48th AND HOLLY LANDFILL (OPERABLE UNITS 3 AND 6)
SAND CREEK INDUSTRIAL SUPERFUND SITE, COMMERCE CITY, COLORADO
RECORD OF DECISION

I. SITE NAME, LOCATION, AND DESCRIPTION

The Sand Creek Industrial Superfund Site (Figure 1) occupies about 300 acres within portions of both Commerce City in Adams County, Colorado and the City and County of Denver, Colorado. The site is centered near the intersection of 52nd Avenue and Dahlia Street. U.S. Interstate 270 is directly north of the site. Four known sources of contamination are present at the Sand Creek Industrial Superfund Site, and all are currently inactive: the Colorado Organic Chemical property, the 48th and Holly Landfill, the L.C. Corporation (LCC) property, and the Oriental Refinery property (a source of petroleum contamination). The 48th and Holly Landfill (Operable Units 3 and 6; OU3/OU6), hereafter referred to as "the Landfill," is the focus of this Record of Decision (ROD) and is located in the southern portion of the Sand Creek Industrial Superfund Site. The Landfill encompasses an area of approximately 150 acres and is bordered on the north by East 52nd Avenue, on the south by East 48th Avenue, on the west by Dahlia Street, and on the east by the intersection of the railroad right-of-way and East 48th Avenue, approximately one-quarter mile east of Ivy Street.

Land use near the Sand Creek Industrial Superfund Site is primarily industrial and includes trucking firms, petroleum refining operations, chemical production and supply companies, warehouses, and small businesses. Several other Superfund sites are also located in the area, including the Rocky Mountain Arsenal, Chemical Sales Company, and Woodbury. Properties adjacent to the site are zoned for light and heavy industrial, industrial park, industrial park storage and agricultural uses. Fifteen residences with approximately 25 people are located within a mile radius of the site. The daytime population reaches several hundred due to the local businesses and industrial nature of the area. The entire Denver parcel is zoned for heavy industrial use. No changes in zoning are anticipated by the City and County of Denver Planning Administration (CCDPA) in the near future. CCDPA indicates that long-range land-use plans will depend on the fate of Stapleton International Airport following completion of the new Denver International Airport.

The Commerce City parcel is zoned for agricultural and heavy industrial use. Commerce City's Comprehensive Plan for 1985 to 2010 indicates that future land use of this area will be primarily industrial with a recreation/open space designation for the Sand Creek floodplain.

Municipal water for the metropolitan area surrounding OU3/OU6 is supplied by the South Adams County Water and Sanitation District (SACWSD) and the Denver Water Department (DWD). Ground water produced from alluvial and bedrock wells

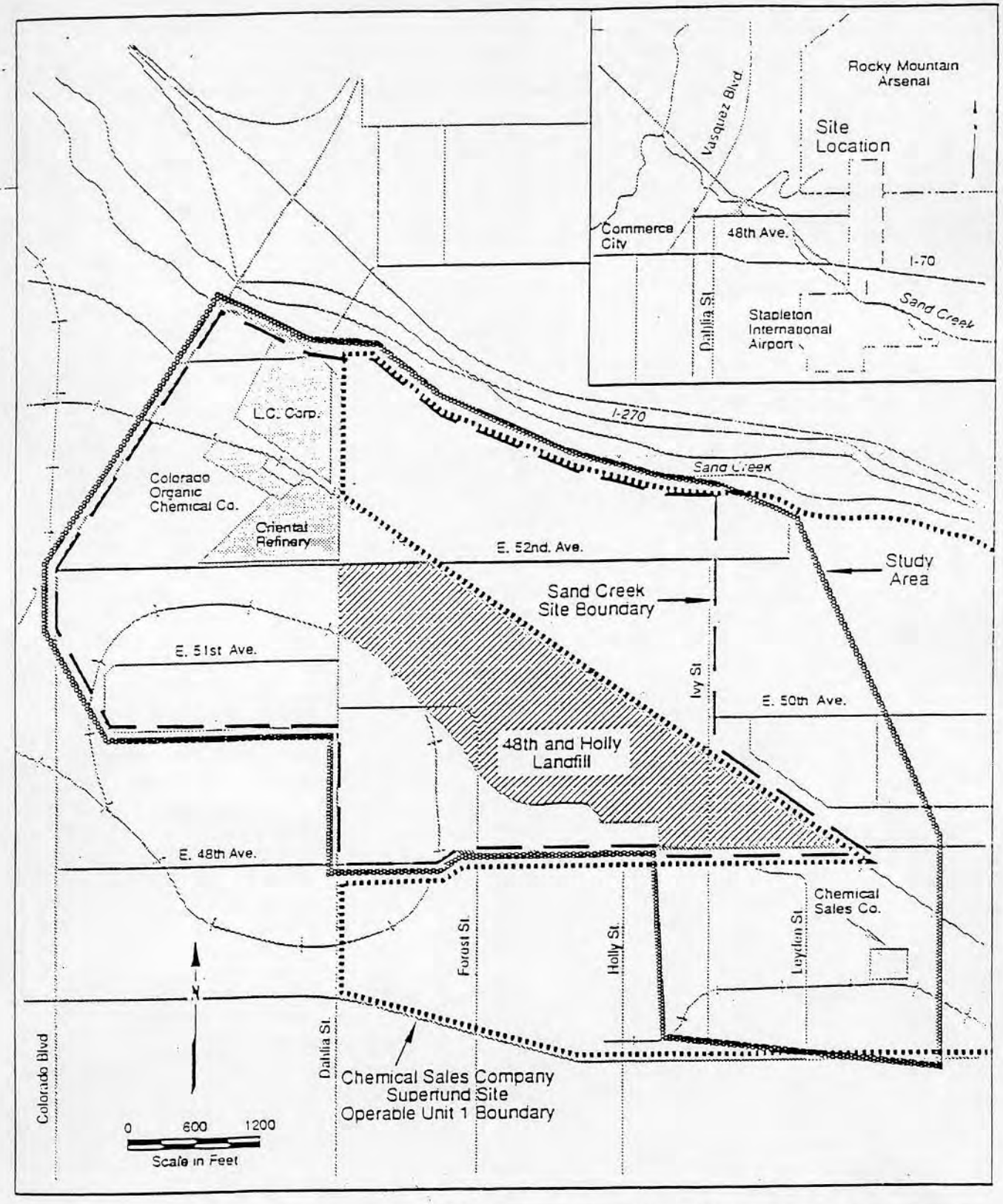

Figure 1. **Location of the 48th and Holly Landfill (OU3/OU6) at the Sand Creek Industrial Superfund Site, Commerce City, Colorado.**

located north of I-270 is a major source of water supplied by SACWSD. Water supplied by the DWD is obtained primarily from surface-water sources located outside of the Sand Creek Industrial Superfund Site area.

In 1990, the Tri-County Health Department (TCHD) prepared an inventory of private wells within the areas bounded on the north by Sand Creek, on the south by Interstate 70 (I-70), on the west by Colorado Boulevard, and on the east by Quebec Street. The Landfill is located within these boundaries and covers most of the western two-thirds of the survey area. The purpose of the inventory was to identify the locations and uses of all wells within the study area. Results indicated only two properties where private wells are used for drinking water and both wells were completed in the Arapahoe Formation (a bedrock aquifer).

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

Before filling operations began at the Landfill, the land was used primarily for agricultural purposes. A review of aerial photographs taken in 1956 and 1964 shows that sand and gravel mining operations occurred along the southern boundary of the Landfill. Aerial photographs also show that in 1967, a finger drain system, consisting of a series of clay tile lateral collector drains, was reportedly installed along the base of an erosional escarpment located along the south side of the Landfill near 48th Avenue. The reported purpose of the drain system was to intercept groundwater seepage from the terrace deposits forming the escarpment. The drain system routes water beneath the Landfill through a concrete drainpipe which empties via a corrugated metal drainpipe into a 1-acre wetland area adjacent to the Landfill.

Aerial photographs indicate that municipal landfilling operations began at the portion of the Landfill east of Ivy Street in 1967. In 1968, landfilling operations were initiated west of Ivy Street. According to the former Landfill operator, fill activities began at the south end of the Landfill and proceeded to the north in one layer or "lift." Daily cover material was graded from on-site areas, and the waste was watered to aid compaction.

The Landfill accepted both demolition and domestic refuse, and the trash was sorted before dumping. Metal refuse, such as stoves and refrigerators, was placed under the Colorado and Eastern Railroad Company right-of-way. Known hazardous and pathological wastes were reportedly excluded from disposal at the Landfill; however, the method used to exclude these wastes is not known. In addition, it is not known whether this reported operating practice was consistently employed. The Landfill was closed in 1975, and the area was revegetated.

In June 1977, two men were killed and five injured in two explosions of combustible gases that occurred in a water conduit under construction by the DWD

northwest of the intersection of 52nd Avenue and Dahlia Street. A subsequent investigation by the Colorado Department of Health (CDH), TCHD, and the South Adams County Fire Prevention Bureau (SACFPB) concluded that the explosions were caused by methane gas migrating from the Landfill. In response to the explosions and the detection of combustible gases migrating offsite, two methane gas venting systems were installed at the Landfill. Burlington Northern Railroad (BNR), in cooperation with TCHD and CDH, installed an experimental passive venting system utilizing wind turbines along the perimeter of the western 25-acre portion of the Landfill in 1978. In early 1980, an additional passive methane-gas venting system was installed in the eastern portion (east of Ivy Street) of the Landfill. Following the explosion, TCHD and SACFPB also periodically monitored for methane gas in businesses surrounding the Landfill. The detection of methane gas in nearby buildings, especially around cracks in foundations and basement walls, supported the conclusion that methane gas was migrating offsite of the Landfill. In 1981, TCHD determined that the passive venting system was ineffective, and as a result, BNR installed an active venting system along the southwest and northwest edge of the Landfill. Gases collected in this system were vented to the surface through three stacks.

In 1982, the U.S. EPA Field Investigation Team (FIT) performed an evaluation of the Sand Creek Industrial Site to see if it should be placed on the National Priorities List (NPL). A composite migration score (SM) of 59.65 was calculated for the site, and in December 1982 the Sand Creek Industrial site was added to the NPL. In its investigation, FIT conducted groundwater sampling downgradient of the Landfill as well as soil and surface water sampling in order to assess the degree of contamination in the area. Analytical results indicated the presence of several volatile organic compounds (VOCs) in ground water, including 1,1-dichloroethane (1,1-DCA); 1,2 trans-dichloroethene (1,2 trans-DCE); 1,1,1-trichloroethane (1,1,1-TCA); and 1,1-dichloroethene (1,1-DCE). Inorganic compounds that were detected at concentrations elevated above background levels included arsenic, cadmium, nickel, and zinc.

In late 1983, BNR installed 12 monitoring wells within and around the Landfill and collected groundwater and surface-water samples for analysis. Concentrations of arsenic, selenium, lead, antimony, and phenols exceeded EPA drinking water standards or clean water standards in the area. In January 1984, EPA resampled these locations in the northern portion of the Landfill. Elevated levels of volatile organics (benzene; chloroform; 1,2-DCA; 1,1-DCE; 1,2 trans-DCE; tetrachloroethene (PCE); and 1,1,1-TCA), heavy metals (cadmium, iron, and manganese), and one phthalate ester were noted in ground water.

In April 1985, Camp Dresser & McKee, Inc. (CDM) began preparation of a Remedial Investigation/Feasibility Study (RI/FS) for the Sand Creek Industrial Superfund Site. The site characterization report was completed in 1988. During that time, BNR continued to investigate possible groundwater contamination in the vicinity of the Landfill. Four newly installed wells and three existing wells were sampled and

indicated the presence of slightly elevated concentrations of total dissolved solids (TDS) and iron, and low concentrations of 1,1-DCE and 1,1-DCA downgradient of the Landfill.

In August 1987, Engineering-Science, Inc. (ES) collected and analyzed one air sample from each of the three active methane gas venting stacks to determine whether emissions could cause adverse health effects. In addition, ES collected four surficial soil samples to assess emissions resulting from the upward diffusion of gas through the Landfill cover. Collectively, sixteen VOCs were detected in the stack vent gas samples. No indication of contamination was observed in the soil samples from the landfill cover.

On February 8, 1990 EPA issued an Administrative Order on Consent (AOC; Docket No. CERCLA-VIII-90-08) to Landfill, Inc. (LI) and BNR to perform an RI/FS for the 48th and Holly Landfill (OU3). EPA's Statement of Work (SOW) in the OU3 AOC included the existing Landfill, the spring emerging from the toe of the Landfill, and the associated surface-water drainage to the point where the drainage enters a concrete-lined ditch. Harding Lawson Associates, Inc. (HLA) on behalf of LI and BNR, completed the draft revised Risk Assessment (RA) in April 1992 and the final OU3 RI in June 1992. In response to EPA comments and current Superfund guidance, the OU3 RA was revised and finalized in early 1993. The Focused Feasibility Study (FFS) for OU3 was completed and submitted to EPA in March 1993.

On August 15, 1990 EPA issued a Unilateral Order (Docket No. CERCLA-VIII-90-20) to LI and BNR which delineated the PRPs' role in the OU6 Removal Action. The OU6 Order addressed explosive and health risks associated with gaseous emissions released from the Landfill and became effective on August 25, 1990. An amendment issued in September 1990 to the OU3 AOC provided for the inclusion of gaseous emissions from the Landfill (i.e., OU6) under OU3 following the full implementation of the OU6 Removal Action.

In November 1990, an Engineering Evaluation/Cost Analysis (EE/CA) was prepared for OU6 at the Landfill. The report described the site conditions which justified a Removal Action, identified Removal Action objectives, discussed remedial alternatives, and presented the chosen remedy. EPA prepared an Action Memorandum to request and document approval of the PRP-financed Removal Action for OU6 in December 1990. An active landfill gas-extraction system (LFGES) was installed by LI and BNR, which began operation in June 1991 as part of the OU6 Removal Action. The LFGES replaced the previously installed systems and consists of a series of gas extraction wells interconnected by gas collection piping. Two centrifugal blowers connected to a single point in the gas collection system are operated alternately to induce the flow of gases from the gas extraction wells. The gas is diverted to an enclosed flare system for treatment. The enclosed flare system is designed to destroy odors and toxic components of the landfill gas. Gas monitoring probes are also installed around the perimeter of the Landfill to monitor the LFGES performance. The probes are monitored at least monthly for methane concentrations and gas pressure.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

The community has expressed limited interest in OU3 and OU6, specifically, and the Sand Creek Industrial Superfund Site, in general. EPA has undertaken several community relations activities to keep the public informed of issues related to the Landfill.

Community involvement activities for the Sand Creek Industrial Superfund Site began in April 1985. EPA distributed an introductory fact sheet to area residents, businesses, and agencies. The fact sheet provided background information about the site and an explanation of the Superfund process. EPA also attended a public meeting organized by the Citizens Against Contamination, a local group from the area, and compiled a list of property owners for the entire site.

EPA mailed a second fact sheet for the Sand Creek Industrial Superfund Site in November 1985. This fact sheet provided additional information on investigation and clean-up activities associated with hazardous waste sites. During the same month, EPA provided a groundwater contamination briefing at a second public meeting held by the Citizens Against Contamination.

In January 1986, EPA contacted property owners and Commerce City officials to inform them of activities at the Sand Creek Industrial Superfund Site. In April 1987, EPA surveyed area residents about their water-use habits to determine future outreach efforts.

An RI report describing the nature and extent of contamination at the Sand Creek Industrial Superfund Site was released for public review in March 1988. In May 1988, EPA contacted owners for permission to sample soils on their property. In October 1988, EPA met with Commerce City officials to brief them and solicit their reaction to clean-up plans for the site.

On three occasions in 1990, EPA held public meetings addressing all of the Superfund sites in South Adams County, excluding the Rocky Mountain Arsenal. At each meeting, EPA presented its intentions for the Removal Action at OU6 and encouraged public participation. A public comment period was held from October 9, 1990 to November 9, 1990 for the OU6 EE/CA, and no comments were received by EPA.

In the fall of 1991, community interviews were conducted to update the site Community Relations Plan (CRP) originally issued in December 1984. The CRP outlines community concerns, EPA's strategy for implementing the plan, and establishes information repositories. A list of contacts and interested parties throughout government and the local community are also provided. The CRP was released in December of 1991. In addition to meeting directly with the public, EPA and the CDH have met with

the Tri-County Health Department staff, South Adams County Water and Sanitation District, Rocky Mountain Arsenal personnel, Commerce City/Adams County officials, Metro Waste Water officials, and Representative Patricia Schroeder's staff to update them on OU3/OU6 activities.

On June 3, 1992 a public meeting was held to discuss the Risk Assessment prepared for OU3. EPA issued the Proposed Plan for OU3/OU6 to the public on March 19, 1993. The Proposed Plan as well as the RI, RA, and FFS reports were made available to the public through the Administrative Record maintained at the EPA Region VIII Superfund Records Center in Denver and at the information repository at the Adams County Library. A notice of availability of these documents and notification of the public meeting were published in *The Rocky Mountain News* on March 28, 1993 and in the *Commerce City Express* on March 30, 1993.

The public comment period for the OU3/OU6 Proposed Plan was open from March 22, 1993 to April 21, 1993. The public meeting was held at 5:30 p.m. on March 30, 1993 at the Commerce City Recreation Center. EPA explained the alternatives and responded to questions. A transcript of the public meeting has been entered into the Administrative Record. No written or oral comments were received.

IV. SCOPE AND ROLE OF RESPONSE ACTION

Due to the complex nature of the Sand Creek Industrial Superfund Site, EPA has divided it into six OUs, or study areas, in order to more effectively address specific contamination problems. The OUs were established based on the types of contaminants present, the type of media affected, and physical characteristics. As discussed above, two OUs (3 and 6) pertain specifically to the 48th and Holly Landfill. The six operable units at the Sand Creek Industrial Superfund Site are as follows:

- Operable Unit 1: OU1 addresses contaminated buildings, soil contamination greater than 1000 parts per million (ppm), and VOCs in the soils. The OU1 area includes approximately 15 acres of the site, including the Colorado Organic Chemical plant property, the land between Colorado Organic Chemical and the L.C. Corporation, and the northern portion of the Oriental Refinery site.

- Operable Unit 2: This OU addresses the acid waste disposal pits, just north of the Colorado Organic Chemical property, commonly referred to as the L.C. Corporation. It is reported that pits located there were used for disposal of acid waste from various chemical manufacturing activities occurring both off and on site.

- Operable Unit 3: This study area comprises the 48th and Holly Landfill and specifically includes contaminated surface water, ground water, sediment, soil, and air in its vicinity.

- Operable Unit 4: This study area comprises the entire site-wide contaminated ground water.

- Operable Unit 5: OU5 includes the same area as OU1, but addresses pesticides and heavy metals in soils to a depth of 5 feet with contamination greater than action levels and less than or equal to 1000 ppm. There are up to approximately 14,000 cubic yards of contaminated soil in OU5.

- Operable Unit 6: This OU addresses the gaseous emissions at the 48th and Holly Landfill.

At the present time, RODs have been prepared to address remediation action for OU1, OU2, and OU5 at the Sand Creek Industrial Superfund Site. A ROD amendment is currently being developed to address fundamental changes made to the selected remedy for OU5, and the RI/FS for OU4 will be completed in the summer of 1993.

This ROD addresses the principal potential threats to humans and the environment resulting from exposure to the 48th and Holly Landfill (OU3/OU6). As noted above, an amendment (September 1990) to the OU3 Administrative Order for the RI/FS allowed for the inclusion of gaseous emissions from the Landfill in OU3 after the OU6 Removal Action had been fully implemented. The OU3 FFS evaluated three alternatives for reducing exposure to contaminated surface water and landfill gas. Ground water, sediment, and soil were assessed, but remedial alternatives were not considered as a result of evaluation of media of concern and potential exposure pathways addressed under OU3. Specific objectives of the remedial action selected for OU3/OU6 are as follows. Landfill and off-site workers as well as off-site residents will be protected from the landfill contents and gas by ensuring that: (1) emissions of landfill gas are controlled to prevent inhalation at levels that pose an endangerment to human health or the environment, (2) accumulation of landfill gas is minimized in order to prevent explosion hazards, (3) dermal contact with the landfill contents is prevented, and (4) the use of ground water underlying the Landfill as a drinking water source is prevented.

A groundwater monitoring program will be implemented at the site to assess changing aquifer conditions and to continue evaluating the Landfill's impact on groundwater quality. The groundwater monitoring data will provide information for conducting periodic site reviews. In the future, such as when the remedial action for the Chemical Sales site is complete, if it is determined from subsequent evaluations that the Landfill is responsible for unacceptable groundwater contamination, remediation of the ground water at the Landfill will be addressed under OU3.

V. SUMMARY OF SITE CHARACTERISTICS

The Sand Creek Industrial Superfund Site, including the 48th and Holly Landfill, is located in an urban environment that has been extensively modified by industrial development over the past 50 years. The site lies in an area of low relief within the Sand Creek flood plain, which is part of the South Platte River system. The on-site drainage represents less than one-half of one percent of the total drainage to Sand Creek. The only surface-water feature within the Landfill study area is a 1-acre wetland located immediately north of the Landfill. The wetland receives water from a "spring" that discharges from a corrugated metal pipe. This pipe is connected to finger drains that were installed before landfilling operations began to divert seeps originating along the escarpment to the south.

The Landfill is in an area classified as mid-latitude semiarid, indicating an area of high summer temperatures, cold winters, and sparse rainfall. The average annual precipitation is approximately 15 inches.

A. Surface Geology

Topography in the area rises gently to the south, with elevations ranging from approximately 5,180 feet above mean sea level (MSL) in the northwestern corner of the site to approximately 5,250 feet MSL in the southeastern corner. Interpretation of natural features is complicated by the extensive amount of fill that has been brought into the area. Between 2 and 10 feet of soil capping material currently covers the refuse at the Landfill. Natural drainage paths also have been altered by development in much of the area. Natural surficial deposits consist of Pleistocene and Holocene alluvium, eolian sediments, and loess. Alluvial deposits in the vicinity of OU3/OU6 range in thickness from less than 20 feet to more than 100 feet. The deposits generally consist of interbedded gravel, sand, silt, clay, and minor amounts of cobbles and pebbles. In addition, paleochannels eroded in the bedrock may influence the occurrence and movement of ground water in the area.

B. Subsurface Geology

The subsurface geology in the vicinity of the Landfill consists of Quaternary alluvial deposits and Tertiary bedrock. Alluvial deposits consist of sand, silt, and clay of the Piney Creek alluvium, eolian deposits of silt and clay, and sand and gravel of the Broadway alluvium. Clay and gravel sediments of the Slocum alluvium are also locally present. Bedrock in the area is made up of claystone, shale, siltstone, and sandstone of the Denver formation. The Denver formation is underlain by the Arapahoe formation, Laramie formation, and Fox Hills sandstone. Outcrops of bedrock are not visible at the Landfill.

C. Hydrogeology

Three discrete aquifers (Aquifers 0, 1, and 2) have been identified within the unconsolidated sediment overlying bedrock in the vicinity of the Landfill. Bore hole logs taken from investigations in the vicinity of the Landfill show that alluvial deposits are composed of relatively high permeability sands and gravels interbedded with low permeability clayey and silty material.

In the southeastern portion of the Landfill, Aquifer 0 is the only alluvial aquifer present, and it directly overlies bedrock or fine-grained alluvial sediments overlying bedrock. In the central part of the Landfill, Aquifer 0 exists under perched conditions above Aquifer 2. Aquifer 0 is unconfined throughout the Landfill and is underlain by a low permeability clayey layer (Aquitard A), which inhibits downward movement of ground water. Within Aquifer 0, groundwater flow is generally toward the north to northwest.

Aquifer 0 receives recharge from upgradient of the Landfill and discharges to Aquifer 2 where the confining unit separating these aquifers pinches out in the northwest portion of the Landfill. Aquifer 0 also discharges to the spring located north of the Landfill via the finger drain system. The direction of groundwater flow in Aquifers 0 and 2 is generally consistent with the regional flow direction of the alluvial system.

Aquifer 1 is present northwest of the Landfill, including the extreme northwestern portion of the Landfill. Aquifer 1 exists under unconfined conditions and is separated from Aquifer 2 by a clayey impermeable unit (Aquitard B). Groundwater flow within Aquifer 1 is generally toward the east. Ground water may discharge from Aquifer 1 to Aquifer 2 in the area where the confining unit separating these aquifers pinches out, in the vicinity of the northern boundary of the Landfill.

The third alluvial aquifer (Aquifer 2) is present over the western two-thirds of the Landfill. Aquifer 2 underlies Aquifer 0 and Aquifer 1 in areas where present and overlies fine-grained alluvial sediments overlying bedrock. Aquifer 2 exists under confined conditions to the west and northwest of the Landfill but is unconfined beneath the Landfill and south of the site. Groundwater flow within Aquifer 2 is generally toward the north.

D. Nature and Extent of Contamination

A site-wide RI completed in 1988 identified several contaminants in various operable units. The sources and extent of contamination were not well established because of the limited number of samples taken. Therefore, additional samples were collected during the OU3 RI to verify or better define contamination associated with the

Landfill. The following media were assessed for the presence of contamination in the vicinity of the Landfill:

- Surficial soil
- Ground water
- Surface water and sediment
- Air/landfill gas

Surficial soil samples collected during previous investigations within OU3 and during the OU3 investigation of sediment within the spring discharge area indicated that contaminants are not present in these two media. Therefore, the Landfill is not considered a contributor of contaminants to surficial soil and sediment.

Several VOCs, including 1,1,1-TCA; 1,1-DCA; 1,1-DCE; 1,2-DCE (total); chloroform; PCE; and TCE were detected in surface-water samples collected from the spring discharge area. The VOCs detected in surface water are essentially the same as those detected upgradient of the Landfill in the Chemical Sales site contaminant plumes in Aquifer 0. Due to the similarity of compounds detected upgradient and downgradient of the Landfill, and the origin of the water discharged to the spring, the OU3 RI concluded that the most likely source of surface-water contamination is the contaminated groundwater plumes in Aquifer 0 that resulted from past releases from the Chemical Sales site.

Groundwater samples collected from Aquifers 0, 1, and 2 and water samples collected from the landfill gas-extraction wells had detectable levels of a number organic and inorganic constituents. VOCs were the most widespread of the organic constituents detected in groundwater samples and were detected at the highest concentrations. Semi-volatile organic compounds (SVOCs) were also detected in these samples. The distribution and range of concentrations for the SVOCs were significantly lower than those observed for the VOCs.

Major sources of groundwater contamination exist in the vicinity of OU3. These sources include the Chemical Sales site, located southeast of the Landfill, and the Colorado Organic Chemical Company and Oriental Refinery sites, located west of the Landfill. Substantial plumes of VOCs within Aquifer 0, including PCE; TCE; 1,1-DCE; 1,1-DCA; cis-1,2-dichloroethene (cis-1,2-DCE); 1,1,1-TCA; vinyl chloride; methylene chloride; and carbon tetrachloride emanate from the Chemical Sales site and extend to the north at least as far as Sand Creek. Concentrations of several VOCs within these plumes exceed 10,000 micrograms per liter (μg/l) near the source area. These contaminated groundwater plumes from the Chemical Sales site pass beneath the eastern portion of the Landfill and may affect groundwater quality downgradient of OU3/OU6.

Major plumes of hydrocarbon compounds, including benzene, toluene, ethylbenzene, xylenes, chlorinated VOCs, and SVOCs are present within Aquifer 1.

These plumes emanate from the Colorado Organic Chemical Company and/or Oriental Refinery sites (OU1 and OU5) and extend northeast to Sand Creek. The contaminant plumes may pass beneath the extreme northwestern portion of the Landfill and affect groundwater quality downgradient of OU3/OU6.

Pesticides and herbicides were generally not detected in ground water in the vicinity of the Landfill. The inorganic constituents detected in groundwater samples were generally consistent upgradient and downgradient of the Landfill. However, a limited number of inorganic constituents appeared to be slightly elevated in downgradient monitoring wells relative to the range of concentrations observed in upgradient wells. The inorganic constituents detected most frequently at significantly elevated concentrations include iron and manganese. A few additional inorganics including antimony, barium, cadmium, calcium, cobalt, magnesium, nickel, potassium, sodium, and chloride, were detected downgradient of the Landfill at slightly elevated levels.

Water samples were collected from selected landfill gas-extraction wells during construction of the LFGES to assess the presence of contaminants within the Landfill. The most frequently detected organic constituents include ketones, benzene, ethylbenzene, toluene, total xylenes, and several chlorinated VOCs. The ketones were detected in the highest concentrations, ranging as high as 5600 μg/l for 2-butanone. Chlorinated VOCs were detected less frequently and at generally lower concentrations. The compounds detected most frequently in samples from landfill gas-extraction wells were generally not detected in monitoring wells located downgradient of the Landfill. Inorganic constituents were detected in samples from landfill gas-extraction wells at concentrations significantly exceeding background concentrations in Aquifer 0.

As discussed in the OU3 RI, the chemical data for the various media indicate that the Landfill is not contributing significantly to organic and inorganic contamination downgradient of the Landfill. Other source areas in the vicinity of the Landfill are clearly contributing substantial levels of organic constituents to ground water, both upgradient and downgradient of the Landfill. The Chemical Sales site appears to be the source for most of the chlorinated VOCs that are detected in the ground water.

The inorganic analytical data indicate that iron and manganese may originate in the Landfill. These constituents are elevated in the landfill gas-extraction well water samples and are also observed at elevated levels downgradient of the Landfill.

Air samples were collected from stack vents associated with landfill gas-collection systems formerly operating at the Landfill. Analytical results for these samples showed the presence of several VOCs, including benzene; chloroform; 1,1-DCE; PCE; and vinyl chloride. Most concentrations were less than 10 mg/m^3. In addition, the methane gas explosions that occurred near the Landfill in 1977 indicated that landfill gas is capable of migrating from the Landfill. The LFGES installed at the Landfill in 1991 as part of the

OU6 Removal Action is designed to prevent the migration of landfill gas from the Landfill.

E. Water Diversions

The rights for surface-water diversion from Sand Creek exist at two separate locations downstream of the Landfill. The first diversion point is the proposed Henrylyn Sand Creek Diversion, which is approximately 1.5 miles downstream of the Sand Creek Industrial Superfund Site on the northeast quarter of Section 12, Township 3 South, Range 68 West (T3S, R68W). Diversions from this location could reach 250 cubic feet per second of water for direct irrigation and storage in existing and planned reservoirs. The second diversion point is approximately 2 miles downstream of the Sand Creek Industrial Superfund Site where the Burlington Ditch intersects Sand Creek. A maximum of 250 cubic feet per second of water is appropriated for irrigation and domestic use at this location. According to a representative of the Burlington Ditch Company, water rights along the proposed Henrylyn Sand Creek Diversion or the existing Burlington Ditch have not been exercised to date.

VI. SUMMARY OF OU3/OU6 SITE RISKS

CERCLA mandates that EPA protect human health and the environment from current and potential exposures to hazardous substances at the 48th and Holly Landfill. Therefore, a Risk Assessment (RA) was prepared for OU3 to evaluate potential human health and environmental baseline risks associated with contamination at the site in the absence of any remedial action. The OU3 RA supplements and updates a previous RA prepared in 1987 for the Landfill by incorporating data collected during the OU3 RI. The OU3 RA also addresses risks posed by baseline conditions present at OU6 prior to implementation of the Removal Action. Two primary types of hazards are associated with the Landfill: the potential health hazard posed by contamination related to the Landfill, and the potential explosive hazard associated with methane gas generated within the Landfill.

A. Contaminants of Concern

Ground water in Aquifers 0, 1, and 2, surface water, and air were identified as media of concern in the OU3 RI. Soil and sediment were eliminated since investigations indicated that they were not significantly contaminated. Analytical data collected from 1986 through 1991 for the media of concern were evaluated according to EPA data validation criteria, a concentration toxicity screen was performed, and the fate and transport properties of individual chemicals were examined in developing a list of chemicals of concern (COC) for the Landfill. The 23 COCs selected include VOCs,

SVOCs, and metals. These contaminants represent all the carcinogenic chemicals detected in media of concern and the non-carcinogenic chemicals present that are the most likely to pose the greatest relative risk to humans and the environment. Chemicals detected in stack vent air samples and used as indicator chemicals in the previous RA are also considered as COCs for the air medium. A list of COCs for specific media of concern is presented in Table 1.

B. Exposure Assessment

Exposure pathways and receptors were identified based on the OU3 site conceptual model. Potential release mechanisms associated with the Landfill include leaching of chemicals in refuse and their subsequent movement into ground water, and volatilization of landfill gas. Although an active LFGES is currently operating at the Landfill, baseline conditions that were present before remedial measures were implemented were considered in assessing risk associated with the Landfill. Transport processes at the Landfill include groundwater flow and withdrawal, groundwater discharge to surface water, and dispersion of VOCs from the Landfill.

Exposure pathways that were quantitatively evaluated for the current land-use scenario in the OU3 RA are: inhalation of ambient air for local residents, nearby workers, nearby neighborhoods, and the nearest school; and dermal exposure to surface water for children potentially wading in the spring discharge area. Environmental receptors (i.e., plants and wildlife) potentially exposed to COCs in surface water were also qualitatively assessed. Under the current land-use scenario, no human receptors are known to be exposed to chemicals at the Landfill via the domestic use of ground water. The ground water beneath the Landfill is classified by the State of Colorado as a potential drinking water supply, and the South Adams County Water and Sanitation District (SACWSD) draws municipal supplies from the area north of the Landfill. There is currently a limited use of ground water for crop irrigation and livestock watering in the area. The SACWSD, irrigation, and livestock watering pathways will be assessed as part of the entire Sand Creek Industrial Superfund Site under OU4.

Exposure pathways that were quantitatively evaluated for local residents under the potential future land-use scenario are: ingestion of groundwater contaminants in drinking water, inhalation of VOCs from ground water while showering, dermal exposure to irrigation water derived from ground water, dermal exposure to surface water for children potentially wading in the spring discharge area, and inhalation of ambient air from vapors emanating from the Landfill. Risks associated with aquatic life coming into direct contact with surface water were also quantitatively assessed for the hypothetical future scenario.

Estimated current and potential future risks were based on an average or most likely exposure concentration (MLE) and a reasonable maximum exposure concentration