

**Kerr-McGee Chemical LLC**

Henderson, Nevada



Conceptual Site Model  
Kerr-McGee Facility  
Henderson, Nevada

**ENSR International**

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Prepared for  
**Kerr-McGee Chemical LLC**  
**Henderson, Nevada**

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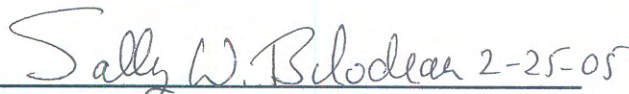
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The undersigned hereby certify that they are responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and, to the best of their knowledge, comply with all applicable federal, state and local statutes, regulations and ordinances.

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## ABBREVIATIONS AND ACRONYMS

µg/kg	micrograms per kilogram
µg/l	micrograms per liter
µS/cm	micro Siemen per centimeter
AP	ammonium perchlorate
AOC	Administrative Order on Consent
AP&CC	American Potash and Chemical Company
AST	above-ground storage tank
ASTM	American Society for Testing and Materials
bgs	below ground surface
BMI	Basic Metals, Inc. also known as Basic Management Inc. and Black Mountain Industrial (Park)
BTEX	benzene, toluene, ethylbenzene, and xylenes
COH	City of Henderson
Cr <sup>+3</sup> and Cr <sup>+6</sup>	trivalent chromium, and hexavalent chromium
CMP	Chromium Mitigation Program
CPE	Cross-linked Polyethylene
CSM	Conceptual Site Model
DAF	dilution alternation factor
DMR	Discharge Monitoring Report
DOT	Department of Transportation
ECA	Environmental Conditions Assessment
ECI	Environmental Conditions Investigation
EP	Extraction Procedure
EPA	United States Environmental Protection Agency

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**ABBREVIATIONS AND ACRONYMS**

FBR	Fluidized Bed Reactor
ft <sup>2</sup>	square feet
ft/day	feet per day
ft./ft.	foot per foot
gpd/ft <sup>2</sup>	gallons per day per square foot
g/m <sup>2</sup>	grams per square meter
gpm	gallons per minute
GWTP	groundwater treatment process
Hardesty	Hardesty Chemical Company
HDPE	High Density Polyethylene
ISEP®	Trade name for regeneratable ion exchange system designed by Calgon Carbon
IX	Ion Exchange
Kerr-McGee	Kerr-McGee Chemical LLC
LOU	Letter of Understanding
lbs	pounds
MCL	Maximum Containment Level
mg/kg	milligrams per kilogram
mg/M <sup>3</sup>	milligrams per cubic meter
mg/l	milligrams per liter
mil	millimeter
msl	mean sea level
NDEP	Nevada, Division of Environmental Protection
NPDES	National Pollutant Discharge Elimination System
PAH	polynuclear aromatic hydrocarbon
PCB	polychloromated biphenyls

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**ABBREVIATIONS AND ACRONYMS**

Pepcon	Pacific Engineering and Production Company
PQL	practical quantitation limit
PRG	Preliminary Remediation Goal
PVC	polyvinylchloride
RIB	Rapid Infiltration Basins
RCRA	Resource Conservation and Recovery Act
sq. ft.	square feet
SSL	Soil Screening Level
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TCA	trichloroethane
TCLP	Toxicity Characteristic Leachate Procedure
TDS	total dissolved solids
TOC	total organic carbon
TE	Trade Effluent
Tetra Tech	Tetra Tech EM Inc.
TPH	total petroleum hydrocarbons
TSDf	Treatment, Storage, and Disposal Facility
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UV	ultraviolet
VOC	volatile organic compound
WECCO	Western Electrochemical Company

## 1.0 INTRODUCTION

### 1.1 Purpose and Scope

The terminology used to describe the Kerr-McGee Chemical LLC Henderson (Kerr-McGee) facility and surrounding environments for this document is as follows: “the Site” refers to the 452-acre facility currently owned and operated by Kerr-McGee and shown on Plate 1 in light blue; “The study area” refers to the area approximately 10,000 feet across in an east-west direction extending from the south boundary of the Site approximately 3 ½ miles north to Las Vegas Wash.

The purpose of the Conceptual Site Model (CSM) is to describe the Site and to document the Site-specific release sources, release mechanisms, transportation pathways, exposure routes and receptors. The CSM was prepared by assessing and summarizing previous environmental work conducted.

The intended use of the CSM is to compile and integrate available Site information and to identify potential data gaps. Furthermore, the CSM is also intended to facilitate the selection of remedial alternatives and to evaluate the effectiveness of remedial actions in reducing the exposure of environmental receptors to contaminants. Lastly, the CSM provides technical and regulatory personnel, as well as members of the public, with a tool to better understand the Site, resolve issues concerning the Site, and facilitate the decision making process.

### 1.2 Guidance Documents

The CSM for the Kerr-McGee Henderson facility (Site), was developed to provide a framework to evaluate the Site with respect to waste sources, release mechanisms, transportation pathways, exposure routes and receptors. The Site has been used for chemical production since 1942. Environmental investigations relating to the Site have been conducted since 1991. Soil, surface water and groundwater samples have been collected and analyzed from the Site and surrounding areas. These data were used to develop this CSM. As new data are developed, the CSM will continue to be re-evaluated and refined.

Consistent with requests from the Nevada Division of Environmental Protection (NDEP), this report follows the Standard Guide for Developing a Conceptual Site Model for Contaminated Sites [Designation E-1689-95 (re-approved 2003)] by the American Society for Testing and Materials (ASTM). Other guidance documents used in structuring this CSM were:

United States Environmental Protection Agency (USEPA), 1996, Soil Screening Guidance Users Guide, Attachment A. Conceptual Site Model Summary;

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USEPA 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, EPA/540/G-89/004 October 1988; and

USEPA 1989, Risk Assessment Guidance for Superfund for Superfund Volume 1, Human Health Evaluation Manual (Part A) Interim Final December 1989.

### 1.3 Report Organization

The CSM includes the following nine numbered sections and four appendices:

**1.0 Introduction** – Discusses the report organization, purpose, scope and intended use of the CSM.

**2.0 Site Summary** – Provides the physical and hydrogeologic setting of the Site and surrounding area.

**3.0 Historical Information** – Summarizes the history of Site uses and the extent of previous investigations.

**4.0 Source Characterization** – Identifies known and potential contaminant sources.

**5.0 Migration Pathway Description** – Describes known and potential primary and secondary migration and transportation pathways in soil, groundwater, surface water, air and biota.

**6.0 Environmental Receptor Identification** – Identifies the known and potential on-site and off-site receptors.

**7.0 Conceptual Site Model** – Presents the conceptual site model based on the information presented in the previous sections.

**8.0 Data Gaps** – Identifies known and potential data gaps that were encountered during development of the CSM.

**9.0 References** – Provides a bibliographic citation for each of the references in the report.

**Appendix A. Monitoring Well Information and Data Tables** – Provides tabulated monitoring well data, including the monitoring well coordinates, elevations, total depth and historical chemical data for on-site wells.

**Appendix B. Soil Boring Logs and Well Construction Diagrams** – Contains a compact disk with electronic files in portable data format (pdf) of the boring logs and well construction diagrams.

**Appendix C. List of Chromium and Perchlorate Reports** – Provides a chronological list of reports addressing Site-related chromium and perchlorate assessment and remediation.

**Appendix D. Diagrams of Sample Locations from Previous Reports** – Provides copies of figures, diagrams and sketches showing where samples were collected. Diagrams are not available for all sites that were sampled.

**Appendix E. Biologic Resources** – Provides lists of plant and animal species known or expected in Las Vegas Wash.

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## 2.0 SITE SUMMARY

### 2.1 Site Location

The Site is part of the Black Mountain Industrial (BMI) complex, formerly known as Basic Management Inc. (BMI) and Basic Metals Inc. (BMI). The Site is approximately 454 acres in size and is located 13 miles southeast of Las Vegas in an unincorporated section of Clark County, Nevada. It is completely surrounded by the incorporated area comprising the City of Henderson (COH) (Figure 1 and Plate 1). The Site is in Township 22S, Range 62E and covers portions of Sections 1, 12 and 13. The approximate center of the Site is longitude 36°02'45" W and latitude 115°00'20" N.

### 2.2 Topography

Elevations across the Site range from 1,677 to 1,873 feet above mean sea level. The land surface across the Site slopes toward the north at a gradient of approximately 0.023 foot per foot (ft./ft.). The developed portions of the Site have been modified by grading to accommodate building foundations, surface impoundments and access roads. Off-Site the slope continues to the north where, at Sunset Road, the land surface flattens and slopes at a gradient of 0.011 ft./ft. to Las Vegas Wash. Plate 1 illustrates the site plan and topography.

### 2.3 Climate

The climate of the Las Vegas Valley is arid, consisting of mild winters and dry hot summers. Average annual precipitation as measured in Las Vegas from 1971 to 2000 is 4.49 inches. Precipitation generally occurs during two periods, December through March and July through September. The winter storms generally produce low intensity rainfall over a large area. The summer storms generally produce a high intensity rainfall over a smaller area for a short duration. These violent summer thunderstorms account for most of the documented floods in the Las Vegas area. Temperatures can rise to 120° F in the summer and average relative humidity is 20 percent. The mean annual evaporation from lake and reservoir surfaces ranges from 60 to 82 inches per year.

Winds frequently blow from the southwest or northwest and are influenced by nearby mountains. Strong winds in excess of 50 miles per hour are experienced occasionally.



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## 2.4 Geology

### 2.4.1 Regional Geology

The Las Vegas Valley occupies a topographic and structural basin trending northwest-southeast and extending approximately 55 miles from near Indian Springs on the north to Railroad Pass on the south. The valley is bounded by the Las Vegas Range, Sheep Range and Desert Range to the north; by Frenchman and Sunrise Mountains to the east; by the McCullough Range and River Mountains to the south and southeast, and the Spring Mountains to the west. The mountain ranges bounding the east, north and west sides of the valley consist primarily of Paleozoic and Mesozoic sedimentary rocks (limestones, sandstones, siltstones, and conglomerates), whereas the mountains on the south and southeast consist primarily of Tertiary volcanic rocks (basalts, rhyolites, andesites and related rocks) that lie directly on Precambrian metamorphic and granitic rocks (Bell, 1981).

In the Las Vegas Valley, basin-fill consists of Tertiary and Quaternary sedimentary and volcanic rocks and unconsolidated deposits which can be up to 13,000 feet thick (Langenheim and others, 1998). The valley floor consists of fluvial, paludal (swamp) and playa deposits surrounded by more steeply sloping alluvial fan aprons derived from erosion of the surrounding mountains. Generally, the deposits grade finer with increasing distance from the source area and with decreasing elevation. The structure within the Quaternary and Tertiary-age basin-fill is characterized by a series of generally north-south trending faults scarps. The origin of the faults is somewhat controversial; they may be tectonic in origin or may be the response to compaction and subsidence within the basin due to groundwater withdrawal.

### 2.4.2 Local Geology

The local geology and hydrology are defined by data collected from the numerous borings and wells that have been installed in the area (Plate 1). Information on the wells, including their coordinates, elevation, total depth and other pertinent information, is presented in Appendix A. Boring logs and well construction diagrams are included as electronic files in Appendix B.

**Alluvium.** The Site is located on Quaternary age alluvial deposits that slope north toward Las Vegas Wash. The alluvium consists of a reddish brown heterogeneous mixture of well-graded sand and gravel with lesser amounts of silt, clay and caliche. Clasts within the alluvium are primarily composed of volcanic material. Boulders and cobbles are common. Due to their mode of deposition, no distinct beds or units are continuous over the area.

A major feature of the alluvial deposits is the stream-deposited sands and gravels that were laid down within paleochannels that were eroded into the surface of the Muddy Creek formation during infrequent flood runoff periods. These deposits are thickest within the paleochannel boundaries, which are narrow and linear. These sand and gravel deposits exhibit higher

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permeability than the adjacent, well-graded deposits. In general, these paleochannels trend northeastward.

The thickness of the alluvial deposits ranges from less than one foot to more than 50 feet beneath the Site. Soil types identified in boreholes on Site include poorly sorted gravel, silty gravel, poorly sorted sand, well-sorted sand and silty sand. The thickness of the alluvium, as well as the surface of the underlying Muddy Creek formation, was mapped to locate these paleochannels. Plate 2 shows the surface of the Muddy Creek formation, whereas Plate 3 shows the thickness distribution of the alluvium. Four east-west and one north-south hydrogeologic cross sections (Plates 4A, 4B, 4C and 4D, respectively) show the spatial relationships between the units.

**Muddy Creek Formation.** The Muddy Creek formation of Miocene and Pliocene(?) age occurs in Las Vegas Valley as valley-fill deposits that are coarse-grained near mountain fronts and progressively finer-grained toward the center of the valley (Plume, 1989). In the Las Vegas Valley, the Muddy Creek is documented in boring logs to be at least 275 feet thick and is estimated to be at least 1,000 feet thick (Plume 1989).

Where encountered beneath the Site, the Muddy Creek formation is composed of at least two thicker units of fine-grained sediments of clay and silt (the fine-grained facies) interbedded with at least two thinner units of coarse-grained sediments of sand, silt and gravel (the coarse-grained facies). Everywhere beneath the Site, the fine-grained facies separates the coarse-grained facies from the overlying Quaternary alluvium.

The Muddy Creek formation represents deposition in an alluvial apron environment near the mountain borders, grading into fluvial, paludal (swamp), playa and lacustrine environments further out into the valley. On Site, the Muddy Creek does not crop out, but instead subcrops beneath a veneer of Quaternary alluvium. Two miles west of the Site, the Muddy Creek formation's fine-grained facies pinch out and the coarse-grained facies directly underlies the Quaternary alluvium.

In on-Site borings, the contact between the Quaternary alluvium and the Muddy Creek formation is typically marked by the appearance of a well-compacted moderate brown silt to sandy silt or a stiff clay to sandy clay, whereas near the Las Vegas Wash, the contact is marked by gray-green to yellow-green gypsiferous clays and silts. Along Las Vegas Wash, about two miles north of the Site, a well was drilled that encountered over 2,000 feet of gypsiferous sediments, the upper part of which is Muddy Creek formation and the lower part is likely the older Miocene Horse Springs formation (Tetra Tech EM, 2004). Geophysical evidence indicates that up to 6,000 feet of basin-fill occurs beneath Las Vegas Wash a few miles north of the Site (Langenheim, 1998).

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## 2.5 Hydrogeology

### 2.5.1 Regional Hydrogeology

The most important aquifers in Las Vegas Valley occur within Pliocene and younger alluvial deposits. Three major intervals, and the overlying discontinuous Holocene surficial deposits, are mapped in most hydrogeologic investigations of Las Vegas Valley (Donovan, 1996). The deepest interval, more than 1,000 feet below land surface, is a low permeability aquifer named by Maxey and Jameson (1948) as the “Deep Zone of aquifers”. This zone does not readily yield water to wells, but contains substantial quantities of groundwater. Discharge from this zone is by upward leakage and underflow. Because it is very difficult to pick the contact between the Pliocene/Quaternary alluvium and Miocene-Pliocene(?) Muddy Creek formation in the subsurface, the thickness of the post-Miocene sediments has been open to interpretation. It is generally thought that the interval below 1,000 feet is the Miocene-Pliocene(?) Muddy Creek formation. Covay and others (1996) state that the principal unconsolidated basin-fill aquifers are more than 3,000 feet thick.

Overlying this deep interval are Maxey and Jameson’s “Middle and Shallow Zone(s) of aquifers”, corresponding to the most permeable part of Harrill’s (1976) “principal aquifers”. The entire “principal aquifers” zone combines Maxey and Jameson’s “Shallow, Middle and Deep Zones of aquifers” into a single hydrogeologic unit. Most of the groundwater supply in the Las Vegas Valley has come from the “principal aquifers”. The age of the confining sedimentary units is most likely Pliocene and younger.

Harrill’s Near-Surface Reservoir, which corresponds to the Near-Surface Aquifer of Maxey and Jameson, is the first good-quality groundwater encountered upon drilling and overlies the “principal aquifers”. It occurs under both unconfined (water table) and confined (artesian) conditions, generally more than 100 feet below ground level. Under natural pre-pumping conditions, the water in this reservoir was derived mostly from upward leakage from the primary artesian system. Infiltration of sanitation process water, industrial process water, and irrigation water subsequently became the main source of recharge to the Near-Surface Reservoir. Discharge is almost entirely through evapotranspiration in the central portions of the Las Vegas Valley. Harrill’s Valley-Fill Reservoir is the combination of the Near-Surface Reservoir and the principal aquifers.

Overlying the Near-Surface Reservoir of Harrill is the “shallow aquifer(s)”, described by Harrill (1976), Van Denburgh and others (1982) and Zikmund (1996), which generally occurs in the upper 30 feet of saturated sediments over about 128 square miles of the valley. Shallow groundwater beneath the Site is within this aquifer. Plate 5 illustrates the potentiometric surface of this aquifer during May, 2004. Recharge to the “shallow aquifer” is generally through over-

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irrigation and other forms of water application to the land surface. Discharge is by evapotranspiration and downgradient movement to Las Vegas Wash.

Aquifers in the Las Vegas Valley are separated by thick sequences of fine-grained deposits which exhibit a low permeability. Interconnection between these aquifers in the valley occurs through upward leakage along fault zones and through semi-confining layers. Recharge to the Near-Surface Reservoir (aquifer) is generally through over-irrigation and other forms of artificial water use to the land surface, as well as “upward leakage” through fault zones and semi-confining layers. Recharge to the “principal aquifers” is primarily through the artesian flow system and run-off from precipitation occurring in the surrounding mountains which infiltrates the alluvium along the valley margins. Locally, some secondary recharge may be derived from downward percolation of excess surface water.

### **2.5.2 Local Hydrogeology**

**Alluvial Aquifer.** The first groundwater encountered in the study area occurs within the “shallow aquifer(s)”, more than 30 feet below ground surface (bgs) beneath the Site on the south, and is at, or near, the ground surface at Las Vegas Wash on the north. The measured horizontal hydraulic gradients in this aquifer are generally northward between 0.001 to 0.04 ft./ft., whereas the average hydraulic gradient is 0.017 ft./ft. As shown on Plate 5, the flow direction of the potentiometric surface mimics the ground surface and is to the north-northeast with minor variations.

As stated above, the Quaternary paleochannels act as preferred pathways for groundwater flow. Based on tracer tests north of Athens Road, the groundwater can flow in these paleochannels at an average rate of 35 feet per day (Kerr-McGee, 1998c and 2001). Extrapolating this velocity over the total distance involved and assuming that perchlorate travels at the same rate as the groundwater; the residence time for perchlorate in the Main Channel to move from Athens Road to Las Vegas Wash is about 6 months.

The results of a 1998 pump test in the Athens Road area indicate a permeability of 50 gallons per day per square foot (gpd/ft<sup>2</sup>), a transmissivity of 1,300 gpd/ft, and a groundwater velocity of 220 ft. per year for groundwater in the Main Channel (Kerr-McGee, 1998c).

In the study area, the chemistry of the groundwater in the “shallow aquifer(s)” is generally a sodium chloride-sulfate type and is classified as slightly to moderately saline. Evapotranspiration concentrates the natural salts in the shallow aquifer, resulting in low-quality water with high total dissolved solids levels in the range of 3,000 to over 10,000 milligrams per liter (mg/l) (Zikmund, 1996, Kerr-McGee, 1998c).

**Muddy Creek Aquifer.** Within the Las Vegas Valley, groundwater also occurs within the coarse-grained facies of the Muddy Creek formation. Based on both depth to water and water quality, it

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is thought that this water is in the Near-Surface Reservoir of Harrill. This water, averaging an electrical conductivity of about 1,100 micro Siemen per centimeter ( $\mu\text{S}/\text{cm}$ ), is of generally good quality where not impacted by industrial and residential contaminants. As sampled beneath the Site in February 2004 in well TR-1, the groundwater from the highest coarse-grained Muddy Creek unit contained 46 mg/l calcium, 190 mg/l chloride, 150 mg/l sodium, and 210 mg/l sulfate. Deep wells drilled into the Muddy Creek formation all exhibit artesian conditions, with some wells flowing at the surface. Most shallow wells drilled into the shallow Muddy Creek also demonstrate an upward hydraulic gradient.

Plate 5 shows that on the Site, south of the interceptor well field (near C-C' on Plate 5), the first groundwater encountered is in the upper part of the highest fine-grained facies of the Muddy Creek. Based on chemistry, this water is within the poorer-quality "shallow aquifer(s)," not the good-quality Near-Surface Reservoir of Harrill.

**Surface Water.** Surface water in the study area flows to the north toward Las Vegas Wash. Flow occurs as infrequent storm runoff which drains across the alluvial apron in shallow washes. Drainage and diversion structures have been constructed around the perimeters of the BMI complex to channel surface water flow. Las Vegas Wash is a tributary to Lake Mead and it is the only channel through which the valley's excess water flows to the lake. The water flowing through Las Vegas Wash comprises less than two percent of the water that flows into Lake Mead and consists of urban runoff, shallow groundwater, storm water, and releases from the valley's three water reclamation facilities (Southern Nevada Water Authority, 2004).

**Water Supply.** Lake Mead is a major reservoir on the Colorado River which supplies about 85 percent of the total water used in the Las Vegas Valley. Groundwater is used to meet approximately 15 percent of the annual water needs for the Las Vegas Valley. During the hot summer months from May to September, groundwater can account for 39 percent of the valley's daily water demands (Las Vegas Valley Groundwater Management Program). There are reportedly 6,800 wells within the Las Vegas Valley that provide groundwater year-round to residents and other users that are not connected to a municipal water supply. There are no water supply wells reported within four miles of the Site that extract water from the "shallow aquifer".

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### 3.0 HISTORICAL INFORMATION

Numerous investigations have been conducted to evaluate the nature, extent, and movement of contaminants on site and in downgradient and cross gradient areas. A summary of the Site history and the soil and groundwater investigations is presented below.

#### 3.1 Historical Summary

The BMI complex has seen operation since 1942 and was originally sited and operated by the United States (US) government as a magnesium production plant. A portion of the complex was leased by Western Electrochemical Company (WECCO) in 1945. In November 1950, a large pilot plant was constructed, which went into operation in 1951. By August 1952, WECCO had purchased several portions of the complex. In May 1953, a ten tons-per-day plant was constructed to replace the pilot plant. In June 1953, production started on high-purity manganese metal. In 1955, WECCO merged with American Potash and Chemical Company (AP&CC) and this company operated at the Site through 1967. In 1962, AP&CC purchased the ammonium perchlorate plant, sodium perchlorate plant, and half of the sodium chlorate plant from the federal government. Kerr-McGee purchased AP&CC in 1967. Other companies that operated within the BMI complex included Stauffer Management Company, Inc., Titanium Metals Corporation, U.S. Lime, Montrose Chemical Corporation, State Industries, Jones Chemical Company, Valite Industries, Hardesty Chemical Company, and Pioneer Chlor Alkali Company, Inc. (Ecology and Environment, 1982; and Kleinfelder, 1993). Details regarding ownership and leases within the BMI complex are available in the 1993 Phase I Environmental Conditions Assessment (Phase I ECA) report (Kleinfelder, 1993).

During the 1970s, the USEPA, the State of Nevada, and Clark County investigated potential environmental impacts from the BMI companies' operations, including atmospheric emissions, groundwater and surface water discharges, and soil impacts (Ecology and Environment, 1982). From 1971 to 1976, Kerr-McGee modified their manufacturing process and constructed lined surface impoundments to recycle and evaporate industrial wastewater. In 1976, Kerr-McGee achieved zero discharge status regarding industrial wastewater management. In 1980, the USEPA requested specific information from the BMI companies regarding their manufacturing processes and their waste management practices by issuing Section 308 letters. In 1994, the NDEP issued a Letter of Understanding (LOU) that identified 69 specific areas or items of interest and indicated the level of environmental investigation they wanted Kerr-McGee to conduct (Plate 6 and Table 1).

Table 2 lists the products made, years of production, and approximate waste volumes for WECCO, AP&CC and Kerr-McGee. This table was developed from data presented in the 1993 Kleinfelder Phase I ECA report.

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Kerr-McGee has undertaken environmental investigations to assess specific impacts in the area. Plates 7 and 8 present the extent of groundwater impacts for chromium and perchlorate from May 2004, extending from the Site to Las Vegas Wash. Plates 9 through 13 present additional detail regarding the groundwater impacts on Site.

### **3.2 Chromium Investigations**

A groundwater investigation was initiated by Kerr-McGee in July 1981 to comply with the federal Resource Conservation and Recovery Act (RCRA) standards for monitoring the existing on-Site impoundments. At that time, nine monitoring wells were installed. In December 1983, the NDEP requested that Kerr-McGee investigate the extent of chromium impact in the groundwater beneath the facility.

The investigation included the installation of 43 monitor wells. A Consent Order between Kerr-McGee and NDEP was issued in September 1986 (NDEP, 1986) which stipulated the requirement for additional characterization and the implementation of remedial activities to address chromium in the groundwater. As a result of the 1986 Consent Agreement, 22 additional monitor wells, 11 groundwater interceptor wells, and two treated-water injection trenches were installed prior to start-up of the chromium mitigation system in September 1987.

Initially, the 11 groundwater interceptor wells delivered approximately 100 gallons per minute (gpm) to the treatment system. The treatment technology was based upon a sacrificial iron electrode which reduced the hexavalent chromium ( $\text{Cr}^{+6}$ ) to trivalent chromium ( $\text{Cr}^{+3}$ ) and co-precipitated the  $\text{Cr}^{+3}$  together with iron oxide.

From initiation of remedial activities through 1993, the system captured and treated over 200 million gallons of groundwater and removed an estimated 8,500 pounds (lbs) of chromium from the environment. In September 1993, an evaluation was completed of the chromium remedial system. This study led to the conclusion that the extensive dewatering of the alluvium in the vicinity of the interceptor well field and the localized groundwater flow in discrete channels in the underlying Muddy Creek formation were contributing to a decline in recovery volumes. Based on these findings, Kerr-McGee installed four additional groundwater recovery wells to improve capture in the discrete channel flow areas. Over the next several years, additional interceptor wells were installed as part of continued alluvial dewatering and groundwater capture efforts. Two wells were installed in 1998 and five more in early 1999.

In late 1999, Kerr-McGee investigated methods to enhance the capture of groundwater in the interceptor well field. The investigation led to installation of a bentonite-slurry barrier wall (barrier wall), approximately 1,600 feet long, 60 feet deep, and 3 feet wide, located on the

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downgradient side of the interceptor well line. This barrier wall was completed in late September 2001 and its location is shown on Plate 10. By November 2001, groundwater recovery volume from the interceptor well field had increased from approximately 23 gpm to over 50 gpm. The interceptor well field has been averaging approximately 55 gpm since that time, and a "clean line" of much reduced chromium concentrations in the groundwater extends significantly downgradient from the barrier wall. The "clean line" was evident in 1999 but discrete areas were significantly improved by this action.

As of May 2004, the interceptor well/treatment system is capturing approximately 55 gpm at a chromium concentration of approximately 15 ppm. Figure 2 shows the potentiometric surface at the barrier wall and the infiltration trenches from May 2004. Since construction of the barrier wall, approximately 85 million gallons of groundwater have been captured and treated, and over 9,000 lbs of chromium have been removed. This value is based on an average flow rate of 55 gpm from October 2001 through September 2004 at an average chromium concentration of 13 mg/l. Plates 7 and 10 illustrate the chromium concentrations in groundwater beneath the Site as measured in May 2004.

Performance reporting for the chromium mitigation program has been ongoing since 1987. A list of the performance reports is provided in Appendix C.

### **3.3 Environmental Conditions Assessment**

In April 1991, Kerr-McGee was one of six companies that entered into a Consent Agreement with the NDEP (NDEP, 1991) to conduct environmental studies to assess Site-specific environmental conditions, which are the result of past and present industrial operations and waste disposal practices. The six companies that entered into the Consent Agreement included those past or present entities that conducted business within the BMI complex. The Consent Agreement specified that the companies accomplish the following:

- Identify past industrial practices and waste products generated;
- Identify known or suspected waste management units or areas active on or after November 19, 1980;
- Identify known or suspected spills of any pollutant or contaminant;
- Identify all current and prior owners and operators of any part of the Site;
- Collect and summarize records or investigations that identify, document or address soil, surface water, groundwater or air impacts; and
- Provide documentation of all measures that have been taken to monitor, characterize, mitigate or clean up Site environmental impacts.



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In April 1993, and in compliance with the 1991 Consent Agreement, Kerr-McGee submitted the Phase I ECA (Kleinfelder, 1993) to NDEP. The purpose of the report was to identify and document Site-specific environmental impacts resulting from past or present industrial activities. The Phase I ECA included a thorough assessment of the geologic and hydrologic setting, as well as historical manufacturing activities. The assessment identified 31 solid waste management units (SWMUs), 20 areas of known or suspected releases or spills, and 14 miscellaneous areas where Site activities may have impacted the environment.

In response to the NDEP review of the Phase I ECA and discussions between the NDEP and Kerr-McGee, the NDEP issued a LOU summarizing requirements for additional information or data collection (NDEP, 1994). The LOU identified 69 study items to be addressed further (Table 1). Each of the LOU study items (referred to herein as LOUs #1 through #69) was addressed by one or more of the following actions:

- A. Kerr-McGee provided additional information to the NDEP in a written response (35 items);
- B. Kerr-McGee conducted field sampling and data collection (12 items);
- C. Field investigation by the Henderson Industrial Site Steering Committee (2 items); or
- D. "No further action required at this time" (20 items).

Table 1 summarizes the action taken for each LOU study item. On October 2, 1996, Kerr-McGee submitted complete responses to the 35 LOU items requiring additional information or explanation (Kerr-McGee, 1996b).

In 1996 and 1997 Kerr-McGee conducted additional data collection as part of a Phase II ECA. The field investigations were conducted in compliance with an NDEP-approved work plan (Kerr-McGee, 1996a). The Phase II ECA addressed the 12 LOUs that were identified as needing additional characterization. In August 1997, Kerr-McGee submitted the Phase II ECA (ENSR, 1997) report to the NDEP.

On June 10, 1998, the NDEP issued comments to the Phase II ECA report (NDEP, 1998a) which conditionally approved the document, subject to selected additional work and development of a conceptual site model.

On November 9, 1998, Kerr-McGee submitted a response to the NDEP comments to the Phase II ECA report, and included with the responses a Supplemental Phase II ECA Work Plan (Kerr-McGee, 1998d) designed to provide the supplemental data required by the NDEP for the Phase II ECA.

On December 17, 1998, the NDEP replied to Kerr-McGee in a letter regarding the Phase II ECA Response to Comments and Supplemental Phase II ECA Work Plan. NDEP

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correspondence indicated that they conditionally approved Kerr-McGee's Response to Comments and the Supplemental Work Plan. According to the NDEP, the Work Plan was approved subject to "including the development of a CSM for the Site and comparing the soil sample results that were and will be obtained to the Nevada cleanup standards and actual background values".

In March and April 1999, the NDEP-approved field work for the Supplemental Phase II ECA was conducted. In April 2001, Kerr-McGee prepared a report of the findings of the supplemental field work and submitted them to the NDEP as the Supplemental Phase II ECA (ENSR, 2001).

In February 2004, the NDEP provided a response to the Kerr-McGee Supplemental Phase II ECA. NDEP indicated that additional work would be required, including identification of all potential contaminants associated with the Site, background sampling, assessment of site-specific action levels, and identification of data gaps.

Attachment A of the February 2004 NDEP Response Letter identified additional issues. To address these issues Kerr-McGee has met regularly with NDEP and developed a schedule for providing the requested information. Individual Kerr-McGee submittals are being modified, as needed, to address specific requests. As part of the development of the CSM, the NDEP requested that the site be addressed as a whole, as opposed to individual source areas. For that reason, the LOUs identified in 1994 have been compiled within groups that demonstrated similar contaminant characteristics. After reviewing the historical data, the following chemical contaminant groups were identified: perchlorate, chlorate, (total dissolved solids) TDS-conductivity, chromium, manganese, boron, petroleum hydrocarbons, and miscellaneous. Table 3 presents the LOUs subdivided within the identified chemical contaminant groupings.

### **3.4 Perchlorate Investigation**

In mid-1997, analytical methods were developed to detect low perchlorate concentrations (down to 0.004 mg/l), and governmental and regulatory concern increased regarding the health hazards of perchlorate in drinking water. Perchlorate was subsequently discovered in the Colorado River and traced upstream to Henderson and the location of two ammonium perchlorate manufacturing facilities, one of which was the Site.

In late 1997, Kerr-McGee undertook a perchlorate characterization study (Kerr-McGee, 1997a) to determine both the subsurface pathway(s) and the perchlorate concentrations in shallow groundwater downgradient from the Kerr-McGee Henderson facility to its discharge in Las Vegas Wash. Historic subsurface data were collected and analyzed and a sampling plan was developed (Kerr-McGee, 1998a). Between March and June 1998, soil borings and monitor wells were drilled and installed and the subsurface data was mapped and analyzed.

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In July 1998, Kerr-McGee submitted the Phase II Groundwater Perchlorate Investigation Report (Kerr-McGee, 1998b) to the NDEP. The report presents a compilation of information from both historical sources and recent field investigations, together with recommendations for further actions.

Results of the field assessment indicate that the main alluvial channel trends from the southwest to the northeast near the northern boundary of the Kerr-McGee facility downgradient to Las Vegas Wash. The channel ranges from 700 to 1,000 feet wide with a maximum depth approaching 60 feet. A permeability of 50 gpd/ft<sup>2</sup> and a transmissivity of 1,300 gpd/ft were calculated from the pump tests within the channel deposits underlying the Pittman Lateral.

Perchlorate concentrations in the alluvial groundwater study area range from 1,500 mg/l at the northern Kerr-McGee facility boundary to around 100 mg/l between the City of Henderson Rapid Infiltration Basins (COH-RIBs) and the Las Vegas Wash. The north-trending perchlorate plume is displaced eastward from the main alluvial channel just north of the Kerr-McGee property by a high conductivity plume which converges from the west and preferentially occupies the western part of the channel. The perchlorate plume eventually begins to merge and mix with the higher conductivity plume at, and downgradient from, the Pittman Lateral.

An outcome of this groundwater investigation report was the first map showing the perchlorate and conductivity plume extent, the most recent depictions of which are shown on Plates 8 and 9. Available historic subsurface data indicated that the perchlorate was generally confined to a Quaternary-age alluvial channel eroded into the underlying sediments. Subsurface mapping demonstrated that the deepest and best defined section of the channel lay beneath the Pittman Lateral (Athens Road) area, about one mile south of Las Vegas Wash. With the NDEP's approval, a strategy was defined for recovery of perchlorate-impacted groundwater. The recovery strategy included:

- Groundwater collection for perchlorate reduction at the source on the Site;
- Groundwater collection for perchlorate reduction at the Athens Road transect (in the Pittman Lateral area).

In September 1998, a recovery well (PC-70) was installed at Athens Road and began the recovery of small volumes of perchlorate-bearing shallow groundwater. The construction history and pump test results were discussed in a report submitted to the NDEP in October, 1998 (Kerr-McGee, 1998c).

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On-Site capture of perchlorate-bearing groundwater began in late 1998. The chromium interceptor well line continued to capture on-Site groundwater for treatment to remove hexavalent chromium. However, instead of re-injecting the groundwater treated for chromium to the shallow aquifer, it was impounded for later, additional, perchlorate treatment. An 11-acre lined pond (GW-11) was completed in late-1998 to contain this recovered groundwater.

In the spring of 1999 hydrologists with the Southern Nevada Water Authority discovered a perchlorate-impacted seep (Seep), on-trend with the buried alluvial channel, discharging into Las Vegas Wash. At the time of discovery, the Seep was flowing at about 400 gpm and contained over 100 mg/l perchlorate. At the request of the regulatory agencies, Kerr-McGee undertook a study to delineate the perchlorate in groundwater and to investigate appropriate and feasible means to remediate perchlorate in the Seep area.

On July 26, 1999, Kerr-McGee and NDEP entered into a Consent Agreement (NDEP, 1999) to initiate remedial measures to intercept and treat the perchlorate-bearing water flowing from the Seep area into Las Vegas Wash. A weir-sump combination and temporary ion exchange (IX) unit were commissioned and began treating collected water in October 1999. This activity represented a third leg of the perchlorate remedial strategy:

- Groundwater collection for perchlorate reduction in the Seep area close to Las Vegas Wash.

In early 2000, there was interest in 1) making an early impact on Las Vegas Wash perchlorate concentrations; 2) determining how the perchlorate in groundwater was entering the wash; and 3) assessing how fast the groundwater moved. This led to another phase of drilling, sampling, and monitor well construction that lasted from March to September 2000. In March 2000, Kerr-McGee submitted a Work Plan for Seep Area Groundwater Characterization to the NDEP (Kerr-McGee 2000). This Work Plan was designed to aid in understanding the hydrogeologic conditions in both the Seep and Pittman Lateral areas, with a goal of delineating the pathways by which perchlorate could enter the Las Vegas Wash from the Site.

In January 2001, Kerr-McGee prepared the Seep Area Groundwater Characterization Report (Kerr-McGee, 2001). This report contains the results of field activities completed consistent with the March 2000 work plan. The first well in the Seep well field area (monitor well PC-99) was installed during this program.

The Seep Area Groundwater Characterization Report documented that the groundwater was traveling an average of 35 feet per day between Athens Road and the Seep; that there were no other major downgradient sources of perchlorate along Las Vegas Wash; and that the entire saturated thickness of the alluvial channel contained variable concentrations of perchlorate.

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In mid-2001, at the direction of NDEP, Kerr-McGee constructed the first three recovery wells in the Seep well field. These wells began contributing groundwater to the temporary ion exchange (IX) plant in late 2001.

To allow groundwater from all three areas intended for remediation to be collected and treated with an efficient permanent perchlorate reduction process, an 825 gpm redeemable IX System (ISEP®)/catalytic destruction plant) was designed and constructed on the Kerr-McGee Henderson facility in early 2002. The Athens Road well field was completed in March 2002 and groundwater collection in this area began shortly afterward in support of commissioning the ISEP®/catalytic destruction process. Continuous pumping from the Athens Road well field began in mid-October 2002. Groundwater capture from the targeted buried alluvial channel underlying Athens Road appears to be complete. Figure 3 presents the potentiometric surface at Athens Road for May 2004.

A temporary IX process treatment system was placed in service on-Site to supplement the Seep area temporary IX process treatment system during the difficult commissioning of the permanent on-Site ISEP®/ catalytic destruction treatment plant.

Under further direction of the NDEP, Kerr-McGee increased the quantity of Seep area groundwater collected for treatment. In February 2003, five additional wells (PC117 to PC121) were completed and added to the Seep well field. At present (February 2005), the Seep well field consists of nine wells – two of which (PC-99R2 and R3) are connected and operate as one. The Seep well field is located over the deepest part of the alluvium channel that comprises the migration path for the highest concentrations of perchlorate. The well field is located about 600 feet upgradient of the Seep area surface flow capture sump.

The permanent on-Site ISEP®/catalytic destruction process treatment system eventually proved to be unworkable and was abandoned in favor of biological Fluidized Bed Reactor (FBR) technology. Construction of a 1,000 gpm (peak flow) biological treatment plant was completed in early 2004. Optimization of the plant operations continued into the fourth quarter of 2004. The temporary IX system at Las Vegas Wash near the Seep well field was shut down on June 11, 2004, and the on-Site temporary IX system was shut down in the first quarter of 2004.

As of October 31, 2004, 1,401.73 tons of perchlorate had been removed from the environment over the life of the perchlorate remediation project.

On October 8, 2001, NDEP and Kerr-McGee entered into an Administrative Order on Consent (AOC) (NDEP 2001). The AOC addresses the remediation of perchlorate in groundwater and surface water. The October 2001 AOC augments the July 1999 Phase I Consent Agreement

which was limited to the treatment of perchlorate-contaminated surface Seep water using a temporary IX system.

The October 2001 AOC stipulates that Kerr-McGee will construct a treatment system capable of treating 825 gallons per minute for removal of the perchlorate from surface and groundwater collected from upgradient of the slurry cutoff wall, the Athens Road groundwater extraction well system, and the Las Vegas Wash and Seep collection areas. The collected groundwater will be treated to remove perchlorate and discharged in accordance with the limits set forth in the existing National Pollutant Discharge Elimination System (NPDES) permit.

Performance reporting for the perchlorate mitigation program has been ongoing since 1997. A list of the perchlorate mitigation performance reports is provided in Appendix C.

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## 4.0 SOURCE CHARACTERIZATION

Potential environmental impacts at the Kerr-McGee Henderson facility were identified, assessed and/or characterized in the 1993 ECA (Kleinfelder, 1993), the LOU (NDEP, 1994), the 1996 Written Response (Kerr-McGee, 1996b), the 1997 Phase II ECA, (ENSR, 1997) and the 2001 Supplemental Phase II ECA (ENSR, 2001). As shown on Tables 1 and 3, the 69 items that are identified in the LOU have been subdivided into common potential contaminant groups for discussion. Some of the LOUs are potential sources for more than one contaminant and, as such, are discussed within one or more of the groups below. The location of each LOU is shown on Plate 6, as well as on Plates 8 through 16. In addition to the broad LOU identification process above, Kerr-McGee has embarked on two remedial efforts as the impacts from chromium and perchlorate in groundwater were identified and characterized. Additional details regarding the chromium and perchlorate groundwater remediation activities are discussed in sections 3.2 and 3.4 above.

As part of the ECA process, Kerr-McGee worked with NDEP to develop and refine a Site-related chemicals list (Table 4). This list includes Site-related chemicals, products, intermediate and breakdown products, and chemical combinations that may be associated with the current or historic activities at the Site as it exists in the geographic setting within an industrial complex, with industrial manufacturing neighbors. Table 5 presents the list of Site-related chemicals in alphabetical order. In response to an NDEP request in the February 11, 2004 letter, Table 6 summarizes the applicable 2004 EPA Region IX Preliminary Remediation Goals (PRGs) and Federal Maximum Contaminant Levels (MCLs) for drinking water.

As part of the development of the CSM, the NDEP requested that the Site be addressed as a whole as opposed to individual potential source areas. For that reason, LOUs identified in 1994 have been subdivided into groups that were suspected to represent potential sources of similar contaminants. After reviewing the historical data, the following chemical contaminant groups were identified: perchlorate, chlorate, TDS-conductivity, chromium, manganese, boron, petroleum hydrocarbons, and miscellaneous (Table 3). Some LOU study areas are included in more than one chemical group because it is possible that a study area may present several types of impact.

Within each section below, the discussion pertaining to a LOU area has been focused on a specific chemical or chemical group. Other chemicals potentially associated with a specific LOU are discussed under the "miscellaneous" grouping. The locations of potential source areas discussed in the LOU are depicted on Plate 6 and Plates 10 through 16. Diagrams of LOU sample locations from previous reports are included in Appendix D.

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## **4.1 Perchlorate**

Perchlorate was identified as a potential chemical contaminant at the Site and has ongoing groundwater remediation in place, both on Site and off Site. Kerr-McGee has focused perchlorate remediation efforts on assessment, containment and clean-up of the impacted groundwater downgradient from suspected source areas. Details regarding the groundwater remediation program progress have been provided in Section 3 of this report and updates are provided quarterly (for perchlorate) and semi-annually (for chromium) to NDEP. Table A-1 in Appendix A contains historic perchlorate analytical groundwater data. Please refer to Plate 11 for the location of the LOUs relative to perchlorate concentrations in groundwater.

### **4.1.1 LOU #16, #17, #18 and #19 AP-1, AP-2, AP-3, AP-4 and AP-5 Ponds and Associated Transfer Lines**

Five synthetically lined surface impoundments (AP-1, AP-2, AP-3, AP-4, and AP-5) were part of the ammonium perchlorate (AP) manufacturing process (Plates 6 and 11). To evaluate potential perchlorate impacts, data from three existing monitor wells, M-17, M-89, and M-25, were reviewed. Refer to Table 7 for the analytical results. Please refer to Plate 11 for pond and transfer line locations relative to perchlorate concentrations in groundwater and other potential perchlorate source areas. LOUs #16 and #17 were also assessed for nitrate and chromium impacts (Table 7). Nitrate and chromium are removed from treated groundwater in the ongoing remedial activities associated with the Site.

### **4.1.2 LOU #30 Ammonium Perchlorate Area – Pad 35**

Pad 35 is located south of the building known as old D-1. It consists of an “L” shaped concrete pad approximately 30 feet by 12 feet. The base of the “L” measures 6 feet by 10 feet. This area was used for accumulation of drummed common trash potentially contaminated with perchlorate and other industrial wastes, such as cooling tower sludge and iron oxide sludge. Please refer to Plate 11 for the location of this pad (LOU #30) relative to perchlorate concentrations in groundwater and other potential perchlorate source areas. The NDEP required no further action for LOU #30.

### **4.1.3 LOU #31 Drum Crushing and Recycling Area**

The drum crushing area (serving the ammonium perchlorate production) consisted of a drum crusher located on an 18 feet by 18 feet concrete pad located just east of the old D-1 building. Drums destined for disposal were emptied and rinsed prior to delivery to this area. Soils adjacent to the drum crushing area were transported to the AP-4 pond for recovery of the residual perchlorate (Kerr-McGee, 1996b). This area is located up-gradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Plate 11 for the



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location of LOU #31 relative to perchlorate concentrations in groundwater and other potential perchlorate source areas.

#### **4.1.4 LOU #32 Groundwater Remediation Unit**

The groundwater remediation unit occupies an approximate area of 1,200 feet by 650 feet. It includes a line of groundwater interceptor wells, the groundwater treatment process (GWTP), the groundwater barrier wall, two recharge trenches and the GW-11 pond. The GWTP is located to the east of new D-1 building on a 60 foot by 20 foot concrete pad with containment curbing. In the early 1990s portions of the recharge trenches became plugged and required modifications. During this time treated water occasionally would emerge from the trenches' water elevation test wells and impact surface soils (Kerr-McGee, 1996b). This water contained iron oxide, which colored the affected area red. Although the trenches were refurbished, system modifications have resulted in the treated water being discharged to the GW-11 pond rather than placed into the recharge trenches. Please refer to Plate 11 for the location of LOU #32 relative to perchlorate concentrations in groundwater and other potential perchlorate source areas.

#### **4.1.5 LOU #33 Sodium Perchlorate Platinum By-product Filter**

The platinum recovery filter press was located on a 75 foot by 100 foot concrete pad east of the Unit 5 cell floor. The pad was equipped with a sump that collected and contained liquids, including process liquids and wash-down water. Cracks in the floor, noted during the Phase I investigation, were coated with a Chevron industrial membrane material that provided a continuous cover over the floor (Kerr-McGee, 1996b). While analysis of groundwater impacts is ongoing, this area is located up-gradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Plate 11 for the location of LOU #33 relative to perchlorate concentrations in groundwater and other potential perchlorate source areas.

#### **4.1.6 LOU #43 Unit 4 and 5 Basements**

Sodium chlorate was historically produced in electrolytic cells located in Units 4 and 5. Additionally, these Units were used to produce sodium perchlorate at times. Both of these electrolytic processes contained chlorate and perchlorate as well as sodium dichromate (hexavalent chromium). In support of the chlorate and perchlorate production, the basements of Units 4 and 5 were used as sumps to collect spillage and wash-water. Operation of the electrolytic cells in Units 4 and 5 was discontinued in the late 1990s, but the buildings and structures remain for future use. Removal of the impacted soil beneath these buildings would likely require destruction of each building. Portions of these buildings actively participate in the manufacturing process. Other portions of the buildings are in good condition and may be utilized for active manufacturing in the future. Some or all of the soil underlying Units 4 and 5

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may be impacted with concentrations of perchlorate, chlorate or chromium. Please refer to Plate 11 for the location of LOU #43 relative to perchlorate concentrations in groundwater and other potential perchlorate source areas.

#### **4.1.7 LOU #52 AP Plant Area Screening Building, Dryer Building, and Associated Sump**

The Dryer and Screening buildings shared a common sump and floor drain system. The sump collected wash-down water and, on rare occasions, overflowed. Secondary containment was installed around the sump and a lined collection ditch was constructed completely around the building. Soil exhibiting white stains was collected and recycled for perchlorate recovery. Please refer to Plate 11 for the location of LOU #52 relative to perchlorate concentrations in groundwater and other potential perchlorate source areas.

#### **4.1.8 LOU #53 AP Plant Area Tank Farm**

The AP tank farm contained a number of vertical open-top and closed-top tanks used for process solution storage. The tank farm was equipped with secondary containment and a sump. Contained spills were reported from the tanks in the past. Please refer to Plate 11 for the location of these tanks relative to perchlorate concentrations in groundwater and other potential perchlorate source areas.

#### **4.1.9 LOU #55 Area Affected by July 1990 Fire**

On July 18, 1990, a fire occurred in the AP drum storage pad area. The fire burned for approximately 45 minutes. The soil around the fire area was impacted with ammonium perchlorate, which was washed off the concrete pad by the fire suppression water. The impacted soil was collected and returned to the AP process to recover residual perchlorate. The burned asphalt and soil surrounding the area (approximately 30 cubic yards of material) were removed and sent to the US Ecology disposal facility in Beatty, Nevada. Please refer to Plate 11 for the location of LOU #55 relative to perchlorate concentrations in groundwater and other potential perchlorate source areas.

#### **4.1.10 LOU #56 AP Plant Area Old Building D-1 Washdown**

During material handling, mixing and blending, small amounts of AP dust fell to the old D-1 building floor. While housekeeping in the area was maintained by dry sweeping, about once every other month, the building was also washed-down after sweeping. The wash-down water contained dissolved AP and drained onto the asphalt pad surrounding the building. Some of the wash water also drained onto the soil adjacent to the asphalt (Kerr-McGee, 1996b). Please refer to Plate 11 for the location of LOU #56 relative to perchlorate concentrations in groundwater and other potential perchlorate source areas.

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#### **4.1.11 LOU #57 and #58 AP Plant Area New Building D-1 Wash-down and AP Plant Transfer Lines to Sodium Chlorate Process**

The AP process-to-pond transfer lines extended from the AP process to the sodium chlorate ponds or process. The ponds and lines were in service from 1974 to 1995. The transfer lines occasionally released process solution to the ground. The lines were repaired, replaced or serviced on an as-needed basis. Please refer to Plate 11 for the location of LOU #57 and #58 relative to perchlorate concentrations in groundwater and other potential perchlorate source areas. The NDEP required no further action for LOU #57 and #58.

#### **4.2 Chlorate**

Chlorate was identified as a potential contaminant due to the historic chlorate manufacturing processes on Site. Kerr-McGee has focused groundwater remediation efforts on assessment, containment, and clean-up of the impacted groundwater downgradient from suspected source areas. Details regarding the groundwater remediation program progress have been provided in Section 3 of this report and are primarily focused on perchlorate and chromium, however, chlorate is also removed from treated groundwater in the ongoing remedial activities associated with the Site. Chlorate impacts have been included on the same Plate as TDS impacts because these constituents increase the specific conductivity of groundwater. Table A-1 in Appendix A contains historic specific conductivity groundwater data. Please refer to Plate 12 for the location of the LOUs relative to specific conductivity in groundwater.

#### **4.2.1 LOU #7 and #8 Old P-2 and P-3 Ponds and Associated Conveyance Facilities**

Surface impoundments were used to collect and concentrate dilute sodium chlorate solutions as part of the sodium chlorate production process. The concentrated solutions were recycled from the ponds back into the process. Old P-2 and P-3 were lined ponds used for this process from 1978 to 1986. Old P-2 encompassed approximately 0.1 acre (4,400 ft<sup>2</sup>) and P-3 encompassed approximately 0.3 acre (13,000 ft<sup>2</sup>) (Kleinfelder, 1993). The ponds were constructed with single-layer synthetic liners. The ponds were taken out of service prior to 1987 and the remaining solids, liner, and underlying soils were removed and disposed at the U.S. Ecology waste disposal facility in Beatty, Nevada.

The Old P-2 and P-3 ponds were investigated in response to LOUs #7 and #8. The Old P-2 pond was identified as SWMU KMCC-010 in the Phase I ECA and the LOU (Kleinfelder, 1993; NDEP, 1994). During the Phase II ECA investigation, considerable effort was undertaken to characterize total chromium impacts associated with the ponds (Table 8) (ENSR, 1997 and 2001). Please refer to Plate 12 for the locations of LOU #7 and #8 relative to specific conductivity in groundwater and other potential chlorate and TDS source areas.

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#### **4.2.2 LOU #9 New P-2 Pond and Associated Piping**

The New P-2 surface impoundment (pond) was initially constructed with two liners: a 30-mil unreinforced PVC liner and a 36-mil reinforced polyester liner. Approximately 18 months after being constructed, an additional 60-mil high-density polyethylene liner was installed. The pond was regulated under NPDES permit #NV0000078. The New P-2 pond had leak detection which was monitored monthly. In addition, there are groundwater wells present upgradient and downgradient of this location. Analysis of groundwater impacts in the area of New Pond P-2 is presented in Table 9. Please refer to Plate 12 for the location of LOU #9 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

#### **4.2.3 Chlorate LOU #11 Specific Information Regarding Sodium Chlorate Filter Cake Drying Pad area**

Prior to the early 1990s the Filter Cake Drying Pad was used to dry particulate material removed from the sodium chlorate process. In the early 1990s a new tank containment system was constructed in the drying pad location. Before construction, the existing pad structure was demolished and the material generated was managed as hazardous waste (due to total chromium content of the upper surface) and appropriately disposed off Site. According to Alan Gaddy, a Kerr McGee employee who observed the demolition, discolored soil was removed and disposed with the concrete (Kerr-McGee, 1996b). Please refer to Plate 12 for the location of LOU #11 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

#### **4.2.4 LOU #12 Hazardous Waste Storage Area**

LOU #12 is located to the northwest of Unit 4 and was the location where waste from the sodium chlorate process was stored in a semi-dump trailer, in preparation for transportation to a commercial hazardous waste disposal site (TSDF). The waste was initially transferred from the process to the trailer by a front-end loader, but in the later years of operation the material was transferred by dumping from a collection bin into the trailer. The semi-dump trailer was periodically transported off Site to the TSDF. NDEP has indicated that no further action was required for LOU #12. Please refer to Plate 12 for the location of LOU #12 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

#### **4.2.5 LOU #13 and #14 Ponds S-1 and P-1**

S-1 and P-1 ponds were single-lined surface impoundments used by the sodium chlorate process. The S-1 pond footprint was approximately 47,500 ft<sup>2</sup>. The liner was constructed of 20-mil PVC on the bottom and 30-mil cross-linked polyethylene (CPE) on the sides (Kleinfelder, 1993). Pond P-1's footprint and liner were similar to S-1. The ponds were closed in 1983 and final closure was approved by the NDEP on December 5, 1985. During closure,

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approximately two feet of soil from beneath the floor of each pond was also removed and soils sampled and analyzed to confirm adequate soil removal. Soil samples were analyzed by Extraction Procedure (EP) Toxicity methods and revealed concentrations of total soluble chromium between <0.02 mg/l and 0.11 mg/l (Tables 10 and 11). NDEP has indicated that no further action was required for LOU #13 and #14. Please refer to Plate 12 for the location of LOU #13 and #14 relative to groundwater specific conductivity and other potential chlorate and TDS source areas. Appendix D contains a diagram of the sample locations.

#### **4.2.6 LOU #15 Platinum Drying Unit**

The platinum drying unit was a 20 foot by 32 foot concrete floored and concrete bermed containment pad. In this area, a sodium perchlorate process by-product that contained recoverable platinum was processed. Following processing the platinum was recovered. In 1993 the concrete pad was sampled and analyzed for metals using Toxicity Characteristic Leachate Procedure (TCLP) extraction. Metal concentrations were below the method detection limit with the exception of chromium sampled. The area was demolished and the concrete transported to a hazardous waste TSDF. Soil under the pad was sampled for total chromium in 1994 (Table 12). Please refer to Plate 12 for the location of LOU #15 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

#### **4.2.7 LOU #32 Groundwater Remediation Unit**

The groundwater remediation unit occupies an approximate area of 1,200 feet by 650 feet. It includes a line of groundwater interceptor wells, the GWTP, the groundwater barrier wall, two recharge trenches and the GW-11 pond. The GWTP is located to the east of the new D-1 building on a 60 foot by 20 foot concrete pad with containment curbing. In the early 1990s portions of the recharge trenches became plugged and required modifications. During this time treated water occasionally would emerge from the trenches' water elevation test wells and impact surface soils (Kerr-McGee, 1996b). This water contained iron oxide, which colored the affected area red. Although the trenches were refurbished, system modifications have resulted in the treated water being discharged to the GW-11 pond rather than placed into the recharge trenches. Please refer to Plate 12 for the location of LOU #32 relative to specific conductivity in groundwater and other potential chlorate and TDS source areas.

#### **4.2.8 LOU #43 Unit 4 and 5 Basements**

Sodium chlorate was produced in electrolytic cells located in Units 4 and 5. Additionally, these Units were used to produce sodium perchlorate at times. Both of these electrolytic processes contained chlorate and perchlorate as well as sodium dichromate (hexavalent chromium). The basements of Units 4 and 5 were used at times as sumps to collect spillage and wash water. Operation of the electrolytic cells in Units 4 and 5 was discontinued in the late 1990s, but the

buildings and structures remain for future use. Removal of the impacted soil beneath these buildings would likely require destruction of each building. Portions of these buildings actively participate in the manufacturing process. Other portions of the buildings are in good condition and may be utilized for active manufacturing in the future. Some or all of the soil underlying Units 4 and 5 may be impacted with concentrations of perchlorate, chlorate or chromium. Please refer to Plate 12 for the location of LOU #43 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

#### **4.2.9 LOU #61 Old Sodium Chlorate Plant Decommissioning**

The old Sodium Chlorate Plant was located in Units 4 and 5. Production occurred in 1,300 electrolytic cells from 1945 to 1989. The process liquids contained primarily sodium chlorate with sodium dichromate as a process chemical additive. Retention of process liquids in the basements and sump areas of Units 4 and 5 was identified as a potential source of chlorate in groundwater. As the process was decommissioned, the electrolytic cells and associated piping were emptied. Residual materials, including the cell shells and other materials, which were hazardous due to the hexavalent chromium concentration, were transferred to a hazardous waste TSD in Beatty, Nevada. The process equipment, such as tanks, pipes and pumps, was dismantled in 1991 and transported off Site for disposal or recycling. The building area was cleaned and made available for other uses. The NDEP required no further action for LOU #61. Please refer to Plate 12 for the location of LOU #61 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

### **4.3 TDS – Conductivity**

TDS were identified as potential chemical contaminants due to the historic use of salts in the on-Site industrial processes. Kerr-McGee has focused groundwater remediation efforts on assessment, containment, and clean-up of the impacted groundwater downgradient from suspected source areas. Details regarding the groundwater remediation program progress have been provided in Section 3 of this report and are primarily focused on perchlorate and chromium. Table A-1 in Appendix A contains historic groundwater specific conductivity data. Please refer to Plate 12 for the location of the LOUs relative to groundwater specific conductivity.

#### **4.3.1 LOU #20 Pond C-1 and Associated Piping**

Pond C-1 was a single-lined surface impoundment. It was constructed with a single 60-mil PVC liner and covered 1.58 acres (69,000 ft<sup>2</sup>). The pond was used to evaporate non-hazardous process water, primarily from steam production, but at times also from the boron and manganese dioxide processes. Four groundwater monitor wells have been monitored in the vicinity of Pond C-1 (Table 13). A review of groundwater manganese and conductivity

records indicates that Pond C-1 does not appear to have impacted groundwater for these constituents (Kerr McGee, 1996b). In addition, C-1 is upgradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Plate 12 for the location of Pond C-1 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

#### **4.3.2 LOU #21 Pond Mn-1 and Associated Piping**

Pond Mn-1 is a double-lined surface impoundment and has leak detection between the liners. The top liner is 60-mil high-density polyethylene (HDPE) and the bottom liner is 4 to 6 inches of compacted bentonite clay with a permeability of  $10^{-6}$  centimeters per second (Kleinfelder, 1993). Mn-1 has a surface area of 1.22 acres (53,000 ft<sup>2</sup>). The manganese pond was placed in operation in May 1983 and received non-hazardous process water wastes, including filter wash water and cathode wash water. The pond contents contain manganese as well as high TDS (Kleinfelder, 1993). Based on groundwater data in the area, Mn-1 does not appear to be contributing to groundwater impacts in the area (Kerr-McGee, 1996b). This pond is upgradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Table 13 for analytical information and Plate 12 for the location of pond Mn-1 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

#### **4.3.3 LOU #22 and #23 Ponds WC-West (WC-1) and WC-East (WC-2) and Associated Piping**

Ponds WC-West (WC-1) and WC-East (WC-2) are both double-lined process water surface impoundments. These ponds were constructed within the former Trade Effluent settling pond area. The bottom liner of WC-West is 40-mil HDPE and the upper liner is 60-mil HDPE, with two leak detection wells between the liners. The bottom liner of WC-East is 40-mil HDPE, the middle liner is 60-mil HDPE, and the top liner is 40-mil HDPE. The current top liner was installed as an ultraviolet (UV) protective liner because the original top liner (now the middle liner) did not have sufficient carbon content to meet Kerr-McGee construction specifications. WC-East has two leak detection wells between the middle and bottom liners. WC-West has a surface area of 1.55 acres (67,600 ft<sup>2</sup>) and WC-East has a surface area of 2.03 acres (88,580 ft<sup>2</sup>). The soils beneath WC-West and WC-East were sampled for volatile organic compounds (VOCs) and eight RCRA metals prior to construction. Each analyte, except barium, was below the detection limit. This data is presented under LOU #1 on Table 26. Barium was detected at concentrations ranging from 0.1 to 1 mg/l (Kleinfelder, 1993). During the Phase I field investigation in 1993, a small spill was noted from the fittings on a Nalco process chemical container placed between the two ponds. An area of soil measuring approximately 5 feet by 10 feet appeared white and crusty (Kleinfelder, 1993). The soil stained with this material, reported to be sodium hypochlorite and other water treatment chemicals, was placed in WC-East (W-2). The NDEP required no further action for LOU #22. Please refer to Plate 12 for the location of

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ponds WC-West (WC-1) and WC-East (WC-2) relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

#### **4.3.4 LOU #32 Groundwater Remediation Unit**

The groundwater remediation unit occupies an approximate area of 1,200 feet by 650 feet. It includes a line of groundwater interceptor wells, the GWTP, the groundwater barrier wall, two recharge trenches, and the GW-11 pond. The GWTP is located to the east of new D-1 building on a 60 foot by 20 foot concrete pad with containment curbing. In the early 1990s portions of the recharge trenches became plugged and required modifications. During this time treated water occasionally would emerge from the trenches' water elevation test wells and impact surface soils (Kerr-McGee, 1996b). This water contained iron oxide, which colored the affected area red. Although the trenches were refurbished, system modifications have resulted in the treated water being discharged to the GW-11 pond rather than placed into the recharge trenches. Please refer to Plate 12 for the location of LOU #32 relative to specific conductivity in groundwater and other potential chlorate and TDS source areas.

#### **4.3.5 LOU #42 Unit 2 Salt Redler**

The Salt Redler was a rubber belt conveyor and was located at the southeast corner of Unit 2. During the period of sodium chlorate production, transfer of salt from storage in Unit 2 to the conveyor feed hopper resulted in some salt spillage to the ground. Spilled salt was swept up and returned to Unit 2. The NDEP required no further action for LOU #42. Please refer to Plate 12 for the location of LOU #42 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.

#### **4.3.6 LOU #43 Unit 4 and 5 Basements**

Sodium chlorate was produced in electrolytic cells located in Units 4 and 5. Additionally, these Units were used to produce sodium perchlorate at times. Both of these electrolytic processes contained chlorate and perchlorate as well as sodium dichromate (hexavalent chromium). The basements of Units 4 and 5 were used as sumps to collect spillage and wash water. Operation of the electrolytic cells in Units 4 and 5 was discontinued in the late 1990s, but the buildings and structures remain for future use. Removal of the impacted soil beneath these buildings would likely require destruction of each building. Portions of these buildings actively participate in the manufacturing process. Other portions of the buildings are in good condition and may be utilized for active manufacturing in the future. Some or all of this soil may be impacted with concentrations of perchlorate, chlorate, or chromium. Please refer to Plate 12 for the location of LOU #43 relative to groundwater specific conductivity and other potential chlorate and TDS source areas.



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## 4.4 Chromium

Chromium was identified as a contaminant due to the historic use of chromium in the manufacturing processes on Site. Kerr-McGee has focused chromium remediation efforts on assessment, containment, and clean-up of the impacted groundwater downgradient from suspected source areas. Details regarding the groundwater remediation program progress have been provided in Section 3 of this report and updates are provided quarterly (for perchlorate) and semi-annually (for chromium) to NDEP. Table A-1 in Appendix A contains historic chromium analytical groundwater data. Please refer to Plate 10 for the location of the LOUs relative to chromium concentrations in groundwater.

### 4.4.1 LOU #7 and #8 Old P-2 and P-3 Ponds and Associated Conveyance Facilities

Surface impoundments were used to collect and concentrate dilute sodium chlorate solutions as part of the sodium chlorate production process. The concentrated solutions were recycled from the ponds back into the process. Old P-2 and P-3 were lined ponds historically used for this process from 1978 to 1986. Old P-2 encompassed approximately 0.1 acre (4,400 ft<sup>2</sup>) and P-3 encompassed approximately 0.3 acre (13,000 ft<sup>2</sup>). The ponds were constructed with single-layer synthetic liners. The ponds were taken out of service prior to 1987 and the remaining solids, liner, and underlying soils were removed and disposed at the U.S. Ecology waste disposal facility in Beatty, Nevada.

The Old P-2 and P-3 ponds were investigated in response to LOUs #7 and #8, the Old P-2 surface impoundment is identified as SWMU KMCC-010 in the Phase I ECA and the LOU (Kleinfelder, 1993 and NDEP, 1994).

During the Phase II ECA, sampling was conducted in the floor of these ponds consistent with the NDEP-approved work plan. Eight shallow soil borings, SB2-1 through SB2-8, were advanced in P-3 pond and five shallow borings, SB2-9 through SB2-13, were advanced in Old P-2 pond. Samples were collected at depths of 0 to 12 inches bgs and 24 to 36 inches bgs. Sample locations are shown on Plates 6 and 17. Prior to sampling, soil boring and sampling locations were selected using a random generation grid superimposed over the investigation area.

Surface soil samples were collected and analyzed for total chromium and soil pH. The analytical results of soil samples collected from the Old P-2 and P-3 ponds are presented in Table 8. Cross sections illustrating the impacts are presented on Plate 17.

With the exception of SB2-3, SB2-5, and SB2-6, the 0 to 12 inches deep samples in the boreholes contained total chromium above 100 milligrams per kilogram (mg/kg). Consequently, all 24 to 36 inches deep samples, with the exception of these locations, were

also analyzed for total chromium. In several areas (SB2-1, SB2-2, SB2-8, SB2-10, and SB2-11), the chromium concentrations from the 0 to 12 inch depths were above 1,000 mg/kg (Plate 17 and Figure 4). Generally, the subsequent analysis of the 24" to 36" deep samples indicated a decrease in total chromium concentration, with the exception of SB2-2 and SB2-8 in Old P-2 pond. The total chromium concentration in all samples from P-3 decreased with depth.

Based on these results, 10 additional soil borings (SB2-14 through SB2-24) were advanced (Figure 4 and Plate 17). Total chromium concentrations were below 100 mg/kg in samples collected from the borings located along the ponds' perimeters. These results indicated that soils impacted with chromium associated with Old P-2 and P-3 pond activities are primarily limited to the interior areas of the ponds.

For borings within the Old P-2 and P-3 pond interiors (SB2-14 through SB2-17), all of the deepest samples collected at the top of the capillary fringe contained less than 100 mg/kg total chromium, except for SB2-17, which was 100 mg/kg at a total depth of 33 feet bgs. Except for SB2-16, which had no total chromium detections exceeding 100 mg/kg, samples collected from the other three borings within the pond interiors (soil borings SB2-14, SB2-15, and SB2-17) encountered total chromium concentrations exceeding 100 mg/kg at varying depths. Among the samples collected from SB2-14, SB2-15, and SB2-17, total chromium concentrations in soil ranged up to a maximum of 540 mg/kg. The deepest total chromium detections exceeding 100 mg/kg, in SB2-14, SB2-15, and SB2-17, were 160 mg/kg, 100 mg/kg, and 100 mg/kg at depths of 30 feet, 27 feet, and 33 feet bgs, respectively. The groundwater capillary fringe was encountered at varying depths of 33 to 42.5 feet bgs.

Levels of pH were measured in soil samples from all Old P-2 and P-3 pond soil borings. The pH levels ranged from a low of 7.8 to a high of 10. The pH levels from the four borings within the Old P-2 and P-3 pond interiors ranged from a low of 8.1 to a high of 10.

Although factors influencing the mobility of chromium are complex, elevated pH values tend to retard the mobility of chromium, especially trivalent chromium (Allen, 1993).

Please refer to Plate 10 for the location of LOU #7 and #8 relative to chromium concentrations in groundwater and other potential chromium source areas.

#### **4.4.2 LOU #9 New P-2 Pond and Associated Piping**

The New P-2 surface impoundment (pond) was initially constructed with two liners, a 30-mil un-reinforced PVC liner and a 36-mil reinforced polyester liner with a leak detection well between the two liners. Approximately 18 months later, an additional 60-mil HDPE liner was installed on top of the top liner. The pond was regulated under NPDES permit #NV0000078. Table 9 presents data from the groundwater wells upgradient and downgradient of this location. Kerr-McGee has focused remediation efforts on assessment, containment, and clean-up of the

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impacted groundwater downgradient from this pond. This pond is upgradient of the on-Site groundwater interception system/groundwater barrier wall. Details regarding the groundwater remediation program progress have been provided in Section 3 of this report and updates are provided quarterly (for perchlorate) and semi-annually (for chromium) to NDEP. Please refer to Plate 10 for the location of LOU #9 relative to chromium concentrations in groundwater and potential chromium source areas.

#### **4.4.3 LOU #11 Sodium Chlorate Filter Cake Drying Pad area**

The Filter Cake Drying Pad was used to dry particulate material removed from the sodium chlorate process. In the early 1990s a new tank containment system was constructed in the drying pad location. Before construction, the existing pad structure was demolished and the material generated was managed as hazardous waste (due to total chromium content of the upper surface) and appropriately disposed off Site. According to Alan Gaddy, a Kerr McGee employee who observed the demolition, discolored soil was removed and disposed with the concrete (Kerr-McGee, 1996b). This area is upgradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Plate 10 for the location of LOU #11 relative to chromium concentrations in groundwater and other potential chromium source areas.

#### **4.4.4 LOU #12 Hazardous Waste Storage Area**

Waste from the sodium chlorate process was stored in a semi-dump trailer in preparation for TDSF, the hazardous constituent being hexavalent chromium. The waste was initially transferred from the process to the trailer by a front-end loader, but in the later years of operation the material was transferred by dumping from a collection bin into the trailer. The semi-dump trailer was periodically transported off Site to the TSDF. NDEP has indicated that no further action was required for LOU #12. This area is upgradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Plate 10 for the location of LOU #12 relative to chromium concentrations in groundwater and other potential chromium source areas.

#### **4.4.5 LOU #13 and #14 Ponds S-1 and P-1 and Associated Conveyance Piping**

S-1 and P-1 ponds were single-lined surface impoundments used by the sodium chlorate process. The S-1 ponds footprint was approximately 47,500 ft<sup>2</sup>. The liner was constructed of 20-mil PVC on the bottom and 30-mil CPE on the sides (Kleinfelder, 1993). Pond P-1's footprint and liner were similar. The ponds were closed in 1983 and final closure was approved by the NDEP on December 5, 1985. During closure, approximately two feet of soil from each pond was also removed from the pond bottom and soil sampling and analysis was conducted to confirm adequate soil removal. Soil samples were analyzed by EP Toxicity methods and revealed concentrations of total soluble chromium between <0.02 mg/l and 0.11

mg/l (Tables 10 and 11). NDEP has indicated that no further action was required for LOUs #13 and #14. This area is upgradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Plate 10 for the location of LOU #13 and #14 relative to chromium concentrations in groundwater and other potential chromium source areas. Appendix D contains a diagram of the sample locations.

#### **4.4.6 LOU #15 Platinum Drying Unit**

The platinum drying unit was a 20 foot by 32 foot concrete-floored and concrete-bermed containment pad. In this area, a sodium perchlorate process byproduct which contained recoverable amounts of platinum was worked and platinum was recovered. In 1993 the pad concrete was sampled for metals using TCLP. The metals were below the method detection limit, with the exception of chromium samples (Table 12). The area was demolished and the concrete was transported to a hazardous waste TSDF. Soil under the pad was sampled for total chromium in 1994 (Table 12). This area is upgradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Plate 10 for the location of LOU #15 relative to chromium concentrations in groundwater and other potential chromium source areas.

#### **4.4.7 LOU #16 and 17 Ponds AP-1, AP-2 and AP-3 and Associated Transfer Lines**

Ponds AP-1, AP-2 and AP-3 and the associated transfer lines were part of the AP manufacturing process. To evaluate potential chromium impacts, data from three existing monitoring wells, M-17, M-25, and M-89, were reviewed. Refer to Table 7 for the analytical results. The soil beneath these ponds was analyzed for chromium in 1993. Table 7 also presents the results of the TCLP analyses. Statistical guidelines were followed to determine the average concentrations of chromium. The average concentration of chromium in AP-1 was 3.13 mg/kg with a confidence interval of 0.45 mg/l. The average concentration of chromium in AP-2 was 2.80 mg/kg with a confidence interval of 0.88 mg/l (Kerr-McGee, 1996b). These ponds were not identified as a potential source of chromium, and therefore, are not on Plate 10.

#### **4.4.8 LOU #28 Hazardous Waste Staging Area**

The Hazardous Waste Staging Area was originally located north of Unit 2 and consisted of a 65 foot by 15 foot concrete pad segregated into four areas by concrete curbs. The staging pad area was constructed for compliance with RCRA requirements for staging material in anticipation of transport to a TSDF. It was used for both hazardous and non-hazardous waste staging, although the types were segregated. The wastes handled consisted of used oil, flammable wastes from parts washing, hexavalent chromium-contaminated material, and

miscellaneous compatible wastes. Material placed on these pads was contained in drums. During later construction projects, the staging pad and surrounding soil were removed to a depth of four feet. The soil removed had elevated levels of total petroleum hydrocarbons (TPH), as analyzed in October 1994. In November 1994 analysis of a soil composite sample from several locations in the bottom of the excavation was non-detect (<10 mg/kg) for TPH (Table 14) (Kerr-McGee, 1996b). This area is upgradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Plate 10 for the location of LOU #28 relative to chromium concentrations in groundwater and other potential chromium source areas.

#### **4.4.9 LOU #32 Groundwater Remediation Unit**

The groundwater remediation unit occupies an approximate area of 1,200 feet by 650 feet. It includes a line of groundwater interceptor wells, the GWTP, the groundwater barrier wall, two recharge trenches, and the GW-11 pond. The GWTP is located to the east of the new D-1 building on a 60 foot by 20 foot concrete pad with containment curbing. In the early 1990s, portions of the recharge trenches became plugged and required modifications. During this time, treated water occasionally would emerge from the trenches' water elevation test wells and impact surface soils (Kerr-McGee, 1996b). This water contained iron oxide, which colored the affected area red. Although the trenches were refurbished, system modifications have resulted in the treated water being discharged to the GW-11 pond rather than being placed into the recharge trenches. Please refer to Plate 10 for the location of LOU #32 relative to chromium concentrations in groundwater and other potential chromium source areas.

#### **4.4.10 LOU #43 Unit 4 and 5 Basements**

Sodium chlorate was produced in electrolytic cells located in Units 4 and 5. Additionally, these Units were used to produce sodium perchlorate at times. Both of these electrolytic processes contained chlorate and perchlorate as well as sodium dichromate (hexavalent chromium). The basements of Units 4 and 5 were used as sumps to collect spillage and wash water. Operation of the electrolytic cells in Units 4 and 5 was discontinued in the late 1990s, but the buildings and structures remain for future use. Removal of the impacted soil beneath these buildings would likely require destruction of each building. Portions of these buildings actively participate in the manufacturing process. Other portions of the buildings are in good condition and may be utilized for active manufacturing in the future. Some or all of the soils underlying Units 4 and 5 may be impacted with concentrations of perchlorate, chlorate, or chromium. Please refer to Plate 10 for the location of LOU #43 relative to chromium concentrations in groundwater and other potential chromium source areas.

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#### **4.4.11 LOU #46 Former Old Main Cooling Tower and Recirculation Lines**

The former old Main Cooling Tower was located north of the manganese dioxide process leach plant. It was approximately 50 feet high and 700 feet long. The tower was installed by the US government when the complex was originally constructed. It operated from 1941 to September 1989. Historically the old Main Cooling Tower experienced several recirculation water upsets, which resulted in discharge of high-conductivity water to the Beta ditch. Individual discharges varied from a few hours to several days. The estimated water discharge was reported to the NDEP along with analytical results for pH, conductivity, sodium chloride, zinc and phosphate. The NDEP required no further action for LOU #46. This area is upgradient of the on-Site groundwater interception system/groundwater barrier wall. Please refer to Plate 10 for the location of LOU #46 relative to chromium concentrations in groundwater and other potential chromium source areas.

#### **4.4.12 LOU #61 Old Sodium Chlorate Plant Decommissioning**

The old Sodium Chlorate Plant was located in Units 4 and 5. Production occurred in 1,300 electrolytic cells from 1945 to 1989. The process liquids contained primarily sodium chlorate with sodium dichromate as a process chemical additive. Retention of process liquids in the basements and sump areas of Units 4 and 5 was identified as a potential source of chromium in groundwater. The electrolytic cells and associated piping were emptied. Residual materials, including the cell shells and other materials which were hazardous due to the hexavalent chromium concentration, were transferred to a hazardous waste TSDF in Beatty, Nevada. The process equipment (e.g., tanks, pipes and pumps) was dismantled in 1991 and transported off-Site for disposal or recycling. The building area was cleaned and made available for other uses. The NDEP required no further action for LOU #61. Please refer to Plate 10 for the location of LOU #61 relative to chromium concentrations in groundwater and other potential chromium source areas.

### **4.5 Manganese**

Manganese was identified as a potential contaminant due to the documented groundwater impacts and the historic use of manganese in the manufacturing processes on Site. Kerr-McGee has focused groundwater remediation efforts on assessment, containment, and clean-up of the impacted groundwater downgradient from suspected source areas. Details regarding the groundwater remediation program progress have been provided in Section 3 of this report and are primarily focused on perchlorate and chromium. Please refer to Plate 13 for the location of the LOUs relative to manganese concentrations in groundwater. Table 15 contains a summary of manganese analytical data from groundwater wells.

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#### **4.5.1 LOU #21 Pond Mn-1 and Associated Piping**

Pond Mn-1 is a double-lined surface impoundment and has leak detection between the liners. The top liner is composed of 60-mil HDPE and the bottom liner is 4 to 6 inches of compacted bentonite clay with a permeability of  $10^{-6}$  centimeters per second. Mn-1 has a surface area of 1.22 acres (53,000 ft<sup>2</sup>). The Mn-1 surface impoundment was put into operation in May 1983 and received non-hazardous liquid wastes, including manganese dioxide cell fed filter waste and potassium phosphate cathode wash water. The wastewater contains high TDS (Kleinfelder, 1993). Based on groundwater data in the area, Mn-1 does not appear to be contributing to groundwater impacts in the area (Kerr-McGee, 1996b). Please refer to Table 13 for analytical information and Plate 13 for the location of this pond relative to manganese concentrations in groundwater and other potential manganese source areas.

#### **4.5.2 LOU #24 and #34 Leach Beds, Associated Conveyance Facilities and Former Manganese Tailings Area**

Prior to 1975, tailings from the beneficiation of manganese dioxide ores were transported as a slurry to unlined surface impoundments/leach beds to the west of the current tailings area. After 1975, filtering of the tailings yielded a semi-dry filter cake. The tailings pile was graded periodically to maintain the desired shape and drainage. Placement of demolition debris into the tailings pile was allowed by NDEP (Kleinfelder, 1993). The tailings were analyzed by EP toxicity in 1979 and by TCLP in 1990 and 1993, and were determined to be non-hazardous. Evaluation of data from monitor wells in the area show that there is no significant manganese impact to groundwater in the vicinity of the tailings (Kerr-McGee, 1996b). Please refer to Table 16 for groundwater and TCLP analytical information and Plate 13 for the location of this area relative to manganese concentrations in groundwater and other potential manganese source areas.

#### **4.5.3 LOU #44 Unit 6 Basement**

High-purity, battery-active manganese dioxide has been produced in electrolytic cells in Unit 6. The basement beneath the cells collected process spillage and wash water and was identified as a source of soil and groundwater impact. Several groundwater monitor wells near Unit 6 are used to monitor manganese concentrations; these are M-10, M-29, and M-77, both up- and downgradient from Unit 6. Remediation measures were undertaken in 1986. The basement was cleaned, the concrete floor was removed, and the subsurface soil was re-contoured. The basement was lined with a 100-mil HDPE liner. The integrity of the basement liner system is periodically checked and serviced. Please refer to Table 17 for groundwater analytical information and Plate 13 for the location of this building relative to manganese concentrations in groundwater and other potential manganese source areas.

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#### **4.5.4 LOU #47 Leach Plant Area Manganese Ore Piles**

Manganese ore has been stored and processed at the Site since 1951. Historically, manganese ore piles were 10 feet to 15 feet high and over 300 feet long. The manganese ore was normally crushed, with particles varying in size but typically 0.25 inch and smaller. An industrial hygiene program is ongoing and eight-hour time-weighted averages for manganese dust exposures have been developed for workers in different settings within the process. An operator turning the roaster piles was exposed to 1.74 milligrams per cubic meter (mg/M<sup>3</sup>) total dust. A maintenance technician in the general area of the plant was exposed to 0.058 mg/M<sup>3</sup> total dust. The dust is composed of 55 percent by weight of manganese dioxide. Table 18 presents the analysis of the manganese dioxide ore. Please refer to Plate 13 for the location of LOU #47 relative to manganese concentrations in groundwater and other potential manganese source areas.

#### **4.5.5 LOU #48, #49, #50, and #51 Leach Plant Process Equipment**

A variety of process equipment is used to beneficiate the manganese dioxide ore and produce high-quality, battery-grade manganese dioxide. The analyte tanks are housed within a containment berm and are used to hold a manganese sulfate solution, that was used in the Unit 6 electrolytic cells, until the used solution is fortified and returned to the electrolytic cells. The sulfuric acid tank is housed on a containment pad and is used to hold this process chemical until needed by the process. The leaching tanks are housed on containment pads and are used to leach the manganese dioxide ore to gain its manganese value for use in the Unit 6 electrolytic cells. An analysis of the appropriateness of wells in the vicinity of the analyte tanks was completed and the results submitted to NDEP in the October 1996 Response to Letter of Understanding. Analysis of groundwater impacts including manganese concentrations, pH and specific conductivity is ongoing (Table 19). Please refer to Plate 13 for the location of LOUs #48, 49, 50 and 51 relative to manganese concentrations in groundwater and other potential manganese source areas.

### **4.6 Boron**

Boron was identified as a potential contaminant due to the historic use of boron in the manufacturing processes on Site.

#### **4.6.1 LOU #20 Pond C-1 and Associated Piping**

The C-1 pond was constructed and lined with a single 60-mil PVC liner. C-1 pond covered 1.58 acres (69,000 ft<sup>2</sup>). The pond was used to evaporate non-hazardous process water. Four groundwater monitor wells are monitored in the vicinity of pond C-1 (Table 13). A review of groundwater manganese and conductivity records indicates that pond C-1 does not appear to



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have impacted groundwater (Kerr-McGee, 1996b). Please refer to Table 13 for analytical information and Plate 15 for the location of LOU #2)...

## **4.7 Hydrocarbons**

Hydrocarbons were identified as a potential contaminant due to the historic use of hydrocarbons on Site.

### **4.7.1 LOU #4 Hardesty Chemical Site**

Hardesty Chemical Company (Hardesty) leased property in the vicinity of Unit 2 (as well as elsewhere in the BMI complex) in September 1945. In 1947, AMECCO gave notice that it had purchased the Hardesty interest in the BMI complex, and it appears AMECCO ceased operations prior to June 1949. Products listed for proposed production included muriatic acid, synthetic hydrochloric acid, monochlorobenzene, paradicychlorobenzene, orthodichlorobenzene, DDT, and soda arsenite solution. A portion of the Hardesty area was later leased by J. B. Kelley, Inc.

Drawings of the facility indicate that there were two underground storage tanks (USTs) located to the north of Unit 2, one for kerosene and one for benzene. A tank farm was also located north of Unit 2 on the north side of the tracks. None of these tanks are currently present.

A groundwater monitoring well (M-97) was installed downgradient from the tank farm and former USTs in 1997 (Plate 14). The borehole was advanced to a total depth of 50 feet bgs and samples were collected every five feet for lithologic logging and control. The borehole was converted to a well. Based on the substances historically used at the Hardesty site, the groundwater was sampled and analyzed for VOCs, semi-volatile organic compounds (SVOCs), specific conductance, TPH, pH, and arsenic by EPA Methods 8240, 8270, 8015M-diesel, 9045, and 6010/7000 and SW-846 9045, respectively (Table 20).

Analyses indicate that TPH was not detected at the practical quantitation limit (PQL). Arsenic was detected at 0.124 mg/l, which is within the expected range. Analysis indicates that 7.8 µg/l of Di-n-butylphthalate is an estimated concentration below the laboratory PQL. The VOC analysis indicated the presence of chloroform (18 µg/l) and acetone (3.1 µg/l). The analysis for acetone showed an estimated concentration because it was below laboratory PQL. Acetone was also detected in the laboratory method blank. Groundwater monitoring well M-97 has also been monitored from 1999-2004 for pH, specific conductivity, total chromium, and perchlorate levels (Table 20).

In summary, the constituents of concern were either not detected, were detected at low levels as a result of laboratory procedures, or were not representative of adverse environmental conditions. This indicates that the former USTs at the Hardesty site have not impacted

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groundwater. Please refer to Table 20 for analytical information and Plate 14 for the location of this area relative to other potential TPH source areas.

#### **4.7.2 LOU #28 Hazardous Waste Storage Area**

A hazardous waste staging area was originally located north of Unit 2 and consisted of a 65 foot by 15 foot concrete pad segregated into four areas with concrete curbing. The staging pad area was constructed for compliance with RCRA requirements and used for both hazardous and non-hazardous waste staging, although the types were segregated. The wastes handled consisted of used oil, flammable washing wastes, hexavalent chromium-contaminated material, and miscellaneous compatible wastes. Material placed on these pads was contained in drums. During later construction projects, the staging pad and surrounding soil was removed to a depth of four feet. The soil removed had elevated levels of TPH, as analyzed on October 1994 (Table 14). In November 1994 analysis of a soil composite sample from several locations in the bottom of the excavation was non-detect (<10 mg/kg) TPH (Table 14) (Kerr-McGee, 1996b). Please refer to Plate 14 for the location of this area relative to other potential TPH source areas.

#### **4.7.3 LOU #39 A.P. Satellite Accumulation Point - AP Maintenance Shop**

Visibly stained soil resulting from a minor spill from a used oil drum was observed in the AP satellite accumulation point-AP maintenance shop during a Phase I investigation. This area was investigated in response to LOU #39 (SWMU KMCC-029) (Plates 6 and 14).

Visibly affected soil was removed and a surface soil sample, S8-1S was collected and analyzed by TPH fuel fingerprint methods to verify whether the TPH-affected soil had been successfully removed (Table 21). The sample results indicated that 180 mg/kg diesel and 1,500 mg/kg motor oil constituents remained in the soil. TPH as gasoline was not detected above the laboratory PQL of 29 mg/kg.

Additional soil was removed from the area and containerized in a Department of Transportation (DOT) approved drum. A second confirmation sample (S8-1RE) was collected from the bottom of the excavated area. The sample analytical result was non-detect (<31 mg/kg) for TPH in the diesel-range.

In summary, the removal of soil from the AP Satellite Accumulation Point-AP Maintenance area effectively remediated the area and the subsequent sampling analysis confirmed that no diesel-range organics above laboratory detection limits remain in this area. Please refer to Plate 14 for the location of this area relative to other potential TPH source areas.

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#### **4.7.4 LOU #41 Unit 1 Tenant Stains**

Unit 1 Tenant stains were investigated as part of the 1997 Phase II ECA field investigation. Visibly stained soils were removed and transported to Environmental Technologies TSDf in Beatly, Nevada. A surface soil sample, S9-1S, was collected and submitted for TPH fuel fingerprint analysis (Table 22). Analytical results indicated that TPH in the range of motor oil was detected at a concentration of 250 mg/kg. TPH in the diesel range was quantified at 73 mg/kg and TPH in the gasoline range was not detected above the PQL of 29 mg/kg. Additional soils were removed from the area with the use of a backhoe. The area was re-sampled. A confirmation soil sample (S9-1RE) from the bottom of the excavation contained 100 mg/kg of TPH heavier than diesel, which is below the NDEP action level. Please refer to Plate 14 for the location of this area relative to other potential TPH source areas. Well samples from M-92 and M-93 were also analyzed in 1993 to investigate potential groundwater TPH impacts from these stained areas. Data in Table 22 indicates TPH and benzene, toluene, ethylbenzene and xylenes (BTEX) concentrations were non-detect.

#### **4.7.5 LOU #45 Diesel Fuel Storage Tank**

The former diesel fuel storage above-ground storage tank (AST) located south of old P-2 pond was removed by Kerr-McGee in 1994 (Plates 6 and 14). Samples were collected for analysis from seven soil borings (SB5-1 through SB5-7) and two groundwater monitor wells (M-10, M-21, and SB5-5 a temporary well). The samples were analyzed for diesel components (TPH-d) by EPA Method 8015M-diesel, BTEX by EPA method 8020, and polychlorinated biphenyls (PAHs) by EPA Method 8270. The soil and groundwater analytical results are presented in Table 23.

The NDEP has published cleanup standards for hydrocarbon-contaminated soil; the established level for TPH-d is 100 mg/kg. Soil samples from boreholes SB5-1, SB5-2 and SB5-3 contained TPH-d at concentrations greater than 100 mg/kg. Soil samples from the other boreholes did not contain TPH-d at concentrations exceeding 100 mg/kg. In addition, soil samples from borings SB5-4, SB5-5, SB5-6, and SB5-7 encountered no detectable concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) or polynuclear aromatic hydrocarbon (PAH) (Plate 17 and Table 23).

Two existing monitoring wells were sampled and analyzed for diesel constituents. Well M-21 is located in the regional downgradient direction and M-10 is located upgradient. Analytical results obtained in 1997 indicated that TPH concentrations in both samples were less than the PQL of 1.0 mg/l. In 1999 the groundwater was investigated again. Analytical results indicate that TPH-d concentrations were either at very low levels in a groundwater sample taken from soil boring (converted into a temporary groundwater well) SB5-5 (13 mg/l), or non-detect in groundwater from M-21 approximately 50 feet downgradient. The results of the sample

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analysis for M-21 conducted during the Supplemental Phase II ECA sampling are consistent with the non-detectable results of groundwater samples collected from monitoring well M-21 in April 1997. These data confirm that groundwater has only been minimally impacted beneath the former diesel fuel storage tank area, and not impacted at all immediately downgradient of this area. Please refer to Plate 14 for the location of this area relative to other potential TPH source areas.

#### **4.7.6 LOU #63 J.B. Kelley, Inc. Trucking Site**

J.B. Kelley, Inc. leased property from Kerr-McGee immediately south and east of the truck unloading area and operated a trucking operation on Site. The company hauled commodities such as lime and soda ash. The area of interest at the J.B. Kelley, Inc. site included a UST that stored diesel (excavated in 1991) and the open concrete vaults which formerly served as foundations for peat storage buildings (Plate 6 and 14).

In 1992 Horn Environmental Consulting Group on behalf of JB Kelley, Inc. conducted a field investigation to close a UST on their facility. In doing so they sampled six borings surrounding the UST at depths of 15, 25, 35, and 37 (at the groundwater interface) feet bgs. In addition, a water sample was taken from existing groundwater well H-38. The soil samples were analyzed for TPH (diesel and gasoline range by EPA Method 8015M) and the groundwater sample for total organic carbon (TOC). The TPH results were non-detect (<10 mg/l) and the TOC was 3.3 mg/l. Table 24 presents the soil and groundwater analytic data.

In March 1992, the groundwater well H-38 was re-sampled to provide BTEX and TPH data for the Clark County Health District. Benzene and Ethylbenzene were present at concentrations of 0.048 mg/l and 0.114 mg/l, respectively (Table 24). TPH both for diesel and gasoline range were non-detect.

In May 1993, Kerr-McGee installed two groundwater monitor wells (M-92 and M-93) to evaluate the groundwater quality on the J.B. Kelley site. M-92 is located upgradient, due south from the UST excavations conducted by J.B. Kelley. M-93 is located approximately 100 feet downgradient from the diesel UST excavation. Following development of the groundwater wells, water samples were collected and analyzed for TPH and BTEX. All results were non-detect (Table 24).

Concerning the open concrete vaults, because materials could potentially migrate through cracks in the concrete vault floor, in 1997 one shallow boring (SB7-1-1) was advanced through a crack in the floor and a soil sample was collected immediately beneath the concrete. Samples were also collected of sand that accumulated within each of the eight vaults. From these samples, a composite "soil" sample was produced, S7-1-S. The samples were analyzed for total metals by EPA Method 6010/7000, soil pH by SW-846 Method 9045, TPH by EPA

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Method 8015M-diesel, and VOCs by EPA Method 8240. The analytical results are presented on Table 24.

Toluene was detected at 1.1 µg/kg in sample S7-1-S. Sample SB7-1-1 contained 1.6 µg/kg of trichloroethane (TCA) and 13 µg/kg of acetone. These analyses were qualified by the laboratory. The concentrations of toluene and TCA were estimated since they were below the laboratory PQL. Acetone was detected in a method blank.

The results of total metal analyses indicate that all constituents were detected at concentrations within the range of average background concentrations in Western U.S. soils. The total chromium concentration in the surface soil sample collected by compositing remnant sands from the bottom of each vault was 42.9 mg/kg. While this concentration is slightly elevated, it is still below the range of average background concentrations, indicating that chromium is not at concentrations likely to represent an environmental concern.

Both samples were non-detect for TPH at the designated laboratory PQL. Based on the analytical results of the soil samples collected, the former J.B. Kelley Trucking operation has not affected surface and subsurface soil. Please refer to Table 24 for the analytical results and Plate 14 for the location of this area relative to other potential TPH source areas. Appendix D contains a sketch of the sample locations.

#### **4.7.7 LOU #64 Koch Materials Company Site**

Koch Materials Company leased an area west of the diesel storage tank for use as an asphalt emulsion batch plant. TPH spills were evident at the leased property and Koch removed visibly stained soils. They also collected soil samples for VOCs, SVOCs, metals, and confirmatory TPH analysis. Please refer to Table 25 for analytical data and Plate 14 for the location of this area relative to other potential TPH source areas. Appendix D contains a figure of the sample locations.

#### **4.7.8 LOU #65 Nevada Pre-cast Concrete Products, Green Ventures International, Buckles Construction Company, and Ebony Construction Sites**

Nevada Pre-Cast Concrete utilized office space near the J.B. Kelley operations from January 1973 to May 1978. Only office activities were conducted by Nevada Pre-cast Concrete (Kleinfelder, 1993). Green Ventures International leased the S-1 change house from August 1980 to September 1981 for use as a marketing office for alfalfa sprouts. Only office activities were conducted by Green Ventures International (Kleinfelder, 1993). Buckles Construction Company leased a portion of Unit 1 from August 1973 to June 1989. Buckles Construction Company activities, including steel fabrication and equipment storage, were conducted in the

crane bay located in the northwest corner of Unit 1 in the crane bay. In 1993, groundwater monitoring wells M-92 and M-93 were sampled for TPH and BTEX constituents to investigate possible groundwater impacts resulting from surrounding operations. All results from this analysis were non-detect (Table 22). In the LOU the NDEP asked if the Unit 1 tenant stains were associated with any of these activities. Unit 1 Tenant stains were investigated in response to LOU #41 (above). As part of the 1997 Phase II ECA effort, visibly stained soils were removed and transported to an appropriate disposal facility. A surface soil sample (S9-1S) was collected and submitted for TPH fuel fingerprint analysis (Table 22). Analytical results indicated that TPH in the range of motor oil, was detected at a concentration of 250 mg/kg. TPH in the diesel range was quantified at 73 mg/kg and TPH in the gasoline range was not detected above the PQL of 29 mg/kg.

Additional soils were removed from the area and the area was re-sampled. A confirmation soil sample (S9-1RE) from the bottom of the excavation contained 100 mg/kg of TPH heavier than diesel, which is below the NDEP action level. Please refer to Plate 14 for the location of these areas relative to other potential TPH source areas.

#### **4.7.9 LOU #66 Above Ground Diesel Storage tank leased by Flintkote**

Flintkote Company leased a diesel AST from July 1973 through 1975. The tank was located near the southwest corner of the Chemstar property. The tank has been removed. The NDEP required no further action for LOU #66. Please refer to Plate 14 for the location of this area relative to other potential TPH source areas.

#### **4.7.10 LOU #68 Southern Nevada Auto Parts Site**

Nevada Pick-a-Part, formerly Southern Nevada Auto Parts, leased property to store wrecked, impounded and repossessed vehicles. Operations included allowing the public to remove parts from the vehicles for a fee. Stained soil was evident in some leased areas. Kerr-McGee worked with the lessee to implement practices to minimize the potential for impacts to soil or groundwater to occur. Please refer to Plate 14 for the location of this area relative to other potential TPH source areas.

### **4.8 Miscellaneous**

The miscellaneous category of contaminants was identified to group LOUs that exhibited traits or included historic operations that may have impacted soil or groundwater, but the specific chemical or chemicals of concern did not appear to be widespread.

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#### 4.8.1 LOU #1 Trade Effluent Settling Ponds

The Trade Effluent (TE) settling pond area is located north of the ammonium perchlorate storage area and west of the existing ponds, WC-East and WC- West (Plate 16). The TE ponds were operated by the U.S. government from the fall of 1942 to fall 1944 as unlined storage impoundments for acid waste neutralized with caustic liquor. The waste was apparently evenly distributed in the ponds, with no segregation of materials in different areas. Each TE pond was approximately 20 acres and the average liquid depth was 7.5 feet.

The TE Ponds were investigated in response to LOU #1 (SWMU KMCC-014). After decommissioning, portions of the TE pond area have been utilized for other activities. Kerr-McGee constructed and operated a hazardous waste landfill in the northwestern portion of the TE pond area between 1980 and 1983. The landfill was closed and capped in 1985 in accordance with RCRA interim status requirements and is currently under a post-closure monitoring program. In October 1988, double-lined surface impoundments WC-East and WC-West were constructed in the northeastern portion of the TE pond area. WC-East and WC-West are permitted by the NDEP and are currently in operation.

In 1987, prior to installation of the double-lined surface impoundments, two soil borings were drilled in the vicinity of the closed landfill (Holes 1 and 2), and nine samples were collected and analyzed. Analysis included metals by method 6010, soil pH by EPA Method 9045, pesticides by EPA Method 608, and Silvex Analyses by EPA Method 615 (Table 26). All results were non-detect except for Barium, with results ranging between 0.10 mg/l and 1.0 mg/l

In 1997, soil sampling was conducted in this area consistent with an NDEP approved work plan. Boring locations were selected by a random generation grid placed over the area of historical use and advanced to a total depth of 10 feet bgs. In order to characterize the potential remnants of the neutralized aqueous waste historically conveyed to the ponds, soil samples were collected at depths of 1, 5, and 10 feet bgs. Soil borings SB1-1 and SB1-2 were located in the area of concern due south of the TE ponds (Plate 6). Five soil borings, SB1-3 through SB1-7, were advanced in the area between the closed landfill and surface impoundments. Soil samples collected from the TE settling ponds were analyzed for eight RCRA metals by EPA Method 6010 and for soil pH by SW-846 Method 9045. Analytical results from samples collected at LOU #1 are contained in Table 26. In summary, metal concentrations were below detection limits, with the exception of barium, which was detected at concentrations of less than or equal to 1 mg/l.

Analytical results of soil samples collected from the TE ponds indicate that metal concentrations in soil samples are within the range of the average concentration of these constituents in soils (ASTM, 1995). Confirmation that these average ranges are applicable to the geographic area within which the facility is sited will be an element included in the

Background Study Work Plan intended for 2005. The range of soil pH within the boring samples is from 8.2 to 9.8. The expected range of pH for soils in a desert environment is 8 to 9, but it is not unusual for pH to range from 7 to 11 (Boul, S.W., 1973). This will be confirmed during the Background Study to be completed in 2005. Please refer to Table 26 for analytical results and to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.2 LOU #2 Open Area due South of Trade Effluent Settling Ponds**

LOU #2 was investigated concurrently with LOU #1, which is discussed above in Section 4.8.1. Soil borings SB1-1 and SB1-2 were located in the area of concern due south of the TE ponds (Plate 6). Analytical results of soil samples collected from the TE ponds indicate that metal concentrations in soil samples were within the range of the average concentration of these constituents in soils (ASTM, 1995). The samples' range of soil pH is from 8.2 to 8.9, which is within the expected range of desert soil. The results of analysis are presented in Tables 27 and 26. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.3 LOU #3 Air Pollution Emissions Associated with Industrial Processes**

In 1997, air emissions from the Kerr-McGee facility were analyzed to determine the patterns of dispersion and probable deposition of emissions. Emission estimates were developed as part of the Title V Federal operating permit and were based on source test data as well as EPA approved emission factors (AP-42). The results of air modeling were included in the October 1996 Kerr-McGee report. In summary, the maximum calculated deposition is 17 grams per square meter ( $\text{g}/\text{m}^2$ ) at a point on the eastern boundary of the plant. This reflects the predominantly southwestern wind direction. At other points along the Kerr-McGee plant boundary, the calculated deposition is significantly less; along over 80 percent of the boundary the deposition is less than  $1 \text{ g}/\text{m}^2$ .

#### **4.8.4 LOU #5 On-Site Portion of Beta Ditch Including the Small Diversion Ditch**

The Beta Ditch could have carried a wide variety of chemicals throughout its history. This ditch was investigated during the 1996 Phase II ECI (ERM, 1996). Soil samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, chlorate, pH, asbestos and radionuclides. Table 28 summarizes the analytical results. Of the 41 individual VOCs analyzed under the EPA Method 8260, only four were detected at relatively low concentrations on Site. Of the 66 individual SVOCs analyzed under EPA Method 8270 only four were detected at relatively low concentrations on Site. Of the 28 constituents analyzed for pesticides/PCBs only four were detected on Site. Please refer to Table 28 for analytical results and Plate 16 for the location of



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this area relative to other potential miscellaneous source areas. Appendix D contains a figure of the sample locations.

#### **4.8.5 LOU #6 Unnamed Drainage Ditch Segment**

This ditch is also referred to as the Northwest Drainage ditch and was used by more than one BMI company. Soil in the area was sampled in 1993. Eight surface soil samples were collected from 0-1 foot bgs. Three samples were collected in the ditch and the other eight were collected from areas adjacent to the ditch. Three additional samples were collected from the 4-5 foot depth interval. No significant concentrations of contaminants of concern were identified (Table 29). In 1994, two nearby groundwater wells were sampled for VOCs by method 8240, metals by method 6010, and PCBs by method 608, see Table 29 for details. In addition, an extensive series of borings and sampling was conducted along the Warm Springs Road Extension in March 1996. A total of 45 soil samples were obtained. Analyses on numerous samples included metals by EPA Method 6010, chlorinated pesticides and PCBs by method 8080, VOCs by method 8260, SVOCs by method 8270, bulk asbestos, and radionuclides by various analyses. Please refer to Table 29 for analytical data and Plate 16 for the location of this area relative to other potential miscellaneous source areas. Appendix D contains a figure of the sample locations.

#### **4.8.6 LOU #10 On-Site Hazardous Waste Landfill**

This landfill was closed consistent with the approved closure and post closure plans. Groundwater analytical data for monitoring wells nearby are shown in Table 30. In a letter dated January 17, 1986 the NDEP approved the landfill closure. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.7 LOU #15 Platinum Drying Unit**

The platinum drying unit was a 20 foot by 32 foot concrete-floored and concrete-bermed containment pad. In this area, a sodium perchlorate process byproduct which contained recoverable amounts of platinum was worked and platinum was recovered. In 1993 the pad concrete was sampled for metals using TCLP. The metals were below the method detection limit, with the exception of chromium (Table 12). The area was demolished and the concrete was transported to a hazardous waste TSDF. Soil under the pad was sampled for total chromium in 1994. The three chromium samples were between 17.9 and 50.7 ppm (Table 12). Please refer to Plates 10, 11 and 16 for the location of LOU #15 relative to groundwater impacts and other potential source areas for perchlorate, chromium and miscellaneous chemicals.

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#### **4.8.8 LOU #16 and #17 Ponds AP-1, AP-2 and AP-3 and Associated Transfer Lines**

As well as being areas where other chemicals were present, ponds AP-1, AP-2 and AP-3 were identified by the NDEP as potential sources of nitrate. Three existing monitoring wells, M-17, M-89, and M-25, were sampled and analyzed for nitrates. Well M-17 is located immediately upgradient of the ponds, and M-89 and M-25 are situated in the downgradient groundwater flow direction. The samples were analyzed for nitrates by EPA Method 300 (Table 7).

The nitrate analysis was conducted by ion chromatography and the laboratory results were presented in terms of elemental nitrogen. The chromatograph was re-examined and the retention time peaks separated for nitrate/nitrite. Virtually no nitrite was present in the samples; the sample results are presented in terms of equivalent concentration of elemental nitrogen. Please refer to Table 7 for the analytical data and Plate 16 for the location of this area relative to other potential miscellaneous source areas. Nitrate is removed from treated groundwater in the ongoing remedial activities associated with the Site.

#### **4.8.9 LOU #18 Pond AP-4**

Surface Impoundment AP-4 was double-lined and had leak detection between the liners. Although no groundwater wells were specifically constructed to monitor groundwater beneath this impoundment, groundwater monitoring occurs upgradient and downgradient in the area (Table 7). Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.10 LOU #19 Pond AP-5**

Surface Impoundment AP-5 is double-lined and has leak detection between the liners. Although no groundwater wells were specifically constructed to monitor groundwater beneath this impoundment, the groundwater is monitored upgradient and downgradient in the area (Table 7). Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.11 LOU #22 and #23 Ponds WC-West and WC-East and Associated Piping**

Ponds WC-West (WC-1) and WC-East (WC-2) are both double-lined process water surface impoundments. They were constructed within the former Trade Effluent settling pond area. For WC-West, the bottom liner is composed of 40-mil HDPE and the upper liner is composed of

60-mil HDPE with leak detection between the two liners. For WC-East the bottom liner is composed of 40-mil HDPE, the middle liner is 60-mil HDPE, and the top liner is 40-mil HDPE. The current top liner was installed as a UV protective liner because the original top liner (now the middle liner) did not have sufficient carbon content to meet Kerr-McGee construction

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specifications. WC-West has a surface area of 1.55 acres (67,600 ft<sup>2</sup>) and WC-East has a surface area of 2.03 acres (88,580 ft<sup>2</sup>). The soil beneath WC-West and WC-East was sampled for VOCs and eight RCRA metals prior to construction. A small spill occurred from the fittings on a Nalco container placed adjacent to WC-East. The soil stained with this material, reported to be sodium hypochlorite and other water treatment chemicals, was placed in WC-East pond (WC-2). Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.12 LOU #25 Process Hardware Storage Area**

The process hardware storage area is located between Units 1 and 2. The area is about 50 feet wide and 200 feet long and was used to store process hardware since 1989. The process hardware stored in this area consisted of scrap metal parts and equipment from decommissioning of the former sodium chlorate and perchlorate processes from Units 4 and 5. Parts, tanks and other equipment destined for this storage area were rinsed or otherwise decontaminated prior to placement on the pad. The NDEP required no further action for LOU #25. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.13 LOU #26 Trash Storage Area**

The trash storage area is located north of Units 1 and 2. The area consists of two asphalt- surfaced areas measuring approximately 56 feet by 100 feet and 65 feet by 50 feet. Common trash from the sodium chlorate and sodium perchlorate processes was placed in 55-gallon drums and delivered to this staging area. The area was used from approximately 1990 to closure of the sodium chlorate process. The drums were inspected, sealed, labeled "non-hazardous waste" and shipped to the U.S. Ecology landfill in Beatty, Nevada. The drums were shipped to Beatty as a precautionary measure. The NDEP required no further action for LOU #26. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.14 LOU #27 PCB Storage Area**

The PCB storage area is located in the northern portion of Unit 2. The PCB storage area consists of three 12 foot by 15 foot vaults with floors that are 12 inches lower than the surrounding area. The vault walls are concrete that is 8 inches thick and the floors are covered with black 6-mil plastic sheeting. The vault area was reserved as a PCB waste staging areas. The USEPA conducted an inspection of the PCB storage area in 1989 and stated that no problems were noted. The NDEP required no further action for LOU #27. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

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#### **4.8.15 LOU #28 Hazardous Waste Storage Area**

The Hazardous Waste Staging Area was originally located north of Unit 2 and consisted of a 65 foot by 15 foot concrete pad segregated into four areas with concrete curbing. The staging pad area was constructed for compliance with RCRA requirements and used for both hazardous and non-hazardous waste staging, although the types were segregated. The wastes handled consisted of used oil, flammable maintenance parts washing wastes, hexavalent

chromium-contaminated material, and miscellaneous compatible wastes. Material placed on these pads was contained in drums. During later construction projects, the staging pad and surrounding soil was removed to a depth of four feet. The soil removed had elevated levels of TPH, as analyzed in October 1994. In November 1994 analysis of a soil composite sample from several locations in the bottom of the excavation was non-detect <10 mg/kg for TPH (Table 14) (Kerr-McGee, 1996b). Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.16 LOU #29 Solid Waste Dumpsters**

The solid waste dumpsters were located south of Unit 4 across from Avenue H. They consisted of open metal dumpsters placed on concrete surfaces separated by areas of gravel-covered soil. The area is about 220 feet by 70 feet. Two dumpsters have routinely been in place - one for recyclable steel and the other for common trash. At times other non-ferrous metal recycle dumpsters were staged for recycle of other than steel material. Scrap metal was washed prior to delivery to this area. The area was used since 1980. The NDEP required no further action for LOU #29. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.17 LOU #32 Groundwater Remediation Unit**

The groundwater remediation unit occupies an area approximately 1,200 feet by 650 feet. It includes a line of groundwater interceptor wells, the groundwater barrier wall, and two recharge trenches. The groundwater treatment unit is also in the area on a 60-foot by 20-foot concrete pad. Portions of the recharge trenches became plugged and required modifications. At times treated water was discharged to near surface soils due to pipeline plugging (Kerr-McGee, 1996b). System modifications have been implemented and treated water is no longer delivered. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.18 LOU #33 Sodium Perchlorate Platinum By-product Filter**

The platinum recovery filter press was located on a 75 foot by 100 foot concrete pad, to the east of the Unit 5 cell floor. The pad was equipped with a sump that collected and contained

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liquids, including process liquids and wash down water. Cracks in the floor, noted during the Phase I investigation, were coated with a Chevron industrial membrane material that provided a continuous cover over the floor (Kerr-McGee, 1996b). Analysis of groundwater impacts is ongoing. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.19 LOU #35 Truck Unloading Area**

The truck unloading area in LOU #35, was identified by NDEP as requiring additional assessment and characterization of "unknown" waste materials disposed in this area. This area is also identified as SMU KMCC-025. Eight shallow soil borings (SB4-1 through SB4-8) were advanced and shallow samples (-S) were collected from depths of 0 to 12 inches bgs, and deep samples (-D) were collected from depths of 24 to 36 inches bgs. The sampling locations were chosen using a random generation sampling grid superimposed over the investigation area (Plate 6).

Based on information provided by a previous terminal manager, the truck unloading area was used for the unloading of inorganic materials. Sample analysis was conducted for total metals by EPA Method 6010/7000 and pH by SW-846 Method 9045. In addition, in order to assess whether degreasing or truck washing material remained at the site, the samples were analyzed for TPH and VOCs by EPA Methods 8015M-d and 8240, respectively. All samples collected were analyzed (Table 31).

Analytical results indicate that metal concentrations in the soil samples were not elevated compared to the range of the average background concentration of these constituents in Western U.S. soils.

The soil samples from the truck unloading area contained TPH at concentrations below the NDEP established criteria of 100 mg/kg for hydrocarbon-impacted soils. The pH for soils ranged from 8 to 10 (Table 31). With the exception of samples SB4-2-D, SB4-5-D, SB4-6-D, and SB4-8-S, the samples did not contain detectable VOC concentrations above the laboratory PQL. Samples SB4-2-D, SB4-5-D, SB4-6-D, and SB4-8-S contained acetone at concentrations of 11, 6.8, 7.0, and 8.7  $\mu\text{g}/\text{kg}$ , respectively. However, acetone was also detected in a laboratory method blank at 4.4  $\mu\text{g}/\text{l}$ . Samples SB4-6-D, SB4-5-D, and SB4-8-S were qualified as estimated values detected at a level less than the laboratory PQL. Analytical results of soil sample SB4-8-S indicated that the surface soil sample contained 2.4  $\mu\text{g}/\text{kg}$  of TCA, which was also an estimated value detected at a level less than the laboratory PQL.

Based on the analytical results the truck unloading area has not been adversely impacted. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

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#### **4.8.20 LOU #36 Former Satellite Accumulation Points**

This satellite accumulation point is located at the southwest corner of Unit 3. It includes a parts washer and the adjacent open area where lead acid storage batteries and waste from the parts washer were stored. From 1989 to 1991 a solvent-based washer was used and after 1991 a caustic detergent was used for washing. Waste stored in this area included drums of oil and grease, solvents (mainly 1,1,1-TCA), sludge, caustic detergent and metal parts. NDEP required no further action for LOU #36. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.21 LOU #37 Former Satellite Accumulation Points**

This satellite accumulation point is located within the northeast portion of Unit 3. It includes a parts washer and the drum for temporary storage of parts washer waste. From 1989 to 1991 a solvent-based washer was used and after 1991 a caustic detergent was used for washing. Waste stored in this area included drums of oil and grease, solvents (mainly 1,1,1-TCA), sludge, caustic detergent and metal parts. NDEP required no further action for LOU #37. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.22 LOU #38 Former Satellite Accumulation Points**

This satellite accumulation point is located outside the north wall of the laboratory. It was used to store hazardous chemicals used in the on-site laboratory. It consists of three metal chemical storage cabinets used to store partially full containers of flammable liquids. Once the containers were full they were placed in 55-gallon drums packed with vermiculite and shipped off site for appropriate disposal. NDEP required no further action for LOU #38. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.23 LOU #40 PCB Transformer Spill**

The PCB transformer spill occurred at the south end of Unit 5. On November 26, 1990, approximately 1.75 pounds of PCB-containing fluid was released. The fluid dripped through access holes and collected on the concrete floor of the basement of Unit 5. The fluid was cleaned up with absorbents and portions of the concrete were also removed. The concrete was 8 inches thick. In August 1991, a small amount of soil was removed from beneath the concrete in preparation for replacing the concrete flooring. The soil removed was incidental to the concrete removal and this material was disposed off Site in Beatty, Nevada. NDEP required no further action for LOU #40. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

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#### **4.8.24 LOU #47 Leach Plant Area Manganese Ore Piles**

Manganese ore has been stored and processed at the Site since 1951. Historically manganese ore piles were 10 to 15 feet high and over 300 feet long. The manganese ore was normally crushed with particles varying in size but typically 0.25 inch and smaller. Table 18 presents the analysis of the manganese dioxide ore. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.25 LOU #54 AP Plant Area Change House/Laboratory and Septic Tank**

The AP plant change house laboratory is located in the west central portion of the Kerr-McGee facility (Plate 6 and 16). The change house was constructed in the early 1950s and the chemistry laboratory was added in 1980. Wastewater effluent from the change house showers, restrooms, and laboratory sinks discharged to a septic system with an associated leach field.

Laboratory operations included rinsing laboratory equipment, preparing standards, analyzing inorganic samples, preparing analytical solutions, and preparing dilute titrants. Hazardous solutions were collected and shipped to an appropriate disposal facility. Rinse water from the laboratory entered the septic system until August 1992. In August 1992, the use of the septic system was discontinued. The change house showers, restrooms, and laboratory sinks now discharge to a pump station, which transfers the water to the City of Henderson sanitary drains.

Two soil borings were advanced and three soil samples collected from each boring in the area of the former septic system leach field. The samples were analyzed for total metals, soil pH, VOCs, and SVOCs. The total metals and pH results are presented in Table 32. VOCs and SVOCs were below detection limits in the samples analyzed with the exception of sample SB6-1-5, which contained acetone at 9.8 µg/kg. This is an estimated value because it is below the laboratory PQL.

Analytical results of soil samples collected from the AP plant area change house/laboratory septic tank area indicate that total metal concentrations in the soil samples were not elevated above the range of the average concentration of these constituents in Western U.S. soils. The soils pH ranged between 8 and 10, which is in the normal range for arid soils. Based on the results of the sample analysis, the waste chemical disposal via the laboratory septic system has not affected soils in the area of the AP plant area change house/laboratory septic tank former leach field. Please refer to Table 32 for analytical results and Plate 16 for the location of this area relative to other potential miscellaneous source areas.

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#### **4.8.26 LOU #59 Storm Sewer System**

The storm sewer system consists of a network of concrete, clay and tile storm drains, manholes and outfalls. Outfalls occur along Beta Ditch, tributaries to Beta Ditch, and other drainage ditches. Between 1941 and 1976 the storm sewer system conveyed storm water and process effluent. In January 1976 Kerr-McGee achieved “zero discharge” of industrial process wastewater. Kerr-McGee process solutions are controlled in vessels or in lined surface impoundments. The storm sewer is used to convey storm water and non-contact cooling water. The storm drain system is subsurface, ranging from 25 to 45 feet below grade. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.27 LOU #60 Acid Drain System**

The acid drain system consists of a network of pipes, manholes and sumps used to collect acid effluent from throughout the BMI complex. The construction included the use of acid resistant materials. The system has a single outfall at the acid effluent neutralization plant. Kerr-McGee plugged the acid drain system beneath the operating portions of the facility in 1984. Acid drains in the non-operating portions of the facility (Units 1 and 2) have been filled with concrete debris and soil. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.28 LOU #62 State Industries Inc. Site, Including Impoundments and Catch Basin**

State Industries leased portions of the Kerr-McGee property for the manufacture and storage of hot water heaters. State Industries operated two surface impoundments between 1974 and 1988. Both surface impoundments have been closed. Prior to closure, analysis of sludge samples indicated that the material was non-hazardous based on EP Toxicity tests. In 1995, seven borings and 24 samples were obtained to investigate soil under the proposed administration/office building. Samples were obtained to assess the engineering properties, sodium and sulfate soil contents, and soil pH (Table 33).

Fourteen soil borings were drilled in 1996 and 17 soil samples were obtained by State Industries, Inc. The samples were analyzed for total metals, corrosivity, and VOCs. Low levels of lead and molybdenum were present. VOCs were also detected in 7 of the 17 samples (Table 33). Split-samples were obtained by Kerr-McGee during the State Industries sampling event. VOCs analyses were conducted and seven samples were found to have detectable concentrations. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas. Appendix D contains a figure of the sample locations.



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#### **4.8.29 LOU #63 J.B. Kelley, Inc. Trucking Site**

J.B. Kelley, Inc. leased property from Kerr-McGee immediately south and east of the truck unloading area and operated a trucking operation on site. The company hauled commodities such as lime and soda ash. The area of interest at the J.B. Kelley, Inc. are included a UST that stored diesel (excavated in 1991) and the site included open concrete vaults which formerly served as foundations for storage buildings. This area was formerly the site of Hardesty Chemical Company (Table 24 and Plates 6 and 16).

Concerning the open concrete vaults, because materials could potentially migrate through cracks in the concrete vault floor, in 1997 one shallow boring (SB7-1-1) was advanced through a crack in the floor and a soil sample was collected immediately beneath the concrete. Samples were also collected of sand that accumulated within each of the eight vaults. From these samples a composite "soil" sample was produced, S7-1-S. The samples were analyzed for total metals by EPA Method 6010/7000, soil pH by SW-846 Method 9045, TPH by EPA Method 8015M-diesel and VOCs by EPA Method 8240. The analytical results are presented on Table 24.

Toluene was detected at 1.1  $\mu\text{g}/\text{kg}$  in sample S7-1-S. Sample SB7-1-1 contained 1.6  $\mu\text{g}/\text{kg}$  of TCA and 13  $\mu\text{g}/\text{kg}$  of acetone. These analyses were qualified by the laboratory. The concentrations of toluene and TCA were estimated since they were below the laboratory PQL. Acetone was detected in a method blank.

The results of total metal analyses indicate that all constituents were detected at concentrations within the range of average background concentrations in Western U.S. soils. Total chromium concentration in the surface soil sample collected by compositing remnant sands from the bottom of each vault was 42.9 mg/kg. While this concentration is slightly elevated, it is still below the range of average background concentrations indicating that chromium is not at concentrations likely to represent an environmental concern.

Both samples were non-detect for TPH at the designated laboratory PQL. Based on the analytical results of the soil samples collected, the former J.B. Kelley, Inc. operation has not affected surface and subsurface soil. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas. Appendix D contains a sketch of the sample locations.

#### **4.8.30 LOU #67 Delbert Madsen and Estate of Delbert Madsen**

The leased property was used as a storage and salvage yard. The property was leased from 1976 through 1995 (Kleinfelder, 1993). Kerr-McGee removed the material and trash that was left on-site and disposed of it at the Silver State Landfill in Apex, Nevada (Kerr-McGee, 1996b).

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Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.31 LOU #68 Southern Nevada Auto Parts Site**

The leased property was used to store wrecked, impounded and repossessed vehicles. Operations also included insurance adjustment and auction of vehicles. Stained soil was present in some areas. Kerr-McGee worked with the lessee to implement practices to minimize the potential for impacts to soil or groundwater to occur. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.32 LOU #69 Dillon Potter Site**

Dillon Potter leased a 2-acre portion of the Kerr-McGee property. The area was used for livestock management and to store approximately 25 vehicles. The NDEP required no further action for LOU #69. Please refer to Plate 16 for the location of this area relative to other potential miscellaneous source areas.

#### **4.8.33 GW-11 pond**

Although not identified as an LOU, the GW-11 pond receives water for treatment. This pond is double-lined with leak detection wells between the liners. The GW-11 pond is located in the area of the former trade effluent ponds (LOU #1). During development of the NPDES permit, an extensive analysis of water discharged to pond GW-11 was completed. The data required to support the impoundment characterization was identified through an evaluation of the historical land use and a review of previous investigations. During the development of the Kerr-McGee Henderson facility NPDES permit for discharges from its groundwater remediation processes, Kerr-McGee worked closely with NDEP to identify and characterize the waste streams that would be placed in GW-11. An extensive sampling suite was jointly developed and applied to the GW-11 characterization. In response to requests from the NDEP Kerr-McGee collected and analyzed additional water samples from GW-11 in August and November 2004. Please refer to Table 34 for analytical data from Pond GW-11.

## 5.0 MIGRATION PATHWAY DESCRIPTION

Potential contaminant migration pathways within or off the Kerr-McGee Site exist through air, soil, surface water, groundwater, and biota. Each pathway is discussed below. Figures 5, 6, 7 and 8 illustrate the surrounding land use, potential source areas, contaminant pathways, and potential receptors.

### 5.1 Air Pathway

Contaminant transport can occur through the air pathway when contaminated soils are present at or near the surface and particulates are mobilized and carried by winds. This transport mechanism can also affect subsurface soils if they are excavated or grading exposes them to the effects of the wind. Due to the lack of surface covering over much of the Site and surrounding area, the lack of vegetation and the documented strong winds, air transportation can occur over many miles.

Contaminants capable of volatilizing or releasing gases can move via air through soil as soil gas. These gasses can migrate into the atmosphere or can be transported deeper into the ground depending on molecular weight and temperature gradients. Due to the high summer temperatures, near-surface chemicals are susceptible to being volatilized. Contaminants in surface water and groundwater can also volatilize.

### 5.2 Soil Pathway

Near-surface contaminated soil may come into contact with human or ecological receptors. Pathways include direct contact through dermal adsorption, ingestion, or exposure to radiation if the soil is radioactively contaminated. Plants and animals often have greater exposure potential to subsurface soil, because their roots and burrows extend below the surface. If site excavations occur, plants, animals and people may be exposed to subsurface soil.

Migration can also occur in subsurface soils from excavation or grading, or mixing contaminated soil with previously non-impacted material. Residual contaminants in the soil can be leached through the pore space and into groundwater via surface water infiltration.

In addition, soil can be moved by surface water as sediment, causing it to be transported downgradient, as discussed below.

### 5.3 Surface Water and Sediment

Contaminated media can be transported on Site or off Site through surface water movement. Water can pick up impacted soil or sediment and move it in a downgradient direction,

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especially when flowing across the Site due to rain or other run-off, or in bermed water control features such as in Beta Ditch. In addition, soluble contaminants can be dissolved and transported across the surface and/or infiltrate into the subsurface, contaminating the vadose zone and possibly continuing into the groundwater. Surface water can also concentrate and deposit dissolved salts when small pools form and the water evaporates.

Where contaminated groundwater surfaces as a seep, surface water is impacted in streams or washes such as the Las Vegas Wash. Surface water can also accumulate in surface water bodies such as Lake Mead. An interceptor system has been set up in the seep at Las Vegas Wash to collect and treat the impacted water. Containment and control of impacted water at the Seep is also supported by groundwater extraction wells in the area (Figure 8 and Plate 5).

#### **5.4 Groundwater**

Contaminants have contacted the groundwater and groundwater impacts have been documented from the Site to Las Vegas Wash (Plates 7 and 8). This pathway has been studied extensively, and several remediation systems have been set up to control, capture and treat the impacted groundwater.

Primarily groundwater movement occurs within the alluvial sediments, as well as within the Muddy Creek Formation. The groundwater tends to follow paleo channels of alluvial deposits, therefore, contaminants migrating with the groundwater travel within the alluvial channels. While higher concentrations of contaminants are primarily within the paleo channels, lower concentration contaminants are found along the edges of the paleo channels and elsewhere within the sediments. Subsequent to installation of the barrier wall, Athens Road, and Seep Interceptors there has been a measurable decrease in groundwater contaminants. In addition, an infiltration trench has been somewhat efficient in supplying water to maintain flow direction towards the Las Vegas Wash and flush channel sediments (Plates 2, 7, and 8 and Figure 8).

#### **5.5 Biotic Pathway**

When terrestrial and aquatic plants and animals come into contact with or ingest contaminated media, exposure, bioconcentration, bioaccumulation, and biomagnification can occur. The movement of contaminated biota can also transport contaminants.

## 6.0 ENVIRONMENTAL RECEPTOR IDENTIFICATION

The human and ecological receptors include on-Site workers, off-Site workers, off-Site residents, visitors, terrestrial plants and animals, and aquatic plants and animals (Figures 7 and 8). For an exposure pathway to be complete, the following conditions must be necessary and present: 1) a release mechanism; 2) a transport medium, and 3) a point of potential contact.

At present, approximately 90 full-time workers are employed at the Kerr-McGee Site. Surrounding land use is predominantly industrial. As shown on the land use and zoning map (Figure 5), there are also residential developments present nearby.

An inventory of biological resources was presented in the Final Environmental Impact Report for the Clark County Wetlands Park (1998). Appendix E lists the biologic resources identified. Ecological receptors including terrestrial and aquatic plants and animals have been identified as shown on Figures 7 and 8.

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## 7.0 CONCEPTUAL SITE MODEL

The CSM of the Kerr-McGee Henderson facility is based upon data collected on the Site since 1986. The model will continue to be evaluated and refined as new data are developed. The CSM is a representation of the environmental system and the biological, physical and chemical processes that determine the transport of contaminants from the sources through the environmental media to human and ecological receptors.

Figures 6, 7 and 8 present generalized conceptual diagrams of the potential contaminant source areas, contaminant pathways, and potential receptors. These diagrams illustrate in a schematic manner the potential source areas, vadose zone, air, groundwater, and surface water pathways and potential receptors. Analysis of Site data indicate that chemicals used on Site have impacted primarily soil and groundwater. Potential source areas are identified and discussed in previous sections. For some source areas, there is not enough data to determine if they contain chemicals that may have the potential to impact human health and the environment. These areas will be addressed in the Work Plan discussed briefly in Section 8 of this CSM.

Vadose zone transport of Site-related chemicals is a function of having the necessary chemical environment and sufficient infiltration to mobilize the chemical through the unsaturated zone to the groundwater. Portions of the Site are paved or covered which prevents infiltration of water. Taking the arid climate and site physical condition into account, there are only a few specific occurrences that can generate sufficient water to mobilize the Site-related chemicals that are present in the subsurface vadose zone. These can include a rainstorm of sufficient quantity and duration to saturate the soil beyond its field capacity; a water supply pipeline break that discharges water to a specific area which then saturates to groundwater or developing a leak in, or beneath, a synthetically lined pond that releases sufficient water to reach the water table.

As discussed in Section 3 lateral groundwater transport of Site-related chemicals is primarily within paleochannels incised within the Muddy Creek Formation. Plates 5 and 7 through 13 illustrate the potentiometric surface and the impacts identified in groundwater. Figures 2 and 3 show that the interceptor well field/groundwater barrier wall and Athens Road well field effectively capture groundwater in those areas. Groundwater flow continues northward towards the Las Vegas Wash where portions of the groundwater daylight (emerge as surface flow). Where the groundwater daylights, there are nine recovery wells, as well as a surface collection and recovery sump.

General exposure routes include inhalation, ingestion and dermal contact. Figure 7 presents the generalized potential source, primary release and transport mechanisms, secondary sources, secondary release and transport mechanisms, pathways, exposure routes, and

potential receptors. Receptors include on-Site workers, off-Site workers, off-Site residents, Site visitors, land plants and animals, and aquatic plants and animals.

Of the potential exposure pathways at the Site, the groundwater pathway is the predominant one for transporting constituents of concern from the Site. Other less significant pathways are air and surface water. If impacted groundwater emerges off Site in Las Vegas Wash, the surface water pathway grows in significance.

Due to the occasional high winds and the exposed on-Site soil, an air transport pathway is via entrainment of constituents of concern on dust particles. In addition, selected chemicals can volatilize into air. The high summer temperatures, however, volatilize near surface VOCs, if they are present.

Surface water transport of Site-related chemicals is minimized by the lack of on-Site surface water. Stormwater and water from leaking supply lines occasionally flows in the Beta Ditch and other ditches constructed for water control or conveyance. Historic transport of selected Site-related chemicals via surface water also occurred when impacted groundwater daylighted in a spring close to the Las Vegas Wash. Las Vegas Wash transports surface water to Lake Mead.

## 8.0 DATA GAPS

The Site has been studied extensively; over 950 wells and boreholes have been drilled in and around the BMI complex to characterize subsurface conditions. Groundwater and surface water impacts have been monitored and evaluated, and remedial actions have been implemented to mitigate chromium and perchlorate impacts.

The following data gaps have been identified:

- 1) **Background Determination.** Although regional information is available, background concentrations of metals and other naturally occurring compounds of concern in soil and groundwater have not been determined for the localized area. This issue is being jointly evaluated by Kerr-McGee and other BMI complex members by development of Background Study Work Plans.
- 2) **Muddy Creek Formation.** The configuration of the fine-grained facies of the Muddy Creek formation in specific areas of the site is not fully known and may affect the groundwater transport pathways and the effectiveness of the groundwater collection systems. This fact will be considered during development of the Work Plan described in item 4 of this Section.
- 3) **Chemicals of Potential Concern.** The potential exists for specific chemicals to pose a threat to human health or the environment, based on the list of Site-related chemicals developed. The nature and extent of impact and the risk posed by specific chemicals has not been fully evaluated, however, it is expected that the remedial actions addressing chromium and perchlorate impacts will also address other chemicals of concern. Development of the Chemicals of Potential Concern will be completed during the Work Plan development process described in item 4 of this Section.
- 4) **Source Area Evaluation.** The Phase I ECA, Phase II ECA and Supplemental Phase II ECA investigations identified sources of potential contamination at the Site. Additional investigation is needed to refine our understanding of the nature and extent of any impacts of source areas at the Site. A Source Area Evaluation Work Plan is under development to address these data gaps and will be submitted to NDEP as a separate document following discussion with NDEP.
- 5) **Data Usability.** The historic data need to be evaluated for their usability for human health and ecological risk assessment purposes. Data quality objectives need to be defined for historic, as well as future, data to ensure that remediation-related decisions



are properly supported. This data usability evaluation is underway and will be submitted to the NDEP as a separate document.

- 6) **Risk Assessment.** The risks posed by the Site to human and ecological receptors both on Site and off Site have not been determined. Following discussion with NDEP a Site Risk Assessment will be prepared, if needed.

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