

SPILL MODELING USING NHDPlus

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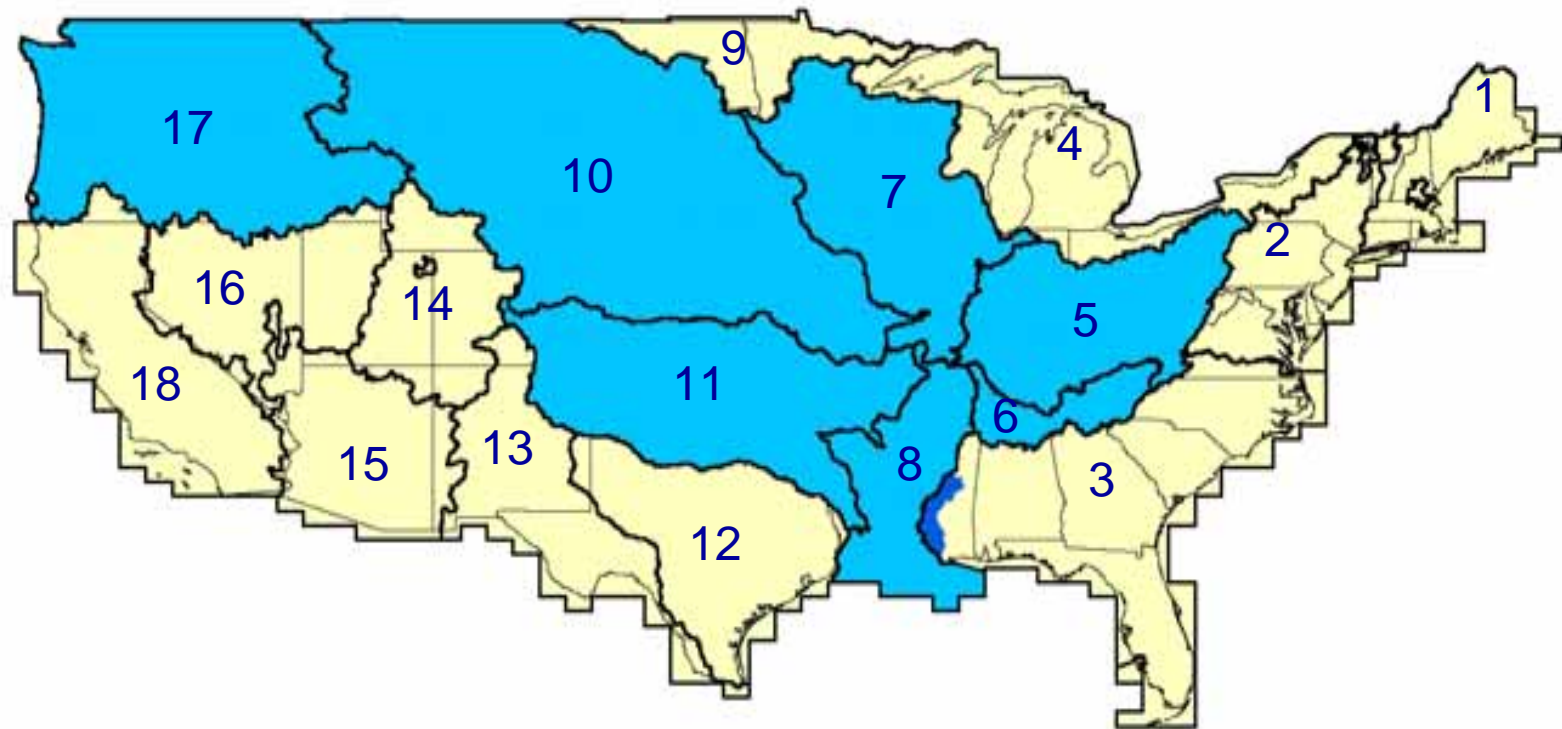
ESRI International User Conference
San Diego, CA
August 8, 2006

Incident Command Tool for Drinking Water Protection (ICWater)

Major Features

- Updated agent database
- Asset databases and hyperlinks
- Potential spill sources
- National Hydrography Dataset (NHDPlus)
- Real-time stream flow
- ARCGIS (version 9) – latest GIS technology
- Desktop, web and web-service versions
- Linkage to CATS, HAZUS, CoBRA and Emergency Response Analyzer

NHDPlus and ICWater Deployment



ICWater (RiverSpill Model)

Time of Travel Calculation

use of real-time stream flow

Time Decay

chemical and biological

based on time-of-travel to intake

Dispersion

based on convective-diffusion equations for
turbulent flow

Constituent Inputs

mass, location, level of concern, half-life



Editor:
Dennis A. Lys, Ph.D., Purdue University

Frequency: Monthly

Table of Contents - Current Issue

The Journal of Hydraulic Engineering accepts a problem, without solution, of concern letter format. Topics include transport processes or presentation of concepts, methods, findings. ISSN: 0733-9429

[ASCE Journals Home Page]

RiverSpill: A National Application for Drinking Water Protection

William B. Samuels¹; David E. Amstutz²; Rakesh Bohadur³; and Jonathan M. Pickus⁴

Abstract: *RiverSpill* is a geographic information system-based software package that calculates time-of-travel and concentration of contaminants in streams and rivers. The purpose of *RiverSpill* is to serve as a tool for response, planning, and training for the protection of the nation's surface drinking water from deliberate (homeland security) threats. *RiverSpill* uses real-time stream flow data, a hydrologically connected stream network, and the locations and populations served by each public, surface drinking water intake. Accidental water contamination events such as spills from transportation infrastructures (highway, railroad, and pipeline), wastewater treatment plants, and hazardous materials storage sites may also be simulated. *RiverSpill* contains a comprehensive database of potential constituents of concern and their chemical and biological attributes. Spills may be modeled as either instantaneous or continuous events. Times-of-travel and concentration curves calculated with *RiverSpill* have been compared with those measured in several streams and rivers using dye. The dye measurements have been used to evaluate and calibrate *RiverSpill* to specific rivers.

DOI: 10.1061/(ASCE)0733-9429(2006)132:4(393)

CE Database subject headings: Hydrologic models; River flow; Spills; Intakes; Infrastructures; Stream gauging; Water pollution; Geographic information systems.

Introduction

The purpose of the *RiverSpill* project was to develop a real-time river flow model, incorporating best available environmental information for the continental United States. The environmental information includes current and historical river flow, watershed characteristics, a hydrologically connected stream network, and geographically referenced features needed to assess potential impacts from river contaminants.

The Environmental Protection Agency (EPA), the Department of Homeland Security (DHS), and the Technical Support Working Group (TSWG)—the United States national forum for counter-terrorism research and development, have identified as a high priority, the need for protecting drinking water sources for homeland security purposes. These Federal agencies have sponsored the development and first applications of *RiverSpill*. The Depart-

ment of Agriculture (USDA) Forest Service and the Defense Threat Reduction Agency (DTRA) have joined in this effort to make *RiverSpill* a part of our nation's emergency capability for first responders and Incident Commanders.

The United States has approximately 180,000 water supply systems, serving over 250 million persons (Orcus and Snyder 2001). An estimated 61×10^{13} L (16 trillion gal) of water are processed annually in the United States by these water utilities. All levels of government recognize the importance of safe drinking water; however, there have been failures, with tragic consequences. For example, in 1993, Milwaukee's drinking water was accidentally contaminated with the pathogen, *Cryptosporidium*, resulting in over 400,000 individuals experiencing illness (Corsi et al. 2001). Recent acts of terrorism, including the attacks on the World Trade Center and Pentagon and the dispersal of Anthrax in the mails, illustrate the need to upgrade protection of drinking water to include defenses against deliberate terrorist acts as well as inadvertent contamination.

The nation can improve the protection of drinking water by upgrading the infrastructure to physically safeguard water supplies and by increasing preparedness to take timely and effective actions, thus minimizing the consequences to the public in the case of an attack. Physical protection will be expensive, may take years to accomplish, and at best provides only partial protection. Strengthening emergency response to attacks on drinking water sources can offer substantial and rapid gains in protecting public safety and civil order and can bolster security while infrastructure is being improved. Emergency response can be strengthened by: (1) improving the speed and accuracy of detecting an attack; and (2) providing personnel who direct the emergency response (Incident Commanders) with critical information to decide who is at risk and what actions will most effectively reduce the risk. *RiverSpill* was developed to help meet these needs.


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Note. Discussion open until September 1, 2006. Separate discussions must be submitted for individual papers. To extend the closing date by one month, a written request must be filed with the ASCE Managing Editor. The manuscript for this paper was submitted for review and possible publication on February 3, 2005; approved on September 9, 2005. This paper is part of the *Journal of Hydraulic Engineering*, Vol. 132, No. 4, April 1, 2006. ©ASCE, ISSN 0733-9429/2006/4-393-403/\$25.00.



Incident Command Tool

ICWater

For Protecting Drinking Water

State/County | Place Name | Coordinate | Bridge

State:

County:

Cancel Create

ICWater 1.0.4 | 1.06 miles S of Sharps Corner, Oregon



Incident Command Tool

ICWater

For Protecting Drinking Water

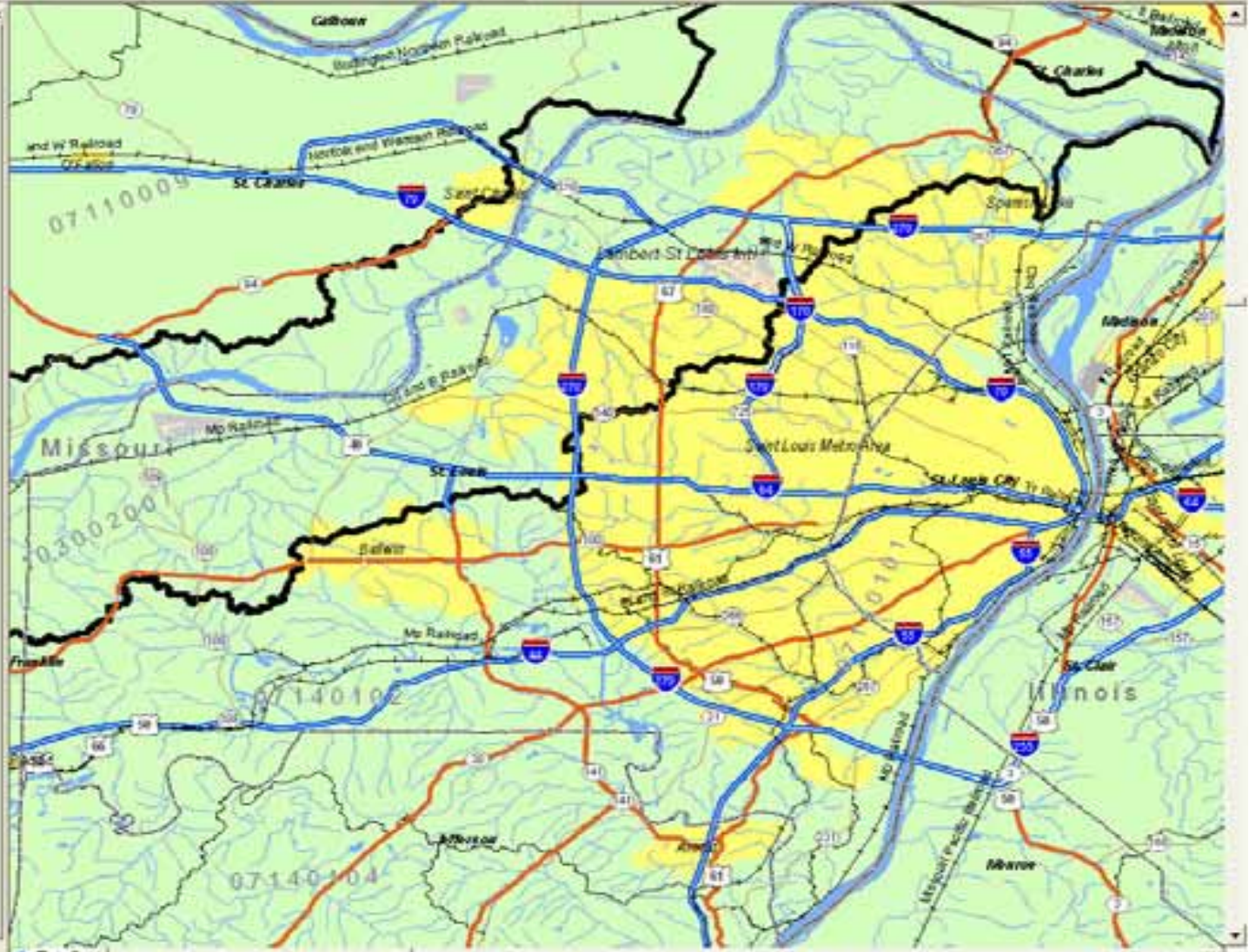
State/County | Place Name | Coordinate | Bridge

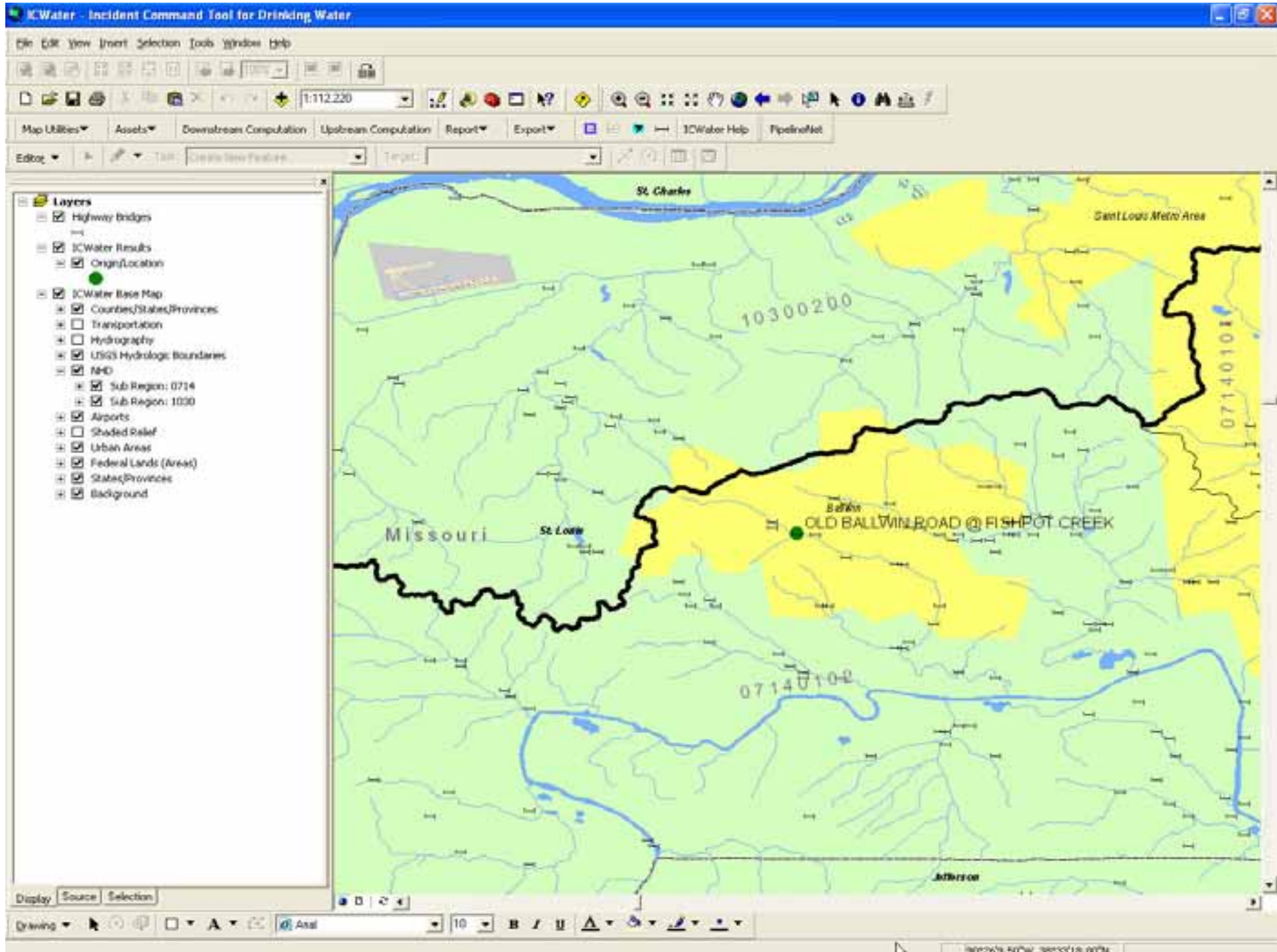
Bridge Name:

Cancel Create Map

ICWater 1.0.4 | 1.06 miles S of Sharps Corner, Oregon

- Layers
 - ICWater Results
 - Origin/Location
 - ICWater Base Map
 - Counties/States/Provinces
 - Transportation
 - Hydrography
 - USGS Hydrologic boundaries
 - NHD
 - Sub Region: 0714
 - Sub Region: 1030
 - Airports
 - Shaded Relief
 - Urban Areas
 - Federal Lands (Areas)
 - States/Provinces
 - Background





ICWater Application - Downstream Tracing

Spill Location

Longitude Latitude

Agent Finder

Biological | **Chemical** | Radiological | User Defined | Search

Select Type

Select an Agent

- Chemical Warfare
- Toxic Industrial Chemical
- Biotoxins
- All

- Barium
- Benzene**
- Benzidene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(ghi)perylene
- Benzo(k)fluoranthene
- Beryllium

Agent Parameters

Level of Concern (mg/l) Value Used

Half Life (days)



Incident Analysis Parameters

Release Type

- Instantaneous
- Continuous Time (hours)

Source Strength

Concentration:

Count/mg

Stream Flow Gage Station Data

Choose Gage Selection Method

- Average Flow
- Automated Real-Time Flow
- User Selected Gage

Gage: N/A

NHD Data

	Mean	Actual
Flow (cfs)	182438.3	182438
Depth (feet)	21.0	21.0
Temp (degrees C)	20	20

Model Parameters

- Max Travel Time Hours
- Max Distance:
- Max Intake Count
- Threshold Concentration mg/l

ICWater - Incident Command Tool for Drinking Water

File Edit View Insert Selection Tools Window Help

Map Utilities Assets Downstream Computation Upstream Computation Report Export ICWater Help Pipeline

Editor

Incident Analysis Parameters

Release Type

Instantaneous

Continuous Time (hours)

Source Strength

Concentration: mg/l

Counting Calculator

Stream Flow Gage Station Data

Choose Gage Selection Method

Average Flow

Automated Real-Time Flow

User Selected Gage

Gage: [07019000, Meramec River near Eureka, MO](#)

User Map Interaction

	Mean	Actual
Flow (cfs)	3028.9	<input type="text" value="174.0"/>
Depth (feet)	5.2	<input type="text" value="2.9"/>
Temp (degrees C)	20	<input type="text" value="19"/>


Model Parameters

Max Travel Time Hours

Max Distance miles

Max Intake Count

Threshold Concentration mg/l



St. Charles

Missouri

St. Louis

0714010-2

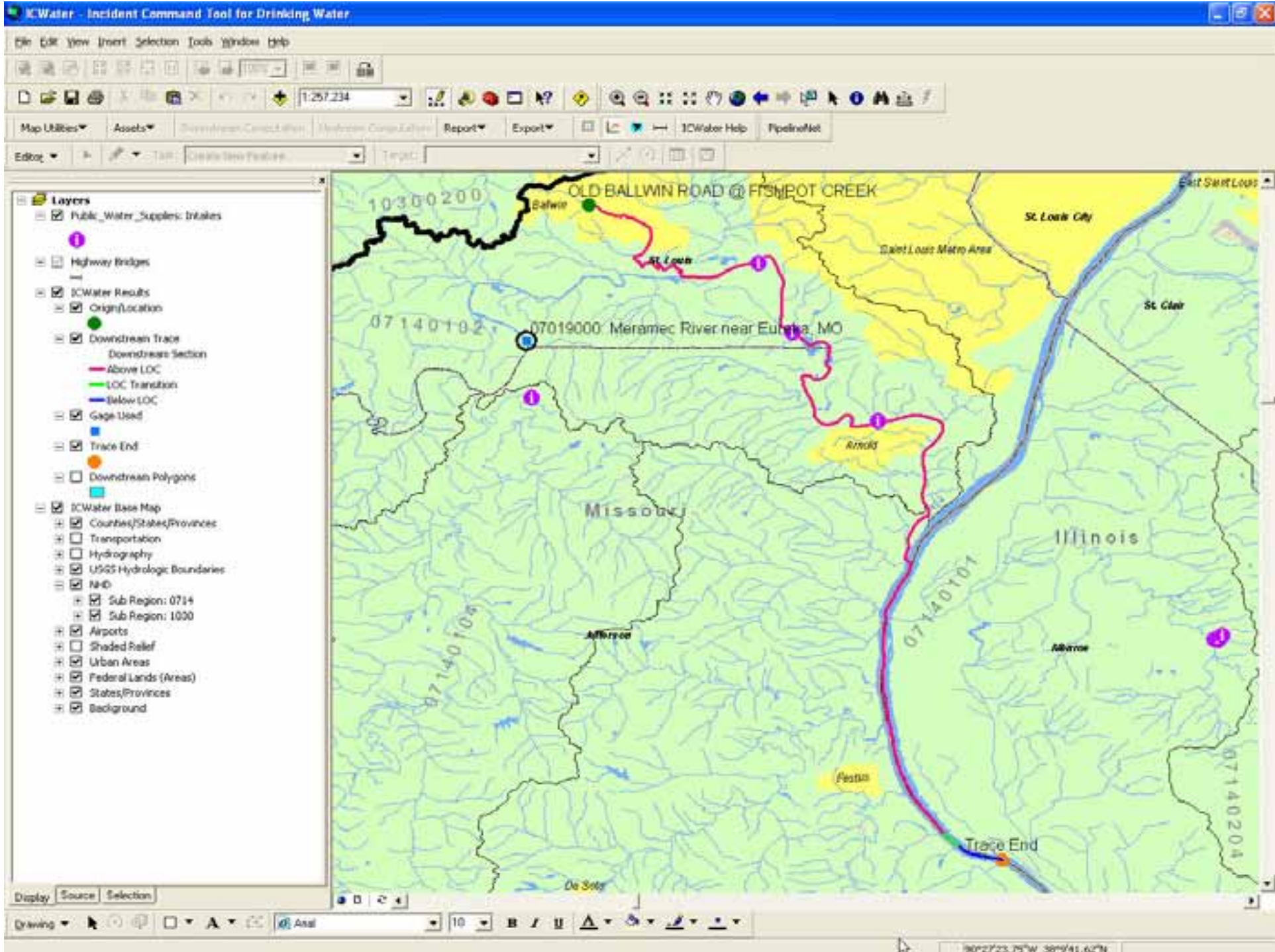
OLD BALLWIN ROAD @ FISHPOT CREEK

Jefferson

10300

90°36'13.95"W 38°29'36.74"N

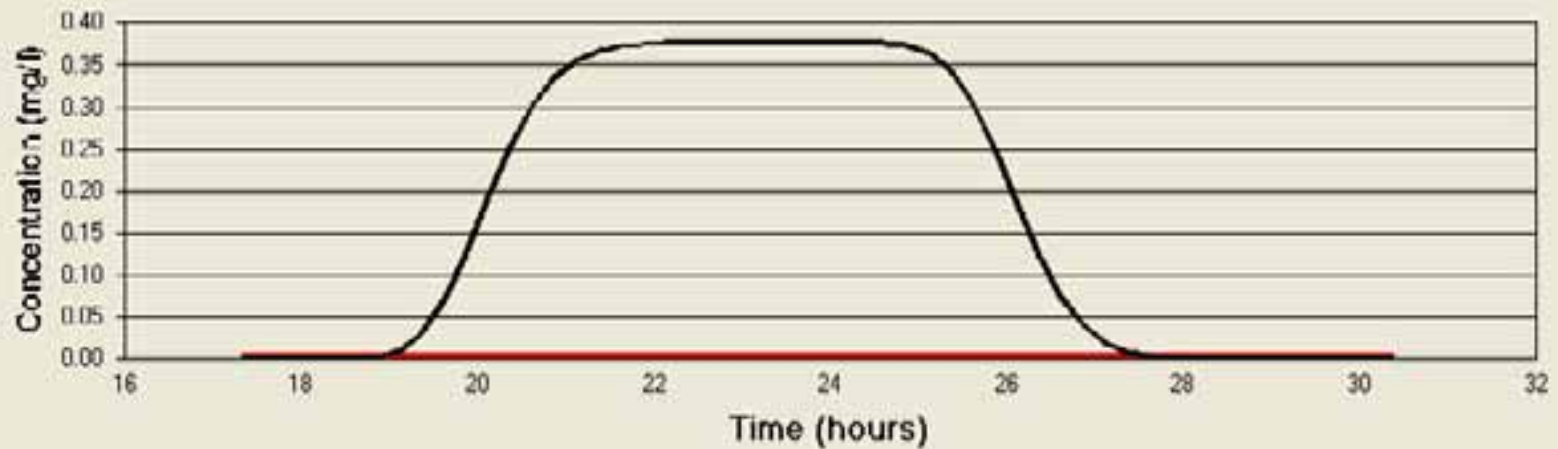




formBreakthrough

File Edit Help

ICWater Breakthrough Curve at Intake: KIRKWOOD WATER DEPT (9.75 miles)



— Model Estimate — Level of Concern

Incident Location: -90.55333, 38.59167
Approximate Location: 0.53 miles W of Ballwin, Missouri
Bridge: OLD BALLWIN ROAD @ FISHPOT CREEK

Agent Type: Chemical
Agent Name: Benzene
Level of Concern: 0.005 mg/l
Decay/Half-life: 16 days

Continuous Release of Concentration: 500 mg/l
Duration: 6 hours
Flow Type: User Selected Gage

[Intake: KIRKWOOD WATER DEPT](#)

Print

Export to Excel

Quit



Safe Drinking Water Information System (SDWIS)

[Recent Additions](#) | [Contact Us](#) | [Print Version](#) EF Search:

[EPA Home](#) > [Envirofacts](#) > [SDWS](#) > Query



Query Results

Query Selections:

Water system id entered: M06010430

State selected: MISSOURI

water_system_status: Both--Active/Closed

Query executed on: JUN-29-2006

Results are based on data extracted on: OCT-14-2005

List of Water Systems in SDWIS

Information about water systems in MISSOURI is maintained by [Department of Natural Resources](#).

For a detailed Violation and Enforcement History, click on the underlined Water System Name. To obtain additional information about drinking water please call EPA's Safe Drinking Water hotline at 1-800-426-4791.

Community Water Systems: Water Systems that serve the same people year-round (e.g. in homes or businesses).

Water System Name	Principal County Served	Population Served	Primary Water Source Type	System Status	Date Closed	Water System ID
KIRKWOOD	ST LOUIS	28000	Surface water	Active		M06010430

Non-Transient Non-Community Water Systems: Water Systems that serve the same people, but not year-round (e.g. schools that have their own water system).

No systems were found.

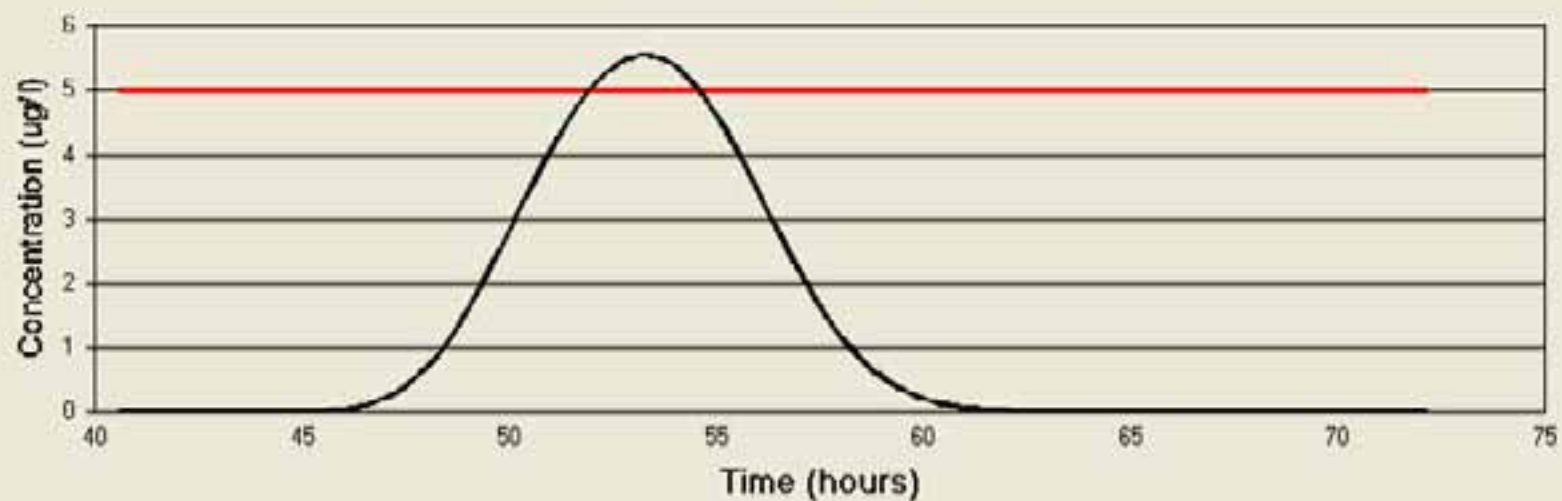
Transient Non-Community Water Systems: Water Systems that do not consistently serve the same people (e.g. rest stops, campgrounds, gas stations).

No systems were found.

formBreakthrough

File Edit Help

ICWater Breakthrough Curve at 32.21 miles



— Model Estimate — Level of Concern

Incident Location: -90.55333, 38.59167
Approximate Location: 0.53 miles W of Ballwin, Missouri
Bridge: OLD BALLWIN ROAD @ FISHPOT CREEK

Agent Type: Chemical
Agent Name: Benzene
Level of Concern: 0.005 mg/l
Decay/Half-life: 16 days

Continuous Release of Concentration: 500 mg/l
Duration: 6 hours
Flow Type : User Selected Gage

Print

Export to Excel

Quit

Streams Report

Reach ID	Stream Name	Flow (cfs)	Velocity (fps)	Area (ft2)	Hyd. Radius (ft)	Width (ft)	Depth (ft)	Length (ft)	A	B	Dispersion	Slope
0714010200040	Fishpot Creek	0.7	0.60	1.2	0.27	4	0.31	4522	0.658	0.270	1.1	0.007566
0714010200040	Fishpot Creek	1.6	0.65	2.4	0.35	6	0.40	16034	0.577	0.270	2.1	0.006126
0714010200039	Fishpot Creek	2.3	0.67	3.5	0.41	8	0.45	6635	0.528	0.270	3.1	0.005280
0714010200038	Fishpot Creek	2.6	0.65	4.0	0.43	9	0.47	7628	0.497	0.270	4.1	0.004970
0714010200038	Fishpot Creek	2.6	0.74	3.6	0.42	8	0.47	331	0.665	0.270	5.1	0.006650
07140102002540	Meramec River	940.8	1.30	729.3	1.40	211	1.51	5925	0.194	0.270	6.1	0.001940
07140102002540	Meramec River	949.0	1.30	729.4	1.40	211	1.51	4281	0.194	0.270	7.1	0.001940
07140102002549	Meramec River	955.4	1.30	733.3	1.41	212	1.52	11667	0.193	0.270	8.1	0.001930
07140102002549	Meramec River	955.7	1.37	695.4	1.41	201	1.52	5550	0.204	0.270	9.1	0.002040
07140102002549	Meramec River	956.1	1.00	954.2	1.44	275	1.52	5750	0.140	0.270	10.1	0.001400
07140102002549	Meramec River	964.8	1.30	734.2	1.41	212	1.62	3425	0.193	0.270	11.1	0.001930
0714010200010	Meramec River	967.8	1.30	734.8	1.41	212	1.62	1289	0.193	0.270	12.1	0.001930
0714010200010	Meramec River	969.4	1.47	608.6	1.40	188	1.62	4816	0.219	0.270	13.1	0.002190
0714010200010	Meramec River	969.7	1.79	535.7	1.38	156	1.52	2365	0.266	0.270	14.1	0.002660
0714010200010	Meramec River	969.9	1.84	520.5	1.37	151	1.52	925	0.273	0.270	15.1	0.002730
0714010200049	Meramec River	969.9	2.64	476.5	1.36	137	1.52	791	0.302	0.270	16.1	0.003020
0714010200049	Meramec River	968.0	1.30	736.2	1.42	213	1.52	3596	0.193	0.270	17.1	0.001930
0714010200049	Meramec River	968.3	1.30	736.4	1.42	213	1.62	6864	0.193	0.270	18.1	0.001930
0714010200049	Meramec River	968.7	1.30	736.6	1.42	213	1.62	7241	0.193	0.270	19.1	0.001930
0714010200048	Meramec River	964.0	1.31	739.8	1.42	213	1.63	2910	0.193	0.270	20.1	0.001930
0714010200048	Meramec River	966.2	1.31	740.0	1.42	213	1.53	2251	0.193	0.270	21.1	0.001930
0714010200047	Meramec River	967.6	1.31	740.0	1.43	213	1.53	14908	0.193	0.270	22.1	0.001930
0714010200046	Meramec River	968.4	1.31	741.3	1.43	213	1.53	2477	0.193	0.270	23.1	0.001930
0714010200045	Meramec River	969.1	1.31	741.0	1.43	213	1.53	7441	0.193	0.270	24.1	0.001930
0714010200044	Meramec River	972.5	1.31	743.0	1.43	214	1.54	5310	0.193	0.270	25.1	0.001930
0714010200043	Meramec River	973.1	1.31	744.2	1.43	214	1.64	2149	0.193	0.270	26.1	0.001930
0714010200043	Meramec River	973.4	1.31	744.4	1.43	214	1.64	1696	0.193	0.270	27.1	0.001930
0714010200043	Meramec River	973.6	1.31	744.5	1.43	214	1.64	4810	0.193	0.270	28.1	0.001930
0714010200042	Meramec River	973.7	1.31	744.6	1.43	214	1.54	1266	0.193	0.270	29.1	0.001930
07140102002524	Meramec River	975.3	1.31	745.6	1.43	214	1.54	2696	0.193	0.270	30.1	0.001930
07140102002524	Meramec River	975.6	1.31	745.7	1.44	214	1.54	2477	0.193	0.270	31.1	0.001930
07140102002524	Meramec River	975.9	1.31	746.0	1.44	214	1.54	4649	0.193	0.270	32.1	0.001930
07140101001389	unnamed	976.0	1.31	745.9	1.44	214	1.64	197	0.193	0.270	33.1	0.001930
07140101001389	unnamed	976.1	1.31	746.1	1.44	214	1.64	9249	0.193	0.270	34.1	0.001930
07140101001389	unnamed	976.6	1.31	746.4	1.44	214	1.64	2566	0.193	0.270	35.1	0.001930
07140101001389	unnamed	976.6	1.31	746.4	1.44	214	1.54	1788	0.193	0.270	36.1	0.001930
07140101000021	Mississippi River	54440.5	3.01	10096.3	13.63	1316	13.90	130	0.145	0.270	6653.7	0.010003
07140101000020	Mississippi River	54440.3	3.26	16666.7	13.61	1214	13.90	12233	0.157	0.270	4237.3	0.020595
07140101000019	Mississippi River	54455.2	3.01	10099.8	13.63	1316	13.90	1305	0.145	0.270	4805.1	0.021760
07140101000018	Mississippi River	44078.6	3.66	10661.1	13.66	1366	13.66	3833	0.136	0.270	4006.3	0.033763

ICWaterToolbar X

Incident Location: -90.55333, 38.59167
 Approximate Location: 0.53 miles W of Ballwin, Missouri
 Bridge: OLD BALLWIN ROAD @ FISHPOT CREEK

Agent Type: Chemical
 Agent Name: Benzene
 Level of Concern: 0.005 mg/l
 Decay/Half-life: 16 days

Continuous Release of Concentration: 500 mg/l
 Duration: 6 hours
 Flow Type : User Selected Gage
 Gage Used: 07019000: Meramec River near Eureka, MO
 Velocity Factor: 0.721

Cutoff at Distance = 50 miles

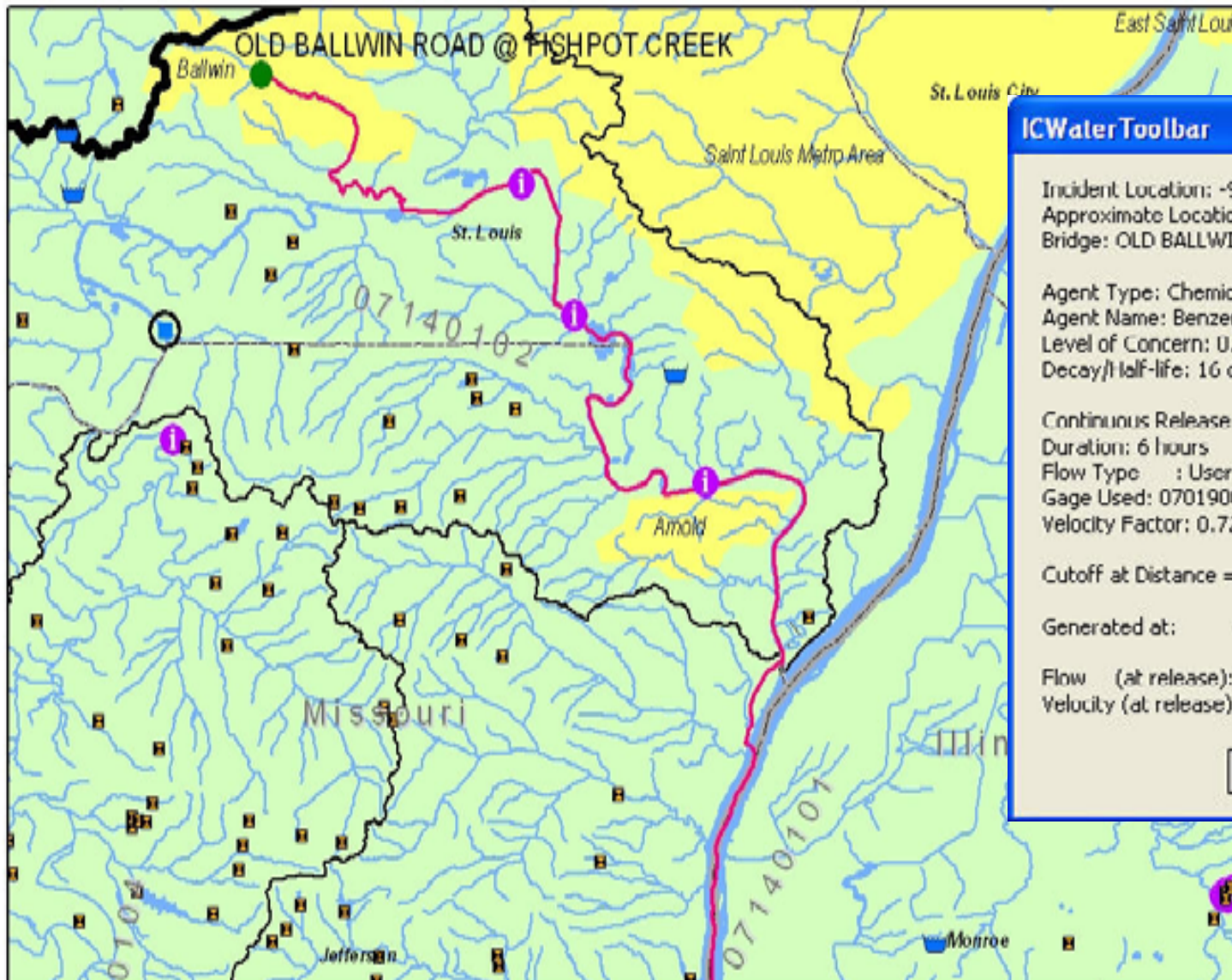
Generated at: 6/29/2006 5:24:57 PM

Flow (at release): 0.7 cfs
 Velocity (at release): 0.599 fps

OK

Asset: Intakes

Index	Facility	City	State	Population Served	Phone	Downstream Distance (miles)	Peak Conc. (mg/l)	Peak Time (Hours)	Leading Edge (Hours)	Trailing Edge (Hours)	Duration LOC (Hours)
1	KIRKWOOD WATER DEPT	KIRKWOOD	MO	21001	9140225846	7.77	0.376	22.89	20.42	25.42	5.00
2	ST LOUIS CO WATER CO	UNIVERSITY CI	MO	1000000	-	13.69	0.376	29.13	26.13	31.36	5.23
3	ST LOUIS CO WATER CO	UNIVERSITY CI	MO	1000000	-	22.61	0.342	40.13	36.48	42.88	6.00



ICWater Toolbar

Incident Location: -90.55333, 36.59167
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 Agent Name: Benzene
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 Decay/Half-life: 16 days

Continuous Release of Concentration: 500 mg/l
 Duration: 6 hours
 Flow Type : User Selected Gage
 Gage Used: 07019000: Meramec River near Eureka, MO
 Velocity Factor: 0.721

Cutoff at Distance = 50 miles

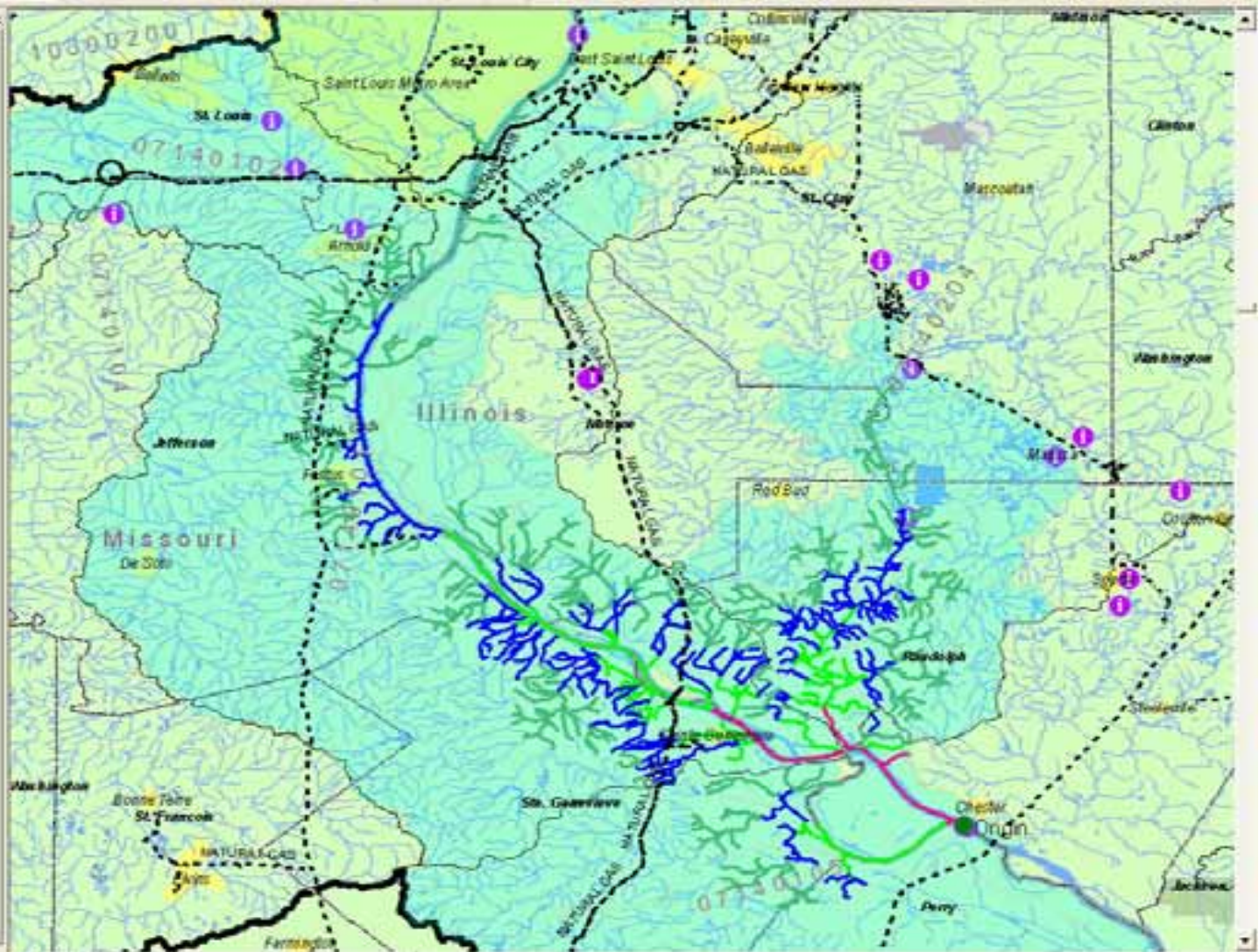
Generated at: 6/29/2006 5:24:57 PM

Flow (at release): 0.7 cfs
 Velocity (at release): 0.599 fps

OK

Layers

- Pipelines
- ICWater Results
 - Origin/Location
 - Upstream Trace
 - Upstream Zone
 - 0.0 hours to 6.0 hours
 - 6.0 hours to 12.0 hours
 - 12.0 hours to 18.0 hours
 - 18.0 hours to 24.0 hours
 - Upstream Polygon
- Public Water Supplies: Breaks
- Highway Bridges
- ICWater Base Map
 - Counties/States/Provinces
 - Transportation
 - Hydrography
 - USGS Hydrologic Boundaries
 - NAD
 - Sub Region: 0714
 - Sub Region: 1030
 - Airports
 - Shaded Relief
 - Urban Areas
 - Federal Lands (Areas)
 - States/Provinces
 - Background



Asset: Municipal & Industrial Facilities

Index	Facility	City	State	Sewage Treatment Plant	Flow Rate (mgd)	Zone	Distance
1	EVANSVILLE STP	EVANSVILLE	IL	Y	0.170	12.0 hours to 18.0 hours	19.27
2	EVANSVILLE WTP	EVANSVILLE	IL	N	N/A	6.0 hours to 12.0 hours	19.44
3	COUNTRY VILLAGE EST MHP NORTH GRABOURI CREEK	SAINTE GENEVIEVE COU	N/A	N	0.020	18.0 hours to 24.0 hours	20.92
4	COUNTRY VILLAGE EST MHP NORTH GRABOURI CREEK	SAINTE GENEVIEVE COU	N/A	N	0.020		
5	BALDWIN WTP	BALDWIN	IL	N	N/A		
6	PRAIRIE DU ROCHER LIME, L.P.	PRAIRIE DU ROCHER	IL	N	N/A		
7	PRAIRIE DU ROCHER LIME, L.P.	PRAIRIE DU ROCHER	IL	N	N/A		
8	PHABODY COAL CO. MINE #6	EAST SAINT LOUIS	N/A	N	N/A		
9	BLOOMSDALE WPC PLANT FOURCHESA DUCLOS CREEK	BLOOMSDALE	N/A	Y	0.70		
10	BLOOMSDALE WPC PLANT FOURCHESA DUCLOS CREEK	BLOOMSDALE	N/A	Y	0.70		
11	UK, RUSH ISLAND PP MISSISSIPPI RIVER	FESTUS	N/A	N	1120.		
12	UK, RUSH ISLAND PP MISSISSIPPI RIVER	FESTUS	N/A	N	1120.		
13	NEW ATHENS STP	NEW ATHENS	IL	Y	0.30		
14	LAROCHIE, CRYSTAL CITY PLY MISSISSIPPI RIVER	CRYSTAL CITY	N/A	N	0.720		
15	LAROCHIE, CRYSTAL CITY PLY MISSISSIPPI RIVER	CRYSTAL CITY	N/A	N	0.720		
16	FESTUS CRYSTAL CITY STP PLATTIN CREEK	FESTUS	N/A	Y	2.040		
17	FESTUS CRYSTAL CITY STP PLATTIN CREEK	FESTUS	N/A	Y	2.040		
18	MERCULANEUM WWTP JOACHIM CREEK	MERCULANEUM	N/A	Y	0.420		
19	MERCULANEUM WWTP JOACHIM CREEK	MERCULANEUM	N/A	Y	0.420		
20	FESTUS AIRPORT LAGOON	FESTUS	N/A	N	0.21		
21	FESTUS AIRPORT LAGOON	FESTUS	N/A	N	0.21		
22	DOW CHEM CO RIVERSIDE PLY	PEVELY	N/A	N	N/A		
23	DOW CHEM CO RIVERSIDE PLY	PEVELY	N/A	N	N/A		
24	BLUE POUNTAIN MHP PLATTIN CREEK	FESTUS	N/A	N	0.20		
25	JONES CHEMICALS INC BRANCH OF PLATTIN CRK	FESTUS	N/A	N	0.001		
26	BLUE POUNTAIN MHP PLATTIN CREEK	FESTUS	N/A	N	0.20		
27	JONES CHEMICALS INC BRANCH OF PLATTIN CRK	FESTUS	N/A	N	0.001		
28	IUC, GODFREY GARDENS SUBD BRANCH OF JOACHIM CREEK	FESTUS	N/A	N	0.115		
29	IUC, GODFREY GARDENS SUBD BRANCH OF JOACHIM CREEK	FESTUS	N/A	N	0.115		
30	IU, OAK POINTE SUBD STP BR OF CHESLEY ISLAND SLOUGH	IMPERIAL	N/A	Y	0.04		
31	IU, OAK POINTE SUBD STP BR OF CHESLEY ISLAND SLOUGH	IMPERIAL	N/A	Y	0.04		
32	IU, SECKMAN VALLEY WWTP ROCK CREEK	IMPERIAL	N/A	N	1.92		
33	IU, SECKMAN VALLEY WWTP ROCK CREEK	IMPERIAL	N/A	N	1.92	18.0 hours to 24.0 hours	51.60
34	ARNOLD-CHURCH OF NAZARENE BRANCH OF POMME CREEK	ARNOLD	N/A	N	0.003	18.0 hours to 24.0 hours	51.77
35	ARNOLD-CHURCH OF NAZARENE BRANCH OF POMME CREEK	ARNOLD	N/A	N	0.003	18.0 hours to 24.0 hours	51.77
36	ME, MERAMEC PP MERAMEC RIV @ MISSISSIPPI RIV	SAINT LOUIS MSD	N/A	N	0.040	18.0 hours to 24.0 hours	53.53
37	MSD, LOWER MERAMEC WWTP BR OF MERAMEC RIVER	SAINT LOUIS MSD	N/A	Y	4.000	18.0 hours to 24.0 hours	53.99
38	MSD, BAUMGARTNER LAGOON MERAMEC RIVER	SAINT LOUIS MSD	N/A	Y	4.000	18.0 hours to 24.0 hours	57.60
39	COLUMBIA STP	COLUMBIA	IL	Y	1.47	18.0 hours to 24.0 hours	60.17
40	COLUMBIA STP	COLUMBIA	IL	Y	1.47	18.0 hours to 24.0 hours	60.17
41	MSD, I K MAY WWTP MISSISSIPPI RIVER	SAINT LOUIS MSD	N/A	Y	147.0	18.0 hours to 24.0 hours	64.07

ICWaterToolbar ✕

Incident Location: 90.55333, 38.50167
 Approximate Location: 0.53 miles W of Ballwin, Missouri
 Bridge: OLD BALLWIN ROAD @ FISHPOT CREEK

Agent Type: Chemical
 Agent Name: Benzene
 Level of Concern: 0.005 mg/l
 Decay/Half-life: 16 days

Continuous Release of Concentration: 500 mg/l
 Duration: 6 hours
 Flow Type : User Selected Gage
 Gage Id card: 07019000: Meramec River near Fireka, MO
 Velocity Factor: 0.721

Cutoff at Distance = 50 miles

Generated at: 6/29/2006 5:24:57 PM

Flow (at release): 0.7 cfs
 Velocity (at release): 0.599 fps

OK

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