5.8 WATER RESOURCES

5.8.1 Affected Environment

Precipitation and Surface Water Drainage

Main Post

Precipitation at SBMR varies seasonally and with elevation. The average annual precipitation is 43.75 inches (111 centimeters). Monthly averages range from 1.63 to 3.78 inches (41 to 10 centimeters) during the dry season (April through October) and from 4.14 to 6.21 inches (11 to 16 centimeters) during the wet season. Average annual rainfall at the highest elevations exceeds 50 inches (127 centimeters) (Wu 1967; USARHAW and 25th ID[L] 2001a).

Precipitation varies from year to year and from storm to storm. SBMR lies within an area in which the 100-year 24-hour rainfall is estimated to be about 16 inches (41 centimeters). The 100-year 24-hour rainfall is the maximum amount of rainfall over a 24-hour period that is expected to occur, on average, in any 100-year timeframe. Such estimates are made based on historical rainfall records. Estimates for rainfall durations and return periods other than 24 hours or 100 years also can be made. Thus, for example, the maximum one-hour rainfall with a 100-year return period in the SBMR area is about four inches (10 centimeters) (Wu 1967). The maximum precipitation likely to ever occur over a 24-hour period at SBMR (probable maximum precipitation) ranges from about 42 inches (107 meters) in the lower part of the watershed to about 50 inches (127 centimeters) on the ridges. Thus, the probable maximum 24-hour rainfall is approximately equal to the average annual rainfall. Figure 5-26 shows the watersheds and principal drainage features and water bodies within the SBMR Main Post. SBMR lies near the drainage divide between the Kaukonahua watershed and the Waikele watershed. These watersheds stretch across the Schofield plateau, from the ridgeline of the Koʻolau Range to the ridgeline of the Waiʻanae Range. The Kaukonahua watershed is bordered on the north by the Poamoho watershed.

The principal surface water feature of the Kaukonahua watershed is the Wahiawā Reservoir (Lake Wilson), which lies just outside the eastern boundary of the reservation, east of Highway 99. The reservoir stores drainage from tributaries of the Kaukonahua Stream that originate in the Koʻolau Range. The reservoir is owned by the Dole Foods Corporation, which operates it for agricultural irrigation. The reservoir receives small amounts of surface drainage from the eastern side of SBMR.

Part of the summit of Mount Kaʻala lies within the extreme northwest corner of SBMR. The summit is a wide nearly level plateau with poor drainage and contains a wetland area.

The main drainages at SBMR are the Waikōloa Gulch and the Waikele Stream. The Waikōloa Gulch drains the area just north of the cantonment and joins the Kaukonahua Stream below Wahiawā Reservoir. Two other streams that drain the north part of SBMR are tributaries to the Kaukonahua Stream—Mohiākea Gulch and Haleanau Gulch. Kaukonahua Stream drains northward, through the area underlain by the Waialua aquifer system, joining the Poamoho Stream to form the Kiʻikiʻi Stream, which discharges to Kaiaka Bay, just east of Waialua.

Figure 5-26
Watershed Boundaries and Drainage Features at Schofield Barracks Main Post

Waikele Stream, which originates in the Honouliuli Forest Preserve along the east slope of the Waiʻanae Range south of SBMR, drains the south boundary of SBMR. It flows south along the west side of WAAF, across land overlying the Waipahu-Waiawa aquifer system, and eventually discharges to the West Loch of Pearl Harbor.

Streams in lower reaches of SBMR tend to be intermittent because runoff from small storms is absorbed in bedrock fractures and never reaches the plateau. Runoff from larger or more intense storms overwhelms the capacity of these fracture systems and continues to flow onto the plateau.

Wheeler Army Airfield

WAAF is a 2,085-acre (844 hectare) installation bounded by Schofield Barracks, Wahiawa Reservoir, the Kamehameha Highway, and Waikele Stream. The mean annual precipitation measured at WAAF is 38 inches, most of falls from November through April. Surface drainage from WAAF drains to Waikele Gulch. Runoff from the runway area reportedly is collected in a network of grated drains that drain to a 15-inch-diameter storm drain believed to discharge to Waikele Gulch (US Geological Survey 1996).

South Range Acquisition Area

The SRAA is a 1,402-acre (567-hectare) area that borders the southern boundary of the Main Post west of WAAF, as shown in Figure D-8. It is drained by Waikele Stream and its tributaries and lies entirely within the portion of the watershed of Waikele Stream that is upstream of WAAF. As described above, the Waikele Stream ultimately discharges to the West Loch of Pearl Harbor. The tributaries to Waikele Stream are ephemeral and generally dry except for during short periods following heavy rainfall. Perched groundwater occurs below the elevation of the stream channels, and therefore does not contribute to local streamflow (Golder Associates 1998).

Schofield Barracks East Range

The mean annual rainfall within SBER varies from about 200 inches (508 centimeters) on the crest of the Koʻolau Range to about 40 inches (102 centimeters) near Wahiawā and WAAF (Oki 1998). The mean annual evaporation rate increases from east to west, ranging from about 20 inches (51 centimeters) on the crest of the Koʻolau Range to over 60 inches (152 centimeters) in the vicinity of Wahiawā. In general, both evaporation and rainfall are correlated with elevation. Rainfall and evaporation maps provided by Oki (1998) indicate that the mean annual rainfall and evaporation are about equal in the region of the Kū Tree and Koʻolau Reservoirs, while evaporation exceeds rainfall to the west and rainfall exceeds evaporation to the east of this region.

SBER occupies a portion of the Waipahu/Waiawa watershed in the Pearl Harbor hydrologic sector, just south of the hydrologic divide that separates it from the Central hydrologic sector. Figure 5-27 shows the principal drainage and surface water features in SBER. Most of SBER is drained by the South Fork of Kaukonahua Stream, which discharges to the Wahiawā Reservoir. The Kaukonahua Stream, downstream of Wahiawā Reservoir, ultimately discharges to Kaiaka Bay at Haleʻiwa. Kaukonahua Stream, at 33 miles (53 kilometers), is the

Figure 5-27
Watershed Boundaries and Drainage Features at Schofield Barracks East Range

longest stream on O'ahu and also the longest perennial stream (30 miles [48 kilometers]). The southern boundary of SBER lies on or near the topographic divide separating the watershed of the South Fork Kaukonahua Stream from the Waikakalaua Stream. Some surface water from SBER may drain to the Waikakalaua Stream, which ultimately drains south to the West Loch of Pearl Harbor.

SBER extends to the crest of the Ko'olau Range, which has the highest rainfall on O'ahu. Thus, the east side of SBER is an important source region for surface water supplies. A number of reservoirs and surface water conveyances (ditches and tunnels) have been constructed along the Kaukonahua Stream drainage and its tributaries. The farthest upstream of these is Canon Dam, a small interception facility that enables water to be diverted in the Ko'olau Ditch to other storage reservoirs off stream of the Kaukonahua Stream, including the Ko'olau Reservoir and the Kū Tree Reservoir. The Kū Tree Reservoir is the largest of these water storage facilities. Currently, the Kū Tree Reservoir is not in use and the lakebed is dry. However, when in use, water released from the Kū Tree Reservoir discharges to a tributary of the Kaukonahua Stream and joins the Kaukonahua Stream below the East Pump Reservoir.

A little farther downstream the Kaukonahua Stream becomes an arm of the Wahiawā Reservoir. Most of the 302-acre (122 hectare) reservoir is west of Highway 80 and the boundary of SBER, but stream channels in the western end of SBER are inundated by the reservoir, to an elevation of about 842 feet (257 meters) msl.

Helemano Trail

Helemanō Trail begins a short distance to the east of the point where the Drum Road joins the Twin Bridges Road. Helemanō Trail turns south from Twin Bridges Road and crosses the Helemanō watershed, which is drained by Helemanō Stream; on the coastal plain Helemanō Stream joins Paukauila Stream, which discharges to Kaiaka Bay, south of Hale'iwa. Helemanō Stream is a perennial Class 1 stream in its upper reaches. The trail crosses four branches or tributaries of the Helemanō Stream before crossing into the adjoining Poamoho watershed at a point west of the HMR.

The Poamoho watershed is drained by the Poamoho Stream and several smaller streams. The Upper Helemanō Reservoir is east of the Helemanō Trail and stores water for irrigation. The water is conveyed to farmland in the Poamoho watershed through a network of canals and ditches, some of which follow existing drainages. Helemanō Trail crosses the main stem of Poamoho Stream near Poamoho Camp. At Kaukonahua Road (Route 80), the trail crosses into the Kaukonahua watershed downstream of Wahiawā Reservoir. The trail then crosses Kaukonahua Stream, which marks the boundary of SBMR.

Flooding

Federal Emergency Management Agency Flood Insurance Rate Maps (FIRMs) and Flood Insurance Studies are available for parts of the County of Honolulu (e.g., FEMA 2000). SBMR is in Zone D, which refers to areas that have not been mapped. The area containing the reach of Waikele Stream adjacent to WAAF has not been mapped.

Surface Water Quality

Main Post and Wheeler Army Airfield

The State of Hawai'i classifies the Kaukokonahua and Waikele watersheds as second tier Category I under the Hawai'i Unified Watershed Assessment (HDOH 1998b). Category I watersheds do not meet, or face imminent threat of not meeting, clean water and other natural resource goals. The classification of the Kaukokonahua watershed was based largely on the fact that the coastal receiving water, Kaiaka Bay, is an impaired water body. Kaukokonahua Stream is not identified as an impaired water body. Waikele Stream is listed as an impaired water body, based on nutrients and turbidity (Henderson and Harrigan 2002). The Waikele watershed drains to Pearl Harbor, which is also an impaired waterbody.

South Range Acquisition Area

No surface water quality data are available for the Waikele Stream where it flows through the SRAA. However, as described above, Waikele Stream is listed as an impaired water body. The US Geological Survey (2001a) monitored water quality at a station south of Wheeler Army Air Field, near Waipahu from 1999 to 2001. Concentrations of trace metals, semivolatile and volatile organic compounds, physical parameters, major ions, organochlorine pesticides, but not explosives, were determined monthly as part of the National Water Quality Assessment Program. Additional samples of streambed sediment, and fish tissue from selected stations along the stream were also analyzed.

East Range

Water quality in Kū Tree Reservoir, when full, is reportedly good, but water quality in the Wahiawā Reservoir has been affected by nutrients, such as phosphates and nitrates, which resulted largely from discharged treated municipal wastewater and possibly from urban nonpoint sources. These pollutants caused algal blooms and eutrophic conditions in the reservoir (Young et al. 1975). In response, the city of Wahiawā studied plans to upgrade its wastewater treatment plant and discharge the effluent through an outfall deep in the Wahiawā Reservoir (Sprague 1998).

As mentioned above for the SBMR, the State of Hawai'i classifies the Kaukokonahua and Waikele watersheds as second tier Category I, under the Hawai'i Unified Watershed Assessment (HDOH 1998b).

Groundwater Flow

Main Post

SBMR is in the Schofield groundwater area of the central O'ahu groundwater flow system, the largest and most productive flow system on O'ahu (Oki 1998; refer to Figure 3-7). The central flow system is bounded on the east by the crest of the Ko'olau Range and on the west by the crest of the Wai'anae Range. On the southeast it is bounded by the Ka'au rift zone, which transects Diamond Head. On the north and south it is bounded by coastal sedimentary deposits, known as caprock because they overlie more permeable rocks and can confine the groundwater contained in those rocks within the coastal zone.

The Schofield subarea lies on the divide between the northern and southern parts of the Central Oʻahu flow system. The northern part includes the Mokulēʻia, Waialua, and Kawailoa hydrologic units, while the southern part includes the Ewa, Pearl Harbor, Moanalua, Kalihi, Beretania, and Kaimukī hydrologic units (Figure 3-7).

The Schofield subarea is bounded on the north and south by vertical low permeability features that reduce or prevent groundwater flow and act like groundwater dams. These features might be dike intrusions or possibly depositional features (Oki 1998). Because the groundwater elevation inside the "dams" is higher than outside, the groundwater in the Schofield Plateau is called high-level groundwater.

As of the mid-1980s, about 72 percent of the groundwater recharge on Oʻahu was estimated to occur in the central flow system. Annual pumpage from the central flow system was estimated to be nearly 200 million gallons (757 million liters) per day (MGD) in 1995 and ranged from about 196 MGD to about 367 MGD between 1927 and 1977 (Oki 1998).

The Koʻolau Basalt formation consists of nearly horizontal basalt flows interbedded on the western margin with alluvial deposits resulting from erosion of the Waiʻanae Range.

Runoff that reaches the plateau tends to percolate slowly and contributes little to groundwater recharge (HLA 1992).

In the SBMR area, the USGS reports that the hydraulic conductivity of the aquifers tapped by wells in the volcanic rocks range from about 655 to 2,317 feet (200 to 706 meters) per day (Oki 1998). (Hydraulic conductivity is a property of a formation that describes the rate of groundwater flow through a given area perpendicular to the line of flow under a hydraulic gradient. A hydraulic conductivity of 655 feet (200 meters) per day means that 655 cubic feet (19 cubic meters) of water can flow across a vertical cross section one square foot in area under a hydraulic gradient of one foot per foot).

Rift zones associated with the Waiʻanae and Koʻolau volcanoes contain swarms of vertical or nearly vertical dikes that bar groundwater flow. The eastern and western sides of the Schofield subarea are bounded by dike zones of the Koʻolau and Waiʻanae volcanoes, respectively.

Recharge over most of the SBMR ranges between about 10 and 25 inches (25 to 64 centimeters) per year. Recharge is higher along the eastern slope of the Waiʻanae Range and in the southeast margin of the reservation (Shade and Nichols 1996). Recharge near the southeast margin of the range is greater because of contributions from irrigation.

Most of the recharge to the central sector (Wahiawā aquifer system) is from the Koʻolau Range. The US Geological Survey (USGS) estimates that about 31 MGD enters the southern half of the sector, and about 64 MGD enters the northern half of the sector as underflow from the Koʻolau Range. In contrast, only about 12 MGD enters the sector from the west (Shade and Nichols 1996).

Annual groundwater pumpage in the Schofield groundwater area (Wahiawā aquifer system) is estimated to be less than 10 MGD and has decreased since 1979, when total pumping was about 20.6 MGD (Oki 1998). While this is less than half the estimated sustainable yield of the aquifer, any consumptive use of groundwater in the Central Sector decreases the underflow to the adjacent Pearl Harbor Sector and/or North Sector.

Groundwater occurs in three types of groundwater aquifer systems, illustrated on Figure 5-28. Beneath the Schofield Plateau, groundwater occurs in the Schofield High-Level Groundwater Body, where groundwater elevations are in the range of 275 feet (84 meters) above msl. Depth to groundwater is approximately 600 feet (183 meters) or more, depending on the ground surface elevation.

Across these groundwater dams is the basal aquifer. Here, groundwater elevations are in the range of only 10 to 30 feet (3 to 9 meters) msl (Oki 1998). The basal aquifer is a freshwater lens occupying porous and permeable volcanic rocks beneath the island. The freshwater lens is thickest near the center of the island and tapers off toward the edges of the island.

The third groundwater system is the dike-impounded groundwater system associated with the dike intrusions within the Waiʻanae Volcanics underlying the Waiʻanae Range. The dike-impounded groundwater system is recharged by runoff in the mountains, but lateral flow of this groundwater is blocked by vertical dike intrusions.

In addition to the three main groundwater systems, groundwater also occurs locally in perched aquifers above the High-Level Groundwater Body or the basal aquifer. Perched aquifers are permeable groundwater-bearing strata that are underlain by strata with much lower permeability that restrict downward groundwater flow.

Wheeler Army Airfield

As described above, WAAF lies over the southern boundary of the Schofield high-level water body. The water table declines from about 275 feet above sea level on the north side of WAAF (high level groundwater, or transitional) to about 30 feet above sea level on the south side (basal aquifer) (US Geological Survey 1996). Groundwater flows south, toward the Pearl Harbor aquifer.

South Range Acquisition Area

The SRAA, as described above, is in the upper portion of the Ewa-Kunia subunit of the Peal Harbor hydrologic unit (see Figure 3-7). The Ewa-Kunia subunit lies along the southern edge of the subsurface basalt groundwater dam that underlies the Schofield Plateau (see Figure 3-8) and is recharged in part by groundwater that overflows this dam and flows southward from the Central or Wahiawā hydrologic unit. It is unlikely that groundwater contributes significantly to flows in Waikele Stream because perched groundwater is at greater depth than the stream channel (Golder Associates 1998). Perched groundwater has been encountered at a depth of about 80 to 100 feet (24 to 31 meters) below the ground surface in the Kunia Village area. The ground surface elevation in this area is about 850 feet (259 meters) msl, but the extent of this perched groundwater is not known. Several wells have

Figure 5-28
Generalized Regional Cross-Section Schofield Plateau

been drilled south of SBMR in the vicinity of Kunia Village. One, called the Navy Well, is about one mile (2 kilometers) north of Kunia Village and provides most of the drinking water for Kunia Village (Golder Associates 1998). The well is believed to be completed in the high level aquifer rather than in the basal aquifer at this location (Golder Associates 1998). The direction of groundwater flow beneath the South Range Acquisition Area is thought to follow the regional trend, as indicated in Figure 3-8, and likely flows south.

East Range

Groundwater in the eastern part of SBER includes high-level volcanic dike-impounded groundwater that overlies and is probably hydraulically connected to the basal aquifer that underlies the island. This area is part of a 135-square-mile (350-square-kilometer) area in the Northwest Rift Zone of the Ko‘olau Range that is the most important and productive of the dike-impounded groundwater reservoirs on the island. The USGS has estimated that approximately 560 billion gallons (2,120 billion liters) of water are stored above sea level in this natural groundwater reservoir (Takasaki and Mink 1985). The elevation of the dike-impounded water is 1,000 feet (305 meters) or more. Additional groundwater is believed to be present below sea level but has not been estimated.

Although the dikes impede the flow of groundwater, they do not prevent it, and groundwater leaks from the dike complex at an estimated rate of 280 MGD. This is over half of the total estimated yield of water from all sources from the Ko‘olau Range of 450 to 580 MGD (Takasaki and Mink 1985).

Groundwater Quality

Main Post and Wheeler Army Airfield

The Southern Oahu Basal Aquifer, which underlies SBMR and part of the East Range was designated by the US EPA as a Sole Source Aquifer in 1987 under Section 1424(e) of the Safe Drinking Water Act (USEPA 2003). A sole source aquifer supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer, and represents a water supply source for which there is no alternative that could “physically, legally, and economically supply all those who depend on it for drinking water.” Under the program, all federally funded projects in the area overlying a sole source aquifer are subject to review by EPA to ensure that they do not endanger the water source.

The quality of groundwater in the Schofield groundwater area is generally high. Agricultural contaminants (pesticides and fertilizers) have affected the regional groundwater system somewhat. Groundwater quality in the SBMR has been affected by contaminants from industrial activities at the reservation.

Groundwater beneath SBMR has been affected by TCE and carbon tetrachloride. Both are chlorinated chemical solvents. For cleaning up the contaminated groundwater, the groundwater beneath SBMR has been identified as an “operable unit,” requiring remediation under CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA). The groundwater is identified as Operable Unit 2 (OU2). The source of the carbon tetrachloride contamination was identified as a former landfill located on SBMR. The source of the TCE contamination was never found. The distribution and extent of groundwater contamination is discussed briefly here and in more detail in the hazardous materials chapter.

TCE concentrations above five ppm have been found in two areas. One area, the smallest, is in the vicinity of a former landfill that was located near the northeast boundary of the Main Post, between Mohiākea Gulch and Waikōloa Gulch. The second area is much larger and underlies the northern half of WAAF and extends northeastward into SBER. In the first area, TCE concentrations are relatively uniform from the depth of the aquifer at 275 feet (84 meters) msl to about 0 feet (0 meters) msl, the greatest depth to which groundwater was investigated (HLA 1996). In the WAAF/SBER plume, the highest TCE concentrations were found in the aquifer at an elevation of about 195 feet (59 meters) msl and decreases to below the drinking water standard at a depth of about 5 feet (2 meters) msl.

The ROD for OU2 identified the groundwater remedy as continued pumping of contaminated groundwater by SBMR supply wells and treatment of the extracted water at the wellhead by air-stripping (HLA 1996). This remedial action was first implemented in 1986 and will continue to be operated indefinitely. Recent data indicate that SBMR drinking water wells contain about 18.5 micrograms per liter of TCE and less than 0.5 micrograms per liter of tetrachloroethene (PCE) before treatment (State of Hawai‘i 1998).

In August 2000, the USEPA delisted SBMR from the NPL because it determined that the site remediation, including continued wellhead treatment of groundwater and long-term monitoring, was adequate to protect human health and the environment.

South Range Acquisition Area

No groundwater quality data are available for the SRAA. Several wells have been installed and are being monitored in the Kunia area, south of the SRAA, as part of a remedial investigation of the Del Monte Corporation Superfund Site. The primary contaminants of concern at this site are pesticides resulting from accidental spills.

Also, monitoring wells 3-2803-05 and & 3-2803-07 in this area are periodically sampled as part of the SBMR groundwater monitoring program. Carbon tetrachloride, as a know groundwater contaminant from OU2, has not been detected in these wells. TCE, as another known groundwater contaminant from OU2, has been detected in this wells, but at low concentration levels just below the USEPA Region IX maximum contaminant level (MVCL).

East Range

Groundwater quality in the dike-impounded groundwater system is generally excellent, with chloride concentrations less than 20 mg/L. Dike-impounded groundwater is not known to be contaminated with organic chemicals within the central O‘ahu flow system (Oki 1998).

As described above, high level groundwater in portions of SBER is contaminated by TCE. The contamination is being addressed by treating the water pumped by domestic water supply wells at the wellhead.

5.8.2 Environmental Consequences

Summary of Impacts

Project activities under the Proposed Action at SBMR would include both construction and training activities, each of which could have both short-term and long-term impacts. Table 5-21 summarizes impacts on water resources. Short-term impacts are those that occur during the construction, or ramp up, phase until the project is built out or fully implemented. Long-term impacts are those from operating and maintaining the project after buildout or full-scale implementation. Table 2-5 in Chapter 2.0 of this EIS summarizes the construction and training activities that would occur as a result of the project. Significant but mitigable impacts would result from an increase in nonpoint source pollutants from training activities and an increase in explosives residue, both of which would adversely affect surface water quality. Less than significant impacts on surface water quality would result from construction and operation of SBCT facilities and wildland fires and on groundwater quality from facility operation. Other less than significant impacts would involve stream crossings from construction of Helemanō Trail, possible flooding impacts from increases in impermeable surfaces, and depletion of groundwater resources from staffing increases.

Table 5-21
Summary of Potential Water Resources Impacts at SBMR/WAAF

Impact Issues	Proposed Action	Reduced Land Acquisition	No Action
Impacts on surface water quality	⦸	⦸	⊙
Impacts on groundwater quality	⊙	⊙	⊙
Increased flood potential	⊙	⊙	⊙
Groundwater supply	⊙	⊙	⊙

In cases when there would be both beneficial and adverse impacts, both are shown on this table. Mitigation measures would only apply to adverse impacts.

LEGEND:

⊗	=	Significant	+	=	Beneficial impact
⦸	=	Significant but mitigable to less than significant	N/A	=	Not applicable
⊙	=	Less than significant			
○	=	No impact			

Proposed Action (Preferred Alternative)

In the following discussion of the potential impacts of the project, the impacts are identified by type of impact and then by source or cause.

Significant Impacts Mitigable to Less than Significant

Impact 1: Impacts on surface water quality. The Proposed Action could affect surface water quality through an increase in nonpoint source pollutants delivered to streams. Nonpoint source pollutants are those that tend to originate from, or to be distributed over, a wide area, as opposed to being discharged from a single point, such as an outfall. Nonpoint source pollutants may include sediments resulting from increased soil erosion associated with construction or training activities, or they may include chemical substances, such as metals, explosives, nutrients, or pathogens.

Impact 1a: Impacts on surface water quality from nonpoint source sediment loading from mounted maneuver training. Training activities under the Proposed Action are expected to result in an increase in mounted maneuver training compared to existing conditions. The increase would occur in the SRAA and in SBER. A significant increase in soil erosion is likely to result in a significant increase in suspended sediment in adjacent streams. Soil erosion is discussed further in Section 5.9. Of most concern are the major perennial streams that receive runoff from SBMR, including Kaukonahua Stream to the north and Waikele Stream to the south.

Impact 1b: Impacts on surface water quality from nonpoint source contamination of surface water during construction. During construction, surface water quality may be affected by stormwater runoff coming into contact with disturbed soil or with contaminants from accidental spills. The resulting stormwater runoff could carry sediments or contaminants to adjacent waterways. Within the urban cantonment area, storm drainage is collected in the storm sewer system and would be discharged through storm outfalls to stream channels. Outside urban areas, drainage would be controlled by topography. Figure 2-8 shows the locations of construction projects at SBMR. Drainage from proposed construction sites could affect water quality in either the Kaukonahua Stream, north of the SBMR boundary, or the Waikele Stream, south of the installation boundary. The proposed QTR1 range footprint extends slightly into the Hale'au'au Gulch drainage, but most of the QTR1 range, as well as the tentative site of the Tactical Vehicle Wash and the BAX, is within the Mohiākea Gulch drainage. The Range Control Facility is in the drainage of Waikōloa Gulch. Each of these drainages is a tributary of Kaukonahua Stream. The South Range Acquisition Area, the Motor Pool Maintenance Shops, the Multiple Deployment Facility, and the Upgrade to the WAAF for C-130 Aircraft project are within the watershed of Waikele Stream.

Impact 1c: Impacts on surface water quality from nonpoint source contamination of surface water during operation of proposed facilities. Each of the proposed construction projects includes engineering components to control site drainage and to minimize erosion. For example, the proposed motor pool maintenance shops would be provided with a storm drainage system incorporating modern oil-water separators; repair activities would be performed indoors to avoid stormwater exposure, and petroleum, oil, and lubricants and hazardous waste storage facilities would be designed according to modern standards. The proposed motor pool would primarily address the increased maintenance requirements of the Proposed Action, which involves approximately an additional 400 wheeled vehicles. The Proposed Action would involve retaining the existing motor pool, so this alternative would not reduce surface water impacts from this motor pool. Accidental spills are not entirely unavoidable, and increased industrial activity under the Proposed Action could result in a greater probability for accidental spills to occur. The impact on water quality from these combined nonpoint sources is considered potentially significant.

Impact 1d: Impacts on surface water quality from sediment and chemical impacts on water quality from wildland fires. The risk of wildland fires is expected to remain at about the same level as under existing conditions, or slightly higher due to the increase in munitions use. The potential for wildland fires on the SRAA is expected to be low but could increase when the land is fallowed, due to growth of grasses and other vegetation. Wildland fires can generate chemical contaminants and loss of vegetation can increase the potential for soil erosion and sediment loading to streams. Either of these effects could result in significant impacts on surface water quality.

Impact 1e: Impacts on surface water quality from migration to surface water of nonpoint source chemical residues in soils on training ranges. Drainage and runoff from training ranges could transport contaminants to streams, reducing water quality in the stream and ultimately discharging contaminants in the ocean. Contaminants associated with military activities include residues of explosives or other constituents of munitions, such as metals, constituents of plastics, or combustion products. Other chemical pollutants, such as petroleum hydrocarbon fuels or lubricants, may be inadvertently spilled or released as an indirect result of military activities. The Proposed Action may result in a significant increase in sediment transported to streams draining the ranges, and ultimately to surface waters beyond the installation boundary. Based on the logic described below, it is possible that surface water could be impacted by current levels of contaminants. In the absence of mitigation an increase in sediment erosion could result in greater impacts, possibly in exceedance of health-based standards, or antidegradation policy goals.

No systematic sampling investigations of the major streams or tributaries that drain the watersheds of SBMR have been performed to determine whether or not explosives residues or other chemical pollutants from military training have affected surface water quality. Samples of surface soils from selected areas on the training ranges were collected and analyzed, and these data provide an indication of the concentrations of metals, semivolatile organic compounds, and explosives in surface soils that could be transported to surface water (USACE 2002a).

The principal explosives chemicals of concern identified in soil samples, listed in order of their water solubilities, were nitroglycerin, 2,4,6-TNT, RDX, and HMX. These are also the most prevalent organic constituents of the explosives used in the munitions used on the ranges.

Solubility is an indicator of the affinity of a chemical for water. Low solubility chemicals tend to have a greater affinity for binding to soil. Other factors influence the partitioning of a chemical between water and soil as well, including the size of the molecule (larger molecules tend to have greater affinity for binding to soils and are also less volatile), the amount of natural organic material in the soil, and the size of the soil particles (fine particles, such as clays, have a large surface area compared to larger particles, and some chemicals tend to bind to them more strongly). While each of these factors may influence the rate of migration of a chemical through soil, other factors contribute to the fate and transport of chemicals. The chemicals may degrade when exposed to air, moisture, sunlight, heat, or microbes (for example, 2,4,6-TNT breaks down into 2,4-DNT). The rates of degradation of the four explosives identified above tend to be in order of their solubilities, with HMX being the least reactive. The ultimate degradation products of these compounds are inorganic nitrogen compounds, carbon dioxide, and water.

Chemicals that bind to soil particles could be transported with soils particles, by storm runoff, into streams. These chemicals tend to bind more strongly to fine particles, so they would likely be more prevalent in the fraction of sediment that remains suspended in the stream flow. Streams continually move their sediment loads downstream, depositing sediments when flows are slow and remobilizing them when flows are high. Since stream flows can vary over a wide range in Hawaiian streams and runoff tends to be routed very quickly through Hawaiian stream systems, most sediment transport may occur during a relatively few high flow, short duration events. Such events would tend to drive contaminants that might enter the stream downstream in a rapid pulse.

It is possible, though unlikely, that the contaminant concentrations observed in soils from ranges at SBMR could significantly affect stream water quality. The chemicals of concern are likely to bind to soil particles and to migrate in this bound state. The amount of water needed to mobilize the contaminated sediments would likely result in very low concentrations in water. Without direct surface water sample data, it is necessary to make some assumptions in order to estimate the concentration of contaminants that might enter stream waters beyond the boundary of SBMR.

Assuming a suspended sediment concentration of 1 g/L in water, which is typical for turbid runoff water, and assuming that the sediment carried by the streams that drain SBMR contain the average RDX concentration (estimated at 5.9 mg/kg, or 5.9 micrograms per gram [USACE 2002a]), the resulting concentration of RDX in the water containing the sediment would be 5.9 micrograms per liter (5.9 μg/L). Using the same logic, the average concentrations of TNT, HMX, and nitroglycerin in the surface water would be 0.21, 0.72, and 16.6 μg/L, respectively, based on their average concentrations in the surface soils (USACE 2002a; see Table M1-1 in Appendix M-1).

Given these assumptions, the projected concentration of RDX in the stream water discharged at the installation boundary would be just slightly above the USEPA lifetime health advisory level (3.7 μg/L versus 2 μg/L), the concentration of nitroglycerin would be about three times the lifetime health advisory level (15.5 μg/L versus 5 μg/L), and the concentrations of the TNT and HMX would be much lower than the lifetime health advisory levels. Lifetime Health Advisory Levels are concentrations of contaminants that apply to drinking water or groundwater. These levels are similar to Maximum Contaminant Levels, which are enforceable standards established to protect public health by limiting the levels of contaminants in drinking water and groundwater; however, Lifetime Health Advisory Levels are not legally enforceable standards, but serve as technical guidance to assist regulators with water consumption advisories and groundwater remedy decisions. The concentration of contaminants that would actually be transported by runoff to the installation boundary is very difficult to predict, and the predicted concentration is highly dependent on the assumptions on which the prediction is based. Therefore, the estimate described above is intended only to illustrate a simple approach to the problem and to provide an idea of the approximate order of magnitude of the concentrations under these assumptions. Note that the average concentration used in this estimate likely greatly overestimates the average concentration in soils over the larger area of the ranges because it is based on sampling that was purposely selected for areas expected to contain higher than average concentrations of contaminants. Also, the sample results indicate that the contaminants occur in some areas but not others, so the distribution is not even. Many contaminants are not highly mobile in water, and sediments may require many months or years to migrate downslope to streams. Meanwhile, some contaminants, such as explosives, would be undergoing chemical degradation.

The assumption of the lifetime health advisories is that the water is consumed at a rate of 2 liters per day for a year. The stream water would not be consumed without filtration, and filtration would remove the contaminants because they are bound to the suspended sediment. After dilution in the main stems of Kaukonahua or Waikele Streams, the concentrations of contaminants would be below detection levels. These low concentrations would not reduce the beneficial uses of the streams, so the impacts on water quality would not be significant under existing conditions, where soil erosion rates are generally low. However, the significance would depend on the loading rate, which is determined by the rate of soil erosion.

A similar analysis can be done for metals, using the concentrations observed in the soil samples on the ranges. The results would show that metals could be transported to streams at concentrations that might exceed drinking water standards. The loading rates would increase with increased soil erosion.

Implementing the following mitigation measures would reduce the impacts on surface water quality to less than significant levels.

Regulatory and Administrative Mitigation 1. The Army will implement design measures in accordance with new Phase II Stormwater Management Regulations of the Clean Water Act. The Army will choose the most practicable solution for the specific project or project area during design. As directed via NPDES permit approval, the contractor will be required to implement a stormwater pollution prevention program during construction.

The Army will continue to implement land restoration measures identified in the INRMP. Mitigation measures include, but are not limited to, implementing the ITAM program to identify and inventory land condition using a GIS database; coordinating between training planners and natural resource managers; implementing land rehabilitation measures identified in the INRMP; monitoring the effectiveness of the land rehabilitation measures; evaluating erosion modeling data to identify areas in need of improved management; and implementing education and outreach programs to increase user awareness of the value of good land stewardship.

The Army will develop and implement a DuSMMoP for the training area. The plan will address measures such as, but not limited to, restrictions on the timing or type of training during high risk conditions, vegetation monitoring, soil monitoring, and buffer zones to minimize dust emissions in populated areas. The plan will determine how training will occur in order to keep fugitive dust emissions below CAA standards for PM_{10} and soil erosion and compaction to a minimum. The Army will monitor the impacts of training activities to ensure that emissions stay within the acceptable ranges as predicted and environmental problems do not result from excessive soil erosion or compaction. The plan will also define contingency measures to mitigate the impacts of training activities that exceed the acceptable ranges for dust emissions or soil compaction.

The Army will implement the existing spill prevention and response plan to all new lands and activities under the Proposed Action. The IWFMP for Pōhakuloa and O'ahu Training Areas was updated in October 2003. The Army will fully implement this plan for all existing and new training areas to reduce the impacts associated with wildland fires. The plan is available upon request. The Army will incorporate BMPs that will reduce runoff and sedimentation to aquatic environments in accordance with CWA regulations for stormwater runoff at construction sites

Additional Mitigation 1. The Army proposes to implement design measures in accordance with Army design standards to reduce soil erosion and sediment loading impacts to Waikele Stream, Konokanahua Stream or tributaries from road construction. Mitigation design measures include, but are not limited to, hardening the roads, raising the elevation of the roadway to improve drainage, installing drainage ditches adjacent to roads to control water running on or off the road, and planting grasses to slow overland flow. The Army would choose the most practicable solution for the specific project or project area during design.

Less than Significant Impacts

Impacts on surface water quality from the use of dust control palliatives. Applying calcium or magnesium chloride or calcium lignosulfonates could affect surface water quality, either by increasing the biological oxygen demand or by increasing total dissolved solids concentrations. These impacts are expected to be less than significant because the chemicals will be applied according to industry standards (Parametrix, undated).

Impacts on groundwater quality during construction of proposed facilities. As described for surface water, chemical or fuel spills might occur during construction activities, resulting in chemicals seeping into the subsurface and eventually to groundwater. However, any spills that occur would be immediately cleaned up, and the depth to groundwater is great enough in the SBMR area that contaminants would not reach groundwater rapidly, increasing the likelihood that surface spills would be addressed before they become a groundwater problem. Standard construction practices and materials would be used, resulting in no greater than usual potential for spills compared to other construction projects.

Impacts on groundwater quality from operation of proposed facilities. Operating several proposed facilities, particularly the motor pool maintenance shops, the tactical vehicle wash, and the Multiple Deployment Facility (MDF) (a current force project that would still be constructed and operated), would involve handling hazardous liquids or other chemicals or processing wastewater or other waste liquids. The MDF is in the Wheeler Gulch area, which reportedly has shallow groundwater conditions. All facilities that generate hazardous wastes or that store hazardous materials would provide appropriately trained personnel to manage these materials. Hazardous materials are managed according to the Army's standard operating procedures and in compliance with state and federal requirements. Facilities would be designed with engineering controls, such as secondary containment, waste treatment facilities, automatic shutoff controls, and other systems, to reduce the potential for releases. If releases were to occur, they would be cleaned up. Implementing these procedures is expected to reduce the potential for impacts on groundwater to less than significant levels.

Impacts on surface water quality from stream crossings. The proposed action could affect waters of the US via stream crossings along the Helemanō Trail at Poamaho Stream. All stream crossings would be reviewed by the Corps of Engineers prior to construction to determine if the activity is regulated under Section 404 of the Clean Water Act. In accordance with Section 404 of the Clean Water Act, any dredge or fill activities in these streams associated with the crossings may require a Department of the Army permit. If a Department of the Army permit is required, then a Clean Water Act Section 401 Water Quality Certification issued by the State of Hawai'i may also be required. The Army would design the stream crossing to minimize any dredge or fill impacts on the stream to the fullest extent practicable in compliance with Section 404 of the Clean Water Act. If the Corps determines that a Department of the Army permit is required, the Army would abide by all appropriate Clean Water Act regulations and permit processes administered by the Corps and the State of Hawai'i.

Increased flood potential. None of the construction projects proposed under the Proposed Action are in a 100-year flood zone. Although minor flooding reportedly occurs in some parts of the cantonment area, no additional housing or support facilities are proposed that would be affected by flooding or that would significantly expose personnel to flood hazards greater than under No Action.

Construction of parking lots and structures can increase the impermeable ground surface area at the expense of permeable surface area, resulting in larger volumes of runoff for a given area over a given period of time during a storm. This can increase the amount of water that arrives at a drain or that is discharged to a stream. The designers of new construction projects would take these effects into consideration when designing the drainage system and would size the drainage system appropriately, or they would divert runoff to channels with adequate capacity to prevent flooding.

Ground water supply. The Proposed Action would result in an increase of 810 Soldiers, accompanied by about 920 family members, for a population increase of about 1,730 individuals. Per capita domestic water use is likely to be on the order of 100 gallons (379 liters) per person per day, which means that the daily water use could increase by about 173,000 gallons, and the annual increase in water use attributable to the Proposed Action would be about 160 acre-feet. Current potable water pumping ranges between 4.0 and 9.0 MGD (see Section 5.14). The projected increase in water use would be about one to three percent, well within the current variation in the amount of groundwater pumping. Compared to the overall sustainable yield of the aquifer, this is a relatively small change, and it would be unlikely to stress existing water supplies or to significantly lower groundwater levels.

The water supply at SBMR comes from several large groundwater wells that were affected by TCE contamination from past practices at the installation. The contaminated groundwater, referred to as Operable Unit 2 was delisted in August 2000 from the Superfund NPL because the remedy for the operable unit successfully addressed the hazards. The solution is treatment of the groundwater at the wellhead to remove the TCE prior to use, a long-term remedy that has been approved by state and federal regulators after public review and comment. The USEPA has recently reduced the PRG for TCE in drinking water, based on a more conservative estimate of the cancer risk. This has not resulted in a change in the primary drinking water standard, but if the standard is lowered, this could affect the compliance status of the groundwater treatment system. The treatment system meets the new PRG, and the lower PRG is not expected to result in any change in the remedy or in the water supply assumptions for SBMR under the Proposed Action.

Reduced Land Acquisition Alternative

Each of the impacts identified under the Proposed Action would also occur under RLA, except that the SRAA would be limited to 100 acres (40.7 hectares) instead of 1,402 acres (567 hectares) and would not include the QTR2 range. The South Range is within the watershed of Waikele Stream, which flows south into the Pearl Harbor watershed. The reduced training area available under this alternative could increase the intensity of soil impacts in the available land area relative to the Proposed Action. However, these impacts would occur in areas that are already affected by training activities, rather than expanding the region of impacts on land that has been previously managed for agriculture. Since there would be fewer modifications to existing land use than under the Proposed Action, including fewer new roads and less ground disturbance in new areas, the potential for soil erosion would be contained mainly within areas that are currently affected. The potential for chemical constituents of munitions associated with the QTR2 to be released to the land surface that exists under the Proposed Action would not occur under RLA. This would result in reduced potential for impacts on surface water quality in the Waikele Stream drainage area relative to the Proposed Action.

No Action Alternative

Less than Significant Impacts

Impacts on surface water quality. The ATTACC modeling results suggest that under current conditions, the erosion impacts from training activities are less than significant. With improved monitoring and implementation of appropriate land rehabilitation measures, moderate impacts may be largely mitigated. The current moderate impacts are considered less than significant.

Some construction activity would occur, resulting in a minor increase in impermeable surface area, which in turn could slightly increase the potential for flooding in flood-prone areas. The amount of increase is expected to be negligible, compared to the overall capacity of the drainage system, and drainage systems at new facilities would be designed to prevent flooding, so this impact is not expected to be significant.

Impacts on surface water quality from chemical residues in training range soils have not been characterized, although, based on data from initial soil sampling on the ranges, it appears that less than significant impacts could occur.