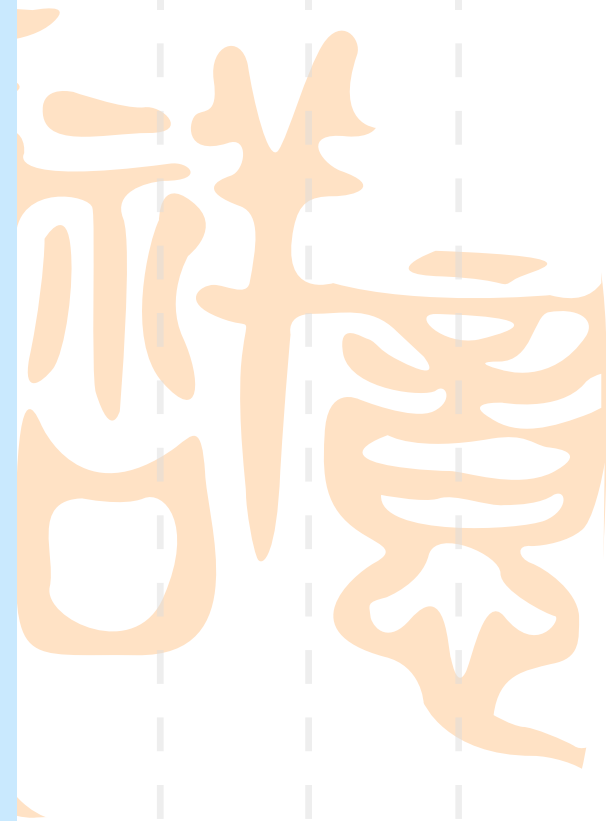


The screenshot displays the Ohio State logo in the top left corner. The main interface features a map of Ohio with various colored regions, a 3D diagram of a landslide cross-section with labels for 'Minor scarp', 'Minor cracks', 'Major cracks', 'Surface of rupture', and 'Minor body', and a circular inset showing a satellite view of a landslide. Two orange banners are overlaid on the map: 'Landslide Hazard Rating System' and 'Landslide Risk Management'. Below these is a circular inset showing a stack of CD-ROMs and a keyboard. A login window is open, containing fields for 'UserID', 'Password', and 'Verifycode' (with the value '9432' visible). A 'Login' button is positioned below the fields. The background is a light blue grid with binary code (0s and 1s) scattered throughout. At the bottom left, it says 'Copyright ©2005'.



An Integrated Landslide Management System for Highway Applications

Kirk Beach, Gene Geiger, Robert Liang



Outline of the Presentation

- ODOT Landslide Hazard Rating Matrix
- GIS Database
- Database Access via Internet



Landslide Management

GIS DATABASE MANAGEMENT PLATFORM

Landslide Risk Analysis

Landslide Hazard Identification (data collection)

1. Landslide Observation Report
2. Landslide Reconnaissance Form A
3. Landslide Reconnaissance Form B
4. Landslide Reconnaissance Form C

Landslide Hazard
Rating Matrix

Landslide Risk Assessment

Numerical
Hazard
Score

Landslide Risk Management

Landslide
Monitoring

Decision Making

Landslide
Rehabilitation

Landslide Reconnaissance Processes

Landslide Observation Report

- Landslide activities are reported to the district highway office

Part A

CM/TM

- Collect the site location.
- Preliminary information of landslide
- Verify whether it is landslide
- Determines the significance of the landslide using “rated” and “non-rated” criteria.
- Collect sketches and photographs
- Upload the information to database

Part B

CM/TM

- Search and report site history
- Search and report traffic information
- Send a notification to DGE if “rated”
- Upload the information to database

Part C

District Power User

- Verify the reported information
- Determine the amount of landslide information to be collected using landslide vulnerability criteria
- Perform hazard rating
- Take additional photograph
- Draw detailed sketches
- Upload information to database



Landslide Vulnerability Criteria (Part A)

Probability of additional movement	Probability of significant impacts to the roadway, structures, adjacent property or features			
	<i>Very High</i>	<i>High</i>	<i>Moderate</i>	<i>Low</i>
<i>Very High</i>	Very High	Very High	High	Moderate
<i>High</i>	Very High	High	High	Moderate
<i>Moderate</i>	High	High	Moderate	Low
<i>Low</i>	Moderate	Moderate	Low	Low

- The landslide with low vulnerability is “non-rated” landslide otherwise “rated”.
- If landslide is “rated”, notification is sent to DGE for detailed investigation.



Criteria for Data Collection (Part C)

Probability of additional movement (A)	Probability of significant impacts to the roadway, structures, adjacent property or features (B)			
	<i>Very High</i> (4)	<i>High</i> (3)	<i>Moderate</i> (2)	<i>Low</i> (1)
<i>Very High</i> (4)	Very High (16)	Very High (12)	High (8)	Moderate (4)
<i>High</i> (3)	Very High (12)	High (9)	High (6)	Moderate (3)
<i>Moderate</i> (2)	High (8)	High (6)	Moderate (4)	Low (2)
<i>Low</i> (1)	Moderate (4)	Moderate (3)	Low (2)	Low (1)

Vulnerability score (X) = A×B

$$X \leq 2$$

- Verify existing information
- Verify sketches from part A
- Take additional photographs

$$2 < X \leq 9$$

- Verify existing information
- Verify sketches from part A
- Take additional photographs
- Fill Form C

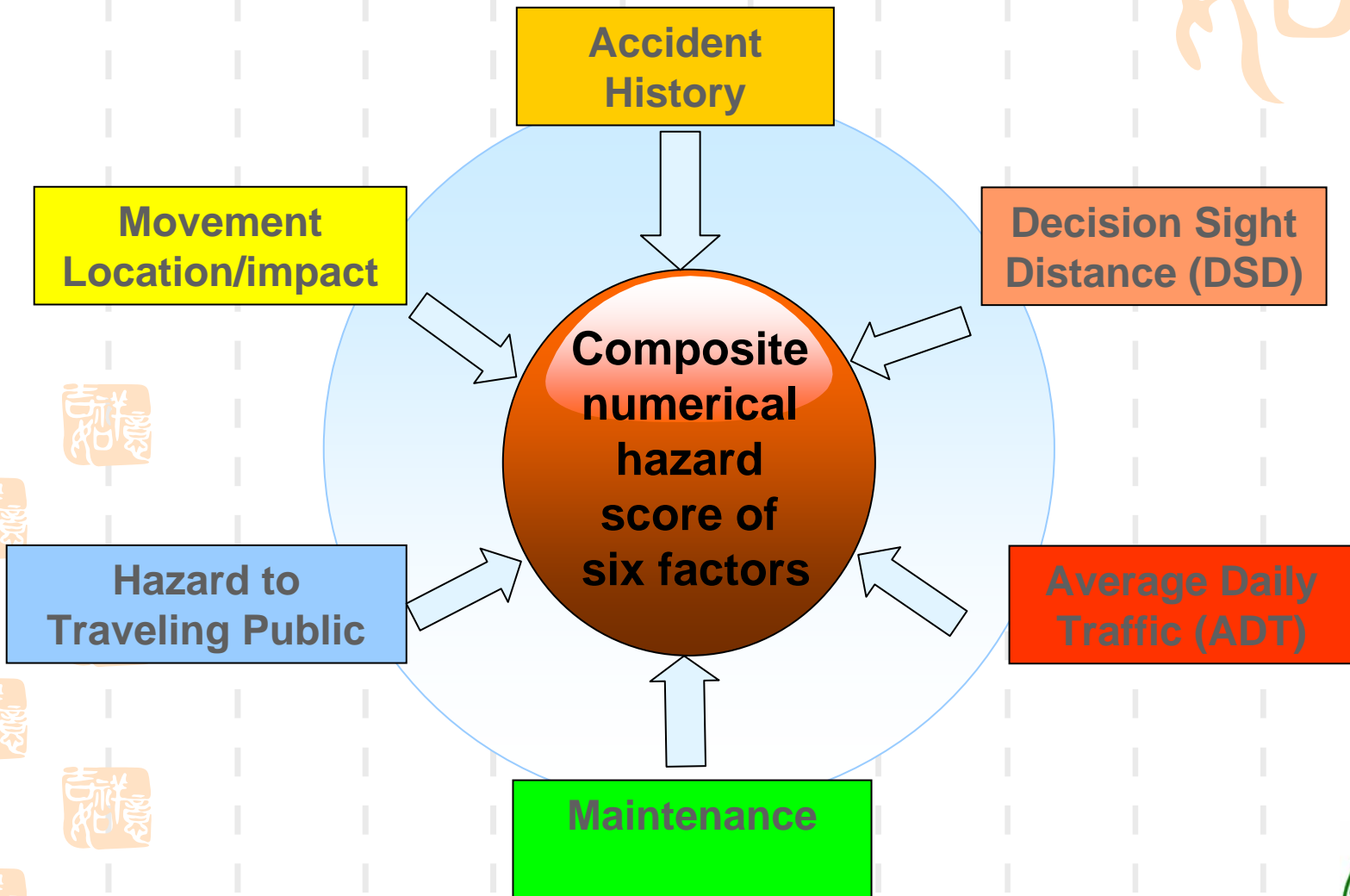
$$X > 9$$

- Verify existing information
- Verify sketches from part A
- Take additional photographs
- Fill Form C
- Provide Detailed Sketches



Six Risk Factors

吉祥



吉祥

吉祥

吉祥

吉祥

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ODOT Landslide Hazard Rating System

CATEGORY		RATING CRITERIA and SCORE			
		Points 3	Points 9	Points 27	Points 81
1. Movement location/ impact (select higher score)	Current and potential impact of landslide on roadway	On slope with a low potential to affect shoulder	On slope with a low potential to affect roadway	On shoulder, or on slope with a moderate potential to affect roadway	On roadway, or On slope with a high potential to affect roadway or structure
	Current and potential impact of landslide on area beyond right of way	On slope with a low potential to impact area beyond right of way	On slope with moderate potential to impact area beyond right of way	On slope with high potential to impact area beyond right of way	On slope with high potential to impact structure beyond right of way
2. Hazard to traveling public (Select higher score)	Rate of displacement in roadway if known	<1-inch/year	1 to 3-inches/year No single event \geq 1-inch	3 to 6-inches/year No single event \geq 3-inches	>6-inches/year Single event \geq 3-inches
	Evidence of displacement in roadway	Visible crack or dip no vertical drop	\leq 1-inch of displacement	1 to 3-inches of displacement	\geq 3-inches of displacement



ODOT Landslide Hazard Rating System

CATEGORY		RATING CRITERIA and SCORE			
		Points 3	Points 9	Points 27	Points 81
3. Maintenance (Select higher score)	Maintenance frequency	None to rare	Annually (one time/year)	Seasonal (1 to 3 times/year)	Continuous throughout year (> 3 times/year)
	Maintenance response	No response	Requires observation with periodic maintenance	Requires routine maintenance response to preserve roadway	Requires immediate response for safe travel or to protect adjacent structure
4. ADT		<2000	2001-5000	5001-15000	>15001
5. %Decision Sight Distance (DSD)		≥ 90	89 -50	49-35	< 34
6. Accident history		No accident	Vehicle or property damage	Injury	Fatality



Numerical Hazard Score Criteria

Low Hazard
Score < 150



Failure on slope/low potential: 3 points

No failure in roadway: 3 points

Need periodic observation: 9 points

16,000 cars/day: 81 points

DSD > 90%: 3 points

No history: 3 points

Total: 102 points



Failure surface

Failure on slope/low potential: 3 points

No failure in roadway: 3 points

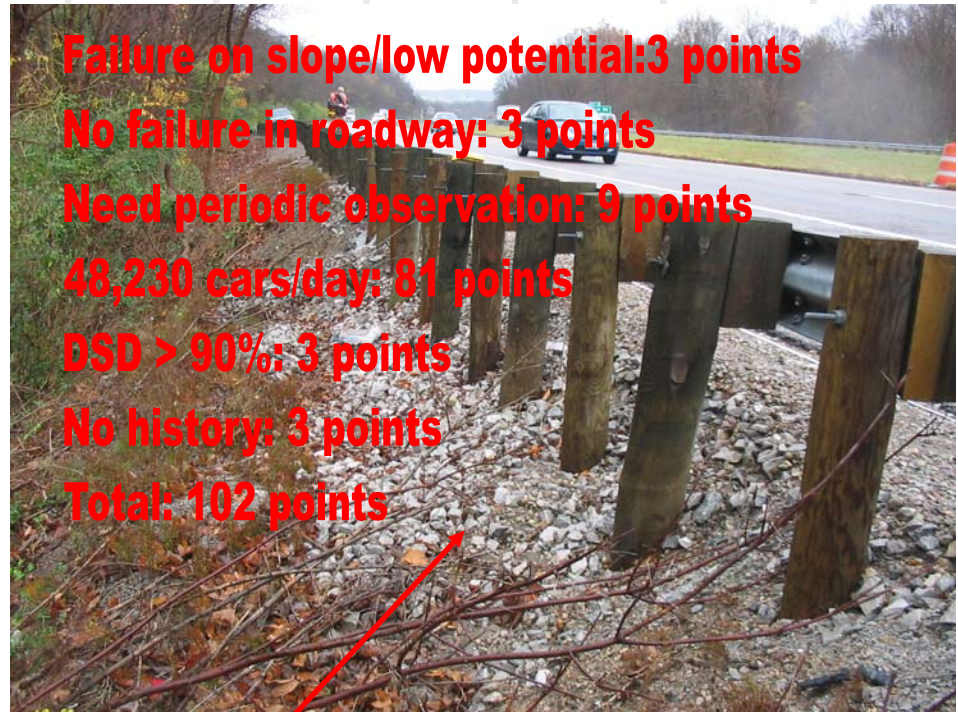
Need periodic observation: 9 points

48,230 cars/day: 81 points

DSD > 90%: 3 points

No history: 3 points

Total: 102 points



Failure surface



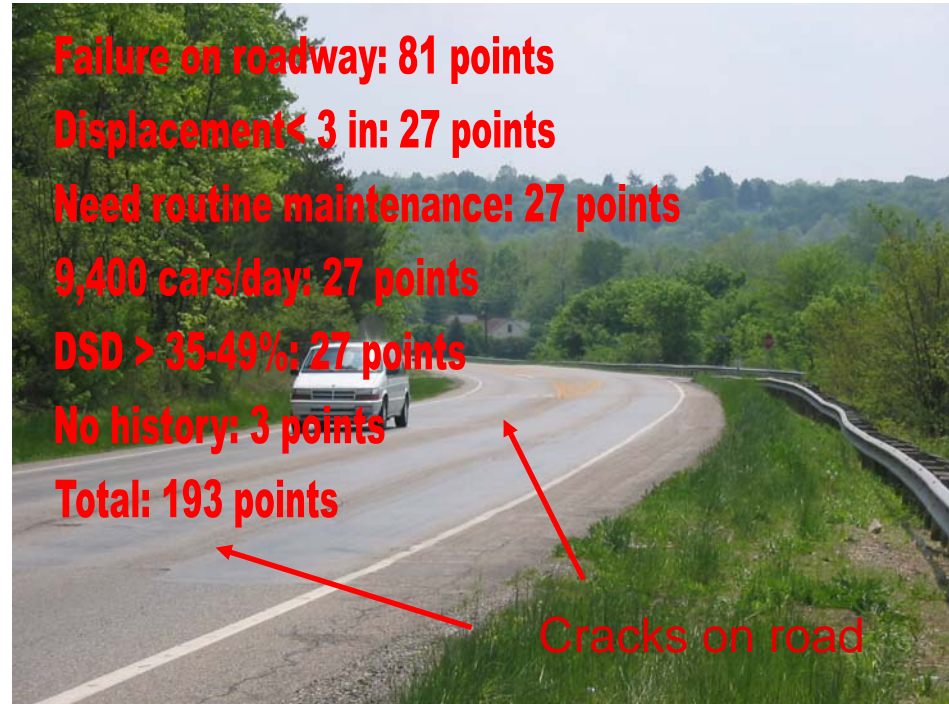
Numerical Hazard Score Criteria



Medium Hazard
 $150 < \text{Score} \leq 250$



- Failure on roadway shoulder: 27 points
- Displacement > 3 in: 81 points
- Need periodic observation: 9 points
- 16,000 cars/day: 81 points
- DSD > 90%: 3 points
- No history: 3 points
- Total: 204 points



- Failure on roadway: 81 points
- Displacement < 3 in: 27 points
- Need routine maintenance: 27 points
- 9,400 cars/day: 27 points
- DSD > 35-49%: 27 points
- No history: 3 points
- Total: 193 points

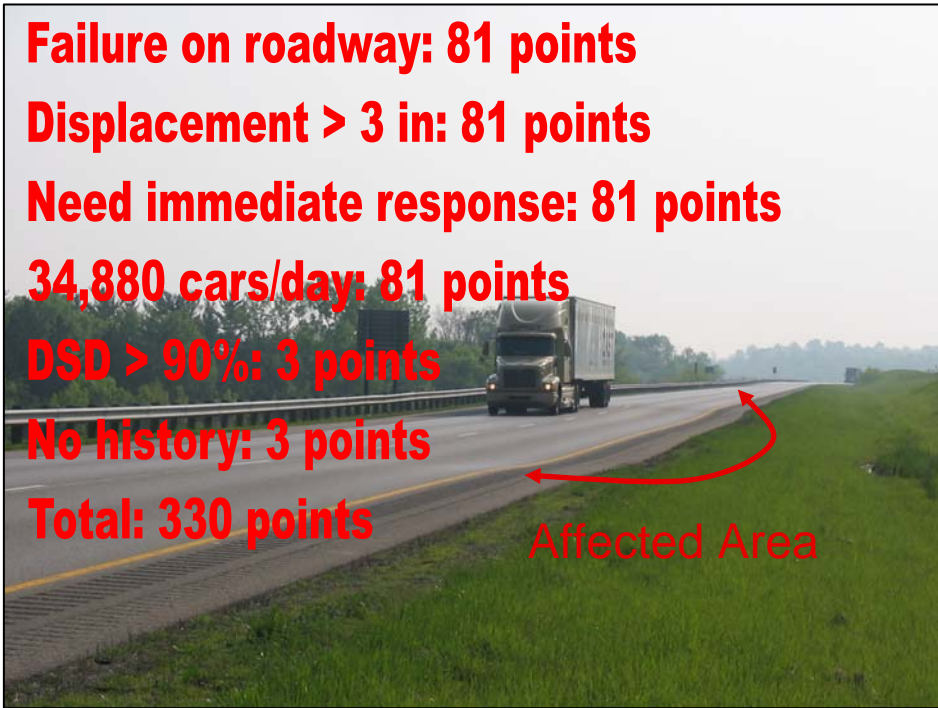
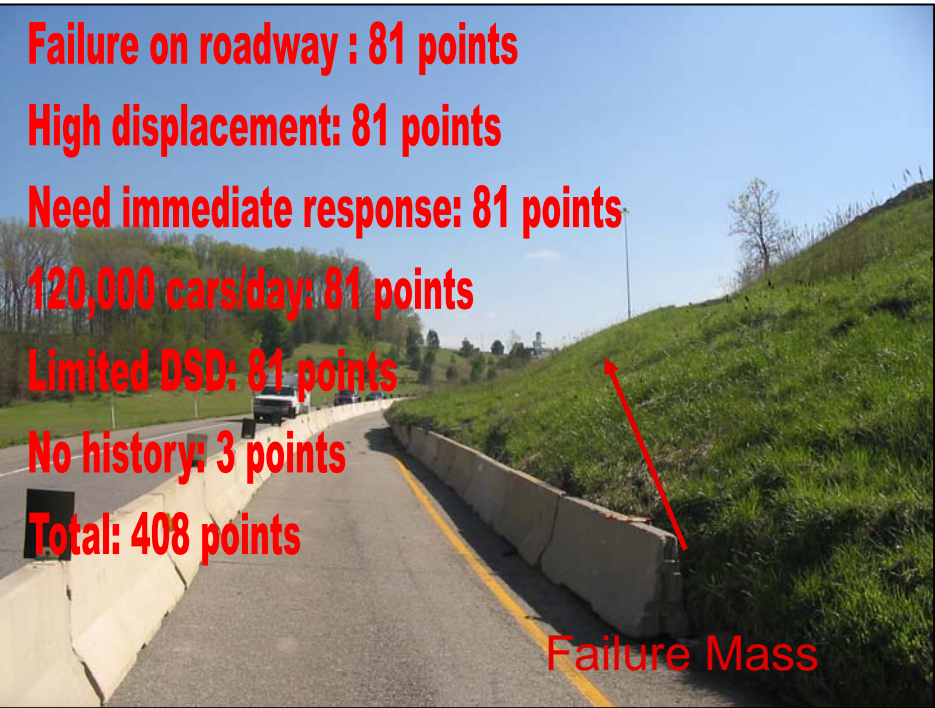
Cracks on road



Numerical Hazard Score Criteria



High Hazard
Score > 250

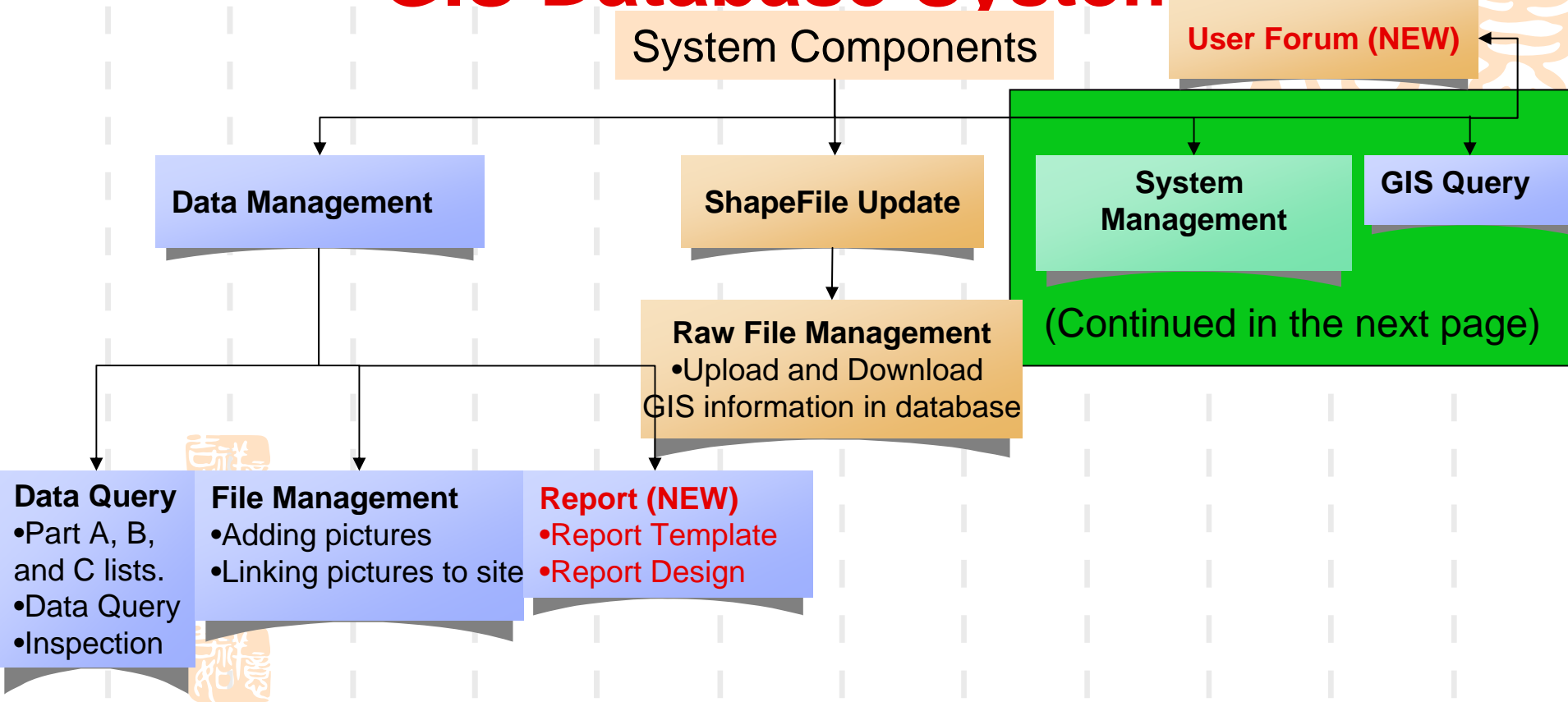


Privileges of Users in Database

User Types \ Privilege	Normal User	County Power User (CM/TM)	District Power User (DGE)	State Power User	Administrator	System Power User	Supervisor
Download	X	X	X	X	X	X	X
Upload shape file into database		X	X	X	X	X	X
Data query		X	X	X	X	X	X
GIS query	X	X	X	X	X	X	X
Add/Edit Parts A and B		X	X	X	X	X	X
Add/Edit Part C			X	X	X	X	X
Delete Parts A, B, and C				X	X	X	X
Manage landslide pictures		X	X	X	X	X	X
Manage regional information (County and District)				X	X	X	X
Update shape files in GIS server				X	X	X	X
Design of database webpage						X	X
User registration					X		X
Set user privileges							X



Components of Web-enabled GIS Database System



Components of Web-enabled GIS Database System

System Components

User Forum

- BugReport
- Suggestion

Data Management

File Management

System Management

GIS Query

- Show location of landslides on GIS map
- Perform various types of data query

User Management

Group Manage
 • authorize new users to some specific functions

User Manage
 • Allow add, edit delete new users to database

Resource Management

Permission Manage
 • Set up function details to users
 • Qualified users have right to see and operate his features.

Page Management

Tab Manage
 • add, edit, and delete tabs

Bar Manage
 • manage items in bar

Item Manage
 • Users could add, edit, delete items in bar

Regional Management

County Manage
 • Add, edit, and delete county

District Manage
 • Add, edit, and delete district



Resource/Asset management using Web-Enabled GIS Database System

User Login

The screenshot shows the user login interface for the Ohio State Landslide Hazard Rating System. The page features a blue background with a grid pattern and binary code. In the top left corner, there is the Ohio State logo and the text "Ohio State". The main content area includes a circular map of Ohio with color-coded regions, a circular inset showing a cross-section of a landslide with labels for "Crown", "Main body", and "Toe", and another circular inset showing a satellite image of a landslide. Below these are two circular images: one showing a stack of CD-ROMs and another showing a keyboard. The text "Landslide Hazard Rating System" and "Landslide Risk Management" is displayed in orange. At the bottom, there is a login form with fields for "UserID", "Password", and "Verifycode" (with a CAPTCHA image showing "9432"). A "Login" button is located below the fields. The copyright notice "Copyright ©2005" is visible at the bottom left of the page.

- ❖ <http://landslide.ascn3.uakron.edu/gisView>
- ❖ Users login with user name and password



Resource/Asset management using Web-Enabled GIS Database System

Data management

Data Management | ShapeFile Update | System Management | GIS Query | User Profile

Data Query

- Part A List
- Part B List
- Part C List
- Inspection
- DataQuery

File Management

Reports

ByUser: Gong

Select	Name	ReportID	County	Route	Mile Marker	Date
<input type="radio"/>	Brent Black	255	Adams	2	17.71-17.74	05/05/2005
<input type="radio"/>	Brent Black	256	Ottawa	2	17.71-17.7	05/05/2004
<input type="radio"/>	Gridsana Pensomboon	258	Ottawa	2	0.0-0.0	05/04/2004
<input type="radio"/>	Gridsana Pensomboon	259	Ottawa	113	4.0-0.0	05/04/2004
<input type="radio"/>	Brent Brent	261	Lorain	60	0.0-0.0	05/05/2004

Next

Select	Name	Date	Annual maintenance cost	Total traffic
<input type="radio"/>	Gridsana Pensomboon	05/05/2004	0.0	16330
<input type="radio"/>	Gridsana Pensomboon	05/05/2004	0.0	2610

Next

Select	Name	Date	Vegetation density	Orientation of all
<input type="radio"/>	Gridsana Pensomboon	05/05/2004		
<input type="radio"/>	Gridsana Pensomboon	05/05/2004		
<input type="radio"/>	Gridsana Pensomboon	05/05/2004		

Data Query

Search Mode: By Location

General
 By Location
 By Date
 By Rating
 By Mile Marker
 By Evaluator Name
 By InspectionSchedules
 By SlopeType
 By Traffic Data

District: District1 | County: Allen | Jurisdiction: County | Route System: IIF-interstate

Route Number:

Query

Select	Name	UserID	Upload date	District	Country	Description	Icon
<input type="radio"/>	Gridsana	Gong	2006-03-15	Central Office		Site no.1 SR. 2 MP. 17.71	
<input type="radio"/>	Gridsana	Gong	2006-03-15	Central Office		SR. 2 MP. 17.71 Downslope area	
<input type="radio"/>	Gridsana	Gong	2006-03-16	Central Office		Site no. 2 on westbound lane	
<input type="radio"/>	Gridsana	Gong	2006-03-16	District 1	Allen	Site no. 2 Westbound lane, area at slope toe	
<input type="radio"/>	Gridsana	Gong	2006-03-16	District 1	Allen	Site no. 3 Gabion wall	
<input type="radio"/>	Gridsana	Gong	2006-03-16	District 1	Allen	Crack on Pavement	
<input type="radio"/>	Gridsana	Gong	2006-03-16	District 3	Allen	Anchored slope and H-beam	
<input type="radio"/>	Gridsana	Gong	2006-03-17	District 2	Hardin	lake at the toe of slope	
<input type="radio"/>	Gridsana	Gong	2006-03-17	District 1	Allen	Slope in the east direction	



Resource/Asset management using Web-Enabled GIS Database System

ShapeFile Update

The screenshot shows the 'ShapeFile Update' section of a web application. The navigation bar includes 'Data Management', 'ShapeFile Update', 'System Management', 'Gis Query', and 'User Forum'. The 'ShapeFile Update' sidebar is active, showing a 'ShapeFileManage' icon. The main content area displays a table of files with columns for 'Select', 'File Name', 'User ID', 'Upload Date', 'Merged Date', and 'Merged Flag'. The table is filtered by 'User: admin'. A dashed arrow points from the sidebar icon to the table.

Select	File Name	User ID	Upload Date	Merged Date	Merged Flag
<input type="radio"/>	slidesite.dbf	Gong	2006-4-18_23	2006-4-18_23	Merged
<input type="radio"/>	slidesite.dbf	Gong	2006-4-18_23	2006-5-23_11	Merged
<input type="radio"/>	slidesite.dbf	Gong	2006-5-23_11	2006-5-23_11	Merged
<input type="radio"/>	slidesite.dbf	Gong	2006-6-9_10	2006-6-9_10	Merged

ShapeFile Management

Filter By: ByUser User: admin GO | MergedFiles | Un-MergedFiles | Upload | DownLoad | ChangeFlag

Select	File Name	User ID	Upload Date	Merged Date	Merged Flag
<input type="radio"/>	slidesite.dbf	Gong	2006-4-18_23	2006-4-18_23	Merged
<input type="radio"/>	slidesite.dbf	Gong	2006-4-18_23	2006-5-23_11	Merged
<input type="radio"/>	slidesite.dbf	Gong	2006-5-23_11	2006-5-23_11	Merged
<input type="radio"/>	slidesite.dbf	Gong	2006-6-9_10	2006-6-9_10	Merged

District: District 1
County: Allen

Dbf File url: Browse...
shp File url: Browse...
shx File url: Browse...
Prj File url: Browse...

Upload needs at least 3 files.
(Dbf, Shp, and Shx)

The screenshot shows a 'File Download' dialog box with the question 'Do you want to open or save this file?'. The file details are: Name: slidesite.dbf, Type: Microsoft Visual FoxPro Table, From: landslide.ascn3.uakron.edu. The dialog has 'Open', 'Save', and 'Cancel' buttons. In the background, a list of download links is visible: 'Download---->slidesite.dbf', 'Download---->slidesite.shp', and 'Download---->slidesite.shx'. A dashed arrow points from the table in the previous block to this dialog.



Resource/Asset management using Web-Enabled GIS Database System

System Management

Data Management ShapeFile Update System Management

User Management

Page Management

Resources

Regions

Detour Cost

Detour Cost Factor

Resources

Permission Management

UserManage

GroupManage

UserManage

PageURLManage

PageManage

UserDataManage
GroupDataManage
TabDataManage
BarDataManage
ItemDataManage
PartADataManage
PartBDataManage
PartCDataManage
RawFileManage
FinalFileManage
DistrictManage
CountyManage

select	resourceName	description
<input type="checkbox"/>	All Users	this group default include all users
<input type="checkbox"/>	System Power User	can do anything except web page management
<input type="checkbox"/>	guest	guest
<input type="checkbox"/>	administrator	can do anything except page management and user management
<input type="checkbox"/>	Normal User	View and query data
<input type="checkbox"/>	County Power User	Enter PartA only,can only edit the data originally created by himself
<input type="checkbox"/>	District Power User	Enter PartC only,Can only edit the data originally entered by himself
<input type="checkbox"/>	State Power User	Edit statewide date entered
<input type="checkbox"/>	supervisor	can do anything

Can add, edit, and delete user groups.

select	Name	Title	Affiliation	County	Phone
<input type="checkbox"/>	admin		District 1	Allen	
<input type="checkbox"/>	Dave Blackstone	GIS Manager	District 6	Franklin	
<input type="checkbox"/>	Frank		District 1	Allen	
<input type="checkbox"/>	Gong				
<input type="checkbox"/>	Gong_administrator				
<input type="checkbox"/>	Gong_systempoweruse				
<input type="checkbox"/>	Gong_Countypoweruse				
<input type="checkbox"/>	Gong_districtpoweruser		District 1	Allen	
<input type="checkbox"/>	Gong_statepoweruser		District 1	Allen	
<input type="checkbox"/>	Gong_normal_user		District 4	Summit	
<input type="checkbox"/>	hlg	Hlg	District 1	Allen	
<input type="checkbox"/>	Kirk Beach		District 6	Franklin	
<input type="checkbox"/>	Kirk B		District 1	Allen	
<input type="checkbox"/>	lai		District 1	Allen	
<input type="checkbox"/>	luo		District 1	Allen	
<input type="checkbox"/>	Yamin		District 1	Allen	

add edit delete

Can add, edit, and delete users.

identity id	identity type	user action
County Power User	group	edit delete
District Power User	group	edit delete
State Power User	group	edit delete
supervisor	group	edit delete
administrator	group	edit delete
System Power User	group	edit delete

Can give permission to users.



Resource/Asset management using Web-Enabled GIS Database System

System Management

User Management

Page Management

TabManage

BarManage

ItemManage

select	Name	Order	IconURL	Description
<input type="radio"/>	DataManage	1	images/tabimg/mapinfo.gif	asdf
<input type="radio"/>	FileManage	2	images/tabimg/finisheactivity_menu.gif	
<input type="radio"/>	SystemManage	3	images/tabimg/myrunninginstances.gif	this is tab2
<input type="radio"/>	GisQuery	4	images/tabimg/allrunninginstances.gif	

add edit delete

select	Name	Order	IconURL	Description
<input type="radio"/>	UserManage	1	asdasfd	asdasfd
<input type="radio"/>	PageManage	2	asdf	asdasfd
<input type="radio"/>	ResourceManage	3	aaaa	asdasdf
<input type="radio"/>	DataQuery	4	adsasdf	asdasdf
<input type="radio"/>	PictureManage	6		
<input type="radio"/>	DataFileManage	7	a	
<input type="radio"/>	Regi			

select	Name	ItemURL	IconURL
<input type="radio"/>	Part A List	/viewPartAList.do?m=list	images/itemimg/271.png
<input type="radio"/>	Part C List	/viewPartCListAll.do?m=list	images/itemimg/118.png
<input type="radio"/>	Part B List	/viewPartBListAll.do?m=listAll	images/itemimg/123.png
<input type="radio"/>	PictureManage	/viewUploadFileManage.do?m=list	images/itemimg/118.png
<input type="radio"/>	DataQuery	/QueryData.do	images/itemimg/calbtn.gif
<input type="radio"/>	PermissionManage	/PermissionMain.do	images/itemimg/processes_icon.gif
<input type="radio"/>	ResourceManage	/ResourceDomainList.do	images/itemimg/actlet_icon.gif
<input type="radio"/>	GisQuery	/gis_redirect.htm	
<input type="radio"/>	UploadDbfFile	/DataMergeManage/dbfFileUpload.jsp	images/itemimg/123.png
<input type="radio"/>	TabManage	/ListTab.do	images/itemimg/field_icon.gif
<input type="radio"/>	GroupManage	/ListGroup.do	images/itemimg/182.png
<input type="radio"/>	UserManage	/ListUser.do	images/itemimg/531.png
<input type="radio"/>	BarManage	/ListBar.do	images/itemimg/forms.gif
<input type="radio"/>	ItemManage	/ListItem.do	images/itemimg/instances_icon.gif
<input type="radio"/>	CountyManage	/ListCounty.do	images/itemimg/120.png
<input type="radio"/>	DistrictManage	/ListDistrict.do	images/itemimg/118.png
<input type="radio"/>	DownloadDbfFile	/SelectDownloadData.do	images/itemimg/Icons.png
<input type="radio"/>	FinalFileManage	/dataFileList.do?FileType=FINALFILE	images/itemimg/finisheActivities.gif
<input type="radio"/>	WorkingFile	/dataFileList.do?FileType=WORKINGFILE	images/itemimg/Applications.png
<input type="radio"/>	RawFileManage	/dataFileList.do?FileType=RAW	images/itemimg/actlet_icon.gif

add edit delete



Resource/Asset management using Web-Enabled GIS Database System

System Management

- User Management
- Page Management
- Resources
- Regions
- CountyManage
- DistrictManage

select	Name	Address	Zip	Fax
<input type="radio"/>	Adams			
<input type="radio"/>	Allen			
<input type="radio"/>	Ashland			
<input type="radio"/>	Ashtabula			
<input type="radio"/>	Athens			
<input type="radio"/>	Auglaize			
<input type="radio"/>	Belmont			
<input type="radio"/>	Brown			
<input type="radio"/>	Butler			
<input type="radio"/>	Carroll			
<input type="radio"/>	Champaign			
<input type="radio"/>	Clark			
<input type="radio"/>	Chloride			

add edit delete

Add, edit, and delete County Information

select	Name	Address	Zip	Fax
<input type="radio"/>	District 1			
<input type="radio"/>	District 10			
<input type="radio"/>	District 11			
<input type="radio"/>	District 12			
<input type="radio"/>	District 2			
<input type="radio"/>	District 3			
<input type="radio"/>	District 4			
<input type="radio"/>	District 5			
<input type="radio"/>	District 6			
<input type="radio"/>	District 7			
<input type="radio"/>	District 8			
<input type="radio"/>	District 9			

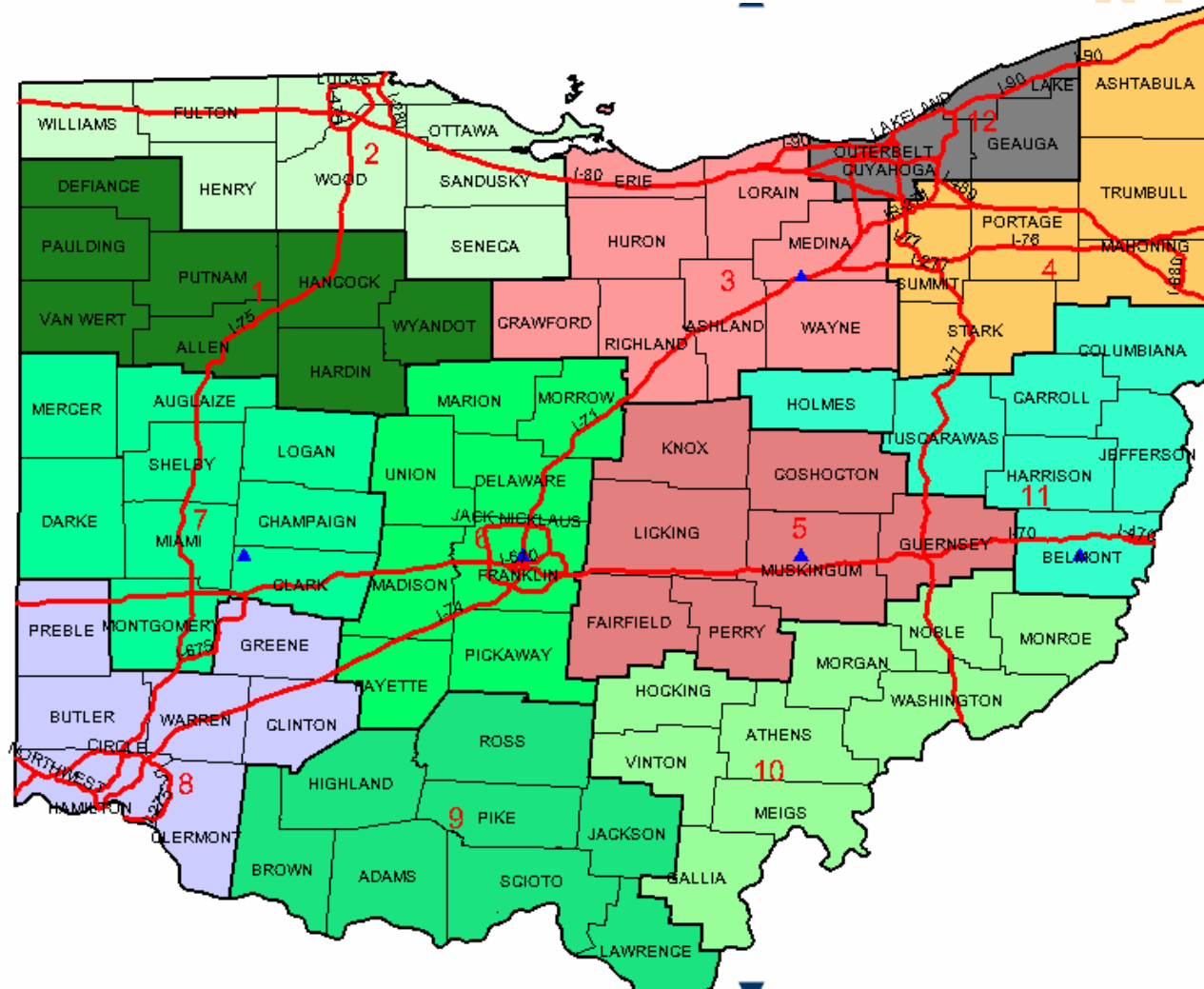
add edit delete

Add, edit, and delete ODOT district Information



Resource/Asset management using Web-Enabled GIS Database System

GIS Query



Resource/Asset management using Web-Enabled GIS Database System

GIS Query



Identify

Rec	Slide ID	Jurisdiction	District	Route System	Route Number	NLF	Lane Number	Risk Level	Rank Score	#SHAPE#	#ID#
1	257	State	2	SR	105	0	1		126	[point]	3

Query

Field: Slide ID Operator: = Value:

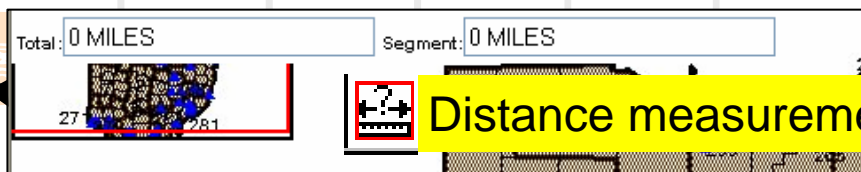
Buttons: And, Or, Not, (,)

Get Samples

Add to Query String

Execute Undo Clear

Distance measurement



Resource/Asset management using Web-Enabled GIS Database System

User Forum

User Forum

BugReport

Suggestions

User Forum

Status Icon: Open | Closed | Investigation | Testing

Status	ID	Topic	Views	Replies
	34	test	1	0
	32	Part B Data	3	0
	23	Partc-Picture manage	3	0
	25	Data query	3	0
	26	Data query	3	0
	31	Interface	2	0
	19	Picture manage	6	0
		agement	2	0
		management	3	1
		um	3	0
			6	1
			5	1
			14	3

Post New Topic | Refresh

Author	Post Date	Last Post
kbeach	04/26/2007	04/26/2007

BugReport: Post new topic and reply a topic

Suggestions: Post new topic and reply a topic


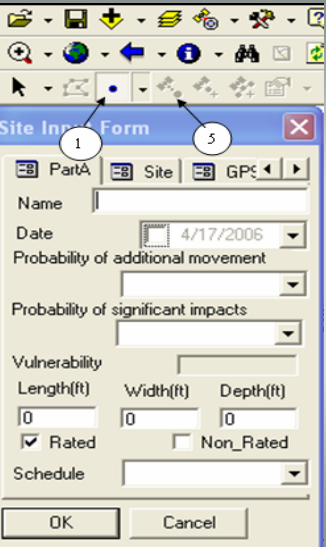
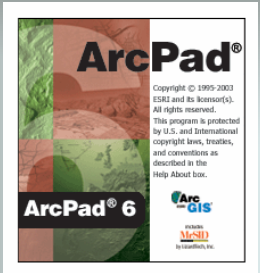

User Forum

Status Icon: Open | Closed | Investigation | Testing

Status	ID	Topic	Views	Replies
	36	Users Lists	1	0
	24	test	4	1
	30	Printing	2	0
	12	Guidance to use this forum	4	0
	14	Topic: Re: personal suggestion from YAN	11	1



Information Collection Process



Part A County/Transportation Manage (CM/TM)
Part B (CM/TM)
Part C District Power User



Benefits of the Development

No paper work

1

Near real time monitoring

2

Centralized information

3

Uniform data collection

4

Shorten work time in office

5

Interchangeable information

6





Thank You !