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MEMORANDUM

City of Tigard | 2020 Pavement Management Program
WE#1492A

DATE: December 20th, 2019

TO: Lori Faha ,PE, City of Tigard
Nichole George, City of Tigard

FROM: Wes Wegner, PE, Wallis Engineering

RE: Proposed Pavement Section Standards

SECTION 1: PROJECT PURPOSE AND INTRODUCTION

The City of Tigard proposes to change the standard pavement sections included in the Engineering Standards, as part of ongoing updates that ensure City standards meet the needs of their existing and future citizens. The goal of this change is to improve the long-term value of the City's infrastructure, and to minimize long-term pavement maintenance costs.

The City of Tigard (City) requested that Wallis Engineering review the proposed standard sections and provide our opinion as to their suitability for the City. This memorandum summarizes the results of our review and our engineering judgement as to how appropriate these standards are compared to the standards of similar cities, and with respect to the City's long-term street infrastructure goals.

SECTION 2: STANDARDS OF SIMILAR CITIES

There are several cities in the Portland-metro area that are similar to Tigard in size and pavement maintenance challenges. Some of these cities include minimum pavement sections in their standards.

Tables 1 and 2 below summarize Tigard's current and proposed pavement sections for local and collector street classifications, alongside pavement section standards from other adjacent and similarly-sized cities. These cities are all located within the Portland-metro area and are relatively similar in population and the number of roadway miles that they own and maintain. Also similar to Tigard, most of these cities have street fees that fund their pavement maintenance programs.

Note that these tables do not list all cities adjacent to Tigard or in the Portland-metro area, because not all cities have pavement section standards. Many require street-specific pavement designs regardless of street classification. Similarly, we did not compare pavement sections for arterial streets, because relatively few cities have a minimum standard for this street classification.

Table 1: Comparison of Pavement Standards for Local Streets

City	ACP[a] depth (in)	Aggregate Base depth (in)
Beaverton[b]	5	16
Hillsboro[b]	5	16
Lake Oswego	4	8
Milwaukie	4	12
Oregon City	4	12
Tigard[b] (current)	**3**	**9**
Tigard[b] (proposed)	**5**	**16**
Wilsonville	4	-[c]

a) ACP is an abbreviation for Asphalt Concrete Pavement. The numbers in this column sum the total thickness of the wearing course and base course for asphalt concrete pavement.

b) Sections shown are for residential local streets; commercial and industrial pavement sections for the Cities of Beaverton, Hillsboro and Tigard are thicker.

c) Wilsonville does not have minimum thicknesses for aggregate base – they require a street-specific design.

Table 2: Comparison of Pavement Standards for Collector Streets

City	ACP depth (in)	Aggregate Base depth (in)
Beaverton	10	21
Hillsboro[a]	10	20
Lake Oswego[b]	-	-
Milwaukie	6	12
Oregon City[b]	-	-
Tigard (current)	**4**	**15**
Tigard (proposed)	**10**	**19**
Wilsonville	5	-[c]

a) Sections shown are for residential collector streets where such a distinction is made; City of Hillsboro requires cement concrete rather than asphalt concrete for commercial and industrial collector streets.

b) The Cities of Lake Oswego and Oregon City do not have a pavement standard for collector streets.

c) Wilsonville does not have minimum thicknesses for aggregate base – they require a street-specific design.

As seen in the tables above, the City of Tigard's current pavement sections for local and collector streets are thinner than sections for all other cities in the area, and the City's proposed standard section thicknesses are comparable to adjacent cities.

The age of each City's standards or standard details correlates somewhat to the level of conservatism identified in the minimum pavement sections. The oldest standards generally require the thinnest sections; as standards have been updated over time, trends show that minimum pavement section increase. This trend is attributed to the ongoing and historic challenge of managing street infrastructure. The largest cities (Beaverton and Hillsboro) have the most conservative pavement sections.

SECTION 3: LONG-TERM PAVEMENT MAINTENANCE GOALS

The City's long-term pavement maintenance goals are particularly relevant to their pavement standards. These standards will be implemented for all new streets constructed within the City limits – either by developers, or by the City itself. As such, these standards dictate the minimum requirements for the quality of the City's infrastructure and have very real implications to the long-term cost of maintaining this infrastructure. Tigard's current standard limits the feasible rehabilitation methods. A more robust standard, as proposed, provides the City with the opportunity to manage their pavement assets cost-effectively.

The City of Tigard owns and maintains over 160 miles of roadways. Each of these roadways has a unique set of conditions, pavement thickness, traffic loadings, and ultimately, maintenance needs. The City's Pavement Management Program (PMP) has an established annual budget for maintaining these roadways, funded by the City's Street Maintenance Fee. That fee is paid by residents and businesses within Tigard.

There are limited funds available for pavement maintenance in comparison to the maintenance needs, and the City's goal is to complete maintenance in the most efficient manner possible. Pavement maintenance reduces the likelihood that a street will need to be fully reconstructed; full reconstruction is extremely costly in comparison to maintenance, and also presents much more disruption to road users. Figure 1 illustrates the condition of a typical roadway over time under two conditions: receiving no maintenance, and receiving regular pavement preservation or maintenance activities.

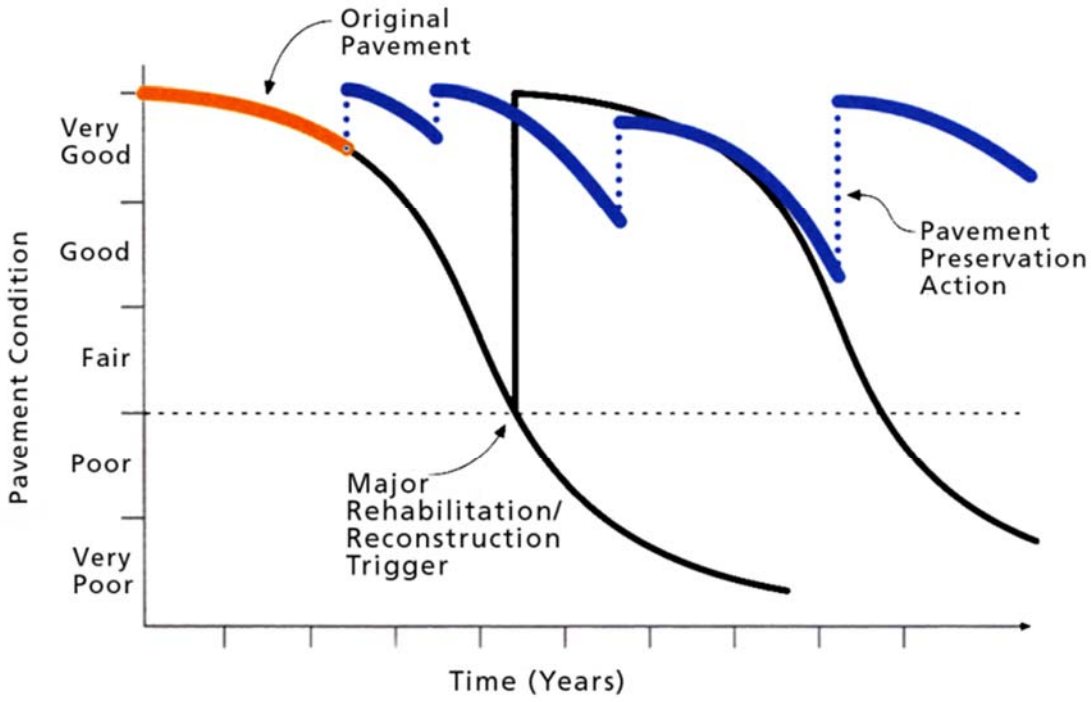

Figure 1: Pavement Conditions Over Time

a) Source of figure is National Park Service website https://www.nps.gov/subjects/transportation/pavement-preservation.htm, accessed 12/9/2019. Similar figures may be found at websites such as https://www.pavementinteractive.org/reference-desk/pavement-management/analysis/pavement-life-cycle/ and https://www.pavementinteractive.org/pavement-maintenance-prevention-or-repair/

As illustrated, regular pavement maintenance activities defer major reconstruction or rehabilitation to a significant degree and are much more cost-effective. However, regular maintenance alone will not eliminate the need to reconstruct pavement. For example, an asphalt pavement thickness of less than four inches – regardless of the traffic loadings – can be challenging to rehabilitate by techniques currently available in the industry. Similarly, if the existing section is relatively thin for the loadings and soil conditions, rehabilitation may not extend the life of the pavement beyond a certain point – pavement failure will occur, and full reconstruction will be necessary at some point.

A more robust and appropriate pavement section can defer reconstruction indefinitely (in some cases) and is referred to as a Perpetual Pavement. Ultimately, the City desires perpetual pavements – long-lasting, reliable pavements requiring less long-term expenditures, with less disruption to roadway users due to reconstruction, and lower costs to residents and businesses within the City of Tigard.

SECTION 4: RECOMMENDATIONS

In our opinion, the City's proposed street section standards will provide the City of Tigard the opportunity to meet their long-term pavement maintenance goals: reducing long-term costs by providing opportunities to complete rehabilitation techniques and reducing the need to fully reconstruct roadway pavements.

The City's proposed local street sections are conservative but appropriate minimum standards. These sections are summarized below in Table 3.

Table 3: Tigard's Proposed Pavement Standard for Local Streets

Classification	Asphalt Wearing Course (in)	Asphalt Base Course (in)	Aggregate Base Course (in)	Aggregate Sub Base Course (in)
Local (Commercial & Industrial)	2.0	6.0	5.0	12.0
Local (Residential)	2.0	3.0	4.0	12.0

For a residential local street, a five-inch thick asphalt concrete section is likely to last indefinitely without reconstruction – under normal circumstances, and with periodic maintenance treatments. As mentioned, anything less than four inches can be challenging to rehabilitate. Similarly, for a commercial or industrial local section, eight-inches of asphalt is an appropriate thickness for a street receiving significant truck traffic or even bus loadings.

A 16 to 17-inch thick aggregate section is conservative but assumes a subgrade strength typical of soils within the Tigard area. This pavement section is appropriate for soil with a resilient modulus of about 2,500 psi (1.67 CBR), a relatively weak silty clay (typical of the area). This is by no means the most conservative aggregate section possible for Tigard; if construction takes place outside of the dry summer months, or in areas of organic silts and clays, thicker sections of aggregate might be appropriate.

In our opinion, the proposed standard sections for neighborhood route, collector, and arterial street classifications are conservative but also appropriate. These sections are summarized below in Table 4.

Table 4: Tigard's Proposed Pavement Standard for Neighborhood Route, Collector and Arterial Streets

Classification	Asphalt Wearing Course (in)	Asphalt Base Course (in)	Aggregate Base Course (in)	Aggregate Sub Base Course (in)
Arterial	2.0	9.0	5.0	18.0
Collector	2.0	8.0	5.0	16.0
Neighborhood Route	2.0	6.0	5.0	12.0

Though these section minimums are thinner than the standards of similar adjacent cities (Beaverton and Hillsboro), they are still appropriately conservative and should be suitable for most common scenarios.

Each of the street classifications shown in Table 4 may be subject to a wide range of traffic loadings, depending on truck traffic and the presence of bus routes. Traffic loading is a significant variable in pavement design when identifying the appropriate depth of asphalt concrete and aggregate base. As a result, traffic loadings result in significant cost implications to construct the infrastructure.

Given the implications to the cost of constructing the higher classification streets and the wide range of potential traffic loadings, we recommend that the City adopt their proposed minimum standards and also allow street-specific pavement design alternatives for all street classifications, except for local residential streets. This will allow pavement and aggregate sections to reflect actual subsurface conditions and proposed traffic loadings. This alternative, if chosen, may result in thicker – or thinner – sections than the minimum proposed standards. However, the street section will be appropriate for actual or forecasted conditions and be more cost-effective from an asset management perspective.

Street-specific pavement design should have minimum requirements for strength, to align with the City's goal to reduce the long-term costs of pavement infrastructure. We recommend that the City's standards be revised to allow a street-specific pavement design based on AASHTO and/or the ODOT Pavement Design Guide requirements for a 40-year design life for new or reconstructed pavements, and a 20-year design life for rehabilitated pavement.

Pavement designs should be stamped by an engineer licensed in the state of Oregon and should include design inputs for ESAL loadings based on actual or projected traffic. Existing aggregate base (rehabilitation only) and subgrade layer resilient moduli should be based on field measurements. Structural layer coefficients, reliability, serviceability and standard deviation inputs should be as recommended in the AASHTO and/or ODOT Pavement Design Guide.

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