

## Bentley Descartes V8i (SELECTseries 5)

### Point Cloud Processing and Scalable Terrain Models

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# What is Bentley Descartes?

### Image Processing

- Raster Geo-Referencing
- Advanced raster transformation (warping, register)
- Raster Scene Creation (merge tool)
- Persistent coordinate system transformation
- Raster Mosaic Creation
- Image filtering (Contrast Stretch, Density slicing, etc)
- Viewing Oracle Spatial Georaster
- Viewing Raster DEM and applying filter on Raster DEM

### Hybrid Raster/Vector

- Binary Raster Editing (ala I/RAS B)
- Color Raster Editing
- Snap on raster content
- Raster to Vector conversion and Vector to Raster conversion
- Convert Raster Text to Vector Text

### 3D Modeling

- Advanced Texture Creation/Editing (e.g.: 3D building texture)

### Terrain Modeling

- Create Scalable Terrain Model (STM)
- Billions of points DTM
- Display Scalable Terrain Model
- High-Resolution Draping of imagery on STM
- Export to MicroStation Terrain
- Viewshed analysis
- RasterDEM export
- Contour export
- Drape Element

### Point Cloud Processing

- Enhanced presentation styles
- Classification Editing
- Line Draping
- Advanced Export
- Geometry Extraction
- Visual Explorer
- Smart Snap Mode
- Clip and section manager
- Coordinate system support
- 3D line following
- Model by Section
- Clash Detection with Point Cloud
- Pipe Run extraction
- Adjust Elbow

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point-cloud class management for any type of presentation style – This enables the flexible display of classes and decreases the need for data conversion, reducing the time required for classifying points.

new presentation styles that can be configured, saved, and managed – This enables quick switching from one display configuration to another, improving object recognition and reducing the time spent viewing, understanding, and manipulating point clouds.

the ability to expand beyond the 13 classes of the LAS file format by defining custom classes (e.g., classification methodologies used in the plant or building industries) – This enriches the point-cloud data, increasing its value.

the ability to create and easily manage clips and sections (e.g., toggle on/off clips or sections) – This makes point-cloud manipulation and review easier, especially when extracting geometries, and shortens the time needed to configure views and analyze point-cloud data, particularly in geometry extraction workflows.

support for geographic coordinate systems – This enables users to integrate point-cloud models from different coordinate systems. These capabilities help enhance the overall project point-cloud model, improving the quality of point clouds and ultimately increasing the return on investment in point-cloud data, even if the data is from different geographic coordinate systems.

the ability to extract linear features with a new set of tools, such as model by section and 3D line following, which are suitable for myriad feature types, from road centerlines to tunnels or rails. This makes the extraction of linear features

geometries and the quality control process more efficient and increases the value users get from point clouds.

## What's new in V8i (SELECTseries 5)

- Point Cloud Processing
  - Clash Detection with Point Cloud
  - Piping tools
    - Extract Pipers
    - Extract Cylinder by a single click
    - Elbow creation
    - Adjust Elbow
- Scalable Terrain Model
  - RasterDEM export
  - Drape Element
  - Contour export



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## Why you need Descartes for Point Cloud

- Need to leverage point cloud data on engineering projects
- Need to fix point cloud classification mistakes and to clean-up point clouds
- Need efficient tools to extract features from point clouds
- Assess design against point clouds
- Difficulty understanding very dense point clouds
- Need to produce point cloud deliverables

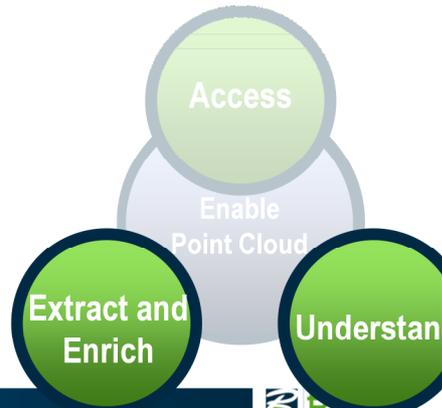


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# Bentley Descartes - Point Cloud Processing

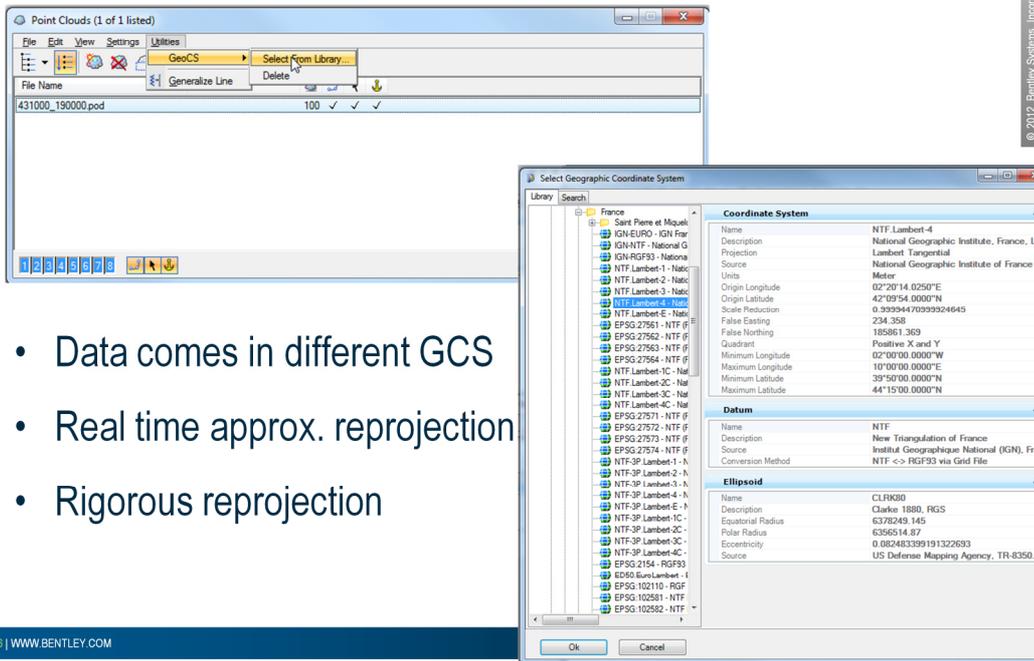
- Geo-coordination
- Enhanced presentation styles
- Clip Manager
- Section Manager
- Classification Editing
- Visual Explorer
- Smart Snap Mode
- Line Draping
- Snap Elements
- **Cylinders, Pipes & Elbow**
- Planes Extraction
- Automatic 3D line following
- Model by Section
- **Clash Detection**
- Advanced Export



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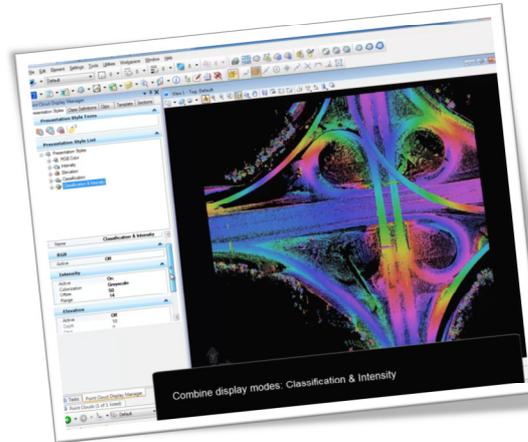
# Geocoordination



- Data comes in different GCS
- Real time approx. reprojection
- Rigorous reprojection

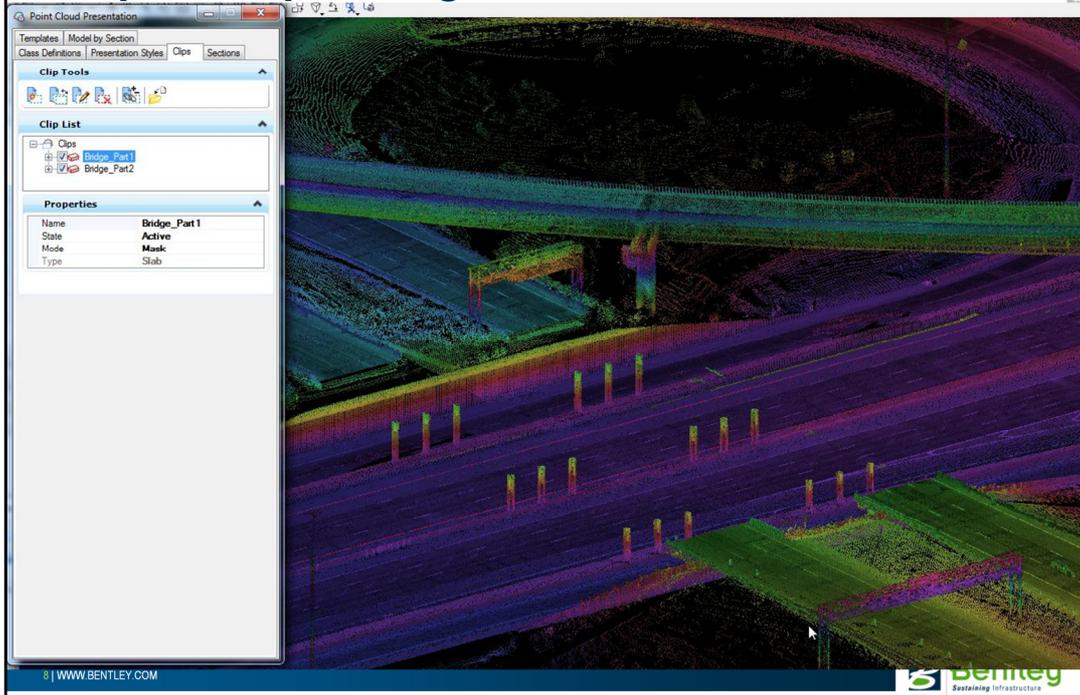
## Presentation Style Manager

- Presentation styles allow the combination of several modes
  - Intensity & Elevation
  - Intensity and Classification....
- Custom classes can be created
- Point-cloud class management is now available for any type of display style. User can toggle on/off classes with all display modes
- New display styles can be configured, saved and exchanged in a Style Manager



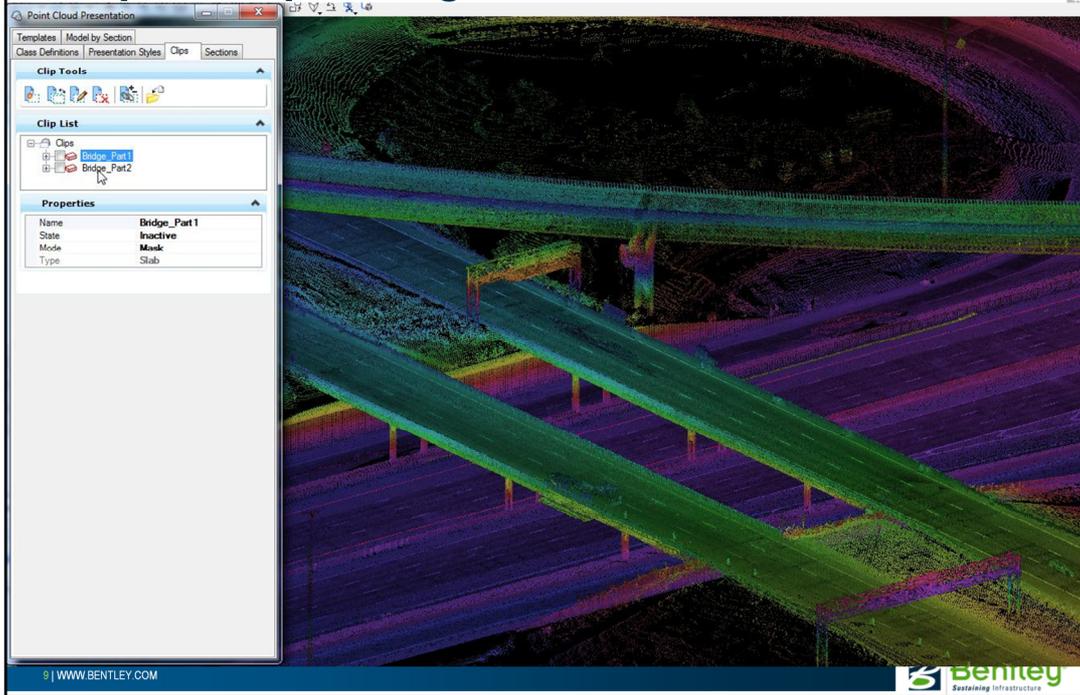
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# Clips & Clip Manager



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# Clips & Clip Manager



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## Clips & Clip Manager – Benefits?

- Easier to create clips with new methods

**Time  
saved!**

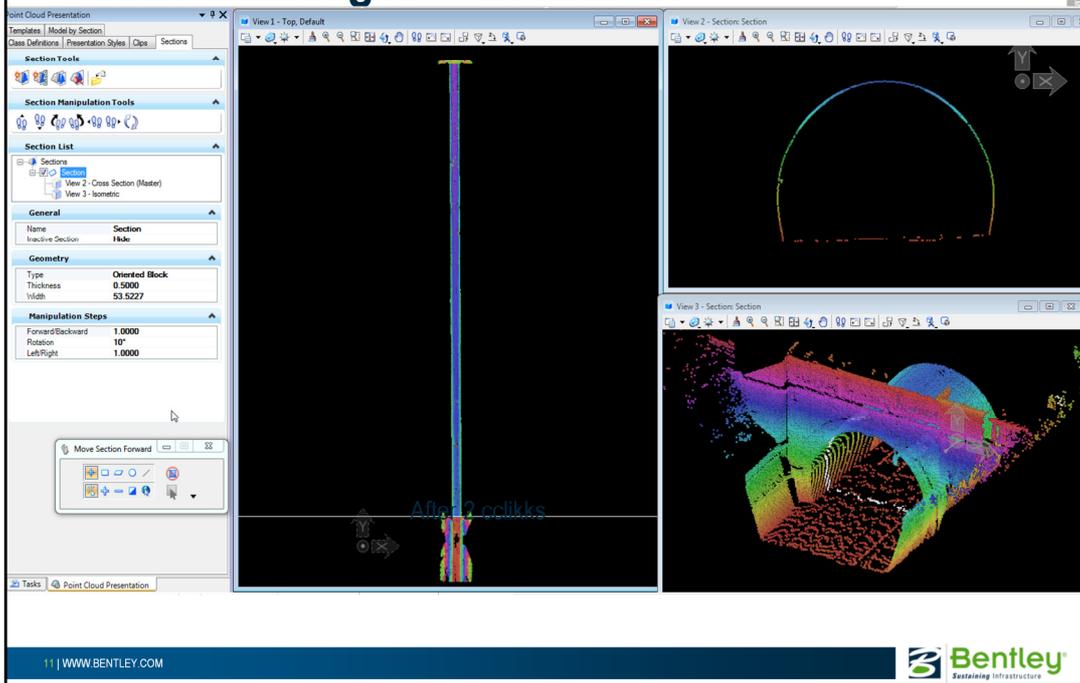
- Clips can be edited. No need to delete and redo

**Time  
saved!**

- Clips can be saved, enabled, disabled exchanged etc...

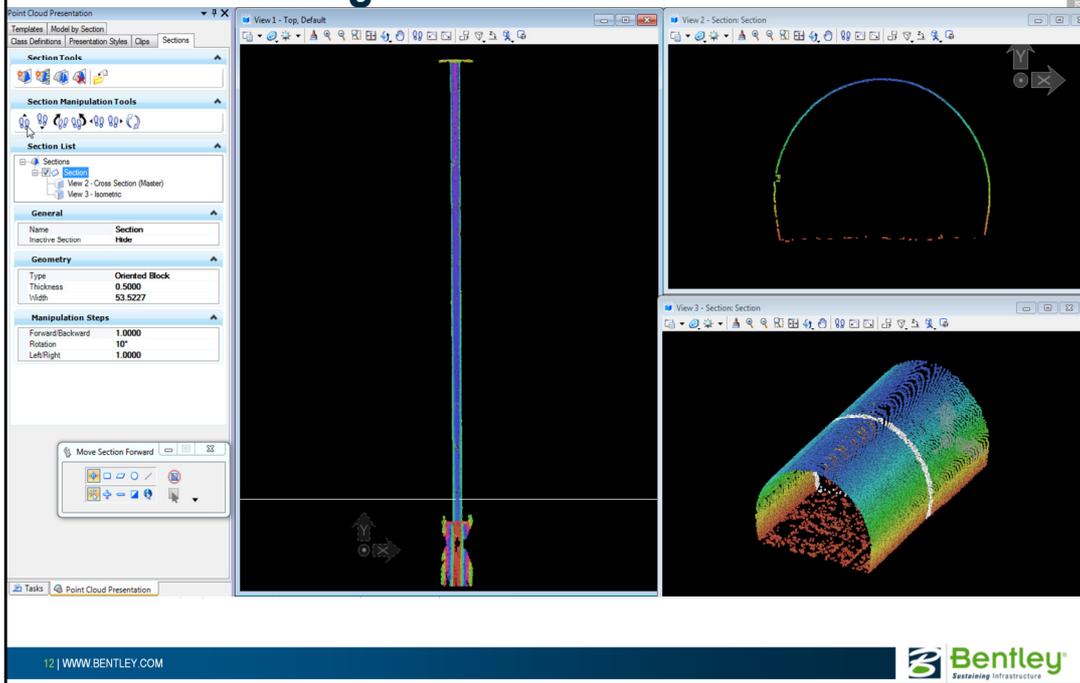
**Time  
saved!**

# Section Manager – What is it?



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# Section Manager – What is it?



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## Section & Section Manager

- Extremely fast way to slice point cloud per view
- 3D Made easy: section concept allows straightforward digitizing in section planes
- Section are easy to manipulate: move, rotate etc...
- Views automatically synchronized

**Time  
saved!**

## Classification Editing

- Fix classification errors
- Eliminate point cloud noise
- Enables hybrid/retrofitting workflows



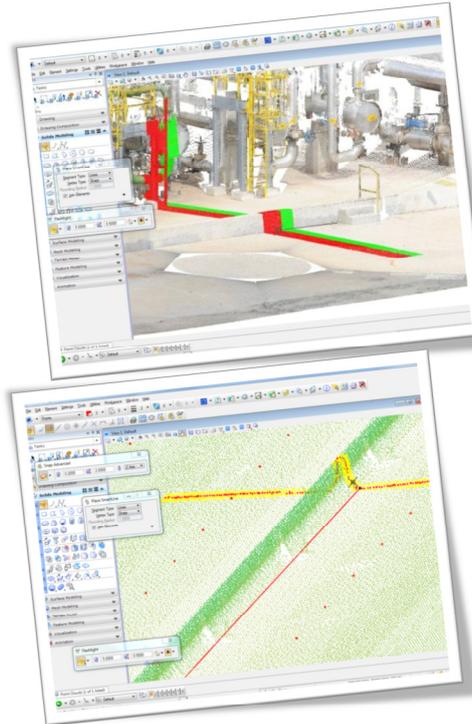
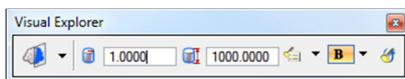
Automated classification software often introduces errors in point cloud classification

Benefits:

- Save time and money by empowering users to fix simple mistakes not detected by automated process
- Improve point cloud data quality by improving the classification thereby adding value to existing data
- Improve downstream processing of point clouds with accurately classified data
- Facilitate hybrid workflows combining point cloud and vector based data

## Visual Explorer

- Patent pending technology
- Visual helper dynamically re-coloring points in the cursor neighborhood
- Simplifies understanding of complex point clouds



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### Benefits:

Enable better understanding of a 3D scene

Provides a dynamic cross section capability

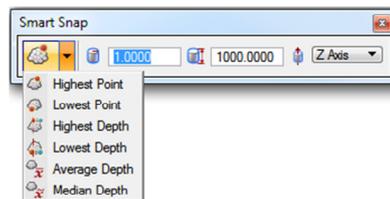
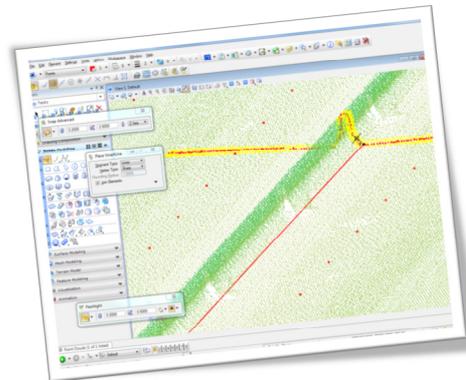
Enable simpler QA/QC of the point cloud data

Enable better navigation of a 3D scene

Provides faster and more accurate digitizing especially when combined with Advanced Snap

## Smart Snap

- Fully integrated with MicroStation AccuSnap
- Pick key points such as the lowest, highest, average or median point
- Simplifies modeling with point clouds



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Benefits:

It enables:

Fast semi-automatic break line extraction

Simple feedback on the particular point the tools are snapped on in the point cloud

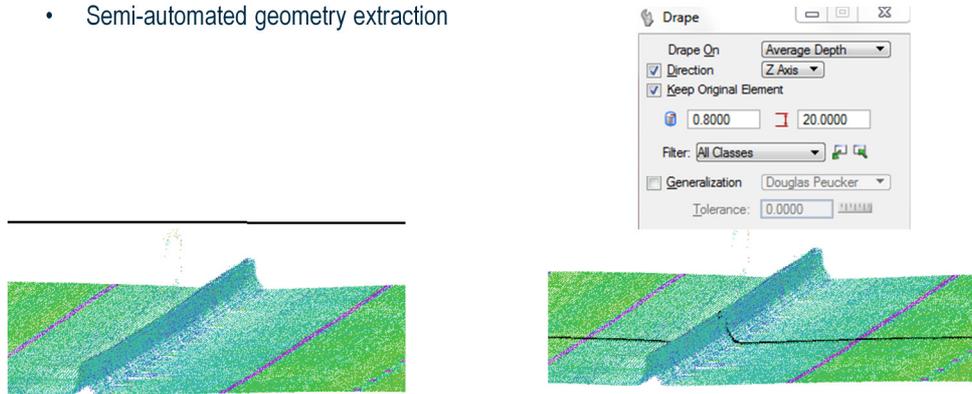
Easier distance measurement

Faster digitizing by reducing the number of view rotations while working

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## Draping

- Automatically drape lines on a point cloud surface
- Convert line approximation exact lines following the point cloud surface.
- Semi-automated geometry extraction



*Data courtesy of HNTB*

The Drape Element tool projects linear elements onto the point cloud in the direction specified in the Tool Settings.

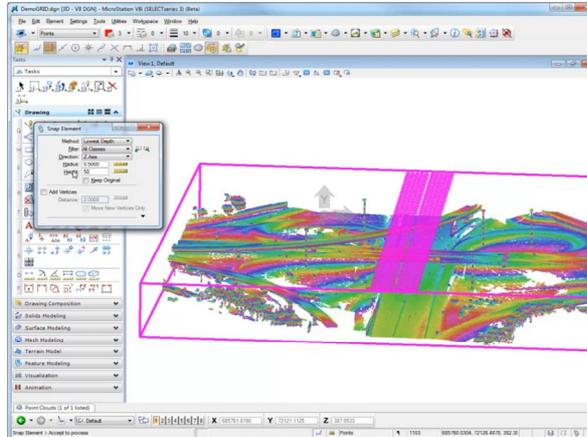
This allows users to draw a vector line that approximates the feature and then drape it to exactly follow the point cloud. It will add as many new vertices as required in order to follow the point cloud.

Draping elements can be used for semi-automated geometry extraction from point clouds, for example for getting road profiles, transmission line cables etc.

Let's see this in action.

# Snapping

- Automatically snap line vertices or points
- Convert line approximation into lines following the point cloud surface exactly
- Convert random points into points exactly on the point cloud surface



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## Benefits:

Enable semi-automated geometry extraction from point cloud

For example

Road profiles

Transmission line cables

Etc.

Enable analysis of the extracted vector data using any MicroStation based tools

Create better terrain models by supporting the creation of break lines

## Geometry Extraction

- Extract primitives from point cloud
  - Planes
  - Cylinder
  - Cylinder center line
- Based on a point cloud subset selection
- Produce vector models from point cloud



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### Benefits:

Help creation of as-built drawing based on scanned data

Enables downstream analysis (clash detection)

Provide based geometry for further downstream intelligent infrastructure modeling

## 3D Line Following – What is it?

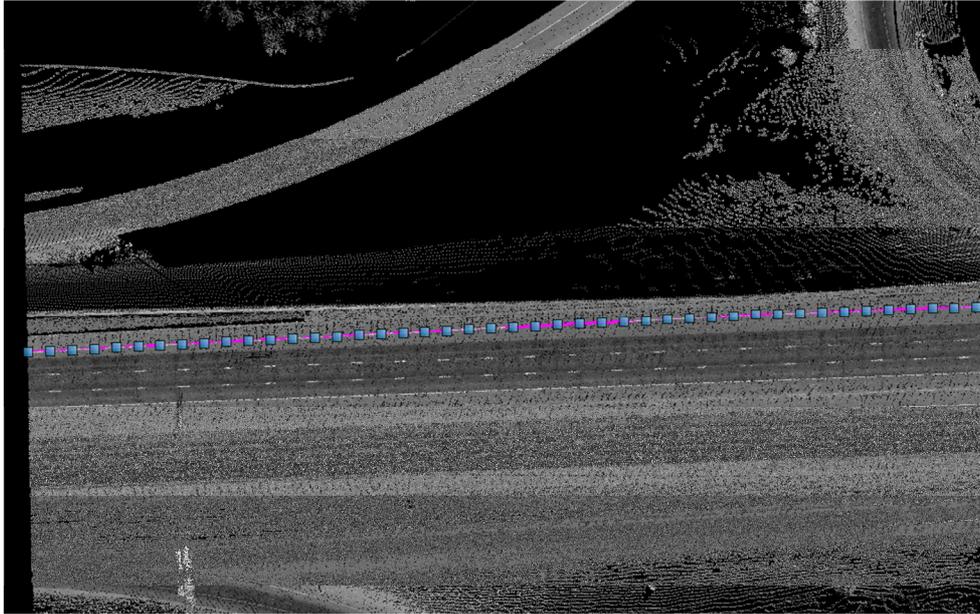


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## 3D Line Following – What is it?



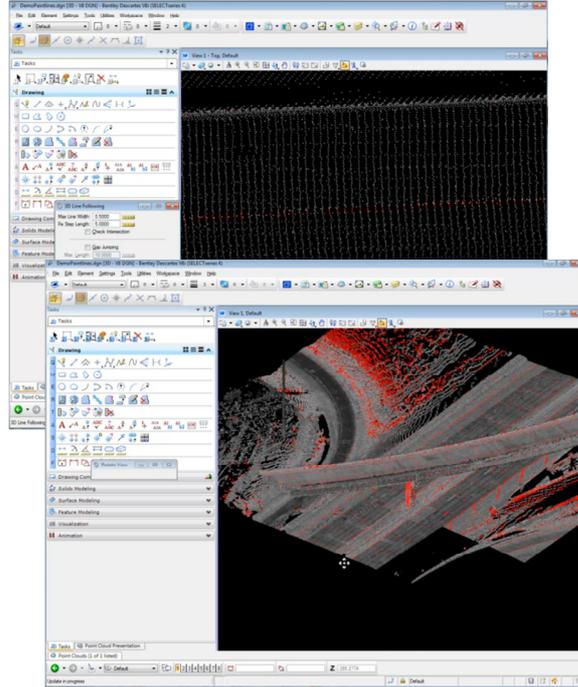
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## 3D Line Following

- Semi-automatic tool for line following
  - Road paint line
  - Transmission lines
  - Rail lines
- Define intensity to be used by tool to follow lines
- Works with curved and broken lines

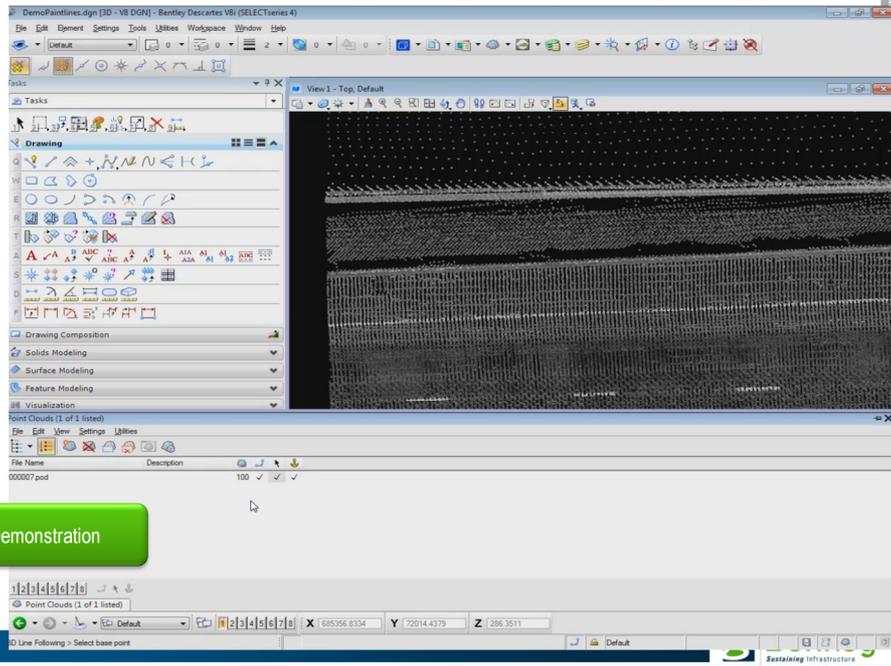


## 3D Line Following

- High Degree of Automation
- Real time quality control
- Applies to other 3D lines: transmission, rail

**Time  
saved!**

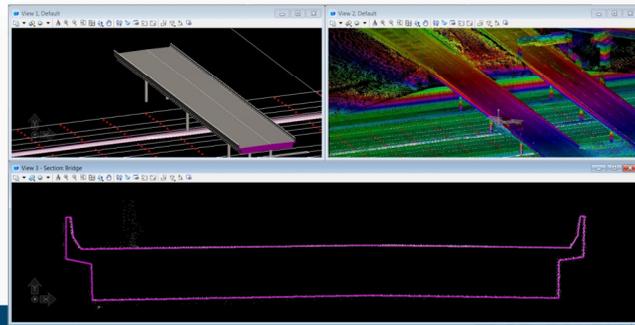
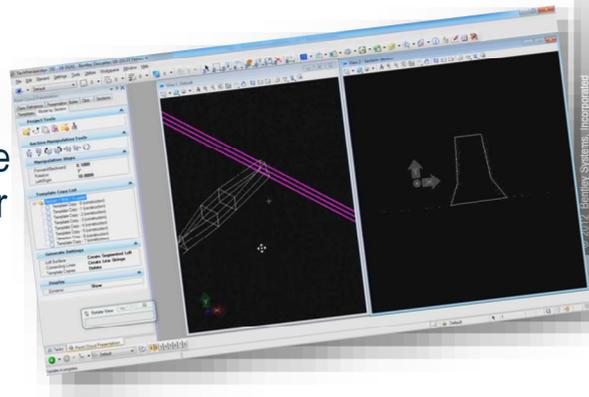
# 3D Lines following



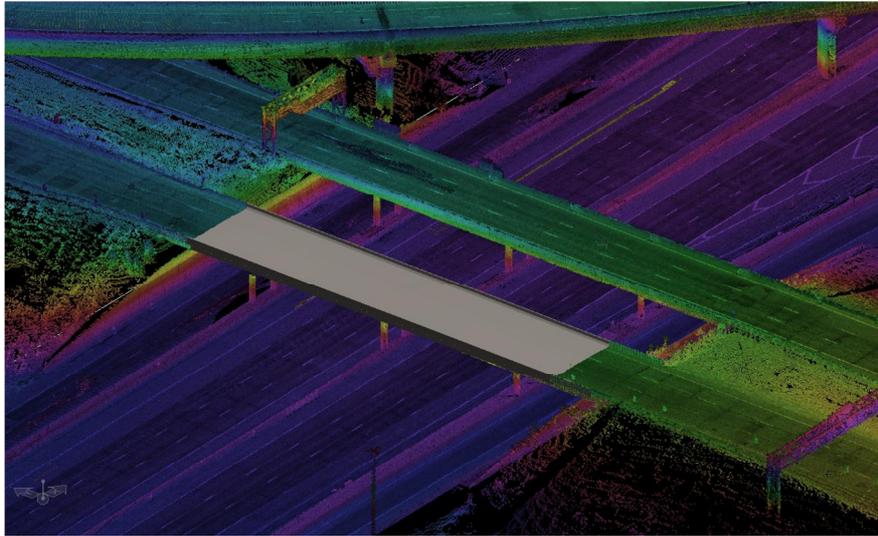
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## Model by Section

- Define a template of the cross section of a linear feature.
- Copy and adjust the template in sections along the feature
- Directly produce :
  - Loft Surfaces
  - Lines
  - Sections



## Model by Section – What is it?



## Model by Section – Benefits?

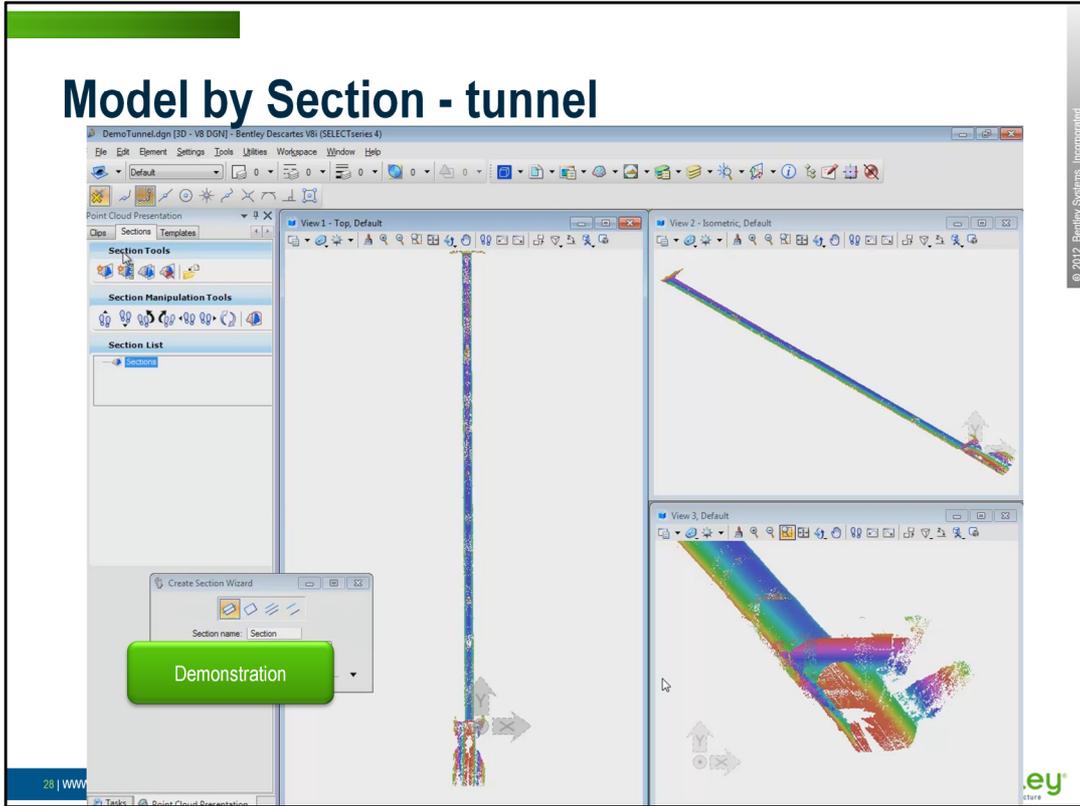
- Suitable for many types of features from road breaklines to complex structures such as bridges, rails, tunnels...

**Flexible &  
Powerful!**

- Generate results as lines and sections but also 3D Volumes

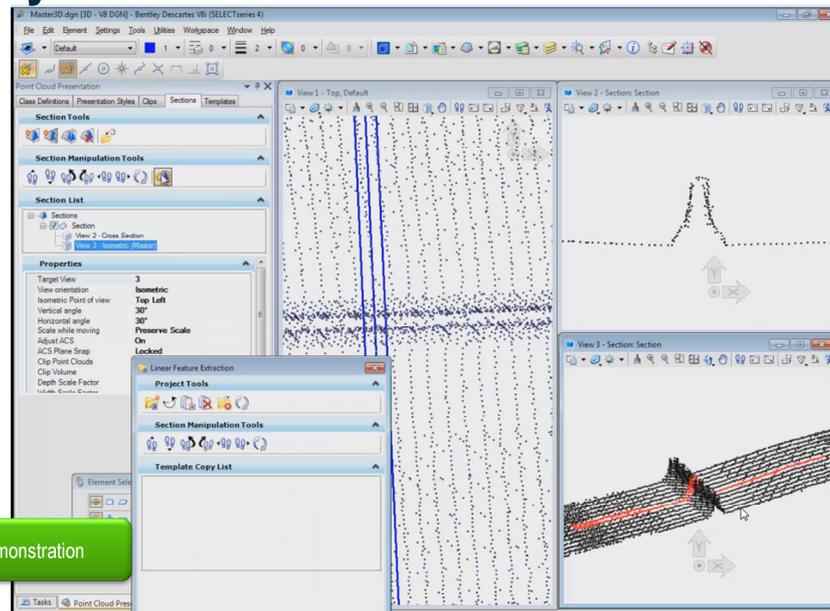
**Unique &  
Innovative!**

# Model by Section - tunnel



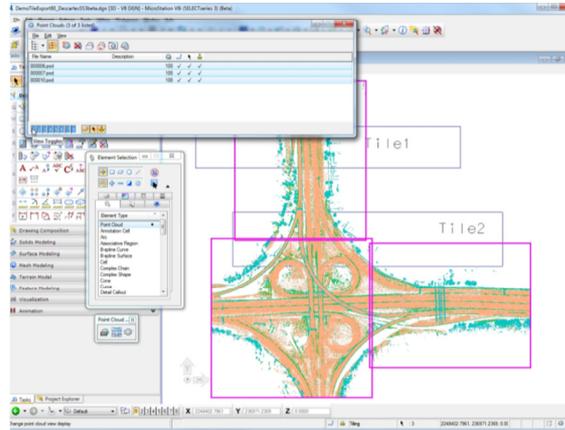
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# Model by Section - breaklines



## Demo: Export tiles

- Export N Point Clouds into M tiled files



Demonstration

Data Courtesy HNTB – [www.HNTB.com](http://www.HNTB.com)

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## Why you need Descartes for Terrain Modeling

- Large scale visualization requirements
- Need to use very large data sets in engineering projects
- Need to display high resolution imagery on the terrain



Imagery courtesy Quebec City

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## Scalable Terrain Model (STM)

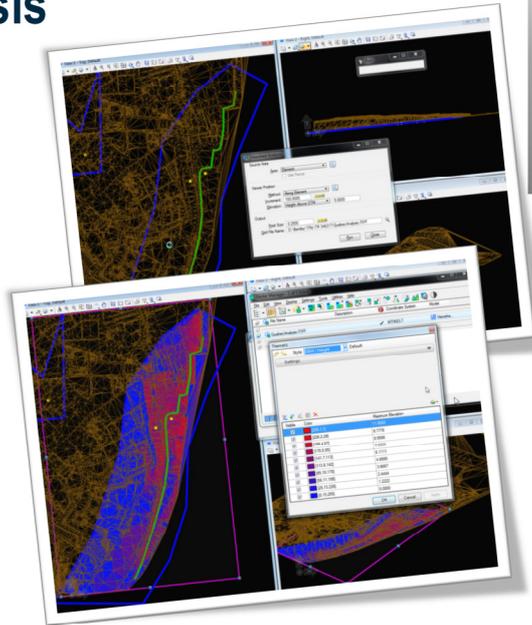
- STM is a revolutionary new technology that enables high-performance display of digital terrain models (DTMs) covering very large areas and containing billions of points
- For viewing huge digital terrain models at geospatial scale
  - City, Region, State, Country
- Potential users
  - Municipal, States, Federal agency and government
  - EPC working in GIS
  - Large infrastructure project



Image courtesy Quebec City

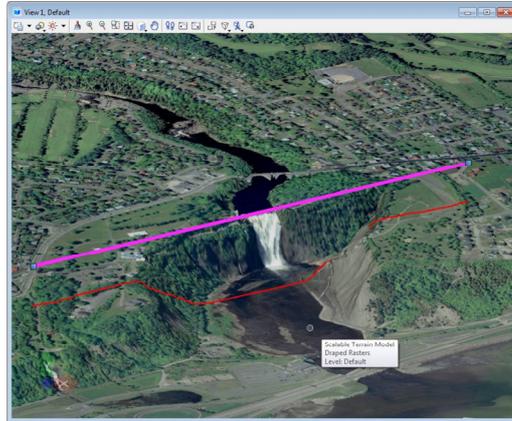
## STM - Viewshed analysis

- Viewshed analysis running natively on Scalable Terrain Model
  - Full resolution of the STM for a user defined extent
- Generate a raster grid showing areas visible from selected viewpoint
- Support multiple points of view and paths



## STM - Drape

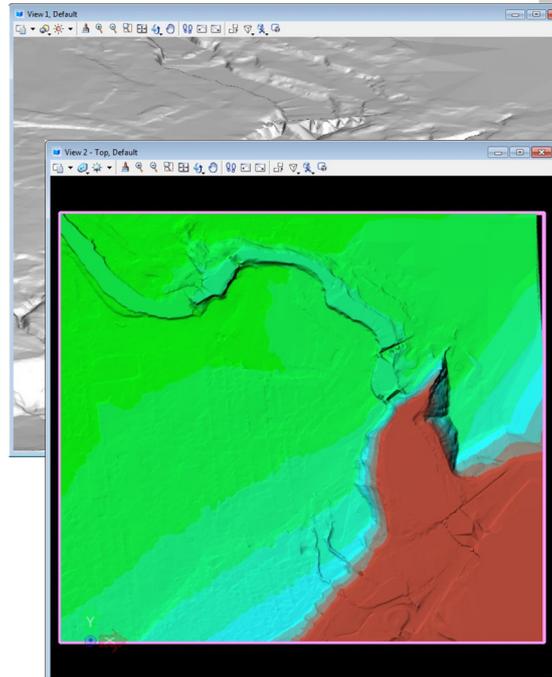
- Drape linear element directly on Scalable Terrain Model
- Full resolution of the STM for a user defined extent



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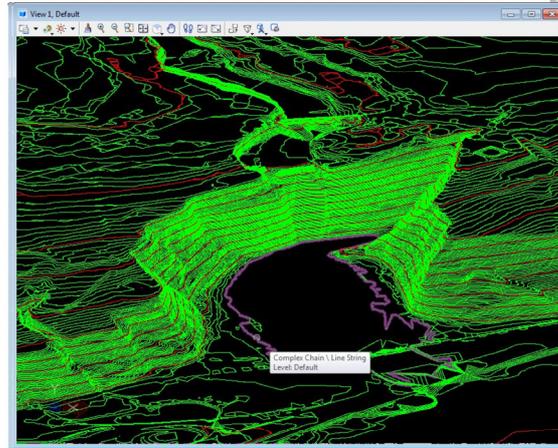
## STM – Raster Dem

- Extract Raster DEM
- Interoperability with other GIS



## STM – Contours

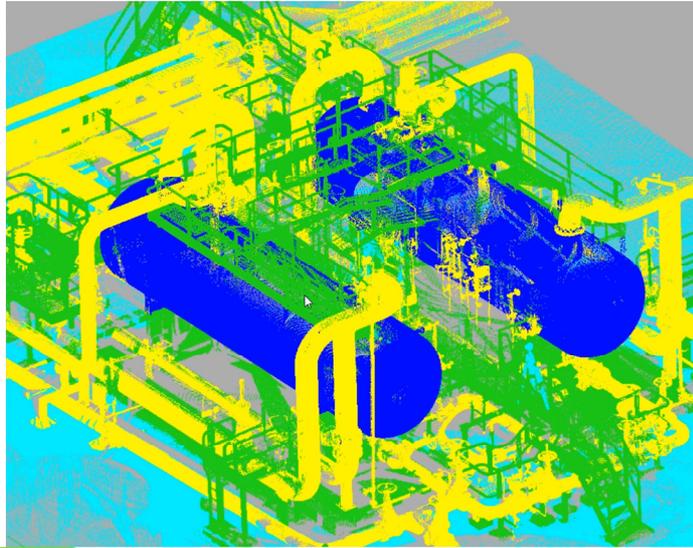
- Convert contours to MS Elements
- Enable editing



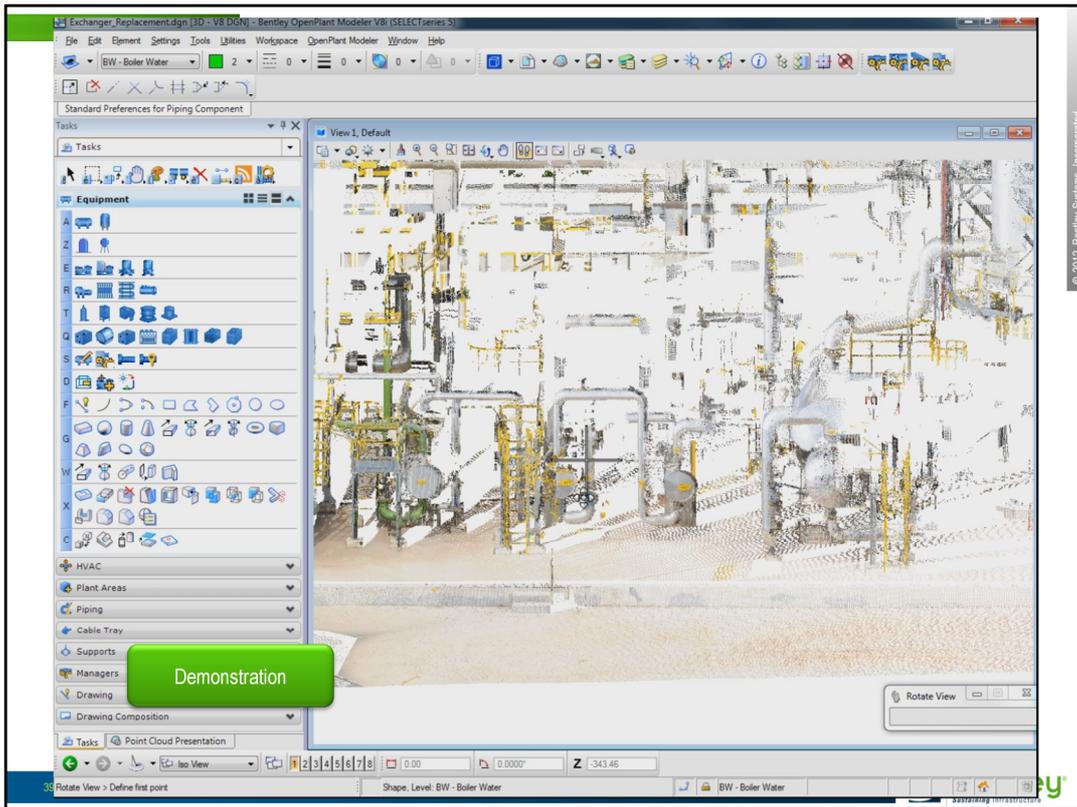


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Demonstration



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## Municipality

- City of Saguenay

- The Scalable Terrain Model (STM) module has been used to validate the localization of the river under a project of mapping quality increase.
- The STM module also allows analysis of the residential development projects.



“The City of Saguenay has a very large territory covering approximately 1136 km<sup>2</sup> and we have always had issues trying to create terrain models covering our entire territory. With the new Scalable Terrain Model (or in short STM) technology shipping with Bentley Descartes V8i (SELECTseries 3) this problem is solved. We have created a large STM of more than 4,000,000 points and have draped more than 1.5 GB of raster imagery on top of the terrain and have seen amazing display performance.”

Mr. Eric Bolduc  
Technicien en système d'information géomatique  
Ressources Informatiques  
Ville de Saguenay, Quebec, Canada

#### Bentley's Products:

- MicroStation
- Bentley Descartes for Microstation

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*The STM module has been used to validate the localization of the river and brook under a project of mapping quality increase. The objective is to identify the presence of rivers and brooks and localize them as much precise as possible with the goal of the implementation of rules of environmental safety (shore, humid areas, etc...).*

*The module also allows analysis of the residential development projects. Indeed, the function allows Drape element of "dressing" the drawing with the topography of the project using the points Clouds. The report assesses the development in regard to the presence of slope, the protection of rivers, the establishment of the proposed excavation or embankment.*

*Finally, as part of a project to map areas prone to stress landslides, the module allowed us to validate sloped areas (orientation and degree of slope, position of the peaks and down slope) by applying polygons projected area of the STM.*

## Local Government

- Conseil Général de L'Ain



*“For several years, we have been using 3D simulations and visualizations to evaluate the impact of road projects and have been sharing these with various project stakeholders and the public. The use of point-cloud data in this context is a very interesting approach, as it allows us to combine design (geometric) models and as-built point clouds in hybrid models more quickly and at reduced cost. We have successfully completed tests using this hybrid approach and now plan to use Bentley Descartes to implement it. The new visualization tools in Bentley Descartes V8i (SELECTseries 4), including the presentation styles and clip management, will help us increase productivity and improve the quality of our deliverables.”*  
Yves Genevois of Conseil Général de L'Ain

Bentley's Products:  
• Bentley Descartes

# Railway



- London Underground
  - Using the point cloud functionality of Bentley Descartes

*“I have been creating 3D models from point clouds for almost a decade, and I am very excited by the point-cloud capabilities in MicroStation, MicroStation-based products, and Bentley Descartes. The Bentley Descartes V8i (SELECTseries 4) technology preview has revealed new tools to clip point clouds, manipulate sections, and extract linear features. I like the section tool, especially the ease with which a section can be duplicated and then rotated by a definable amount while automatically managing my view and auxiliary coordinate systems. Bentley users who are already using or proposing to use point clouds now have access to more than enough tools to produce any 2D or 3D information they could wish for.”*

*Matthew McCarter | CAD Technician  
Capital Programmes Directorate | London Underground*

Bentley's Products:  
• Bentley Descartes

Commenting on the new release of Bentley Descartes, Matthew McCarter, CAD technician, Transport for London, said, “I have been creating 3D models from point clouds for almost a decade, and I am very excited by the point-cloud capabilities in MicroStation, MicroStation-based products, and Bentley Descartes. The Bentley Descartes V8i (SELECTseries 4) technology preview has revealed new tools to clip point clouds, manipulate sections, and extract linear features. I like the section tool, especially the ease with which a section can be duplicated and then rotated by a definable amount while automatically managing my view and auxiliary coordinate systems. Bentley users who are already using or proposing to use point clouds now have access to more than enough tools to produce any 2D or 3D information they could wish for.”

# Railway



- NetworkRail
  - Using the STM and point cloud functionality of Bentley Descartes

*“We have been early adopters of Bentley Descartes V8i (SELECTseries 4) and this new release provided us exactly what we were looking for. Scalable terrain models now allow us to create and manage terrain models with hundreds of millions of points and the section modeling capability of Descartes V8i (SELECTseries 4) addresses tunnel modeling perfectly. With the flexible display options for point clouds we can visualize the terrain or only the vegetation as necessary. With its fast scalable terrain model manipulation and very powerful modeling tools, Bentley Descartes allows us to integrate point clouds and engineering data into intelligent hybrid models.”*

*John Nolan | CAD Manager |  
NetworkRail*

Bentley's Products:  
• Bentley Descartes

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## Engineering

- NIRAS BlomInfo A/S
  - Using the Scalable Terrain Modeling functionality of Bentley Descartes, for visualization/communication of large project proposals

*“With the release of Bentley Descartes V8i (SELECTseries 3) a strong improvement in the visualization of our survey data is now possible, because in Bentley Descartes V8i (SELECTseries 3) it is now possible to manipulate very large terrain models and to drape high resolution orthophotos on them. These new functions have streamlined our workflows and improved the outputs, so it's now possible for us to communicate our results to our clients faster, better and in a more convincing manner.”*

*Morten M. Sørensen, Project Lead*

*NIRAS BlomInfo A/S*

#### Bentley's Products:

- MicroStation
- Bentley Descartes for Microstation

3d engineering : by using the 3d urban model, they can have engineering tasks performed. For example, if a side walk needs to be elevated for a renovation project, using 3d allows them to validate that no window will be obfuscated, have begun to capture more 3D water data for a future migration to a full 3D dataset. Oracle data is currently in 2D, but had attributes that provides the elevation data (z)

## Engineering

- CIMA+
  - Using Descartes for Point Cloud Modeling in variety of survey workflows

*“CIMA+ recently tested the beta version of Bentley Descartes (SELECTseries 4) on a project which required us to process terrestrial point clouds. Bentley Descartes enabled us to execute our point cloud processing routine simply, quickly and efficiently. We strongly recommend this product for advanced point cloud processing.”*

*Régis Roberge*

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CIMA+

Bentley's Products:  
• Bentley Descartes

3d engineering : by using the 3d urban model, they can have engineering tasks performed. For example, if a side walk needs to be elevated for a renovation project, using 3d allows them to validate that no window will be obfuscated, have begun to capture more 3D water data for a future migration to a full 3D dataset. Oracle data is currently in 2D, but had attributes that provides the elevation data (z)

## Wrap-up

- Point clouds are viewable in most Bentley desktop products
- Bentley Descartes is the tool for advanced point cloud workflows
- Bentley Descartes also adds tools for fast display of very large digital elevation models and draped imagery
- Bentley Descartes works directly with most Bentley desktop software. (OpenPlant, AECOSIM Building Designer, InRoads...)

