Willamette River Transit Bridge

PSU CTS Seminar
January 16, 2009

Dave Unsworth, TriMet
Guenevere Millius, Portland Design Commissioner, WRBAC member and SRM Architecture and Marketing
Today’s Agenda

• Portland-Milwaukie Light Rail Project
• Plans for a new Willamette River Bridge
• Public Process
Light Rail Project:

- 11 stations – one future station (SE Harold)
- 2,000 park and ride spaces
  - Tacoma
  - Park Avenue
- 7.3 miles
- Shared transitway
- Connects to trails
Portland-Milwaukie Light Rail Project

Light rail would:

• 27,400 daily transit trips
• Result in 8.2 million transit trips per year
• Create more than 9,040 new jobs
• Generate more than $314 million in personal income
• Transit travel time savings
• Increased transit mode Portland

Existing light rail:

• $6 billion invested near stations
• 15,000 new housing units
• 100,000 daily light rail trips and growing - up 3.2% from last year
Exciting Future Lies Ahead

- 1 million new residents in region
- 100,000 new jobs in this growing corridor
Growing South Waterfront

Willamette River Transit Bridge

OHSU’s South Waterfront Master Plan with rail
Anchors the Innovation Quadrant  Willamette River Transit Bridge
Locally Preferred Alternative Alignment

Willamette River Transit Bridge
Willamette River Bridges

Willamette River Transit Bridge

Source: The Portland Bridge Book
Willamette River Bridges

Willamette River Transit Bridge

Source: The Portland Bridge Book

Movable Bridges – 5 total
Fixed Bridges – 5 total

New Willamette River Bridge
Created Review Teams

• Willamette River Bridge Advisory Committee (WRBAC)
• Working Group (technical staff and consultants)
<table>
<thead>
<tr>
<th>Member Name</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob Durgan</td>
<td>Andersen Construction</td>
</tr>
<tr>
<td>Thomas Hacker</td>
<td>THA Architecture</td>
</tr>
<tr>
<td>Art Johnson</td>
<td>KPRR Consulting Engineers</td>
</tr>
<tr>
<td>Sue Keil</td>
<td>Portland Department of Transportation</td>
</tr>
<tr>
<td>Pat Lacrosse</td>
<td>OMSI</td>
</tr>
<tr>
<td>Guenevere Millius</td>
<td>SRM Architecture and Marketing, Inc.</td>
</tr>
<tr>
<td>Karl Rohde</td>
<td>Bicycle Transportation Alliance</td>
</tr>
<tr>
<td>David Soderstrom</td>
<td>Portland Opera Board</td>
</tr>
<tr>
<td>Chuck Steinwandel</td>
<td>Ross Island Sand and Gravel</td>
</tr>
<tr>
<td>Mark Williams</td>
<td>OHSU</td>
</tr>
<tr>
<td>Rick Williams</td>
<td>BPM Development</td>
</tr>
<tr>
<td>Mike Zilis</td>
<td>Walker &amp; Macy</td>
</tr>
</tbody>
</table>

**Committee Chair**

Mayor Vera Katz

**Facilitator**

David Knowles
Meetings in 2008:

July 8
August 8
September 16
October 8
November 13
December 11

Next meeting:
February 5, 2009
Willamette River Transit Bridge

Portland-Milwaukie Light Rail Project
Willamette River Bridge Advisory Committee (WRBAC)

Next Meeting  General Information  Past Meeting Documents
Willamette Bridge River Study Working Group

Notes, agendas, materials and presentations from:

- WRBAC
- Working Group

trimet.org/WRBAC
Vision

Deliver a bridge that embodies the Portland aesthetic--functional and affordable

- Aesthetic – the right bridge for the context
- Function – the right bridge for the use, site and environment
- Cost – the right bridge for the budget
- **Viable solutions must balance all three**
Bridge Architect: Rosales + Partners
With Schlaich Bergermann as Structural

Willamette River Transit Bridge

www.rosalespartners.com
Structural: HNTB
With Greg DeMond as Bridge Architect

Willamette River Transit Bridge

Both as Primes
Information Gathering
Establish Bridge Design Framework

Develop Range of Potential Bridge Types (Many)

Engineer, Architecture and Urban Design Development of Initial Viable Alternatives (Some)

Verify Viable of Alternatives (Few)

Begin Full Public Conversation
The Universe of Bridge Alternatives

• Trusses and Arches
• Cable Supported
• Movable
Design Parameters and Constraints

Proposed Bridge Alignment from SDEIS

1720’-0”
Additional analysis on vertical clearance to occur during Preliminary Engineering.
Design Parameters and Constraints

Willamette River Transit Bridge

LPA included a range of spans

300’ to 780’ clear
Evaluation Criteria

Cost
Risk
Fundamental Performance
Architectural – Urban Context
Greenway
Environmental – Sustainability
Bridge Operations
Miscellaneous
Opportunities

Willamette River Transit Bridge
# Evaluation Criteria

## Willamette River Transit Bridge

![Image of evaluation criteria chart]

### Template for 91508 Working Group Meeting

<table>
<thead>
<tr>
<th>Aesthetics: Urban Design</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Core Values and Traditions/Symbolism</td>
<td>x</td>
</tr>
<tr>
<td>Looking at the Bridge: Beauty, Proportion, and Scale</td>
<td>y</td>
</tr>
<tr>
<td>Being near the Bridge: Experience on the Greenway, Walkways, and River</td>
<td>z</td>
</tr>
<tr>
<td>Being on the Bridge: Experience Crossing the River</td>
<td>aa</td>
</tr>
<tr>
<td>Compatibility w/Existing Context, Fabric, and Adjoining Bridges</td>
<td>bb</td>
</tr>
<tr>
<td>Reflection of Current Technology and Innovation</td>
<td>cc</td>
</tr>
<tr>
<td>Views of Portland: Static - Viewpoints</td>
<td>ee</td>
</tr>
</tbody>
</table>

| Total Aesthetics: Urban Design Scores | 0 |
| Rank | 8 |

### Initial Ranking from 82808 Working Group Meeting

<table>
<thead>
<tr>
<th>Aesthetics: Urban Design</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Core Values and Traditions/Symbolism</td>
<td>x</td>
</tr>
<tr>
<td>Looking at the Bridge: Beauty, Proportion, and Scale</td>
<td>y</td>
</tr>
<tr>
<td>Being near the Bridge: Experience on the Greenway, Walkways, and River</td>
<td>z</td>
</tr>
<tr>
<td>Being on the Bridge: Experience Crossing the River</td>
<td>aa</td>
</tr>
<tr>
<td>Compatibility w/Existing Context, Fabric, and Adjoining Bridges</td>
<td>bb</td>
</tr>
<tr>
<td>Reflection of Current Technology and Innovation</td>
<td>cc</td>
</tr>
<tr>
<td>Views of Portland: Static - Viewpoints</td>
<td>ee</td>
</tr>
</tbody>
</table>

| Total Aesthetics: Urban Design Scores | 13 |
| Rank | 3 |

### Legend

- Working Group Ranking during 91508 Meeting
- Consultant Team Ranking issued prior to meeting for Working Group to review
“Some” Bridge Types

Willamette River Transit Bridge

Wave Frame

Tied Arch

Through Arch

Cable Stayed - 4

Cable Stayed - 2
Tied Arch Examples

Willamette River Transit Bridge
View Comparison
West Bank – Future Greenway Trail

Willamette River Transit Bridge
View Comparison
East Bank – Greenway Trail

Willamette River Transit Bridge
View Comparison
On the Bridge
View Comparison
On the River

Willamette River Transit Bridge
“Few” Bridge Types

Willamette River Transit Bridge

Wave Frame

Tied Arch

Through Arch

Cable Stayed - 4

Cable Stayed - 2
“Few” Wave Frame

2 Pier Cable Stayed

4 Pier Cable Stayed
Each alternative has opportunities and challenges
Recent Work

Willamette River Transit Bridge

• Evaluated structural performance of options
• Defined construction sequence
• Created computer models
• Analyzed for service loads
• Analyzed for seismic loads
Recent Work

Willamette River Transit Bridge

- Determine member sizes and quantities
- National Constructors Group
  - Cost bases
  - Cost certainty
  - Constructability review
  - Contractor’s risk assessment
- J. Paul Silvestri, National Constructors Group
J. Paul Silvestri

Graduate of Stanford

39 years building major heavy civil

Founded National Constructors Group in 1991

13 years advising transportation agencies on construction of major infrastructure projects

Numerous awards of excellence from public agencies

Published articles in Civil Engineering, Construction Methods Engineering News Record, American Segmental Bridge Institute

Willamette River Transit Bridge
Evaluation Criteria

- Cost
- Risk
- Fundamental Performance
- Architectural – Urban Context
- Greenway
- Environmental – Sustainability
- Bridge Operations
- Miscellaneous
- Opportunities
Risks

- Foundations
  - Wave Frame

- Material – Substructure

- Material – Superstructure
  - 2 Pier Cable Stayed
  - 4 Pier Cable Stayed

- Fabrication - Erection

- Schedule

- Design
Opportunities and Challenges

Willamette River Transit Bridge

Cable Stayed 2 Pier
More open – no landside piers
Cable Stayed – 2 Pier

Willamette River Transit Bridge

Lifecycle cost

Low lifecycle cost - more concrete and less steel
Willamette River Transit Bridge

Cable Stayed – 2 Pier

Navigation

Opportunity

Largest horizontal clearance

760’ Clear
Cable Stayed – 2 Pier

Environmental

Willamette River Transit Bridge

Challenge

Piers closest to shallow water

760’ Clear
Cable Stayed – 2 Pier

Navigation

Challenge

Willamette River Transit Bridge

Lowest vertical clearance (still exceeds 75’)

Cable Stayed – 2 Pier

Accommodation of curved spans at greenway

Stay Cables – Overhead Catenary Wire
Opportunities and Challenges

Willamette River Transit Bridge

Cable Stayed 4 Pier
Cable Stayed – 4 Pier

Lifecyle cost

Low lifecycle cost - more concrete and less steel
Willamette River Transit Bridge

Cable Stayed – 4 Pier

Risk Profile

Opportunity

Lowest risk profile for schedule and budget
Cable Stayed – 4 Pier
Willamette River Transit Bridge

Navigation
Opportunity

Second largest horizontal clearance
700’ Clear
Cable Stayed – 4 Pier

Mode Flexibility

Opportunity

Accommodates various bike/ped – train/bus configurations
Cable Stayed – 4 Pier

Willamette River Transit Bridge

Greenway Challenge

Landside pier closest to greenway
Cable Stayed – 4 Pier

Greenway

Widest bridge over greenway – 69’ versus 66’
Height Comparison

Willamette River Transit Bridge

Other Bridges
Comparison

Steel Bridge

Cable Stayed - 4

Cable Stayed - 2
Comparison

Willamette River Transit Bridge

Steel Bridge | Cable Stayed - 4 | Cable Stayed - 2

198’ | 187’ | 210’

<table>
<thead>
<tr>
<th></th>
<th>Steel Bridge</th>
<th>Cable Stay 4 Pier</th>
<th>Cable Stay 2 Pier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width of deck</td>
<td>74</td>
<td>69</td>
<td>66</td>
</tr>
<tr>
<td>Height of tower above deck</td>
<td>198</td>
<td>187</td>
<td>210</td>
</tr>
<tr>
<td>Total Height</td>
<td>270</td>
<td>254</td>
<td>277</td>
</tr>
<tr>
<td>Height - width ratio</td>
<td>27%</td>
<td>27%</td>
<td>24%</td>
</tr>
</tbody>
</table>
### Comparison

<table>
<thead>
<tr>
<th>Bridge Type</th>
<th>Steel Bridge</th>
<th>Cable Stayed - 4</th>
<th>Cable Stayed - 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (feet)</td>
<td>270’</td>
<td>254’</td>
<td>277’</td>
</tr>
<tr>
<td><strong>Width of deck</strong></td>
<td>74</td>
<td>69</td>
<td>66</td>
</tr>
<tr>
<td><strong>Height of tower above deck</strong></td>
<td>198</td>
<td>187</td>
<td>210</td>
</tr>
<tr>
<td><strong>Total Height</strong></td>
<td>270</td>
<td>254</td>
<td>277</td>
</tr>
<tr>
<td><strong>Height - width ratio</strong></td>
<td>27%</td>
<td>27%</td>
<td>24%</td>
</tr>
</tbody>
</table>
Opportunities and Challenges

Willamette River Transit Bridge

Wave Frame
Portland known for innovation: Light Rail – Streetcar – Tram
Wave Frame
Environmental Opportunity

Willamette River Transit Bridge

Piers closer to deeper water
Wave Frame
Environmental

Willamette River Transit Bridge
Opportunity

Piers farther away from contaminated media

600' Clear
Wave Frame

Navigation

Willamette River Transit Bridge

Challenge

Narrowest horizontal clearance

600' Clear
Increase design and construction engineering costs
Wave Frame

Willamette River Transit Bridge

Prototype

Challenge

Increase design and construction engineering costs

Bid risk

- Reduced competition for steel fabrication
Wave Frame

Willamette River Transit Bridge

Steel

Challenge

Higher price volatility than concrete
Wave Frame
Willamette River Transit Bridge
Steel
Challenge

Higher price volatility than concrete
Increased lifecycle costs
  • Weld inspections
  • Impact to service for recoating (painting)
Piers in contaminated media and at top of bank (riparian zone)
## Revised Risk Summary

**Willamette River Transit Bridge**

### Major Risk Categories

<table>
<thead>
<tr>
<th></th>
<th>Wave frame</th>
<th>Tied Arch</th>
<th>Thru Arch</th>
<th>4 Pier Cable Stayed</th>
<th>2 Pier Cable Stayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material - Substructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material - Superstructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fabrication - Erection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Legend

- **Higher Risk**
- **Moderate (+) Risk**
- **Moderate Risk**
- **Lower Risk**

### Images

- **Wave Frame**
- **2 Pier Cable Stayed**
- **4 Pier Cable Stayed**
Evaluation Criteria

Willamette River Transit Bridge

Cost
Risk
Fundamental Performance
Architectural – Urban Context
Greenway
Environmental – Sustainability
Bridge Operations
Miscellaneous
Opportunities
Cost: Baseline Quantity Estimate

Willamette River Transit Bridge

Process

- Wave frame design was revised
- Construction methodology was revised
- Revised quantities were generated (all three)
- Design, market and construction risks were removed
- Contractor style estimates generated

Result

Baseline Quantity Estimate
Draft Cost Results

Willamette River Transit Bridge

Final Review in Process

$115 – $119M
Over Budget

$32 – $37M

$82 – $85M
On Budget

$89 – $93M
Over Budget

$7 – $11M
Next Steps

• WRBAC – Staff to report on additional work related to future steel prices and aesthetic opportunities for cable stayed type. (February 5, 2009)

• WRBAC recommendation to PMLR Steering Committee (March 12, 2009)

• Additional design and process to select final bridge type (March 2009)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Publish Draft Environmental Impact Statement</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adoption of the Locally Preferred Alternative</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submit FTA New Starts Application</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTA Preliminary Engineering Application</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preliminary Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2009 - 2010</td>
</tr>
<tr>
<td>Final Environmental Impact Statement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2009 - 2010</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2010 - 2011</td>
</tr>
<tr>
<td>Full Funding Grant Agreement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Late 2011</td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Late 2011-15</td>
</tr>
<tr>
<td>Service Begins</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Willamette River Transit Bridge

- Federal share
  - 60/40
  - 50/50
- Metro – $72m
- State - $250m
- Milwaukie $5m
Thank you.

Questions? Comments?

trimet.org/pm