6.5 Naval Air Station Jacksonville OU 03, Florida

Naval Air Station Jacksonville (NAS JAX), located along the west bank of the St. Johns River in Jacksonville, Florida, is a 3,400-acre facility. NAS JAX was established in 1940 as an air defense strategic base to protect Florida's 1,200 miles of coastline from enemy attack. As a master antisubmarine warfare (ASW) and industrial base, NAS JAX maintains and operates facilities and provides services and materials to support aviation operations. Tenants include the Fleet Readiness Center Southeast (FRCSE), Fleet Logistic Center Jacksonville, seven air reconnaissance squadrons, four helicopter squadrons, one reserve air reconnaissance squadron, and two Fleet Logistics Support Squadrons.

The Navy Environmental Restoration Program (ERP) oversees environmental remediation activities at the base, mostly conducted under the CERCLA program. NAS JAX has eleven designated CERCLA OUs. The NAS JAX Partnering Team (NAS JAX Team) oversees the implementation of the ERP and comprises representatives of the Navy, the Florida Department of Environmental Protection (FDEP), USEPA, and Navy environmental contractors.

The most challenging sites at NAS JAX includes several chlorinated solvent plumes and other contaminant areas at OU 3 (Figure 28). OU 3 is the largest site at NAS JAX and includes over 100 buildings that historically housed dry cleaning, painting, stripping, degreasing, and electroplating operations. These operations resulted in significant soil and groundwater contamination. The OU 3 primary tenant is FRCSE. In 1993, the NAS JAX Team began a multiphase RI/FS that supported the development of the September 2000 ROD. This ROD documented the selected remedies for six of the eight source areas for chlorinated solvent plumes. The remaining two source areas require further assessment and will be addressed later.

A former dry cleaner (former Building 106, Source C) and a former solvent recycler (Building 780, Source D) located in the northern area of OU 3 were the subject of interim remedial actions (IRAs). These remedies were adopted as final remedy components in the 2000 ROD and consisted of air sparging with soil vapor extraction (AS/SVE) at former Building 106 and groundwater P&T and SVE at Building 780.

Source Areas A, B, and E are in the central areas of OU 3. These areas did not initially require active remedial action because there was no documented impact to receptors and therefore no completed exposure pathways. Areas A and B eventually were placed in MNA programs. Source Areas F and G were identified in the southern area of OU 3. Initially, chemical oxidation was selected to treat Source Area F; however, studies found that conditions were not suitable for chemical oxidation and no source treatment was conducted at that time. The selected remedy for Area G is MNA.

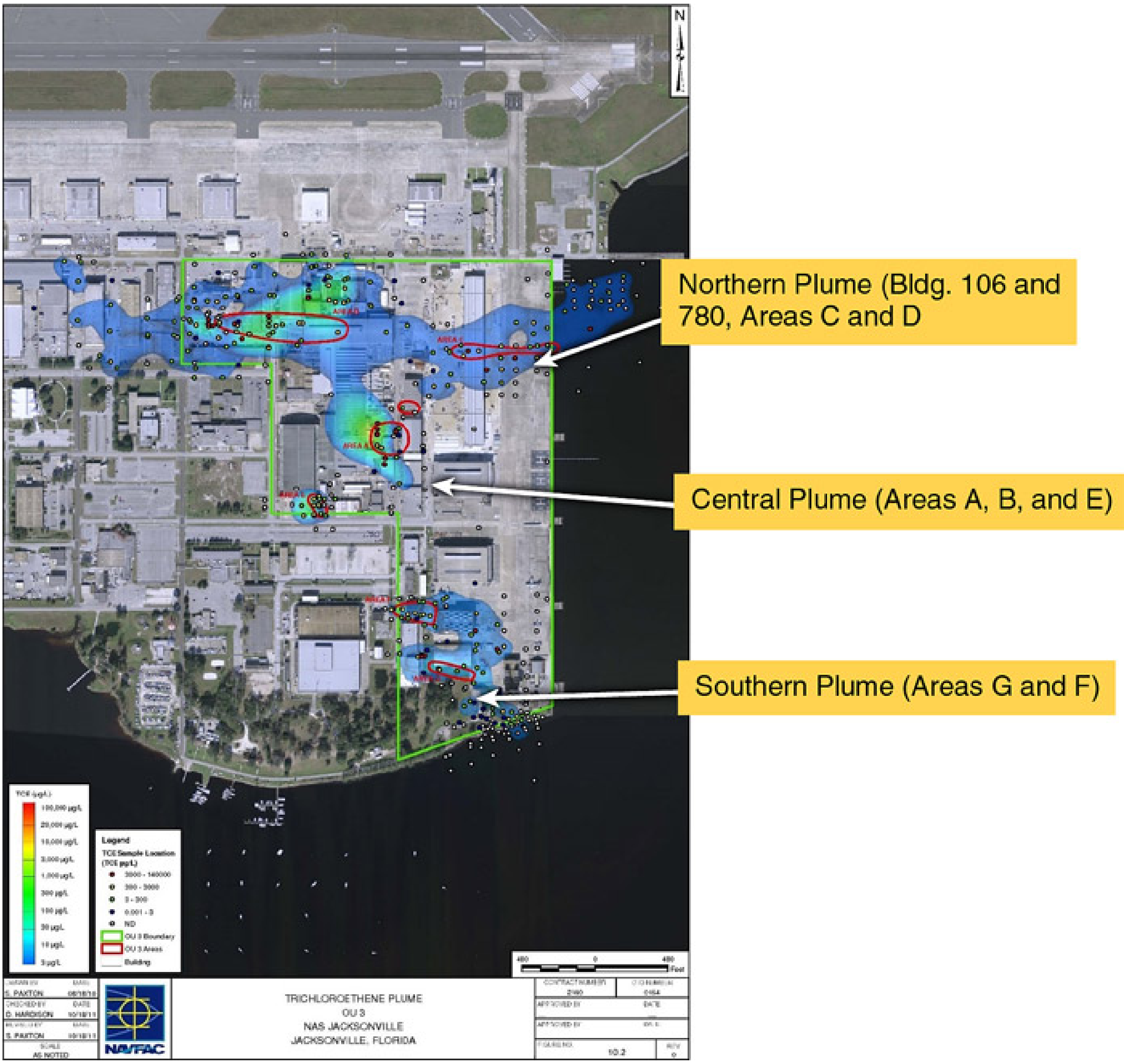

Figure 28. Major groundwater plumes at OU 3 NAS JAX (Goodwin et al. 2010)**.**

6.5.1 Technical Basis for Remedial Action

Following initial remedial actions, several optimization studies were conducted. Results of the optimization studies and Five-Year Reviews conducted in 2005 and 2010 recommended the following tasks to resolve CSM data gaps:

- Improve information about DNAPL contaminant mass that has diffused into an extensive clay layer and acts as a continuing source to the groundwater plume.
- Evaluate risks posed to site workers and building occupants through potential indoor air VI.
- Verify that the groundwater plume has not entered the St. Johns River via discharge from the storm sewer network or via direct migration and discharge, adversely impacting surface water and sediment.

Because of these findings, initial remedial actions adopted for Buildings 106 and 780 in the north end of the site were discontinued and additional site risk characterization was planned.

6.5.2 Decisions

After the findings of the optimization studies and Five-Year Review process, the NAS JAX Team reached consensus that adaptive site management and a comprehensive remedial approach was needed to protect potential receptors, including additional site characterization, CSM refinement, and exposure pathway risk determination (Figure 28). NAS JAX Team concluded that the original area-by-area approach was ineffective in reaching site objectives. The team adopted an OU-wide risk-based remediation approach in which RI and FS Addendums and a single replacement ROD would be developed to address the multiple source areas and comingled plumes at OU 3 (Figure 29).

The OU 3 RI Addendum, FS Addendum, and ROD documents are being prepared under the Navy Clean Contract program. Pilot Studies, Remedial Design, and Remedial Actions are being completed by the Navy Remedial Action Contract (RAC) program. Innovative research technology demonstrations have been performed by DOD's Environmental Security Technology Certification Program (ESTCP 2010) to better characterize source area DNAPL diffused in clay layers and the risk to workers posed by potential VI. In addition, ESTCP and the Navy Environmental Technical Services (Amonette et al. 2012) contracts are being used to efficiently perform treatability and pilot studies for innovative remediation technologies applicable to similar source areas across OU 3.

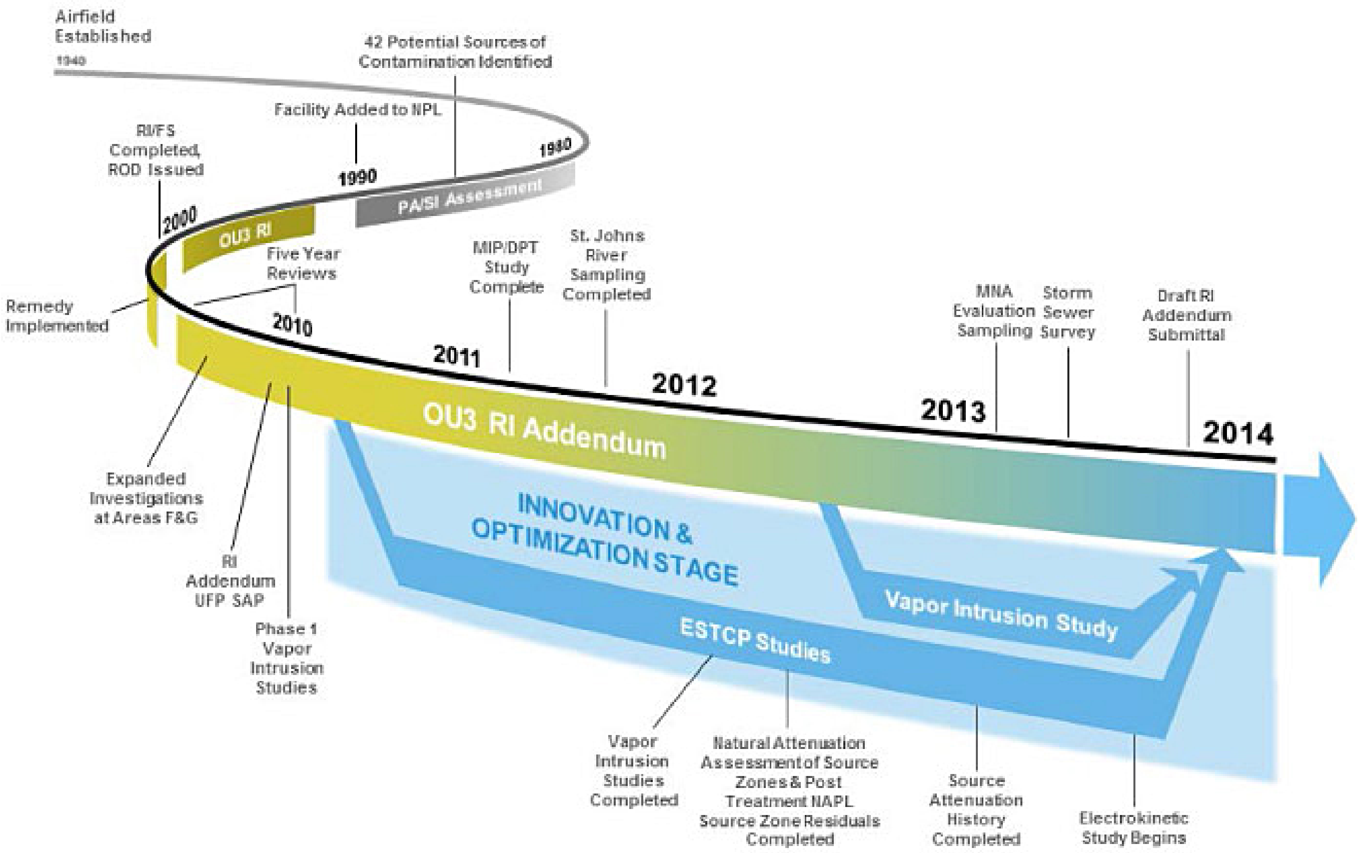

Figure 29. Adaptive site management and site risk characterization process at NAS JAX OU 3 (NAVFAC SE, 2016)**.**

6.5.3 Assessment

OU 3 RI/FS Addendum activities have been conducted to evaluate COC migration to potential human or ecological receptor exposure points. Site media have been assessed using innovative approaches. State-of-the-science technology demonstrations have assessed VI potential, characterized the nature and extent of DNAPL and contaminant mass in key source zones, and evaluated potential COC transport to surface water including groundwater migration into storm sewers and directly to the St. Johns River.

6.5.3.1 VI

The NAS JAX Team developed and implemented innovative methods to investigate subsurface to indoor air VI within and near FRCSE. This project included a systematic screening and prioritization process to select the highest priority buildings, the use of emerging field and laboratory analytical methods, and stakeholder involvement throughout the project. Accomplishments included the following:

- Identification of 12 priority buildings out of 167 that were potentially impacted. This screening and prioritization significantly reduced investigation costs.
- Implementation of emerging sampling techniques with potential to provide significant long-term cost savings to the Navy.
- Minimized impact on NAS JAX operations by reducing the number of buildings identified for further evaluation.

- Demonstrated minimal VI risks at buildings of interest.

Phase 1 of the VI investigation identified buildings of potential interest for further investigation. Only 37 out of 167 buildings within the study area were retained for analysis during Phase 2. Phase 2 consisted of Summa canister sampling and emerging sampling techniques, including Vapor Pin subslab soil gas sampling equipment, HAPSITE portable gas chromatography/mass spectrometry (GC/MS) units, and passive samplers. Results highlighted 12 primary buildings of interest.

6.5.3.2 DNAPL Characterization

Proven and innovative site characterization methods were used to develop a more thorough understanding of COC distribution in the subsurface at OU 3. NAS JAX Team used the Triad Approach to iteratively address groundwater data gaps using direct push technology (DPT) and other screening methods to efficiently locate additional monitoring wells and refine the CSM. ESTCP demonstrations of innovative technologies were used to characterize the distribution of DNAPL contamination present in low-permeability layers at OU 3 and the potential for back-diffusion to serve as a long-term source to groundwater plumes. An ESTCP demonstration also characterized the potential for source zone natural attenuation.

The following innovative technologies were demonstrated at OU 3 to improve understanding of DNAPL distribution and aid in the design of remediation systems:

- High-resolution sampling of aquifer sediment and groundwater to delineate and estimate the amount of DNAPL mass diffused into low-permeability layers
- Membrane interface probe (MIP) to characterize the geotechnical properties of clay layers and the presence of DNAPL contamination
- On-site mobile laboratory and multilevel sampling equipment for real-time delineation of clay layers and detailed profiles of contaminant mass in those clay layers
- Modeling tools to evaluate the natural attenuation of contamination in the clay layers, through long-term diffusion and biodegradation.

6.6.3.3 Storm Sewers and Groundwater Water Exposure Pathways to Surface Water

NAS JAX Team also evaluated the potential impacts to surface water in the adjacent St. Johns River via infiltration of contaminated groundwater into storm sewers and direct migration of contaminated groundwater to the river.

Studies evaluated the tidally influenced stormwater system by conducting sampling throughout tidal cycles at various locations upgradient and downgradient of the point of entry for source areas at Areas A, E, F, and G. The potential impacts of COCs in storm sewers was then evaluated using mixing zone models to estimate the mass and concentration of COCs at discharge points to the St Johns River that were not directly accessible. Results demonstrated that storm sewer discharge of contaminated groundwater to the St. Johns River did not pose a significant ecological or human health risk.

In addition, offshore sampling was conducted through a variety of methods to characterize the nature and extent of COCs migrating beyond the shoreline in groundwater below a clay layer that extends beneath the river. Sediment pore water quality was evaluated by collecting samples at the interface zone in shallow sediments. Sampling tools included DPT methods from a barge anchored in target off shore areas and use of the Trident Probe to collect pore water samples within shallow sediment horizons (Figure 30).

Figure 30. COC plume migrating beneath clay layer in St. Johns River was assessed using trident probe ([NAVFAC SE, 2016](#))**.**

Results of the offshore investigation supported the conclusion that biodegradation processes within organic rich sediment of the river effectively reduce COC concentrations to below applicable regulatory thresholds and there is no significant exposure risk from direct migration of contaminated groundwater to surface water.

6.5.3.4 Refined CSM

Data collected during these studies were used to develop new CSMs for OU 3. Source areas and related comingled plumes were grouped based on similar potential exposure pathways. This approach resulted in groups of plumes in the northern, central, and southern areas of OU 3 and a distinct CSM for each area. In the northern area, potential exposure pathways include VI, contaminated groundwater infiltration into storm sewers, and direct migration of contaminated groundwater to the St. Johns River (Figure 31). In the central area, potential exposure pathways include VI and contaminated groundwater infiltration into storm sewers. In the southern area, potential exposure pathways include contaminated groundwater infiltration into storm sewers and direct migration of contaminated groundwater to the St. Johns River.

The RI Addendum (2015) includes the results of the additional site characterization, including detailed evaluations of nature and extent of contamination, fate and transport, and risk assessment.

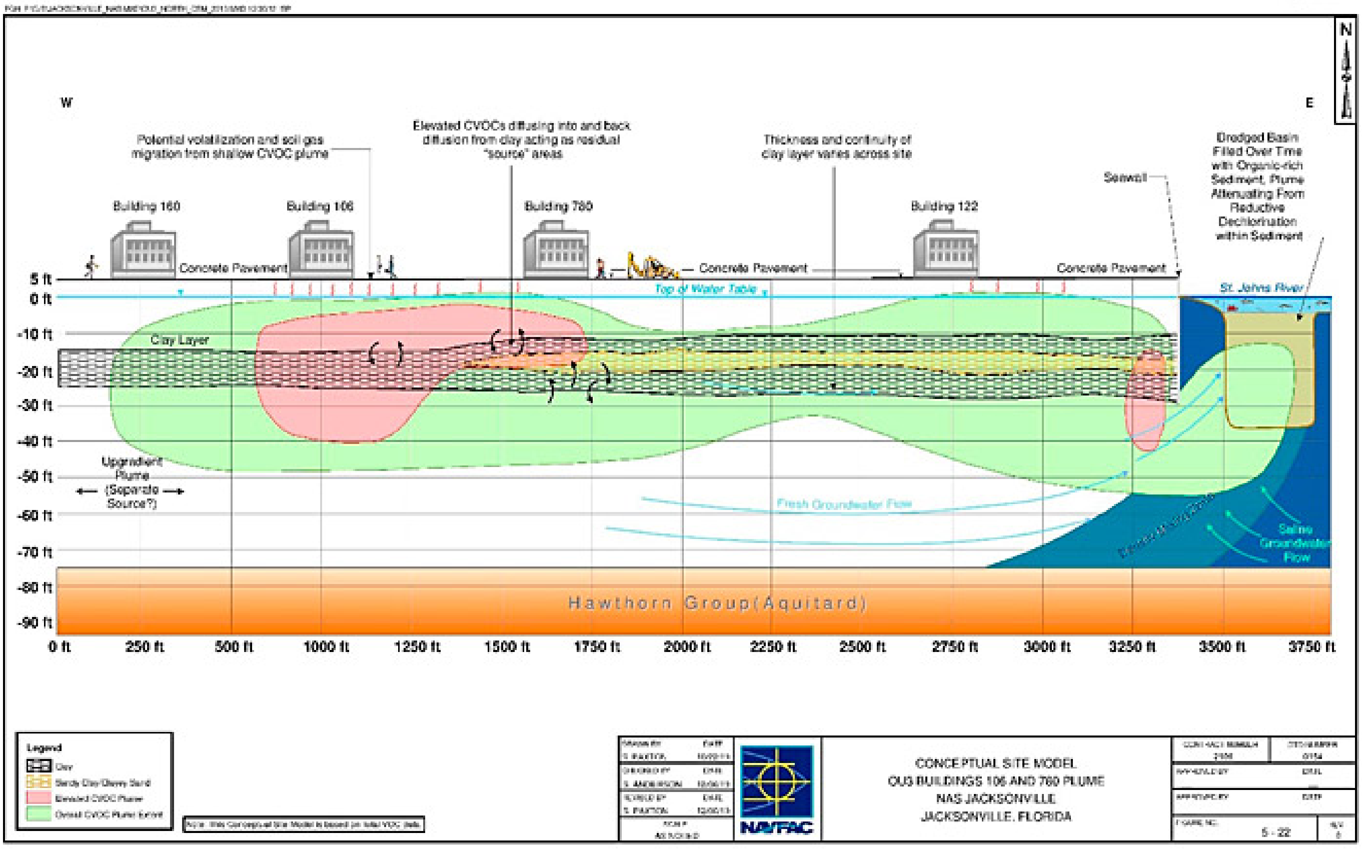

Figure 31. Refined CSM for Northern Area at NAS JAX OU 3 ([Tetra Tech 2015](#))**.**

6.5.4 Monitoring/Optimization (Source Area Treatability/Pilot Studies)

An FS addendum will evaluate further remedial options for the northern, central, and southern source areas at OU 3 to support the site objectives. Long-term monitoring to ensure protection of receptors will be part of any remedy selected. To assist with the remedy evaluation and selection process, the NAS JAX Team commissioned a series of source zone technology demonstrations and pilot studies in the northern and southern areas of OU 3. Demonstration project results will be evaluated in the FS Addendum to support the site-wide replacement ROD. Treatability/pilot studies include the following:

- Enhanced in situ bioremediation (EISB) is being investigated to treat recalcitrant DNAPL and contaminant mass tied up in fine-grained silts and clays within the source area at Building 106. This ESTCP study is being conducted in two phases: Phase I is designed to reduce mass in the surficial aquifer and Phase II will use electrokinetic methods to deliver EISB substrates to DNAPL mass tied up in the silty and clayey aquitard that lies at the base of the surficial aquifer.

- In situ bioremediation pilot test of COCs in the Building 780 source area is being conducted, which includes a significant trichloroethane (TCA) component.
- A full-scale in situ biodegradation pilot study is underway for two source areas in the southern area of OU 3 (Areas F and G) and their comingled plume. The plume is near a primary storm sewer that is a potential pathway for groundwater infiltration and migration to the St. Johns River.

The combined results of these pilot studies will be evaluated during the sitewide FS Addendum.

6.5.5 Regulatory and Stakeholder Involvement

USEPA and FDEP regulators are partnering members with the Navy on the NAS JAX Team, which typically meets bimonthly to review current data and reach consensus on the path forward for OU 3 and other sites at NAS JAX. The formal partnering process at NAS JAX has improved communications and decision making, and has resulted in an efficient and protective site remediation program. NAS JAX Team's commitment to continuous optimization and the use of innovative technologies at OU 3 has saved approximately $2.5 million to date. In addition, successes and lessons learned through innovative technology demonstrations at NAS JAX have been shared throughout the Navy.

Community involvement in this process is provided by the Regional Advisory Board (RAB). Annual updates on the progress of work at NAS Jacksonville and OU 3 are provided to the RAB for their input. After the FS Addendum is completed, a proposed plan will be developed and broader community input solicited and addressed in the selection of a final replacement remedy for OU 3.