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Tetra Tech
Agenda

- Introduction
- Ft Saskatchewan Project Overview
- Roads methodology
- Roads Results & Recommendations
- Utility Methodology
- Utility Results & Recommendations
- Questions & Discussion
Tetra Tech

- Founded in 1966
- $2.5 billion in revenue in 2014
- 14,000 employees worldwide
- Worked in more than 135 countries in 2014
- Publicly-traded on NASDAQ as TTEK
Tetra Tech
North American Office Locations
What We Do...

WATER
- Water Resources
- Drinking Water
- Groundwater
- Wet Weather Infrastructure/CSOs
- Wastewater Treatment
- Water and Agriculture

NATURAL RESOURCES
- Mining
- Industrial Process
- Oil and Gas

ENVIRONMENT
- Air Quality
- Environmental Compliance
- Environmental Management
- Environmental Response/Disaster Management
- Remediation
- Waste Management

INFRASTRUCTURE
- Transportation
- Dams, Locks, and Levees
- Buildings
- Ports, Harbors, and Waterfront
- Communications
- Information Technology
- Construction

ENERGY
- Wind
- Solar
- Hydropower
- Nuclear
- Emerging Renewables
- Transmission and Distribution
- Utilities/Market Analytics
- Energy Efficiency
Asset Management Demands a Shift From the Traditional

Silo Views to Enterprise Decisions

ASSET MANAGEMENT
Case Study

CITY OF FT SASKATCHEWAN, AB
Road Corridor Asset Management Optimization
The original objectives of the study were:

- Develop GIS based location referencing in support of not only PMS but also other linear assets
- Life Cycle Cost based strategy selection for all paved roads based on newly collected data;
- Compare the present condition of the network to the predicted condition in future years based on the current and alternate funding levels
- Provide information to allow the City to select annual funding level that will sustain the quality and value of the pavement network in the long term
Data Collection Methods

- Network Inventory
  - Using Ortho-photography
  - GPS Video
- Surface Distress
  - Cracking, patching, potholes, etc..
- Measuring road roughness and rutting
- Falling Weight Deflectometer (FWD) for pavement strength assessment
Roads: Network Definition and Location Referencing
Pavement Condition Indices

<table>
<thead>
<tr>
<th>Composite Legacy Indices</th>
<th>Pavement Serviceability Index (PSI) (roughness)</th>
<th>Structural Adequacy Index (SAI) (strength)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement Distress Index (PDI) (surface distress)</td>
<td>Pavement Quality Index (PQI) Function of (SAI, PDI, PSI)</td>
<td></td>
</tr>
<tr>
<td>Structural Crack Area (%) – ACA (All)</td>
<td>Structural Crack Area (%)</td>
<td>Structural Crack Area (low)</td>
</tr>
<tr>
<td>ACL (Slight)</td>
<td>TCL (Slight)</td>
<td></td>
</tr>
<tr>
<td>ACW (wide)</td>
<td>TCW (wide)</td>
<td></td>
</tr>
<tr>
<td>Thermal Crack Area (%) – TCA (All)</td>
<td>Roughness- IRI (mm/m)</td>
<td></td>
</tr>
<tr>
<td>Ravelling and Weathering Area (%) – WRL (low), WRH (high)</td>
<td>Rutting- Mean Rut depth (mm)</td>
<td></td>
</tr>
<tr>
<td>Structural Number modified for subgrade (SNP)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Potential Preservation Strategies

- Several Strategies are Evaluated for Each Pavement Segment Using Life Cycle Cost Analysis

Sample pavement strategies (combination of treatments)
Roads: Five Year Rehab Program ($2.7M)
Roads: Predicted Pavement Condition (PQI)

- Maintenance Only
- $2.1 Million
- $2.4 Million
- $2.7 Million

Year 2013: 6.4
Year 2033: 3.5

Pavement Quality Index (PQI)
Road Corridor Asset Management Optimization

What about?
Utilities: Key Steps in Methodology

1. **What do you have?**
   - Compile asset inventory

2. **What is it worth?**
   - Asset valuation

3. **What is its condition?**
   - Estimate asset condition using expected service lives & deterioration curves

4. **What needs to be done?**
   - Timing & type of interventions

5. **How could the Utility interventions be coordinated with Roads?**
   - Coordination of infrastructure works

6. **How much does it cost?**
   - Reinvestment profile

**SECTION 2**

**SECTION 3**

**SECTION 4**

**SECTION 5**

**SECTION 6**
Compilation of Utility Asset Inventory: Initial Data Gaps

- Initial Data Gaps (by total utility length, respectively):
  - Approximately 75% of the water mains did not have install dates, and 9% did not have diameter data
  - Approximately 20% of the sanitary sewers did not have install dates, and 8% did not have diameter data
  - Approximately 13% of the storm sewers did not have install dates, and 15% did not have diameter data
Creation of Thiessen Polygons
Location Distribution of Mains by Decade of Installation
### Annual Length of Underground Utility Mains Installed in City of Ft. Saskatchewan

#### Table: Utility Length and Replacement Value

<table>
<thead>
<tr>
<th>Utility</th>
<th>Length (m)</th>
<th>Replacement Value ($ M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>111,521</td>
<td>$53</td>
</tr>
<tr>
<td>Sewer</td>
<td>105,034</td>
<td>$52</td>
</tr>
<tr>
<td>Storm</td>
<td>57,568</td>
<td>$64</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>274,124</strong></td>
<td><strong>$169</strong></td>
</tr>
</tbody>
</table>

#### Graph: Length of Utility Mains by Year

- **Storm**
- **Sewer**
- **Water**

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6/4/2015

9th International Conference on Managing Pavement Assets | May 18-21, 2015
Use of dTIMS as Analysis Tool

**ASSET INVENTORY/CONDITION**
- Pipe Type
- Pipe Diameter & Length
- Pipe Install Date
- CCTV
- Consequence

**Deterioration Curves**

**Risk Criteria if desired**

**INTERVENTIONS**
- Inspections
- Pipe Bursting
- CIPP Lining
- Open-Cut Excavation

**Process Flow / Decision-Rules**

**Analysis & Optimization**
- Optimize on:
  - Min LCC cost
  - Min Risk
  - Max ESL

**Expenditure Profiles**

**Network Condition**

**Drill-Down to Asset Level**

**Unit Cost Tables**
adjacent pipes to be reconstructed <10 years apart

YES

consolidate pipe reconstruction to average year

NO

adjust road reconstruction to match pipe reconstruction

pipe reset: 80 years

road reset: as per PMS

reconstruct road and pipe(s)

7.1 - 7.3

1 => refers to a specific unit cost lookup table in MS Excel
Asset Condition – Use Weibull Deterioration Curves

Good
Fair
Poor
Very Poor

BEYOND SERVICE LIFE = NOT IN A “STATE OF GOOD REPAIR”
Interventions (Treatments)

For the purposes of life cycle costing analysis (LCCA), treatments are grouped into inspection, renewal and replacement treatments:

- **INSPECTIONS**
  - Water: Leak detection
  - Sanitary & Storm: CCTV Inspection

- **RENEWAL**
  - CIPP Liners
  - Extends pipe life by 25 years

- **REPLACEMENT**
  - Pipe bursting if viable for up-sizing
  - Open cut replacement
Parameters Supplied by External Excel Files are Easily Updateable

- Weibull Curves
- Inspection Costs
- ESLs
<table>
<thead>
<tr>
<th>WATER</th>
<th>ESL (Years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER</td>
<td>Esk</td>
</tr>
<tr>
<td>Asbestos</td>
<td>60</td>
</tr>
<tr>
<td>Cement</td>
<td>70</td>
</tr>
<tr>
<td>Cast Iron</td>
<td>70</td>
</tr>
<tr>
<td>PVC</td>
<td>80</td>
</tr>
<tr>
<td>Steel</td>
<td>80</td>
</tr>
<tr>
<td>Unknown</td>
<td>60</td>
</tr>
</tbody>
</table>
- Open Cut Cost Under Road
- Relining Costs
- Open Cut Cost Outside Road
- Multiple Pipes Costs
- Etc.
Coordination of Infrastructure Works

1. STEP 1: Optimization of the timing of interventions between the water, sanitary sewer and storm sewer mains.
2. STEP 2: Optimization of the timing of interventions between the underground utilities and roads.
Analysis Results – Work Program
Thiessen Polygon
Results – Work Program
Uncoordinated Water Replacement Year

Water Main: 2034
Results – Work Program
Uncoordinated Sanitary Replacement Year

Sanitary Main: 2024
Results – Work Program
Road Mill/Overlay Year

Road: 2031
Results – Work Program
Utility Work Coordinated with Road Work

All: 2031
Sample Capex Dashboard: Sanitary

Figure 1: Sanitary: Average Annual Expenditure and Condition – Do Nothing

Figure 2: Sanitary: Annual Expenditure and Condition - Relining

Figure 3: Sanitary: Annual Expenditure and Condition – Open-Cut

Figure 1: Projected Sanitary Network Condition Under Three Expenditure Scenarios
### Summary & Recommendations

- **Annual Expenditure ($)**
  - Storm
  - Sanitary
  - Water
  - Average $1.4M / year
  - Overall Network Condition - $1.4M / year
  - Overall Network Condition - Do Nothing

### Chart Description:
- The chart illustrates the annual expenditure for different categories (Storm, Sanitary, Water) over a period of years from 2014 to 2024.
- The blue line represents the overall network condition maintaining an average expenditure of $1.4M per year.
- The red line indicates the overall network condition if no action is taken, showing a gradual decrease in expenditure.

### Conclusion:
- The chart provides a visual representation of how different expenditure strategies affect the network condition over time.
- The data suggests that maintaining an expenditure of $1.4M per year is beneficial for network condition improvement.

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6/4/2015

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• Budget for an average expenditure of $1.4M per year for pipe renewal and replacement:
  - Water: $0.63M / year (45%)
  - Sewer: $0.71M / year (51%)
  - Storm: $0.05M / year storm (4%)
• Inspection Budget: $35,000 / year
Some of the key innovations developed in this project were:

- Defining the pricing of multiple asset interventions and use of life-cycle cost optimization to identify the least cost intervention strategies across multiple asset classes.
- Spatial coordination and optimization of infrastructure work between roads and utilities, resulting in a projected 5% saving in City capital expenditures over 30 years.
- Development of a GIS-based asset inventory to serve as the central store of asset information.
- Assisting the client to articulate target levels of service in the context of overall efficiency and long-term financial sustainability.
Silo Views

FROM

PLANNING
FINANCE
WATER
DRAINAGE
SEWER
ROADS
MANAGEMENT

TO

Enterprise Decisions

ROADS
DRAINAGE
FINANCE
WATER
SEWER
MANAGEMENT
PLANNING

Improved above and below-ground asset inventory
Understanding the medium to long term reinvestment needs for all road corridor assets
Optimization of the type and timing of interventions
Coordination of interventions on road corridor assets to minimize life cycle cost and disruption

Road Corridor Asset Management Optimization
Key Takeaways

• GIS is instrumental in data management and asset management.
• Road corridor management makes both practical and financial sense.
• Current asset management requires a paradigm shift in thinking from traditional silo approach to less traditional holistic approach.
Can YOU Answer This Question?

Is your City’s (Agency’s) long-term financial performance and position sustainable by meeting planned long-term service and infrastructure levels and standards without unplanned increases in rates or disruptive cuts to services?
Questions & Discussion

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