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Final Memorandum

To	Kimberly Swan, Clackamas River Water Providers
From	Jennifer Schmidt, Herrera Environmental Consultants
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Subject	GIS-Based Watershed Emergency Response System

Introduction

The Clackamas River is a source of drinking water for more than 300,000 people in Clackamas County and is a vital resource for meeting future water demand in the region. The Clackamas River Water Providers (CRWP) represents five municipal surface water intakes on the Clackamas River: City of Estacada, Clackamas River Water, North Clackamas County Water Commission, South Fork Water Board, and City of Lake Oswego. In 2010, the CRWP developed a drinking water protection plan identifying potential threats to source wate rquality and outlining a series of strategies and programs to help protect the Clackamas River as a viable long-term source of high-quality drinking water. As part of this effort, hazardous material spills from commercial and industrial areas, railroad lines, transportation activities along HWY 212/224, and road bridges crossing the Clackamas River were identified as being one of the most significant threats to source water quality in the Clackamas River watershed (Clackamas River Water Providers 2010).

In April 2011, the Eugene Water and Electric Board (EWEB) led an effort to coordinate, design, and develop a geographic information system (GIS) based watershed emergency response plan for the McKenzie River to help provide guidance to emergency responders in the first crucial hours following a hazardous spill (Morgenstren 2003). The purpose of this memorandum is to outline recommendations to the CRWP for developing and implementing a similar GIS-based watershed emergency response system in the Clackamas River watershed.

GIS Watershed Emergency Response Plan Approach

A watershed emergency response plan is intended to help emergency first responders avoid the initial confusion that may accompany the first few hours after a hazardous spill by providing necessary response logistics quickly and efficiently. A comprehensive emergency response plan: 1) provides the location and intensity of potential contaminant sources; 2) identifies critical resources to be prioritized for protection in the event of a spill such as surface water intakes and sensitive habitat; 3) outlines site-specific spill response strategies, equipment availability, command post locations, first responder bases, and other logistical information; and 4) identifies potential spill response constraints, including seasonal weather patterns and access issues, reach-

specific flow velocities, and infrastructure such as narrow roads and bridge loading rates (HEC 2011).

As demonstrated by the success of the EWEB McKenzie Watershed Emergency Response System (MWERS), GIS is an ideal choice as a tool for managing and distributing spatial data and other important spill response information to partner agencies and first responders in the event of an emergency. Collecting, organizing, and distributing all of the information necessary for a rapid, effective emergency response however can be a challenging effort. To accomplish this task, Herrera recommends that the CRWP implement the following phased approach:

1. Identify a comprehensive list of spatial and non-spatial datasets required for an effective spill response.

2. Use this data to complete a GIS-based risk analysis identifying potential spill risk "hot spots" in the Clackamas River watershed, including high vehicle accidents areas, dangerous highway segments, repeat spill areas, and clusters of chemical storage facilities (EWEB 2004) and map sensitive resources downstream of these locations.

3. Based on the results of the GIS "hot spot" risk analysis, identify and coordinate with partner agencies and other key stakeholders to conduct a workshop where stakeholders can contribute to the development of site-specific spill response strategies, and the gathering of information on equipment availability, communication details, and other logistics.

4. Integrate the results of the GIS risk analysis and the information gathered in the workshop into a web-based and/or mobile GIS watershed emergency response tool that can be distributed to first responders for use in the event of an emergency.

The following sections provide more detailed guidance on implementing each of these steps.

GIS Dataset Needs

First responders need access to a variety of datasets in the event of an emergency, including watershed characteristics, potential spill threats, and critical resources to be protected. Herrera recommends that the CRWP consider incorporating the following spatial datasets and other watershed characteristics data into planning for and implementing a GIS based watershed emergency response tool for the Clackamas River watershed. Many of these datasets have already been collected as part of the 2011-12 drinking water protection risk analyses and geodatabase development work conducted by Herrera; these datasets are indicated with an astericks:

- Major transportation infrastructure, including highways*, railroads*, bridges*, and stream culverts;

- Water resources, including streams*, lakes and wetlands*, and well locations;*

- Utilities infrastructure, including major pipelines and stormwater outfalls;
- Tax parcel boundaries with property ownership information;*
- Sensitive resources, including surface water intakes*, fish and wildlife habitat*, archaeological sites and other cultural resources, and wetlands;*
- Census statistics to help provide socioeconomic information on the population living in the proximity of a contaminant release;*
- Groundwater data, including dept to groundwater tables and groundwater source areas;*
- Boat ramps, water access points, and recreation locations
- Federal Aviation Administration flight restriction maps
- Stream flow rates and potential travel times once a contaminant has entered the Clackamas River
- Underground Injection Control (UIC) locations*
- 2002-03 Potential Contaminant Source (PCS) dataset from Oregon DEQ*
- Hazardous Substance Information Survey (HSIS) results from the Oregon State Fire Marshall (OSFM)*
- Toxic Release Inventory (TRI) facility data from U.S. EPSA*
- Hydroelectric facilities and dam locations
- Shoreline characteristics and habitat designations
- Topographic data*
- Soil charactertistics*
- Oregon Department of Transportation accident data from the statewide Crash Locator database

This list is not comprehensive and there are likely several other datasets that would be beneficial to incorporate in the GIS watershed emergency response system; this list should however provide a good starting point for GIS isk assessment and response planning.

Identify Potential Emergency "Hot Spots"

The Clackamas River watershed drains more than 940 square miles and contains several major highways, three Portland General Electric (PGE) hydroelectric facilities, the Union Pacific railroad line, and numerous bridges, tunnels, ditches, and other transportation infrastructure. Rather than preparing an emergency response plan covering the entire watershed, Herrera recommends that the CRWP start by completing a GIS risk analysis to identify potential emergency "hot spots" in the watershed and focus planning efforts on these specific areas. One possible approach to this analysis is provided below:

1. Using spatial data from the ODOT Crash Locator database, the U.S. EPA TRI database, OSFM HSIS, and Oregon PCS, the CRWP should identify the following areas:

    - High traffic accident clusters and dangerous highway segments to help plan spill response from transportation accidents.

    - Previous spil locations (particularly where spill clusters are present)

    - Facilities and locations where potential contaminants are stored to help plan spill response from fixed facilities.

2. After the areas at highest risk for a future contaminant release are identified, the CRWP should map spatial data downstream of these areas that identify sensitive resources in the watershed that should be prioritized for protection during an emergency, including:

    - Surface water intakes

    - Hydroelectric facilities

    - Sensitive species habitat, fish spawning beds, and bird nesting areas

    - Cultural and archaeological resources

The results from this analysis can be used to help focus the emergency response planning efforts on small, manageable areas that are likely to experience the most significant impacts in the event of a spill. The next several sections focus on gathering more detailed information to support emergency response at these locations.

Identify Key Stakeholders and Partnerships

Identifying key stakeholders and coordinating effective partnerships between agencies and organizations involved with disaster response and preparedness in the Clackamas River watershed is a critical next step towards developing an effective watershed emergency response system. Stakeholders and partner agencies may already have local emergency response protocols in place, spill equipment trailers or waterhouses, and other resources and efforts that could be coordinated and streamlined to help develop a watershed-level emergency response system. In

addition, these stakeholders have valuable first-hand knowledge of geographic resources and constraints in the watershed that is crucial for developing effective spill response strategies.

Stakeholders and partner agencies commonly involved in large-scale emergency response planning efforts include federal, state, and local agencies with expertise in oil spill emergency response; representatives from industry, tribes, utilities, ports, and environmental organizations; and response contractors. A partial example list of stakeholders in the Clackamas River watershed could include:

Federal Agencies

- U.S. Forest Service (USFS)
- U.S. Bureau of Land Management
- U.S. Environmental Protection Agency
- U.S. Army Corps of Engineers
- National Weather Service

Clackamas County Departments

- Dept. of Emergency Management
- Sheriff Dept.
- Water Environment Services

Industry and Response Contractors

- Portland General Electric
- Union Pacific Railroad

State Agencies

- Oregon Dept. of Fish & Wildlife
- Oregon Dept. of Environmental Quality
- Oregon State Police
- Oregon Dept. of Transportation
- Oregon Water Resources Division
- Oregon Health Division
- Oregon Emergency Response System

Fire Districts and HazMat Teams

- Region 3 HazMat Team
- Sandy Fire District #72
- Estacada Rural Fire District #69
- Gresham HazMat Team
- Clackamas Fire District #1

Conduct Stakeholder Workshops

After key stakeholders and partner agencies have been identified, the next step in developing a watershed emergency response plan is to conduct an emergency response planning workshop. The first goal of this workshop is for stakeholders to collaborate and identify sensitive resources, physical features, hydrology, currents, winds and climates that may affect response strategies. Specific response locations and strategies are then developed by the group based on this information, including the amount and type of equipment necessary for implementation, site access, and potential staging areas. The second goal of the workshop is to identify important logistical information needed for effective emergency response, including:

1. Names and contact information for individuals and organizations to notify in the event of a spill and response chain-of-command.

2. Locations of potential response operations centers.

3. Local equipment caches and trained emergency response personnel.

4. Local facilities, responder services, and appropriate contacts for each.

5. Response times for bringing equipment in from other areas.

6. Personnel, equipment, and data gaps that need to be addressed to provide effective emergency response.

Herrera recommends that logistical information like access points and response strategies be collected and entered into GIS at the workshop through an interactive, moderator-led session so that participants are able to visually see, collaborate, and agree on key information that will be used to develop the watershed emergency response plan in real time. To facilitate this session, GIS data should be compiled into a map project prior to the workshop to provide an interactive overview of the Clackamas River watershed, including aerial photography, topographic maps, utilities data, land ownership, hydrology, sensitive species information, and other relevant data as listed earlier. The Drinking Water Protection geodatabase developed for the CRWP by Herrera in 2012 contains most of the spatial data needed to complete this effort.

Field Reconnaissance

After the Stakeholder Workshop has been completed and the information provided by participants has been summarized, the second step in developing the Clackamas River emergency response plan should include a field reconnaissance effort. The purpose of the field effort is to briefly visit each potential response site to confirm site access, note any major features of interest not captured in the workshop, and to take several photographs of each site. Field reconnaissance also provides an opportunity to photograph general watershed characteristics that can affect spill response. For example, response strategies and equipment needs vary based on shoreline type, so taking representative shoreline photograph to help orient first responders is a helpful addition to an emergency response plan.

Field reconnaissance is an ongoing effort, particularly in areas where seasonal weather variations have an impact on spill response feasibility. For example, if a boat ramp is frequently inaccessible during winter months due to snow or ice, this is important information to capture in the emergency response plan through photographs and alternative strategy development.

Develop a Watershed Emergency Response Plan

The next step is to compile the information collected in the stakeholder workshop and field reconnaissance efforts into a Clackamas River GIS-based watershed emergency response plan for first responders. This plan should contain the following information collected at the stakeholder workshop:

- Watershed characteristics
- Critical resources to protect
- Equipment inventories and other response resources
- Communications and other logistical information
- Pre-developed spill response strategies

The following sections discuss the development of the Clackamas River emergency response plan as a traditional hard-copy report. After a discussion of the emergency response plan content, more guidance is provided in the next section on using this information develop a GIS-based watershed emergency response system like the MWERS system developed by EWEB.

Watershed Characteristics

Information on watershed characteristics that "may influence the mobility and behavior of a chemical spill in the environment and on the river" is critical for first responders (EWEB 2003). This includes physical site characteristics like topography and soil characteristics, population statistics, hydrology, river flow rates and spill travel time, climate, and an assessment of hazardous spill risk sources in the watershed.

The development of potential spill travel time estimates for the McKenzie River by EWEB was accomplished using GIS to analyze information from a USGS study that used dye testing to develop contaminant travel rates for high, medium, and low river flow rates (USGS 1968; EWEB 2003). A similar dye test study was completed for the Clackamas River in 1992; Herrera recommends that this be used in combination with a GIS routing analysis to estimate travel time from spill incidents to downstream features based on flow rates in the Clackamas River watershed (Laenen and Bencala, 2001; Lee, 1995).

Critical Resources to be Protected

Critical resources identified through the stakeholder workshop and field reconnaissance efforts to be prioritized for protection in the event of a spill should be mapped and summarized in the watershed emergency response plan document. These resources typically include features like public drinking water intakes, public drinking water well fields, critical species habitat and spawning areas, hydroelectric facilities, culturally-sensitive resources, wildlife flight restrictions, individual intakes and wells, and wetlands. Information captured for each critical resource should include: 1) type or resource and reason for protection; 2) agency name(s) and contact person(s) responsible for the resources; 3) resource priority for protection; 4) notification criteria; and 5) special response requirements (EWEB 2003; HEC 2011).

Equipment Inventories

During the stakeholder workshop, key stakeholders and partners will have provided an equipment inventory list that can be used in the event of a hazardous spill. This information

should be documented in the watershed emergency response plan, including: 1) contact information and emergency numbers for using the equipment; and 2) location of each equipment warehouse or spill response trailer in the watershed. In addition to documenting physical equipment, EWEB also inventoried and mapped information on special expertise such as bomb squads, dive teams, and air sampling and analytical services in their watershed emergency response plan (EWEB 2003). This is helpful information to solicit from partner agencies and other participants at the stakeholder workshop.

One critical component of an equipment inventory is to determining if there are any gaps in the location, type, and amount of available equipment required to implement spill response strategies. If gaps are identified, the CRWP and partner agencies should seek funding to purchase additional resources to fill these gaps.

Communications and Other Logistical Information

Documenting emergency notification contacts for all key stakeholders and participating agencies is a critical component of an effective watershed emergency response plan. The lack of a clear chain-of-command in the first crucial hours following a hazardous spill is one of the most difficult obstacles for first responders and can significantly delay the onset of spill clean-up.. The CRWP could help overcome this obstacle by taking a leadership role as a coordinating agency in the event of a hazardous spill.

Other logistical information that could be solicited at the stakeholder workshop and included in the Clackamas River watershed emergency response plan includes: 1) command post locations; 2) cell phones and radio equipment availability; 3) vehicle rental and helicopter air support; 4) and lodging and catering options.

Spill Response Strategies

The spill response strategies developed in the stakeholder workshop that are designed to prioritize and protect critical resources in the event of a hazardous spill are one of the most important components of the watershed emergency response plan. Each response strategy summary identified in the workshop meetings should include a description of the resource being protected, a strategy description, the amount, type, and placement of boom and other equipment required to implement the strategy, staging area and site access information, a watercourse description, seasonal access constraints, directions to the site, and maps and photos.

Implementing a GIS-Based Watershed Emergency Response System

EWEB has developed a GIS-based Emergency Response System for the McKenzie River that allows first responders to quickly retrieve information and make assessment about tools and equipment needed to effectively response to a hazardous spill. The purpose of this section is to outline the steps needed for the CRWP to develop a similar computerized, web-based tool for first responders in the Clackamas River watershed. These recommendations are based on the assumption that the CRWP will first prepare a traditional hard-copy emergency response plan as described in the previous sections; the majority of the content for the GIS system (response strategies, equipment locations, contact information, site access, etc.) will have already been

developed through this process. After the emergency response plan document has been completed, Herrera recommends that the CRWP complete the following steps to begin developing and implementing a GIS-based watershed emergency response system for the Clackamas River watershed:

1. Complete a brief GIS needs assessment exercise to identify key hardware, software, personnel resources, and application requirements for the development and use of the Clackamas River Emergency Response System by first responders in the watershed. This should include identifying hosting options for the system, responsibility for system upkeep and maintenance, and equipment needed for first responders to implement the system in the field. The CRWP should coordinate with Karl Morgenstern at EWEB on this effort to help streamline the process. Coordination with the Environmental Systems Research Institute (ESRI) and other agencies can help the CRWP identify grant opportunities for obtaining sufficient GIS software, laptop computers, handheld GPS equipment, and mobile GIS systems to adequately equip first responding partner agencies.

2. Compile and prioritize a "wish-list" of custom GIS system functionality to help develop a phased plan for system implementation over multiple fiscal years if necessary. This includes identifying existing programs that could be leveraged as part of the system, such as the ICWater Spill Response tool developed by the U.S. Forest Service. The purpose of this exercise is both to plan for future uses of the system and to prioritize key functionality for a first implementation. Some examples of custom functionality provided by the EWEB system include the ability to (EWEB 2003):

    - Enter the location of a spill and then zoom in on a map and photo of the area.
    - Click on a location and get a detailed, specific response plan for the segment of the river where the spill occurred.
    - Get an inventory of equipment that is available nearby.
    - Get a list of contacts and locations of where equipment is located.
    - Identify storm drains and culverts.
    - Create a report that shows the travel time of the pollutant that has spilled.
    - Get an estimate of the population that might be affected.
    - Get a list of upstream facilities that use or store hazardous materials.

3. Use this prioritized wish-list to coordinate with a GIS-capable partner agency or GIS consultant to develop a scope, level of effort, and timeline for implementing the first phase of this system.

Herrera recommends that the first phase of a GIS-based emergency response plan for the Clackamas River watershed focus primarily on 1) identifying data gaps and gathering additional spatial data that could be helpful for emergency response in the watershed; 2) completing a GIS "hot spot" analysis to identify areas at highest risk of a spill and sensitive downstream resources

and incorporating the results of these analyses into the Drinking Water Protection geodatabase; 3) distributing a survey to partner agencies and other stakeholders to begin the process of collecting detailed data, equipment, watershed characteristics, and communication information to incorporate into GIS, being sure to request approximate spatial locations for as much of the information as possible; 4) coordinating with partner agencies to develop a plan for hosting and maintaining a GIS watershed emergency response system over time; and 5) incorporating as much of the information gathered as possible into an interactive GIS projectthat can be used to help facilitate discussion and collect information at an emergency response stakeholder workshop.

Conclusions

The CRWP have identified hazardous material spills from commercial and industrial areas, transportation activities along HWY 212/224, railroad lines, and road bridges crossing the Clackamas River and its tributaries as being one of the most significant threats to source water quality in the Clackamas River watershed. The development of a Clackamas River Emergency Response Plan and GIS-based Emergency Response System is an important step in helping to mitigate this threat and protect the Clackamas River as a long-term source of quality drinking water for the region.

Herrera has outlined strategies in this document to help the CRWP begin implementing a GIS-based wateshed emergency response plan for the Clackamas River watershed. These include1) identifying data needs and data gaps; 2) completing a GIS "hot-spot risk analysis to identify potential spill locations and sensitive downstream resources; 3) identifying key stakeholders and conduct an emergency response planning workshop; 4) using the information gathered through the GIS analysis and the workshop to develop a traditional emergency response report; and 5) identifying the primary software, hardware, and personnel needed and incorporating this information into a web-based and/or mobile GIS emergency response system.

References

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