NWT GRANULAR USERS FORUM: SUMMARY REPORT

FINAL

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Indian and Northern Affairs Canada | Affaires indiennes et du Nord Canada

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EXECUTIVE SUMMARY

A forum was held on September 27 and 28th of 2006 in Yellowknife in order to bring together parties interested in managing Northern granular resources. The purpose was primarily to provide interested parties in open forum to discuss issues related to information exchange. Possibilities for development and further use of granular resources were discussed.

A 45 minute presentation was prepared by SoilVision Systems Ltd. related to the current status of geotechnical data management. The presentation appeared to be well-received and there was interest in adopting data standards in further initiatives.

Comments at the forum resulted in the following recommendations from SoilVision Systems Ltd.

- The DIGGS standard should be adopted where possible for the management of particle-size information.
- Existing particle-size scanned reports should be digitized and imported into a database structure such that the information can be searched by consultants through a web interface.
- A framework should be developed to ensure ongoing consistency of data managed in a central repository.
- Joint ventures should be explored in order to offset potentially high development costs and allow development of advanced system features.
- More advanced generation of grain-size and borehole reports could be accomplished with reasonable effort.

While these are current recommendations it is envisioned that further discussion will allow a certain amount of focusing of future efforts.

1 FORUM OVERVIEW

A forum was held on September 27 and 28th of 2006 in Yellowknife in order to bring together parties interested in managing Northern granular resources. The purpose was primarily to provide interested parties in open forum to discuss issues related to information exchange. Possibilities for development and further use of granular resources were discussed.

SoilVision Systems Ltd. was requested to participate in this forum, do a presentation, and provide a brief summary report containing recommendations for proceeding. This report provides a summary of the recommendations resulting from the forum.

2 FORUM PRESENTATION

The prepared PowerPoint presentation provided a literature review as well as an overview of related efforts in the area of geotechnical data management. It also provided an overview of the historical development of geotechnical data standards and their use in the current level of practice in various places around the world.

The presentation lasted approximately 45 minutes in length and provided an overview of the current implementation of geotechnical data standards. Key organizations around the world which have attempted similar data management schemes were identified as per the relation to the current effort in the management of geotechnical particle-size information.

The presentation also covered the historical development of the AGS data standard in the UK and it's subsequent transformation into the current DIGGS data format being adopted but the transportation industry in the US.

3 PERSONNEL

Dr. Murray Fredlund has published over 20 research papers on topics related to database design, finite element modeling, and unsaturated soil knowledge-based systems. He has directed the development of six software packages covering areas unsaturated soil knowledge-based prediction systems,.groundwater flow, contaminant transport, geothermal analysis, stress/deformation, and slope stability. He has been involved in a number of numerical modeling projects involving heap leach flow, salt migration, cover design, tailings water balance, and retaining-wall anchor analysis. The software products of SoilVision Systems Ltd. are used in over 45 countries by consultants, universities, government agencies and multinational corporations.

4 FORUM DISCUSSION

The following subsections outline the impressions of the author during some of the forum discussions as pertaining to the adoption of data standards for the management of particle-size information.

4.1 Data Availability

There is a vast amount of information currently available as provided by investigations undertaken by consultants, government, private land owners, as well as mining and oil companies. Much work has been done to date through the 'Northern Granular Resources Bibliography' website in order to compile this information.

Issues still remain with this resource as to the quality of information from each source as well as the format of the information. Much valuable information is available in borehole logs but much of the information has only been scanned and not digitized. It is therefore of limited value.

There seems to be significant value appreciated for the centralized management of granular resources in a central data repository. It is anticipated that moving towards centralized data management will allow streamlined updating of a data repository as well.

4.2 Digitizing of Legacy Particle-Size data

Detailed particle-size distributions have currently been scanned and are geo-referenced. The current web system does not have the ability to allow contractors to scan the database given a specific grain-size specification. There seemed to be interest in digitizing particle-size information such that a more comprehensive searching method could be implemented in any proposed web database system.

There was limited discussion related to methods of economically digitizing large amounts of scanned particle-size distribution legacy reports.

4.3 Ongoing Data Management

There do not seem to be clear methodologies for maintaining current data in a centralized data repository. Various ideas were discussed but it appears that a clear methodology for maintaining current data needs to be developed. It also appears from the discussions that such a methodology is best implemented in the context of a centralized web-based data repository. Methods of data submission using XML structures may be possible.

4.4 Data Volume Estimates

It was apparent at the forum that it would be difficult to obtain accurate estimates of current resource volumes. This seemed primarily due to the lack of accurate records for

each resource. The issue was further complicated by the lack of clarity regarding resource ownership. It was the general feeling that some methodology should be put in place to ensure that reasonable estimates of volume were retained through a centralized web system.

5 RECOMMENDATIONS

The forum was a useful resource for the exchange of ideas. Based on the knowledge obtained in the form we would make the following recommendations.

5.1 Management of Particle-Size Distributions

Grain-size information should be added to the existing web-based GIS system.

a. As a progression existing grain-size reports should be compiled in a PDF format and linked into the system through a geo-reference.
b. PDF information should then be digitized and stored in a consistent database format.
c. Digitized information should then be analyzed in a global way such as to develop a related table of summary statistics such as % coarse, % sand, % silt, % clay, D10, D30, D60, and a summary classification of the material.
d. Methods of searching grain-size material based on summary parameters should be implemented.
e. There should be the ability to generate a standard grain-size report on the internet system which would consist of a single material or a selection of materials from a single pit/strata.

5.2 Data Format

It was the general consensus of the meeting that the data format of grain-size information should be consistent with the DIGGS format.

5.3 Ongoing Data Management

Standard methods of submission of grain-size information should be developed and implemented. Each of the data sources should have an adequate system of ensuring timely data development into the future. Such a system is best implemented in conjunction with a web-based data management system.

5.4 Joint Venture Initiatives

Implementation of a centralized software system for comprehensive management of all particle-size information is costly. Large amounts of investment have been directed to such systems in the US and in Europe. There is benefit in the current initiative to explore

collaboration with provincial government organizations such as transportation departments as well as groundwater management groups as there is significant overlap in the developed technologies. There is significant possibility of using joint ventures in order to maximize the effectiveness of the current effort.

Joint ventures may allow the development of more advanced features such as 3D visualization of resources as well as advanced reporting. Implementation of more advanced features may be possible with Joint Ventures.

5.5 Reporting

Development of graphical borehole reports should be added to the system. These could be developed through the existing web-based interface.

6 SUMMARY

The forum provided an excellent means of collaboration among interested parties for the management of northern granular resources. It was also educational for SoilVision Systems Ltd. in order to guage the potential needs of the northern community as related to management of geotechnical data. The data gathered at this forum allowed the identification of data management initiatives which can be incorporated into future design specifications.

7 APPENDIX A – DATA STANDARDS PRESENTATION

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GEOTECHNICAL DATA: REVIEW OF EXISTING SOFTWARE AND STANDARDS

Presenter:
Murray Fredlund, PhD, PEng
SoilVision Systems Ltd.

Prepared for: INAC

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Overview

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Introduction

- Collection of geotechnical data in a digital format has proceeded since the popularization of personal computers in the late 1980's
- The software utilized and the data format selected varied significantly between organizations
- This difference resulted in chaos when consultants, universities, or government organizations attempted to exchange geotechnical data
- Since the setup of the Association of Geotechnical and Geoenvironmental Specialists (AGS) in 1991 there has been an ongoing effort worldwide to move towards established standards for the exchange of geotechnical data
- This report provides a summary of existing data standards and software that can be used for the exchange of geotechnical data

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OVERVIEW

- The standardization of geotechnical and geoenvironmental data format would represent a significant improvement in the practice of geotechnical engineering
- Data could be more easily exchanged within and across national boundaries
- The standardization would also allow data to be made available and searchable through "Web servers" anywhere in the world
- The need for global standardization has been recognized since 1991 with the formation of the "Association of Geotechnical and Geoenvironmental Specialists", AGS in the UK
- AGS
  - On third edition (3.1)
  - Widespread use throughout the UK, Singapore, and Hong Kong
  - Estimated usage at about 700 firms

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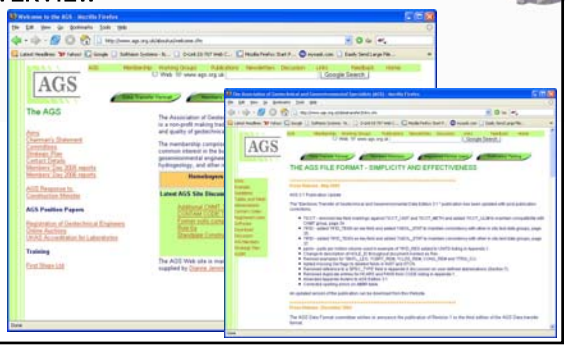
OVERVIEW



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OVERVIEW

- More recently
  - Exchange of data over the Web
  - Popularization of the XML data format
- This new data exchange tool has initiated a revisitation of geotechnical data standards
- Changing a standard is complex since it requires a "buy in" of
  - industry leaders in data management
  - software developers
  - AGS cost est. $3M
- SoilVision Systems Ltd. was retained in February, 2006 by Indian and Northern Affairs Canada (INAC)
  - Review existing efforts that have been made towards the standardization of the geotechnical data dictionary
  - Review status of software programs
  - Review current efforts of INAC

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HISTORICAL DEVELOPMENT

- Important to understand the context of its historical development
- The current status is the result of a number of significant initiatives by various organizations and individuals
- The first recognition of the need for a global geotechnical data standard - Association of Geotechnical and Geoenvironmental Specialists, AGS, in 1991 - UK
- The first published AGS standard appeared in 1992
- Second and Third editions of the AGS Format were published in 1994 and 1999, respectively
- Third edition included rules for the creation of user-defined fields
- Feature was leveraged significantly with the publication of AGS-M for monitoring data (CIRIA, 2002)

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HISTORICAL DEVELOPMENT

- AGS - it was considered important that there not be a conflict with the requirements of geotechnical and geoenvironment communities following the "National Codes of Practice or Standards“
- AGS format acceptance
  - Widespread acceptance by the geotechnical and geoenvironmental industry in the UK
  - Specified by most major clients and organizations in UK
  - Used by the British Geological Survey for the transfer of ground investigation data
  - The AGS format is used by an estimated 700 geotechnical offices in the UK and is widely used in Hong Kong, Ireland and Singapore
  - The AGS format has currently received reasonable support from about 25 compatible software programs listed on www.GGSD.com (Geotechnical and Geoenvironmental Software Directory)

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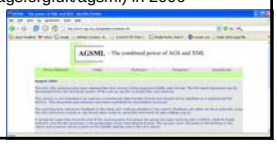
HISTORICAL DEVELOPMENT

- Recently been a push to update the AGS Format to an XML format
- XML is recommended as the W3C standard for sharing structured data over the internet
- There are significant advantages to adopting the XML format - seems to be the way of industry
- The need to incorporate XML into the AGS standard has led to a new standard called AGSML
- A "discussionary" implementation of the AGSML format has been posted on the AGSML website (www.ags.org.uk/agsml) in 2006



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HISTORICAL DEVELOPMENT

- It is anticipated that the first draft of the AGSML report will be made available sometime in the year 2006
- The AGSML group has also formed a data coalition with the COSMOS group, USA Federal Highway Administration and Florida University in order to develop an international transfer format based on the AGSML format
- It is anticipated that AGS will adopt AGSML as the basis for its new format called AGS 4 which has a tentative release date of 2007/2008
- This is Europe – what is happening in the US?

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HISTORICAL DEVELOPMENT

- Geotechnical management system workshop held in Newport Beach, California in June 2004
- The event was jointly sponsored by the FHWA and COSMOS
- The intent of the meeting was to meet the state Department of Transport, DOT, geotechnical management system needs as well as presenting the work of COSMOS, UKHA, and AGS
- There was significant interest from state DOT representatives to pursue the development of standards for geotechnical management systems
  - Exchange of data!
  - A state DOT highway project could conceivably take advantage of subsurface investigation data obtained by state Environmental Protection Agencies (EPA), USGS, US Army Corps of Engineers, and others

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HISTORICAL DEVELOPMENT

- The focus of the geotechnical management system workshop became to create the DIGGS standard
- The DIGGS project currently has $643,000 (US), in funding to combine existing geotechnical data standards (AGS, UF, COSMOS)
- The first version of the DIGGS standard is due to be published in the first part of 2007 and is likely to become the primary international data standard

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HISTORICAL DEVELOPMENT

Year	Description
1991	Association of Geotechnical and Geoenvironmental Specialists (AGS) set up Working Party
1992	First edition AGS 1 released
1994	Second edition AGS 2 released
1996	NGES (National Geotechnical Experimentation Site) developed at University of New Hampshire (http://www.unh.edu/nges/)
1996	XML Working group formed by W3C
1998	XML first published (Specification 1.0)
1999	Third edition AGS 3.1 released - user defined fields added - incorporated AGS-M
2000	XML Second Edition specification published
2001	Geotech-XML format developed by Oklahoma State University
2003	Presentation of Geography Markup Language (GML) version 3.00
2004	W3C World Wide Web Consortium, http://www.w3.org/XML/
2005	DIGGS draft data dictionary proposed
2006	AGSML format published
2007	DIGGS version 1 specification released
2008	AGS 4 format release ? - incorporating XML data format

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ORGANIZATIONS/EXISTING STANDARDS

- **Creating and proposing a geotechnical data standard is not a trivial task**
- **It requires a significant investment from a number of different organizations as well as reasonable endorsement from the software industry**
- **These factors must also be considered in light of varying standards of practice throughout the world**
- **Because of the complexity of this task there have been a number of standards that have been proposed over the years**
- **Many of these have not gained significant usage**
- **So where are we now?**

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ORGANIZATIONS/EXISTING STANDARDS

- **Previously - a historical overview of the primary standardization initiatives**
- **Now will provide a comprehensive list of the formats that have been proposed along with the supporting organizations**
- **WARNING – there are a lot of formats and this may be confusing…!**
- **A comprehensive list of geoscience standards has been compiled by Tim Spink (CIRIA, 2006)**
- **Presented on the Geotechnical and Geoenvironmental Software Directory (GGSD) at www.ggsd.com**

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ORGANIZATIONS/EXISTING STANDARDS

- **GEOLOGICAL file formats**

Format name	File extension	Description	Status	Ownership	Number of programs
Datamine		Drilling information and 3-D geological modelling	In use	Proprietary	1
DGSM		Digital Geoscience Spatial Model. Geology, structural geology, landforms, stratiraphy	In use	Proprietary	0
Earthvision		3D modelling format for proprietary software	In use	Proprietary	1
eEarth	.xml	International borehole data interchange format	Active	Open source	0
episEM IS	.xml	EPIcentre Shared Earth Model. Petroleum industry focussed research project for transfering geological models.	Development	Open source	0
ESML	.xml	Earth Science Markup Language to describe the structure, semantics and content of any earth science dataset	Active	Open source	0
GeoSciML	.xml	Geology, structural geology, landforms and text	Development	Open source	0
LogPlot		Borehole information	In use	Proprietary	5
Micromine		Mining data processing software with proprietary data format.	In use	Proprietary	2
NADM	.xml	North American geological map Data Model	Development	Open source	0
RESCUE		Petroleum industry transfer of data from geomodels through the use of the Epicenter data	Active	Open source	0
Rockworks		Borehole information	In use	Proprietary	2
SBB	.xml .txt. or .xls	Shallow boreholes tranfer format for sales from The Netherlands National Geological Survey	Active	Open source	0
SEP	.mdb	Borehole information	In use	Open source	2
Surpac		Mining industry data transfer format	In use	Proprietary	1
Vulcan		Mining data and 3-D mining modelling	In use	Proprietary	4
WinCORE		Borehole information	In use	Open source	1
WinLog		Borehole information	In use	Proprietary	8
XMML	.xml	Data transfer format for Mining Industry (eXploations and Mining Markup Language)	Active	Open source	0

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ORGANIZATIONS/EXISTING STANDARDS

- **GEOTECHNICAL file formats**

Format name	File extension	Description	Status	Ownership	Number of programs
AGS	.AGS	Geotechnical field, laboratory and monitoring data transfer format.	Active	Open source	28
AGS-M	.AGS	Monitoring data transfer format. Now included in AGS 3.1	In use	Open source	1
AGSML	.xml	Geotechnical field, laboratory and monitoring transfer format. Incorporated within DIGGS	Development	Open source	0
bch	.bch	Inclinometer monitoring data file type.	Obsolete	Proprietary	1
CivilXML	.xml	Construction records - principally piling, and associated geotechnical data. Incorporated within DIGGS.	Development	Open source	0
COSMOS	.xml	California based geotechnical data transfer format for earthquake studies. Incorporated within DIGGS	Development	Open source	0
DIGGS	.xml	Data interchange for geotechnical and geoenvironmental specialists. Based on AGSML, COSMOS and CivilXML	Development	Open source	0
GEF	.gef	CPT test results	Active	Open source	3
GeoMil		CPT test results	In use	Proprietary	2
Geopoint		CPT test data format	In use	Proprietary	1
GeotechML	.xml	Geotechnical field, laboratory and monitoring transfer format	Inactive	Open source	0
Gorilla!		CPT test results	In use	Proprietary	1
NENGEO		Dutch CPT test results format.	Obsolete	Open source	1
NGES	.xml	Geotechnical data exchange format for scientific research sites	In use	Open source	0
RocProp		Database of Rock Properties	In use	Proprietary	0
RPP	.rpp	Inclinometer monitoring data	In use	Proprietary	1
SGF		CPT test results	In use	Open source	1
SlopesML	.xml	Slope stability case history format	Inactive	Open source	0

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ORGANIZATIONS/EXISTING STANDARDS

- **GIS & MAPPING file formats**

Format name	File extension	Description	Status	Ownership	Number of programs
Atlas BNA	.bna	Atlas GIS file format	Obsolete	Proprietary	7
Atlas GIS	.axf	Geographical Information System spatial data format.	Obsolete	Proprietary	3
DEM	.dem	Digital Elevation Model.	In use	Open source	14
DLG	.dlg	USGS Digital Line Graphics mapping data	In use	Open source	5
E00	.e00	Geographical Information System spatial data format. Transfer format for ArcInfo	Obsolete	Proprietary	3
ERDAS	.lan or .gis or .img	Mapping image format	In use	Proprietary	3
GeoHO		3D engineering modelling software transfer format used by MOSS/MX	In use	Proprietary	2
Geopak		3D engineering modelling software.	In use	Proprietary	1
GEOSPOT		Geographical Information System image data format for satellite imagery	In use	Proprietary	2
GML	.xml	Geography Markup Language	Active	Open source	0
GRASS		File format for Geographic Resources Analysis Support System open source GIS	In use	Open source	3
LandGML	.xml	Incorporates spatial data used by designers, contractors and surveyors using GML 3.	Active	Open source	0
LandXML	.xml	Incorporates spatial data used by designers, contractors and surveyors. Interoperability with MX	Active	Open source	0
LAS	.las	Interchange format for LiDAR data	Active	Open source	0
MEF / MID	.mif or .mid	MapInfo data transfer files	In use	Proprietary	29
MOSS		3D engineering modelling software transfer format. Now known as MX	Obsolete	Proprietary	2
SDSFIE		Spatial data standard for facilities, infrastructure and environment. US military standard, adopted for USACE geotechnical data management	In use	Open source	0
SDTS		Spatial data transfer standard. Mandatory compliance for US federal agencies	In use	Open source	0
Shape	.shp	ESRI ArcView GIS file format	Active	Proprietary	43
Surfer boundary	.bln	Surfer sector boundary file format	In use	Proprietary	5
Surfer grid	.grd	Surfer gridded data file	In use	Proprietary	3
TIGER		Topologically Integrated Geographical Encoding and Referencing Files. Line based.	In use	Open source	0
XYZG		Rockworks 3D model transfer format	Inactive	Proprietary	2

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WHY XML?

- **There is a wide range of existing file formats for geotechnical soil data**
- **The XML standard offers particular benefits in the development of a worldwide geotechnical data standard**
- **There are a host of compelling reasons to adopt the XML format for the establishment of a geotechnical data standard**
- **Since its first incarnation in 1998 the use of XML has gained worldwide acceptance and is theW3C standard for sharing structured data over the Internet**

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WHY XML?

- **Platform-independent:** A XML file can be defined on any particular software platform and exchanged with other software platforms. XML resources are widely available for both Windows and Linux platforms.
- **Widely Supported and Adopted:** XML is a standard for structured Internet data exchange as proposed by the World Wide Web Consortium (W3C) in 1998.
- **Self Describing:** an XML file format can be deciphered by software to determine what data elements are contained in the file. Tables, relationships, and data types are all defined in an XML file.
- **Variety in Supported Data Types:** It is possible to store text and numbers, graphics, multimedia objects such as towns, and active formats as Java applets or ActiveX components.

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WHY XML?

- **Verifiable:** The XML schema allows for quick and easy verification of an XML file.
- **Style Sheets:** style sheets can be used to format the data in any manner without changing the original data.
- **Internationalism:** XML supports multilingual documents through the use of the Unicode standard.
- **Distributed Data:** XML documents can consist of data stored on multiple servers located anywhere on the web.
- **Unit Conversions:** Units and coordinate-dependent data can be automatically tagged in an XML format which allows automatic conversion from one system to another.
- **Archival Advantages:** Binary file formats require specific software in order to obtain access to the data. The use of a text-based file format means the data can be stored and transformed more easily when technologies change in the future.

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WHY XML?

- The theory behind XML provides a format for general data exchange. If one software application receives an XML file, the file is run through a filter that allows the data to be processed appropriately
- An example of how this might work can be readily seen in the HTML code used in an Internet browser

```
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en"><!-- InstanceBegin template="/Templates/main.dwt"
      codeOutsideHTMLIsLocked="false" -->
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1" />
<!-- InstanceBeginEditable name="doctitle" -->
<title>Data Interchange for Geotechnical and Geoenvironmental Specialists</title>
<!-- InstanceEndEditable --><link href="includes/main.css" rel="stylesheet" type="text/css" />
<!-- InstanceBeginEditable name="head" --><!-- InstanceEndEditable -->
</head>
<body>
<div class="box-wrap">
<div class="box-header">
<h1><a href="index.asp"><img src="images/diggs_header.gif" alt="DIGGS Logo - Go To Homepage" width="744" height="101" class="logo"
      /></a></h1>
</div>
<div class="nav-menu">
 <ul>
```

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WHY XML?

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WHY XML?

- Example – finite element model files from the SVFLUX groundwater modeling software (SoilVision Systems Ltd.)

```
<?xml version="1.0"?>
<SVSModel xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema">
 <ApplicationName>SVFlux</ApplicationName>
 <ApplicationVersion>6.00.16</ApplicationVersion>
 <SVS_Front_End_Model>
  <Project_ID>Examples</Project_ID>
  <Model_ID>Subsidence</Model_ID>
  <System_Type>THREE_DIMMENSION</System_Type>
  <TransientProblem>false</TransientProblem>
  <Model_Bounding_Box Min_X="-5" Min_Y="-5" Min_Z="0" Max_X="110" Max_Y="110" Max_Z="10" />
  <WCSLeft>0</WCSLeft>
  <WCSBottom>0</WCSBottom>
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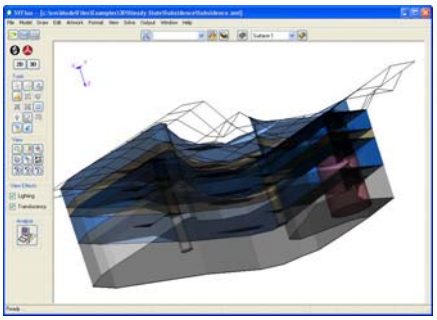
WHY XML?



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THE MOVE TOWARDS XML

- It can be seen that there has been significant endorsement of the XML standard through the following proposed formats

Geotechnical XML	(www.ejge.com/GML)
GeotechML	(http://www.dur.ac.uk/geo-engineering/geotechml/)
SlopesML	(http://www.ins.itu.edu.tr/bulent/slopesml/)
ISO	(http://isotc.iso.org/livelink/livelink?func=ll&objId=138420&objAction=browse&sort=name)
eEarth	(http://www.eearth.nl)
XMML	(https://www.seegrid.csiro.au/twiki/bin/view/Xmml)
GeolSciML	(https://www.seegrid.csiro.au/twiki/bin/view/CGIModel/GeoSciML)
COSMOS	(http://www.cosmos-eq.org/GVDC.html)
AGSML	(http://ags.org.uk/agsml/)
FDOT	(http://fdot.ce.ufl.edu/)
GADML	(http://www.hagdms.com/)
DIGGSML	(http://www.diggsml.org/)

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THE FUTURE - DIGGSML

- Given the significant number of geoscience formats currently available, it might initially appear to be a daunting task to have a single format that will eventually dominate the computer system
- The concept of a global standard has always been desirable
- The work initially done by AGS has led to a number of greater initiatives that are currently underway
- The primary new initiative, (i.e., DIGGS) has begun with the endorsement of the primary management groups worldwide at the government level
- As this new standard is published and becomes more widely used, it remains unlikely that it will replace proprietary software formats but rather provide an avenue for easy exchange of geo-data

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THE FUTURE - DIGGSML

- The DIGGS project has the support of the following organizations:
  - 12 State Department of Transportation, DOTs
  - Federal Highway Administration (FHWA)
  - US EPA (U.S. Environmental Protection Agency)
  - US Army Corps of Engineers
  - US Geological Survey
  - UF
  - AGS
  - COSMOS
  - Construction Industry Research and Information Association (CIRIA)
  - Ohio Department of Transportation (ODOT)
- Given the significant level of “buy-in” to the DIGGS project, it is quite likely to become the new world standard when it is published in 2007.

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SOFTWARE SYSTEMS

- The development of a data standard is highly beneficial for software systems
- Many software systems have used proprietary data formats in the past and it is likely they will be used in the future
- Proprietary formats generally complicate the exchange of data between agencies

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SOFTWARE SYSTEMS – AGS SUPPORT

- AGS File Manager - Data validation
- ALF - Data validation
- Contam Data System - Geoenvironmental database systems
- CPT-pro - Insitu testing
- DataSystem 7 - Laboratory testing (soil)
- GEODASY - Database systems (with log production)
- GeoSmart II - Borehole log production
- GEOVIEW - Geographical information systems
- gINT LogWRITER+ - Database systems (with log production)
- gINT Professional - Database systems (with log production)
- HoleBASE III - Database systems (with log production)
- INCLI-pro - Instrumentation
- KeyAGS - Data validation information
- KeyGeoView - Geographical systems
- KeyHOLE - Database systems (general)
- KeyLAB - Laboratory testing (soil)
- MonitoringPoint - Instrumentation
- PocketSI - Field data collection
- SID - Database systems (with log production)
- Smart Lab - Laboratory testing (soil)
- Smart-M - Instrumentation
- SOILVISION – Database system (saturated and unsaturated soils)
- TECHBASE - Database systems (with log production)

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SOFTWARE SYSTEMS – WEB BASED

- It should be noted that any proposed data standard does not necessarily provide a good database design format
- The purpose of a data standard is primarily for data exchange
- Web-based geotechnical database systems show promise for the future of managing and using geotechnical data
- Off-the-shelf commercial web-based systems are not currently available
- Governmental companies have a strong desire to manage larger amounts of information and make it public to all companies
- Web platforms offer an ideal setting for the dissemination of geotechnical data for these organizations
- Web-based systems have therefore been developed in conjunction with large initiatives where data from multiple organizations must be managed

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CASE STUDY – US DOTs

- State DOT geotechnical specialists are pursuing means to better manage geotechnical data (e.g., boring logs, lab test data), geologic hazards (e.g., landslides, rockfalls, mine subsidence), and assets (e.g., walls, reinforced slopes)
- The geotechnical investigation records for the state drilling crews are stored in a warehouse at the central DOT vehicle maintenance facilities once the projects are completed
- Multiple projects are stored in each cardboard records box and the boxes are indexed by the section of warehouse shelf where they are stored


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CASE STUDY – US DOTs

- Over 21,000 index cards are maintained to provide a reference to the project boxes
- Frequently, box location and subsequent reference numbers are changed without updating the index cards
- This makes the retrieval of information difficult and time consuming
- It currently requires 20-30 person hours per week to retrieve information for planning and preliminary design of projects


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CASE STUDY – US DOTs

- This historical information is valuable for nearly all future highway projects including rehabilitation and widening
- The information stored at the central office is valued at $½ billion
- An equivalent amount of geotechnical data is also stored at District offices
- It is estimated that the use of this information will reduce the amount of drilling for projects by 10-20% resulting in cost savings of $12-24 million per year

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CASE STUDY – US DOTs

- Subsurface investigation data and reports for consultant designed projects are placed in their respective project files residing at each District office
- This information is held in the file until several years (usually about 7 to 8 years) after the completion of the project
- Then, the project files are purged and disposed of (difficult to search in the future)
- This practice may result in the loss of geotechnical data valued at an estimated $52 million per year

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CASE STUDIES – CALTRANS

- The current archives of geotechnical information at California Department of Transportation (Caltrans) includes large volumes of paper records
- There is significant pressure to expedite project delivery and this heightens the need for more efficient data management practices as well as data collection practices

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CASE STUDIES – CALTRANS

- In order to expedite the entire workflow, Caltrans has undertaken a number of initiatives:
- **Borehole logging data:** Collaboration with the DIGGS geotechnical data management committee has resulted in efforts to develop and finalize a reasonable data dictionary – standardized borehole information
- **Field borehole logging with Tablet PC's:** Four PCs have been deployed over the course of a year in 2005. It is anticipated that the use of these units will minimize errors from multiple handling of data between field and office operations.

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CASE STUDIES – CALTRANS

- **Laboratory Data Management Software:** Work is currently underway to develop and test an advanced soils laboratory data management system. The system is designed to replace previous laboratory processes where test data is logged on paper forms.
- **Insitu test data:** A study was undertaken 2002 to explore the feasibility of an effective web-based repository for Cone Penetration Test (CPT) data. The result of this work:

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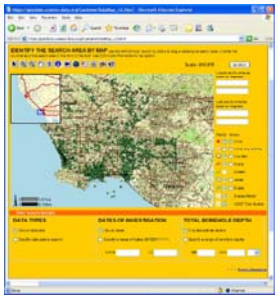
CASE STUDIES – CALTRANS

- **Partnerships: COSMOS/DIGGS**



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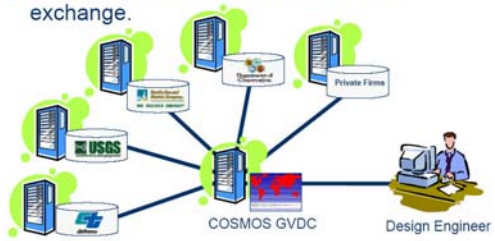
CASE STUDIES – CALTRANS

- Partner agencies benefit through data exchange.



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CASE STUDIES – Mn/DOT

- The Minnesota Department of Transportation (Mn/DOT) has advanced over 20,000 soil borings and CPT soundings in the past 46 years (Dasenbrock, 2006)
- With this significant amount of data there has been a concerted effort over the past few years to improve the methodology associated with handling the data
- A web-based interface and set of query tools was developed in 2003. A public version of this system is expected to be ready in 2006
- Mn/DOT is one of the organizations involved in the development of the new DIGGS standard and the organization is working towards compatibility

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CASE STUDIES – eEarth

- The eEarth system (http://fraga.nitg.tno.nl/dinoLks/eEarth.jsp) allows the user to browse borehole data held by six European geological surveys, representing the United Kingdom, Netherlands, Germany, Poland, Czech Republic and Lithuania
- The system incorporates a multilingual web GIS interface, and borehole information can be displayed in seven European languages: English, Dutch, German, Polish, Czech, Lithuanian and Italian

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CASE STUDIES – eEarth

- Support:
  - The Netherlands Institute of Applied GeoScience (TNO-NITG, NL)
  - The Dutch Geological Survey
  - British Geological Survey (BGS, UK)
  - German Geological Survey (Bundesanstalt fur Geowissenschaften und Rohstoffe, BGR)
  - Lithuanian Geological Survey (LTG, LT)
  - Polish Geological Institute (PGI, PL)
  - Geofond (CZ)
  - Geodan Mobile Solutions (NL)
  - Golder Associates (IT)

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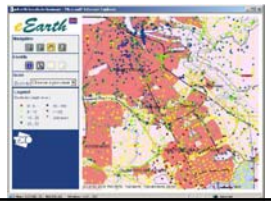
CASE STUDIES – eEarth

- Initial project development took place over a span of approximately 18 months.
- A great deal of effort was invested in converting information from a various formats into a consistent standard.
- The eEarth project developed its own data standard based on the XML schema (http://eearth.nitg.tno.nl/schema/e_earth.xsd).



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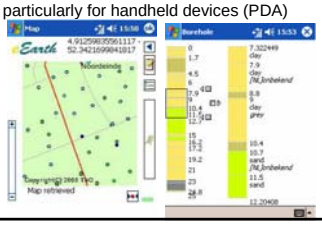
CASE STUDIES – eEarth

- The eEarth initiative has also included support for mobile handheld devices
- A mobile user is able to visualize his location as well as displaying a log of a borehole of their interest
- The borehole can be selected by a means of a GIS applications developed particularly for handheld devices (PDA)



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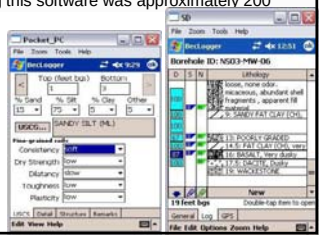
CASE STUDIES – Bechtel

- Bechtel has now attempted to improve the handling of borehole data by developing a software application known as a Personal Digital Assistant, PDA
- It is estimated that the manpower savings for logging and producing final logs for 20 boreholes using this software was approximately 200 hours
- The initiative spearheaded by Bechtel has also involved Idaho National Labs and resulted in the development of a borehole logging program called BecLogger



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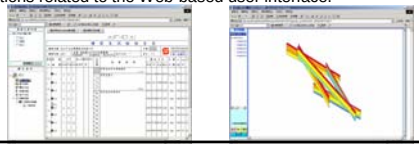
CASE STUDIES – Sinotech

- Sinotech engineering consultants in Taiwan had a need for proper management at geotechnical engineering sites
- A preliminary web-based system named GENET has been established and applied in practice (Wang, 2006)
- The system includes modules for project management, borehole log report generation, strata definition, and a geological database of 16,417 boreholes around Taiwan
- The most common complaint associated with the system has to do with limitations related to the Web-based user interface.



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APPLICATION TO INAC

- There are many similarities between current INAC efforts and existing efforts by other government organizations in other countries
  - Consideration should be given to supporting the DIGGS recommended exchange format in the current database design.
  - The DIGGS XML format should provide reasonable avenues for:
    - easy submission of new data, and,
    - validation of new and existing data.
  - It may be reasonable to review the design of existing databases for borehole data, in situ and laboratory test results in light of the DIGGS format.
  - Storage of sieve analysis data should be designed such that it conforms to the DIGGS format
  - Data reporting methodologies could benefit from the use of XML style-sheets
  - Design of the current web system could benefit from an in-depth review of related efforts

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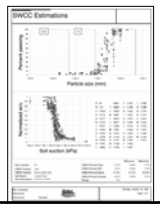
APPLICATION TO INAC

- Other possible expansions of the web-based database system include:
  - Data standard/expectation for each resource location
  - Digitization of sieve analysis paper reports. Consultants would then be able to search for related resources within a certain design “band”
  - Quality – grain-size distributions within a certain pit can be pulled up
  - Calculation of statistical parameters, mode, median, graphic mean, skewness, effective grain diameter, D10, D30, etc.
  - Advancement of sieve analysis reports



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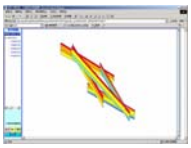
APPLICATION TO INAC

- Other possible expansions of the web-based database system include:
  - Generation of graphical borehole logs
  - Fence diagram reporting for multiple boreholes
  - Support for PDA devices



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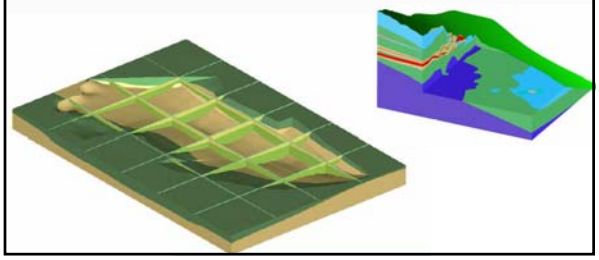
APPLICATION TO INAC

- Other possible expansions of the web-based database system include:
  - 3D representation of granular resource



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THANK YOU…