APPENDIX 2
STATE OF GOOD REPAIR BENEFIT METHODOLOGY

Maintenance costs should be considered when evaluating benefits of a particular roadway or improvement projects. While a roadway reconstruction might be costly, maintaining the roadway might be more costly and expensive over the life-cycle.

ROADWAY PROJECTS

LIFE CYCLE COST ANALYSIS METHODOLOGY

A life-cycle cost analysis (LCCA) is a tool to determine the most cost-effective option among different competing alternatives to replace or maintain a paved roadway surface, when each option is equally appropriate to be implemented on technical grounds. It is important to note that in this situation most projects will include the replacement of sub-surface drainage, water, and sanitary sewer upgrades that make it necessary to reconstruct the entirety of the facility. As such, the LCCA is being completed not to programmatically justify the reconstruction, but to explore the benefits associated with reconstruction as opposed to continued on-going preventive maintenance of the existing paved roadway surface. These benefits include an analysis of agency costs (actual reconstruction versus repair) as well as user costs (time delay associated with one-time reconstruction versus more frequent repair).

The methodology used in this report assumes that if the proposed project is not implemented, then a full depth concrete panel repair/replacement or mill and overlay would be conducted at select intervals to maintain the functionality of the roadway. Full-depth repair reinstates the structural integrity of the roadway and fixes localized structural problems. The expected life extension for full-depth repair or mill and overlay maintenance is between 6 and 18 years. This analysis assumes that the service life of concrete repairs is 15 years, and mill and overlay for asphalt is 10 years.

Two to three iterations of full depth repair of jointed concrete and mill and overlay repairs would be required over the next 20 years (Table 2.1) The table below shows the schedule for each project.

TABLE 2.1
ROADWAY REPAIR SCHEDULE

Project	*Type of Repair*	*2020*	*2030*	*2035*	*2040*
Century	Mill and Overlay	X	X		X
Monticello	Mill and Overlay	X	X		X

A life cycle savings of roadway repair is quantified for each project using the following methodology:

AGENCY COST FROM CONCRETE PAVEMENT FULL DEPTH REPAIR

According to TxDOT's 2017 Average Low Bid Unit Prices, the cost for full-depth repair of joint concrete pavement is $205 per square yard (2017$). The total cost of full-depth repair can be calculated using the following formula:

Cost (Full-Depth Repair) = L * W * 0.11111 * P * C

L = project length
W = width of concrete pavement
P = the unit price of full-depth repair of jointed concrete pavement (2018$)
C = percentage of concrete in need of repair
0.11111 = conversion factor between square feet and square yards

An additional 15% of the estimated total cost is added for traffic control and mobilization and 6% is added for design.

AGENCY COST FROM PAVEMENT MILL AND OVERLAY

According to TxDOT's 2017 Average Low Bid Unit Prices, the cost for mill and overlay is $174,640 per mile (2017$). The total cost of mill and overlay can be calculated using the following formula:

Cost (Mill and Overlay) = L * W * P

L = project length
W = width of concrete pavement
P = the unit price of mill and overlay (2018$)

L is the project length
W is the width of concrete pavement
P is the unit price of mill and overlay in base year dollars

An additional 15% of the estimated total cost is added for traffic control and mobilization and 6% is added for design.

USER COST

During the repair treatment, there will be a user cost incurred due to delays. During construction, a driver would have to merge lanes, reduce speed, or even wait in a queue. Thus, travel time during construction is anticipated to be increase by 50% during construction periods. The total free flow time that was calculated (assuming standard free flow at the speed limit) would be doubled.

Repairs are assumed to take approximately 60 days per mile. Per H-GAC, the average Value of Travel Time (VoTT) is $16.69/hour for each person, and vehicle occupancy is 1.25 persons/vehicle. Traffic volumes are obtained from the latest H-GAC conformity model runs and/or TxDOT traffic volume counts. The annual growth rate for traffic volumes is calculated through looking at a small network surrounding the project. The repair cost would be incurred multiple times, and the annual traffic volume should be adjusted for the year of repair.

The total user cost during the construction period would be calculated as follows:

Cost (User) = AADT * PPV * VoTT * T * D

AADT for year n = AADT for current year*$(1+x\%)^n$
-x% is assumed to be the annual growth rate; this is derived from the H-GAC model
PPV = 1.25
VoTT = $16.69
T = Travel time (in hours) during construction
D = number of weekdays during construction period

ANALYZING RESULTS

The agency and user costs are combined for an estimated cost for conducting repairs during the next 20 years, summed up and discounted at a 3% and 7% rate. The proposed projects would reconstruct the concrete pavement (along with other improvements) along the corridor. The service life of the reconstructed roadway would be 40 years. With the new concrete pavement in the reconstruction, no full depth repair of existing pavement would be required. Therefore, the life cycle cost savings from the roadway maintenance during the next 20 years would be the cost of maintenance of the concrete of pavement or mill and overlay.

BACK OF CURB PROJECTS

For sidewalk and other improvements that improve the walkability of an area, there is a presumed maintenance benefit from automobile trips being converted into pedestrian trips, as there will be fewer miles traveled on the roadway. To quantify the benefit, internal trips inside a half mile radius of the project corridor are assumed to be eligible for conversion. An internal trip is defined as a trip with both the origin and destination inside the half-mile radius of the project corridor. The Houston-Galveston Area Council (H-GAC) assumes that back of the curb improvements will result in 26% of internal trips being converted from automobile to pedestrian trips, with an average one-way walking trip length of 0.50 mile. The methodology involved in this report assumes (based on the field inventory completed) that the existing corridor conditions do not currently support pedestrian activity. Thus, the back of curb improvements are assumed to allow the conversion of 26% of existing internal trips to pedestrian trips. The vehicle miles traveled (VMT) reduced from the back of the curb improvements is calculated by multiplying the number of trips reduced by the half mile average trip length.

The reduction in VMT traveled on roadways thereby reduces the need for maintenance on roadways. Research conducted by the Victoria Transport Policy Institute found that the average maintenance cost per VMT is 5.27 cents in urban areas (2017$).[1] Therefore, the total maintenance avoided by reducing VMT is as follows:

Maintenance Savings = VMT * MC

VMT = VMT reduced in project opening year*$(1+ x\%)^n$
-x% is assumed to be the annual growth rate; this is derived from the H-GAC model
-n is the number of years
MC = Maintenance Costs per VMT (assumes $0.0527)

[1] Victoria Policy Institute. Transportation Cost and Benefit Analysis II – Roadway Costs. Retrieved in July 2017 from http://www.vtpi.org/tca/tca0506.pdf.

Accumulated benefits from 2020 to 2040 are summed up and discounted at a 3% and 7% rate.