GASOLINE PIPELINE RUPTURE AND EXPLOSION AT WHATCOM CREEK: A FOCUS ON RESPONSE MANAGEMENT

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ABSTRACT: *Safety for the public and responders was the first priority in responding to the estimated 231,000 gallons unleaded gasoline release and explosion that killed three boys in Whatcom Park in Bellingham, Washington and devastated the environment. Establishment of the Unified Command structure was critical to manage the vast resources and multitude of issues that arose in the wake of the release to Hannah and Whatcom Creeks on June 10, 1999. The pollution response, investigations, infrastructure rebuilding, natural resource (trustee) restoration, and community outreach/public information were completed with funds from the potentially responsible party (PRP), Olympic Pipe Line (OPL), as mandated by the Oil Pollution Act of 1990. Goals evolved as projects changed from fire and explosion emergencies to time critical environmental emergencies. Bellingham's drinking water capacity was restored, and initial restoration of the creeks was completed in time for the August salmon runs. Ongoing activities include the operation and maintenance of a vapor extraction plus a ground water interception system as well as long-term creek restoration plans managed by natural resource trustees. This paper summarizes the fire and explosion emergency phase, pipeline investigation removal, streambed restoration and cleanup, and the cleanup of the source area.*

911 Emergency Operations Center

In the afternoon of June 10, 1999, an Olympic Pipe Line (OPL) 16-inch pipeline, carrying ARCO unleaded gasoline experienced a rupture, which was reported to be between 84,000 and 277,200 gallons. The gasoline entered Hannah Creek and Whatcom Creek, which flow through Bellingham, Washington. At 5:02 p.m. PST, 38 minutes after the first 911 calls reporting a gasoline smell, an explosion occurred when the fuel ignited. Figure 1 shows some of the burned 25 acres of creek beds and creek banks that stretched more than 2 miles downstream from the rupture location at Bellingham's Water Treatment Facility in Whatcom Falls Park. The explosion crippled the water supply, and the fires consumed the vast majority of the fuel. Three boys were killed, and nine people were injured.

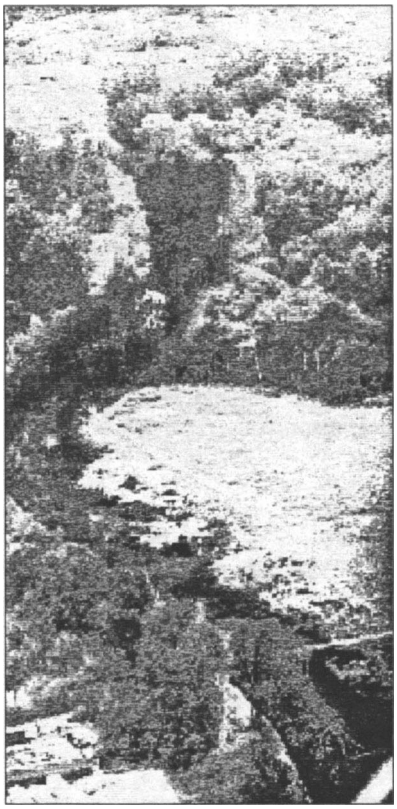

Figure 1. Aerial shot of lower Whatcom Creek June 14, 2000 (view is toward east).

Responders established a Unified Command (UC) consisting of federal (U.S. Environmental Protection Agency [EPA]), state (Washington Department of Ecology [WDOE]), and local (Bellingham Fire Department) officials as well as the potentially responsible party (PRP—OPL—and tribal representation. An Emergency Operations Center (EOC) was initially set up at the

Best Western Motel on June 10 and moved to the Whatcom County EOC the next day. A natural resource damage assessment (NRDA) team including the U.S. Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), and WDOE assembled on June 12 to begin damage surveys and direct OPL representatives to develop an Emergency Restoration Plan for the creek area.

An accident investigation team including the National Transportation Safety Board (NTSB), U.S. Department of Transportation's Office of Pipeline Safety (OPS), and WDOE assembled on June 11 to determine the cause of the pipeline failure. Because of the size and significance of the spill, the Federal On-Scene Coordinator (FOSC) requested activation of the Regional Response Team (RRT); however, the RRT was not activated. At the source, residual spot fires continued for 5 days. On June 14, at the direction of the UC, Bellingham Fire Department extinguished the main source fire due to concerns regarding a potential toxic smoke fume threat to the responders in the area. The OPL pipeline failure reduced the 300,000 barrels (12.6 million gallons) per day pipeline transportation capacity to the Seattle, Washington and Portland, Oregon vicinities by approximately 50%.

Emergency phase

On June 10, 1999, about 231,000 gallons of gasoline was released from a 16-inch buried OPL pipeline. The gasoline flowed 1,200 feet down Hannah Creek and over a mile down Whatcom Creek in Whatcom Park, downtown Bellingham, Washington. Vapor clouds were reported visible to 10 feet over the city streets just prior to 5:02 p.m. when the gasoline found an ignition source, a fireplace lighter held by two 10-year-old boys near the confluence of Hannah and Whatcom Creeks. The two boys were evacuated by helicopter and died in the hospital of burns. A third 18-year-old young fisherman was later discovered to have drowned.

For 22 days (from June 10 to July 1) more than 2,770 people responded to the spill and explosion during the emergency phase. The principle of escalation applied where local county and city responders first on the scene were followed by tribal, state, federal officials and OPL, PRP with Equilon (PRP emergency crisis managers). The Bellingham Fire Department implemented parts of the National Incident Management System/Incident Command System (NIMS/ICS) and was familiar with the concept of UC. EPA immediately implemented the UC at 7:45 p.m. to support the Incident Commander of Bellingham Fire and Washington State Police, with Lummi Tribe representation.

Bellingham Fire and Police departments took the initial steps to protect public safety during the emergency phase of the response. The city closed the park, and police officers with assistance from private security officers secured the impacted areas along 2 miles of creeks and park. Safety personnel under the UC were given broad authority to establish protocols for team entry, medical monitoring, and access. Safety monitors accompanied entry teams. Some specialized teams with less training in hazardous materials were paired with safety monitors. Specialized training in hazardous materials response was provided to workers before entry. The large park and stream areas were evaluated continually for hazards. Exclusion zones were established in areas of high risk. Operations and technician level (HAZMAT) trained personnel worked in the exclusion zones. Access control was gradually relaxed as hazards, including fire, product, fire-weakened trees, and other physical hazards were reduced. Public access was restricted for 6 months. Injuries were limited to bumps, scrapes, and bruises, which demonstrated the success of the safety efforts.

Search and rescue (SAR) teams and medivac helicopters located the injured and deceased. Emergency response teams temporarily relocated displaced persons, secured the site around the creeks and water treatment plant, and monitored the air in downtown Bellingham sewers, park areas, and the county jail. The city's public works department flushed sewer systems. One concern included the potential evacuation of inmates at the county jail. A recurring problem was the lack of hazardous materials training of responders including NTSB, state wildlife personnel, SAR teams, laborers, city parks personnel, and public works personnel.

Utilities were impacted severely by the incident. At the pipeline rupture location, the bomb-like blast and fire destroyed the Dakin-Yew city drinking water supply pump station vault, which cut off one-third of the water supply. Electrical power was knocked out to 4,000 residences. Cell phone service became overloaded and unreliable. Roads became impassable. Interstate 5 (I-5) and city streets throughout a 2-square-mile area came to a standstill. Aviation and automotive gasoline pipeline capacities to the Seattle and Portland areas were reduced by 50% from the Ferndale refineries, and fuel reserves at Seattle Tacoma International Airport were reduced to the extent that plane fueling was rerouted to other areas.

Fires extended 2 miles from the pipe break at the city water treatment plant, down Hannah Creek, Whatcom Creek, and through industrial and residential areas of Bellingham almost to I-5. Local fire fighters managed 30 units that responded to the fire. Forest fire fighters from Washington Department of Natural Resources (WDNR) were integrated into the fire teams to extinguish the burning trees and wooded areas along the 2 miles of burning creeks. WDNR removed fire-weakened trees and cut trees that were later recycled in constructing a fish habitat resource. WDNR also mapped the burn areas with GPS systems, which proved valuable to manage crews, track progress, and map ecosystem resources, hot spots, and remedies. The source area burned for 5 days before foam was applied to extinguish the gasoline-fed fires. In some locations, the placement of sorbent materials complicated worker entries because of vapor levels. Firefighters sprayed to manage vapors and called for flooding of the creek.

Unified Command structure

Planning and working relationships developed prior to the incident proved invaluable in establishing partnership and trust within the UC. The UC first included EPA, Washington State Police, City of Bellingham, Lummi Tribe, and OPL. Command staff included safety, public information, and legal staff. As federal lead, the retention and distribution of the administrative record called for honoring the Freedom of Information Act as well as protecting the private citizen, as required by the Privacy Act of 1974. Finance, logistics, operations, and planning (FLOP) sections were augmented with "source" and "environment" sections. Daily Incident Action Plans (IAPs) were used to identify the strategic objectives. There were four initial objectives:

1. Ensure safety (public, responders)
2. Consider short-term and minimize long-term environmental issues
3. Secure the source (minimize the release and threat of further release)
4. Reassure stakeholders (public, agencies, officials) of UC's intent to minimize the short- and long-term impacts of the spill.

Daily UC meetings assured safety, communication, and prioritization of emergency response goals. Separate daily natural resource trustee meetings were held as well. Trustees worked to-

gether to develop restoration goals and coordinated their efforts with the UC. Early in the response, trustees and the city park representatives worked within the environmental unit as a separate section. As the response matured, the environmental section became the Joint Restoration Committee (JRC) responsible for long-term restoration. At several times, there were efforts by WDOE to transition from non-emergency status to JRC lead without Federal Lead Administrative Trustee (FLAT) as chair. The transitions from short- to long-term restoration and from UC lead to a long-term restoration committee, lead by the FLAT (NOAA), is a significant and anticipated step. The decision to terminate emergency status restores normal permitting channels and may impact the rate and extent of the cleanup in the future.

Investigation of pipeline failure

Large incidents warrant participation of federal, state, and local investigating authorities with whom the EPA does not commonly exercise. Future exercises and planning with all participants would enhance the response. NTSB took the lead on investigating the pipeline failure. The pipeline failure investigation is critical to determine cause, actions to be taken prior to future startup, operations procedures changes needed and setting any federal or state civil penalties. NTSB Hazardous Materials Safety (USC title 49, Chapter 11) has priority over any civil investigation by another department, agency, or instrumentality of the U.S. government to determine facts, circumstances, and causes of pipeline accidents in which there is a fatality, substantial property damage, or significant injury to the environment. The Office of Pipeline Safety manages regulations regarding pipeline operations and startups (49 CFR 194-5).

NTSB continues (as of November 2000) to evaluate the case, and results may be released within a year. The pipe was removed under direction of NTSB (Figure 2). NTSB appointed a still photographer (a fireman trained in hazardous materials response) and an EPA contractor for video photographs. The excavation and pipe removal was completed 18 days after the explosion.

Figure 2. Crews work to forensically uncover ruptured pipeline.

Two sections of pipe, including a rupture measuring 28 inches long by 7 inches wide and a relief valve from the Bayview terminal, were forensically removed and transported to NTSB, Washington, D.C. Pipeline operations and procedures at the OPL Renton headquarters were reviewed. The supervisory control and data acquisition system (SCADA) computer data also were reviewed. The record of actions taken prior to and after the release is based on these reviews. Pipeline operators refused to talk to NTSB. The blowout in the 16-inch "312" (0.312 inches thick) steel buried pipe occurred at a location below a 72-inch water pipe plus a 24-inch to 16-inch valve "T" connection and immediately adjacent to a water pump vault. Other numerous subsurface pipes, chemical treatment lines buried telephone lines and the Dakins-Yew water pump vault were in the vicinity of the pipe break which complicated the investigation dig.

Other challenges included the availability of HAZMAT trained investigators that were government officials, as NTSB investigators were not hazardous materials trained. The EPA OSC's request for two EPA civil investigators to assist in this matter was not approved. The forensic excavation of the pipeline under NTSB direction subsequently was slow, which necessarily delayed the soil cleanup process at the source. Gasoline eventually migrated into bedrock and emerged at Whatcom Creek up gradient of the burn areas. Other issues included the coordination with WDOE on possible penalty filing.

Emergency streambed restoration

An emergency restoration plan was developed and implemented by OPL to begin the habitat restoration of the 25 burned acres on Whatcom and Hannah creeks. The late August salmon runs set the plan timetable. Immediate concerns included secondary erosion and sedimentation. The UC served as the principle decision-making body. The JRC was comprised of local, tribal, state, and federal trustees with Western Washington University. The committee provided review and oversight of OPL's plan. Members of the JRC included City of Bellingham, WDNR, WDOE, and Washington Wildlife, Fish and Game (WWFG); National Marine Fisheries Service (FLAT), NOAA, USFWS, and EPA; and Lummi Nation and Nooksack Tribe.

By June 22, the emergency restoration plan was drafted. The plan identified source area assessment and remediation options. The options included excavation, extraction, and groundwater pump-and-treat remediation. Soil erosion and sedimentation plans identified creek areas impacted by the loss of vegetation. Hydraulic, physical erosion controls and operational controls were identified. In stream remediation, particularly streambed sediment, pore waters assessment and remediation was developed. Riparian habitats were evaluated and plans for re-vegetation were developed as well as selective removal of snags. Regarding recreational use, plans were developed for security as well as access routes for workers and future park users. An information management resource was planned for capturing baseline data.

The creeks were subdivided into six major areas and mapped as a joint city and WDNR effort with the use of WDNR's geographical positioning system. Surface water sample analyses showed up to 20,000 ug/L (ppb) gasoline in waters on June 11 and reduced to less than 1,000 ug/L by June 14. Freeze core sampling of sediments showed sheens to a depth of 1 foot below streambed surface and levels to 4,800,000 ug/L (ppb).

The Whatcom Creek canal enhancement was a high priority. To remove gasoline from the interstitial pores, sediment agitation was done manually by crews and mechanically by heavy equipment (track-hoes and spyder-hoe). Enhancement treatments of constructing pool/bar, step pool, woody debris, and bioengineered banks were accelerated so they could be done before the first salmon runs in late summer. Design details of stone size and wood debris placement were developed to match fish species. Revegetation of stream banks and upland areas was determined to be addressed in long-term restoration as seed banks within the soils were in place.

A crew of 75 local laborers was hired and hazardous materials trained. Silt fences were installed, and crews with float-a-pumps washed down the streambanks. Crews and heavy equipment were used to agitate creek bed sediments to release gasoline trapped in the sediments under the creeks. Figure 3 shows a crew washing the stream bank and streambed.

Figure 3. Float-a-pumps used low pressure to wash the banks and high pressure to spray streambeds.

Over several weeks, crews agitated the sediments by walking and jostling rocks with shovels and slam bars that released the gasoline from the sediments. After four manual-crew passes up and down the creeks, two track-hoes and a spyder-hoe worked the sediments and boulders to agitate sediments to depths of up to 2 feet below the creek bottom. During daily operations, the creek flow was reduced at the Whatcom Lake floodgates and following the daily sediment reworking, the creek level was raised 1–2 feet to flush Whatcom Creek for about 12 hours over night.

Source area cleanup: Hannah Highway or Hannah Creek

Hannah Creek was removed, including the creek bed and banks where gasoline saturated up to 5 feet into the banks. The creek was dammed and bypassed through a pump and an 8-inch PVC pipe to Whatcom creek. An excavator removed over 1,200 feet of the creek bed and banks. Sheen (gold pan) tests were used to determine the extent of contamination as the excavator removed the bed and banks. Gasoline penetrated into gravel stringers and bank mats up to five feet from the original creek side. Surveys prior to removal were used to resurvey back the elevations and locations of the creek. The creek was backfilled with glacial gravel tills. Trees, jute mats, gravel, and boulders were placed to groom the "Hannah Highway" back to Hannah Creek. Water was rerouted back into the creek prior to the winter flood level rain season. Hannah Creek is shown in Figure 4 in December 1999. The picture illustrates creek reconstruction with logs, jute, and gravel placed to restore fish habitat. Figure 5 shows a picture of Whatcom creek, also in December 1999, illustrating a pool reconstruction area.

Areas of contamination were delineated using surface soil samples, monitoring wells, and direct push sampling instruments (e.g., Geoprobe®) as shown in Figure 6. Excavation steps removed the majority of unburned gasoline. Soils were sampled

Figure 4. Hannah Creek, December 1999, shows creek reconstruction with logs, jute, and gravel placed to restore fish habitat.

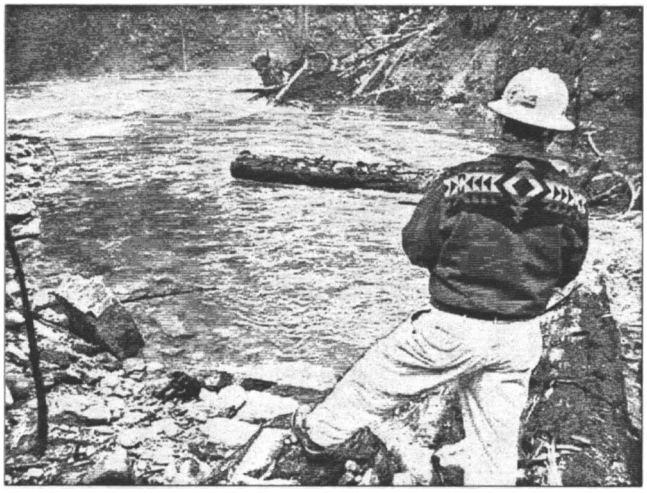

Figure 5. Whatcom Creek, December 1999, salmon habitat riffle and pool restoration including log and gravel placement.

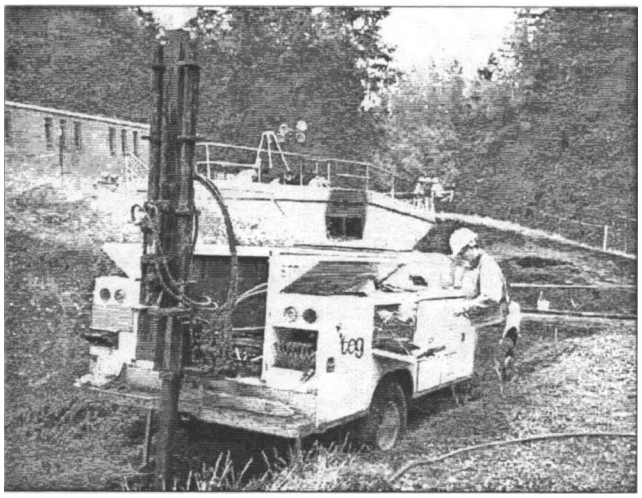

Figure 6. Extent of contamination was assessed with Geoprobe® and monitoring wells.

and trucked to Tacoma, Washington, where they were incinerated. Gasoline seeps became apparent north of the source area through the bedrock and skimmer operations were set up to manage the releases to Whatcom creek. Contaminated soils near the pipeline break were excavated and soils were incinerated off site. Over 9,500 cubic yards of contaminated soils were removed of which 2,000 yards were removed from the Hannah Creek, and 7,500 yards were removed from the pipeline rupture area and water pump vault area. The controlled density fill and gravel pack around the water pipes influenced subsurface gasoline movement.

A ground water interception and treatment system was used to address gasoline seeps that formed along the Whatcom Creek bank. Subsurface probes outlined a gasoline pocket that flowed from the rupture area through bedrock to Whatcom Creek.

A 450-foot horizontal boring was installed for an interception trench 25 feet below grade between the subsurface gasoline source area at the Dakin-Yew pump station vault and Whatcom Creek. Figure 7 is a map of the pipeline rupture location, and shows the location of the interception trench. This trench successfully intercepted the gasoline moving north through the shallow bedrock prior to entering Whatcom Creek where seeps had been observed in the first days of the incident. A pump and gasoline/water separation system was installed, which drew down the ground water and intercepted the gasoline that migrated toward Whatcom Creek. To address additional residual gasoline in surrounding areas that were not excavated, a vapor extraction system was designed and installed with a catalytic oxidation system. The system was completed under the emergency restoration plan, bypassing any potential permit delays related to construction, and began operation in November 1999. Future efforts will include the operation and maintenance of the systems for several years into the future until the site is remedied.

Conclusions

- Safety is the common objective for all. Empower safety officers.
- Meet partners across the aisle in government as well as industry and citizens' groups to build trust and a foundation for working under stress. Stress in the community and on the job should be anticipated. Manage for stress reduction. Practice UC.
- Use the National Contingency Plan roles and requirements to prepare for natural resource trustee integration, to distinguish cleanup roles from restoration roles, and furthermore to assure that public safety remains paramount. Differentiate local and state UC roles from local and state natural resource trustee roles.
- Plan for NTSB, OPS, state, local and other parties to participate in the investigations. Seek each other's expertise.
- Expect cleanup, investigation, trustee, private citizen, pipeline startup, and political issues to create competing agendas.
- Assure public right to know and honor the privacy act.
- Explore RRT activation.

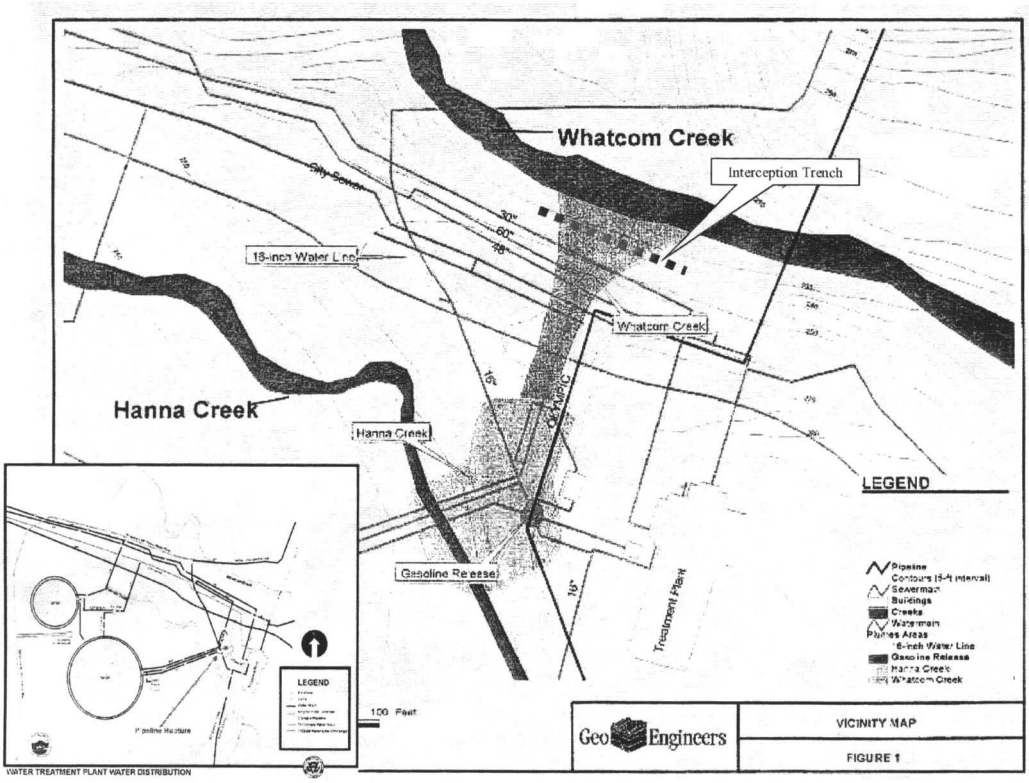

Figure 7. Pipeline rupture location at Dakin-Yew Water Treatment Plant, Bellingham, Washington.

Biography

Thor Cutler, an environmental scientist, holds a B.A. in Physics and Geology and a M.S. in Marine Geology and Geophysics. He has served over 10 years as a Federal On-Scene Coordinator and experience includes *Exxon Valdez*, Mississippi Floods of 1993, Boomsnub, and Palermo Well field. He has over 26 years diversified experience in emergency response, oil and chemical industry regulation, and the private oil industry.

Anthony L. Barber, an environmental engineer, joined the EPA in 1997. He has responded to over 100 petroleum, chemical, biological, and radioactive spills. He served 7 years in the U.S. Navy, and 2 years at Fred Hutchinson Cancer Research Center. He holds a B.S./BA in Chemical Engineering, Sociology, and History.