Ministry of Transportation Ontario
Highway 6, 11 & 17 - Corridor Assessment

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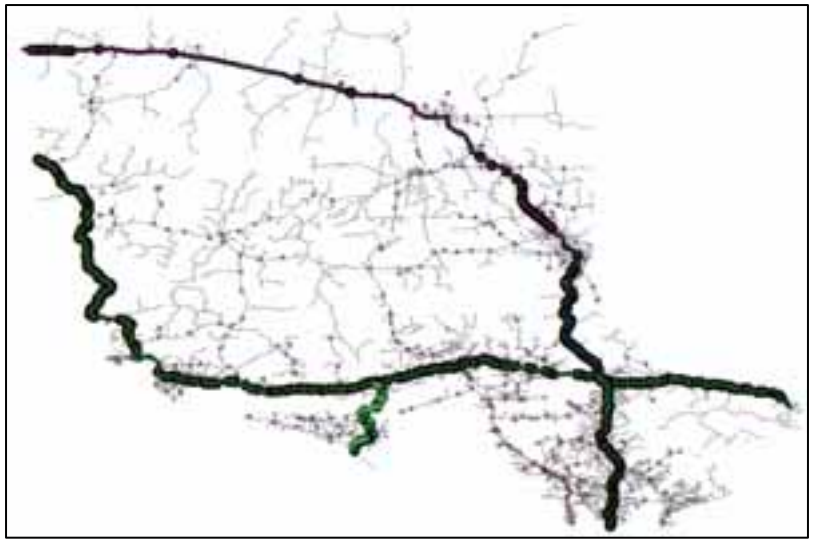
One Team. Infinite Solutions

Stantec

Outline of Presentation

1. Introduction
2. Scope & Objectives
3. Data Collection
4. Asset Extraction
5. Data Model



Introduction
Project Description

Preliminary Design Assignment to:

- Collect data for approximately 1,180 centerline miles of Highway 6, 11 and 17;
- Review geometric and operational deficiencies, roadway assets, traffic data; and
- Develop a model to estimate lifecycle and deficiency costs over a 25 year timeframe.

Data Collection

Mobile Data Capture – What's on the Truck?

Data Collection
Mobile Data Capture

Data Collection
Mobile Data Capture

Data Collection
Results

- High resolution digital video log for Highway's 6, 11 & 17 in both directions, approximately 4,000 km
- Two (left and right) camera images collected at 5m intervals
- Each image geo-referenced to accurately locate the X, Y, and Z coordinates of the asset features within the right-of-way
- Sub-metre accuracy GPS collected
- ~500 GB of video ready for the asset extraction process
- ~500 GB of LiDAR data

Data Collection
Results

The collected video and GPS provided the ability to extract the following assets:

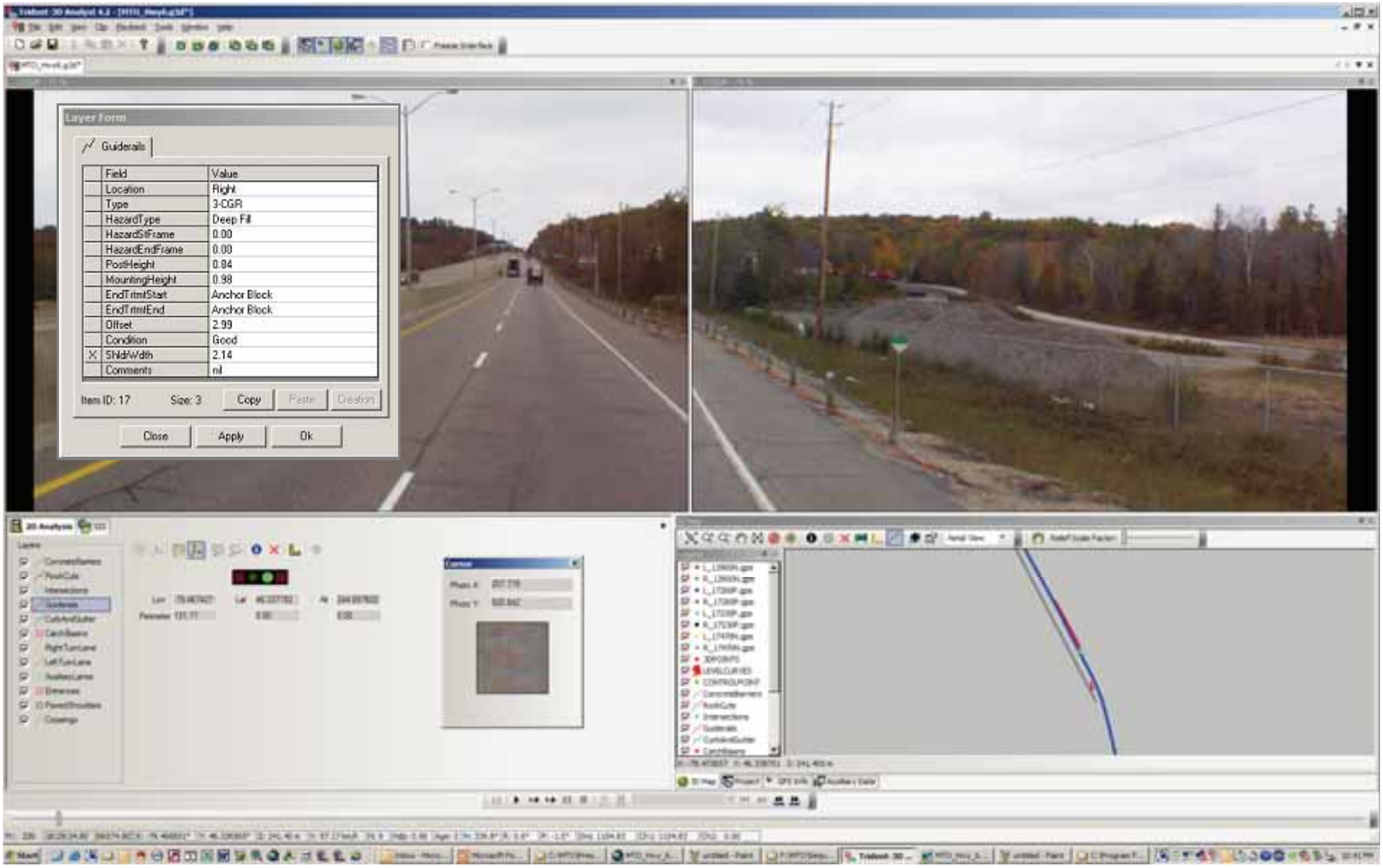
- Concrete Barriers
- Clear Zones (Rock Cuts)
- Intersections
- Paved Shoulders
- Guiderail
- Curb and Gutter
- Catch Basins
- Entrances
- Auxiliary Lanes
- Crossings
- Linear Passing Zones
- Lane Width Measurements

Asset Extraction
Definition

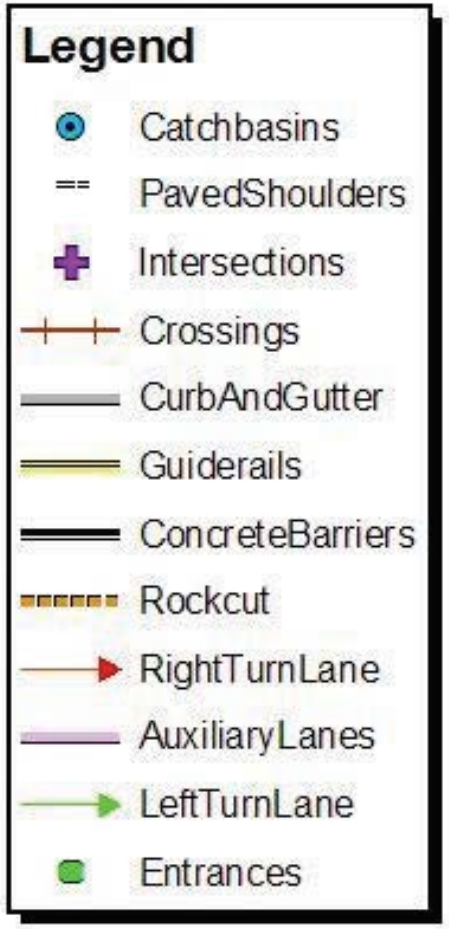
- Asset extraction is the exercise of collecting spatial and physical information of assets.
- The principle software used in the asset extraction process is Geo-3D's Trident 3-D Analyst software with the use of collected video and GPS coordinate information.

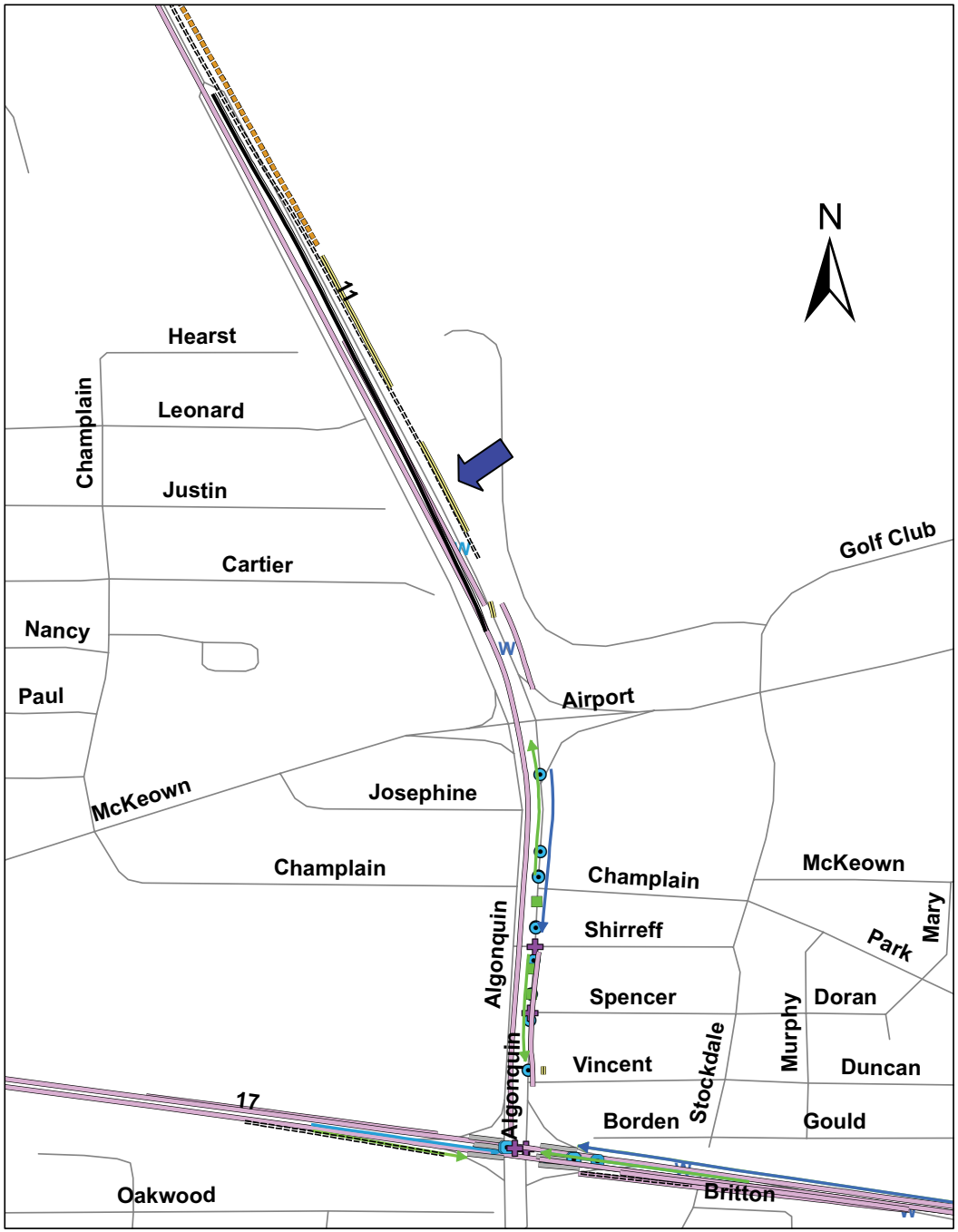
Let's look at an example…

Asset Extraction



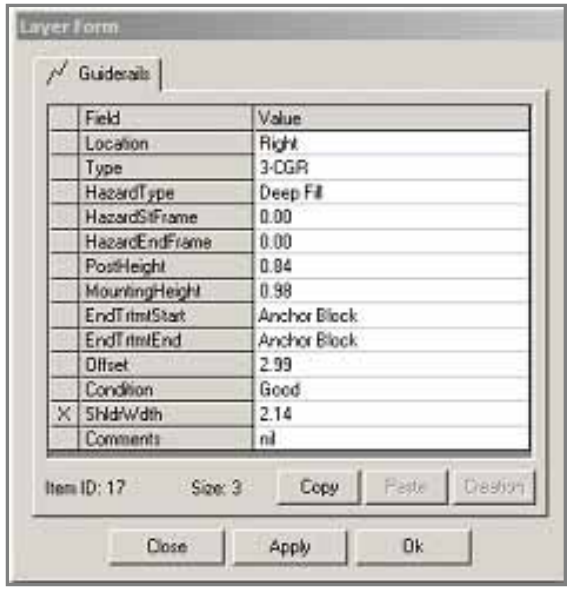
Asset Extraction
Example Results





Asset Extraction
Guiderail Attributes Extracted

- Guiderail type
- Location
- Condition
- End treatment type
- Hazard type
- Mounting and post heights
- Offset
- Shoulder width



Asset Extraction
Guiderail Types

Guiderail Ty

Guiderail Type: SB

Guide

Guiderail Type: Post Only

Asset Extraction
Guiderail End Treatments

Approach/L
Treatments

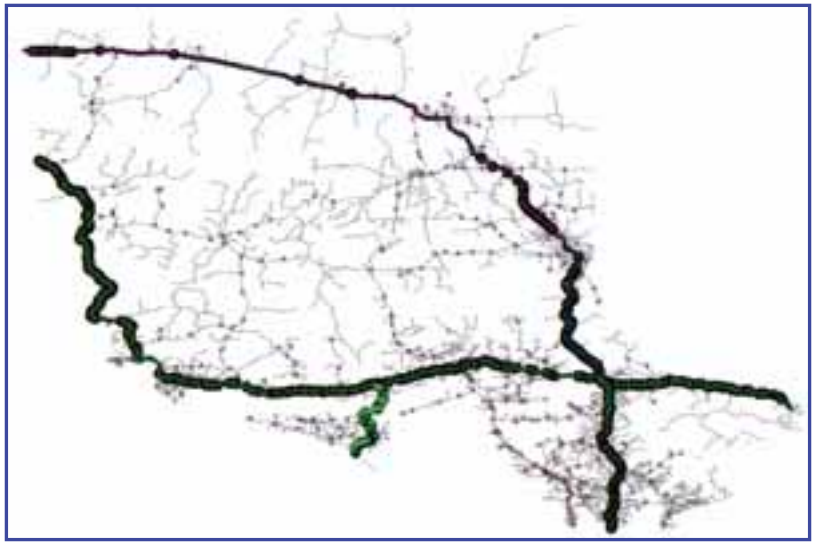
Approach
Treatments:

Approach/
Treatme
D

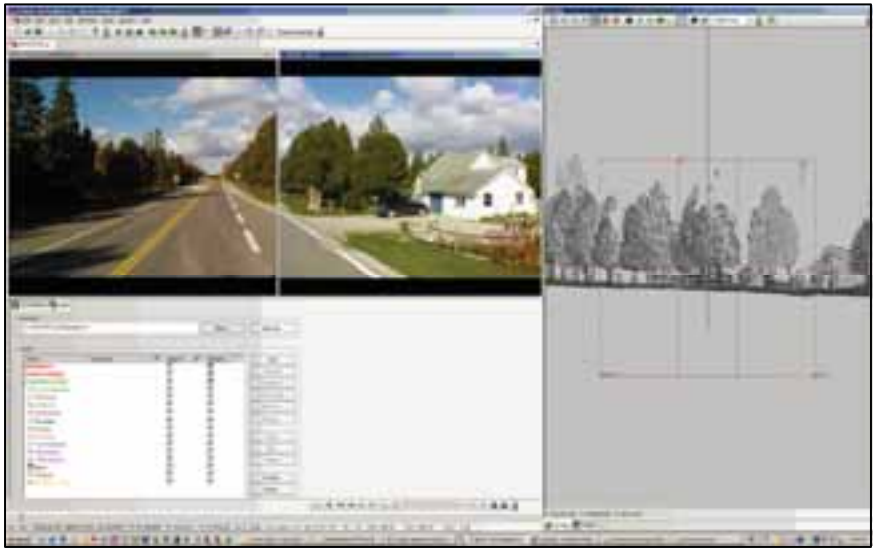
Approach/Leaving End
Treatments: Bridge

Data Collection
Results

High Resolution Video Data



LiDAR Data



Quality Assurance

- Each asset type is described in detail in the project Asset Extraction Manual.
- During the extraction process, any cases where the technician was uncertain about a particular asset or attribute encountered, a field called “Supervisor Check” was used and later reviewed by the supervisor.
- All extracted assets were verified for location and attribute accuracy via ESRI’s ArcMap.
- Any anomalies or questionable assets were verified and reviewed using Trident 3-D Analyst.

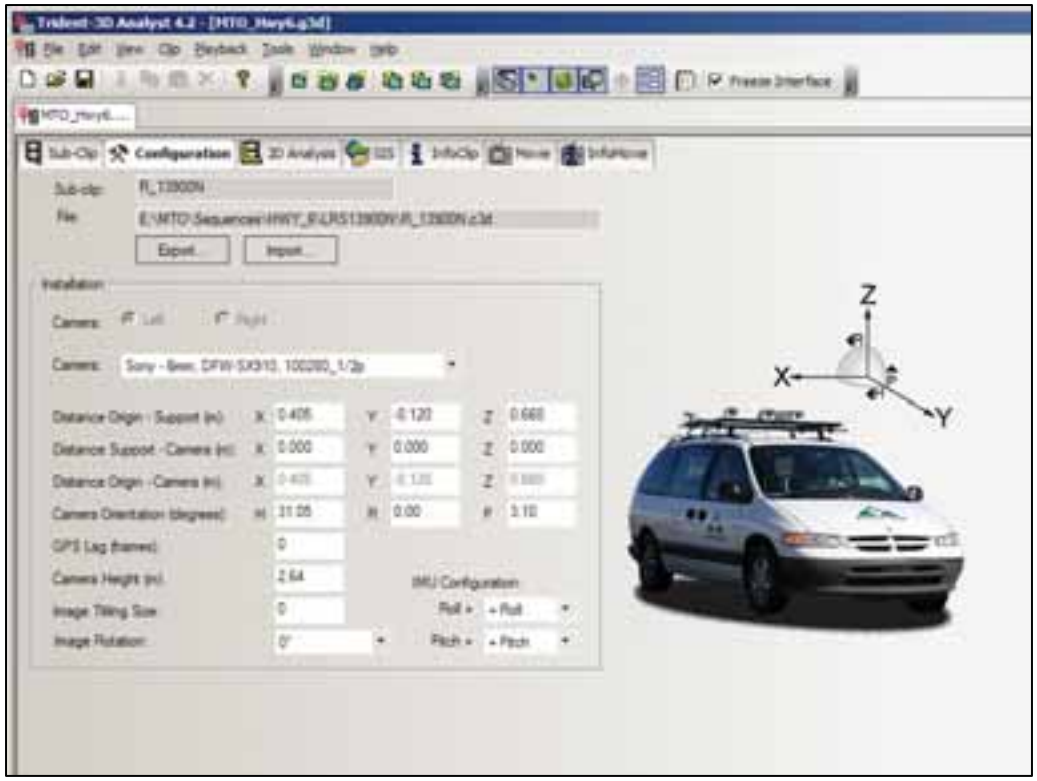
Quality Assurance

In addition to reviewing all Comments, the data was subjected to a series of logical queries in order to locate as many anomalous values as possible.

Some examples of logical queries are:

- Clear zone width > 15 m
- Guiderail mounting heights higher than post heights and post heights greater than 2 m height
- Missing data such as Location, Type, etc.
- A linear feature (e.g. Guiderail) with no defined end point

Asset Extraction
Video & GPS - Calibration



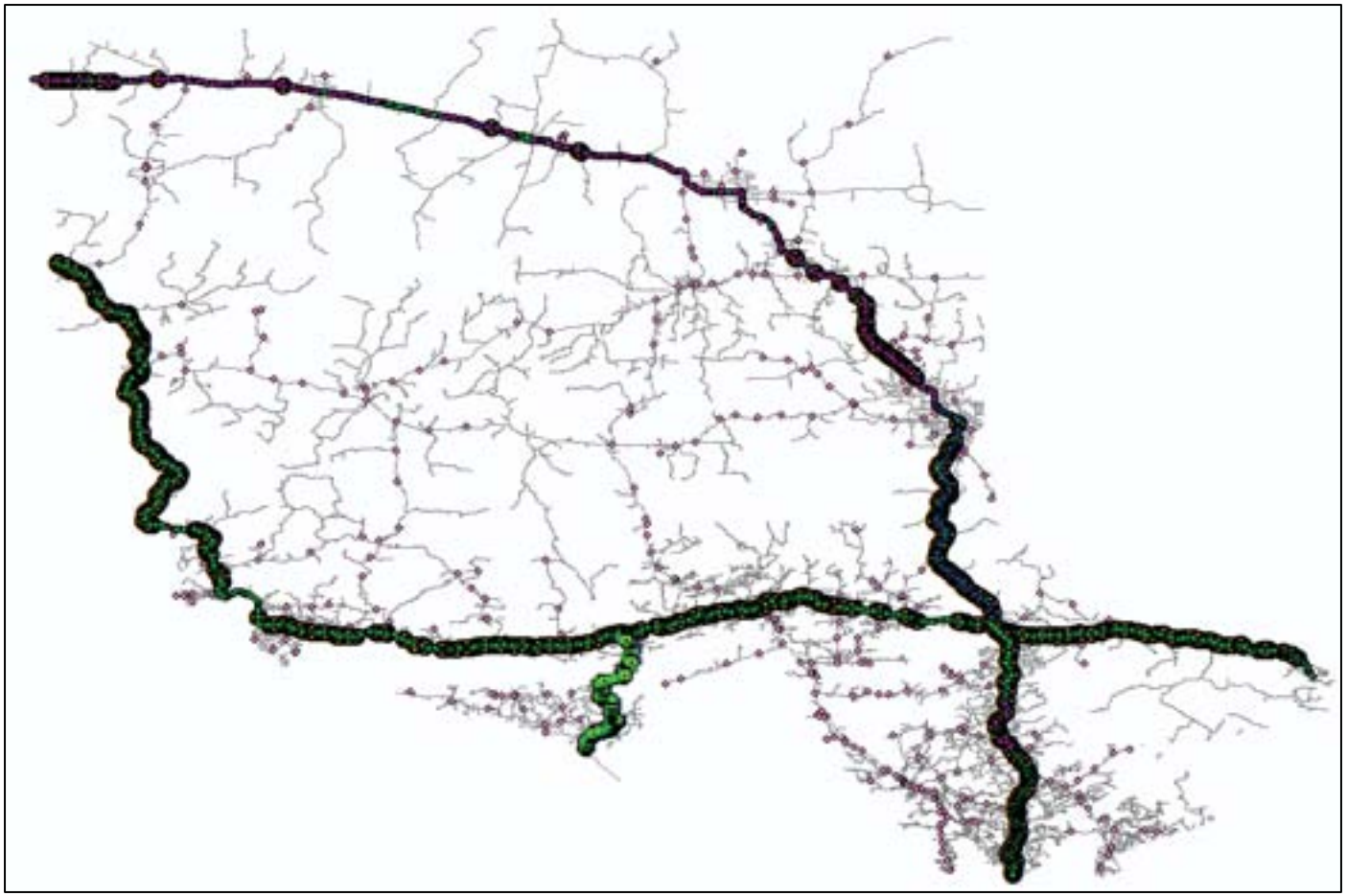
The technician loaded an associated camera calibration file for each video file so that the position of each camera relative to the location defined by the GPS unit could be calculated within the software.

Asset Extraction
Results

Highway 6
1,438 Assets

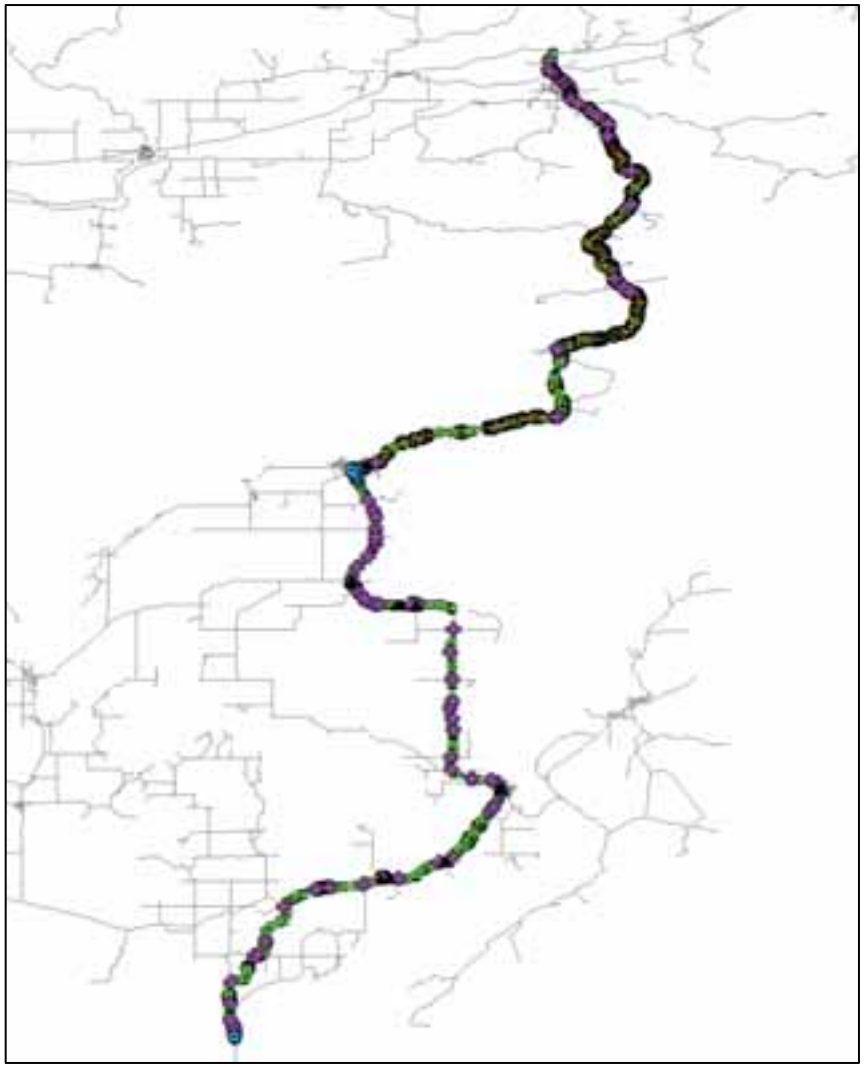
Highway 11
9,863 Assets

Highway 17
15,014 Assets



Asset Extraction
Results for Highway 6

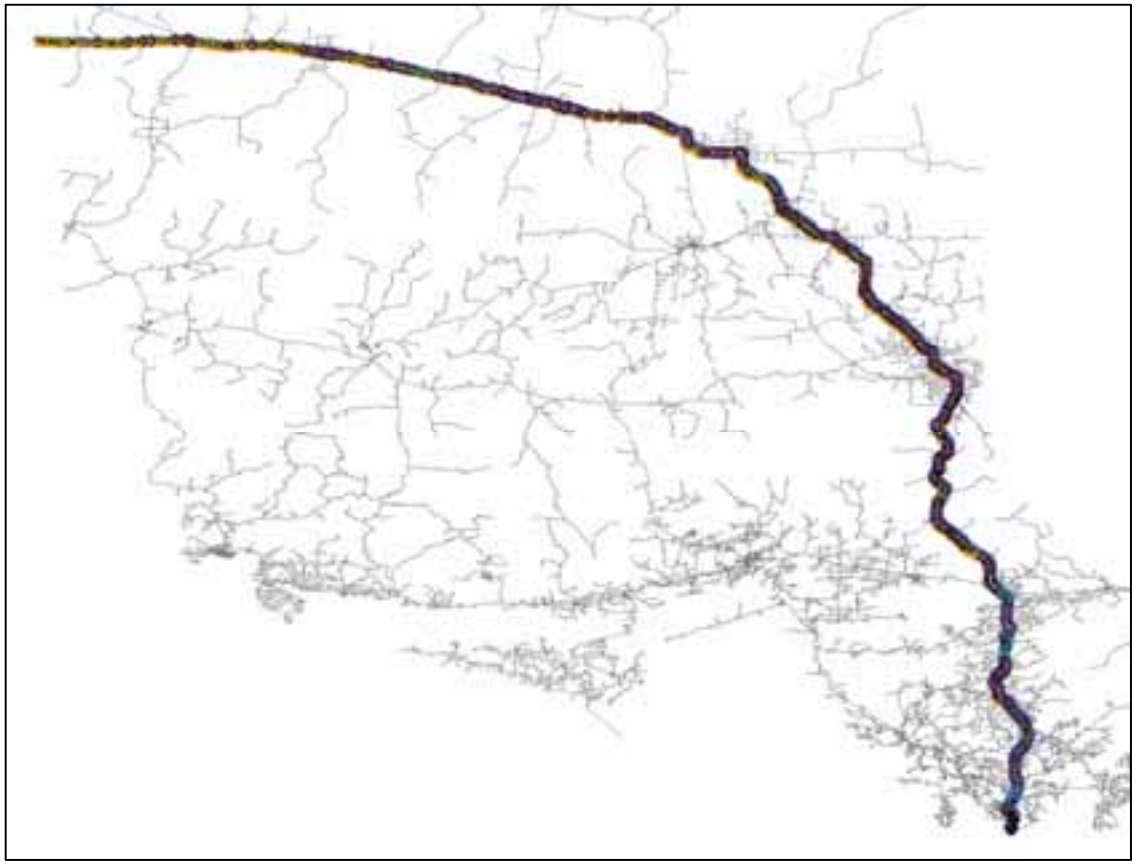
- 5 Concrete Barriers
- 224 Clear Zones (Rock Cuts)
- 127 Intersections
- 29 Paved Shoulders
- 140 Guiderail
- 76 Curb and Gutter
- 32 Catch Basins
- 455 Entrances
- 17 Auxiliary Lanes
- 4 Crossings
- 84 Linear Passing Zones
- 245 Lane Width Measurements



Asset Extraction

Results for Highway 11

157 Concrete Barriers
877 Clear Zones (Rock Cuts)
493 Intersections
229 Paved Shoulders
1,343 Guiderail
452 Curb and Gutter
303 Catch Basins
3160 Entrances
198 Auxiliary Lanes
11 Crossings
592 Linear Passing Zones
1,839 Lane Width Measurements



Asset Extraction
Results for Highway 17

137 Concrete Barriers

1,953 Clear Zones (Rock Cuts)

649 Intersections

655 Paved Shoulders

1,926 Guiderail

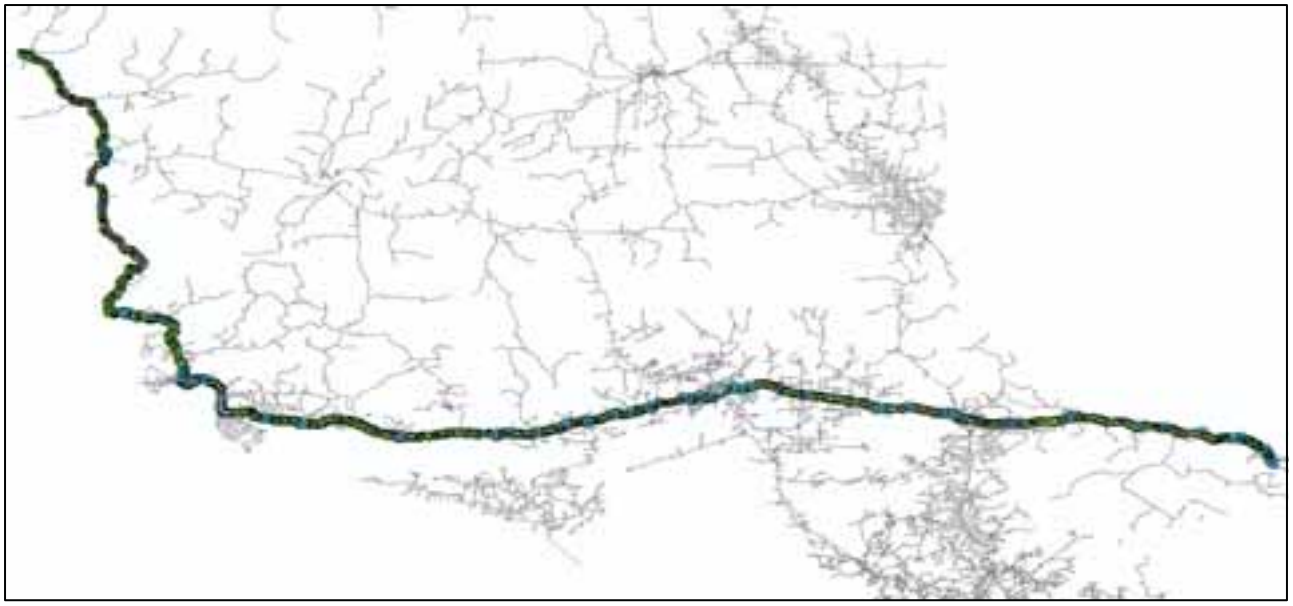
648 Curb and Gutter

720 Catch Basins

4,168 Entrances

281 Auxiliary Lanes

35 Crossings

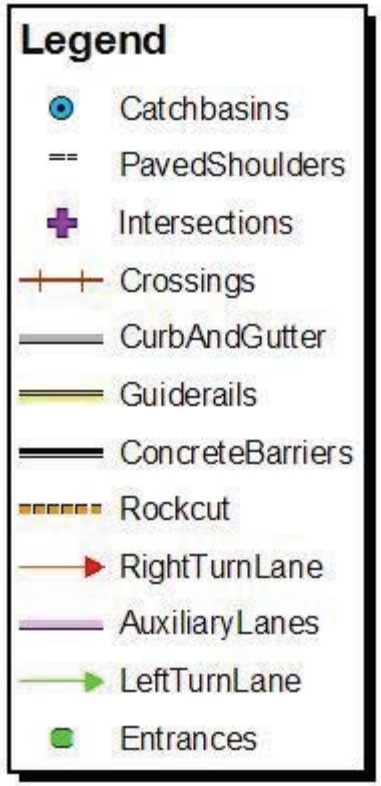


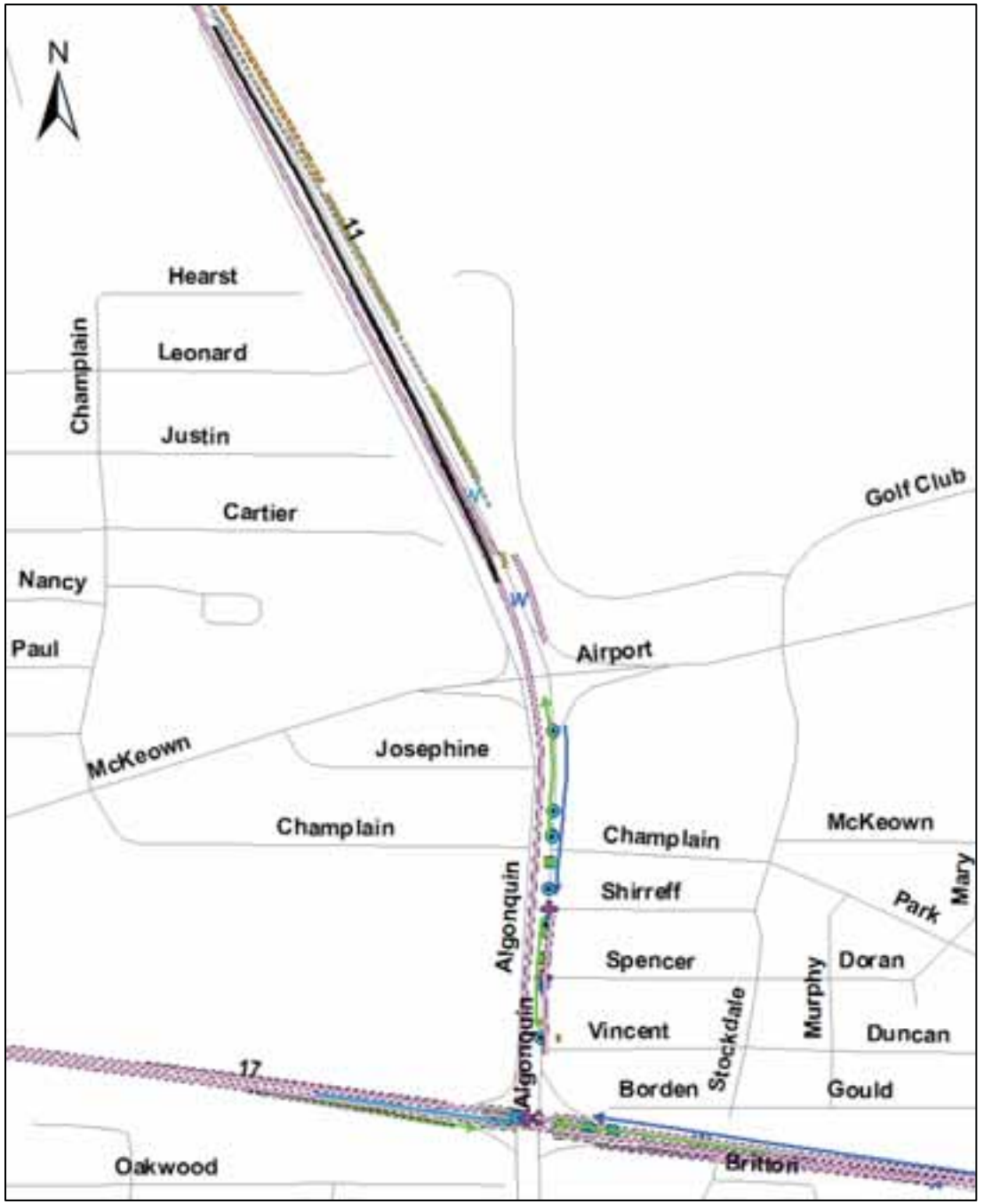
1,926 Linear Passing Zones

1,916 Lane Width Measurements

Asset Extraction
Results for

Highway 11





Data Extraction

The deliverable for the data model was GIS shape files for the following assets, ready for input into the model.

- Concrete Barriers
- Clear Zones (Rock Cuts)
- Intersections
- Paved Shoulders
- Guiderail
- Curb and Gutter
- Catch Basins
- Entrances
- Auxiliary Lanes
- Crossings
- Linear Passing Zones
- Lane Width Measurements

Data Extraction
Other Possible Assets

Other Assets that could be collected in the future:

- Signs
- Supports
- Luminaires
- Traffic Signals
- Pavement Markings
- Medians
- Bridges
- Drainage Features
- Some Pavement Condition
- Sidewalks & Ramps
- Lane Attributes

Data Extraction
Other Possible Uses for the Asset Data

- Analysis
- Spatial display and analysis of attributes
- Asset Management
- Engineering
- GIS
- Safety Studies
- Persons With Disabilities Compliance Investigations
- Emergency Response
- Legal
- Public Relations

Data Collection
Other Possible Uses for the Videolog Data

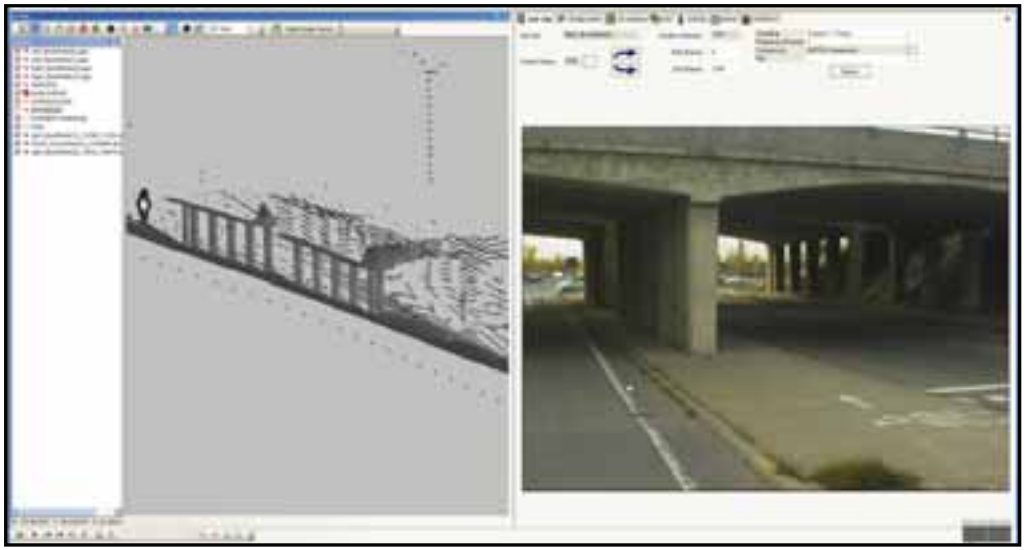
- Linking asset data and images can provide valuable tools to answer questions from customers, Council and management.
- Track customer complaints, service requests and work orders related to individual assets
- Ability to quickly view information regarding assets either visually or in report formats.
- Pavement or asset condition review from the office.
- Pre-plan a trip in the field by reviewing relevant videolog first.

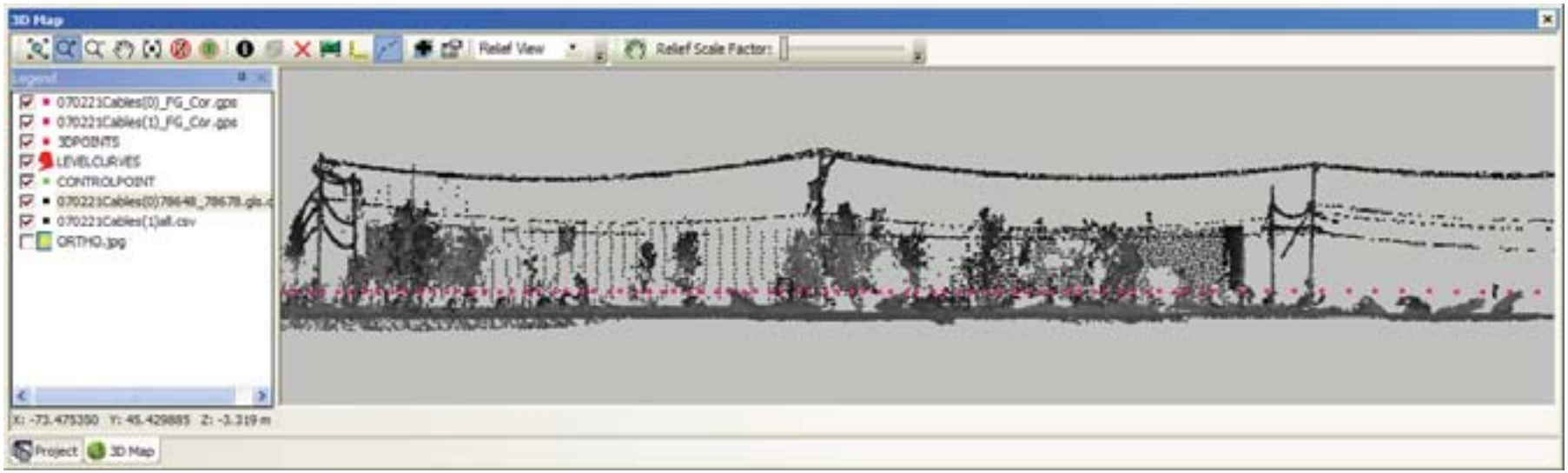
Data Extraction

Possible Measurements With LiDAR Data

Laser Point Clouds

- Pole Heights
- Bridge Clearances
- Sign heights
- Offsets





Data Extraction
Data Delivery

Once extracted, all assets were packaged and delivered for input into the data model…

The Data Model
What is “The Model”?

- Asset Inventory Database
- Geometric Inventory Database
- Asset and Geometric data from EXCEL spreadsheet Templates
- Develop lifecycle models
- Report asset lifecycle costs over 25-year planning period
- Report geometric deficiencies and recommended improvements
- Develop models to estimate preliminary costs for recommended geometric improvements

The Data Model
Purpose

The “Model” will provide a systematic, traceable, defensible, consistent, accountable methodology for decision making support.

- Prescribed / defined method for calculations
- Documented assumptions
- Outputs are reproducible

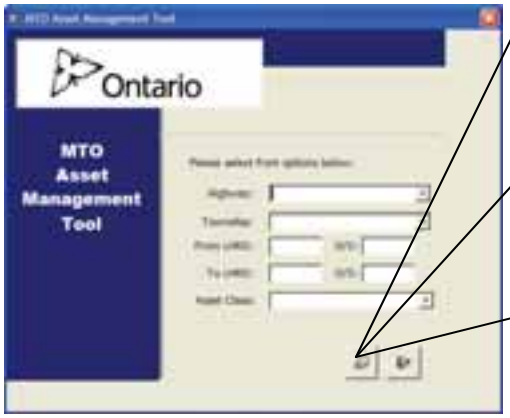
The Data Model
Purpose

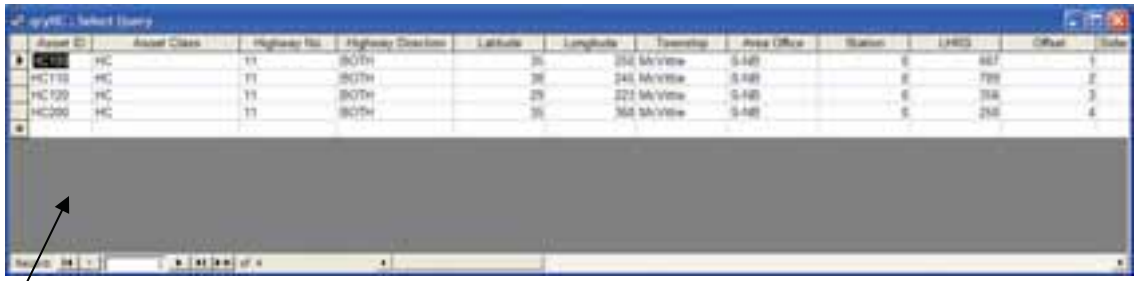
Benefits

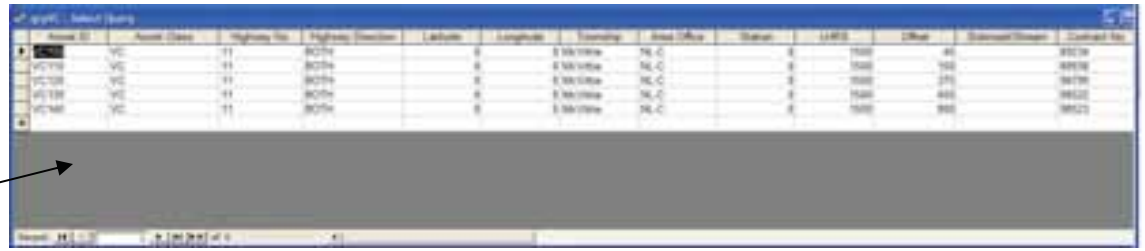
- Inventory of assets
- Help to improve cost estimation at the preliminary design stage
- Help to budget / plan for rehabilitation and replacement
- Ability to search by GPS, LHRS or township/station
- Link references (contracts, Project Appraisal Reports, Preliminary Design Reports, pictures, etc.)
- Output annual cost profile over a 25-year span, unconstrained (future assignment to determine constrained)

The Data Model
Highway Inventory

Asset Feature Sheets



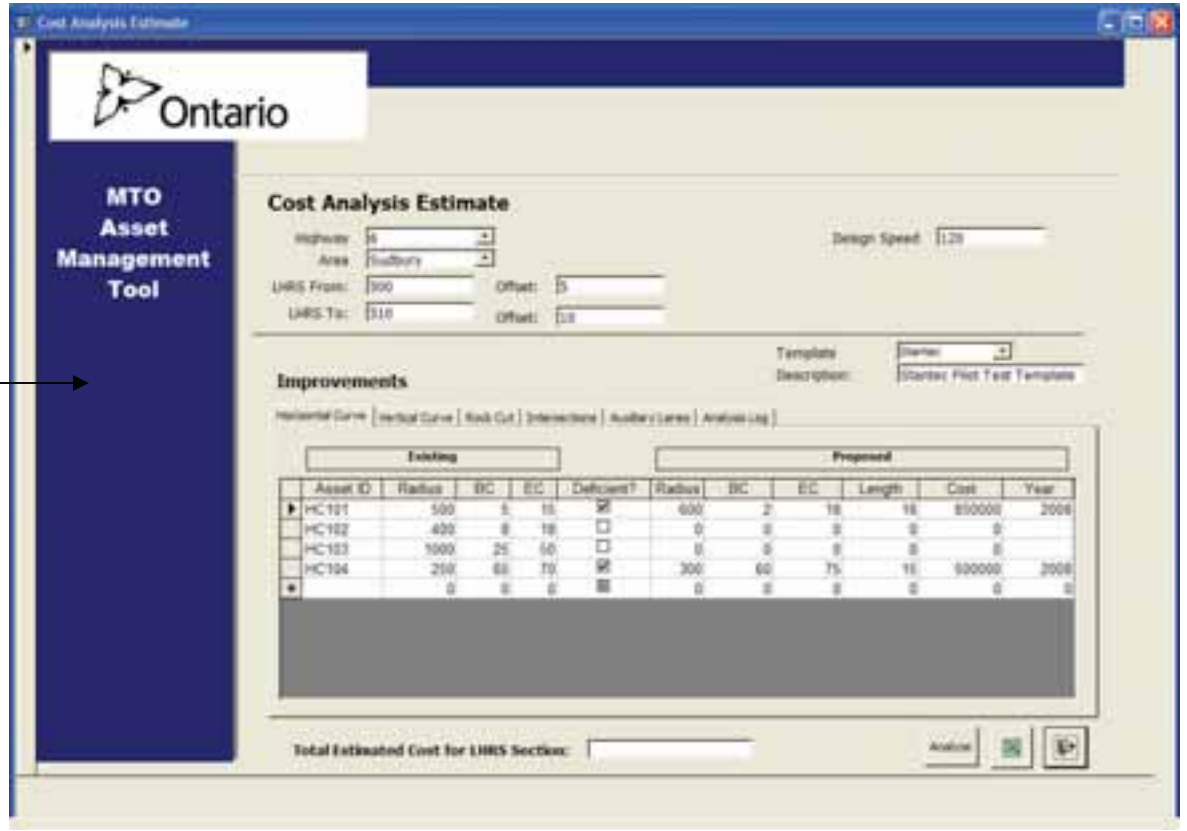




The Data Model
Analysis Methodology - Assets

Asset Search Form

Main Menu

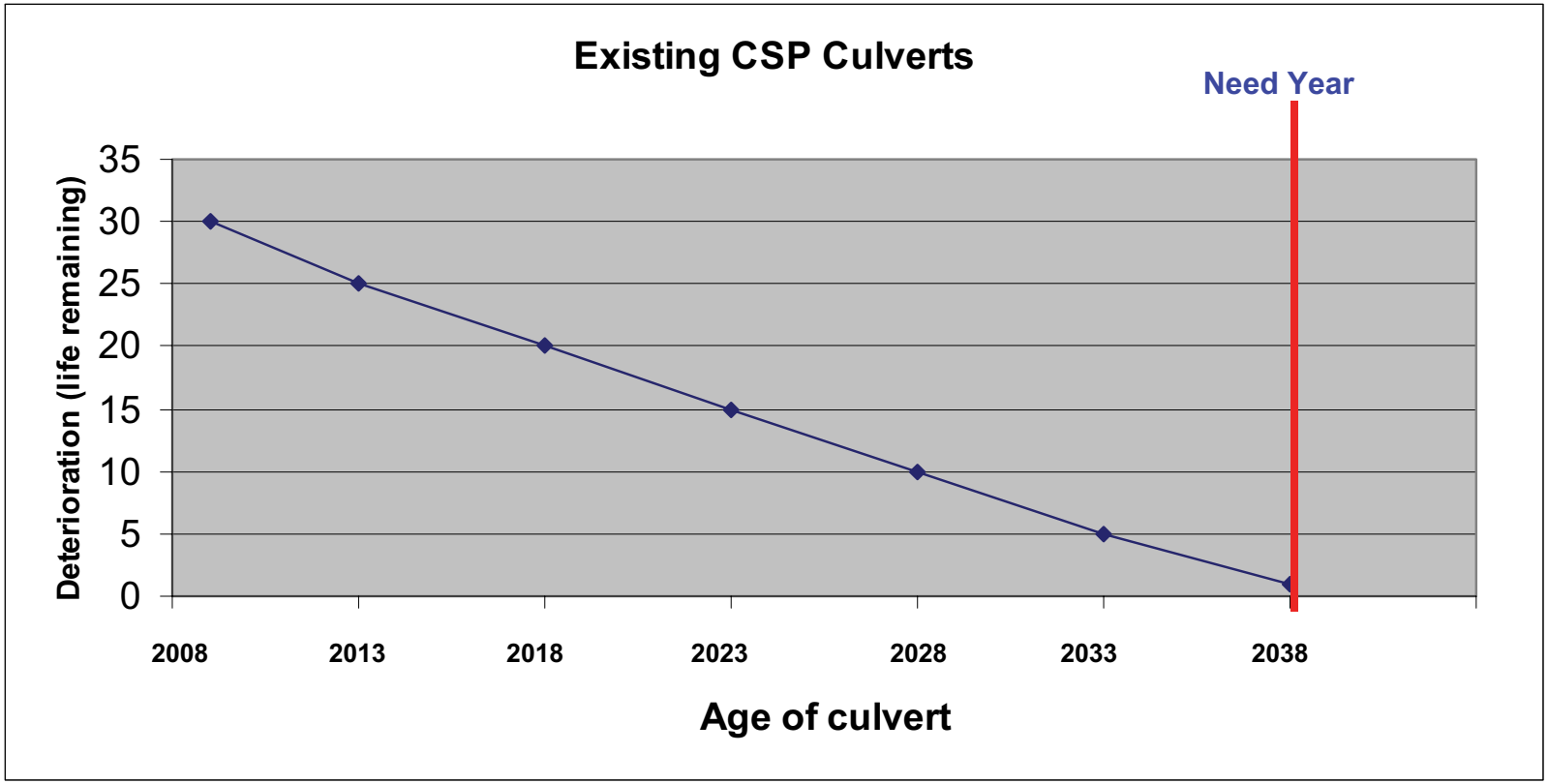


Asset Analysis Form

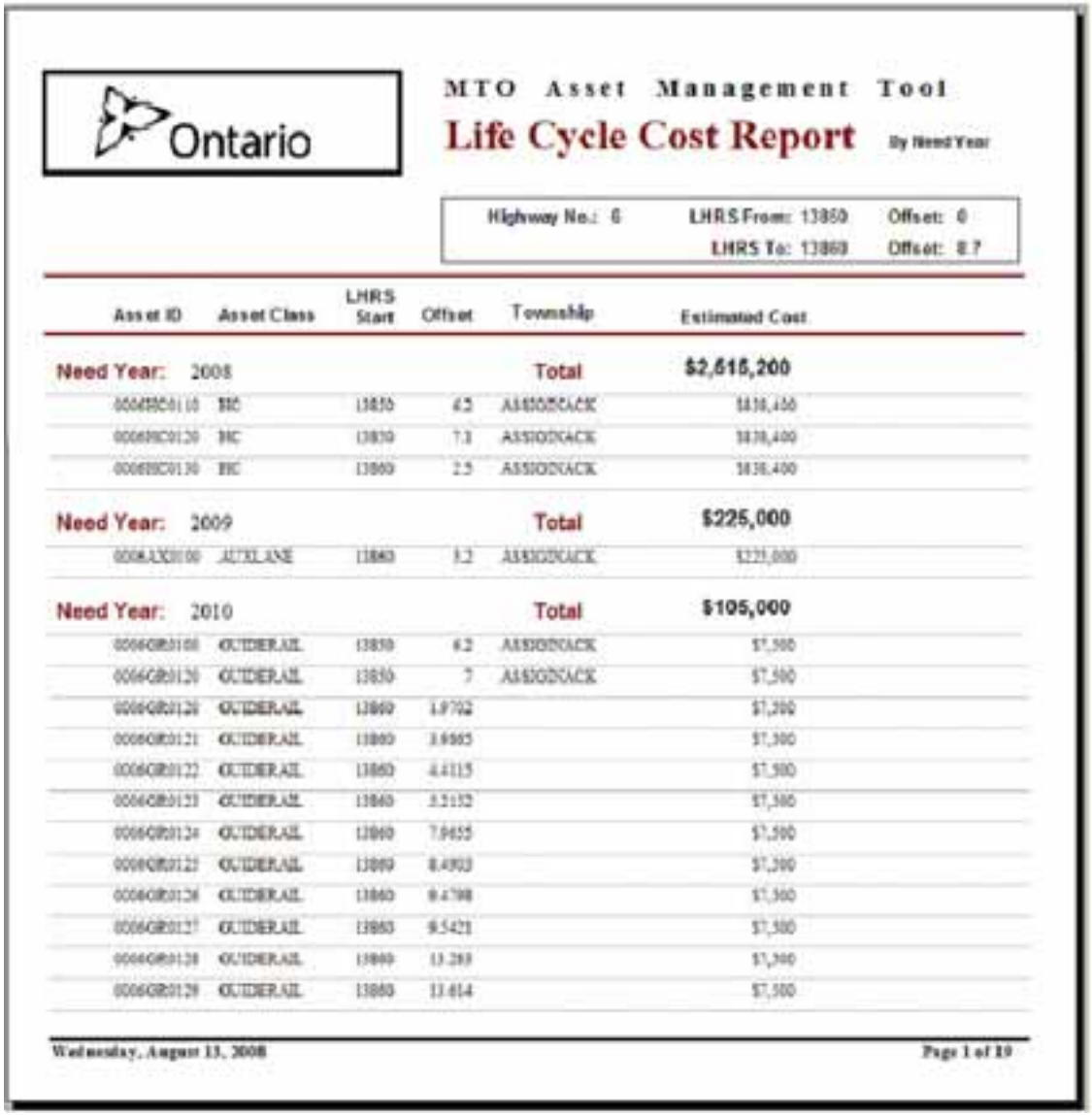
The Data Model
Analysis Methodology - Assets

Need Year – The year in which an asset is in "need" of treatment

Treatment – An intervention (i.e. replacement, repair, improvement or rehabilitation) to extend the life of an asset



The Data Model
Reporting



Ontario

MTO Asset Management Tool

Life Cycle Cost Report By Need Year

Highway No.: 6	LHRS From: 13850	Offset: 0
	LHRS To: 13869	Offset: 8.7

Asset ID	Asset Class	LHRS Start	Offset	Township	Estimated Cost
Need Year: 2008				**Total**	**$2,615,200**
0006BC0110	BC	13850	4.2	ASSIGINACK	$838,400
0006BC0120	BC	13850	7.3	ASSIGINACK	$838,400
0006BC0130	BC	13860	2.5	ASSIGINACK	$838,400
Need Year: 2009				**Total**	**$225,000**
0006AX0100	AUXLANE	13860	5.2	ASSIGINACK	$225,000
Need Year: 2010				**Total**	**$105,000**
0006GR0100	GUIDERAIL	13850	6.2	ASSIGINACK	$7,500
0006GR0120	GUIDERAIL	13850	7	ASSIGINACK	$7,500
0006GR0120	GUIDERAIL	13869	1.9792		$7,500
0006GR0121	GUIDERAIL	13860	3.9865		$7,500
0006GR0122	GUIDERAIL	13860	4.4115		$7,500
0006GR0123	GUIDERAIL	13860	5.5152		$7,500
0006GR0124	GUIDERAIL	13860	7.9655		$7,500
0006GR0125	GUIDERAIL	13869	8.4903		$7,500
0006GR0126	GUIDERAIL	13860	9.4798		$7,500
0006GR0127	GUIDERAIL	13860	9.5421		$7,500
0006GR0128	GUIDERAIL	13869	13.289		$7,500
0006GR0129	GUIDERAIL	13860	13.614		$7,500

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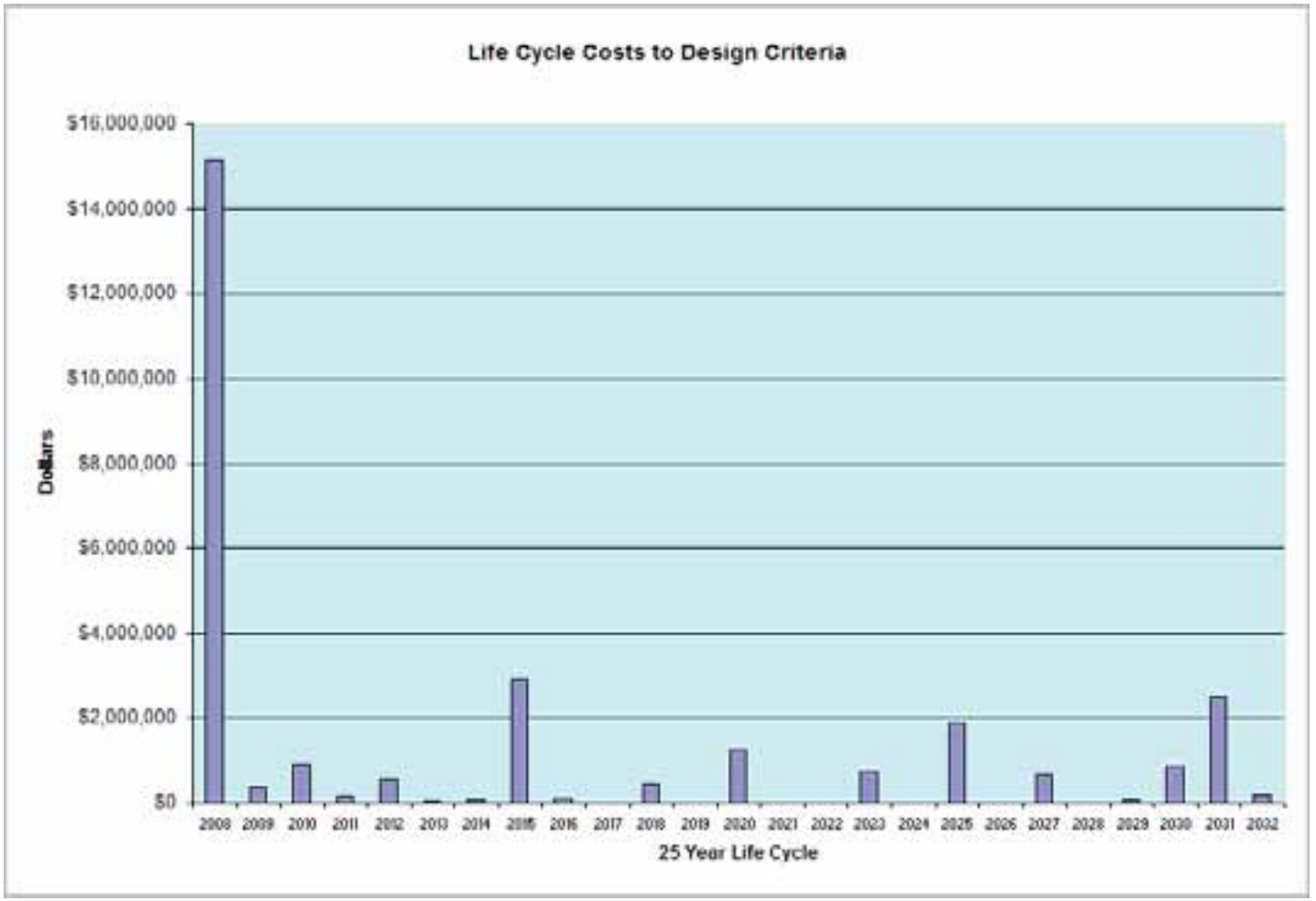
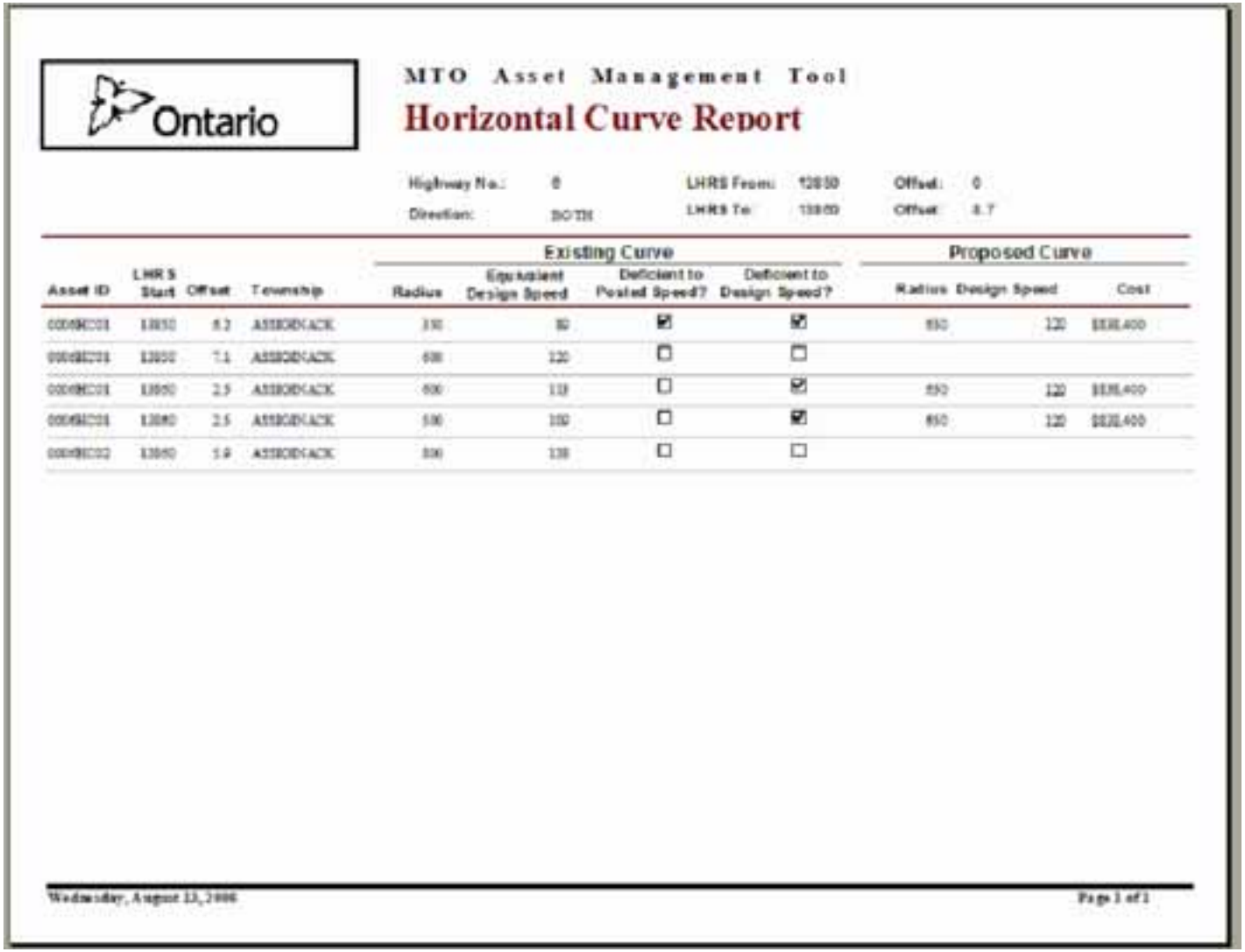
The Data Model
Reporting



The Data Model
Reporting



Ontario

MTO Asset Management Tool

Horizontal Curve Report

Highway No.: 0 LHRS From: 12850 Offset: 0

Direction: BOTH LHRS To: 13850 Offset: 8.7

				Existing Curve				Proposed Curve		
Asset ID	LHRS Start	Offset	Township	Radius	Equivalent Design Speed	Deficient to Posted Speed?	Deficient to Design Speed?	Radius	Design Speed	Cost
[illegible]	13850	8.2	ASSIGINACK	330	80	☑	☑	650	120	$[illegible]
[illegible]	13800	7.1	ASSIGINACK	600	120	☐	☐			
[illegible]	13650	2.5	ASSIGINACK	600	110	☐	☑	650	120	$[illegible]
[illegible]	13580	2.5	ASSIGINACK	500	100	☐	☑	650	120	$[illegible]
[illegible]	13650	5.9	ASSIGINACK	800	130	☐	☐			

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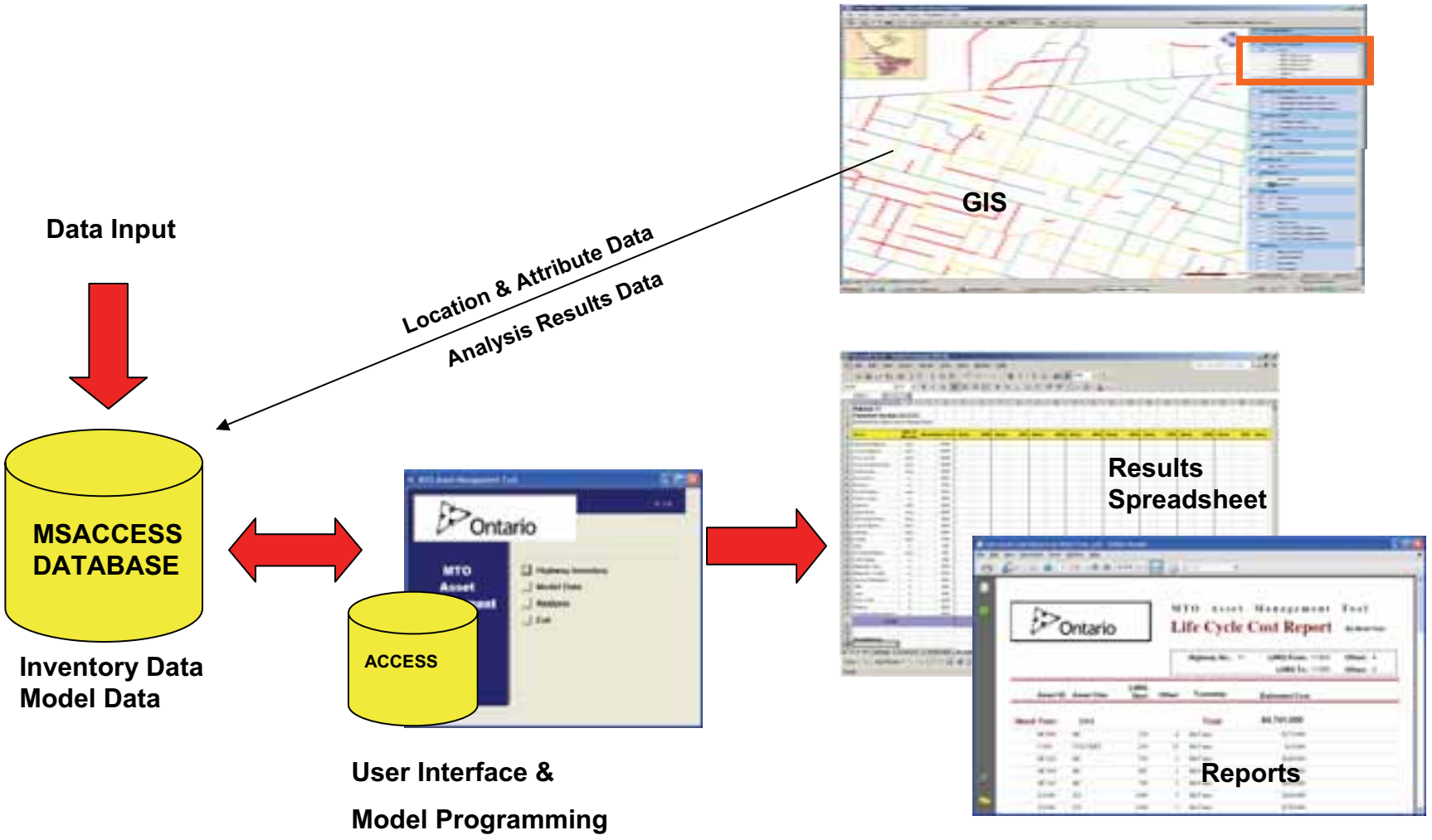
The Data Model
Model Framework



The Data Model

Model Work Flow – How Does It Work?

- Load Geometric and Asset Data
- Update / Maintain Geometric & Asset Data
- Configure the geometric deficiency models
- Configure the asset life cycle deterioration models
- Run analysis to calculate “Need Year” and estimated costs
- Reports – Geometric Deficiency
  Asset Lifecycle

The Data Model
Analysis Methodology - Geometrics

Geometrics – Geometrics are assessed against current Highway Design Standards. If the existing geometrics are found to be below design standards, the geometric is considered deficient and the "Need Year" is identified as the current year.

Horizontal Curves – If the existing radius is less than the minimum radius for the design speed of the highway.

Vertical Curves – If the existing K factor is less than the minimum K for the design speed of the highway.

Rock Cuts – If the existing clear zone offset is less than the minimum clear zone offset for the design speed of the highway.

The Data Model

Analysis Methodology - Geometrics

Knowledge Sharing

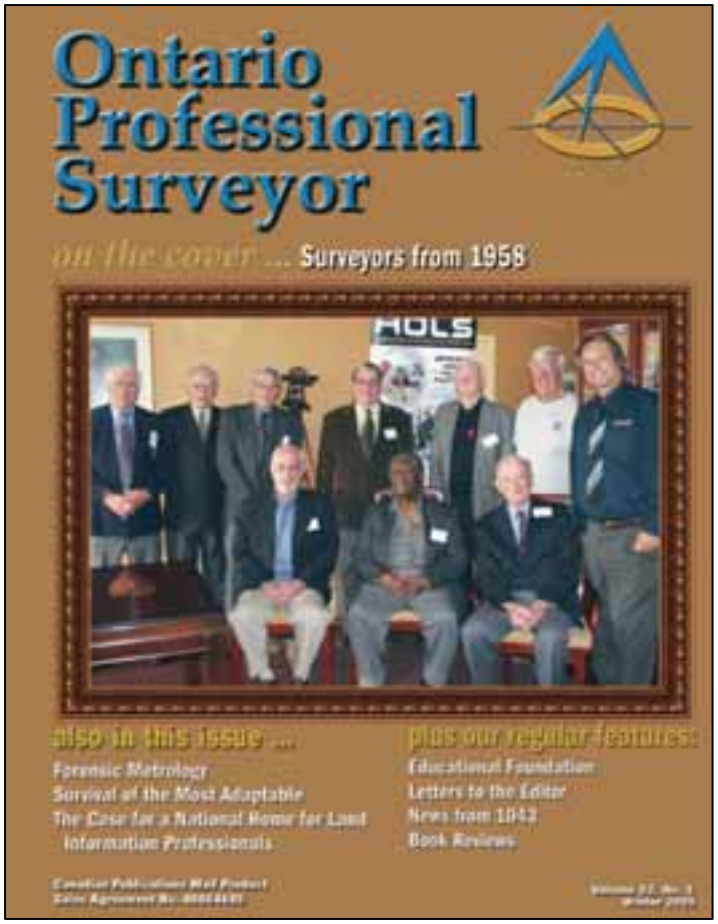
- Multiple users for same information (better relay of information – everyone sees the same thing)
- With improved history tracking we can make better decisions

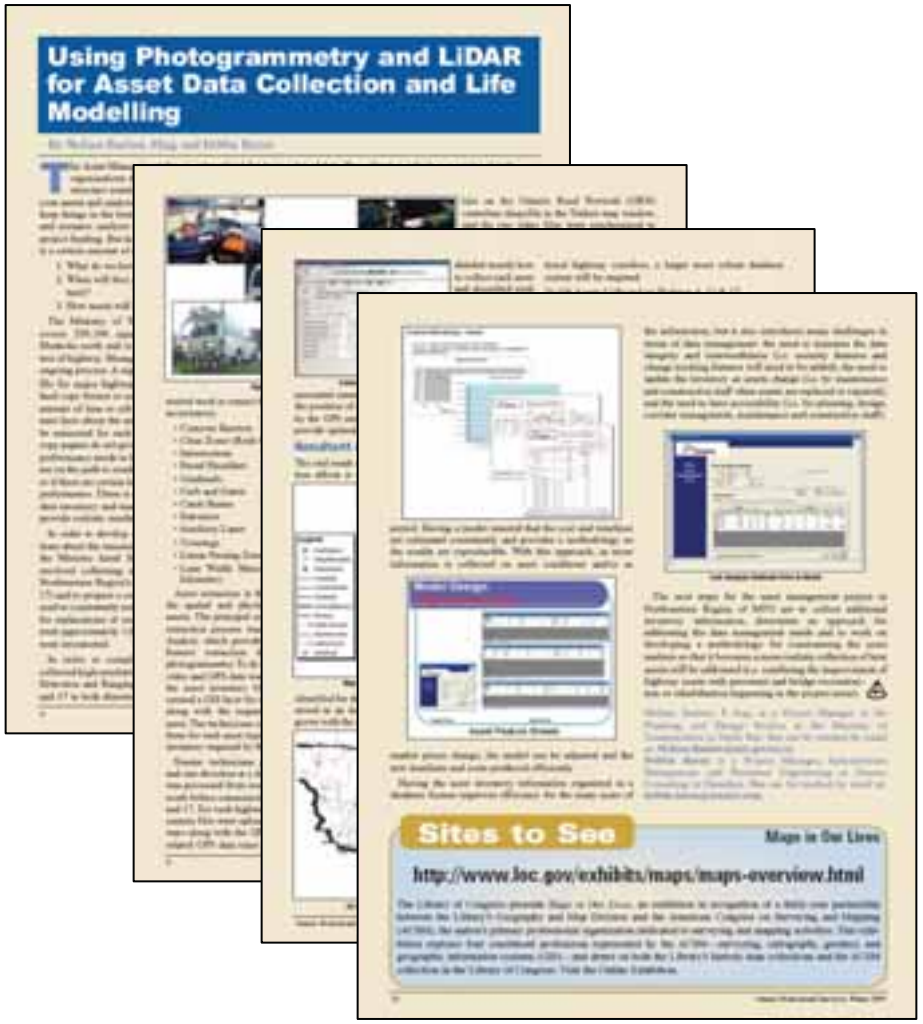
Efficiency and Cost Savings

- Use field trips are for verifying inventory rather than recollecting it (save on retyping time and searching time)
- Good opportunity to develop condition database to verify performance
- Develop more consistent and better estimates (improve case for funding)

Association of Ontario Professional Surveyors Magazine

Feature Article Winter 2009 Issue





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Thank You!