# TOXIC THREATS FOR MIGRANT CHILDREN AT GOODFELLOW AIR FORCE BASE

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## 1.0 INTRODUCTION

I am the principal and owner of Ground Water Consultants, Inc. (GWC), an environmental consulting company, in Beverly, Massachusetts since 1987. I was retained by counsel for Earthjustice of 1617 John F Kennedy Blvd, Philadelphia, PA 19103 to review environmental conditions at the Goodfellow Air Force Base (GAFB), San Angelo, Texas where GAFB plans to provide sufficient land and facilities for the placement of living and sleeping quarters for 7500 unaccompanied children and workspace for approximately 7500 HHS work support. The area chosen appears to be on or adjacent an old landfill and a major fuel and chemical release.

## 2.0 QUALIFICATIONS

I, David J. Lang, the author of the report, am a Licensed Site Professional (LSP) in the Commonwealth of Massachusetts. I have 39 years of professional experience as a hydrologist with the U.S. Geological Survey and the U.S. Environmental Protection Agency's Superfund Program and for the past 30 years as the President of Ground Water Consultants, Inc. (GWC). My Curriculum Vitae is attached (Appendix C).

## 3.0 METHODS

The analysis presented in this report is based on (1) a review of the documents found online and (2) also supplied by Earthjustice and (3) database at Air Force Civil Engineering Center, *available at* http://afcec.publicadmin-record.us.af.mil/Search.aspx.

## 4.0 DESCRIPTION OF THE PROPOSED ACTION AND SUMMARY OF FINDINGS

Under the Proposed Action, the Air Force would provide the Department of Health and Human Services (HHS) sufficient land and facilities for the placement of living and sleeping quarters for approximately 7,500 unaccompanied children on Goodfellow Air Force Base (GAFB), with additional workspace for approximately 7,500 HHS support personnel. HHS identified the following activities that would be necessary to enhance capacity in a timely manner and to avoid elevated costs:

> (1) Clearing and leveling land for the purpose of erecting semi-permanent structures to shelter unaccompanied children; (2) Allowing HHS to use DoD's temporary facilities for mass sheltering; (3) Erecting temporary facilities; and (4) Helping transport unaccompanied children from one facility to another in the event of a significant weather event or natural disaster.

There are significant environmental and health implications in proceeding with the Proposed Action. Past hazardous material storage and disposal activities on GAFB in the vicinity of the proposed housing may pose significant health threats to children inhabiting housing constructed in areas not fully investigated and remediated. The GAFB's inadequate and outdated investigations of multiple waste sites raise significant questions regarding the safety of the sites and their suitability for construction of residential housing for minors.

This memorandum reviews three areas of hazardous substance disposal on GAFB near *and within* the proposed HHS migrant housing. The three areas are evaluated to determine their current suitability for construction of residential housing and to determine whether gaps in information exist that could endanger the health of children. Goodfellow AFB has a total of 21 Environmental Restoration Program (ERP) sites, two of which are located near or in the proposed action area: LF002 and AOC 13.[1] Sites that were contaminated before 1984 are covered by the ERP. Later sites are covered by the Compliance Cleanup Program. We have no record of how many Compliance Cleanup Program sites there are. Below is a summary of my findings:

- **Residential housing should not be constructed on top of a former landfill that has not been fully remediated until additional studies confirm the construction at this location protects the health and safety of residents, future HHS employees and construction workers:** The proposed footprint of the residential housing area is both on top of and adjacent to an old GAFB landfill, referred to as the Southeast Landfill (LF002)[2] where various chemicals, fuels, and other solid wastes were dumped from at least 1970 to 1982 when regulations for addressing spilled chemicals were nearly non-existent. The proposed housing appears to be inside the footprint of the landfill[3] as shown in a recent 2018 Air Force Report,[4] as well as several other earlier Air Force reports. *See* Site Map 1. In contrast, the footprint of the old

[1] Draft Environmental Assessment, HHS Temporary Facilities for Sheltering Unaccompanied Children, Goodfellow AFB, July 2018, pg. 3-15 and Figure 3-3.
[2] The Southeast Landfill is also referred to as SL002 and LF-02 in various GAFB documents.
[3] Draft Environmental Assessment, HHS Temporary Facilities for Sheltering Unaccompanied Children, Goodfellow AFB, July 2018, Figure 3-3.
[4] Final Annual Inspection Report, Goodfellow AFB, LATA-KEMRON Remediation, LLC, May 2018, Figure 2.

landfill depicted in GAFB's recent draft Environmental Assessment (EA) for the HHS facilities (July 2018) appears much smaller than the landfill boundaries shown in earlier GAFB studies.[5,6] The 2017 Five-Year Review (FYR) by Weston Solutions on behalf of the GAFB also shows a small footprint when compared to Figure 2.[7] Further clarification is needed to ensure the new housing will not be located on the landfill.

- **Per- and polyfluoroalkyl substances (PFASs), also referred to as perfluorinated chemicals (PFCs), were recently detected near the proposed HHS Facilities.** EPA is particularly concerned about PFAS chemicals. They are persistent in the environment, quite soluble in groundwater, bioaccumulative in wildlife and humans, and are toxic to laboratory animals and wildlife, producing reproductive, developmental, and systemic effects in laboratory tests. These chemicals were found in fire-fighting foams and are therefore common at many military facilities where firefighting was a routine activity. In fact, there have been nine potential test areas identified in a recent Site Investigation (Figure 2.3-1)[8] submitted to TCEQ. The Air Force has agreed to do additional testing but no funds are currently available. We request all historical information and any sampling at these nine sites.

- **A carbon tetrachloride (CT) plume was detected onsite near the proposed housing and off-site.** The volatile organic chemicals contained in the CT plume are extraordinarily high. At least one well (MW 4-29)[9] located at the former Fuel Storage Area (ST004) contained 21,000 micrograms per liter (μg/L) of CT (4,200 times the MCL of 5.0 ug/L), and monitoring wells at ST004 contained 110,000 ug/L of trichloroethylene (TCE) (22,000 times the MCL of 5.0 ug/L), 100,000 ug/L of methylene chloride (MC), and 130,000 ug/L of chlorobenzene (CB) (1,300 times the MCL of 100 ug/L). With such high organic chemical concentrations in groundwater, indoor air concerns are a priority. Groundwater sample results for the Fuel Storage Area (ST004) and CT plume area (SS007) should have triggered indoor air concerns. Previous studies indicated a flow path to the east from the Fuel Storage Area. CT is heavier than water and is referred to as a sinker. This deeper flow has not been evaluated toward and beneath the Southeast Landfill (LF002). Yet early studies by NUS Corporation in 1987 detected CT above its MCL on the west end of LF002. All wells have since been removed where housing construction will occur. In addition to additional groundwater monitoring and vapor testing, it is critical to know the precise footprint of the housing plan, the extent of any foundations, and a description of how the buildings will be heated and ventilated.

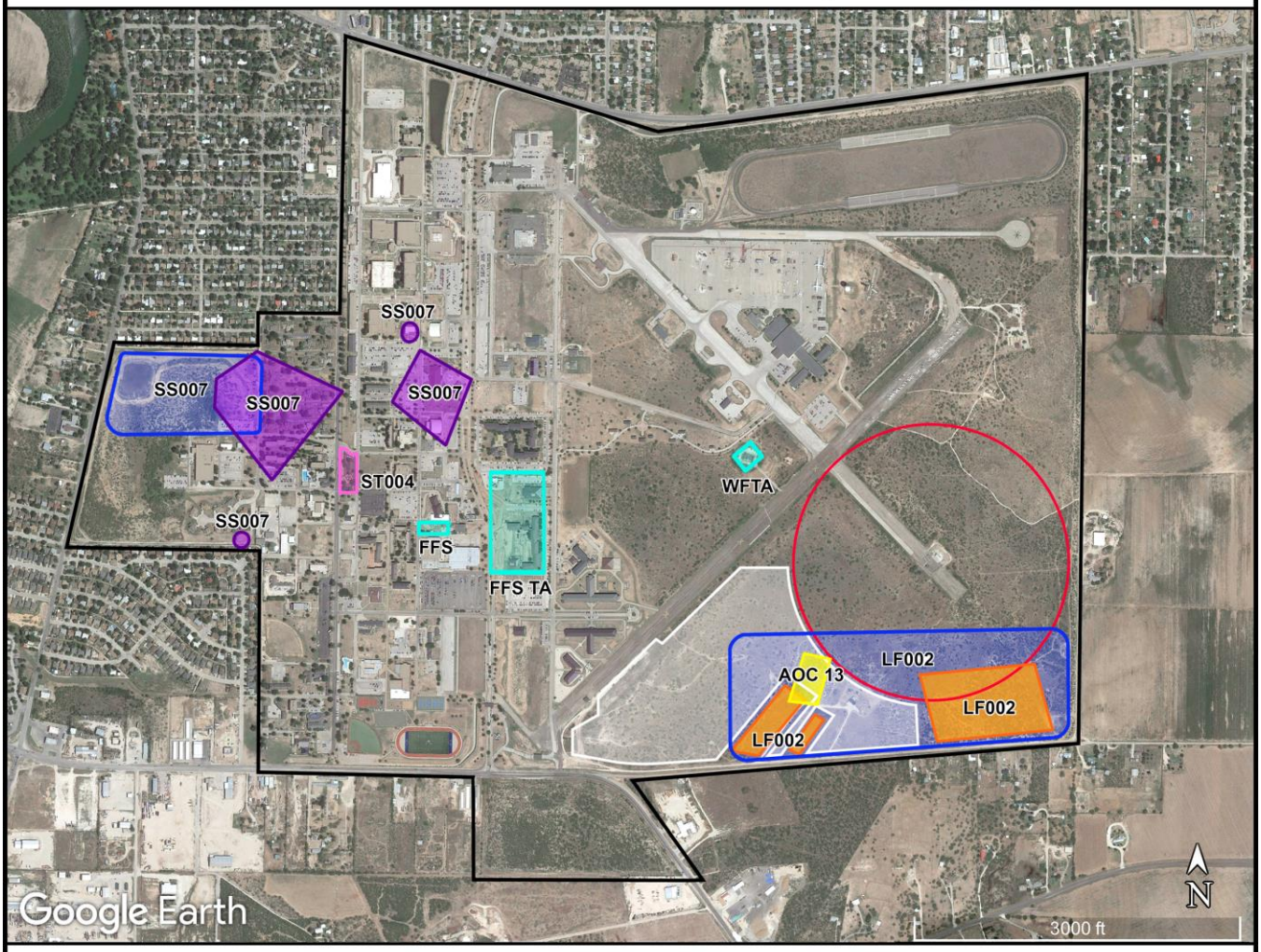
- **Incomplete and outdated investigations and cleanup:** Environmental studies in the 1980s conducted at the Southeast Landfill (LF002) noted a variety of organic chemicals in soil and groundwater. However, these studies were incomplete and inadequate. They lacked the rigor of current assessments implemented today to make determinations on public health, safety, and the

[5] Installation Restoration Program, Phase 1: Record Search, Goodfellow AFB, Reynolds, Smith and Hills, Inc. & Environmental Science and Engineering, Inc., March 1985, Figure ES-1.
[6] Community Relations Plan for the Installation Restoration Program at Goodfellow AFB, Gutierrez-Palmenberg, Inc., January 1999, Figure 3, pg. 2.11.
[7] Final Five-Year Review, Goodfellow AFB, Weston Solutions, Inc., April 2017, Figure 1-2.
[8] Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas, Draft Final Site Inspection Report, Goodfellow AFB, September 2018.
[9] Site ST-04 Comprehensive Report, Goodfellow AFB, Roy F. Weston, Inc., July 1995.

environment. This is particularly obvious when one considers that children will be housed and have their recreational needs met here on soils only approved for a commercial enterprise and not for residential living. The proposed housing area contains AOC 13, an "Area of Concern" due to elevated lead in soil from its former use as a firing range. Although soil has been removed, it is unclear if the lead in soil remaining is safe for children. Before children are housed and play here, more soil may have to be removed, and the commercial/industrial restrictions will need to be lifted to allow residential housing for children. A fence would have to be installed to surround LF002 to restrict access to the (landfill) sites.[10] In addition, the most recent FYR states, "*The remedy at Site LF002 is not protective because contaminants may remain in the groundwater that are above levels appropriate for potable use.*"[11] Groundwater has not been tested in 30 years at LF002, and a large arsenic and CT plume remained to the west with no source ever identified. Groundwater flow has been mapped from the Fuel Storage Facility (ST004) to the northwest and also northeast toward the housing. All monitoring wells around the landfill were destroyed.

[10] Draft Environmental Assessment, HHS Temporary Facilities for Sheltering Unaccompanied Children, Goodfellow AFB, July 2018, pg. 3-15.
[11] Final Five-Year Review, Goodfellow AFB, Weston Solutions, Inc., April 2017, pg. 8-1.

## **Site Map 1** – Goodfellow Air Force Base (*San Angelo, Texas*)




**LEGEND / SOURCE:**

- **Proposed Detention Center Area** / *Draft Environmental Assessment ("EA") (July 2018), Fig. 2-1*
- **Restricted Area** / *Draft EA (July 2018), Fig. 3-2*
- **Firing Range (AOC 13)** / *Draft EA (July 2018), Fig. 3-3*
- **Southeast Landfill (LF002)** / *Draft EA (July 2018), Fig. 3-3*
- **Carbon Tetrachloride Spill (SS007)** / *Final First Five-Year Review ("FYR") (July 2012), Fig. 1-2; Final FYR (Apr. 2017), Fig. 1-2*
- **LF002 & SS007 Inspection Sites** / *Annual Inspection Report (May 2018), Fig. 2*
- **Fuel Storage Area (ST004)** / *Final First FYR (July 2012), Fig. 1-2; Final FYR (Apr. 2017), Fig. 1-2*
- **Aqueous Film Forming Foam (AFFF) Release Areas** / *Draft Final Site Inspection Report, Amec Foster Wheeler (Sept. 2018), Figs. 2.3-1, 3.1-1, & 3.2-1*
- **Air Force Installation Boundary**

## STATED NEED FOR THE PROPOSED ACTION

The Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA) require that an Environmental Assessment (EA) specify the underlying purpose of and need to which an agency is responding in proposing actions and alternatives (40 C.F.R. § 1502.13).

The purpose of the Proposed Action is to support the "urgent" HHS requirement, as documented in a Request for Assistance, for providing temporary shelter by using available military resources, as directed by the Secretary of Defense and documented in an Action Memorandum (June 29, 2018). Specifically, the purpose of the Proposed Action is to establish and operate a location and erect temporary, short-term facilities for sheltering approximately 7,500 unaccompanied children at Goodfellow AFB.

The purported need for the Proposed Action is to respond to a humanitarian crisis resulting from the increased influx of unaccompanied children across the southern border of the United States. The current influx of unaccompanied children along the U.S. southern border continues to strain HHS's usual system of caring for unaccompanied children. However, before any construction planning can proceed, a complete and updated environmental assessment must be completed.

The assessment must be designed after an accurate construction footprint of the proposed housing development is released, which includes all new residential buildings, recreational areas, and maintenance shops. Both the Southeast Landfill and AOC 13 (Area of Concern due to elevated lead in soil) overlap the construction area as described above in various early maps and the GAFB EA. In addition, there are at least 19 additional waste disposal sites[12] on the Goodfellow Air Force Base that require or have had an environmental cleanup. Several of these individual waste sites deserve attention because of the threat of soil contamination, groundwater contamination, and vapor intrusion. Additional studies are required to update risk assessments that were done in some cases 30 years ago. Three of the most relevant sites are described below.

## SOUTHEAST LANDFILL (LF002)

The Southeast Landfill comprises 37 acres and is located on the southeastern corner of the GAFB. Wastes were buried in a series of trenches typically 600 feet long, 15 feet deep, 15 feet wide, and 12 feet apart. Some trenches are still visible; therefore confirming the landfill was never properly covered and closed. Landfills, especially those where hazardous materials were buried, are ordinarily covered with low permeability material and at least 6 inches of topsoil to enable cultivation of a grass cover.

As noted in the Installation Restoration Program (IRP) Phase 1 Investigation, LF002 began operations in 1970 and closed in 1982. Landfill contents may have included small containers of

[12] Draft Environmental Assessment, HHS Temporary Facilities for Sheltering Unaccompanied Children, Goodfellow AFB, July 2018, pg. 3-15.

solvent, fuels and oils.[13] At MW-307, which is a landfill well to the west and likely in or adjacent to the proposed housing footprint, carbon tetrachloride at 11 ug/L and bis (2-ethylhexyl phthalate) at 28 ug/L were the highest concentrations of constituents in groundwater found in 1987. Other pesticides were also found at lower concentrations.[14] A large contaminant plume of CT has been partially remediated near the landfill, but no source was ever identified by the Air Force.

During the Remedial Investigation (RI) activities in 1987 by NUS, organic and inorganic contaminants were detected in soils and groundwater. The principal contaminants observed in surface soils were 1,1 dichloroethane, trichloroethane, chloroform, fluoranthene, chlordane, and lead. The principal groundwater contaminants were 1,1, 2,2·tetrachloroethane, tetrachloroethene, trichloroethene, carbon tetrachloride, acetone, phthalates, several pesticides, and lead.[15] Arsenic has also been detected as a concern in soils and groundwater. The observed average concentrations of chlorides, sulfates, and nitrates exceeded the Secondary Drinking Water Standards (SOWS). Groundwater was encountered at LF002 at depths of 25 to 42 feet, generally in the upper levels of the Choza formation. The shallow groundwater acts under partially confined conditions, flowing to the northeast at LF002.[16] Vapor intrusion is a potential pathway that needs to be discussed and evaluated with new data in appropriate locations.

Only seven monitoring wells were installed in 1987 around the areas where LF002 landfill operations were known to have occurred. The number of monitoring wells is inadequate to evaluate conditions at a 37-acre landfill. The highest concentrations of chemicals in groundwater were in the west near where construction will occur. To sample only once in each of seven wells is inadequate. To further aggravate the situation, in May 2007, EarthTech on behalf of the Air Force plugged up and abandoned all 7 wells around LF002[17] making them unusable. More groundwater sampling is necessary to evaluate the extent of contamination, particularly on the west side near MW-307 where elevated carbon tetrachloride was noted and whether any vapor intrusion pathways exist.

Wastes were buried from 1970 to 1982, which may have included household wastes, demolition debris, industrial wastes and some containerized liquids.[18] In a recent interview, Mr. Allen "AJ" Sohn, GAFB Environmental Scientist, regarding land use at this site stated that there have been no dumping or unauthorized use issues at the site, and there is no post-closure care being performed. It is unclear why his statement was made because disposal here has been documented by GAFB consultants and the previous sampling described above.[19] It is clear the Air Force is conducting

[13] Installation Restoration Program, Phase 1: Record Search, Goodfellow AFB, Reynolds, Smith and Hills, Inc. & Environmental Science and Engineering, Inc., March 1985, pg. 7.
[14] NUS Corporation, Installation Restoration Program, Decision Document, LF002- Southeast Landfill, June 1990, Figure 3 and Table 2.
[15] NUS Corporation, Installation Restoration Program, Phase II/ Phase IVA-Goodfellow Air Force Base, Sites 1,2,3&4, Oak Ridge TN, March 1987, Table 7-2.
[16] Final Environmental Restoration Management Action Plan, Goodfellow Air Force Base, Texas, December 22, 1993.
[17] Final Report Plug and Abandon Groundwater Monitoring Wells, GAFB, EarthTech, May 2007.
[18] Draft Environmental Assessment, HHS Temporary Facilities for Sheltering Unaccompanied Children, Goodfellow AFB, July 2018.
[19] Final Annual Inspection Report, Goodfellow Air Force Base, LAT-KEMRON, GAFB, pg. 9, May 2018.

post-closure care as required by State and Federal regulations at almost all their landfills throughout the United States. LF002 does not appear to have received that same care if trenches are still visible.

LF002 was officially closed December 1988 after some unknown post-closure maintenance period was completed.[20] LF002 was closed under State of Texas requirements for a Type I Municipal Solid Waste Disposal Facility closure. The site currently meets Commercial/Industrial land use closure conditions only and does not meet residential criteria for children to reside on the landfill. The GAFB conducts very minimally post-closure care (annual inspections, five-year reviews, and periodic mowing), but no groundwater sampling. In a June 18, 1999 letter to the commander of GAFB,[21] the Texas Natural Resource Conservation Commission (TNRCC) warned that their Solid Waste Permit for LF002 was considered canceled and any new disposal would require another permit. In the 2013 Annual Inspection of LF002,[22] the GAFB reports the closed landfill cover is only non-engineered soil and vegetation. The west side is the edge of a paintball course and jogging trails. A trench was also discovered adjacent to an old training site. This may have been a shooting range similar to AOC 13 (discussed later.in this report). There are signs at the site that unpermitted dumping may have occurred after 1999. A soil berm was reported using soil from base construction projects, and the berm serves to restrict the view of the site according to the GAFB. There would be no apparent reason to block the view of a flat vegetated parcel. All of these activities likely required discussion and approval from TNRCC, particularly dumping waste soils, which could have originated from any one of the numerous disposal sites. More detail and testing should be required at this barrier berm and another permit from the Texas Commission on Environmental Quality for these past and future activities appears warranted.

The 1990 Decision Document[23] for the Southeast Landfill concluded (Section 4.0, pg. 15) that "Analytical results from soil and water samples obtained during this investigation indicate that past activities have not introduced dangerous levels of contamination into the environment and that increased contamination in the future is unlikely." However, groundwater has not been tested in 30 years. A major carbon tetrachloride and TCE plume were found and are being managed not far away from LF002. Monitoring wells in disposal areas LF002 and ST004 and SS-007 had wells above the EPA Maximum Contaminant Level (MCL) for carbon tetrachloride and trichloroethene. At the west end of SL002 at SL002-MW-307, CT was found at 11ug/L,[24] and, as stated earlier, no source for the plume has ever been determined. No additional studies were conducted at the landfill. It is time to sample the area beneath the proposed housing at LF002.

Thirty-year-old Risk Assessment calculations revealed no unacceptable risks to public health (NUS, 1990).[25] Because the data are 30 years old and risk assessment methods have changed, and

[20] Annual Inspection Report, GAFB, LATA-KEMRON, November 2013, pg. 9.
[21] Decision Document LF002-Southeast Landfill, NUS Corporation, Air Force Installation Restoration Program, June 1990.
[22] Final Annual Inspection Report, Goodfellow Air Force Base, November 2013, pg. 10.
[23] Decision Document LF002-Southeast Landfill, NUS Corporation, Air Force Installation Restoration Program, June 1990.
[24] Final Five-Year Review, Goodfellow AFB, Weston Solutions, Inc., April 2017, pg. 5-3.
[25] Final Annual Inspection Report, GAFB, LATA-KEMRON, May 2018, pg. 9.

in the meantime, a new plume of chemical contamination has been discovered, the risk assessment is no longer valid. Minimal investigations for the CT (which sinks in groundwater) were never done. The GAFB needs to delay construction until an update of conditions at LF002 is completed.

Furthermore, the landfill was closed only for commercial/industrial activities. In order for children to safely reside here, extensive soil and groundwater sampling data in LF002 and adjacent property are necessary to update the understanding of the current site conditions because minimal soil and groundwater data were collected 30 years ago. Also, because of the change in land use from commercial to residential, additional data will be necessary. There are also new emerging chemicals of concern at landfills that contain or are associated with chlorinated organic compounds that should be tested including polyfluoroalkyl substances (PFAS), 1,4 dioxane and BCEE. These chemicals have never been tested at LF002 or the other Sites described below. Many more wells would have to be installed and chemically tested to properly assess a 37-acre landfill since the original wells were destroyed.

The first Five Year Review (FYR) at GAFB was written in July 2012 by Weston Solutions.[26] Surprisingly, there was no mention of LF002. The base map (Figure 1-2) showed it in three small parcels that were discontinuous, and the size was too small and not consistent with other mapping described earlier. Figure 1-2 also showed AOC 13 and SS006 adjacent to LF002, but there was no discussion of their regulatory status. This is highly unusual because a FYR always discusses all previously identified sites. Site Map 2, below, uses this base map and overlays the new HHS facilities with the three disposal sites shown on Figure 1-2. This Figure also shows many other base disposal sites including multiple locations for AOC-02 (at 5 locations); SS007 (at 4 locations); AOC-03 (at 3 locations); AOC-05 (2 locations); and LF002 (first time LF002 is shown as 3 locations). The following AOCs and other sites were shown as one location including AOC--01; AOC-06; AOC-07; AOC-08; AOC-09; AOC-10; AOC-11; AOC-12; SS-03; SS-08; PR-889; ST-04; and ST-05.

It is imperative that an independent engineer and surveyor stake out the new facilities and these disposal sites near LF002 to make sure they do not overlap dormitory plans. Residential housing was never intended when regulatory officials accepted a commercial industrial closure. The most recent Five-Year Review (2017 FYR)[27] of GAFB was critical of the LF002 closure. It noted that constituent concentrations remaining in groundwater at LF002 should be considered if the use of groundwater at the site for potable purposes is planned in the future.

As part of the 2017 FYR, chemical of concern (COC) concentrations reported during the most recent sampling event at LF002 (collected in 1987) were compared to current (March 2016) Texas Risk Reduction Program (TRRP) Tier 1 Protective Concentration Levels (PCLs) (TCEQ, 2016). The 1987 COC concentrations are presented in Table 5.2 of the FYR. COC concentrations remaining in soil were below current TRRP residential soil PCLs; however, concentrations of several COCs remaining in groundwater (carbon tetrachloride, methylene chloride, bis(2-ethyl-hexyl) phthalate, dieldrin, and lead) exceed the March 2016 TRRP residential groundwater PCLs.

[26] Final First Five-Year Review for Goodfellow AFB, Weston Solutions, July 2012.
[27] Final Five-Year Review, Goodfellow AFB, Weston Solutions, Inc., April 2017.

Therefore, the selected remedy for the site may not be functioning as intended (2017 FYR, pg. 2.4). Groundwater at the site is not currently used for potable purposes, and it was recommended that groundwater at this site not be used for potable purposes in the future without additional evaluation of current groundwater conditions. There was no mention in either FYR of residential housing on this property.

Based on information presented in the inspection reports from July 2012 through October 2015, a commercial/industrial Land Use Covenant (LUC) is in place at LF002; however, no deed certification or other additional documentation included in the Administrative Record (AR) suggests that LUCs are in place at the site. Additionally, GIS records provided by GAFB indicate the site is closed with no use restrictions. If official LUC documentation exists for LF002, it should be included in the Administrative Record, and it should reflect that only commercial industrial use is allowed and not residential. Any residential use requires much more study and risk analysis.

The 2017 FYR concludes, "***The remedy at Site LF002 is not protective because contaminants may remain in the groundwater that are above levels appropriate for potable use***."[28] Annual inspection reports indicate a LUC is in place, but it is not identified in the Decision Document (DD) or GAFB Information Development Plan/Geographical Information System (IDP/GIS). No documentation of a LUC was found in the Administrative Record during this review. The most important section in any 5-year review is the Protectiveness Statements. Without this statement proclaiming the remedy is still protective, additional remedial actions are necessary. This document was filed with the Texas Commission on Environmental Quality just last year. Ironically, the GAFB destroyed most of the base wells including seven wells at the former Southeast Landfill as described in a May 2007 study.[29] LF002 was closed under TNRCC with post-closure responsibilities removed according to the consultant Earth Tech. That is clearly not usually the case when landfills are closed. There is always post-closure care, especially when VOCs, pesticides. and lead are identified.

In summary, there are large differences in the footprint depicted on various maps for LF002. The recent 2017 FYR shows the landfill in three small parcels in stark contrast with the footprint in other earlier reports cited, as well as a March 2016 Exit Strategy Report by the GAFB.[30] Second, the lack of post-closure monitoring of groundwater near the landfill and the resulting 30-year gap in monitoring data prevents an assessment of the present state of the groundwater. Due to the presence of plumes discovered after monitoring ceased, such data are essential to assess threats that may be posed by vapor intrusion or contaminated drinking water. Lastly, the identification of numerous "AOCs" that were not fully investigated near the proposed housing raises concerns that these potentially contaminated sites may also pose threats to children in the detention center. The LF002 site was closed with commercial/industrial standards and not to allow children to reside there.

[28] Final Five-Year Review, Goodfellow AFB, Weston Solutions, Inc., April 2017, pg. 8-1.
[29] Plug and Abandon Groundwater Monitoring Wells, Goodfellow AFB, Earthtech, May 2007.
[30] Final Optimized Exit Strategy, Effectiveness Report, Goodfellow AFB, March 2016, Figure 2-1.

**PER- AND POLYFLUOROALKYL SUBSTANCES (PFASs)**

The Air Force Civil Engineer Center (AFCEC) contacted HGL to prepare a Preliminary Assessment (PA) of the Fire Training Areas (FTA) and non-FTA areas at Goodfellow AFB to identify locations where PFAS may have been used and released into the environment, and to provide an initial assessment of possible migration pathways and receptors of potential contamination.[31] Nine potential Aqueous Film Forming Foam (AFFF) release areas were identified during the PA research, with one AFFF release area recommended by HGL for a site investigation (SI) (Figure 2.3-1). The Air Force has not made the 2016 HGL study available for review.

1) Former Fire Station Area (FFS): The FFS, referred to as Area 1, was in operation from the 1950s to 1995. The FFS consists of two separated areas (the FFS and the FFS Test Area) where AFFF may have been stored or released. Based on information gathered during ISWP (OTIE, 2017) development, installation personnel reported that AFFF activities may have been performed in the grassy area immediately south of the FFS (referred to as the FFS) and that AFFF distance testing and hose flushing activities occurred in the grassy area located between the former aircraft apron and former runways approximately 525 feet east of the FFS building (referred to as the FFS Test Area). The amount of AFFF historically stored at the former fire station is unknown (HGL, 2016). AFFF may have infiltrated the ground or drained into the nearby storm culvert inlets. The area was identified in the Preliminary Assessment as a potential release area, but it was not recommended for further study.

2) Wildland Fire Training Area (WFTA): The WFTA, referred to as Area 2, is an active fire training area that has been used since 2006. The WFTA was constructed with a training structure on a concrete pad to replicate fires in a burning building.[32] The fire training structure has been demolished, and current fire training practices include igniting hay bales on a concrete surface and extinguishing them using water. The amount of AFFF used during fire training activities at the WFTA since 2006 is unknown, but the chemicals were clearly used and are detected in the soil. There is no information on where the training areas or related structures were before 2006.

The GAFB investigation for PFAS has been limited to soil sampling as described in the Site Inspection Report dated September 2018. PFASs were detected during the recent sampling in the surface soil at various intervals ranging from 0.0 to 14.5 ft below ground surface (bgs) at concentrations exceeding the Texas Risk Reduction Program (TRRP) Tier 1 Protective Concentration Levels (PCLs) at AFFF Release Areas 1 and 2. Surface soil at AFFF Release Areas 1 (FFA) and 2 (WFTA) contain PFAS and are potentially accessible by GAFB personnel, residents, miscellaneous workers, site visitors, and trespassers involved in any activity that exposes them to the impacted soil. The deeper surface soil (>5.0 ft bgs) at AFFF Release Areas 1 and 2 are primarily accessible by miscellaneous workers involved with excavating, drilling, or any activity that exposes them to the impacted deeper surface soil. Potential exposure routes for soil include inhalation of impacted surface soil dust particles and ingestion and dermal contact with impacted soil. Based on the SI results described above, potentially complete soil exposure pathways for

[31] Preliminary Investigation of Aqueous Film Foaming Form, Hydrogeologic, Inc. (HGL), 2016.
[32] Site Inspection of Aqueous Film Forming Foam (AFFF) Release Areas, Draft Final Site Inspection Report, Amec Foster Wheeler Programs, Inc., Goodfellow AFB, September 2018, pg. 9-10.

human exposure to PFAS-impacted surface soil through inhalation, ingestion, and/or dermal contact were identified for AFFF Release Areas 1 and 2. Further explanation, investigation and evaluation of specific exposure conditions are required to determine if these exposure pathways are complete at these two sites as well as the other seven found at the base during their research.

Because no sampling of groundwater for PFAS was conducted, far more assessment is necessary prior to building HHS facilities. More information should be provided on the seven other potential PFAS sites, including where the sites are located, depth to groundwater and whether any PFAS have migrated off-site in groundwater.

## AOC 13 SMALL ARMS FIRING RANGE

There appear to be multiple shooting ranges that are now AOCs. The Former Small Arms Firing Range (AOC 13) was an area used by base personnel from the late 1960s to the 1990s as a firing range inside the boundary of LF002. The U-shaped berm measured about 130 feet long by 120 feet wide with the firing line on a concrete slab at the open end. Varied concentrations were detected in surface soils at AOC 13, with some concentrations of lead were as high as 11,000 mg/kg.

In February 2009, the GAFB and its consultant Weston Solutions pursued closure and no further response actions at AOC 13, after several years of discussions with the Texas Commission on Environmental Quality. Groundwater sampling has not been conducted to date at AOC 13. Also, the GAFB residential Target Cleanup Level of 500 mg/kg for lead is much higher than the residential standard for lead used in other states. EPA uses a standard of 400 mg/kg for lead in soil. The Massachusetts standard for dermal contact for lead in residential soils is 200 mg/kg. As of February 2009, the majority of AOC 13 is comprised of vacant undeveloped land and a Paint Ball recreational area to the southeast. An unpaved jogging trail also extends through AOC 13. Large portions of AOC 13 appear to be within LF002. Two soil removals were implemented here, and the Response Action was performed under TRRP Remedy Standard A for a residential closure. However, a children's residential development project such as base housing was not being considered in the 2009 Decision Document (pg. 13) and would need to be revisited for children to play safely here.[33]

Although soils were removed at AOC 13, the lead bullets and fragments may have escaped outside the designated areas. Also, AOC 1 was another shooting area which is inside LF002 and adjacent to AOC 13. Risk standards for children are much lower than for a 70 kg adult, which is what most risk assessments use. Before children's housing can be installed at AOC 13, soil cleanup standards for lead would need to be revisited because the AF chose a cleanup to 500,000 ug/kg, which is not likely safe for children.

[33] Final, No Further Response Action Planned, Goodfellow Air Force Base, Weston Solutions, Inc., February 9, 2009, pg. 13.

## FUEL STORAGE FACILITY (ST004) AND THE CARBON TETRACHLORIDE SPILL (SS007)

During the period of aircraft operations at GAFB, there was an area that reportedly contained nine 25,000-gallon storage tanks that were removed in the first phase of work. In addition, there were four 12,000-gallon tanks, one 3,000-gallon tank and a 1000-gallon tank. The large tanks stored aviation fuels used prior to 1958. The four 12,000-gallon tanks stored unknown fluids, and the smaller tanks reportedly stored kerosene or fuel oil. There is no discussion on the storage and use of chlorinated solvents such as CT and TCE even though they were found in high concentrations in groundwater there. Some evidence of leakage was reported when the tanks were removed in the 1970s. Five monitoring wells were installed initially, and results indicated chemicals had migrated off-site. In total 20 temporary wells (discussed later) were installed to determine the diameter of the plume as shown in Figure 1-3 of the 1990 Decision Document.[34]

As shown in Figure 3-2 of the draft EA, existing housing dorms are shown within the carbon tetrachloride (SS007) and Fuel Storage Area plume (ST004) release areas. Figure ES-1 shows the early delineations of South Landfill (SL001), Southeast Landfill (LF002), the Drum Storage Area (SS003) and the Fuel Storage Area (ST004). We have concerns about a suitable closure at ST004 as groundwater flow here was shown to be northeast in the vicinity of the proposed housing area[35] within LF002. Additional groundwater sampling is needed at the proposed housing areas.

In 1987, five monitoring wells were installed to study the ST004 area. In 1990, the GAFB tried to close out the tank area because they described it as minor aircraft fuel spills. More wells were required and ultimately installed. A variety of organic chemicals were then found at very high concentrations. These findings were not from "minor fuel spills." This was clearly not the case. As of February 2016, four gallons of free product were still being removed nearly 30 years later.

The chemicals detected at ST004 listed below include carbon tetrachloride, trichloroethylene, methylene chloride, which are not associated with aircraft fuels especially at these high concentrations. In 1988, seven additional temporary wells and 17 additional permanent wells were installed and sampled, and the five wells installed in 1987 were resampled. Benzene was detected in 16 of 47 ground-water samples at a maximum concentration of 110,000 ug/L (MW411). Well MW411 also contained the maximum concentrations of toluene (160,000 ug/L), chlorobenzene (130,000), trichloroethene (110,000 ug/L), 1,1 dichloroethene (84,000 ug/L), and methylene chloride (100,000 ug/L). It is clear that these concentrations are not related only to aircraft fuel storage and certainly not likely related to a minor fuel spill. MW-411 also contained floating product. Well MW-413, also contained floating product and the maximum concentration of ethyl benzene (120,000 ug/L), chloroform (29,000 ug/L), and carbon tetrachloride (21,000 ug/L), as well as toluene at 69,000 ug/L.

The highest concentrations of arsenic were found in MW406 (151 and 370 ug/L). These concentrations exceed the 1990 MCL of 50 ug/L and the current MCL of 10 ug/L. Lead was elevated in MW-411, where the maximum concentration of 70 ug/L exceeds the existing MCL for

[34] Decision Document, Site 4 Fuel Storage Area, NUS Corporation, May 1990, pg. D-31 and Figure 1-3, pg. D-33.
[35] Remedial Investigation-Feasibility Study, Martin Marietta Energy Systems, October 1987, Figure 2-1.

lead at 15 ug/L. A new proposed MCL of lead of 5 ug/L was exceeded in several wells (MW4-06, MW4-07, MW4-08, MW4-13, MW4-14, and MW4-17).[36] Groundwater at the Fuel Storage Area (ST004) flows both northwest and northeast, but the faster flow is in the gravel flowing northwest. Depth to groundwater is 15 to 35 feet deep.[37] There is a concern that these high concentrations could cause vapor intrusions to existing buildings as well as any new buildings constructed to house the children. Also, as noted in the 1987 Remedial Investigation by Martin Marietta, Figure 2-1, groundwater is flowing northeast and near the residential housing. EPA has published extensively on vapor migration, particularly as a result of spills and dumping of organic chemicals at Sites across the United States. A recent addition to National Priority List (NPL) was the Rockwell International Site in Mississippi. The Hazard Ranking System (HRS) evaluation focused scoring on the subsurface intrusion in the main plant building related to releases, but also identified Site-associated contamination in other locations and pathways/components that may require future investigation.[38] Vapor intrusion is an important pathway that needs to be addressed prior to any construction activities.

In June 1990, a GAFB Decision Document recommended that ST004 be removed from further IRP consideration to close out the Tank Farm[39] but instead Texas regulators required additional investigations that turned out to constitute almost 30 additional years of study and cleanup.

In a 1991 newspaper article in the Goodfellow Monitor on February 5, 1991, Lyndal Fischer who was the Base Environmental Coordinator, stated, "we're talking about a small quantity of petroleum product." Mr. Fischer went on to say a remedial action study *would determine what if any, action should be taken.* This was a full year after the Tank Farm data showing extremely high concentrations of carbon tetrachloride, TCE, methylene chloride, benzene and many other chemicals were found in the Tank Farm Area and had already migrated off-site. Clean up would be mandatory in spite of the GAFB Environmental Coordinators minimization of the contamination. After 20 years, and ten rounds of sodium lactate injections, a plume management zone was set up and was approved by the TCEQ in 2006. The site is being managed with Land Use Restrictions and CT and arsenic are still above MCLs in wells in ST004 and SS007.

GAFB later decided to continue investigations under a different site name: the Carbon Tetrachloride (CT) Spill Site (SS007). It became its own IRP site in March 2002 when CT was found both on and off base property. This CT plume extends across much of the western part of the base as well as off-base into residential neighborhoods to the northwest and southwest. The site was delineated vertically and horizontally in 2005 and documented in an Affected Property Assessment Report (APAR) (Earth Tech, 2005). Off-site impacts in private water wells were reported. As a result, the response action was to pump water from the residential well at 303 Windham for 6 months until the effluent was less than 5 ug/L. Other nearby impacted residential

[36] Remedial Investigation Goodfellow Air Force Base, NUS Corporation, HAZWRAP Support Contract, December 1990.
[37] Initial Restoration Program, Waterstone Group, San Angelo Constraint Maps, December 15, 2005, Section 3.2.
[38] Support Document for the Revised National Priorities List Final Rule Rockwell International Wheel & Trim , Office of Superfund Remediation and Technology Innovation, Office of Land and Emergency Management, September 2018, pg. 43
[39] Community Relations Plan for the Installation Restoration Program at Goodfellow AFB, Gutierrez-Pallenberg, Inc., January 1999, pg. 2.5.

wells were at 225, 325 and 326 River Oaks.[40] Again, the source of the carbon tetrachloride and TCE were never identified; however, GAFB stated that nearby wash racks may be responsible. There were wash racks between LF002 and ST004.

The history of closure indicates a response action plan (RAP) authorizing a plume management zone with sodium lactate injections that were approved by the TCEQ in 2006 to treat the VOCs. After ten rounds of injections, the TCEQ agreed that the plume had significantly decreased in size and no longer threatened off-site receptors. A Remedy Standard B had been obtained for SS007 such that no further post-closure care would be required (Earth Tech, 2008). According to the closure letter from TCEQ on October 1, 2008, "…the site fulfills the institutional control requirements of 30 TAC §350.33(f)(4)(C)(I) for PMZs [plume management zones] with a proof of deed notice filing on July 7, 2006."

The chemicals of concern in the groundwater are managed so that human exposure is prevented and other groundwater resources are protected. The concentrations of various solvents we saw in the Fuel Storage Area (ST004) including carbon tetrachloride appear similar to SS007. We also saw elevated CT in the early sampling at LF002, and this exceedance was never followed up on. We are concerned that the CT plume extends to LF002, but all the wells around LF002 were destroyed 10 years ago.

Site ST004 was closed under the Texas Commission on Environmental Quality (TCEQ) Petroleum Storage Tank (PST) division as LPST No. 109653 on May 17, 2004 (Weston 2007). A TCEQ letter dated July 16, 2004 states that groundwater at the site was considered protective of construction workers (assumed to be industrial standards). However, a comparison of groundwater data results was later done to TRRP Protective Concentration Levels (PCLs), and carbon tetrachloride exceeded residential assessment levels at SS007. Furthermore, arsenic levels in groundwater exceeded the Commercial/Industrial TRRP PCL of 10 ug/L and the site background value of 2.3 ug/L.

In April 2005, Earth Tech, Inc. submitted the APAR for SS007. GAFB designated site SS007 to address volatile organic compounds (VOCs), such as carbon tetrachloride, that were identified in groundwater during investigation activities associated with the Fuel Storage Area site (ST004). The source of the VOCs was never identified, however.

Recently, site ST004 is receiving additional attention. FPM Remediations, Inc.[41] in February 2018 prepared a Response Action Plan (RAP) Addendum at ST004 on behalf of GAFB to describe additional response actions necessary for elevated arsenic and monitoring the CT plume remnants. In October 2018, FPM submitted a monitoring report[42] that showed elevated arsenic above the TRRP standard of 10 ug/L in wells MW4-28 at 20 ug/L and MW4-20 at 14.9 ug/L in October 2017. Free product was still being found in wells MW4-10 and MW4-13, so they were not tested in October 2017. In April 2018, arsenic was again elevated and continued sampling was

[40] Response Action Plan, Site No. SS007, Chlorinated Solvents Plume, Goodfellow AFB, Earth Tech, Inc, November 2005.
[41] Final Response Action Plan Addendum for Site ST004, Goodfellow Air Force Base, FPM Remediations, Inc.
[42] Final 2017 Annual Long Term Monitoring report at Site ST004, FPM Remediations, Inc., October 2018.

recommended by FPM. In October 2018, TCEQ rejected a deed restriction on the ST004 area until a survey of the entire tract of land is included.

For convenience, the GAFB has requested that the arsenic affected groundwater be included in the Plume Management Zone (PMZ) associated with CT at ST004 as a post-closure monitoring activity until the redox geochemical conditions return to pre-petroleum impacts (oxidative versus reductive geochemical conditions).

Although the source of arsenic at the site is not confirmed, the most likely potential source according to the GAFB is historic agricultural application of arsenic-based pesticides and herbicides. A secondary potential source is soil leaching that can result from natural degradation of residual petroleum hydrocarbons in the former storage tank area of ST004. In 1987, 1988, 1995, and 2000 a total of 60 soil samples were collected and analyzed for arsenic from 27 soil borings and groundwater well installation locations. Two soil samples exceeded the arsenic 30-acre Tier 1 Residential PCL of 22 mg/kg.

The performance of natural attenuation as an effective response action will be measured by monitoring the concentrations of arsenic in the saturated Leona formation. If the monitoring indicates a stable or decreasing plume within the two-year monitoring timeframe, then reasonable progress is being made, and the response action will be considered successful.

Another emerging chemical often associated with large volatile organic chemical releases we note here is 1,4-Dioxane (1,4D). EPA now samples for 1,4 D at most hazardous waste sites, and it should be tested here particularly near the CT plume, Fuel Storage Area, and the construction zone at LF002.

In summary, it appears the Fuel Storage Area (ST004) continues to have free product being recovered. SS007 is being managed for elevated arsenic and CT. Any additional sampling should include 1,4D. A risk assessment should be conducted to determine the nature and extent of contaminants on the nearby facilities planned for sheltering the unaccompanied children.

## SUMMARY AND CONCLUSIONS

The Southeast Landfill (SL002/LF002) appears inside the Proposed Action Area where housing for children is being proposed by HHS as shown in Figure 2 of a recent 2018 Air Force Report[43] as well the 2017 FYR Figure 1-2.[44] *See* Map X. In addition, early environmental studies in the 1980s conducted at the Southeast Landfill noted a variety of organic chemicals in soil and groundwater and a much larger footprint. Our primary concern is that the construction of housing for these unaccompanied children would be where chemicals have been previously disposed and detected.

During the Remedial Investigation (RI) activities by NUS at the Southeast Landfill, organic and inorganic contaminants were detected in soils and groundwater. The principal contaminants

[43] Final Annual Inspection Report, Goodfellow AFB, LATA-KEMRON, May 2018.
[44] Final Five-Year Review, Goodfellow AFB, Weston Solutions, Inc., April 2017, Figure 2.

observed in surface soils were 1,1 dichloroethane, trichloroethane, chloroform, flouranthene, chlordane, and lead. The principal groundwater contaminants were 1,1,2,2·tetrachloroethane, tetrachloroethene, trichloroethene, acetone, carbon tetrachloride, methylene chloride, phthalates, several pesticides, arsenic and lead. Both carbon tetrachloride and methylene chloride were detected above the MCL of 5 ug/L at the SL002, were widespread contaminants across the base, and no known source was ever confirmed by numerous investigations.

These GAFB studies were incomplete and inadequate. They lacked the rigor of current standards used today to make determinations on public health, safety, and the environment. The wells around the Southeast Landfill (LF002) were inadequate to characterize the contamination, and these wells were destroyed by the GAFB and their consultant Earth Tech after only one sample appears to have been collected from each of these wells over 30 years ago. The need for new testing and risk analysis is particularly obvious when one considers that children will be housed and have their recreational needs met here. Much more assessment work is needed before planning and construction can begin.

In April 2001, the Air Force (AR Document 209) stated that additional investigation was requested by the TNRCC at both the Southeast Landfill (LF002) and at the Fuel Storage Area (ST004). Studies at ST004 continue, and we have reviewed these documents. However, we have not seen any additional investigation at LF002 as described in the Air Force Fact Sheet.[45] We request these investigations.

Figure 3-3 of the draft EA shows existing base housing dorms within the carbon tetrachloride (SS007) and Fuel Storage (ST004) plume areas. We have concerns that indoor air risks remain before a suitable closure can be achieved. Additional studies are underway by FPM Remediations Inc. to finally close out the ST004 where free product was previously found. The Carbon Tetrachloride plume area is continuing to be monitored with exceedances of CT and may extend east to the Southeast Landfill where CT was detected above the MCL many years ago.[46]

A shelter for unaccompanied children is being planned on an old landfill. Current data is necessary to assess existing health risks from the old carbon tetrachloride and arsenic plumes that remain today. The Air Force destroyed the monitoring wells around LF002 in 2007. Carbon tetrachloride was found in the southwest corner of LF002 at 11 ug/L where groundwater flow may be to the northeast based on earlier studies. Previous investigations appear inadequate. Our concern is that the VOCs in groundwater have been downplayed for decades and residual contamination (FYR, 2017, pg. 5-3) has moved in the bedrock to the area of housing dorms or where the future temporary housing will be located. The 1987 groundwater mapping shows the plume could easily flow northeast toward the proposed Housing Detention Area. There are currently no wells in use to monitor current conditions at LF002.

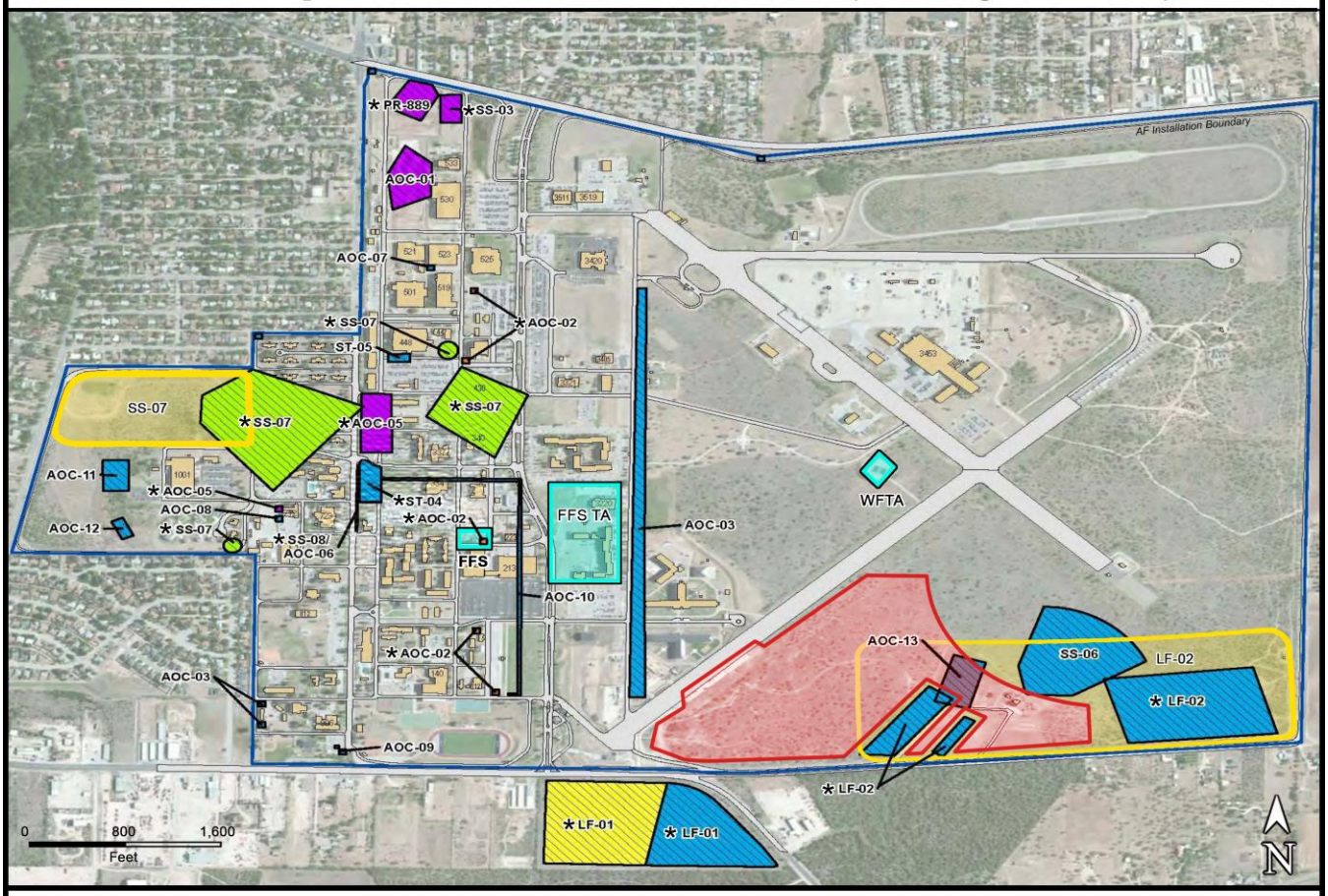
We request additional groundwater data be collected at LF002 to verify a clean closure and to determine whether recent dumping along the perimeter, shooting galleries, and paint ball course

[45] ENVIRO facts, Goodfellow AFB Environmental Program Update, Fact Sheet 5, April 2001, "Restoration Sites" Table.
[46] Final Five-Year Review, Goodfellow AFB, Weston Solutions, Inc., April 2017, pg. 5-3.

have not contaminated the groundwater or caused indoor air vapors and pathways to be present. New replacement monitoring wells in the LF002 area should be planned. Substantial new investigations are necessary to determine current environmental conditions and whether residential development here can be constructed safely for the new residents. The Southeast Landfill (LF002) had a commercial/industrial closure in December 1988. Since then, shooting ranges and miscellaneous debris from base projects and paintball facilities were placed without any regulatory approvals as required. The footprint of the facility needs to be laid out and then a comprehensive sampling plan to collect soil and groundwater data must be prepared prior to have children inhabit portions of LF002.

Finally, per- and polyfluoroalkyl substances (PFASs), also referred to as perfluorinated chemicals (PFCs), were recently detected near the proposed HHS Facilities. Nine potential locations were identified. EPA is particularly concerned about PFAS chemicals. They are persistent in the environment, quite soluble in groundwater, bioaccumulative in wildlife and humans, and are toxic to laboratory animals and wildlife, producing reproductive, developmental, and systemic effects in laboratory tests. These chemicals were found in Fire-Fighting Foams used in fire training areas. Before any HHS housing is planned, the exact nature, extent and exposure potential for PFAS should be well understood in all nine locations.

**Site Map 2** – Goodfellow Air Force Base (*San Angelo, Texas*)




**LEGEND**

**SOURCE #1:**
*Draft Environmental Assessment (July 2018), Fig. 2-1*

Proposed Detention Center Area

**SOURCE #2:**
*Final First Five-Year Review ("FYR"), Weston Solutions, Inc. (July 2012), Fig. 1-2*

- Site Status Closed
- Site Status Open
- Residential land use, Soil and Groundwater disturbance prohibited
- Residential land use prohibited
- Soil and Groundwater disturbance prohibited
- Groundwater disturbance prohibited
- No restrictions

**SOURCE #3:**
*Final FYR, Weston Solutions, Inc. (Apr. 2017), Fig. 1-2*

* Sites marked with asterisks appear in both Source #2 (2012 FYR) & Source #3 (2017 FYR)

NOTE: All sites appear to have the same designations in Source #2 & Source #3, with the exception of ST-04 which appears as "Status Open" in Source #3.

**SOURCE #4:**
*Annual Inspection Report, Lata-Kemron Remediation, LLC, (May 2018), Fig. 2*

Inspection Site

NOTE: This map includes the inspection sites for LF-02 and SS-07 only.

**SOURCE #5:**
*Draft Final Site Inspection Report, Amec Foster Wheeler (Sept. 2018), Figs. 2.3-1, 3.1-1, & 3.2-1*

Aqueous Film Forming Foam (AFFF) Release Area

*Note*: Some site names, shapes, and sizes shift from report to report over the years (1985-2018). In addition, AOC-04 is described in documents, but does not appear in any of the source maps reviewed.