Utility Cut Impact Assessment and Fee Development

Final Report

NCE Project No. 1004.05.55
Jan 2022

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Executive Summary

Interest in studying and quantifying the impact of utility cuts on road and street performance has been high for over 30 years. 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.

The purpose of this study was to conduct a literature review on utility cut impacts in other agencies, estimate any damage caused by utility cuts to the pavements, and develop a fee schedule to recover the costs associated with such damage.

To accomplish this, NCE looked at both the structural and functional deterioration of pavements due to utility cuts. The field evaluation included selecting sixteen sites on city streets of different ages. Deflection testing using a falling weight deflectometer (FWD) was conducted to assess loss of structural capacity due to cuts. In addition, the City's StreetSaver® database, which contains 15 years of pavement distress data and thousands of data points with a wide range of pavement age and conditions, was analyzed to assess the impact of utility cuts.

The findings from this study include:

- Pavements with cuts of any size deteriorate more than pavements without cuts across all age groups (0-5 years, 6-10 years, 11-15 years and >15 years). The exception is residentials older than 10 years with small cuts (cut area <10% of section area)
- On average, the PCI drops by 30% if the cut area is greater than 10% of the section area.
- Cuts do more damage to new (< 10 years) pavements than older (≥10 years) pavements. This results in an average percent reduction of the remaining service life of approximately 33% for new pavements and 17% for old pavements.

All these findings were used to develop fee schedule for the City of Pacifica which is shown in the table below.

Fee, $/SF			
Functional Class	Age Group	Cut Area (Percent of Section Area)	
		<10% of Section Area	≥10% of Section Area
Arterials/ Collectors	<10 years	$ 2.50	$ 4.00
	≥10 years	$ 1.50	$ 2.50
Residential	<10 years	$ 1.50	$ 3.00
	≥10 years	$ 1.00	$ 2.50

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1 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. In addition, the impact of utility cuts on pavement performance can vary significantly based on site-and agency-specific information.

Thus, the purpose of this study was to compare pavement performance for the street sections with and without cuts, quantify damage caused by utility cuts to the pavements within the City of Pacifica (City) and develop a fee schedule for the City to recover any costs associated with such damage.

1.1 BACKGROUND

Studies of utility cut impacts 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 areas 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.

The impact of utility cuts varies 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

Further, 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.

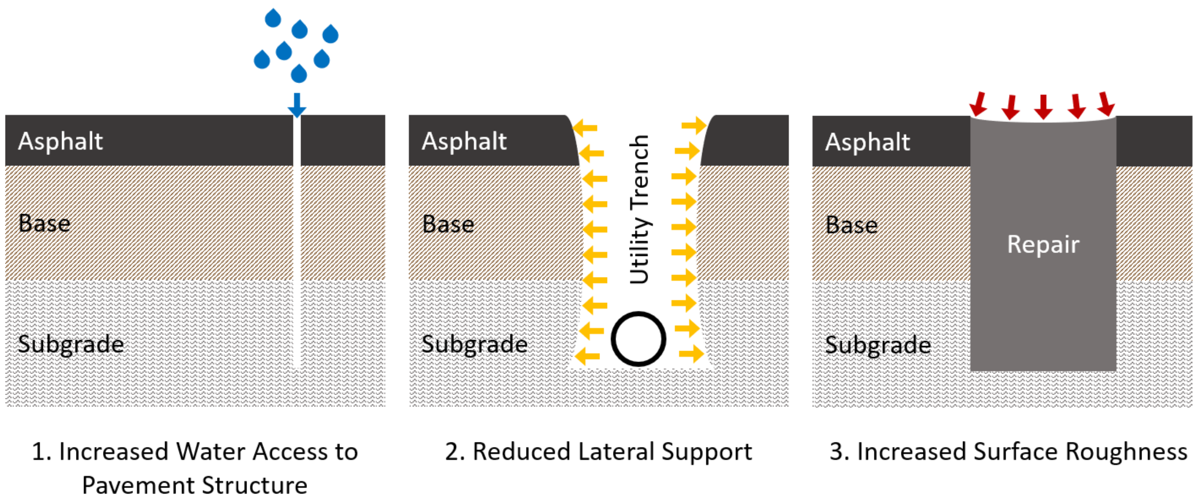


Figure 1. Utility Cut Damage Mechanism

First, the act of cutting a pavement structure creates an easy-entry point for water that can 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*).

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 (*San Francisco Department of Public Works 1998, Tarakji 1995*).

1.2 Literature Review

Research has shown that utility cuts can reduce pavement life by 15% to 55%, 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, Pavement Condition Index (PCI), and/or utility cut depth and orientation (longitudinal or transverse).

As evidenced by the variety of studies, standards, policies, and fees presented in Appendix A, 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.

Appendix A 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.

2 Technical Approach

Based on the relevant studies reviewed, it is clear that utility cuts have an overall negative impact on pavement performance. These impacts can take two forms:

- Structural – Reduced pavement strength
- Functional – Shortened pavement service life

Impact fees can be developed using either of the two approaches to compensate for shortened pavement service life or reduced pavement strength. Consequently, City streets both with and without cuts were evaluated in terms of both structural and functional deterioration in this study.

The structural deterioration is evaluated by measuring the overlay thickness needed to reach an acceptable structural capacity under a specified traffic load, usually expressed through the Traffic Index (TI). If the cut weakens the pavement structure, then the sections with cuts will require a higher overlay thickness than the sections with no cuts. The overlay thickness is calculated using deflection data obtained through falling weight deflectometer (FWD) testing following Caltrans Highway Design Manual. Deflection data can be used as measures to establish the relative loss of structural capacity resulting from the presence of utility cuts, where higher deflections represent weaker pavements. This loss of structural capacity necessitates thicker overlays, thus increasing the cost of rehabilitation for a street with utility cuts over the cost for a street without cuts.

The functional deterioration is evaluated in terms of "Pavement Condition Index (PCI)," which ranges from 0 to 100. Pavement in excellent condition have a PCI above 85, pavement in good condition have a PCI between 70 and 84, pavements in fair condition have a PCI between 50 and 69, pavement in poor condition have a PCI between 25 and 49, and pavements in failed condition have a PCI below 25. Note that these condition categories are consistent with those presented in the City's Budget Options Report with one modification—the excellent condition category was added to provide an additional data point during the analysis portion of this study. 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 found as well as the severity and quantity of those distresses. It is expected that the PCI of the sections with cuts will be lower than the PCI of sections without cuts.

The flowchart shown in Figure 2 presents the methodology for this study where both structural and functional deterioration approaches were used to evaluate the pavement damage due to the cuts. As shown, the functional deterioration approach was conducted using distress data from the StreetSaver® database and field testing was used to estimate loss in structural capacity due to cuts (structural deterioration approach).

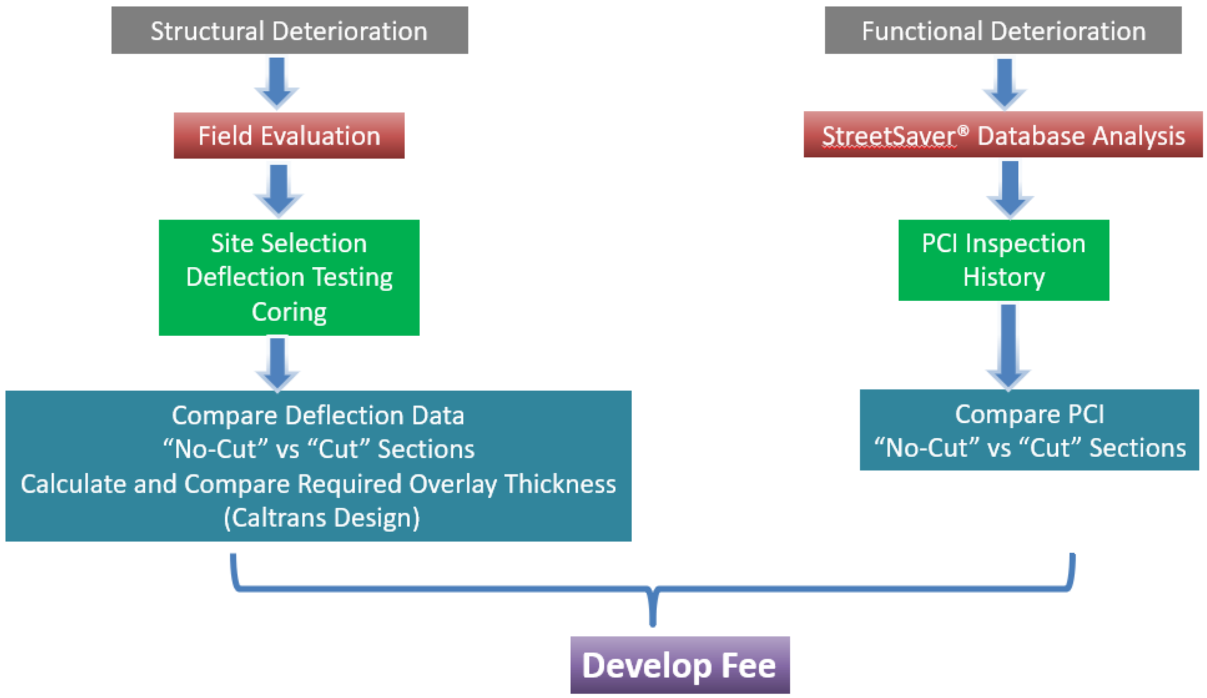


Figure 2. Technical Approach

2.1 STRUCTURAL EVALUATION

The following tasks were performed for the field evaluation:

- Selected 16 sites with and without cuts.
- Conducted deflection testing and coring.
- Calculated and compared overlay thicknesses for the sections with and without cuts.

2.2 FUNCTIONAL EVALUATION

To perform a rigorous analysis using this approach, a pavement management system (PMS) database that contains sufficient historical data to allow comparison of streets with and without utility cuts is required. The city has a robust PMS (StreetSaver®) containing pavement distress data from the last 15 years with thousands of data points.

The following tasks were completed as part of this evaluation:

- Exported PCI inspection history.
- Sorted PCI by distress type (with and without utility cuts).
- Extracted last rehabilitation dates or construction dates for the sections to derive age of the pavement.
- Compared the PCIs of the sections with and without cuts by functional class and age group.

- Developed pavement deterioration curves based on inspection history for sections with and without utility cuts.
- Calculated and compared the percent reduction in life by functional class, age group and size of the cut from the pavement deterioration curves.

3 Structural Evaluation

3.1 SITE SELECTION

Sixteen sites were selected; each site had a section with a cut and one without a cut (Figure 3 has examples of test sites). The variables in the experiment design were functional class and age group. Table 1 below shows the planned versus actual site selection in each age group. Ideally, approximately four sites would have been identified in each age group.

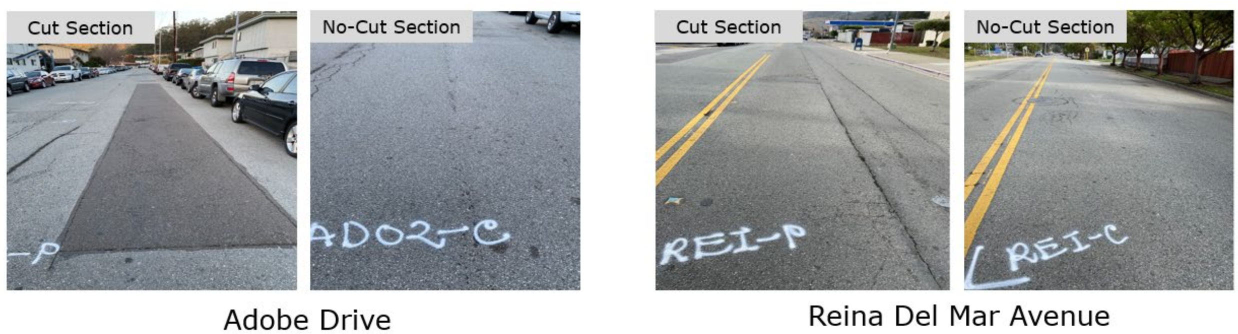


Figure 3. Examples of Site Selection

Table 1. Experimental Design for Site Selection

Functional Class	Pavement Age at Time of Cut, years	No. of Sites in Each Age Group	
		Plan	Actual
Arterials/ Collectors or Residentials	0-5	4	3
	5-10	4	2
	10-15	4	0
	>15	4	11

However, as can be seen from Table 1, the sites were not well-distributed among different age groups as 69% of the sections were older than 15 years at the time of the cut. This is due to the lack of testing sites that met the age criteria and cut-size criteria to conduct the deflection testing and consequently, the analysis is skewed towards older pavements.

3.2 STRUCTURAL DETERIORATION

Deflection testing was performed using an FWD, which delivers a transient impulse load to the pavement surface and measures the resultant pavement response in terms of deflection. Testing was conducted along the cut, 2 feet away from the cut as well as on sections with no cuts (see Figure 4).

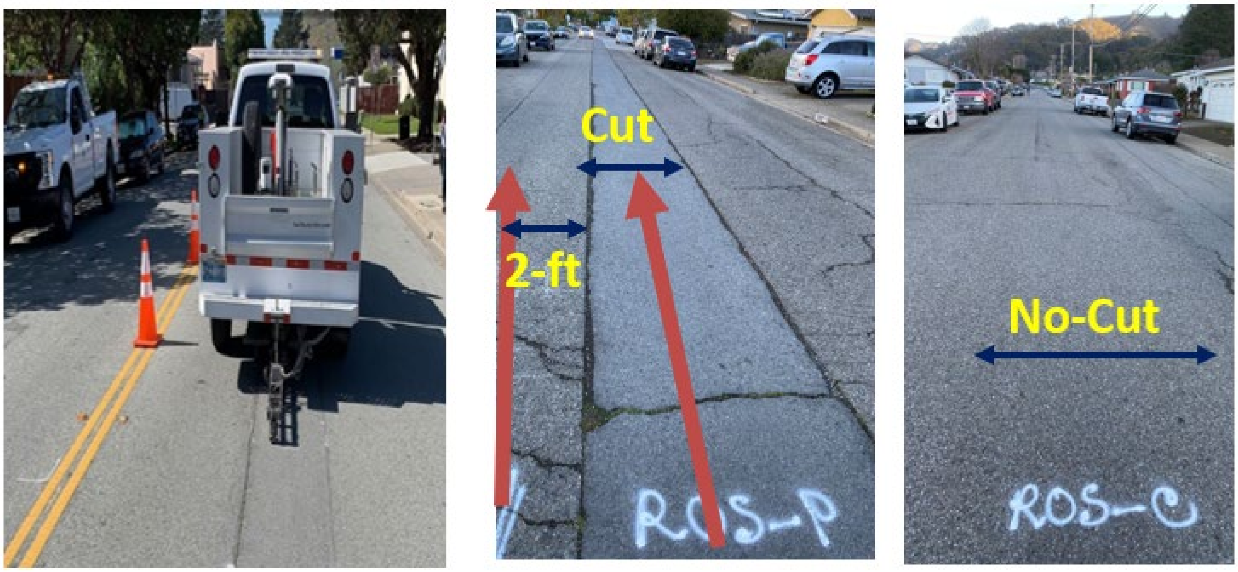


Figure 4. FWD Testing Layout

Since the selected sites were not well-distributed among different age groups, it was not possible to develop performance trends based on pavement age. Therefore, the results were not incorporated in the remainder of this assessment.

It is important to mention that the lack of the structural analysis results does not impact the development of a fee; again, as was noted in Chapter 2, fees can be developed using either structural or functional approaches. For this study, the functional deterioration approach was utilized and is further discussed in the subsequent chapters.

4 Functional Evaluation

The City maintains a StreetSaver® PMS, which contains inspection data dating back to 2001. The StreetSaver® database contains an inventory of all the City's streets, which are divided into management sections. For each management section, one or more sample units were surveyed for pavement condition based on a 10% sampling rate. Using the surveyed distresses, the PCI for each sample unit was calculated according to ASTM D6433.

Since the condition of the sample units is representative of the overall condition of the management section, the average PCI for all sample units within a management section is the PCI for that management section. The database contains 15 years of inspection history with approximately 1,500 sample units that include a recorded rehabilitation date for the corresponding management sections. Only sample units for sections with known rehabilitation dates were used for this study because pavement age is a crucial variable for this analysis and the rehabilitation date provides an estimate of pavement age. The observations based on the analysis of sample units could be used for management sections.

This study analyzed the following relationships between utility cuts and pavement performance based on three variables:

1. Different functional class (arterials/collectors versus residentials)
2. Different pavement age groups (0-5 years, 6-10 years, 11-15 years and >15 years)
3. Different sizes of cuts (small, medium and large)

4.1 DEVELOPMENT OF PERFORMANCE MODEL

Pavement deterioration curves of cut and no-cut sections for arterials/collectors and residentials were developed using the historical data from the City's database. These curves are shown in Figures 5 and 6.

These curves indicate the following:

- For arterials/collectors, overall sections with cuts deteriorate more rapidly than sections without cuts within all age groups.
- For residentials, the above observation is true for pavements less than 15 years old. Some streets more than 15 years did not exhibit this trend due to the existing distresses present.

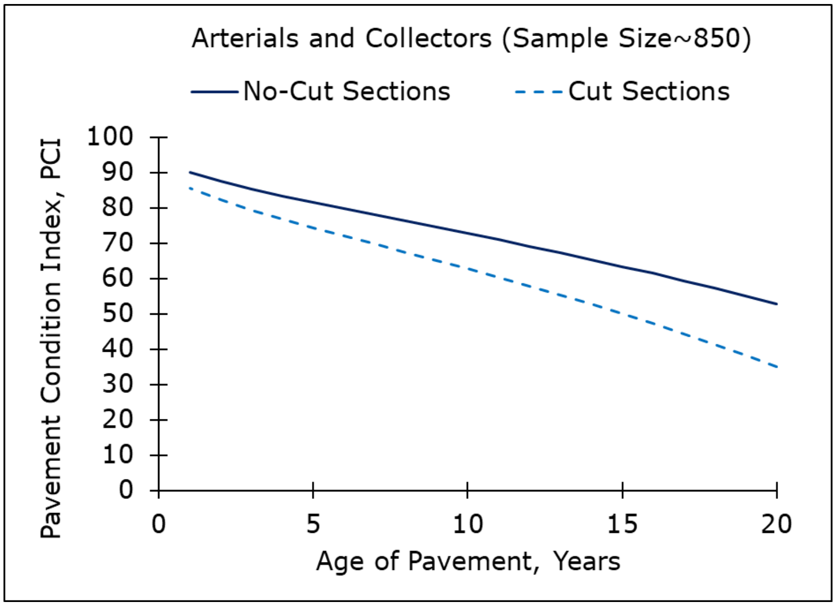


Figure 5. Pavement Deterioration Curve for Cut and No-Cut Sections – Arterials and Collectors

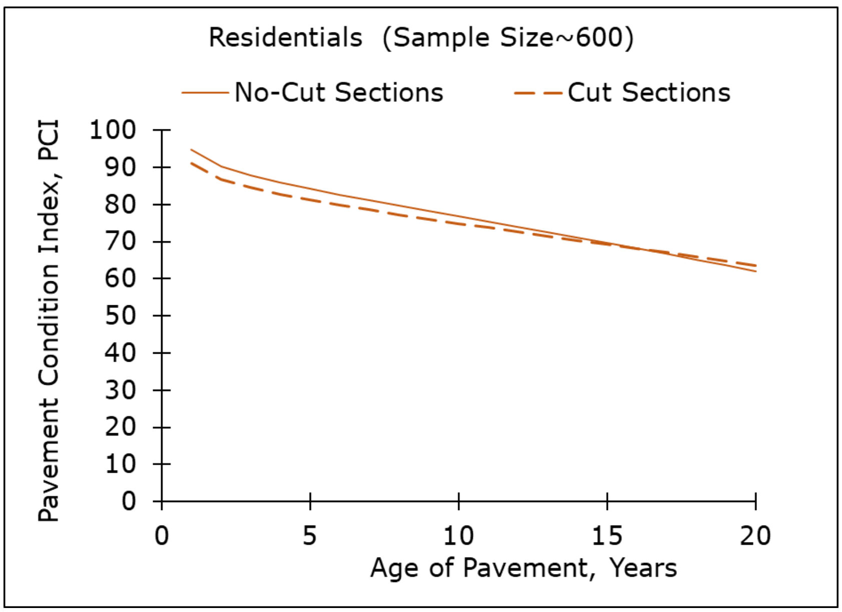


Figure 6. Pavement Deterioration Curve for Cut and No-Cut Sections - Residentials

4.2 PCI DIFFERENCE BY AGE GROUP AND CUT SIZE

Next, the sample units of different functional classes were grouped by cut size within different age groups (0-5 years, 6-10 years, 11-15 years and >15 years) for further evaluation. Different cut sizes ranging between 0.2% to 77.3% of the sample unit area were analyzed and finally categorized into two groups; cut area <10% (small cuts) and cut area ≥10% (large cuts) of sample unit area. The selection of this threshold is discussed in the next section.

However, very few data points were available for streets older than 15 years and a small sample size (N<5) can affect the reliability of analysis because it leads to a higher variability, which may lead to bias. Consequently, data points for all streets older than 10 years were grouped together to ensure avoid the bias. The PCI of cut and no-cut sections in each group were then compared.

Figures 7 and 8 show the PCI comparison for arterials/collectors and residentials, respectively. These figures indicate the following:

- Overall PCI decreases with pavement age.
- The PCI decreases as the cut size increases.

Note that data points for newer residential streets with large cuts were not available.

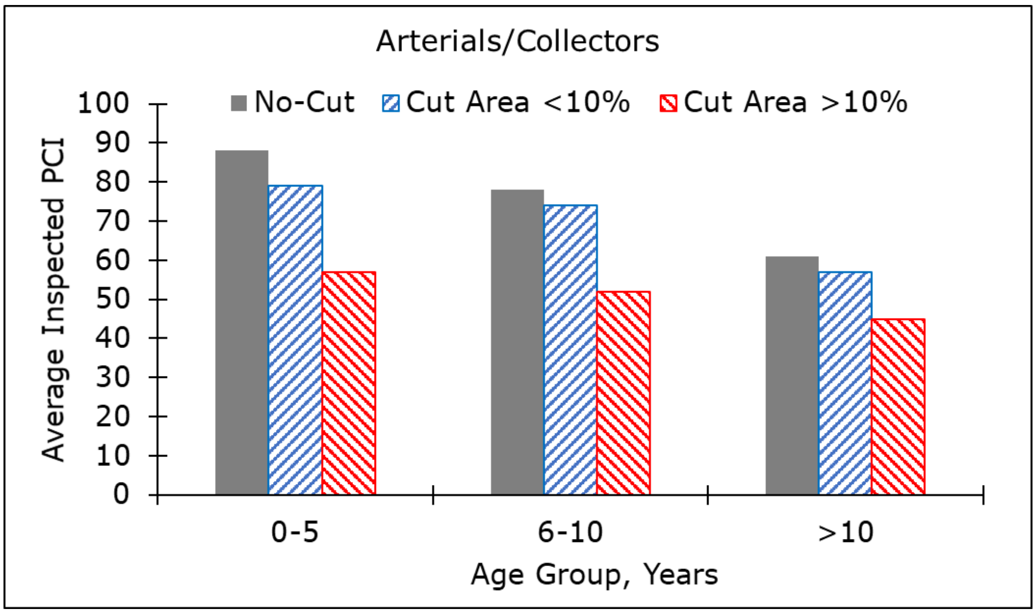


Figure 7. PCI Comparison by Functional Class, Age Group and Cut Size – Arterials/Collectors

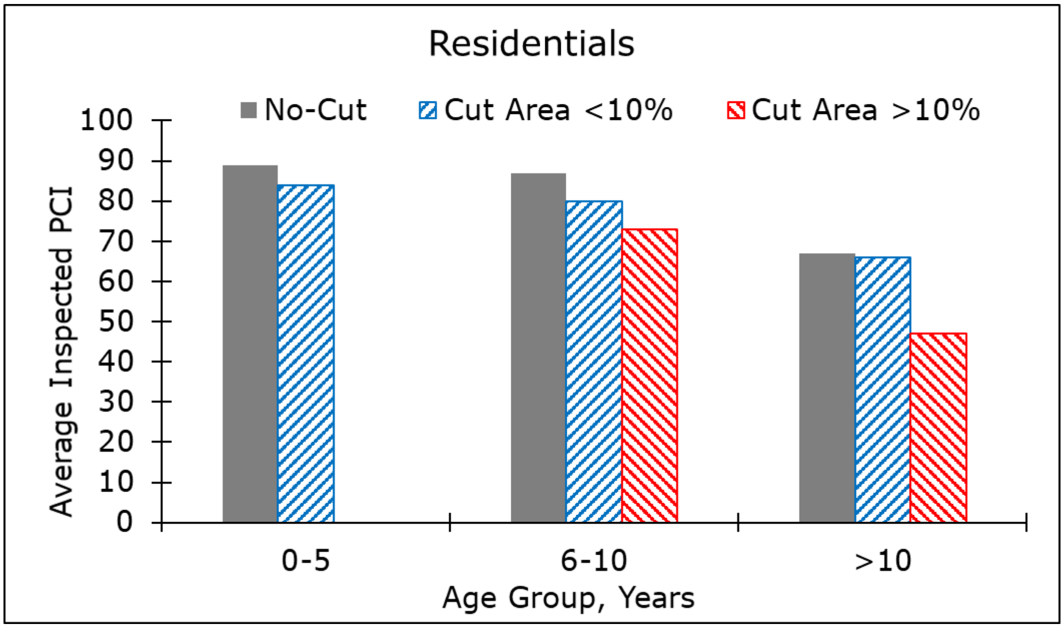


Figure 8. PCI Comparison by Functional Class, Age Group and Cut Size – Residentials

4.3 REDUCTION IN PCI

Table 2 below presents reduction in PCI within each age group based on cut-size.

Table 2. Reduction in PCI by Age Groups and Cut Size

Functional Class	Age Group	Percent Reduction in PCI by Cut Size*	
		Small Cut	Large Cut
Arterials/ Collectors	0-5 years	13%	36%
	6-10 years	14%	34%
	>10 years	11%	32%
Residential	0-5 years	6%	-
	6-10 years	8%	16%
	>10 years	1%	30%

*Represents the amount the PCI of the section would be reduced compared to a no-cut section
Small cut =Cut Area <10% of Section Area
Large cut =Cut Area ≥10% of Section Area

Table 2 indicates the following:

- Overall, an average PCI reduction of approximately 10% was observed if the cut area was less than 10% of the section area.
- If the cut area was equal to or greater than 10% of the sample unit area, overall, an average PCI reduction of 30% was observed (34% for arterials/collectors and 23% for residentials). Note that residentials within the-0-5 year age group and with large cuts were not included in the average.

Based on the PCI range, pavements are assigned one of five condition categories (Table 3). A 30% reduction in PCI means that the pavement condition drops an entire condition category. An example is shown below in Table 3, where large cuts made to the pavements result in PCI drops that bring the pavement to a lower condition category. This means that a street requiring a slurry seal would now need a thin overlay because of the presence of a large cut and this further triggers a higher treatment unit cost for maintenance.

This analysis indicates cut sizes equal to or above 10% of the section area have a critical impact on pavement performance and more expensive restoration measures need to be considered on bigger cuts.

Table 3. Impact of PCI Reduction on Pavement Condition Category

Condition Category	PCI Range	Examples	
		No-Cut Section PCI	Cut Section PCI after 30% Reduction (Cut Area≥10%)
I- Excellent	85-100	90	-
I- Very Good/Good	70-85	80	-
II/III- Fair	50-70	60	63, 56
IV- Poor	25-50	35	42
V- Failed	0-25		24

4.4 PERCENT REDUCTION IN PAVEMENT LIFE

The percent reduction in pavement service life was next estimated using the StreetSaver® family deterioration curves for asphalt concrete (AC) streets. Those family deterioration curves are illustrated in Figure 9.

Based on the standard Remaining Service Life (RSL) definition, a pavement's RSL reaches zero when a pavement falls into failed condition, meaning it has a PCI of 24 or less. Consequently, residentials have a total service life of approximately 34 years, while arterials/collectors have a total service life of approximately 29.5 years.

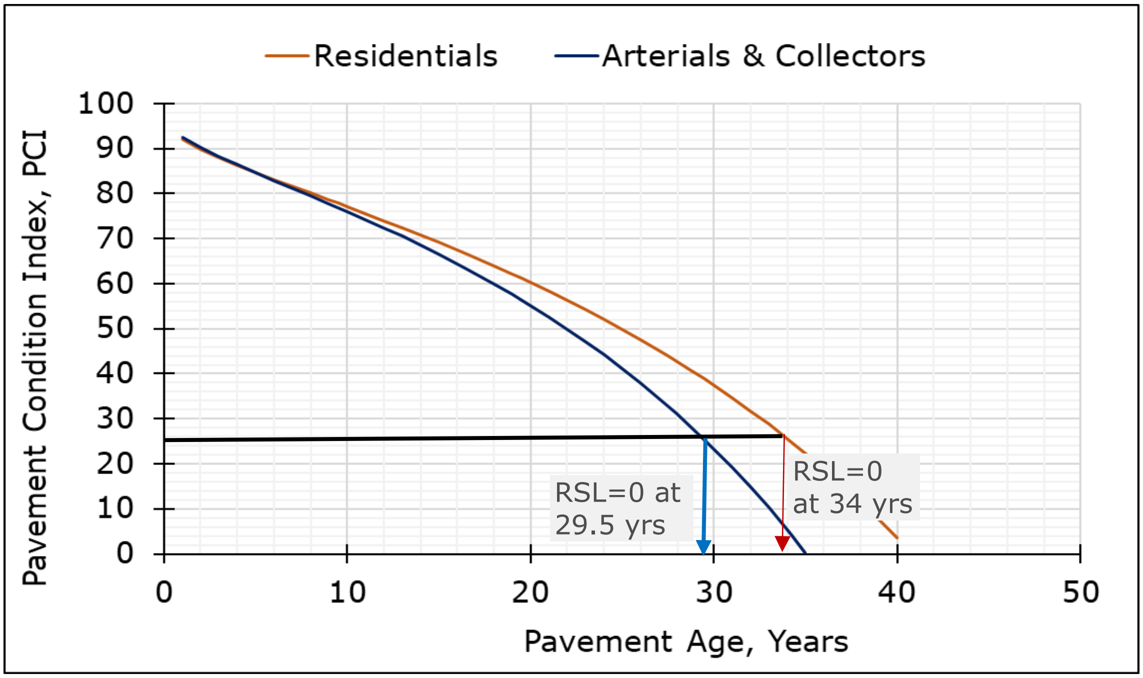


Figure 9 Pavement Deterioration Family Curves for Streets in the City of Pacifica

For example (see Figure 10), an arterial/collector (aged 0-to-5 years) with no cut has a PCI of 89. Based on the analysis in the previous section, a cut area greater than 10% of the section area would drop the PCI to 57. A PCI of 89 for arterials/collectors corresponds to an equivalent service life of approximately 2 years, whereas a PCI of 57 corresponds to an equivalent service life of 19 years. Consequently, the cut in this example reduces the pavement service life by 17 years, or 58% of its 29.5-year service life.

The above calculation was performed for both functional classes in all age groups and for all cut sizes to estimate the percent reduction in pavement service life and illustrated in the Figures 11 and 12.

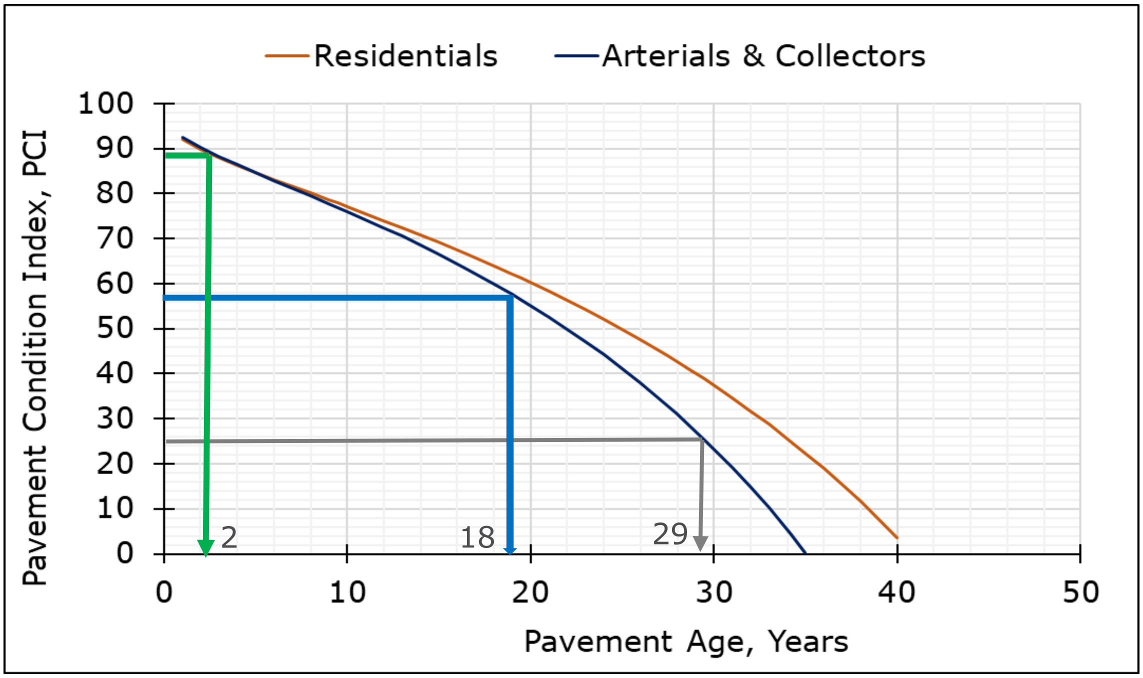


Figure 10. Example of Percent Reduction in Life

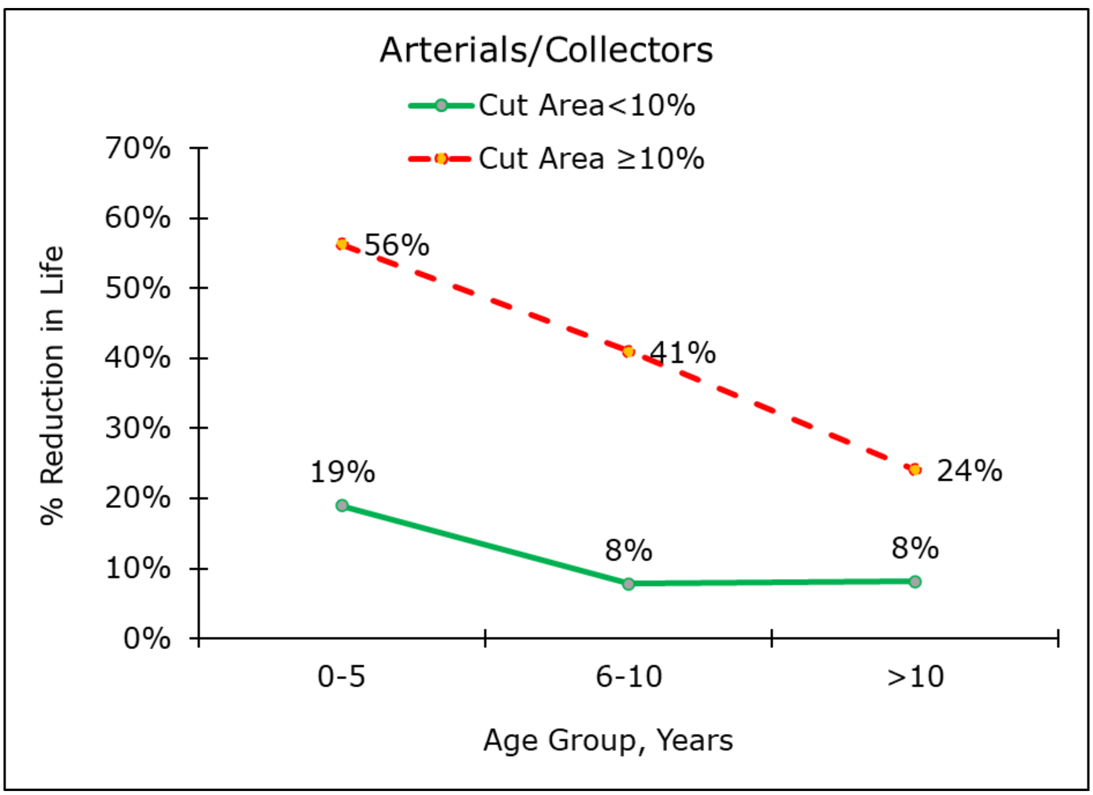


Figure 11. Percent Reduction in Pavement Service Life -Arterials/Collectors

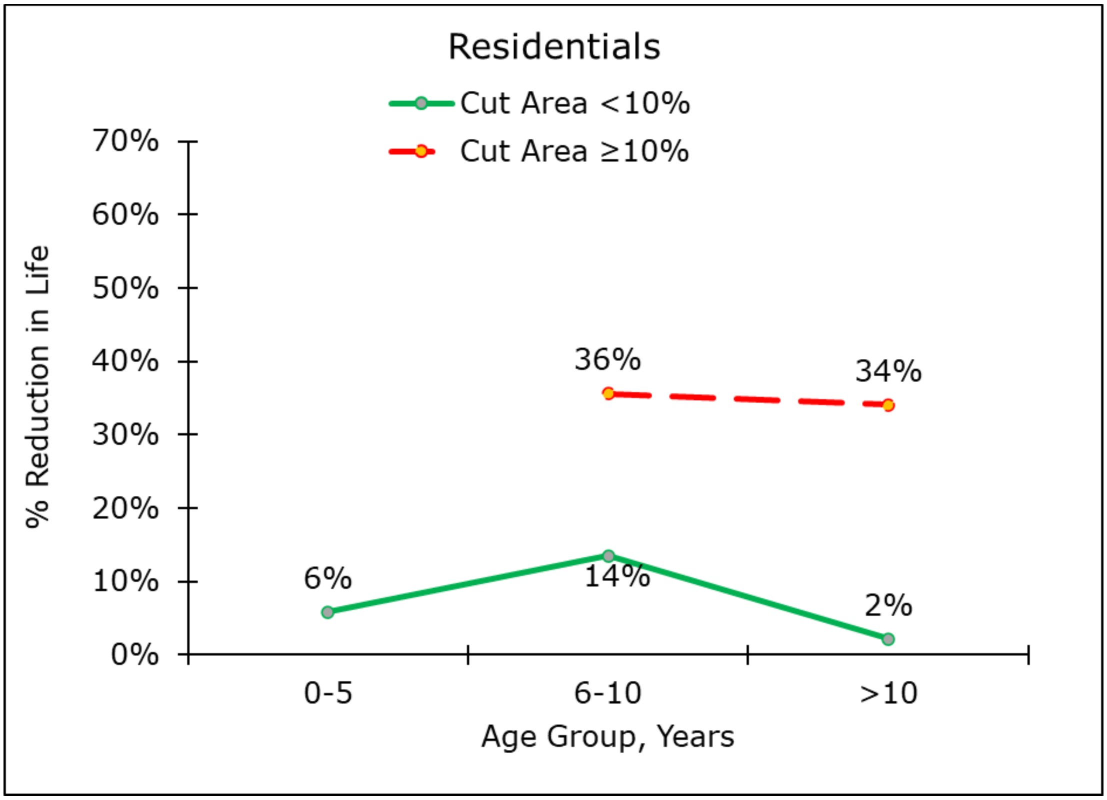


Figure 12. Percent Reduction in Pavement Service Life -Residentials

Figures 11 and 12 indicate the following:

- The reduction in pavement life decreases as pavements get older; this means that cuts have a greater impact on new pavements than old pavements.
- Larger cut sizes result in greater reductions in pavement service life. An average pavement life is reduced by approximately 38% if the cut area is equal to or greater than 10% of the section area.

Also, multiple small cuts on one street combined that when add up to more than 10% of the section area would be more detrimental than small- or medium-sized cuts on streets that total less than 10% of the section area.

Table 4 summarizes the percent reduction in pavement life based on functional class, pavement age, and cut size following the analysis in the previous sections. Since data was not available for residential streets within age group of 0-5 years with large cuts, streets newer than 10 years were grouped together which resulted in two final age groups (Age < 10 years and Age ≥ 10 years) for both functional classes.

Table 4. Percent Reduction in Pavement Life by Functional Class, Pavement Age and Cut-Size

Percent Reduction in Pavement Service Life*			
Functional Class	**Age Group**	**Small Cut**	**Large Cut**
Arterials/ Collectors	<10 years	25%	55%
	≥10 years	10%	25%
Residentials	<10 years	15%	40%
	≥10 years	2%	35%

*Represents the amount the service life of the section would be reduced compared to a no-cut section
Small cut =Cut Area <10% of Section Area
Large cut =Cut Area ≥10% of Section Area

4.5 STATISTICAL ANALYSIS

A statistical analysis was next conducted on the data from StreetSaver® to determine whether significant differences in the PCI exist between pavements with cuts and those without cuts within the groups specified in Table 4. The t-test was performed within each pavement age group to compare the cut and no-cut sample units. The t-test provides a "P-value" that indicates the probability of a statement being true or how likely a particular set of observations would occur. In this case, the goal is to determine if the probability of two groups of data (PCI of cut and no-cut sample units) are significantly different.

- A P-value less than 0.05 (at a 95% confidence level) indicates that the PCI of the cut sample units are significantly lower than PCI of no-cut sample units. Thus, it is expected that cuts would have an adverse impact on the pavement.
- A P-value above 0.05 indicates that the PCI of cut and no-cut sample units are not statistically significant.

As can be seen from Table 5, residential streets older than 10 years do not have a significant difference if the cuts are small (less than 10% of the section area). A P-value of 0.32 in Table 5 indicates that the probability of not finding any adverse impact due to small cuts on residential streets older than 10 years is 32%.

However, if multiple small cuts are made over time (as is the case for most streets), their individual impacts will add up and have an equivalent impact of a large cut, thus resulting in an adverse impact on pavement performance.

Table 5. Statistical Analysis of StreetSaver® Data Grouped by Age and Cut-Size

Category	Age Group	PCI No-Cut Section	PCI Cut-Section		P-Value		Significant Difference	
FC			Small Cut	Large Cut	Small Cut	Large Cut	Small Cut	Large Cut
Arterials/ Collectors	<10 years	83	72	53	0.00	0.00	Yes	Yes
	≥10 years	61	56	42	0.02	0.04	Yes	Yes
Residentials	<10 years	89	82	73	0.00	0.00	Yes	Yes
	≥10 years	67	66	47	0.32	0.00	No*	Yes

*Although individual small cuts do not show a significant difference, there is a cumulative impact from multiple small cuts. Over time, this impact will be equivalent to a section with large cuts.

5 Fee Development

5.1 APPROACH FOR TIERED FEE

To calculate a cost value equivalent to pavement life reduction, the StreetSaver® decision tree was used to extract unit costs for overlays (including milling) for each functional class. These unit costs were estimated using the City's construction bid tabs. The costs were $6.25 per square foot (SF) for arterials/collectors and $5.25/SF for residentials.

These unit costs were multiplied by the percent reductions in service life in Table 4 and a slurry seal cost ($0.50/SF) was then added to derive a fee per square foot based on pavement age and cut size (the slurry seal is part of the restoration requirements after the cut have been made). Table 6 presents the fees rounded to the nearest 50 cents based on functional class, pavement age and cut size.

Table 6. Tiered Fee Schedule ($/SF) (Option 1)

Fee, $/SF			
Functional Class	Age Group	Cut Area (% of Section Area)	
		Small Cut	Large Cut
Arterials/ Collectors	<10 years	$ 2.50	$ 4.00
	≥10 years	$ 1.50	$ 2.50
Residential	<10 years	$ 1.50	$ 3.00
	≥10 years	$ 1.00	$ 2.50

5.2 FEE IMPLEMENTATION

Table 6 can be used to charge the full recovery costs for the damage caused by the cuts. Note that "section area" for fee implementation is defined here as City's individual management section area from StreetSaver®. The typical management section area obtained from the StreetSaver® database for residential streets (700 feet x 30 feet) or arterials/collectors streets (1,274 feet x 40 feet) could be used as representative average section area. However, actual street areas or block areas can be utilized with similar implementation strategy if desired.

5.2.1 Large Pavement Cuts

The analysis in Chapter 4 showed that large cuts have (cut area equal to or greater than 10% of the section area) critical impact on pavement performance and results in the pavement condition dropping by an entire condition category. In addition, it also results in a 30% reduction in the pavement service life. Therefore, large cuts equal to or greater than 10% of the section area would trigger a more aggressive restoration measure e.g., overlay of the entire section.

The following fee equation was developed for large cuts:

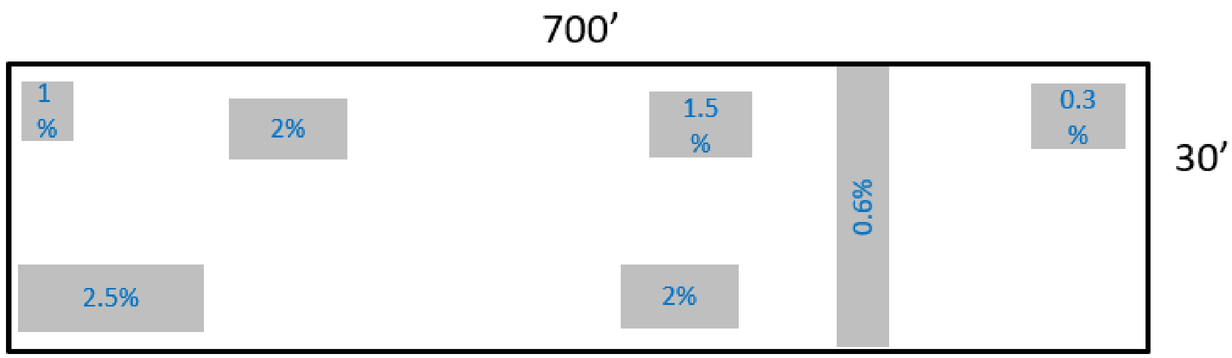
$$Total\ Recovery\ Fee, \$ = Unit\ Cost\ from\ Table\ 6 * Total\ Management\ Section\ Area\ to\ Overlay$$
Eqn 1

If the utility cut area is large enough (either singly or in combination) to require an overlay, then the responsible party(ies) will pay the full amount of the overlay cost.

5.2.2 Small Pavement Cuts

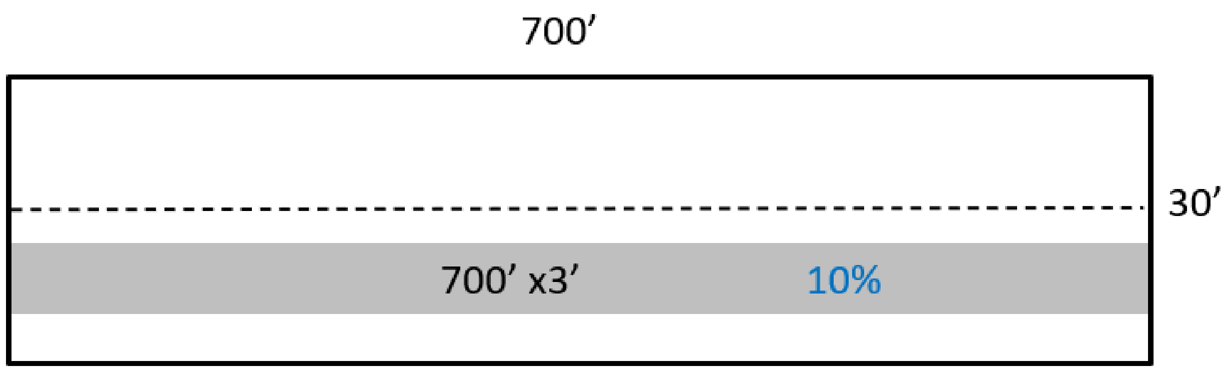
For small cuts, the fees in Table 6 need to be pro-rated so that their individual impacts are captured (see Figures 13 and 14). Over time, as multiple small cuts are made, their impacts will be cumulative and eventually be equivalent to the impact of a large cut.

For example, the fee for a large cut (10% of section area) would be the total overlay cost (100%) as mentioned in Section 5.2.1 while the fee for a small cut (2% of section area) would be (2/10)%= 20% of the total overlay cost.



(Multiple small cuts can add up to 10% of the section area, and their impacts are pro-rated accordingly)

Figure 13. Multiple Small Cuts



(A 3-foot side trench cut that is the length of the section will be = 10% of section area)

Figure 14. One Large Cut

This is illustrated in the steps below.

$$Total\ Overlay\ Cost, \$ = Unit\ Cost * Total\ Management\ Section\ Area\ to\ Overlay$$
Eqn 2

Eq 2 with the unit costs from Table 6 is applicable for the sections with cuts equal to or greater than 10% of the total section area.

If Area of Cut ≥10% Area of Section:

$$Total\ Recovery\ Fee, \$ = Total\ Overlay\ Cost \qquad \text{Eq 3}$$

If Area of Cut < 10% Area of Section:

$$Total\ Recovery\ Fee, \$ = \left(\frac{Area\ of\ Cut}{10\%\ Area\ of\ Management\ Section}\right) * Total\ Overlay\ Cost \qquad \text{Eq 4}$$

Incorporating Unit Costs:

$$Total\ Recovery\ Fee, \$ = \left(\frac{Area\ of\ Cut}{10\%\ Area\ of\ Management\ Section}\right) * (Unit\ Cost * Total\ Management\ Section\ Area) \qquad \text{Eq 5}$$

Simplifying, by eliminating Area of Section:

$$Total\ Recovery\ Fee, \$ = \left(\frac{Area\ of\ Cut}{10\%}\right) * Unit\ Cost\ (From\ Table\ 6) \qquad \text{Eq 6}$$

An additional 2-feet in each direction is included in the fee calculation to incorporate 2-foot zone of influence surrounding the cut area because a slumping effect is usually predominant. Thus, the following fee equation for small cuts would be:

$$Total\ Recovery\ Fee, \$ = Unit\ Cost\ (From\ Table\ 6) * (Cut\ Length + 2' + 2') * (Cut\ Width + 2' + 2')/10\% = Unit\ Cost\ (From\ Table\ 6) * (Cut\ Length + 4') * (Cut\ Width + 4')/10\% \qquad \text{Eq 7}$$

5.2.3 Examples of Fee Implementation

Figure 15 presents three examples of cuts of different sizes on residential streets. Based on the StreetSaver® database, the typical length and width of a residential management section in the City is 700 feet by 30 feet. Thus, if a cut of 4 feet x 4 feet is made to a residential street that is less than 10 years old, it would be only 0.1% of the section area and the fee charged would be $1.50/SF (Table 6).

A similar fee would be applied for a cut of 30 feet x 6 feet, where the cut area is 1% of the section area.

For large cuts, we observed many full-block longitudinal trench cuts (Figure 16). A cut of this type would be equal to or greater than 10% of the section area and thus $3.00/SF would be charged for the full recovery.

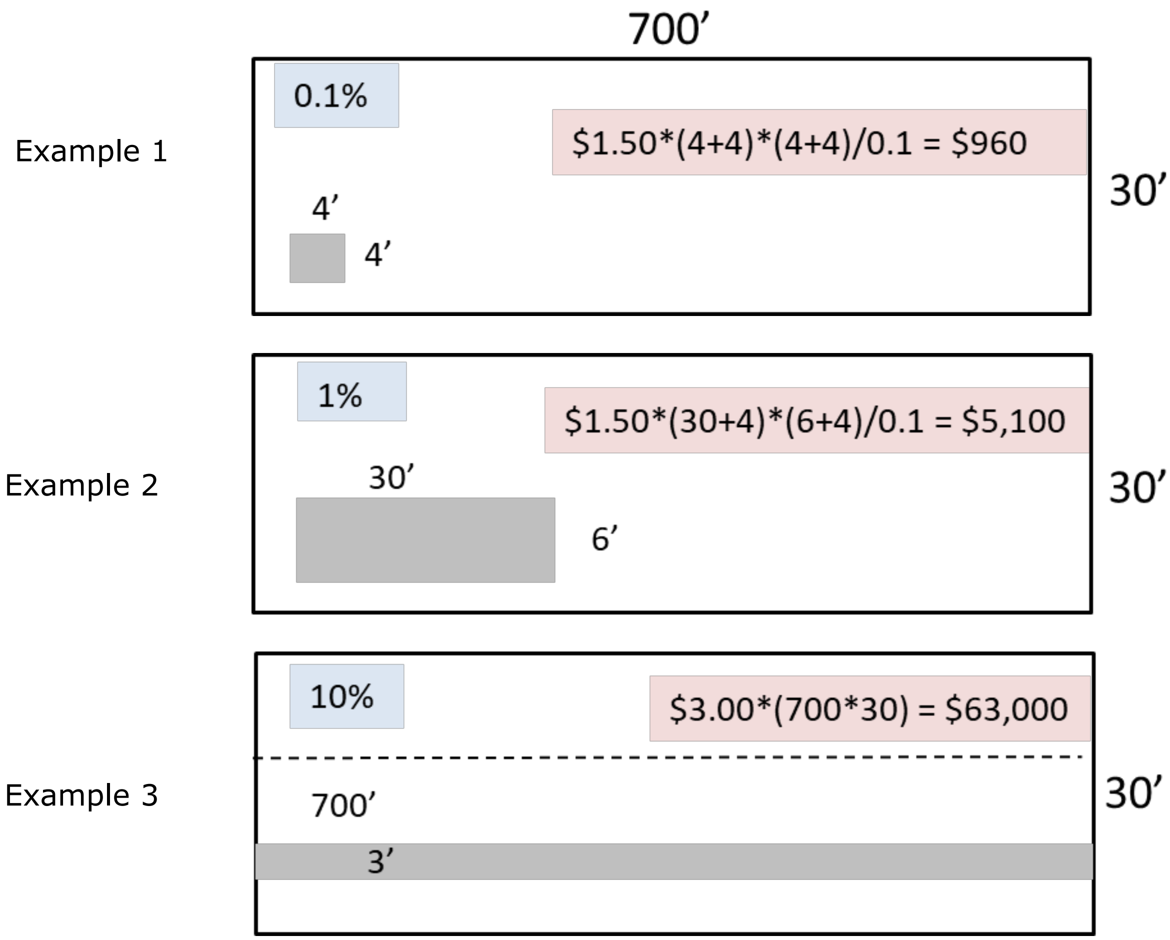


Figure 15. Examples of Fee Implementation for Typical 700'x30' Residential Street

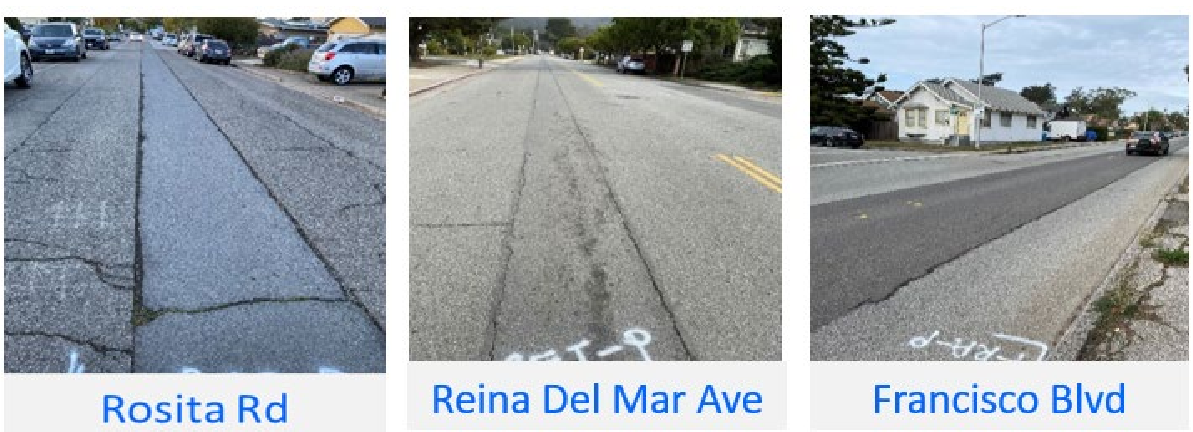


Figure 16 Typical Full Block Trench Cut in Pacifica

5.3 FEE COMPARISON WITH OTHER AGENCIES

Utility cut fees are prevalent as a way for local agencies to recoup the cost of pavement damage associated with underground utility work. Table 7 summarizes various utility cut fees for 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.

As can be seen from Table 7, the proposed fee range in Pacifica aligns very closely with the fee in the City and County of San Francisco where the range is $1.00/SF to $3.50/SF. When compared with longitudinal cut fees from other agencies, the proposed utility cut fee for Pacifica is in the same ballpark as many of the other agencies. The transverse cut fees for other agencies are higher than the fees proposed for Pacifica. When comparing fees among different agencies, it is important to consider that the overall pavement condition varies among different agencies and thus the performance of pavements with cuts are critical to existing condition.

Table 7 Utility Cut Fee Schedule Range Comparison

Agency	Criteria	Range, $/SF
Pacifica	Type of Street, Size of Cut, Age of Pavement	$1.00-$4.00
City and County of San Francisco	Age of Pavement	$1.00-$3.50
Sacramento County, Elk Grove, Santa Cruz	Trench Depth, Type of Streets, 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	Type of Cut, Pavement Age	$1.00-$3.50 (Longitudinal Cut)
		$2.00-$7.00 (Transverse Cut)
Modesto	PCI	$0-$2.50
Patterson	PCI	$0-$7.30
Santa Ana	Type of Streets and Age of Pavement	$6.21-$13.68
Los Angeles	Type of Street	$8.24-$19.44

6 Summary

The purpose of this study was to conduct a detailed literature review of existing studies, determine the impact of utility cuts on pavement performance in Pacifica, quantify the damage and develop a fee to recover the costs associated with such damage.

Two approaches were utilized in this study based on both the functional and structural deterioration of the pavement. Due to the limited number of sites available among different age groups for the latter, the fee was developed using the functional approach.

The following conclusions were determined:

- Pavements with cuts of any size deteriorate more than pavements without cuts across all age groups (0-5 years, 6-10 years, 11-15 years and >15 years). The exception is residentials older than 10 years with small cuts (cut area <10% of section area)
- On average, the PCI drops by 30% if the cut area is greater than 10% of the section area.
- Cuts do more damage to new (< 10 years) pavements than older (>10 years) pavements. This results in an average percent reduction of the remaining service life of approximately 33% for new pavements and 17% for old pavements.

Finally, a fee schedule was developed to recover the full costs of repair for the damage caused by the cuts. The information required to implement this fee includes the functional class, age of the pavement, size of the management section area and size of the cut (see Tables 6).

7 References

Department of Public Works. 1998. *The Impact of Excavation on San Francisco Streets*. Department of Public Works, City and County of San Francisco and Blue-Ribbon Panel on Pavement Damage.

Tarakji, G. 1995. *The Effects of Utility Cuts on the Service Life of Pavements in San Francisco.* Volume I, Department of Public Works, San Francisco State University.

Todres, H.A. and Baker, P.E., 1996. *Utilities Conduct Research in Pavement Restoration*. APWA Reporter, 63(10).

Wilde, W.J., Grant, C.A., and Nelson, P.K. 2002. *Manual for Controlling and Reducing the Frequency of Pavement Utility Cuts.* FHWA Report No. FHWA-RD-02-%%%

Appendix A (Summary of Utility Cut Studies and Policies)

Collaboration. Commitment. Confidence.SM

MEMORANDUM

Date:	July 31, 2021
To:	City of Pacifica
From:	Debaroti Ghosh, Sharlan Montgomery Dunn, Margot Yapp
Subject:	Summary of Utility Cut Studies and Policies
Job Number:	1004.05.55

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).

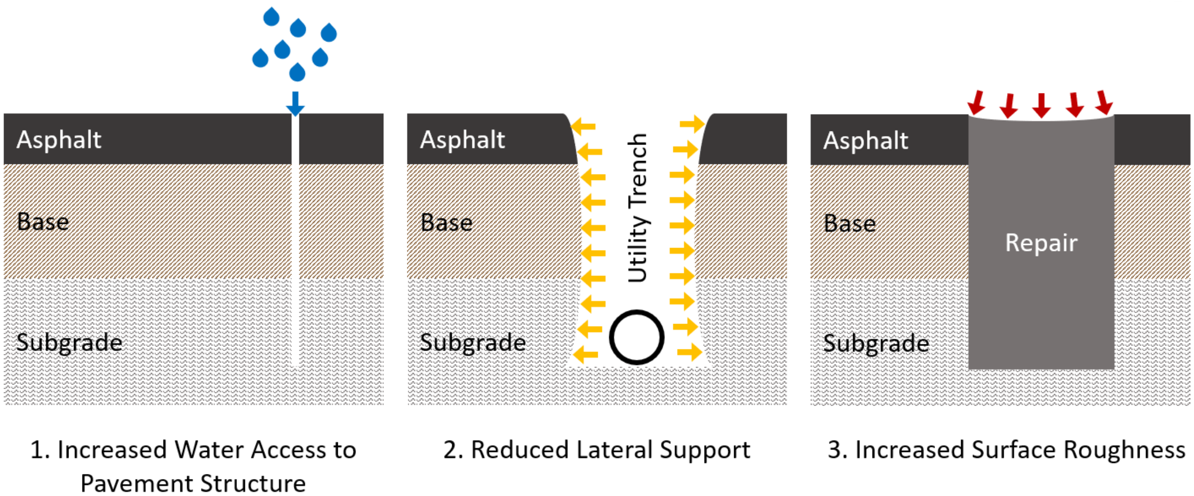


Figure 1. Utility Cut Damage Mechanisms

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.

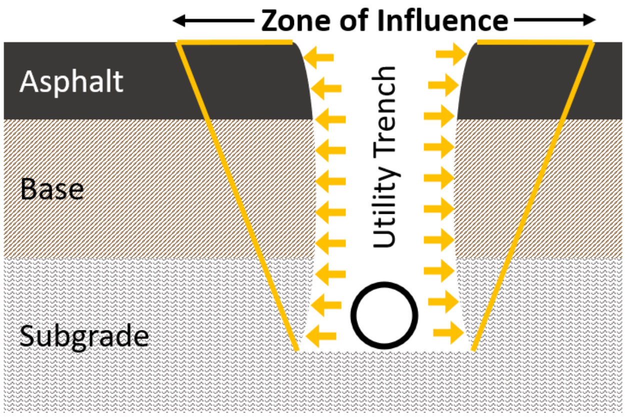


Figure 2. Zone of Influence

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).

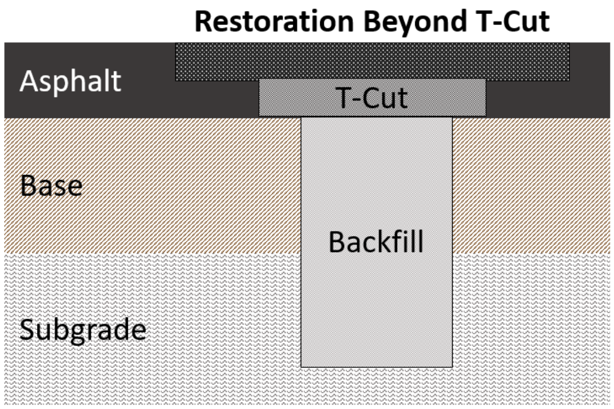


Figure 3. Example Restoration Plan.

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)
Pacifica	Yes	6	None	NA	Existing Thickness (min of 4)
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

<table>
<tr><th>Agency</th><th>Year</th><th colspan="3">Criteria</th><th>Fee ($/SF)</th></tr>
<tr><td>Anaheim*</td><td>1994</td><td colspan="3">Age < 1 Year</td><td>16.48</td></tr>
<tr><td rowspan="20">Elk Grove</td><td rowspan="20">2020</td><td rowspan="10">Trench Depth < 4 ft</td><td rowspan="5">Major Streets or All Streets within 5 years of construction or structural overlay</td><td rowspan="2">PCI 100 and 70</td><td>3.90 (long.)</td></tr>
<tr><td>7.80 (trans.)</td></tr>
<tr><td rowspan="2">PCI 69 and 26</td><td>2.20 (long.)</td></tr>
<tr><td>4.40 (trans.)</td></tr>
<tr><td>PCI 25 and 0</td><td>-</td></tr>
<tr><td rowspan="5">All Other</td><td rowspan="2">PCI 100 and 70</td><td>2.41 (long.)</td></tr>
<tr><td>4.82 (trans.)</td></tr>
<tr><td rowspan="2">PCI 69 and 26</td><td>1.18 (long.)</td></tr>
<tr><td>2.36 (trans.)</td></tr>
<tr><td>PCI 25 and 0</td><td>-</td></tr>
<tr><td rowspan="10">Trench Depth > 4 ft</td><td rowspan="5">Major Streets or All Streets within 5 years of construction or structural overlay</td><td rowspan="2">PCI 100 and 70</td><td>5.91 (long.)</td></tr>
<tr><td>11.82 (trans.)</td></tr>
<tr><td rowspan="2">PCI 69 and 26</td><td>3.34 (long.)</td></tr>
<tr><td>6.68 (trans)</td></tr>
<tr><td>PCI 25 and 0</td><td>-</td></tr>
<tr><td rowspan="5">All Other</td><td rowspan="2">PCI 100 and 70</td><td>3.66 (long.)</td></tr>
<tr><td>7.32 (trans.)</td></tr>
<tr><td rowspan="2">PCI 69 and 26</td><td>1.80 (long.)</td></tr>
<tr><td>3.60 (trans.)</td></tr>
<tr><td>PCI 25 and 0</td><td>-</td></tr>
<tr><td rowspan="2">Los Angeles</td><td rowspan="2">2018</td><td colspan="3">Select Streets</td><td>19.44</td></tr>
<tr><td colspan="3">Local Streets</td><td>8.24</td></tr>
<tr><td rowspan="3">Modesto</td><td rowspan="3">2020</td><td colspan="2" rowspan="3">All Streets</td><td>PCI 70-100</td><td>2.5</td></tr>
<tr><td>PCI 26-69</td><td>1.25</td></tr>
<tr><td>PCI 0-25</td><td>-</td></tr>
<tr><td rowspan="3">Patterson</td><td rowspan="3">2020</td><td colspan="2" rowspan="3">All Streets</td><td>PCI 70-100</td><td>7.3</td></tr>
<tr><td>PCI 50-69</td><td>5.25</td></tr>
<tr><td>PCI 0-49</td><td>-</td></tr>
</table>

*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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