

2014 ESRI UC Conference

San Diego, CA
July 13-18, 2014

Creating Web-based Nonpoint Source Monitoring/Reporting Tool

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Ohio University's Voinovich School of Leadership and Public Affairs



Acid Mine Drainage (AMD)

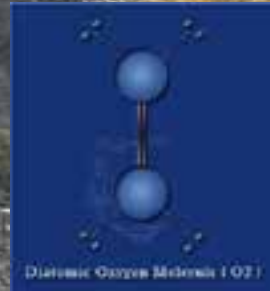
Iron Pyrite + Water + Oxygen = Sulfuric Acid



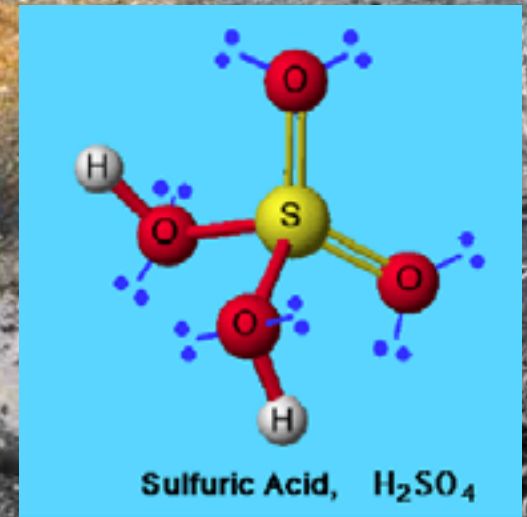
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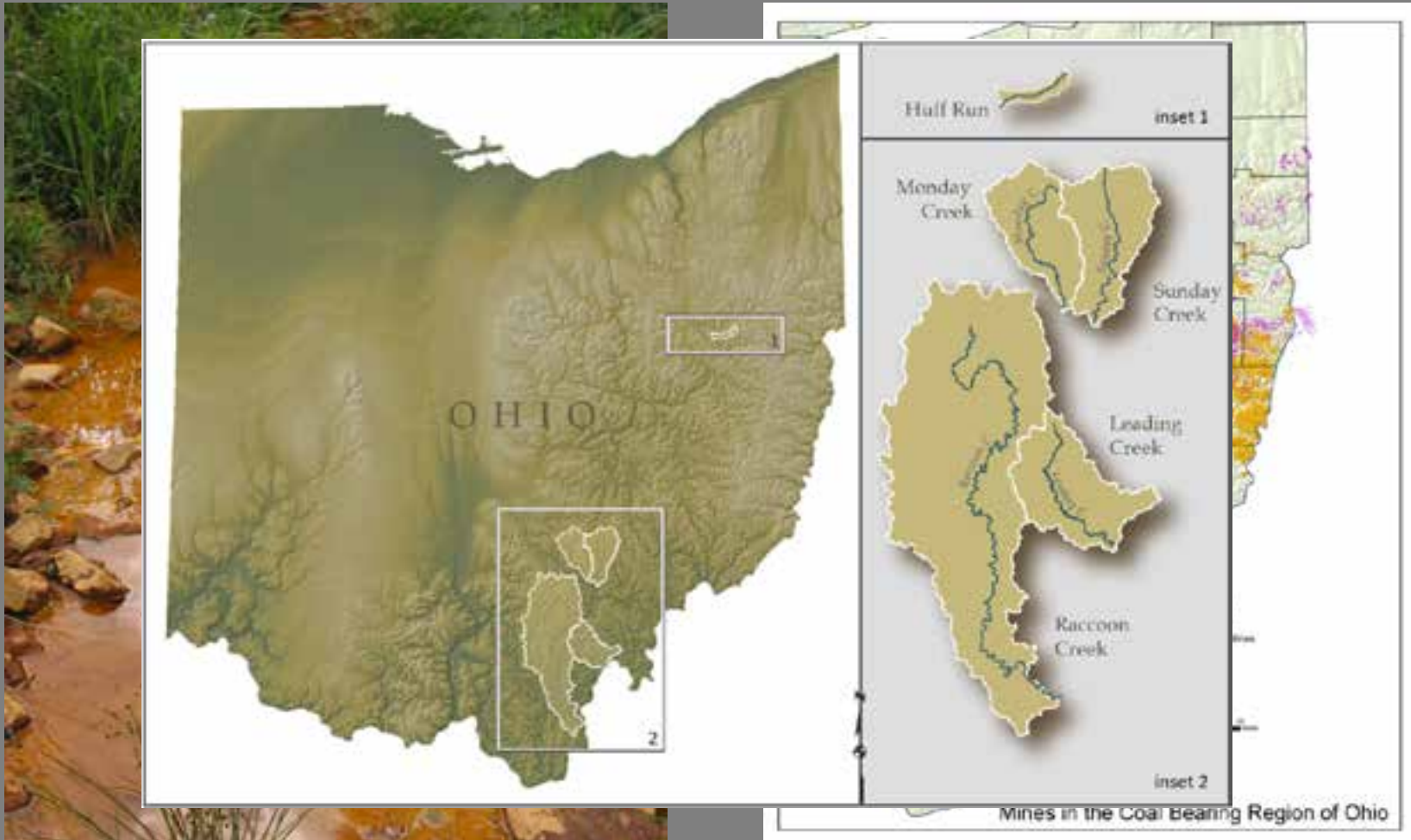


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Acid Mine Drainage in Southeastern Ohio

- Abandoned underground mines (1900-70's)
- Acidity, high conductivity, SO_4^{2+} , Fe, Al, Mn
- \$20 million spent in 3 watersheds (43 projects)
- Passive and active treatment of AMD inputs



Reducing Input:

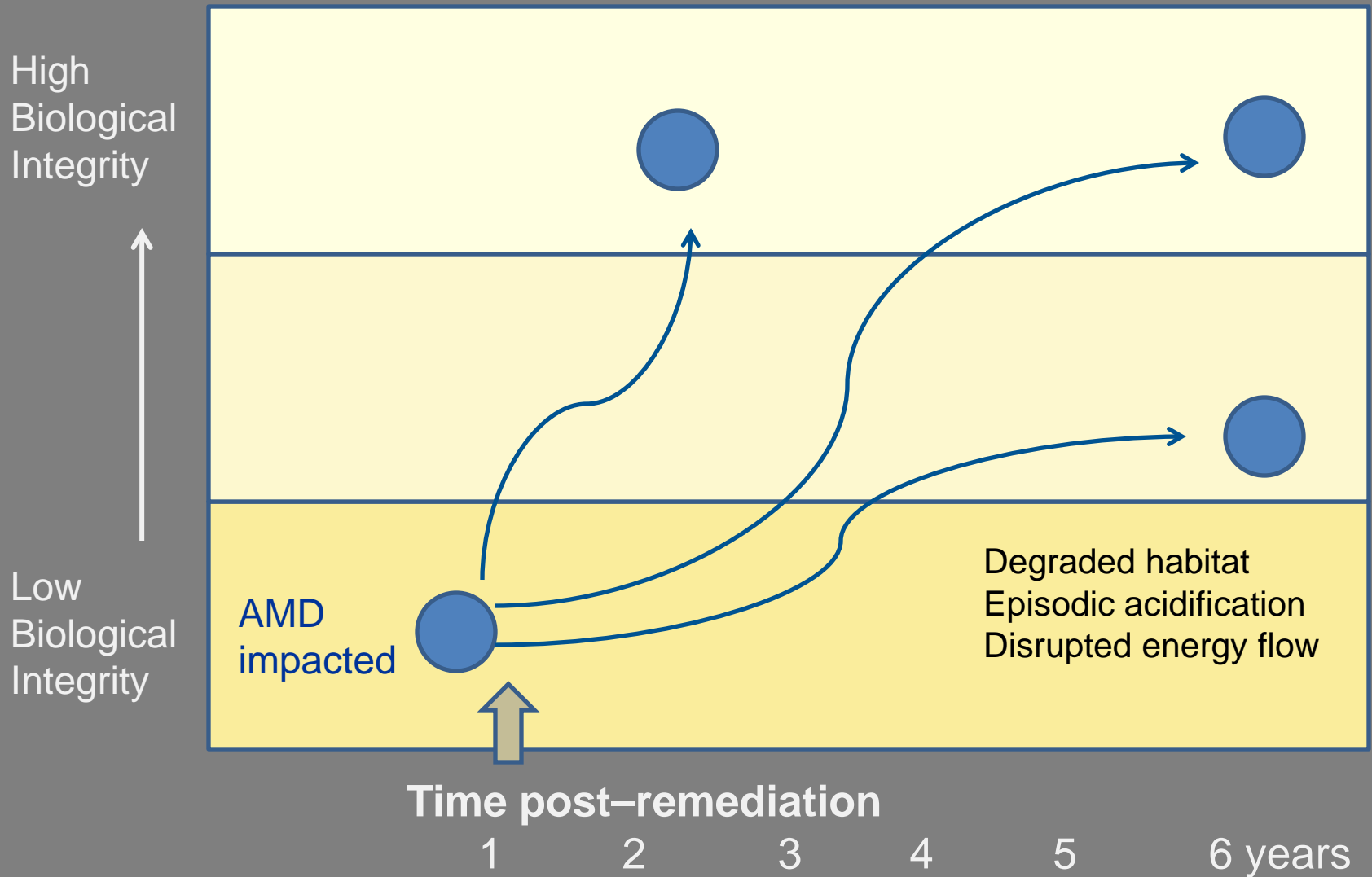
- Capping gob piles
- Closing subsidences
- Surface reclamation

Alkaline Addition:

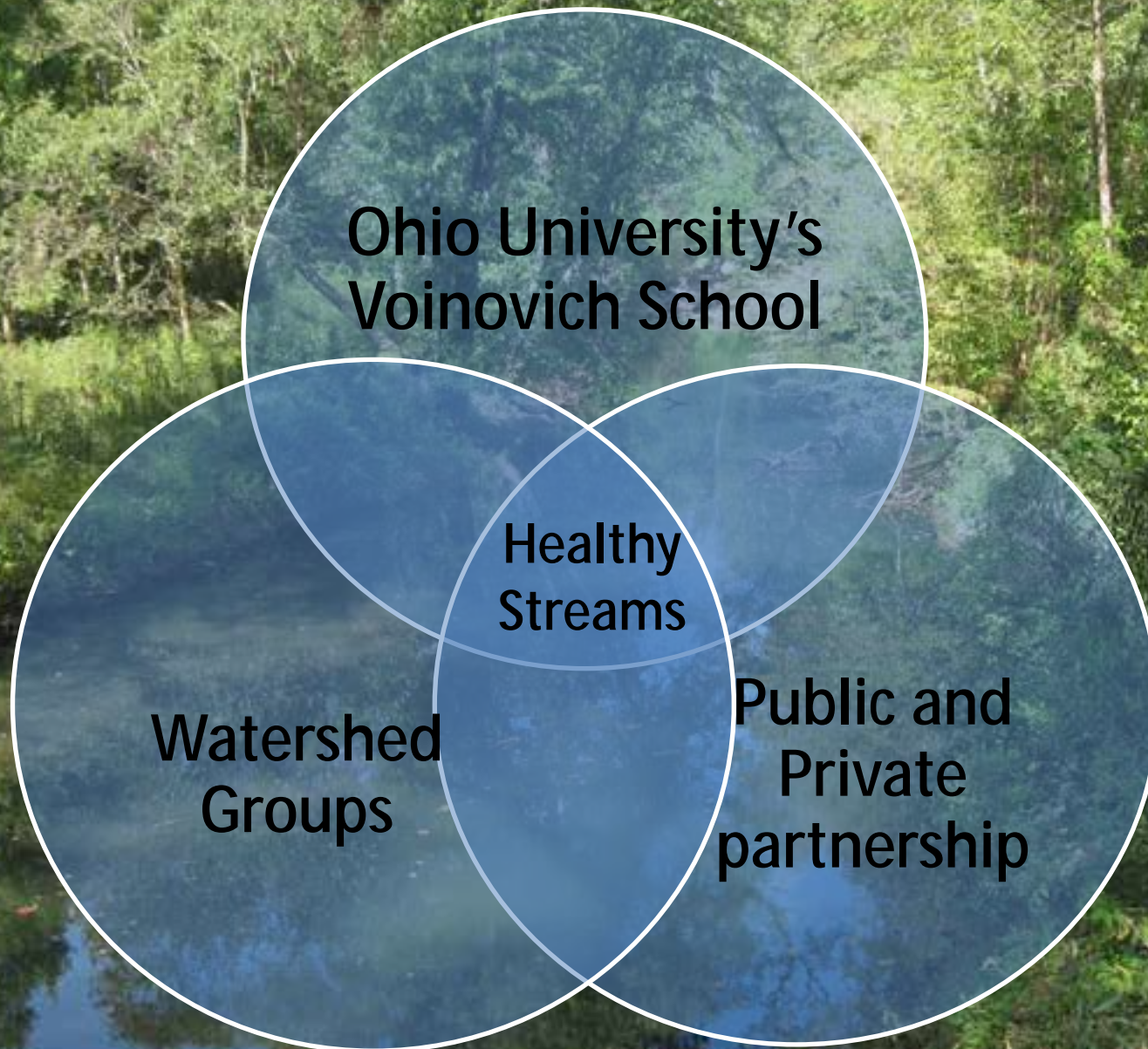
- Limestone channels
- Anoxic limestone drains
- Steel slag beds
- Active dosers (CaO)



Biotic Recovery or Recovery Potential



Collaborative Partnership



Monitoring

We use aquatic organisms as the ultimate indicator of healthy streams:

Chemical Water Quality

Fish

Macroinvertebrates




Visualize Data on a Map- Ohio Watershed Data

Ohio Watershed Data

Home Surface Water Groundwater AMD Projects Partner Watersheds Contact Log In

Restoring Ohio's Watersheds

Coal mining and agriculture have taken their toll on the pristine waterways of Ohio. Abandoned mine drainage (AMD), pesticides, fertilizers, erosion, and livestock waste seep into rivers and streams disrupting the delicate balance of their ecosystems. This site compiles and tracks changes in Ohio's watersheds to measure the success of ongoing reclamation efforts.

21,906 
Samples Collected Since January 1, 1995

Fertilizer & Pesticides

Livestock Waste

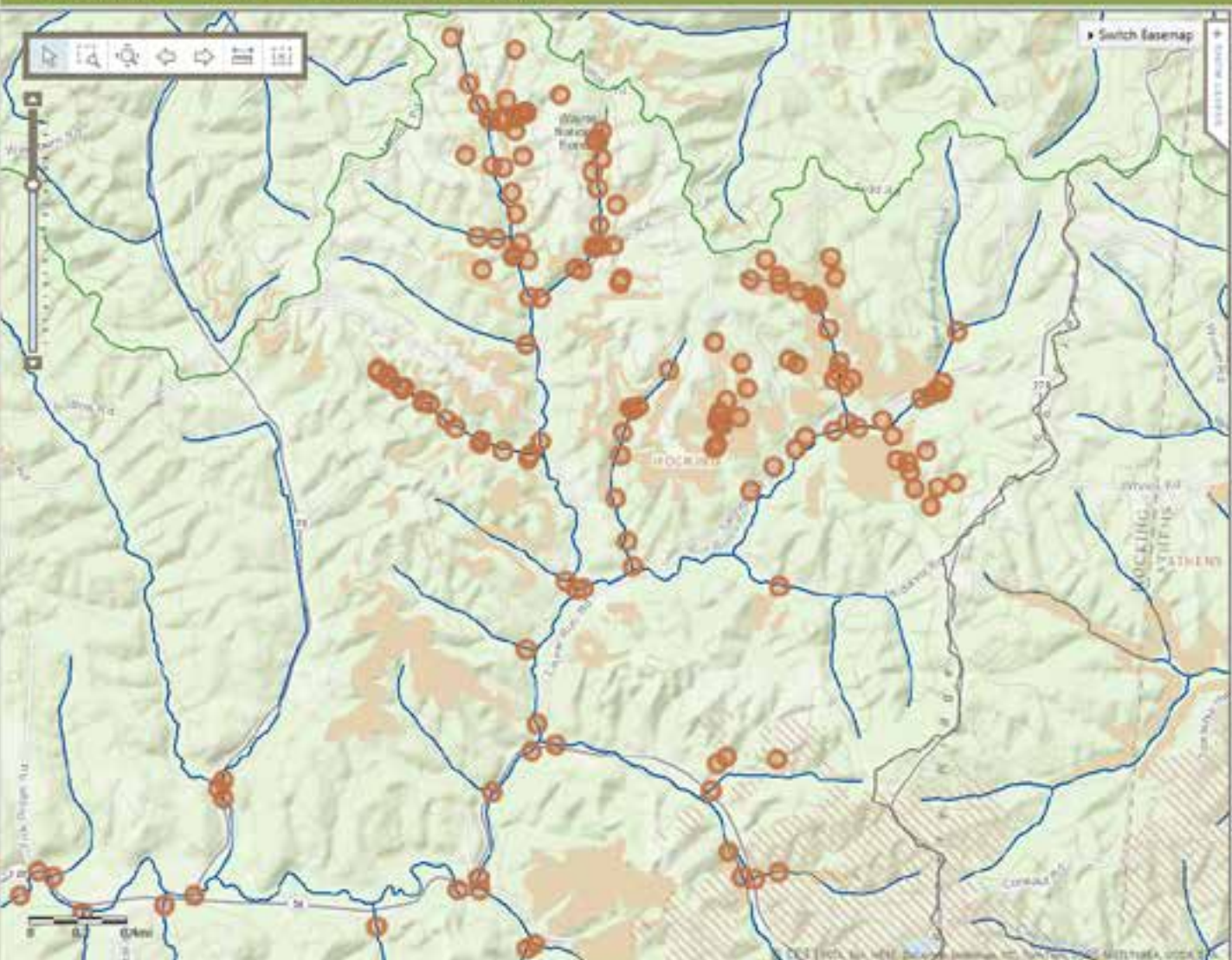
Acid Mine Drainage

Erosion & Sedimentation

Ohio Watershed Data

Home Surface Water Groundwater AMD Projects Partner Watersheds Contact login

RaccoonCreek Search Search by SRS ID Download Print



Switch Basemap

Longitude: -82.36545
Latitude: 39.31531

Site_ID: MSLH120
Historical Name:
Subwatershed Name: Lake Hope
Site Description: Mouth of Sandy Run Det L. Hope
Mile Markers:
Drainage Area:
Comments:
Section: 21
County: Vinton
Township: Brown
HUC_12: 050901010205
Landowner contact:
 primary headwaters headwaters
 wadeable boatable

Data storage and results

The screenshot displays the Watershed Data Map web application. The interface includes a navigation menu with options like Home, Surface Water, Groundwater, AMD Projects, Partner Watersheds, Contact, and login. A search bar is present with options for 'Search' and 'Search by site ID'. A 'Print' button is located in the top right corner.

The main content area is divided into two sections. On the left, a map shows a satellite view of a watershed with a red pin indicating a specific location. On the right, a data entry form is displayed, titled 'Features Identified * - Required Field'. The form contains the following fields:

- Longitude
- Latitude
- Site ID: WB 003
- Site Description: CR 31 bridge, S of Drakes, WB @ RM 10.3
- Type of site: stream/creek/river
- Treatment Type: <Select Treatment Type>
- Sample Date*: 9/21/2010
- Data Source: OEPA-SEDO
- Field Researcher: capuzzi
- Delta Purpose: NPS Monitoring Project
- Funding Source: Ohio EPA
- Credibility: [empty field]

Below the form, there is a 'Biological Database Feature' section with the instruction: 'For each field, enter a numerical value (or -2)'. The fields and their values are:

- IBI: 20
- MIWB: [empty field]
- fish count: 368
- fish diversity: 11
- HAAS: 4
- TCI: [empty field]
- QJAL: [empty field]
- HHCI: [empty field]
- QJCI: 55.5

At the bottom of the form, there are checkboxes for 'primary headwaters', 'headwaters', 'wadable', and 'habitable'. The 'wadable' checkbox is checked.

On the right side of the map, a table displays a list of data points. The table has columns for 'site_id', 'sample_date', and 'datasource'. The data points are as follows:

View	site_id	sample_date	datasource
View	WB 003	7/6/2010	Ohio University
View	WB 003	9/21/2010	OEPA-SEDO
View	WB 003	9/21/2010	OEPA-SEDO
View	WB 003	9/21/2010	OEPA-SEDO
View	WB 003	9/21/2010	OEPA-SEDO
View	WB 003	9/21/2010	OEPA-SEDO
View	WB 003	7/5/2011	Ohio University
View	WB 003	10/5/2011	Ohio University
View	WB 003	7/5/2012	
View	WB 003	7/5/2012	

At the bottom of the table, there is a pagination control showing 'Page size: 10' and '29 items in 3 page'. The current page is 3.

At the bottom of the application, there is a copyright notice: '© 2005-2013 CFS. CFS is housed at the Ohio University research School of Environment and Public Affairs, in partnership with the Ross College of Engineering and Technology and the College of Arts and Sciences. All rights reserved.'

www.watersheddata.com

Project information and results

Ohio Watershed Data

Home Surface Water Groundwater AMD Projects Partner Watersheds Contact Log Off

Name > AMD Projects > NPS Report

Project Contact Location/Description Design Reclamation Maintenance Treatment BMP

Monitoring Water Quality Data (TM station data) Project discharge data Biological Data Section Biological Data

Misc Upload Info Finalization Delete NPS Form NPS report list

Site ID	HF129		HF131		HF130	
	Upstream of project site		Project discharge		Downstream of project site	
Average	Pre construction Start Date: 8/1/1996 End Date: 5/1/2003	Post construction Start Date: 6/1/2004 End Date: 12/31/2012	Pre construction Start Date: 6/1/1996 End Date: 5/1/2003	Post construction Start Date: 6/1/2004 End Date: 12/31/2012	Pre construction Start Date: 8/1/1996 End Date: 5/1/2003	Post construction Start Date: 6/1/2004 End Date: 12/31/2012
pH	6.57 (n=5)	6.82 (n=21)	2.8 (n=20)	8.73 (n=33)	4.42 (n=7)	8.54 (n=24)
Net Acidity (mg/l)	-14.26 (n=5)	-17.46 (n=21)	357.52 (n=20)	-213.02 (n=33)	41.66 (n=7)	-56.98 (n=24)
Discharge (dfs)	4.68 (n=1)	4.11 (n=3)	0.46 (n=19)	0.33 (n=28)	11.3 (n=1)	3.28 (n=3)
Metals Iron (Fe) + aluminum (Al)	0.77 (n=5)	1.06 (n=20)	73.79 (n=20)	79.43 (n=22)	8.69 (n=7)	13.3 (n=21)
Site ID	HF190		HF090		HF075	
	Downstream of project site		Downstream of project site		Downstream of project site	

Annual Water Quality Report

2011 NPS Report - Raccoon Creek Watershed - Carbondale II Doser

Generated by Non-Point Source Monitoring System
www.waterbiodata.com

Project Status: Complete, 2004 ODNR Project Number: AT-WI-05

Pre-construction



Carbondale East Sloop, Photo by Brett Lawry

Post-construction



Carbondale II Project Doser, Photo by AT Kinross

Carbondale II Wetland is located in Section 50 of Webster Township in Athens County and lies within the 14-digit HUC unit #050001003010. The site is seven acres and located in the subwatershed Hewitt Fork of Raccoon Creek Watershed. The majority of AMD in Hewitt Fork originates from abandoned underground coal mines near Carbondale. ODNR-DMRM installed a passive wetland treatment system to reduce the acid and metal load from two mine portals in this area in the mid 1990's. This wetland was effective at reducing metal and acid loads but was not efficient enough to produce improvements in Hewitt Fork. The Carbondale Doser was implemented as Phase II at the site to remediate the entire acid load from the mine discharge in 2004. The design was completed by ATC Associates for \$48,025. The treatment approach for this site was to install an Aqua-fix lime-dosing unit. The major considerations in this design were the metal precipitates discharge into Hewitt Fork because of the limited space for storage ponds on site. The goal of the design was to reduce 100 percent of the acid load discharging from the Carbondale mine sloop. One problem encountered at this site was the dosing material performance. Initially lime kiln dust was used, but the material bridges in the dosing unit. The material was switched to calcium oxide, a more expensive material but one with greater neutralizing potential. Therefore the doser now has the ability to over-treat and neutralize acid mine drainings from downstream sources. Construction was complete April 1, 2004, by Law General Contracting for a cost of \$380,057. The major responsibility of the construction company was to remove existing metal retention wetlands and install the doser and a concrete mixing channel. The funding source for the project design was ODNR-DMRM, and for construction the sources were ODNR-DMRM, OEPA, and OSMA/ACS. Figures 3 and 4 (shown on page 3) estimate approximately 7.75 lbs/day of acid were reduced from entering into Hewitt Fork as a result of this AMD remediation project. In addition to the acid load

Site: HF131



reduction there is an addition of approximately 50 lbs/day of alkalinity to Hewitt Fork both as dissolved and solid unreacted calcium oxide. Dissolved metal load reduction occurring at this site was approximately 95 lbs/day. The metals precipitate as a result of the high pH water and become part of the substrate in the receiving stream.

2011 NPS Report - Raccoon Creek Watershed - Carbondale II Doser

Generated by Non-Point Source Monitoring System
www.waterbiodata.com

Water Quality Report

Water quality data was collected at the project discharge as well as multiple stations pre- and post-construction. The graphs below show changes in pH (Figure 1) and acidity (Figure 2) along the watershed of the receiving stream upstream and downstream of the project discharge as a result of the AMD remediation project.

As a result of the Carbondale II Doser project, the pH and net acidity has improved downstream of the reclamation site for 11 miles. Pre-construction data showed pH in the range of 2.8 - 5.0 downstream of the project. However, after installation of the Carbondale II Doser, post-construction data shows pH in the range of 6.1 - 9.0 downstream of the project discharge. The net acidity concentration decreased, showing net alkaline conditions continuing for 11 miles downstream to station HF101.

Figure 1. Pre and Post pH

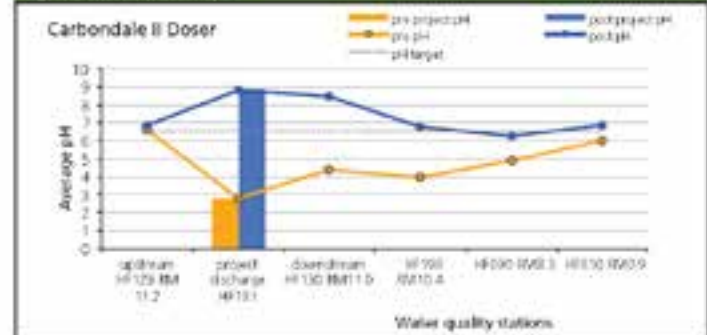
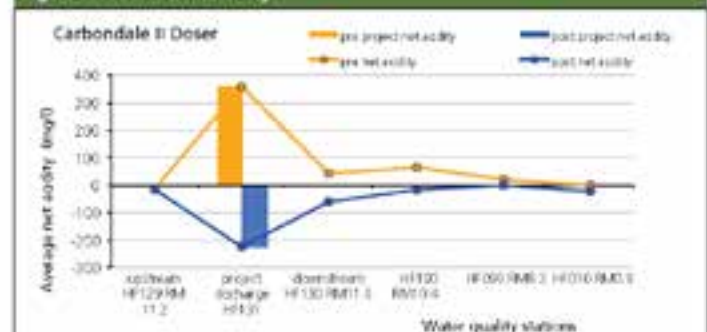


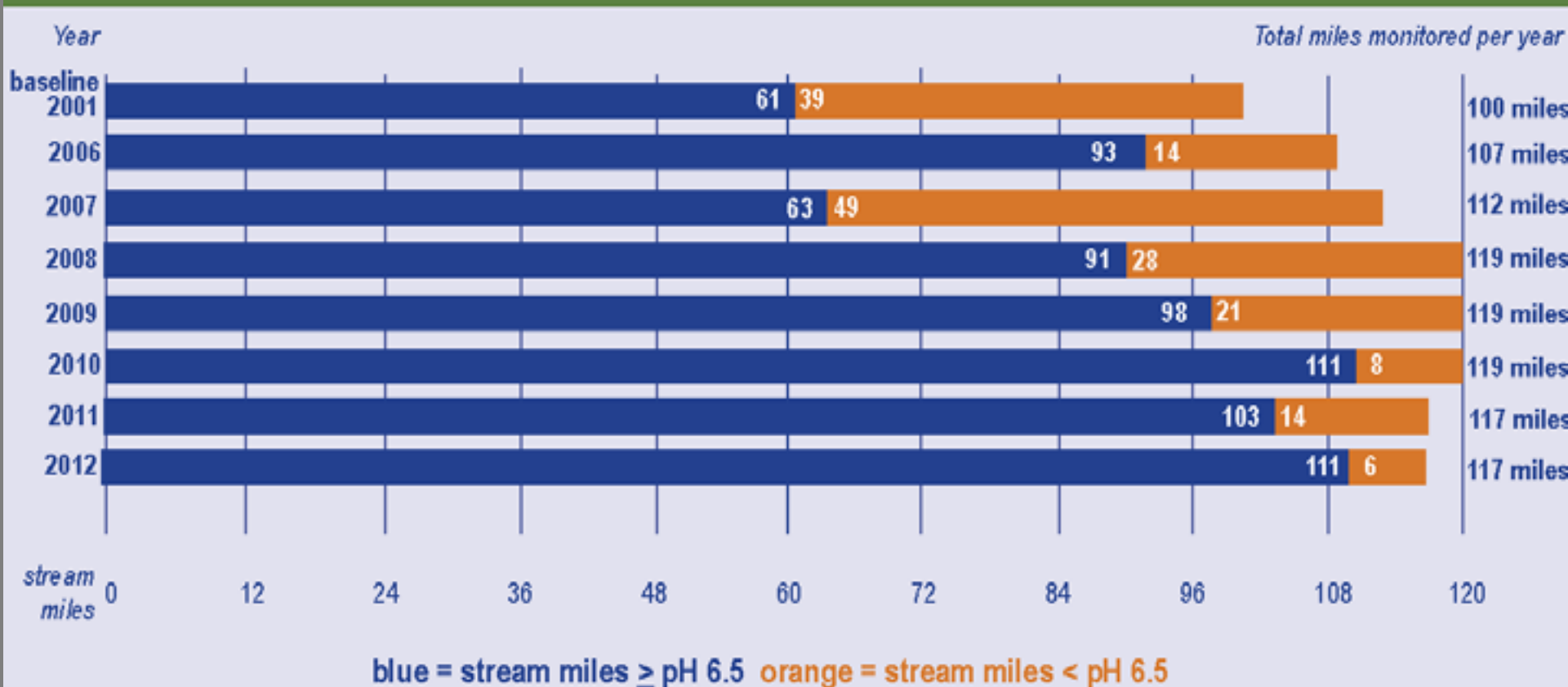
Figure 2. Pre and Post Acidity



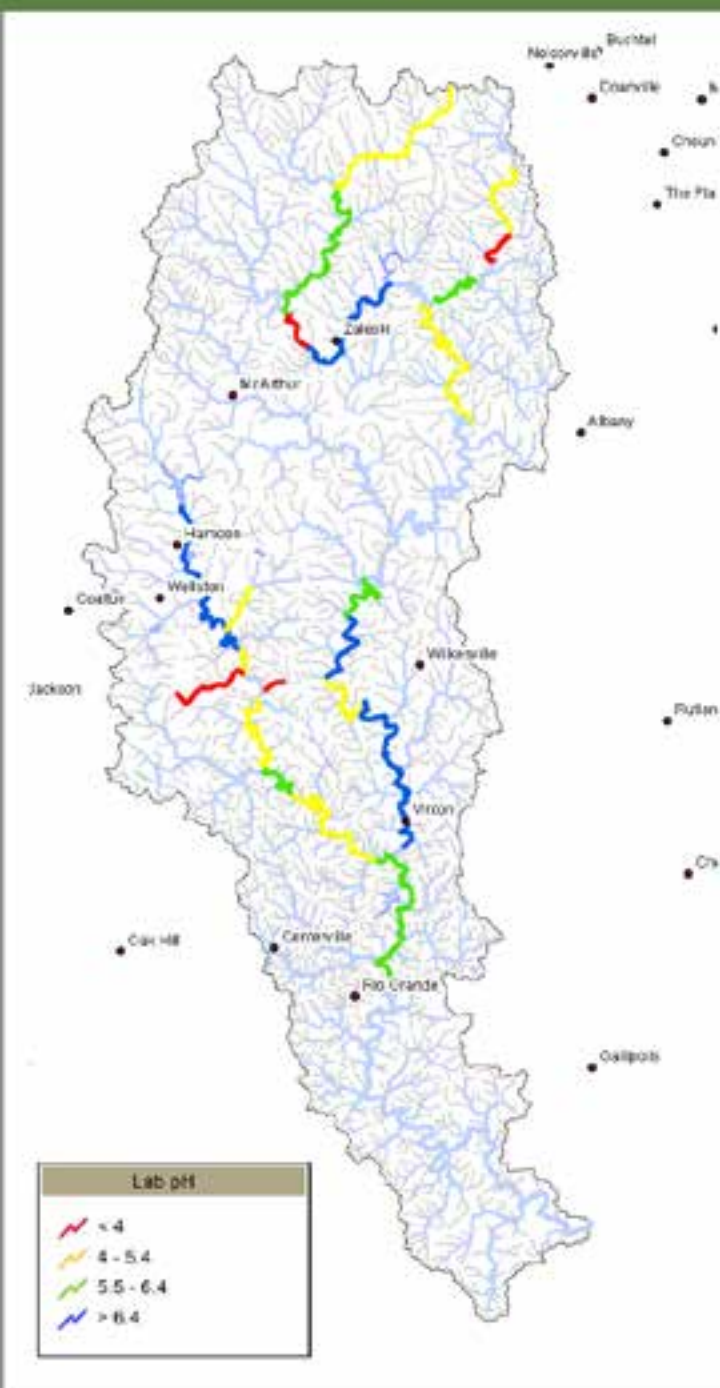
Successful Results

Raccoon Creek - pH

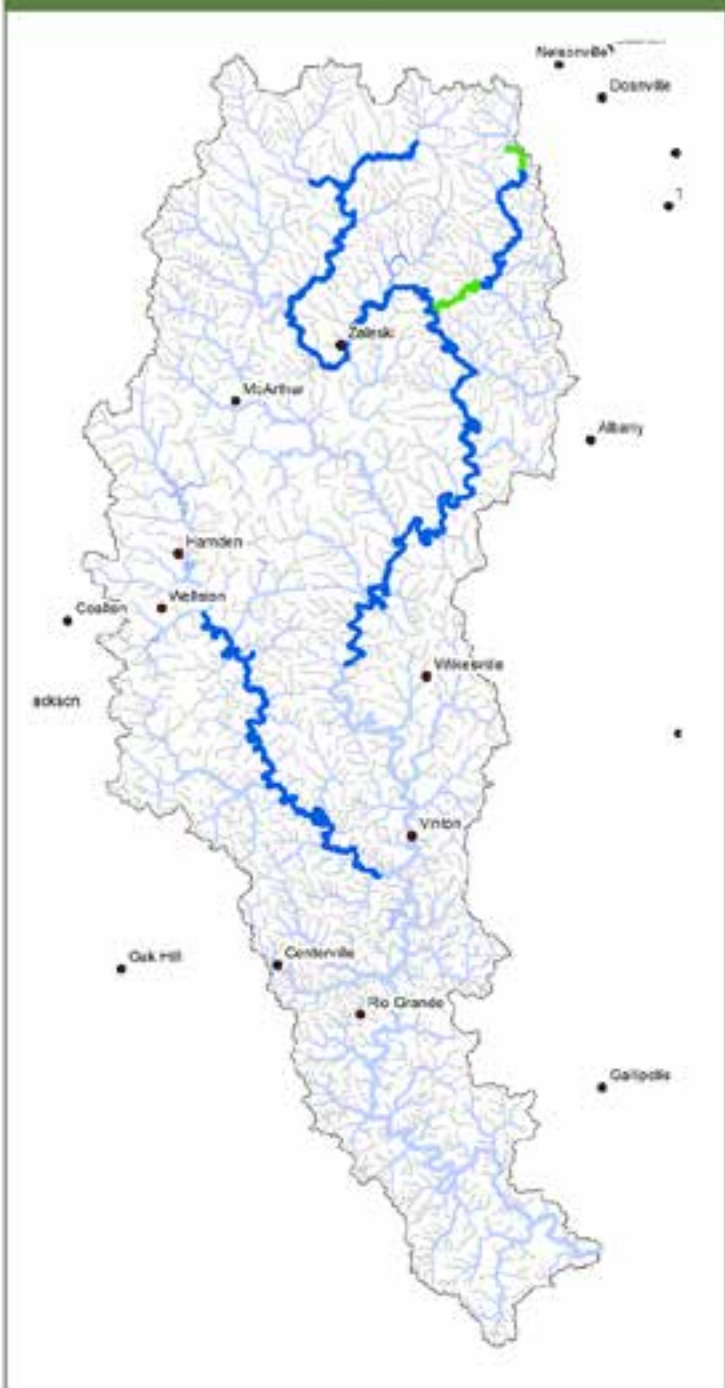
Figure 1. Raccoon Creek total stream miles monitored for pH through time



Raccoon Creek baseline pH

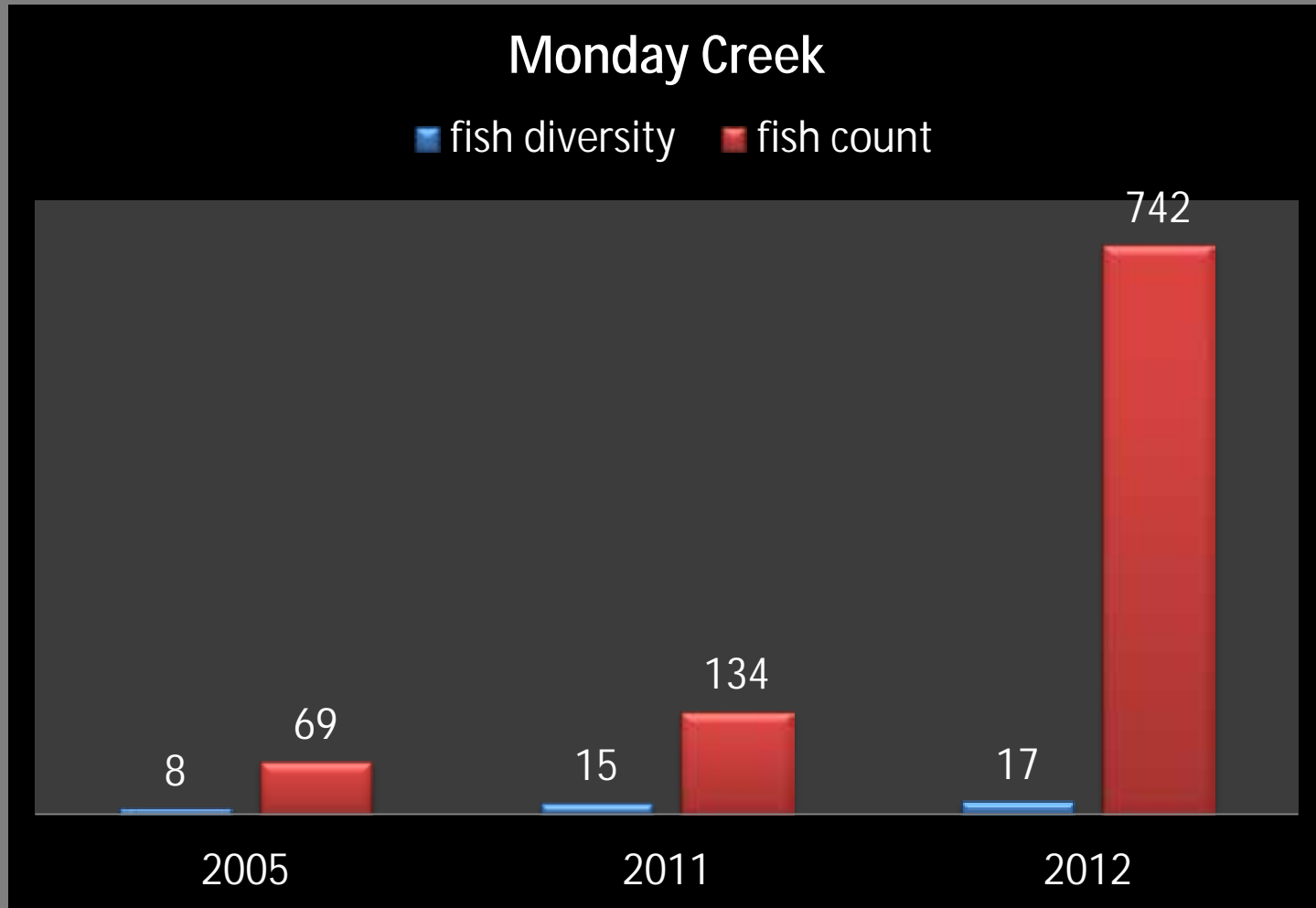


Raccoon Creek 2012 pH



Raccoon
Creek
pH

Incremental changes



Built an evaluation system using GIS and web mapping technology to visualize information and analyze data

MondayCreek

Home Surface Water Groundwater AMD Projects Partner Watersheds Contact Logout

Search Search by Site ID Download

Switch Basemap

Longitude * -82.30342

Latitude * 39.69638

Get Location

Site_ID * Check Site_ID

Historical Name

Subwatershed Name * Select a Subwatershed

Site Description *

Mile Markers

Drainage Area

Comments

Section

County * Perry

Township

MUC_12 050302040502

Landowner contact

primary headwaters headwaters

wadeable boatable

Save Cancel

Creating High Performance Spatial Databases with SQL Server 2008 and ArcGIS Server 10

An interactive web map using a .NET-based web entry form and ArcGIS API for JavaScript, SDE, and SQL databases.



ArcGIS®
ArcMap™ | 10

Initializing Application...



esri

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System Requirements

- SQL Server 2008 or higher
- ArcGIS server 10.1 or higher
- .NET Framework 3.5 or higher
- ArcGIS API for JavaScript
- Dev Tools
 - Visual Studio 2008 or higher
 - SQL Management Studio 2008
 - ArcMap 10.1

SQL Server 2008

- Points, Linestrings, Polygons
- Accurate calculations
 - Ellipsoid model (geography)
 - Flat plane (geometry)
- Full complement of spatial methods
 - Intersects, Contains, Crosses, Touches
 - Distance, Length, Area
 - DE-9IM

SQL Server Spatial Data Types

- Creating Spatial Data- Geography- Geometry

Type of Object	Well-Known Text	Well-Known Binary	Geography Markup Language
Point	STPointFromText()	STPointFromWKB()	GeomFromGml()
LineString	STLineFromText()	STLineFromWKB()	GeomFromGml()
Polygon	STPolyFromText()	STPolyFromWKB()	GeomFromGml()
MultiPoint	STMPPointFromText()	STMPPointFromWKB()	GeomFromGml()
MultiLineString	STMLineFromText()	STMLineFromWKB()	GeomFromGml()
MultiPolygon	STMPolyFromText()	STMPolyFromWKB()	GeomFromGml()
Geometry Collection	STGeomCollFromText()	STGeomCollFromWKB()	GeomFromGml()
Any supported type	STGeomFromText() Parse()	STGeomFromWKB()	GeomFromGml()

Creating Spatial Data

- The use of spatial data

ü Management of spatial data

```
CREATE TABLE SpatialTable  
  (Id int IDENTITY (1,1),  
   GeomCol1 geometry,  
   GeomCol2 AS GeomCol1.STAsText ());  
GO
```

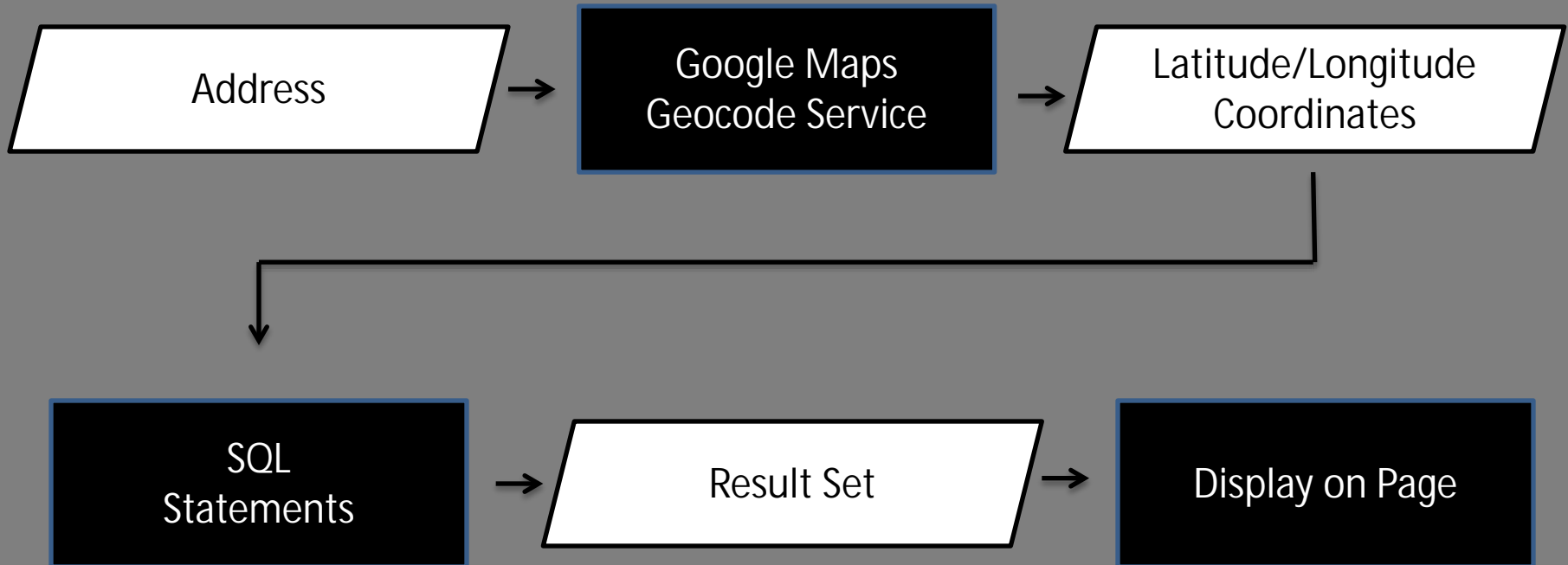
```
INSERT INTO SpatialTable (GeomCol1)  
VALUES (geometry :: STGeomFromText ('LINESTRING (100 100, 20 180,  
180 180), 0));  
geometry::STPointFromText('POINT(258647 665289)', 27700)
```

Import Spatial Data in SQL Server

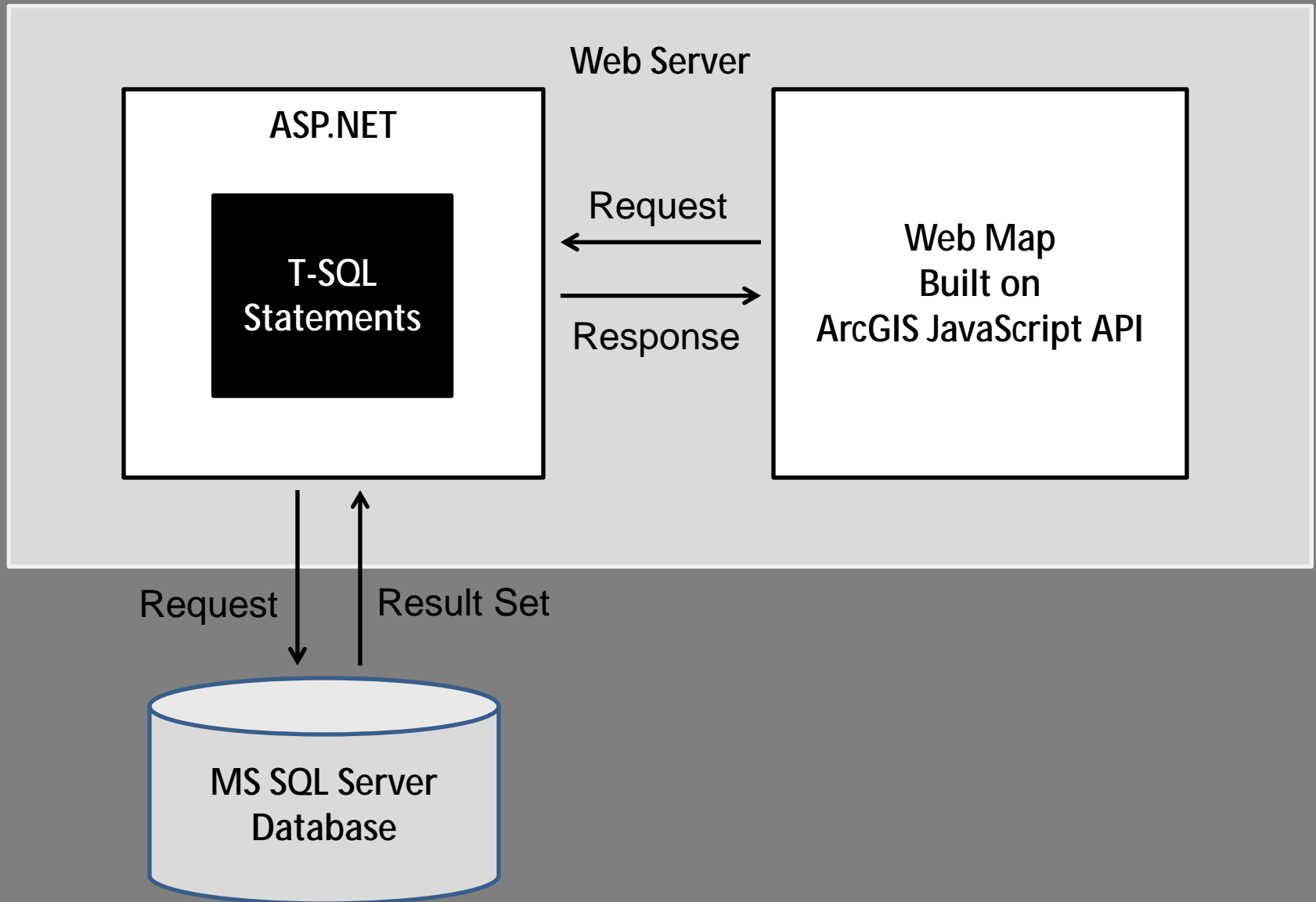
üConversion Utilities:

- ShapeToSQL: www.social.msdn.microsoft.com
- Shp2text: www.obviously.com
- FME : www.safe.com
- Manifold: www.manifold.net

SQL Solution: Application Process



T-SQL Script Implementation:



Geospatial Features

- Points
- Polylines
- Polygons



Points



Polylines



Polygons

For more information about water related projects
contact Jen Bowman, Senior Project Manager at the
Voinovich School at Ohio University

Jen Bowman
bowmanj2@ohio.edu



www.watersheddata.com

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