PART II

Decision Summary

Introduction

This Decision Summary includes the findings, evaluations, decision-making process, and selected remedial actions for the North/East/West Industrial Operable Units (NEWIOU) Soil, Sediment, and Surface Water (SSSW) Record of Decision (ROD) also referred to as the NEWIOU SSSW ROD. This Decision Summary consists of the following sections.

- **Section 1.0**—Describes the physical and ecological setting, and current land use of Travis Air Force Base (AFB or Base).

- **Section 2.0—**Provides an overview of the Travis AFB Restoration Branch and environmental programs.

- **Section 3.0—**Summarizes the nature and extent of soil contamination as presented in the three remedial investigations (RIs) (*Remedial Investigation, North Operable Unit, Travis Air Force Base, California*, Radian Corporation [Radian], 1995 [NOU RI]; *Remedial Investigation Report, East Industrial Operable Unit, Travis AFB, California*, Weston, 1995a [EOU RI]; and *Remedial Investigation, West Industrial Operable Unit, Travis AFB, California*, Radian, 1996a) [WIOU RI].

- **Section 4.0—**Presents the remedial alternatives that were considered and the comparison of the alternatives to the criteria set forth in the National Contingency Plan (NCP) as presented in the *North/East/West Industrial Operable Unit Feasibility Study, Travis Air Force Base, California* (NEWIOU FS) (Radian, 1996b).

- **Section 5.0—**Identifies the selected remedial actions, the selected soil and sediment cleanup levels, and the rationale for their selection. Land use controls, statutory determinations, remedial design/remedial action (RD/RA) implementation and schedule, site closure, and documentation of significant changes are also discussed.

- **Section 6.0—**Presents the applicable or relevant and appropriate requirements (ARARs) and performance standards for the actions.

- **Section 7.0—**Presents the list of cited works.

Note that Sections 3.0 and 4.0 summarize the RIs and FS, respectively, from a historical perspective. As discussed in Section 2.2.3, after the NEWIOU SSSW Proposed Plan (Travis AFB, 1998a) was completed, there was a four-year delay while the WABOU Soil ROD (Travis AFB, 2002a) was completed. Thereafter, work began on the NEWIOU SSSW ROD using the approach that proved successful for the WABOU Soil ROD. One of the changes implemented in the NEWIOU SSSW ROD was to base cleanup levels on U.S. EPA Region 9's preliminary remediation goals (PRGs) unless there are site-specific considerations that justify a less stringent cleanup level. Although PRGs are "To Be Considereds" (TBCs), not federal and state ARARs, the use of PRGs as the basis for cleanup levels for human health is discussed in Section 5.2.3. In

addition, due to delay and the complexity of dealing with 18 sites, 40 contaminants of concern (COCs), 3 media (soil, sediment, and surface water), and 3 types of receptors (human, ecological, and groundwater) in one document, it was decided to use technical memoranda (tech memos) as ROD development documents. Three tech memos were prepared to aid in development of the ROD: The *Summary of Remedial Investigation Data and Risk Management Decisions for Human Health at NEWIOU Soil Sites, Travis Air Force Base, California* (referred to as the Human Health Tech Memo [URS, 2004a]); the *Ecological Technical Memorandum for the NEWIOU at Travis Air Force Base, California* (referred to as the Eco Tech Memo [URS, 2005]); and the *Groundwater Protection at NEWIOU Soil Sites Technical Memorandum, Travis Air Force Base, California* (referred to as the Groundwater Protection Tech Memo [URS, 2004b]). These tech memos provided site-by-site summaries and maps with RI data and any updated site information. The Eco Tech Memo provided an extensive update of the ecological risk assessment. After extensive discussion between the Air Force and the regulatory agencies, selected remedial alternatives were included in each tech memo for each site with supporting rationale. The information from the three tech memos was summarized and consolidated in this ROD. The intent was to have this ROD provide the decisions on remedial actions and how they were developed, yet still be concise (approximately 1 inch thick). The details of the ROD development are available in the tech memos (a total of approximately 5 inches thick) if needed. Sections 5.2.3, 5.2.4, and 5.2.5 discuss each of the tech memos in more detail.

The tech memos built upon the NOU, EIOU, and WIOU RIs, the NEWIOU FS, and the NEWIOU SSSW Proposed Plan, but at some sites, the remedial alternative selected in the ROD differed from the NEWIOU SSSW Proposed Plan. All remedial alternatives selected in this ROD were included and discussed in the NEWIOU SSSW Proposed Plan. The Responsiveness Summary (Part III) of this ROD documents the presentation of the differences between the NEWIOU SSSW Proposed Plan and this ROD to the public and their response.

PART II

1.0 Travis AFB Description

Travis AFB is located midway between San Francisco and Sacramento, California, about 3 miles east of downtown Fairfield in Solano County. The Base occupies over 6,383 acres. In addition, the Base maintains ownership of, or administrative control over, 11 annexes at off-base locations. Travis AFB's workforce consists of approximately 14,300 military members and civilian employees. Figure II-1-1 presents maps of the regional location of Travis AFB and its annexes.

Travis AFB is currently part of the Air Mobility Command (AMC) and is host to the 60th Air Mobility Wing (AMW). The AMW operates C-5 Galaxy cargo aircraft and KC-10 Extender refueling aircraft. The primary missions of Travis AFB since its establishment have been strategic reconnaissance and airlift of freight and troops.

1.1 Physical Description

Travis AFB has a gently sloping to nearly flat topography, with variations in topographic relief of up to 50 feet. Elevations at Travis AFB range from over 100 feet above mean sea level (msl) near the northern boundary to less than 20 feet above msl near the South Gate. The ground surface generally slopes to the south or southeast at about 30 feet per mile. Areas surrounding Travis AFB have a varied topography.

The Travis AFB area has a Mediterranean climate, with wet winters and dry summers. The Base is located near the Carquinez Straits, which is the major break in the Coast Range. Travis AFB usually experiences mild temperatures because of its proximity to the Carquinez Straits and the coast. The mean annual temperature is 60 degrees Fahrenheit (°F). The lowest temperatures occur in January, with a mean of 46°F. The highest temperatures occur in July and August, with a mean of 72°F. Monthly mean relative humidity typically ranges from a low of 50% in June to a high of 77% in January. The mean annual relative humidity is 60.5%.

Travis AFB averages 17.5 inches of rain annually. Approximately 84% of the annual precipitation falls during the winter season of November through March. January is the wettest month, averaging 3.7 inches of precipitation; July is the driest month, averaging 0.02 inch of precipitation. Potential evapotranspiration (ET) ranges from about 50 to 75 inches per year.

Travis AFB experiences sea breezes during the summer because of its proximity to the Carquinez Straits. The average annual wind speed is 8 knots, with a winter average of 5 to 6 knots and a summer average of 12 knots. The predominant wind directions are from the southwest and west-southwest.

1.2 Land Use

Travis AFB occupies over 6,383 acres of land near the center of Solano County, California, and is approximately 3 miles east of downtown Fairfield and 8 miles south of downtown Vacaville. Solano County's population in 1990 was 340,421 (U.S. Department of Commerce/U.S. Bureau of the Census, 1990). In 2000, the population of Solano County was 394,542; the populations of

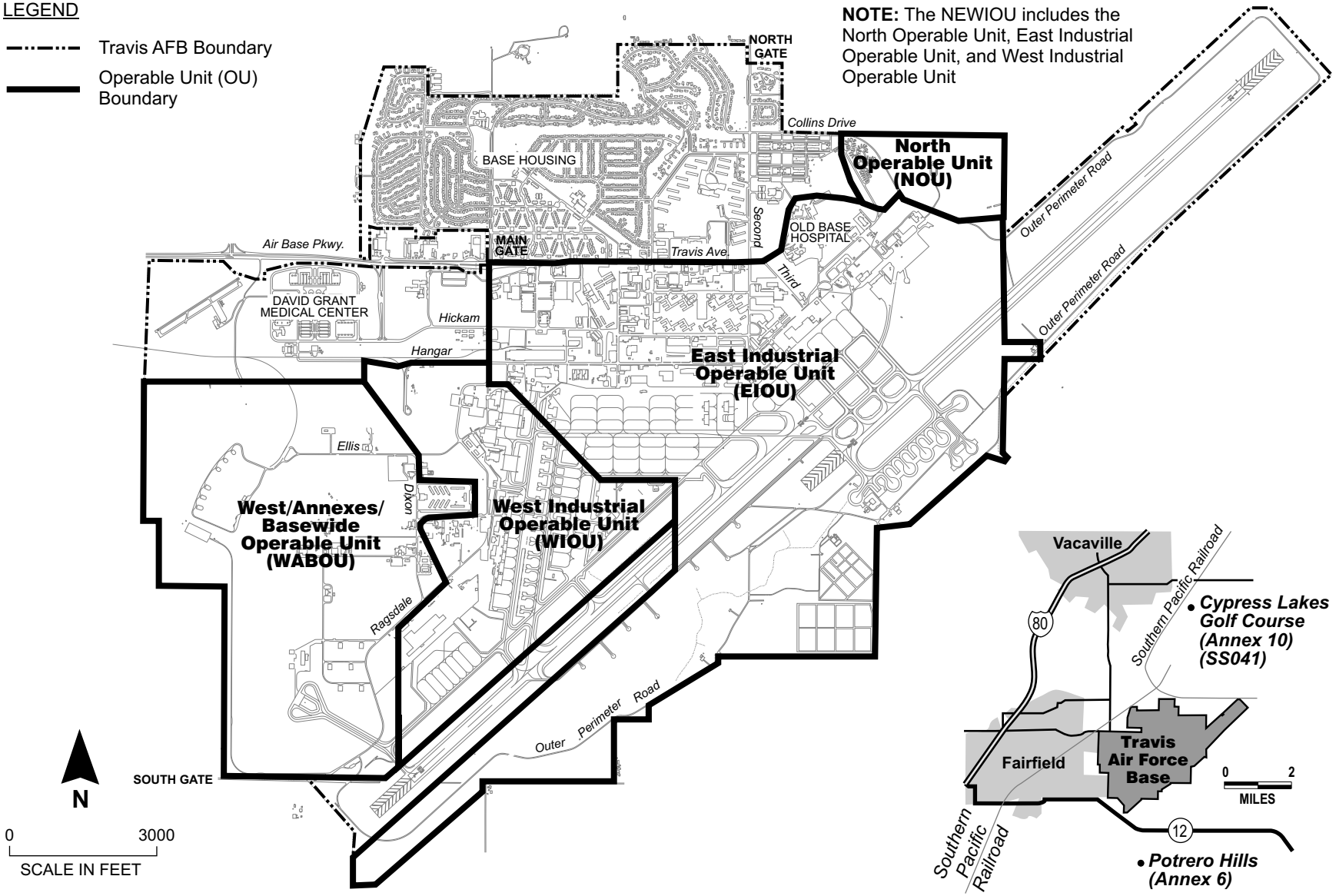

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Figure II-1-1. Travis AFB and Operable Units

Fairfield and Vacaville were 96,178 and 88,625, respectively (U.S. Department of Commerce, U.S. Bureau of the Census, 2000).

According to the Travis AFB Office of Public Affairs, Travis AFB currently employs about 7,315 active military personnel and 3,549 reservists. Approximately 7,732 people live on Base in the 2,736 family housing units and 22 dormitories. There are 3,494 civilians employed at Travis AFB. Approximately 17,000 people are on base daily.

The land use areas of Travis AFB are grouped into eight functional categories.

- **Mission**—Uses are closely associated with the airfield and include facilities such as maintenance hangars and docks, avionics facilities, and other maintenance facilities. Aircraft operations facilities include control towers, Base operations, flight simulators, and other instructional facilities.
- **Administrative**—Uses include personnel, headquarters, legal, and other support functions.
- **Community**—Uses include both commercial and service activities. Examples of commercial uses include the Base Exchange, dining halls, service station, and clubs; service uses include the schools, chapel, library, and family support center.
- **Housing**—Uses include both accompanied housing for families and unaccompanied housing for singles, temporary personnel, and visitors.
- **Base Support/Industrial**—Uses are for the storage of supplies and maintenance of Base facilities and utility systems.
- **Medical**—Uses include facilities for medical support, including the David Grant Medical Center.
- **Outdoor Recreation**—Uses include ball fields, golf course, equestrian center, swimming pools, and other recreational activities.
- **Open Space**—Uses are to provide buffers between Base facilities and to preserve environmentally sensitive areas.

The lands surrounding Travis AFB on the northeast and east are primarily used for ranching and grazing. Areas to the south are a combination of agricultural and marshland. A few commercial/light industrial areas are present to the north of the Base. The area west of Travis AFB is predominantly residential.

Land use within the NEWIOU consists of open grasslands, light industrial support areas, administrative areas, personnel training areas, ammunition storage areas, and service/storage areas.

1.3 Ecology

Travis AFB has a variety of terrestrial and aquatic/wetland habitats and wildlife that are typical of the region. The information used in identifying biological resources was taken from field studies and reports produced by Biosystems Analysis, Inc. (Biosystems) (1993a, b; 1994), CH2M

HILL (1996), Jacobs Engineering Group, Inc. (JEG) (1994a, b), Radian (1994), and Weston (1995a,b).

1.3.1 Terrestrial Habitats

The terrestrial habitats at Travis AFB and in adjacent areas consist of herbaceous-dominated habitats (annual grassland, pasture, and early ruderal habitat) and urban habitat (industrial areas, lawns, and ornamental plants), according to the California Department of Fish and Game (CDFG) classification system (Mayer and Laudenslayer, 1988). Aquatic/wetland habitats at Travis AFB include riverine (Union Creek) and riparian habitat, lacustrine habitat (Duck Pond), and herbaceous-dominated wetlands, marshes, and vernal pools.

In general, annual grassland habitat is dominated by non-native plant species, such as slender wild oat (*Avena fatua*), fescues (*Festuca)*, soft chess (*Bromus hordeaceus*), field bindweed (*Convolvulus arvensis*), and yellow star-thistle (*Centaurea solstitialis*). Some native plants, such as bunchgrass (*F. viridula)* and johnny-tuck (*Triphysaria eriantha*) also may be found, usually associated with undisturbed areas.

Mowed/disked grassland is generally composed of soft chess, Italian ryegrass (*Lolium multiflorum*), and wild oats. Pasture grassland can contain varying frequencies of filaree (*Erodium* sp.), ripgut brome (*Bromus diandrus*), soft chess, Italian ryegrass, and yellow star-thistle. Ruderal grasslands, on the other hand, contain higher numbers of perennial species and, in some areas, woody species, such as coyote brush (*Baccharis pilularis*), eucalyptus (*Eucalyptus* sp.), Peruvian pepper-tree (*Schinus molle*), and black locust (*Robinia pseudoacacia*).

The urban habitat on base contains maintained lawns as well as trees and shrubs, such as eucalyptus, Fremont cottonwood (*Populus fremontii*), arroyo willow (*Salix lasiolepis*), and coyote brush. Most isolated stands of shrubs or trees are located within or near urban areas and permanent water sources or near artificial surface mounds (for example, rail lines, blast protection, and building/road foundations).

1.3.2 Aquatic/Wetland Habitats

Herbaceous wetland vegetation is found along the permanent (natural or artificial) drainages on base and can also occur seasonally within vernal pools, swales, and ditches. Native species include salt grass (*Distichlis spicata*); non-native species include meadow fescue (*Festuca elatior*), sickle grass (*Parapholis incurva*), and cattails (*Typha* sp.). Vernally inundated areas support seasonal vegetation, such as non-native Mediterranean barley (*Hordeum murinum* ssp. *leporinum*) and brass buttons (*Cotula coronopifolia*), and native plants, such as downingia (*Downingia* sp.) and toad rush (*Juncus bufonius*).

Vernal pools are shallow depressions or small, shallow pools that fill with water during the winter rainy season, dry out during the spring, and become completely dry during the summer. The vernal pools at Travis AFB contain indicator species, such as goldfields (*Lasthenia fremontii*), coyote thistle (*Eryngium vaseyi*), dwarf woolly-heads (*Psilocarphus brevissimum*), water pygmy-weed (*Crassula aquatica*), and one or more species of downingia and popcornflower (*Plagiobothrys* sp.). Figure II-1-2 shows the vernal pools at Travis AFB.

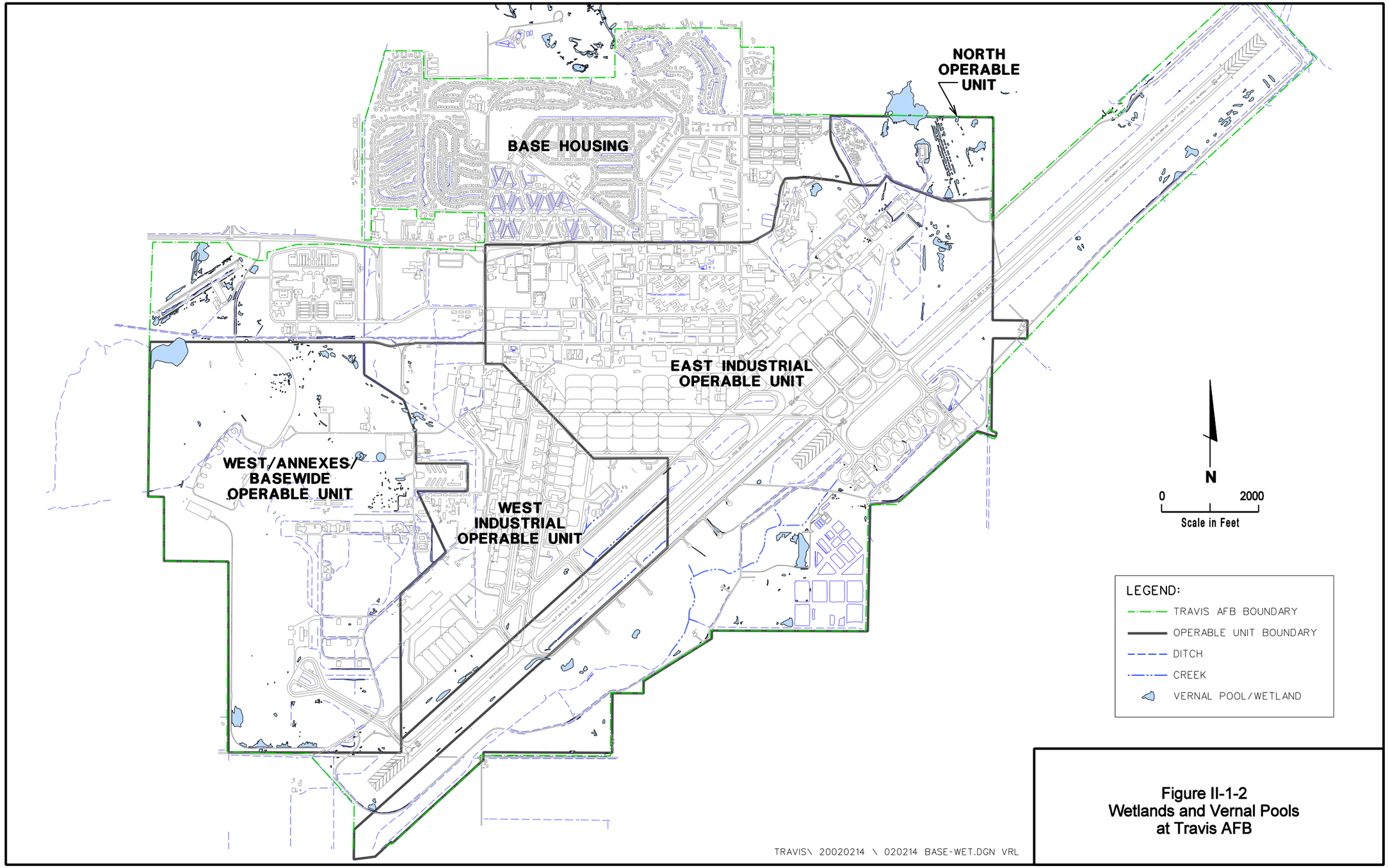

Figure II-1-2
Wetlands and Vernal Pools
at Travis AFB

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Although a few willows and coyote brush can be found along Union Creek, the dominant plant species found in the riparian zone of Union Creek are mainly herbaceous and consist of beardless wild rye (*Leymus triticoides*), broad-leaved pepperwort (*Lepidium latifolium*), Harding grass (*Phalaris aquatica*), and saltgrass. Hydrophytes, such as cattails and rushes, are also common.

1.3.3 Wildlife

Terrestrial vertebrates associated with the non-native annual grasslands are commonly found on base. Typical avian species include the ring-necked pheasant (*Phasianus colchicus*), American kestrel (*Falco sparvarius*), American robin (*Turdus migratorius*), and western meadowlark (*Sturnella neglecta*). Reptiles observed, or potentially occurring, at the Base include the western fence lizard (*Sceloporus occidentalis*), gopher snake (*Pituophis melanoleucus*), western pond turtle (*clemmy marmorata*), and California red-sided garter snake (*Thamnophis sirtalis* ssp. *infernalis*). Common mammals identified include deer mouse (*Peromyscus maniculatus*), California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), black-tailed hare (*Lepus californicus*), and red fox (*Vulpes vulpes*).

Permanent wetlands and seasonally wet areas support aquatic invertebrates, fish, amphibians, reptiles, birds, and mammals. Some aquatic invertebrate species observed in herbaceous wetlands and vernal pools at Travis AFB include vernal pool fairy shrimp (*Branchinecta lynchi*), damselflies, crayfish, and aquatic snails. Amphibian species identified include bullfrog (*Rana catesbeiana*) and Pacific tree frog (*Hyla regilla*). Aquatic birds observed on or near the Base include mallard (*Anas platyrhynchos*), great egret (*Casmerodiuis albus*), and great blue heron (*Ardea herodias*).

Because wildlife use riverine and riparian habitat somewhat similarly, these habitats are discussed together. Many aquatic invertebrates and amphibians are the same as those discussed above for herbaceous wetlands and vernal pools. These include damselflies, crayfish, aquatic snail, bullfrog, Pacific tree frog, and California tiger salamander (*Ambystoma californiense tigrinum*), although no tiger salamanders have been observed at Travis AFB. Fish species include mosquitofish (*Gambusia affinis*), fathead minnow (*Pimephales promelas*), threespine stickleback (*Gasterosteus aculeatus*), bluegill (*Lepomis macrochirus*), and fall or late fall run chinook salmon. Riverine/riparian habitats also are used extensively by birds and terrestrial mammals for forage and shelter and as a source of water. These include the red-winged blackbird (*Agelaius phoenicus*), raccoon (*Procyon lotor*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), and river otter (*Lutra canadensis*).

Habitats that support special-status species are considered sensitive habitats. Sensitive aquatic/ wetland areas include vernal pools, swales, and ditches that can support special-status plants and animals. Urban environments, scattered throughout the Base, also can support special-status species. For example, burrowing owls (*Speotyto cunicularia*) may use man-made culverts, perches, and bare earth areas that contain burrows provided by ground squirrels. Loggerhead shrikes (*Lanius ludovicianus*) may nest on antenna wires and forage in grasslands. Both owls and shrikes are typical species of the grassland habitats on base. Also, vernal pool fairy shrimp have been found in artificially created depressions that seasonally fill with water.

1.4 Geology and Hydrogeology

This section provides a discussion of the regional geologic setting near Travis AFB and specific geologic conditions in the NEWIOU.

1.4.1 Geology and Soils

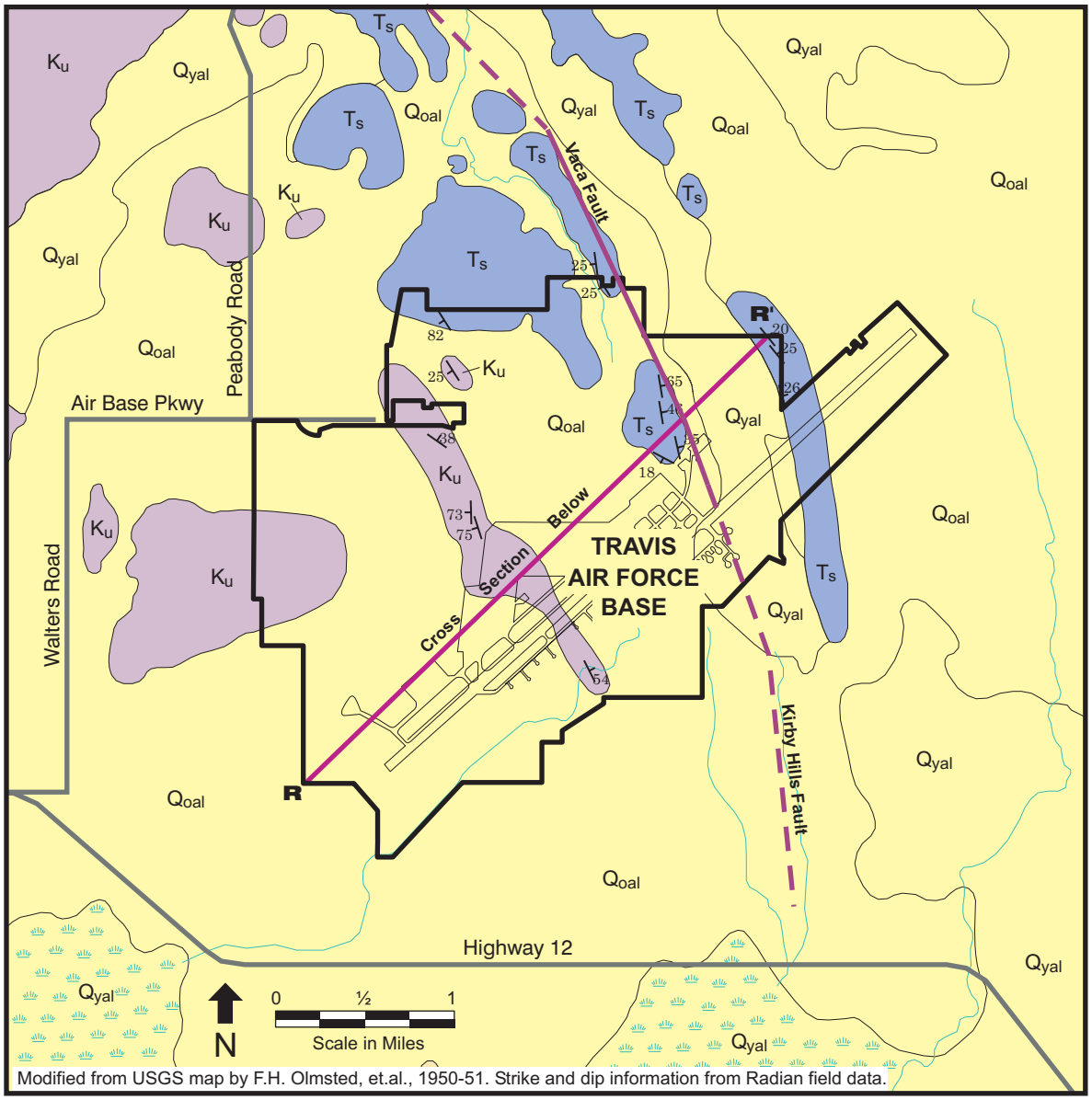
Travis AFB is on the western edge of the Sacramento Valley segment of the Great Valley Geomorphic Province. This province is a sediment-filled synclinal basin with a northwest-to-southeast-oriented axis. The Coast Range Geomorphic Province lies just to the west of Travis AFB (Thomasson et al., 1960; Olmsted and Davis, 1961).

Bedrock units that outcrop in the vicinity of Travis AFB include (from oldest to youngest) the Domengine Sandstone, the Nortonville Shale, the Markley Sandstone, the Neroly Sandstone, and the Tehama Formation. Figure II-1-3 is a geologic map and generalized cross-section illustrating the shallow bedrock units and alluvium in the area surrounding Travis AFB. Bedrock at the NEWIOU has been defined as consisting of consolidated to semi-consolidated sedimentary rock. It has been distinguished from the overlying unconsolidated sediment by such criteria as fissility, cementation, bedding, blow counts, color, texture, and gradation into competent rock (Weston, 1995a). Because of its lower permeability, relative to the unconsolidated alluvium that overlies it, the bedrock may form a boundary for groundwater flow and therefore influence the migration of contaminants in groundwater. Table II-1-1 is a stratigraphic column that summarizes the lithology and age of the geologic units in the area.

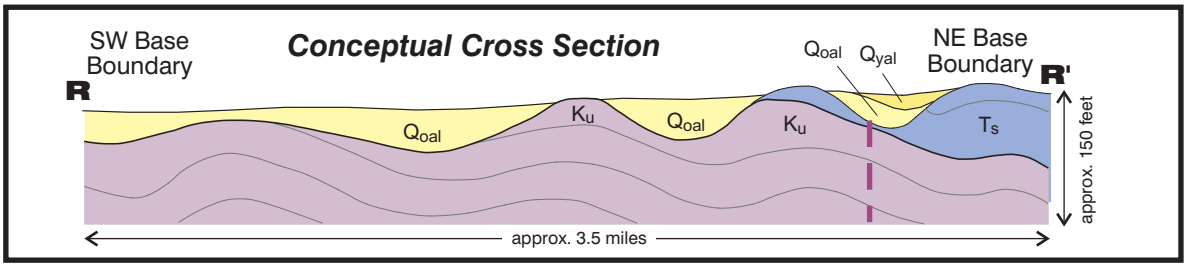
Outcrops of the relatively resistant Markley and Domengine Sandstones form most of the topographic high points on the Base, including the hill at the old Base hospital, the low ridge along the boundary between the WIOU and the EIOU, near the center of Travis AFB, and the hills north of Travis AFB. Erosion of the less resistant bedrock units, such as the Nortonville Shale, formed low areas that were later filled with alluvium. Three major subsurface bedrock ridges have been identified in the EIOU: the Eastern Ridge, the Central Ridge, and the Western Ridge (Weston, 1995a). These areas have bedrock at 20 feet below ground surface (bgs) or less. The three ridges are anticlines that plunge slightly towards the south—as does the surface elevation in these areas. The material between these anticlines is alluvium—predominantly silts and clays with intermittent sand lenses. The Western Ridge bisects the EIOU and the WIOU. The bedrock consists of poor to moderately indurated (cemented) sandstone.

Travis AFB is on the northeastern margin of the Fairfield-Suisun Basin, astride the Vaca Fault. The Vaca Fault runs through the Central Ridge in a south-southeastern direction and is mapped as a fault with late Quaternary (during the past 700,000 years) activity (Jennings, 1994). No historic activity has occurred on this fault. Travis AFB lies on alluvial fans (drainages between parent rocks that have filled with alluvium) that extend from the Vaca Mountains to the Suisun Marsh, referred to as older and younger alluvium. At Travis AFB, the overall thickness of the alluvium ranges from 0 to approximately 70 feet but is generally less than 50 feet. West of Travis AFB, the thickness of the alluvium increases to over 200 feet (Thomasson et al., 1960).

The Tehama Formation consists of poorly sorted deposits of clay, silt, clayey silt, sandy silt and clay, and silty sand containing generally thin lenses of gravel and sand. In areas of outcrop, it consists chiefly of siltstone, sandstone, and conglomerate (Page, 1986). The thickness of the



Modified from USGS map by F.H. Olmsted, et.al., 1950-51. Strike and dip information from Radian field data.



Legend:

- Vaca-Kirby Hills Fault (*from Thomasson et al, 1960*)
- Qyal — Younger Alluvium
- Qoal — Older Alluvium
- Ts — Undifferentiated Sandstones, Siltstones, and Shales
- Ku — Undifferentiated Rocks
- 75 — Strike and Dip of Geologic Units

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Figure II-1-3. Geologic Map of Travis AFB and Vicinity

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Table II-1-1
Stratigraphic Column of Geologic Units at Travis AFB
North/East/West Industrial Operable Unit Soil, Sediment, and Surface Water Record of Decision, Travis AFB, California

Million Years Ago	Era	Period	Epoch	Geologic Unit	Lithologic Description	Possible Range of Thickness
1.8	Cenozoic	Quaternary	Pleistocene and Recent	Younger Alluvium	Interbedded clays, silts, sands and gravels; continental	0–70 feet
				Older Alluvium	Interbedded clays, silts, sands, and gravel; continental	0–100 feet
				Bay Mud	Interbedded clays, silts, sands and gravel; continental	
5			Pliocene	Tehama Formation	Interbedded gravels, sands, silts and clays, partially consolidated, occasional volcaniclastic sediments; continental	
					Unconformity	
27.5		Tertiary	Miocene	Neroly Sandstone (San Pablo Group)	Interbedded sandstone, siltstone, and shale; distinctive bluish color; marine	0–60 feet
					Unconformity	
38			Oligocene			
55			Eocene	Markley Sandstone	Massive micaceous, arkosic sandstone, interbeds of siltstone and shale; marine	0–60 feet
				Nortonville Shale	Predominantly dark gray marine shale and siltstone, minor sandstone, coal and glauconitic sandstone unit	80 feet
				Domengine Sandstone	Coarse–grained sandstone, minor siltstone and shale interbeds, gray to brown; marine (in outcrop only as mapped by Sims et al., 1973).	50 feet
			Paleocene	Unnamed Formation	Interbedded shale, siltstone, and thinly laminated friable sandstone; marine (as mapped by Sims et al., 1973)	

NEWIOU = North/East/West Industrial Operable Unit
ROD = record of decision

Source: Sims et al., 1973.

formation beneath the NEWIOU is unknown. Some topographic relief in the form of very low ridges is provided by near-surface bedrock or outcrops of sedimentary rocks characterized as bedrock in the Travis AFB area.

The younger and older deposits are distinguished at the surface by the difference in the maturity of their soil profiles. The portion of the alluvium near the ground surface has been altered, or weathered, over time by physical, chemical, and biological actions. The Younger

Alluvium generally has an immature soil profile; the Older Alluvium generally has a well-developed, mature soil profile. Most of the sediment encountered at Travis AFB consists of Older Alluvium. The Younger Alluvium overlies the Older Alluvium and is found only in the northeastern portion of the Base.

Soils in the vicinity of Travis AFB are classified as alfisols, which are primarily silt and clay loams that exhibit low permeabilities and poor drainage characteristics. Most of the Base, including the NEWIOU, is covered with soils derived from older alluvium designated as the Antioch-San Ysidro Complex. These soils are predominantly sandy loams with clay and clay loams 12 to 30 inches below the surface. The soils are old and are characterized by a well-developed soil profile that includes a well-defined clay hardpan beneath the surface that limits the percolation of water.

1.4.2 Hydrogeology

Travis AFB is located along the northeastern edge of the Fairfield-Suisun Hydrogeologic Basin. The basin is a hydrogeologically distinct structural depression adjacent to the Sacramento Valley segment of the Central Valley Province. The basin is bordered to the north by the Vaca Mountains and to the east by the ridge that runs along the eastern portion of the NOU and EIOU. The basin slopes south toward the Suisun Marsh; consequently, groundwater and surface water at Travis AFB tend to flow south to Suisun Marsh (California Department of Water Resources, Central District, 1994).

The primary water-bearing deposits in the region surrounding Travis AFB are the coarse-grained sediments (sand and gravel) within the Older Alluvium and Younger Alluvium. Depth to groundwater varies seasonally from 0 to 12 feet bgs. The bedrock units generally do not yield groundwater of usable quantity or quality in the Fairfield-Suisun Hydrogeologic Basin (Thomasson et al., 1960).

Groundwater recharge occurs from the direct infiltration of rainfall on the ground surface and from the infiltration of runoff through depressions and local creek beds. Natural groundwater discharge may occur in the ditches and branches of Union Creek that flow into Suisun Marsh, as well as directly into the marshlands near the Potrero Hills, south of Travis AFB (Thomasson et al., 1960). When the water table elevation intersects the ground surface in an area with a high water table, discharge of groundwater occurs. Groundwater is likely to infiltrate the storm sewer system in the storm sewer right-of-way, of which Union Creek is a continuation (Weston, 1995a). There is also a connection between groundwater and surface water at the vernal pools on base; however, the hydraulic connection has not been quantified. Depth to groundwater changes seasonally, depending on the amount of rainfall and subsequent infiltration. Thus, at the end of the dry season, depths to groundwater are greater than during the rainy season.

The groundwater gradient results from the differences in hydraulic potential and indicates the direction of groundwater flow. The general direction of groundwater flow within the alluvium at Travis AFB is southerly, similar to the regional gradient. However, local variations (groundwater mounds and depressions) exist within the boundaries of Travis AFB. Alluvium is between 0 and 70 feet thick, and the magnitude of the hydraulic gradient varies with the thickness. The groundwater contours are closer (i.e., the gradient is steeper) in areas where alluvium is thinner (i.e., the bedrock ridges). The change in gradient is due to the decreasing thickness of the more permeable alluvium and the increasing thickness of the less permeable

bedrock. For example, gradients are steep at LF007, where bedrock is close to the surface, and flatten out at FT004, where bedrock is deeper beneath the surface and the saturated alluvium thickens.

The typical upper end of horizontal gradients in the upper portion of the aquifer at Travis AFB is approximately 0.02 (vertical foot per horizontal foot) at the groundwater mound near the old base hospital. A typical lower end horizontal gradient in the upper portion of the aquifer is approximately 0.002 near the southern border of Travis AFB. The average magnitude of the groundwater gradient in the upper portion of the aquifer at Travis AFB is approximately 0.005. The horizontal hydraulic gradients in the deep portion of the aquifer range from 0.01 to 0.003.

Hydraulic conductivities vary from 0.0001 to 0.079 feet per minute based on the aquifer tests conducted at Travis AFB, depending on grain size and sorting observed in the alluvial units.

1.4.3 Groundwater Use

Intensive extraction of groundwater generally occurs only to the west of Travis AFB and Fairfield, where the alluvium is thicker and contains a greater abundance of coarse-grained sediment. Groundwater wells in the area of Travis AFB are limited to domestic, stock watering, and irrigation wells, with typical screened depths within 100 feet of the ground surface (Weston, 1995a). Domestic wells, several of which are downgradient from Travis AFB, are used typically for households and gardens (Weston, 1993). Solano County does not supply water to the residences surrounding Travis AFB. The two nearest domestic wells are within 1,700 feet of the southern boundary of Travis AFB.

Several wells 4 miles north of Travis AFB, at the Cypress Lakes Golf Course (Annex 10), produce 400 to 500 million gallons of water per year. This well water is mixed with surface water purchased from the City of Vallejo to supply potable water to Travis AFB. The Fairfield public water supply field is approximately 3 miles west of Travis AFB. The large production wells at the golf course and in Fairfield tend to be deeper than the nearby domestic wells, ranging to 1,000 feet deep.

No on-base wells are used for potable water production. However, numerous wells are used to extract contaminated groundwater, which is then treated at one of the groundwater treatment plants. Extraction wells located on base yield groundwater at a range of less than 1 gallon per minute (gpm) (several extraction wells within the WIOU) to approximately 12 gpm (EW605x16 in the EIOU). Groundwater contamination from Travis AFB does not affect Fairfield's water supply, and remedial actions implemented by Travis AFB are and will be protective of Fairfield's wells.

1.5 Surface Water

Travis AFB is in the northeastern portion of the Fairfield-Suisun Hydrologic Basin. Within the basin, water generally flows south to southeast toward Suisun Marsh, an 85,000-acre tidal marsh that is the largest contiguous estuarine marsh, as well as the largest wetland, in the continental United States. Suisun Marsh drains into Grizzly and Suisun Bays. Water from these bays flows through the Carquinez Straits to San Pablo Bay and San Francisco Bay, and ultimately discharges into the Pacific Ocean near the City of San Francisco.

Union Creek is the primary surface water pathway for runoff at Travis AFB (Figure II-1-4). The headwaters of Union Creek are approximately 1 mile north of the Base, near the Vaca Mountains, where the creek is an intermittent stream. Union Creek splits into two branches north of the Base, with the main (eastern) branch being impounded into a recreational pond designated as the Duck Pond. At the exit from the Duck Pond, the creek is routed through a storm sewer to the southeastern Base boundary, where it empties into open creek channel.

The West Branch of Union Creek flows south and enters the northwestern border of Travis AFB east of the David Grant Medical Center in an excavated channel. This channel flows south to the northeastern corner of the WABOU and continues southeast along the western side of the WIOU until flow in the channel is directed to a culvert under the runway and discharges to the main channel of Union Creek at Outfall II. From Outfall II, Union Creek flows southwest and discharges into Hill Slough, a wetland located 1.6 miles from the Base boundary. Surface water from Hill Slough flows into Suisun Marsh.

Local drainage patterns have been altered substantially within the Base by the rerouting of Union Creek, the construction of the aircraft runway and apron, the installation of storm sewers and ditches, and general development (e.g., the Base Exchange, industrial shops, maintenance yards, roads, housing, and other facilities). Surface water is collected in a network of underground pipes, culverts, and open drainage ditches. The surface water collection system divides the Base into eight independent drainage areas. The eastern portion of the Base is served by one of the drainage systems that collects runoff from along the runway and the inactive sewage treatment plant area and directs it to Denverton Creek and Denverton Slough. Denverton Creek is an intermittent stream in the vicinity of the Base. The northwestern portion of the Base drains to the west toward the McCoy Creek drainage area. McCoy Creek is also an intermittent stream in the vicinity of the Base. With the exception of these drainages, the remaining six drainage areas at the Base empty into Union Creek.

Travis AFB has limited topographic relief, and the clayey soils prevent rapid drainage. This swale topography leads to the formation of vernal pools. The annual cycle of vernal pools includes standing water during the winter and spring and desiccation during the summer and fall. During the time that the vernal pools contain water, biotic communities develop over relatively restricted areas. In the larger areas, grasslands form; in more confined, deeper areas, wetlands form. The vernal wetlands are concentrated along the western, southern, and southeastern boundaries of the Base. All of the surface water bodies on and in the vicinity of the Base empty into the Suisun Marsh. No springs have been recorded within the confines of Travis AFB.

Surface water pathways, as defined in this NEWIOU SSSW ROD, include Union Creek, drainage channels, the storm and sanitary sewer system, and the backfill material surrounding underground sewer lines.

N

0 2200

Scale in Feet

Duck Pond

SD033
West Branch of
Union Creek

LF007

LF006

SD031

FT004

FT003

FT002

SS015

SD034

SD033

SS035

SS016

ST032

Outfall 4

OT010

SD001

Outfall 3

SD033

SS029

WP017

SD036

SD037

SD033

SS030

FT005

SD001
Main Branch of
Union Creek

SD033

Outfall 2

SD033

Legend

- Union Creek (Above ground)
- Union Creek (Underground)
- Outfall Location
- Boundary of ERP Site Included in the Feasability Study (FS)
- NEWIOU Boundary
- Base Boundary

Figure II-1-4
Location of On-Site Surface Water at Travis AFB

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PART II

2.0 Overview of Travis AFB Restoration Branch and Environmental Programs

The Travis AFB Environmental Management Office is divided into four branches: Compliance, Restoration, Conservation, and Pollution Prevention. This section describes the Restoration Branch and the programs that are designed to comply with current federal and state environmental regulations.

The Restoration Branch manages the Travis AFB Environmental Restoration Program (ERP), which was initiated in 1983 to investigate the nature and extent of reported hazardous waste releases to the surrounding environment (Engineering-Science, 1983). On the basis of the evaluation of ERP data by the United States Environmental Protection Agency (U.S. EPA), Travis AFB was placed on the National Priorities List (NPL) on 21 November 1989 (54 Federal Register 48187).

The Air Force, U.S. EPA, California Environmental Protection Agency's Department of Toxic Substances Control (Cal-EPA/DTSC), and San Francisco Bay Regional Water Quality Control Board (RWQCB) negotiated and signed a Federal Facility Agreement (FFA) in September 1990. The FFA is a legally binding document that establishes the framework and schedules for the environmental cleanup at Travis AFB. This document also requires Air Force compliance with the NCP, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), and other federal and state laws and regulations that are ARARs.

2.1 Management Action Plan and Travis AFB General Plan

The Travis AFB Management Action Plan (MAP) summarizes the current status of the Travis AFB environmental compliance, restoration, and pollution prevention programs and presents a comprehensive strategy for implementing response actions necessary to protect human health and the environment. Travis AFB updates the MAP annually. Travis AFB environmental staff and Air Force headquarters use the MAP to direct and monitor environmental response actions and to schedule activities needed to resolve technical, administrative, and operational issues.

The Travis AFB General Plan provides an organized, systematic, and comprehensive approach to current and future planning and development. The Base General Plan is a tool that addresses a multitude of installation requirements and assists in the long-range growth of the Base, including natural resources, environmental protection, land use, airfield operation, utilities, transportation, and architectural compatibility. Of particular importance is its role in environmental protection. The Base General Plan addresses proper hazardous waste management and recognizes CERCLA-related activities through proper land use at Travis AFB. The Travis AFB Community Planner maintains the Base General Plan. Section 5.4 of this ROD addresses the incorporation of land use controls and soil and sediment disturbance restrictions into the Base General Plan based on CERCLA-related activities.

2.2 CERCLA Process

CERCLA was passed in 1980 and amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986. This law established a program to remediate sites contaminated with hazardous constituents to protect public health and the environment. CERCLA established a series of steps to investigate site contamination and design and implement appropriate remedial actions at these sites. The major CERCLA steps are described hereafter.

2.2.1 Remedial Investigations (RIs)

Separate RIs were conducted for each of the three operable units (OUs) within the NEWIOU. These RIs were used to collect data to characterize site conditions, to determine the nature of the waste, and to assess risk to human health and the environment. The NEWIOU RIs used phased and sequenced approaches to minimize the collection of unnecessary data and maximize data quality. Initial data collection efforts provided a basic understanding of site characteristics. As this basic understanding was achieved, subsequent data collection efforts focused on filling identified data gaps in the conceptual site models (CSMs) and gathering the information necessary to support evaluations of remedial alternatives. The results and conclusions of these investigations were published in the three RIs (i.e., the NOU RI [Radian, 1995], the EIOU RI [Weston, 1995a], and the WIOU RI [Radian, 1996a].

2.2.2 Feasibility Study (FS)

The FS is divided into three general phases: development of alternatives, screening of alternatives, and detailed analysis of alternatives. In the first phase, the technology types and process options available to implement the general response actions for contaminated soil, sediment, surface water, and groundwater were defined. A technology implementability screening was conducted that provided the basis for the selection of representative process options for soil, sediment, surface water, and groundwater remediation. In the second phase, the remedial alternatives were assembled using the representative process options and the site-specific conditions in the NEWIOU. In the last phase, the alternatives were evaluated against seven of the nine CERCLA criteria. The NEWIOU FS provided a comparative analysis of alternatives to identify the advantages and disadvantages of each alternative to assist the decision-making process. The results of this study were published in the NEWIOU FS (Radian, 1996b), which included analyses of all three OUs in the NEWIOU.

2.2.3 Proposed Plan

The Proposed Plan presents to the public the preferred alternative for each site and the rationale for the preferences. The *North/East/West Industrial Operable Unit, Travis Air Force Base, Proposed Plan for Soil, Sediment, and Surface Water* (Travis AFB, 1998a) (NEWIOU SSSW Proposed Plan) gave the public an opportunity to comment on the preferred soil, sediment, and surface water alternatives during a 30-day public comment period (8 July 1998 to 8 August 1998). All community members on the Travis AFB Community Relations list received a copy of the NEWIOU SSSW Proposed Plan just prior to the start of the public comment period. The Air Force formally presented the preferred soil, sediment, and surface water alternatives to the public at the 23 July 1998 public meeting. After completion of the NEWIOU SSSW Proposed Plan, the planning effort at Travis AFB focused on the implementation of basewide interim

groundwater remedial actions and the development of the WABOU Soil ROD. Further development of the NEWIOU SSSW ROD was halted at this point. In the interim, Travis AFB negotiated and executed two groundwater interim records of decision (IRODs) and one large soil ROD, the WABOU Soil ROD (Travis AFB, 2002a). When the WABOU Soil ROD was completed in December of 2002, Travis AFB resumed work on this NEWIOU SSSW ROD.

2.2.4 Record of Decision (ROD)

The ROD presents the selected remedial alternatives and cleanup levels. It summarizes all CERCLA activities at each site and documents that the Air Force and the regulatory agencies are in agreement regarding how the cleanup is to take place. The *Groundwater Interim Record of Decision for the North/East/West Industrial Operable Unit* (Travis AFB, 1997) (NEWIOU Groundwater IROD) and the *Groundwater Interim Record of Decision for the West/Annexes/Basewide Operable Unit* (Travis AFB, 1998b) (WABOU Groundwater IROD) describe the interim remedial actions for the groundwater sites. The Travis Air Force Base WABOU Soil ROD describes the remedial actions for the soil sites in the WABOU (Travis AFB, 2002a).

The development of this NEWIOU SSSW ROD used the RIs, FS, and Proposed Plan as described above, but also used three tech memos as ROD development documents. The three tech memos (Human Health Tech Memo, Eco Tech Memo, and Groundwater Protection Tech Memo) provided site-by-site summaries and maps with RI data and any updated site information. The Eco Tech Memo provided an extensive update of the ecological risk assessment (ERA). After extensive discussion between the Air Force and the regulatory agencies, selected remedial alternatives were included in each tech memo for each site with supporting rationale. The information from the three tech memos was summarized and consolidated in this ROD. Additional information on the approach used in this ROD is provided in the introduction to Part II (Decision Summary) (Page II-Intro-1). Sections 5.2.3, 5.2.4, and 5.2.5 discuss each of the tech memos in more detail.

2.2.5 Remedial Design (RD)

The RD specifies the engineering design used to implement the selected alternative at each site.

2.2.6 Remedial Action (RA)

The RA is the construction and operation of the selected alternatives specified in the ROD and designed in the RD. The Air Force will submit a schedule for the RD/RA activities to the regulatory agencies 21 days after the NEWIOU SSSW ROD is signed.

2.3 Operable Units

2.3.1 Scope and Role of Operable Units at Travis Air Force Base

Initially, Travis AFB was treated as a single entity with one associated comprehensive cleanup schedule. However, as with many Superfund sites, the problems at Travis Air Force Base are complex and involve many separate sites with contamination in various media (soil, sediment, surface water, and groundwater). Therefore, In May 1993, Appendix A (Deadlines) of the FFA was revised, and the Base was divided into four OUs of a more manageable size to facilitate the overall cleanup program. The OUs and media of concern in each OU are as follows:

- East Industrial Operable Unit (EIOU) with soil, sediment, surface water, and groundwater contamination;

- West Industrial Operable Unit (WIOU) with soil and groundwater contamination;

- North Operable Unit (NOU) with soil and groundwater contamination; and

- West/Annexes/Basewide Operable Unit (WABOU) with soil and groundwater contamination.

Operable unit boundaries are shown in Figure II-1-1. Separate RIs were conducted for each of the OUs. In October 1995, the first three OUs were combined (because of the similarity of contaminants found in the RIs for those OUs), and together are referred to as the North/East/West/Industrial Operable Unit, or NEWIOU.

2.3.2 NEWIOU Description

The following three OUs are within the NEWIOU.

- North Operable Unit—The NOU includes two inactive landfills (Landfills 1 and 2). Landfill 1 (LF006) was in use from 1943 until the early 1950s, when operation of Landfill 2 (LF007) was begun (Radian, 1995). Landfill 1 was used as a burn-and-fill landfill, primarily for disposing of general refuse. Based on risk assessments performed for Landfill 1, no further evaluation was recommended for soil, sediment, or surface water in the RI. Landfill 2, operated from the early 1950s until 1974, also was used for general refuse disposal using a trench-and-fill method. In addition to open fields, large vernal pool complexes are present at Landfill 2.

- East Industrial Operable Unit—The EIOU, the largest OU, covers approximately 1,726 acres and includes industrial shops, administration facilities, runways, taxiways, an aircraft parking apron, an inactive sewage treatment facility and associated ponds, open fields, vernal pools, and Union Creek.

- West Industrial Operable Unit —The WIOU is located in the west-central portion of Travis AFB and includes facilities related to the maintenance and repair of C-141 and C-5 aircraft. Facilities include aircraft taxiways, a refueling area, fuel storage areas, and portions of three pipeline systems: the fuel distribution pipeline, Storm Sewer System II (formerly Storm Sewer System B), and the sanitary sewer. Several sites were combined because of geographic proximity or commingling of contaminants (Radian, 1996a). The combined sites are as follows:

  - Facilities 810 and 1917, Storm Sewer System II, and the South Gate Area (SD033)
  - Facility 811 (SD034)
  - Facilities 818/819 (SS035)
  - Facilities 872, 873, and 876 (SD036); and
  - Sanitary Sewer System including Facilities 837, 838, 919, 977, 981, the Area G Ramp, and the Ragsdale/V Area (SD037).

2.3.3 WABOU and NEWIOU Status in the Cleanup Process

WABOU Status

In 1998, the WABOU FS (CH2M HILL, 1998a) and WABOU Groundwater Interim ROD (Travis AFB, 1998b) were completed. Interim groundwater actions were designed, constructed, and are in operation. Until a Basewide Groundwater ROD is completed, Travis will continue to operate the extraction and treatment systems implemented by the WABOU Groundwater IROD, which will reduce contamination in the groundwater. In December 2002, the U.S. EPA and Travis AFB co-selected remedial actions for soil sites in the WABOU. Remedial soil actions have been designed, and actions are complete except for one site (SD045-Former Small Arms Range), which is planned for 2007.

NEWIOU Status

Fifty-nine sites with potential contamination resulting from past industrial activities were originally identified during the NOU RI, EIOU RI, and WIOU RI. After the RIs, these three OUs were merged into the NEWIOU for purposes of the FS, Proposed Plan, and ROD. In 1996, the NEWIOU FS (Radian, 1996b) was finalized on 12 September with agency concurrence. In 1997, the U.S. EPA and Travis AFB co-selected interim remedial actions for groundwater in the NEWIOU, as documented the NEWIOU Groundwater Interim ROD (Travis AFB, 1997). Interim groundwater actions were designed, constructed, and are in operation. Until the Basewide Groundwater ROD is completed, Travis will continue to operate the pump and treat systems implemented by the NEWIOU Groundwater IROD, which will reduce contamination in the groundwater and contain plume migration.

The NEWIOU SSSW Proposed Plan (Travis AFB, 1998a) was completed in 1998, and was submitted for public comment on 8 July 1998. After completion of this Proposed Plan, the planning effort at Travis AFB focused on the development of the NEWIOU and WABOU Groundwater IRODs, the implementation of interim groundwater remedial actions, and the development of the WABOU Soil ROD. When the WABOU Soil ROD was completed in December of 2002, Travis AFB resumed work on the NEWIOU SSSW ROD.

This NEWIOU SSSW ROD presents the remedial actions co-selected by the U.S. EPA and Travis Air Force Base to address contamination in soil, sediment, and surface water in the NEWIOU.

2.4 Removal Actions

Travis AFB has initiated one groundwater removal action and several interim remedial actions in the NEWIOU that are described in the NEWIOU Groundwater IROD (Travis AFB, 1997). A soil removal action was initiated at NEWIOU Site SS015 in 2003, as described in the *Soil Removal Action Summary Report for North/East/West Industrial Operable Unit Soil Removal Action at Site SS015, Travis AFB, California* (Environmental, Inc., 2003).

2.5 Risk Assessment

Human health risk assessments (HHRAs) and ERAs were conducted during the NOU, EIOU, and WIOU RIs. The results of these assessments are summarized in Section 3.0. In addition, the potential ecological risks to plants and animals were quantified from a basewide perspective

and were presented in the *Final Comprehensive Basewide Ecological Risk Assessment - Tier 2 Screening Assessment, Travis Air Force Base, California* (CH2M HILL, 1996). An updated ecological risk assessment was conducted in the Final *Ecological Technical Memorandum for the NEWIOU* (URS, 2005). The NEWIOU Eco Tech Memo provided a Tier 2 risk-based ecological evaluation and built on the findings and conclusions of the previous ERAs in the RIs and the basewide ERA that provided a comprehensive evaluation of Union Creek. In addition, a few new ecological receptors were added to some sites to ensure that all appropriate feeding guilds and trophic levels were represented in the ERA.

2.6 Community Participation

Travis AFB has had a community relations program since 1990. This program is designed to inform the public and involve the community in the environmental decision-making process.

The highlights of the community relations activities implemented by Travis AFB are presented hereafter.

- **Federal Facility Agreement (FFA).** The Air Force, U.S. EPA, Cal-EPA/DTSC, and San Francisco Bay RWQCB have negotiated an interagency agreement that includes requirements for community relations activities based on provisions in federal (and where applicable, state) statutes, regulations, and guidelines.

- **Restoration Advisory Board (RAB).** In 1994, Travis AFB established a RAB comprising representatives of the community and the regulatory agencies. Through its quarterly meetings and its focus groups, the RAB has provided valuable input about community concerns regarding the ERP. The Technical Document Review focus group has reviewed and commented on the draft version of every major report. The Relative Risk focus group has provided input on the project prioritization, and the Community Relations focus group is working to reach out to all community members. The RAB replaced the Technical Review Committee, which met periodically to review program progress.

- **Administrative Record/Information Repository.** The Air Force established an Administrative Record to support Air Force decisions related to the Travis AFB ERP. In addition, the Air Force established a public information repository for the relevant portion of the Administrative Record at the Vacaville Public Library. Copies of RI reports, FS reports, Proposed Plans, and decision documents for the OUs are available for public review.

- **Community Relations Plan (CRP).** The Air Force implemented the first Travis AFB CRP in 1991. The Air Force revised the CRP in 2003. The Travis AFB Remedial Project Manager (RPM) is currently implementing the CRP.

- **Mailing List.** A mailing list of all interested parties in the community is maintained by Travis AFB and updated regularly. The mailing list currently includes more than 1,300 names.

- **Fact Sheets and Newsletters.** The Air Force has been publishing fact sheets describing activities and milestones in the ERP occasionally since 1993. Since 1995, the Air Force has published and mailed quarterly newsletters to everyone on the mailing list. The newsletters

contain information about public participation, issues of potential concern to the public, and program updates. The RAB co-chairs also write columns in each newsletter.

- **Proposed Plans.** The Air Force mailed copies of the NEWIOU SSSW Proposed Plan to all parties on the Travis AFB mailing list, which includes government officials, representatives of interested community groups, and members of the media. To inform the public of changes between the NEWIOU SSSW Proposed Plan and the associated NEWIOU SSSW ROD, the Air Force mailed a fact sheet to the same distribution in 2006. Copies of the Proposed Plan and fact sheet are available at three Solano County libraries (Vacaville, Fairfield, and Travis AFB) for public review.

- **Public Meetings.** The Air Force held a 30-day public comment period for the NEWIOU SSSW Proposed Plan (8 July 1998 to 8 August 1998). The Air Force held a public meeting on the evening of 23 July 1998 to present the preferred remedial alternatives for the NEWIOUS sites. In addition, the Air Force held a second 30-day public comment period (16 January 2006 to 15 February 2006) to inform the public of changes in the preferred alternatives and to solicit public input on the new preferred alternatives. The Air Force provided a fact sheet and public notice, and on 26 January 2006 conducted a public meeting with a supplemental handout. These actions provided the public the opportunity to comment on the revised proposed alternatives.

The selected remedies in this ROD are the same as the preferred alternatives identified in the 2006 fact sheet, the 2006 supplemental handout, and at the public meeting, except that the name of the selected remedy for surface water at SD001 and SD033 is changed from "Source Control" to "No Action." As explained in Section 5.8, Section 5.1.1, and footnote c to Tables I-3 and II-5-15, this is a change in the name of the remedy only and not a change in the actual actions to be taken for surface water under this ROD. More specific information on the 2006 public meeting and public response to the NEWIOU public comment periods is provided in Part III (Responsiveness Summary) of this ROD.

2.7 Petroleum-Only Contaminated Sites Program

The Travis AFB Petroleum-Only Contaminated Sites (POCOS) program is designed to manage on-base sites with petroleum-related contamination. Travis AFB and the regulatory agencies agreed to remove the POCOS from the Travis AFB CERCLA program because the law excludes petroleum as a CERCLA contaminant. The Air Force will address petroleum contamination under CERCLA where it is commingled with CERCLA contaminants.

POCOS are typically associated with surface and subsurface releases from fuel spills, piping leaks, oil/water separators (OWS), or underground storage tanks (USTs). The POCOS program includes the removal of leaking USTs and the remediation of petroleum-only-contaminated soil and groundwater. An example of a POCOS that was removed from the CERCLA program by the regulatory agencies and the Air Force is the North/South Gas Station site. The San Francisco Bay RWQCB is the lead oversight agency for this program.

2.8 Remedial Design/Remedial Action

The RD/RA will include the design and implementation of all actions specified in this NEWIOU SSSW ROD. The regulatory agencies will be involved in the approval and oversight of the design and construction of the RAs.

The Air Force will submit the RD/RA schedule for implementing the ROD 21 days after signing the ROD, in accordance with the FFA. The regulatory agencies will review and approve the RD/RA schedule, as well as all reports and actions specified in the RD/RA schedule. The Air Force prepared a *Basewide Soil Remedial Design/Remedial Action (RD/RA) Plan, Travis Air Force Base, California* (Soil RD/RA Plan) (URS, 2002) that covers the general approach for implementing the remedies at all Travis AFB soil sites.