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# FINAL TECHNICAL MEMORANDUM REGARDING VARIANCES FROM PLANNED APPROACH TO REMEDIAL SYSTEMS OPERATION AND MAINTENANCE OF RE-INJECTION SITE 12 NAB LITTLE CREEK VA

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# Variances from Planned Approach, Remedial System Operation and Maintenance Re-Injection, Site 12, Joint Expeditionary Base (JEB) Little Creek – Fort Story, JEB Little Creek, Virginia Beach, Virginia

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## Background

Site 12 includes a chlorinated volatile organic compound (VOC) groundwater plume associated with the Navy Exchange Laundry/Dry Cleaning Facility located in former Building 3323, adjacent to the intersection of Amphibious Drive and B Street, in the eastern portion of JEB Little Creek (Figure 1). Investigations were conducted at Site 12 to evaluate the extent to which media at the site was impacted from past waste disposal practices. Based on the investigations, contamination was determined to be limited to chlorinated VOCs in the Columbia (surficial) aquifer. A risk assessment identified potential unacceptable risks to future and adult and child residents (CH2M HILL, 2005a). Therefore, an FS and FS addendum were completed in 2004 to evaluate remedial action (RA) alternatives to address chlorinated VOCs in groundwater at Site 12. A Proposed Remedial Action Plan (PRAP) was completed in May 2005 (Navy, 2005a) and a Record of Decision (ROD) was signed in September 2005 (Navy, 2005b) to document the Selected Remedy for contaminants of concern (COCs) in groundwater. The Selected Remedy documented in the ROD consisted of *in situ* chemical oxidation (ISCO) followed by enhanced reductive dechlorination (ERD) to treat chlorinated VOCs in groundwater; groundwater monitoring to assess remedy effectiveness; and land use controls (LUCs) to prevent exposure to chlorinated VOCs in groundwater. Following signature of the ROD (Navy, 2005b), additional site data were collected to determine the mass of oxidant required to implement the ISCO component of the remedy. Based on the results of the data, the calculated mass of oxidant was much more substantial than the mass estimated in the ROD. Moreover, the calculated mass of the selected oxidant had the potential to increase the metals concentrations in groundwater to levels exceeding the Safe Drinking Water Act maximum contaminant levels (MCLs). Consequently, the ISCO component was eliminated from the remedy and an Explanation of Significant Difference (ESD) was signed in October 2006 to document the change. Based on the ESD, the Selected Remedy for Site 12 is ERD, groundwater monitoring, and LUCs (Navy, 2006). Risks to the construction worker were also evaluated after the ROD was finalized. Unacceptable risks were identified and the JEB Little Creek Partnering Team agreed to add LUCs to prevent exposure.

Initial remedy construction/implementation was completed in 2009. This initial phase of implementation included two rounds of substrate injection to facilitate ERD of chlorinated VOCs. Long-term monitoring (LTM) at Site 12 began in March 2011. Results of the initial LTM event indicated a third round of injections was needed to maintain remedy performance. Consequently, an additional injection round was planned under Navy CLEAN Contract N62470-08-D-1000 Contract Task Order 0066. The injection approach for the third round of treatment was approved by the JEB Little Creek Partnering Team and is documented in *Project Instructions for Remedial System Operation and Maintenance Re-Injection, Site 12, JEB Little Creek, Virginia Beach, Virginia* (CH2M HILL, August 2011). However, during implementation, the field team encountered conditions that were not favorable for reinjection in accordance with the August 2011 project instructions. Consequently, several variances were proposed to the Partnering Team and the field approach was modified to be more achievable. This technical memorandum summarizes those variances and potential impacts to the effectiveness of the remedy.

# Injection Approach and Variances

The injection approach for the third round of treatment at Site 12 included in the project instructions specified injection of Lactoil into five shallow (I17S, I23S, I24S, I25S, and I26S) and seven deep (I17D, I18D, I23D, I24D, I25D, I26D, and I27D) injection wells and injection of SRS-Buffered (SRS-B) into four deep (101D, 102D, 103D and 104D) injection wells. Well locations are shown on Figure 1. Dosing specifications were included in Attachment C of the project instructions. For wells designated for Lactoil injection, a 77-gallon mixture of Accelerite, sodium bicarbonate buffer, and Lactoil was to be injected with water at a ratio of 60:1 water to substrate. The total volume of injectate specified for each well was 4,700 gallons. For the wells designated for SRS injection, 123 gallons of SRS-B was to be mixed with water at a ratio of 37:1 water to substrate. The total volume specified for each well was 4,700 gallons. Injections were completed into eight wells simultaneously through two Dosatron systems injecting into four wells each. Flow meters recorded the flow of substrate into each well.

Injections were initiated on August 25th and were completed by September 2, 2011. Hurricane Irene passed through the area on August 27th. Prior to Hurricane Irene, all SRS-B injections into wells I01D, I02D, I03D, and I04D occurred as specified in the project instructions, with slightly more than the designed volume of injectate placed in each well to utilize excess injectate delivered to the site. Following Hurricane Irene, the groundwater table was significantly elevated at the time of the injections. Lactoil injections into wells I17S, I17D, I24S, I24D, I25S occurred as specified in the project instructions; however, daylighting was observed during injection into wells I18D, I23S, I23D, I25D, I26S, I26D, and I27D. Following the observation of daylighting, the JEB Little Creek Partnering Team was notified via email and modifications to the original design were proposed. While USEPA could not be reached to agree to the modified approach during the time that the field team was mobilized, VDEQ was able to provide approval for the revised approach via email dated September 2, 2011. Subsequent to VDEQ's approval, USEPA reviewed the design modifications and concurred with VDEQs decision. Per the modified approach, the dosing ratio for the Lactoil was reduced to 30:1 with a total target volume of injectate of 2,350 gallons, and attempts were made to inject the remaining substrate into each well. With this design modification, injections were successfully completed into I18D, I25D, and I27D. However, the total volumes (including chase water) injected into I23S, I26S, and I26D were only 53, 98 and 1,191 gallons, respectively. The field team reduced the flow rate as low as possible during injection into these wells (near 2 gallons per minute for each well), but was unable to add volume without causing daylighting. Consequently, injections into these wells were discontinued and the remaining injection volume was injected into wells I18D, I24S, I25S, I25D, and I27D. Volumes injected into each well, flow rates, and total substrate volumes are shown on Table 1.

# Conclusions

As a result of daylighting, designed quantities of Lactoil substrate could not be injected into I23S, I26S, and I26D during the reinjection at JEB Little Creek, Site 12. Excess volume from these locations was injected into locations in the vicinity of these points. While this may impact the treatment efficacy in the vicinity of the MW02 monitoring well cluster at the site, which is a higher concentration area, it is believed that increased dosing in other areas upgradient of this area will allow for treatment of this area through advective transport of substrate.

# References

CH2M HILL, 2004. *Revised Final Feasibility Study, Site 12, NAB Little Creek, Virginia Beach, Virginia*

CH2M HILL, 2005a. *Final Supplemental Remedial Investigation, Site 12, NAB Little Creek, Virginia Beach, Virginia*

Navy, 2005a. *Proposed Remedial Action Plan, Site 12, Former Exchange Laundry/Dry Cleaning Facility, NAB Little Creek, Virginia Beach, Virginia*

Navy 2005b. *Record of Decision, Site 12, Former Exchange Laundry/Dry Cleaning Facility, NAB Little Creek, Virginia Beach, Virginia*

TABLE 1
Summary of Injection Substrates
Site 12 Reinjection
*JEB Little Creek, Virginia Beach, Virginia*

**JEB Little Creek Site 12 (Downgradient) SRS Injection**

| | Well ID | Date of Injection | Total Fluids Volume Injected Including Chase | Total Fluids Volume Injected Without Chase | *Target Volume (Total Fluids)* | *UndilutedSubstrate Volume* | Difference between designed and actual volume | Average Flow Rate | Comments/Path Forward |
|---|---|---|---|---|---|---|---|---|---|
| Downgradient Injection Wells [4 wells] | I01D | 8/25/2011 | 5,270 | 5,210 | *4,700* | *124* | 510 | 6.56 | Extra injectate added to use excess delivered to site. |
| | I02D | 8/25/2011 | 5,265 | 5,195 | *4,700* | *124* | 495 | 6.42 | Extra injectate added to use excess delivered to site. |
| | I03D | 8/25/2011 | 5,194 | 5,124 | *4,700* | *124* | 424 | 6.50 | Extra injectate added to use excess delivered to site. |
| | I04D | 8/25/2011 | 5,194 | 5,124 | *4,700* | *124* | 424 | 6.56 | Extra injectate added to use excess delivered to site. |
| | Totals | | 20,923 | 20,653 | *18,800* | *496* | 1,853 | 6.51 | |

**JEB Little Creek Site 12 (Source Area) LactOil Injection**

| | Well ID | Date of Injection | Total Fluids Volume Injected Including Chase | Total Fluids Volume Injected Without Chase | *Target Volume (Total Fluids)* | *Undiluted Substrate Volume* | Difference between designed and actual volume | Average Flow Rate | Comments/Path Forward |
|---|---|---|---|---|---|---|---|---|---|
| Injection Wells (00-Series) at Source Area [12 wells] | I17S | 9/2/2011 | 2,390 | 2,350 | *2,350* | *78* | 0 | 6.64 | |
| | I17D | 9/1/2011 | 2,405 | 2,350 | *2,350* | *78* | 0 | 7.41 | |
| | I18D | 8/30/2011 | 4,332 | 4,285 | *3,733* | *97* | 552 | 6.50 | Received Shortage from I-26D |
| | I23S | 9/2/2011 | 53 | 43 | *2,350* | *2* | -2,307 | 1.34 | Daylighted immediately upon commencing of injection. Could not complete this well. |
| | I23D | 9/1/2011 | 2,375 | 2,350 | *2,350* | *78* | 0 | 5.50 | Daylighted for the last 452 gal. Resumed to completion @ 2 gpm. |
| | I24S | 9/2/2011 | 4,695 | 4,644 | *2,350* | *153* | 2,294 | 6.84 | Received shortage from I-23S and I-26S |
| | I24D | 9/1/2011 | 2,419 | 2,350 | *2,350* | *78* | 0 | 7.36 | |
| | I25S | 9/1/2011 | 5,336 | 5,172 | *2,350* | *192* | 2,822 | 7.98 | Received shortage from I-23S and I-26S |
| | I25D | 8/30/2011 | 4,416 | 4,332 | *3,773* | *97* | 559 | 7.00 | Received Shortage from I-26D |
| | I26S | 9/2/2011 | 98 | 78 | *2,350* | *3* | -2,272 | 2.50 | Daylighted immediately upon commencing of injection. Could not complete this well. |
| | I26D | 8/30/2011 | 1,191 | 1,158 | *2,815* | *19* | -1,657 | 2.22 | Daylighting occurs 10' South West when anything over 2 gpm is attempted. Could not complete this well. |
| | I27D | 8/30/2011 | 5,386 | 5,293 | *3,786* | *97* | 1,507 | 6.82 | Received Shortage from I-26D and I-23S, I-26S - Received less "extra" injectant to keep the majority of the volume into the shallow zone |
| | Totals | | 35,096 | 34,405 | *32,907* | *971* | | 5.68 | |

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## Legend

- Monitoring Well
- Injection Well (purple highlighted wells are to be injected)
- Deep Groundwater Plume
- Shallow Groundwater Plume

**LTM Wells**

- Source Monitoring Well
- Contingent Sample Location
- Plume Monitoring Well
- Perimeter Monitoring Well

- Canal
- Former Dry Cleaner/Laundry
- Land Use Control Boundary
- Installation Boundary
- Groundwater Flow Direction

N W E S

0 80 160 Feet

Figure 1
Site 12 Layout
Navy Exchange Laundry and Dry Cleaning Facility
JEB Little Creek
Virginia Beach, Virginia

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