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Final Report

Utility Cut Impact Assessment and Fee Development

Davis, CA

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Executive Summary

The purpose of this study was to assess and quantify pavement damage caused by utility cuts in the City of Davis (City) and to develop an appropriate fee schedule for the City to recover any costs associated with such damage if they exist.

To accomplish this, NCE evaluated both functional and structural damage at 24 test sites with varying functional classes and PCIs throughout the City. The functional evaluation compared PCIs and corresponding percent reductions in pavement life while the structural evaluation compared deflection measurements and required overlay thicknesses.

Key findings of the study include:

- Sixty-seven percent of test sites exhibited both functional and structural damage due to cuts and 96 percent of test sites exhibited at least one form of damage.
- On average, the PCI of sections with cuts was approximately 5 points lower than those without cuts.
- The average percent reduction in life due to cuts was 6 percent.
- Sixty-three percent of test sites exhibited damage 2 feet from the edge of the patch, thus indicating that the zone of influence extends past the current restoration standard repair area.
- Fifty-four percent of test sites needed an average additional overlay thickness of 1.5 inches in the cut or zone of influence to compensate for structural damage.
- Functional class and PCI were the best indicators of how much damage was caused by utility cuts.

These findings informed the development of a utility cut damage fee schedule for the City of Davis, which is provided in the following table.

Functional Class	PCI	Damage Fee ($/SF)
Arterial	All	$1.04
Collector & Residential	≥70	$1.14
	<70	$1.51

The information required to implement this fee includes the functional class, the PCI at the time of cut, and the trench dimensions. NCE recommends that the fee schedule be indexed based on inflation and adjusted annually to reflect appropriate repair costs.

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1 Introduction

Utility companies often need to cut existing pavements to install, access, and service underground equipment. Ideally, all underground utility maintenance would be performed prior to pavement rehabilitation or reconstruction so that new pavement structures will not be cut. However, despite the best coordination, utility cuts cannot always be avoided; unanticipated work is often required to maintain essential public services.

With this in mind, local agencies have sought answers to the following questions:

- How do utility cuts affect pavement performance?
- If pavement performance is reduced, what is the corresponding financial impact?

To answer these questions, public agencies and utility companies have sponsored engineering investigations and studies (Todres and Baker 1996). Although some of these are available for review, many such studies are performed in-house or by consulting companies and are therefore unpublished or difficult to access. In addition, the impact of utility cuts on pavement performance can vary significantly based on site- and agency-specific information.

Consequently, the purpose of this study was to assess and quantify pavement damage caused by utility cuts in the City of Davis (City) and to develop an appropriate fee schedule for the City to recover any costs associated with such damage.

1.1 DAMAGE MECHANISMS

The impact of utility cuts on pavement performance can vary significantly depending on a variety of factors, such as:

- Existing pavement condition, structure, and age
- Location, orientation, and extent of the utility cut
- Environmental factors
- Traffic loads
- Restoration practices and standards

Furthermore, quantifying utility cut impacts also depends on local maintenance treatments and costs. Therefore, to really understand the impact of utility cuts on roadway performance for a particular agency, a site-specific study and analysis must be performed.

Underground utility work can damage pavements in three general ways, as illustrated in Figure 1. First, cutting a pavement structure creates an entry point for water, which can damage the underlying pavement layers. Second, removing pavement layers creates a plane of weakness where the pavement structure may not be adequately supported laterally – particularly during underground utility maintenance, but also after restoration. This lack of lateral support can cause the trench sidewalls to bulge into the trench and weaken the material under the existing pavement. This weakened area is known as the zone of influence. Third, repairing the pavement can introduce roughness if the quality of the repair does not closely match the adjacent pavement structure. Rough pavements can cause vehicles to bounce, which creates greater loads on the pavement and leads to more rapid deterioration (Tarakji 1995, Wilde et al. 2002).

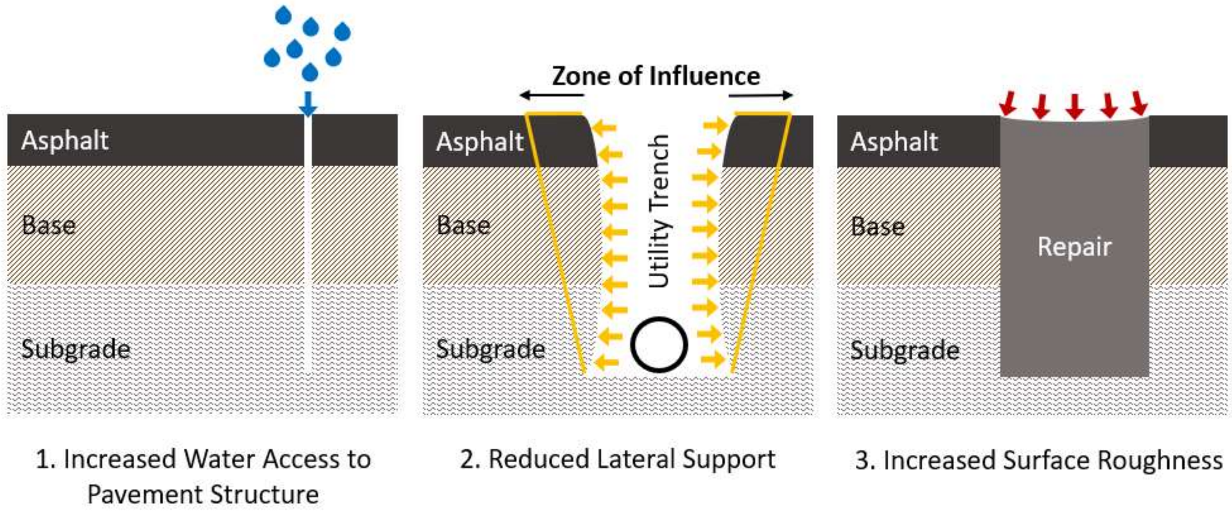

Figure 1. Utility Cut Damage Mechanisms

These damage mechanisms can reduce the condition and structural capacity of a pavement, which reduces the pavement life within and adjacent to the utility cut (Stevens et al. 2010). Multiple utility cuts on the same street or within a small area can magnify this impact (San Francisco Department of Public Works 1998, Tarakji 1995).

1.2 LITERATURE REVIEW

In previous studies, researchers have used deflection testing, condition surveys, and statistical analyses to quantify the impact of utility cuts on pavement performance. The performance impacts are typically expressed as a loss of structural capacity and/or a decrease in pavement condition. Results have shown that utility cuts can reduce pavement life by 15 to 55 percent, which consequently costs local agencies millions of dollars in premature street repair and remediation expenses. Studies have also shown that underground utility work affects not only the excavated area, but often weakens the adjacent pavement. The affected area, or zone of influence, varies based on agency and location but typically extends as much as 4 to 5 feet beyond the edge of the cut.

To help restore some of the lost structural capacity and pavement life caused by cutting pavement, many agencies have put restoration standards in place. Restoration standards in California typically include a T-Cut along with a restoration treatment that may be as extensive as treating the full lane for the entire affected block with a thin mill and overlay or surface seal.

To recover the cost of pavement damage associated with performing underground utility work, many agencies impose utility cut damage fees. In California, these fees are typically based on factors such as functional classification, pavement age, PCI, and/or utility cut depth and orientation (longitudinal or transverse).

Appendix A provides a detailed literature review of previous studies on the impact of utility cuts on pavement performance, as well as additional details gathered from California agencies on restoration standards and other policies established to address pavement degradation caused by utility cuts.

2 Technical Approach

The impact of utility cuts on pavement performance can be quantified in two forms:

1. Structural deterioration – reduced pavement strength
2. Functional deterioration - shortened pavement service life

Since utility cuts can cause damage to pavements both structurally and functionally, both types of evaluations are crucial in developing a fee to compensate for appropriate damages. Therefore, for this study parallel quantification and analysis of both structural and functional deterioration were used to identify in-situ damage and inform the development of an appropriate utility cut fee schedule. The flowchart shown in Figure 2 outlines the study methodology.

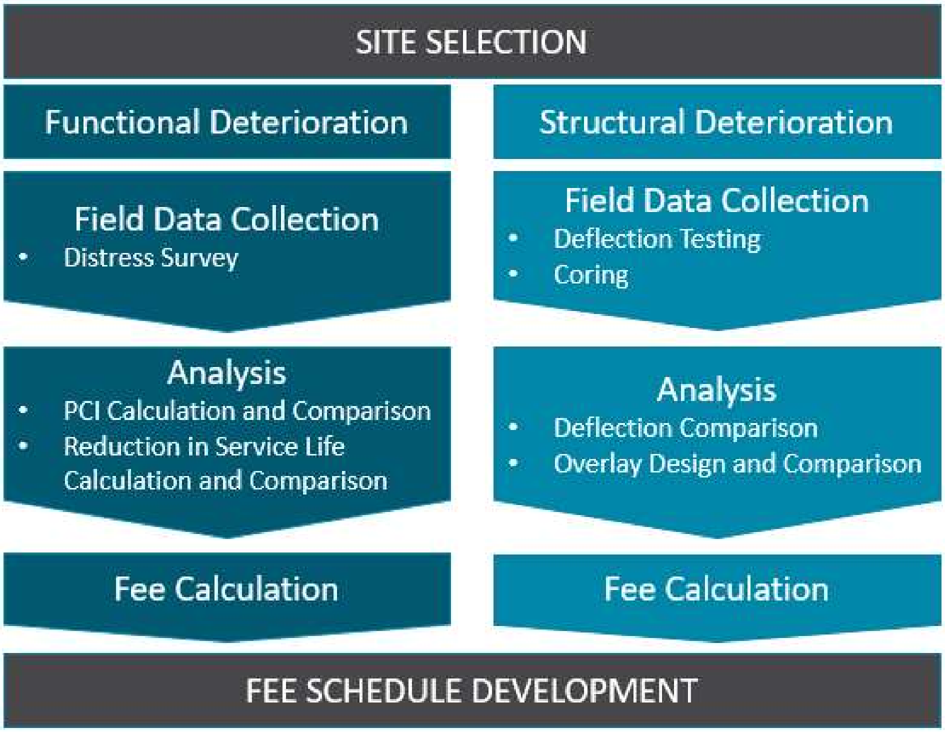

Figure 2. Study Methodology

Functional and structural field data were collected at 24 test sites throughout the City. As shown in Figure 3, each test site included a section with a utility cut and an adjacent section without a cut (hereinafter referred to as a "no-cut" section). The cut and no-cut test sections were typically 100 feet long and one or more lanes wide and were located as close to each other as reasonably possible, considering other cut locations and traffic-control needs.

Figure 3. Example Test Site

To ensure the results would be generalizable and representative of City streets, the test sites were selected to include a balanced representation of all functional classifications (arterial, collector, and residential) and cover a wide range of pavement conditions.

3 Functional Evaluation

Functional deterioration is evaluated in terms of the Pavement Condition Index or PCI, which ranges from 0 to 100. Pavement in excellent condition has a PCI above 85, pavement in good condition has a PCI between 70 and 84, pavement in fair condition has a PCI between 50 and 69, pavement in poor condition has a PCI between 25 and 49, and pavement in failed condition has a PCI below 25.

The PCI is calculated from pavement distress data collected through visual inspection surveys. The degree of pavement deterioration is affected by the types of distresses present as well as their severity and quantity. A section exhibiting functional deterioration due to a utility cut will have a PCI lower than that of its paired no-cut section.

The following subsections present the process and results involved in the functional evaluation portion of this study, including collecting distress data, calculating and comparing the PCI values for the cut and no-cut sections, and calculating and comparing the corresponding reductions in service life. These data were then used to calculate the corresponding cost of functional damage due to pavements caused by utility cuts.

3.1 FIELD DATA COLLECTION

At each set of test sites in the City, NCE performed separate distress surveys for the cut and no-cut sections. Distress surveys were performed in accordance with ASTM D6433 (ASTM 2020) and included identification of each distress type and severity, as well as a measurement of the extent. The PCIs for both the cut and no-cut sections were then calculated per ASTM D6433.

3.2 PCI RESULTS

Table 1 lists the calculated no-cut and cut PCIs for all test sites. At 88 percent of the test sites the cut PCI was lower than the no-cut PCI, thus indicating the presence of functional deterioration due to cuts. This trend is illustrated in Figure 4, which shows the cut PCI compared to the no-cut PCI with a diagonal line illustrating a one-to-one relationship. Data points that fall above the line indicate locations with functional damage. Two locations showed no change in PCI due to the cut and one location exhibited functional improvement.

On average, the PCI of the no-cut sections was 52.6, while the average PCI of the cut sections was 47.5. This average drop of 5.1 PCI points is primarily due to the presence of the cut but is also contributed to by additional longitudinal and transverse cracking near the cut. Figure 5 shows propagating longitudinal and transverse cracking near the patch on John Jones Road.

Table 1. PCI Data

Site ID	Functional Classification	$PCI_{No\text{-}Cut}$	PCI_{Cut}
MACE	Arterial	88	72
FST		84	82
5TH		71	69
JOHN		65	65
ANDER		58	53
COV1		52	43
COV2		51	43
COV3		43	29
2ND	Collector	85	84
OAK		69	65
HAMEL		60	59
SYCA		56	49
CALAV		43	43
MARIN		40	37
CHILES		32	23
14TH		6	4
DRAKE	Residential	81	66
SCAMP		57	46
TAMAR		47	43
BROWN		38	34
WAKE		36	32
PINE		35	41
COLBY		35	30
WILLO		30	29

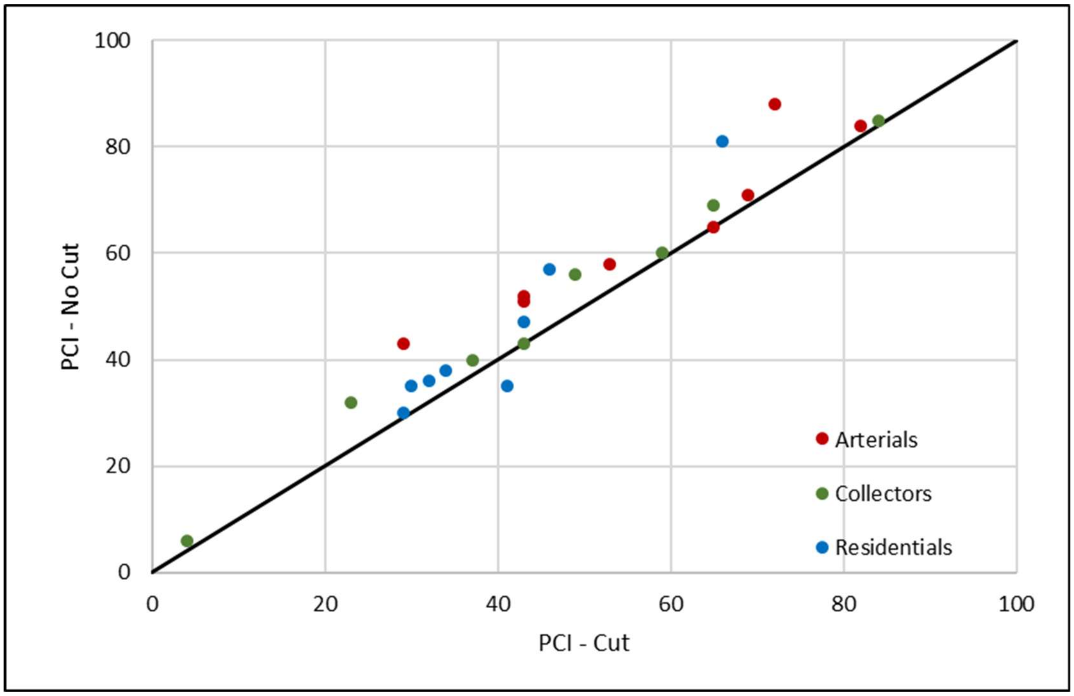

Figure 4. Comparison of No-Cut and Cut PCIs

Figure 5. Propagating Cracks Near Patch on John Jones Road.

3.3 REDUCTION IN SERVICE LIFE

A reduction in PCI corresponds to a reduction in remaining service life (RSL) of a pavement. A pavement's RSL is the number of years until it falls into failed condition (i.e., a pavement's RSL reaches zero when the PCI drops below 25). Based on the asphalt concrete (AC) family deterioration curves in StreetSaver® (a pavement management decision-support tool used by the City), shown in Figure 6, arterials have a total service life of approximately 27 years, collectors have a total service life of 26 years, and residentials have a total service life of 39 years.

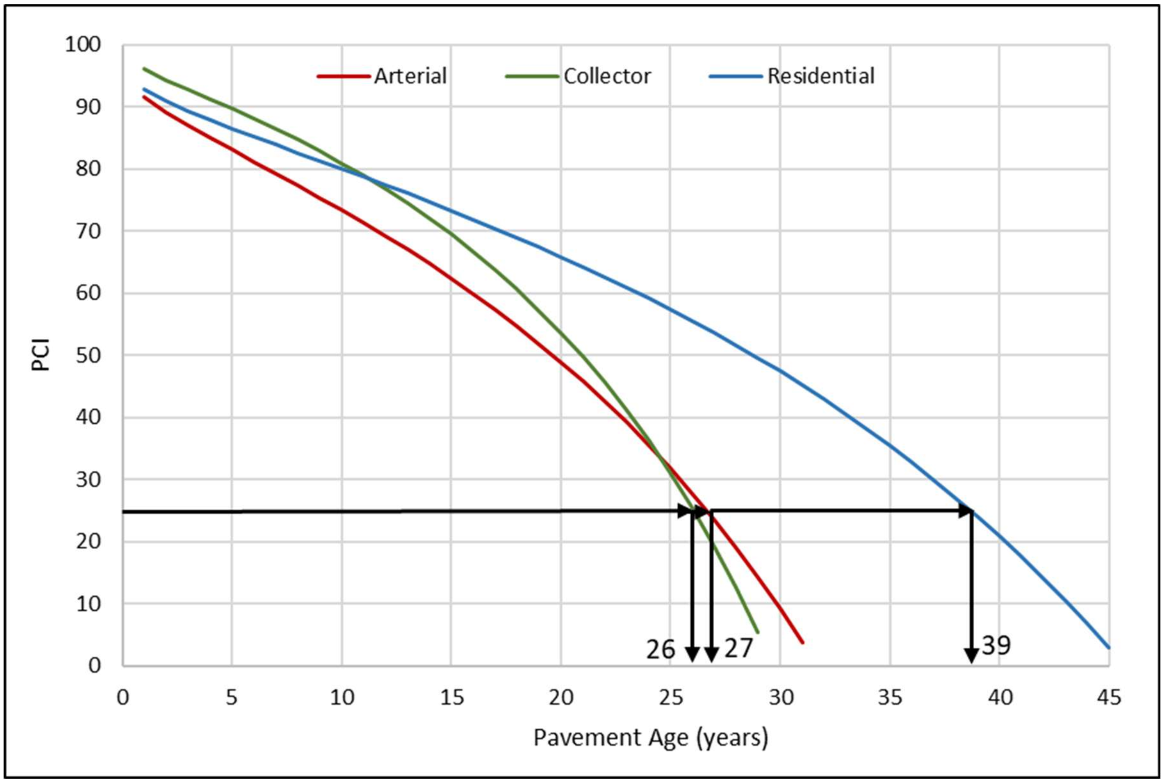

Figure 6. Pavement Deterioration Curves for Streets in Anaheim

For each test site, the percent reduction in service life due to utility cuts was estimated using the StreetSaver® family deterioration curves. For example, South Campus Way, a residential street with no cuts had a PCI of 57, which corresponds to an effective pavement age of 25 years. In contrast, the paired section that had been cut had a PCI of 46, which corresponds to an effective pavement age of 31.5 years. Consequently, the service life of the pavement was reduced by approximately 5.5 years by cutting the pavement. This corresponds to a reduction in service life of 14.1 percent (5.5 years/39 years). This calculation was performed for all test sites and the resulting percent reductions in life were plotted relative to the PCIs of the no-cut sections (See Figure 7). The percent reduction in service life ranges from -6 to 31 percent and has an average value of 6 percent. The single location with a negative percent reduction in life indicates that life was added to the pavement (PCI increased). This test location was a residential street with a low PCI resulting from fatigue and longitudinal and transverse cracking some of which was likely repaired when the trench was placed thus causing a slight increase in PCI.

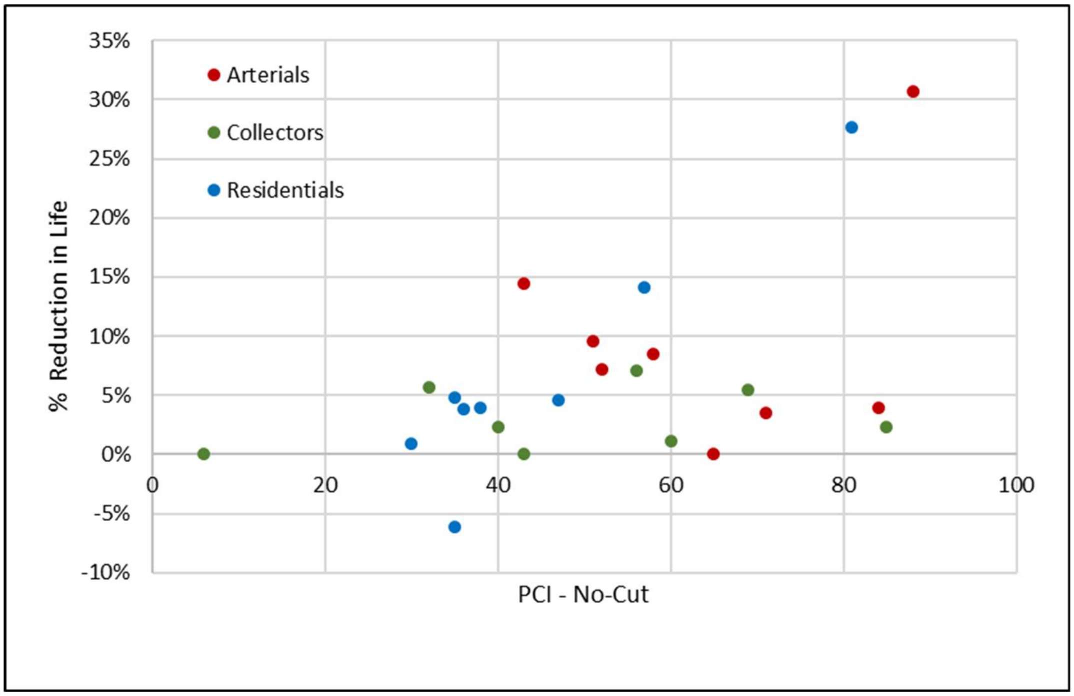

Figure 7. Pavement Deterioration Curves for Streets in Anaheim

3.4 DAMAGE COST

To quantify the cost impacts of the reduction in service life due to cuts, the estimated percent reduction in life was multiplied by typical pavement reconstruction costs for the City, which were obtained from the City's recently updated pavement management decision tree[1]:

- Arterials: $10.36 per square foot
- Collectors: $8.67 per square foot
- Residentials: $7.53 per square foot

For example, South Campus Way (site SCAMP), had a 14.1 percent reduction in service life. For a residential street, the typical cost of pavement reconstruction is $7.53 per square foot. Therefore, the cost corresponding to the reduction in service life due to the cut is $1.06 per square foot (0.141*$7.53/square foot). Table 2 presents the percent reduction in life due to cuts and the corresponding equivalent cost for all test sites.

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[1] A pavement management decision tree maps out the City's typical maintenance and rehabilitation treatment strategies by functional class and pavement condition.

Table 2. Percent Reduction in Life and Corresponding Equivalent Cost

Site ID	Functional Classification	$PCI_{No\text{-}Cut}$	Reduction in Life (%)	Reduction in Life Cost Equivalent ($/SF)
MACE	Arterial	88	31%	$3.17
FST		84	4%	$0.41
5TH		71	4%	$0.37
JOHN		65	0%	-
ANDER		58	8%	$0.88
COV1		52	7%	$0.74
COV2		51	10%	$1.00
COV3		43	14%	$1.50
2ND	Collector	85	2%	$0.20
OAK		69	5%	$0.47
HAMEL		60	1%	$0.10
SYCA		56	7%	$0.61
CALAV		43	0%	-
MARIN		40	2%	$0.20
CHILES		32	6%	$0.49
14TH		6	0%	-
DRAKE	Residential	81	28%	$2.08
SCAMP		57	14%	$1.06
TAMAR		47	5%	$0.35
BROWN		38	4%	$0.30
WAKE		36	4%	$0.29
PINE		35	-6%	-
COLBY		35	5%	$0.36
WILLO		30	1%	$0.07

4 Structural Evaluation

The relative loss of structural capacity caused by utility cuts can be evaluated by comparing the deflection measurements and required overlay thicknesses of similar test sections (i.e., the same pavement structure, traffic demands, environmental conditions) both with and without cuts. Pavements with higher deflection measurements represent weaker pavement structures. Weaker pavement structures require thicker overlays, thus increasing the cost of rehabilitation.

The following subsections present the process and results involved in collecting, analyzing, and comparing deflection measurements and required overlay thicknesses during the structural evaluation portion of this study. These data were then used to calculate the corresponding cost of structural damage due to pavements caused by utility cuts.

4.1 FIELD DATA COLLECTION

At each set of test sites (cut and no-cut sections), NCE performed falling weight deflectometer (FWD) testing in general accordance with the California Test Method 356 (Caltrans 2013). During testing, the FWD delivered a nominal 9,000-pound impulse load to the pavement surface and measured the resulting pavement response in terms of deflection using a geophone directly under the load. A minimum target of 21 deflection measurements were taken at each of three measurement locations, as shown in Figure 8:

a) Within the no-cut section
b) Two feet from the edge of the cut (within the zone of influence)
c) Within the cut section

a) Within the no-cut Section b) Two feet from the edge of the cut c) Within the cut

Figure 8. FWD Testing Layout

Since the City's restoration standard requires a T-cut patch, the exact edge of the cut at the test sites was unknown. NCE therefore performed deflection testing 2 feet from the edge of the patch to see if structural damage was occurring outside the restoration area.

Additionally, coring was performed within the no-cut section and the original asphalt concrete (AC) thickness was measured.

4.2 DEFLECTION RESULTS

Comparing the deflection data across the three measurement locations identifies the relative loss of structural capacity resulting from the presence of utility cuts. For example, a section exhibiting damage due to a cut would have higher deflections in the cut or zone of influence than in the no-cut section.

Figure 9 shows the average measured deflections for each test site organized by the PCI of the site's no-cut section. Sections exhibiting damage due to cuts are represented by red lines. Green lines represent sections where the deflections in the cut and zone of influence were lower than the deflections in the no-cut section, meaning the repair and restoration were performing well at the time of testing.

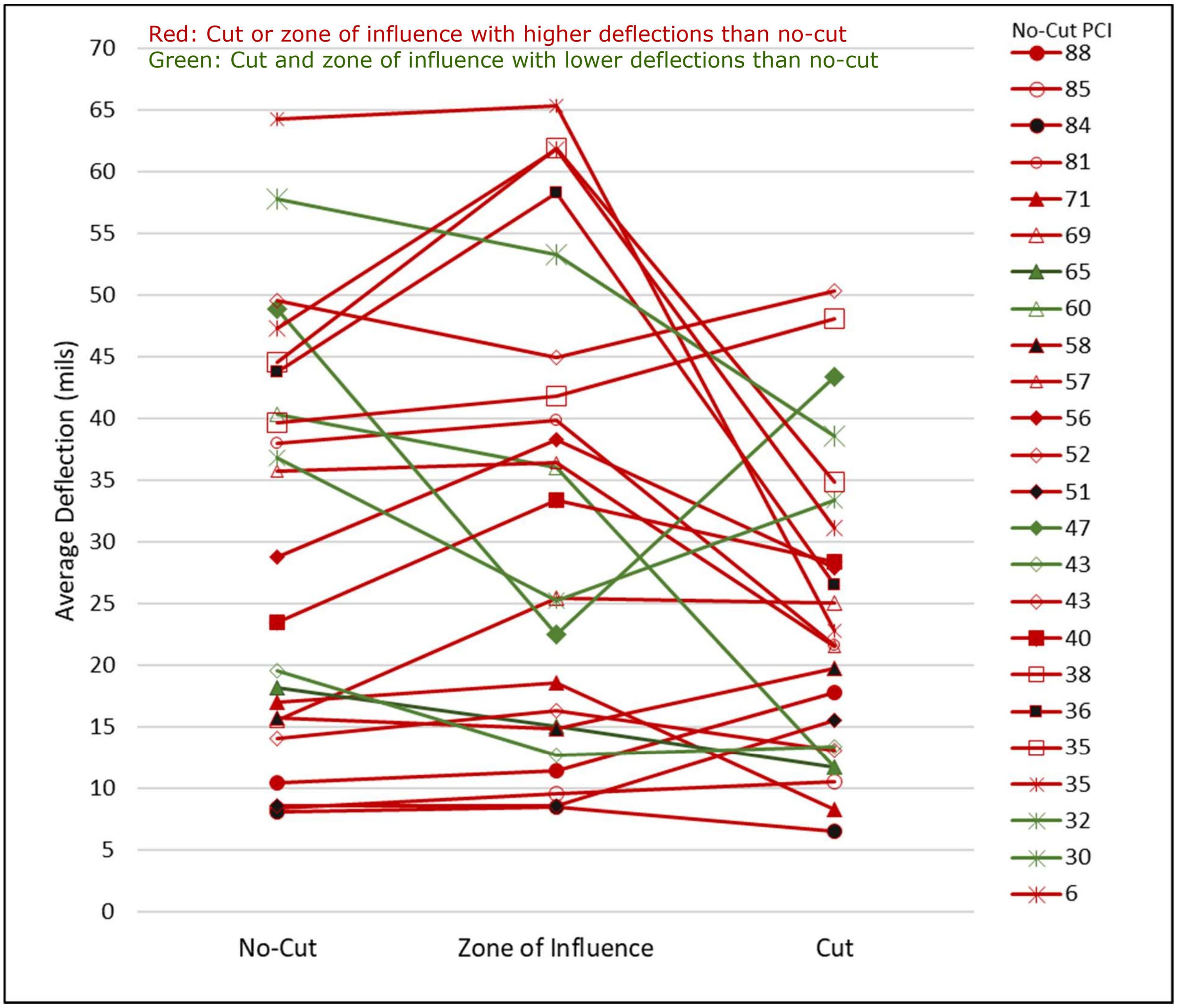

Figure 9. Deflection Trends Organized by No-Cut PCI

Based on the deflection data, 75 percent of test sites showed structural damage in the cut or zone of influence (red lines in Figure 9) while the remaining 25 percent showed a structural improvement in both the cut and zone of influence compared to the no-cut section (green lines in Figure 9). Sixty-three percent of test sites exhibited damage 2 feet from the edge of the patch, thus indicating that the zone of influence typically extends past the current restoration standard repair area.

4.3 REQUIRED OVERLAY THICKNESS

The required overlay thickness for each of the three measurement locations (no-cut, zone of influence, and cut) were calculated for each test site per the California Department of Transportation's (Caltrans) *Highway Design Manual* (Caltrans 2018). Design inputs were as follows:

- Traffic Index (TI)
    - Specific to each test site and based on records in the City's StreetSaver® database

- Existing AC thickness
    - No-cut – Measured core thickness
    - Zone of influence – Measured core thickness
    - Cut – 4 inches, or the measured core thickness, whichever is greater (based on the City's restoration standard detail)
- Deflection data obtained through FWD testing

Two examples of sections exhibiting damage due to utility cuts are provided. Note that if a cut damages a pavement structure, then the cut and/or zone of influence will require a thicker overlay than the no-cut section. Figure 10 shows the results for Mace Blvd, where the cut and zone of influence do not yet need an overlay. In contrast, the cut section requires a 1.5-inch overlay.

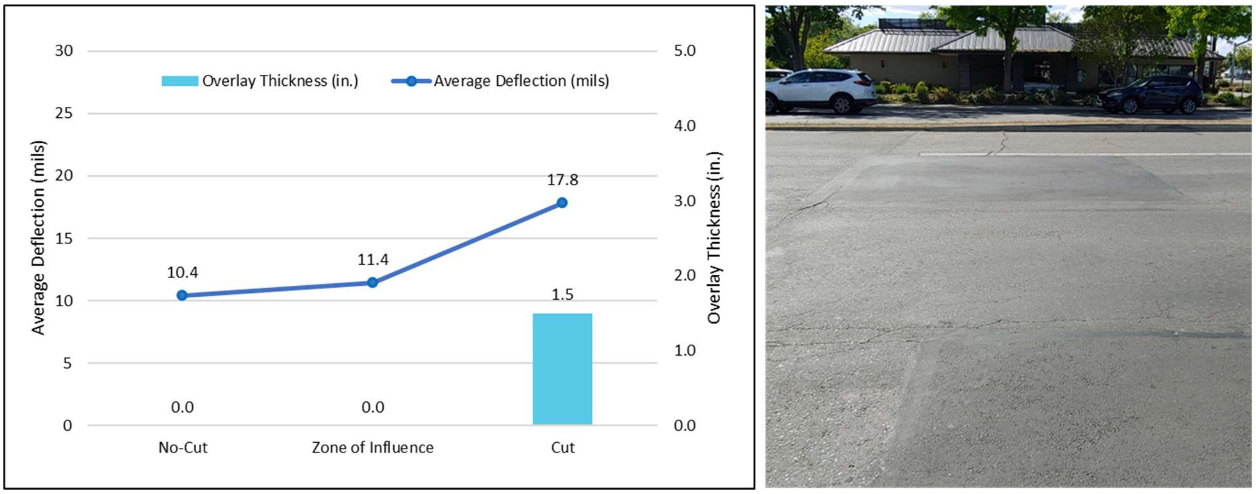

Figure 10. Deflection and Required Overlay Thickness for Mace Blvd

Figure 11 shows the results for Sycamore Lane, where the no-cut section needs an overlay of 3.0 inches, the zone of influence needs an overlay of 4.5 inches, and the cute needs an overlay of 1.5 inches to satisfy structural capacity for a TI of 9.5. For this test site, the zone of influence exhibited the most structural damage and therefore required the thickest overlay.

Figure 11. Deflection and Required Overlay Thickness for Sycamore Lane

Figure 12 summarizes the differences in overlay thickness between the no-cut section and the maximum value of either the cut or zone of influence for all test sites. The data are organized by the PCI of the no-cut section.

- Red bars indicate test sections that required a thicker overlay to compensate for a loss in structural capacity at the cut or zone of influence compared to the no-cut section.
- Green bars indicate that the repaired cut was performing better than the no-cut section.
- PCI values shown without bars indicate that, for that test site, the same overlay thickness, or no overlay at all, was required at all three of the measurement locations.

It was observed that 54 percent of the sites would need an average of 1.5 inches of additional overlay in the cut or zone of influence to compensate for the loss in structural capacity due to utility cuts.

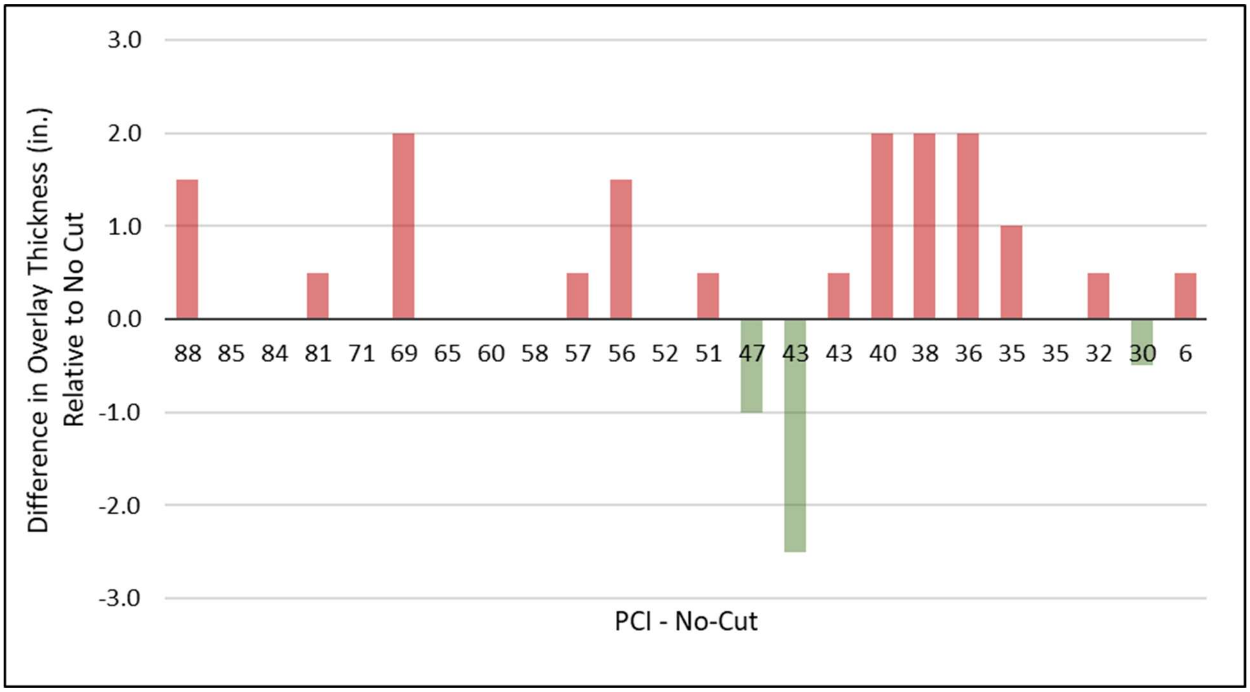

Figure 12. Differences in Overlay Thickness

4.4 DAMAGE COST

Table 3 lists the additional required overlay thickness for all test sites, which represents the difference between the required overlay thickness for the no-cut section and the maximum required overlay thickness at the cut or zone of influence. The additional required overlay thickness is zero if no overlay was required at any of the measurement locations (no-cut, zone of influence, and cut) or if both the cut and zone of influence were performing better than the no-cut section.

The cost of the additional required overlay thickness, also provided in Table 3 was calculated using the following typical costs, which were based on recent (2019-2021) rehabilitation projects performed in the City:

- Hot Mix Asphalt: $105 per ton
- Cold Plane Milling: $0.42 per square foot
- Other Costs (e.g. concrete repairs, ADA upgrades):
    - Arterials - 55% of mill and overlay costs
    - Collectors – 50% of mill and overlay costs
    - Residentials – 35% of mill and overlay costs
- Design/Engineering/Contingency: 10% of mill and overlay costs

Table 3. Additional Overlay Thickness and Corresponding Equivalent Cost

Site ID	Functional Classification	PCI No-Cut	Add'l Overlay Thickness* (in.)	Add'l Overlay Cost ($/SF)
MACE	Arterial	88	1.5	$2.47
FST		84	0.0	-
5TH		71	0.0	-
JOHN		65	0.0	-
ANDER		58	0.0	-
COV1		52	0.0	-
COV2		51	0.5	$1.28
COV3		43	-2.5	-
2ND	Collector	85	0.0	-
OAK		69	2.0	$2.98
HAMEL		60	0.0	-
SYCA		56	1.5	$2.40
CALAV		43	0.5	$1.24
MARIN		40	2.0	$2.98
CHILES		32	0.5	$1.24
14TH		6	0.5	$1.24
DRAKE	Residential	81	0.5	$1.13
SCAMP		57	0.5	$1.13
TAMAR		47	-1.0	-
BROWN		38	2.0	$2.70
WAKE		36	2.0	$2.70
PINE		35	1.0	$1.65
COLBY		35	0.0	-
WILLO		30	-0.5	-

*Difference between required overlay thickness of no-cut section and maximum of cut or zone of influence.

5 Fee Development and Implementation

5.1 MAXIMUM DAMAGE COST

Since utility cuts can cause damage to pavements both structurally and functionally, both types of evaluations are crucial in developing a fee to compensate for appropriate damages. Overall, 67 percent of test sites exhibited both functional and structural damage due to utility cuts, and 96 percent of test sites exhibited at least one form of damage. Table 4 lists both the functional and structural damage costs previously calculated for each test site in the study. It also indicates the maximum damage cost, which is the larger of the functional or structural damage costs. Fifty percent of the maximum damage costs were functional while 46 percent were structural. Only one test site did not experience either type of damage.

Table 4. Maximum Damage Cost

Site ID	Functional Classification	Functional Evaluation	Structural Evaluation	Max Damage Cost ($/SF)
		Cost of Reduced Life ($/SF)	Cost of Thicker Overlay ($/SF)	
MACE	Arterial	$3.17	$2.47	$3.17
FST		$0.41	-	$0.41
5TH		$0.37	-	$0.37
JOHN		-	-	-
ANDER		$0.88	-	$0.88
COV1		$0.74	-	$0.74
COV2		$1.00	$1.28	$1.28
COV3		$1.50	-	$1.50
2ND	Collector	$0.20	-	$0.20
OAK		$0.47	$2.98	$2.98
HAMEL		$0.10	-	$0.10
SYCA		$0.61	$2.40	$2.40
CALAV		-	$1.24	$1.24
MARIN		$0.20	$2.98	$2.98
CHILES		$0.49	$1.24	$1.24
14TH		-	$1.24	$1.24
DRAKE	Residential	$2.08	$1.13	$2.08
SCAMP		$1.06	$1.13	$1.13
TAMAR		$0.35	-	$0.35
BROWN		$0.30	$2.70	$2.70
WAKE		$0.29	$2.70	$2.70
PINE		-	$1.65	$1.65
COLBY		$0.36	-	$0.36
WILLO		$0.07	-	$0.07

5.2 STATISTICAL ANALYSIS

Statistical analyses were conducted to evaluate whether the functional and structural damages were statistically significant and to evaluate which factors best predict the damage a pavement will experience due to a cut. Specifically, paired t-tests were performed on the PCIs at the cut and no-cut sections as well as on the deflections at the no-cut and the maximum of the cut or zone of influence. A 95% confidence level was used for all t-tests.

Table 5 shows the results of the statistical analyses. As shown, both the functional and structural damage due to utility cuts was statistically significant and functional class and PCI were significant predictor variables. The greatest statistical significance was observed by grouping the arterials separate from the collectors and residentials and by also by grouping the collectors and residential PCIs above and below 70.

Table 5. Statistical Analysis of Damage Due to Utility Cuts

Criteria		Statistically Significant	
		Functional	Structural
All Functional Classes		YES	YES
Arterial		YES	NO
Collector		YES	NO
Residential		NO	NO
Arterial & Collector		YES	YES
Collector & Residential		YES	YES
Arterial	PCI ≥70	NO	NO
	PCI <70	YES	NO
Collector & Residential	PCI ≥70	YES	NO
	PCI <70	YES	YES
Arterial	PCI ≥50	YES	YES
	PCI <50	NA – no data	NA – no data
Collector & Residential	PCI ≥50	YES	NO
	PCI <50	YES	YES

5.3 RECOMMENDED FEE SCHEDULE

Based on the maximum damage cost and the results of the statistical analyses previously discussed, the recommended tiered fee schedule is provided in Table 6. The recommended fees represent the average damage cost for each functional classification and PCI range combination.

Table 6. Tiered Damage Fee Schedule

Functional Class	PCI	Damage Fee ($/SF)
Arterial	All	$1.04
Collector & Residential	≥70	$1.14
	<70	$1.51

Since these recommended fees are based on 2022 cost estimates, the fees should be indexed based on inflation and adjusted annually to reflect appropriate damage costs.

5.4 FEE IMPLEMENTATION

Cut areas greater than 10 percent of a management section area trigger a PCI drop sufficient to result in a section-wide mill and overlay. Consequently, in such cases a full recovery fee is appropriate. This means that for utility work in which the affected area (cut area plus zone of influence) constitutes more than 10 percent of the management section area, the damage fee in Table 6 should be multiplied by the full section area. In contrast, for utility work in which the affected area (cut area plus zone of influence) constitutes less than 10 percent of the management section, the recovery fee should be pro-rated.

Based on the City's pavement management inventory in StreetSaver®, the average management section area for arterial streets is approximately 58,000 square feet (sf) while the average management section area for collectors and residentials is approximately 25,000 sf.

Consequently, the fee implementation equations are as follows:

For Affected Area ≥ 10% average management area *(5,800 sf for arterials or 2,500 sf for collectors or residentials)*

$TRF = UC * AMA$

where

TRF: Total Recovery Fee ($)

UC: Unit Cost (from Table 6)

AMA: Average Management Area (58,000 sf for arterials or 25,000 sf for collectors or residentials)

For Affected Area < 10% average management area *(5,800 sf for arterials or 2,500 sf for collectors or residentials)*

$PRF = UC * AA / 0.1$

where

PRF: Pro-rated Recovery Fee ($)

UC: Unit Cost (from Table 6)

AA: Affected Area (cut area + zone of influence)

Two examples are provided.

Example 1, shown in Figure 13, is a residential street with a PCI of 60. A longitudinal trench cut 2 feet wide is performed the length of the section, which is 750 feet. Since the zone of influence extends at least 2 feet from the edge of the cut, the affected area is 6ft x 750ft, which represents an affected area of 4500 square feet, or approximately 18 percent (6x750/25,000 =0.18) of the average management area for residentials. Since the affected area is greater than the critical value of 10 percent, the total recovery fee is $1.51/sf (from Table 6) * 25,000sf = $37,750.

Figure 13. Example Fee Calculation 1

Example 2, shown in Figure 14, is also a residential street with a PCI of 60. However, in this case the utility cut is only 4ft wide and 30 feet long. Since the zone of influence extends at least 2 feet from the edge of the cut, the affected area is 8ft x 34ft, which represents an affected area of 272 square feet, or approximately 1 percent (8x34/25,000 =0.01) of the average management area for residentials. Since the affected area is less than the critical value of 10 percent, or 2,500 square feet for collectors or residentials, the pro-rated recovery fee is $1.51/sf (from Table 6) * (8ftx34ft)/0.1 = $4,107.

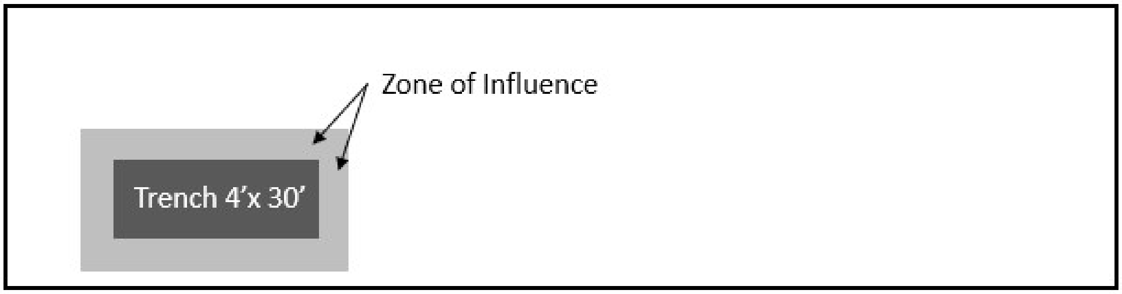

Figure 14. Example Fee Calculation 2

5.5 COMPARISON WITH OTHER AGENCIES

Table 7 summarizes utility cut fees for agencies throughout California. These fees are based on factors such as those discussed in this report, including functional classification, pavement age, PCI, and utility cut depth and orientation (longitudinal or transverse). The fees are typically in terms of in dollars per square foot and are multiplied by the utility cut area to obtain a dollar value representing the damage done to the pavement.

As shown, the proposed fee range for the City of Davis aligns closely with the fees listed for several cities and counties – particularly, the City of Ukiah and the City of Modesto. When comparing fees among different agencies, it is important to remember that the overall pavement condition and standard structures vary among agencies, which will in turn influence the impact of cuts on pavement performance.

Table 7. Utility Cut Fee Schedule Comparison

Agency	Criteria	Range, $/SF
Davis (2022)	Functional Class and PCI	$1.04 - $1.51
Anaheim (2021) (Implementation in Progress)	PCI	$3.60-$11.60
Ukiah (2021) (Implementation in Progress)	Type of Street, Size of Cut, Age of Pavement	$0.50-$4.25
Pacifica (2021)	Type of Street, Size of Cut, Age of Pavement	$0.50-$4.00
City and County of San Francisco (1998)	Age of Pavement	$1.00-$3.50
Sacramento County (1999), Elk Grove (2020), Santa Cruz (2003)	Trench Depth, Type of Street, PCI, Type of Cut	$1.80-$3.90 (Longitudinal Cut and Trench Depth <4ft)
		$2.36-$7.80 (Transverse Cut and Trench Depth <4ft)
		$1.80-$5.91 (Longitudinal Cut and Trench Depth >4ft)
		$3.60-$11.82 (Transverse Cut and Trench Depth >4ft)
Sacramento (1997)*	Type of Cut, Pavement Age	$1.00-$3.50 (Longitudinal Cut)**
		$2.00-$7.00 (Transverse Cut)**
Modesto (2020)	PCI	$0.0-$2.50
Patterson (2020)	PCI	$0.00-$7.30
Santa Ana (1999)	Type of Street and Age of Pavement	$6.21-$13.68
Los Angeles (2018)	Type of Street	$8.24-$19.44

*Fee under revision as of 2022

**Fee per lineal feet instead of per square foot

6 Summary

The purpose of this study was to assess and quantify pavement damage caused by utility cuts in the City of Davis (City) and to develop an appropriate fee schedule for the City to recover any costs associated with such damage.

To determine appropriate utility cut fees, this study measured and analyzed both the functional and structural damage at several test sites within the City. The study yielded the following results:

- Sixty-seven percent of test sites exhibited both functional and structural damage due to cuts and 96 percent of test sites exhibited at least one form of damage.
- On average, the PCI of sections with cuts was approximately 5 points lower than those without cuts.
- The average percent reduction in life due to cuts was 6 percent.
- Sixty-three percent of test sites exhibited damage 2 feet from the edge of the patch, thus indicating that the zone of influence extends past the current restoration standard repair area.
- Fifty-four percent of test sites needed an average additional overlay thickness of 1.5 inches in the cut or zone of influence to compensate for structural damage.
- Functional class and PCI were the best indicators of how much damage was caused by utility cuts.
- The resulting fee schedule represents the cost corresponding to the maximum damages (structural or functional) caused by utility cuts and is provided in the following table.

Functional Class	PCI	Damage Fee ($/SF)
Arterial	All	$1.04
Collector & Residential	≥70	$1.14
	<70	$1.51

The information required to implement this fee includes the functional class, the PCI at the time of cut, the trench dimensions. NCE recommends that the fee schedule be indexed based on inflation and adjusted annually to reflect appropriate costs.

7 References

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Appendix A

SUMMARY OF UTILITY CUT STUDIES

NCE Collaboration. Commitment. Confidence.SM

MEMORANDUM

Date:	March 17, 2021
To:	City of Davis
From:	Sharlan Montgomery Dunn, Debaroti Ghosh, Margot Yapp
Subject:	Summary of Utility Cut Studies and Policies
Job Number:	370.24.55

INTRODUCTION

Utility companies often need to cut existing pavements to access and service their underground equipment. Ideally, all underground utility maintenance would be performed prior to pavement rehabilitation or reconstruction so that cuts are never made in new pavement structures. However, despite the best coordination, utility cuts cannot always be avoided because unanticipated work is often required to maintain essential public services.

Over the last 30 years, local agencies have been interested in understanding and quantifying the impact of utility cuts on pavement performance as well as the corresponding financial impacts. To obtain this information, public agencies, as well as utility companies, have sponsored engineering investigations and studies (Todres and Baker 1996). Many such studies are performed in-house or by consulting companies and are therefore unpublished or difficult to access. These studies often use deflection testing, condition surveys, and statistical analyses to quantify reduced pavement performance as a loss in structural capacity and a decrease in pavement condition. To manage the identified impacts, many studies have recommended restoring additional area surrounding the cut, increasing the overlay thickness, or imposing a restoration fee on utility companies.

These studies and recommendations have led to an increase in public policies that 1) compensate local agencies for the loss of pavement life caused by utility cuts through a utility cut fee, and 2) achieve more acceptable performance of repair work following underground utility access and maintenance through rigorous utility cut restoration standards and moratoria, or “no cut”, periods.

This technical memorandum discusses the impact of utility cuts on pavement performance, details the importance of adequate utility cut restoration, and summarizes the policies in place by various California agencies to address pavement degradation caused by utility cuts.

IMPACT OF UTILITY CUTS

The impact of utility cuts on pavement performance can vary significantly based on site- and agency-specific information. Such variables can include the existing pavement condition, structure, and age; location, orientation, and extent of the utility cut; environmental factors; traffic loads; and restoration practices and standards. Quantification of utility cut impacts further depend on local maintenance treatments and costs. Therefore, to really understand the impact of utility cuts on roadway performance for a particular agency, a site-specific study and analysis must be performed.

That said, underground utility work can damage pavements in three general ways as illustrated in Figure 1. First, the act of cutting a pavement structure creates an easy-access point for water to enter the pavement structure and damage the underlying pavement layers. Second, the removal of the pavement layers creates a plane of weakness where the pavement structure may not be adequately supported laterally – particularly during underground utility maintenance, but also after restoration. Third, the quality of the repair may not match the adjacent pavement structure, thus introducing roughness into the pavement. Rough pavements can cause vehicles to bounce, which creates greater loads on the pavement and leads to more rapid deterioration (Tarakji 1995; Wilde et al. 2002).

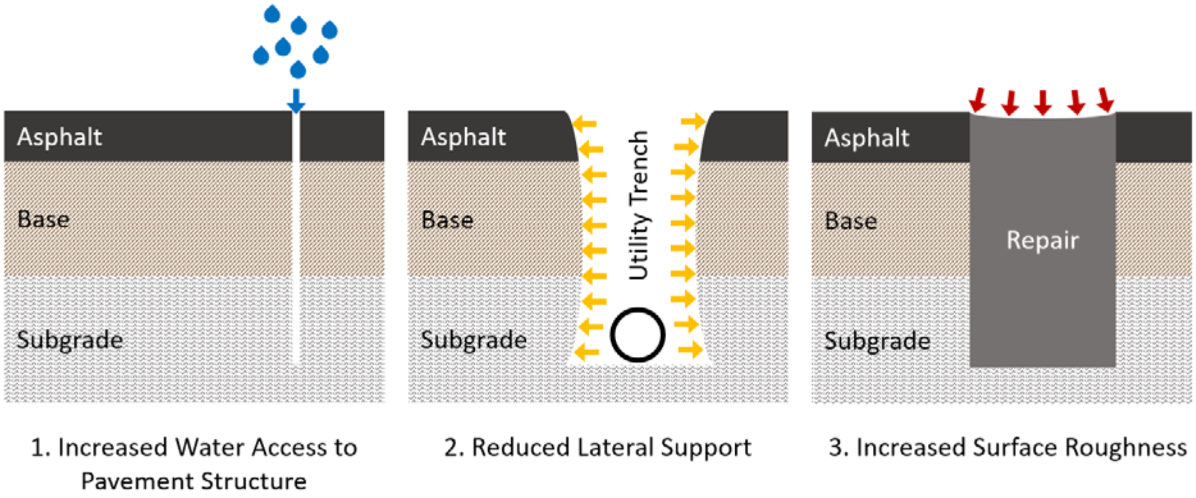

Figure 1. Utility Cut Damage Mechanisms

These deterioration mechanisms reduce the condition and structural capacity of a pavement, which reduces the life of the pavement within and adjacent to the utility cut (Stevens et al. 2010). Multiple utility cuts on the same street or within a small area can magnify this impact (Department of Public Works 1998, Tarakji 1995).

Reduction in Pavement Life

In the mid-1990s, San Francisco completed a study on the effect of utility cuts on the life of pavement (Tarakji 1995) and confirmed that additional damage was caused. Other cities, including Austin, Cincinnati, Salt Lake City, Philadelphia, and Phoenix, conducted similar foundational studies and found that utility cuts not only reduced the expected life of the streets but consequently cost local agencies millions of dollars in premature street repair and remediation expenses (Arudi et al. 2000; Bodocsi et al. 1995; ERES 1990; NCE 2003; Peters 2002; Wilde et al. 1996).

For example, Bodocsi et al. (1995) reported that new asphalt pavements, which are typically designed to last between 15 and 20 years, once cut can lose as much as 8 years of pavement life. Other studies performed in Austin, Anaheim, Los Angeles, Sacramento, and Phoenix estimated between 15 and 20 percent reductions in pavement life due to utility cuts (AMEC 2002; CHEC 1997; IMS 1994; Shahin and Associates 2017; Wilde et al. 1996). For a typical pavement design life of 20 years, this represents a loss of 3-4 years of pavement life.

Additional factors such as cold climates and multiple excavations can increase the impact of utility cuts. For example, utility cuts in areas subject to freeze-thaw conditions were estimated to reduce pavement life by 20 percent (AMEC 2002; Stevens et al. 2010). Streets with multiple excavations for utility work were estimated to reduce a pavement's life by 30 to 55 percent (Shahin and Associates 2017; Tarakji 1995; Tiewater 1997).

Statistical data reported by the Department of Public Works in San Francisco (1998) showed that the pavement condition rating decreases as the number of utility cuts increases. For example, the pavement condition index (PCI) for a newer pavement was reduced from 85 to 64 as the number of utility cuts increased to 10 or more.

Zone of Influence

As previously mentioned, a utility cut can result in a loss of lateral support to the existing pavement structure surrounding the perimeter of the trench. This can cause the trench sidewalls to bulge into the trench and weaken the material under the existing pavement. This weakened area is termed the zone of influence, is illustrated in Figure 2.

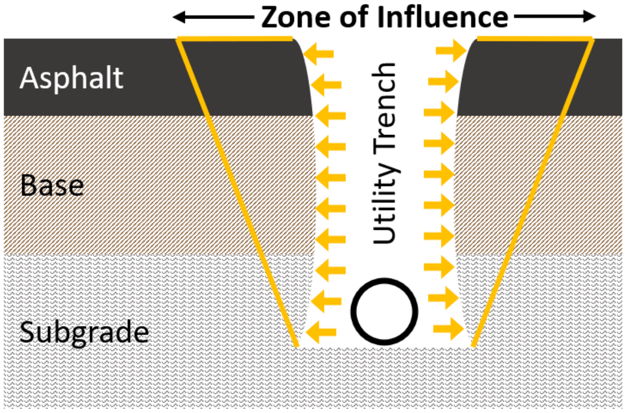

Figure 2. Zone of Influence

Various studies have used deflection testing to investigate the loss of pavement strength near utility cuts, estimate the zone of influence, and provide recommendations on restoration (Bodosci et al 1995; Shahin 1999; CHEC 1997, 1998, 1999, 2000; NCE 2000, 2003). Such studies showed a substantial loss of strength in the zone of influence around the utility cut area (Stevens et al. 2010). For example, studies performed in Union City and Los Angeles showed that the deflection values within the zone of influence were 41-74 percent higher than in uninfluenced pavement (CHEC 1998; Shahin and Associates 2017).

These studies also indicated that the zone of influence varies by agency and location but is most often 4 to 5 feet from the edge of the trench. Table 1 summarizes research estimating the zone of influence.

Table 1. Summary of Zone of Influence Research

Agency	Investigator	Publication Year	Zone of Influence from Trench Edge (feet)
Alameda Co, CA	CHEC Consulting Engineers, Inc.	2000	5.5
Calgary, Canada	Karim et al.	2014	3.3
Cincinnati, OH	Bodosci et al.	1995	3
Iowa Department of Transportation	Stevens et al.	2010	4
Los Angeles, CA	Shahin and Associates	2017	2.5 to 10 (average of 5.2)
San Mateo Co, CA	CHEC Consulting Engineers, Inc.	1999	5
Seattle, WA	Nichols Consulting Engineers	2000	At least 2
Springville, UT	Guthrie et al.	2015	4
Union City	CHEC Consulting Engineers, Inc.	1998	4 to 7

An extensive field and laboratory study by Iowa State University researchers concluded that the loss of lateral support in the zone of influence is a critical factor in the restoration of utility trenches (Jensen et al. 2005).

IMPORTANCE OF UTILITY CUT RESTORATION

As discussed previously, utility cuts can affect pavement performance in and adjacent to the cut area. The excavation equipment and process can also damage the pavement adjacent to the cut (Stevens et al. 2010). Simply backfilling the excavated area will not restore and match the strength and performance of the original material. Therefore, for long-term pavement performance within and adjacent to utility cuts, adequate repair and restoration is necessary.

It is difficult to restore cut pavement to a condition and performance level matching the surrounding pavement. When the repaired pavement condition varies from the existing pavement condition, the result can be a rough surface. Even if the pavement surface is smooth and consistent at the time of the repair, the materials may settle and deteriorate differentially over time. This leads to surface roughness, which then leads to more rapid deterioration (Noel and Tevlin 2012; PEI 1996; Stevens et al. 2010; Wilde et al. 1996).

Utility cut restoration involves performing a treatment, in addition to adequate filling and compaction of the excavated area, to restore the pavement life and maintain the pavement's structural capacity and performance. Restoration often includes a T-Cut as well as another treatment, such as an overlay or surface seal, that extends beyond the length of the T-Cut arm. This restoration combination is illustrated in Figure 3.

T-Cuts involve cutting back a portion of the pavement surface beyond the edge of the trench to better protect the zone of influence and bridge the plane of weakness. Such repairs have been found advantageous in the restoration of utility cut trenches by alleviating the effects of the lateral support loss due to the excavation (Peters 2002; Stevens et al. 2010). Research has shown that the thickness of the restoration, the quality of materials used, and the placement and compaction methods of fill materials are key factors in ensuring strong pavement performance in future years (Jensen et al. 2005; Stevens et al. 2010 Todres and Baker 1996).

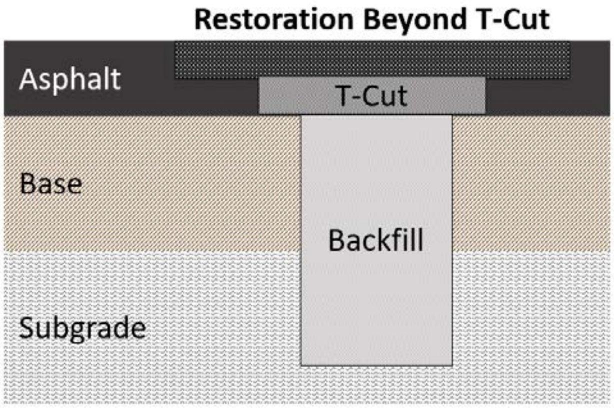

Figure 3. Example Restoration Plan.

Restoration Standards in California

Table 2 summarizes the restoration standards held by several city and county agencies throughout California. The specific restoration requirements vary depending on the length of the utility cut, existing PCI, functional classification, and age of the pavement.

Although the use of the T-Cut is widespread among these standards, the additional surface restoration requirements range from no additional treatment beyond the T-Cut to full lane replacements for the entire affected block. For example, the cities of Oakland and San Francisco require a full block restoration depending on the length of the utility cut. Other agencies require only 6 to 24 inches of restoration beyond the edge of the T-Cut. The most common restoration treatment in California is a mill and overlay to a minimum specified depth.

The final required restored pavement thickness also varies among agencies. These final thickness standards are included in Table 2 as the final asphalt thickness over the trench and provide insight into how standards vary throughout California. The typical requirement is for the new restored pavement to conform to the existing pavement thickness over the trench, but additional thickness is sometimes required.

Table 2. Summary of Restoration Standards in California Agencies

Agency	T-Cut Required	T-Cut Arm Width (in.)	Surface Restoration Requirement Beyond T-Cut	Restoration Treatment	Final Asphalt Thickness Over Trench (in.)
Alameda Co	Yes	12	None	NA	Existing thickness
Anaheim	Yes	12	For local streets with cut length >651 ft, restore all affected lanes for the entire block	PCI ≥ 60: Slurry Seal from gutter to gutter PCI<60: 2-in. Mill and Overlay from gutter to trench limit	Existing thickness + 1.25 or Match existing thickness if ≥ 16 in.
Contra Costa Co	Yes	12	None	NA	Existing thickness + 1.25
Davis	Yes	10	Restoration shall extend 10’ before first patch and 10’ beyond last patch and be the full width of the affected lanes	Slurry Seal	Existing thickness (min of 4)
Fremont	If Trench Width >24 in.	12	None	NA	Existing thickness (min of 6) If no T-Cut, 12-15
Fresno Co	Yes	6	Minimum of 12 in. beyond the edge of the T-Cut	1.25-in. Mill and Overlay	Existing thickness
Long Beach	Yes	12	None	NA	Existing thickness (min of 4)
Los Angeles	Yes	12	If pavement age<8 Yrs, restore 24 in. beyond the edge of the T-Cut	1.5-in. Mill and Overlay (or half the existing asphalt thickness, whichever is less)	Existing thickness (min of 6)
Los Angeles Co	Yes	12	None	NA	Existing thickness (min of 4)

Table 2 Cont. Summary of Restoration Standards for California Agencies

Agency	T-Cut Required	T-Cut Arm Width (in.)	Surface Restoration Requirement Beyond T-Cut	Restoration Treatment	Final Asphalt Thickness Over Trench (in.)
Oakland	Yes	12	If cut length >0.25*block length, restore all affected lanes for the entire block	PCI >65: Slurry Seal PCI ≤ 65: Mill and Overlay	Existing thickness (min of 6)
Sacramento	Yes	6	None	NA	Existing thickness (min of 4)
Sacramento Co	Yes	8	If pavement age<5 Yrs, restore a minimum of 12 in. beyond the edge of the T-Cut	1.5-in. Mill and Overlay	Existing thickness (min of 6 on major streets) (min of 4 on minor streets)
San Francisco	Yes	12	Minimum of 12 in. beyond the edge of the T-Cut or If cut length >0.25*block length, restore all affected lanes for the entire block	2-in. Mill and Overlay	Existing thickness (min of 2)
San Diego Co	Yes	6-12 (Based on Trench Width)	6 in. beyond the edge of the T-Cut	1.5-in. Mill and Overlay	Existing thickness +1 (min of 4)
San Jose	Yes	12	None	NA	Existing thickness +3
Santa Clara	Yes	6	None	NA	Existing thickness (8-10)

UTILITY CUT POLICIES

A detailed 2002 report prepared for the Federal Highway Administration provided methods that agencies can use to reduce and minimize the damage to streets due to the ever-increasing installation and maintenance activities of utility companies (Wilde et al. 2002). Specifically, the report presents three types of policies local agencies can use to improve the quality of utility cut repairs and promote coordination of facilities. These strategies are 1) incentive-based policies, 2) fee-based policies, and 3) regulation-based policies.

Incentive-based policies provide financial or other incentives for using trenchless technology where technically suitable, performing higher-quality pavement cut repairs, making smaller or less-damaging cuts, and coordinating with other utility companies to share trenches or underground resources.

Examples of fee-based policies include requiring a deposit prior to beginning work to protect against poor repairs, assessing financial penalties for non-compliance with restoration standards or for failed repairs within a specified period, implementing a time-based lane rental fee to encourage utility companies to restore traffic access as quickly as possible, and collecting flat-rate or area-based fees to compensate for increased degradation associated with cutting and excavating pavement.

Regulation-based policies do not require fees or provide incentives, but place requirements on the contractor regarding quality of work, and/or restrictions on when and where trenching can be done. Examples include establishing moratorium periods that restrict utility cuts in newly resurfaced pavements for a specified time, requiring pavement restorations to encompass an area larger than the trench area, enhancing inspections, and enforcing restoration specifications.

Utility Cut Fees in California

Fee-based policies have been growing in popularity throughout California as way for local agencies to recoup the cost of pavement damage associated with poor performing underground utility work. Table 3 summarizes several utility-cut fee schedules for various agencies throughout California. These fees are based on factors including functional classification, pavement age, PCI, and/or utility cut depth and orientation (longitudinal or transverse). The fees, in dollars per area, are multiplied by the utility cut area to obtain a dollar value that represents the damage done to the pavement. In contrast to having a utility cut fee by area, the city of Santa Barbara has utility cut fee by linear foot. This fee is multiplied by the length of linear feet cut rather than the affected area to obtain a dollar value.

Table 3. Summary of Utility Cut Fees for California Agencies

Agency	Year	Criteria			Fee ($/SF)
Anaheim*	1994	Age < 1 Year			16.48
Elk Grove	2020	Trench Depth < 4 ft	Major Streets or All Streets within 5 years of construction or structural overlay	PCI 100 and 70	3.90 (long.)
					7.80 (trans.)
				PCI 69 and 26	2.20 (long.)
					4.40 (trans.)
				PCI 25 and 0	-
			All Other	PCI 100 and 70	2.41 (long.)
					4.82 (trans.)
				PCI 69 and 26	1.18 (long.)
					2.36 (trans.)
				PCI 25 and 0	-
		Trench Depth > 4 ft	Major Streets or All Streets within 5 years of construction or structural overlay	PCI 100 and 70	5.91 (long.)
					11.82 (trans.)
				PCI 69 and 26	3.34 (long.)
					6.68 (trans)
				PCI 25 and 0	-
			All Other	PCI 100 and 70	3.66 (long.)
					7.32 (trans.)
				PCI 69 and 26	1.80 (long.)
					3.60 (trans.)
				PCI 25 and 0	-
Los Angeles	2018	Select Streets			19.44
		Local Streets			8.24
Modesto	2020	All Streets		PCI 70-100	2.5
				PCI 26-69	1.25
				PCI 0-25	-
Patterson	2020	All Streets		PCI 70-100	7.3
				PCI 50-69	5.25
				PCI 0-49	-

*Standard is currently under revision. Fee update anticipated in 2021.

Table 3 Cont. Summary of Utility Cut Fees for California Agencies

Agency	Year	Criteria			Fee ($/SF)
Sacramento*	1997	Longitudinal Cut		Age <5	3.50
				Age 5 to 10	3.00
				Age 10 to 15	2.00
				Age Over 15	1.00
		Transverse Cut		Age <5	7.00
				Age 5 to 10	6.00
				Age 10 to 15	4.00
				Age Over 15	2.00
Sacramento Co	1999	Trench Depth < 4 ft	Major Streets or All Streets within 5 years of construction or structural overlay	PCI 100 and 70	3.90 (long.)
					7.80 (trans.)
				PCI 69 and 26	2.20 (long.)
					4.4 (trans.)
				PCI 25 and 0	-
			All Other	PCI 100 and 70	2.41 (long.)
					4.82 (trans.)
				PCI 69 and 26	1.18 (long.)
					2.36 (trans.)
				PCI 25 and 0	-
		Trench Depth > 4 ft	Major Streets or All Streets within 5 years of construction or structural overlay.	PCI 100 and 70	5.91 (long.)
					11.82 (trans.)
				PCI 69 and 26	3.34 (long.)
					6.68 (trans)
				PCI 25 and 0	-
			All Other	PCI 100 and 70	3.66 (long.)
					7.32 (trans.)
				PCI 69 and 26	1.80 (long.)
					3.60 (trans.)
				PCI 25 and 0	-
City and County of San Francisco	1998	All streets		Age 0-5	3.50
				Age 6-10	3.00
				Age 11-15	2.00
				Age 16-20	1.00

*Standard is currently under revision. Fee update anticipated in 2021.

Table 3 Cont. Summary of Utility Cut Fees for California Agencies

Agency	Year	Criteria			Fee ($/SF)
Santa Ana	1999	Arterials Streets Age of street since last repaving		Age 0-5 Years	13.68
				Age 6-10 Years	12.11
				Age 11-15 Years	11.39
				Age 16-20 Years	9.11
		Local Streets Age of street since last repaving		Age 0-5 Years	9.27
				Age 6-10 Years	8.24
				Age 11-15 Years	7.74
				Age 16-20 Years	6.98
				Age 21-25 Years	6.21
Santa Barbara Co		Flat fee			$0.75 per LF
Santa Cruz	2003	Trench Depth < 4 ft	Major Streets or All Streets within 5 years of Construction or Structural overlay	PCI 100 and 70	3.9 (long.)
					7.8 (trans.)
				PCI 69 and 26	2.2 (long.)
					4.4 (trans.)
				PCI 25 and 0	-
			All Other Streets	PCI 100 and 70	2.41 (long.)
					4.82 (trans.)
				PCI 69 and 26	1.18 (long.)
					2.36 (trans.)
				PCI 25 and 0	-
		Trench Depth > 4 ft	Major Streets or All Streets within 5 years of construction or structural overlay.	PCI 100 and 70	5.91 (long.)
					11.82 (trans.)
				PCI 69 and 26	3.34 (long.)
					6.68 (trans)
				PCI 25 and 0	-
			All Other Streets	PCI 100 and 70	3.66 (long.)
					7.32 (trans.)
				PCI 69 and 26	1.80 (long.)
					3.60 (trans.)
				PCI 25 and 0	-
Union City	1998	Flat fee			17.3

Some agencies allow fee exemptions if the utility work is performed on older pavement or if the work is performed before an upcoming rehabilitation. For example, the City and County of San Francisco waive the fee for utility work performed on pavements with PCIs less than 53 or a pavement age of at least 20 years. The City of Los Angeles does not require utility cut fees on pavements with rehabilitation scheduled within the next year.

Moratorium Standards in California

Regulation-based policies, particularly moratoria, have been passed by cities and counties to protect public infrastructure and preserve the life of streets (Wilde et al. 2002). Moratoria impose a time period after treatment during which utility or other companies may not perform trenching activities. Table 4 summarizes several California agencies with slurry and rehabilitation moratorium standards. If for some reason utility work during a moratorium period is deemed necessary, agencies often impose higher restoration standards and limits than those required after the moratorium period has expired.

For example, Los Angeles County only requires a surface restoration of 24 inches beyond the edge of the T-Cut for non-moratorium streets but requires that the whole block be repaved for moratorium streets. Such strict moratorium restoration standards encourage utility companies to perform underground utility maintenance prior to pavement rehabilitation or reconstruction and discourages utility work in new pavement structures.

Table 4. Summary of Moratorium Standards for California Agencies

Agency	Slurry Moratorium (years)	Rehabilitation Moratorium (years)	Restoration Details if Moratorium Work Approved
Anaheim	1	3	Extensive pavement restoration according to the utility cut standard Limits shall be determined by the City Engineer
Commerce	2	5	Pavement restoration shall be a length of not less than 50 ft either side of the trench edge lines, either perpendicular or parallel to the curb line
Encinitas	3	5	Resurface at least the length of excavation from curb to curb or from curb line to the raised median Longitudinal trenches – Extend T-Cut, grind and overlay over the entire affected lane or lanes (from curb to curb or from curb to median curb) Transverse trenches - Extend T-Cut, grind and overlay to 10 feet beyond each side of the trench and over the entire affected lane
Los Angeles	None	1	Repave the whole block
Los Angeles Co	2	2	Resurface the entire lane width
Oakland	5	5	Pavement restoration shall match or exceed the most recent resurfacing pavement section depth and material or as directed by the Engineer
Sacramento Co	3	3	Slurry seal half of the roadway at locations affected by the excavation for a minimum total length of 1,000 feet
San Diego	3	5	Resurface the entire lane width from street intersection to intersection and from curb to curb
San Diego Co	3	3	Resurface the entire width of the affected road and the method of resurfacing shall be the same as adjacent pavement
San Francisco	5	5	Resurface all affected lanes for entire width of affected property frontages

SUMMARY AND CONCLUSION

Interest in studying and quantifying the impact of utility cuts on road and street performance has increased over the last 30 years. Consequently, public agencies, as well as utility companies, have sponsored engineering investigations and studies to quantify the impact of utility cuts on pavement performance and estimate the corresponding financial impacts.

Research has shown that utility cuts can reduce pavement life by 15 to 55 percent, which consequently costs local agencies millions of dollars in premature street repair and remediation expenses. Studies have also shown that underground utility work affects not only the excavated area, but often weakens the adjacent pavement. The affected pavement varies based on agency and location but is typically 4 to 5 feet from the edge of the trench.

To help restore some of the lost structural capacity and performance due to cutting the pavement, many agencies have set restoration standards. Restoration standards in California typically include a T-Cut along with a restoration treatment that may be as extensive as replacing the full lane for the entire affected block.

To recover the cost of pavement damage associated with performing underground utility work, many agencies impose utility cut fees. In California, these fees are typically based on factors including functional classification, pavement age, PCI, and/or utility cut depth and orientation (longitudinal or transverse).

As evidenced by the variety of studies, standards, policies, and fees, the impact of utility cuts on roadway performance can vary significantly based on site-and agency-specific information. Therefore, to really understand and quantify the impact of utility cuts on roadway performance for a particular agency, a site-specific study and analysis must be performed. In addition, utility cut fees should be updated regularly to reflect accurate and current damage costs.

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