Vision

Willamette River Transit Bridge

Deliver a bridge that embodies the Portland aesthetic, is 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**
Engineer Team
Architectural Team
Stakeholder Committee

Information Gathering
Establish Bridge Design Framework

Develop Range of Potential Bridge Types *(Many)*

Screen

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

Screen

Verify Viable of Alternatives *(Few)*

**Begin Full Public Conversation**
“Some” Bridge Types

Willamette River Transit Bridge

Wave Frame

Tied Arch

Through Arch

Cable Stayed - 4

Cable Stayed - 2
“Some” Bridge Types

Willamette River Transit Bridge
Wave Frame

Willamette River Transit Bridge

Steel shown as white  –  Concrete shown as gray
Tied Arch

Examples

Willamette River Transit Bridge
Willamette River Transit Bridge

Through Arch

Steel shown as white  –  Concrete shown as gray
Cable Stayed – 4 Pier

Willamette River Transit Bridge

Steel shown as white  –  Concrete shown as gray
Willamette River Transit Bridge

Cable Stayed – 2 Pier

Steel shown as white – Concrete shown as gray
View Comparison

Willamette River Transit Bridge

Aerial
View Comparison
West Bank – OHSU Area

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
Willamette River Transit Bridge

On the River
Engineer Team
Architectural Team
Stakeholder Committee

Information Gathering
Establish Bridge Design Framework

Develop Range of Potential Bridge Types (Many)

Screen

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

Screen

Verify Viable of Alternatives (Few)

Begin Full Public Conversation
Evaluation Criteria

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

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### Draft Risk Analysis Summary

#### Willamette River Transit Bridge

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**Legend**

- Higher Risk
- Moderate Risk
- Lower Risk

![Bridge Images]

---

Willamette River Transit Bridge is a project involving the analysis and evaluation of various risk categories. The table above highlights the center-to-center span width and risk levels for different categories such as foundations, material substructure, material superstructure, fabrication erection, schedule, and design. The risk analysis is crucial for ensuring the safety and efficiency of the construction project.
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**Willamette River Transit Bridge**

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## Draft Risk Analysis Summary

### Willamette River Transit Bridge

### Team’s Charge

Develop methods to reduce risk profile of Wave Frame

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Revised Risk Summary

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

Risk profile lowered for wave frame
Risks

- Design
  - Prototype design
  - Very complex connections
  - Non redundant structure
  - Higher cost and schedule risk
Risks

- Material - Superstructure
  - High performance steel
  - Available from only one source
  - Volatile pricing
  - Special run - availability limited
  - Material sizes at upper limit of availability
  - Higher cost and schedule risk
Risks

- **Fabrication**
  - Highly complex connections
  - Longest fabrication duration
  - Concern from local fabricator
    - Insufficient schedule for complex fabrication
    - Potential delay
Risks

- **Erection**
  - **High performance steel at superstructure**
  - **Complex – highly technical field welding**
  - **Higher cost and schedule risk**
Revised Risk Summary

Willamette River Transit Bridge

Questions?

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Legend:
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- Moderate (+) Risk
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## Evaluation Criteria

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Cost
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Fundamental Performance
Architectural – Urban Context
Greenway
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Bridge Operations
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Opportunities
Each alternative has opportunities and challenges

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Legend:
- Lowest Score
- Moderate Score
- Highest Score
Each alternative has opportunities and challenges
Tied and Through Arches

Willamette River Transit Bridge

Challenges

- Environmental Permitting Risk
  - Piers in shallow water
- Navigational Permitting Risk
  - Horizontal - vertical clearances, maneuvering
- Greater depth of structural section over the Greenway trail
- In-water pier proximity to existing subsurface utilities
- In-water pier proximity to proposed contaminated media cap
Challenges

- In-water pier proximity to existing subsurface utilities

20” Gas main
12’ Fiber optic line
Tied and Through Arches

Willamette River Transit Bridge

Challenges

- In-water pier proximity to proposed contaminated media cap
Challenges

- Environmental Permitting Risk
  - Piers in shallow water
Tied and Through Arches

Challenges

- Navigational Permitting Risk
  - Horizontal and vertical clearances
Tied and Through Arches

Challenges

• Navigational Permitting Risk
  ➢ Maneuvering
Tied and Through Arches

Challenges

- Greater depth of structural section over the Greenway trail
Tied and Through Arches

WRBAC Recommendation

- Remove Tied and Though Arches from list of viable bridge types
Opportunities and Challenges

Willamette River Transit Bridge

Cable Stayed 2 Pier
Cable Stayed – 2 Pier
Greenway

Opportunity

Willamette River Transit Bridge

More open – no landside piers
Cable Stayed – 2 Pier

Lifecycle cost

Low lifecycle cost - more concrete and less steel
Cable Stayed – 2 Pier

Environmental Challenge

Willamette River Transit Bridge

Piers closest to shallow water
Cable Stayed – 2 Pier
Willamette River Transit Bridge
Navigation
Challenge

Lowest vertical clearance (still exceeds 75’)

Image of the Willamette River Transit Bridge seen from above, showing the bridge and surrounding area.
Cable Stayed – 2 Pier
Willamette River Transit Bridge
Accommodation of curved spans at greenway

Challenge

Stay Cables – Overhead Catenary Wire
Opportunities and Challenges

Willamette River Transit Bridge

Cable Stayed 4 Pier
Cable Stayed – 4 Pier

Willamette River Transit Bridge

Lifecycle cost

Opportunity

Low lifecycle cost - more concrete and less steel
Cable Stayed – 4 Pier

Risk Profile

Willamette River Transit Bridge

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
Willamette River Transit Bridge

Mode Flexibility

Opportunity

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

Greenway

Challenge

Landside pier closest to greenway
Cable Stayed – 4 Pier

Willamette River Transit Bridge

Greenway

Challenge

Widest bridge over greenway – 69’ versus 66’
Willamette River Transit Bridge

Cable Stayed – 2 and 4 Pier
Architectural – Urban Design

Challenge

Height of Towers
Height Comparison

South Waterfront Development
Height Comparison

Willamette River Transit Bridge

South Waterfront

- Tram 195'
- Wave – 120'
- CS 4 – 254'
- CS 2 – 277'

Height Comparison

- 0'
- 50'
- 100'
- 150'
- 200'
- 250'
- 300'
- 350'
Height Comparison

Other Bridges
<table>
<thead>
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**Willamette River Transit Bridge**

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<td><strong>Width of deck</strong></td>
<td>74</td>
<td>69</td>
<td>66</td>
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<tr>
<td><strong>Height of tower above deck</strong></td>
<td>198</td>
<td>187</td>
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<td><strong>Total Height</strong></td>
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**Notes:**
- The table compares the height of the tower above the deck, total height, and height-width ratio for the steel bridge and the two cable-stayed bridge designs.
- The steel bridge has a height of 198’, while the cable-stayed bridges have heights of 187’ and 210’.
- The total height differences are 270’ for the steel bridge, 254’ for the 4 pier cable-stayed bridge, and 277’ for the 2 pier cable-stayed bridge.
- The height-width ratio is consistent at 27% for both cable-stayed bridge designs, compared to 24% for the steel bridge.
# Comparison

## Willamette River Transit Bridge

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# Comparison

**Willamette River Transit Bridge**

## Steel Bridge – CS4 – CS2

![Bridges](image)

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Wave Frame
Willamette River Transit Bridge

Wave Frame

Innovative

Opportunity

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

Willamette River Transit Bridge
Opportunity

Piers closer to deeper water
Willamette River Transit Bridge

Wave Frame
Environmental

Opportunity

Piers farther away from contaminated media

600’ Clear
Wave Frame

Navigation

Willamette River Transit Bridge

Challenge

Narrowest horizontal clearance

600’ Clear
Willamette River Transit Bridge

Wave Frame

Environmental Challenge

Piers in contaminated media and at top of bank (riparian zone)
Wave Frame
Prototype
Challenge
Wave Frame

Prototype

Challenge

Willamette River Transit Bridge

Increase cost for design and construction engineering
Increase schedule risk for design and construction
Bid risk

- Reduced competition for steel supply and fabrication
Higher price volatility than concrete
Higher price volatility than concrete
Increased lifecycle costs

- $875,000 – $900,000 per year for recoating fund
- Impact to service for recoating
FTA – Hold contingency for high risk items

- Hold until high risk elements are 20% complete
- Funds held well into construction
- Opportunity to apply resources for other needs reduced
Opportunities and Challenges

Questions?
Evaluation Criteria

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

Willamette River Transit Bridge

Cost
Risk
Fundamental Performance
Architectural – Urban Context
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Bridge Operations
Miscellaneous
Opportunities
**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

$82 – $85M
On Budget

$89 – $93M
Over Budget

$32 – $37M

$7 – $11M
Next Steps

- Additional analysis on steel prices
- Additional analysis on impact to project budget
  - Additional cost for extended duration?
  - Additional contingency amount?
  - Additional construction financing costs?
  - FTA 50/50 cost split request?
Next Steps

- WRBAC meeting for further deliberation of “few” viable types (February 5, 2009)
- WRBAC recommendation to Steering Committee (Mid February 2009)
- Additional design and process to refine vertical clearance (January – March 2009)
- Continued bridge design and refinement (Preliminary Engineering)
Thank you