DIGGS

Digital Interchange for Geotechnical and Geoenvironmental Specialists

Development of Geotechnical Data Schema in Transportation

Results Presentation
Ohio DOT
June 22, 2012

Marc Hoit, PI
Vice Chancellor for IT and Professor Civil Engineering
North Carolina State University

FHWA Pooled fund study TPF-5(111)

Outline

- Why do we need DIGGS?
- What is DIGGS?
- What can DIGGS do?
- Some examples of software using DIGGS
- A short technical description of the schema
- Future of the standard

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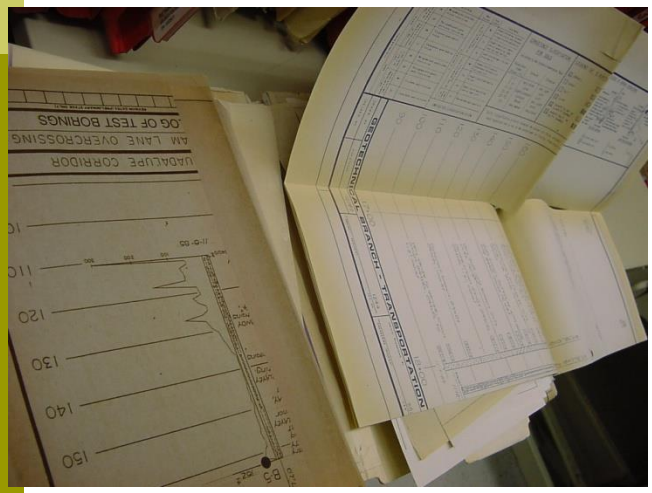
Caltrans Experience

- 30,000 project files
- 2 million documents
- 300 projects/year
- 80 years of data
- Difficult to access information



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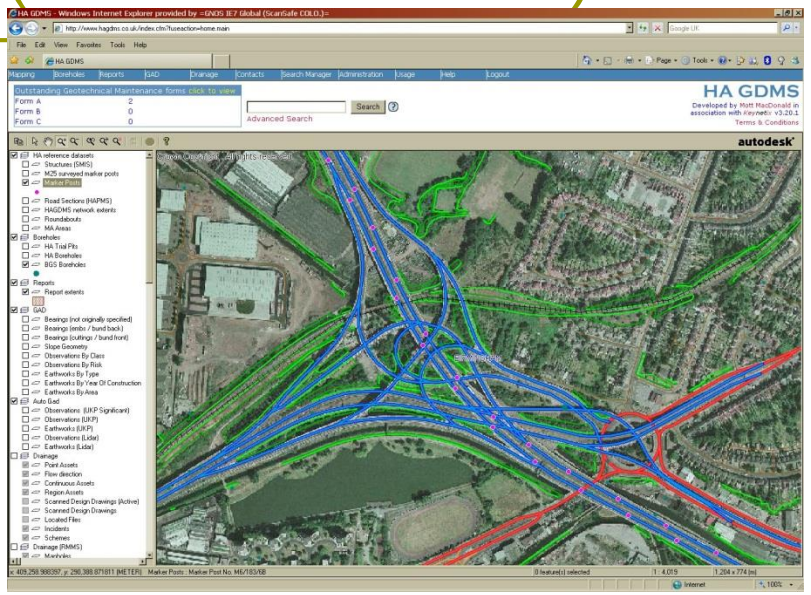
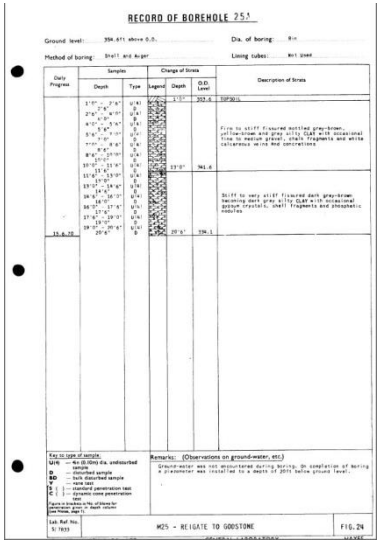
Ohio DOT Experience

- 20-30 person hours per week to retrieve information

The HA Geotechnical Data Management System (HA GDMS)

- Internet-based GIS
- Stores data on:
  - spatial context (mapping and aerial photos)
  - assets
  - reports
  - boreholes
- Supports UK AGS data transfer format
  - data storage/retrieval
  - summary logs
  - summary test sheets





AGS

AGS Data Committee History

Key dates for the Data Format Committee

1991 -convened in after a conference to discuss electronic data transfer
1992 AGS v1
1994 AGS v2
1999 AGS v3
2002 AGS-M
2004 AGS v3.1
2004 Launch of the web site
2008 renamed **Data Management Committee**

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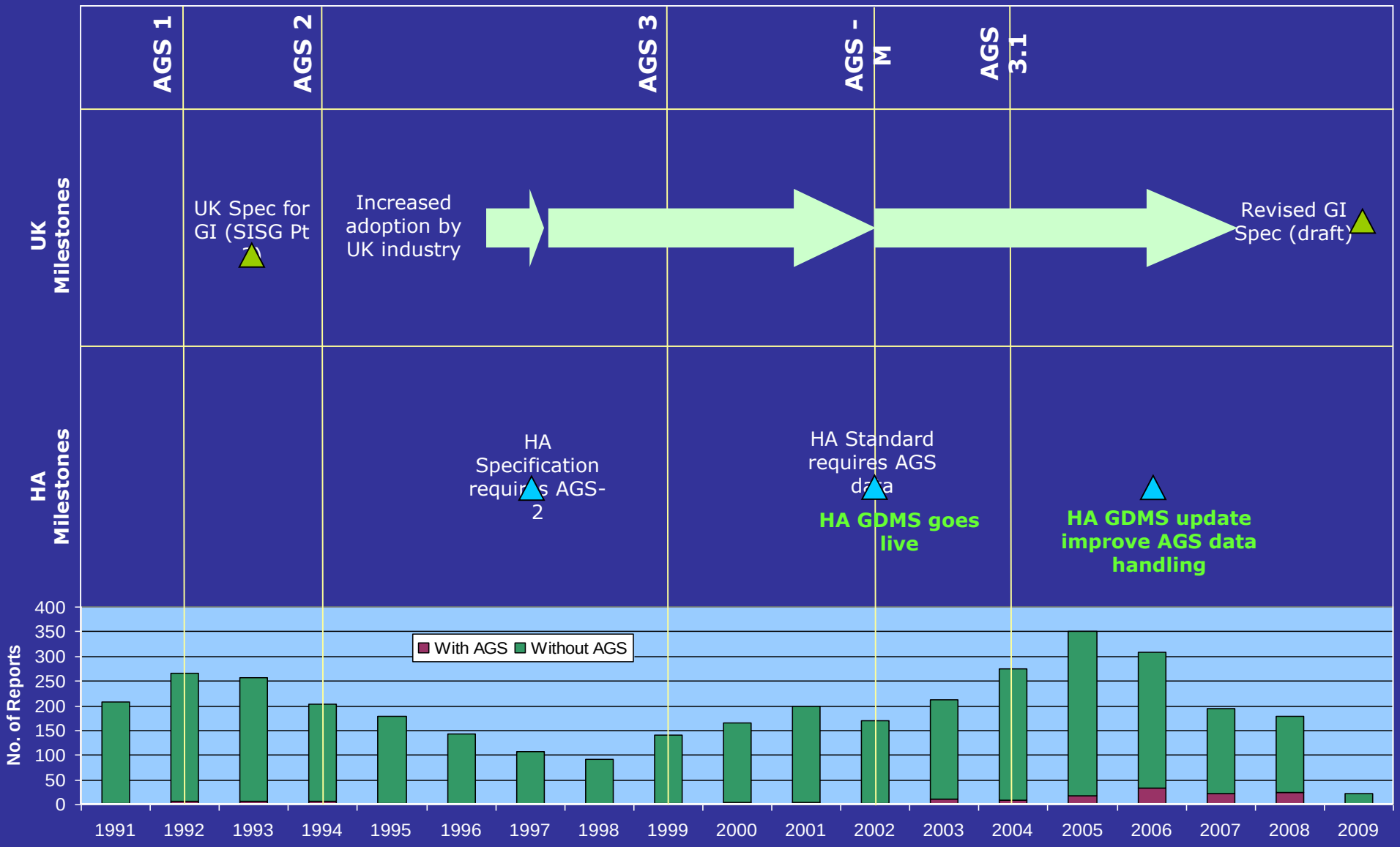
AGS Implementation Timeline



What is DIGGS?

- DIGGS = "Data Interchange for Geotechnical and Geoenvironmental Specialists"
- Standardized international format for the electronic transfer of geotechnical and geoenvironmental data
- Software neutral and non-commercial
- Fully extensible
- DIGGS is not:
  - A software application
  - A database structure

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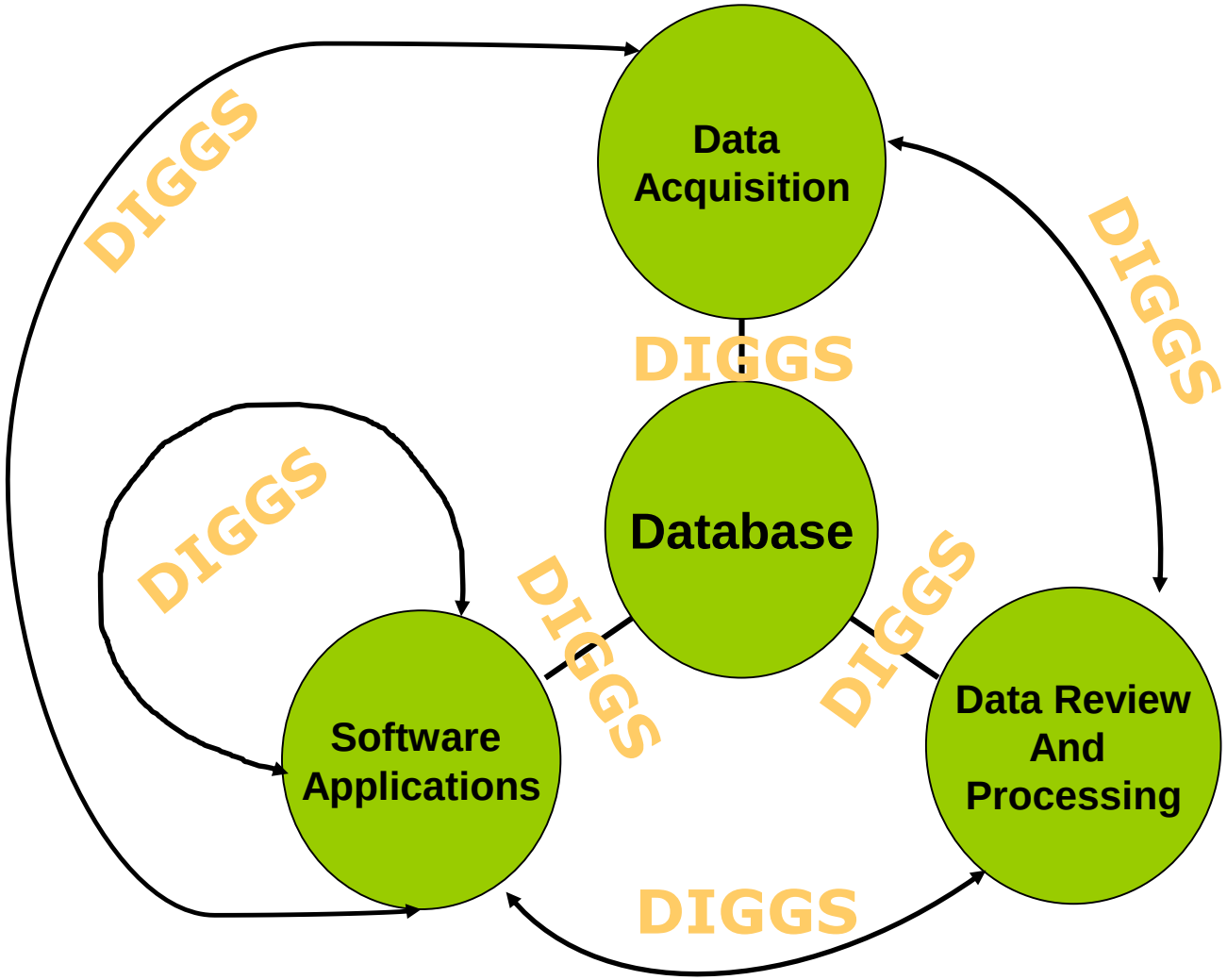
The DIGGS Advantage



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Characteristics of DIGGS

- DIGGS provides a context for different kinds of data that may be related administratively or spatially
- Transfers data commonly reported as part of a geotechnical investigation
  - Borehole records
  - In-situ test data
  - Monitoring data
  - Laboratory test summaries
  - Geophysical data (Logging)
  - Geoenvironmental data (Water quality & Testing)

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Key Activities

- Borehole Data
  - Point Location
  - Drilling Operations

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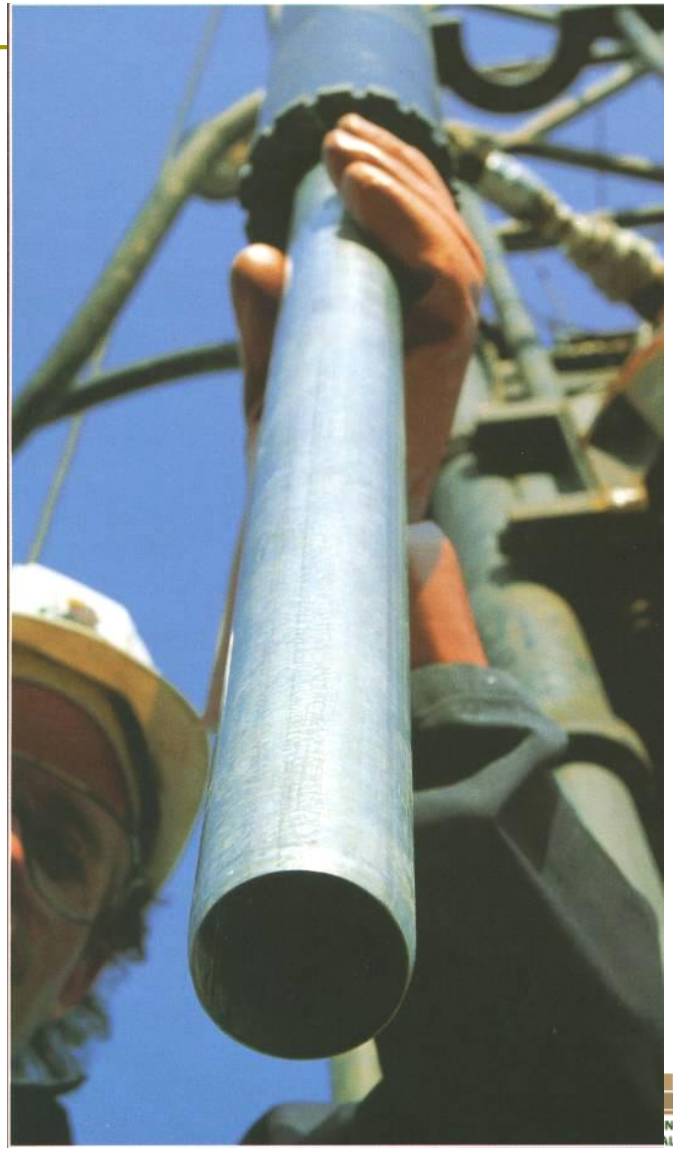
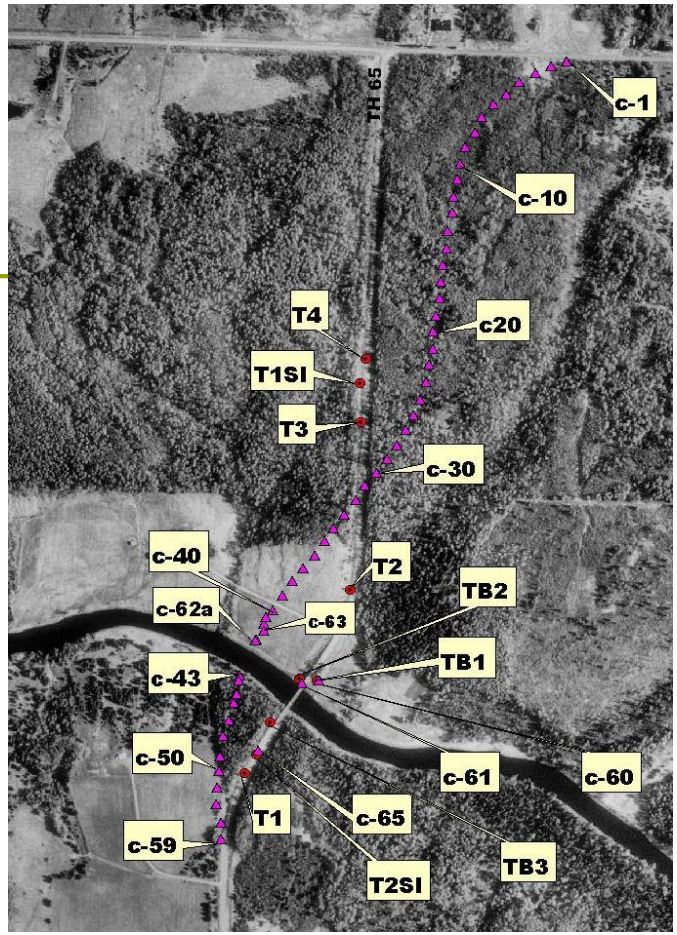
Key Activities

- Borehole Data
  - SAMPLES!



Data TRANSFER

- Site Information
- Depth Information
  - Field
  - Lab Testing
  - Soil and Rock



Data TRANSFER

- Lab Data (results and/or test data)

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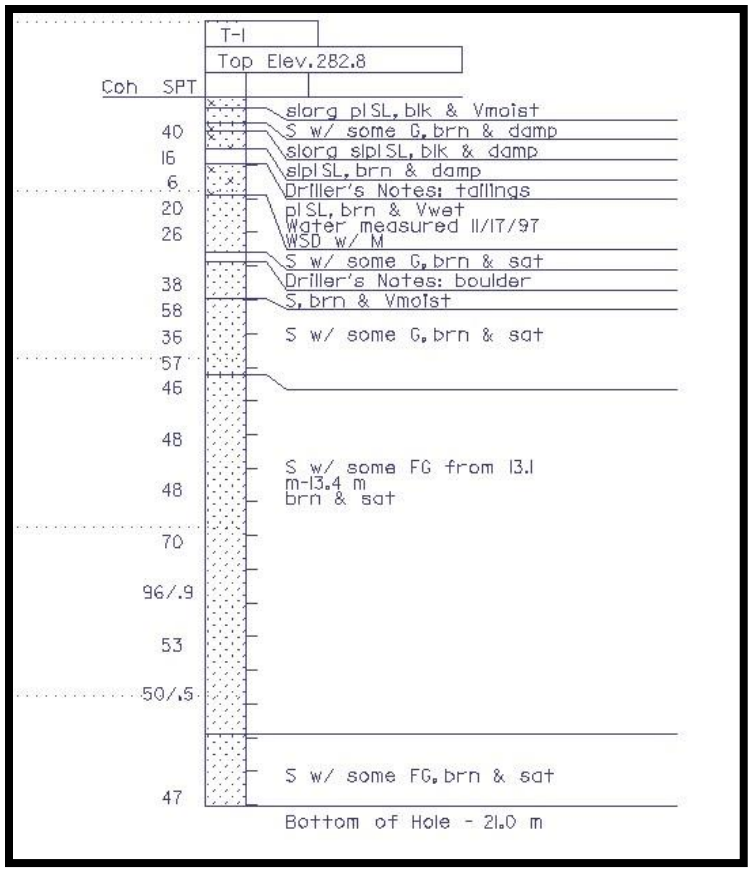
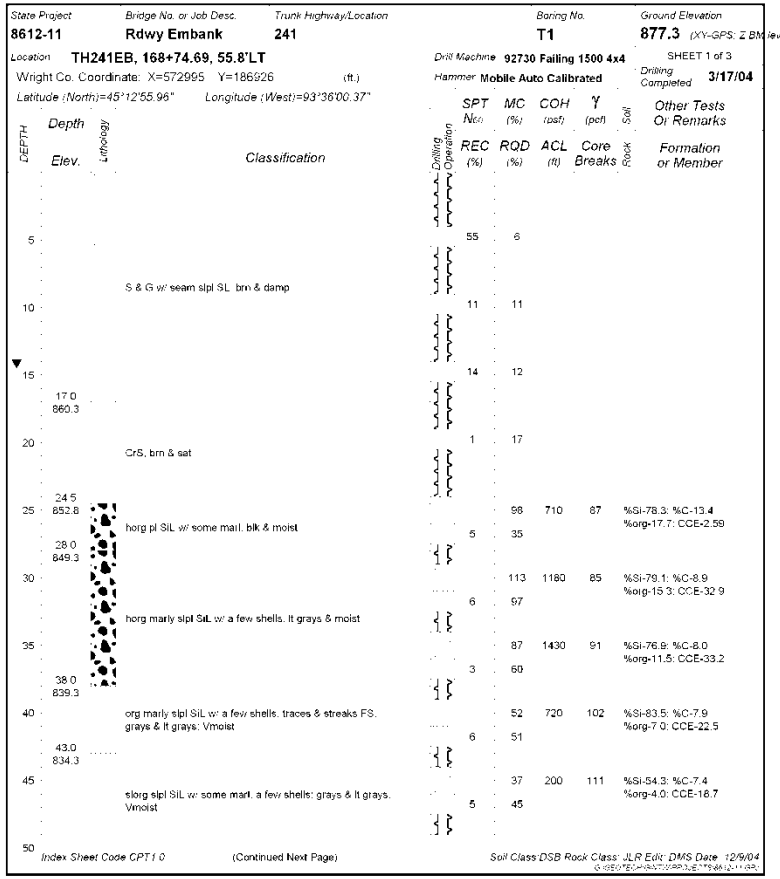
Logs and Log Data

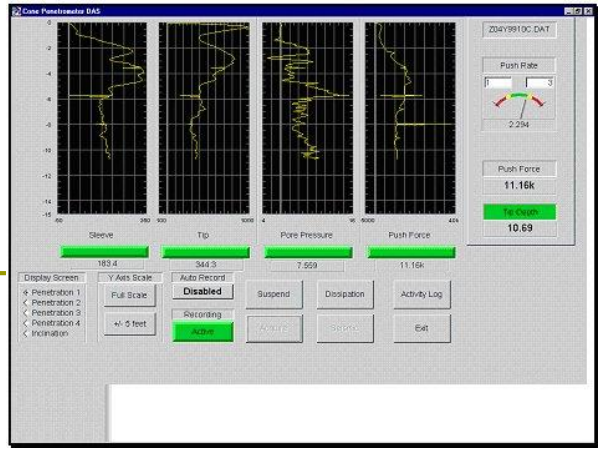
- Electronic / Paper

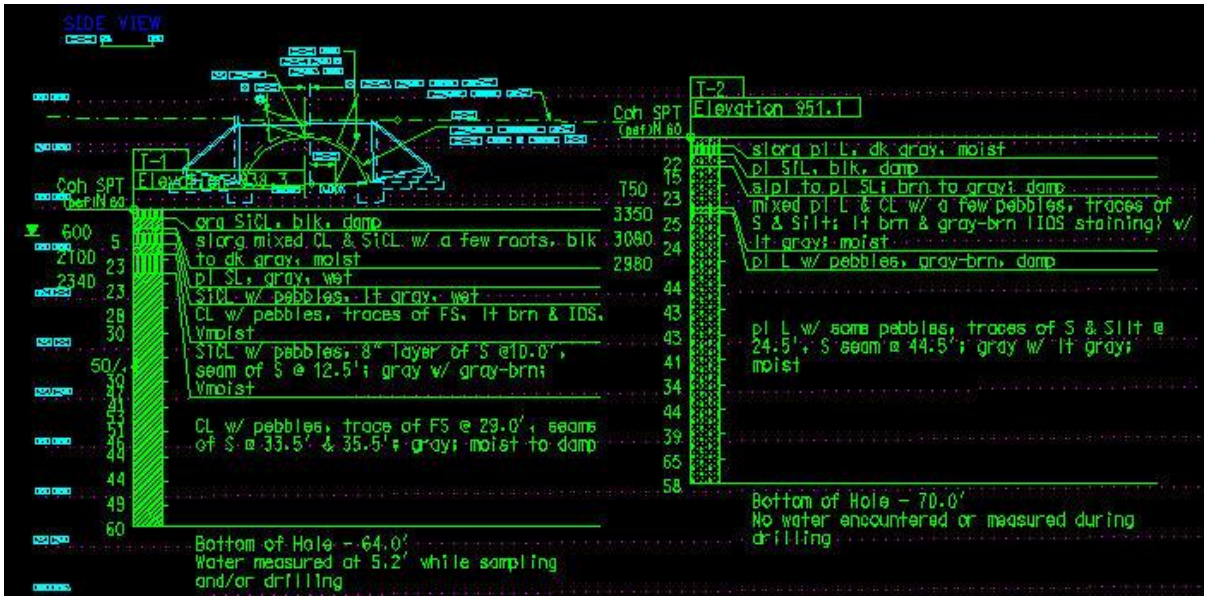




Data TRANSFER

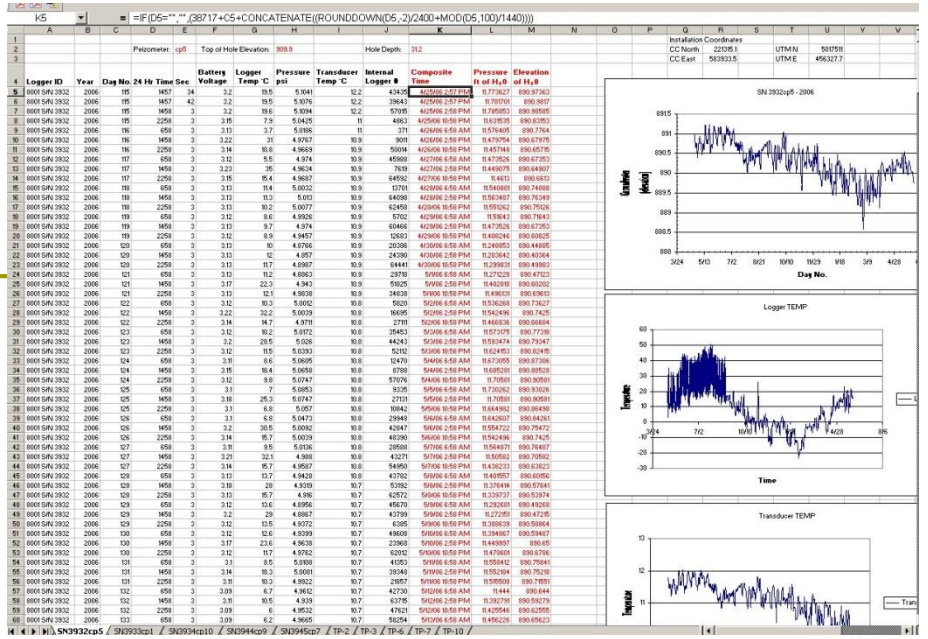
- Borehole data
  - From field to office
  - Intraoffice (among software)
  - Interoffice (among staff)
  - From office to External

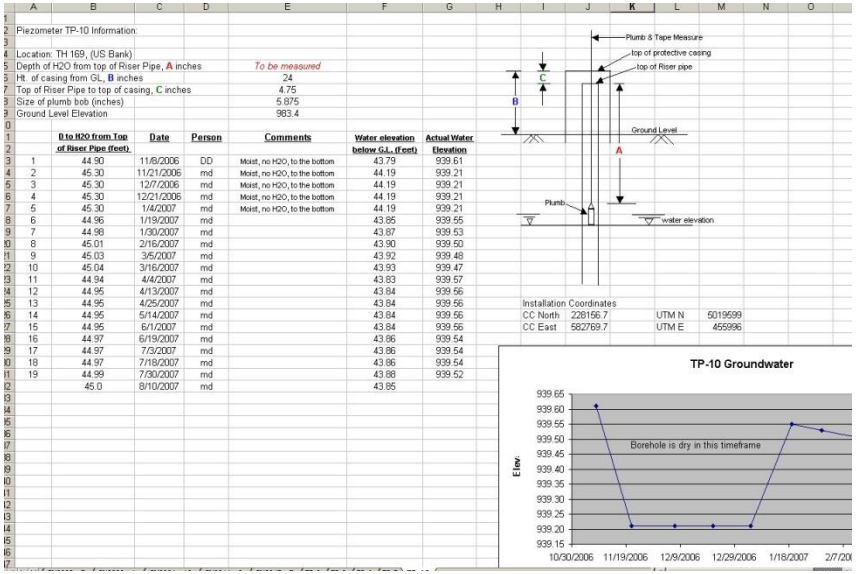




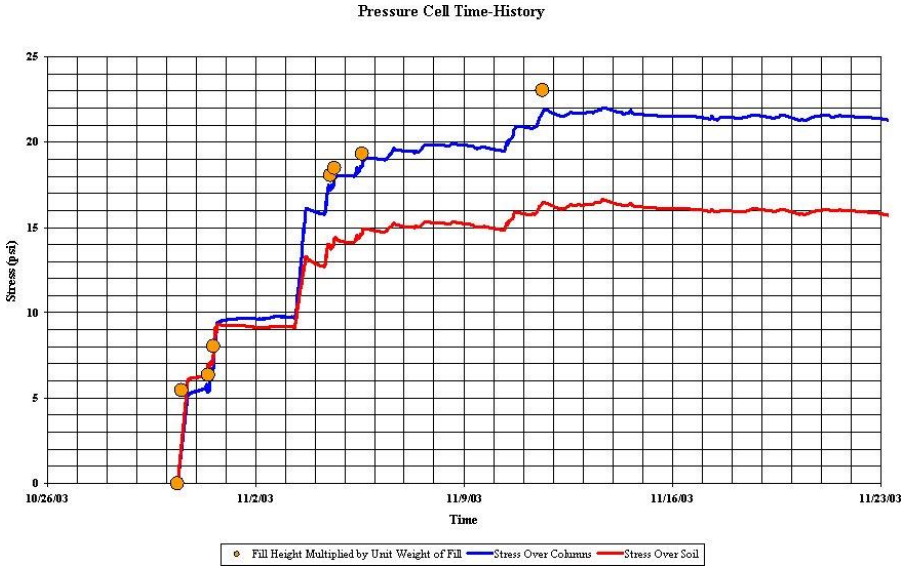
Sensor Data

- Manual
- Automated





	B to H2O from Top of Riser Pipe (feet)	Date	Person	Comments	Water elevation below GL, (Feet)	Actual Water Elevation
1	44.90	11/6/2006	DD	Moist, no H2O, to the bottom	43.79	939.61
2	45.30	11/21/2006	md	Moist, no H2O, to the bottom	44.19	939.21
3	45.30	12/7/2006	md	Moist, no H2O, to the bottom	44.19	939.21
4	45.30	12/21/2006	md	Moist, no H2O, to the bottom	44.19	939.21
5	45.30	1/4/2007	md	Moist, no H2O, to the bottom	44.19	939.21
6	44.96	1/19/2007	md		43.85	939.55
7	44.98	1/30/2007	md		43.87	939.53
8	45.01	2/16/2007	md		43.90	939.50
9	45.03	3/5/2007	md		43.92	939.48
10	45.04	3/16/2007	md		43.93	939.47
11	44.94	4/4/2007	md		43.83	939.57
12	44.95	4/13/2007	md		43.84	939.56
13	44.95	4/25/2007	md		43.84	939.56
14	44.95	5/14/2007	md		43.84	939.56
15	44.95	6/1/2007	md		43.84	939.56
16	44.97	6/19/2007	md		43.86	939.54
17	44.97	7/3/2007	md		43.86	939.54
18	44.97	7/18/2007	md		43.86	939.54
19	44.99	7/30/2007	md		43.88	939.52
	45.0	8/10/2007	md		43.85	



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Workflow within an Organization

Data is collected in the field electronically

Data files are transferred to a central repository

Design Engineer

Drafter

Other Staff

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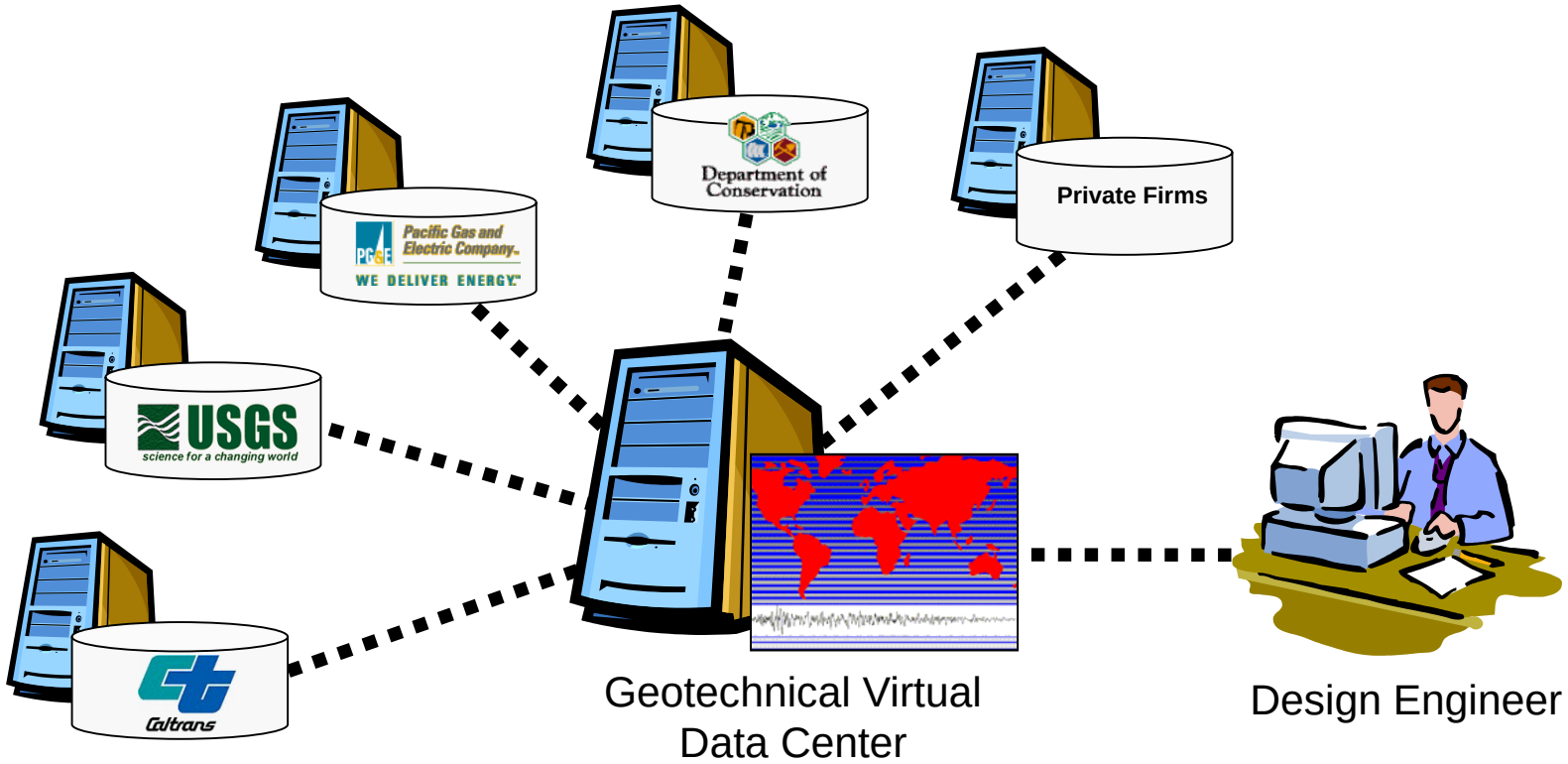
Connection to Multiple Data Sources



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Cost Savings

- Ohio DOT:
  - 10-20% less drilling, savings $12-24M per year
- Florida DOT:
  - Fewer borings saving $250,000 - $500,000 on one project
- Missouri DOT:
  - 10-15% fewer borings per bridge
- Missouri DOT:
  - $81,000 savings per year in boring log preparation by using electronic data entry in the field
- California DOT:
  - 20% savings ($200k/year) with laboratory data management system implementation

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DIGGS Research Objective

- **Develop a standard XML schema and data dictionary for geotechnical data**
  - Survey of GMS stakeholders to identify specific geotechnical data needs (at dictionary level).
  - Survey based on previous standards by AGS, COSMOS, UF-FDOT, and EPA
  - Results were used to develop a consensus to define the international standard XML (GML compliant) data interchange format schema.
  - Majority of the effort was in agreement on definitions and XML structure.

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Characteristics of DIGGS

- Extensible Mark-Up Language (XML)
- XML Schema Definition (XSD)
  - Normative document
  - Defines elements
- Standard for internet data transfer
  - Platform independent
  - Tools available for validating, querying, processing, displaying, and transforming

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DIGGS Evolution

- Pooled Fund Study to create DIGGS
  - TPF-5(111), started 2005 (managed by Ohio DOT)
  - Merger of existing XML standards:
    - AGS standard (UK)
    - COSMOS standard (CA, Earthquake group)
    - FDOT/UF Pile standard
  - GML Compliant (International Geo-Spatial XML standard)
  - Version 2 is final result from study (June 2012)
  - Partners: AGS, COSMOS, EarthSoft, EPA, FHWA, GINT, KeyNetix, UK-HA, UF, USGS, State DOTs

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Research Scope and Phasing

- Original Proposal:
  - Phase I – Develop survey (dictionary and XML schema based on AGS, COSMOS & UF-FDOT)
  - Phase II – Complete dictionary and schema using workshops and volunteer effort
  - Phase III – Add special interest groups for new areas
- Final structure – Two major stages:
  - Stage 1 – Original Phase I, most of Phase II and part of Phase III
  - Stage 2 – Contract with GML expert to convert Stage 1 results into the final schema

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Initial Collaboration Meeting

May 2005

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Development History

Meeting	Purpose	Date	Outcomes
Pre-planning	Develop consensus on basic structure of schema	May 16-17, 2005, Atlanta, GA	Draft schema structure and plans for proposal
First Workshop	Schema outline & Data dictionary for data in existing systems. Dates, Deadlines and Deliverables	August 10-13, 2005, San Francisco, CA	Schema team and dictionary team, refined schema structure, data dictionary,
Second Workshop	Continue development of schema and dictionary	November 18, 2006, Orlando, FL	Draft schema, dictionary and users guide for presentation to GMS
GMS Meeting	Update governing body on progress and get approval for directions	January 18-19, 2006, Atlanta, GA	Approved
AGS Meeting	Develop plan to improve progress	March 2007, UK	Move to UML version with now tool to automate schema creation for consistency
Workshop V1.0 review	Review release candidate for V1.0 and plan final corrections – using new UML tool system	September, 2007, Boston, MA	Set actions, assignments and tasks to finalize V1.0 – set release for spring 2008
Invitational Workshop	Present and approve new directions for DIGGS	Orlando Florida, March 25-26, 2009	Approved new timeline, consultant for final stages, plan for permanent governance/ownership
Consultant hired	Send RFP and hire consultant	August 2009	Galdos Hired to complete Schema
Update Schema to v1.1	Consultant completes v1.1 – working with GDC members and Loren Turner – weekly calls	May 19, 2010	V1.1 released
Completion of v2.0a	Consultant delivers v2.0a schema, dictionary and report	June 30, 2012	V2.0a released
Final Transfer Workshop	Transfer DIGGS to ASCE-GeoInstitute, develop implantation proposal to ODOT	June 22-23, 2012, SF, CA	Developed proposal to ODOT for new funding to transfer schema to ASCE-GeoInstitue and make available to community.

Five Examples of DIGGS in Use

- Public
  - CalTrans – Virtual Data Center
  - Florida DOT – Geotechnical Database
- Commercial
  - Earthsoft - Equis
  - Gint
  - KeyNetix - Holebase

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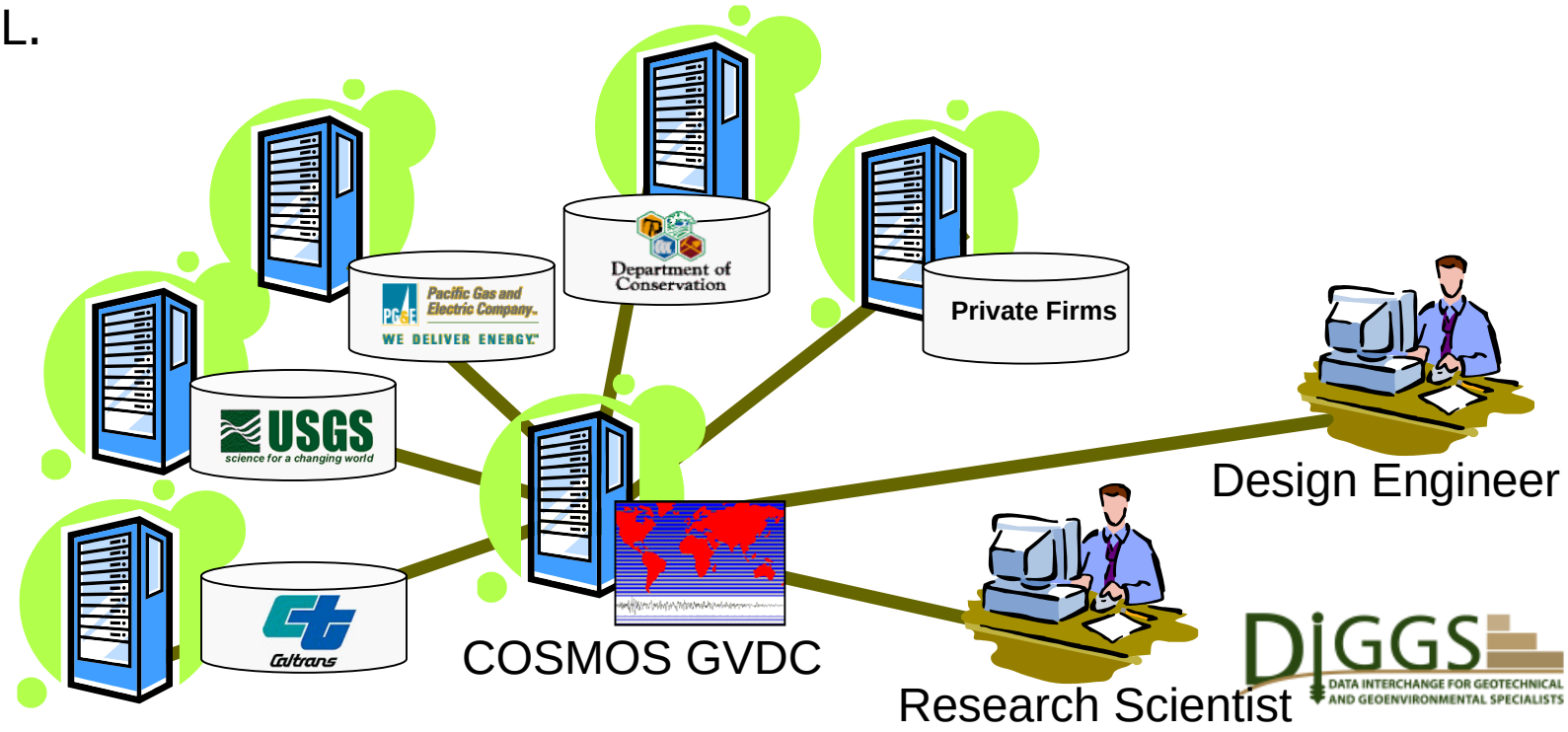
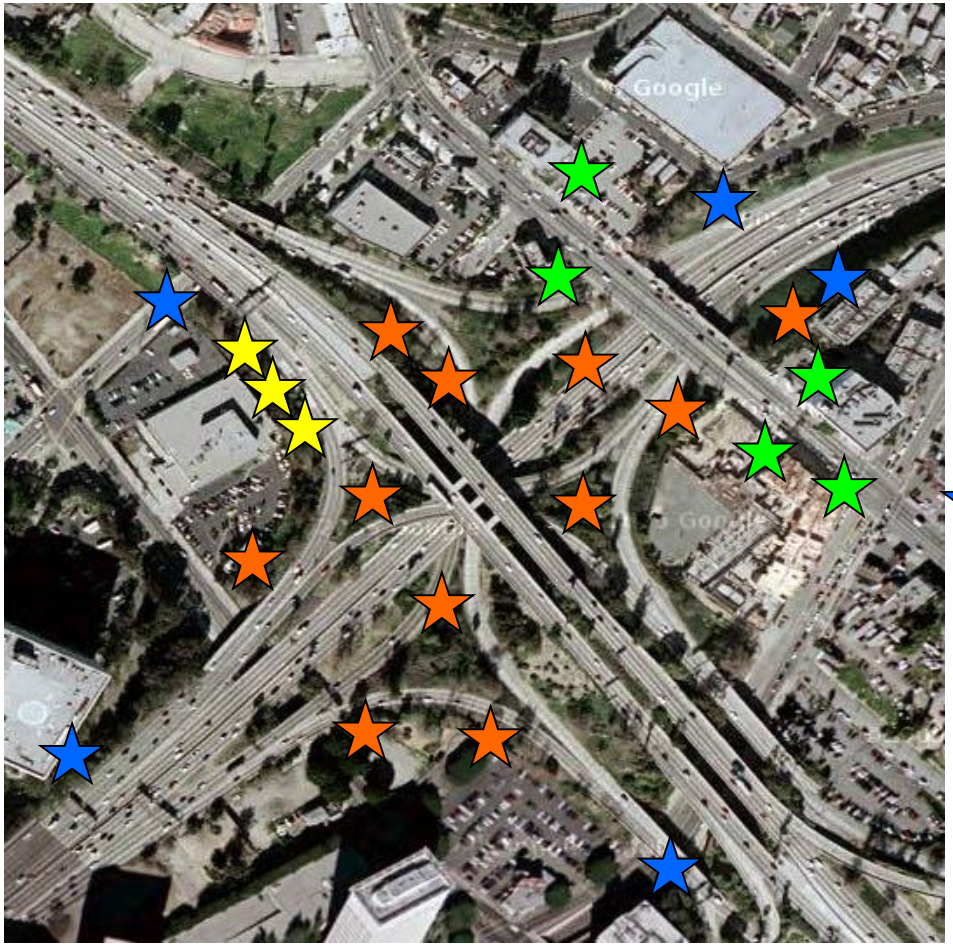
Geotechnical Virtual Data Center

- The GVDC is a web application that acts as a "broker" for geotechnical data. It is not a data repository.
- Data is held by registered data providers who maintain their data in their own proprietary systems, and make available to the GVDC only the data they choose.
- Data is transmitted to the end-user via the GVDC as DIGGS XML.



Virtual Data Center



Caltrans

PG&E

CALIFORNIA GEOLOGICAL SURVEY
CALIFORNIA CONSERVATION

USGS
science for a changing world

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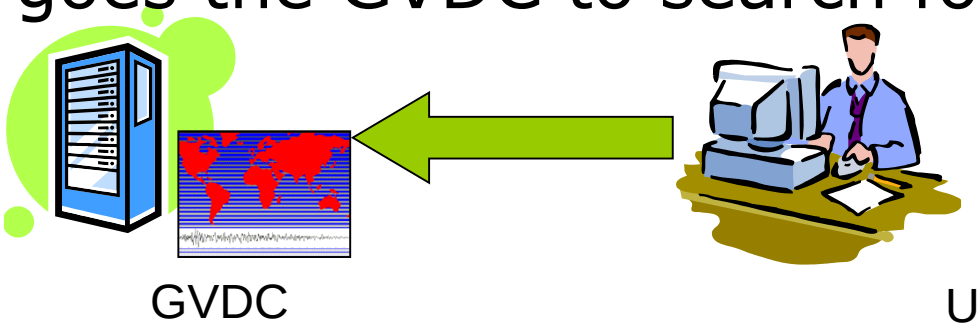
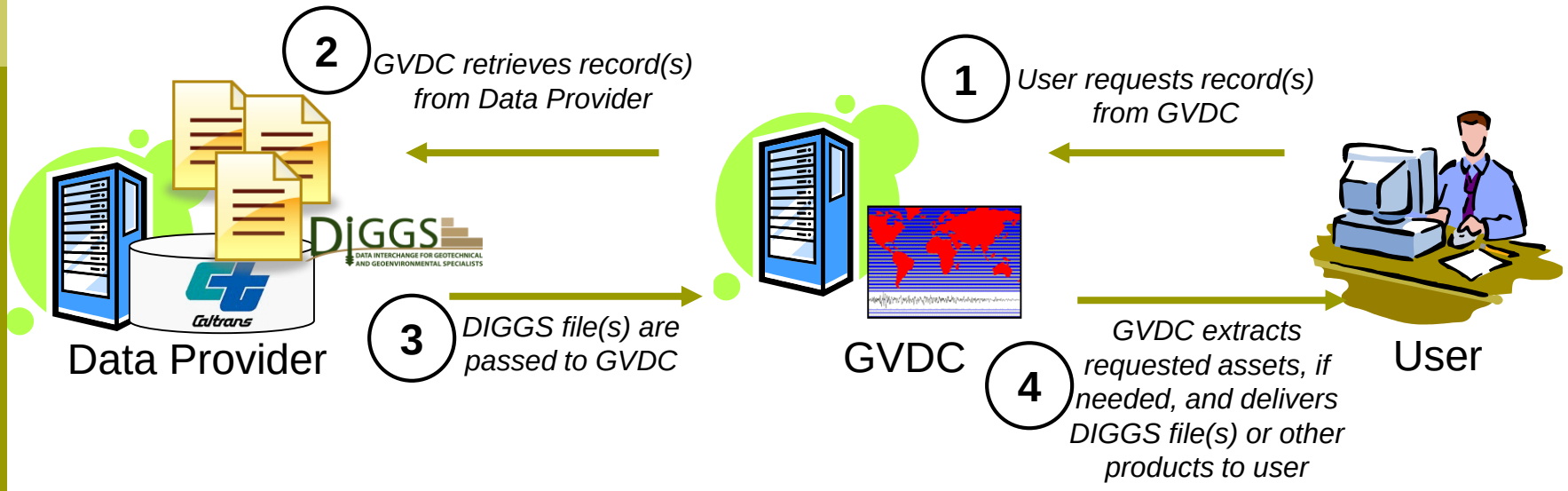
User Experience

- A user goes the GVDC to search for data



- The user requests to download and/or preview the record(s) returned by the search process.



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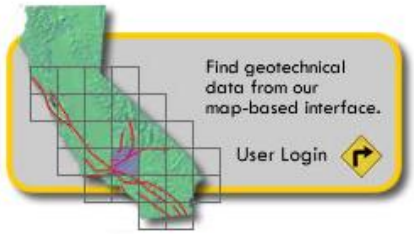
Geotechnical Virtual Data Center (GVDC)

The overall project is divided into a short-term and a long-term objective. The project we are now undertaking encompasses the short-term objective only, to develop a pilot web-based system linking the PG&E, Caltrans, CGS and USGS example geotechnical data sets. The long-term objective (a future project not yet funded) is to extend the pilot system and develop a web-based system linking multiple data sets... read more >>



Please see the Project Workshop agenda , June 21-23 '04 in Newport Beach, CA. The results of the user scenario survey more >>

The objective is to develop consensus recommendations for classifying, archiving, and web dissemination of geotechnical data... more >>

COSMOS and the PEER Lifelines Program are coordinating additional workshops and establishing a pilot project leading to... more >>

Sponsored by:

- CalTrans
- California Energy Commission
- Pacific Gas & Electric
- PEER-Lifelines Program

In Partnership with:

- Pacific Earthquake Engineering Research Center
- United States Geological Survey
- California Geological Survey

Implemented by:

- University of Southern California
- Consortium of Organizations for Strong-Motion Observations Systems

Caltrans PG&E USGS science for a changing world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Document Search
Use this page to search our database of geotechnical documentation.
Map Satellite Hybrid
Latitude: -116.90826416015625 Longitude: 33.911454454267606
Search
Provider - All Providers - Project Date(mm/dd/yyyy) from to
Asset Name Project Name Borehole Depths min max
Boundaries (decimal degrees) Longitude min Longitude max Latitude min Latitude max
Search for Selected Data Types All Checked by Default
Results Per Page 60 search


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Home Search Account Data Provider Administrator Help Log Out
Document Search
Use this page to search our database of geotechnical documentation.
Map Satellite Hybrid
VDC_754
VDC_12
VDC_753
000007_00177_33118G1
000007_00363_33118H1
VDC_755
...and 912 more
Click to list all data in this cluster.
Latitude: -117.59078979492188 Longitude: 33.831638461142866
Search
Provider - All Providers - Project Date(mm/dd/yyyy) from to
Asset Name Project Name Borehole Depths min max
Boundaries (decimal degrees) Longitude min Longitude max Latitude min Latitude max
Search for Selected Data Types All Checked by Default
Results Per Page 60 search


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Home Search Account Data Provider Administrator Help Log Out
Document Search
Use this page to search our database of geotechnical documentation.
Map Satellite Hybrid
Geotechnical Virtual Data Center Asset
Asset Name: CT-070604_07182201_04231
Project Name: 07062004_07-182201_CPT-C9-4
Data Type(s): static cone
Depth: 9.45 m Vertical
Date: 2004-07-06
Provider: CALTRANS
E Compton Blvd
Compton
Compton Par 3 Golf Course
E Alondra Blvd
Alondra
Suburban Medical Center
Artesia Fwy
E Artesia Blvd
Google
Map data ©2007 Tele Atlas
Latitude: -118.15323829650879
Longitude: 33.8767579211837
Search
Provider - All Providers -
Project Date(mm/dd/yyyy) from to
Asset Name
Project Name
Borehole Depths min max
Boundaries (decimal degrees) Longitude min Longitude max Latitude min Latitude max
Search for Selected Data Types All Checked by Default
Results Per Page 60 search

Search - Mozilla Firefox

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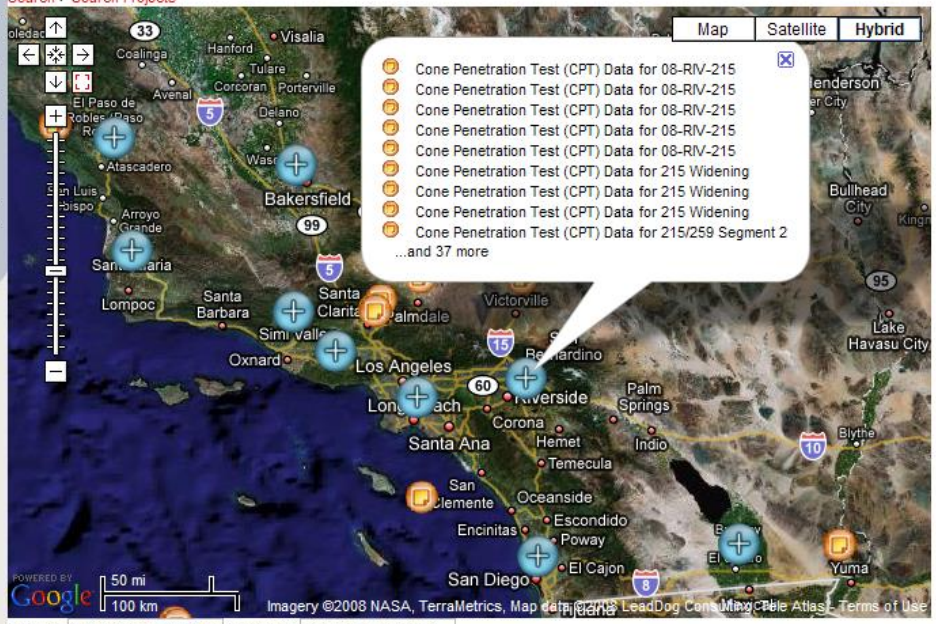
CA.GOV CALIFORNIA DEPARTMENT OF TRANSPORTATION

Welcome: Admin Profile

Search > Search Projects



Latitude: 34.0162418896670 Longitude: -114.1259765625

GEODOG TOOLS

- Home
- Search projects
- Logout
- Add Data to GeoDOG
- Manage My Account

ADMINISTRATIVE TOOLS

- System Setup
- Manage Users

LINKS

- Caltrans
- Division Of Research Innovation
- GeoResearch Group

GeoResearch Group — Caltrans — Research & Innovation

Project Information	
Project Name	
District	Any
County	Any
Route	eg: 80
Postmile /Kilopost	to eg: 90 to 120
Bridge	- eg: 34-0012 L
EA Number	eg:01-123456
Project Completion	To eg: 2004-12-31 (YYYY-MM-DD)
Search Limit	50 Projects

Location Information		
Location Description		
Latitude	Min :	Max:
Longitude	Min :	Max:

Documents and Files

COSMOS: Station USC: Long Beach, CA, Long Beach LDS Church, 6979 Orange Ave - Mozilla Firefox

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COSMOS VIRTUAL DATA CENTER

Consortium of Organizations for Strong-Motion Observation Systems

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USC: Long Beach, CA
Long Beach LDS Church
6979 Orange Ave

Agency Number: 5380
Latitude: 33.8810
Longitude: -118.1760
Site Geology: Alluvium QYM Q
Owner: University of Southern California
References

Structure: 1-Story Bldg
Instrument: Ground Level

☐ Add all data on this page to the download bin

Go to Download Bin | View Map

Whittier Narrows, California 1987-10-01 14:42:20 UTC

Summary page for this earthquake

☐ Add this station record to the download bin

Component: Up	**PGA (cm/s/s):** 132.70	**PGV (cm**
Component: 10	**PGA (cm/s/s):** 221.50	**PGV (cm**
Component: 280	**PGA (cm/s/s):** 152.50	**PGV (cm**

Return to top

Landers, California 1992-06-28 11:57:34 UTC

Summary page for this earthquake

☐ Add this station record to the download bin

Component: Up	**PGA (cm/s/s):** 19.70	**PGV (cm**
Component: 10	**PGA (cm/s/s):** 48.40	**PGV (cm**
Component: 280	**PGA (cm/s/s):** 58.70	**PGV (cm/s):** -

☐ Add this to bin

COSMOS: Data Plot Long Beach, CA Whittier Narrows - Mozilla Firefox

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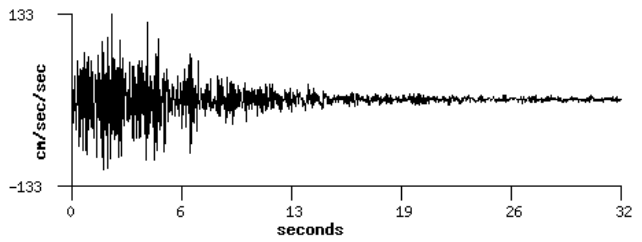
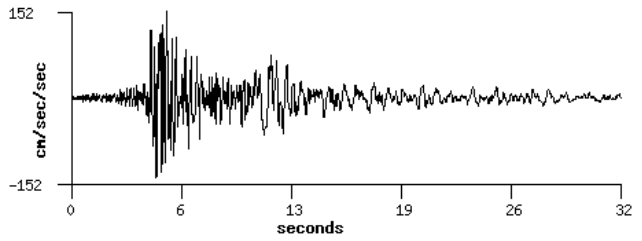
http://db.cosmos-eq.org/scripts/plot.plx?st



Component: 280 Ground Level



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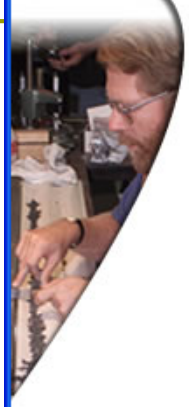
File Edit View History Bookmarks Tools Help

COSMOS/PEER-LL



Home | Search | Account | Data Provider | Administrator | Help | Log Out

Document Search Results

This page displays the results of your search of our geotechnical documentation database.

Your search returned data sets from the following data provide

CALTRANS (490)
CGS (358)
USGS (971)

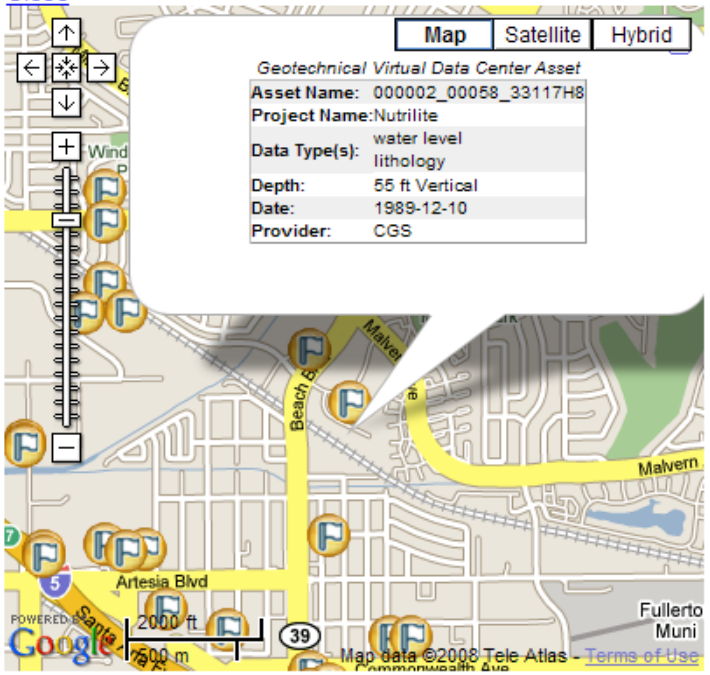
Records shown 1 - 60 of 358

1 2 3 4 5 6 Next >>

Data From CGS

Asset Name (1)	Project Name (2)			
000002_00043_33117G8	ARCO Former Station No. 1365			
000002_00049_33117H8	Shell Station			
000002_00050_33117G8	Exxon Station 7-2314			
000002_00052_33118G1	Texaco U.S.A.			
000002_00053_33117H8	Mobile Service Station No. 11-H9N			
000002_00054_33118G1	Gateway Chevrolet			
000002_00055_33117G8	Williams Volvo			
000002_00058_33117H8	Nutrilite	water level lithology		
000002_00060_33117H8	Pomona Box Company			
000002_00064_33117H8	Fast Fuel Station No. 971			
000002_00065_33117H8	Fast Fuel Station No. 971	31.5 ft vertical	1989-12-10	
000002_00067_33118G1	Bergen Brunswig Drug Company	20 ft vertical	1989-12-10	
000002_00071_33117G8	G and M Oil (50976)	15 ft vertical	1989-12-10	
000002_00073_33118G1	Unocal Station No. 5599	16.5 ft vertical	1989-12-10	
000002_00075_33117H8	Los Coyotes Country Club	55 ft vertical	1989-12-10	
000002_00078_33117G8	Percy Owens Estate	31.5 ft vertical	1989-12-10	

Close



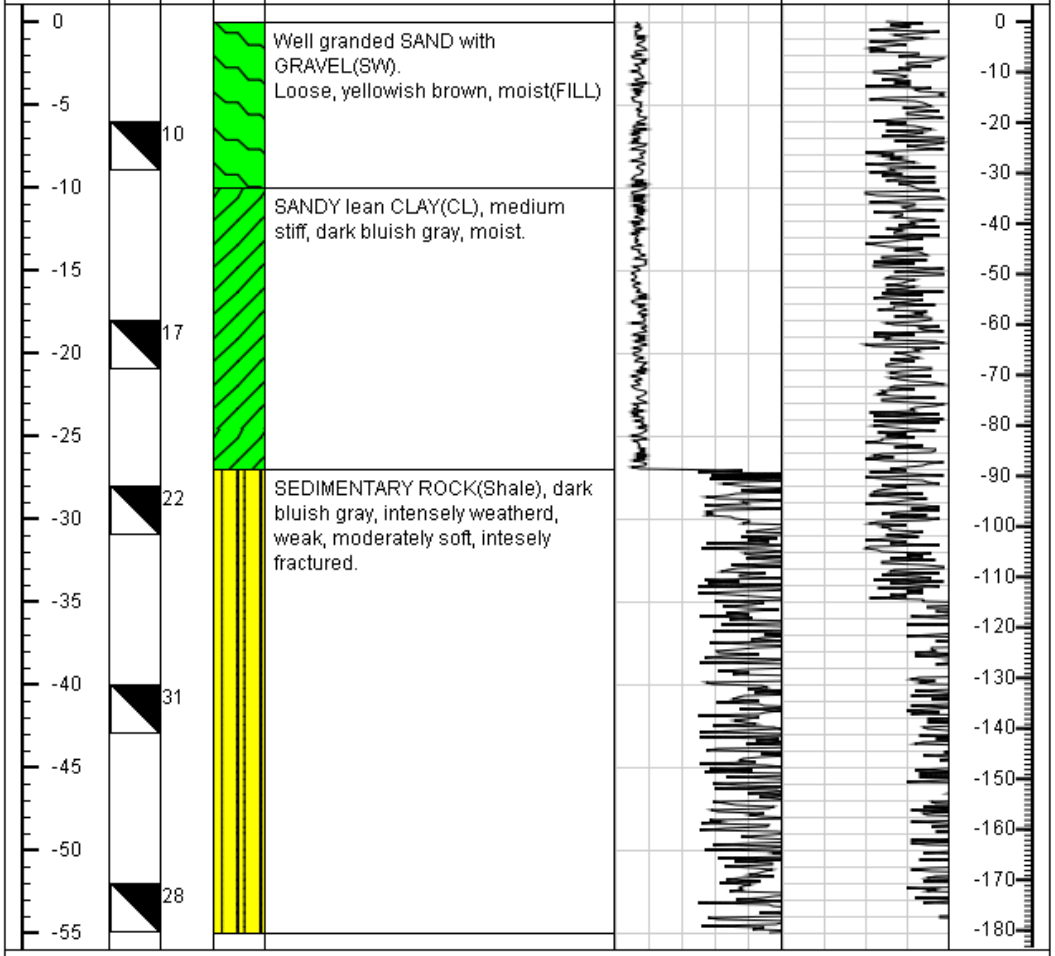
Borehole Viewer - Mozilla Firefox

File Edit View History Bookmarks Tools Help

Site Name: Leffingwell Rd. Pedestrian Undercrossing
Data Provider: CGS
Data Source: CA Dept of Transportation
Record Updated: 3/14/2002

Hole Type: test/exploratory boring
Total Depth: 51.5 m
Driller: CDT
Log Date: 8/10/1989

Record Updated: -118.1044573 deg
Record Updated: 33.90529083 deg



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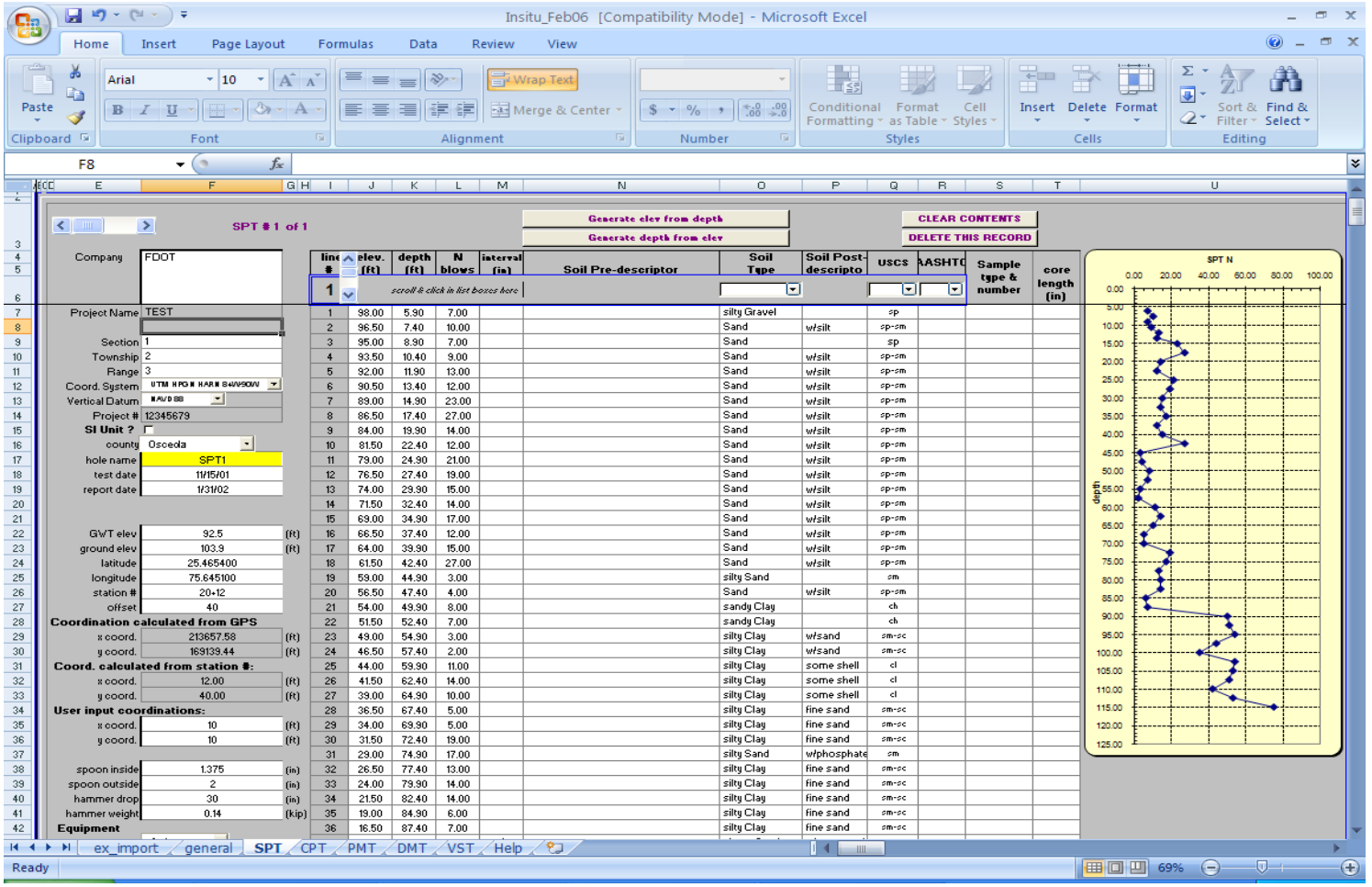
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Florida

- FDOT Geotechnical Database
- Bridge Software Institute (BSI) has developed three unique pieces of software that can access the database
  - FB-Deep
  - Pile Technician
  - Database Spreadsheets
  - http://bsi-web.ce.ufl.edu

Example of In-situ spreadsheet



BSI Bridge Software Institute

EarthSoft Data Management Software

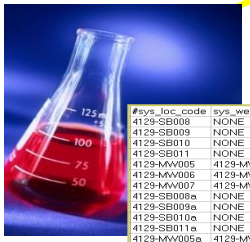
- **Environmental Quality Information System (EQuIS)**
  - The most widely used system in the world for managing technical sample data:
    - Groundwater
    - Surface Water (Stream or Lake/Reservoir)
    - Geology / Geotechnical
    - Meteorological
    - Air
  - Data Quality first, then Data Usability
  - Open System

DiGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

EQuIS Data Management Software

Field Data Collection

Monitoring/ Instrumentation

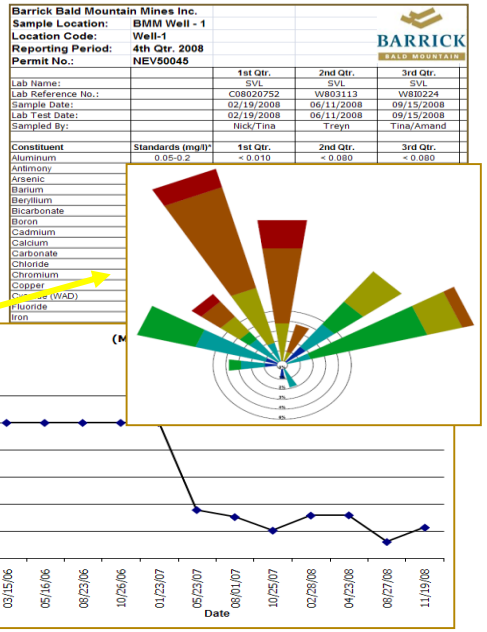


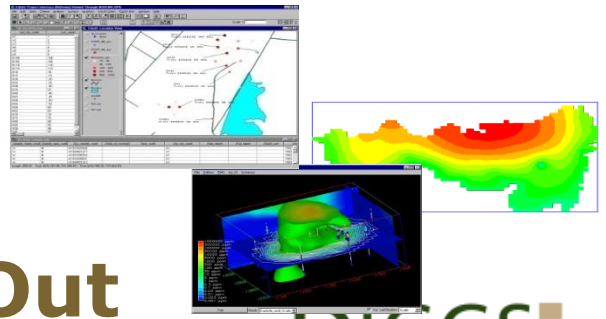
#sys_loc_code	sys_well_code	X_coord	Y_coord
4129-SB008	NONE	620071.4941	3339792.757
4129-SB009	NONE	620085.495	3339809.48
4129-SB010	NONE	619666.5208	3339949.574
4129-SB011	NONE	619505.707	3339908.768
4129-MW005	4129-MW005	619443.7651	3339953.166
4129-MW006	4129-MW006	620133.2989	3340195.292
4129-MW007	4129-MW007	620162.5517	3340127.655
4129-SB008a	NONE	620071.4941	3339792.757
4129-SB009a	NONE	620085.495	3339809.48
4129-SB010a	NONE	619666.5208	3339949.574
4129-SB011a	NONE	619505.707	3339908.768
4129-MW005a	4129-MW005	619443.7651	3339953.166
4129-MW006a	4129-MW006	620133.2989	3340195.292
4129-MW007a	4129-MW007	620162.5517	3340127.655

Laboratory EDDs

EDP

EQuIS 5





Data In, Information Out

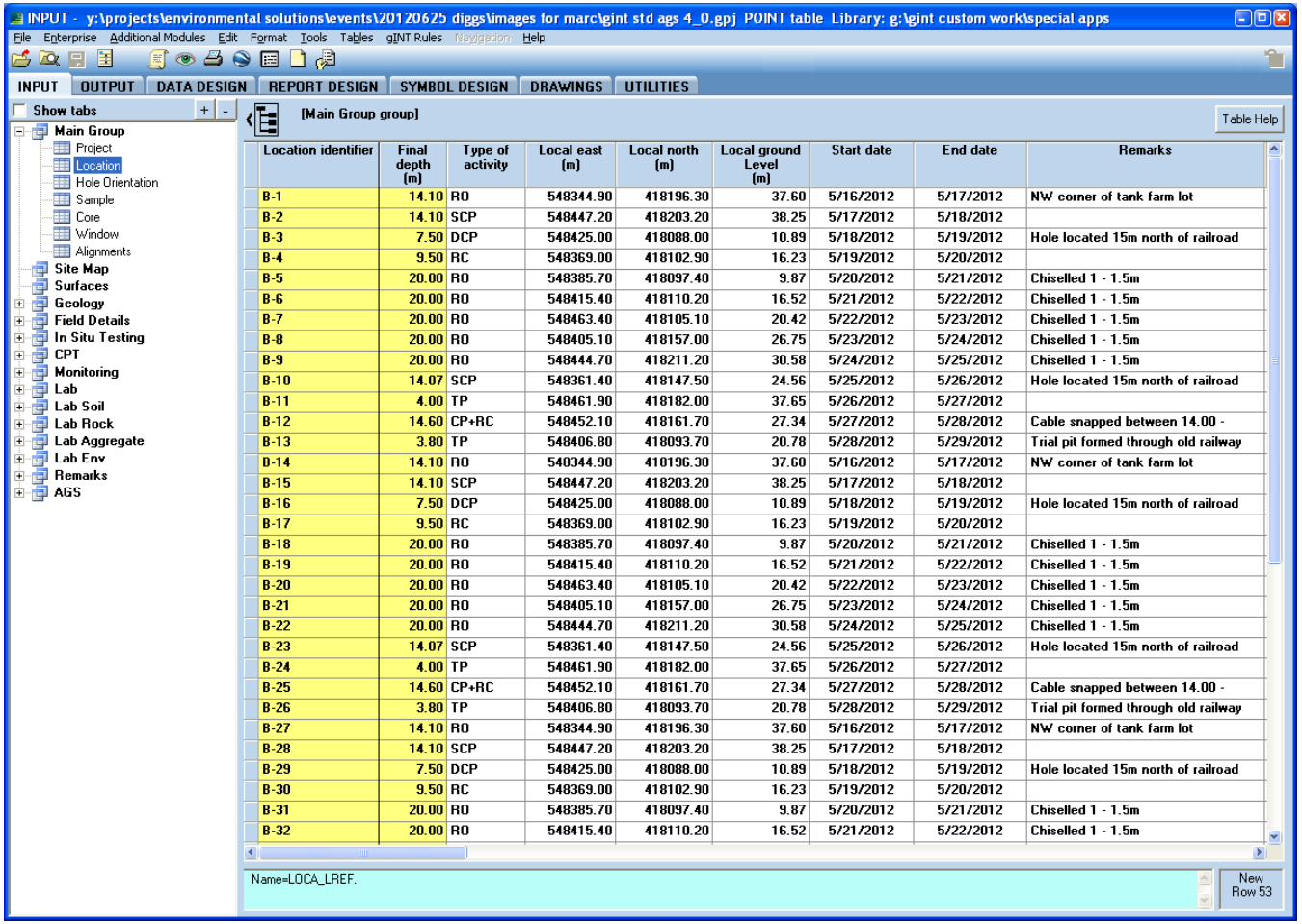
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

gINT – Geotechnical Data Management System

- Geoenvironmental and geotechnical software for reporting, managing and storing data
- Customizable:
  - borehole/boring
  - well logs
  - fence diagrams
  - geotechnical testing

DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

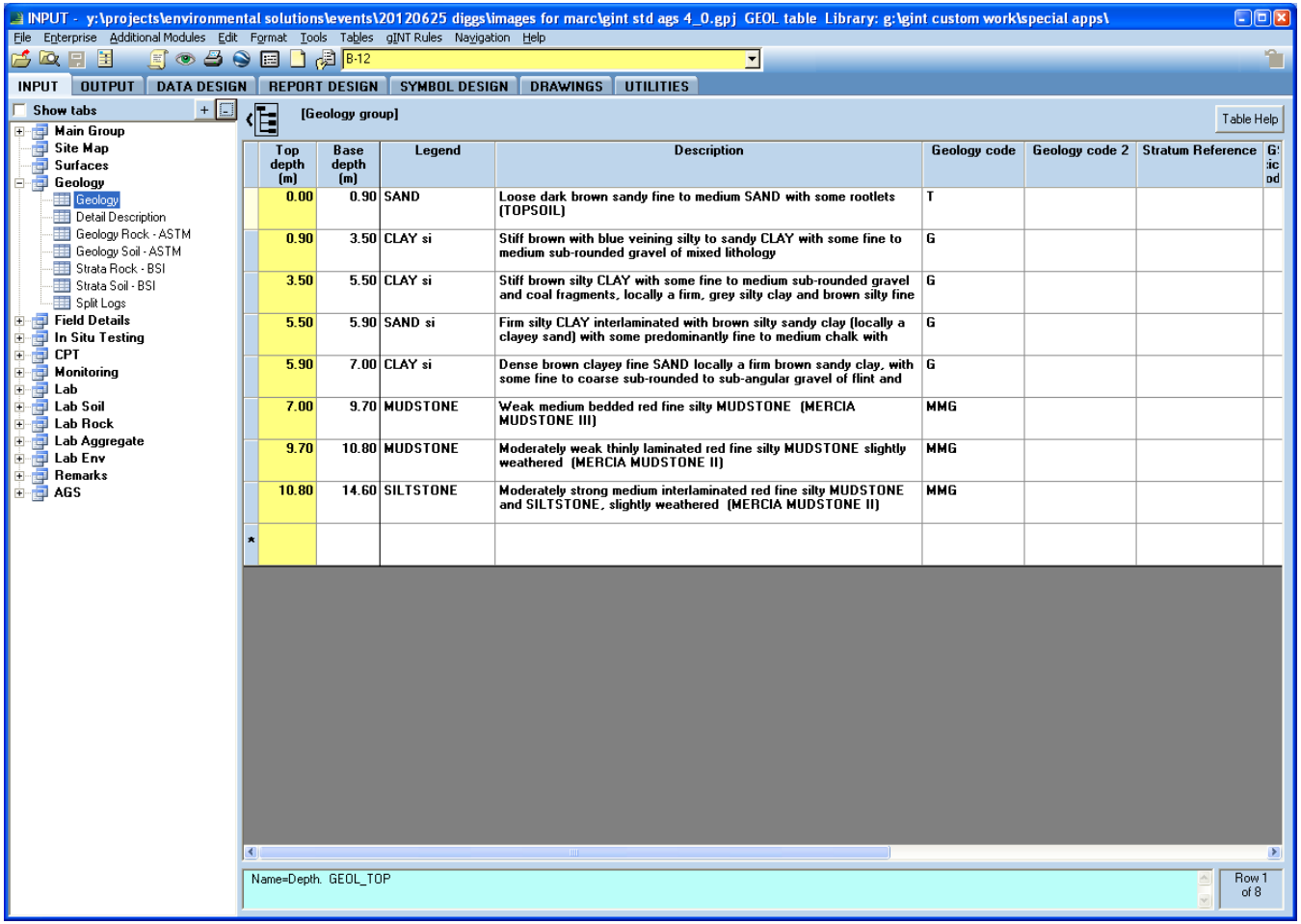
gINT - Examples



Location identifier	Final depth (m)	Type of activity	Local east (m)	Local north (m)	Local ground Level (m)	Start date	End date	Remarks
B-1	14.10	RO	548344.90	418196.30	37.60	5/16/2012	5/17/2012	NW corner of tank farm lot
B-2	14.10	SCP	548447.20	418203.20	38.25	5/17/2012	5/18/2012	
B-3	7.50	DCP	548425.00	418088.00	10.89	5/18/2012	5/19/2012	Hole located 15m north of railroad
B-4	9.50	RC	548369.00	418102.90	16.23	5/19/2012	5/20/2012	
B-5	20.00	RO	548385.70	418097.40	9.87	5/20/2012	5/21/2012	Chiselled 1 - 1.5m
B-6	20.00	RO	548415.40	418110.20	16.52	5/21/2012	5/22/2012	Chiselled 1 - 1.5m
B-7	20.00	RO	548463.40	418105.10	20.42	5/22/2012	5/23/2012	Chiselled 1 - 1.5m
B-8	20.00	RO	548405.10	418157.00	26.75	5/23/2012	5/24/2012	Chiselled 1 - 1.5m
B-9	20.00	RO	548444.70	418211.20	30.58	5/24/2012	5/25/2012	Chiselled 1 - 1.5m
B-10	14.07	SCP	548361.40	418147.50	24.56	5/25/2012	5/26/2012	Hole located 15m north of railroad
B-11	4.00	TP	548461.90	418182.00	37.65	5/26/2012	5/27/2012	
B-12	14.60	CP+RC	548452.10	418161.70	27.34	5/27/2012	5/28/2012	Cable snapped between 14.00 -
B-13	3.80	TP	548406.80	418093.70	20.78	5/28/2012	5/29/2012	Trial pit formed through old railway
B-14	14.10	RO	548344.90	418196.30	37.60	5/16/2012	5/17/2012	NW corner of tank farm lot
B-15	14.10	SCP	548447.20	418203.20	38.25	5/17/2012	5/18/2012	
B-16	7.50	DCP	548425.00	418088.00	10.89	5/18/2012	5/19/2012	Hole located 15m north of railroad
B-17	9.50	RC	548369.00	418102.90	16.23	5/19/2012	5/20/2012	
B-18	20.00	RO	548385.70	418097.40	9.87	5/20/2012	5/21/2012	Chiselled 1 - 1.5m
B-19	20.00	RO	548415.40	418110.20	16.52	5/21/2012	5/22/2012	Chiselled 1 - 1.5m
B-20	20.00	RO	548463.40	418105.10	20.42	5/22/2012	5/23/2012	Chiselled 1 - 1.5m
B-21	20.00	RO	548405.10	418157.00	26.75	5/23/2012	5/24/2012	Chiselled 1 - 1.5m
B-22	20.00	RO	548444.70	418211.20	30.58	5/24/2012	5/25/2012	Chiselled 1 - 1.5m
B-23	14.07	SCP	548361.40	418147.50	24.56	5/25/2012	5/26/2012	Hole located 15m north of railroad
B-24	4.00	TP	548461.90	418182.00	37.65	5/26/2012	5/27/2012	
B-25	14.60	CP+RC	548452.10	418161.70	27.34	5/27/2012	5/28/2012	Cable snapped between 14.00 -
B-26	3.80	TP	548406.80	418093.70	20.78	5/28/2012	5/29/2012	Trial pit formed through old railway
B-27	14.10	RO	548344.90	418196.30	37.60	5/16/2012	5/17/2012	NW corner of tank farm lot
B-28	14.10	SCP	548447.20	418203.20	38.25	5/17/2012	5/18/2012	
B-29	7.50	DCP	548425.00	418088.00	10.89	5/18/2012	5/19/2012	Hole located 15m north of railroad
B-30	9.50	RC	548369.00	418102.90	16.23	5/19/2012	5/20/2012	
B-31	20.00	RO	548385.70	418097.40	9.87	5/20/2012	5/21/2012	Chiselled 1 - 1.5m
B-32	20.00	RO	548415.40	418110.20	16.52	5/21/2012	5/22/2012	Chiselled 1 - 1.5m

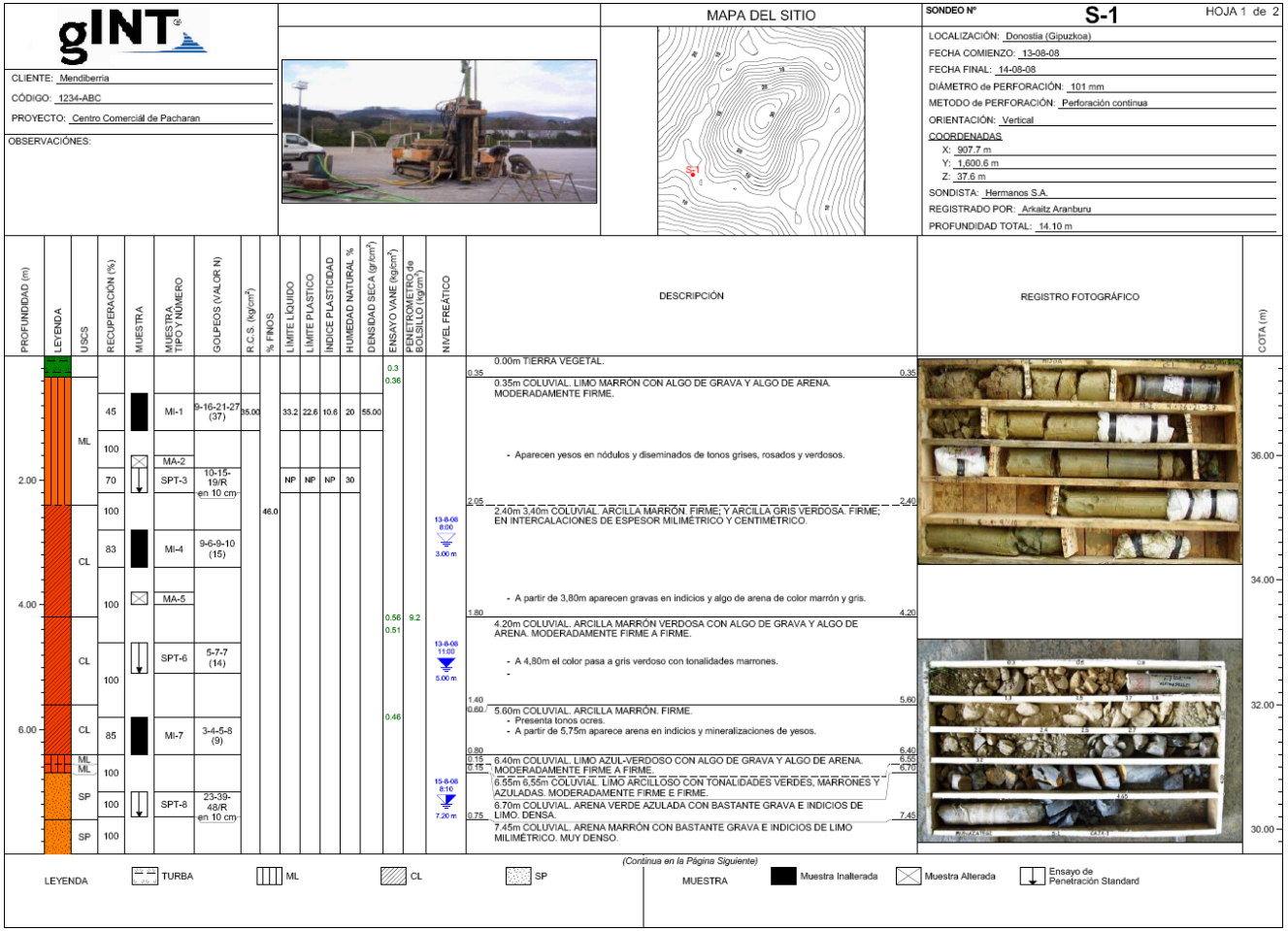
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

gINT - Examples



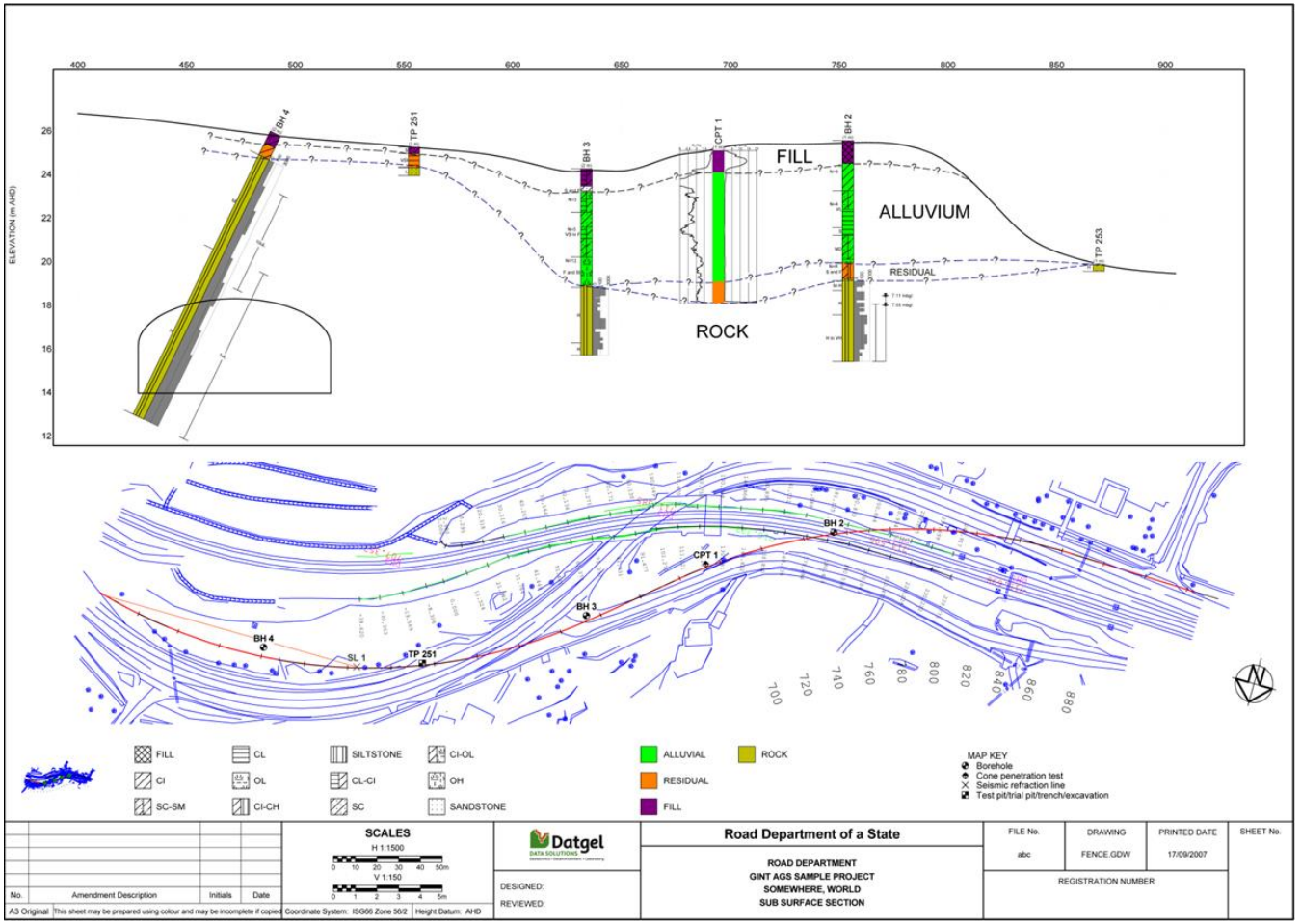
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

gINT - Examples



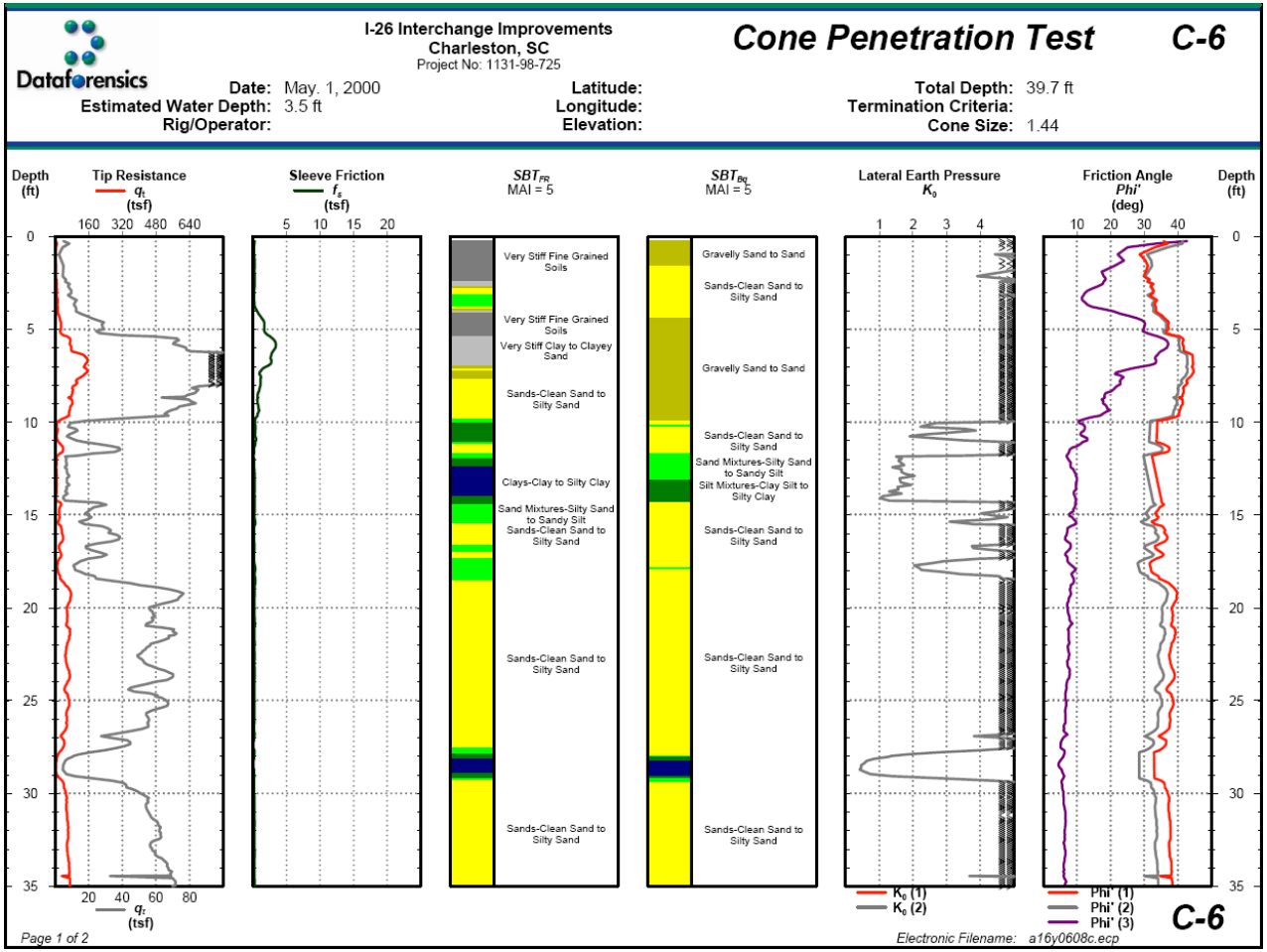
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

gINT - Examples



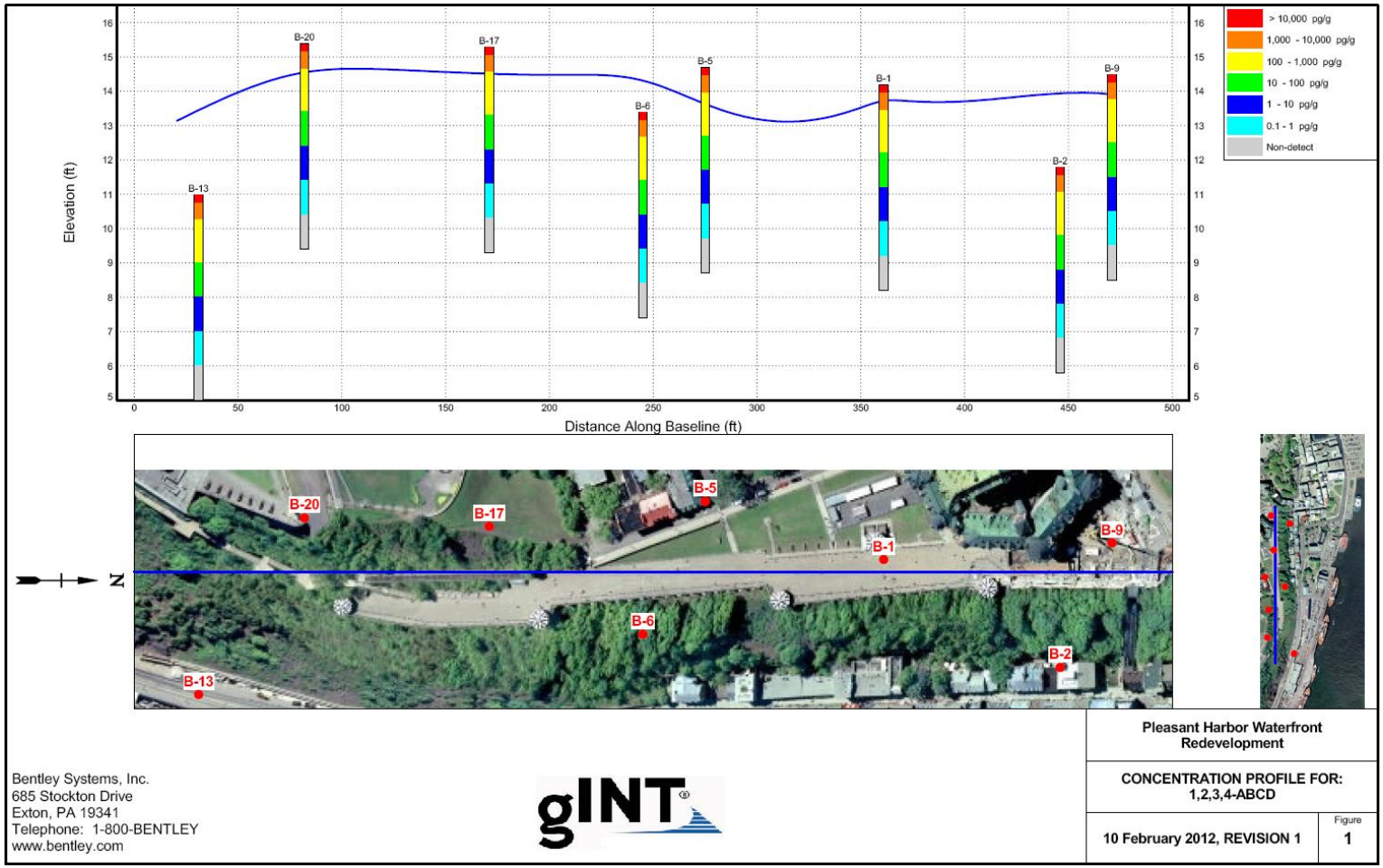
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

gINT - Examples



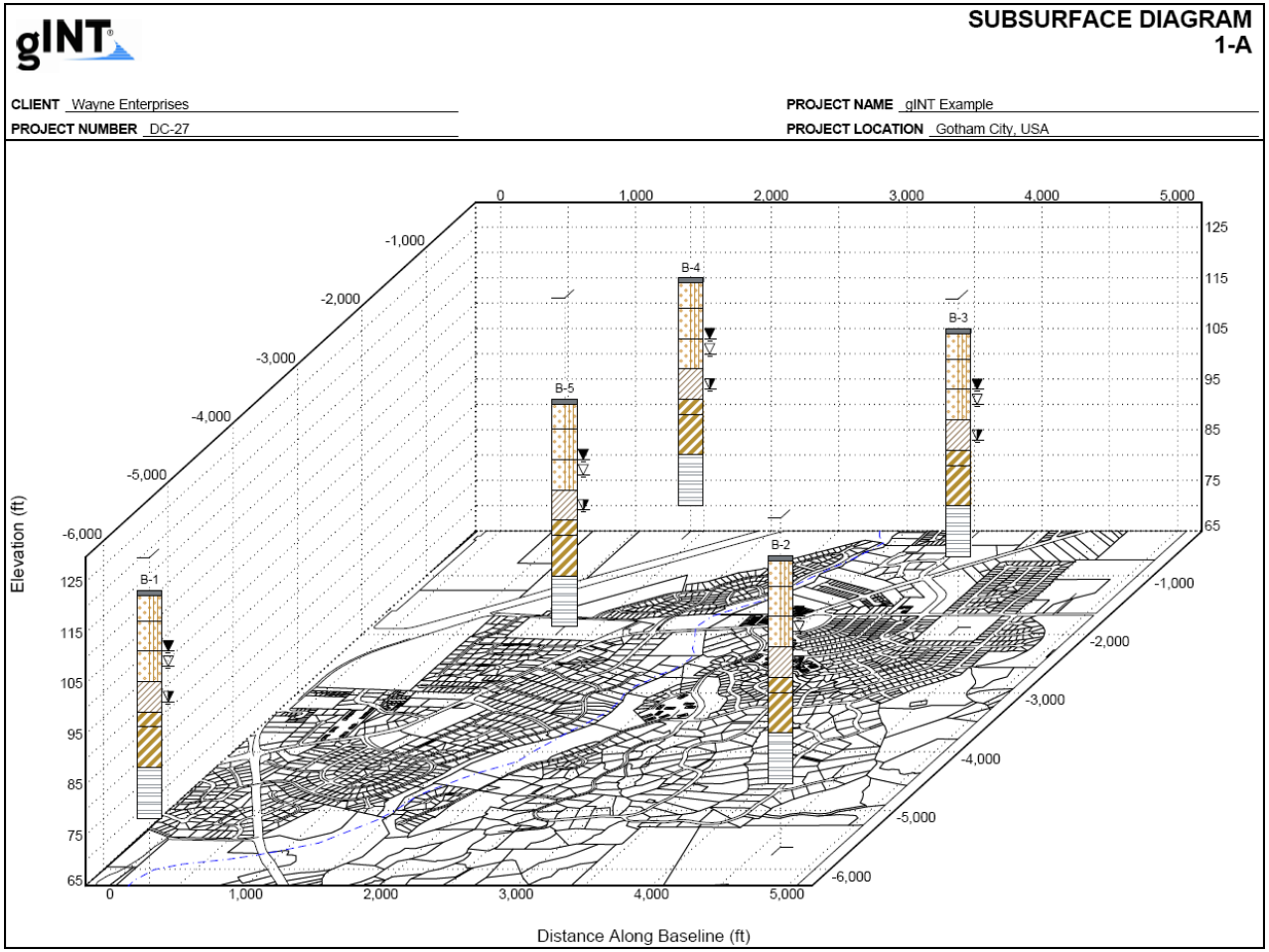
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

gINT - Examples



DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

gINT - Examples



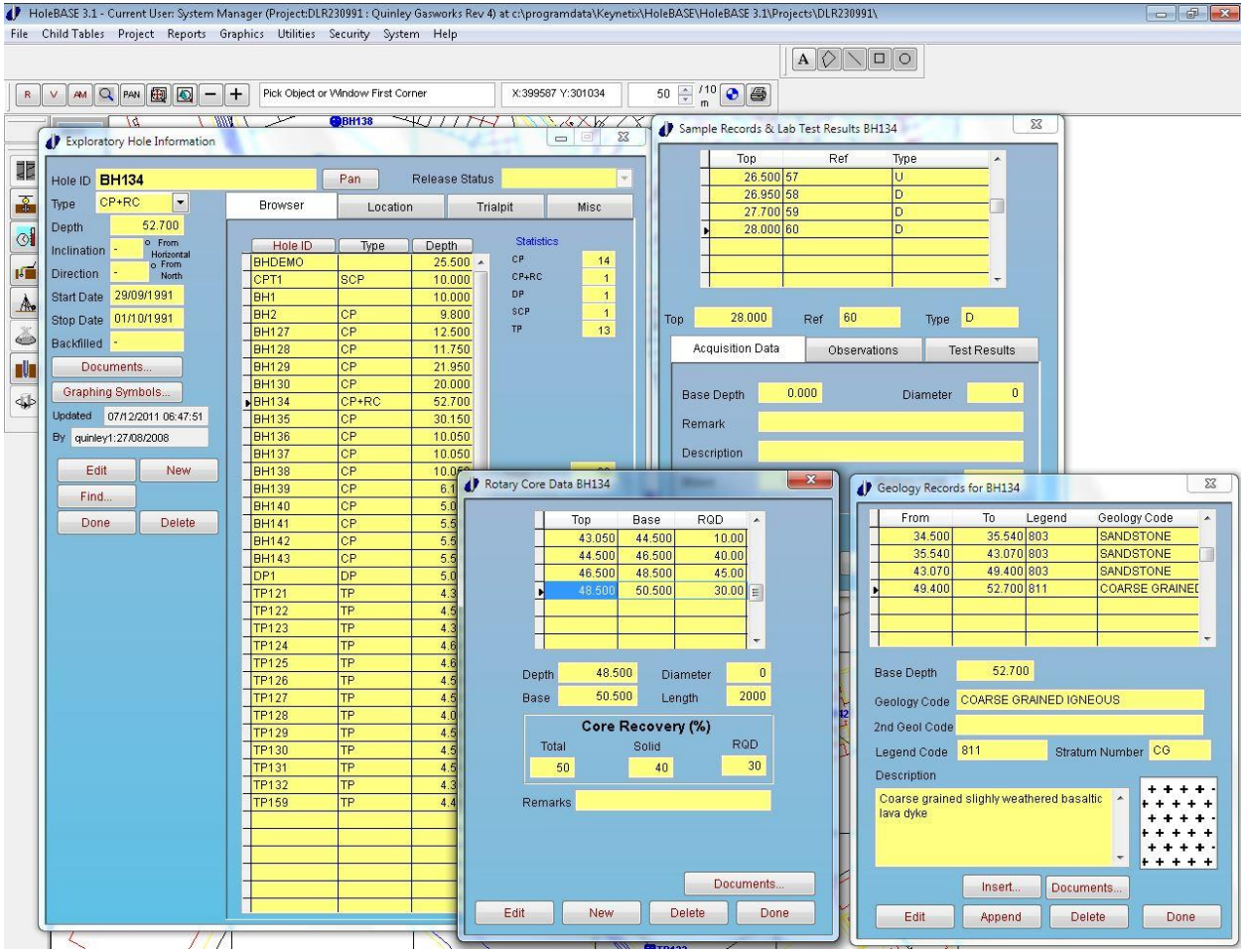
DiGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

HoleBASE – Geotechnical Data Management

- Data management and borehole logging software package for geotechnical and geoenvironmental site investigations
- Capabilities include:
  - Borehole logging
  - Draw cross sections
  - Complete bill of quantities
  - Invoices
  - AutoCAD drawings

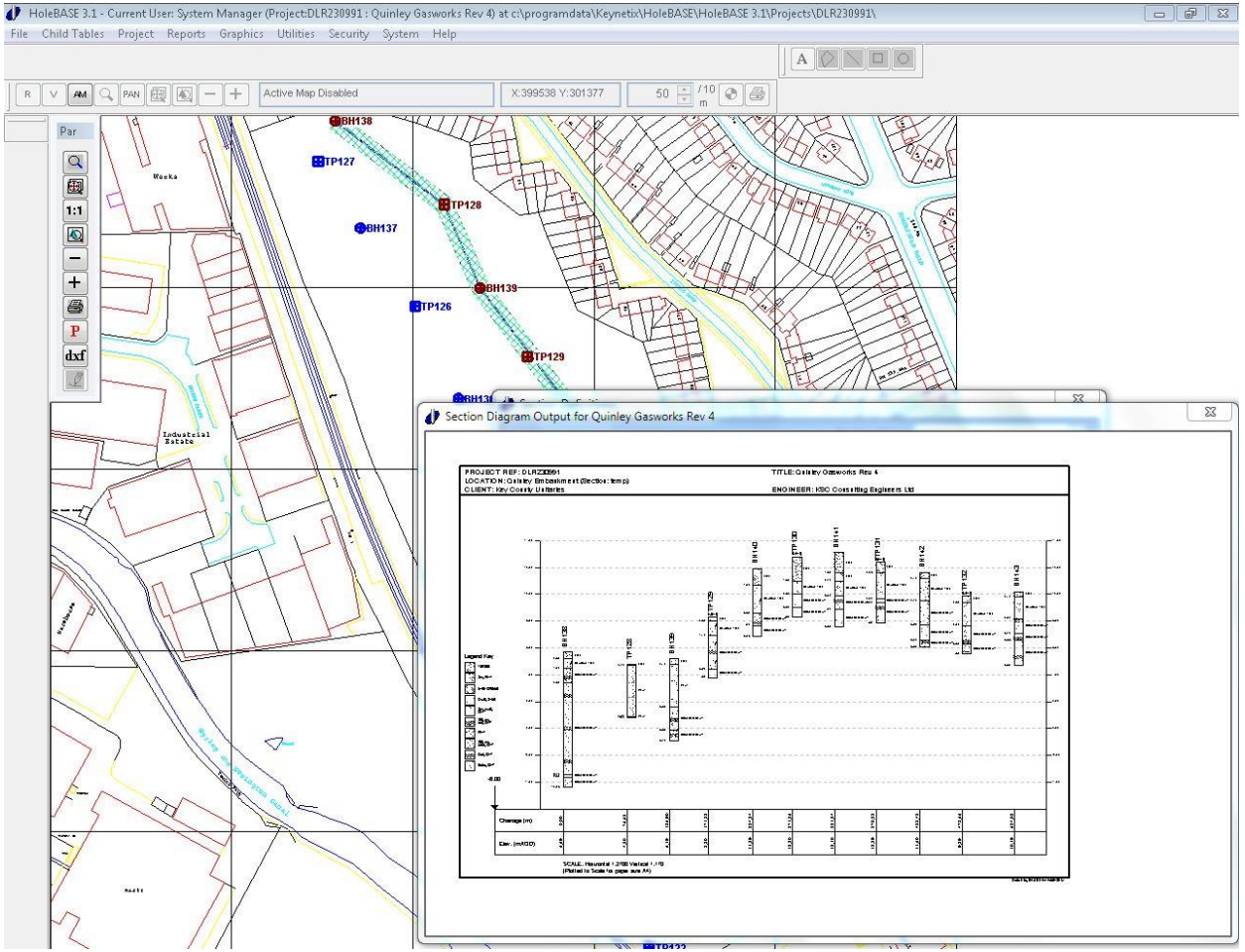
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Holebase



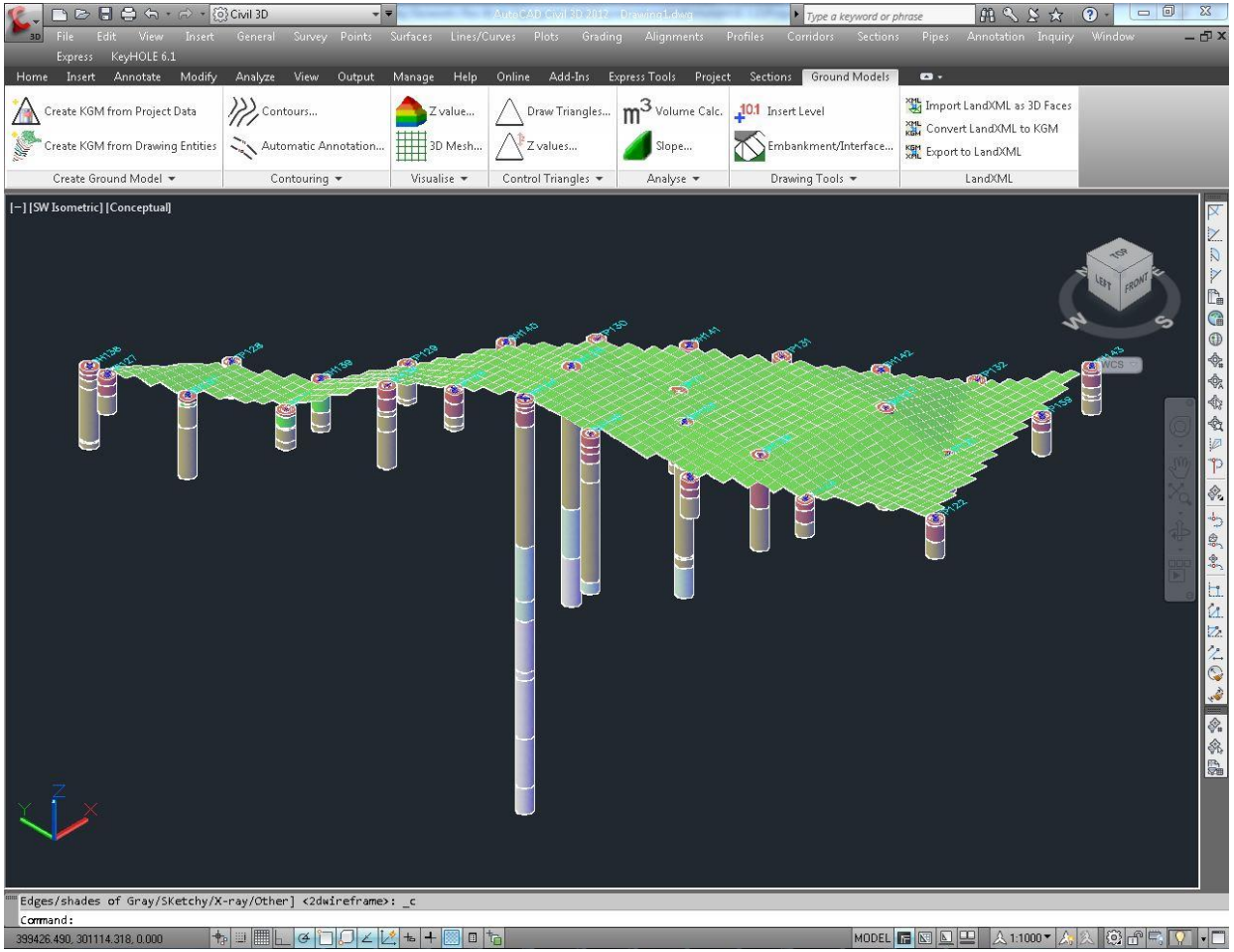
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Holebase



DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Holebase



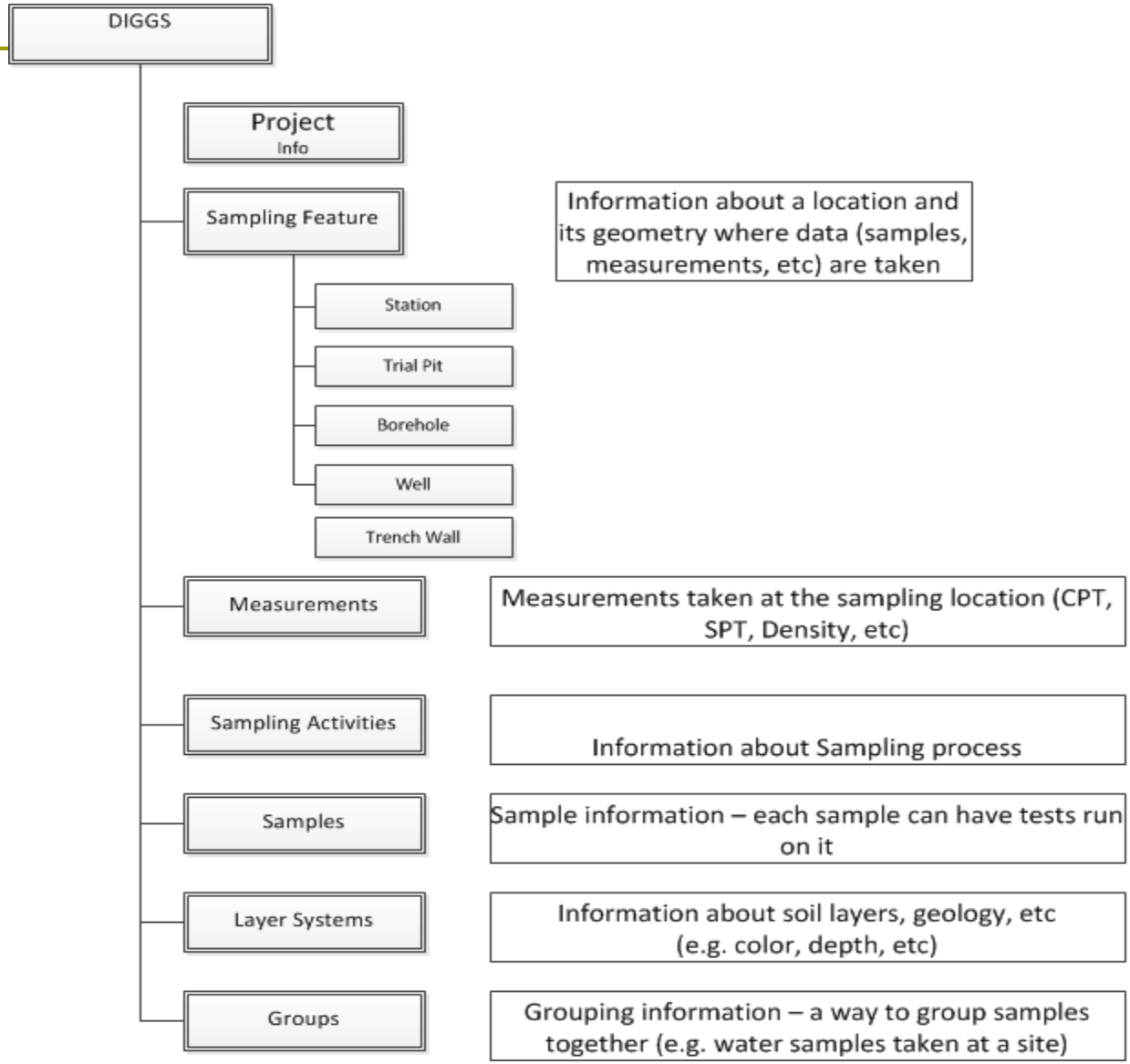
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

DIGGS Research Results

- Project deliverables consist of:
  - Final data dictionary (imbedded in the XML schema)
  - XML schema including:
    - Boreholes, soil layers, tests & measurements, samples, wells, logging, code lists
  - A guideline for using and adding to the schema
  - Tools supporting the schema:
    - MS Excel extractor
    - Google KML converter tool

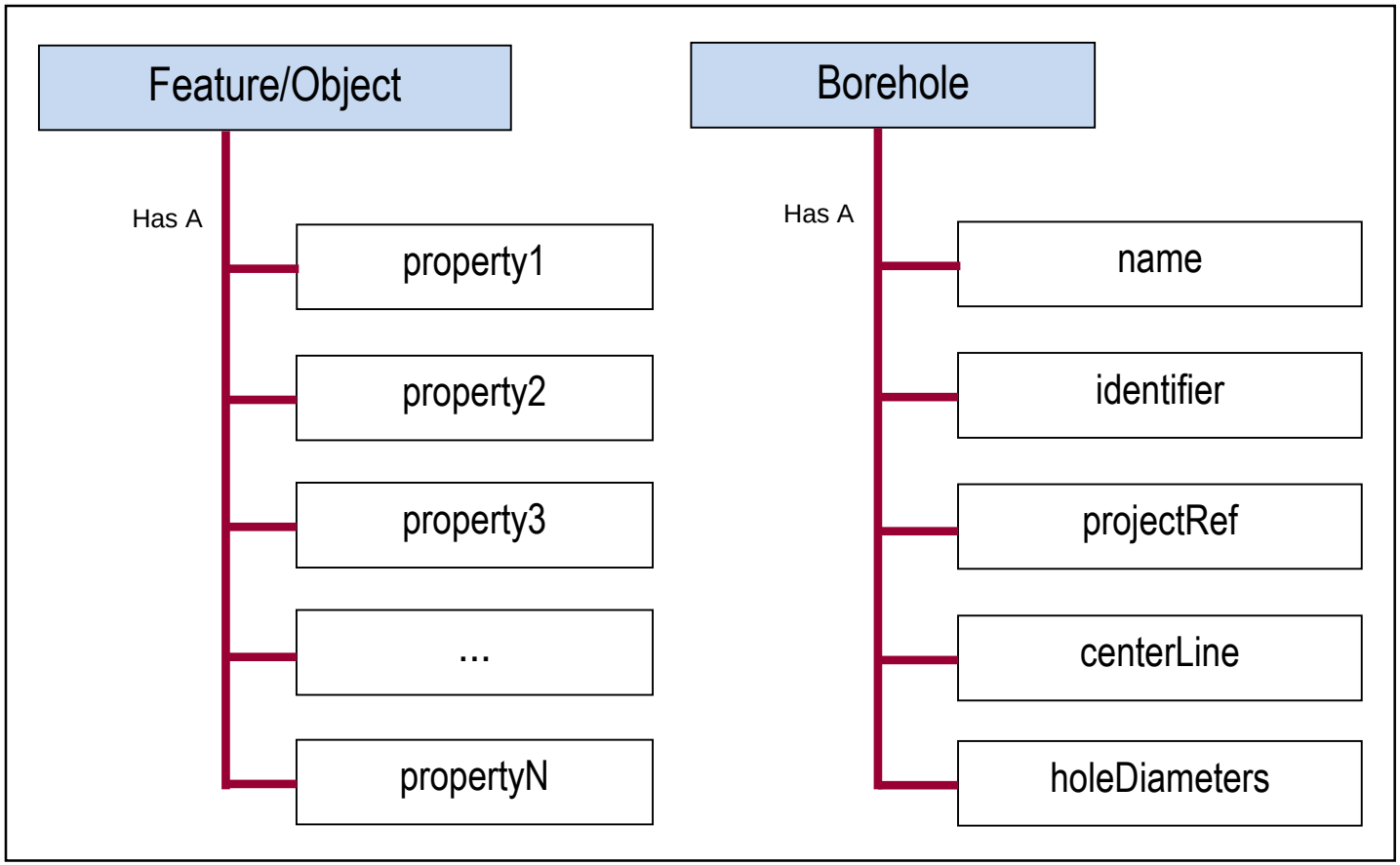
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Basic Schema Layout



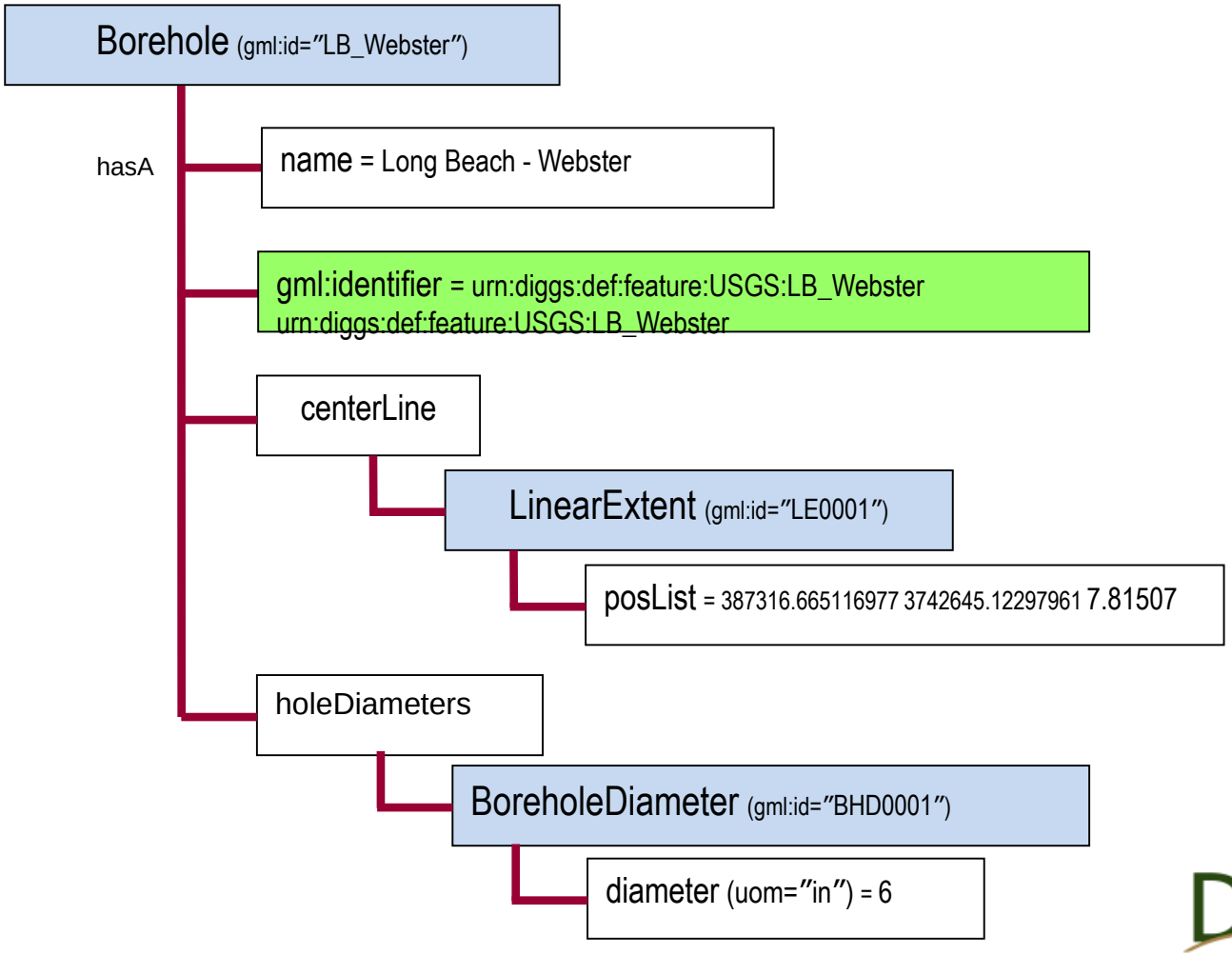
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

GML - Feature



DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

DIGGS – Borehole Feature



DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

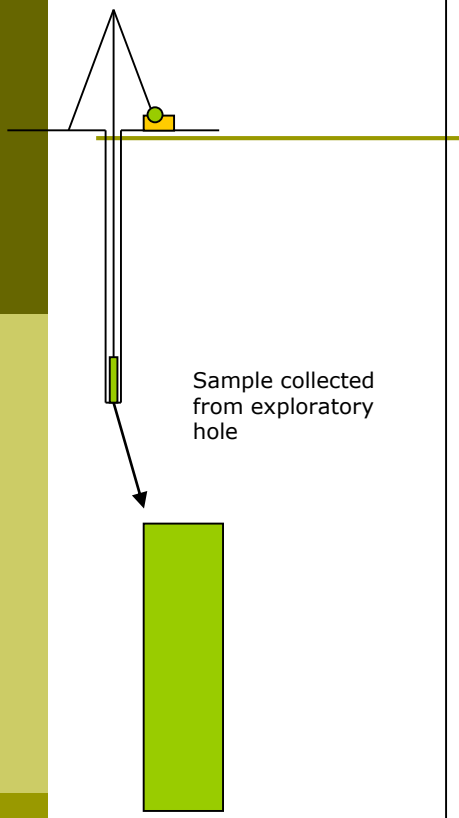
Example XML Excerpt

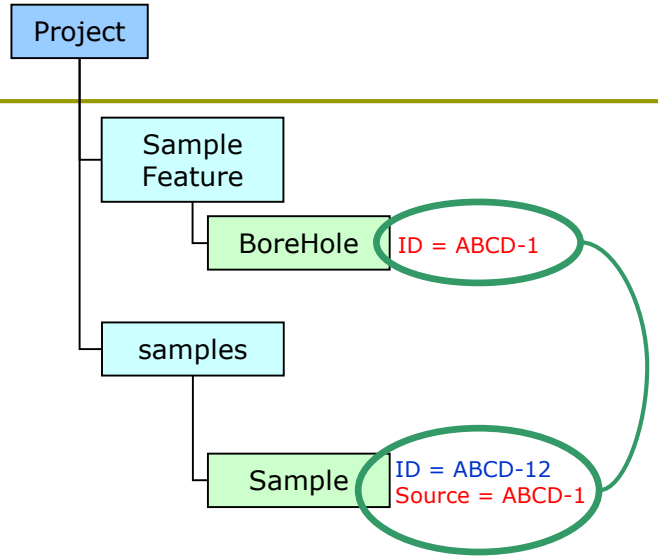
```
<Borehole gml:id="LB_Webster">
    <gml:name>Long Beach - Webster</gml:name>
    <gml:identifier>urn:diggs:def:feature:USGS:LB_Webster
                    </gml:identifier>
    …
    <centerLine>
      <LinearExtent srsName="urn:diggs:def:crs:DIGGS:
              26911_5703" srsDimension="3" gml:id="LS0001">
        <gml:posList>387316.665116977 3742645.12297961
                    7.81507 387316.665116977 3742645.12297961 -
                        420.124129847717</gml:posList>
      </LinearExtent>
    </centerLine>
    …
    <holeDiameters>
      <BoreholeDiameter gml:id="bhd1">
        <diameter uom="in">6</diameter>
      </BoreholeDiameter>
    </holeDiameters>
    …
</Borehole>
```

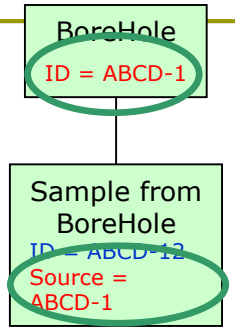
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Example 1 – Sample Taken from an Exploratory Hole

Real World	*Data Construction*	*Linkages*

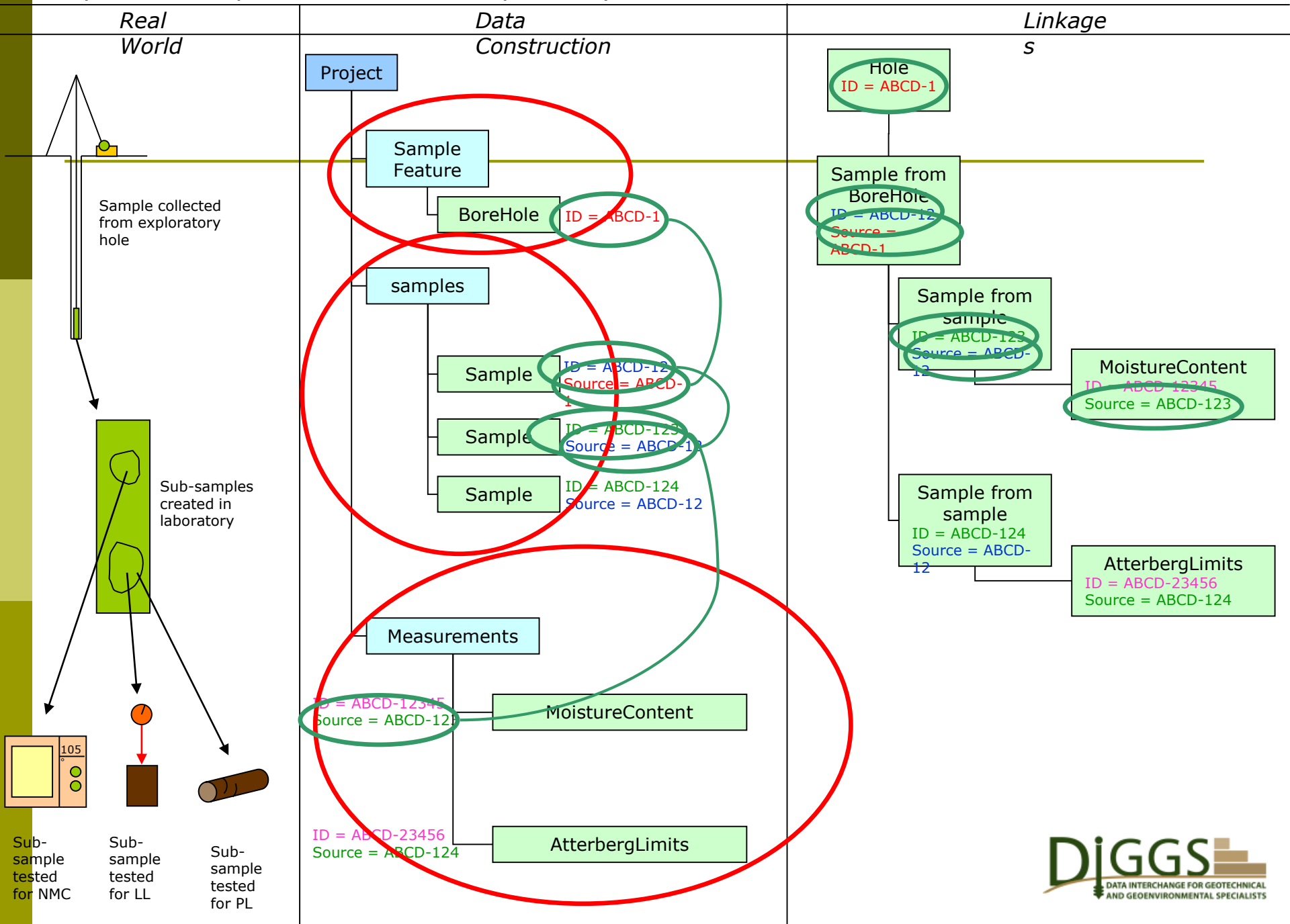






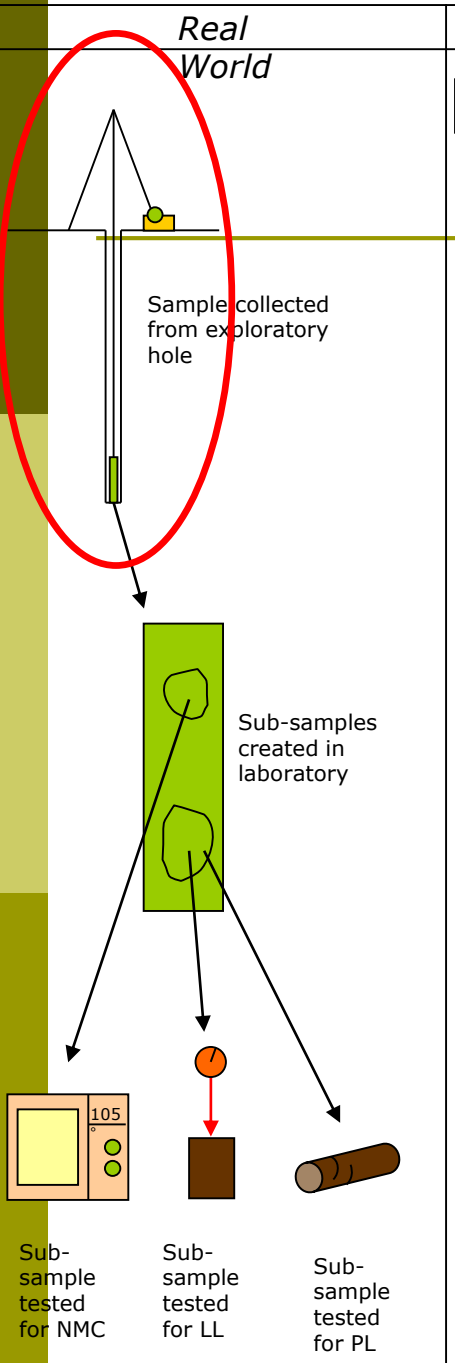
DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Example 2 – Sample Taken from an Exploratory Hole, tested for NMC, LL and PL



DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

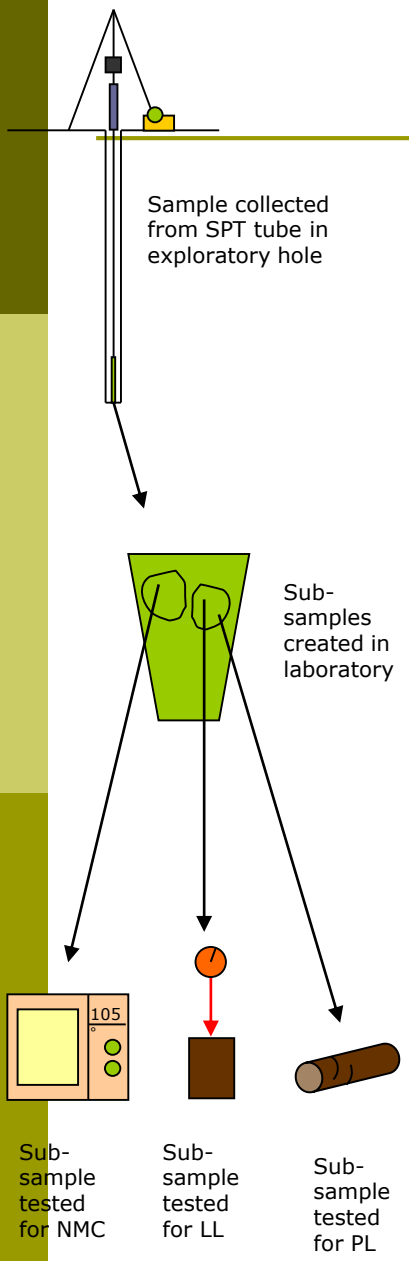
Example 2 – Sample Taken from an Exploratory Hole, tested for NMC, LL and PL



DIGGS
DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Example 3 – Sample Taken from an SPT in an Exploratory Hole, tested for NMC, LL and PL

Real World



Data Construction

- Project
  - Sample Feature
    - BoreHole — ID = ABCD-1
      - insituTesting
        - ID = ABCD-5
        - StandardPenetrationTest
  - samples
    - Sample — ID = ABCD-12, Source = ABCD-1, Process = ABCD – 5 (optional)
    - Sample — ID = ABCD-123, Source = ABCD-12
    - Sample — ID = ABCD-124, Source = ABCD-12
  - Measurements
    - ID = ABCD-12345, Source = ABCD-123 — MoistureContent
    - ID = ABCD-23456, Source = ABCD-124 — AtterbergLimits

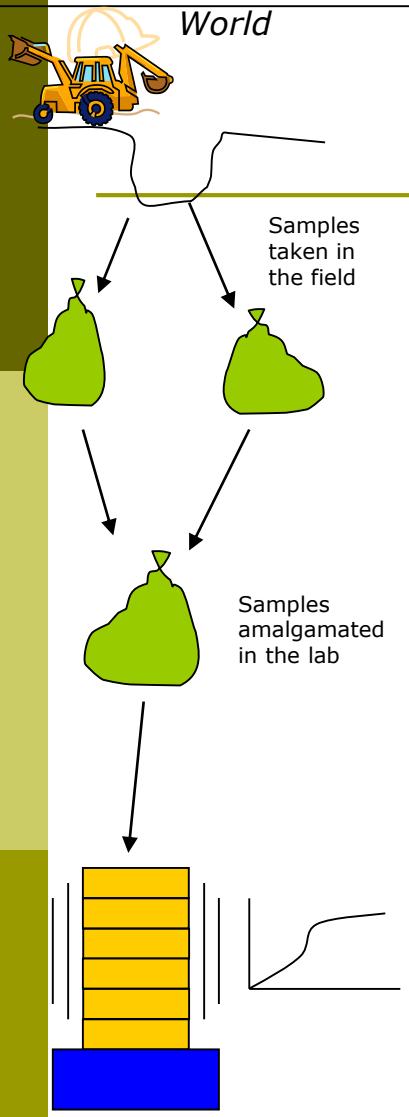
Linkages

- BoreHole ID = ABCD-1
  - Sample from SPT Test ID = ABCD-12, Source = ABCD-1
    - Sample from sample ID = ABCD-123, Source = ABCD-12
      - MoistureContent ID = ABCD-12345, Source = ABCD-123
    - Sample from sample ID = ABCD-124, Source = ABCD-12
      - AtterbergLimits ID = ABCD-23456, Source = ABCD-124

DIGGS — DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

Example 4 – Two samples taken from trial pit, amalgamated and tested for PSD

Real World



Data Construction

- Project
  - Sample Feature
    - Trial Pit — ID = ABCD-1
  - samples
    - Sample — ID = ABCD-12, Source = ABCD-1
    - Sample — ID = ABCD-13, Source = ABCD-1
    - Sample — ID = ABCD-124, Source = ABCD-12, Source = ABCD-13
  - Measurements
    - ID = ABCD-12345, Source = ABCD-124
      - ParticleSize
        - Grading

Linkage

- Pit — ID = ABCD-1
  - Sample from Trial Pit — ID = ABCD-12, Source = ABCD-1
  - Sample from Trial Pit — ID = ABCD-13, Source = ABCD-1
    - Amalgamated Sample — ID = ABCD-124, Source = ABCD-12, Source = ABCD-13
      - ParticleSize — ID = ABCD-12345, Source = ABCD-124
        - Grading

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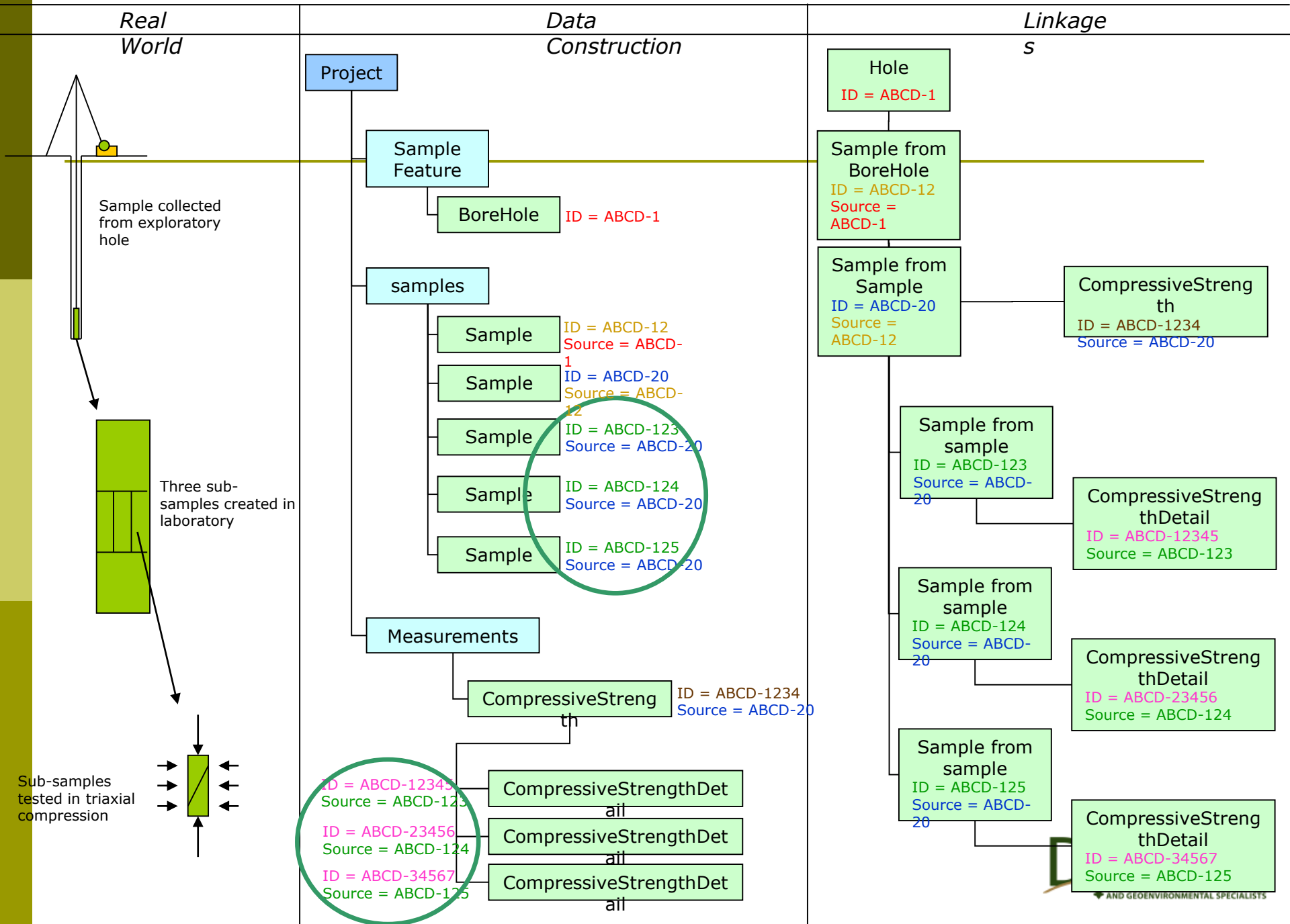
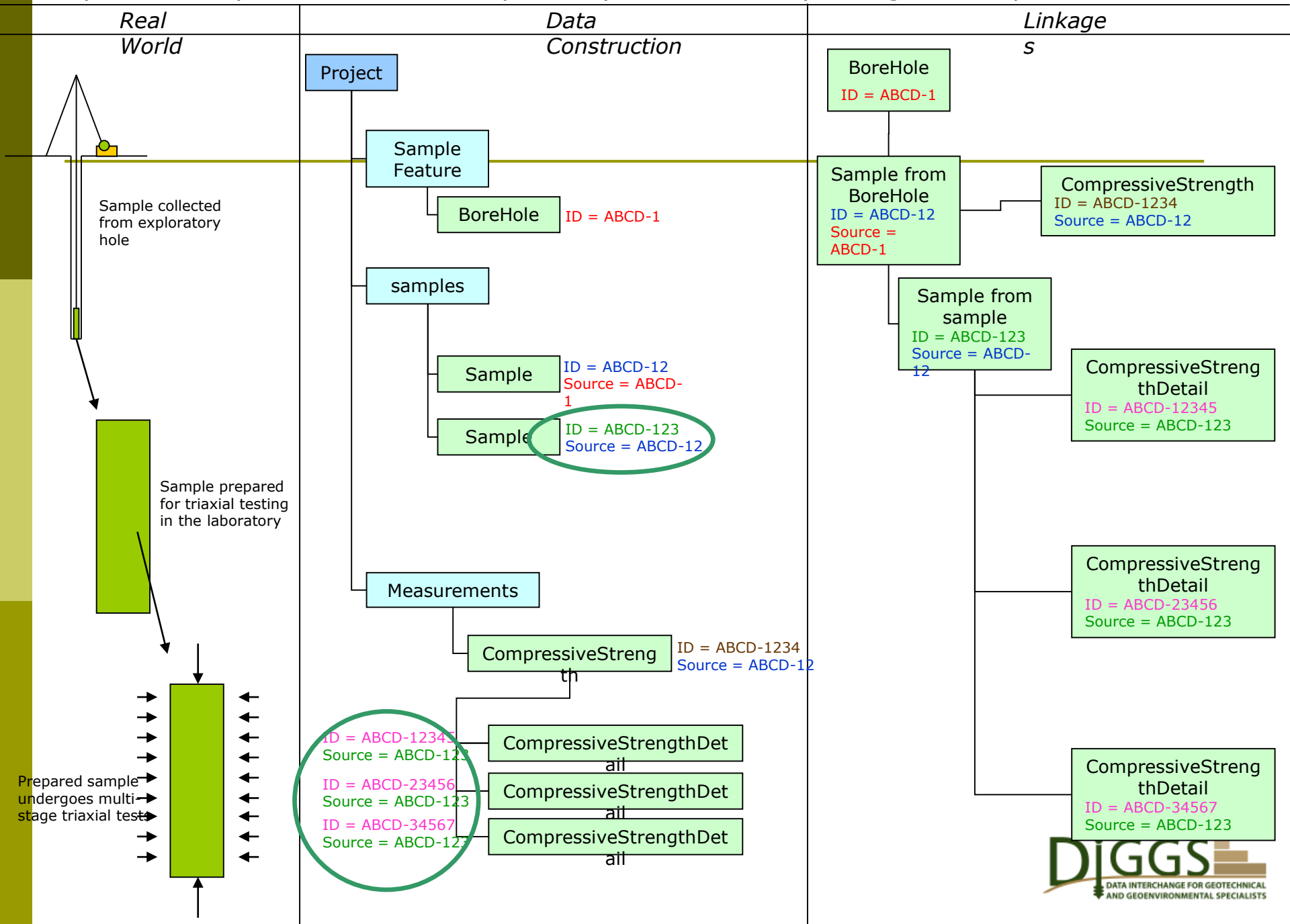
Example 5 – Sample Taken from an Exploratory Hole, tested by 3 stage, 3 sample triaxial test

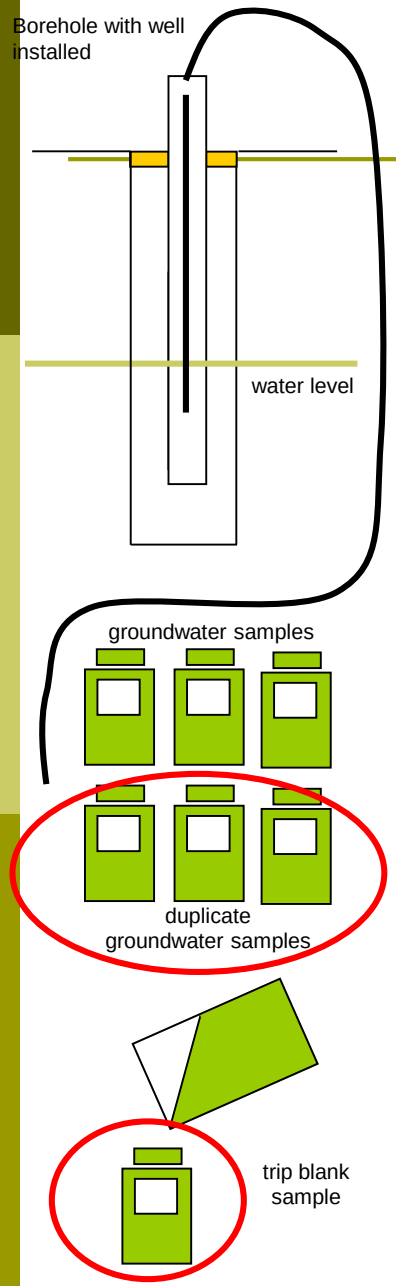


Example 6 – Sample Taken from an Exploratory Hole, tested by 3 stage, 1 sample triaxial test

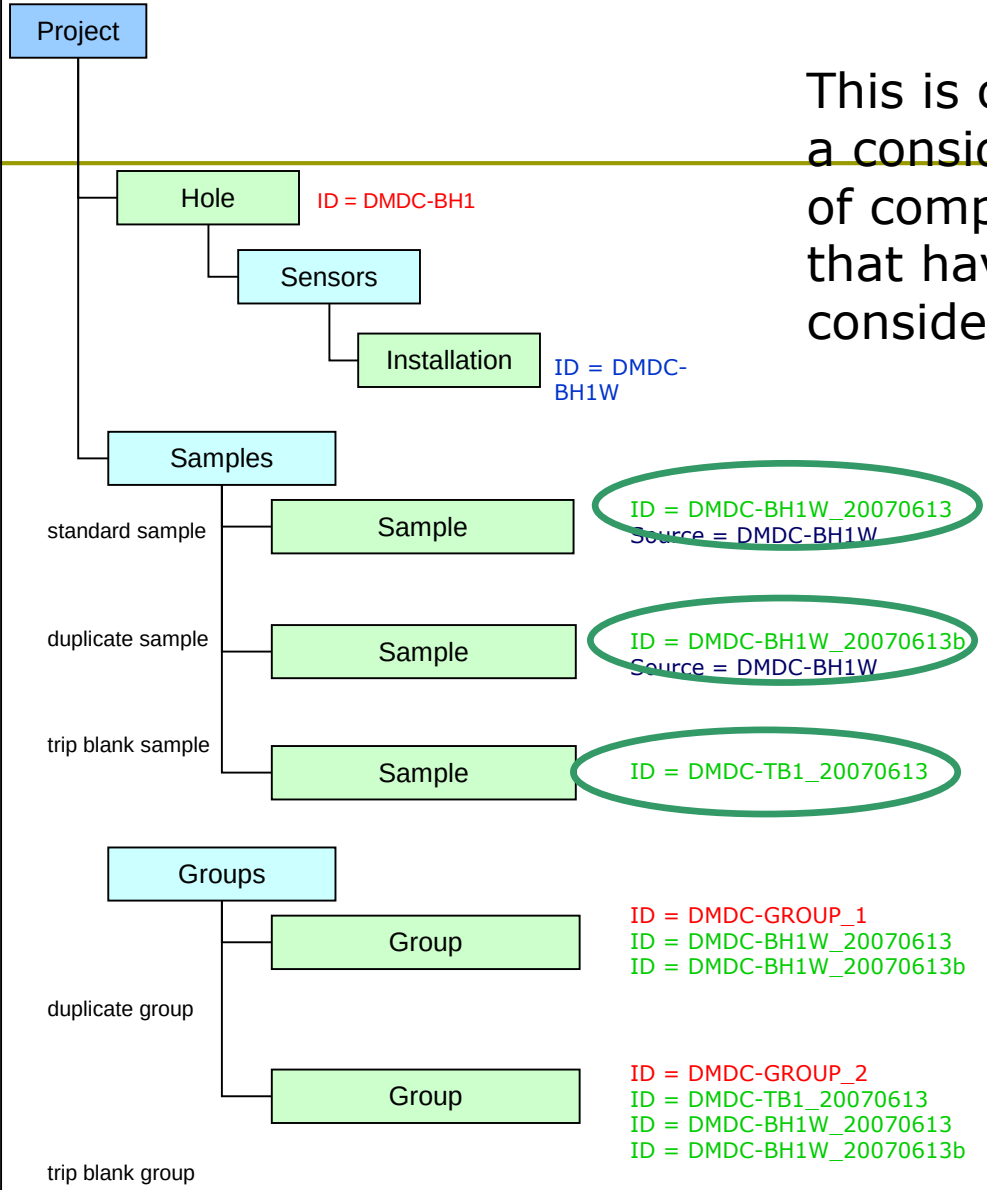


Example 7 – Geoenvironmental: Field Quality Control Samples

Real World

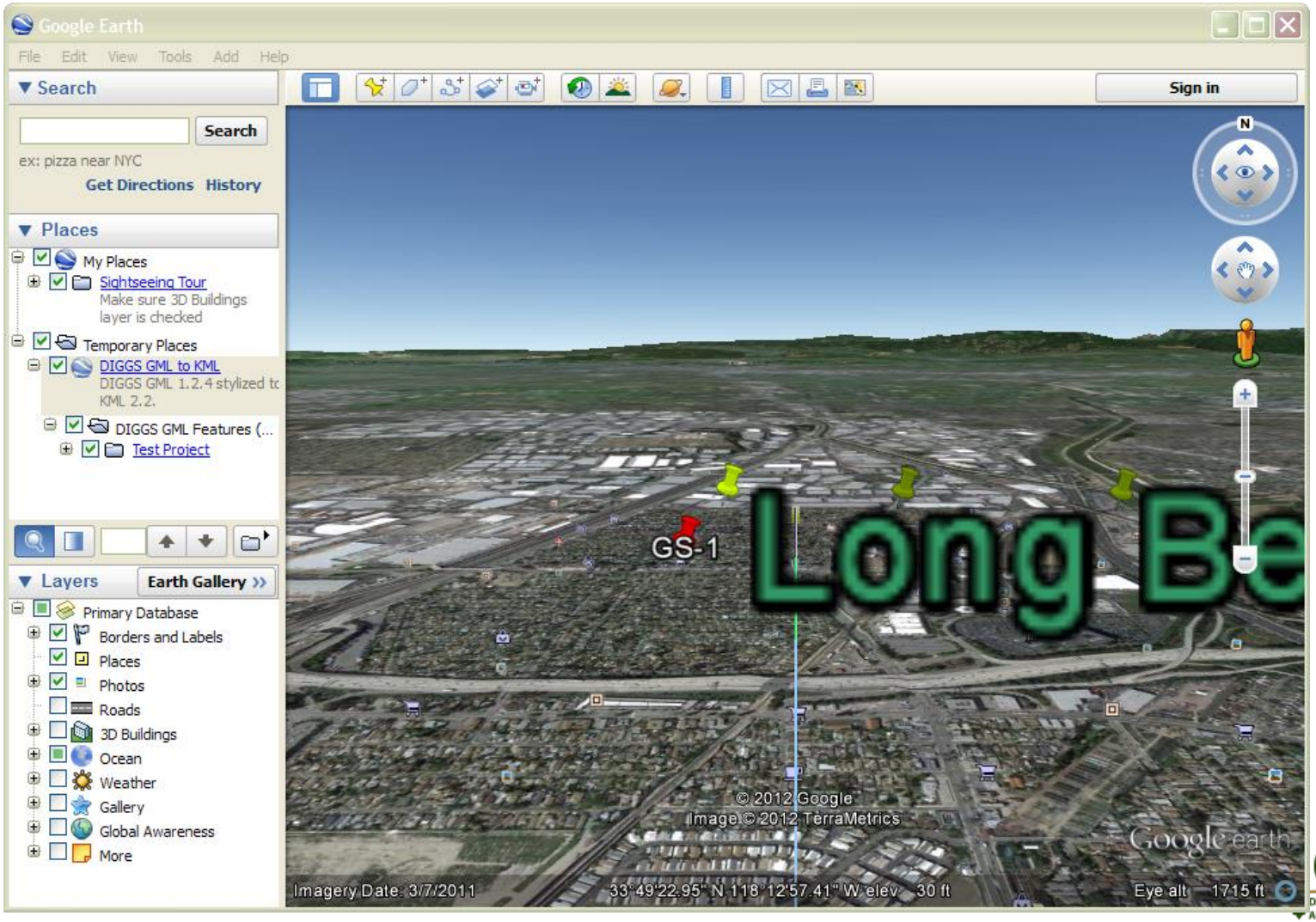


Data Construction



This is one example of a considerable number of complex examples that have been considered

DIGGS – KML (Google) Viewer



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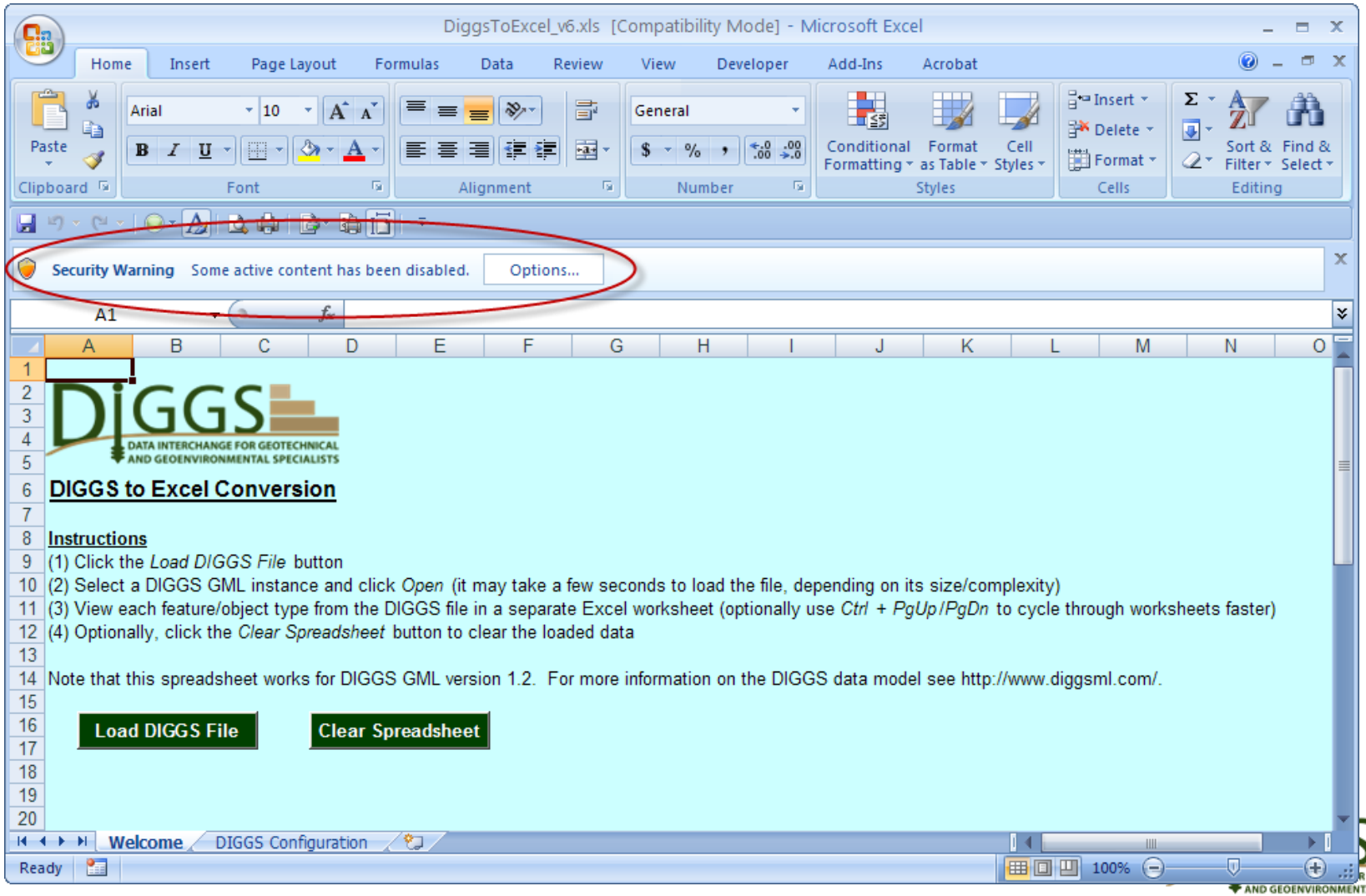
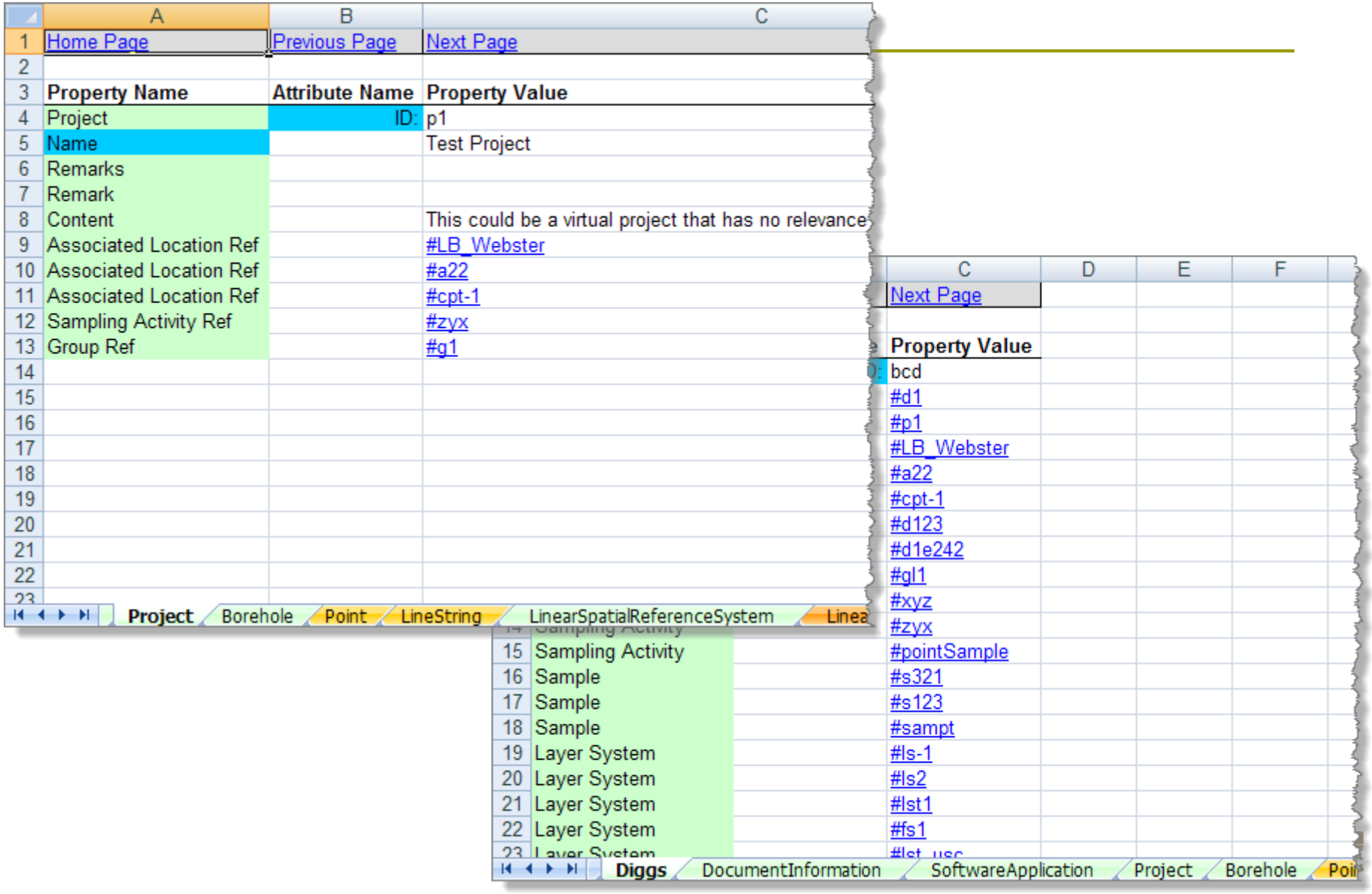
DIGGS to Excel Converter



Excel – Tabbed Structure for Data



	A	B	C
1	Home Page	Previous Page	Next Page
2			
3	**Property Name**	**Attribute Name**	**Property Value**
4	Project	ID:	p1
5	Name		Test Project
6	Remarks		
7	Remark		
8	Content		This could be a virtual project that has no relevance
9	Associated Location Ref		#LB_Webster
10	Associated Location Ref		#a22
11	Associated Location Ref		#cpt-1
12	Sampling Activity Ref		#zyx
13	Group Ref		#g1
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			

Project | Borehole | Point | LineString | LinearSpatialReferenceSystem | Linea

	C	D	E	F
	Next Page			
	Property Value			
	bcd			
	#d1			
	#p1			
	#LB_Webster			
	#a22			
	#cpt-1			
	#d123			
	#d1e242			
	#gl1			
	#xyz			
	#zyx			
15	Sampling Activity		#pointSample	
16	Sample		#s321	
17	Sample		#s123	
18	Sample		#sampt	
19	Layer System		#ls-1	
20	Layer System		#ls2	
21	Layer System		#lst1	
22	Layer System		#fs1	
23	Layer System		#lst_usc	

Diggs | DocumentInformation | SoftwareApplication | Project | Borehole | Poi

CPT Data Extract

	A	B	C	D	E	F	
1	Home Page	Previous Page	Next Page				
2							
3	**Property Name**	**Attribute Name**	**Property Value**				
4	Log	ID:	MPC001				
5			Log position (#cptsr1)	Tip Resistance (kN/m2)	Sleeve Resistance (kN/m2)	Friction Ratio	Pore V
6			0.010	0.1300	0.40	0.0000	0.0013
7			0.020	0.2400	0.40	0.1000	0.0078
8			0.030	0.5500	0.40	0.0040	0.0126
9			0.040	0.6800	0.40	0.0070	-0.0017
10			0.050	0.7800	0.30	0.0120	-0.0121
11			0.060	0.9000	0.30	0.0150	-0.0161
12			0.070	0.9600	0.40	0.0200	0.0191
13			0.080	1.0400	0.40	0.0240	-0.0120
14			0.090	1.0700	0.30	0.0270	-0.0129
15			0.100	1.1000	0.30	0.1000	-0.0123
16			0.110	1.1300	0.40	0.0350	-0.0176
17			0.120	1.1800	0.30	0.0400	-0.0234
18			0.130	1.2400	0.40	0.0430	-0.0206
19			0.140	1.2600	0.40	0.0460	-0.0277
20			0.150	1.2600	0.40	0.0480	-0.0303
21			0.160	1.2800	0.40	0.0490	-0.0413
22			0.170	1.2900	0.40	0.0500	-0.0482
23			0.180	1.2600	0.30	0.0500	-0.0455

DensityTest | DensityTestResults | StaticConeTest | BoreholePosition | StaticConeTestResults | Log

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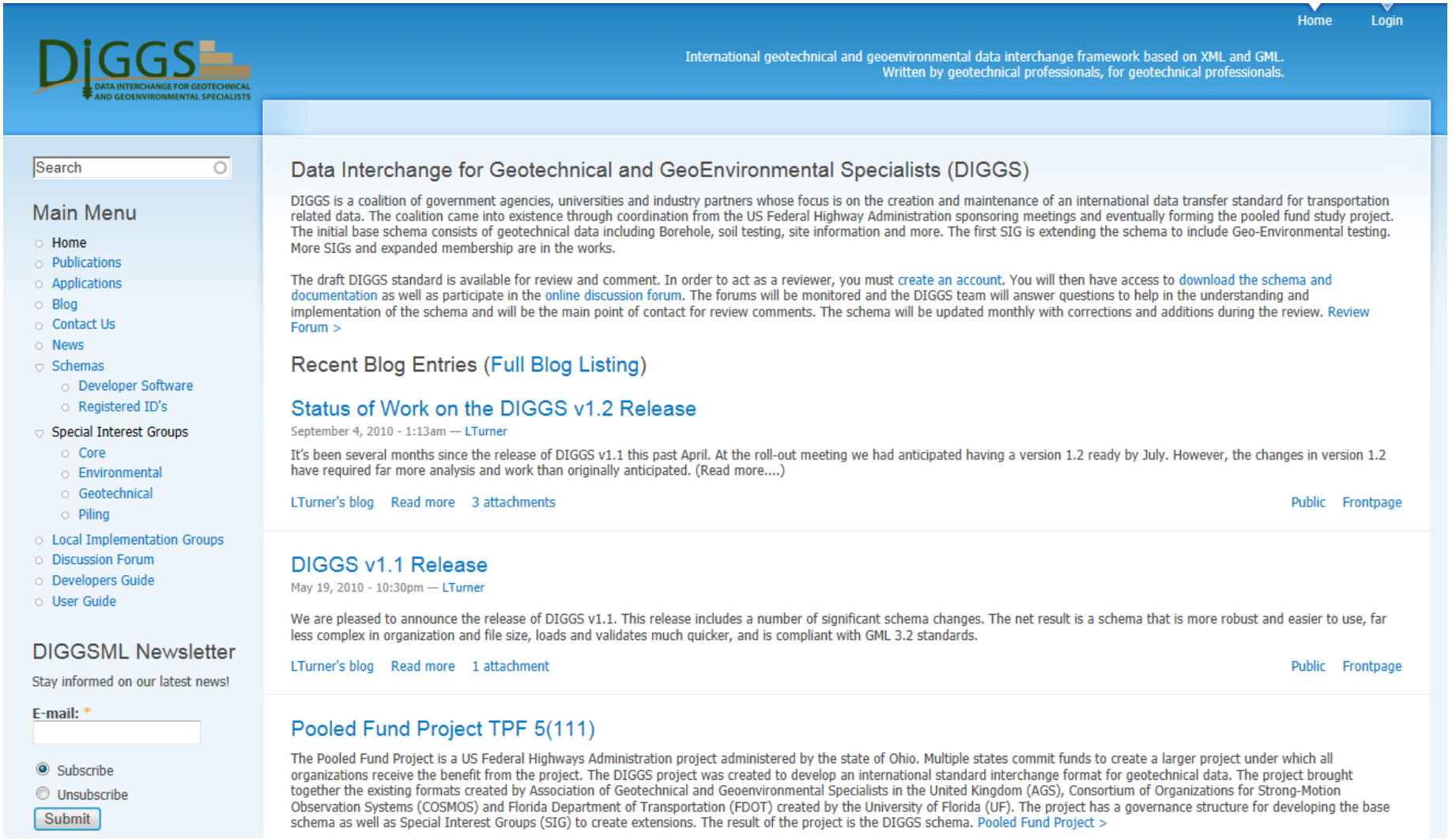
http://diggsml.org – Website



Lessons Learned

- **Data Dictionary is the most critical part**
  - Agreement on how to:
    - measure a reference point (top or bottom), how to define a collection process, how to assign sample numbers, etc

  required a huge investment of time, large number of experts from various countries and disciplines.
  - Using a core team of people and concentrated time (workshops) was critical to success
- **Recommended:** Best practices from AGS involving stakeholders in developing corrections, new additions and releases.

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Lessons Learned

- **Involve a paid industrial partner (GML expert) sooner in the process.**
  - Workshops were excellent format for dictionary & early schema versions.
  - Handled the difficult consensus building with subject matter experts

- **Recommendation:** when converting to a final schema, schema experts should have been brought in sooner for GML expertise

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Recommendations – Future Work

- **Items not included in the current version**
  - Deep Foundations (parts of the UF-FDOT schema)
    - Geotechnical components are covered, deep foundation portions are not.
    - Recommended that SIG formed to include in next release
  - Parts of the US-EPA schemas.
    - Many parts can be covered by DIGGS,
    - Recommended that a SIG be created in conjunction with US-EPA and develop the remaining portions.

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Future Additions to DIGGS

- Schematron validation tool
- Web authoring tool for readable forms
- Web validator – to check files compliance
- Data and Map server for detailed mapping
- Identifier Registry to share specific changes
  - CRS and Units Registry
  - Data/Metadata Registry for businesses, equipment codelists and other data to ensure compatibility

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Future of DIGGS

- ASCE – Geo-Institute will take ownership of DIGGS
  - Treat as new standard (under Codes & Standards Division)
  - Form a committee (with outside members)
  - Maintain:
    - Schema standard (new form of technical standard)
    - Website, standard updates, etc
- Transfer process:
  - Ohio DOT to fund implementation (transfer and startup)

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Supporters/Promoters of DIGGS

- AGS (UK Association of Geotechnical and Geoenvironmental Specialists)
- Bridge Software Institute, University of Florida
- CIRIA (UK Construction Industry Research and Information Association)
- COSMOS (Consortium of Organizations for Strong-Motion Observation Systems)
- Delta Environmental Consultants, Inc.
- EarthSoft Inc.
- Galdos Inc.
- gINT Software Inc. (Bentley Systems, Inc.)
- Keynetix Ltd.
- Mott MacDonald
- North Carolina State University
- Petrochemical Open Standards Consortium
- United States Federal Highways Administration
- United Kingdom Highways Agency
- US Departments of Transportation (CA, CT, FL, GA, IN, KS, KY, MN, MO, NC, OH, TN)
- United States Geological Survey
- United States Army Corps of Engineers
- United States Environmental Protection Agency
- United States Navy
- University of New Hampshire

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