

SECTION 5

# Descriptions of RI/FS Sites

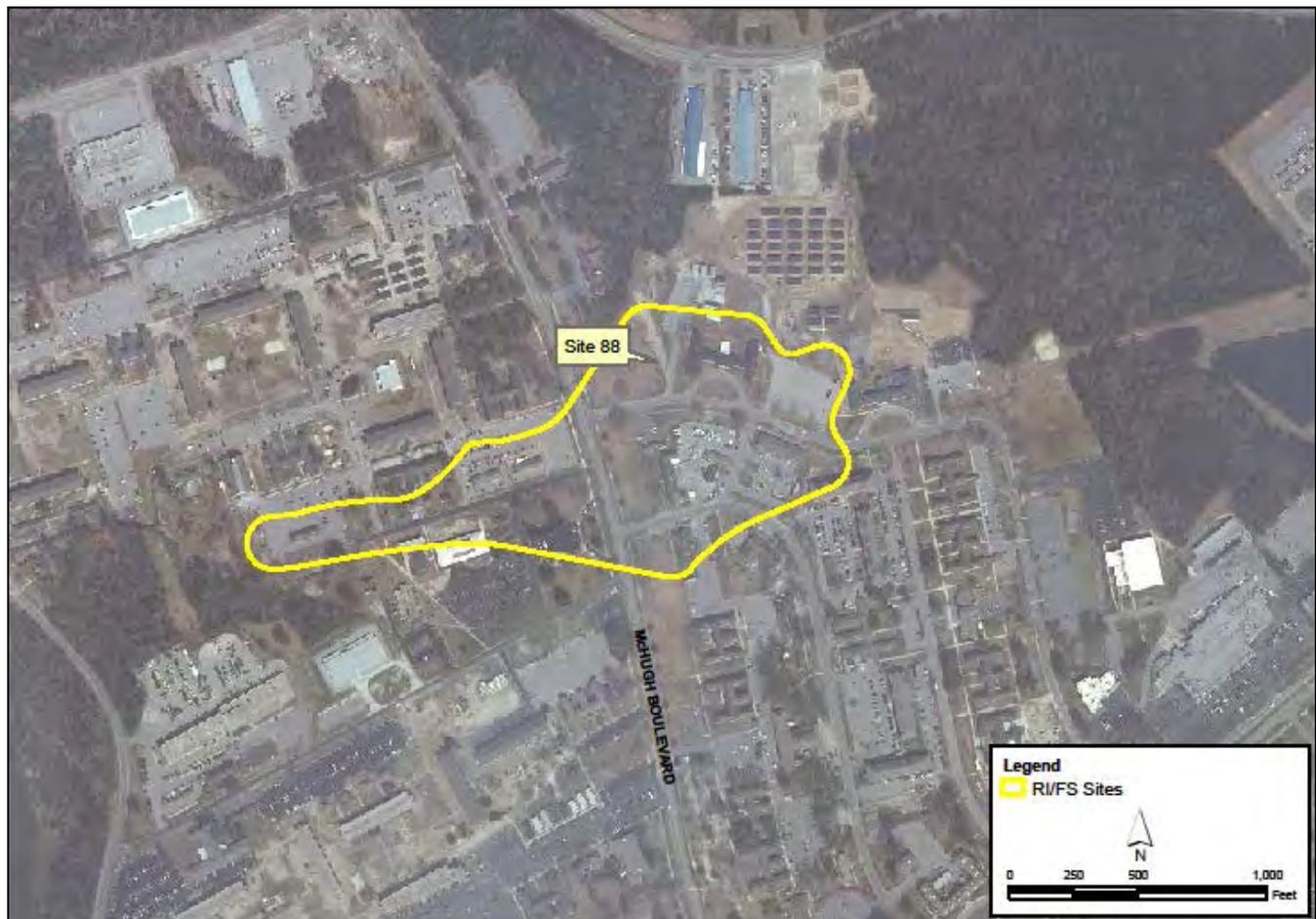
The following sections discuss the site history, summary of previous investigations, and future activities of the two IRP sites and two MMRP sites that are in the RI/FS phase of the CERCLA process. Because these sites are currently under investigation, the site boundaries encompass the current nature and extent of contamination.

## 5.1 IRP RI/FS Sites

### 5.1.1 Site 88 (OU 15)—Base Dry Cleaners

Site 88, the former Base Dry Cleaning Facility Building 25, encompasses approximately 41 acres in the Hadnot Point Industrial Area (HPIA) of MCIEAST-MCB CAMLEJ (**Figure 5-1**). Building 25 began operating as a dry cleaning facility in the 1940s. Five 750-gallon USTs were installed on the north side of the building to store dry cleaning fluids. Initially, Varsol was used in dry cleaning operations. Because of flammability concerns, Varsol’s use was discontinued in the 1970s and it was replaced with tetrachloroethene (PCE). The PCE was stored in one 150-gallon aboveground storage tank (AST) adjacent to the north wall of Building 25, in the same vicinity as the USTs. PCE was reportedly stored in the AST from the 1970s until 1995. Spent PCE was reportedly disposed of in floor drains during this time. In December 1986 and March 1995, self-contained dry cleaning machines were installed in Building 25, eliminating the need for bulk storage of PCE. The USTs and AST were removed in November 1995. The dry cleaning operations ceased in January 2004, and the building was demolished to slab in August 2004.

FIGURE 5-1  
IRP Site 88, OU 15



Previous investigations are listed in **Table 5-1**.

TABLE 5-1  
Previous Investigations Summary, IRP Site 88

Previous Investigation/Action	Date	Activities
Focused Remedial Investigation (Baker, 1998)	1996 - 1998	During removal of the USTs and ASTs, chlorinated volatile organic compounds (CVOCs) and metals were detected in soil samples, and CVOCs, total petroleum hydrocarbons (TPH), and naphthalene were detected in groundwater samples. As a result of these findings, a Focused RI was initiated. Field activities included soil and groundwater sampling for VOCs, and natural attenuation indication parameters (NAIPs). Subsurface soil contamination was identified under and near Building 25, and adjacent to the underground sewer line. Chlorinated solvent contamination was identified in surficial and upper Castle Hayne aquifer groundwater, and Building 25 was confirmed as the source area, suggesting the presence of a dense non-aqueous phase liquid (DNAPL).
Dense Non-aqueous Phase Liquid Recovery (Duke Engineering and Services, 1999)	1998 - 1999	Based on the results of the Focused RI, Site 88 was selected as a candidate for a surfactant enhanced aquifer remediation (SEAR) demonstration for DNAPL remediation. The presence of PCE DNAPL was confirmed, ranging from 16 to 20 feet below ground surface (bgs), directly beneath Building 25 and in an area adjacent to the north side of the building. The SEAR demonstration was conducted in the area north of Building 25 and DNAPL was extracted. Post-SEAR investigations indicated the DNAPL plume was removed from the upper, more permeable regions in the aquifer.
Long-term Monitoring	1999 - 2002	LTM at Site 88 was implemented in April 1999 and discontinued in 2002 when an Amended RI was initiated.
Reductive Anaerobic Bioremediation In Situ Treatment Technology (Battelle Memorial Institute, 2001)	2000 - 2001	Reductive Anaerobic Bioremediation In Situ Treatment Technology treatability testing was performed to the northwest of Building 25 to investigate if "microbially-catalyzed reductive dechlorination of chloroethenes could be stimulated in situ". PCE-contaminated groundwater was pumped from 88-MW051W, amended with electron donor solution (butyric acid and yeast extract), and then injected into 88-MW051W, and groundwater samples were collected and analyzed over a period of 30 weeks. The study concluded that native microbial populations were capable of sequentially reducing PCE to ethene. Also, PCE and trichloroethene (TCE) concentrations were reduced to below detectable levels in almost all pilot study wells after 14 weeks and remained depressed throughout the remainder of the demonstration.
Draft Supplemental Site Investigation (CH2M HILL, 2002)	2002	The Supplemental Site Investigation (SSI) was conducted to determine the nature and extent of contamination and to provide recommendations for completing a comprehensive RI. Groundwater samples were collected and analyzed for VOCs, metals, and NAIPs. The analytical results indicated a general northwest migration of contaminants. Further, the vertical distribution of VOCs suggested that although appreciable volumes of DNAPL are observed to have accumulated upon the shallow silt layer, this layer was not impermeable, and was evidently allowing dissolved-phase VOCs to migrate vertically to the intermediate-depth aquifer zone.
Membrane Interface Probe Investigation	2004	A membrane interface probe (MIP) investigation was conducted to refine previous source area characterization efforts and conduct vertical soil profiling in the vicinity of Building 25 and the nearby sewer systems. Information provided by the MIP investigation was used to evaluate the horizontal and vertical distribution of the DNAPL source area.
Engineering Evaluation/Cost Analysis and Non-time-critical Removal Action (CH2M HILL, 2004; AGVIQ/CH2M HILL, 2006)	2004 - 2006	An EE/CA for the source area beneath Building 25 was completed and presented at a public meeting in June 2004 and shallow soil mixing with clay/zero-valent iron (ZVI) was the recommended technology. In 2005, the removal action was completed, treating approximately 7,050 cubic yards (yd <sup>3</sup> ) of impacted soil. Within the treatment area, PCE concentrations in the soil were reduced by greater than 99 percent. Despite the significant source area reduction, residual dissolved phase groundwater contamination remained over a large portion of the surrounding and downgradient areas.
Remedial Investigation (CH2M HILL, 2008)	2005 - 2008	An RI was completed to address previous data gaps and complete the source identification and delineation of the release. Field activities included monitoring well installation and groundwater sampling. Samples were analyzed for VOCs and NAIPs. Results indicated a delineated VOC plume in groundwater that extended south of the source area. Potential human health risks were identified from VOCs in groundwater. No unacceptable ecological risks were identified.

TABLE 5-1  
Previous Investigations Summary, IRP Site 88

Previous Investigation/Action	Date	Activities
Treatability Study and Technical Memorandum, Summary of ISCO, ERD, and Biobarrier Pilot Studies OU 15, Site 88 (CH2M HILL, 2011)	2010-2011	To evaluate effectiveness of remedial technologies to treat the VOC plume, a pilot study was conducted using enhanced reductive dechlorination (ERD) and in situ chemical oxidation (ISCO) for contaminant mass reduction and ERD as a biobarrier to prevent further downgradient contaminant migration. For mass reduction, ISCO was demonstrated to be most effective based on a VOC reduction of 87 percent, whereas for ERD, an appropriate dose would be cost-prohibitive. The ERD biobarrier achieved up to 97 percent PCE reduction and was effective. The results of the pilot study will be used for the development of remedial alternatives in the FS.
Draft Feasibility Study (CH2M HILL, 2012)	2011-2012	Remedial alternatives were evaluated to address VOCs in soil and groundwater in three zones. Zone 1 is defined as the location of the initial source area with high concentrations of VOC at shallow depths. Zones 2 and 3 are downgradient from Zone 1 and include constituent of concern (COC) concentrations at a wide range of depths covering a large footprint. Alternatives for Zone 1 soil included no action, LUCs, and excavation. Zone 1 groundwater alternatives included no action, vertical air sparging/soil vapor extraction (SVE), and vertical ISCO. Zone 2 alternatives for groundwater included no action, horizontal air sparging, and horizontal ISCO. Zone 3 groundwater alternatives included no action, monitored natural attenuation (MNA), and an ERD barrier. The current CSM is shown on Figure 5-2.
Basewide Vapor Intrusion Evaluation (AGVIQ/CH2M HILL, 2009, CH2M HILL, 2011, and CH2M HILL, 2015)	2007 - 2015	Site 88 was included in the phased Basewide vapor intrusion evaluation, conducted from 2007-2011, to determine if complete or significant exposure pathways exist for vapor intrusion into buildings. Vapor intrusion was identified as a pathway of concern at 1 building and a VIMS was installed in 2012. VIMS were installed in three additional buildings in 2012 to reduce the possibility of future vapor migration and additional sampling was recommended at Building HP57 to assess temporal variability. Additional sampling was conducted at Building HP57 and Buildings 37A (identified based on exceedances of groundwater in the vicinity) in 2013. Based on the results, NFA was recommended for Building 37A and follow-up monitoring was recommended at Building HP57.
Building HP57 Additional Vapor Intrusion Investigation (CH2M HILL, 2015)	2014 - 2015	<p>An additional vapor intrusion investigation was conducted at Building HP57 based on the temporal variability of TCE concentrations and the potential for preferential transport of vapors through underground utilities. Field activities included subslab soil gas, indoor air, and outdoor air sampling. PCE, TCE, and chloroform were detected in indoor air; however, the concentrations found in the subslab were not high enough to result in vapor intrusion at levels above indoor air screening levels. Therefore, a HAPSITE investigation was conducted to identify the source of the indoor air detections.</p> <p>An uncapped sewer pipe was identified as a potential vapor entry point and the pipe was plugged. Additional indoor air samples were collected from Buildings 58, 59, and HP55, which are connected to the same sewer line. Samples were also collected, utilizing the HAPSITE, from sewer connections within Building 37, which currently has VIMS. VOCs were detected within the buildings suggesting the sewer line may act as a potential pathway for vapor to enter the buildings. The p-traps will be inspected and repaired if necessary to prevent vapors from entering spaces through the sewer line by maintaining a water barrier. Additional indoor air sampling will be conducted to evaluate PCE and TCE concentrations throughout Building HP57. A pilot study is also planned to evaluate the effectiveness of venting the sewer line.</p>

### 5.1.1.1 Future Activities

A Draft FS was submitted in 2012. A tracer study and additional groundwater, soil, and vapor intrusion investigation was initiated in FY 2015 to support finalizing the FS. The finalized FS, Proposed Plan, and ROD will follow (**Schedule 5-1**). If buildings are planned for construction in the vicinity of the VOC groundwater plume, the potential for a vapor intrusion pathway will be evaluated and mitigated if needed. Base Master Planning maintains current groundwater plume data in the geographic information system (GIS), and all construction projects on-Base go through environmental review.



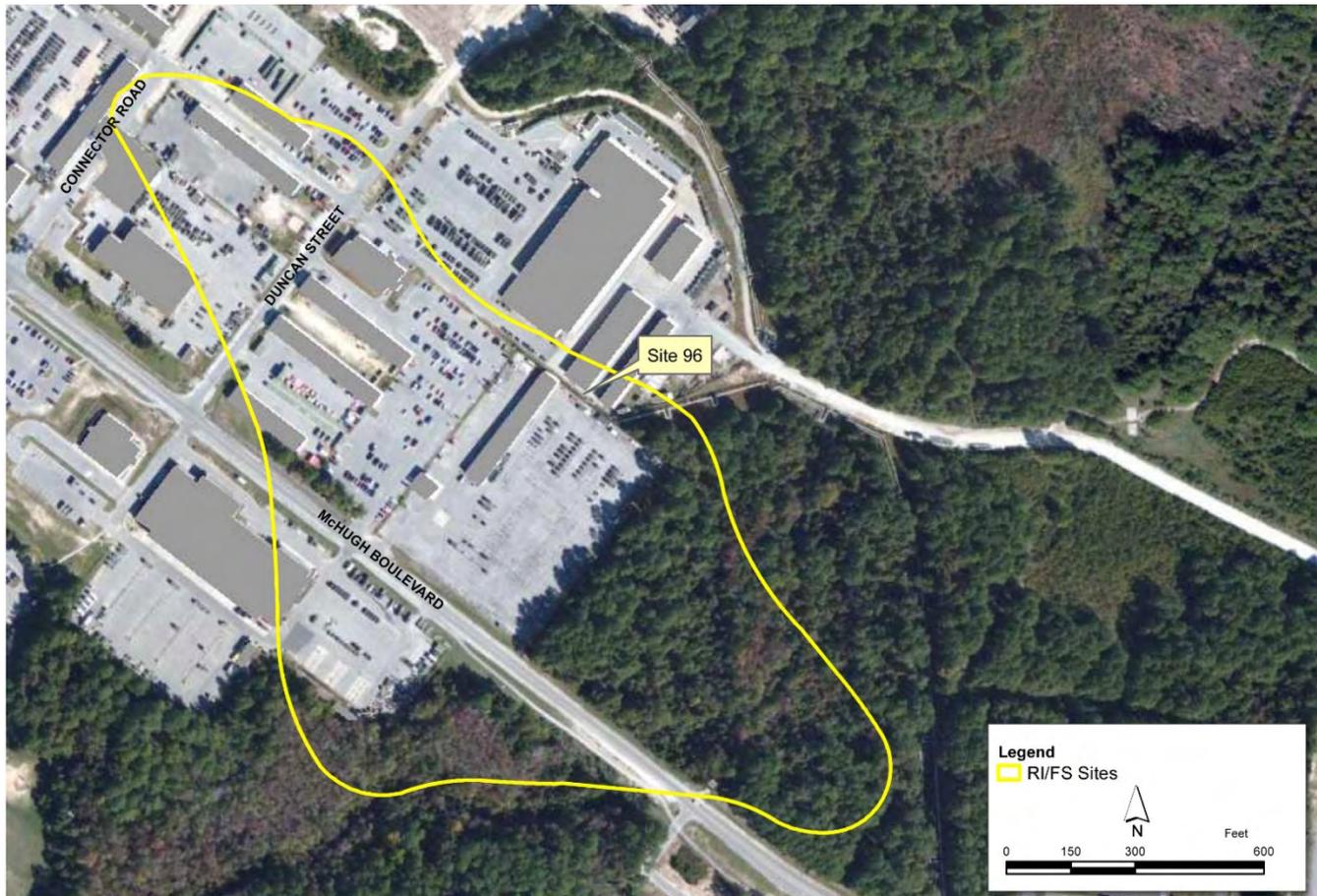


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### 5.1.2 Site 96 (OU 22)—Building 1817 UST

Site 96, previously Solid Waste Management Unit (SWMU) 360, encompasses approximately 14 acres in the Mainside HPIA between Connector Road and McHugh Boulevard (**Figure 5-3**). Site 96 is the site of a former 300-gallon waste-oil UST positioned near Building 1817. Building 1817 is a Hazardous Materials Consolidation Center. The former UST was located in the eastern portion of the compound, which is currently used as a temporary staging area for batteries, refrigeration units, and other used equipment prior to disposal and or reutilization.

FIGURE 5-3  
IRP Site 96, OU 22



Previous investigations are listed in **Table 5-2**.

TABLE 5-2  
Previous Investigations Summary, IRP Site 96

Previous Investigation/Action	Date	Activities
UST Removal and Investigations (Catlin, 1997)	1997	The 300-gallon waste oil UST was removed in July 1997, and confirmatory samples were collected under the UST Program. Additional sampling was completed in December 1997, indicating a petroleum release had occurred at the UST. A Limited Site Assessment was also conducted under the UST Program, which included installing monitoring well 1817MW01 within the former UST excavation. Upon discovery of elevated concentrations of chlorinated compounds in groundwater, the site was removed from the UST Program and included in the Confirmatory Site Investigation (CSI) under the Resource Conservation and Recovery Act (RCRA).
Confirmatory Site Investigation (Baker, 2005)	2002 - 2005	The CSI included soil and groundwater sampling for VOCs, SVOCs, pesticides, and RCRA metals analyses. The CSI identified VOCs, SVOCs, and pesticides in groundwater that exceeded screening criteria.
Resource Conservation and Recovery Act Facility Investigation (RFI) (Baker and CH2M HILL, 2005) and Amended RFI (CH2M HILL, 2006)	2005 - 2006	The RFI included soil and groundwater sampling for VOCs, pesticides, and RCRA metals analysis. A CVOC plume was identified in groundwater. Potential unacceptable human health risks to future residents were identified from exposure to PCE, TCE, and heptachlor epoxide in groundwater.
Corrective Measures Study (CH2M HILL, 2007)	2007	A Corrective Measures Study (CMS) was conducted to develop remedial goal options for the site and to evaluate management options for groundwater at SWMU 360. The corrective measures evaluated were ERD, air sparging, and ISCO.
Additional Groundwater Delineation (Osage, 2009)	2007 - 2009	The downgradient and vertical extent of the CVOC plume was not fully delineated and additional groundwater samples were collected for analysis of PCE and its daughter products. As a result, the vertical extent of contamination was delineated but the plume extends horizontally more than 1,800 feet southeast from the source area and is not fully delineated to NCGWQS. Because the contamination is not associated with the former UST, the SWMU was transferred to the IRP to complete the delineation under an RI/FS.
Basewide Vapor Intrusion Evaluation (AGVIQ/CH2M HILL, 2009, CH2M HILL, 2011, and CH2M HILL, 2015)	2007 - 2015	Site 96 was included in the phased Basewide vapor intrusion evaluation, conducted from 2007-2011, to determine if complete or significant exposure pathways exist for vapor intrusion into buildings. Groundwater, soil gas, and air samples were collected from Building 1817 and subslab soil gas samples were collected from Buildings 1827 and 1828 which are located within the Site 96 boundary southwest of Building 1817. Although significant vapor intrusion impacts were not expected, additional sampling was recommended at Buildings 1827 and 1828 to assess temporal and spatial variability. Based on results of the phased investigations and monitoring reports, NFA was recommended for Buildings 1817 and 1827 and periodic monitoring was recommended at Building 1828 and will be conducted in FY 2018.

### 5.1.2.1 Future Activities

An RI/FS is planned in FY 2015/2016, followed by a Proposed Plan and ROD (**Schedule 5-2**). If buildings are planned for construction in the vicinity of the VOC groundwater plume, the potential for a vapor intrusion pathway will be evaluated and mitigated if needed. Base Master Planning maintains current groundwater plume data in the GIS and all construction projects on-Base go through environmental review.

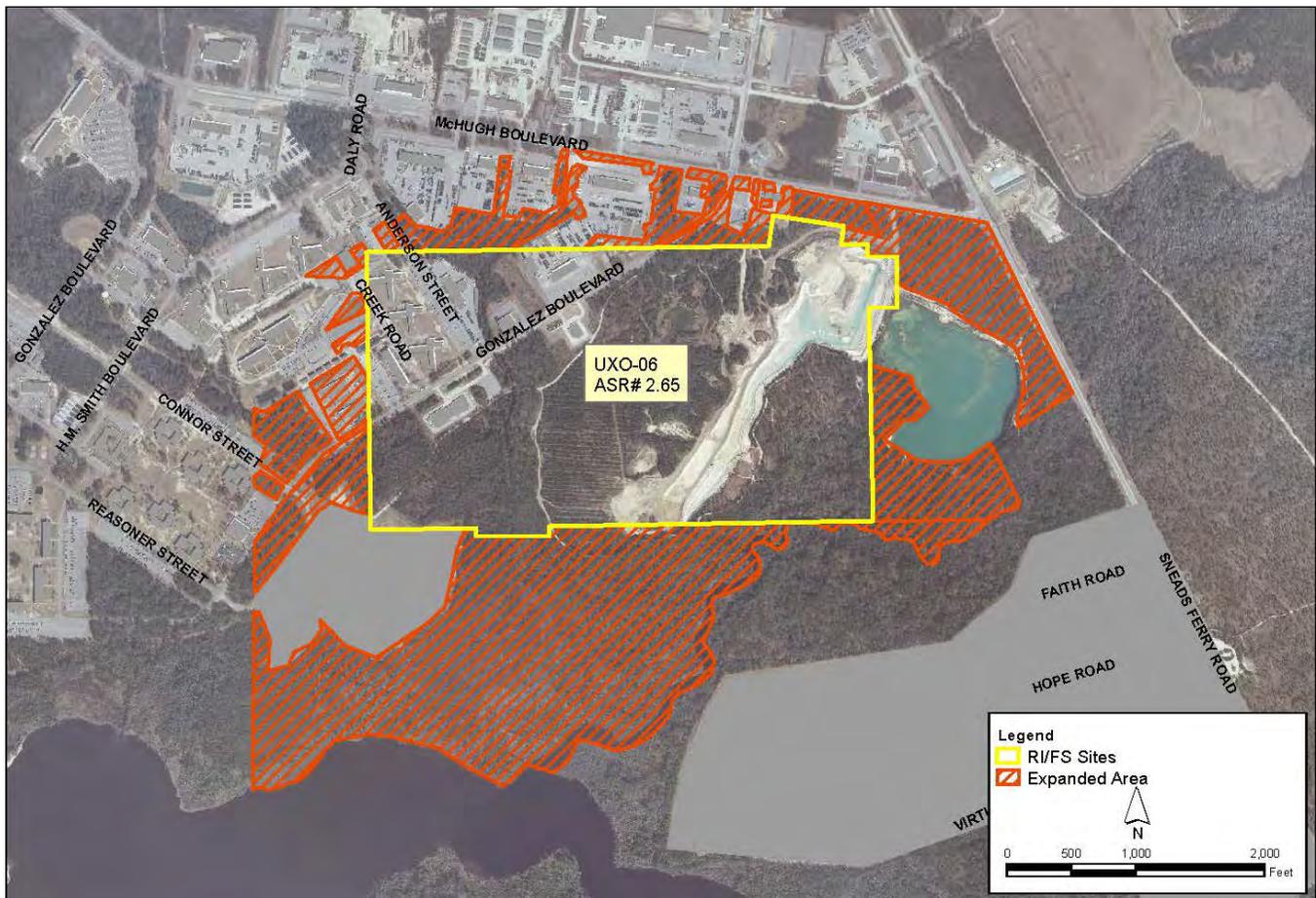


## 5.2 MMRP RI/FS Sites

### 5.2.1 UXO-06 (OU 24)—Fortified Beach Assault Area (ASR #2.65)

Site UXO-06, the Fortified Beach Assault Area, encompasses approximately 177 acres in the Mainside of MCIEAST-MCB CAMLEJ, south of McHugh Boulevard and west of Sneads Ferry Road (**Figure 5-4**). This range was reportedly in use from 1953 until approximately 1977. The types of munitions used onsite include blank small arms, demolitions, flame throwers, 3.5-inch practice rockets, practice rifle grenades, and smoke and white phosphorus hand grenades. In addition, solvents and solutions were used at the site to clean equipment. The east central portion of Site UXO-06 has been investigated and cleared and is being used as a borrow pit to support construction projects across the Base.

FIGURE 5-4  
MMRP Site UXO-06 (OU 24), ASR #2.65



Previous investigations are listed in **Table 5-3**.

TABLE 5-3  
Previous Investigations Summary, MMRP Site UXO-06 (OU 24), ASR #2.65

Previous Investigation/Action	Date	Activities
Focused Site Investigation MILCON Area (CH2M HILL, 2007)	2006 - 2007	In support of MILCON activities for an armory and extended parking area, soil and groundwater sampling, and 100 percent DGM were conducted in a 4-acre area at UXO 6. Samples were analyzed for VOCs, SVOCs, pesticides/PCBs, explosives residues, perchlorate, TPH, and metals. No unacceptable human health or ecological risks were identified in site media. The 1,368 anomalies that were identified during DGM were investigated and removed prior to MILCON activities. Several MEC items were discovered and removed including a practice rocket, colored smoke hand grenade, and hand signal flare. Because it is not possible to provide 100 percent assurance that all MEC items have been removed from the site, "3R" (Recognize, Retreat, Report) training was provided for protection of construction workers.
Focused Preliminary Assessment/Site Investigation (Arcadis, 2007)	2007	To evaluate the presence of UXO and impacted soil or groundwater within a proposed sewer line easement, the Onslow Water and Sewer Authority initiated a Focused PA/SI at UXO-06. Field activities included soil and groundwater sampling and DGM. Samples were analyzed for VOCs, SVOCs, TPH, explosives residues, perchlorate, and metals. No unacceptable risks to construction workers were identified in site media. 790 geophysical anomalies that were identified during DGM were investigated and were removed. All anomalies with the exception of two practice 3.5-inch rockets and one expended smoke rifle grenade were construction/cultural debris.
Preliminary Assessment/Site Investigation (CH2M HILL, 2012)	2008 - 2012	A sitewide field investigation was conducted to identify the presence and nature of MC contamination and evaluate the number and density of anomalies that represent potential subsurface MEC. Field activities included soil, groundwater, surface water, and sediment sampling; and 10 percent DGM and intrusive anomaly investigation. The samples were analyzed for VOCs, SVOCs, pesticides, explosives residues, TPH, perchlorate, and metals and no unacceptable human health or ecological risks were identified from exposure to environmental media. MPPEH was found on the ground surface and in burial pits and there is potential for MEC/MPPEH to remain in the surface and subsurface at the site. An RI was recommended to further evaluate the potential for subsurface MEC in uninvestigated and undeveloped areas within the site and along the site boundaries.
Focused Site Investigations (CH2M HILL, 2010, 2011, 2012)	2010 - 2012	A Focused SI was conducted at the UXO-06 Borrow Pit Expansion Area in a phased approach. Field activities included 100 percent DGM and intrusive investigations. A total of 10,250 geophysical anomalies were investigated, 15 MEC items were identified and destroyed through controlled detonations, and over 2,000 MPPEH items were identified. Based on the clearance activities, the borrow pit was recommended to be opened for excavation in January 2012. The intrusive investigation significantly reduced the risk of encountering subsurface MEC. However, because it is not possible to provide 100 percent assurance that all MEC items have been removed from the site, "3R" (Recognize, Retreat, and Report) training was recommended for protection of site operators. On-call support from Base EOD or a qualified UXO contractor for inspection and disposal of suspected MEC that may be unearthed was also recommended.
Remedial Investigation (CH2M HILL, 2015)	2012-2015	An RI was conducted to further evaluate the nature and extent of subsurface MEC in uninvestigated and undeveloped areas within the site and in areas adjacent to UXO-06 boundaries. Field activities included DGM, an intrusive investigation, and post-detonation soil sampling. Approximately 3,300 anomalies and 190 MPPEH items were discovered. MPPEH was demilitarized onsite and classified as material documented as safe (MDAS). Post-detonation soil sampling results did not indicate any unacceptable human health or ecological risks due to exposure to soil within the area of the controlled detonation.  Human health risk assessment (HHRAs) and ecological risk assessments (ERAs) previously conducted at UXO-06 were reviewed and updated for the RI. There were no impacts to environmental media from MEC/MPPEH and no unacceptable risks to human or ecological receptors identified from exposure to MC in site media. Based on the results of the RI, NFA is recommended for the Borrow Pit Area, Cantonment Area A, and Cantonment Area C. An FS is recommended for the Cantonment Area B, Wooded, and Limited Use Areas in order to develop remedial alternatives to address potential threats from any MEC that remains at the site.

### 5.2.1.1 Future Activities

An FS will be completed in FY 2015/2016 followed by a Proposed Plan, ROD, and RD. (**Schedule 5-3**).

**Schedule 5-3**  
**MMRP Site UXO-06 (OU 24), ASR #2.65**  
**IRP & MMRP Site Management Plan FY 2016**  
**MCIEAST-MCB CAMLEJ**

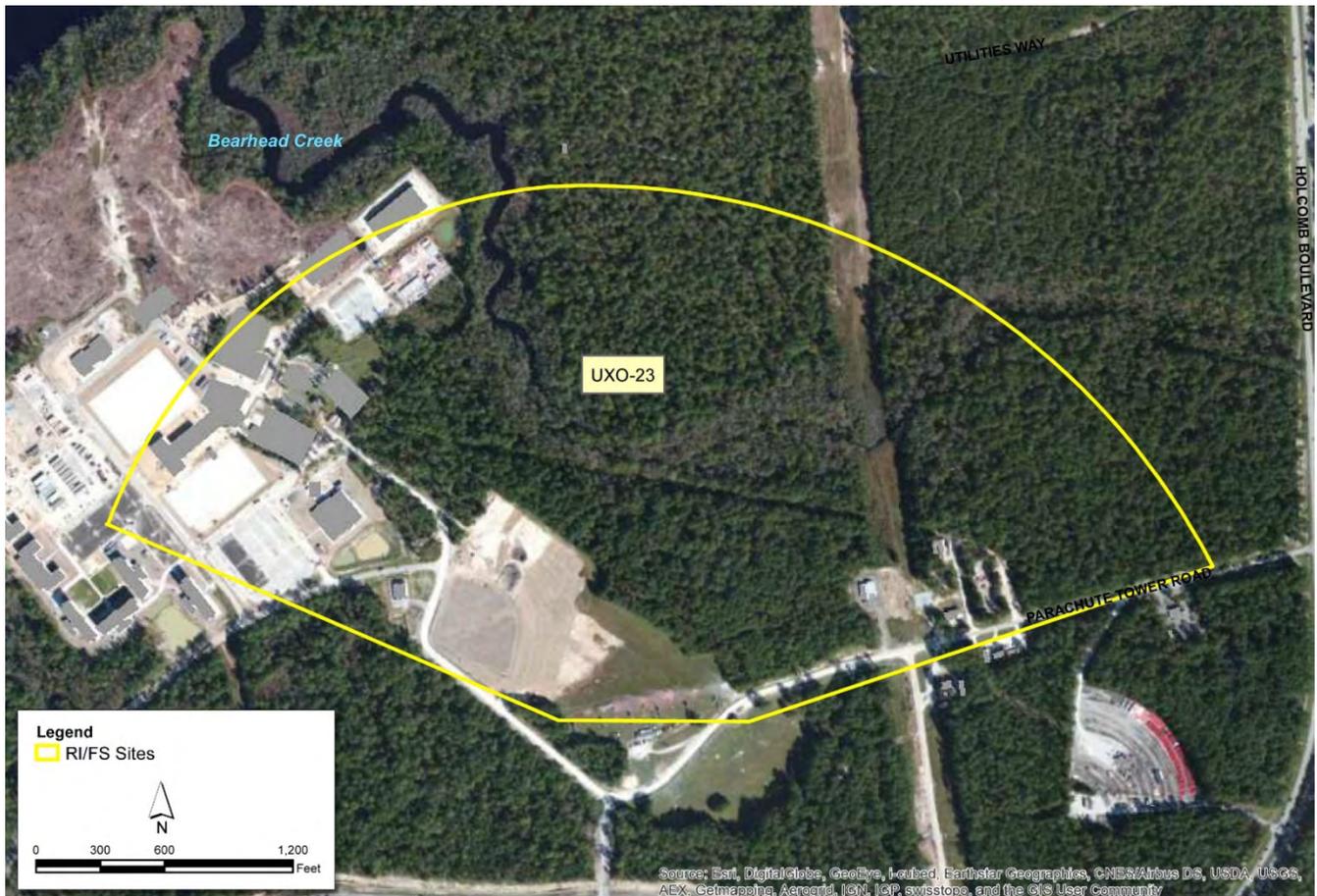
ID	Task Name	Duration	Start	Finish	2016												2017																
					Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
1	<b>FS</b>	<b>154 days</b>	<b>Mon 3/30/15</b>	<b>Thu 10/29/15</b>	▶																												
2	Draft FS	80 days	Mon 3/30/15	Fri 7/17/15	■																												
3	Review Period (Navy/Base)	30 days	Mon 7/20/15	Fri 8/28/15					■																								
4	Review Period (USEPA/NCDENR)	30 days	Mon 8/31/15	Fri 10/9/15							■																						
5	Final FS Report	14 days	Mon 10/12/15	Thu 10/29/15							■																						
6	<b>Proposed Plan</b>	<b>138 days</b>	<b>Fri 10/30/15</b>	<b>Tue 5/10/16</b>	▶																												
7	Draft Proposed Plan	40 days	Fri 10/30/15	Thu 12/24/15					■																								
8	Review Period (Navy/Base)	30 days	Fri 12/25/15	Thu 2/4/16							■																						
9	Review Period (USEPA/NCDENR)	30 days	Fri 2/5/16	Thu 3/17/16									■																				
10	Final Proposed Plan	14 days	Fri 3/18/16	Wed 4/6/16									■																				
11	Public Meeting/Review Period	24 days	Thu 4/7/16	Tue 5/10/16									■																				
12	<b>ROD</b>	<b>142 days</b>	<b>Fri 3/18/16</b>	<b>Mon 10/3/16</b>	▶																												
13	Draft ROD	68 days	Fri 3/18/16	Tue 6/21/16					■																								
14	Review Period (Navy/Base)	30 days	Wed 6/22/16	Tue 8/2/16									■																				
15	Review Period (USEPA/NCDENR)	30 days	Wed 8/3/16	Tue 9/13/16											■																		
16	Final ROD	14 days	Wed 9/14/16	Mon 10/3/16											■																		
17	<b>RD</b>	<b>134 days</b>	<b>Wed 9/14/16</b>	<b>Mon 3/20/17</b>	▶																												
18	Draft RD	60 days	Wed 9/14/16	Tue 12/6/16									■																				
19	Review Period (Navy/Base)	30 days	Wed 12/7/16	Tue 1/17/17													■																
20	Review Period (USEPA/NCDENR)	30 days	Wed 1/18/17	Tue 2/28/17															■														
21	Final RD	14 days	Wed 3/1/17	Mon 3/20/17															■														

## 5.2.2 UXO-23—D-9 Skeet Range (ASR #2.82)

The D-9 Skeet Range is located west of Holcomb Boulevard and north of Parachute Tower Road and encompasses approximately 187 acres (**Figure 5-5**). The D-9 Skeet Range was used for recreational shooting from 1953 until it was closed in July 2011. The range was one of four live-fire ranges within a training area known as Area D. The weapons historically accommodated included 12-, 16-, 20-, 28-, and 410-gauge shotguns and sizes of lead shot used on the range included 7.5 mm, 8 mm, 8.5 mm, and 9 mm. Although the total amounts of ammunition used on the skeet ranges are not available, it is estimated that several hundred thousand rounds were fired each year.

Currently, the Wallace Creek MILCON project covers approximately 100 acres north of Hadnot Point and south of Wallace Creek and includes the theoretical shot fall-zone of the D-9 Skeet Range. Planned and ongoing construction consists of barracks support buildings (such as the mess hall and fitness center) and parking areas.

FIGURE 5-5  
MMRP Site UXO-23, ASR #2.82



Previous investigations are listed in **Table 5-4**.

TABLE 5-4  
Previous Investigations Summary, MMRP Site UXO-23, ASR #2.82

Previous Investigation/Action	Date	Activities
Focused Site Investigation (CH2M HILL, 2008)	2007 - 2008	A field investigation was conducted to evaluate the distribution of lead within the area south of Bearhead Creek. Surficial soil samples were field screened using X-ray fluorescence (XRF) to identify potential lead impacts. Soil and groundwater samples were also collected and analyzed for lead to confirm the XRF results. The highest concentrations of lead were generally found to correspond with the theoretical shot fall-zone for the range. Additional sampling of surface soils and groundwater and an HHRA was recommended.
Focused Preliminary Assessment/Site Investigation (CH2M HILL, 2010)	2008 - 2010	The Focused PA/SI was conducted to evaluate potential impacts to human health and the environment in the area north of Bearhead Creek. Soil, groundwater, surface water, and sediment samples were collected and were analyzed for perchlorate, polycyclic aromatic hydrocarbons (PAHs), and metals. Potential human health risks to future residents from PAHs in groundwater north of Bearhead Creek and potential ecological risks from metals and PAHs in Bearhead Creek were identified.
Wallace Creek Expanded Site Investigation (CH2M HILL, 2010)	2009 - 2010	Additional soil sampling was conducted in the theoretical shot fall-zone to delineate the horizontal and vertical extents of lead impacts and to investigate potential impacts to drainage features that convey surface water runoff from the theoretical shot fall-zone. A human health risk screening (HHRS) and an ecological risk screening (ERS) were performed on the data collected to-date. In the north area, potential risks have been identified from PAHs in groundwater, metals and PAHs in surface water and sediment within Bearhead Creek and associated wetlands and drainages. In the southern area of the Skeet Range, outside of the shot fall-zone, no unacceptable risks were identified in soil and groundwater. In the vicinity of the theoretical shot fall-zone, potential unacceptable risks to human health and the environment were identified from exposure to lead and PAHs in surface soil, and a removal action was recommended once the Skeet Range is closed.
Draft Engineering Evaluation/Cost Analysis (CH2M HILL, 2010)	2010	The EE/CA evaluated alternatives for the NTCRA to address potential unacceptable risks from lead and PAHs in the shot fall-zone. The alternatives were no action, excavation with offsite disposal, excavation with particle separation and backfill, excavation with stabilization and offsite disposal, and in situ stabilization.
Environmental Update (CH2M HILL, 2011)	2011	After submission of the Draft EE/CA, several MILCON projects were planned/initiated adjacent to the NTCRA area and additional investigation was conducted in 2011. Additional soil sampling for lead and PAH analysis was conducted in the theoretical shot fall-zone to verify and update the NTCRA removal area. Lead concentrations exceeded the cleanup level at three soil sample locations within the proposed NTCRA area. Soil samples were also screened using an XRF analyzer and three surface soil samples contained lead concentrations in exceedance of the cleanup level. The proposed NTCRA area was modified based on these results.
Engineering Evaluation/Cost Analysis (CH2M HILL, 2012)	2011 - 2012	The EE/CA evaluating alternatives for the NTCRA to address potential unacceptable risks from lead and PAHs in the theoretical shot fall-zone was updated with the modified NTCRA area based on the Environmental Update.
Action Memorandum (CH2M HILL, 2012)	2012	An AM was completed to propose in situ stabilization followed by excavation and offsite disposal as the NTCRA to address lead and PAHs in soil.
Wallace Creek Bachelor Enlisted Quarters Confirmation Sampling (CH2M HILL, 2012)	2012	In support of MILCON activities for a Bachelor Enlisted Quarters (BEQ) facility located northwest of the theoretical shot fall-zone, soil and groundwater sampling was conducted to evaluate whether environmental impacts related to historical activities could pose unacceptable risks to construction workers and future residents. The samples were analyzed for VOCs, SVOCs, pesticides/PCBs, and metals. There were no unacceptable risks for human and ecological receptors at the proposed BEQ location. Therefore, MILCON activities were recommended to proceed as planned.
Non-time-critical Removal Action Construction Completion Report (Osage, 2013)	2012-2013	The NTCRA was initiated to treat and remove lead and PAH contaminated soil in the theoretical shot fall-zone and three drainages connected to the southern portion of the shot fall-zone. Approximately 52,000 tons of contaminated soil were removed. During the NTCRA activities, nine munitions-related items, including 81-mm practice mortars, were identified. Because PAH and lead concentrations in exceedance of screening criteria were identified at greater depths than expected, the NTCRA was placed on hold until the contaminated soil could be vertically delineated. The contaminated soil was covered with a geotextile liner and 1 foot of clean fill.

TABLE 5-4  
 Previous Investigations Summary, MMRP Site UXO-23, ASR #2.82

Previous Investigation/Action	Date	Activities
Non-time-critical Removal Action Technical Memorandum (CH2M HILL, 2014)	2014	In support of the remaining NTCRA area, soil samples were collected to vertically delineate PAH and lead contaminated soil. Depths to soil with concentrations below the action levels ranged from 2 to 6.5 feet bgs. Based on these results, the estimated volume of impacted soils remaining in the NTCRA area beneath the geotextile fabric was calculated to be approximately 7,000 yd <sup>3</sup> .

### 5.2.2.1 Future Activities

The removal of the remaining PAH and lead-impacted soil is projected for completion in FY 2015/2016. The RI will be completed in FY 2016/2017 followed by an FS, Proposed Plan, ROD, and RD (**Schedule 5-4**).

**Schedule 5-4**  
**MMRP Site UXO-23, ASR# 2.82**  
**IRP & MMRP Site Management Plan FY 2016**  
**MCIEAST-MCB CAMLEJ**

ID	Task Name	Duration	Start	Finish	2016												2017												2018												2019
					Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	NTCRA Completion	261 days	Thu 1/1/15	Thu 12/31/15	[Bar]																																				
2	<b>RI</b>	<b>799 days</b>	<b>Mon 7/28/14</b>	<b>Thu 8/17/17</b>	[Bar]												[Bar]																								
3	Additional RI Activities	635 days	Mon 7/28/14	Fri 12/30/16	[Bar]																																				
4	Draft Report	90 days	Mon 1/2/17	Fri 5/5/17													[Bar]																								
5	Review Period (Navy/Base)	30 days	Mon 5/8/17	Fri 6/16/17													[Bar]																								
6	Review Period (USEPA/NCDENR)	30 days	Mon 6/19/17	Fri 7/28/17													[Bar]																								
7	Final Report	14 days	Mon 7/31/17	Thu 8/17/17													[Bar]																								
8	<b>FS</b>	<b>164 days</b>	<b>Mon 6/19/17</b>	<b>Thu 2/1/18</b>													[Bar]																								
9	Draft FS	90 days	Mon 6/19/17	Fri 10/20/17													[Bar]																								
10	Review Period (Navy/Base)	30 days	Mon 10/23/17	Fri 12/1/17													[Bar]																								
11	Review Period (USEPA/NCDENR)	30 days	Mon 12/4/17	Fri 1/12/18													[Bar]																								
12	Final FS Report	14 days	Mon 1/15/18	Thu 2/1/18													[Bar]																								
13	<b>Proposed Plan</b>	<b>158 days</b>	<b>Fri 2/2/18</b>	<b>Tue 9/11/18</b>													[Bar]																								
14	Draft Proposed Plan	60 days	Fri 2/2/18	Thu 4/26/18													[Bar]																								
15	Review Period (Navy/Base)	30 days	Fri 4/27/18	Thu 6/7/18													[Bar]																								
16	Review Period (USEPA/NCDENR)	30 days	Fri 6/8/18	Thu 7/19/18													[Bar]																								
17	Final Proposed Plan	14 days	Fri 7/20/18	Wed 8/8/18													[Bar]																								
18	Public Meeting/Review Period	24 days	Thu 8/9/18	Tue 9/11/18													[Bar]																								
19	<b>ROD</b>	<b>134 days</b>	<b>Fri 6/8/18</b>	<b>Wed 12/12/18</b>													[Bar]																								
20	Draft ROD	60 days	Fri 6/8/18	Thu 8/30/18													[Bar]																								
21	Review Period (Navy/Base)	30 days	Fri 8/31/18	Thu 10/11/18													[Bar]																								
22	Review Period (USEPA/NCDENR)	30 days	Fri 10/12/18	Thu 11/22/18													[Bar]																								
23	Final ROD	14 days	Fri 11/23/18	Wed 12/12/18													[Bar]																								