



## Can We Talk? - Getting LandXML Data Out to Construction

For use in Automated Machine Guidance

Quinton Tillman & Bruce Dana

Session: 77 – Tuesday July 29, 2:00 P.M. – 2:45 P.M.



## Automated Machine Guidance



## *Then and When?*

- It's been all about the paper
- It's becoming about the data



## *Data Model formats*

- ▶ LandXML file format is most universal for communicating highway geometric data.
  - The gold standard of data transfer in the civil / survey industry
  - Most software still only supports the version 1.0 schema
  - Files can become *cumbersome* on slower machines with very large surface models
  - LandXML's format was agreed upon by a consortium of major civil / survey product manufacturers (including Bentley and Autodesk), as well as government agencies (including FDOT and FHWA)
  - A required FDOT Electronic Delivery format !
- ▶ 3D Graphics data for surfaces being supported by more systems
  - Autodesk DWG format for TIN surfaces extractable by some equipment
  - DGN can be converted to DWG by either MicroStation or AutoCAD.

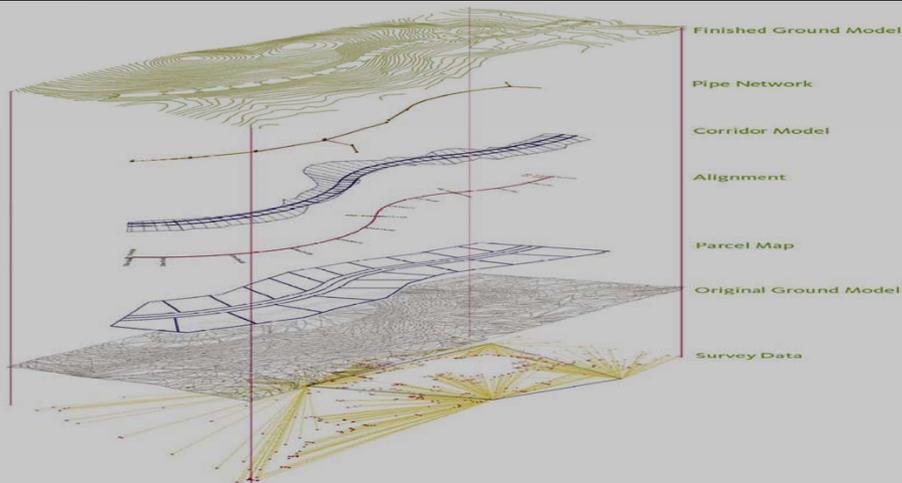


## What is LandXML? Open Design / Data Exchange

- ▶ An XML file format for civil engineering design and survey measurement data for the purposes of:
  1. Transferring engineering design data between producers and consumers.
  2. Providing a data format suitable for long-term data archival.
  3. Providing a standard format for electronic design submission.



## What is LandXML?



- ▶ A specialized XML data file format containing civil engineering and survey measurement data



## LandXML is a “grass roots” Industry Standard

- ▶ LandXML-1.0
  - July 17, 2002 Ratified as an industry standard by LandXML.org.
  - Based on W3C XML Schema Recommendation May 2, 2001.
  - LandXML Software Developers Kit 1.0 and documentation.
- ▶ LandXML-1.1
  - Ratified by W3C July 21, 2006
  - LandXML Software Developers Kit 1.1 and documentation.
- ▶ LandXML-1.2
  - Draft Schema April 23, 2008, Voting for ratification ends July 30, 2008.
  - LandXML Software Developers Kit 1.2 available now.
- ▶ Over **50 or so** Registered Software Applications from Autodesk, Bentley, Carlson, Eagle Point, Leica GeoSystems, Trimble Navigation, Tripod Data Systems, Topcon, the U.S. FHWA and many more.
- ▶ Adopted for use by governments around the world.



## LandXML Data Model

- ▶ **Project**
  - Project name and description.
- ▶ **Application**
  - Application used to produce the data.
- ▶ **Author**
  - Who created the data.
- ▶ **Units**
  - Linear, angular, area, time, temperature, pressure, diameter, volume, flow and velocity.
  - Elevation unit and Lat / Long and Angular units
- ▶ **Coordinate Systems**
  - Grid and Projected coordinate systems
- ▶ **COGO Points**
  - The basic 3D point with name, number, description, code and purpose.
  - All points support Latitude, Longitude, ellipsoid elevation attributes.
- ▶ **COGO Geometry**
  - Lines, circular curves, spirals, irregular lines and chains.



## LandXML Data Model

### ► PlanFeatures

- Generic geometric data like fence lines, as-built data (curbs, building outlines, etc...).

### ► Parcels

- Closed parcel coordinate geometry
- Area, centroid, owner, class, type
- 3D parcel volumes

### ► Alignments

- Road centerline 2D coordinate geometry.
- Profiles: vertical design alignments and sampled ground profiles.
- Cross Sections: design cross sections and sampled surface (existing) sections.
- Superelevation stations
- Station Equations

### ► Surfaces (digital terrain models)

- TIN – The computed Triangulated Irregular Network of 3-point triangle faces.
- Grid – 4-point grid faces.
- Source Data: break lines, contours and points used to compute the TIN/GRID.



## LandXML Data Model

### ► Roadways (3D road model)

- Alignments (profiles, design cross sections)
- Surfaces (top and sub-surfaces)
- Plan Features
- Lanes and Intersections

### ► PipeNetworks

- Storm water pipes and structures.

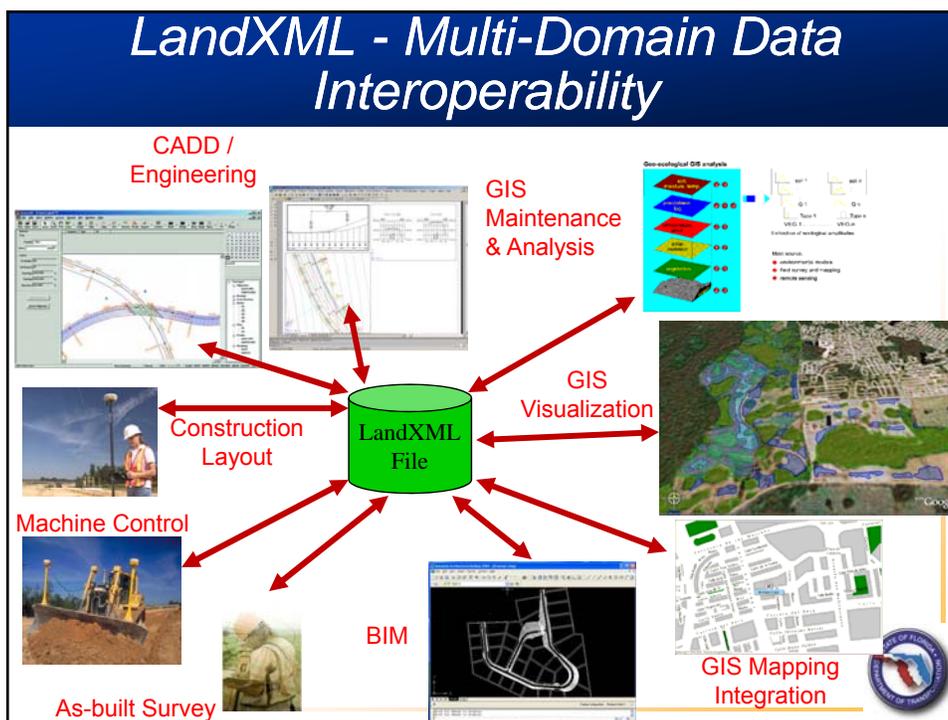
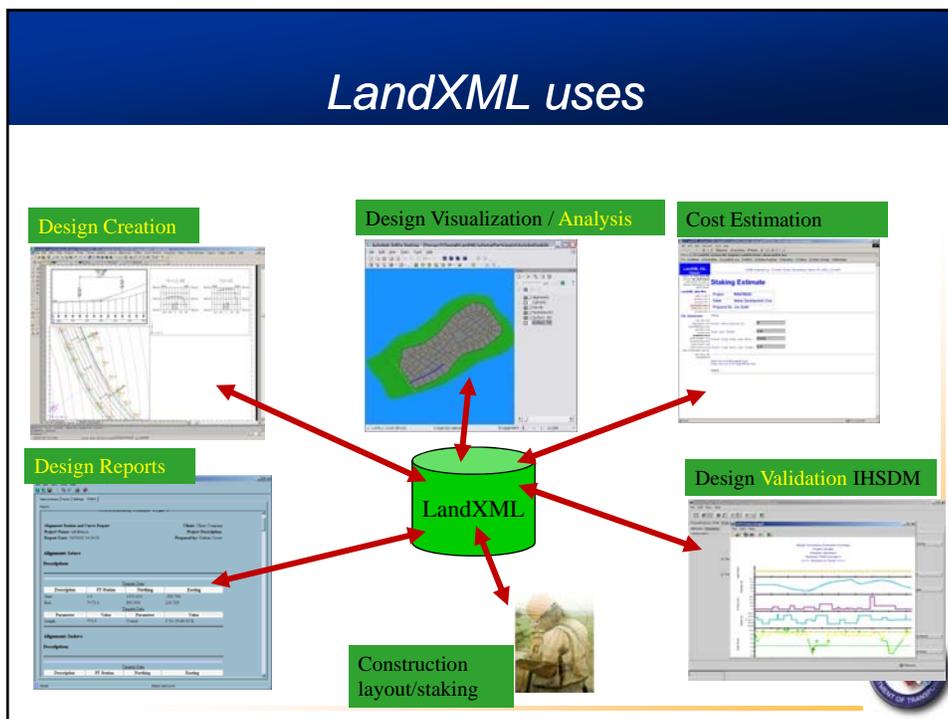
### ► Monuments

- Survey monument data
- Survey order, class, type, description.

### ► Survey

- Field book data: raw and reduced survey observations.
- Equipment, personnel and data collection parameters.
- Optical, EDM and GPS supported.
- Supported by FDOT EFB version 3



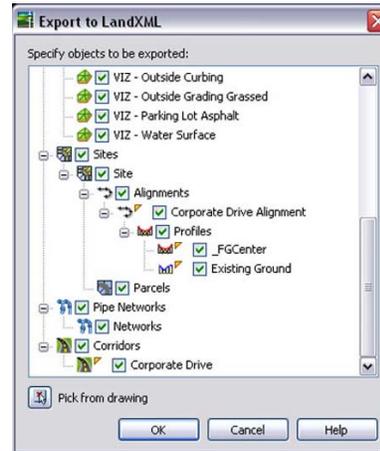


## Exporting LandXML from Autodesk Civil 3D

- ▶ In Civil 3D, choose File / Export / Export to LandXML.
  - Choose the objects you want to include in the LandXML data file through a tree view

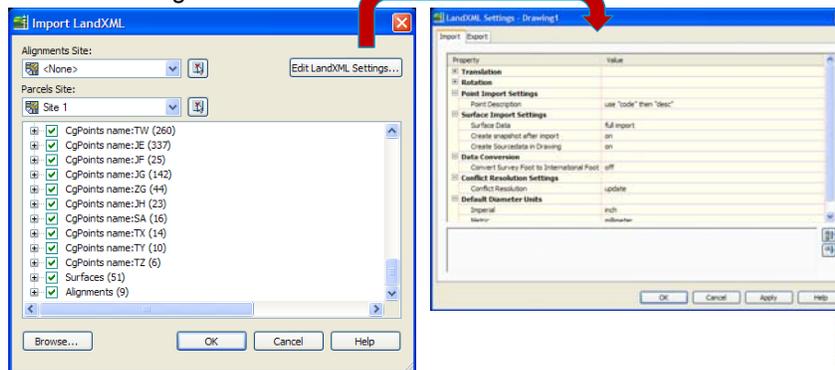
You can also pick items directly from the drawing, if that's more convenient. LandXML files created by Civil 3D are also able to include pipe networks.

Note also that exporting a Corridor will add any alignments, profiles and associated corridor surfaces to the LandXML file, but the corridor definition itself is not included.



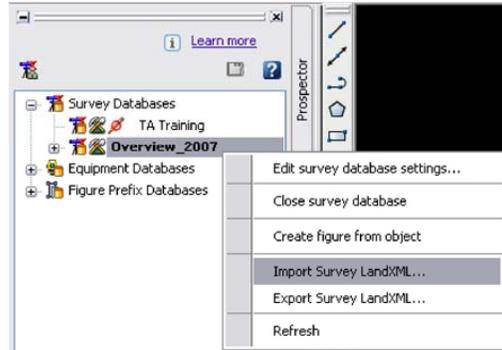
## Importing LandXML into Civil 3D

- ▶ You can import LandXML data into Civil 3D through the File / Import / Import LandXML Data command.
  - The Import LandXML command provides another tree view very similar to the one used in the Export command. Users are free to turn on checkboxes for only the data they wish to include in the current drawing.



## Importing and Exporting LandXML Data into and out of a Civil 3D Survey Database

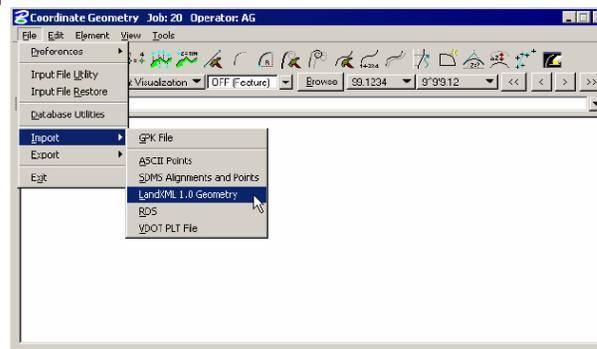
- ▶ The Survey Toolspace provides a separate Import LandXML command with options that relate to Survey functions.
  - Locate this command by right-clicking on the name of the Survey Database in the Survey Toolspace. Note there is also an Export LandXML command available in this context menu



## Bentley GEOPAK Support for LandXML

- ▶ GEOPAK supports the LandXML 1.0 schema Import and Export for:

- Geometry points
- Chains
- Profiles
- DTM

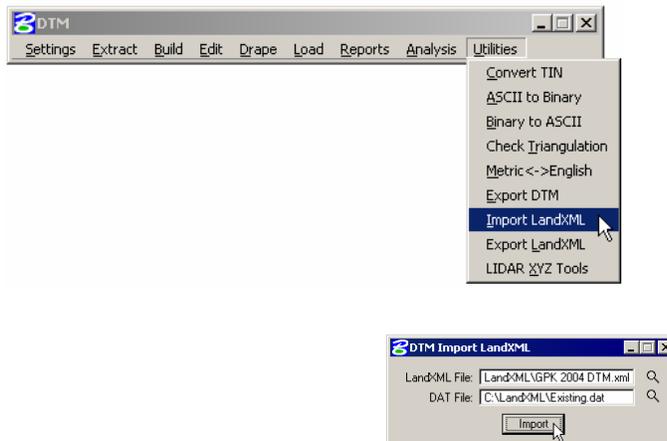


Points, Chains and Profiles are imported and exported to LandXML from the GEOPAK COGO Tool



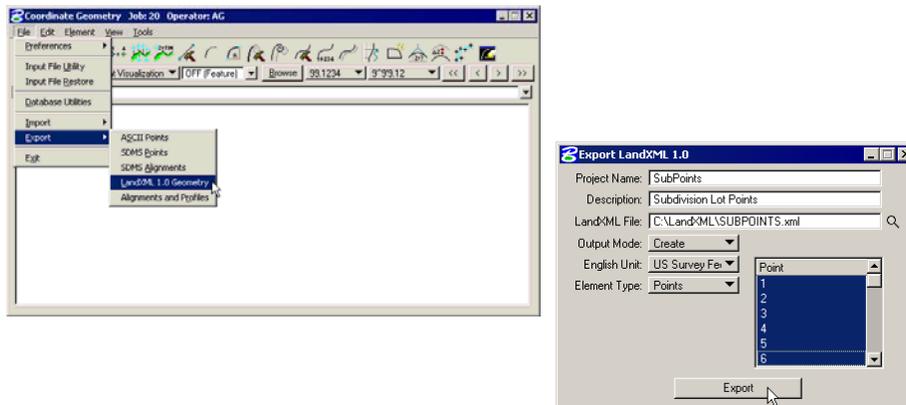
## Import of DTMs into GEOPAK

- ▶ The GEOPAK DTM Tool is used for Import and Export of GEOPAK TIN Models.



## Exporting GEOPAK geometry to LandXML

- ▶ The GEOPAK COGO Tool is used for Export GEOPAK Points, Chains and Profiles.



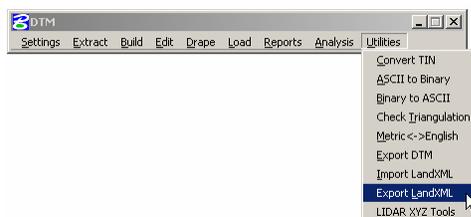
## Exporting GEOPAK geometry to LandXML

- ▶ The GEOPAK COGO Tool is used for Export GEOPAK Chains and Profiles too.



## Export of DTMs from GEOPAK

- ▶ The GEOPAK DTM Tool is used for Import and Export of GEOPAK TIN Models.



## Now What?

- So I've "Black Boxed" some LandXML data out my design system...Is it any good?
  - I could "round trip" the data back in to test it...
  - Or validate it independently...But how?
- (Someday someone might ask me to sign / seal this stuff !)



## Independent LandXML Validation

- ▶ How do I validate and view LandXML if I don't have a design package that supports LAndXML?
  - <http://www.landxml.org/LandXMLValidator.aspx>
    - ✓ LandXML 1.0 – 1.1 schema files of up to 20 MB as XML, or and XML contained in ZIP (so a LandXML of well over 100 MB could be uploaded!)
  - <http://www.xmllabs.com/landxmlvalidator/>

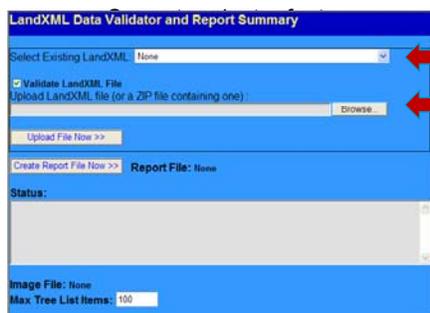
Selects sample LandXML files already on the server

You upload your own LandXML file or one that has been Zipped



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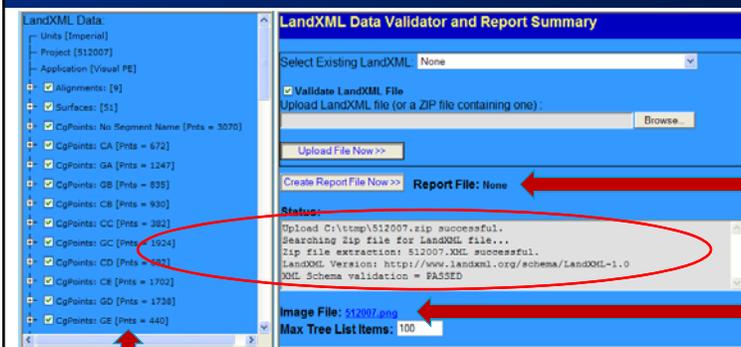


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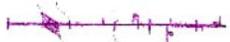
## The LandXML Validator



The data tree, select what to include in the PDF report to be generated

To generate a PDF with same name as the LandXML file

To open the temporary graphics file (.PNG)



Temporary graphics of the XML data shown



## PDF of LandXML data

Use Adobe Acrobat's zoom, pan controls to see details.

3D viewing to be implemented soon

Control visibility sub layers

## Summary

- ▶ The LandXML standard is supported by many applications.
- ▶ LandXML improves the usefulness of the design data for construction, as can be used by those AMG systems for field grading.
- ▶ DWG files for terrain surfaces are also useful for some AMG systems, and can be produced from both Bentley MicroStation, AutoCAD, and even other 3<sup>rd</sup> party software.

PAPER

MODEL