

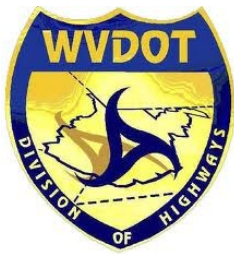
Landslide Hazard Management System in West Virginia Phase I

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2013 WVDOT/MPO/FHWA Transportation
Planning Conference

September 18, 2013 Weirton, WV



Current WV DOT Landslide Management System



District based:

- 10 districts
- Overseen by District Engineers
- Varying rating criteria
- Varying naming convention
- Paper based or Mixed stored in district office

Problems:

- Civilian Reports
- Landslides are hard to locate: fixed, paved over, new or old
- Funding allocation: proper respond and repair method
- Coordination/prioritization
- Accurate inventory





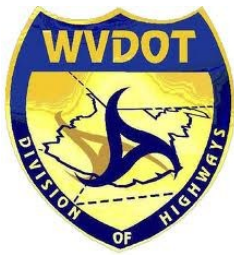
TO
ONCOMING
TRAFFIC





Phase I Objectives

System Creation and Completing a Pilot Project in District 2



- Conducting an extensive literature review to acquire experience and lessons learnt of other State DOTs.
- Developing an effective electronic field reconnaissance method or form.
- Creating an appropriate database that could meet the current and future landslide management goals.
- Developing, pilot testing and deploying a web-enabled, GIS-based landslide application in District 2.
- Developing a beta version of the WVDOT standardized landslide hazard rating matrix.

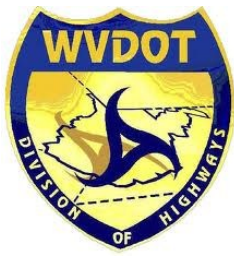
Data Dictionary



Date
Slide Name
Collected by
Slide Longitude
Slide Latitude
Center Line
ADT
Area
Toe
Scarp
Slope
Break
ASD
Ditch
Guardrail
Utilities
Vegetation
etc...

- A standard data dictionary for landslides in WV
- Standard naming convention:
 - County
 - Road/Highway
 - Slide number
- Digital cameras were used to take photos
- Post Processing done at the office



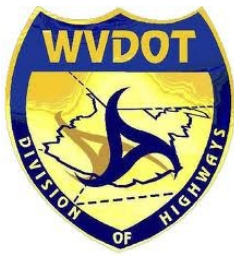


Hazard Rating Matrix

- Develop the hazard rating matrix that fits best for West Virginia
- Utilize 12 criteria with varying impact factor (1-5)
 - 5: Very important
 - 1: Least impact
- Four category with odd point scaling (1,3,5,7)
 - 1 point: low risk
 - 7 point: high risk
- Rating Calculation: Total points between 39 to 273
- Overall Risk :
 - Low Risk: $39 \leq \text{Total Score} < 97$
 - Moderate Risk: $97 \leq \text{Total Score} < 156$
 - High Risk: $156 \leq \text{Total Score} < 215$
 - Very High Risk: $215 \leq \text{Total Score} \leq 273$



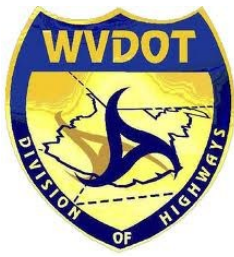
Hazard Rating Matrix Components



1. Potential Loss of life [5]
2. Average Daily Traffic [4]
3. Percent of Decision Sight Distance (% DSD) [5]
4. Is this a certified emergency route (Y/N) ?[3]
5. Impact to Road Structure and Adjacent Features (i.e. , such as culverts, tunnels, bridge/flyover and their technical elements) [3]
6. Expected Damage to Structures (i.e. Building, Utilities, Railroad, and other Roads/Structure) [3]
7. Rate of Movement (inches/year) [3]



Hazard Rating Matrix Components

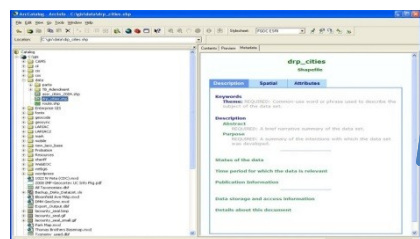


8. Amount of Surface Water (Hydrology) [3]
9. Detour Route Distance [3]
10. Length of Landslide (feet) [3]
11. Vertical & Horizontal Displacement in Road (inches)
[2]
12. Annual Maintenance Cost [2]

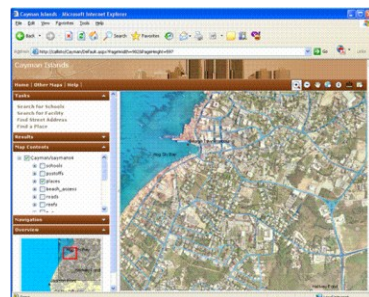
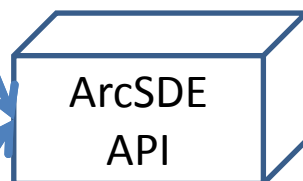
[Landslide Hazard Rating Criteria and Score](#)



Architecture



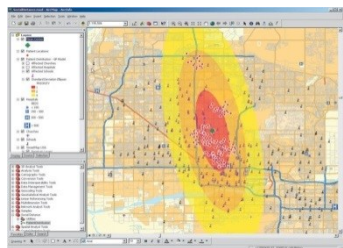
ArcCatalog



Web Application



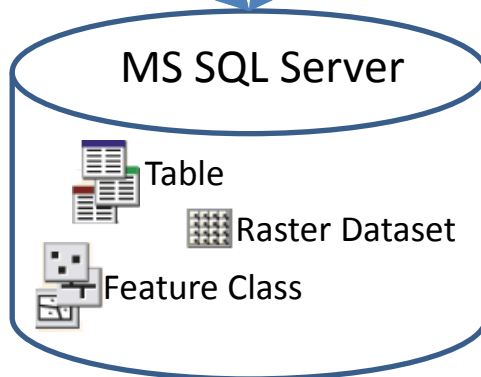
Mobile Devices



ArcMap

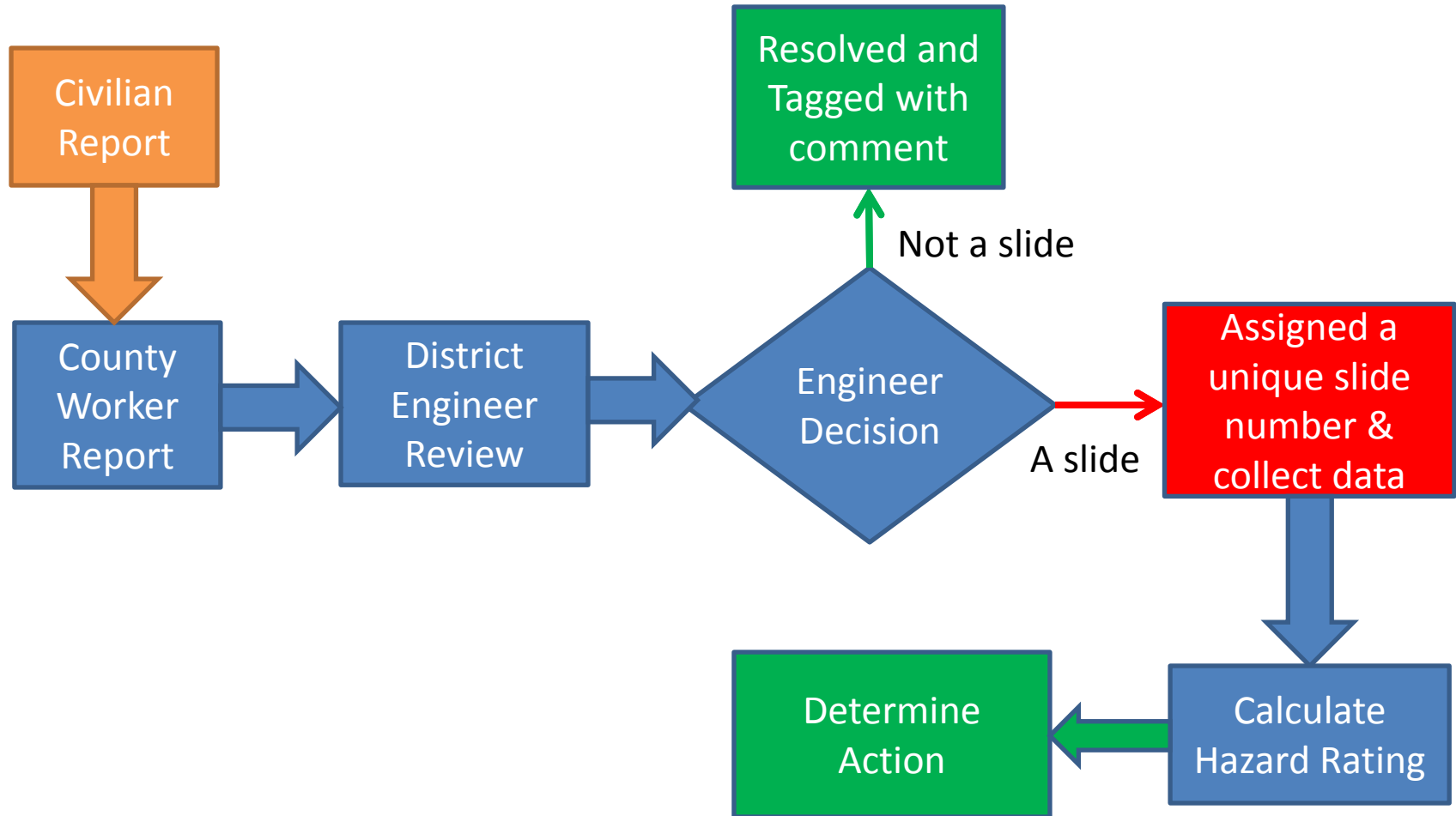
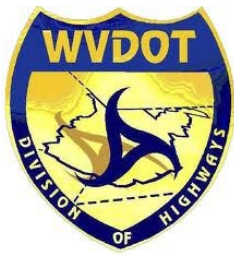


PC



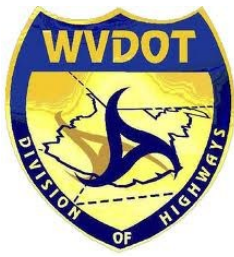


Web Application Framework





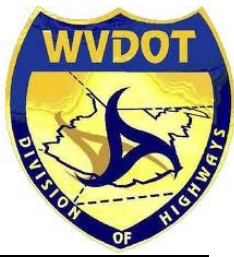
Civilian Report



- No login required
- Name, Address and contact information
- County of the landslide
- Free Text:
 - Location of landslide
 - Description of landslide
 - Additional comments
- Image uploading capabilities (3)
- Captcha verification



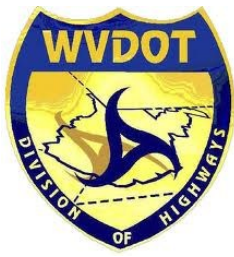
Civilian Report Feature



A screenshot of a web browser window. The address bar shows 'localhost/landslide/'. The page header includes a circular logo for the State of West Virginia Department of Transportation, the text 'WV DOH', and the title 'Landslide Hazard Management System'. A '[Log On]' link is in the top right. Below the header is a navigation menu with 'Home | About | Report'. The main content area has a heading 'Homepage' and a paragraph: 'Welcome to the homepage of the Landslide Hazard Matrix Management System. To report a new landslide incident click the create report link below.' A red 'Report' link is highlighted with a mouse cursor. At the bottom of the content area is the copyright notice '© 2012 West Virginia Division Of Highways'. The browser's status bar at the bottom shows 'Waiting for localhost...' and a file named 'Picture 11671.webp'.



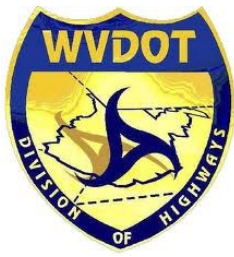
County Worker Report



- Provide additional detailed information
- Login required
 - Each county worker is responsible for a county
- All civilian report of landslides in that county will be listed
- County worker will provide and update of the report:
 - Latitude and Longitude
 - Additional images
 - Comments



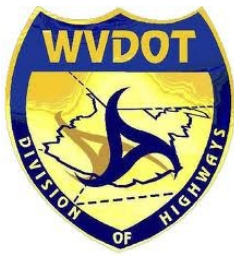
County Worker Report



The screenshot shows a web browser window with the address bar displaying 'localhost/landslide/'. The page header includes a '[Log On]' link in the top right corner. On the left side, there is a circular logo for the 'STATE OF WEST VIRGINIA DEPARTMENT OF TRANSPORTATION' featuring a blue stylized 'W' and 'V' on a yellow background. To the right of the logo, the text 'WV DOH' is displayed above the main title 'Landslide Hazard Management System'. In the top right of the main content area, there are navigation links: 'Home | About | Report'. Below this, a yellow horizontal line separates the header from the main content. The main content area is titled 'Homepage' and contains the following text: 'Welcome to the homepage of the Landslide Hazard Matrix Management System. To report a new landslide incident click the create report link below.' Below this text is a red underlined link labeled 'Report'. At the bottom of the page, there is a copyright notice: '© 2012 West Virginia Division Of Highways'.



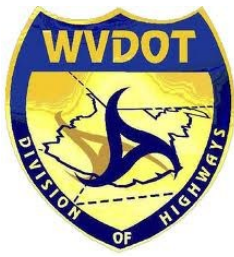
Engineer Tools



- Provide additional tools to support district and central office engineers
- Ability to show reports by Civilian and County worker
 - Sorting and filtering capabilities
- Engineers can then update the report



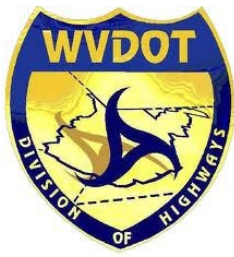
Engineer Reports Viewing and Updating



The screenshot shows a web browser window with the address bar displaying 'localhost/landslide/'. The page header includes a '[Log On]' link. On the left is the WV DOH logo, and to its right is the text 'WV DOH' and 'Landslide Hazard Management System'. A navigation menu at the top right contains links for 'Home | About | Report'. The main content area is titled 'Homepage' and contains the text: 'Welcome to the homepage of the Landslide Hazard Matrix Management System. To report a new landslide incident click the create report link below.' Below this text is a red underlined link labeled 'Report'. At the bottom of the page, a copyright notice reads '© 2012 West Virginia Division Of Highways'.



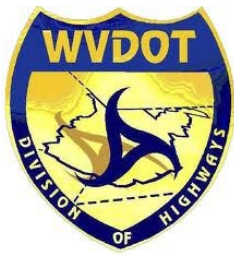
Interactive Flex Map



- Interactive Map of landslides in WV
- Utilize various base maps:
 - USA Topo
 - Street Map
 - Imagery
 - WV Geological Map
- Search feature: Landslide ID
- Filters: by county, by district, etc
- Driving Directions



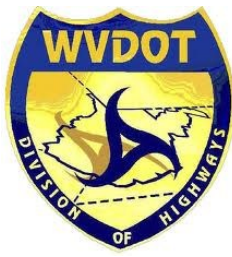
Interactive Flex Map



A screenshot of a web browser window. The address bar shows 'localhost/landslide/'. Below the address bar, there is a notification: 'Do you want Google Chrome to save your password?' with buttons for 'Save password' and 'Never for this site'. The main content area of the browser shows a webpage with a grey header. On the left is the circular logo of the West Virginia Department of Transportation, featuring a blue stylized 'W' and 'V' on a yellow background, surrounded by the text 'STATE OF WEST VIRGINIA' and 'DEPARTMENT OF TRANSPORTATION'. To the right of the logo, the text 'WV DOH' is displayed. Below that, the title 'Landslide Hazard Management System' is shown in a large, bold, blue font. In the top right corner of the header, it says 'Welcome demodengineer! [Log Off]'. Below the header is a navigation menu with links for 'Home | About | Tools | Account'. The main content area has a yellow border and contains the following text: 'Homepage', 'Welcome to the homepage of the Landslide Hazard Matrix Management System.', and a copyright notice at the bottom: '© 2012 West Virginia Division Of Highways'.



Flex Map Driving Directions



West Virginia DOH
Landslide Hazard Project

ROUTE 64

About

More... Basemap

Drive Directions

ROUTE 64

Enter an address, then press enter.

Address 1: WV 37 Wayne, WV 25570

Address 2: WV 37 Wayne, WV 25570

Add Stop Add Barrier Reset

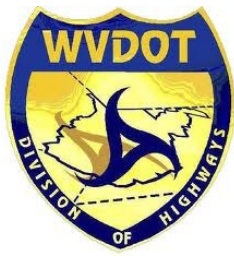
Calculate Shortest: Time Distance

Find Best Sequence Return to First Stop

POWERED BY esri



Hazard Rating Matrix Calculator



Welcome **demoadmin!** [[Log Off](#)]



WV DOH

Landslide Hazard Management System

[Home](#) | [About](#) | [Admin](#) | [Tools](#)

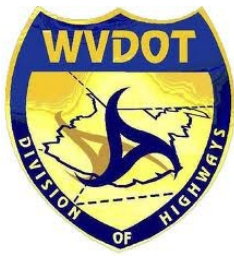
Tools Menu

Tools

- [View Reports](#)
- [View Map](#)
- [Hazard Matrix Calculator for Landslide](#)



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Landslide Hazard Matrix Calculator

Select a landslide:

test

Landslide test is at:

MODERATE RISK

[History](#)

Score: 165 out of 315

Fill out the following options to calculate the severity of the selected landslide

Potential Loss of Life:

- Landslides that upon failure would lead to no expected loss of life or significant economic damage
- Landslides that upon failure might cause loss of life or appreciable economic damage
- Landslides that upon failure would cause probable loss of life or serious economic damage
- Landslides that upon failure would cause significant loss of life or severe economic damage

Average Daily Traffic:

- ≤ 2000
- 2001-5000
- 5001-15000
- > 15000

Percent Decision/Actual Sight Distance [%DSD=(ASD/DCD)*100]:

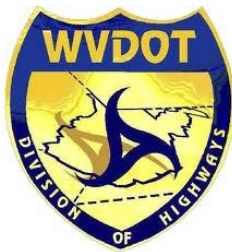
- ≥ 90
- 50-89
- 35-49
- < 35

School Bus/Emergency Route Distance (Miles):

- ≤ 5
- 6-15
- 16-25
- > 25

Impact to Road Structure and Adjacent Features:

- Low potential to affect road shoulder and low potential to affect adjacent features
- Low potential to affect roadway and moderate potential to affect to impact adjacent features
- Moderate potential to affect roadway and high potential to affect adjacent features
- High potential to affect roadway and high potential to affect adjacent features



Expected Damage to Structures (i.e Buildings, Utilities, Railroad, and other Roads/Structure):

- Low potential to affect adjacent structures
- Moderate potential to affect adjacent structures
- High potential to affect adjacent structures
- Very high potential to affect adjacent structures

Rate of Movement (inches/year)

- ≤ 1
- 1-3
- 3-6
- > 6

Amount of Surface Water

- Low
- Medium
- High
- Very high

Posted Traffic Speed (Miles/Hour)

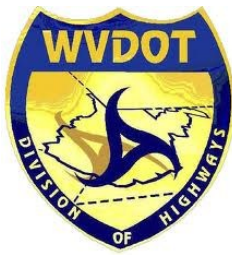
- ≤ 15
- 16-35
- 36-55
- > 55

Detour Route Distance (Miles)

- ≤ 10
- 11-20
- 36-55
- > 55

Length of Landslides (inches)

- ≤ 197
- 198-590
- 591-985
- > 985



Repair Cost (Thousand Dollars per Landslide)

- ≤ 25
- 26-75
- 76-125
- > 125

Vertical and Horizontal Displacement of Scarp (inches)

- ≤ 5
- 6-20
- 21-35
- > 35

Annual Maintenance Cost (Thousand Dollars per Landslide)

- ≤ 10
- 11-20
- 21-30
- > 30

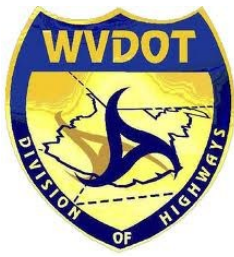
Level of Ground Water (Hydrogeology)

- Low
- Medium
- High
- Very High

Calculate



Hazard Rating Matrix History



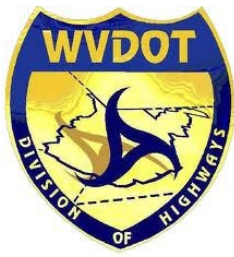
Landslide Hazard History for test

Date	Score	Risk Level (45-315)
7/29/2013 3:03:03 PM	103	LOW
7/29/2013 3:04:38 PM	165	MODERATE

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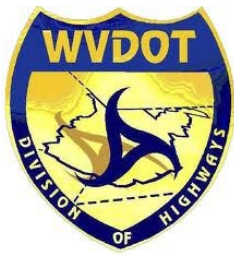
Phase I Status



- Data Dictionary is complete
- Database is populated with existing landslides in district 2
- Web Application is ready for beta testing
- Currently finalizing Hazard Rating Matrix
 - Perform testing on existing slides

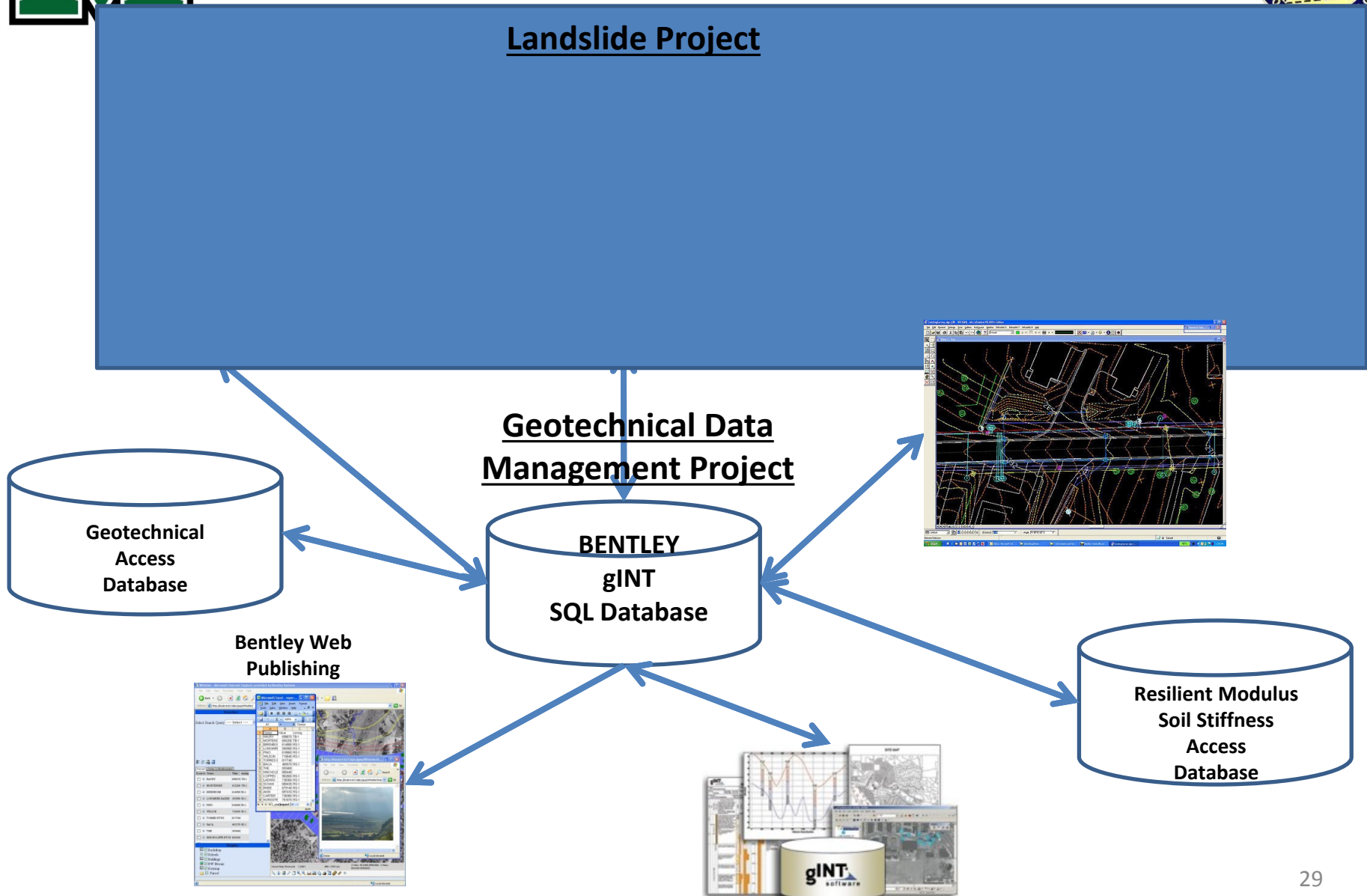


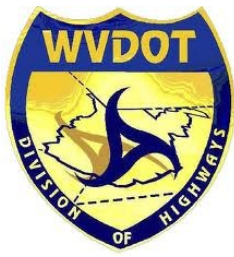
Phase II



- ❖ Extend Hazard Rating Matrix evaluation to facilitate landslides in other districts
- ❖ Modify and populate database for existing landslide sites for the Districts
- ❖ Modify the web-enabled, GIS-based landslide application for the remaining Districts
- ❖ Utilize the landslide hazard rating matrix on all the gathered entries of the nine Districts.

Complete Picture





gINT[®]

software

gINT works seamlessly

- standard applications
- Microstation
- ArcGIS
- Google Earth™
- More

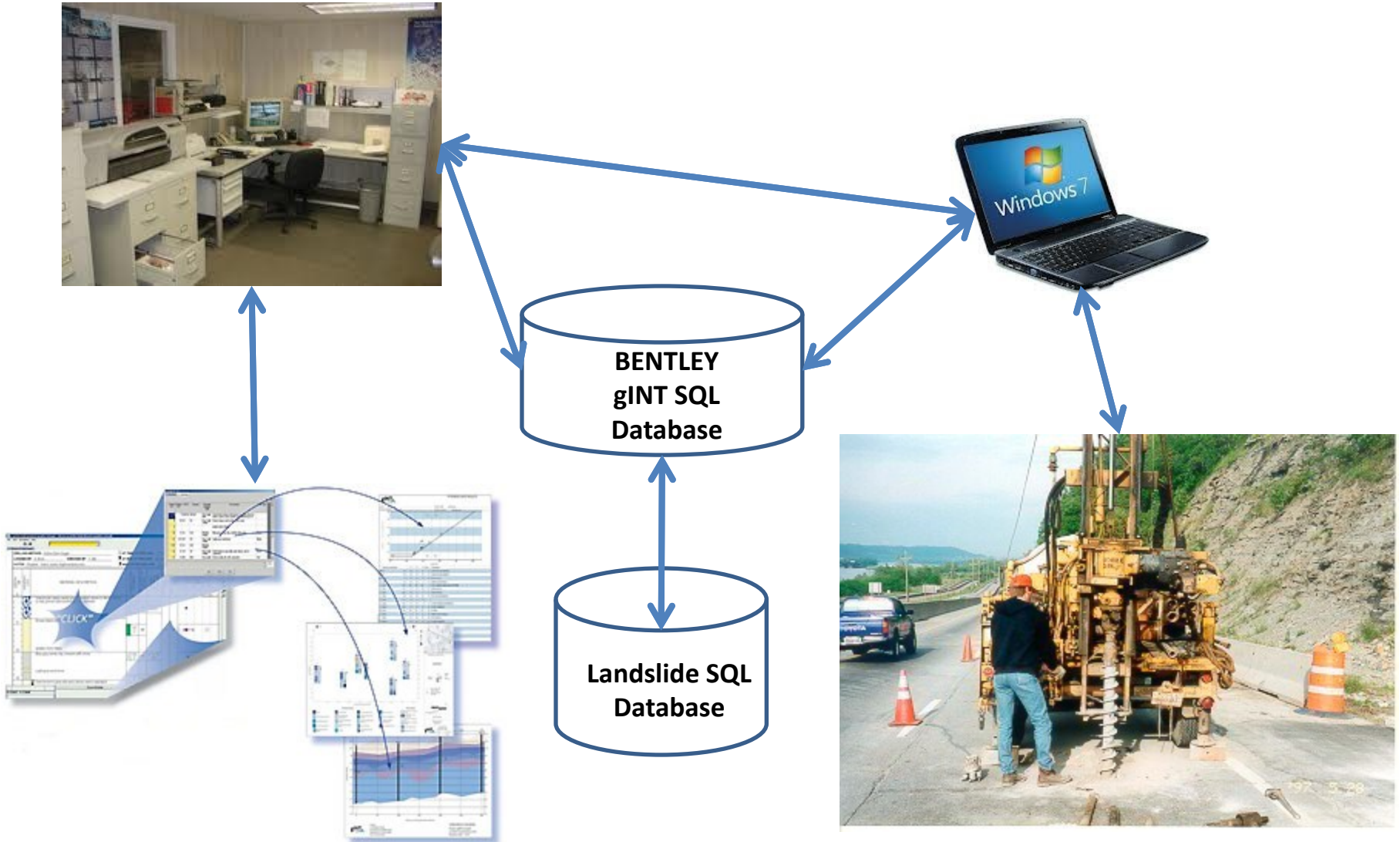


Consolidate all of Geotechnical Projects

- Centralized data storage
- Multi-project reporting
- Extended querying power.

Smart Reports, Graphics, Mapping and Publishing Abilities

Subsurface Information



A photograph of a paved road surface. In the upper left corner, there are two parallel yellow lines. In the upper right corner, there is a white line and some green grass. In the center of the road, a white chalk drawing of a car is visible. The car is a simple outline with a rectangular body, a smaller rectangle for the front, and a vertical line for the rear. The text "Thank you" is overlaid in the center of the car's body in a black, sans-serif font.

Thank you