Introduction

- My background
- Five key points in three focus areas:
  - User volume forecasts
  - AASHTO Bike Guide
  - Context-sensitive design
- Summary and conclusion

EXHIBIT NO. 116

User Volume Forecasts

Key point #1: There are still aspects of the user volume forecasts that defy engineering judgment and that do not conform to accepted guidelines.

User Volume Forecasts

Highest annual hourly volume

30th highest hourly volume

Table 1 – Demand Model Reported Peak Volumes for the ELST

ELST Segment B Locations	Average Weekday	Average Weekend	Peak Weekday	Peak weekend	Peak Hour	30th Peak Hour*	30th Peak Hour**	Annual
2017 Inglewood Hill Road	847	1,578	1,230	6,790	696	342	340	321,829
2025 Inglewood Hill Road	903	1,578	1,307	6,982	696	342	340	337,724
2040 Inglewood Hill Road	938	1,578	1,356	7,097	696	342	340	347,626
2017 190th Place SE	541	1,317	894	5,715	603	296	300	208,151
2025 190th Place SE	565	1,317	932	5,846	603	296	300	215,109
2040 190th Place SE	579	1,317	954	5,921	603	296	300	219,177

Year and ELST segment

**This value is the estimated 30th highest peak hour of trail traffic based on an analysis of the ratio of peak hourly bicycle volume to 30th highest hourly bicycle volume from similar trails in the region (calculated in Table A.1 as 2.04).*

*** This value is a rounded value of the calculated 30th Peak Hour from the previous column to reflect the accuracy of the direct demand model.*

Key point #1

User Volume Forecasts

Forecasted Population by Decade, from the Puget Sound Regional Council:

- 2020: 4.2 million
- 2030: 4.5 million
- 2040: 4.9 million (a 17 percent increase over 2020)

Key point #1

User Volume Forecasts

Direct Demand Models defined by NCHRP 770.

Their structure is to explain observed levels of bicycle or pedestrian activity on facilities (links) or at intersections (points) as recorded through counts, using a range of factors that describe local context. This is usually done using regression modeling techniques, with the calibrated models then applied back on all or a subset of the sampled system of intersections or links to assess their accuracy in replicating choices.

Key point #1

User Volume Forecasts

Variables often used according to NCHRP 770:

- ***Population density or employment density**, sometimes differentiated by type (e.g. populations differentiated by age, gender or income or employment categorized as office or retail).*
- ***Population or employment activity levels within a nominal buffer distance** of ¼ or ½ mile from the [location].*
- ***Land use mix**, measured either through an index (e.g. entropy) or implicitly through corresponding buffered activity levels.*
- ***Characteristics of the facility**, including type of bike path and sidewalk existence and sufficiency.*
- ***Interaction with vehicle traffic** (e.g., adjacent speeds or volumes, intersection approaches with crosswalks, sidewalk widths, on-road versus off-road bike facilities).*
- ***Transit availability** (e.g., transit frequency and stop density).*
- ***Major generators** (e.g. proximity to universities, schools, recreation, neighborhood shopping, major transit centers, and civic centers).*

Key point #1

User Volume Forecasts

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"Demographic Characteristics of the Catchment Area" [ed. – presumably applied as a percentage rather than population]

"Trail Experience"

Additional variable: "Miles of Trail in the Catchment Area"

Key point #1

User Volume Forecasts

Sample regression equation with three variables:

$$Forecast = e^{(\boldsymbol{X}*demo.characteristics+\boldsymbol{Y}*\ experience+\boldsymbol{Z}*miles\ of\ trail)}$$

Sample regression equation with four variables:

$$Forecast = e^{(\boldsymbol{A}*demo.characteristics+\boldsymbol{B}*\ experience+\boldsymbol{C}*miles\ of\ trail+\boldsymbol{D}*pop.)}$$

Variable abbreviations:
"demo.characteristics" means "Demographic characteristics"
"experience" means "Trail experience"
"miles of trail" means "Miles of trail in the catchment area"
"pop." means "Population within ½ mile of the trail"

Key point #1

User Volume Forecasts

Key point #2: Even if we accept the user volume forecasts as-is, the 30th highest hourly volume forecasts are right at the 300 users per hour threshold. Not two- or three-times the threshold, but exactly at the threshold.

User Volume Forecasts

From AASHTO's A Policy on Geometric Design of Highways and Streets (the AASHTO Green Book):

It is recommended that the hourly traffic volume that should generally be used in design is the 30th highest hourly volume.

Key point #2

User Volume Forecasts

Highest annual hourly volume

30th highest hourly volume

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Key point #2

AASHTO Bike Guide

Key point #3: The AASHTO Bike Guide uses specific language to make it clear when the guidelines are flexible and inflexible.

AASHTO Bike Guide

PREPARATION OF CONTENT

Project Team

- Toole Design Group
  Jennifer Toole – Principal Investigator
- Subconsultants:
  - John LaPlante, P.E., PTOE
  - Michael Moule, P.E.
  - Michael Ronkin
  - Mia Birk
  - Matthew Ridgeway
  - Shawn Turner, P.E.
  - Srinivasa Sunkari, P.E.
  - Bill Hunter

NCHRP Panel

- Dwight Kingsbury, Chair
- Denise Chaplick
- David Church, P.E.
- Ann Do
- Eric Glick
- Thomas Huber
- Mary Meletiou
- Richard Moeur, P.E.
- William Prosser, P.E.
- William Riccio, Jr., P.E.
- Cara Seiderman
- Richard Pain

Key point #3

AASHTO Bike Guide

From the August 10, 2012 Pedestrian and Bicycle Information Center Webinar:

"...we launched the preparation of the content of the 4th edition. And that was overseen by a panel of experts..."

"Folks from all over the United States were involved, from all different kinds of backgrounds."

Key point #3

AASHTO Bike Guide

From the August 10, 2012 Pedestrian and Bicycle Information Center Webinar:

"I do want to point out that it is a guideline. It is not a standard. And that's, I think, a very important thing to understand. The Bike Guide does not use words like shall or must; it uses words like should or may. And so, there is a lot of flexibility in the design guidance it provides."

Key point #3

AASHTO Bike Guide

Key point #4: Based on the user volume forecasts and the flexibility provided by the AASHTO Bike Guide's language, it is consistent with the AASHTO Bike Guide to build a 12-foot paved trail where physical constraints do not exist. However, it is also consistent with the AASHTO Bike Guide to build a narrower trail where physical constraints do exist.

AASHTO Bike Guide

What the AASHTO Bike Guide states in regards to trail width:

- *The minimum paved width for a two-directional shared use path **is** 10 ft.* (p. 5-3)

Relatively inflexible

Flexible

- *A path width of 8 ft **may be used** for a short distance due to a physical constraint such as an environmental feature, bridge abutment, utility structure, fence, and such.* (p. 5-3)

Flexible

- *Wider pathways, 11 to 14 ft **are recommended** in locations that are anticipated to serve a high percentage of pedestrians (30 percent or more of the total pathway volume) and high user volumes (more than 300 total users in the peak hour).* (p. 5-3)

Key point #4

AASHTO Bike Guide

What the AASHTO Bike Guide states in regards to physical constraints:

*A path width of 8 ft **may be used** for a short distance due to a physical constraint such as an environmental feature, bridge abutment, utility structure, fence, and such.* (p. 5-3)

In describing physical constraints, the Guide does not say (from Mr. Schultheiss' testimony):

- "Really challenging to move"
- "Really expensive"
- "A property line that you can't purchase the land"
- A wetland with "no way to mitigate"

Key point #4

AASHTO Bike Guide

The AASHTO Bike Guide states in regards to flexibility:

Sufficient flexibility is permitted to encourage designs that are sensitive to local context and to incorporate the needs of bicyclists, pedestrians, and motorists.

However, in some sections of the guide, suggested minimum dimensions are provided. These are recommended only where further deviation from desirable values could increase crash frequency or severity. (p. 1-2)

Key point #4

Context-sensitive Design

Key point #5: A context-sensitive design process would conclude that the trail can be narrowed without causing disproportionate safety effects. Additionally, accepted guidelines support widening only selected trail segments and widening in 1-foot rather than 2-foot increments.

Context-sensitive Design

Context-sensitive solutions, defined by WSDOT:

Its essence is that a proposed transportation project must be planned not only for its physical aspects as a facility serving specific transportation objectives, but also for its effects on the aesthetic, social, economic, and environmental values, needs, constraints, and opportunities in a larger community setting.

Key point #5

Context-sensitive Design

As engineers, we strive to design facilities to meet guidelines whenever possible. However, it frequently occurs that meeting all desirable guidelines comes at a great cost and results in other impacts including to private property, environmental resources or other resources. When this occurs, we make case-by-case decisions whereby we weigh the costs (dollars, property, environment, etc.) against the risks (safety, level of service, etc.).

Key point #5

Context-sensitive Design

From the Shared-use Path Level of Service Calculator user's guide:

- *Maintaining an optimum speed (for the bicyclist) is a key criterion.*
- *Service measures are primarily related to freedom to maneuver. These include meetings, active passes, delayed passes, and the perceived ability to pass.*
- *Safety is not included in the set of measures that establish service levels.*

Key point #5

Context-sensitive Design

From the Shared-use Path Level of Service Calculator:

Interpreting Shared-use Path Level of Service (LOS) grades:

LOS A: Excellent. *Trail has optimum conditions for individual bicyclists…*

LOS C: Fair. *Trail has at least minimum width to meet current demand…*

LOS D: Poor. *Trail is nearing its functional capacity.*

LOS E: Very Poor. *…the trail has reached its functional capacity.*

LOS F: Failing. *Trail significantly diminishes the experience for at least one, and most likely for all user groups.*

Key point #5

Context-sensitive Design

Shared-use Path Level of Service calculations to identify the 300 users/hour threshold from the AASHTO Bike Guide.

	Assumptions	% Delayed Passings	Level of Service
1.	10-ft wide 190 users/hour	66%	C
2.	10-ft wide 310 users/hour	82%	D
3.	10-ft wide 320 users/hour	83%	E

LOS D/E Threshold

The 300 users/hour threshold corresponds approximately to the LOS D/E threshold.

Assumes default mode split.

Key point #5

Context-sensitive Design

From the Shared-use Path Level of Service Calculator user's guide:

In general, grades A-C can be considered acceptable levels of service and D-F can be considered degraded levels of service.

Each political jurisdiction and trail managing agency certainly has latitude to adopt different policies covering acceptable levels of service for trails within their own communities.

Key point #5

Context-sensitive Design

Shared-use Path Level of Service calculations on the ELST.

	Assumptions	% Delayed Passings	Level of Service
1.	10-ft wide 260 users/hour	80%	D
2.	10-ft wide 300 users/hour	84%	E
3.	10-ft wide 340 users/hour	87%	E

LOS D/E Threshold

A 10-foot path with 300-340 users per hour would add to delayed passings by 4-7 percentage points over a trail at LOS D. This is a marginal effect.

Assumes ELST mode split (50% bike, 50% other).

Key point #5

Context-sensitive Design

Shared-use Path Level of Service calculations on the ELST.

	Assumptions	% Delayed Passings	Level of Service
1.	8-ft wide 300 users/hour	84%	F

An 8-foot path with 300-340 users per hour would operate at LOS F. This effect is more than marginal.

Assumes ELST mode split (50% bike, 50% other).

Key point #5

Context-sensitive Design

Shared-use Path Level of Service calculations on the ELST.

	Assumptions	% Delayed Passings	Level of Service
1.	11-ft wide 300 users/hour	35%	C
2.	12-ft wide 300 users/hour	35%	C

An 11-foot or 12-foot path improves LOS to LOS C; however, the guide is clear that each jurisdiction has latitude to adopt difference policies covering acceptable levels of service for trails. There is no effect to delayed passings of a 11-foot trail compared to a 12-foot trail.

Assumes ELST mode split (50% bike, 50% other).

Key point #5

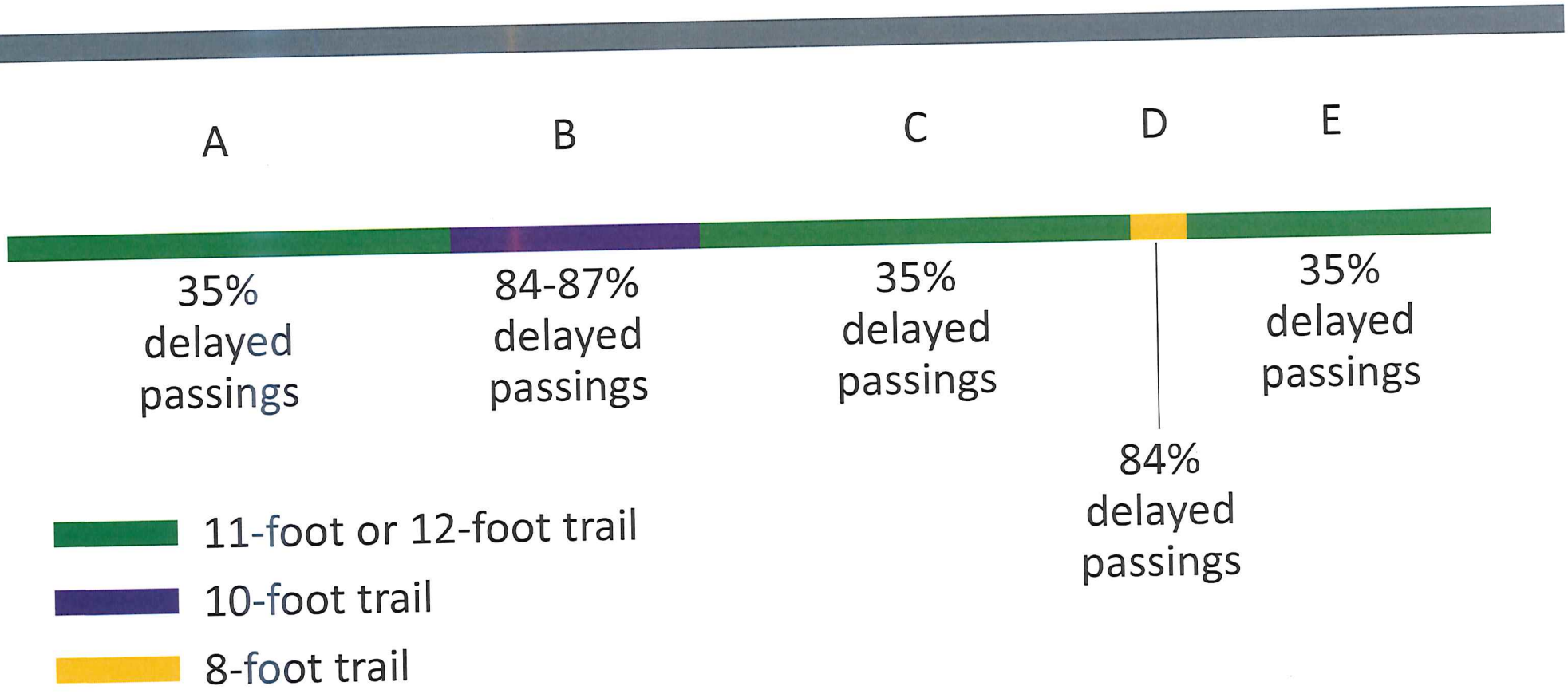
Context-sensitive Design

From the Shared-use Path Level of Service Calculator user's guide:

- *During design of new trails and widening of existing trails, designers may want to consider varying the trail width to achieve LOS goals in key locations but not overbuild in other locations. Adding width to improve LOS is valuable to trail users, even if it is provided only on selected segments.*
- *When considering wider trails, designers and decision makers may want to think in 1-ft, rather than 2-ft increments. Typical practice has been to consider widths in 2-ft increments. Using this approach may miss opportunities to provide measurable increases in LOS while at the same time containing costs and minimizing environmental impacts.*

Key point #5

Context-sensitive Design



Key point #5

In Summary

Key point #1: There are still aspects of the user volume forecasts that defy engineering judgment and that do not conform to accepted guidelines.

In Summary

Key point #2: Even if we accept the user volume forecasts as-is, the 30th highest hourly volume forecasts are right at the 300 users per hour threshold. Not two- or three-times the threshold, but exactly at the threshold.

In Summary

Key point #3: The AASHTO Bike Guide uses specific language to make it clear when the guidelines are flexible and inflexible.

In Summary

Key point #4: Based on the user volume forecasts and the flexibility provided by the AASHTO Bike Guide's language, it is consistent with the AASHTO Bike Guide to build a 12-foot paved trail where physical constraints do not exist. However, it is also consistent with the AASHTO Bike Guide to build a narrower trail where physical constraints do exist.

In Summary

Key point #5: A context-sensitive design process would conclude that the trail can be narrowed without causing disproportionate safety effects. Additionally, accepted guidelines support widening only selected trail segments and widening in 1-foot rather than 2-foot increments.

Conclusion

My recommendations to the City:

- Where physical constraints do not exist, a 12-foot trail is desirable given the forecasted user volumes and mode split. This is consistent with the AASHTO Bike Guide. It is not consistent with the AASHTO Bike Guide to suggest that narrower path widths are unallowable.
- Where physical constraints do exist:
  - A 11-foot trail is consistent with the AASHTO Bike Guide and has nearly no effect to trail LOS. It is not reasonable to cause disproportionate impacts to other resources if they can be avoided with an 11-foot trail.
  - A 10-foot trail is consistent with the AASHTO Bike Guide and has a marginal effect to trail LOS. This should be considered the minimum trail width for long distances of the trail.
  - An 8-foot trail is consistent with the AASHTO Bike Guide but has a more than marginal effect to trail LOS. Therefore, this should only be applied for short distances.
- Guidance suggests that trail widening only on selected segments is valuable to trail users, further supporting intermittent 10-foot and 8-foot trail segments with 11- or 12-foot segments between.