Evaluation of Completed MTP Projects

Project Evaluation Criteria, Project Scoring, and Project Evaluation Frameworks

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Introduction

Transportation performance management has been defined as a strategic approach that uses data to inform investment decisions that are consistent with a set of goals. A performance-based approach to planning is mandated with national, state, and Metropolitan Planning Organization (MPO)-level targets for safety, infrastructure condition, system performance, and environmental sustainability. Moving Ahead for Progress in the 21st Century (MAP-21) further requires that MPOs develop "…a system performance report and subsequent updates evaluating the condition and performance of the transportation system concerning the performance targets."

Figure 1 shows the framework for performance-based planning, with major modules for **Planning**, **Programming**, and **Implementation and Evaluation**.

- The **Planning Module** sets the strategic direction of the entire process and defines the goals and performance measures. An analysis function determines how the planning program will achieve its defined goals.
- The **Programming Module** determines what it will take to fulfill the planning program according to its defined targets.
- The **Implementation and Evaluation Module** is a monitoring function to determine how the programmed projects have performed.

Figure 1: Performance-Based Planning Framework

Source: FHWA Performance-Based Planning and Programming Guidebook

This project is focused on the **Implementation and Evaluation Module**, with the main purpose to evaluate the performance of completed projects from past Metropolitan Transportation Plans (MTPs). The goal is both to verify that past projects have contributed to regional goals after their completion and to verify that the MTP evaluation process is set up to score and select worthwhile projects. An additional goal of the project touches on all aspects of performance-based planning with a thorough evaluation of the measures themselves to review how well they are suited for supporting regional goals.

The KTMPO System Performance Report

Under the Fixing America's Surface Transportation (FAST Act) federal regulations, MPOs are required to include a System Performance Report within their long-range plans to report on their adopted performance measures. As of May 2019, the required performance measures are defined in five program areas:

- Highway Safety Improvement Program (HSIP) and Highway Safety
- Transit Asset Management
- Public Transportation Safety Program
- Pavement and Bridge Condition
- System Performance, Freight, and Congestion Mitigation & Air Quality (CMAQ) Improvement Program

Table 1 shows the performance measures, baselines, and adjusted 2019 targets for the adopted KTMPO performance measures, demonstrating how their transportation planning efforts have supported progress towards their adopted goals.

Table 1: KTMPO Performance Measures

Summary of Performance Measures and Targets

Performance Measures	Baseline	2-Year Condition/ Performance	2-Year Target	4-Year Target	4-Year Adjustment
Percentage of Pavements of the Interstate System in Good Condition		66.6%		66.4%	66.5%
Percentage of Pavements of the Interstate System in Poor Condition		0.1%		0.3%	0.2%
Percentage of Pavements of the Non-Interstate NHS in Good Condition	54.5%	55.2%	52.0%	52.3%	54.1%
Percentage of Pavements of the Non-Interstate NHS in Good Condition (Full Distress + IRI)					
Percentage of Pavements of the Non-Interstate NHS in Poor Condition	14.0%	13.5%	14.3%	14.3%	14.2%
Percentage of Pavements of the Non-Interstate NHS in Poor Condition (Full Distress + IRI)					
Percentage of NHS Bridges Classified as in Good Condition	50.7%	50.7%	50.6%	50.4%	
Percentage of NHS Bridges Classified as in Poor Condition	0.9%	1.3%	0.8%	0.8%	1.5%
Percent of the Person-Miles Traveled on the Interstate That Are Reliable	79.5%	81.2%	61.2%	56.6%	70.0%
Percent of the Person-Miles Traveled on the Non-Interstate NHS That Are Reliable		83.0%		55.0%	70.0%
Truck Travel Time Reliability (TTTR) Index	1.40	1.44	1.70	1.79	1.76
Annual Hours of Peak Hour Excessive Delay Per Capita: Urbanized Area 1		12.2%		15.0%	
Annual Hours of Peak Hour Excessive Delay Per Capita: Urbanized Area 2		13.4%		16.0%	14.0%
Percent of Non-Single Occupancy Vehicle (Non-SOV) Travel: Urbanized Area 1	19.5%	19.5%	19.9%	20.2%	
Percent of Non-Single Occupancy Vehicle (Non-SOV) Travel: Urbanized Area 2	20.1%	19.6%	19.7%	19.5%	20.0%
Total Emission Reductions: PM2.5					
Total Emission Reductions: NOx	2864.540	6882.338	4312.390	6945.980	8833.027
Total Emission Reductions: VOC	566.574	1514.190	768.970	1280.210	2048.624
Total Emission Reductions: PM10	0.969	11.369	4.733		21.963
Total Emission Reductions: CO	580.239	490.753	434.931	891.111	841.615

The System Performance Report documents the baseline conditions, targets, and progress for each measure. While the report and this study both involve the review of performance measures, purpose, and scale, the timeframe and metrics of the two tasks are different. The System Performance Report focuses on the regional transportation system as a whole, with recurring snapshots of performance based on adopted metrics and targets for future performance. In contrast, the focus of this study is to examine the performance of individual projects before and after completion using available objective data.

This project supplements and complements the System Performance Report by reviewing how well KTMPO's historic projects and adopted project selection criteria have advanced overall system performance. As this involves actual performance and not subjective evaluations, only the readily available data sources of measured AADT and LOS were originally specified in the scope. Crash data for fatalities and serious injuries from the Crash Record Information System (CRIS) was also used for evaluating projects to address the HSIP targets.

Evaluate Project Issues, Attributes, and Effectiveness

Project Issues

Each of the historic projects was evaluated for traffic and congestion. These measures are objective, readily available, and have been consistently used in the KTMPO project evaluation process. Early on in the evaluation process, it was quickly apparent that some projects were not directly related to these issues. Therefore, the projects were grouped into five categories based on their issues and purpose:

- **Active Transportation**, with four projects. This group of projects had scopes that typically built sidewalks, shared-use paths, or bicycle lanes. Their issues were seen as not directly related to traffic, but rather to providing pedestrian and bicycle infrastructure which is safely isolated from traffic.
- **Aesthetics,** with five projects. This group of projects had scopes that typically built landscaping, streetscaping, and gateways. None of these issues are directly related to traffic or congestion.
- **Capacity**, with twenty-one projects. This group of projects had scopes that typically built new lanes or new roads or bridges. The issues underlying this group of projects are the most closely related to traffic and congestion, and so are the most closely aligned with the available data for this study.
- **Operations**, with eight projects. This group of projects had scopes that typically built turn lanes, shoulders, and auxiliary lanes and performed ramp reversals. These issues are related to traffic and congestion, but are at a finer scale and typically focus on peak periods rather than daily traffic.
- **Safety**, with nine projects. This group of projects had scopes that typically built surface texturing, rumble strips, and chevrons on curves. None of these issues are directly related to traffic or congestion.

Project Attributes

The Congestion Management Process (CMP) criteria of operational, intersection, and capacity deficiencies and a modified list of ten criteria are used to evaluate the projects, as shown in **Table 2**. Project attributes were evaluated using Tables 4-2 through 4-4 of the CMP to determine how well they align with those criteria. The evaluation follows the convention of the CMP scoring using Harvey Balls, with a empty ball for the lowest score and a full ball for the highest score.

The evaluation shows how well the five defined categories of Active Transportation, Aesthetics, Capacity, Operations, and Safety are in alignment with the CMP. As would be expected, the Capacity and the Operations categories have the closest match to the CMP. The categories of Active Transportation and Aesthetics do not have any matches in the criteria of deficiencies and have limited matches under the other criteria. The Safety category has no matches against any of the CMP criteria.

Table 2: Evaluation of Historic Project Issues and Effectiveness

Evaluation of Historic Project Issues and Effectiveness Referencing Congestion Management Plan Measures

CONTROL SECTION JOB	PROJECT ID	ROAD	LIMITS FROM	LIMITS TO	PROJECT DESCRIPTION	PROJECT TYPE	Operational Deficiency	Intersection Deficiency	Capacity Deficiency	New Lanes	New Roadway	Auxiliary Lanes or Ramps	Median Treatments	Geometric Improvements	Grade Separated Intersection	Roundabout Intersections	Bottleneck Removal	Bicycle Paths	Sidewalks
0015-05-048	A00004508	S MAIN ST / SH 317	AVENUE C	AVENUE J	REPAIR AND INSTALL SIDEWALKS ON EASTSIDE OF SOUTH MAIN ST/ SH 317	ACTIVE TRANSPORTATION	◔	○	○	○	○	○	○	○	○	○	○	◔	●
0909-36-135	A00002938	Chisholm Trail	HARRIS COMMUNITY PARK	UNIVERSITY OF MARY-HARDIN BAYLOR	CONSTRUCT ALTERNATE TRANSPORATION ROUTE CONSISTING OF SHARED-USE PATH FOR PEDESTRIANS AND BICYCLISTS		◑	○	○	○	○	○	○	○	○	○	○	●	●
0909-36-144	A00002945	9th Street	LP 121 IN BELTON, EAST	UNIVERSITY DR ON UMHB CAMPUS	CONSTRUCT ALTERNATE TRANSPORTATION ROUTE CONSISTING OF PEDESTRIAN/BICYCLE FACILITIES		◑	○	○	○	○	○	○	○	○	○	○	●	●
0909-36-145	A00002946	Live Oak Ridge Trail	WATERCREST ROAD	WEST ELMS ROAD	CONSTRUCT ALTERNATE TRANSPORTATION ROUTE CONSISTING OF SHARED-USE PATH FOR PEDESTRIANS AND BICYCLISTS		◑	○	○	○	○	○	○	○	○	○	○	●	●
0909-36-150	A00002951	N 31st Street	@ SH 53	JACK WHITE ST	CONSTRUCT ALTERNATE TRANSPORTATION ROUTE CONSISTING OF PEDESTRIAN SIDEWALKS		◔	○	○	○	○	○	○	○	○	○	○	◔	●
0231-02-061	A00004474	US 190	DEWALD ST	CONSTITUTION AVE	LANDSCAPE DEVELOPMENT	AESTHETICS	○	○	○	○	○	○	○	○	○	○	○	○	○
0320-01-069	A00001619	1st St	W AVE U (TEMPLE)	SW HK DODGEN (LP 363)	PHASE I - IMPROVE ROADWAY AESTHETICS CONSISTING OF LANDSCAPING MEDIANS ON TEMPLE H & B TRAILS		○	○	○	○	○	○	○	○	○	○	○	◑	◑
0724-05-009	A00002169	Avenue B	FM 116	MAIN ST	STREETSCAPE IMPROVEMENTS TO DOWNTOWN COPPERAS COVE INCLUDING SIDEWALK, ADA RAMPS, RAILINGS AND SIGNAGE		○	○	○	○	○	○	○	○	○	○	○	◔	●
0752-03-024	A00002190	MAIN ST	MAIN ST FROM IH 35 FRTG RD	FRONT STREET	STREETSCAPE IMPROVEMENTS TO DOWNTOWN TROY		○	○	○	○	○	○	○	○	○	○	○	○	●
0836-02-069	A00002481	SH 195	@ KILLEEN SOUTH CITY LIMITS	.	LANDSCAPE ENHANCEMENT CONSISTING OF LANDSCAPING AND GATEWAY		○	○	○	○	○	○	○	○	○	○	○	○	○

Table 2 (continued): Evaluation of Historic Project Issues and Effectiveness

Evaluation of Historic Project Issues and Effectiveness Referencing Congestion Management Plan Measures

CONTROL SECTION JOB	PROJECT ID	ROAD	LIMITS FROM	LIMITS TO	PROJECT DESCRIPTION	PROJECT TYPE	Operational Deficiency	Intersection Deficiency	Capacity Deficiency	New Lanes	New Roadway	Auxiliary Lanes or Ramps	Median Treatments	Geometric Improvements	Grade Separated Intersection	Roundabout Intersections	Bottleneck Removal	Bicycle Paths	Sidewalks
0015-04-067	A00000343	IH 35	NORTH LP 363	N OF TROY	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY		◑	○	●	●	○	○	○	○	○	○	◑	○	○
0015-04-073	A00000349	IH 35	N OF TROY	FALLS CO LN	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY		◑	○	●	●	○	○	○	○	○	○	◑	○	○
0015-06-071	A00000394	IH 35	AMITY ROAD	US 190	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY		◑	○	●	●	○	○	○	○	○	○	◑	○	○
0015-06-077	A00000400	IH 35	AT LAMPASAS RIVER (NB FR)	.	ADD NORTHBOUND FRONTAGE ROAD TO REDUCE CONGESTION AND ENHANCE SAFETY		●	○	●	●	○	○	○	○	○	○	◑	○	○
0015-07-065	A00000422	IH 35	FM 2843	FM 2484	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY		◑	○	●	●	○	○	○	○	○	○	◑	○	○
0015-07-072	A00000428	IH 35	FM 2484	AMITY ROAD	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY		◑	○	●	●	○	○	○	○	○	○	◑	○	○
0015-14-091	A00000454	IH 35	S LP 363 IN TEMPLE	NUGENT AVE	RECONSTRUCT AND WIDEN FROM FOUR TO EIGHT LANES		◑	○	●	●	○	○	○	○	○	○	◑	○	○
0015-14-102	A00000465	IH 35	NUGENT AVE	NORTH LP 363	RECONSTRUCT AND WIDEN FROM FOUR TO EIGHT LANES		◑	○	●	●	○	○	○	○	○	○	◑	○	○
0231-03-103	A00001289	US 190	WS YOUNG	1.0 MI W OF FM 2410 IN HARKER HEIGHTS	WIDEN FROM FOUR TO SIX LANES AND RESURFACE (PHASE I OF ULIMATE DESIGN)		◑	○	●	●	○	○	○	○	○	○	◑	○	○
0231-03-107	A00001293	US 190	SP 172 (FT HOOD MAIN GATE)	WS YOUNG	WIDEN FROM FOUR TO SIX LANES AND RESURFACE		◑	○	●	●	○	○	○	○	○	○	◑	○	○
0231-19-002	A00001371	US 190	FM 2657	US 190 W OF CLARKE RD	CONSTRUCT TWO-LANES OF ULTIMATE FOUR-LANE DIVIDED CONTROL ACCESS ROADWAY FOR COPPERAS COVE RELIEF ROUTE	CAPACITY	●	●	●	○	●	○	○	○	○	○	●	○	○
0320-06-001	A00001648	LP 363	IH 35 NORTH OF TEMPLE	SH 53	CONSTRUCT NORTHBOUND FRONTAGE ROAD TO PROVIDE INTERIM 4-LANE DIVIDED HWY & ADD OVERPASS AT WENDLAND DR & AT SH 36/SH 53		●	●	●	○	●	○	●	●	●	○	●	○	○
0398-04-059	A00001774	SH 317	0.2 MI S OF FM 2305	~~0.4~~ 0.5 MI N OF FM 439	RECONSTRUCT AND WIDEN FROM TWO TO FOUR LANES WITH RAISED MEDIAN		◑	○	●	●	○	○	●	○	○	○	◑	○	○
0398-04-072	A00001786	SH 317	FM 439	0.5 MI N OF FM 439	WIDEN FROM TWO TO FOUR LANES WITH RAISED MEDIAN		◑	○	●	●	○	○	●	○	○	○	◑	○	○
0836-02-050	A00002466	SH 195	AT STAGECOACH RD/SH 201 IN KILLEEN	.	CONSTRUCT OVERPASS & RAMPS		●	●	●	○	○	●	○	●	●	○	●	○	○
0909-36-128	A00002931	W 9TH ST	LP 121 IN BELTON, EAST	UNIVERSITY DR ON UMHB CAMPUS	EXTEND WEST NINTH STREET AND CONSTRUCT BRIDGE OVER NOLAN CREEK		◑	○	●	○	●	○	○	○	○	○	●	●	●
0909-36-156	A00004513	Rosewood Dr	RIVERSTONE DRIVE	CHAPARRAL ROAD	CONSTRUCT FOUR-LANE ROADWAY WITH CENTER MEDIAN AND OFF-SYSTEM BRIDGE OVER TRIMMIER CREEK		◑	○	●	○	●	○	●	○	○	○	●	●	●
2304-02-036	A00003830	FM 2410	ROY REYNOLDS DRIVE	ANN BLVD	WIDEN FROM TWO TO FOUR LANES WITH CONTINUOUS LEFT TURN LANE TO REDUCE CONGESTION AND ENHANCE SAFETY		◑	◑	●	●	○	○	○	○	○	○	◑	○	○
2304-02-040	A00003833	FM 2410	S ANN BLVD	COMMERCIAL DR	WIDEN FROM TWO TO FOUR LANES WITH CONTINUOUS LEFT TURN LANE TO REDUCE CONGESTION AND ENHANCE SAFETY		◑	◑	●	●	○	○	○	○	○	○	◑	○	○
3534-01-009	A00004299	SH 201	KILLEEN-FT HOOD REGIONAL AIRPORT	SH 195	ADD TWO LANES TO PROVIDE FOUR LANE DIVIDED ROADWAY		◑	○	●	●	○	○	○	○	○	○	◑	○	○
3623-01-001	A00004308	SH 9	US 190	FM 116	CONSTRUCT INITIAL TWO-LANE OF ULTIMATE FOUR-LANE DIVIDED FOR COPPERAS COVE NE RELIEF RTE & TANK DESTROYER BLVD CONNECTION		●	●	●	○	●	○	●	●	●	○	●	○	○

Table 2 (continued): Evaluation of Historic Project Issues and Effectiveness

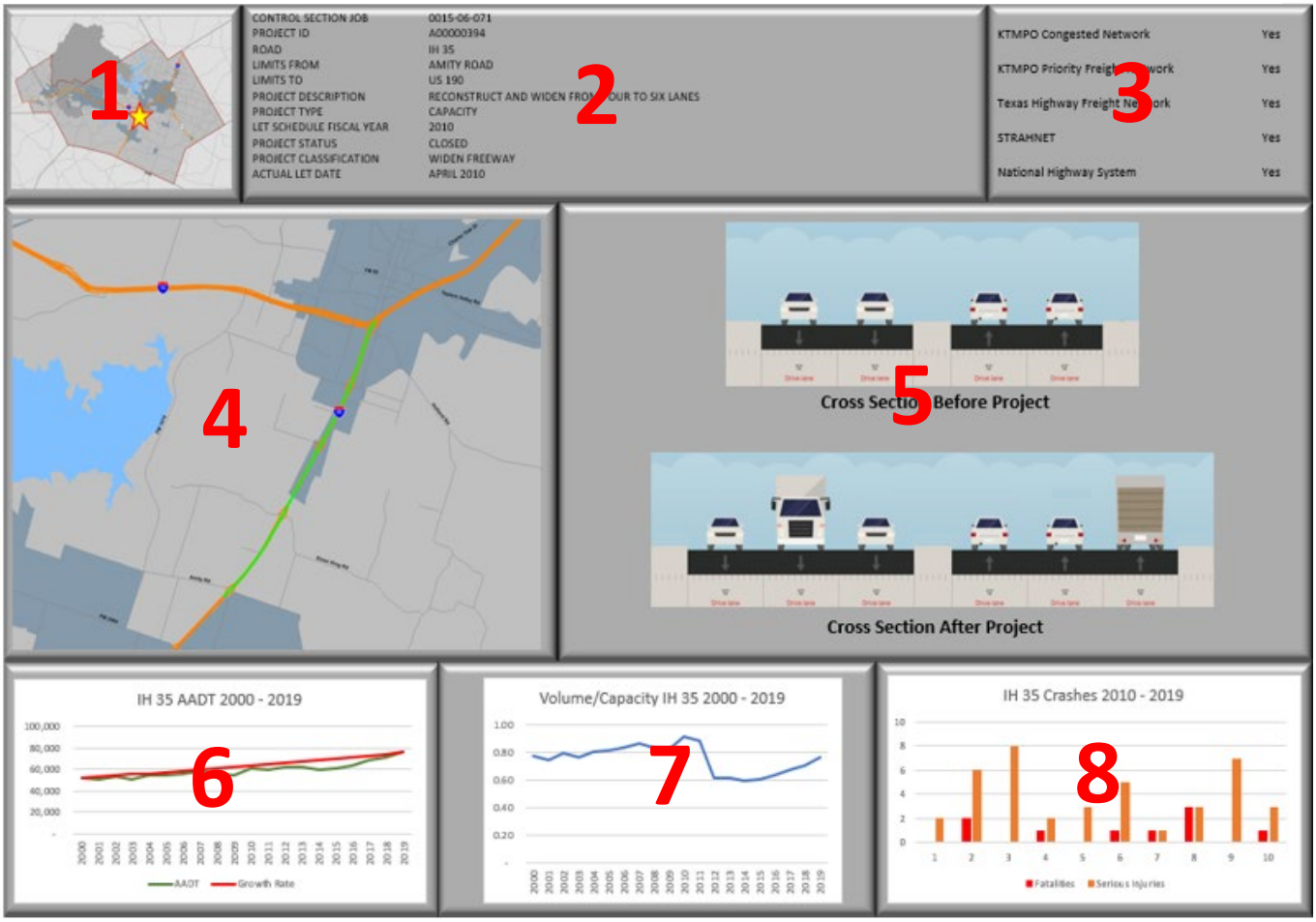
Evaluation of Historic Project Issues and Effectiveness Referencing Congestion Management Plan Measures

CONTROL SECTION JOB	PROJECT ID	ROAD	LIMITS FROM	LIMITS TO	PROJECT DESCRIPTION	PROJECT TYPE	Operational Deficiency	Intersection Deficiency	Capacity Deficiency	New Lanes	New Roadway	Auxiliary Lanes or Ramps	Median Treatments	Geometric Improvements	Grade Separated Intersection	Roundabout Intersections	Bottleneck Removal	Bicycle Paths	Sidewalks
0015-14-125	A00000551	IH 35	MIDWAY DRIVE	S LP 363 IN TEMPLE	REVERSE ENTRANCE RAMP, EXIT RAMP AND CONSTRUCT AUXILIARY LANE	OPERATIONS	●	●	◑	○	○	●	○	●	○	○	◑	○	○
0398-04-073	A00001787	SH 317	SH 36	FM 2305	INSTALL CONTINUOUS LEFT TURN LANE		●	○	◑	○	○	●	○	○	○	○	◔	○	○
0752-02-015	A00002179	FM 1237	SH 317	IH 35	REHABILITATE AND WIDEN PAVEMENT TO ADD SHOULDERS		◔	○	◔	○	○	○	○	○	○	○	○	○	○
0909-36-147	A00002948	TRIMMIER RD	JASPER RD	ELMS ROAD	RECONSTRUCT AND WIDEN TO ADD CONTINUOUS LEFT TURN LANE		●	○	◑	○	○	●	○	○	○	○	◔	○	○
0909-36-153	A00004509	COMMERCIAL DRIVE	At COMMERCIAL DRIVE		CONSTRUCT ROUNDABOUT IN HARKER HEIGHTS		●	●	◔	○	○	○	○	○	○	●	◔	○	○
0909-39-126	A00003104	COURTNEY LANE	FAIRBANKS ST	FM 116	CONSTRUCT RIGHT TURN LANE AND ADD ADA PEDESTRIAN RAMPS		●	○	◑	○	○	●	○	○	○	○	◔	○	○
3409-01-004	A00004250	FM 3481	0.16 MI N OF FM 2410	0.50 MI S OF FM 2410	CONSTRUCT LEFT TURN LANE AT WAL-MART IN HARKER HEIGHTS		●	○	◑	○	○	●	○	○	○	○	◔	○	○
3534-02-002	A00004302	SH 201	@ MOHAWK DRIVE IN KILLEEN	.	ADD TURN LANES, TRAFFIC SIGNAL AND LIGHTING FOR IMPROVED ACCESS TO WEST FT HOOD		●	○	◑	○	○	●	○	○	○	○	◔	○	○
0231-04-058	A00004500	US 190	0.6 MI W OF IH 35	IH 35	HIGH FRICTION SURFACE TREATMENT ON CURVE	SAFETY	○	○	○	○	○	○	○	○	○	○	○	○	○
0231-16-032	A00001368	FM 436	IH 35 IN BELTON	BU 190J IN HEIDENHEIMER	CENTERLINE TEXTURING		○	○	○	○	○	○	○	○	○	○	○	○	○
0836-03-060	A00002512	FM 439	0.549 MI E OF ROY REYNOLDS DR	FM 2271	CENTERLINE TEXTURING		○	○	○	○	○	○	○	○	○	○	○	○	○
1308-01-029	A00003410	FM 1123	FM 436	TOWERY DR IN HOLLAND	PROVIDE ADDITIONAL PAVED SURFACE WIDTH		○	○	○	○	○	○	○	○	○	○	○	○	○
2136-01-021	A00004635	FM 2268	0.1 MI W OF FM 2268 SPUR	SUMBERA ROAD	INSTALL CHEVRONS ON CURVE, INCREASE SUPERELEVATION		○	○	○	○	○	○	○	○	○	○	○	○	○
2136-01-022	A00004636	FM 2268	LILY LANE	SHEPHERD LANE	INSTALL CHEVRONS ON CURVE, INCREASE SUPERELEVATION		○	○	○	○	○	○	○	○	○	○	○	○	○
2304-03-012, 2304-03-013	A00004493, A00004523	FM 2484	2.1 MI E OF FM 3481	IH 35	MILLED CENTERLINE RUMBLE STRIP, IMPROVE GUARDRAIL TO DESIGN STANDARDS; SAFETY TREAT FIXED OBJECTS		○	○	○	○	○	○	○	○	○	○	○	○	○
2390-01-014	A00004494	FM 2484	SH 195	2.1 MI E OF FM 3481	MILLED CENTERLINE RUMBLE STRIP		○	○	○	○	○	○	○	○	○	○	○	○	○
2696-01-015	A00004524	FM 3219	FM 439	BU 190F	MILLED CENTERLINE RUMBLE STRIP		○	○	○	○	○	○	○	○	○	○	○	○	○

Project Effectiveness

The effectiveness of each of the historic projects was evaluated using the objective measures of AADT and LOS and displayed in dashboards for each of the five categories. Additional information was added to the dashboards to provide context. **Figure 2** shows a typical dashboard, with information provided as noted for all categories of projects.

Figure 2: Typical Project Dashboard



The components of the dashboard are:

1. Map of the full region to show the project location.
2. General descriptive data including Control Section Job (CSJ) and KTMPO project numbers, limits, and description.
3. Context of the project as lying on any of five designated planning networks.
4. Focused map of the project in its immediate context.
5. Cross-sections of the road before and after the project.
6. Chart of the historic trend of AADT, with a straight-line regression element for reference.
7. Chart of the historic trend of congestion represented as the volume to capacity ratio.
8. Chart of the historic trend of safety represented as fatality and serious injury crashes.

To supplement the previous evaluaton of historic project attributes against the CMP measures, in this section the projects were evaluated for effectiveness based on the historic trends of available objective data. To be consistent, the evaluation uses a 0 to 5 point scale, with 0 being the least effective or no score and 5 being the most effective. The evaluation is shown in **Table 3**.

Table 3: Evaluation Scores of Historic Projects

Evaluation Scores of Historic Projects							AADT	Congestion	Safety	Overall Effectiveness	Evaluation Notes
CONTROL SECTION JOB	PROJECT ID	ROAD	LIMITS FROM	LIMITS TO	PROJECT DESCRIPTION	PROJECT TYPE					
0015-05-048	A00004508	S MAIN ST / SH 317	AVENUE C	AVENUE J	REPAIR AND INSTALL SIDEWALKS ON EASTSIDE OF SOUTH MAIN ST/ SH 317	ACTIVE TRANSPORTATION	0	0	0	0	AADT and congestion not applicable; safety data is negligible
0909-36-135	A00002938	Chisholm Trail	HARRIS COMMUNITY PARK	UNIVERSITY OF MARY-HARDIN BAYLOR	CONSTRUCT ALTERNATE TRANSPORATION ROUTE CONSISTING OF SHARED-USE PATH FOR PEDESTRIANS AND BICYCLISTS	ACTIVE TRANSPORTATION	0	0	0	0	AADT and congestion not applicable; no safety data
0909-36-144	A00002945	9th Street	LP 121 IN BELTON, EAST	UNIVERSITY DR ON UMHB CAMPUS	CONSTRUCT ALTERNATE TRANSPORTATION ROUTE CONSISTING OF PEDESTRIAN/BICYCLE FACILITIES	ACTIVE TRANSPORTATION	0	0	0	0	AADT and congestion not applicable; no safety data
0909-36-145	A00002946	Live Oak Ridge Trail	WATERCREST ROAD	WEST ELMS ROAD	CONSTRUCT ALTERNATE TRANSPORTATION ROUTE CONSISTING OF SHARED-USE PATH FOR PEDESTRIANS AND BICYCLISTS	ACTIVE TRANSPORTATION	0	0	0	0	AADT and congestion not applicable; no safety data
0909-36-150	A00002951	N 31st Street	@ SH 53	JACK WHITE ST	CONSTRUCT ALTERNATE TRANSPORTATION ROUTE CONSISTING OF PEDESTRIAN SIDEWALKS	ACTIVE TRANSPORTATION	0	0	0	0	AADT and congestion not applicable; no safety data
0231-02-061	A00004474	US 190	DEWALD ST	CONSTITUTION AVE	LANDSCAPE DEVELOPMENT	AESTHETICS	0	0	0	0	AADT, congestion, and safety data not applicable;
0320-01-069	A00001619	1st St	W AVE U (TEMPLE)	SW HK DODGEN (LP 363)	PHASE I - IMPROVE ROADWAY AESTHETICS CONSISTING OF LANDSCAPING MEDIANS ON TEMPLE H & B TRAILS	AESTHETICS	0	0	0	0	AADT and congestion not applicable; no safety data
0724-05-009	A00002169	Avenue B	FM 116	MAIN ST	STREETSCAPE IMPROVEMENTS TO DOWNTOWN COPPERAS COVE INCLUDING SIDEWALK, ADA RAMPS, RAILINGS AND SIGNAGE	AESTHETICS	0	0	0	0	No AADT, congestion, or safety data
0752-03-024	A00002190	MAIN ST	MAIN ST FROM IH 35 FRTG RD	FRONT STREET	STREETSCAPE IMPROVEMENTS TO DOWNTOWN TROY	AESTHETICS	0	0	0	0	No AADT, congestion, or safety data
0836-02-069	A00002481	SH 195	@ KILLEEN SOUTH CITY LIMITS		LANDSCAPE ENHANCEMENT CONSISTING OF LANDSCAPING AND GATEWAY	AESTHETICS	0	0	0	0	AADT, congestion, and safety data not applicable;

Table 3 (continued): Evaluation Scores of Historic Projects

Evaluation Scores of Historic Projects

CONTROL SECTION JOB	PROJECT ID	ROAD	LIMITS FROM	LIMITS TO	PROJECT DESCRIPTION	PROJECT TYPE	AADT	Congestion	Safety	Overall Effectiveness	Evaluation Notes
0015-04-067	A00000343	IH 35	NORTH LP 363	N OF TROY	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY	CAPACITY	3	5	1	3	Gradual rise in AADT, sharp drop in congestion followed by gradual rise, safety is stable following spike during construction.
0015-04-073	A00000349	IH 35	N OF TROY	FALLS CO LN	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY	CAPACITY	1	1	1	1	Effect on AADT and congestion is negligible, but sharp decrease after completion may show effects of other construction in the area. Safety is stable.
0015-06-071	A00000394	IH 35	AMITY ROAD	US 190	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY	CAPACITY	3	5	1	3	Gradual rise in AADT, sharp drop in congestion followed by gradual rise, safety is stable.
0015-06-077	A00000400	IH 35	AT LAMPASAS RIVER (NB FR)	.	ADD NORTHBOUND FRONTAGE ROAD TO REDUCE CONGESTION AND ENHANCE SAFETY	CAPACITY	0	0	0	0	Historic trends not applicable for new construction road.
0015-07-065	A00000422	IH 35	FM 2843	FM 2484	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY	CAPACITY	1	1	0	1	Effect on AADT and congestion is negligible, but sharp decrease before project letting may show effects of other construction in the area. No data for safety.
0015-07-072	A00000428	IH 35	FM 2484	AMITY ROAD	RECONSTRUCT AND WIDEN FROM FOUR TO SIX LANES TO REDUCE CONGESTION AND ENHANCE SAFETY	CAPACITY	0	0	0	0	No historic trend data for this road section.
0015-14-091	A00000454	IH 35	S LP 363 IN TEMPLE	NUGENT AVE	RECONSTRUCT AND WIDEN FROM FOUR TO EIGHT LANES	CAPACITY	3	5	3	4	Gradual rise in AADT, sharp drop in congestion followed by gradual rise, safety shows a gradual rise around construction and a gradual decrease afterwards.
0015-14-102	A00000465	IH 35	NUGENT AVE	NORTH LP 363	RECONSTRUCT AND WIDEN FROM FOUR TO EIGHT LANES	CAPACITY	3	5	3	4	Gradual rise in AADT, sharp drop in congestion followed by gradual rise, safety shows a gradual rise around construction and a gradual decrease afterwards.
0231-03-103	A00001289	US 190	WS YOUNG	1.0 MI W OF FM 2410 IN HARKER HEIGHTS	WIDEN FROM FOUR TO SIX LANES AND RESURFACE (PHASE I OF ULIMATE DESIGN)	CAPACITY	2	2	3	2	AADT and congestion show a gradual decrease with a shart drop around the construction period. Safety data is mixed after construction.
0231-03-107	A00001293	US 190	SP 172 (FT HOOD MAIN GATE)	WS YOUNG	WIDEN FROM FOUR TO SIX LANES AND RESURFACE	CAPACITY	2	2	0	1	AADT and congestion show a gradual decrease with a small but distinct drop before the construction period; possibly showing the effects of other construction in the area. Sharp decrease in safety after construction.
0231-19-002	A00001371	US 190	FM 2657	US 190 W OF CLARKE RD	CONSTRUCT TWO-LANES OF ULTIMATE FOUR-LANE DIVIDED CONTROL ACCESS ROADWAY FOR COPPERAS COVE RELIEF ROUTE	CAPACITY	0	0	0	0	Historic trends not applicable for new construction road.
0320-06-001	A00001648	LP 363	IH 35 NORTH OF TEMPLE	SH 53	CONSTRUCT NORTHBOUND FRONTAGE ROAD TO PROVIDE INTERIM 4-LANE DIVIDED HWY & ADD OVERPASS AT WENDLAND DR & AT SH 36/SH 53	CAPACITY	2	2	1	2	Historic data is only after construction. AADT shows a sharp rise followed by a sharp decrease; possible effect of other construction in the area. Safety is stable.
0398-04-059	A00001774	SH 317	0.2 MI S OF FM 2305	~~0.4~~ 0.5 MI N OF FM 439	RECONSTRUCT AND WIDEN FROM TWO TO FOUR LANES WITH RAISED MEDIAN	CAPACITY	0	0	0	0	AADT and congestion show a gradual gentle rise with no discernable effect from the project. No safety data.
0398-04-072	A00001786	SH 317	FM 439	0.5 MI N OF FM 439	WIDEN FROM TWO TO FOUR LANES WITH RAISED MEDIAN	CAPACITY	3	4	2	3	AADT shows a gradual gentle rise. Congestion has a sharp drop from the project followed by a gradual rise. Safety data is stable.
0836-02-050	A00002466	SH 195	AT STAGECOACH RD/SH 201 IN KILLEEN	.	CONSTRUCT OVERPASS & RAMPS	CAPACITY	0	0	3	1	Limited data for AADT doesn't show before and after results of project. Safety data is mixed after the project.
0909-36-128	A00002931	W 9TH ST	LP 121 IN BELTON, EAST	UNIVERSITY DR ON UMHB CAMPUS	EXTEND WEST NINTH STREET AND CONSTRUCT BRIDGE OVER NOLAN CREEK	CAPACITY	0	0	0	0	Historic trends not applicable for new construction road.
0909-36-156	A00004513	Rosewood Dr	RIVERSTONE DRIVE	CHAPARRAL ROAD	CONSTRUCT FOUR-LANE ROADWAY WITH CENTER MEDIAN AND OFF-SYSTEM BRIDGE OVER TRIMMIER CREEK	CAPACITY	0	0	0	0	Historic trends not applicable for new construction road.
2304-02-036	A00003830	FM 2410	ROY REYNOLDS DRIVE	ANN BLVD	WIDEN FROM TWO TO FOUR LANES WITH CONTINUOUS LEFT TURN LANE TO REDUCE CONGESTION AND ENHANCE SAFETY	CAPACITY	2	5	3	3	AADT data is volatile, but congestion shows a sharp drop. Safety is improved from a low baseline.
2304-02-040	A00003833	FM 2410	S ANN BLVD	COMMERCIAL DR	WIDEN FROM TWO TO FOUR LANES WITH CONTINUOUS LEFT TURN LANE TO REDUCE CONGESTION AND ENHANCE SAFETY	CAPACITY	2	5	0	2	AADT data is volatile but with a gentle rise, but congestion shows a sharp drop. No safety data.
3534-01-009	A00004299	SH 201	KILLEEN-FT HOOD REGIONAL AIRPORT	SH 195	ADD TWO LANES TO PROVIDE FOUR LANE DIVIDED ROADWAY	CAPACITY	1	0	0	0	Limited data for AADT but showing a gradual rise in congestion after project. Safety shows an increase in crashes.
3623-01-001	A00004308	SH 9	US 190	FM 116	CONSTRUCT INITIAL TWO-LANE OF ULTIMATE FOUR-LANE DIVIDED FOR COPPERAS COVE NE RELIEF RTE & TANK DESTROYER BLVD CONNECTION	CAPACITY	1	0	0	0	Limited data for AADT but showing a gradual rise in congestion after project. No safety data.

Table 3 (continued): Evaluation Scores of Historic Projects

Evaluation Scores of Historic Projects							AADT	Congestion	Safety	Overall Effectiveness	Evaluation Notes
CONTROL SECTION JOB	PROJECT ID	ROAD	LIMITS FROM	LIMITS TO	PROJECT DESCRIPTION	PROJECT TYPE					
0015-14-125	A00000551	IH 35	MIDWAY DRIVE	S LP 363 IN TEMPLE	REVERSE ENTRANCE RAMP, EXIT RAMP AND CONSTRUCT AUXILIARY LANE	OPERATIONS	2	2	2	2	Gradual increase in AADT with a slight dip in congestion after construction . Safety is mixed after construction.
0398-04-073	A00001787	SH 317	SH 36	FM 2305	INSTALL CONTINUOUS LEFT TURN LANE	OPERATIONS	2	2	5	3	AADT and congestion show a gradual dip and gradual rise starting before the project. Safety shows an improvement.
0752-02-015	A00002179	FM 1237	SH 317	IH 35	REHABILITATE AND WIDEN PAVEMENT TO ADD SHOULDERS	OPERATIONS	0	0	1	0	AADT and congestion are volatile with a gentle upward trend and no discernable impact from the project. Safety is stable.
0909-36-147	A00002948	TRIMMIER RD	JASPER RD	ELMS ROAD	RECONSTRUCT AND WIDEN TO ADD CONTINUOUS LEFT TURN LANE	OPERATIONS	0	0	4	1	AADT shows a sharp drop after the project; possibly an effect of other construction in the area. Safety shows a drop in crashes.
0909-36-153	A00004509	COMMERCIAL DRIVE	At COMMERCIAL DRIVE		CONSTRUCT ROUNDABOUT IN HARKER HEIGHTS	OPERATIONS	0	0	0	0	Limited AADT data doesn't support trend analysis. No safety data.
0909-39-126	A00003104	COURTNEY LANE	FAIRBANKS ST	FM 116	CONSTRUCT RIGHT TURN LANE AND ADD ADA PEDESTRIAN RAMPS	OPERATIONS	0	0	0	0	No discernable effect from the project. No safety data.
3409-01-004	A00004250	FM 3481	0.16 MI N OF FM 2410	0.50 MI S OF FM 2410	CONSTRUCT LEFT TURN LANE AT WAL-MART IN HARKER HEIGHTS	OPERATIONS	0	0	0	0	AADT data and congestion is volatile with a gentle upward trend and no discernable effect from the project. No safety data.
3534-02-002	A00004302	SH 201	@ MOHAWK DRIVE IN KILLEEN	.	ADD TURN LANES, TRAFFIC SIGNAL AND LIGHTING FOR IMPROVED ACCESS TO WEST FT HOOD	OPERATIONS	0	0	0	0	AADT data and congestion is volatile with a gentle upward trend and no discernable effect from the project. Safety shows an increase in crashes.
0231-04-058	A00004500	US 190	0.6 MI W OF IH 35	IH 35	HIGH FRICTION SURFACE TREATMENT ON CURVE	SAFETY	0	0	0	0	AADT and congestion have an upward trend with no discernable effect from the project. No safety data.
0231-16-032	A00001368	FM 436	IH 35 IN BELTON	BU 190J IN HEIDENHEIMER	CENTERLINE TEXTURING	SAFETY	0	0	1	0	AADT and congestion have an upward trend with no discernable effect from the project. Safety is stable.
0836-03-060	A00002512	FM 439	0.549 MI E OF ROY REYNOLDS DR	FM 2271	CENTERLINE TEXTURING	SAFETY	0	0	3	1	AADT and congestion have an upward trend with no discernable effect from the project. Safety had a shrrp drop but has risen again.
1308-01-029	A00003410	FM 1123	FM 436	TOWERY DR IN HOLLAND	PROVIDE ADDITIONAL PAVED SURFACE WIDTH	SAFETY	0	0	2	1	Limited AADT data doesn't support trend analysis. Safety is mixed.
2136-01-021	A00004635	FM 2268	0.1 MI W OF FM 2268 SPUR	SUMBERA ROAD	INSTALL CHEVRONS ON CURVE, INCREASE SUPERELEVATION	SAFETY	0	0	1	0	AADT and congestion have an upward trend with no discernable effect from the project. Safety is stable.
2136-01-022	A00004636	FM 2268	LILY LANE	SHEPHERD LANE	INSTALL CHEVRONS ON CURVE, INCREASE SUPERELEVATION	SAFETY	0	0	1	0	AADT and congestion have an upward trend with no discernable effect from the project. Safety is stable.
2304-03-012, 2304-03-013	A00004493, A00004523	FM 2484	2.1 MI E OF FM 3481	IH 35	MILLED CENTERLINE RUMBLE STRIP, IMPROVE GUARDRAIL TO DESIGN STANDARDS; SAFETY TREAT FIXED OBJECTS	SAFETY	0	0	5	2	AADT and congestion are volatile with an upward trend with no discernable effect from the project. Safety has fewer serious injuries but more fatalities, then no crashes for the past two years.
2390-01-014	A00004494	FM 2484	SH 195	2.1 MI E OF FM 3481	MILLED CENTERLINE RUMBLE STRIP	SAFETY	0	0	2	1	AADT and congestion are volatile with an upward trend with no discernable effect from the project. Safety is mixed.
2696-01-015	A00004524	FM 3219	FM 439	BU 190F	MILLED CENTERLINE RUMBLE STRIP	SAFETY	0	0	1	0	AADT and congestion have an upward trend with no discernable effect from the project. Safety is stable.

Summary of Project Effectiveness Evaluations

Of the five projects in the **Active Transportation** Category, four had no AADT data available for their adjacent streets. When the data was available, it referred to the adjacent street rather than directly to the sidewalk. This is a useful proxy for safety; the AADT on a street is one of the factors that drives the need for sidewalks to isolate pedestrians from traffic. However, it is not a direct measure of pedestrian volumes. Additionally, four of the five projects had no CRIS crash data for the adjacent streets. Again, data for the adjacent streets are a proxy for the safety needs of the sidewalks but are not direct measures. Overall, the available measures of AADT, volume-to-capacity ratio, and the number of crashes with serious injuries and fatalities are not adequate to measure the performance of Active Transportation projects.

The five projects in the **Aesthetics** category have better data inventories but show similar results. Two of the five projects had no data at all, and one other project was missing the CRIS crash data. However, for Aesthetics projects, the concepts of AADT, volume-to-capacity ratio, and the number of crashes with serious injuries and fatalities do not seem to be relevant measures for landscaping, streetscaping, and gateway projects.

Of the twenty-one projects in the **Capacity** category, ten had zero scores in one or more categories due to missing data, although this includes four new construction projects. In general, this category was supported by the available data, but the scale and timeframe of the data were sometimes an issue – ongoing construction over a large area seemed to override the data trends shown for smaller projects, and data was not available during construction periods.

In the **Operations** category, the eight projects were for items such as short turn lanes or a roundabout to address issues at specific sites. While the higher-level regional measures of AADT, volume-to-capacity ratio, and the number of crashes with serious injuries and fatalities are relevant to these types of projects, they are at too high of a scale to effectively measure their performance for smaller specific sites.

None of the nine projects in the **Safety** category showed any discernible impact on their AADT and congestion data, which is to be expected given the scale of the projects and their scopes as installing centerline texturing, rumble strips, and chevrons on curves. It does not appear that the AADT and volume-to-capacity ratio measures are amenable to measuring safety impacts. Safety is directly measured by the CRIS data on crashes, but the results of the projects were often stable or mixed. It does not appear that crash history data is at an appropriate scale to effectively evaluate these types of safety projects. The Federal Highway Administration (FHWA) Systemic Safety Process, which measures risk rather than the history of crashes, was developed specifically to addres this issue where logically a project improves safety, but the crash history is not adequate to show the improvement.

Overall, the scores for the projects as listed in **Table 3** seem to relate more to the available data than to project effectiveness. **Table 4** tallies the number of projects by categories and by their scores on a zero to five-point scale to be consistent with other KTMPO project evaluation schemes, while **Table 5** shows the percentage of each category's projects receiving each score.

Table 4:Tally of Project Scores by Category

Counts of Projects with Each Value of Overall Score						
Overall Score	Active Transportation	Aesthetics	Capacity	Operations	Safety	Total Counts by Score
0	5	5	8	5	5	28
1	-	-	4	1	3	8
2	-	-	3	1	1	5
3	-	-	4	1	-	5
4	-	-	2	-	-	2
5	-	-	-	-	-	-

Table 5: Percentage of Project Scores by Category

Percent of Projects with Each Value of Overall Score						
Overall Score	Active Transportation	Aesthetics	Capacity	Operations	Safety	Total Percent by Score
0	100%	100%	38%	63%	56%	58%
1	-	-	19%	13%	33%	17%
2	-	-	14%	13%	11%	10%
3	-	-	19%	13%	-	10%
4	-	-	10%	-	-	4%
5	-	-	-	-	-	-

The two tables show that 58% of all projects received no score at all, including 100% of the Active Transportation and Aesthetics projects. Even the Capacity category, which is most closely aligned with the AADT and volume-to-capacity ratio measures, had more than a third of its projects with a zero score.

These results indicate that some additional measures are necessary; the available historic objective data is not adequate to determine the effectiveness of historic projects.

Other Potential Evaluation Criteria

The focus of this project was to gather available objective data on the performance of individual projects before and after construction to establish how well they supported progress towards goals. Unfortunately, the data collected in **Table 1** through **Table 5** has demonstrated that the available objective at the individual project scale is often inappropriate, inadequate, insufficient, or missing. Alternative data and methods are therefore proposed in order to support individual project evaluation. The following sections explore data which might be useful to the process for future analysis. In many cases, the timeframe and the availability of the data means that it may not be possible to evaluate past projects. Rather, alternative data for new projects can be collected as the project is let for funding, and then again after completion to provide a before-and-after comparison. Although the scope of this project is to consider objective data, to more appropriately capture the effects of Aesthetics, Active Transportation, and Safety categories of projects, some subjective data sources were considered.

National Performance Management Research Data Set (NPMRDS)

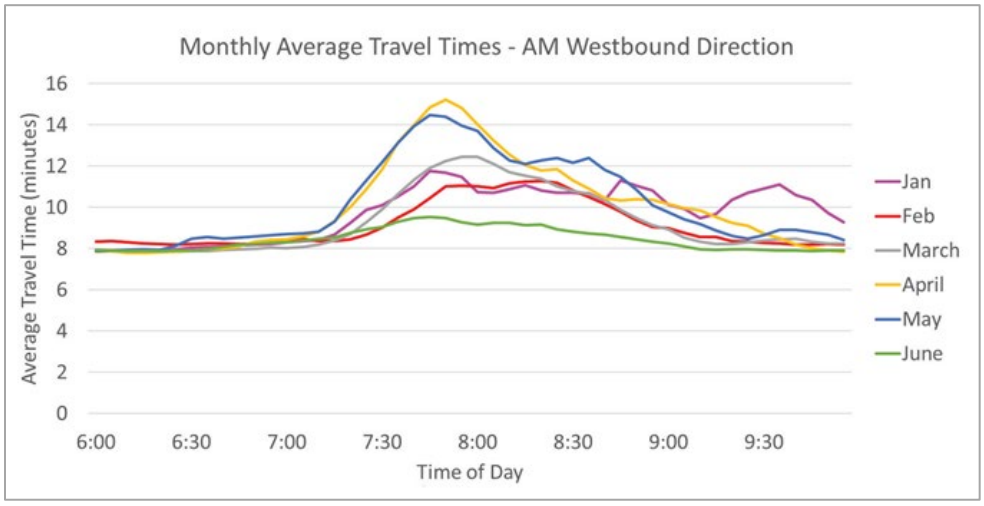
Description of the Program

To provide data and support for performance management requirements imposed under MAP-21, FHWA has arranged for the National Performance Management Research Data Set (NPMRDS) to be available to public agencies such as KTMPO. This dataset provides INRIX probe-vehicle data on the National Highway System (NHS) to public agencies at no charge. Data for additional roads which are not in the NPMRDS and additional analysis tools can be purchased directly from INRIX.

Description of the Data

The NPMRDS data set provides speed and travel time data for the National Highway System (NHS). Data is aggregated in five-minute, fifteen-minute, and one-hour increments for all hours of the day and every day of the year. The dataset is updated with data from the previous month on a monthly basis; it is not real-time data. **Figure 3** is an example of NPMRDS data used in a project to show the variation in monthly travel times by the time of day. In this example, a work zone was implemented in January with increased activity and detours in place through May. Construction was completed and travel times returned to the baseline value in June. This illustrates how the data set can be used to display road performance before and after a project.

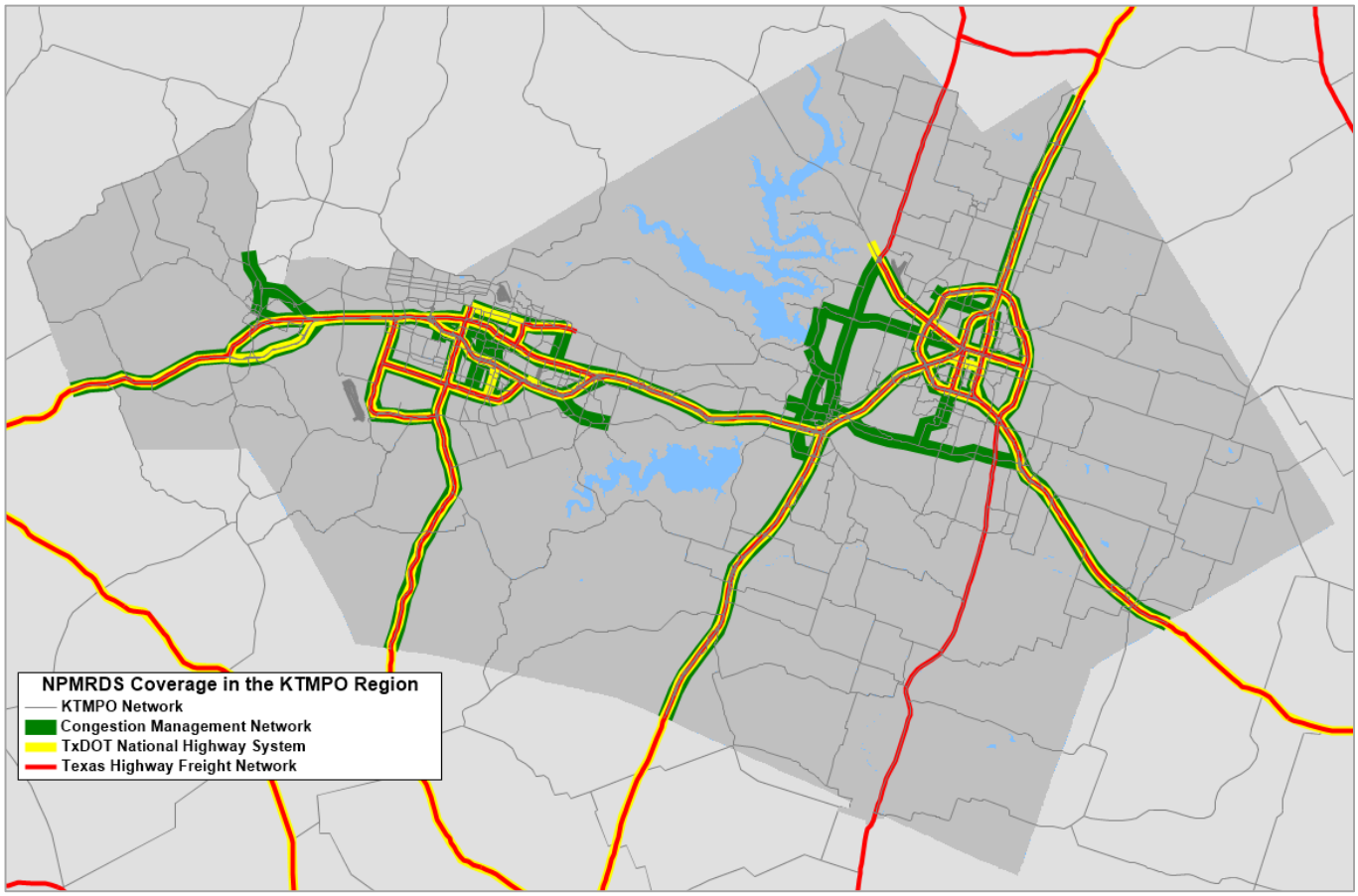
Figure 3: NPMRDS Data Graph of Monthly Travel Times



Geographic and Time Coverage

Coverage of the NPMRDS data set is restricted to the defined National Highway Network (NHS). The NHS in the KTMPO region is shown in **Figure 4** overlaid with the KTMPO congestion management process list of congested links and the Texas Highway Freight Network. The three important planning networks largely overlap, with some exceptions:

Figure 4: NHS and Other Network in the KTMPO Region



- SH 95 and SH 317 north of SH 36 are in the Texas Highway Freight Network but not in the NHS.
- Arterials including SH 9, Trimmier Rd, Roy Reynolds Dr, FM 2410, Loop 121, SH 317, W Adams Ave, FM 93, 31st St, and Industrial Blvd are in the congestion management network but not in the NHS.

Overall, there is an extensive commonality between the three planning networks. The coverage of the NPMRDS is therefore very good for the designated significant roads in the KTMPO region, but does not have coverage of all roads and so is not available for all potential projects unless additional coverage is purchased.

NPMRDS data is available for years as far back as 2008, but they changed vendors from HERE to INRIX in 2017 and the different methodologies make the two vendors' data incompatible. INRIX does offer to create a backfill to 2016 data for a fee.

Implementation and Cost of the Program and Data

The basic program is provided through AASHTO for free, but additional options and extensions are available at additional cost. The exact costs vary depending on which options the state DOT has selected, the size of the study area, and the desired options.

Online access to the NPMRDS data and tools is available at http://www.npmrds.ritis.org.

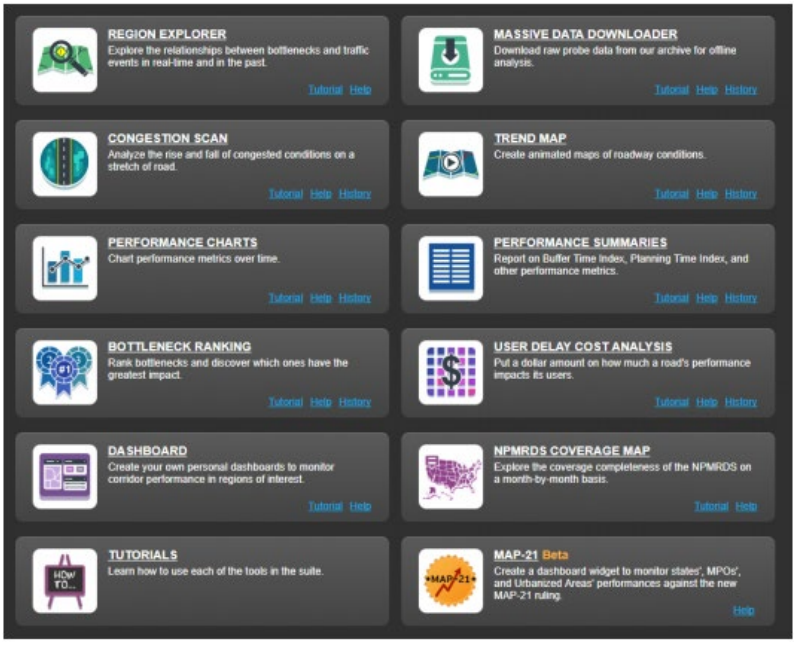
Evaluation of the Program

NPMRDS provides monthly data by time of day for periods as recent as the previous month, which is quite sufficient for evaluating projects in the "Capacity" category. Additionally, the speeds and volumes by periods as small as five minutes support evaluating "Operations" category projects which address peak hour issues.

As the data is based on probe vehicles, the NPMRDS data vendor cautions that there may be gaps and outliers in the data. When a road segment is not covered by a vehicle during a given period, the corresponding data cells are left blank.
Road segments can be as long as ten miles in rural areas, which may impact the accuracy of the data for smaller parts of the segment. Agencies can compensate for this issue by purchasing more detailed data directly from INRIX.

AASHTO also provides an option to purchase data to expand the NPMRDS data to additional road segments beyond the NHS, but this still does not include every road in the region.

Figure 5: NPMRDS Deep Dive Tool Set



The basic NPMRDS access which is provided by FHWA is free but does not include pre-built analytical tools. The data may be imported to Excel for analysis, or additional NPMRDS "Deep-Dive Analytical Toolsets" may be purchased through the American Association of State Highway Transportation Officials (AASHTO) Pooled Fund Study. The additional tools, shown in **Figure 5**, are specifically designed to calculate the data needed for the required MAP-21 performance management reporting. The University of Maryland Center for Advanced Transportation Technology (CATT), the Texas Transportation Institute (TTI), and INRIX collaborate with AASHTO and FHWA to provide full technical support including training webinars, how-to videos, and one-on-one technical help. These tools may be available through TxDOT participation in the Pooled Fund Study.

The *INRIX U.S. Signals Scorecard* is an additional analysis tool available directly from INRIX. It is a free interactive map which shows traffic signal performance for all signals in the region, based on one week's worth of data from October 2020. The map shows the delay per vehicle at each signal. The map is available online at https://inrix.com/signals-scorecard/map/, with an associated technical report describing the data. This is a new product and so far is only reported for October 2020, so further investigation is needed to determine if the data will be available for subsequent years.

A sample of the *INRIX U.S. Signals Scorecard* map for traffic signals in the Killeen, Harker Heights, and Nolanville area is shown as **Figure 6**.

Figure 6: INRIX Traffic Signals Scorecard

Overall, the NPMRDS is a valuable resource of traffic volume and speed data for small time increments, even though it does not have full coverage of all the roads in the KTMPO region. Additional data and tools can be purchased directly from INRIX. The data can provide the precision and accuracy to evaluate the effects of road projects in the "Capacity" and "Operations" categories, and would also be useful for compiling the System Performance Report.

Texas Transportation Institute (TTI) Urban Mobility Report (Congestion Index)

Description of the Program

The Congestion Index is an analysis of regional traffic conditions in 494 urban areas across the nation. The data is broken into two classes: the top 101 urban areas, with data from 1982 through 2017 and detailed reporting, and a further 393 urban areas, with data from 2014 through 2017 and more limited reporting. Killeen and Temple are reported separately in the second group, but no other KTMPO jursidictions are covered in this dataset.

Description of the Data

Data reported for Killeen and Temple include their 2014 through 2017 annual total person-hours of delay, annual hours of delay per commuter, and travel time index. For 2017 only, data is reported for the commuter stress index and freeway planning time index.

The Urban Mobility Report uses highway inventory data from HPMS and traffic and speed data from INRIX.

Geographic and Time Coverage

Within the KTMPO region, the Congestion Index is compiled only for the separate urban areas of Killeen and Temple. Data is available for the years 2014 through 2017.

Implementation and Cost of the Program and Data

There is no cost for this report. The Urban Mobility Report is available for download on the TTI Mobility Division website at https://mobility.tamu.edu/umr/. The website also has appendices describing the analysis methodology and a spreadsheet of summary data.

Evaluation of the Program

TTI continually updates its data collection and analysis methodologies to improve the Urban Mobility Report. As a result, they caution that data or performance measures from different reports should not be used to develop trends.

The congestion data from the Urban Mobility Report is a summary of a specific urban area. Coverage within the KTMPO region is limited to the cities of Killeen and Temple.

Overall, the TTI Congestion index does not appear to be a useful precedent or source of data for this study because its geographic coverage is limited to only the cities of Killeen and Temple, the scale is for the entire city, and the data is not comparable across the time series.

Highway Economic Requirements System – State Version (HERS-ST)

Description of the Program

The Highway Economic Requirements System (HERS-ST) is a software package developed by the FHWA as a tool to evaluate the economic benefits and costs of highway projects. The HERS-ST model can be used to explore the effects of different levels of funding and to determine the optimum mix of projects with the greatest system-wide benefits. Performance measures output by HERS-ST includes roadway segment peak speeds, peak hours of delay, volume to capacity ratios, deficiency ratings, and crash rates before and after the improvements.

The HERS-ST model is a cost-benefits rather than a traffic model. Traffic growth induced by improved capacity and operating conditions is estimated by default models.

Description of the Data

The HERS-ST model uses input data with standard Highway Performance Monitoring System (HPMS) formatting. The analyst defines four five-year funding periods for a total twenty-year analysis period. The HERS-ST model evaluates capacity deficiencies on the roadway system and uses a cost-benefit analysis to evaluate several alternative improvements to determine an economically cost-effective solution. The best alternative is then implemented in the model to report the resulting overall system performance.

The HERS-ST model considers three groups affected by project costs and benefits: users, agencies, and externalities.

User costs are reported as Travel Time Costs, Operating Costs, and Crash Costs. This group typically accounts for 99% of the total costs and benefits in the analysis. Agency costs are associated with the reduction in the cost of routine maintenance. External costs are a reflection of pollution damages associated with vehicle emissions by vehicle class.

Benefits are defined as a reduction in costs as a result of the project, measured as the difference in total twenty-year costs between the No-Build Scenario and the Build Scenario.

Geographic and Time Coverage

As the HERS-ST model is based on HPMS, its geographic coverage is consistent with the KTMPO regional network but does not fully cover all regional roads. Evaluation is defined for alternatives of pavement, width, and alignment.

Implementation and Cost of the Program and Data

The HERS-ST model is developed and supported by FHWA. It can be downloaded without cost from their website at http://www.fhwa.dot.gov/infrastructure/asstmgmt/hersindex.cfm. Documentation, a collection of case studies, and sample screen images showing how HERS-ST was used to evaluate a program of improvements for a network are available at http://www.fhwa.dot.gov/infrastructure/asstmgmt/hersrprep.cfm.

Evaluation of the Program

The HERS-ST model relies on an extensive library of national default values for cost and benefit data, which inherently limits its accuracy for objective evaluation of specific projects.

The most significant features of the HERS-ST model related to this study are that it does not provide any additional data sources and that it performs analysis on the projected roadway system rather than evaluating the performance of individual past projects. It does provide estimates of peak speeds, delays, and crashes, but the estimates are not based on traffic modeling.

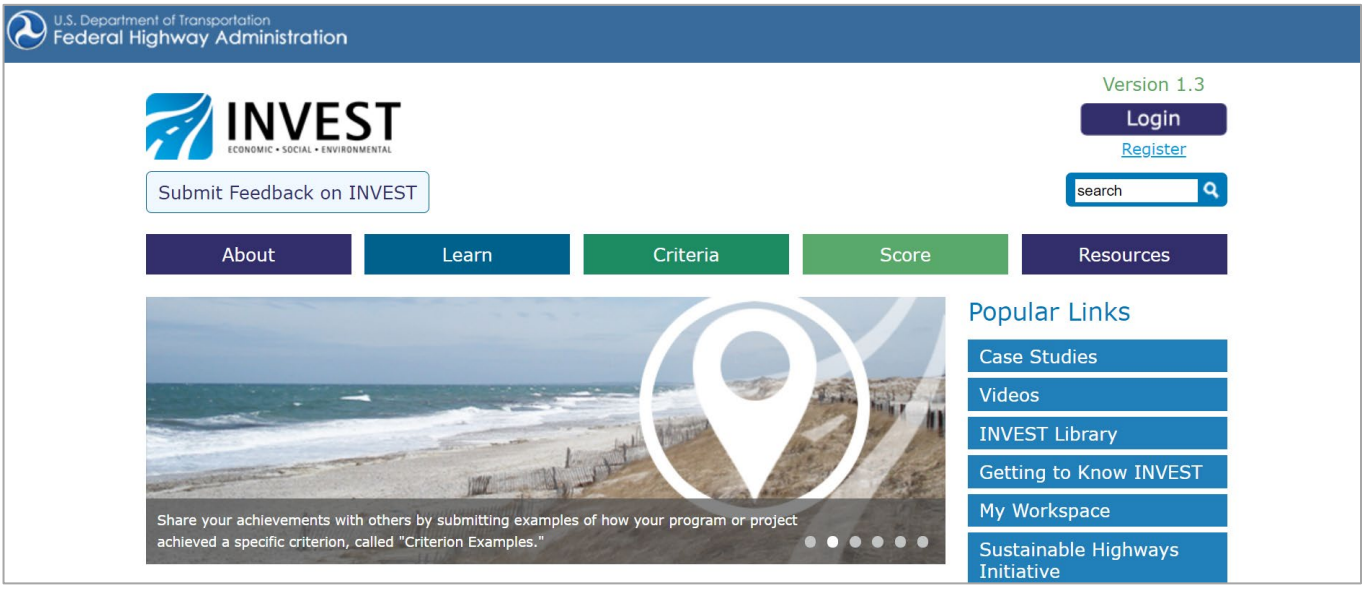
Overall, the HERS-ST model does not appear to be a useful tool for this study.

Infrastructure Voluntary Evaluation Sustainability Tool (INVEST)

Description of the Program

The Infrastructure Voluntary Evaluation Sustainability Tool (INVEST) is a free online tool developed by the Federal Highway Administration (FHWA), available at https://www.sustainablehighways.org/. It is a collection of best practices designed to help transportation agencies integrate sustainability into their programs and projects. The best practices, called criteria, cover the full lifecycle of transportation services, including system planning, project planning, design, and construction, and continuing through operations and maintenance. FHWA developed INVEST for voluntary use by transportation agencies to assess and enhance the sustainability of their projects and programs. A screenshot of the INVEST home page is shown as **Figure 7**.

Figure 7: INVEST Home Page Screenshot



The different module scoring provides recognition for implementing sustainability best practices and helps identify gaps and opportunities. The process can lead to improvements in practice and the identification of cost-effective measures. Although FHWA encourages transportation professionals to use INVEST, it is completely voluntary. The use of INVEST is not intended to encourage comparisons across transportation agencies. The data that transportation organizations use to make their evaluations using INVEST belongs to them. However, INVEST users may choose to share results within their organizations or collaborate with others to ensure a more accurate assessment.

The North Central Texas Council of Governments (NCTCOG) is one of the agencies that pilot tested INVEST in 2012 to assess its long-range transportation plan (LRTP), Mobility 2035, using the System Planning module. More recently, the agency re-scored Mobility 2035 with INVEST Version 1.0 to create a baseline with which to compare and inform NCTCOG's next LRTP, Mobility 2040. A case study of the NCTCOG practice with an overview, reports in .pdf format, and a link to the NCTCOG website is available on the INVEST website at https://www.sustainablehighways.org/779/79/nctcog-using-invest-to-advance-performance-measurement-and-improve-long-range-planning.html.

Description of the Data

INVEST is based on a collection of sustainability best practices called criteria. Each INVEST criterion describes a particular sustainability best practice and assigns it a point value (or weight) according to its relative impact on transportation sustainability. The points associated with the criteria that are achieved for a given program or project are added together to give a total score. The fundamental basis for weighting the criteria is based on the triple bottom line principle, which measures sustainability performance in environmental, economic, and social areas.

INVEST includes 81 criteria organized by module. The tool offers four different modules throughout the life cycle:

- System Planning for States (SPS)
- System Planning for Regions (SPR)
- Project Development (PD)
- Operations and Maintenance (OM)

Each module is independent, measures sustainability across individual criteria, and is evaluated separately. These four sets of criteria comprise a comprehensive self-evaluation tool to aid agencies in evaluating the sustainability performance of their projects and programs. The SPS, SPR, and OM modules are intended for evaluating an agency's programs and the PD module is for the evaluation of projects, from early project planning through construction. The PD module consists of multiple scorecards designed to recognize the varying scope, scale, and context of projects across the country. There is one scorecard each for the SPS, SPR, and OM modules that includes all of the criteria in the respective module. The PD module includes seven scorecard options, depending on the land use and the kind of project being evaluated. One of the scorecards is a custom one for projects that do not fit the pre-defined scorecard options.

The Project Development (PD) scorecard, which is most applicable to project evaluation, is shown as **Figure 8** with all criteria listed. There are thirteen criteria total for the Project Development module. While these criteria are all focused on project development, FHWA recognizes that not all criteria apply to all projects so different combinations of these criteria were used to create scorecards for different types of projects in both rural and urban settings. Each criterion relies on several resources for its evaluation, including many FHWA research papers and case studies. Overall, the scoring system is both quantitative and qualitative.

Figure 8: INVEST Project Development Scorecard

Project Development by Criteria Scorecard

	Paving	Urban Basic	Urban Extended	Rural Basic	Rural Extended	Scenic and Recreational	Custom Core Criteria[1]
PD-01: Economic Analyses			✓		✓		
PD-02: Life-Cycle Cost Analyses	✓	✓	✓	✓	✓		✓
PD-03: Context Sensitive Project Development		✓	✓	✓	✓	✓	
PD-04: Highway and Traffic Safety	✓	✓	✓	✓	✓	✓	✓
PD-05: Educational Outreach		✓	✓	✓	✓	✓	
PD-06: Tracking Environmental Commitments	✓	✓	✓	✓	✓	✓	✓
PD-07: Habitat Restoration		✓	✓	✓	✓	✓	
PD-08: Stormwater Quality and Flow Control		✓	✓	✓	✓	✓	
PD-09: Ecological Connectivity			✓	✓	✓	✓	
PD-10: Pedestrian Facilities		✓	✓			✓	
PD-11: Bicycle Facilities		✓	✓			✓	
PD-12: Transit and HOV Facilities		✓	✓			✓	
PD-13: Freight Mobility			✓		✓		
PD-14: ITS for System Operations		✓	✓		✓		
PD-15: Historic, Archaeological, and Cultural Preservation		✓	✓	✓	✓	✓	
PD-16: Scenic, Natural, or Recreational Qualities			✓	✓	✓	✓	
PD-17: Energy Efficiency		✓	✓	✓	✓		
PD-18: Site Vegetation, Maintenance and Irrigation		✓	✓	✓	✓	✓	
PD-19: Reduce, Reuse, and Repurpose Materials	✓	✓	✓	✓	✓	✓	✓
PD-20: Recycle Materials	✓	✓	✓	✓	✓	✓	✓
PD-21: Earthwork Balance			✓		✓	✓	
PD-22: Long-Life Pavement	✓	✓	✓	✓	✓	✓	✓
PD-23: Reduced Energy and Emissions in Pavement Materials	✓	✓	✓	✓	✓	✓	✓
PD-24: Permeable Pavement	✓	✓	✓	✓	✓	✓	✓
PD-25: Construction Environmental Training		✓	✓	✓	✓	✓	
PD-26: Construction Equipment Emission Reduction	✓	✓	✓	✓	✓	✓	✓
PD-27: Construction Noise Mitigation		✓	✓			✓	
PD-28: Construction Quality Control Plan	✓	✓	✓	✓	✓	✓	✓
PD-29: Construction Waste Management	✓	✓	✓	✓	✓	✓	✓
PD-30: Low Impact Development		✓	✓	✓	✓	✓	
PD-31: Infrastructure Resiliency Planning and Design			✓		✓	✓	
PD-32: Light Pollution		✓	✓	✓	✓		
PD-33: Noise Abatement		✓	✓				
Total Number of Criteria in Scorecard	11	27	34	23	29	27	11

1 – Indicates the core criteria that must be included in the custom scorecard. The user may choose as many additional criteria as desired.

Geographic and Time Coverage

The original INVEST tool was launched in 2012, which was developed using feedback from state and local transportation agency officials and staff as well as professional organizations. The most current update, Version 1.3, was released in 2018. Version 1.3 has renamed some criteria to "Planning and Environmental Linkages (PEL)" to better align to FHWA's PEL program. It also repaired broken resource hyperlinks in the INVEST tool, which is a major challenge for users since it is not continuously updated.

There are no geographic limitations for the INVEST tool and any transportation agency in the U.S. can use the tool. Many state DOTs, MPOs, and other agencies have successfully used this tool to improve the sustainability of individual transportation projects.

Implementation and Cost of the Program and Data

The INVEST tool is web-based and free for all users, so there are no start-up costs. It also does not require a third-party certification and is entirely based on self-evaluation. However, it will take an investment in time to become familiar with the tool and additional time will be needed to use the tool depending on the complexity of the analysis desired. Case studies of implementation costs for INVEST are on their website at https://www.sustainablehighways.org/1469/investing-time.html.

> *The first time an agency uses INVEST there will be a learning curve to become familiar with the tool. Subsequent evaluations will see a significant decrease in time. A typical process for using INVEST first requires a point person to browse the tool and become familiar with how it works. This typically takes about a day. After that, the person will need to identify subject matter experts and have them gather supporting documents that they will each use to develop an initial score. The agency may then choose to hold a workshop so that all experts and stakeholders can reach consensus on their scores and discuss options for sustainability improvements. Finally, the agency can use this final score and the options for improvements discussed, to develop, analyze, and implement recommendations for improving future sustainability practices at their agency.*

Evaluation of the Program

The INVEST tool can be used to evaluate both projects that are planned or currently under development or past projects to identify areas of improvement. The tool covers the full transportation lifecycle, from early system planning, through preliminary design, final design and construction, and continuing through operations and maintenance. It is also free, web-based, easy to use, and specific to transportation projects. Another benefit is that it can be customized as needed. For example, the Illinois Tollway developed supplemental text to add to existing INVEST criteria and developed some of their own criteria based on Tollway-specific needs, as documented at https://www.sustainablehighways.org/1470/relating-invest-to-other-sustainability-tools.html. The INVEST tool is structured to allow these types of additions to measure performance above and beyond current requirements and typical practices, so agencies who use this tool can use it based on what areas of sustainability are most important to the agency.

Since it is designed to be flexible and customizable, it can be used for the System Performance Report and for the evaluation of individual projects. However, using this tool will be a significant task requiring training, gathering data and supporting documents for each criteria score, and agreeing on a final score based on stakeholder feedback. It is limited in scope by its focus only on sustainability.

GreenRoads

Description of the Program

Greenroads is a non-profit organization that has developed a sustainability rating system for road projects. They describe themselves as "LEED for roads."[1] The Greenroads rating system is essentially a framework for measuring and managing sustainability for road projects. Staff and board members of Greenroads are some of the original authors of the FHWA INVEST assessment tool. The two programs are similar, but the Greenroads system is considered more advanced. Greenroads staff considers that INVEST is a great tool to use early in the planning and project development phases, while Greenroads is more oriented to construction.

Overall, the Greenroads rating system is designed to incentivize meaningful performance in sustainable infrastructure planning and construction.

The Greenroads rating system certifies completed projects as Bronze, Silver, Gold, and Evergreen. Additionally, they offer individual professional certifications as a Sustainable Transportation Professional (STP) with four levels: a Brown Badge

[1] LEED stands for Leadership in Energy and Environmental Design and is the most widely used green building rating system in the world.

(Community Advocate), Orange Badge (Project Associate), Blue Badge (Project Manager), or White Badge (Registered Affiliate).

Description of the Data

The rating system is divided into requirements and voluntary credits.

The requirements portion is designed to be reasonably achievable by any project that tries to include them in its design and development. Meeting the requirements carries no points in the scoring; they are instead considered as the baseline for a project to be considered as "green." Requirements cover the full range of the project from early planning to construction and operations in a series of twelve credits.

Voluntary credits are arranged in five core categories and an extra credit category:

- **Environment and Water**, with ten credits.
- **Construction Activities**, with eleven credits.
- **Materials and Design**, with six credits.
- **Utilities and Controls**, with eight credits.
- **Access and Livability**, with ten credits.
- **Extra Credit for Creativity and Effort,** with four credits.

Geographic and Time Coverage

Completed Greenroads-rated projects include the full range of project types including simple reconstruction, enhanced pedestrian areas, routine pavement resurfacing, corridor improvements, stormwater management, and bridge replacements. There are no programmatic restrictions; any construction project can be rated using the Greenroads system.

Implementation and Cost of the Program and Data

There are inspection and certification fees for projects and membership and exam fees for personal credentials. There are also construction and operations cost savings from achieving green targets. Cited benefits of completed projects include savings from using alternative or recycled materials, local sourcing, natural water infiltration, and lifetime operations costs.

Evaluation of the Program

None of the historic MTP projects evaluated in this study and none of the current round of submitted projects directly address sustainability or have been documented as taking advantage of the cost savings from using sustainable practices. The Greenroads rating system can help implement sustainability in the region by incentivizing behavior and by providing documentation, training, and examples.

The Greenroads rating system in concept aligns with the intent of this study to evaluate projects, but is limited in scope to focus only on sustainability. However, where this study has defined categories of projects as Active Transportation, Aesthetics, Capacity, Operations, and Safety, sustainability is an element of each category. It could therefore be implemented not as an additional project category, but as criteria incorporated into the rating system for all projects.

Guidebook for Developing Pedestrian and Bicycle Performance Measures

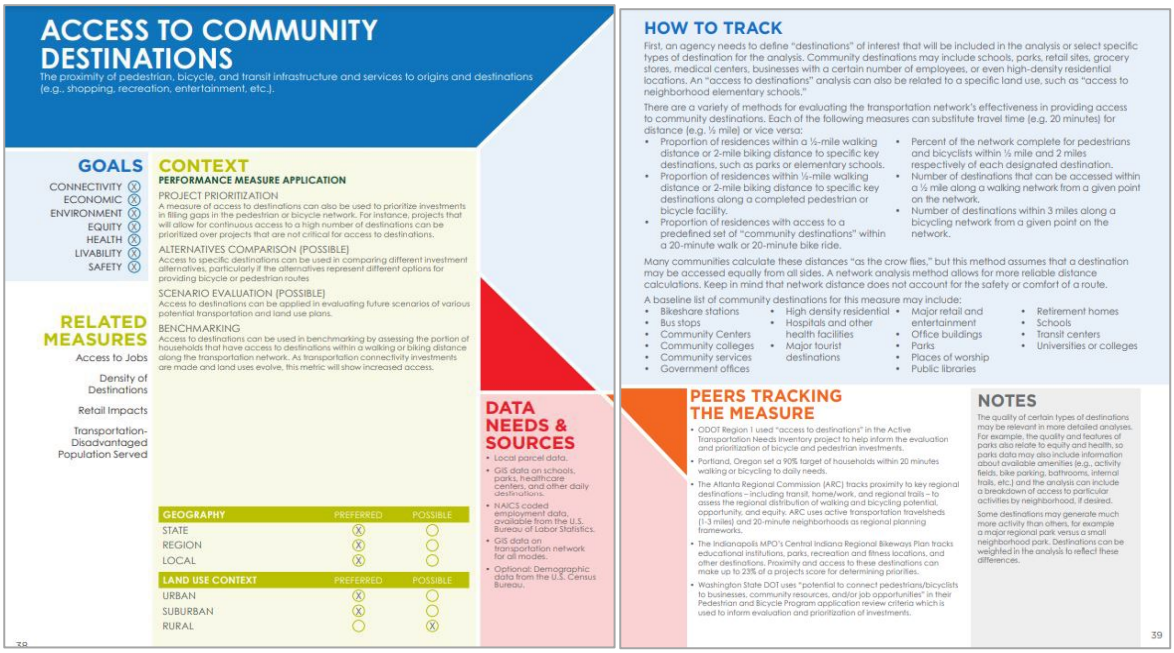
Description of the Program

The Guidebook for Developing Pedestrian and Bicycle Performance Measures was developed by the U.S. Department of Transportation (USDOT) and the FHWA in 2016. The purpose of the guidebook is to provide a starting point to develop performance measures for bicycle and pedestrian projects. It is available online at https://www.americantrails.org/images/documents/GuidebookforDevPedBikePerfMeas.pdf.

The guidebook starts by providing an introduction and background information on bicycle and pedestrian project performance measures. Most of the guidebook focuses on a performance measures toolbox. Each of the strategies in the toolbox relates to seven goals proposed by the guidebook. The goals are Connectivity, Economic, Environment, Equity, Health, Livability, and Safety.

There are twenty performance measures in the toolbox, which range from access to jobs to user perceptions. Each measure is provided in a scorecard format, which contains goals the performance measure is related to, context, related measures, data needs and sources, geography, land use context, how to track, case studies, and notes. A sample scorecard is shown in **Figure 9**.

Figure 9: Performance Measure Scorecard



Description of the Data

The guidebook has developed the performance measures toolbox from a variety of studies and plans from USDOT, state DOTs, and consulting firms. There are no scores associated with the individual performance measures, although they can probably be developed in the future. The purpose of this resource is to provide a starting point on how to develop, gather data, monitor, and track project performance measures.

Geographic and Time Coverage

Each of the performance measures listed in the toolbox has a preferred geography and land use. Geographies are defined as state, region, and local, and land uses are urban, suburban, and rural. The performance measures are crafted using results from studies and plans developed in between 2006 and 2016. The data section for each performance measure is a list of data sources for each specific measure.

Implementation and Cost of the Program and Data

The guidebook is free and provides a starting point to develop or update bicycle and pedstrian performance measures. In addition to this, data sources for each performance measure are listed to help evaluate whether or not they are feasible for implementation.

Evaluation of the Program

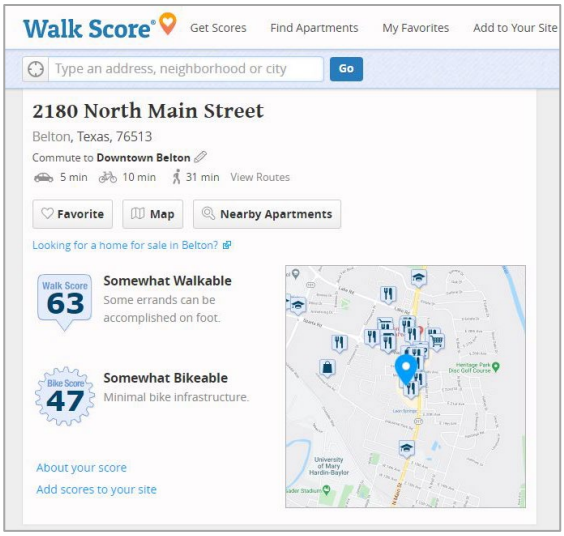
This document can serve as a guide on how to collect data for specific performance measures for active transportation projects in the future. This would not apply to past projects unless specific data mentioned in the guidebook can be accessed for past years for the region. The main intention of this guidebook would be to understand what types of data need to be collected so that future projects can be evaluated after they are complete. Thus, it is not good for past projects but is a useful resource for current and future projects.

Walk Score

Description of the Program

Walk Score is an online tool available at https://www.walkscore.com/ that shows the walkability of an address using a score of 0 (worst) to 100 (best). Walk Score has been popular with real estate websites, allowing users to see the walkability of a neighborhood. Users can search using their address, neighborhood, city, or current location. When a user searches for their location, they are provided with a walk score, transit score, bike score, crime grade, information about the neighborhood and city, and neighborhood rankings. The results also present commuting times by car, bus, bike, or walk to a specific destination that the user can input. Lastly, the results present a map that shows the nearest restaurants, schools, and other amenities as shown in **Figure 10**.

Figure 10: Walk Score Screenshot



Description of the Data

Walk Score uses data from Google, Open Street Maps, U.S. Census, Factual, Great Schools, Open Street Maps, Localeze, and community input. The walk score is calculated by analyzing routes to amenities in a variety of categories such as shopping, food, and schools. Walk Score also mentions that in addition to these sources they also look at population density and roadway features. However, it does not explicitly note if they review whether or not sidewalks are present, which can be an issue when determining the walk score of an area.

Transit scores are determined by looking at transit route data and the distance of the nearest stop to the address the user searches. This is also graded on a scale from 1 to 100. Bike scores are determined by using the United States Geological Survey (USGS), Open Street Map, Census data, and bicycling infrastructure.

Geographic and Time Coverage

Walk Score has data for the U.S., Canada, and Australia. Although it is not explicitly stated, it can be assumed that Walk Score data is updated on an annual basis since they release an annual list of places with the highest walk scores.

Implementation and Cost of the Program and Data

The program is free to use and user-friendly. There is an option to purchase an application programming interface (API) to obtain raw data and shapefiles. The price ranges for these APIs are not listed on the Walk Score website.

Evaluation of the Program

Although Walk Score can be a good starting point in rating the impacts of projects, questions have been raised about its accuracy and scale because the calculations are based on the density of economic activity rather than explicity on walkability. The accuracy of Walk Score is discussed in an article from the Congress for the New Urbanism (CNU) at https://www.cnu.org/publicsquare/2016/09/19/value-walkability-and-walk-score-inaccuracies.

Overall, the Walk Score program could be used as a reference for active transportation projects, but the tool would need to be carefully reviewed for accuracy. Since the Walk Score is a neighborhood-level tool and since it is calculated independently without reference to local projects, it would be useful as a regional measure for the System Performance Report of past conditions rather than for evaluations of specific projects.

Strava

Description of the Program

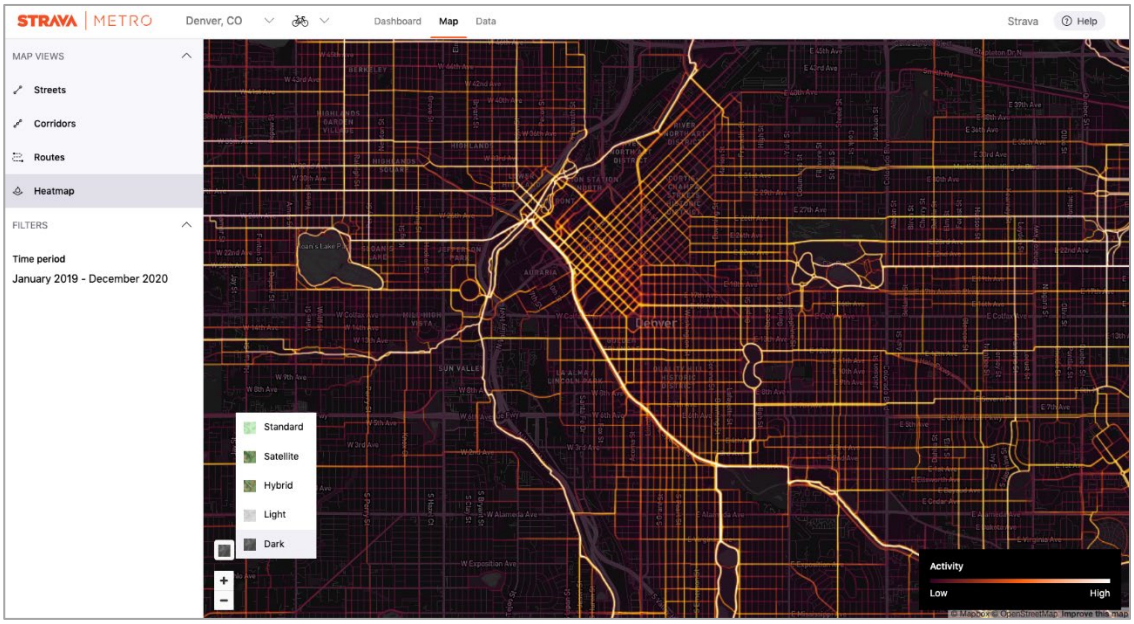
Strava is a mobile phone application used by cyclists, runners, and walkers to track their activity and compete with other users. The application is available online at https://www.strava.com/, but must be downloaded and installed on mobile phones. The application uses the GPS functions of mobile phones to track travel routes. The Strava application is a publicly available interface that allows developers to access Strava data. Strava data can be used to show heat maps of its users' bicycle and pedestrian activity.

Description of the Data

The data comes from Strava users who use the app to track their activities. Since it is GPS data provided through the users' mobile smartphones, it provides fine-grain detail for where cycling and pedestrian activity is most prevalent. Strava strips this dataset of identifiers and aggregates it to protect the privacy of the app's users.

Strava data can be used to show heat maps of its users' activity. A sample STRAVA heat map is shown as **Figure 11**. It helps provide a stronger picture of where there is existing demand for bicycle and pedestrian infrastructure and where gaps exist. It is important to keep in mind that the data only reflects people bicycling and pedestrian activity with the app turned on and in record mode, so it does not provide a complete picture of all these activities in a specific area. Users are also a self-selected group rather than a random sample of the population.

Figure 11: STRAVA Heat Map



Geographic and Time Coverage

The data provided by Strava is real-time data based on the activity of its users. The geographic coverage for Strava is entirely dependent on how many people have the Strava mobile app and are actively using it. Also, Strava is popularly used for athletic or recreational activity rather than commuting by foot or bike. However, research from the Centers for Disease Control cited as a case study at https://medium.com/strava-metro/cdc-finds-strava-metro-data-correlates-strongly-with-census-active-commuting-data-8ab1be0fe130 shows that Strava Metro data closely resembles Census data about biking and walking activity by the general public.

Implementation and Cost of the Program and Data

Data can be used in different ways, depending on the level of technical expertise needed. Strava Metro's new web platform helps partners explore trends, visualize patterns, and draw insights with no technical experience required. However, some level of GIS knowledge is needed to work with the datasets and develop heatmaps of activity.

Strava Metro data is free to any organization that shares its "mission to make cities better for cyclists and pedestrians."

Evaluation of the Program

These maps only reflect people bicycling, running, or walking with the app being turned on and in record mode, so it does not provide a complete picture of all these activities within the communities. However, the heat map does provide a snapshot of relative activity and can be a useful data point in understanding active transportation in a given geographic area. This program would be useful for evaluating projects that would have an impact on the bicycle and pedestrian networks and could provide a general impression of the change in active transportation activity over time. Despite its limitations, it is the most readily available tool suitable for both the System Performance Report and the evaluation of individual projects.

American Association of Retired Persons (AARP) Livability Index

Description of the Program

The Livability Index is a web-based tool developed by the AARP Public Policy Institute to measure community livability on a scale of 0 to 100, with higher scores representing greater livability. It is available online at https://livabilityindex.aarp.org/. Users can search the Index by address, ZIP Code, city, or county and receive an overall score along with scores in each of seven livability categories. The Livability Index takes a holistic approach to understanding livability. It wasn't created to solely

measure the quality of the built environment or the health of residents. It includes those elements, but it also considers engagement, opportunity, and the natural environment. It encourages policymakers and professionals to understand the interrelated nature of livability. The Livability Index is intended for open use by the public to prompt conversations and action regarding livable communities.

Description of the Data

The Livability Index measures 40 metrics and 20 policies across different categories of livability:

- Housing
- Neighborhood
- Transportation
- Environment
- Health
- Engagement
- Opportunity

These metrics pull from over 50 different data sources, including data from the U.S. Census Bureau, American Community Survey, County Business Patterns, Longitudinal Employer-Household Dynamics, U.S. Department of Education, Federal Communications Commission, U.S. Election Assistance Commission, Corporation for National and Community Service, Centers for Disease Control and Prevention, Robert Wood Johnson Foundation and University of Wisconsin Population Health Institute, Dartmouth Institute for Health Policy & Clinical Practice, U.S. Environmental Protection Agency, U.S. Department of Transportation, Bureau of Transportation Statistics, U.S. Department of Housing and Urban Development, National Highway Traffic Safety Administration, Texas A&M Transportation Institute, and private data sources). The data sources are publicly available data provided by federal agencies or research institutions. In some cases, the Index combines multiple sources or creates estimates when data aren't available.

Scores are built from the neighborhood level up. Scores for larger geographies are based on the average scores of neighborhoods within their boundaries. Each category contains 4-9 metrics and 2-5 policies. Each category receives equal weight.

Geographic and Time Coverage

The AARP Livability Index covers all of the U.S. and users can search the Index by address, ZIP Code, city, or county to see the scoring information at a more detailed scale. AARP hopes to update the Livability Index annually, though this depends on financial resources and data availability. The majority of the data sources listed in the current index are from 2018.

Implementation and Cost of the Program and Data

This program and data are free for the user, within the context of the AARP Livability Index, though you cannot access the raw data. The Index is very user-friendly so would require little training time.

Evaluation of the Program

Livability scores are calculated by AARP. Spot checks of scores for various geographies in the region show a lack of accuracy for specific criteria such as transit accessibility, ADA scores, access to parks, and access to grocery stores. The Index is limited to evaluating "Livability" across the defined metrics at geographies including the county, city, and ZIP Code level. There would be no way to see how an individual project impacts the livability of the region or to use the Index to evaluate the project itself. It could be used as a subjective regional measure but is not a candidate for evaluation of individual projects. Since this measure is developed by AARP at their own expense and on their own schedule, there is some risk of its continuing availability and update cycle.

KTMPO Key to Connectivity Survey Program

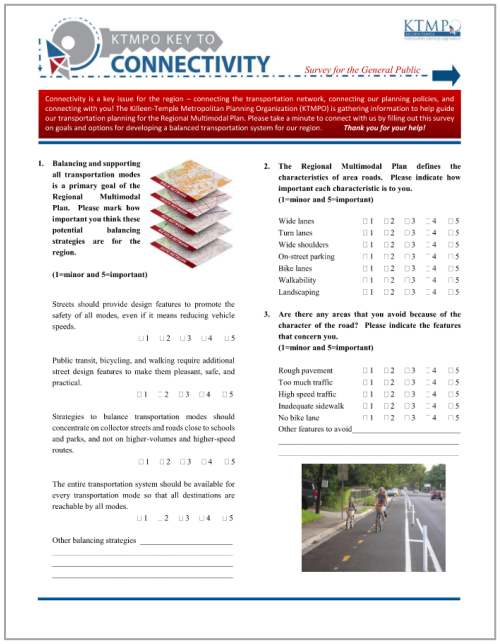
Description of the Program

While objective data is the obvious preference for performance measures, subjective data is necessary to capture the full effect and performance of project types including Aesthetics, Active Transportation, Operations, and Safety. Longitudinal surveys documenting public perceptions before and after a project are therefore a reasonable component of a full-featured performance measurement program.

The KTMPO Key to Connectity Survey Program is an established program which is specifically designed for this type of application. It has already been used for several KTMPO projects including the Regional Multimodal Plan, the Regional Vulnerability and Resilience Framework, and the Freight Transportation and Parking Study.

Figure 12 shows one of the customized survey instruments used on a previous KTMPO project. The program has established the brand of the survey with a consistent logo, a "look and feel" with a color palette similar to other MPO products, and a consistent format. These features work together to establish the brand and official status of the survey and to emphasize the continuity of data collection at the MPO.

Figure 12: Sample KTMPO Key to Connectivity Survey Instrument


KTMPO KEY TO CONNECTIVITY

Survey for the General Public

Connectivity is a key issue for the region – connecting the transportation network, connecting our planning policies, and connecting with you! The Killeen-Temple Metropolitan Planning Organization (KTMPO) is gathering information to help guide our transportation planning for the Regional Multimodal Plan. Please take a minute to connect with us by filling out this survey on goals and options for developing a balanced transportation system for our region. *Thank you for your help!*

1. **Balancing and supporting all transportation modes is a primary goal of the Regional Multimodal Plan. Please mark how important you think these potential balancing strategies are for the region.**

(1=minor and 5=important)

Streets should provide design features to promote the safety of all modes, even if it means reducing vehicle speeds. ☐1 ☐2 ☐3 ☐4 ☐5

Public transit, bicycling, and walking require additional street design features to make them pleasant, safe, and practical. ☐1 ☐2 ☐3 ☐4 ☐5

Strategies to balance transportation modes should concentrate on collector streets and roads close to schools and parks, and not on higher-volumes and higher-speed routes. ☐1 ☐2 ☐3 ☐4 ☐5

The entire transportation system should be available for every transportation mode so that all destinations are reachable by all modes. ☐1 ☐2 ☐3 ☐4 ☐5

Other balancing strategies _____

2. **The Regional Multimodal Plan defines the characteristics of area roads. Please indicate how important each characteristic is to you. (1=minor and 5=important)**

Wide lanes	☐1	☐2	☐3	☐4	☐5
Turn lanes	☐1	☐2	☐3	☐4	☐5
Wide shoulders	☐1	☐2	☐3	☐4	☐5
On-street parking	☐1	☐2	☐3	☐4	☐5
Bike lanes	☐1	☐2	☐3	☐4	☐5
Walkability	☐1	☐2	☐3	☐4	☐5
Landscaping	☐1	☐2	☐3	☐4	☐5

3. **Are there any areas that you avoid because of the character of the road? Please indicate the features that concern you. (1=minor and 5=important)**

Rough pavement	☐1	☐2	☐3	☐4	☐5
Too much traffic	☐1	☐2	☐3	☐4	☐5
High speed traffic	☐1	☐2	☐3	☐4	☐5
Inadequate sidewalk	☐1	☐2	☐3	☐4	☐5
No bike lane	☐1	☐2	☐3	☐4	☐5

Other features to avoid _____

Description of the Data

Data gatherd by the KTMPO Key to Connectity Survey Program can be objective or subjective. The precedent established by previous surveys allows for a customized format with different question types.

Geographic and Time Coverage

Coverage of the survey is completely customizable regarding its distribution and timeframe.

Implementation and Cost of the Program and Data

Costs of the survey have been minimal with email distribution to a limited sample size of identified stakeholders. More extensive sample sizes to develop more robust data on public opinions will require alternative distribution methods, which may include websites, mail outs, and physical distribution of paper surveys. More robust sample sizes will also complicate tallying and analyzing the results.

Evaluation of the Program

The regional performance metrics specified in the System Performance Report are objective by design and are specified with readily available data for the region. Subjective data is therefore not seen as a need for that report. For the evaluation of individual projects, however, the range of project types including Aesthetics, Active Transportation, Operations, and Safety do establish a need for public opinions on non-quantifiable project performance. The established KTMPO Key to Connectivity Survey Program is an appropriate tool for this task, with modifications to survey platforms as necessary to develop an adequate sample size and equitable distribution.

FHWA Systemic Safety Approach

Description of the Program

The history of crashes as detailed in CRIS data is a valuable resource, but analysis has shown that it doesn't track historic safety projects well. Additionally, FHWA has recognized that safety issues can exist in areas which have low traffic volumes and consequently a low number of crashes. To more accurately identify safety issues, FHWA has developed the Systemic Safety Approach. This approach has three elements:

- Roadway attributes are examined to define physical conditions which are safety issues, regardless of the actual crash history.
- Safety attributes are paired with a list of proven safety countermeasures.
- The effectiveness of the countermeasures in a particular application is evaluated.

The Systemic Safety Approach and the more traditional crash histories are balanced together to form a comprehensive approach to safety management. The combined approach references crash hot spots, but also considers multiple locations with similar risk characteristics, sleecting the preferred countermeasures which are appropriate for widespread implementation.

Explanations, data, and rsources on the Systemic Safety Approach are available on the FHWA website at https://safety.fhwa.dot.gov/systemic/.

Description of the Data

While the program is developed by FHWA, the data underpinning the analysis is completely local. It is essentially a detailed inventory of roadway characteristics. Once the safety issues associated with a particular road characteristic are identified, then the appropriate countermeasures are selected from the FHWA Safety Countermeasure Clearinghouse.

Geographic and Time Coverage

Since the core data is CRIS data and locally-developed road inventories, there are no restrictions on geographic or time coverage for this approach.

Implementation and Cost of the Program and Data

Local road characteristic inventories dictate the level of detail in the analysis. While a Systemic Safety analysis can be completed with sparse data, more detailed data will support more refinement of the risk factors.

Evaluation of the Program

The combination of CRIS data and the FHWA Systemic Safety Approach is a comprehensive approach to defining safety risk rather than just crash history. It is strongly aligned with the process of evaluating the effects of individual safety projects and avoids the issue of the crash history being too sparse to demonstrate the performance of the completed safety project.

Potential Performance Management Frameworks

Evaluation of individual projects in the categories of Active Transportation, Aesthetics, Capacity, Operations, and Safety has been demonstrated to be impractical using available data for AADT, volume to capacity ratio, and CRIS crash data. As an alternative, an array of other potential evaluation data and criteria were explored. Using these alternatives, frameworks for each project category can be developed to support a before-and-after analysis of individual projects. This type of analysis can support the review of project effectiveness to ensure that transportation investments are made for projects which have the ability to meet the system goals defined in the MTP.

Active Transportation Projects Evaluation Framework

Project Types and General Framework

Typical project types which may be expected in the Active Transportation category include bicycle lanes, shared use paths, and sidewalks.

The project evaluation framework for Active Transportation projects can be defined by the Guidebook for Developing Pedestrian and Bicycle Performance Measures, the Walk Score, and the AARP Livability Index. All these measures can be supplemented with objective and subjective data collected through KTMPO Key to Connectivity surveys.

Data Components

Active transportation volumes are not reported by and cannot be estimated from TxDOT traffic counts or NPMRDS data. While commercial active transportation counters are available, the cost of setting up the number of counters to gather regional data would be prohibitive. However, counters can be set up and data collected at specific locations before and after individual projects are completed. This field data collection can be supplemented with STRAVA data, with the field data providing verification and correction factors for the STRAVA data and extending the geographic coverage of the volume data. The corrected STRAVA data also has the advantage of being continually updated to real time.

The Walk Score, Livability Index, and KTMPO Key to Connectivity survey can be used to describe the subjective parameters of the transportation system before and after Active Transportation Projects are completed. Since the Walk Score and Livability Index are completed by their respective sources and have issues with precision and accuracy, the KTMPO Key to Connectivity surveys can be used to customize and enhance these programs to better fit local data and conditions.

Implementation

The cost and complexity of implementing an evaluation framework for Active Transportation projects depends on the degree of data collection and customization. A usable framework can be developed referencing only the STRAVA volume data and the Walk Score and Livability Index. Additional active transportation counts, analysis, and customization can serve to enhance the framework.

Aesthetics Projects Evaluation Framework

Project Types and General Framework

Typical project types which may be expected in the Active Transportation category include gateways, landscaping, median treatments, and streetscapes.

The project evaluation framework for Aesthetics projects can be defined by the Walk Score and the AARP Livability Index. Similar to the framework for Active Transportation, this framework can be better fit to local data and conditions through updates based on KTMPO Key to Connectivity survey data.

Data Components

Traffic volumes and crash records are not applicable to the Aesthetics category of projects. Data on the effects of these types of projects is mostly subjective, and is best defined by multi-faceted evaluations such as the Walk Score and the AARP Livability Index.

Implementation

As with the Active Transportation evaluation framework, a framework for Aesthetics can be implemented using only the available programs without modification. However, enhancements based on survey data can provide more precision and a better fit to local conditions.

Capacity Projects Evaluation Framework

Project Types and General Framework

Typical project types which may be expected in the Capacity category include new construction roads, adding lanes to existing roads, and updating the functional class or facility type of existing roads. Complete Streets treatments are a special class of Capacity projects which balance capacity among multiple transportation modes.

The project evaluation framework for Capacity projects should continue to include AADT, but this data by itself is insufficient and is sometimes unavailable. An improved framework should include NPMRDS or INRIX data for better coverage of before-and-after project conditions, particularly the travel speed. The speed data from these sources provides a more localized and precise measure of project effects.

Data Components

Traffic volume and speed data from NPMRDS or INRIX should be collected before and after project completion.

Implementation

NPMRDS data is available without charge on a limited coverage of regional roads, and limited extensions to additional roads is also available without charge through the TxDOT agreement. Additional data on roads not covered in the TxDOT agreement and additional analysis tools are available directly from INRIX with fees charged.

Operations Projects Evaluation Framework

Project Types and General Framework

Typical project types which may be expected in the Operations category include auxiliary lanes, continuous turn lanes, turn lanes at intersections, roundabouts, and traffic signals. Many of these types of projects focus on peak period traffic issues rather than daily issues.

The project evaluation framework for Operations projects should reference AADT, but the primary focus should be on peak period traffic volume and speed data. NMPRDS and INRIX data are the core data for this framework.

Data Components

Traffic volume and speed data from NPMRDS or INRIX should be collected before and after project completion.

Implementation

As with Capacity projects, NPMRDS data is available without charge on a limited coverage of regional roads, and limited extensions to additional roads is also available without charge through the TxDOT agreement. Additional data on roads not covered in the TxDOT agreement and additional analysis tools are available directly from INRIX with fees charged.

Safety Projects Evaluation Framework

Project Types and General Framework

Typical project types which may be expected in the Safety category include chevron signs on curves, friction treatments, texturing and rumble strips, and lane widening without adding new lanes.

Traffic volume data is not useful in detailing safety issues. Paradoxically, CRIS crash histories also can't provide a detailed or reliable description of project effects. The FHWA Systemic Safety approach is a more powerful framework that evaluates safety projects based on their characteristics rather than their crash history.

Data Components

Roadway characteristics, defined countermeasures, and evaluations of the roadway before and after project construction are the core of this framework. This framework is unique in that it is not based on traffic data but rather on roadway characteristics.

While CRIS crash history data is not sufficient to measure the performance of safety projects, it can be an important element in identifying crash hot spots to prioritize systemic safety issues.

Implementation

Implementation of this framework is straightforward, with all needed resources made available through the FHWA website. However, staff training and familiarity with the countermeasures and processes is necessary.

Summary

Transportation performance management has been defined as a strategic approach that uses data to inform investment decisions that are consistent with a set of goals. There are two approaches to evaluating projects. The System Performance Report focuses on the region rather than on individual projects, and evaluates the anticipated future performance of the transportation system to determine how well it progresses towards defined regional performance targets and goals. A complementary view of performance management is provided by this study, which focuses on data and frameworks to evaluate the performance of individual completed projects.

This study evaluated individual completed projects in terms of traffic and congestion, which aligns with the current and the historic project evaluation criteria most closely and which uses only objective data. Early on in the evaluation process, it was quickly apparent that some projects were not directly related to these issues. Therefore, the projects were grouped into five categories based on their issues and purpose:

- Active Transportation
- Aesthetics
- Capacity
- Operations
- Safety

Project attributes were evaluated using the Congestion Management Process (CMP) criteria to determine how well they align with those criteria. The evaluation showed that the available data for AADT, volume to capacity ratios, and CRIS crash history were inadequate for historic project evaluation.

As a result, a set of eleven alternative evaluation data sources and programs were reviewed. Based on the review of the potential criteria, data coverage, and implementation, an evaluation framework using these alternatives can be suggested for each of the five project categories. The suggested frameworks and their relation to the System Performance Report and to this study's evaluation of individual projects is summarized in **Figure 13**.

Figure 13: Summary of Recommended Project Evaluation Frameworks by Project Category

Active Transportation Project Evaluation Framework

Review the **Guidebook for Developing Pedestrian and Bicycle Performance Measures**, the **Walk Score**, and the **AARP Livability Index** to develop appropriate performance measures.

Collect specific bicycle and pedestrian volume counts using specialized counters, and use this data to extend and validate **STRAVA** data.

Customize, augment, and validate these criteria with data collected through the **KTMPO Key to Connectivity** survey program.

The **Walk Score** and the **AARP Livability Index** are regional measures which can support the System Performance Report if they are up-to-date. Performance evaluation of individual projects must rely on specific before-and-after data collection from **STRAVA** or specialized bicycle and pedestrian counters.

Aesthetics Project Evaluation Framework

Review the **Guidebook for Developing Pedestrian and Bicycle Performance Measures,** the **Walk Score**, and the **AARP Livability Index** to develop appropriate performance measures.

Customize, augment, and validate these criteria with data collected through the **KTMPO Key to Connectivity** survey program.

The **Walk Score** and the **AARP Livability Index** are regional measures which can support the System Performance Report if they are up-to-date. Since aesthetics is a strictly subjective criterion, performance evaluation of individual projects must rely on specific before-and-after project information from the **KTMPO Key to Connectivity** survey program.

Data on aesthethics projects would not be reported in the System Performance Report. Performance evaluation for before-and-after conditions of individual aesthethics projects would be appropriate.

Capacity Project Evaluation Framework

Continue to include **AADT** measures from TxDOT traffic counts, but expand the criteria to include travel speed data from **NPMRDS**, supplemented with data from non-covered roads purchased directly from INRIX.

Where large-scale or phased construction is anticipated, data in specific locations may be affected by the construction taking place in other locations. In these cases, the "before" condition data for projects must be anticipated and collected before any of the larger-scale construction begins.

The System Performance Report will rely heavily on regional **AADT** and **NPMRDS** performance data. These types of data will also feed the performance evaluation for before-and-after conditions of individual capacity projects.

Operations Project Evaluation Framework

Continue to include **AADT** measures from TxDOT traffic counts, but expand to include peak period counts and travel speed data from **NPMRDS**, supplemented with data from non-covered roads purchased directly from INRIX.

Data collected through the **KTMPO Key to Connectivity** survey program can help establish the "before" conditions for operations projects, particularly those which have different performance during different periods of the day.

The objective regional **AADT** and **NPMRDS** performance data for operations projects will support the System Performance Report. These types of data will also feed the performance evaluation for before-and-after conditions of individual capacity projects.

Safety Project Evaluation Framework

CRIS crash history data is a valuable asset to define safety hot spots, but must be supplemented by programs such as the **FHWA Systemic Safety Process** in order to capture the full effects of safety projects.

However, the performance measures in the System Performance Report are based on regional-level safety performance, so CRIS data is more appropriate. For evaluation of the performance of individual safety projects, before-and-after comparisons of the roadway characteristics based on the **FHWA Systemic Safety Process** is more appropriate.

In addition, sustainability in project construction and operation is an overarching consideration that affects all categories of projects. Sustainability is not a targeted performance measure for the System Performance Report, but it may be added as a measure using objective performance measure criteria from a regional system such as the **KTMPO Regional Vulnerability and Resilience Framework**. Implementation of a project rating framework like **INVEST** or **GreenRoads** is appropriate for evaluating the before-and-after sustainability performance of specific projects.