## Bridge Planning









### Introduction

- Purpose of Bridge Planning
- Effective Bridge Planning
- When do you need Bridge Planning ?
- Bridge Planning Skills
- Bridge Planning Considerations
- AIT Workflow Processes





### Purpose of Bridge Planning

#### Find the most suitable solution for the roadway to cross the stream/road



Ensure that all issues are considered early in the design process so that they can be adequately addressed and an optimum solution can be developed.





### Effective Bridge Planning

- Identifies the unique characteristics, issues and opportunities of a given bridge site
- Develops feasible, practical and cost effective solutions
- Uses engineering judgement and addresses minimum & desirable standards
- Comprehensively examines all issues
  - Balances competing issues and desires
- Precedes structural design & regulatory approvals





### Effective Bridge Planning is...

- the *creative* development of alternatives and options to address the issues of the site
- a subjective evaluation of the bridge planning considerations and options
- the use of judgement, not rules
- collaboration with others





### When Do You Need Bridge Planning?

- Functional Planning Studies
  - Examining new roadway corridors
  - Upgrading or twinning existing roadways
  - Re-alignment of roadways
- Bridge Assessments / Site Assessments
- Bridge Design
- River Engineering Design
- Flood Repair (for bridge or roadway)





### Bridge Planner Skills

- A bridge planner needs to have:
  - a strong understanding of Hydrotechnical and Roadway engineering
  - a broad understanding of many disciplines that influence the bridge planning process
  - the ability to question and evaluate the importance and significance of many conflicting issues and constraints
  - the ability to look at the Big Picture



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# Bridge Planning Considerations







Each bridge site has unique challenges & opportunities. The Bridge Planning process needs to consider:

- Bridge site history
- Hydrotechnical
  - Hydrology
  - Hydraulics
  - RPW
  - Roadway
    - Horizontal alignment
    - Vertical alignment

- Structural
- Geotechnical
- Environmental
- Economics/Risk
- Stakeholders
- Construction
- Future Staging



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### **Bridge Site History**

### Flood Danger In High River Believed Over

Bridges Carried Away; Water Receding from Streets Friday Morning

#### Impossible as Yet To Estimate Damage

Worst Flood in History of Town Old-Timers Assert

(Special Dispatch to the Herald) HIGH RIVER, June 3. —Climaxing its career by carrying away the C.P.R. spillway bridge north of town and dislodging the highway bridge at the same point, at midnight Thursday, the raging Highwood river receded rapidly from the Data on Sun Spots Predicts More Rain In Western Canada

OTTAWA, June 3 (C.P.)-Western Canada may expect fairly generous rains for some time to come if sun spot data collected by the Dominion observatory runs true to form.

According to observatory officlais Canada is now approaching a "sun spot period" which should produce plenty of moisture for the western grain fields. The effect of sun spots, it was explained Friday is to increase the rainfall over a long period. A sun spot period lasts for 11 or 11 1-2 years.

This does not mean that tremendous quantities of rain will fail for a short period, but rather that over a long period the precipitation will be higher than when the sun spots are not in evidence.



As in other years of flood experience residents of the Bragg Creek district find themselves cut off from communications with the outside and have to depend on various expedients for food and other supplies.

Bragg Creek area which lies Bragg Creek area which lies about eight miles west of the city is always a bad sufferer when the Elbow river overflows its banks and the unusual sight of twin bridges spanning almost dry ground while the surrounding country and highways are under flood water is to be seen every year, when floods occur.

The bridges have been badly damaged and on Monday residents of the district were to be seen crawling over the framework carrying in food supplies which had been brought as near



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## Hydrotechnical - Hydrology





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### Hydrotechnical - Hydraulics







### Hydrotechnical - RPW (River Protection Works)





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### Roadway – Horizontal







### Roadway - Vertical







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### Structural















### Environmental















### Stakeholders

- Owner (AT)
  - Regional Office
  - Head Office
  - Politicians
- Government
  - Municipal Governments
  - Regulatory Bodies
- Public
  - Landowners (Right of way, access, impact)
  - Other Interest Groups



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### Future Staging















## AT Workflow Process





### Workflow Process

- Review Available Data + Site Inspection
- Develop Design Parameters Hydrotechnical, Road Geometrics, Other
- Review Survey, Other Constraints (Geotechnical, Environmental, etc.)
  - Develop and Evaluate Alternatives
- Document Solution + Independent Review





### **Review Available Data**

#### • File History

- Performance history, HW Data, channel details
- Site specific issues
- Design drawings, scour survey, reports

#### • GIS

- DA, local terrain, channel plan, slope and size
- Georeference airphotos from multiple years track changes in channel, road, development, slopes

#### • Other

WSC Data, AENV COP maps, floodplain study,...



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### Site Inspection

#### • River :

- Typical channel dimensions
- Channel features, controls, flow alignment
- Areas of erosion, scour
- HWM, drift potential, ice scars
- Performance of existing works

#### Road :

- Safety issues, improvement possibilities
- Access survey, geotechnical, detour
- Assess survey requirements



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### Hydrotechnical Design Parameters

- Determine design Y,Q,V for stream
- Hydrotechnical Design Guidelines (HDG)
  - Channel Capacity
  - Historic Highwater
  - Basin Runoff Potential
- Compare with published HIS values
- Compare with U/S and D/S crossings





### Roadway Geometric Design Parameters

- Review Existing Geometry
  - alignment, profile, cross slope
- Determine Design Designation
  - Based on AADT, Classification, FPS
  - Determine Design Speed, Clear Roadway
- Identify Design Parameters
  - Horizontal tangent/radius, clear zone
  - Vertical K sag & crest, max/min grade





### **Review Survey Data**

#### Check survey for completeness

- Required components views for site plan, elevation, road profile, stream profile
- Required extents and density of survey shots near key features
- Additional features e.g. existing bridge, utilities
- Check survey for consistency
  - Points on each view should be consistent
  - Views should agree with site observations
  - Check with available DTM, airphoto data



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### **Review Other Constraints**

#### • Geotechnical

- Sufficient info for detailed design?
- Is headslope ratio consistent with observations?
- If headslope > 2:1, what are options to steepen?

#### Environmental

- Fish Habitat Compensation works reasonable?
- Wildlife passage handled with hydraulic opening?
- Fish passage possible with natural stream?



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### Initial Bridge Option

- Alignment :
  - existing, offset (avoids detour), improvement
- Gradeline :
  - hydraulic (HW + freeboard + structure depth)
  - standard (grade, K, cut/fill)
  - minimum bridge grade (match existing?)

#### Fill Location :

- Match banks (minimal constriction)
- Skew consider both high flow and low flow paths
- RPW standard headslope protection



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### Initial Culvert Option

- Size :
  - Dia = burial + Y + headloss
- Gradeline :
  - Hydraulic (U/S Crown + Cover)
  - standard (grade, K, cut/fill), (match existing?)

#### Geometry

- Length = road (clear zone) + fill sideslope + bevels
- Align with channel at ends
- Set inverts to meet burial at each end



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### **Develop** Options

- Range of culvert sizes, shapes, types, tunnel
- Fills located closer, further from channel
- Alignment reduce skew with channel work
- RPW options spurs, guidebanks
- Span arrangement pier location, gradeline
- Stable headslope vs. 2:1 + geotech. remediation
  - Optimize each distinct option iteration





### **Evaluate** Options

#### Costs

- Structure + RPW
- Geotechnical, Environmental, other
- Roadway, Traffic Accommodation

#### Pros / Cons

- Road Safety and Operations (User Costs)
- Construction risks, difficulty, staging
- Environmental impact, approvals
- Life cycle rehabilitation, maintenance
- Owner Preferences
- Select Optimal Solution



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### **Document Solution**

- Provide Info For Detailed Design
  - Site Plan
  - Elevation View (XS Bridge, Profile Culvert)
  - Road Plan and Profile
  - DD drawings (formal CAD drawings)
    - an effective way to document the Bridge Planning results

#### Bridge Planning Report

 document parameters, constraints, and optimization process. Usually precedes DD drawings.





### Independent Review

- Accuracy
  - minimize any errors
- Consistency
  - standards, guidelines
- Completeness
  - missing any key items
- Optimal Value
  - judgement
- This is a review, *not* an independent design exercise



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