Hydro Seminar 1
Transcript

Starting at 4:12

Slide 1
Welcome to the U.S. Geological Survey Hydrography Webinar Series.
My name is Jeff Simley and I'll be your host for today's April 9th session.
This is the first of several sessions scheduled to be given about every six weeks.

Slide 2
Our featured speaker today is Dr. William Samuels from the Center for Water Science and Engineering at Leidos Incorporated in Alexandria, Virginia. Dr. Samuels will speak on RiverSpill and the Incident Command Tool for Drinking Water Protection

Slide 3
Our session today will be in four parts:
First I will give an introduction to the series by discussing the role of hydrography at the USGS.
Second, I will give a brief history to how we got to where we are today with the NHD.
Then, Dr. Samuels will give his talk…
…and that will be followed by a discussion you are invited to have with Dr. Samuels.

Slide 4
Let's start by looking at how hydrography fits into the USGS.
At the U.S. Geological Survey, Core Science Systems is an organization that provides data about Earth and its resources in a format that is understandable and accessible.
One of the ways it does this is through the National Geospatial Program, which organizes, maintains, and publishes the geospatial baseline of the Nation's topography through The National Map.

Slide 5
The underlying foundation to topography consists of surface elevations, and the hydrography that shapes, and is shaped by, that surface.

Slide 6
The USGS provides a <u>geospatial fabric</u> of surface elevations through its three-dimensional elevation program, or 3DEP.

Slide 7
Complementing this, the USGS provides a <u>geospatial fabric</u> of hydrography in two datasets. The first is the National Hydrography Dataset.

Slide 8
The second is the Watershed Boundary Dataset.

Slide 9

Combined, these two datasets identify watercourses on the landscape, and the drainage basins that contain them.

Slide 10

Combined again, with elevation data, we have created a highly detailed and accurate account of the foundational elements of the landscape. This is available seamlessly across the nation, is easily accessible to all, and is ready to use by all sectors of science, resource management, and commerce.

Slide 11

Importantly, these data are designed to allow us to perform analytics, thereby increasing the power of the data beyond mapping, and giving us answers to many questions about the landscape.

Slide 12

An example is the ability to navigate the nation's waterways and instantly measure the length of networks.

Slide 13

We can look at elevation data and make landscape measurements…

Slide 14

…such as instantly determining the area of a basin...

Slide 15

…and taking that one step further to generate drainage catchments.

Slide 16

The capabilities of these data have led to powerful interactive analytical systems like StreamStats that can estimate the water flows of rivers and streams for a wide variety of conditions. 3DEP, the NHD, and the WBD, are all critical components that make this possible.

Slide 17

Similarly, the NHDPlus uses these data along with other landscape characteristics to estimate flow on a massive scale across the nation and provide this as an enhanced geospatial dataset.

Slide 18

A great example of intigrating geospatial data to understand complex analysis is GeoFin developed by the U.S. Fish and Wildlife Service for examining the ability for fish to reach upstream spawning grounds.

[animate] This begins with the USGS NHD to represent the rivers and streams.

[animate] These rivers and streams have been enhanced by the U.S. Forest Service working as stewards of the NHD data.

[animate] Those streams declared impaired, are mapped by the U.S. Environmental Protection Agency using the NHD.

[animate] The U.S. Army Corps of Engineers identifies dams on rivers that have the potential to block fish from swimming upstream.

[animate] The U.S. Fish and Wildlife Service and the State of California have then identified locations in the NHD where fish movement is potentially restricted by culverts, waterfalls, and rapids.

Slide 19
Another application of the NHD is to identify water rights in the State of California to make it easier for the state to adjudicate water rights.

Slide 20
In a similar manner the USEPA uses the NHD to identify the location of water discharge permits that helps manage the allocation of permits.

Slide 21
The NHD that makes these and many other systems possible, maps streams, rivers, lakes, ponds, ditches, water diversions, streamgages, dams, and a range of other surface water features that would typically be shown on topographic maps. It also identifies the flow direction of water that makes upstream-downstream cause and effect analysis possible.

Slide 22
One of the major issues in the mapping of hydrography is to determine how much detail to show. The fractal nature of the flow network as it collects water on the landscape means that we can map streams down to an extremely dense level. But the cost to collect, manage, and utilize such data can be beyond the resources available.
This is an example of streams that would be collected on 1:100,000-scale maps.

Slide 23
As we increase the resolution of the map to 1:24,000-scale there is a need to show even more streams in a denser pattern as we see here.

Slide 24
Then as we increase the resolution of the map even further to 1:5,000-scale, a new level of density can be generated.
The question is where to stop. That can be hard to say because scientists and managers are analyzing the landscape at ever-enlarged scales and demanding more and more data. Feeding this need are vastly improved methods to obtain this level of data at costs that are generally affordable.

Slide 25
Next we'll look at a brief history of the hydrography data that has given rise to the NHD of today.

Image 301 – Multi-tiered maps		The mapping of water has a rich history.
Image 302 – Shoshone Map		That history could be said to begin before the New

		World was discovered by Europeans. This petroglyph found in lands once occupied by the Shoshone people in Idaho is known as Map Rock and is believed to map the Snake River. Pre-European maps can be said to make up the first era of mapping water on the continent.
Image 300f – Time Series		The second era of mapping water in North America started in 1507 with European exploration and lasted through 1878. Throughout this period, the most prominent feature found on maps was rivers.

Image 0 – Topographic Surveyors		Then, in 1879, the U.S. Geological Survey was created to, and I quote: "begin a rigid scientific classification of the national domain for general information", unquote. The great surveys of the west were discontinued and brought under the auspices of the USGS. In 1889, funds were allotted specifically for topographic surveys. The first maps were one-degree in size and used a scale of 1:250,000, but this quickly transitioned to...
Image 100 – Little Rock		… the thirty-minute – by – thirty-minute size at 1:125,000-scale, as seen on this map of Little Rock, Arkansas. These maps would launch the systematic coverage of the United States with "quadrangle" topographic maps.
Image 102		By 1935 the USGS was producing maps at 1:24,000-scale in a 7.5-minute-by-7.5-minute format that defines topographic mapping in the United States to this day. The area covered by this map is one-sixteenth of the previous map and shows the land to the northwest of Little Rock in the North Little Rock quadrangle. A contour interval of 10 feet means great precision of the topography, including the hydrography. Maps of the 1930's and 40's still used ground survey methods.
Image 103		In the 1930's aerial photography was introduced into the mapmaking process. In the 1940's the science of photogrammetry – the measurement of photos - matured to the point where it could be used systematically in mapping. This is the 1954 edition of the North Little Rock which incorporated photogrammetric methods. Photogrammetry made updating the hydrography much easier.
Image 107		This 2014 edition introduces the US Topo product,

		and a new type of mapping. The US Topo process uses digital mapping techniques to construct maps in which all the base information, including the hydrography, has been converted to a digital format and the finished map is then produced in an all-digital environment.
Image 300j - Timeline		We'll call the period of national large-scale systematic mapping that started in 1879 and lasts to the present time, as Era 3 in the mapping of hydrography. It is characterized by a number of revolutions in technology that has allowed increased resolution, increased accuracy, increased frequency, and decreased the resources necessary to map the country.

Image 149 – Dot matrix printout of a map		Overlapping with the third era of mapping hydrography is the fourth era, characterized by geographic information systems. This began in the 1960 with computers and computer printout graphics. At first, digital maps were rather crude, but they were a milestone. The age of hand drafted maps was now giving way to computer drafted maps. This is a map of water turbidity in Lake Mendota in Wisconsin.
Image 150 – Vector Print		The technology improved steadily throughout the 1970's with vector plotters.
Image 151 – a CRT		By the 1980's, mapping was transformed by min-computers and interactive computer graphics. This allowed cartographers to rapidly create different mapping scenarios and made integrating, relating, measuring, and analyzing data much faster and more accurate.
Image 153 – A DLG of hydro		In the 1980's, the systematic digitizing of maps became commonplace. Maps now existed as databases within a computer environment. To better manage the information, data themes were created.
Image 292 – Blue separate		Water on most maps was printed in blue. The materials used to make the blue printing plate were digitized separately from other materials. The information collected in this manner was organized in separate database files. The files with water were referred to as the hydrography theme.
Image 154 – SIS computer map.		Maps made using geographic information systems were composed of multiple themes. Hydrography was established as one of the primary themes of

		topography.
Image 156 – DLG		The USGS became heavily involved in digital mapping when the U.S. Census Bureau produced a digital hydrography theme for their 1990 census maps. These maps were produced at 1:100,000-scale and provided nationwide coverage. They were called Digital Line Graph's or DLG's. The U.S. Census version of this data was known as TIGER data.
Image 135 – RF1		In the 1970's, the Environmental Protection Agency had begun to model the flow of water in a geographic information system using hydrography data digitized from 1:250,000-scale aeronautical charts that had been photo-reduced to 1:500,000-scale. The EPA modeled the flow of water using a flow network in a dataset called the RF1.
Image 136 – RF3		In the late 1980's the RF3 at 1:100,000-scale was developed by EPA's Office of Water to provide a nationally consistent database to promote comparability for national, regional, and state reporting requirements such as those found in 305(b) and other sections of the Clean Water Act.
Image 157 – Colored segments		In the RF1 and RF3, streams were broken into segments.
Image 158 – NHD colored by PermID with flow direction arrows		By piecing the stream segments together, river networks were established and the flow of water through the nation's drainage networks could be analyzed by computer modeling software. Combining digital cartography and hydrologic modeling in a geographic information system was a milestone in the evolution of geographic science.
Image 159 – NHD		In 1993, the USGS and the EPA realized they could combine their two hydrography programs to produce a new, improved flow network for the nation at a 1:100,000-scale. It would improve resolution as well as produce a dataset with a flow network suitable for environmental modeling. The combined data became the National Hydrography Dataset.
Image 161		Several years of joint development and planning by the USGS and the EPA finally led to production of the National Hydrography Dataset, which was completed in 2002. The dataset was an immediate success and was put to use by scientists and resource managers all around the country.
Image 162		Even as the NHD was being produced, data users began to inquire about the possibility of increasing

		the resolution. The USGS had begun digitizing its 1:24,000-scale maps, but digitizing and processing over 55,000 maps to provide nationwide coverage was too large a task for a single agency. Growing interest led to a combined effort by states and federal agencies and soon the 1:24,000-scale NHD, now known as the high resolution NHD, was developed. By pooling the resources of some 60 partnering agencies, the USGS was able to complete the production of high resolution NHD for the nation in 2007.
Image 169 – WBD		Paralleling the development of the NHD was the development of the Watershed Boundary Dataset, or WBD, jointly produced by the USGS and the Natural Resource Conservation Service. This dataset defines the perimeters of watersheds, or drainage areas, on the landscape and was completed in 2010.
Image 170 – NHD + WBD		The NHD and WBD are companion datasets that created a comprehensive water information system easily accessible to thousands of water scientists. They created a systematic approach to mapping rivers, lakes, and watersheds across the nation.
Image 166A – 100K NHD		During this period, the EPA was developing the 1:100,000-scale NHD in a significant new direction. All streams are different. Each one is uniquely characterized by the amount of water that flows through them. This is largely determined by the upstream drainage area, precipitation, and other landscape and geologic factors.
Image 166B – 100K NHD + Catchments		If the drainage areas could be determined, it would be possible to include a variety of other factors into a model to…
Image 166C – Flow+Catchments		…estimate streamflow for each segment of a stream. This would give scientists a huge boost in their ability to model the nature of the nation's waters.
Image 166D – NED/WBD image		To determine the drainage areas, the National Elevation Dataset produced by the USGS, was used along with watershed boundaries found in the Watershed Boundary Dataset.
Image 166E – NED/WBD/NHDPlus		This new form of the NHD dataset integrating watershed data, elevation data, and landscape data, would become known as the NHDPlus and was completed in 2008. It marked yet another milestone in the development of geospatial data. With streamflow and velocity estimates embedded in the

		NHD, the dataset was transformed into an even more valuable and useful water information system that made major improvements in how water could be analyzed.
Image 300p - Timeline		This so called fourth era, or GIS era, in the mapping and analysis of water has made a huge impact on water science and management. [animate] What's next for the computer analysis of digital hydrography data? Lidar data will certainly play an important role in recording our understanding of the landscape. Also, the web will likely transform how we interact with geospatial data through the use of data delivery and analytical services. It is also probable that new innovations will influence the future of water analysis and create yet another new era in hydrography. It is safe to bet that these changes will come with greater and greater frequency as technology rapidly advances over the years.
Image 171 – WBD + NHD + NED		The NHD, WBD, and National Elevation Dataset produced by the USGS provide a triad of geospatial data to define the topography of the nation.
Image 172		This has revolutionized scientific hydrographic observation, data collection, and analysis. It is now possible to integrate many types of water information in a geographic information system and model the behavior of water to better inform us on how we manage our water resources.

Slide 200 – In today's talk, Dr. Samuels will be talking about West Virginia. Let's take a quick look at the NHD for West Virginia. [animate] Hydrography data was first digitized in the 1990's. [animate] By 2004 the high resolution NHD was completed for the state. [animate] In the 2005 to 2012 timeframe, NHD data at one to four thousand eight hundred scale resolution was produced. [animate] In the 2013 to 2016 timeframe, the NHD is being used in the development of StreamStats.

Slide 201 – The current focus of NHD is the changing hydrography associated with surface mining.

Slide - Our feature speaker today is Dr. William Samuels from the Center for Water Science and Engineering at Leidos Incorporated located in Alexandrea, Virginia. Dr. Samuels will speak on RiverSpill and the Incident Command Tool for Drinking Water Protection. Dr. Samuels is the Director of the Center for Water Science and Engineering at Leidos (formerly SAIC). Leidos is a science and technology company working to address problems in national security, health, and engineering. He is currently the Principal Investigator for the Waterborne Transport Modeling Program, sponsored by the Defense Threat Reduction Agency. Bill we'll turn this over to you. Thank you Jeff.

Slide 1 - Okay I'm going to spend the next 20 minutes or so talking about an application of this tool called ICWater, or the Incident Command Tool for Drinking Water Protection, and how it was used for the West Virginia chemical spill that occurred in January of 2014.

Slide 2 - With the case of drinking water protection, when a hazardous material is released into a river that serves as a source for drinking water supply, protection and contamination risk mitigation requires information on the fate of waterborne contaminants be made available to decision makers.

Slide 3 - And so what happened in January of 2014 was that a chemical spill of 4-methylcyclohexane methanol, which is a foaming agent used in coal preparation, leaked from a tank at Freedom Industries into the Elk River. This particular tank was about one mile upstream from the intake for the Charleston water supply. On January 9th in the morning at about 8:15 or so, Charleston residents noticed a sweet smell in the air and the West Virginia Department of Environmental Protection began receiving odor complaints from Charleston residents. Later on that morning at the Freedom Industries tank facility, two employees noticed a leak from a tank into the containment area surrounding it. Later on that morning at about 11 o'clock the Department of Environmental Protection inspectors were there and they discovered the leak in response to the resident's complaint of odor. When they arrived at the facility they discovered that this chemical, MCHM was leaking through a concrete block containment dike.

Slide 4 - Later on, at about noon, West Virginia American Water, which operates the water treatment plant for Charleston became aware of the spill. They assumed they could filter it, but by about 4 PM the carbon filtration system could no long handle the large amount of contamination in the water. The chemical began flowing through the carbon filter and entered the distribution system. In addition, they noticed a four-foot wide stream of chemical liquid flowing across the floor of the containment dike and into the ground where the dike's wall joined the floor. Furthermore, they found an approximately four hundred square foot size pool of liquid outside the damaged white stainless tank area. That material then leaked from the containment area into the ground and then traveled into the Elk River. You see in this picture the location of the tank facilities and the proximity to the Elk River.

Slide 5 - What did we do? We received a call from the Greater Cincinnati Water Works, which is a downstream facility that was concerned about that particular contamination. It was too late to do anything in terms of the Charleston area but downstream utilities, particularly Cincinnati were concerned about protecting their water supply. So we started to make some runs of the ICWater model. The model consists of a number of components. It's the NHDPlus, which Jeff as just previously described. We coupled that with real time USGS stream gages so we can update the flows and velocities of the NHDPlus with real-time data. We have a database of assets, which includes drinking water intakes, municipal and industrial dischargers, emergency sites like fire stations, police stations, and other critical facilities like hospitals and schools. And also a contaminant database, which has several hundred contaminants ranging from chemical, biological and radiological materials, with information about their toxicities, maximum contaminant levels, physical and chemical properties used for modeling. This system is GIS based. RiverSpill is the modeling engine that we use, the user interacts with it by identifying the location of the incident and defining the source term whether it be instantaneous or continuous, how much was released, what was released. The RiverSpill model will perform the hydraulic transport downstream. The outputs include a downstream trace, which can be delineated by distance or time. The trace can be interrogated at any location to get a breakthrough curve, which is a concentration as a function of time. The system can also be run in the reverse direction to look at an upstream trace so if you had detection at some site and you were interested in the possible locations of where that might have come from, you can look at the model upstream and see possible sources of contamination. So it is designed to work in emergency management cases as well as planning and contingency operations. We set it up to use minimal input data, a fairly simple user interface, to get an answer fairly quickly to an emergency responder. By using the NHDPlus we can perform hydraulic transport on any stream in the NHDPlus network. We try to select water quality state variables that control the major processes and parameters available from the national database.

Slide 6 - The system is designed to answer four basic questions: Where is the contaminant going. Is there a drinking water intake in its path? If so, when will it reach drinking water? And is the level of the contaminant high enough to be a human threat.

Slide 7 - The modeling principles behind ICWater. With respect to the source term, the spill can be modeled as an instantaneous release or a continuous release over a period of time. We make some assumptions about mixing. In this case we're assuming instantaneous and complete mixing in the water column. For the velocity data, we take the mean flow and velocity data from the NHDPlus and we scale it based on measurements of USGS real time gages, or in some cases flow forecasts and velocity forecasts from the NOAA, or National Weather Service-River Forecast Centers. We have a one-dimensional longitudinal dispersion model and we also model first order decay for chemical contaminants and that equation is modified by temperature for biological contaminants.

Slide 8 - This is what the interface looks like for this particular area. You see a map of the NHDPlus, the spill site, and then very closely downstream is the location of the intake. You notice a number of gages and one gage is very close, just downstream of the intake. It is one of the gages we used for the real-time flow data. When we interrogate that gage in this case we are able to retrieve real-time flow and also real-time velocity. In the user interface down in the lower left, we are reporting the flow from that gage and the velocity. And then we are looking at the average flow and average velocity from the NHDPlus and we can make some scaling factors based on the comparison of those two flows and we can then employ those scaling factors downstream until we get to the next gage and update it as we move downstream.

Slide 9 - Some outputs: Here we are looking at the entire flow regime from where the spill occurred on the right hand of the screen, all the way down about 200 miles or so along the Kanawha River and the Ohio River to Cincinnati. You can see a number of gages there. The most immediate gage was reporting flow and velocity. The other downstream gages were reporting only water elevation. We were able to get from those other gage sites information from the National Weather Service Ohio River Forecast Center, which we used to update the mean flows and velocities in the NHDPlus.

Slide 10 - Information about the water intakes is stored in the EPA's Safe Drinking Water Information System (SDWIS). We can interrogate any intake in the system. It will go out to SDWIS and bring up information about the population served as well as contact information for the plant so a notice or a warning could be called in or sent to them.

Slide 11 - One of the first questions we were asked when the spill occurred was where the spill was going to be in 24 hours. So this is a 24-hour trace from the site of the spill. We color the trace red, yellow, or blue depending upon whether it is above the level of concern, in transition, or below the level of concern. In addition, you can see here on this map, we are plotting other assets from our database so there are many other dischargers downstream, both municipal and industrial. There are several toxic release inventory sites, a few hospitals, and other facilities that may be of interest to users to see what the environment looks like downstream.

Slide 12 - Types of results that we were reporting: We made some comparisons with measurements and observations that were being collected by West Virginia and other agencies downstream so we could compare our model with field observations. We have that data for Charleston, for Huntington, West Virginia where there was another water intake, and also for Cincinnati. We were comparing both the time of travel of the peak concentration as well as the max concentration from the observations as well as the ICWater simulated forecasts. You can see from looking at this data that in some cases the results with respect to time of travel were very close. At Huntington the observed peak was at 90 hours after the spill. The simulated result was at 84 hours and the peak concentrations were quite close. At Cincinnati, again very close with respect to time of travel. The ICWater model under-predicted what was observed with

respect to the peak concentration. But still the results were used by the decision makers to make some decisions about closing their intakes and then re-opening them.

Slide 13 - Here is the breakthrough curve for Cincinnati. So what did the folks in Cincinnati do with some of this information? The water utilities shut down their intakes shortly before midnight on Tuesday, January 14, which was 136 hours after the spill. Assuming the spill began about 8 AM on January 9th. This was a precautionary measure to protect the drinking water supply. The contaminant MCHM was first detected in the Ohio River near the Greater Cincinnati Water Works Richard Miller Treatment Plant on Tuesday, January 15th at approximately 7 AM, which was 143 hours after the spill. ICWater predicted a time of arrival of peak concentration about 150 hours, or 2 PM, on January 15th. Then the Cincinnati water works reopened their intake at approximately 2 PM on January 16th, 174 hours after the spill. You can see all of these events plotted on this particular graph. The smooth curve is the ICWater breakthrough curve forecast. The diamond symbols are the measurements. You can see that the peak time of arrival of the maximums correspond quite closely. The maximum observed peak was about six parts per billion higher than what was predicted by ICWater.

Slide 14 - So there are a number of challenges associated by this particular event. Particularly with uncertainty of input parameters: The spill duration, how long did the chemical actually leak from the tank and what kind of release pattern did it show. Was it continuously releasing over a period of time? Or were there sort of ups and downs to the flow? And exactly how much volume was released. Initial estimates were about 5,000 gallons, and then it went up to 7,500, and then it was finally agreed upon that it was 10,000 gallons released. Toxicity levels of the contaminant were not well-known. The CDC offered a toxicity level of concern of about one milligram per liter. A lot of folks are using that as a benchmark. Also, accounting for how much mass was lost through other downstream intakes. That was an unknown. Also the accuracy of actual measurements that were made for model updates and comparison. Other factors with respect to how the pollutant was delivered to the river. Attenuation by the soil that it had to seep through. That was again another unknown.

Slide 15 - There were a number of success factors - using both models, as well as observations for the Cincinnati Water Works. The ability to use a national river network like the NHDPlus, coupled with real-time streamflow data, and river forecast data, allowed simulations of leading edge, peak concentration and trailing edge from the origin of the spill to hundreds of miles downstream. Having measurements along the way were useful for updating the model forecast and for making comparisons to what was being predicted. What we were finding with respect to travel time was very good agreement. With the peak concentrations at some of the intermediate stations like Huntington very good agreement with the peak concentration and we were underestimating at Cincinnati.

Slide 16 - We have a number of lessons learned for future experiences with this kind of event and this kind of modeling. Initial spill reports are often inaccurate. You need to constantly update forecasts based on changes in the source term and also environmental conditions like the flow. Using both real-time gage data as well as streamflow forecasts is important. Not all gages that we encountered were recording flow; some were just reporting surface water elevation. The water utility was making their decisions not just on modeling forecasts, but also on field observations. It was important to validate what the model was predicting. Working collaboratively with local authorities, with water utilities, and data providers, was very useful in getting this modelling effort launched.

Slide 17 - So, just a number of conclusions: For an event of this magnitude, I think this exercise showed the utility of a national toxic spill model to simulate the entire pathway of the spill from the tributaries upstream like the Elk River, onto the main stem of the Ohio River. And that the integration of this national level stream network, coupled with real-time streamflow and the river forecast data as well as

sampling observations, enabled decision makers at this water utility to take appropriate action to protect their water supply.

Slide 18 - Finally I offer a little bit of further reading for more details about what I just presented. Two recent papers: one, Modeling the Fate and Transport of a Chemical Spill in the Elk River, which was recently published in the Journal of Environmental Engineering. And secondly, a paper published in the Water and Environment Journal on the Incident Command Tool for Drinking Water Protection. This gives all the details on equations, assumptions, applications, of this particular tool. So that concludes my particular presentation and I thank everyone for their attention.

Thanks a lot Dr. Samuels. Let's open it up to questions via the chat. I ask my colleagues in Reston if you want to bring up some of these questions.

If people don't see the chat, there is a little tool at the top of the screen that will open up a chat window and you can ask your questions there. With the number of people on the line we have decided not to open up the phone line itself. If you want to ask a question you need to type it into the chat and then send it to everyone. There is a little pull-down above the chat box that asks you were you want to send it to and everyone is at the very top of that list.

Okay, Dr. Samuels we have a couple of questions streaming in here. The first one.

Can the referenced articles and presentation be sent to the meeting participants? We can post this on the NHD web site.

Yes, we sure can.

Also, a number of questions about access to the ICWater tool. Where do you get it and is it proprietary?

Okay, I can answer that one. The tool is developed with funding from a number of government agencies including EPA, Forest Service, and the Department of Defense. Right now it is maintained and developed through a contract with the Defense Threat Reduction Agency. They can make that tool available to any federal, state, or local government agencies that request it. I can provide the point of contact for making a request to DTRA for the tool.

We had a question from the New York Water Science Center asking about how fast was the response, how fast were you able to respond to the spill and start getting information to your clients?

Okay, we received a call from Cincinnati and we were able to get results to them in about 12 hours or so, once we were able to get information from them about the source term and the nature of the release. We kept making updates several times a day to provide them with some updated information. The model run took, depending on how far we were doing the simulation, if we started at the site of spill all the way to Cincinnati would take maybe two or three hours. If we were starting further downstream at say Huntington and going to Cincinnati we could get results out in 45 minutes to an hour. That gives you a feel for the nature of our response.

I would like to ask a follow-up. You have been working on the Open Water Data Initiative team that is looking at spill response. Can you give us some idea how we might change the way the response happens so we can be better prepared in the future?

Yes, I think one thing that can change is through the architecture of the tool. It is running now basically, it is a desktop application, run as an extension to the ArcGIS system. A user needs to have it set up on their system with an Arc license and have the data loaded. If that's already to go you can respond fairly quickly. If not you need to get all of that software installed, and the data installed, and learn to use the system. I think we could probably increase, or cut down, the response time if we had a web based version of the tool where a user can log in. Then, all the data would be sitting there on the cloud, ready to go. You don't have to spin up an Arc license and load your data. So I think moving to a more web based client-server environment would be the next iteration of this kind of application.

We had several questions about the data the goes into the model and what kinds of things it can consider? For instance, would geomorphological data along the river have helped? Or, would it consider meteorological conditions or ice cover on the river?

Yes, it's really set up to look just at the hydraulic transport in the river itself with some simplifying assumptions, particularly one-dimensional longitudinal transport. Some of the geomorphologic data along the riverbank or course is of interest, but right now the model wouldn't be able to do much with that, except maybe if we knew how that might influence how much material, for the total amount spilled, might not get into the river. That could be use used to help define the source term. With respect to meteorological data, you recall from one of the graphs on the presentation, the flow was fairly low and steady in the tribs and the Ohio main stem for the first 24 to 36 hours, and then there was a rainfall event. You started to see the flow increasing rapidly over time. The gages then do see that signal from the rainfall data so the flows and velocities are going to change as a result of that. Through the gages these rainfall and meteorological events are factored into the travel time.

We have a question from Drew Grant in the Alaska DEC. He asked how toxic the MCHM was? Could you address how toxic that was, and whether you would need to change how you would model something that was either more or less toxic than that particular substance?

Yes. What I recall is that there was not a lot known about the toxicity of this particular chemical when this occurred. I think that were some studies done, some animal studies, with some number produced by the CDC. They came out with a level of concern of about one milligram per liter. But that was more of a guideline. The event did not cause any fatalities as far as I know. Because when a lot of people began to notice that smell in the water they just wouldn't drink it. So form that perspective it was a big inconvenience as oppose to an event where a lot of people were getting sick. I think that there are studies now that have occurred, and still may be occurring, to look at the toxicity of this particular contaminant.

55:03 End