DECISION DOCUMENT FOR FINAL REMEDIAL ACTION AT THE POST SOUTH CENTRAL LANDFILL (FST-01) FORT STEWART, GEORGIA

PURPOSE OF THE FINAL REMEDIAL ACTION

This decision document describes the selected Final Remedial Action (FRA) for the Post South Central Landfill (FST-01) at Fort Stewart, Georgia, which consists of Institutional Controls (ICs). Specifically, the ICs proposed for FST-01 include documentation in the Base Master Plan (BMP), deed recordation, zoning controls, maintenance of existing physical barriers, abandonment of eight monitoring wells, installing post-mounted warning signs, and implementation of the Operation & Maintenance (O&M) plan tentatively approved by the Georgia Environmental Protection Division (GA EPD). The selected remedial action is described in detail in the *Final Corrective Action Plan for the South Central Landfill (SWMU 1)*, dated December 1999, and tentatively approved by GA EPD, pending the outcome of the scheduled public review and comment period (August 2000).

This decision document presents the justification for the selected FRA and specifically provides details on the following:

- Site History
- Nature and Extent of Contamination
- Contaminant Fate and Transport
- Preliminary Risk Evaluation (Human and Ecological)
- Human Health Baseline Risk Assessment
- Justification and Purpose of Corrective Action
- Conceptual Design and Implementation
- Public Notification
- Declaration

SITE HISTORY

FST-01, which is located approximately 0.75 mile northwest of the Fort Stewart main cantonment area, has been used for solid waste disposal since the 1940s. Disposal practices at the landfill have ranged from burn-pit to trench-and-fill operations. During the Phase I RFI conducted in 1997, the old, inactive portion of FST-01 was discovered east of the active landfill. The old, inactive portion of the landfill is heavily forested and estimated to encompass approximately 143 acres.

The active, permitted landfill operations are being constructed on the clay cap of the former trench-and-fill portion of the landfill. The active, permitted landfill is comprised of two cells: the eastern cell covers approximately 35 acres, while the western cell, which is closed, covers about 30 acres. The active landfill is operated under Permit No. 089-010 D (SL), issued by the state of Georgia in 1982. The nonputrescible landfill is operated under Permit No. 089-020 D (L), issued by the state of Georgia in 1982. Since 1983, the Post South Central Landfill has been operated under the provisions of the Design and Operation Plan as an area fill landfill with appropriate groundwater monitoring. As a permitted facility, the Post South Central Landfill must meet closure and post-closure requirements in accordance with the requirements of 40 CFR 258.60 and Chapter 391-3-4, Rules of the GA EPD.

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Active Landfill

From 1960 to 1970, the active landfill's eastern cell operated as a garbage, paper waste, and construction debris landfill. Other waste disposed of included sludge from wash racks, sludge from industrial and sanitary wastewater treatment plants, waste air filters from the paint booth in the Directorate of Logistics Allied Trades Shop, grease from mess halls, autoclaved infectious wastes bagged in special containers, and ash from the energy plant. Operational practices have prohibited the disposal of ordnance at the landfill; however, some explosive ordnance has been discovered during routine operations. Upon such discoveries, the subject explosive ordnance has been removed and properly disposed of by Fort Stewart (FSGA). From 1970 to 1982, trench-and-fill operations were used in the active Post South Central Landfill's eastern cell. The trench-and-fill operation has moved from east to west, with previously filled land being restored to forest.

Beginning in the spring of 1982, tumulus refuse disposal operations began, representing the present-day disposal practices at the landfill. These operations have been performed over the western portion of the trench-and-fill area of the landfill. The active portion of the Post South Central Landfill is comprised of two cells that are constructed on the clay cap of the former trench-and-fill landfill. The eastern cell covers approximately 35 acres and the western cell about 30 acres. Wastes disposed of at the active landfill include dry, construction-type waste; putrescible garbage; and properly packaged asbestos.

The northwest portion of the Post South Central Landfill was previously a borrow pit for the site and is presently being used for disposal of demolition/construction debris (nonputrescible waste).

Based upon the results reported in the Revised Final Phase II RFI Report (SAIC 1999) for the active portion of FST-01, a few constituents present in the groundwater were detected above maximum contaminant levels (MCLs) [i.e., bis(2-ethylhexyl)phthalate at SC-M9 and NMW-2A]. In accordance with the GA EPD-approved recommendation for corrective action, these constituents will continue to be monitored through the Groundwater Monitoring Plan (GMP), approved by the GA EPD Land Protection Division. Corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells is not required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify if any contaminant levels become elevated and/or any trends develop in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. All analytical data will continue to be submitted to the GA EPD Land Protection Division. The implementation of the GMP for the Active Landfills is funded with OMA dollars, as part of the Installation's compliance monitoring program.

Old, Inactive Landfill

During the Phase I RFI, it was discovered that an older portion of the landfill existed east of the active landfill and continued to Georgia State Route 144/119. The old, inactive landfill is estimated to encompass approximately 80 acres. Aerial photographs dated 1947 and 1957 indicate disposal was occurring at the old, inactive landfill during that period.

A 1966 aerial photograph shows approximately two-thirds of the old landfill immediately west of Georgia State Route 144/119 with successional vegetation, indicating that by that time the landfill was no longer being used. Disposal at the current, active Post South Central Landfill site and complete vegetative cover of the old, inactive landfill area are evident in a 1975 aerial photograph; these conditions continue today. Additional prominent site features associated with the old, inactive portion of the landfill include a fenced cemetery, a dumpster maintenance area, and a drainage ditch to drain the low area around a dumpster maintenance area. The dumpster maintenance area is located on the south side of the FST-01 access road, approximately 600 feet from the Wilson Avenue entrance gate. Dumpsters are stored and refurbished at the facility. A drainage ditch, which begins southwest of the dumpster cleaning area, circles the area, and ultimately discharges to the marshy area along Taylors Creek, was dug to drain the low area around the dumpster cleaning area so that the area could be built.

The old, inactive landfill received all waste generated at Fort Stewart during its operation. According to previous operators, this waste included materials similar to those currently received at the active landfill in addition to sludges from the sewage treatment plant, scrap metal, demolition/construction debris, sanitary/municipal waste, and drummed waste from the tear gas training facility. According to information provided by former landfill employees, operational practices at the old, inactive landfill involved excavation of a large pit to below the water table; stockpiling of the excavated soil; disposal and compaction of the solid waste; and covering with the stockpiled, excavated soil. In addition, intermittent burning in the large pits was used to reduce the volume of the disposed waste. Again, former employees have stated that this operational practice was discontinued because it was reducing air quality and there was concern regarding live rounds discharging during the burning. The disposal areas were covered with local soil that had been removed during excavation of the pits and the surrounding area. Some areas of the old, inactive landfill were planted with pines, whereas other areas were allowed to revegetate naturally with successional species.

Based on the findings presented in the Revised Final Phase II RFI Report dated March 1999 (SAIC 1999), a "no further action required" status was assigned to the old, inactive portion of FST-01 for investigative purposes. As recommended by the Phase II RFI Report and as agreed to with GA EPD, a Corrective Action Plan (CAP) was recommended for FST-01 because buried waste will remain in place. The CAP is necessary to control intrusive activities at this site and to be protective of the health of humans potentially coming in contact with the buried waste and to prevent the use of groundwater as a drinking water source.

NATURE AND EXTENT OF CONTAMINATION

Results of chemical analyses performed during the Phase I and Phase II RFIs indicate that soils, groundwater, sediment, and surface waters contain organic and metal contaminants at concentrations greater than their reference background concentrations.

The reference background criteria for the Post South Central Landfill have been developed based on data from background samples collected across Fort Stewart for Solid Waste Management Units (SWMUs) under Phase I and/or

Phase II RFIs. In general, reference background samples were collected in each medium at locations upgradient or upstream of each site so as to be representative of naturally occurring conditions at SWMUs under investigation.

EPA Region IV methodology (EPA 1996) was used as guidance for the development of the background data set for screening metals data. In cases in which enough samples (e.g., more than 20) are collected to define background, a background upper tolerance level can be calculated. In cases in which too few samples (e.g., fewer than 20) are collected to define background, background can be calculated as two times the mean background concentration (EPA 1996). Given that fewer than 20 background samples were collected for Fort Stewart, the latter method was used for calculating reference background concentrations.

The reference background concentrations for surface soil, subsurface soil, groundwater, surface water, and sediment were calculated as two times the average concentration of all of the locations selected to be in the background data set. If a chemical was not detected at a site, then one-half the detection limit was used as the concentration when calculating the reference mean background concentration.

Inorganics were considered site-related contaminants (SRCs) if their concentrations were above the reference background concentrations. Organics were considered SRCs if they were simply detected because organic constituents are considered anthropomorphic in nature.

Appendix G of the Revised Final Phase II RFI Report (SAIC 1999) presented the summary of background data as well as the two-times-mean background concentrations. Given the limited background data, the mean concentration for soils in the eastern United States is also presented for comparative purposes. Because of the limited number of background samples, the screening value for background may be heavily skewed as a result of an outlier in the sampling data.

Isolated low levels of organic contamination (VOCs, SVOCs, and pesticides) and metals are present in soil; however, no clear distribution or trends of contaminants are evident. Acetone, methylene chloride, toluene, and 1,2,4-trichlorobenzene were detected in surface soil. 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected in two surface soil samples, SC-M13 and SC-M18. 1,2,4-Trichlorobenzene, pyrene, 2-butanone, acetone, methylene chloride, styrene, and toluene were detected in subsurface soil.

Selenium was detected in surface soil above the reference surface soil background concentration in a single soil sample. Selenium concentrations in surface soil were not above the FSGA reference background concentrations for subsurface soil.

Low levels of VOCs, SVOCs, metals, and Radium 226/228 are present in the surficial aquifer; however, no clear distribution or trends of contaminants are evident. Trichloroethene was detected in a single groundwater sample (direct-push sample GP-7) above its respective MCL. Bis(2-ethylhexyl) phthalate was detected in groundwater above its MCL (6 μg/L) at two locations (NMW-2A and SC-M9) at concentrations of 7.8 μg/L and 61.4 μg/L, respectively. Metals were detected in groundwater, with only one containing a concentration above the MCL. Lead was detected at 18.4 μg/L at monitoring well SC-M17 (action level 15 µg/L). However, the filtered lead concentration at SC-M17 was nondetect, indicating that the lead may be associated with colloid particulates in the groundwater. Barium, cadmium, chromium, iron, and lead were detected above the FSGA reference background concentrations. Low levels of Radium 226/228 were detected in the groundwater. The combined Radium 226/228 concentrations exceeded the MCL at two locations (SC-M5 and SC-M19). The groundwater field sampling data (dissolved oxygen, oxidation-reduction potential, pH) do not indicate that leachate is impacting the groundwater.

Low levels of organics, metals, and Radium 226/228 were detected in sediment and surface water. Chromium, lead, mercury, and Radium 228 were detected in sediment above site-specific background criteria. Two VOCs (acetone and 2-butanone) were detected in one sediment sample, and one SVOC (1,2,4-trichlorobenzene) was detected in two sediment samples. Diethyl phthalate and pyrene were detected in surface water. Radium 228 was detected in surface water above the site-specific background criterion. A tabular summary of SRCs for the Post South Central Landfill (FST-01) is presented in Table 1.

CONTAMINANT FATE AND TRANSPORT

Contaminant fate and transport analysis provided an assessment of the potential migration pathways and transport mechanisms affecting the chemicals at the sites. In particular, the leachability of contaminants from soil to groundwater and their natural attenuation in groundwater were evaluated.

Acetone and methylene chloride in the soil at the Post South Central Landfill exceeded EPA Generic Soil Screening Levels (GSSLs). These constituents may leach into groundwater at concentrations that exceed groundwater standards [i.e., concentrations that exceed the MCL or, in the absence of an MCL, the risk-based concentration (RBC) for drinking water]. The concentration of acetone exceeded the GSSL in only one out of nine detections in soil. This soil sample, SC-M16, was located outside of the boundary of the landfill or the area affected by the landfill operations. Therefore, the acetone present in this sample is not associated with the landfill operations. Acetone is not considered a contaminant migration contaminant of potential concern (COPC). Acetone was detected in groundwater above its RBC as established by EPA Region III and was considered to be a human health COPC in groundwater.

All of the detected methylene chloride concentrations (seven out of 25 soil samples) exceeded the GSSL. One of the detections of methylene chloride (SC-M15) was located outside the boundary of the landfill or the area affected by the landfill operations. The maximum concentration of methylene chloride (52.2 µg/kg) was detected at SC-M15. Methylene chloride was the only contaminant migration COPC in soil around the old, inactive portion of the landfill. Methylene chloride was not detected in groundwater.

Selenium exceeded its reference background criterion in soil; however, it did not exceed its GSSL based on leaching to groundwater; therefore, selenium was not considered a contaminant migration COPC.

Chromium, lead, and Radium 226/228 exceeded their respective RBCs/MCLs in groundwater. The one elevated concentration of lead may be due to colloid particulates in the groundwater. Off-site migration of chromium, lead, and Radium 226/228 will be limited, however, because of their high retardation factors.

Bis(2-ethylhexyl)phthalate and trichloroethene exceeded their MCLs but were not found in soils. Therefore, bis(2-ethylhexyl)phthalate and trichloroethene were not screened as contaminant migration COPCs in soils. Maximum groundwater concentrations of bis(2-ethylhexyl)phthalate and trichloroethene were detected at 61.4 µg/L (MCL 6 µg/L) and 5.4 µg/L (MCL 5 µg/L), respectively. These two concentrations above MCLs represent only a single detection out of 51 groundwater samples (23 direct-push, two vertical-profile, and 22 groundwater monitoring wells). Bis(2-ethylhexyl)phthalate and trichloroethene were detected in the groundwater only and not in soils, indicating that these contaminants may have leached in the past or are potentially leaching directly from a very confined or small point source. Off-site migration of these organic contaminants will be limited due to retardation and degradation through various processes as well as the slow movement of groundwater (12.8 feet/year). At the velocity of 12.8 feet/year, site groundwater will take 94 years to reach Taylors Creek. In reality, contaminants will move slower than groundwater due to retardation, and the organic contaminants will gradually decay in nature.

PRELIMINARY RISK EVALUATION

Human Health Preliminary Risk Evaluation

The human health preliminary risk evaluation included a Step 1 risk evaluation to determine potential human health risks associated with the contaminants. Human health COPCs have been identified as those constituents present at concentrations higher than their reference background criteria and higher than their respective risk-based or applicable or relevant and appropriate requirement-based screening criteria. Based on the results of the screening and the weight-of-evidence analysis, potential human health COPCs have been identified for groundwater. There are no human health COPCs for surface soil, subsurface soil, surface water, or sediment.

The initial human health COPCs for groundwater were identified because they present a potential threat to human health as a result of use of groundwater as a source of drinking water. The initial human health COPCs for groundwater are iron, acetone, benzene, chromium, lead, Radium 226, Radium 228, bis(2-ethylhexyl)phthalate, 1,2-*cis*-dichloroethene, and trichloroethene. Iron, Radium 226, and Radium 228 are not hazardous constituents as defined by Section I.E of FSGA's Hazardous Waste Facility Permit #HW-045 (S&T) and are not subject to the corrective action requirements under the terms and conditions of the permit or under the Georgia Hazardous Waste Management Act, O.C.G.A §12-8-60, et seq., as amended, and the Rules for Hazardous Waste Management, Chapter 391-3-11, promulgated pursuant thereto, as amended. Therefore, iron, Radium 226, and Radium 228 were eliminated as human health COPCs in groundwater at FST-01.

A baseline human health risk assessment (BHHRA) was performed to quantitatively assess the risks associated with exposure to human health COPCs in groundwater. In addition, the baseline risk assessment evaluated the risks associated with the leaching of the contaminant migration COPC (methylene chloride) to groundwater underlying the site and migrating off-site via groundwater. A tabular summary of contaminant screening of groundwater results to action levels is presented in Table 2.

Ecological Preliminary Risk Evaluation

The Phase II RFI performed an ecological preliminary risk evaluation (EPRE) for potential terrestrial and aquatic receptors at the site. The EPRE for the Post South Central Landfill identified ecological COPCs in groundwater based on a comparison of their maximum site concentrations to EPA Region IV ecological screening values (ESVs). No ecological COPCs were identified in surface water or sediment. Preliminary risk calculations for identified ecological COPCs in surface soil (selenium and DDT) and groundwater [barium, iron, lead, bis(2-ethylhexyl)phthalate, and total xylenes] were based on a comparison of detected concentrations to toxicity reference values (TRVs) for surrogate species representing ecological receptors. Uncertainty analysis of the ecological COPCs in surface soil and groundwater resulted in their being eliminated as ecological COPCs. The uncertainty analysis is summarized below.

Selenium and the pesticide DDT and its metabolites were detected in surface soil at the Post South Central Landfill at concentrations that exceeded both reference background criteria and the TRVs for terrestrial receptors. Selenium was detected in only one of eight surface soil samples at FST-01 at only slightly above its background concentration (0.69 mg/kg versus 0.63 mg/kg).

Selenium was not detected in the other seven soil samples. Therefore, selenium is not considered an ecological COPC in surface soil at SWMU 1. DDT and its metabolites in surface soil at SWMU 1 are ecological COPCs for birds with small home ranges ingesting soil-dwelling invertebrates. DDT and its metabolites are likely to be present in surface soil in most areas of Georgia and the southeast due to the past widespread use of DDT as an insecticide. Assuming the effects of DDT, DDE, and DDD are additive, the combined exposure at each of the two sampling locations at which these constituents were detected does not exceed the lowest-observed-adverse-effect level (LOAEL) dose. The fact that maximum estimated doses lie between the no-observed-adverse-effect level and the LOAEL suggests that the pesticides and their metabolites are not ecological COPCs in surface soil at FST-01.

Barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes (total) are present in groundwater at the Post South Central Landfill at concentrations that exceed EPA Region IV ESVs for surface water. Bis(2-ethylhexyl)phthalate was detected in groundwater at concentrations above background criteria and that resulted in estimated exposures exceeding TRVs for terrestrial ecological receptors that ingest fish and other aquatic biota. The ecological COPCs in groundwater are barium, iron, lead, bis(2-ethylhexyl)phthalate, and xylenes for aquatic biota and bis(2-ethylhexyl)phthalate for birds ingesting fish exposed to groundwater potentially discharging to surface water. The concentrations of these constituents in numerous monitoring wells and direct-push groundwater samples exceeded background criteria and risk-based screening or reference values.

However, none of these constituents is an ecological COPC in surface water and sediment at FST-01. This suggests that dilution, degradation, sorption, or other processes are operating to reduce the low concentrations in groundwater discharging to Taylors and Mill creeks or that groundwater at FST-01 has not yet migrated to the creeks. Groundwater flow rates indicate that it takes approximately 94 years for groundwater to reach Mill and

Taylors creeks. Therefore, groundwater constituents are not ecological COPCs at the present time because they have not been indicated as ecological COPCs in surface water and sediment. The groundwater constituents are not likely to be ecological COPCs in the future because of their low concentrations and associated small hazard quotients (HQs) and the continued natural attenuation processes occurring in the subsurface soil (e.g., dilution, degradation, absorption).

In summary, the Phase II RFI (SAIC 1999) concluded that there is no present ecological risk at FST-01 and that the site is unlikely to pose an ecological risk in the future.

BASELINE HUMAN HEALTH RISK ASSESSMENT

A BHHRA was performed to assess groundwater around FST-01. The human health COPCs identified in groundwater include acetone, benzene, bis(2-ethylhexyl)phthalate, 1,2-*cis*-dichloroethene, trichloroethene, chromium, and lead. Methylene chloride was identified as a contaminant migration COPC based on its potential to leach into groundwater, resulting in potential exposure of receptors. Although acetone was identified as a contaminant migration COPC, it was detected above its GSSL in only SC-M16, which was located in an area determined to not be impacted by FST-01; therefore, the potential for acetone to leach into groundwater from soil was not evaluated in the BHHRA. Potential future groundwater concentrations of methylene chloride were estimated using the Seasonal Soil Compartment Model. This concentration was included in the risk assessment in addition to the human health COPCs.

The potential current and future receptors evaluated included an on-site and off-site worker, a resident (adult and child), and a child playing in Taylors Creek, a point of groundwater discharge. The worker and resident were evaluated based on a potential drinking water scenario in which drinking water is obtained from the surficial aquifer. The Installation worker is the only likely receptor population. However, GA EPD guidance states that resident populations must be evaluated as both on-site and off-site receptors. Groundwater underlying FST-01 flows predominantly in the direction of Taylors Creek, where it is likely to discharge to surface waters; therefore, the potential risk to a child playing in Taylors Creek was also evaluated.

Constituents migrating off-site were modeled to determine groundwater concentrations at the points of exposure. The model assumed that the maximum measured concentration of a constituent was present in groundwater at the northern boundary of the old, inactive landfill. It was assumed that all off-site receptors come into contact with the groundwater at some point north of the site, which is the predominant direction of groundwater flow. The exposure-point groundwater concentrations of COPCs for the off-site receptors were negligible; therefore, potential risks resulting from exposure of off-site receptors would be well below target values.

Ingestion, dermal absorption, and inhalation were evaluated as the potential exposure pathways (i.e., routes of exposure of the constituent to the body). The risks associated with carcinogenic hazardous constituents were estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen [i.e., the incremental lifetime cancer risk (ILCR)]. The ILCRs for the individual carcinogens are summed to provide the total ILCR. A total ILCR of less than 1E-6 does not represent a significant carcinogenic risk. The risks associated with the systemic effects of noncarcinogenic toxicity were evaluated by comparing an estimated intake (mg/kg/day) to a reference dose. This ratio of estimated intake over the reference dose is termed the HQ. The sum of all of the HQs for a given exposure route (i.e., oral, inhalation, or dermal) is called the hazard index (HI). HIs less than 1.0 indicate that the sum of exposures to all of the constituents present is not likely to result in adverse health effects. Lead does not have a reference dose, but it does have a maximum acceptable blood-lead concentration of 10 μg/dL in children, which represents the most sensitive receptor population. The blood-lead levels for children ages 1 to 7 were estimated to determine if there is an unacceptable risk associated with exposure to lead in groundwater.

Constituents present in groundwater at FST-01 do not present a significant noncarcinogenic risk to human health. The quantitative estimates of noncarcinogenic risks were below their target values for both on-site occupational and residential receptor populations. The carcinogenic risks for the occupational receptor population was below the target risk value of 1E-6; however, the carcinogenic risk for the on-site residential receptors exceeded the target value with an ILCR of 8.9E-6. This value includes an ILCR of 3.4E-6 resulting from exposure to methylene chloride that may leach into groundwater. The other risk drivers are benzene (ILCR = 2.5E-6) and bis(2-ethylhexyl)phthalate (ILCR = 2.1E-6).

The remedial levels for benzene and bis(2-ethylhexyl)phthalate were based on their respective MCLs (5 μg/L and 6 μg/L, respectively). The MCL for benzene was greater than the maximum detected value of 2.5 μg/L; therefore, corrective action is not required to address the presence of benzene in groundwater. Groundwater concentrations of bis(2-ethylhexyl)phthalate exceeding the remedial level were detected in only those wells (NMW-2A and SC-M9) associated with the active landfill; therefore, bis(2-ethylhexyl)phthalate is not associated with the old, inactive landfill (Table 3) and is not addressed in this Decision Document.

The remedial soil level for methylene chloride was determined to be 3.3 mg/kg and represents a concentration of the constituent in soil that is not likely to leach into groundwater and result in groundwater concentrations that exceed the MCL for methylene chloride (5 μg/L). Only four sampling locations indicated methylene chloride above the 3.3 mg/kg remedial level. SC-M11, SC-M12, SC-M14, and SC-M16 had methylene chloride concentrations of 9.2 mg/kg, 13.7 mg/kg, 3.9 mg/kg, and 52.2 mg/kg, respectively; SC-M16 is not located within the boundaries of the FST-01 (Table 4).

The exposure scenario for methylene chloride soil contamination leaching to groundwater assumes that in the future a residence will be built on-site and that the household drinking water will come directly from the surficial aquifer. Current planning under the Fort Stewart Base Master Plan (BMP),

which goes through the year 2020, does not include construction of any facilities on the old, inactive portion of the landfill. Methylene chloride degrades rapidly in groundwater (its biodegradation half-life in groundwater equals 112 days); therefore, the methylene chloride potentially leaching to groundwater would completely degrade before any structure would be built on the site. In addition, methylene chloride was not detected in any of the groundwater samples associated with the old, inactive portion of the landfill, including those located in the area of the methylene chloride soil contamination (SC-M11, SC-M12, and SC-M14), indicating that natural attenuation of methylene chloride may be occurring. Therefore, given the unlikely possibility of exposure of an on-site resident to methylene chloride in the surficial groundwater and the restricted usage through 2020 under the BMP, Fort Stewart's recommendation of no further action for methylene chloride in soil, as presented in the Revised Final Phase II RFI Report, was approved by GA EPD.

In conclusion, of the two constituents detected in groundwater [benzene and bis(2-ethylhexyl)phthalate], benzene was not detected above its MCL and bis(2-ethylhexyl)phthalate was detected in monitoring wells (NMW-2A and SC-M9) located around the active portion of the landfill, indicating that this constituent is associated with the active landfill and not the old, inactive landfill. The active portion of FST-01 is operated under Permit Nos. 089-010D (SL) and 089-020D (L), and bis(2-ethylhexyl)phthalate, which was detected above the MCL at SC-M9 and NMW-2A, will continue to be monitored through the GMP, as approved by the GA EPD Land Protection Division, and corrective action to reduce the identified concentrations of bis(2-ethylhexyl)phthalate in these two wells will not be required. The GMP will allow continued evaluation of potential contaminant migration of the groundwater and surface water and will identify any elevation of contaminant levels and/or development of any trends in contaminant distribution across the active portion of the landfill. In addition, the present operational and design procedures are structured to prevent off-site migration of contaminants from the active landfills. The active portion of FST-01 will continue to be monitored in association with the approved GMP, and all analytical data will continue to be submitted to the GA EPD Land Protection Division.

Methylene chloride was indicated in soil above its remedial level as a contaminant migration COPC at three locations around the old, inactive portion of the landfill; therefore, methylene chloride was identified as a contaminant migration COPC in soil based on the unlikely possibility of exposure to someone constructing a residence on the site and drinking groundwater containing methylene chloride. Fort Stewart's recommendation of no further action, as presented in the Revised Final Phase II Report, was approved by GA EPD as long as restricted use of the groundwater, as currently planned in the BMP, was maintained and controlled.

JUSTIFICATION AND PURPOSE OF CORRECTIVE ACTION

Purpose

EPA has established corrective action standards that reflect the major technical components that should be included with a selected remedy (EPA 1988). These include the following: (1) protect human health and the environment; (2) attain media cleanup standards set by the implementing agency; (3) control the source of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment; (4) comply with any applicable standards for management of wastes; and (5) other factors.

Remedial Response Objectives

Based on the findings of the site characterization at this site, the primary goal and purpose for implementing corrective measures at the old, inactive portion of FST-01 is limited to protection of human health and safety. To achieve this goal, two primary remedial response objectives have been established for FST-01: (1) to prohibit the ingestion of shallow groundwater from the subject site; (2) to limit the disturbance of subsurface soils to minimize contact with buried waste; and (3) to identify procedures to evaluate the subsurface characteristics prior to any construction within the boundary of the old, inactive portion of the landfill. Any corrective measures that pose a significant threat to human health and safety during implementation (e.g., methods that would involve disturbance of subsurface soils) will not be evaluated. Implementation of the selected remedial response will achieve the best overall results with respect to such factors as long-term reliability and effectiveness, short-term effectiveness, implementability, and cost.

CONCEPTUAL DESIGN AND IMPLEMENTATION

Based on the level and type of subsurface soil and groundwater contamination, a cost-effective corrective action was selected that would adequately protect human health.

Based on the technology evaluation performed for the site (see Table 5 above), Alternative 1 (see CAP, SAIC 1999) was selected because it will provide a sufficient level of protection of human health at a relatively low cost. The selected corrective action alternative involves a multi-layered approach to restricting human activity within the boundaries of the subject site. The selected set of institutional controls comprising this alternative will provide a combination of land use restrictions and prohibitions and physical barriers. Land use restrictions will be documented and/or enforced through deed recordation, BMP, zoning restrictions, and signage. In addition to establishment of prohibitions for groundwater use, eight monitoring wells will be abandoned. No additional access barriers will be constructed because existing man-made and natural physical barriers, which include site access gates, Taylors Creek, existing roads, and natural and man-made drainage features, are suitable for restricting human activity.

Justification of Selection

Alternative 1 has been selected because it will provide effective protection of human health at a relatively low cost. Although the installation of fencing would provide an additional degree of protection, Alternative 2 is not considered cost effective. The additional protection that the fence would provide against inadvertent access to the site and unauthorized excavation below ground would be minimal and would not justify the significantly greater expense of implementing Alternative 2. Additionally, suitable physical barriers are already present at the subject site to discourage human activity that might result in disturbance of the subsurface (e.g., vehicular traffic, hunting). Institutional controls described for Alternative 1 will provide a sufficient level of protection for human health and an adequate degree of long-term reliability and effectiveness as well as short-term effectiveness. The institutional controls under Alternative 1 can be easily and affordably implemented. Justification for selection of this corrective action alternative is further detailed in the following evaluations of effectiveness, implementability, and cost.

Effectiveness. Warning signs and documented land use restrictions will be highly effective and provide long-term reliability with respect to preventing human exposure to physical contact with the buried waste within the boundaries of the old, inactive portion of FST-01. To maintain an acceptable level of long-term reliability and effectiveness, the BMP will establish land use controls during ownership by DoD. Prior to the planning of any construction activities at FSGA, the BMP must be reviewed. In addition, all construction projects will be reviewed for approval by the Base Master Planner and the Fort Stewart Directorate of Public Works during the planning stages. These land use controls will remain in effect after transfer of DoD ownership by restrictions imposed through deed recordation.

Existing natural and man-made barriers will provide long-term reliability and effectiveness in preventing unauthorized access. The existing access gates at landfill access points are closed and locked during non-operational hours. Since the installation of the gate at Wilson Avenue, FSGA has observed a marked decrease in activity (i.e., vehicular traffic) at this site. Taylors Creek provides a natural barrier along the northern boundary of the site.

Additionally, the proposed well abandonment and groundwater use restrictions will provide an effective method for preventing the use of groundwater as drinking water or for irrigation at the site. The surficial aquifer is not an adequate source of drinking water at Fort Stewart and is not used. The BMP will be modified to officially restrict use, further avoiding use of the surficial groundwater at the site.

An annual O&M program will be administered to replace or repair warning signs, which may deteriorate over time. Implementation of the O&M Plan will ensure the effectiveness of this program. The O&M program for this CAP will involve inspection as well as potentially replacing or repairing warning signs.

Providing institutional controls over the short term will be a very effective means of minimizing or eliminating human exposure to buried waste within the boundaries of FST-01. Posting of warning signs together with existing access restrictions will be most effective over the short term. There is no current risk, and the site is not being used, so access is already limited.

Implementability. Very few factors limit implementability of the institutional controls under evaluation. On-site personnel or contractors can readily perform posting of signs. Suitable barriers already exist that restrict unauthorized access to the site. O&M inspections require few resources with respect to inspection personnel and materials for repair. Establishment of an adequate combination of land use management tools will require additional time and effort for development, preparation, and processing of necessary paperwork. However, the time and resources are available to administer and acquire necessary land use controls; the property is not expected to be sold or leased in the near future. Administrative provisions already exist to facilitate incorporation of land use controls into the BMP and to facilitate deed recordation.

Cost. The estimated total life-cycle cost of installation of warning signs, well abandonment, administrative activities associated with acquisition of legal controls, O&M activities, and management and oversight is $44,843. Alternative 2, which would provide the same land use controls as Alternative 1 but would also include installation of fencing, was significantly more expensive ($126,679) than the selected alternative.

PUBLIC NOTIFICATION

GA EPD has prepared a notification which explicitly describes the FRA selected for FST-01, and per Fort Stewart's Hazardous Waste Permit HW-045(S&T) the public will be afforded to review the notification and/or the entire Corrective Action Plan for a period of thirty days. At the conclusion of the review period, GA EPD will either grant final approval of the selected FRA or revise their tentative approval based on review and comments received by the public. It is anticipated that this review period will occur in August 2000 and final approval from GA EPD will be provided to the Installation in early September 2000.

DECLARATION

The selected Final Remedial Action are protective of human health and the environment, attains Federal and State requirements that are applicable or relevant and appropriate to the FRA, and will be cost-effective.

Due to the fact that the selected course of action was presented in the CAP and approved by GA EPD, the five-year review will not apply to the proposed FRA.

This decision document was developed by the Directorate of Public Works at Fort Stewart, with support from the U.S. Army Corps of Engineers and Science Applications International Corporation.

Table 1. Summary of Site-Related Contaminants

Analyte	Maximum Concentration			Maximum Concentration	
	Surface Soil	Subsurface Soil	Sediment	Groundwater	Surface Water
Volatile Organic Compounds					
	µg/kg			*µg/L*	
1,1,2,2-Tetrachloroethane				0.69	
1,1-Dichloroethane				0.56	
1,2-Dichloropropane				0.24	
1,2-*cis*-Dichloroethene				21	
1,2-*trans*-Dichloroethene				1.6	
2-Butanone		14.1	14.5	8.6	
Acetone	44,100	638	297	1,140	
Benzene				2.5	
Chlorobenzene				9.8	
Chloroform				22	
Ethylbenzene				26.9	
Methylene chloride	52.2	2.8			
Styrene		0.67		0.29	
Tetrachloroethene				0.36	
Toluene	59.4	6.1		17.8	
Trichloroethene				5.4	
Xylenes, total				212	
Semivolatile Organic Compounds					
	µg/kg			*µg/L*	
1,2,4,Trichlorobenzene	3.2	2.4	3.4		
4-Methylphenol				1.1	
Bis(2-ethylhexyl)phthalate				61.4	
Diethyl phthalate				5.2	0.86
Pyrene		2.5			0.1
Radionuclides					
	pCi/g			*pCi/L*	
Radium 226				1.63	
Radium 228			1.29	6.9	3.97
Pesticides					
	mg/kg			*mg/L*	
4,4'-DDD	3.8				
Dieldrin				0.025	
Heptachlor		0.39			
Metals					
	mg/kg			*mg/L*	
Barium				134	
Cadmium				0.59	
Chromium			3.5	11.6	
Iron				22,000	
Lead			6	18.4	
Mercury			0.02		
Selenium	0.69				

Table 2. Contaminant Screening of Groundwater Results to Action Levels

Analyte	Freq. of Detection	Minimum Detected	Maximum Detected	Human Health Criterion	Human Health COPC	Justification
			Metals (µg/L)			
Barium	21/21	20.9	134	260	No	Max Detect < Risk Criteria
Cadmium	2/21	0.25	0.59	1.8	No	Max Detect < Risk Criteria
Chromium	7/21	0.71	11.6	10.9	Yes	Max Detect > Risk Criteria
Iron	21/21	76.5	22,000	1,100	Yes	Max Detect > Risk Criteria
Lead	17/21	0.12	18.4	15 [a]	Yes	Max Detect > Risk Criteria
			Radionuclides (pCi/L)			
Radium 226	10/21	0.501	1.63	0.161 [b]	Yes	Max Detect > Risk Criteria
Radium 228	21/21	1.33	6.9	0.192 [b]	Yes	Max Detect > Risk Criteria
			Pesticides (µg/L)			
Delta-BHC	1/21	0.04	0.04	ND	No	Weight of Evidence [c]
Dieldrin	1/21	0.025	0.025	0.0042	No	Weight of Evidence [c]
			Semivolatile Compounds (µg/L)			
4-Methylphenol	1/21	1.1	1.1	18	No	Max Detect < Risk Criteria
Bis(2-ethylhexyl)phthalate	8/21	0.53	61.4	4.8	Yes	Max Detect > Risk Criteria
Diethyl phthalate	6/21	0.56	5.2	2,900	No	Max Detect < Risk Criteria
			Volatile Compounds (µg/L)			
1,1,2,2-Tetrachloroethane	1/50	0.69	0.69	0.052	No	Weight of Evidence [c]
1,1-Dichloroethane	1/50	0.56	0.56	81	No	Max Detect < Risk Criteria
1,2-Dichloropropane	1/50	0.24	0.24	0.16	No	Weight of Evidence [c]
1,2-*cis*-Dichloroethene	9/46	0.4	21	6.1	Yes	Max Detect > Risk Criteria
1,2-*trans*-Dichloroethene	1/46	1.6	1.6	12	No	Max Detect < Risk Criteria
2-Butanone	1/50	8.6	8.6	190	No	Max Detect < Risk Criteria
Acetone	11/32	15.1	1,140	370	Yes	Max Detect > Risk Criteria
Benzene	3/50	0.23	2.5	0.36	Yes	Max Detect > Risk Criteria
Chlorobenzene	1/50	9.8	9.8	3.9	No	Weight of Evidence [c]
Chloroform	2/50	0.51	22	0.15	No	Weight of Evidence [c]
Ethylbenzene	13/50	0.22	26.9	130	No	Max Detect < Risk Criteria
Styrene	1/50	0.29	0.29	160	No	Max Detect < Risk Criteria
Tetrachloroethene	1/50	0.36	0.36	1.1	No	Max Detect < Risk Criteria
Toluene	11/50	0.27	17.8	75	No	Max Detect < Risk Criteria
Trichloroethene	3/50	0.35	5.4	1.6	Yes	Max Detect > Risk Criteria
Xylenes, total	16/50	0.43	212	1,200	No	Max Detect < Risk Criteria

[a]Lead action level of 15 mg/L is based on a blood lead concentration of 10 mg/dL.
[b]Risk-based concentrations for radionuclides have been calculated for use at U.S. Department of Energy facilities (DOE/ORO 1998).
[c]Weight-of-evidence analysis indicated this constituent was detected infrequently (frequency of detection of 5 percent or less).
ND = No data available.

Table 3. Remedial Levels for Groundwater and Soil

Chemical	Groundwater Remedial Level MCL (µg/L)	Maximum Groundwater Concentration (µg/L)	Target Groundwater Concentration (µg/L)	Remedial Level Soils (mg/kg)	Maximum Soil Concentration (mg/kg)
Benzene	5	2.5	NA	NA	NA
Bis(2-ethylhexyl)phthalate	6	61.4	NA	NA	NA
Methylene chloride	NA	NA	5	3.3	13.7

NA = Not applicable.

Table 4. Location of Exceedances above Remedial Levels

Chemical	Groundwater		Soil	
	Concentration above Remedial Level (µg/L)	Location[a]	Concentration above Remedial Level (mg/kg)	Location[b]
Bis(2-ethylhexyl)phthalate	61	SC-M9	NA	NA
	7.8	NMW-2A	NA	NA
Methylene chloride	NA	NA	9.2	SC-M11
	NA	NA	13.7	SC-M12
	NA	NA	3.9	SC-M14

Note: Exceedances of acetone in surface soil were at only SC-M19, which was not impacted by SWMU 1.
[a]Groundwater locations are presented on Figure 5-5 of the Revised Final Phase II RFI Report (SAIC 1999).
[b]Surface soil locations are presented on Figure 5-1 of the Revised Final Phase II RFI Report (SAIC 1999).
NA = Not applicable.

Table 5. Corrective Action Alternatives

Corrective Action	Description	Protection of Human Health	Cost	Comments
Alternative 1: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Maintenance of Existing Physical Barriers, Well Abandonment, Post-mounted Warning Signs, Implementation of O&M Plan	This action would require legal and local land use controls and signage to enforce restrictions on land and groundwater usage. This alternative would also include abandonment of eight groundwater monitoring wells.	Protection of human health would be primarily dependent upon enforcement of compliance with land use controls. Existing physical barriers (access gate and creek) provide effective restrictions on human access to the site to further discourage any unauthorized excavation activities.	$44,843	Least expensive providing sufficient level of protection.
Alternative 2: Institutional Controls: BMP, Deed Recordation, Zoning Controls, Well Abandonment, Partial Wood Fence Barrier, Maintenance of Existing Physical Barriers, Post-mounted and Fence-mounted Warning Signs, Implementation of O&M Plan	This action would require legal and local land use controls and signage to enforce restrictions on land and groundwater usage. Physical barriers to be installed would include a 3,500-linear-foot, pretreated wood fence along the eastern boundary curving westward to SC-M18. This alternative would also include abandonment of eight groundwater monitoring wells.	In addition to the protection provided by Alternative 1, human access would be further restricted by fencing along the eastern and southeastern boundaries of the site. The fencing would be slightly more effective than signs alone in deterring or discouraging unauthorized excavation activities, but even fencing would not totally prevent someone from gaining access to the site.	$126,679	Significantly more expensive with only slight increase in level of protection compared to Alternative 1.