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T/B APEX 3508: Best Practices for Detection and Recovery of Sunken Oil

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In Memory: On November 22, 2016, with much regret, LCDR Greg Schweitzer (NOAA SSC) passed away unexpectedly. He was a substantial contributor to this paper and to the success of this case. For that, we owe him a debt of gratitude. He was an extraordinary professional, friend, father and spouse. This paper is dedicated to his memory and professional work. Farewell shipmate!

ABSTRACT

On September 2, 2015, two towing vessels collided on the Lower Mississippi River at Mile 937, near Columbus, Kentucky, resulting in the complete breach of the #3 starboard cargo tank on the *T/B APEX 3508* and the release of 120,588 gallons of clarified slurry oil (CSO; Group V oil; Specific Gravity: 1.14) into the navigable waterway. The incident was classified as a Major Inland Spill in accordance with the National Oil and Hazardous Substance Contingency Plan and a Major Marine Casualty that was jointly investigated by the United States Coast Guard and the National Transportation Safety Board. Over flights conducted as far as 20 miles downriver indicated only light, sporadic sheening for 1-2 days. On-water and shoreline assessments conducted up to six miles downriver revealed no visible signs of surface oiling. Based on its properties, the vast majority of the CSO was presumed to have sunk, but its precise disposition and location was not confirmed. Using side scan sonar (SSS) technology, two distinct subsurface anomalies with an approximate combined area of 9,200 m^2 were identified on the river bed in the vicinity of the incident. The anomalies were confirmed as oil by divers and direct sampling, and were then divided into 25 m grids for identification and tracking. The Unified Command evaluated best available technologies and determined that GPS guided environmental dredging would be the safest, most effective and efficient of the recovery options. The established cleanup endpoint was a maximum of 10% sporadic oil distribution in each grid. Two endangered mussel species were identified as potentially inhabiting the affected area. A diver survey was conducted in the area and concluded that bottom habitat was not likely to support the listed species. Further consultations with the resource manager indicated that proposed recovery operations posed low risk to the species. Recovery operations commenced on September 15, 2015 and concluded on September 25, 2015. Endpoint verification was conducted via SSS.

In total, response operations lasted 23 days (eight operational periods), involved over 120 responders and 75 specialized response assets, and cost approximately $5 million. Approximately 2,524 m^3 of dredged material (liquid and solids) were removed. After decanting, approximately 1,730 m^3 of oiled solids representing approximately 50 to 75% of the spilled product was recovered. This case serves as a benchmark for sunken oil detection and recovery operations, and identified many best practices that should be considered on future cases with similar spill conditions.

INCIDENT

On September 2, 2015, the uninspected towing vessel (UTV) *P.B. SHAH* was traveling upriver on the Lower Mississippi River pushing 24 barges (18 loaded and 6 empty) and the *UTV DEWEY R* was traveling downriver pushing four tank barges loaded with clarified slurry oil (CSO) in a 2x2 configuration. At 7:55 p.m., the *UTV P.B. SHAH* collided with the *UTV DEWEY R* at mile 937 near Columbus, Kentucky. This caused the

complete structural failure and breach of the #3 starboard cargo hold, located near the stern of the barge *T/B APEX 3508* (O.N. 567136) which was in the *UTV DEWEY R's* tow, and subsequent discharge of 120,588 gallons of CSO in the Mississippi River. Three other barges sustained minor damages, one in the *UTV DEWEY R's* tow (*T/B APEX 1703*) and the other two (*T/B ING 571 and T/B IB 1947*) in the tow belonging to the *UTV P.B. SHAH*. The damages sustained by the T/Bs *APEX 1703*, *ING 571* and the *IB 1947* required repairs and/or cleaning prior to returning to service; however, the only substantial pollution threat emanated from *T/B APEX 3508*. Following the collision, the master of the *UTV DEWEY R* pushed the *T/B APEX 3508* into the left descending bank (Kentucky side) where it came to rest.

In this location on the Lower Mississippi River, the jurisdiction is split down the middle of the river between the State of Missouri and Kentucky, as well as EPA Regions IV and VII. The Coast Guard assumed the role of the Federal On-Scene Coordinator to direct response efforts and the incident was managed using the Incident Command System. A Unified Command was established and consisted of representatives from the State of Kentucky, State of Missouri (initially, until their concerns were addressed and they requested to revoke their role as a member of the Unified Command and serve as a liaison), Coast Guard Marine Safety Unit Paducah and the Responsible Party. EPA Region IV and EPA Region VII, at the request of the Coast Guard, provided two On-Scene Coordinators as liaisons to the Unified Command.

INITIAL RESPONSE AND ASSESSMENTS

After receiving the initial notification of the incident, Coast Guard Marine Safety Unit Paducah dispatched teams to the scene to direct initial response efforts, conduct

damage assessments and commence the investigation (See Figure 1). Upon the Coast Guard's arrival on-scene on the night of September 2, 2015, the Oil Spill Removal Organization (OSRO) had boomed off the barge and placed absorbents pads within the breached cargo hold. Only light sheening was visible in vicinity of the cargo tank. The Responsible Party's Qualified Individual immediately arrived on-scene and activated the vessel response plan, including mobilization of their designated salvage company. The Coast Guard established a safety zone from mile 938-922, in effect closing the Mississippi River in the vicinity of the incident due to the uncertainty of oil migration and the possibility of the spread of oil via passing traffic.

Shortly before the damage assessment was completed at approximately 3:00 a.m. on September 3, 2015, the Coast Guard requested the mobilization of the National Oceanic Atmospheric Administration Scientific Support Coordinator (NOAA SSC), the Coast Guard Gulf Strike Team, the Coast Guard Public Information Assist Team and the Incident Management Assist Team. Although the Regional Response Teams (IV and VII) were not formally activated, they were consulted periodically by the Unified Command, the NOAA SSC and Eighth Coast Guard District Incident Management Preparedness Advisor (RRT Co-Chair) throughout the incident response.

On the morning of September 3, 2015, as part of the Initial Response Phase, on-water and shoreline assessments were conducted ten miles downriver. The initial assessments indicated no significant presence of oil on the surface, nor on or near the adjoining shorelines. Two over flights were conducted at first light from the incident location to 20 miles downriver. Both over flights revealed light on-water sheening in isolated locations and no signs of shoreline impacts. These assessments continued

throughout the incident with no change in results with the exception of the sheen being no longer visible beyond one to two days after the incident.

By the end of September 3, 2015, the Incident Command Post was established at the Paducah Convention Center (approximately 1-hour from the incident site), and the Unified Command and the Incident Management Team had completed the planning process promulgating the first Incident Action Plan for an operational period commencing on September 4, 2015. At this point, while the oil had yet to be detected, all requests for resources, including Salvors (T&T Salvage), NOAA SSC, RP's Spill Management Team (Witt O'Briens), Strike Team, had arrived and commenced operations. The Unified Command established the staging area at the Clermont-Belmont State Park, Kentucky, 0.5 miles downriver from the incident location.

Figure 1: *T/B APEX 3508* Damage (Courtesy of the U.S. Coast Guard)

PRODUCT CHARACTERISTICS

CSO is a heavy oil by-product of petroleum refineries. The safety data sheet (SDS) indicated the CSO has a specific gravity of ~1.1 and a relatively high viscosity

(often heated to ~49°C or higher for pumping). Oils of this type are typically classified as Group V Oils which are known to sink in freshwater.

Based on tailgate tests by the NOAA SSC conducted on September 4, 2015, a heated sample and representative sample of river water indicated the product likely sank (See Figure 2). Slow shaking of the sample also suggested the CSO remained a cohesive mass as opposed to breaking into smaller droplets in the weak river currents present during the incident. Finally, an adhesion tailgate test showed CSO affinity for oleophilic snare. Tailgate tests (See Figure 2) were invaluable to the sunken oil workgroup in choosing future sunken oil detection and recovery techniques (Schweitzer et al., 2016).

Laboratories at Louisiana State University (LSU), the Emergencies Science and Technology Section (ESTS) of Environment Canada, and University of New Hampshire (UNH) provided laboratory analysis support. LSU and ESTS provided oil characterization analysis while UNH conducted flume studies of oil mobilization.

Working closely with the NOAA Scientific Support Team (SST), the NOAA SSC shared the following results with Unified Command and the Environmental Unit:

> Analytical results indicated a specific gravity 1.14 (API of -7.4), viscosity of 1.0x10^5 cSt (very close to that of sour cream) and pour point was measured at 10-15°C. A flat bottom Mylar grid flume test (water and oil temp 30°C, water velocity .5 m/s) demonstrated an impressive elasticity with CSO lengthening 730% in the direction of the flow at one 1 hour with many erosions occurring. This test suggested that downstream migration was likely; however, the frictional effect of bottom sediment and sand wave formations on migration was unknown.

Full analytical characterization was available and more detailed, but consistent with tailgate test observations. (Schweitzer et al., 2016)

Figure 2: Tailgate Test Photo (Courtesy of NOAA)

DETECTION

From the on-set, the NOAA SSC and a robust Environmental Unit consisting of specialists in the field of sunken oil (i.e., Polaris Applied Science, NOAA Sunken Oil Workgroup, and Qualitech Inc.), were engaged reviewing case histories and field assessment reports on the best techniques for detection, delineation and then recovery. Additionally, specialists had access to a draft copy of the API Sunken Oil Detection and Recovery Operational Guide[1], which was used to evaluate response tactic effectiveness from previous CSO spills given their environmental conditions and limitations compared to this incident. This research and evaluation was critical in determining the preferred detection and recovery approach approved by the Unified Command. Based on delays in arrival of passive bottom snare detection technology on September 4, 2015, the Unified Command, following recommendations from NOAA SSC, employed low resolution side

[1] American Petroleum Institute. 2016. *Sunken Oil Detection and Recovery Operational Guide* (API Technical Report 1154-2, First Edition, February 2016). Washington, DC: API Publishing Services. Available at: http://www.oilspillprevention.org/oil-spill-research-and-development-cente

scan sonar (SSS), provided by local municipalities beginning on the morning of September 4, 2015. These preliminary SSS were conducted in the area of the barge collision and up to 10 km downstream of the incident and continued September 5 to 7, 2015. Preliminary SSS surveys indicated the presence of low-reflectivity sonar anomalies on the river bottom and were the first indication in this incident that the release could be submerged, present in the vicinity of the release and detectable by SSS (See Figure 3). Anomalies were discovered using SSS in two locations.

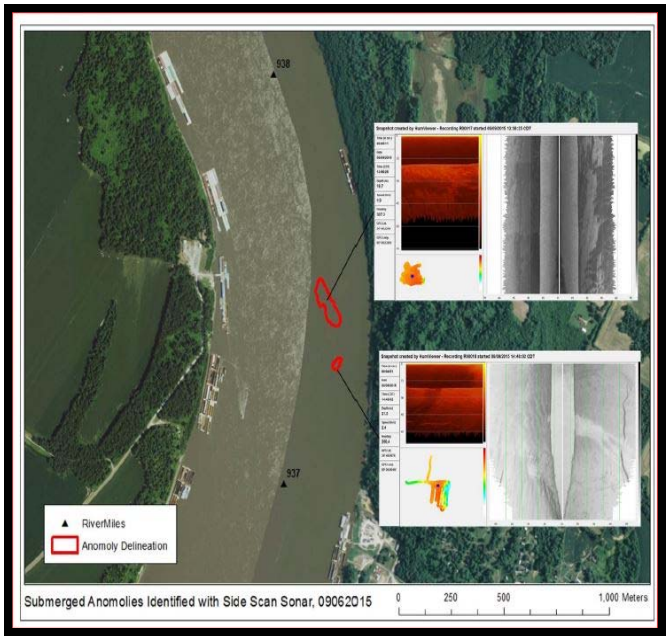


Figure 3: Initial Side Scan Results (Courtesy of Polaris)

Additional high resolution SSS surveys were conducted September 5 to 7, 2015 with a 455/800 kHz dual-frequency unit installed on a commercial survey vessel (Mainstream Commercial Diving). Results were viewed and interpreted in real time using a heads-up display. The 800 kHz imagery was exceptionally grainy, therefore the surveyor operated successfully in 455 kHz mode for the remainder of the surveys.

Low-reflectivity acoustic anomalies were confirmed using the high resolution SSS; the northern anomaly (originally measured at 5,570 m^2 but revised to 7,850 m^2

following downriver migration as measured on September 20, 2015) stretched ~305 m southeastward from the collision area to the barge holding location and the ~198 m southern anomaly (1,350 m^2) where the barge came to rest and is thought to have discharged additional oil before salvage operations commenced. (See Figure 3). Post-acquisition, SSS imagery was integrated into a geographic information system (GIS).

Multiple lines of evidence were utilized to truth the acoustic anomalies from the initial high resolution SSS surveys. GIS was a critical tool for providing precise spatial information to field responders attempting to locate the anomalies. First, divers conducting freshwater mussel habitat surveys encountered sunken oil, providing validation the anomalies were in fact sunken oil. Next, a ponar sediment grab on September 7, 2015 contained 100 percent oil at the center of the northern anomaly. Weighted oleophilic snares were also dropped on September 8, 2015 at several locations chosen from the SSS imagery. This sampling confirmed an accumulation of sunken oil at multiple locations. Divers provided additional details regarding visibility, current, substrate, and active sediment transport. Interpretation of these multiple lines of evidence suggested sunken oil pooled in between riverbed sand waves, with thinner accumulations possibly being remobilized by river bottom currents.

As agreed upon by members of the Unified Command and Environmental Unit: The preliminary SSS surveys were extremely useful for reconnaissance, but they also presented significant limitations in terms of navigation precision, image resolution, and proprietary data formats. Therefore, a commercial hydrographic surveyor was contracted to produce precisely navigated, motion-corrected bathymetric and acoustic data of the area. Bathymetric data were acquired with a

200 kHz singlebeam echosounder (SBES); acoustic imagery was acquired with a Klein 3900 dual frequency SSS, operated in 445 kHz mode (See Figure 4).The resulting bathymetric maps had a horizontal resolution of .3m, enabling complete interpretation of SSS imagery and precise delineation of the sunken oil on the riverbed. These datasets were used as the basemap for planning recovery operations. (Schweitzer, et. al, 2016)

Figure 4: Grid Overlay (Courtesy of Polaris)

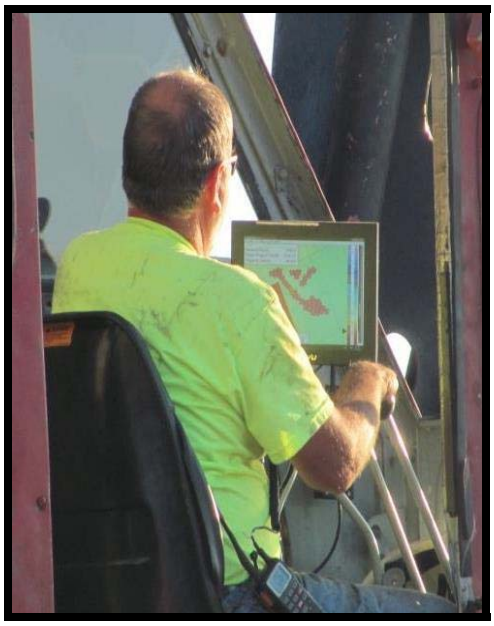
RECOVERY

After considering responder safety, operating environment (Average 19 meters depth, 2 mph current and 0 visibility), case history, the draft API field guide and consultation amongst sunken oil specialists, the Unified Command ultimately decided on environmental clam shell dredging as the preferred recovery tactic. The designated salvage company (T &T) was best positioned with expertise and resources to implement recovery efforts. An environmental clam shell was deployed on a spud barge with a four-point mooring system. The environmental clam shell used was manufactured and operated by CableArm. The design of the clam shell utilizes vents to reduce the amount

of water collected per grab while preventing the loss of recovered material. Additionally, the clam shell used ClamVision proprietary software which employed six GPS transponders on the bucket head, providing real-time imagery to the crane operator tracking recovery progress (See Figures 5 and 6).

Since the environmental clam shell (mechanical recovery) is classified as dredging, the U.S. Army Corp of Engineers had to grant approval. A preliminary jurisdiction determination (PJD) was made that a Clean Water Act Section 404 permit was required for the work. The project met the criteria of a Nationwide Permit (NWP) 38 (Cleanup of Hazardous and Toxic Waste) and it was granted on September 9, 2015, provided certain conditions were met. One condition was a Section 401 Water Quality Certification or waiver from the state's certifying agency must be provided. Since the operation was being conducted exclusively in Kentucky's jurisdiction, Kentucky waived the right to issue a Section 401 Water Quality Certification on September 10, 2015. The recovery operations commenced on September 15, 2015 and concluded on September 25, 2015.

During recovery operations, over 250 water samples were taken in accordance with the approved Environmental Sampling and Analysis Plan (approved on September 15, 2015). Samples were taken at various depths and locations, primarily downriver of the incident site. Overall, only trace levels of oil were identified in less than 10 samples.



Figures 5: ClamVision (U.S. Coast Guard)

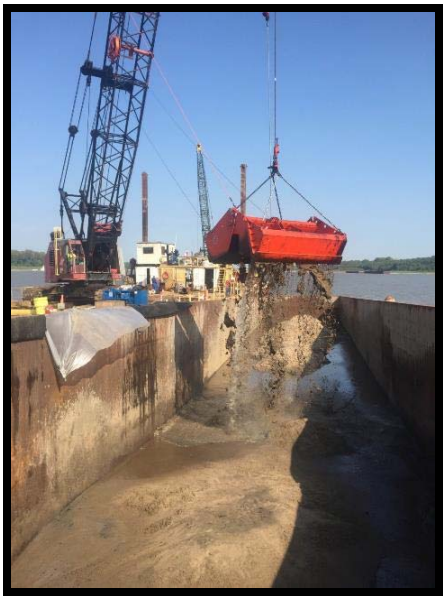


Figure 6: Environmental Clam Shell (U.S. Coast Guard)

ENDPOINT VALIDATION

Commercial hydrographic survey and Klein 3900 dual frequency SSS imagery conducted on September 7, 2015, were used to generate a baseline map for post recovery validation of cleanup endpoints. The approved Endpoint Plan called for no more than

sporadic distribution (less than equal to 10%) detectable sunken oil in each defined 25 m x 25 m operations grid (See Figure 4). This endpoint was chosen in consultation with resource trustees and in careful consideration of the detection limits of the SSS and the pixel resolution of the side scan backscatter imagery, and to bridge the gap between the ability of the side scan to theoretically detect 10 cm x 10 cm area of sunken oil and the abilities/resources of the recovery efforts (i.e. “chasing droplets downriver”).

RESOURCES AT RISK

Prior to commencement of recovery operations and in order to meet the statutory obligations under Section 7 of the Endangered Species Act (ESA) and Section 106 of the National Historic Preservation Act (NHPA), as well as the requirements of the Native American Graves Protection and Repatriation Act and the Archeological Resources Protection Act, consultations were initiated and communication with respective trustees were maintained throughout the incident as appropriate.

U.S. Fish and Wildlife Service (USFWS) identified two ESA listed freshwater mussels, commonly referred to as the Fat Pocketbook (*Potamilus capax*) and Pink Mucket (*Lampsilis orbiculata*), at greatest potential risk within the action area. USFWS requested a species and habitat survey of the area prior to commencement of recovery operations. A dedicated dive survey for freshwater mussels and habitat determined no mussels present and an unsuitable substrate which was not preferred habitat for native freshwater mussels. The USFWS concluded that future remobilization of sunken oil into sensitive habitats downstream was likely during high flow events. USFWS concurred that 100% recovery was not likely; however, sunken oil removal to less than equal to 10%

would greatly reduce the risk for future potential adverse effects to listed and sensitive species downstream.

The Bureau of Indian Affairs concluded no impact to the trust resources within the action area. Referencing Section 106 of the NHPA, the State of Kentucky Heritage Council and State Historic Preservation Office (SHPO) initially indicated potential for impacts to trust resources, however once the action area was refined to on-water activities to remove sunken oil, they concluded that recovery actions were not likely to impact historic and archeological resources. Based on the responder's proactive measures and careful observations, there were no reported or discovered impacts to any resources at risk during the recovery operations.

SALVAGE

On September 6, 2015, T & T Salvage lightered the remaining cargo on the *T/B APEX 3508* to a receiving barge and dewatered the affected tank and voids into intact onboard tanks. The operation required heating the cargo to 120 degrees F to complete the transfer. The transfer lasted approximately 12 hours to remove approximately 16,000 bbl. Salvage efforts then increased the vessel's freeboard at the breach in the cargo tank by installing wood planking and covering. The barge left the incident site on September 10, 2015, and traveled safely to a suitable location for cleaning and permanent repairs. Following the successful salvage of the barge, T&T Salvage was selected to manage the tactical sunken oil recovery response operation.

IMPACTS TO THE MARITIME TRANSPORTATION SYSTEM

The Mississippi River remained closed to vessel traffic near the incident from September 2, 2015, until a determination was made on the probable location of the oil

and the possible disturbance of oil from passing traffic. The closure of such a vital economic artery required an expedient location of the oil and a thorough environmental risk assessment prior to reopening. The Unified Command established a Marine Transportation System (MTS) Recovery Unit (MTSRU) with participation from industry. This served as a best practice for tracking vessel queues, communicating status updates, developing traffic management protocols, and served as a conduit to industry special interest groups. On the evening of September 4, 2015 (48 hours after the closure), the Unified Command, based on a "tail gate" test of the product by NOAA SSC and members of the Environmental Unit to determine oil fate in the water column, and following the location of two anomalies identified by low resolution SSS which presumed to be the product (outside of the main traffic channel), reopened the waterway to vessel traffic. In 36 hours, a vessel queue of 79 vessels was cleared, resuming the flow of commerce in the areas with continued safety notifications to passing vessels regarding the hazards associated with incident response efforts in the vicinity.

DECANTING

The recovered oily water and sediment was deposited by environmental clam shell into four open hopper receiver barges. After the Unified Command's approval of the Contact Water Plan (consistent with the RRT IV Contact Water and Disposal Policy) and upon receiving a Discharge Permit from Kentucky, decanting operations proceeded to remove excess water from each barge. The decanted water was processed through an on-site filtration system to remove visual oil sheen and oil droplets prior to discharge. The filtration consisted of a controlled flow submersible hydraulic pump lowered into decanted water to direct water thought a water filtration container (See Figure 7). The

returned water was visibly and laboratory tested to be free of oily residue. In total, 36,500 gallons of water was decanted. The remaining oily sediment was offloaded from the barges and transported via truck into a state landfill in accordance with state and federal law. The four barges were cleaned and returned to service.

Figure 7: Decanting (Courtesy of NOAA)

RECOVERY ESTIMATIONS

Position and volume estimate data for the environmental clam shell operation was collected throughout recovery operations. Clam shell dredge volume was based on the capacity of the clam shell (3.4 m x 3.7 m) with the predetermined target depth of 15 cm for an average of 1.87 m^3 of material per clamshell cycle. Thus, recovery volumes were estimated as follows:

# of clam shell cycles X 1.87 cubic meters = total cubic meters of recovered dredge spoils

As concluded by the NOAA SSC in the final recovery estimate calculation:

> According to this calculation 2,524 m^3 of oil and sediment were recovered. This calculation does not account for or attempt to quantify the amount of oil recovered and is based on a rough estimate of the percentage of water in each clamshell. Based on periodic observations from the

Environmental Unit, oil amounts in clam shells varied from a trace or 1-2% to as much as 20-30%. One difficulty in observation was determining the relative amount of oil that may have been mixed into the sediment or separated into smaller droplets as a result of the splashing and mixing that occurred while emptying the clam shell into the receiving barge. Thus, a calculation of recovered oil based on these values would likely be a very rough estimation at best.

In an attempt to better quantify the amount of recovered oil, operations performed an assessment of barges after most of the water was decanted and the barges were undisturbed for several days allowing most of the oil to resettle to the bottom. The average depth of spoils was estimated based on the known depth of the barge. From these estimates, a total revised estimate of 1,730 m^3 was calculated.

Based on a visual assessment of these barges post decanting, the relative amount of oil was estimated to be between 10 and 20%. A very rough estimation of recovered oil based on these values would equal approximately 172,615- 345,608 liters, or about 38-76% of the total discharge volume of 2,870 bbls (456,475 liters). This would not account for any oil in the water fraction that was removed during decanting. Another means of estimating the amount of oil recovered could be based on the data derived from the SSS. Table 1 gives a range of oil volumes based on different presumed average thicknesses for the total area identified by the September 20th SSS. According to Table 1, the average

thickness of the oil throughout the area identified by the sonar survey would need to have been in the 4-5 cm (~1.5-2 inches) range to account for the total amount of oil discharged (456,475 liters). In addition, the average oil thickness could not have exceeded about 5 cm (~2 inches) without exceeding the total amount of oil discharged. A ponar sample was collected from the center of the northern anomaly early on in the incident and revealed that oil thickness was at least 15 cm. However, in some instances where thick oil was encountered during removal operations, a second, deeper cut beyond the nominal 15 cm clamshell recovery depth was taken. There were only a few operational grids where very thick oil was observed in clam shell recovery. (Schweitzer et al., 2016)

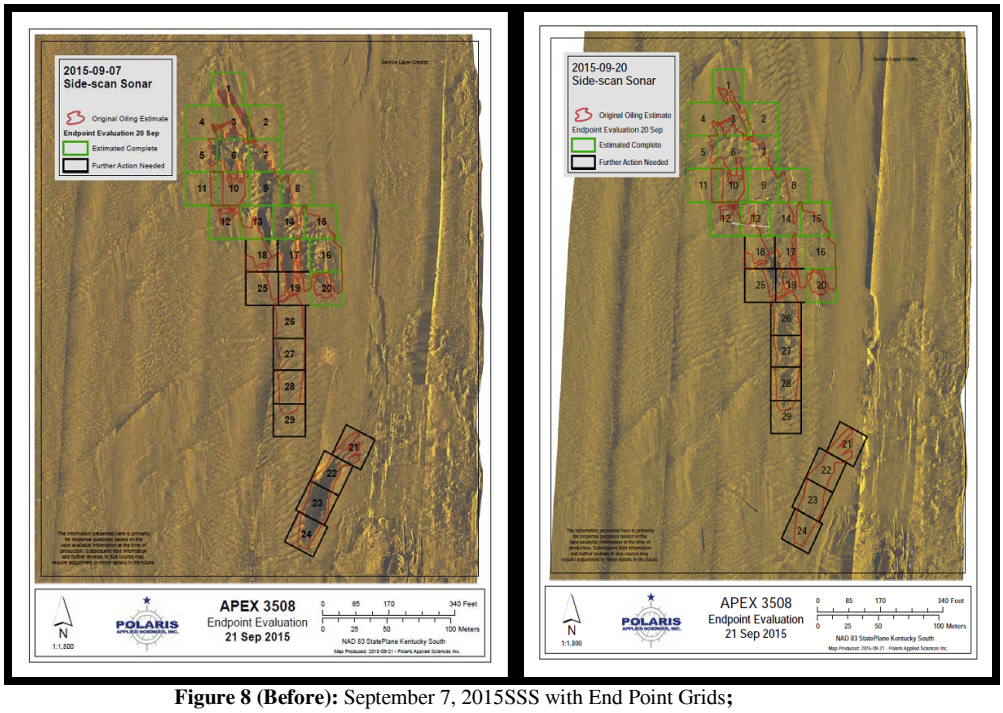


Figure 8 (Before): September 7, 2015SSS with End Point Grids**;**

Figure 9: September 20, 2015 SSS Showing Depicting Recovery Progress and Dowriver Migration (Grids 26-29); (Courtesy of Polaris)

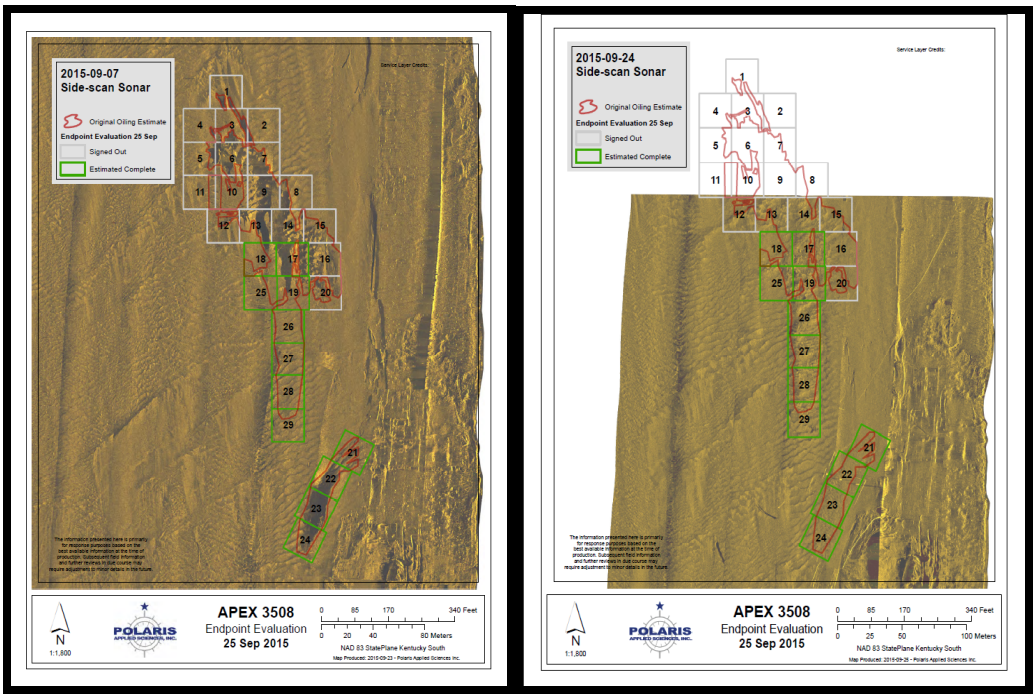


Figure 10 (After): Endpoint Validation on September 25, 2015 Depicting Grids Signed Off**; Figure 11:** Final Grids Endpoint Validation Depicting All Grids Complete. (Courtesy of Polaris)

LESSONS LEARNED AND BEST PRACTICES

There were a multitude of lessons learned and best practices as a result of the incident. Table 1 captures the most valuable items that should be considered for similar incidents.

Table 1: Lessons Learned and Best Practices

Lesson Learned/Best Practice	Description
Value of the Salvage and Marine Firefighting Regulations	**The establishment of the SMFF regulations which required identification of a salvage company with specialized salvage and lightering expertise proved significant in expediting review and approval of barge repairs, and the commencement of salvage and lightering operations. The plans submitted were detailed and provided necessary information for the Coast Guard's Salvage Engineering Response Team (SERT) analysis and to mitigate risk suitable for the Unified Command. Additionally, although OSROs are well versed and skilled in on-water oil spill containment and recovery, the designated salvor was better positioned with greater breadth of expertise for allocating resources and implementing/managing tactics for sunken oil recovery. As a direct result from the feedback of this case, the Coast Guard revised the OSRO Guidelines on March 31, 2016 to include a "Non-Floating Oils" classification. Plan holders can now easily identify a classified OSRO specifically capable of responding to non-floating oil incidents.**
API Sunken Oil Detection and Recovery Operations	**The draft API guidance was a valuable tool in evaluating different detection and recovery operations. Also, this incident was valuable in**

Guide	**expanding and validating the guidance before publication.**
Common Operating Picture Software	**Environmental Resource Mapping Application (ERMA) is consistently used by NOAA and the EPA. It was determined that USCG should consider adopting ERMA as enterprise common operational picture (COP) system. In 2016, Coast Guard adopted ERMA as the universal COP system and NOAA SSC's began training Coast Guard personnel.**
ICS Enterprise System	**ICS Enterprise software system needs to be implemented. The RP's SMT used an ICS Command Pro software that saved tremendous time in IAP development. The U.S. Coast Guard has since adopted an ICS Enterprise System.**
Robust Environmental Unit	**A robust Environmental Unit was essential for this incident due to the complexities of the environment and the characteristics of the slurry oil in water.**
NOAA SSC	**NOAA SSCs and their support personnel were invaluable to the incident. The SSC effectively managed the natural resource trustee consultation process, and environmental plan development and approval. Additionally, the SSC served as wealth of information and valued asset to the Unified Command.**
Marine Transportation System Recovery Unit (MTSRU)	**Appointing an industry representative as MTSRU Leader to develop traffic management protocols, track vessel ques, and manage traffic once waterway was opened with restrictions proved to be of great value to the operation. Within 48-hrs of opening the waterway, 79 vessels were cleared eliminating the queue. Also, having an industry representative MTSRU Leader created an ideal conduit of information from the IC to the industry in addressing their concerns and providing updates before and after the waterway was opened. Two Coast Guard members were also assigned to the MTSRU and responsible for updating the Common Assessment and Recovery Tool (CART) and proactively providing information to the Situation Unit Leader.**
Sunken Oil Detection/Recovery Resources	**Identifying Group V detection and recovery resource assets in the area or via OSRO/SMFF is necessary to reduce delays in detecting and recovering oil. Additionally, a comprehensive list of specialized Group V technology resources, VRP recognized Salvage and Marinefighting Service Providers, and OSROs capable of responding to non-floating oil incidents should be highlighted in Area Contingency Plans.**
Local Area Contingency Plan Development	**EPA has created various sub-area plans for the Inland zone; however, there is a gap in contingency planning in high-risk, trafficked areas. An Area Contingency Plan or similar document is needed locally with contacts, ESI maps, salvage resources, equipment, etc. The Coast Guard, EPA Region IV, V & VII, ORSANCO and state entities have created a Great Rivers Spill Coordination Group to build a Great Rivers Spill Coordination Plan which will include at least three tactical response plans.**
Specialized Teams	**The Coast Guard Incident Management Assist Team (IMAT), Sunken Oil Workgroup, SERT, Strike Team and other specialized teams integrated exceptionally well. These teams brought great breadth of expertise, particularly in critical Incident Command positions. The effective management of the response was attributed in part to the expertise of these specialized teams.**
Stakeholder Interaction	**There was overwhelming support from all levels of government to support incident management and risk assessments. Furthermore, the Unified Command was truly unified in decision making and messaging.**

CONCLUSION

Upon validating that all endpoints were reached in accordance with the approved Endpoint Validation Plan, the Unified Command concluded all response operations in a final decision memo on September 25, 2015. The 23-day response effort involved 8 operational periods (Incident Action Plans), over 120 responders and technical specialists, 70 items of specialized response equipment, and cost roughly $5 million. In total, 1,730 m^3 (~3,392 tons) of oily sediment was recovered with an estimated product recovery rate of 75% (See Table 2 for Incident Summary). One could conclude that if the product was detected within the technical specifications of the side scan sonar, most, if not all, product was successfully recovered. This case serves as an example for a successful outcome in the deployment of detection and recovery techniques on sunken oil.

Table 2: Incident Summary

Incident Summary (Type II) **Unified Command included:** **FOSC – CDR Mark Sawyer – MSU Paducah** **RPIC – Inland Marine Services** **SOSC– KY Dept. of Environmental Protection**		
Number of OPS period: 8 **Number of days** : 23 **2 SEP 15 – 25 SEP 15** **River Closure: 18 miles (48 hours)**	**Total Personnel Responded :** 120+ Including USCG (IMAT/NSF), NOAA, EPA,OSRO- SWS, T&T	**Total Equipment Responded :**65 + Including various barges and tug boats, 18ft-25ft response boats, dive boats, aircraft and cranes
Oil Released: 120,588 gallons Experts believe majority of product was confined in two anomalies near incident location	**Type of product**: Clarified Slurry Oil, Group V Residual Fuels Oils (GPVFRO) referred to by industry as LAPIO (Low API Oils)	**Resources at risk**: 2 (USFWS) ESA listed freshwater mussels
Detection: Combination of low resolution and high resolution side scan sonar, along with overflight and dive ops were used.	**Recovery**: Combination of Cable Arm Environmental Bucket with ClamVision dredge positioning system, Vessel Submerged Oil Recovery System (VSORS) and decanting–water polishing processes were used.	**Oily sediment/ water recovered** : 2,524 m^3 (~3,301 Cubic Yards) (~4,667 tons) **Oily sediment recovered (after decanting):** 1,728 m^3 (~2,261 Cubic Yards) (~3,392 tons)
Number of water & sediment samples : 220 **Number of samples positive for oil** : 5	**Outcome After Recovery**: Both Anomalies were determined to have no more than 10% sporadic oil distribution within each 25 meter by 25 meter grid on 25 SEP 15.	**FPN 15050 – Ceiling: $300 K** Costs as of 30 SEP 15: Indirect $281,437 - Direct $193,308 Total $474,745 RP- Actual Cost: $5 million

References:

Schweitzer, G, McClinton, T, Michel, J., Thom, B., Davis, A, Mauseth, G, Scott, T, Sawyer, M, and Elliott, J. 2016. Response to the T/B Apex 3508: A Successful Case History for Detection and Recovery of Sunken Oil. Proceedings of the 39th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar on Contamination and Response (yet to be released). Environment Canada. Halifax, Nova Scotia.