

KING COUNTY DEPARTMENT OF TRANSPORTATION ROAD SERVICES DIVISION

A Financial Review of King County Roads Funding Need Estimates

Prepared for:

**King County Department of Transportation
Road Services Division**

Prepared by:



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1.0 INTRODUCTION

In the 2014 Update to the King County Department of Transportation *Strategic Plan for Road Services July 2014 Update*, King County estimated that it would need \$350 million annually for ten years to maintain, preserve, and operate its roadway and right of way infrastructure.

BERK Consulting was engaged to compare the estimates reported in the 2014 *Strategic Plan Road Services* (Strategic Plan) to the underlying needs estimation model. BERK was asked to review the models used to estimate funding needs, evaluate the reasonableness of the assumptions and methodologies used, and, where appropriate, suggest possible refinements to either methods or assumptions. Finally, BERK was asked to provide context to the funding needs discussion by comparing current spending and estimated King County needs with those of other local transportation agencies.

Overall, BERK found that King County's estimation methods were reasonable. BERK also found that, given the level of uncertainty about many of the key assumptions in the models, Road Services Division's funding need is better expressed as a range and the 2014 estimates presented in the Strategic Plan fall within the range of expected costs.

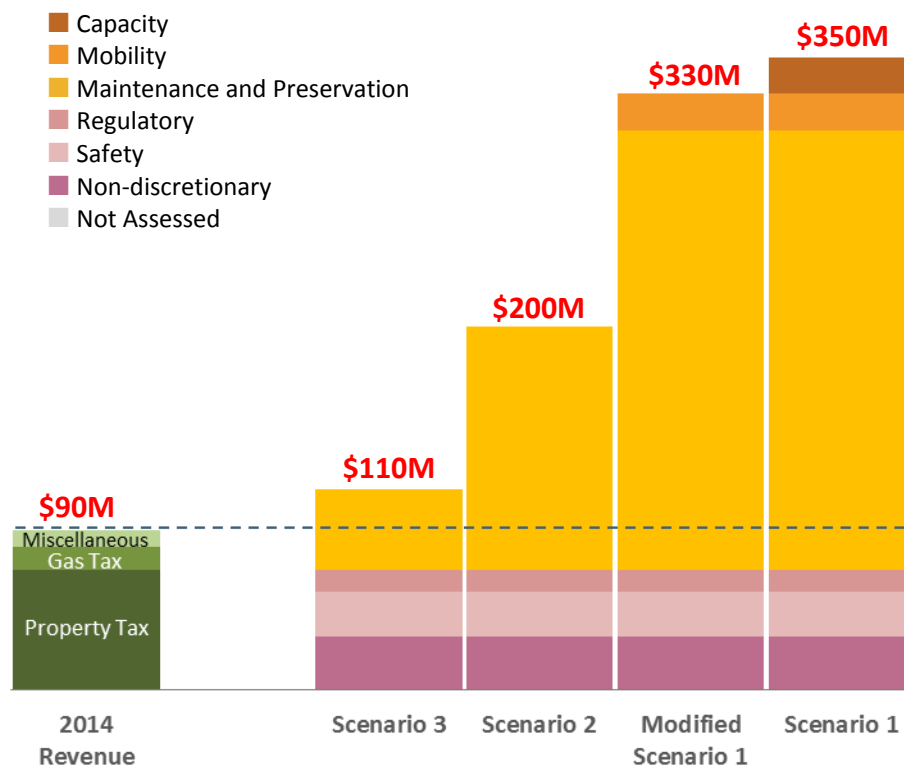
1.1 Strategic Plan and Model Comparison

As part of the Strategic Plan needs estimate, Road Services Division developed four different funding scenarios based achieving particular alternative outcomes:

1. The amount of funding needed to mitigate risk to public safety;
2. The amount needed to moderate decline in condition of current assets and further mitigate risks;
3. The amount needed to maximize road system life and provide some increase in mobility; and finally,
4. The amount needed to maximize road system life, increase mobility, and meet capacity demands.

For the purposes of the funding needs analysis, maximizing road system life would mean that the Road Services Division would be able to fund the current backlog of capital needs and fund capital replacement projects based on a lifecycle approach to maintain the condition of the road network and minimize overall lifecycle costs. These funding scenarios were represented in the Strategic Plan in the chart reproduced in Exhibit 1.

Exhibit 1. Funding Estimates from the *Strategic Plan for Road Services Update 2014* (2014\$)



Source: King County, *Strategic Plan for Road Services July 2014 Update*, 2014; BERK Consulting, 2015.

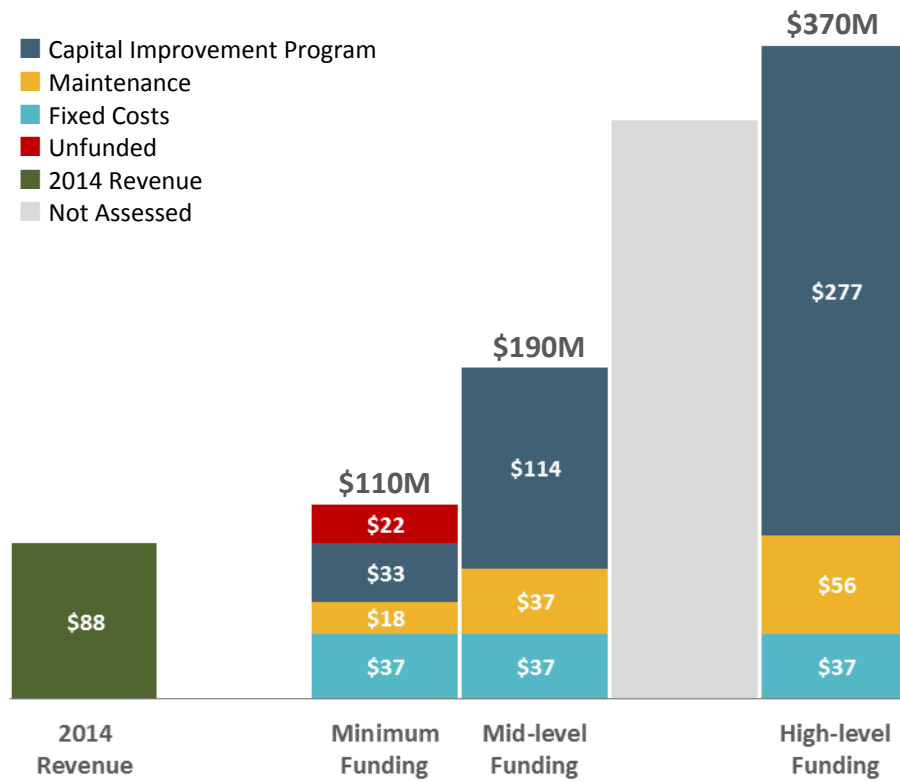
To create these funding scenarios, Road Services Division developed a flexible model to estimate future funding needs based on desired outcomes. The model includes detailed cost estimates for each major program area in both capital and operating programs. In each program area, the method chosen to estimate future funding needs was based on best available information at the time and the ability to align costs with some measure of level-of-service or policy outcome. As a result, the estimating methods vary among program areas, but the net effect of this approach is greater confidence in the overall results.

The model was used to estimate funding needs for three different funding scenarios:

- A minimum funding scenario (Scenario 3 in the Strategic Plan)
- A mid-level funding scenario (Scenario 2 in the Strategic Plan)
- A high-level funding scenario (Scenario 1 in the Strategic Plan)

Exhibit 2 below shows three scenarios in their model in relation to the funding scenarios found in the 2014 Update to the Strategic Plan.

Exhibit 2. Road Services Division Model Estimates' Correspondence with 2014 Strategic Plan Funding Estimates (2014\$)



Source: BERK Consulting, 2015.

There are differences between the amounts from the model and what appeared in the Strategic Plan; the mid-level model estimate is \$10 million lower, while the high-level model estimate is higher by \$20 million.

1.2 The Strategic Plan Funding Scenarios

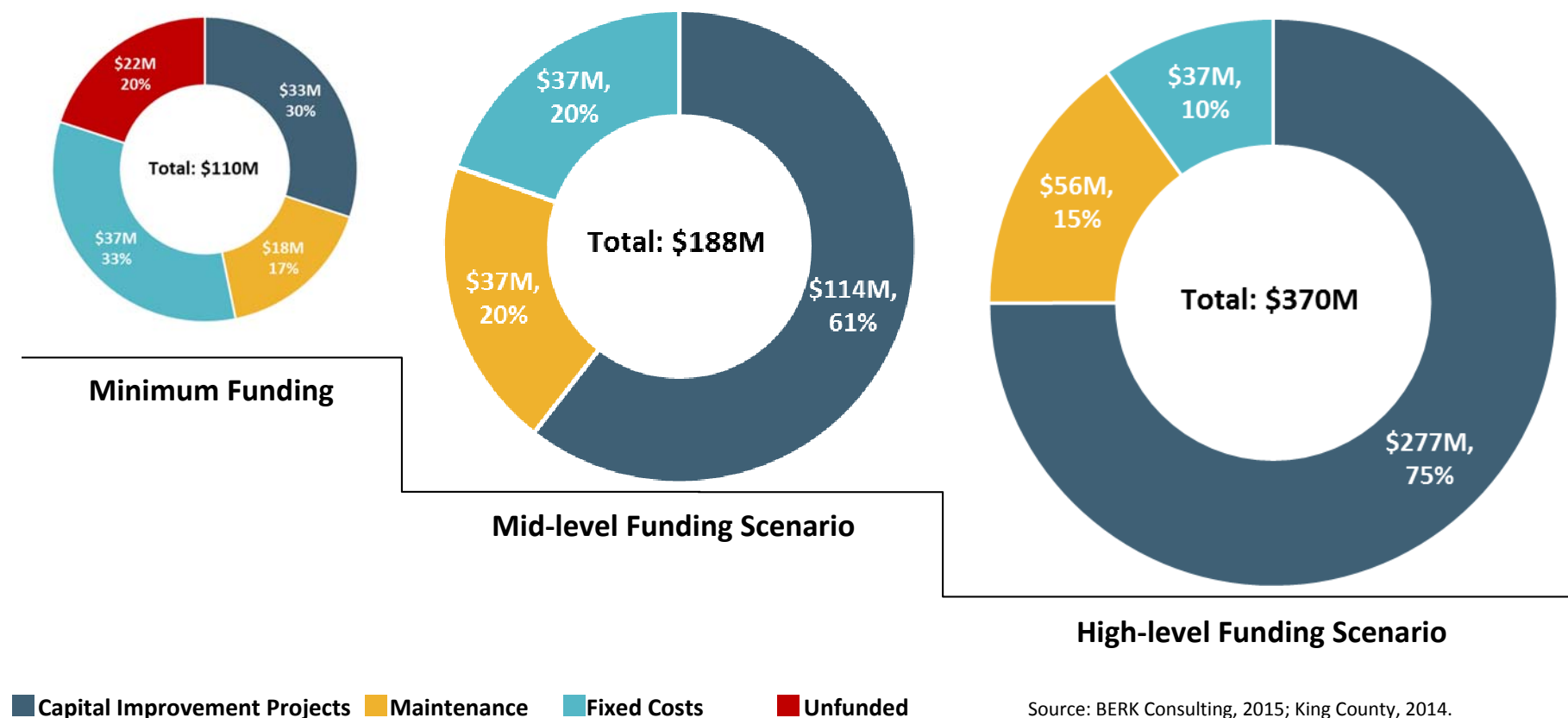
These three funding scenarios represent three different approaches to maintaining King County's right-of-way infrastructure, including roads and bridges. The next page contains an overview of the three and the expected outcome. Following that is a discussion of each scenario, including what is expected to happen to given asset classes, where funding is spent, and what each rise in spending level represents.

Overview of Modeled Scenarios

Road Services Division's model contained four funding scenarios, two of which BERK evaluated and compared to the minimum funding scenario:

- **Minimum Funding:** manage risk while existing infrastructure will degrade and needs remain unmet
- **Mid-level Funding Scenario:** approximately what is needed to moderate decline in asset condition
- **High-level Funding Scenario:** approximately what is needed to maximize life cycles plus address some mobility and capacity needs

Exhibit 3. Road Services Division Funding Scenarios by Major Spending Area



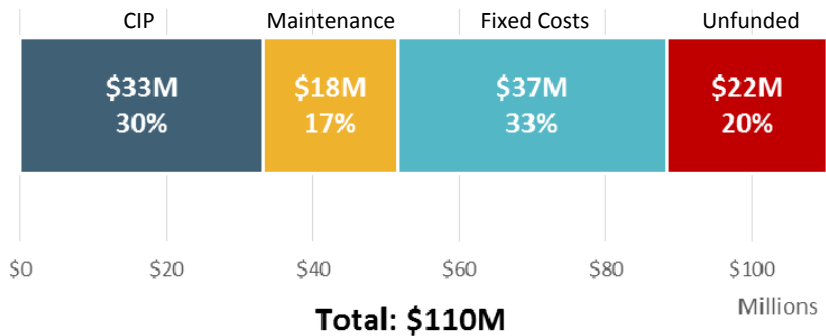
Source: BERK Consulting, 2015; King County, 2014.

Minimum Funding Scenario

In Road Services Division's planning-level estimation model, this scenario was restricted to just the \$88 million in expected revenue in 2014. For the Strategic Plan, Road Services Division identified an additional \$22 million in unfunded need.

Road Services Division anticipates

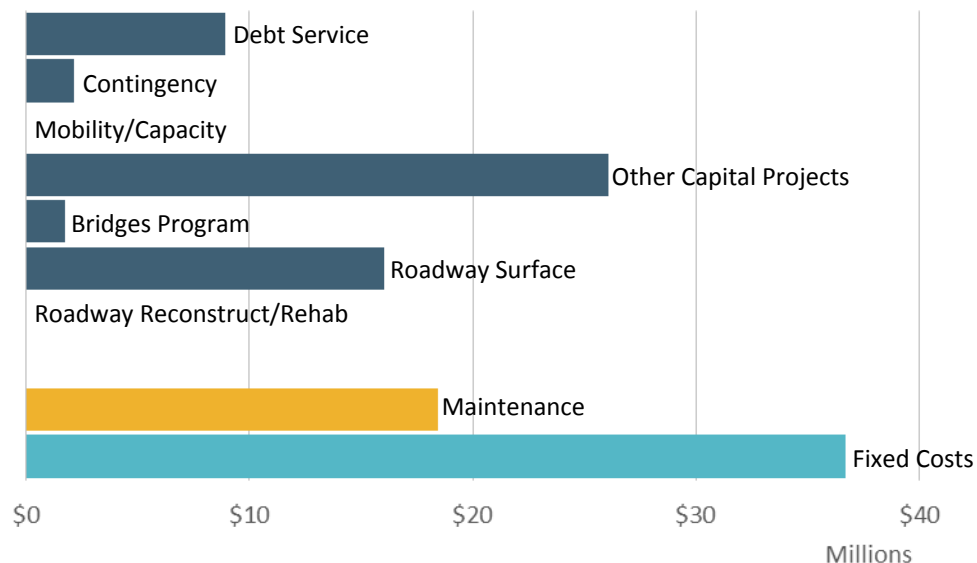
that at this level, future costs will be much greater because of deferred maintenance and preservation work. This funding scenario:



- **Meets only 80% of the estimated minimum funding requirement.** Road Services Division identified an additional \$22M needed to meet basic safety requirements.
- **Provides approximately 30% of Road Services Division's identified need for maintenance.** Road Services Division estimated that this funding level would provide some basic maintenance, but that this level of funding would not keep the system from deteriorating.
- **Begins to pay a minimal amount from the 2014 known CIP project backlog.** From prior experience, Road Services Division expects projects to be added beyond what has been published in the *2012 Transportation Needs Report*. Road Services Division further expects that **the number of new projects will outpace the number of completed projects** at this funding level.
- **Does not increase capacity or mobility.** This funding scenario does not include any funding for capacity or mobility projects.

Exhibit 4 contains Road Services Division's original spending levels, plus the \$22M in unfunded need applied proportionally to CIP projects.

Exhibit 4. Minimum Scenario Annual Spending by Service Area (2014\$)

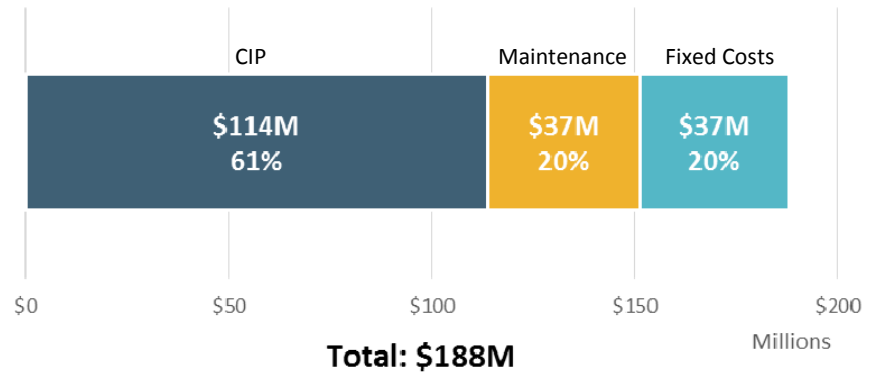


Source: King County, 2014; BERK Consulting, 2015.

Note: Other Capital Projects includes all capital project categories that individually were under 5% of total funding each. This includes some safety projects, drainage, and ADA compliance.

Mid-Level Funding Scenario

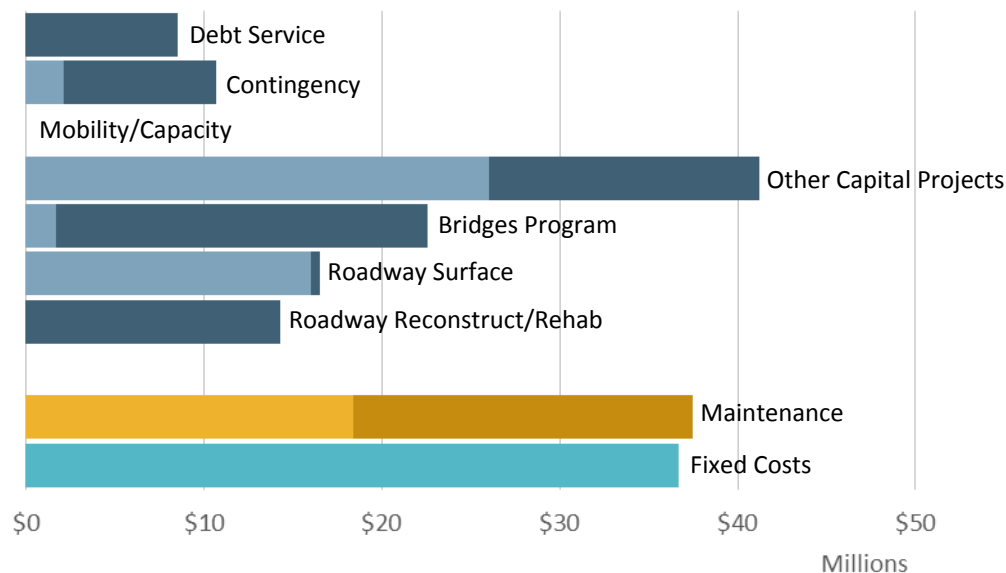
In Road Services Division's model, this scenario is roughly equivalent to Scenario 2 in the *Strategic Plan for Road Services 2014*. Road Services Division described this scenario as the funding needed to moderate the decline in the road system, although funding would not be enough for major preservation projects or improvements. This funding scenario:



- **Doubles maintenance spending compared to the Minimum Funding Scenario.** Provides for approximately 67% of Road Services Division's expected total annual need.
- **Begins to pay down the 2014 known CIP project backlog.** Will reduce the number of projects in the backlog by 44%, and in most spending categories, will keep up with expected additional capital projects.
- **Does not increase capacity or mobility.** As in the minimum funding scenario, this scenario does not include any funding for capacity or mobility projects.

Exhibit 5 displays the minimum spending scenario in light blue and any additional spending for the mid-level scenario in dark blue.

Exhibit 5. Mid-level Funding Scenario Annual Spending by Service Area (2014\$)

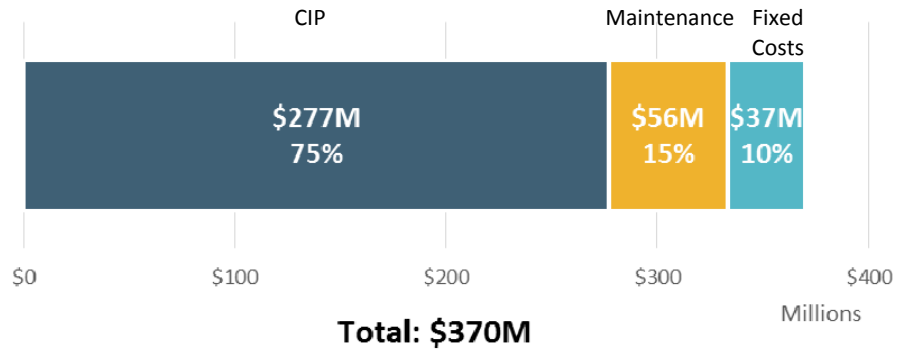


Source: King County, 2014; BERK Consulting, 2015.

High-level Funding Scenario

This scenario aligns with Scenario 1 in the *Strategic Plan for Road Services 2014*.

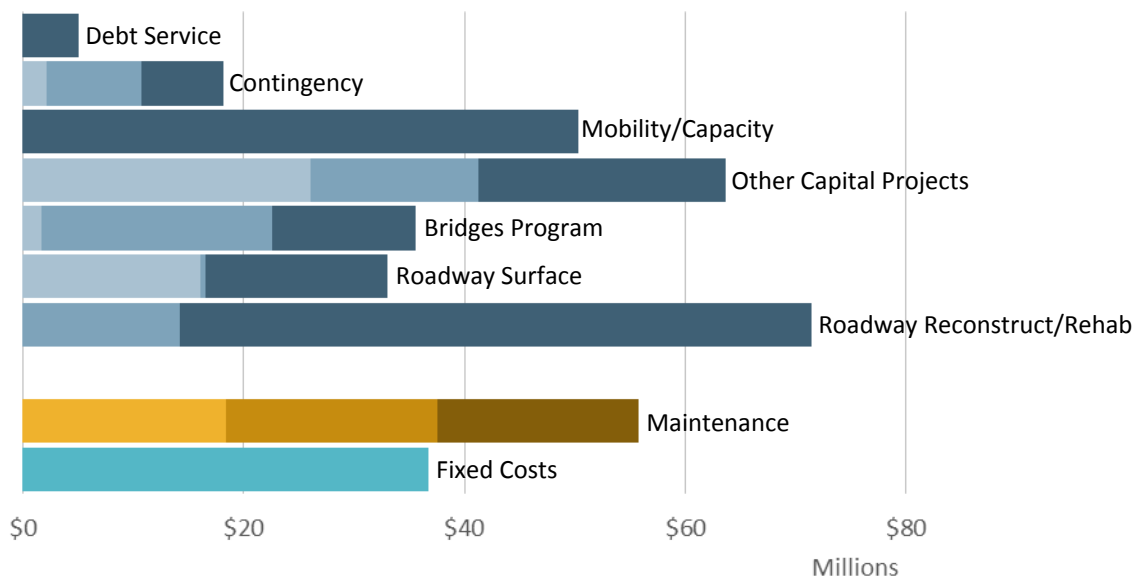
The Strategic Plan characterized this spending level as that needed to maximize asset lifecycles. More specifically, this spending level would provide the lowest costs over the lifetime of King County's assets, although it also has the highest upfront cost. This funding scenario:



- **Fully funds Road Services Division's estimated annual maintenance need.** This maintenance level is over three times the annual maintenance spending level in the minimum scenario.
- **Can pay down known 2014 backlog to manageable levels.** Over the course of ten years, this scenario would pay for approximately 85% of the listed projects in the *Transportation Needs Report* plus all of Road Services Division's expected additional capital project need.
 - However, funding could also be prioritized for **additional, unidentified projects**.
 - Or this funding could be used for **capacity and mobility projects**, especially if future annexations remove other projects from the backlog.

Exhibit 6 shows Road Services Division's suggested spending for the minimum (light blue), mid-level (medium blue), and high-level (dark blue) funding scenarios. Capital projects are broken down by project area starting on page 14.

Exhibit 6. High-level Funding Scenario Annual Spending by Service Area (2014\$)



Source: King County, 2014; BERK Consulting, 2015.

2.0 KEY FINDINGS OF COST REVIEW

BERK conducted a review of Road Services Division's methods, assumptions, data, and documentation used to create the Strategic Report financial need estimates. Road Services Division provided the underlying model, access to subject matter expertise, and background material, including models created for specific spending areas.

While BERK's review was comprehensive, it was not exhaustive. As an example, BERK did not examine Road Services Division's unit costs for maintenance activities, which drive the estimates for maintenance costs. BERK's review was restricted to methodological validity and any possible estimation refinements.

2.1 Estimation Methods Reasonable

BERK found that **Road Services Division's estimates were based on reasonable methods and assumptions**. Road Services Division used a variety of methods to produce planning-level estimates (see Planning-Level Estimates sidebar), appropriate for planning and policy discussions. For more information on individual need components, please see the analysis of individual spending areas beginning on page 12.

While the estimation approach varied for some cost elements, this was done to reflect the **best available information at the time**. The 2014 Strategic Plan update was conducted before the implementation of *Roadworks*, Road Services Division's asset management system. *Roadworks* allows King County to collect and centralize condition data and is expected to help Road Services Division further data-drive decision making processes. As such, these estimates reflected the understanding of asset condition and capital replacement needs at the time.

While the estimates are based on reasonable methods and assumptions, there is a significant level of uncertainty around many of the key assumptions and available data, which suggests that a better approach is to consider how this uncertainty might result in a **reasonable range of funding levels to meet the stated goals for each funding scenario**.

To explore the issue of uncertainty and the implications for future funding needs, BERK developed alternative cost estimates based on variations in underlying assumptions and used this information to generate an overall range of funding need for each scenario.

There are some uncertainties that could influence costs but are difficult to quantify, such as regulatory changes or significant shifts in development patterns. BERK focused on areas where the uncertainty was largely related to the available information or specific assumptions. For example, roadway conditions are based on a limited sample areas – actual funding needs could be significantly different from the estimated need, depending on the degree to which the sample is representative of the overall system condition.

Uncertainty does not inherently increase cost estimates – for example, the decrease in petroleum costs that began mid-2014 has caused a decline in petroleum-heavy construction projects, like roadway resurfacing. As a result, BERK identified areas where uncertainty could result in a meaningful increase or decrease in the estimate of project costs for each funding scenario.

Many cost assumptions were based **on actual costs** for completed projects, with **appropriate adjustments based on input from subject matter experts**. In some cases the review identified assumptions which were no longer reasonable due to changes in conditions. In these instances, BERK worked with Road Services Division to create an updated cost factor, which was also used to inform the overall range of needs.

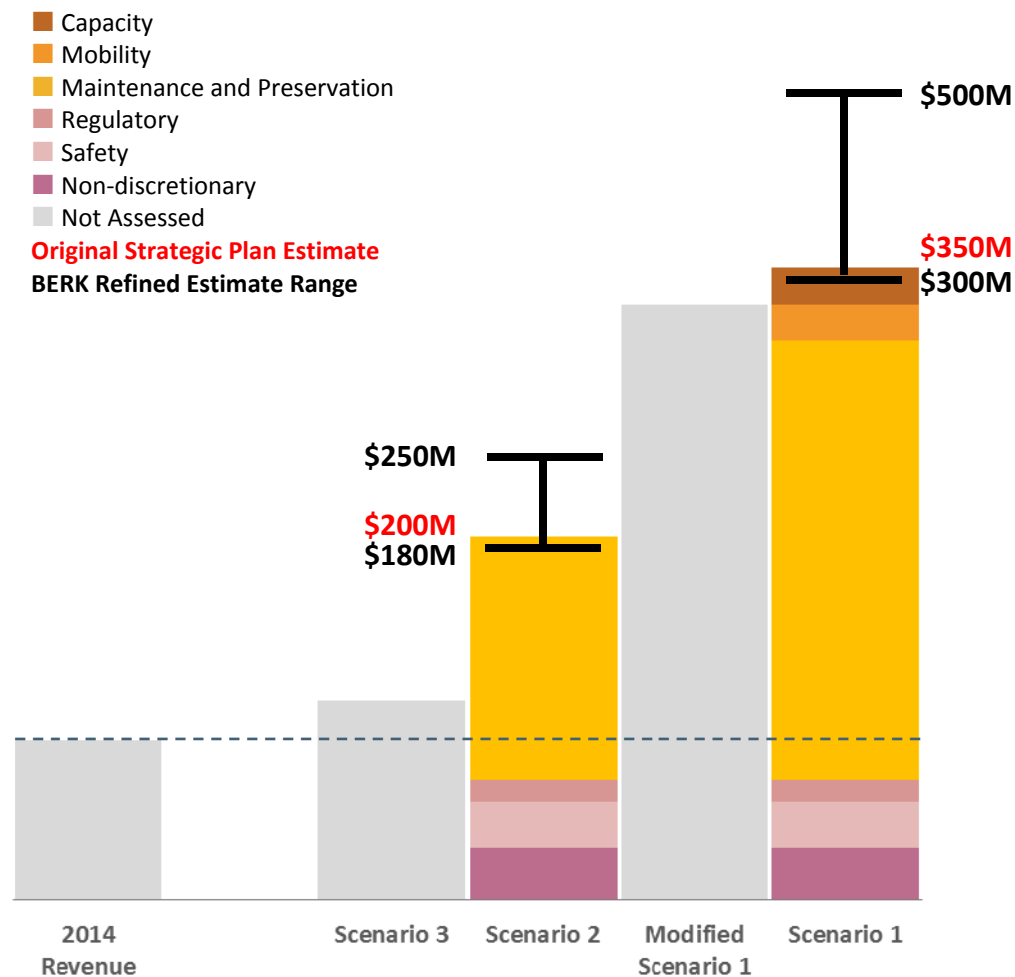
Planning-Level Estimates are expected costs based on average project or unit costs, as opposed to a specific design. Planning-level estimates do not account for site-specific issues that may come up in individual project design and implementation.

2.2 Refined and Updated Estimates

Using industry research as well as updated information provided by King County subject matter experts, BERK developed a set of refined and updated the Strategic Plan estimates using Road Services Division's model. A key factor in the refined estimates is an attempt to quantify the effect of risk and uncertainty on estimates of cost, which results in a range of potential costs to achieve a given policy outcome.

A range of costs also better describes the actual funding challenge because a single number suggests a precision that is not appropriate for planning-level estimates and runs the risk of understating what it could take to achieve some of the policy goals in each scenario. Exhibit 7 presents Road Services Division's 2014 original estimates with BERK's refinements presented as partial range bars around the mid-level and high-level funding scenarios. Please note that only the midpoint of the overall estimated sensitivity and the upper bound of the costs are included in the graph. Road Services Division's estimates are 70% below the upper bound in the mid-level funding scenario and 75% below the upper bound for the high-level funding scenario.

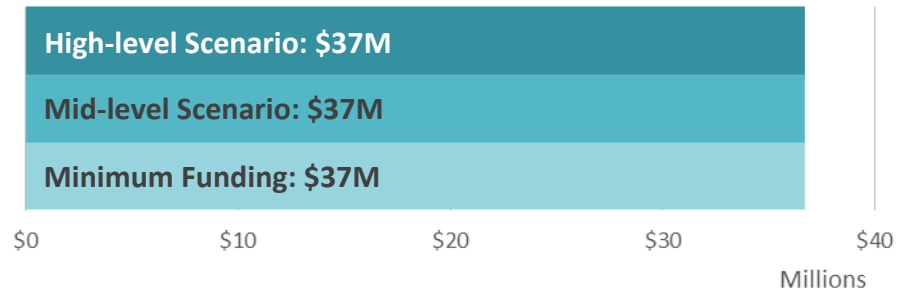
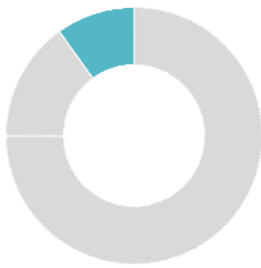
Exhibit 7. 2015 Refined Ranges of Estimated Needs (2014\$): Midpoint to Upper Bound



Source: BERK Consulting, 2015.

3.0 ANALYSIS OF INDIVIDUAL SPENDING AREAS

3.1 Fixed Costs



For each of the funding needs scenarios, there is a fixed cost component which accounts for the following:

- Administrative costs
- Departmental infrastructure and systems

Estimation Method

The estimate was held constant across three funding scenarios.

All new positions are related to new projects in combination with Road Services Division:

- Investment in systems, such as the ongoing implementation of Road Services Division asset management system, *Roadworks*
- Human capital in the form of current employees

Observations/Findings

King County's estimated needs are reasonable given Road Services Division's organizational and systems capacity to support increased programming levels.

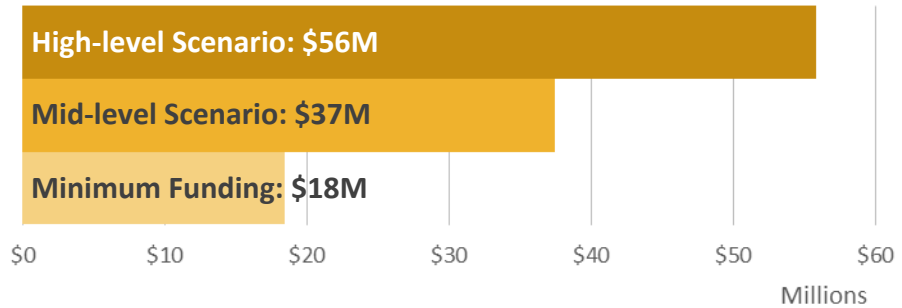
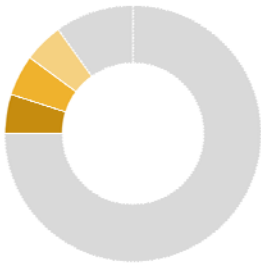
Project costs include some overhead, so adding costs here would double count overhead costs.

In the consultant's judgment, this spending area contains little risk.

Estimate Refinement

None – use estimate as presented.

3.2 Maintenance



Maintenance and repair costs were identified for the following program areas:

- Roadway
- Roadside
- Traffic
- Storm Response
- Facilities
- Structures

For example, maintenance activities include shoulder grading, signal electrical repair, and bucket ditching.

Each increase in funding scenario generally increases the frequency of maintenance activities.

Estimation Method

1. Each maintenance activity had a unit cost from Road Services Division's maintenance management system
2. For each scenario, Road Services Division determined a desired level of accomplishment, defined using a frequency of service measure
3. Quantity of maintenance times the unit cost, where:
 - a. The quantity of maintenance = total maintained inventory × annual frequency of service

Observations/Findings

Some maintenance is interrelated – more mowing should mean less future hand brushing, for example – but Road Services Division's model does not reflect interconnected maintenance needs. This is not necessarily a criticism, as integrating these types of relationships goes beyond what would typically be expected in planning-level cost estimates.

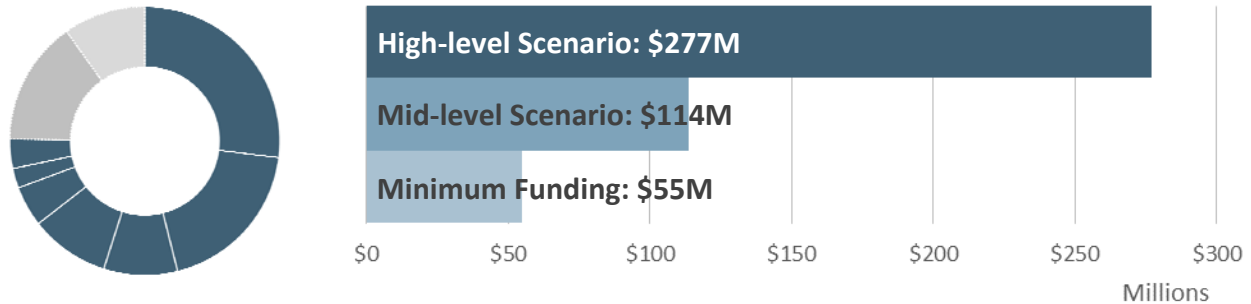
Unit costs are project level, not historic costs.

It was unclear what the rationale was in setting the level of service standards for individual maintenance areas. As such, the estimates more accurately reflect a scaling of current operations as opposed to the cost of achieving clearly defined service levels.

Estimate Refinement

For now, use estimate as presented. Road Services Division's asset management system, *Roadworks*, will provide more detailed condition data and greatly improve the ability to manage resource allocation and planning. The tool will also improve the ability to link funding levels with service standards and capture the inter-dependencies among maintenance functions.

3.3 Capital Improvement Program (CIP)



Needs Included

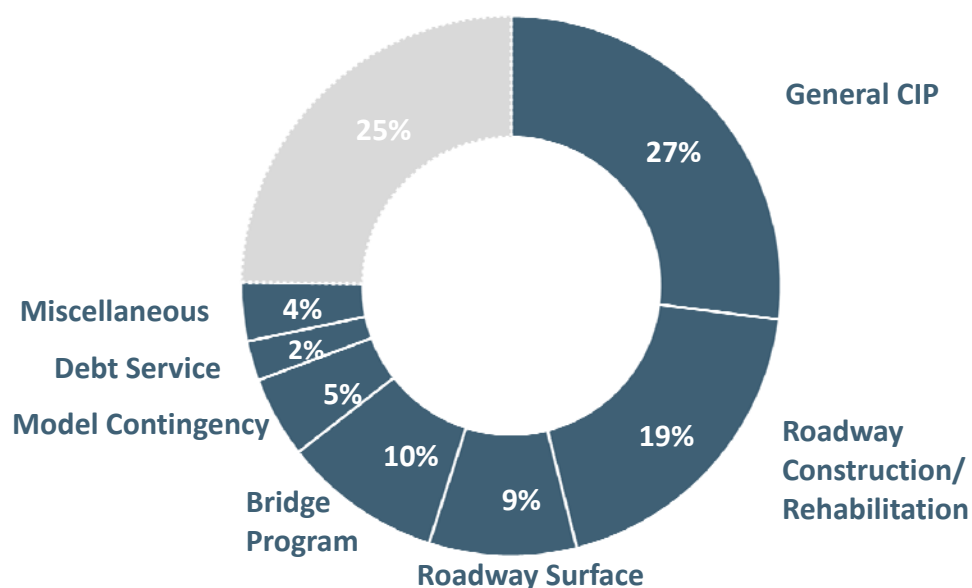
Projects to build, repair, preserve, and improve infrastructure. Road Services Division categorizes capital improvement program (CIP) projects into 21 areas. Generally, these projects address safety, capacity, mobility, or preservation, and many projects address multiple needs. Other costs, such as model contingency and debt service, are included in this category as well.

Estimation Method

To estimate existing and future need, Road Services Division used different methods depending on the complexity of the projects and the data available. For some project areas, extensive subject matter expertise was used to create estimates, such as bridges and fish passage culverts. For some types of projects, Road Services Division used the *2012 Transportation Needs Report* as a catalog of existing need, but attempted to compensate for the additional future needs not yet identified. For BERK's review, Road Services Division's estimations were split by method rather than project type. The review is organized according to the cost/program areas shown in Exhibit 8, which includes the relative size of each program area in the High-level Funding Scenario.

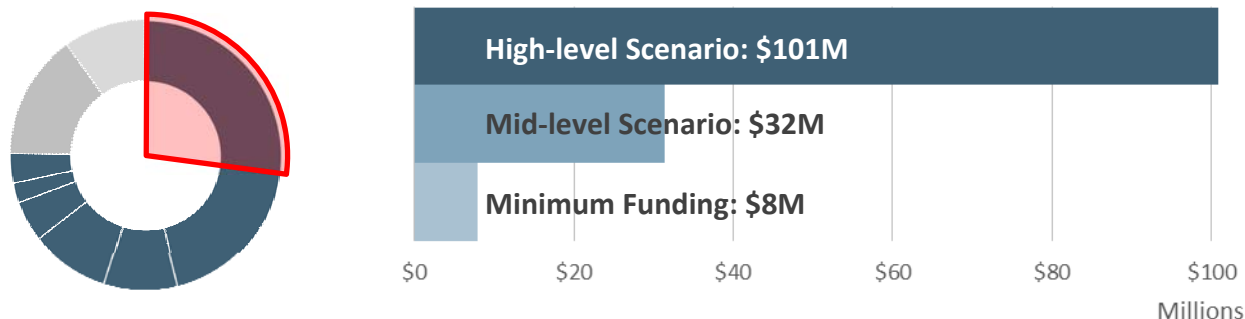
Among these cost elements the CIP accounts for the majority of estimated needs and contains significant cost risks, associated with uncertainty about future project needs because of King County's extensive inventory of facilities and, in a few key areas, limited condition information. This latter point is critical since the vast majority of CIP needs are relative to capital replacement investments.

Exhibit 8. CIP Project Spending Areas for High-level Scenario



King County, 2014; BERK Consulting, 2015.

General CIP



The project list from the *2012 Transportation Needs Report* was used for all categories that did not require specialized estimation methods. The *Transportation Needs Report* categorizes projects into thirteen types. Eleven of those categories were included in this method. These projects range from guardrail installation to intelligent transportation systems components.

Also included are all of safety and capacity categories, most of mobility, and around one-tenth of preservation spending.

Using the high-level scenario suggested by Road Services Division, the projects listed in the *Transportation Needs Report* from these categories will be fully funded in:

- High-level Scenario: 7.0 years
- Mid-level Scenario: 15.2 years
- Minimum Funding: 74.4 years (funds around 9% of these types of projects)

Estimation Method

Road Services Division used the *Transportation Needs Report* costs estimates with inflation adjustment. However, because the *Transportation Needs Report* is updated every two to four years, Road Services Division increased the total expected need by adding projects over the life of the strategic plan to try to capture cost of future additions.

The mid-level and high-level estimates were created by estimating the annual amount

needed to fund one-third and two-thirds of the *Transportation Needs Report* projects, respectively, plus all new projects. A project was added in each category for seven years, leading to a total addition of 77 projects.

Observations/Findings

In the consultant's judgment, Road Services Division's estimated need is within the expected range and was based on a rational method.

The *Transportation Needs Report* is a list of the council-approved projects, with some adjustment for expected changes in population as mandated by the Growth Management Act. It is a snapshot of needs. However, by adding projects, Road Services Division increased the total by \$309M, or more than 40%, to account for needs not fully incorporated into the *Transportation Needs Report*. These additional projects are not specifically identified and act as a general allowance for transportation needs.

Estimates are expressed in year-of-expenditure dollars instead of a consistent basis year. Rather than adding a set number of projects across categories, BERK recommends using historical knowledge of the number of projects added annually.

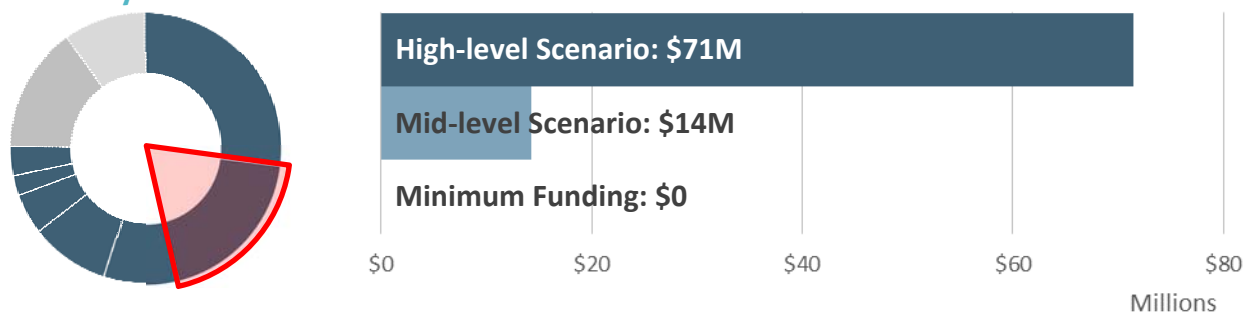
Estimate Refinement

BERK estimates the mid-level scenario need to be between \$31M and \$43M, and recommends increasing the midpoint estimate by approximately 25%, from \$32M to \$40M. For the high-level funding scenario, BERK recommends decreasing estimates by approximately 20% from \$101M to \$83M, although the total need may be \$109M.

2014 County Identified Existing Need

Total	339 projects totaling \$711M
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Roadway Reconstruction and Rehabilitation



King County has approximately 1,440 miles of paved roads and another 50 miles of unpaved roads. To maintain roadway pavement condition, Road Services Division uses overlay/chip seal, rehabilitation, and reconstruction, which are distinguished by depth of treatment. Overlay and chip seal are discussed separately in the roadway surface section.

Rehabilitation is similar to overlay, described on page 18, but with more extensive preparation, removal of the existing surface, and/or greater surface treatment (typically 2-3 in. thick).

Reconstruction is the deepest reaching work that removes the existing roadway and replaces with roads engineered and designed to current standards.

Road Services Division assumed that only arterial roads would receive reconstruction and rehabilitation. Arterials represent approximately one-third of County roads.

Using the high-level scenario spending level, 114 miles of arterial roads would receive reconstruction or rehabilitation between 2014 and 2024.

Under the mid-level scenario spending level, 23 miles would be reconstructed or rehabilitated.

The 2014 spending level included no funding for roadway reconstruction or rehabilitation.

Estimation Method

Road Services Division assumed that only arterial streets would be included.

Using results from three rounds of testing in 2003, 2007, and 2009, Road Services Division estimated that 70% of existing arterials need either rehabilitation or reconstruction.

Using an assumption that half would need reconstruction and half would need rehabilitation, Road Services Division multiplied the number of arterial center lane miles by the unit cost for each repair type:

1. 457 Arterial Center Lane Miles (CLM)
2. 70% Need Repair: 320 CLM
3. 50% Need Reconstruction: 160 CLM
 - a. At \$8M per CLM: \$1,280M in total need
4. 50% Need Rehab: 160 CLM
 - a. At \$4.5M per CLM: \$720M in total need

High-level scenario based on funding 25% of the overall estimated need 2020: \$71.4M per year which would fund 36% of the total need by 2024.

Mid-level scenario funds 5% of need by 2020: \$14.3M per year or 7% of the total need by 2024.

2014 County Identified Existing Need

Total	320 miles of roads	\$1,999M
Rehabilitation	160 miles of roads	\$720M
Reconstruction	160 miles of roads	\$1,280M

Observations/Findings

In the consultant's judgment, Road Services Division's methodology is a reasonable approach to estimating planning-level funding

needs. However, in discussing the assumed unit costs, Road Services Division and BERK determined that current costs are likely lower than those originally used in the Strategic Plan estimates.

Working with Road Services Division, a revised unit cost for rehabilitation of \$1.0M per mile was determined to better reflect recent experience. By updating this key cost assumption, the high-level scenario is reduced to \$49.7M per year and mid-level scenario to \$9.9M per year.

While the unit cost change suggests the possibility of a lower cost estimate, this program also contains significant cost uncertainty. There are two areas of uncertainty that are likely to influence future program costs: (1) current conditions of King County's roadway system; and, (2) the portion of the roadway system that is assumed to require rehabilitation and/or reconstruction.

Road Services Division's understanding of the condition of its extensive roadway system is incomplete. The condition information is based on roadway testing that was conducted using a geographic sample, which may or may not be representative of the overall system.

Additionally, the 2009 testing did not include core sampling, so a determination of the expected balance between the need for rehabilitation versus the much more costly road reconstruction is difficult.

It has now been eight years since the last round of condition testing was completed. As a result, the 2009 testing provides a limited view of the current conditions of the roadway system. However, due to chronic CIP funding challenges, Road Services Division has not been able to invest in either type of repair for a number of years, and so road condition is likely to have deteriorated further.

Beyond the condition level uncertainty, the cost estimates were also limited to the expected needs in the arterial roadway system, which represents approximately one-third of King County's total roadway inventory.

While local roads experience less traffic from heavy vehicles and, thus are less prone to deterioration, the sheer size of King County's local roadway system suggests that the estimated roadway rehab and reconstruction needs could be significantly higher for funding scenarios that are designed to maximize the useful life of the system.

Estimate Refinement

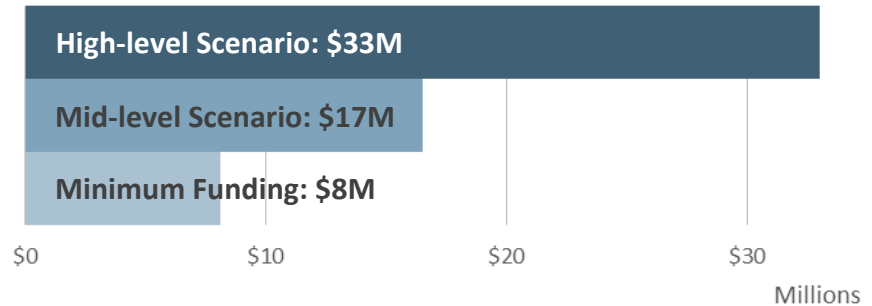
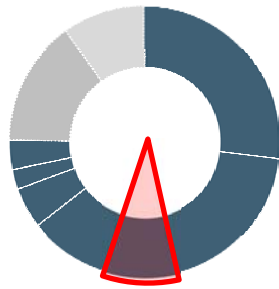
BERK estimated a need range for each scenario:

- High-level Scenario: \$36M-\$125M
- Mid-level Scenario: \$7M-\$25M

BERK recommends using an estimate of \$80M for the high-level scenario and \$16M for the mid-level scenario. Despite lower updated unit costs, BERK's estimates are increases compared to Road Service Division's original estimates because these refined estimates include surface treatments for local roads, which were not included in Road Service Division's original estimates.

Condition data does not exist for rehabilitation and reconstruction needs of local roads, but given the size of the local system and known condition of the arterial road inventory, local roads are a substantial cost risk, which contributes to wider range of need.

Roadway Surface



King County has approximately 1,440 miles of paved roads. To maintain roadway pavement condition, Road Services Division uses overlay/chip seal, rehabilitation, and reconstruction which are separated by the depth of treatment. Overlay and chip seal are included in roadway surface estimates. Reconstruction and rehabilitation are discussed in a separate section beginning on page 16.

Overlay is a single layer of hot mix asphalt placed over existing roadways (typically 1.75-2 inches thick) and any applicable ADA improvements needed. Overlay repairs generally last 10-12 years.

Chip seal comprises of one or more layers of broken aggregate (chip) bound together by asphalt. This type of repair has been temporarily suspended, with an expected reinstatement in 2016. Chip seal has a lifespan of 5-7 years.

Using the high-level funding scenario, the entire roadway system would have an overall condition score of 70. With this funding level, approximately 94 center lane miles of roadway would be resurfaced over 10 years.

The mid-level scenario assumed half the available funding of the high-level scenario, which would support resurfacing of approximately 47 center lane miles and an expected overall condition score of 56. For comparison purposes, the 2014 spending level would provide overlay service for only two center lane miles of arterial roadway and result in an expected overall condition score of 43.

Estimation Method

The Road Services Division estimate of \$33M came from a 2013 memo that cites a 2012 report to the Puget Sound Regional Council. Road Services Division has not been able to locate this report.

The mid-level scenario estimate was set at half the spending of the high-level scenario.

BERK discussed the unit cost assumptions for the roadway resurfacing program to determine if they reasonably reflected current cost experience. The memo provided as support for the original assumption included an exploration of multiple funding scenarios, from which estimates of pavement deterioration rates and system response to different funding levels could be evaluated. On the basis of this assessment, BERK and Road Services Division developed an updated cost estimate.

Observations/Findings

After working with Road Services Division staff, the \$33M estimate to achieve a system-wide average condition of "Good" was revised to \$25M. Partially, this is due to the reinstatement of chip seal treatment where applicable. The lower estimate accounts for both chip seal's lower cost and shorter usable lifespan.

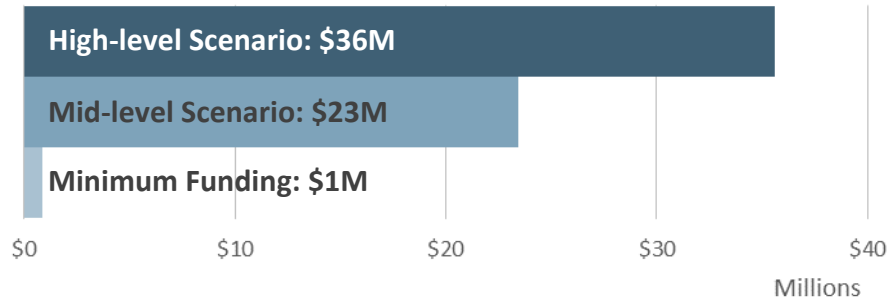
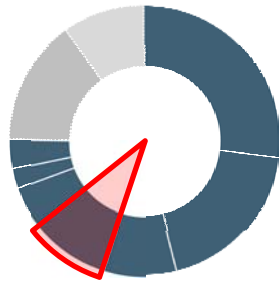
Estimate Refinement

Depending on the mix of treatment, BERK estimates the road surfacing need to be between \$17M and \$26M, and best estimate of \$23M. BERK recommends creating another basis for the mid-level scenario estimate, such as a goal average pavement condition.

2014 County Identified Existing Need

System-wide Average Condition of "Good" \$33M

Bridges Program



The bridge estimates include the following subcategories of bridge project:

- Replacement of Long Span Bridges
- Replacement of Short Span Bridges
- Bridge Improvement Projects ("Priority Bridge Maintenance")

King County has 181 bridges in its inventory, of which 131 are long span bridges (longer than 20 feet) and 50 short span bridges (20 feet or less). Funding for priority bridge maintenance is used to make capital improvements to bridges that extend their lifespan.

The Federal Highway Administration (FHWA) requires that every bridge be inspected and assigned a sufficiency rating, a number between 0-100 that incorporates each bridge's design, condition, and functionality for public use.

Federal funding is available for long span bridge rehabilitation and replacement. Funding eligibility is based on a bridge's sufficiency rating: bridges with sufficiency ratings between 50 and 80 are eligible for rehabilitation funding and those with ratings below 50 are eligible for replacement funding.

At the high-level funding scenario and based on average cost per bridge replacement, Road Services Division would replace 30 long span bridges and 40 short span bridges between 2014 through 2024. At the mid-level funding scenario, 20 long span bridges and 20 short

span bridges would be replaced. The 2014 funding level would replace two short span and no long span bridges over this period.

Estimation Method

For long and short span bridges, a replacement rate was selected by a subject matter expert and compared against historic averages.

Long Span: average bridge cost of \$9.5M

- High-level Scenario: 3 bridges replaced per year, or \$28.5M annually
- Mid-level Scenario: 2 bridges replaced per year, or \$19.0M annually

Short Span: average bridge cost of \$1.15M

- High-level Scenario: 4 bridges replaced per year, or \$4.6M annually
- Mid-level Scenario: 2 bridges replaced per year, or \$2.3M annually

For bridge improvement projects, a subject matter expert from Road Services Division provided estimates of need, which were compared to historical averages.

Estimates were adjusted for each funding scenarios by increasing the 2014 budgeted amount by a flat rate:

- High-level: 2014 spending × 4, or \$2.5M annually (approximately 300 work orders)
- Mid-level: 2014 spending × 2, or \$1.25M annually (approximately 150 work orders)

2014 County Identified Existing Need

Bridges		Total:	\$335M
Long Span	30 projects totaling		\$285M
Short Span	40 projects totaling		\$46M
Improvement	400 work orders totaling		≈\$4M

Observations/Findings

In the consultant's judgment, Road Services Division's approach to estimating bridge costs is reasonable for planning-level, programmatic costs. In general, the approach relies on the

subject matter expertise of Road Services Division staff (who are most familiar with the bridge inventory) and FHWA sufficiency ratings.

While this approach is reasonable, there is also significant uncertainty regarding potential future bridge conditions. Using data from Road Services Division and *Annual Bridge Reports*, BERK examined how some of these risks could affect costs.

To explore the potential variability in potential funding need as relates to the County's inventory of aging bridges, BERK used simple deterioration rates to estimate what need *could* look like over time. Actual funding needs will be based on judgments by engineers responding to real world conditions. Investments in maintenance and minor capital improvements will effect actual funding needs.

Long Span Bridge Replacement

As of the 2013 King County *Annual Bridge Report*, there were 17 long span bridges with sufficiency ratings below 50, the Federal minimum rating to receive replacement funding. There were an additional 21 bridges older than 75 years (the typical engineered lifespan for King County's bridges) but with sufficiency ratings greater than 50.

Using a simple average deterioration rate developed using Road Services Division's bridge data, BERK estimates that an additional 8 long span bridges could deteriorate below a sufficiency rating of 50, or a total of 25 by 2024.

Comparing this potential need to the 30 long span bridges replaced under Road Services Division's suggested high-level replacement rate, BERK determined that it is reasonable to assume that this funding level would address the expected replacement need and while also replacing five additional bridges that would be beyond their engineered lifespan.

Short Span Bridge Replacement

Replacing four short span bridges a year would replace all 50 short span bridges within 13 years. In 2013, seven of King County's short span bridges had sufficiency ratings less than

50, versus 35 bridges listed for replacement in the *2012 Transportation Needs Report*.

Within five years after the 2024 end date for the Strategic Plan, 23 short span bridges will reach the end of their engineered lifespans. Given the large number of aging bridges, it is reasonable to begin replacements earlier to help smooth out funding needs and support an orderly bridge replacement program.

Conclusion

Between the coming wave of aging bridges and the condition of the current inventory, there is clearly a major bridge replacement need. However, bridge improvement projects can add years to bridge usable lifespans, and these are not accounted for in the Division's estimates.

Sufficiency ratings and engineered lifespans are imperfect metrics to gauge bridge replacement needs. It is possible that conditions could deteriorate faster, in which case King County could face considerably higher funding needs. Alternatively, a number of bridges in King County's inventory have continued to function far beyond their assumed engineering lifespan, so an assumption of replacement at 75 years may somewhat overstate the need.

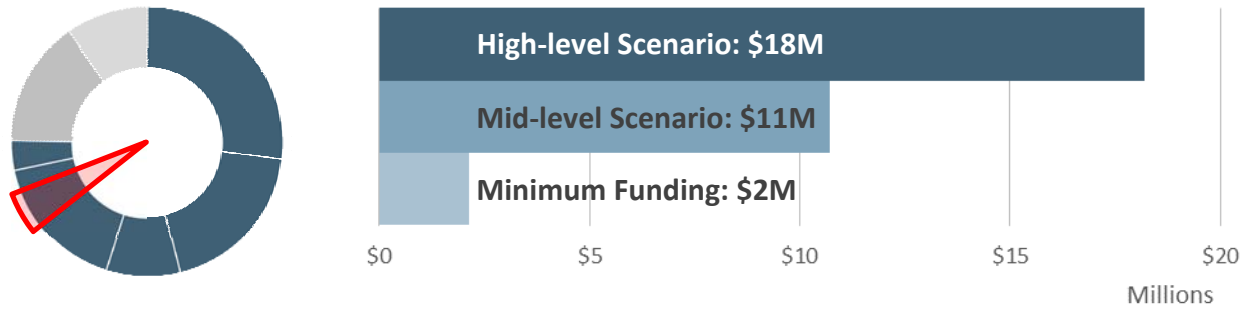
Estimate Refinement

For short span bridges, adjusting the replacement rate to smooth the coming need would reduce the high-level funding need for from four bridges per year to an average of 2.5 per year; there is also opportunity to reduce the long span replacement rate from three to an average of 2.5 per year. These updated replacement rates would reduce the high-funding scenario estimate from \$36M to \$29M annually, within a range of \$27M to \$50M.

The mid-level funding scenario might be increased to \$26M to accommodate a higher replacement rate in long-span bridges to meet potential minimum replacement needs. BERK estimates the mid-level scenario need to be between \$18M and \$35M.

In both cases, these alternative estimates are used to create a range of potential needs at the respective funding levels.

Model Contingency



Contingencies were incorporated into the cost analysis to account for potential risks associated with design uncertainties and site specific characteristics, such as soil conditions, that are not captured in average unit costs. Contingencies also include potential scope changes to reflect regulatory or community needs.

Estimation Method

Estimates were adjusted for each funding scenario by increasing the 2014 contingency funding level amount by a fixed factor:

- High-level Scenario: 2014 level $\times$ 8.5
- Mid-level Scenario: 2014 level $\times$ 5

Observations/Findings

Some capital projects include additional contingency funding; Road Services Division reported to BERK that department policy is to apply a flat contingency rate to all capital projects.

Some model calculations included contain additional contingencies at the program level, such as roadway reconstruction/rehab, and bridge replacement.

To avoid double counting the contingency factor, BERK recommends removing the contingency allowance within these program areas and applying a flat 10% contingency rate. Doing so would reduce the contingency estimate for both scenarios by \$6.5M.

However, the contingency is applied at a programmatic level and not at a project level, and Road Services Division's estimates capture uncertainty not reflected in 10% contingency rate method. The flat percent rate method only increases in relation to overall capital spending, but does not respond to the change in the number or complexity of projects. As each scenario increase tends to add increasingly complex projects, BERK suggests using Road Services Division's estimates as range maximums.

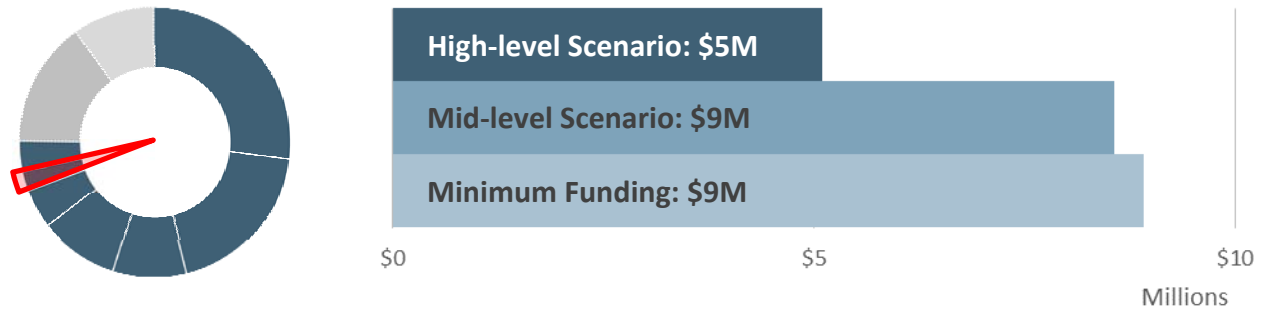
Estimate Refinement

Remove redundant contingency estimates and reduce overall annual estimates to:

- High-level Scenario: \$12M
- Mid-level Scenario: \$6M

BERK estimates the model contingency need in the high-level scenario is between \$10M and \$18M, and for the mid-level scenario, between \$4M and Road Services Division's original estimate of \$10M.

Debt Service



Debt service needs reflect both existing debt service commitments plus an allowance for potential future debt issuance to support the capital program. Debt is a useful tool to align cash flow needs and funding availability which can be particularly important if there is are significant overlapping needs in a short period of time.

Estimation Method

Road Services Division did not provide background information.

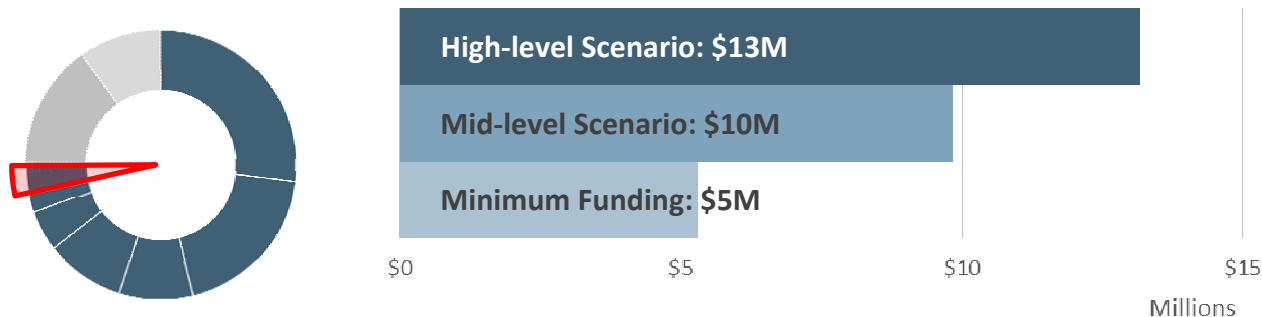
Observations/Findings

Debt service reduces as the total spending increase.

Estimate Refinement

None proposed – use estimate as presented.

Miscellaneous Projects



Three categories used information provided by subject matter experts and used a modified version of the *2012 Transportation Needs Report* projects methodology. These three categories are:

- Drainage: Fish Crossings/Culverts
- Drainage: Other
- ADA Projects

Two types of drainage projects, fish culverts and miscellaneous drainage projects, are not included in the *Transportation Needs Report*. Fish culvert replacements or repairs are projects to remove fish passage barriers and are required by environmental regulation. The other category is for all projects not in the *Transportation Needs Report* or related to fish passage. For the two categories combined:

- Road Services Division subject matter experts determined that 209 known projects and estimated approximately 55 more would be added annually
- High-level Scenario: \$11.4M, or 96 projects a year
- Mid-level Scenario: \$8.9M, or 83 projects a year

ADA projects are those meant to bring King County in alignment with Americans with

Disabilities Act requirements, generally ADA ramp installations or retrofitting.

For ADA projects:

- High-level Scenario: 2014 spending $\times$ 4, \$1.7M or approximately 85 ramps
- Mid-level Scenario: 2014 spending $\times$ 2, \$0.9M or approximately 42 ramps

Estimation Method

Road Services Division subject matter experts provided information on drainage and ADA projects, including the number of projects expected over the course of the strategic plan and the average project cost.

Fish culvert funding levels were set based on completing a certain number of projects annually:

- Road Services Division used historic average spending levels to find a unit cost
- High-level Scenario: complete 16 projects a year
- Mid-level Scenario: complete 8 projects a year

Other drainage projects:

- Road Services Division used historic average spending levels to find a unit cost
- High-level scenario set to eliminate three-quarters of 2014 existing projects by 2020 while adding new projects
- Mid-level scenario set to eliminate half of 2014 existing projects by 2020 while adding projects

ADA estimates were adjusted for each funding scenario by increasing the 2014 by a flat rate,

2014 County Identified Existing Need

Drainage	209 projects totaling \$32M
Fish Culverts	80 projects totaling \$20M
Other	129 projects totaling \$12M
ADA Projects	Not Identified

quadrupled for high-level scenario and doubled for mid-level scenario.

Observations/Findings

King County has an ADA compliance project list in the *Transportation Needs Reports*; however, King County anticipates more work will be needed. Without more information, BERK is not able to quantify risks specific to the ADA projects. The existing ADA calculation did not include inflation.

The needs related to investments to support fish passage are likely a source of significant risk related to future funding levels. The cost of these types of projects can vary widely depending on the specific site conditions involved, adding uncertainty around unit cost estimates.

Additionally, as shown by a recent court order, the Washington State Department of Transportation is required to meet more aggressive timelines in addressing fish passage issues that threaten Federally-recognized endangered salmon.

While these requirements have not been extended to county jurisdictions, the fact that fish passage issues have become a significant element in addressing the Endangered Species Act significantly raises the risk around this program.

Estimate Refinement

Removing the year-of-expenditure dollar estimates and converting all costs to a single basis year would reduce the high-level funding scenario estimate to \$11M and the mid-level funding scenario to \$9M. BERK estimates the high-level scenario annual need is between \$5M and \$12M, and the mid-level scenario need is between \$2M and \$13M.

4.0 JURISDICTION COMPARISON

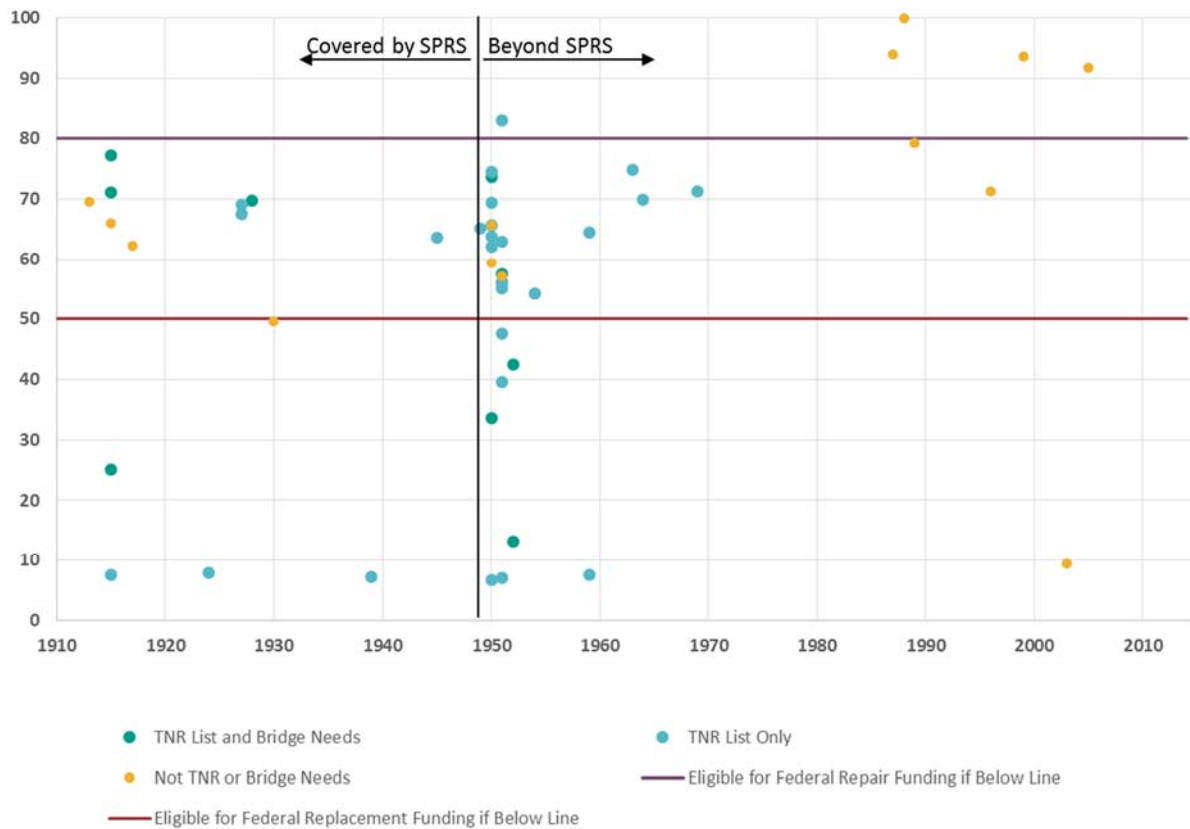
The funding challenges facing King County are not unique in the region or around the country – aging transportation infrastructure is a national issue. Examples include:

The American Society of Civil Engineers' 2013 *Report Card for America's Infrastructure* gave the U.S. an overall grade of poor (D+) and estimated that \$3.6 trillion would need to be invested by 2020 to "maintain a state of good repair." While ASCE has a vested interest in civil engineering funding, the *Report Card* captures the perspective of at least one group of engineering professionals.

TRIP, a national transportation research group, released a report on urban roads. In it, TRIP reported that more than a quarter of urban roads in the U.S. are in substandard condition. TRIP looked at pavement condition data from the Federal Highway Administration's 2013 annual survey. The Federal Highway Administration collects data at the state level on major state and locally maintained roads and highways and measures road smoothness, a measure of ride quality. The urban area of Seattle came in 22nd for roads in the poorest condition.

As can be seen in Exhibit 9, much of the capital replacement needs are related to infrastructure from the post-war building boom – almost half of King County's short span bridges were built in the 10 years after WWII.

Exhibit 9. Short-Span Bridges by Year Built and Sufficiency Rating



Source: BERK Consulting, 2015, using King County 2013 Annual Bridge Report.

It is difficult to make comparisons between jurisdictions because counts like those found in Exhibit 10 do not account for the condition of each jurisdiction's inventory and the types of individual components (e.g., Snohomish County has a significant number of timber bridges). With these limitations in mind, BERK looked at inventory counts, population, and expenditures.

Exhibit 10. Comparison of King, Pierce, and Snohomish Counties and the City of Seattle

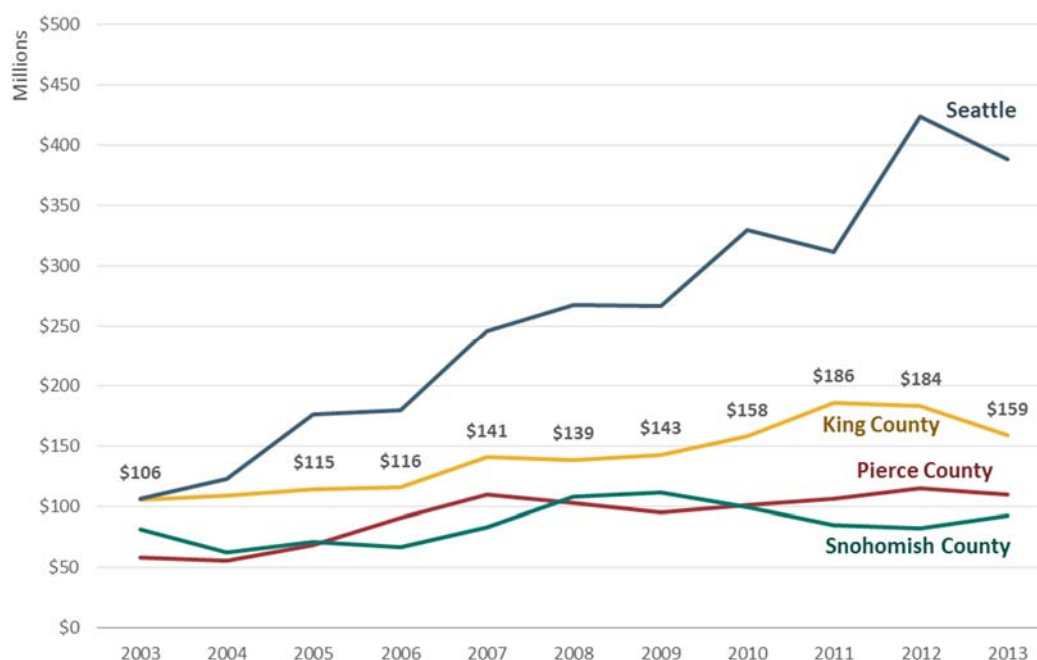
	Counties			City of
	King	Pierce	Snohomish	Seattle
Roads (Lane Miles)	2,961	3,100	3,257	3,954
Arterial Roads (Lane Miles)	961	1,420	1,028	1,547
Bridges	181	141	200	122
Total Population (2014)	2,079,967	831,928	759,583	668,342
Service Area Population (2014)	252,050	381,970	320,335	668,342
Percent of Population in Service Area	12.1%	45.9%	42.2%	100%
Service Area (Sq. Miles)	1,704	1,520	1,950	83

Note: County populations are for unincorporated areas only; road statistics do not include traffic volume.

Source: Washington State OFM and U.S. Census Bureau, 2015. King County, Pierce County Public Works, Seattle DOT, and Snohomish DOT.

Compared to Pierce and Snohomish, King County has a relatively small population supporting a similarly sized inventory and service area. King County also has a relatively small percent of the total population living within its service area and paying for the upkeep of its infrastructure.

Exhibit 11. Annual Expenditures (2013\$)



Source: BERK, 2015, using: Washington State *County Road and City Street Revenues and Expenditures Database*, 2003-2013.