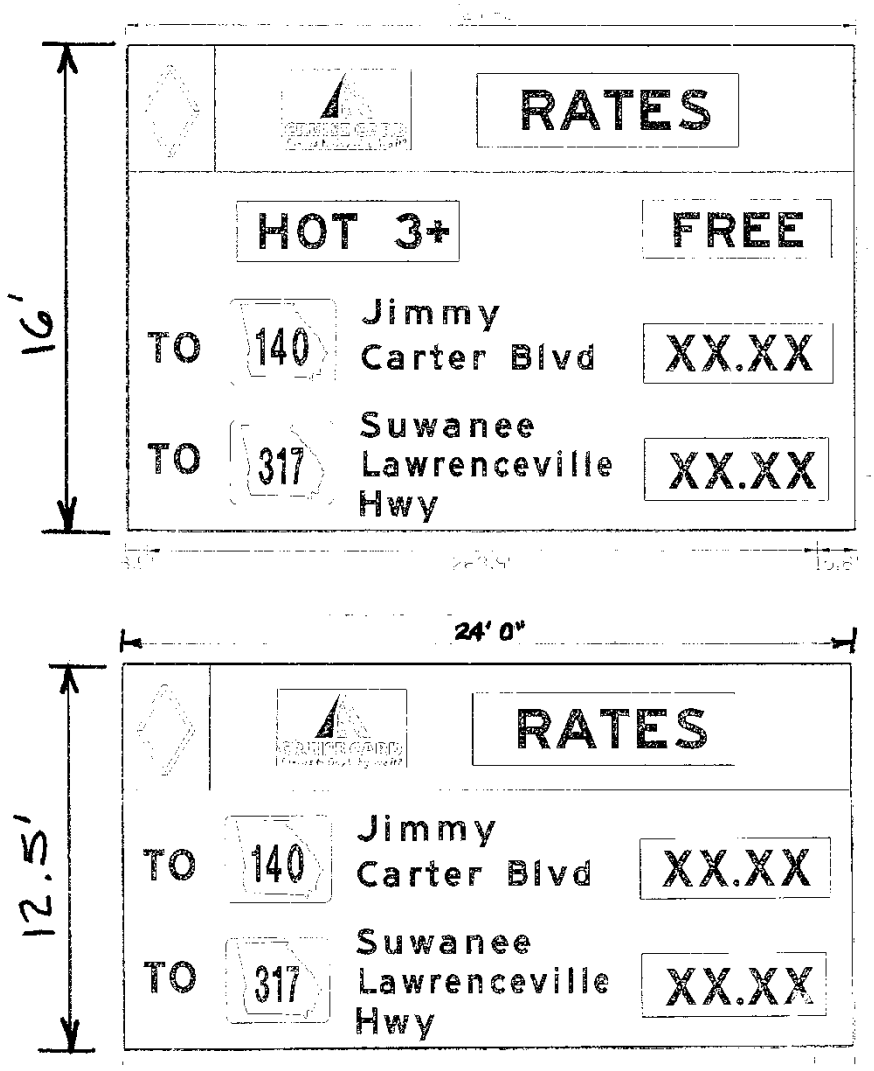
The current main toll sign is very busy and displays a lot of information. It shows the RATES and Cruise Card Logo, that HOT 3+ can ride for free, and the rates for usage to specified destinations. This is the primary sign to display rate information for managing the lane. It must be easy to read and understand so travelers can decide whether or not they want to use the HOT lane. Registered users will know that HOT 3+ users ride for free making this information unnecessary. Advance corridor signs will also identify who can use the HOT lane. Eliminating the "HOT 3+ FREE" line from this sign will make it less cluttered, save sign fabrication costs, and result in a smaller sign potentially saving footing costs.

The changeable toll sign needs to remain uncluttered since the traveler has to view, take in, and analyze the displayed information in order to make a decision on whether or not to use the HOT lane, all while travelling in traffic at high speeds. Eliminating the "HOT 3+ FREE" display will minimize information displayed and reduce sign clutter.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$25,000		
- Proposed	$0		
- Savings	$25,000		$25,000
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$25,000**

SKETCH

Project: I-85 HOV to HOT Conversion Project	Idea No.: F-1 Client: GDOT Sheet 2 of 4



COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project

Idea No.: F-1
Client: GDOT
Sheet 3 of 4

CONSTRUCTION ELEMENT		ORIGINAL ESTIMATE			NEW ESTIMATE		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Highway Signs Extruded Aluminum Panels	SF	840	$25.00	$21,000	0	$0	$0
SUBTOTAL				$21,000			$0
(10% E & C) **MARK-UP (10%)**				$2,100			$0
TOTAL				$23,100			$0
TOTAL ROUNDED				**$25,000**			**$0**

CALCULATIONS

Project: I-85 HOV to HOT Conversion Project	Idea No.: F-1 Client: GDOT Sheet 4 of 4

Reduction in the sign size

3.5 ft x 24 ft = 84 SF per sign

10 signs x 84 SF = 840 SF

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
F-2	1 of 5	Use electric changeable sign in-lieu-of the proposed reflective/electric sign.

Comp By: GO Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept: The current design calls for using specially fabricated signs to convey the rates to the motorists. They will include partial electronic displays for the specific rates charged to specific destinations.

Proposed Change: Use a full matrix all electric changeable message sign.

Justification: The current main toll sign is very busy and displays a lot of information. It shows the RATES and Cruise Card Logo, that HOT 3+ can ride for free, and the rates for usage to specified destinations. This is the primary sign to display rate information for managing the lane. It must be easy to read and understand so travelers can decide whether or not they want to use the HOT lane.

The toll rates are the only variable message displayed. Providing a complete variable message sign will show the same information and also provide the flexibility to display a different message and / or additional information. In addition to the rate display, it can also show time savings or trip times to specific destinations/exits. This could be an enticement for use and an additional tool for lane management, the primary function of the project. Due to the flexibility with a total variable message sign, it can also be used for special events, incident management, and other responsive or active considerations.

The changeable toll sign needs to remain uncluttered since the traveler has to view, take in, and analyze the displayed information in order to make a decision on whether or not to use the HOT lane, all while travelling in traffic at high speeds. The variable message sign allows GDOT / SRTA to adjust the message and minimize sign clutter, especially when combined with recommendation F-1, eliminating the free use designation for HOT 3+ users.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$950,000		
- Proposed	$1,100,000		
- Savings	($150,000)		($150,000)
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**($150,000)**

CONTINUATION

Project: I-85 HOV to HOT Conversion Project	Idea No.: F-2 Client: GDOT Sheet 2 of 5

A full changeable message sign will also provide more flexibility to change the displayed messages for current conditions.

The variable message signs comply with FHWA sponsored ITS National Architecture and Communications Protocol Standards. Signs have been tested and certified to meet National Standards. Full Matrix electronic signs do not need any new communications protocols for this application nor do they require any special manufacturing (i.e. they are standard, production products). Additionally, all back-up and replacement parts are readily available. Furthermore, they are adaptable to new requirements that may emerge from "lessons learned" through HOT lane operations.

The current signs will require special construction and possibly new sign protocols.

Note: This idea results in a cost increase.

SKETCH	
Project: I-85 HOV to HOT Conversion Project	Idea No.: F-2 Client: GDOT Sheet 3 of 5

COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project					Idea No.: F-2 Client: GDOT Sheet 4 of 5		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Current Design							
Extruded Aluminum Sign with changeable toll rate	EA	10	$85,000	$850,000			
VE Design Concept							
Full Matrix Changeable Electronic Sign	EA				10	$100,000	$1,000,000
SUBTOTAL				$850,000			$1,000,000
(10% E & C) **MARK-UP (10%)**				$85,000			$100,000
TOTAL				$935,000			$1,100,000
TOTAL ROUNDED				**$950,000**			**$1,100,000**

CALCULATIONS

Project: I-85 HOV to HOT Conversion Project	Idea No.: F-2 Client: GDOT Sheet 5 of 5

Estimated cost to install a full matrix changeable electronic sign.

Assume

sign cost of $80,000 each
Installation of $20,000 per sign

Total cost = $80,000 + $20,000 = $100,000 each

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA:
H-1	1 of 3	Use the proper size (ports/features) and number of Ethernet switches.

Comp By: BA Date: 9/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current design uses 32 Type A, 8 Type F(a), and 5 Type F6 3-layer switches. The 8 Type F(a) switches are very large $25,000 switches. There was no network architecture, diagrams, or analysis of the requirements/communication loading provided to review.

Proposed Change:

Reduce the size of the field Ethernet switches where possible.

Justification:

The typical ATMS field network uses hardened Layer 2 Ethernet switches that are typically priced at $4,200 installed. If the architecture uses corridor subnets that interface with a backbone network only F(6) switches are utilized.

The large Type F(a)Ethernet switches are usually only used in the ”back office.” The current plans did not indicate how the F(a) and F6 switches are being used.

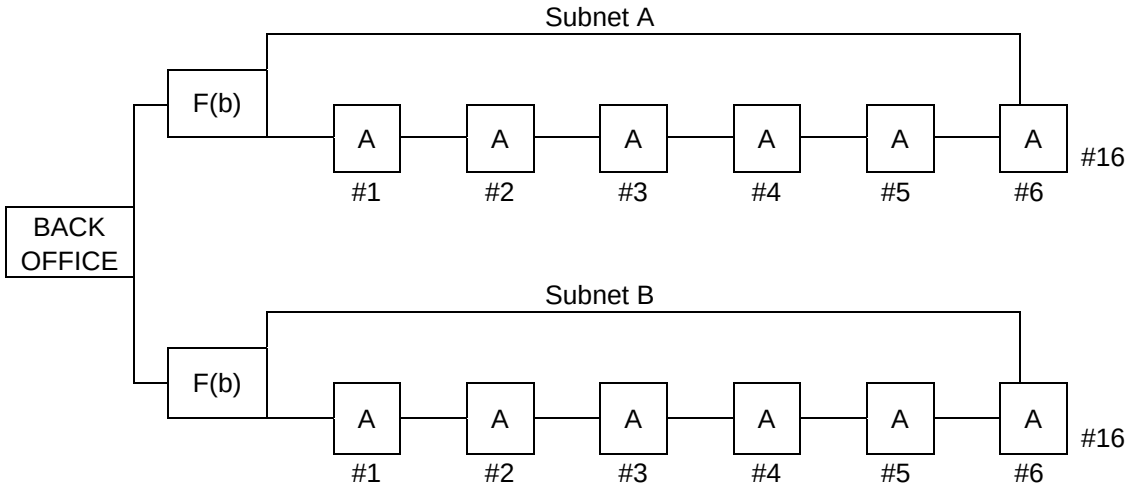
Tailor the size of the field Ethernet switches to meet the field network requirements. One switch is required at each location where toll collection electronics are deployed.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: - Original	$400,000		
- Proposed	$180,000		
- Savings	$220,000		$220,000
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**$220,000**

SKETCH

Project: I-85 HOV to HOT Conversion Project	Idea No.: H-1 Client: GDOT Sheet 2 of 3

Assumed Architecture Since None Provided



A	Type A Hardened Ethernet Roadside Switch (edge switch)
F(b)	Backbone Network Node Switch
	Configuration Limits OF 16 Switches per Subnet

COST WORKSHEET

Project: I-85 HOV to HOT Conversion Project					Idea No.: H-1 Client: GDOT Sheet 3 of 3		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Current Design:							
Network Switches Type A	EA	32	$4,200	$134,400			
Network Switches Type F(a)	EA	8	$25,000	$200,000			
Network Switches Type F(6)	EA	5	$5,800	$29,000			
VE Concept:							
Network Switches Type A	EA				32	$4,200	$134,400
Network Switches Type F(6)	EA				5	$5,800	$29,000
SUBTOTAL				$363,400			$163,000
(10% E & C) **MARK-UP (10%)**				$36,340			$16,300
TOTAL				$399,740			$179,300
TOTAL ROUNDED				**$400,000**			**$180,000**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA: Design Consideration**
B-1	1 of 1	Develop a footing design that will allow the contractor to complete its construction over one weekend.

Comp By: FN Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current plans do not include any footing design for the sign columns. It was assumed that a spread footing would be used for all sign footings.

Proposed Change:

Develop a footing design that will allow the construction contractor to complete its construction or cover it up and protect the site in a single weekend.

Justification:

All work in the median will have to be completed during nighttime and weekend lane closures. There are many locations where sign footings are to be placed in the median were the shoulder is less than four-feet wide. In these areas, the use of a spread footing will encroach into the HOT lane. This lane encroachment will make it extremely unlikely that all footing construction work can be completed in a single weekend.

If the footing is not completed, the site will have to be covered up and protected by some type of barrier system. In these very narrow shoulder areas the placement of barrier wall will certainly encroach into the HOT lane, especially if the footing already extends into the HOT lane. Any encroachment into the HOT lane would reduce the lane width and force the lane to be closed presenting an unacceptable situation.

LIFE CYCLE COST SUMMARY	**CAPITAL COST**	**FUTURE COST**	**TOTAL COST**
INITIAL COST: – Original	**Design Consideration**		
- Proposed			
- Savings			
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA: Design Consideration** Add signing to the HOT lanes and mainline roadway to advise motorists of the traffic merge areas at the various entrance/exit points.
C-8	1 of 1	

Comp By: GO Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current plans do not include any signing to caution motorists of upcoming merge areas at the nine entrance/exit points along the HOT lanes.

Proposed Change:

Add signing to the HOT lanes and mainline roadway to advise motorists of upcoming traffic merge areas at the various entrance/exit points.

Justification:

The current plans show nine HOT lane entrance/exit points along the system. These locations will experience dual merging from vehicles wanting to exit the HOV/HOT lanes and from vehicles wanting to enter the HOV/HOT lanes. These double merge areas present potential conflict areas that warrant additional signing to alert motorists to the merge situation.

These HOT merge areas are along/within two interior traffic lanes instead of the normal merging concept that occur from ramps along acceleration/deceleration lanes on the outside lane of the freeway.

LIFE CYCLE COST SUMMARY	**CAPITAL COST**	**FUTURE COST**	**TOTAL COST**
INITIAL COST: – Original	**Design Consideration**		
- Proposed			
- Savings			
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA: Design Consideration**
D-1	1 of 1	Fully coordinate the HOV to HOT lane design and construction contracts.

Comp By: BA Date: 9/23/09 Checked By: KB Date: 09/28/09

Original Concept:

GDOT is providing the civil and infrastructure work for the project while SRTA is providing the system tolling backbone and devices for the project. No information was available on the HOT Lane backbone system to review and determine its compatibility with GDOT's civil plans to construct the communication and power infrastructure for the system.

Proposed Change:

Obtain/verify the network data load analysis, interface standards, and power loading at each installation.

Justification:

Full coordination is required between GDOT and SRTA to assure adequate information is available to correctly develop the civil plans in order to assure total compatibility between the two contracts.

Communication and power system requirements being constructed by GDOT must support the HOT system electronic device interfaces, data needs and power loads to be installed by SRTA. The system must be integrated to minimize any interface issues or the required opening date could be in jeopardy.

LIFE CYCLE COST SUMMARY	**CAPITAL COST**	**FUTURE COST**	**TOTAL COST**
INITIAL COST: – Original	**Design Consideration**		
- Proposed			
- Savings			
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA: Design Consideration
D-5	1 of 1	Evaluate the existing GDOT fiber optic cable to see if it can be used in-lieu-of installing new conduit and cable.

Comp By: BA Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current project would install entirely new conduit and fiber optic cable for everything throughout the entire project.

Proposed Change:

The existing GDOT fiber optic cable (located in the northern portion of the project) should be evaluated to determine whether there are adequate existing spare fiber optic strands to accommodate the new HOT lane system.

Justification:

The HOT lane system could be installed using only two fiber optic strands and incorporating wave division multiplexing at 1310 and 1550 nm (which is standard and available from manufacturers of Ethernet interface).

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: – Original	**Design Consideration**		
- Proposed			
- Savings			
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA: Design Consideration**
D-6	1 of 1	Use compressed "IP" video to reduce the bandwidth requirements and simplify the communication network.

Comp By: BA Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

No information was provided on the toll license plate reader video or surveillance video.

Proposed Change:

Compressed video should be used for the HOT lane system if it is not already included in the current design. This system should include HD cameras with integrated video code and Ethernet interface.

Justification:

New toll facilities in other States are using HD video cameras and typically eight frames are captured and stored for electronic tolling and enforcement.

Using compressed video will reduce the band with needs of the supporting communications network. This concept will result in a cost savings.

LIFE CYCLE COST SUMMARY	**CAPITAL COST**	**FUTURE COST**	**TOTAL COST**
INITIAL COST: – Original	**Design Consideration**		
- Proposed			
- Savings			
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA: Design Consideration**
D-7	1 of 1	Use smaller controller cabinets that are better suited for the small size of the electronic equipment being housed.

Comp By: BA Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current design uses a standard large traffic controller cabinet to house a small Ethernet switch and its UPS backup.

Proposed Change:

Use a new smaller cabinet more suited to the size of the equipment being housed.

Justification:

The size of a hardened Ethernet switch for this type of field installation is generally less than 12" x 12" x 4." This type of Ethernet switch can also be backed-up by a small, inexpensive UPS much smaller than the one specified in the current design. Also the UPS specified in the design utilizes an automatic transfer switch and thus does not provide power surge protection available from other UPS architecture.

Installing a smaller controller cabinet more suited to the size of the equipment being housed would provide the same function and cost less. The smaller unit may also be able to be mounted on the gantry structure and eliminate the need for a separate concrete support pad.

LIFE CYCLE COST SUMMARY	**CAPITAL COST**	**FUTURE COST**	**TOTAL COST**
INITIAL COST: – Original	**Design Consideration**		
- Proposed			
- Savings			
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA: Design Consideration
D-9	1 of 1	Consolidate the electronic hardware into a single controller cabinet located on the outside shoulder of the roadway.

Comp By: BA Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current plans show a typical standard traffic controller cabinet on the outside shoulder to house the Ethernet switch and UPS unit. The plans also show a separate cabinet(s) to house the ATMS/Toll electronics attached to the gantry structure in the median.

Proposed Change:

Integrate all of the electronics into a single cabinet and locate it on the outside shoulder side of the roadway to facilitate maintenance without having to interrupt either HOT lane or mainline traffic. Calculate distribution cable voltage drop to assure proper sizing of the power distribution cable.

Justification:

This concept provides the same function and would reduce costs, simplify maintenance, and reduce interference with HOT lane or mainline traffic during maintenance.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: – Original	**Design Consideration**		
- Proposed			
- Savings			
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA: <u>Design Consideration</u>** Use the existing freeway lighting power cable conduit for the installation of the new fiber optic cable where possible.
D-12	1 of 1	

Comp By: BA Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current contract includes new conduit for fiber optic cable for the ATMS system.

Proposed Change:

Use freeway lighting power cable conduits to install the fiber optic cable for the ATMS system where existing conduits are available.

Justification:

The National Electric Code (NEPA 70/2008) allows dielectric fiber optic cable to be installed in conduits with electric power cables.

Installing fiber optic cable in power conduits when available/practicable would reduce cost and construction time since no new conduit(s) borings would have to be constructed.

LIFE CYCLE COST SUMMARY	**CAPITAL COST**	**FUTURE COST**	**TOTAL COST**
<u>INITIAL COST</u>: – Original	**Design Consideration**		
- Proposed			
- Savings			
<u>FUTURE COST</u>: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA: <u>Design Consideration</u>** Have a "human factors export" review the complex HOT signing system for readability and associated safety standpoint.
D-13	1 of 1	

Comp By: BA Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current signing for the HOT lane corridor is very complex.

Proposed Change:

Have a "human factors expert" review the complex HOT signing system for readability and associated safety issues.

Justification:

Signing for the HOT lanes is very complex. Many sign are very large and contain detailed information about numerous items. The very large changeable toll message signs contain information on who can use the HOT lanes, a listing of different destinations, and the changeable tolls to each destination.

All of the information presented on the signs along the HOT corridor present a visual and comprehensive challenge to motorists. In other states under similar applications, this item has been the center of law suits associated with large, complex signs on road infrastructure. A human factors expert with experience evaluating transportation related signage should be utilized to insure the HOT lane signing can be understood by the motorists within an acceptable time frame that does not cause the motorists to divert attention from driving his/her vehicle.

LIFE CYCLE COST SUMMARY	**CAPITAL COST**	**FUTURE COST**	**TOTAL COST**
<u>INITIAL COST</u>: – Original	**Design Consideration**		
- Proposed			
- Savings			
<u>FUTURE COST</u>: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA: Design Consideration**
D-17	1 of 1	Raise electronic cabinets high enough to prevent flooding of the units.

Comp By: BA Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

The current plans do not have any notes describing the height at which the electronic cabinet mounting pads need to be placed in order to protect the cabinets from flooding.

Proposed Change:

Raise the height of all cabinets to at least the height of the roadway. Review/evaluate the flood potential especially around the SR-316 Interchange area and specify cabinet mounting heights sufficient to keep them above any potential flood elevations.

Justification:

Flooding would damage all of the electronic equipment in the cabinets and shut down the managed HOT lanes. Raising the heights of the cabinets to protect them against flooding is prudent design. The potential for loss of electronic equipment to flooding is approximately $365,000 if left unprotected plus the damage to terminal blocks, surge protectors, and any other electronic devices in the cabinets.

LIFE CYCLE COST SUMMARY	**CAPITAL COST**	**FUTURE COST**	**TOTAL COST**
INITIAL COST: – Original	**Design Consideration**		
- Proposed			
- Savings			
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: I-85 HOV to HOT Conversion Project

IDEA No.:	Sheet No.:	CREATIVE IDEA: Design Consideration
I-5	1 of 1	Identify the power load requirements at every location and include this information on the GDOT civil plans.

Comp By: BA Date: 09/23/09 Checked By: KB Date: 09/28/09

Original Concept:

This GDOT civil project will install the communication and power infrastructure for the managed HOT lane system. The plans do not include the power load requirements for any electronic equipment to be installed.

Proposed Change:

Identify and note on the plans all of the power load requirements for each electronic installation throughout the corridor. Specify power cable type and conductor size based on an analysis.

Additionally, voltage drop analysis should be conducted on electrical cable size being utilized to assure that interconnected power to electronic devices meets the manufacturer's requirements. The analysis should also consider expected voltage sags associated with utility power and impact on power connected to the electronic devices.

Justification:

The power load requirements must be identified at each electronic installation to properly design the power and additional capacity needs for that system in compliance with the National Electric Code.

LIFE CYCLE COST SUMMARY	CAPITAL COST	FUTURE COST	TOTAL COST
INITIAL COST: – Original	**Design Consideration**		
- Proposed			
- Savings			
FUTURE COST: – Savings			
TOTAL PRESENT WORTH SAVINGS			**Design Consideration**

APPENDIX

Sources

Approving/Authorizing Persons

Name:	Position:	Telephone:
Ron Wishon	Project Review Engineer	404-631-1753
Ben Rabun	Executive Assistant to the Chief Engineer – Project Manager	404-631-1008

Personal Contacts

Name:	Telephone:	Notes:
Jeff Van Dyke	404-478-3950	Project Briefing
Jeff Van Dyke	404-478-3950	Discuss ability to get HOT network backbone information
Ben Rabun	404-631-1008	Availability of network backbone information. General information on Integrator contract

Documents/Abstracts

Reference:	Reference:
Preliminary Plans	Draft Project Concept Report
Preliminary Cost Estimate for GDOT contract	GDOT Average Bid Price List
Project Layout Sheets	GDOT Design Manual
Draft Preliminary Field Inspection Report	GDOT Standard Specifications
PowerPoint File of VE Study Briefing	PowerPoint Presentation of HOT Concept
White Paper on Managed Lane	

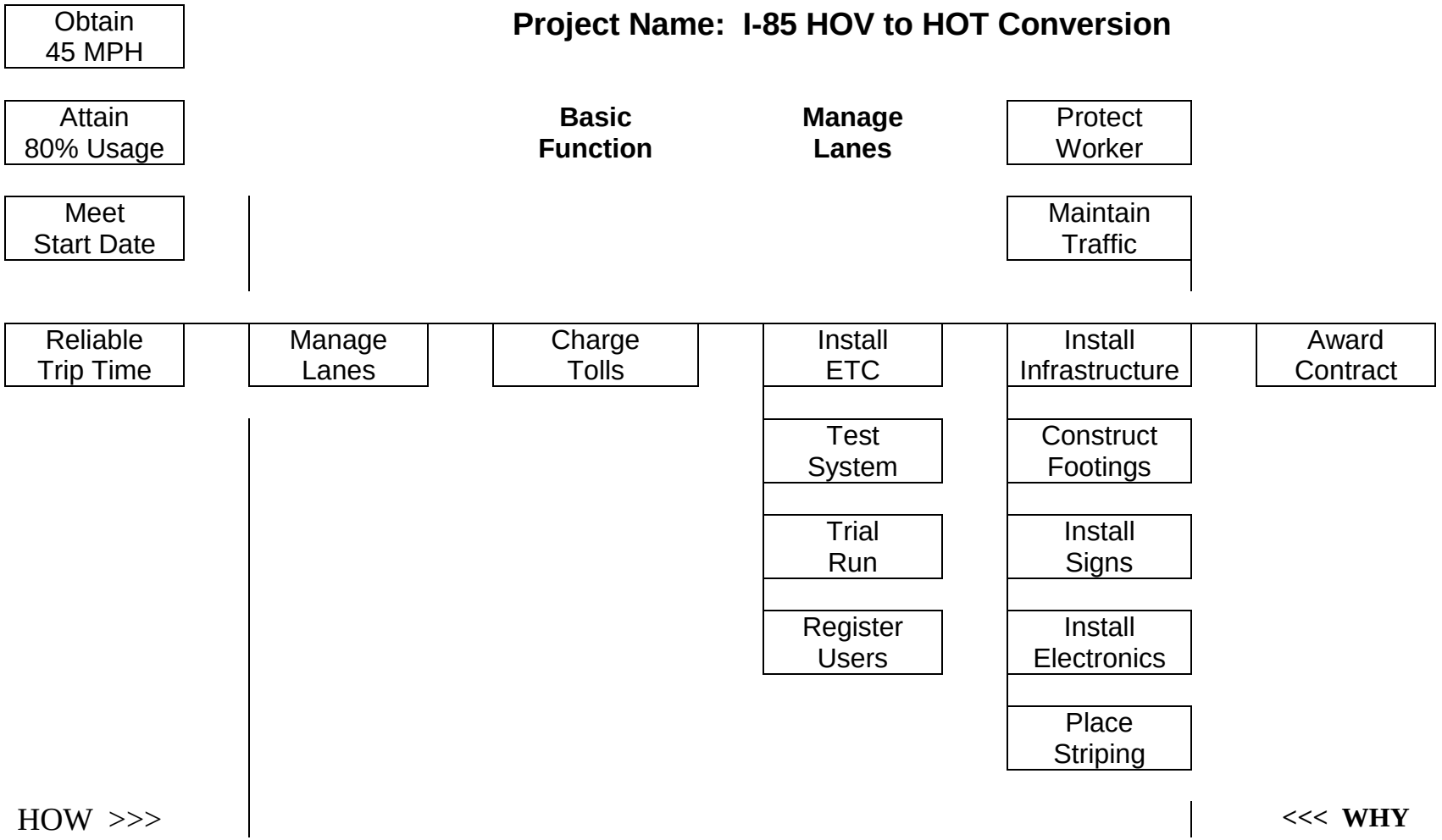
I-85 HOV to HOT Conversion

Cost Model / Distribution

Item	Description	$ Amount	% of Total Project
A	Asphalt Concrete & Base	$7,251,000	33.5%
B	Traffic Control	$5,100,000	23.5%
C	Signing	$3,125,000	14.4%
D	Advance Traffic Management System (ATMS)	$3,022,000	13.9%
E	Mill Asphalt Concrete Pavement	$1,144,000	5.3%
F	Permanent Message Signs	$850,000	3.9%
G	Pavement Markings	$655,000	3.0%
H	Network Switches	$363,000	1.7%
I	UPS Backup Hub	$160,000	0.1%
J	Footings	N/A	
K	Utilities	N/A	
L	Borings	N/A	
	Subtotal:	**$21,670,000**	
	10% E & C	$2,167,000	
	Total:	**$23,837,000**	
Note: The 10% Engineering & Contingency item will be used as the Mark-Up percentage in the Recommendation Cost Worksheets.			

FAST DIAGRAM

Project Name: I-85 HOV to HOT Conversion



INFORMATION PHASE – FUNCTION ANALYSIS

Project: I-85 HOV to HOT Conversion
Function: Manage Lanes

ITEM No.	DESCRIPTION	FUNCTION		INITIAL DOLLARS		
		Verb	Noun	Cost	% of Total	Worth/Save
A	Asphalt Concrete & Base	Resurface	Roadway	$7,251,000	33.5%	Yes
		Cover	Footings			
		Cover	Striping			
B	Traffic Control	Build	Project	$5,100,000	23.5%	Yes
		Protect	Workers			
		Manage	Traffic			
		Stage	Construction			
C	Signing	Inform	Motorists	$3,125,000	14.4%	Yes
		Identify	Lanes			
		Restrict	Lanes			
		Identify	Entrance/Exits			
D	Advance Traffic Management System	Collect	Tolls	$3,022,000		Yes
	(ATMS)	Manage	Traffic			
		Gather	Data			
		Disperse	Data			

INFORMATION PHASE – FUNCTION ANALYSIS

Project: I-85 HOV to HOT Conversion
Function: Manage Lanes

ITEM No.	DESCRIPTION	FUNCTION		INITIAL DOLLARS		
		Verb	Noun	Cost	% of Total	Worth/Save
	ATMS (Continued)	Spot	Vehicle			
		Communicate	Message			
		Illuminate	License Plate			
E	Mill Asphalt	Remove	Striping	$1,144,000	5.3%	Yes
F	Changeable Message Signs	Advise	Motorists	$850,000	3.9%	Yes
		Charge	Fee			
		Manage	Lane			
		Maintain	45 MPH			
G	Pavement Markings	Identify	Lane	$655,000	3.0%	Yes
		Control	Entrance/Exit			
		Require	Milling			
		Separate	Traffic			
H	Network Switches	Combine	Information	$363,000		Yes
		Route	Information			

INFORMATION PHASE – FUNCTION ANALYSIS

Project: I-85 HOV to HOT Conversion
Function: Manage Lanes

ITEM No.	DESCRIPTION	FUNCTION		INITIAL DOLLARS		
		Verb	Noun	Cost	% of Total	Worth/Save
I	UPS Backup Hubs	Maintain	System	$160,000		Yes
		Provide	Power			
		Eliminate	Outage			
J	Footings	Support	Structures	N/A	N/A	Yes
		Support	Signs			
K	Utilities	Maintain	Service	N/A	N/A	Yes
		Drain	Pavement			
L	Borings	Gather	Data	N/A	N/A	Yes
		Provide	Information			
M	Toll Integrator	Install	Readers	N/A	N/A	Yes
		Install	Cameras			
		Construct	Ops Center			
		Test	System			
		Provide	Software			

CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
A	**Asphalt Concrete & Base**		
A-1	Eliminate full lane milling/resurfacing and re-stripe the pavement using “black” and “white” thermoplastic markings.	Reduce cost, reduce construction time, eliminate unnecessary item from contract	✓
A-2	Mill and resurface only the 3-foot wide area containing the current striping. (entire length of the project)	Reduce cost, reduce construction time, minimize unnecessary item from contract	X
A-3	Eliminate the milling and simply place new surface course over the existing pavement.	Provides uneven surface between mainline and shoulder, safety issues for motorcyclists	X
A-4	Mill and resurface only the 3-foot wide area containing the existing striping in the entrance/exit areas.	Reduce cost, reduce construction time, minimize unnecessary item from contract	✓
A-5	Eliminate the overlay and paint over the solid stripes with black paint.	See Idea A-1	X
A-6	Place a thin overlay over the 3-foot area containing the current striping and restripe.	Provides uneven surface between mainline and shoulder, safety issues for motorcyclists	X
B	**Traffic Control**		
B-1	Modify the footing design in the narrow shoulder areas to allow the contractor to finish all work in one weekend.	Meet tight construction schedule, improve safety, reduce impact to HOT lanes	✓
✓ = Will be considered further; X = will be dropped; DS = Design Consideration –written for consideration by design team			

CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
B-2	Close the HOV lanes for a short time and require the contractor to complete all footing work by working 24/7. Add an Incentive/Disincentive clause for this work phase.	Improve constructability of the footings, reduce overall construction time, High road user impact	X
B-3	Allow daytime "right shoulder" closures to perform necessary electrical work.	Reduce construction time	✓
C	**Signing**		
C-1	Optimize the use of new & existing sign trusses.	Reduce cost	DS
C-2	Use Type II or V, Cantaliver signs in-lieu-of sign trusses where possible.	Reduce cost	✓
C-3	Use Type II or V, Cantaliver sign in-lieu-of Type I sign trusses for the main toll signs	Reduce cost	✓
C-4	Add NB advance advisory signs to the signing plans (sheet 26-01).	Correct / complete plans	DS
C-5	Add NB sign advising HOV-2 Motorists to exit lane before HOT lane unless a registered HOT lane user.	Provide needed information to the motorists, reduce possible confusion at the start of HOT	X
C-6	Eliminate the word "FREE" from the changeable message sign.	See Idea F-1	X
C-7	Check signing location and readability to the motorists.	Improve / simplify understanding by users	DS
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CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
C-8	Add signs to HOT &general purpose lanes to advise motorists of merges at entrance/exit points.	Improve safety in merge areas	DS
C-9	Reduce Span lengths of sign trusses	Reduce cost, Possible impact on clear zone	X
D	**ATMS**		
D-1	Coordinate the design/construction between the GDOT and SRTA work.	Assure construction deadline is met.	DS
D-2	Eliminate the toll tags and use only video to identify vehicles.	Reduce cost, follow generally accepted vehicle identification process used in other toll lane facilities	✓
D-3	Assure the communication infrastructure is compatible and not excessive for the proposed hardware being used on the project.	Assure project is not overdesigned	DS
D-4	Reduce the size of the fiber optic cable from 72 strands to 36 strands or less.	Reduce cost, reduce over design of cable	✓
D-5	Verify whether or not the existing GDOT fiber optic cable could be used to operate the new toll system.	Reduce cost, reduce construction time	DS
D-6	Require the use of compressed video for the HOT system.	Improve system operation, current standard	DS
D-7	Assure that the signal control cabinets are the correct size to accommodate any / all likely systems.		DS
✓ = Will be considered further; X = will be dropped; DS = Design Consideration –written for consideration by design team			

CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
D-8	Reduce the size of the signal controller cabinet to only what is needed to hold the Ethernet switch.	Combine with Idea D-9	X
D-9	Consolidate the three cabinets (1 GDOT this contract, 2 SRTA second contract) into a single cabinet on the outside shoulder	Reduce cost, properly size system, improve maintainability	DS
D-10	Add Lighting for the video license plate reader.	Required for nighttime operation	✓
D-11	Eliminate the manhole under the butterfly sign base and direct connect to the equipment.	Reduce cost, not required to wire cabinet	DS
D-12	Use existing power conduit to run new dielectric fiber cable.	Reduce cost, accelerate construction	DS
D-13	The signing system is very complex and will distract drivers causing a safety problem.	Safety concerns for motorists	X
D-14	Add lightning protection to all applicable units.	Required for system protection	✓
D-15	Use License Plate reader and open lane to everyone and send bill to non-registered drivers for cost plus surcharge	Expand the use of the system to all motorists, maximize use of the HOT lanes, see D-2	✓
D-16	Construct wireless system in-lieu-of wired system	Reduce cost and construction time	✓
D-17	Raise cabinets above roadway to avoid flooding.	Improve reliability	DS
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CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
E	**Mill Asphalt**		
E-1	Eliminate milling	See Ideas A1, A-2, & A-4	✓
F	**Changeable Message Signing**		
F-1	Eliminate the word "FREE" from the changeable message sign. (make sign more understandable)	Simplify overall message on sign, reduce cost	✓
F-2	Use full electric sign in-lieu-of reflective / electric sign.	Provide more information to motorists	✓
G	**Pavement Markings**		
G-1	Use "black" thermoplastic markings to cover existing solid white lines to get dashed white lines.	See Idea A-1	X
G-2	Use "black" thermoplastic markings to cover existing dashed white lines and restripe to get solid white lines.	See Idea A-1	X
G-3	Change the diamond high occupant symbol painted in the lanes to HOT 3+ for additional clarification.	Provide better lane information to motorist, differentiate from HOV-2 lanes	X
G-4	Use one standard size lane stripe width (8" or 5") over the entire project.	Maintain uniformity throughout the project	X
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CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
H	**Network Switches**		
H-1	Use the proper size of the unit needed by number & type of ports and proper bandwidth.	Reduce cost, properly size system	✓
H-2	Verify the need for the large number of Layer 3 switches ($25,000 cost)	Combine with Idea H-1	X
I	**UPS Backup Units**		
I-1	Eliminate the UPS backup system	Reduce toll collection, reduce reliability	X
I-2	Revise the size of the UPS backup systems to properly size the unit for the power needed in the field. (only providing backup for Ethernet switch)	Reduce cost, properly size system	DS
I-3	Provide only half the backup units since it is unlikely the entire system will go down.	Reduce toll collection, reduce reliability	X
I-4	Revise the size of the controller cabinet to store only what is needed (Ethernet switch).	See Idea I-2	X
I-5	Provide power information in the plans	Needed to build project	DS
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CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
J	**Footings**		
J-1	Modify to reduce time need to construct.	See Idea B-1	X
J-2	Identify/modify type to be used in areas of narrow shoulders.	See Idea B-1	X
K	**Utilities**		
K-1	Evaluate whether the existing lighting system can be used to provide power.	Reduce cost and construction time	X
K-2	Assure the footing design is compatible with all the adjacent utilities.	See Idea K-3	X
K-3	Identify all utilities and drainage in the areas of each footing to expedite construction.	Reduce construction time	DS
K-4	Identify the various utility costs in the estimate	Update cost estimate to include all items	DS
L	**Borings**		
L-1	Provide the contractor with boring information at each footing to expedite construction.	Accelerate footing design time, reduce overall construction time	DS
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VE STUDY SIGN-IN SHEET

Project No.: CSMSL-0009-00(295)(296)(297) County: Dekalb/Gwinnett PI No.: 0009295,0009296,0009297 Date: 9/21/09 - 9/24/09

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	~~Matt Sanders~~		~~Engineering Services~~	~~404-631-1752~~	~~msanders@dot.ga.gov~~
	James K. Magnus		Construction	404-631-1971	jmagnus@dot.ga.gov
	Ken Werho		Traffic Operations	404-635-8144	kwerho@dot.ga.gov
	Ron Wishon		Engineering Services	404-631-1753	rwishon@dot.ga.gov
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✓	STEVEN SHEFFIELD		SRTA - DID NOT ATTEND	(CONTACT ONLY)	
	BILL BEAUSOLEIL		MSI	937-603-3705	

✓ = Attended both days (Project Overview & Presentation) ____ Attended Project Overview ____ Attended Project Presentation