

Mobility Alternative Finance Study

Analysis of Managed Lane Alternatives to Phase 2 Plan

Study Status Update

Presentation to Steering Committee
October 18, 2006



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Who is CRA?

- **Charles River Associates was founded in 1965 as a transportation economics consulting firm**
- **CRA International has grown into a global finance and business consulting firm with economic analysis as its core strength**
- **Over 20 offices in North America, Europe, Middle East and Asia-Pacific**
- **Analysis of transportation issues and projects has been a core strength of the firm since its founding**
- **We have completed over 500 engagements in the transportation sector**
- **We are recognized for our objectivity and technical analysis**
- **We have no connection to firms that finance, build or operate toll roads**
- **We have no stake in the decisions taken here about toll roads**
- **In studies such as this, our goal is to move the public debate beyond disagreements over facts and towards informed discussion of issues**



Examination of managed lane alternatives

MAFS Task 4.4 asks about alternative financing and traffic management models to build Phase 2 roadways

- **It specifically mentions three alternative concepts**
 - A mixture of non-tolled lanes and managed lanes
 - A mixture of non-tolled lanes and managed lanes with congestion pricing
 - A mixture of non-tolled lanes and high occupancy toll (HOT) lanes
- **We will refer to all of these as *managed lane* concepts**
- **Managed lanes = a generic term that refers to a situation where specific lanes on a roadway are restricted for use by certain vehicles and actively managed, generally by tolling; the other lanes are general purpose**
- **We were asked to give high priority to the analysis of these concepts, and to report our results in this meeting**
- **We discussed with members of the MAFS Steering Committee, the Technical Advisory Committee, CAMPO and CTRMA the most appropriate definition of these concepts and analysis approach**
 - These were agreed approximately one month ago
- **Our analysis compares each of these managed lane concepts with the fully tolled (Phase 2 Toll Plan) and the non-tolled alternatives**

Definition of managed lane concepts to be analyzed

- **Express Lanes consist of a mixture of non-tolled and managed lanes**
 - Here we have taken managed lanes to mean lanes that can be used by any vehicle that pays a toll
 - The toll is fixed and does not vary by time of day or other factor
- **Express Lanes CP consists of a mixture of non-tolled lanes and managed lanes with congestion pricing**
 - Congestion pricing refers to a situation where a vehicle pays higher charges at higher levels of congestion
 - Different forms of congestion pricing have been proposed and implemented
 - Here we have taken it to mean time-of-day pricing:
 - Toll rates differ between the peak and off-peak periods
 - Toll rates are fixed within each period
 - Toll rates apply uniformly on a project but may vary between projects
- **HOT Lanes consists of a mixture of non-tolled lanes and high-occupancy toll lanes**
 - HOT lanes are lanes that can be used without charge by high-occupancy vehicles (HOVs): any passenger vehicle with 2 or more occupants
 - Single-occupant vehicles (SOVs) can use HOT lanes if a toll is paid

Application of managed lane concepts

- **In this analysis, we assume that each managed lane concept applies uniformly across the entire set of Phase 2 roads**
 - All Phase 2 roadways are implemented together as either Express Lanes, Express Lanes CP or HOT Lanes concepts
 - No mixing of different concepts within or across different roads
- **In each concept, we assume that each roadway's cross-section is the same as was proposed in the Phase 2 Toll Plan**
 - Limited access main lanes (total 2, 3 or 4 lanes)
 - Main lanes consist of one managed lane with the remainder non-tolled
 - Parallel frontage roads provide access to local activities as well as short- or medium-distance mobility
- **We assume that the length and coverage of each managed lane project is the same as the corresponding Phase 2 toll project**
- **The toll rates used in this analysis are applied uniformly within projects and are distance-based. In current dollars, the analyzed rates are:**
 - Phase 2 Toll Plan: 12¢ / mile
 - Express Lanes: 12¢ / mile
 - Express Lanes CP: 10 - 24¢ / mile for peak periods; 2¢ / mile for off-peak
 - HOT Lanes: 10 - 33¢ / mile for peak periods; 4¢ / mile for off-peak



Focus of the analysis

- **In general, the two main purposes of any toll project are to produce revenue and to influence traffic conditions**
 - Different systems emphasize each objective to different degrees
- **Accordingly, our analysis has focused on the impacts of the managed lane concepts in terms of**
 - Traffic impacts, measured in a variety of different ways
 - Revenue generation
- **At the level of detail of this analysis, the differences in construction, maintenance and operating costs between the different managed lane concepts and with the Phase 2 toll plan are not significant**
 - Each project's cost can be considered to be the same as the Phase 2 toll project
- **Quantitative investigation of the traffic and revenue impacts of the managed lanes concepts requires application of a travel forecasting model**

Analysis approach

- **Our analysis was based on the CAMPO travel demand forecasting model**
 - CAMPO made its travel forecasting model available to us
 - We thank the CAMPO directors and modeling team for the considerable assistance that they provided in this effort
- **The CAMPO travel forecasting model, like almost all metropolitan travel forecasting models, was not originally designed to analyze managed lanes**
- **We made a number of adaptations to the CAMPO model in order to improve its applicability to managed lanes**
- **In brief, the adapted model predicts the amount of SOV and HOV traffic flowing on different available (non-tolled and tolled) paths**
 - Based on the “generalized cost” (travel time and toll payment) of each path
 - Taking account of the effects of congestion on path travel times
- **We believe that the adapted model is a suitable tool for comparing tolling and managed lane concepts in relative terms and on an equitable basis**
- **However, because of differences in approach and detail, its outputs are not strictly comparable to those of other models applied in the Capital District**

Impacts determined for each concept

- **Total regional (Capital District) network performance**
 - Vehicle-miles traveled (VMT)
 - Vehicle-hours traveled (VHT)
- **Average AM and PM peak speeds by project**
- **Travel times for representative trips in the Capital District**
- **Average traffic volumes by project, relative to volumes on the Phase 2 toll project**
- **Revenues by project, relative to revenues generated by the Phase 2 toll project**

Study Results

Results: CAMPO Regional-Level Performance

Percentage VMT and VHT change relative to Phase 2 Toll Plan

	VMT	VHT
Express Lanes	-0.04%	-1.23%
Express Lanes CP	-0.02%	-1.32%
HOT Lanes	0.00%	-1.19%
Phase 2 Roads w/ No Tolls	0.03%	-1.59%

- All managed lane concepts reduce VHT relative to the Phase 2 Toll Plan
- There is little difference in the regional level of miles traveled between the Phase 2 Toll Plan and each of the managed lane concepts



Note: VMT = Vehicle-Miles Traveled; VHT = Vehicle-Hours Traveled

Results: Project-Level Speeds

SH 45 Southwest: Average Speeds for Tolled & Non-Tolled Lanes

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	45	NA	42	NA
Express Lanes	47	35	43	33
Express Lanes CP	47	35	44	32
HOT Lanes	46	36	44	31
Phase 2 Roads w/ No Tolls	NA	42	NA	36

- **The managed lane concepts have minimally faster average speeds than the Phase 2 Toll Plan**
- **In all concepts, the managed lanes have average travel speeds 10+ mph faster than the non-tolled lanes**



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Notes: Average speeds represent volume-weighted average speed computed as VMT divided by VHT for each project-lane combination

Results: Project-Level Speeds

SH 71 East: Average Speeds for Tolled & Non-Tolled Lanes

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	39	NA	33	NA
Express Lanes	40	30	36	26
Express Lanes CP	40	31	36	25
HOT Lanes	40	31	38	25
Phase 2 Roads w/ No Tolls	NA	34	NA	27

- In the AM, the managed lane concepts have minimally faster average speeds than the Phase 2 Toll Plan
- In the PM, the managed lane concepts provide faster speeds than the Phase 2 Toll Plan, particularly the HOT lanes
- In all concepts, the managed lanes have average travel speeds ~10 mph faster than the non-tolled lanes



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Notes: Average speeds represent volume-weighted average speed computed as VMT divided by VHT for each project-lane combination

Results: Project-Level Speeds

SH 71 West: Average Speeds for Tolled & Non-Tolled Lanes

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	44	NA	44	NA
Express Lanes	45	33	44	31
Express Lanes CP	45	33	44	33
HOT Lanes	44	35	44	32
Phase 2 Roads w/ No Tolls	NA	44	NA	44

- **The Express Lane concepts provide average speeds minimally faster or the same as those for the Phase 2 Toll Plan; the HOT Lane concept provides the same average speeds as the Phase 2 Toll Plan**
- **In all concepts, the managed lanes have average travel speeds ~10 mph faster than the non-tolled lanes**



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Notes: Average speeds represent volume-weighted average speed computed as VMT divided by VHT for each project-lane combination

Results: Project-Level Speeds

US 290 West: Average Speeds for Tolled & Non-Tolled Lanes

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	38	NA	38	NA
Express Lanes	28	29	28	27
Express Lanes CP	28	29	27	26
HOT Lanes	30	28	29	26
Phase 2 Roads w/ No Tolls	NA	31	NA	28

- **The Phase 2 Toll Plan provides the fastest average speeds**
- **Both Express Lane concepts have a slightly slower AM average speed than the non-tolled lanes**
 - **Primarily an artifact of the average speed computation, but highlights some congestion**



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Notes: Average speeds represent volume-weighted average speed computed as VMT divided by VHT for each project-lane combination

Results: Project-Level Speeds

US 183 South: Average Speeds for Tolled & Non-Tolled Lanes

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	41	NA	37	NA
Express Lanes	40	32	35	28
Express Lanes CP	39	32	35	27
HOT Lanes	39	32	36	27
Phase 2 Roads w/ No Tolls	NA	34	NA	29

- **The Phase 2 Toll Plan provides average speeds 1-2 mph faster than the managed lane concepts**
- **In all concepts, the managed lanes have average travel speeds ~8 mph faster than the non-tolled lanes**



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Notes: Average speeds represent volume-weighted average speed computed as VMT divided by VHT for each project-lane combination

Results: Project-Level Speeds

US 290 East: Average Speeds for Tolled & Non-Tolled Lanes

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	36	NA	33	NA
Express Lanes	32	30	28	28
Express Lanes CP	33	30	28	28
HOT Lanes	36	30	31	28
Phase 2 Roads w/ No Tolls	NA	31	NA	29

- **The Phase 2 Toll Plan provides the fastest average speeds**
- **The average speed premiums of managed lanes relative to the non-tolled lanes are lower than for other projects, and disappear for some concepts in the PM peak**



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Notes: Average speeds represent volume-weighted average speed computed as VMT divided by VHT for each project-lane combination

Results: Project-Level Speeds

Loop 360: Average Speeds for Tolled & Non-Tolled Lanes

	AM Peak		PM Peak	
	Tolled	Non-Tolled	Tolled	Non-Tolled
Phase 2 Plan	31	NA	21	NA
Express Lanes	30	24	20	17
Express Lanes CP	32	23	22	17
HOT Lanes	34	22	25	16
Phase 2 Roads w/ No Tolls	NA	25	NA	18

- **Express Lanes CP and HOT Lanes have minimally faster average speeds than the Phase 2 Toll Plan**
 - Both of these concepts use a form of variable pricing
- **The average speed premiums of managed lanes relative to the non-tolled lanes vary from 3 – 12 mph**



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Notes: Average speeds represent volume-weighted average speed computed as VMT divided by VHT for each project-lane combination

Results: Representative Travel Times

Year 2030 travel times in minutes from Oak Hill to City Hall

	Tolled Path	Non-Tolled Path
Phase 2 Plan	28	34
Express Lanes	27	29
Express Lanes CP	27	29
HOT Lanes	26	27

- **The next set of results compares AM peak end-to-end travel times for representative trips under the toll and managed lane concepts**
 - Tolled path = uses a toll road or managed lane for part of trip
 - Non-tolled path = does not use a tolled facility at all
 - The non-tolled path may use completely different roads than the tolled one
- **For this representative trip, all managed lane concepts offer shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**

Results: Representative Travel Times

Year 2030 travel times in minutes from Shady Hollow to City Hall

	Tolled Path	Non-Tolled Path
Phase 2 Plan	31	35
Express Lanes	31	33
Express Lanes CP	31	33
HOT Lanes	29	32

- **The HOT Lane concept offers shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**
- **The other concepts offer shorter travel times for only the non-tolled option**

Results: Representative Travel Times

Year 2030 travel times in minutes from Airport to Arboretum

	Tolled Path	Non-Tolled Path
Phase 2 Plan	28	40
Express Lanes	28	37
Express Lanes CP	28	37
HOT Lanes	28	37

- **All managed lane concepts offer shorter travel times for the non-tolled option relative to the Phase 2 Toll Plan**

Results: Representative Travel Times

Year 2030 travel times in minutes from Airport to Barton Creek Mall

	Tolled Path	Non-Tolled Path
Phase 2 Plan	21	27
Express Lanes	20	25
Express Lanes CP	20	25
HOT Lanes	20	26

- **All managed lane concepts offer shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**

Results: Representative Travel Times

Year 2030 travel times in minutes from Manor to City Hall

	Tolled Path	Non-Tolled Path
Phase 2 Plan	33	43
Express Lanes	33	40
Express Lanes CP	32	41
HOT Lanes	32	41

- **The Express Lanes CP and HOT Lanes concepts offer shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**
- **The Express Lanes concept offers shorter travel times for only the non-tolled option**

Results: Representative Travel Times

Year 2030 travel times in minutes from Arboretum to Barton Creek Mall

	Tolled Path	Non-Tolled Path
Phase 2 Plan	21	30
Express Lanes	21	29
Express Lanes CP	19	30
HOT Lanes	18	29

- **The HOT Lanes concept offers shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**
- **The Express Lanes CP concept offers shorter travel times only for the tolled option**
- **The Express Lanes concept offers shorter travel times only for the non-tolled option**

Results: Representative Travel Times

Travel times in minutes from Airport to City Hall

	Tolled Path	Non-Tolled Path
Phase 2 Plan	20	22
Express Lanes	19	21
Express Lanes CP	19	21
HOT Lanes	19	21

- **All managed lane concepts offer shorter travel times for both the tolled and non-tolled options relative to the Phase 2 Toll Plan**

Results: Project-Level Traffic Volumes

SH 45 Southwest: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lanes projects

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	122%	13%	87%	118%	25%	75%
Express Lanes CP	124%	15%	85%	117%	24%	76%
HOT Lanes	126%	17%	83%	116%	22%	78%
Phase 2 Roads w/ No Tolls	136%	NA	100%	127%	NA	100%

- **For this and the other projects, all managed lane concepts serve more traffic volume than the corresponding Phase 2 toll project**
 - The Phase 2 roads without tolls serve the highest traffic volume



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The tolled lanes' shares in the PM peak are larger than in the AM peak

Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Results: Project-Level Traffic Volumes

SH 71 East: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	138%	14%	86%	122%	24%	76%
Express Lanes CP	141%	15%	85%	121%	22%	78%
HOT Lanes	146%	19%	81%	123%	23%	77%
Phase 2 Roads w/ No Tolls	152%	NA	100%	125%	NA	100%



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Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Results: Project-Level Traffic Volumes

SH 71 West: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	108%	15%	85%	105%	18%	82%
Express Lanes CP	109%	15%	85%	106%	24%	76%
HOT Lanes	110%	19%	81%	105%	23%	77%
Phase 2 Roads w/ No Tolls	114%	NA	100%	111%	NA	100%



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Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Results: Project-Level Traffic Volumes

US 290 West: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	127%	14%	86%	128%	17%	83%
Express Lanes CP	127%	13%	87%	127%	15%	85%
HOT Lanes	127%	14%	86%	128%	15%	85%
Phase 2 Roads w/ No Tolls	129%	NA	100%	130%	NA	100%



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Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Results: Project-Level Traffic Volumes

US 183 South: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	151%	12%	88%	130%	24%	76%
Express Lanes CP	151%	12%	88%	129%	23%	77%
HOT Lanes	161%	18%	82%	133%	24%	76%
Phase 2 Roads w/ No Tolls	168%	NA	100%	131%	NA	100%



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Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Results: Project-Level Traffic Volumes

US 290 East: Average Traffic Volumes relative to Phase 2 project, and tolled vs. non-tolled shares on managed lane projects

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	142%	16%	84%	139%	16%	84%
Express Lanes CP	141%	14%	86%	138%	16%	84%
HOT Lanes	144%	17%	83%	141%	17%	83%
Phase 2 Roads w/ No Tolls	153%	NA	100%	151%	NA	100%



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Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Results: Project-Level Traffic Volumes

Loop 360: Average Traffic Volumes relative to Phase 2 toll project, and tolled vs. non-tolled shares on managed lane projects

	AM Peak			PM Peak		
	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share	% of Fully Tolled Volume	Tolled Share	Non-Tolled Share
Phase 2 Plan	100%	100%	NA	100%	100%	NA
Express Lanes	111%	41%	59%	106%	46%	54%
Express Lanes CP	106%	36%	64%	104%	44%	56%
HOT Lanes	103%	33%	67%	100%	39%	61%
Phase 2 Roads w/ No Tolls	120%	NA	100%	109%	NA	100%

- **For Loop 360, the tolled lanes' shares are much higher than for the other projects**



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Notes: Average volumes computed as VMT divided by segment length for each project-lane combination

Results: Revenue

Managed lane revenue relative to Phase 2 toll project revenue

	Express Lanes	Express Lanes CP	HOT Lanes
SH45 SW	13%	15%	12%
SH 71 E	13%	16%	11%
SH 71 W	9%	8%	8%
US 290 W	9%	11%	10%
US 183 S	26%	27%	17%
US 290 E	14%	17%	9%
Loop 360	34%	66%	51%
Total	22%	34%	25%

- **Of the managed lane concepts, Express Lanes CP generates the most revenue**
 - But this represents only one-third of the revenue generated from the Phase 2 Toll Plan

Results: Revenue

Revenue of each project as share of concept total

	Phase 2 Plan	Express Lanes	Express Lanes CP	HOT Lanes
SH45 SW	12%	7%	5%	6%
SH 71 E	15%	8%	7%	6%
SH 71 W	3%	1%	1%	1%
US 290 W	6%	2%	2%	2%
US 183 S	18%	21%	15%	12%
US 290 E	14%	9%	7%	5%
Loop 360	33%	51%	64%	68%
Total	100%	100%	100%	100%

- **Loop 360 generates the largest revenue share in all concepts**
 - It represents one-third of the revenue generated from the Phase 2 Toll Plan, and up to two-thirds of the revenue generated from the managed lane concepts



Managed lanes analysis summary and conclusions

- **The Phase 2 Toll Plan generates the highest revenue, but has relatively less impact on traffic conditions than do managed lane or non-toll concepts**
- **The non-tolled concept produces no revenues but has the greatest impact on traffic conditions**
- **The managed lane concepts are intermediate:**
 - **For representative trips, travel times on both managed lane and non-tolled paths are comparable to or faster than in the Phase 2 Toll Plan**
 - **On most managed lane projects, the managed lanes provide faster travel than the Phase 2 Toll Plan**
- **These results are intuitively reasonable**
- **However, the Express Lanes CP concept would only generate one-third as much revenue as the Phase 2 Toll Plan**
 - **The other managed lane concepts would generate even less revenue**
- **At the level of this analysis, the costs of each managed lane project concept are not significantly different from those of the corresponding Phase 2 toll project**

Study Status Update

Study Status Update

- **We are working towards presentation of the main study results in the joint MAFS Steering Committee / CAMPO Board meeting on November 13**
- **Results will not be available much before that date**
- **We propose to make the MAFS draft final report a combined text / Powerpoint document**
 - **We believe a succinct presentation of data, analysis methods and results will be more useful to stakeholders than a conventional verbose technical report**
 - **Powerpoint slides will present the main conclusions**
 - **Associated text will briefly explain the analyses that led to the conclusions, as well as any additional relevant points**
- **We ask for your approval of this final report format**

Thank you!

Questions?