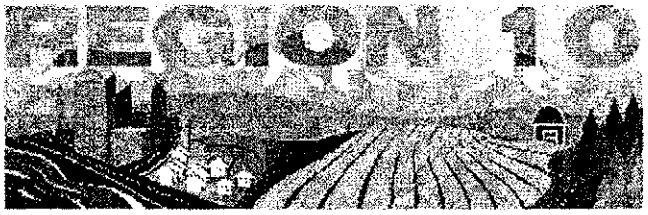
Response Action Contract
Contract No. 68-W-98-228

EPA United States Environmental Protection Agency



Five-Year Review Report

(Third) Five-Year Review
United Chrome Products Site
Corvallis, Oregon
March 2003

URS Greiner
in association with
CH2M HILL
White Shield, Inc.

Five-Year Review Report

(Third) Five-Year Review Report

for

United Chrome Products

ORD009043001

Corvallis

Benton County, Oregon

March 2003

PREPARED BY:

USEPA Region 10
Oregon Operations Office
Portland, Oregon

Approved by: Date: 3/31/03

Michael F. Gearheard

Director, Environmental Cleanup Office

U.S. EPA Region 10

CVO\030520001

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (*from WasteLAN*): United Chrome Products Superfund Site		
EPA ID (*from WasteLAN*): ORD009043001		
Region: 10	**State:** OR	**City/County:** Corvallis/Benton
SITE STATUS		
NPL status: ☒ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☒ Operating ☐ Complete		
Multiple OUs?* ☐ YES ☒ NO	**Construction completion date:** 8 / 15 / 1988	
Has site been put into reuse? ☒ YES ☐ NO Small portion of site redeveloped for propane distribution		
REVIEW STATUS		
Lead agency: ☒ EPA ☐ State ☐ Tribe ☐ Other Federal Agency		
Author name: Alan Goodman		
Author title: Remedial Project Manager	**Author affiliation:** U.S. EPA, Region 10	
Review period:** 12 / 4 / 2002 to 3 / 24 / 2003		
Date(s) of site inspection: 12 / 5 / 2002 and 1 / 11 / 2003		
Type of review: ☐ Post-SARA ☒ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☐ 1 (first) ☐ 2 (second) ☒ 3 (third) ☐ Other (specify)		
Triggering action: ☐ Actual RA On-site Construction at OU #____ ☐ Actual RA Start at OU # NA ☐ Construction Completion ☒ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date (*from WasteLAN*): 3 / 24 / 1998		
Due date (*five years after triggering action date*): 3 / 24 / 2003		

* ["OU" refers to operable unit.]
** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

Although no specific cleanup standard for soil was identified in the ROD, the upper zone remedy is not expected to achieve further chromium concentration reductions in upper zone soil. The levels currently present will prevent the site from achieving an unrestricted use and unrestricted exposure status.

Concerns have been expressed in the past about subsurface soil contamination that might be present beneath the concrete floor of the former United Chrome Products building. Subsurface soil sampling performed beneath the floor during a July 2000 investigation did not reveal the presence of elevated chromium concentrations (*United Chrome – Phase 2 Upper Zone Groundwater Source Investigation Results* (CH2M HILL August 2000).

The deep aquifer remedy was not successful in blocking or controlling the drainage of chromium contaminated pore water from the upper aquitard. Consequently, it is unlikely that the ROD performance standard for deep aquifer groundwater can be achieved, and compliance demonstrated, at two of the eight remaining well locations.

Concerns regarding historical chromium contamination detected in offsite sediments have also been raised.

Recommendations and Follow-up Actions:

Evaluate the hydrogeology and contaminant transport between the soil, upper zone, upper aquitard, and lower aquifer as necessary to understand the causes of the recent groundwater contaminant trends. Based on the results of this evaluation, re-evaluate the clean-up levels and current remedial approach.

Place additional institutional controls for land use restrictions as needed.

Collect data on site-related contamination in the down-gradient drainage ditches and water bodies, and then evaluate the ecological risks posed by these sediments.

Protectiveness Statement(s):

A protectiveness determination of the remedy at the United Chrome Products site cannot be made at this time until further information is obtained. Further information to determine whether the remedy currently protects human health and the environment will be obtained by the data collection and ecological evaluation of the down-gradient drainage ditches and surface water. It is expected that these actions will take six months to complete, at which time a protectiveness determination will be made. The soil and lower aquifer remedy currently protects human health and the environment because the site is fenced and not being used and the area of the lower aquifer with contamination above the chromium MCL is not being used for drinking water. Additional actions described in the recommendations above are needed to ensure long-term protectiveness.

Other Comments:

Contents

Section Page

Executive Summary ES-1

1. Introduction 1-1
   1.1 Objectives 1-1
   1.2 Summary of Work Performed 1-1
1.2.1 Document Review 1-1
1.2.2 Standards Review 1-1
1.2.3 Community Interviews 1-2
1.2.4 Site Inspection1-2
1.2.5 Prepare Five-Year Report 1-2
   1.3 Current Site Status 1-2

2. Site Chronology 2-1

3. Background 3-1
   3.1 Physical Characteristics 3-1
      3.1.1 Location Description 3-1
      3.1.2 Sensitive Habitat 3-1
      3.1.3 Hydrogeology 3-2
      3.1.4 Surface Water Hydrology 3-2
   3.2 Land and Resource Use 3-2
   3.3 History of Contamination 3-3
      3.3.1 Discovery 3-3
   3.4 Initial Response 3-4
   3.5 Basis for Taking Action 3-4
      3.5.1 Public Health and Environmental Impacts 3-4
   3.6 Feasibility Study 3-5

4. Remedial Actions 4-1
   4.1 Remedy Selection 4-1
      4.1.1 ROD Amendments or Explanation of Significant Differences 4-1
      4.1.2 Remedial Action Objectives 4-1
      4.1.3 Remedy Description 4-2
   4.2 Remedy Implementation 4-2
      4.2.1 Phase I Design and Construction 4-3
      4.2.2 Phase II Design and Construction 4-5
      4.2.3 Supplemental Engineering and Institutional Controls 4-6
   4.3 System Description and Operations 4-6
      4.3.1 Groundwater Extraction Wells 4-6
      4.3.2 Infiltration System 4-7

4.3.3 Groundwater Treatment System 4-9
4.3.4 Performance Monitoring Program 4-11
4.4 Responsible Party Lead Actions 4-11
4.5 Operation and Maintenance Costs 4-13

5. Progress Since the Last Five-Year Review 5-1

6. Five-Year Review Process 6-1
6.1 Administrative Components 6-1
6.2 Community Involvement 6-1
6.3 Review of Applicable or Relevant and Appropriate Requirements 6-1
6.4 Document and Data Review 6-2
6.5 Site Inspection 6-2
6.5.2 Site Cover 6-3
6.5.3 Groundwater Remedy 6-3
6.5.4 Onsite Drainage 6-9
6.5.5 Site Safety 6-9
6.6 Community Interviews 6-10
6.6.1 Site Operations Personnel 6-10
6.6.2 Community Organizations 6-10
6.6.3 Mailed Questionnaires 6-11
6.6.4 Local Residents 6-11

7. Technical Assessment 7-1
7.1 Is the Remedy Functioning as Intended? 7-1
7.1.1 Remedial Action Performance 7-1
7.1.2 System Operations 7-3
7.1.3 Implementation of Institutional Controls and Other Measures 7-3
7.1.4 Opportunities for Optimization 7-4
7.1.5 Indicators of Potential Remedy Problems 7-5
7.2 Have the Assumptions on Which the Remedy was Based Changed? 7-6
7.2.1 Changes in Standards and to be Considered 7-6
7.2.2 Changes in Cleanup Levels 7-7
7.2.3 Changes in Exposure Pathways 7-7
7.3 Has Any Other Information Come to Light that Could Effect the Remedy's Protectiveness? 7-8
7.3.1 DEQ Recommendations 7-9
7.4 Technical Assessment Summary 7-10

8. Issues 8-1

9. Recommendations and Follow-up Actions 9-1

10. Protectiveness Statement 10-1

11. Next Review **11-1**

12. References **12-1**

Appendices

A Site Interview and Inspection Summary
B Upper Zone Groundwater Pumping Data
C Deep Aquifer Groundwater Pumping Data
D United Chrome Deed Restriction

Tables

2-1 Site Chronology 2-1
3-1 Feasibility Study Alternatives Summary 3-5
4-1 Treatment System Improvements 4-14
4-2 Upper Zone Remedial Action Monitoring and Reporting Schedule 4-15
4-3 Deep Aquifer Remedial Action Monitoring and Reporting Schedule 4-16
4-4 Well Abandonment History 4-17
5-1 Status of Recommendations Provided in Second Five-Year Review 5-2
6-1 United Chrome Well Inventory – January 2003 6-6
7-1 Comparison of Annual O&M Costs 7-4
7-2 Comparison of Groundwater and Soil Cleanup Levels 7-7
8-1 Issues Potentially Affecting Remedy's Current or Future Protectiveness 8-1

Figures

3-1 Vicinity Map
3-2 Site Plan in 1992
3-3 Generalized Hydrogeologic Cross-section
3-4 Initial Distribution of Cr(VI) in Upper Zone and Deep Aquifer
4-1 Upper Zone Groundwater Extraction and Monitoring Well Network
4-2 Upper Zone Extraction Well Installation Detail
4-3 General Operations Data
4-4 Deep Aquifer Groundwater Extraction and Monitor Well Network
4-5 Groundwater Treatment System
4-6 General Treatment System Operations Data
6-1 Site Plan – December 2002
7-1 Chromium Plume Boundary Changes in Upper Zone Groundwater – 1988, 1993, 1998, and 2002
7-2a Upper Zone Groundwater Chromium Concentration Trends
7-2b Upper Zone Groundwater Chromium Concentration Trends
7-3 Chromium Plume Boundary Changes in Deep Aquifer Groundwater – 1991, 1993, 1998, and 2002
7-4 Areas of Upper Zone Soil with Chromium Concentrations Greater than 1.0E-06 Protective Level for Residential Exposure
7-5 Deep Aquifer Groundwater Chromium Concentration Trends

Acronyms and Abbreviations

aka	Also known as
ARARs	Applicable or relevant and appropriate requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information Systems
CIC	Community Involvement Coordinator
City	City of Corvallis
DEQ	Oregon Department of Environmental Quality
DW	Extraction Well (deep aquifer)
ESD	Explanation of Significant Difference
EW	Extraction Well (upper zone)
FAA	Federal Aviation Administration
FS	Feasibility study
gpm	gallon per minute
HDPE	high-density polyethylene
HSP	Health and Safety Plan
Kg	Kilogram
L	Liter
LTRA	Long-term Remedial Action
MCL	Maximum Contaminant Level
mg	Milligram
MSDS	Materials Safety Data Sheet
MW	Monitor Well
NPL	National Priorities List
O&M	Operation and Maintenance

OAR	Oregon Administrative Rules
ORS	Oregon Revised Statutes
OWRD	Oregon Water Resources Department
PCOR	Preliminary Closeout Report
POTW	publicly owned treatment works
PPE	personal protective equipment
PRG	Preliminary Remedial Goal
PVC	Polyvinyl Chloride
PZ	Piezometer
RAC	Remedial Action Contract
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of decision
RP	Responsible Party
RPM	Remedial Project Manager
SARA	Superfund Amendment and Reauthorization Act
SSC	site safety coordinator
SPLP	Synthetic Precipitation Leaching Procedure
TCLP	Toxicity Characteristic Leaching Procedure
USEPA or EPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

Executive Summary

This report presents the findings of the third five-year review performed for the United Chrome Products Superfund site located in Corvallis, Oregon. The five-year review was performed to confirm that immediate threats to human health and the environment have been addressed through implementation of the selected remedy.

The five-year review, which was conducted in accordance with the *Comprehensive Five-year Review Guidance* (U.S. Environmental Protection Agency, June 2001), included the following activities:

- Review of changes to Federal, State and local regulations that could affect the remedy's overall protectiveness with respect to the performance standards specified in the Record of Decision.
- A site inspection to confirm that the remedy is operating and being maintained in accordance with expectations.
- Interviews with community representatives and local residents to obtain an independent appraisal of the cleanup effort and to identify any remaining concerns associated with the site.
- Review of performance monitoring data to determine compliance with the groundwater performance standards specified in the Record of Decision and to assess current and long-term protectiveness.

This five-year review has concluded that a protectiveness determination of the remedy at United Chrome cannot be made at this time until further information is obtained. The soil and lower aquifer remedy currently protects human health and the environment because the site is fenced and not being used and the area of the lower aquifer with contamination above the MCL is not being used for drinking water. Additional actions described in the recommendations in Section 8 are needed to ensure long-term protectiveness.

Based on the long-term protectiveness findings, it is recommended that the remedy and groundwater cleanup goals specified in the Record of Decision be re-evaluated in light of the current understanding of subsurface conditions, and expectations for future site land and groundwater beneficial uses. To determine if chromium contamination detected in historical sediment samples poses a risk to ecological resources, it is recommended that the results of surface water and sediment sampling recently completed by the responsible party be reviewed against potentially applicable standards.

1. Introduction

1. Introduction

The United States Environmental Protection Agency (EPA) Region 10 has conducted a five-year review of completed and ongoing remedial action at the United Chrome Products Superfund site (United Chrome or the site) in Corvallis, Oregon, as required under §121 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This five-year review, which is the third conducted for the site, was triggered by the March 24, 1998, signature date for the second five-year review. This five-year review has been identified as a policy review because the Record of Decision (ROD) for the site was signed on September 12, 1986, approximately one month prior to promulgation of the Superfund Amendment and Reauthorization Act (SARA).

1.1 Objectives

The primary objective for this five-year review is to confirm that immediate threats to human health and the environment have been addressed through implementation of the selected remedy. Since the site's long-term remedial actions are ongoing, the five-year review also evaluated specific elements of the remedy to verify that construction and operation are performing in accordance with expectations.

1.2 Summary of Work Performed

The five-year review was conducted between December 4, 2002, and February 24, 2003, by CH2M HILL in accordance with EPA Work Assignment # 102-FR-FE-1032. A majority of this work was performed by CH2M HILL's site manager, who has been involved in the project for 15 years, initially as a hydrogeologist and for the last 10 years as the site manager. CH2M HILL's work was reviewed by Alan Goodman, EPA's Remedial Project Manager (RPM) for United Chrome. Specific tasks related to the acquisition of information presented in subsequent chapters of this report are described in the following subsections.

1.2.1 Document Review

Because of the site manager's familiarity with United Chrome's historical record, no document review was needed for this five-year review effort.

1.2.2 Standards Review

The purpose for this task was to research and identify changes in applicable or relevant and appropriate requirements (ARARs), promulgated since the ROD was signed, that might effect the overall protectiveness of the remedy. Regulation changes were identified through reviews of the Federal Register, Oregon Revised Statues (ORS), Oregon Administrative Rules (OAR) and City of Corvallis and Benton County information.

1.2.3 Community Interviews

CH2M HILL interviewed a number of individuals with historical involvement at the site. These individuals included the current site operations and maintenance manager, the City of Corvallis Airport Manager (the United Chrome site lies within the airport complex), the Corvallis - Benton County Economic Development Council Manager, the Deputy Administrator for the Benton County Health Department, and several residents living within a 1.5-mile radius of the site. CH2M HILL also mailed questionnaires to individuals on the current United Chrome mailing list with no media or local government affiliation. The interview findings were documented in the *Site Inspection and Interview Report* (CH2M HILL Memorandum, January 29, 2003) included as Appendix A to this report.

1.2.4 Site Inspection

The purpose of this task was to conduct a technical compliance inspection focusing on those elements of the remedy necessary to protect human health and the environment. The inspection considered operator safety, the groundwater extraction system, fencing, cover integrity, current as-built conditions, and institutional controls. Field observations were recorded on an inspection form obtained from the *Comprehensive Five-Year Review Guidance* (EPA, June 2001). The site inspection was designed to complement a prior comprehensive inspection completed in 1999 and documented in the *United Chrome Site Inspection* (CH2M HILL Memorandum, July 30, 1999).

1.2.5 Prepare Five-Year Report

This task included activities related to the preparation of the five-year review report, which documents how the implemented remedy protects human health and the environment. The five-year review report was generally organized in accordance with the format provided in Appendix E of the *Comprehensive Five-Year Review Guidance* (EPA, June 2001).

1.3 Current Site Status

United Chrome is the site of an ongoing, long-term remedial action (LTRA). The site remedy initially included groundwater pumping from 23 shallow wells and seven deep wells, and flushing of chromium-contaminated soil using two shallow infiltration basins. Extracted groundwater was pumped to an onsite chemical reduction and precipitation treatment system to convert soluble hexavalent chromium (Cr^{+6}) to insoluble trivalent chromium (Cr^{+3}) in a dry solid form. Solid-phase trivalent chromium was accumulated onsite in a roll-off box and transported every 90 days to the Chemical Waste Management facility in Arlington, Oregon.

The groundwater remedial action was initiated on August 15, 1988. Except for part-time operation during the startup phase, temporary shutdowns for cold weather, and a recent soil removal action, the system has operated continuously, logging 107,502 hours of operation for an overall efficiency of 85 percent. During this time, 32,004 pounds of chromium have been recovered from 78.7 million gallons of extracted groundwater.

The City of Corvallis, the responsible party (RP), has maintained full responsibility for operation of the groundwater extraction and treatment system, performance monitoring, and preparation of remedial action progress reports.

The remedial action has been highly successful and is currently in the final stages of operation. ROD performance standards have been achieved at all but three of the 30 extraction well locations, and at all 51 monitor well locations. EPA is currently reevaluating the appropriateness of site cleanup goals and will determine whether changes are warranted based on expectations for the site's future land and groundwater beneficial uses.

2. Site Chronology

2. Site Chronology

This chapter provides a chronology (Table 2-1) of events related to the site's discovery, contamination history, and overall cleanup.

TABLE 2-1
Site Chronology
United Chrome Products, Corvallis, OR

Activity	Start Date	End Date
United Chrome Products begins operations	1956	1985
Discovery	07/01/1979	-
Hazard Ranking Site (HRS) Assessment (Score = 31.7) and Site Inspection	06/27/1983	-
Proposed to National Priorities List (NPL)	09/09/1983	-
Final NPL Listing and Preliminary Assessment	09/21/1984	-
Remedial Investigation and Feasibility (RI/FS) Work Plan Approved	-	09/30/1984
Removal	07/02/1985	11/06/1985
Community Involvement	07/08/1985	08/28/1985
Remedial Investigation	03/11/1984	11/26/1985
Feasibility Study	11/1984	08/19/1985
Technical Assistance	04/19/1985	09/12/1986
Record of Decision	-	09/12/1986
Design Assistance	07/11/1985	09/11/1987
Remedial Design and Construction	02/04/1987	09/11/1987
Begin Upper Zone Groundwater Extraction and Treatment	08/15/1988	Ongoing
Administrative Order on Consent	-	08/07/1989
Removal Assessment	-	09/10/1990
Install Stage 1 and Stage 2 Deep Aquifer Monitor and Extraction Wells	09/01/1989	07/01/1990
Design and Construction of Surface Water Drainage Bypass Ditch Around the Site	09/1/1989	02/28/1990
Remedial Design/Remedial Action (RD/RA) Negotiations	03/05/1991	03/05/1991
NPL Responsible Party (RP) Search	11/29/1990	03/05/1991
Removal Assessment	-	07/24/1991
Explanation of Significant Differences	-	12/17/1991
Preliminary Closeout Report	-	12/19/1991
Consent Decree Negotiations and Section 107 Litigation	06/14/1992	09/21/1992
Lodging of Consent Decree by US District Court	-	06/29/1992
First Five-year Review	-	11/30/1992
Initiate Deep Aquifer Groundwater Extraction	08/15/1991	Ongoing
Deep Aquifer Groundwater Performance Standard Revised from	-	07/30/1992

TABLE 2-1
Site Chronology
United Chrome Products, Corvallis, OR

Activity	Start Date	End Date
0.05 mg/L to 0.1 mg/L		
Removal Assessment	11/26/1993	11/26/1993
Management Assistance	08/01/1992	06/30/1996
Second Five-Year Review	-	03/24/1998
Phase 1 Upper Zone Groundwater Source Investigation	05/01/1998	10/15/1998
Phase 2 Upper Zone Groundwater Source Investigation	07/01/2000	08/28/2000
Upper Zone Soil Remedial Action Design Criteria Report	08/01/2000	08/31/2000
DEQ Human Health and Ecological Risk Screening	11/30/2001	08/20/2002
PRP Lead Activities		
Install Upper Zone Infiltration Trench	04/06/1990	06/30/1990
Local Pretreatment Limits Development (7-pound per discharge of partially (reduced) treated groundwater)	07/15/1991	01/01/1992
Discontinue Partially (Reduced) Treatment	02/03/1994	11/28/1994
Clean Chromium Contaminated Sediment from Onsite Culvert and Plug with Concrete	07/01/1991	10/01/1991
Abandon Upper Zone Wells EW-1, PL-2, PL-3, PL-4, PL-5, BG-2, MW-2A and Deep Aquifer Well DW-7. Convert Deep Aquifer Wells DW-9 and DW-10 from Injection to Extraction Wells.	06/01/1996	06/30/1996
Abandon Upper Zone Wells EW-19, EW-22, EW-24, EW-25, EW-26, SW-3, PZ-A, PZ-C and PZ-E.	05/01/1997	05/31/1997
Abandon Upper Zone Wells SW-2A and SW-4, and Deep Aquifer Wells DW-3A, DW-6 and DW-19	05/01/1998	05/31/1998
Abandon Upper Zone Wells EW-8, EW-28 and EW-29, and decommission Infiltration Basins 1 and 2 in Conjunction with Upper Zone Soil Removal.	08/15/2000	08/31/2000
Treatment Infrastructure Removed and Building Decommissioned	03/15/1999	04/15/1999
Upper Zone Soil Removal Action Work Plan Approved	-	09/13/2000
Upper Zone Soil Removal Project (1956 tons of Soil Excavated and Transported to Chemical Waste Management, Arlington, Oregon for Stabilization and Disposal)	09/11/2000	10/04/2000
Upper Zone Soil Removal Construction Report	-	01/15/2001
Abandon Upper Zone Wells EW-17, EW-18, EW-20, EW-21, BG-1, MW-1, PL-1, PZ-D, PZ-F and Deep Aquifer Wells DW-11, DW-14, DW-16 and DW-17.	06/01/2001	06/15/2001
Person-Down Alarm Discontinued due to Site Risk Reduction	-	01/31/2003

References:

1. CERCLIS United Chrome Products Site, Corvallis, Oregon. United Chrome Products Region 10 Superfund Home Page.
2. CH2M HILL Files.
3. City of Corvallis Public Works Wastewater Treatment Plant Files.

3. Background

3. Background

This chapter presents a brief overview of the United Chrome site's physical characteristics, discovery and contamination history, and investigations leading up to the understanding of site conditions as documented in the remedial investigation and feasibility study (RI/FS) report. The purpose of this chapter is to identify the threat posed to the public and the environment at the time of the ROD. New information obtained through the course of subsequent design investigations and LTRA operations, with the potential to effect the remedy's overall protectiveness, is presented in the Technical Assessment provided in Chapter 7 of this document.

3.1 Physical Characteristics

This section describes the United Chrome site's physical characteristics including geographic information, a description of the hydrogeologic strata underlying the site, and a description of surface water drainages hydraulically connected with the site's shallow groundwater flow system.

3.1.1 Location Description

The United Chrome site is a former industrial hard-chrome plating facility located at 2000 Airport Place (a.k.a. Ingalls St), in the Airport and Industrial Research Park (airport complex), approximately 3.5 miles south of Corvallis, Oregon (Figure 3-1). The 1.5-acre site is relatively flat, with an average ground surface elevation of 240 feet mean sea level (msl).

The site (Figure 3-2) is bounded by a City of Corvallis Airport runway and taxiway to the south and west; agricultural land, the bypass ditch, and CoEnergy (propane distributor) to the north; undeveloped property, airplane hangars, and Bertea Aviation to the east; and Ferrill Gas (propane distributor) to the south. The United Chrome site and all contiguous properties are owned by the City of Corvallis.

The site is situated in a sparsely populated section of Benton County, at the southern limits of the City of Corvallis' urban growth boundary. Benton County is located in the heart of the Willamette Valley in west-central Oregon. With approximately 78,000 residents, Benton County is the 11th largest county, in terms of population, in Oregon. The residential area nearest to the United Chrome site is located approximately 4,400 feet to the northeast alongside and east of State Highway 99W. There are approximately 50 homes in this area, all of which obtain their water from private wells.

3.1.2 Sensitive Habitat

Three national wildlife refuges - Ankeny, Baskett Slough and William L. Finley - are located within 5 miles of the United Chrome site. These refuges include a variety of wildlife habitats such as wetlands, prairies, riparian and upland forests, and cultivated farmlands. The refuges provide important wintering habitat for the dusky Canada goose, a species of concern within the Pacific Flyway, and six other subspecies of Canada geese. Several

endangered plants and the endangered Fender's blue butterfly also occur within the refuge boundaries. According to U.S. Fish and Wildlife Service (USFWS) information, the refuges receive about 180,000 visitors a year.

Although site soils and vegetation may exhibit one or more characteristics typical of a wetland, the United Chrome property was not identified as a wetland through the recently completed Oregon Division of Lands Local Wetland Inventory (National Wetland Inventory, Wetlands and Hydric Soils, Southern Corvallis, 2000). Recent mapping (Corvallis General Flood Hazard Map, 2000) also shows that the United Chrome site lies above the 100-year floodplain.

3.1.3 Hydrogeology

The hydrogeology beneath the United Chrome site is characterized by two water-bearing zones separated by an aquitard. The uppermost water-bearing zone (upper zone), which occurs at depths between ground surface and 20 feet, is comprised of silt and fine sand. Beneath the upper zone is the upper aquitard, a layer of stiff, silty clay varying in thickness from 1.5 to 5.5 feet. Beneath the upper aquitard is the lower water-bearing zone (deep aquifer), which occurs at depths of approximately 25 feet to 45 feet beneath the site, extending to a depth of 75 feet to the northeast (Figure 3-3). The deep aquifer is comprised of sand and silt-cemented gravel capable of supplying water for domestic, commercial, and industrial uses. Because of its low permeability and variable saturated thickness, there are no recognized beneficial uses for upper zone groundwater other than deep aquifer recharge.

Horizontal groundwater flow velocities in the upper zone are approximately 9 feet per year and 44 feet per year in the deep aquifer. Groundwater also flows vertically down from the upper zone to the deep aquifer at a rate of 11 feet per year. Groundwater in both zones flows in a northeasterly direction, ultimately discharging to the Willamette River about 2 miles away.

3.1.4 Surface Water Hydrology

In late 1989, a bypass ditch was constructed around the northern perimeter of the United Chrome site to isolate it hydraulically from the surface drainage network. Most onsite surface water now infiltrates down through the soil column to the upper zone.

Prior to construction of the bypass ditch, surface water runoff drained overland to shallow drainage ditches bordering the west and north site boundaries. Runoff from these drainage ditches discharged to a deep culvert passing beneath the site (see Figure 3-2). From this culvert, surface water flowed east to Airport Place and then north to Airport Avenue (a.k.a. Airport Road). The ditch parallels Airport Avenue for approximately 0.5-mile before flowing southeast beneath the railroad tracks and State Highway 99W where it discharges to Dry Creek. Dry Creek flows northeast for approximately 1,500 feet where it converges with the West Fork of the Booneville Slough. The Booneville Slough eventually merges with the Willamette River, which is a primary source of drinking water for the City of Corvallis.

3.2 Land and Resource Use

The land surrounding the United Chrome site currently supports agricultural (non-food grass seed), aviation, and light industrial use. The site is zoned under the City of Corvallis Comprehensive Land Use Plan as general industrial. According to the airport master plan (personal communication, January 11, 2003) this portion of the airport property has been designated as a fuel farm. After the cleanup has been completed, Ferrill Gas is expected to relocate their propane fueling station inside the United Chrome site fence.

With respect to current groundwater use, there are no known groundwater users within 0.5-mile of the site. The nearest residential drinking water wells are located approximately 4,400 feet northeast alongside and east of State Highway 99. It is estimated there are 50 wells in this area. The City also has two inactive water supply wells in the area. The nearest well, identified as CW-3, is located approximately 700 feet northeast of the site, and a second well approximately 3000 feet northeast. Although the wells are still in place, the pumps and wellhead piping have been removed.

Under Oregon Revised Statute (ORS) 536.340 and Oregon Administrative Rule (OAR) 690-500 to 520, the Oregon Water Resources Department (OWRD) may classify groundwater resources for current and future specific uses. The United Chrome site lies within the Mid-Willamette Basin, and as such, groundwater has been designated to support a broad array of uses including drinking. In conjunction with the requirements of a consent decree, (Civil Action No. 92-6232-H0, October 14, 1992), the City established a 1,250-foot by 1,250-foot groundwater pumping exclusion zone around the site. This institutional control prevents installation of any new wells within this designated area.

The Willamette River is a primary drinking water source for the City of Corvallis and supports warmwater fish, such as large mouth and small mouth bass, crappie, bluegill, catfish, and carp. The Willamette River also supports anadromous fish passage, which include Chinook salmon and steelhead trout.

3.3 History of Contamination

United Chrome Products leased the property from the City and began electroplating operations at the site in 1956. In the same year, the operators constructed a dry well disposal pit outside the southwest building corner. Between 1956 and 1975, the dry well disposal pit was reportedly used to dispose of floor drippings, washings, and product rinsate collected within a building sump. Quantities of waste disposed in this manner are unknown, but were estimated by the facility operator to be approximately 1,000 gallons per year. Other probable sources of contamination include leakage from the two plating tanks inside the building, and spillage from the acid and caustic storage tanks maintained outside the building, north of the dry well. United Chrome Products ceased operations in early 1985 and sold the equipment and building contents in May 1985.

3.3.1 Discovery

Contamination at the United Chrome Products site was initially discovered during Oregon Department of Environmental Quality (DEQ) Resource Conservation and Recovery Act

(RCRA) compliance inspections. These inspections resulted in subsequent surface water and sediment sampling by DEQ staff beginning in November 1982. Based on the results of this sampling, the site was referred to EPA for a Hazard Ranking Site Assessment in 1983, which yielded a score of 31.7 and eventual placement on the EPA National Priorities List (NPL).

3.4 Initial Response

Accumulated sludges from the two plating tanks were removed from the site in 1982 and disposed under DEQ guidelines. In 1983, following two DEQ Notices of Violation, United Chrome Products removed chromium sludge from the disposal pit area and placed it in drums that were later disposed of at a RCRA-permitted land disposal facility. EPA placed the site on the NPL on September 21, 1984, because of suspected surface water, soil, and groundwater contamination. EPA also conducted a removal action at the site from July to November 1985 that included removal of 8,130 gallons of chromium-contaminated liquid from tanks and containers, and 11,000 pounds of chromium-contaminated soil.

3.5 Basis for Taking Action

A CERCLA Remedial Investigation (RI) and Feasibility Study (FS) was completed in August 1985 by CH2M HILL and Ecology & Environment, Inc. Because the facility was still active during the RI, contamination beneath the facility building was not characterized. The RI confirmed that high levels of chromium were present in soil and groundwater, and in surface water and sediment downstream of the site.

Soil in the vicinity of the dry well had the highest levels of chromium observed onsite. Concentrations ranged from a high of 200,900 milligrams per kilogram (mg/kg) at the surface to 29,500 mg/kg at a depth of 12 to 15 feet below ground surface (bgs). At other soil sampling locations around the building, but away from the dry well, chromium levels were significantly lower, with a maximum observed concentration of 1,680 mg/kg at the surface and 1,350 mg/kg at a depth of 20 feet.

Groundwater samples collected from the upper zone revealed a plume extending approximately 400 feet northwest (downgradient) from the dry well with chromium concentrations ranging between 142 and 689 milligrams per liter (mg/L). Samples from the deep aquifer revealed a plume 400 feet in length with chromium concentrations between 0.7 and 6.5 mg/L (Figure 3-4).

Surface water samples collected from nearby drainage ditches and locations downstream of United Chrome revealed chromium concentrations between 0.08 and 4.3 mg/L. Sediment samples showed chromium concentrations between 48 mg/kg and 27,900 mg/kg. Chromium was detected in the surface water (0.08 mg/L) and sediment sample (52 mg/kg) collected from the Booneville Slough location.

3.5.1 Public Health and Environmental Impacts

Although a baseline risk assessment was not conducted for the RI, laboratory testing revealed chromium concentrations in groundwater at levels approximately 10,000 times higher than the 0.05 mg/L drinking water standard. Surface water samples revealed

chromium concentrations approximately 400 times higher than the chronic freshwater ambient water quality criteria of 0.011 mg/L. Accordingly, the principal threat posed by site conditions was offsite chromium migration, ingestion of contaminated groundwater by residents living northeast of the site, and adsorption of chromium present in surface water and sediment by ecological receptors.

3.6 Feasibility Study

The FS developed an array of technologies to address soil and groundwater contamination at the site by screening commercially available technologies and assembling the technologies into 12 remedial action alternatives. The twelve alternatives were subjected to an initial screening that considered technical feasibility, environmental and public health impacts, and cost, to eliminate the least suitable alternatives and narrow the list of potential remedial actions for further detailed analysis. From the list of 12, seven alternatives were carried forward (Table 3-1) for more detailed evaluation. From this list, alternative 5 was initially proposed, but based on DEQ and community feedback, alternative 12 was selected.

TABLE 3-1
Feasibility Study Alternatives Summary
United Chrome Products, Corvallis, OR

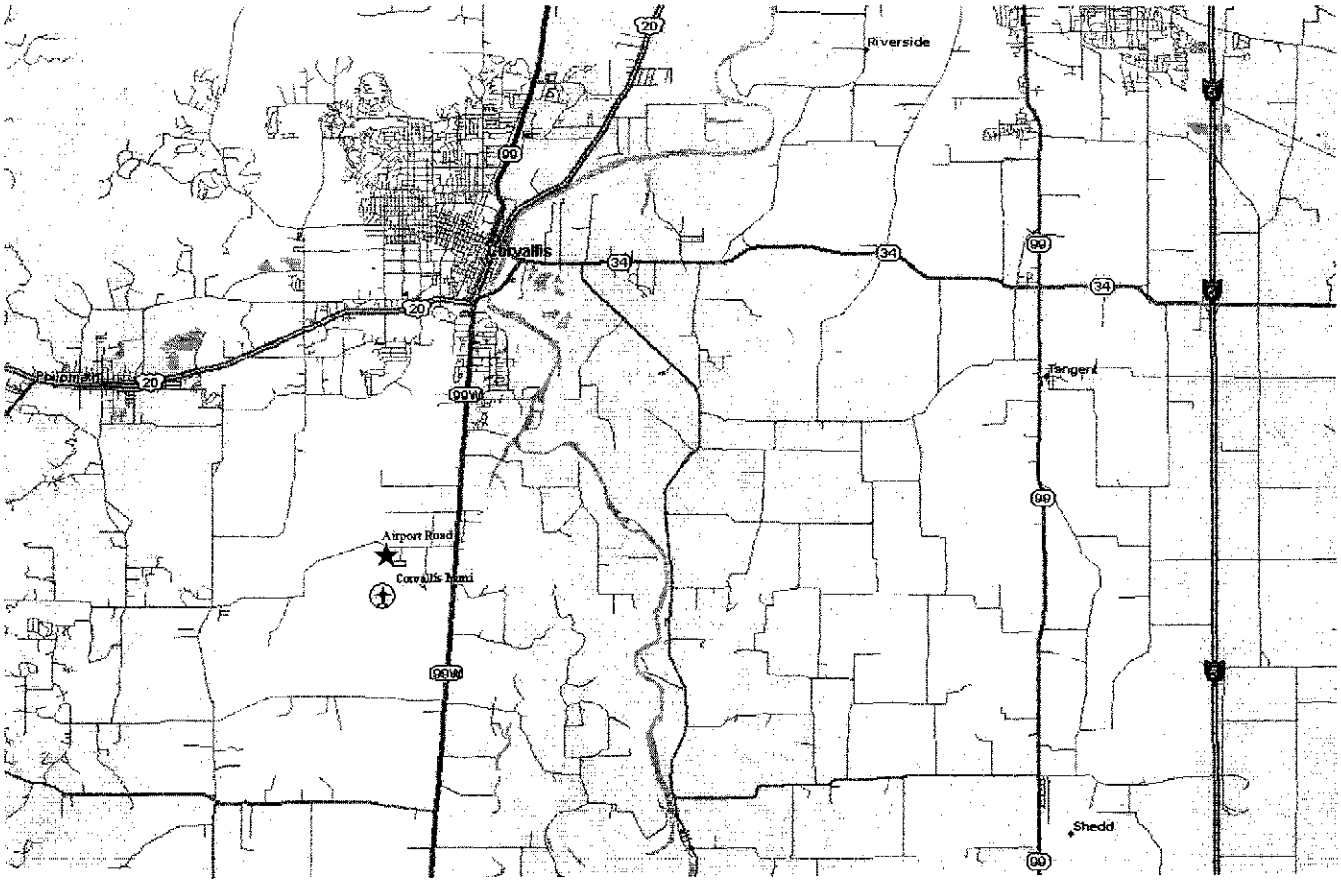
No.	Description	Capital Cost	Annual O&M Cost	Present Worth Cost – 1987	Implementation Time (1)
1	No Action	$0	$	$0	Not Applicable
2	Alternative Water Supply	$172,000	None	$172,000	Not Applicable
3	Soil Excavation	$599,000	None	$599,000	1 yr.
4	Upper Zone Groundwater Extraction	$929,000	$168,000	$1,745,000	7 yr.
5	Soil Flushing and Upper Zone Groundwater Extraction	$1,063,000	$168,000	$1,699,000	5 yr.
6	Soil Excavation and Alternate Water Supply	NS	NS	$800,000	NS
7	Deep Aquifer Groundwater Extraction	NS	NS	$2,000,000	NS
8	Soil Excavation and Deep Aquifer Groundwater Extraction	NS	NS	$2,500,000	NS
9	Upper Zone Groundwater Extraction and alternate Water Supply	NS	NS	$2,300,000	NS
10	Upper Zone and Deep Aquifer Groundwater Extraction	$1,452,000	$261,000	$2,724,000	7 yr.
11	Soil Flushing, Upper Zone Groundwater Extraction and Alternate Water Supply	NS	NS	$1,900,000	NS
12	Soil Flushing and Upper Zone and Deep Aquifer Groundwater Extraction	$1,580,000	$261,000	$2,570,000	5 yr.

Notes:

(1) Implementation time from O&M cost estimate duration.

(2) NS = not specified in FS.

Shaded cells indicate alternatives eliminated by initial screening.



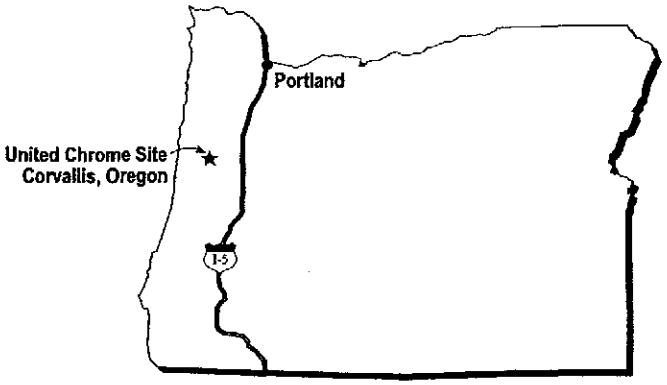
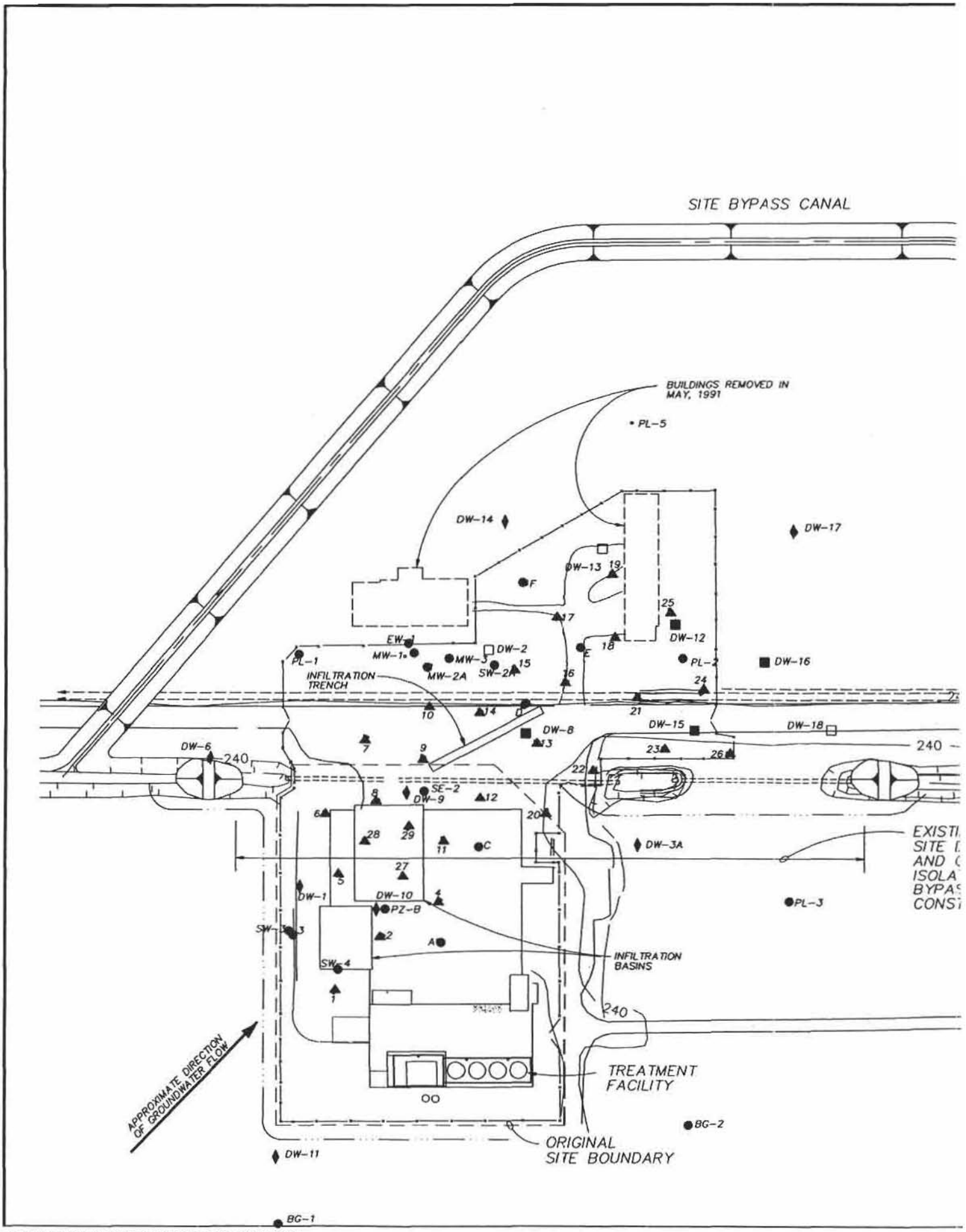


Figure 3-1
Vicinity Map
United Chrome Products
Corvallis, Oregon

CH2MHILL



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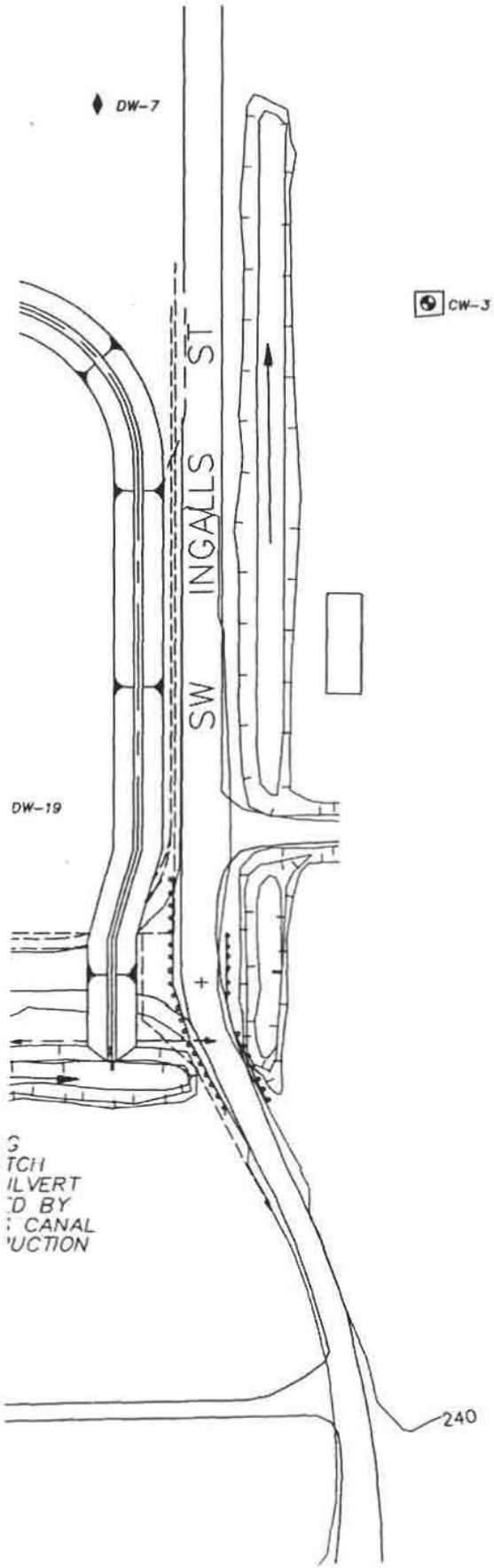


LEGEND:

EXISTING DEEP AQUIFER WELLS

◉	CW-3	MONITORING WELLS (CITY WELLS)
♦	DW-1	MONITORING WELLS
■	DW-1	ACTIVE EXTRACTION WELL
□	DW-1	INACTIVE EXTRACTION WELL

EXISTING UPPER ZONE WELLS

▲	EW-3	EXTRACTION WELLS
●	PIEZO-B	MONITORING WELLS
●	MW-1	MONITORING WELLS
●	PL-3	MONITORING WELLS
●	BG-2	MONITORING WELLS

ESTIMATED EXTENT OF UPPER ZONE GROUNDWATER CHROMIUM CONTAMINATION

ESTIMATED EXTENT OF DEEP AQUIFER GROUNDWATER CHROMIUM CONTAMINATION

0 50 100 150 200

SCALE: FEET

N

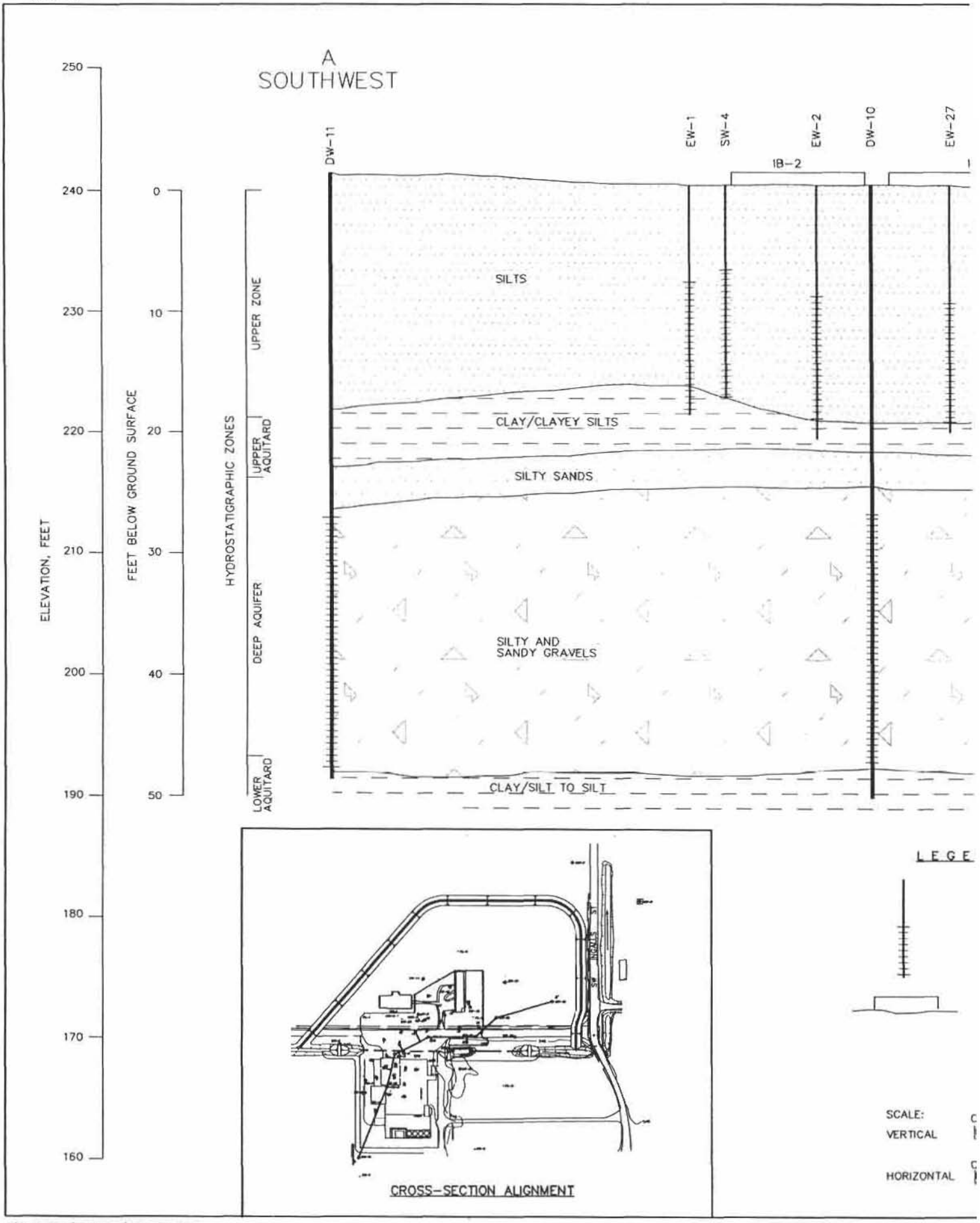
FIGURE 3-2

SITE PLAN IN 1992

UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

CH2M HILL

09-24-90



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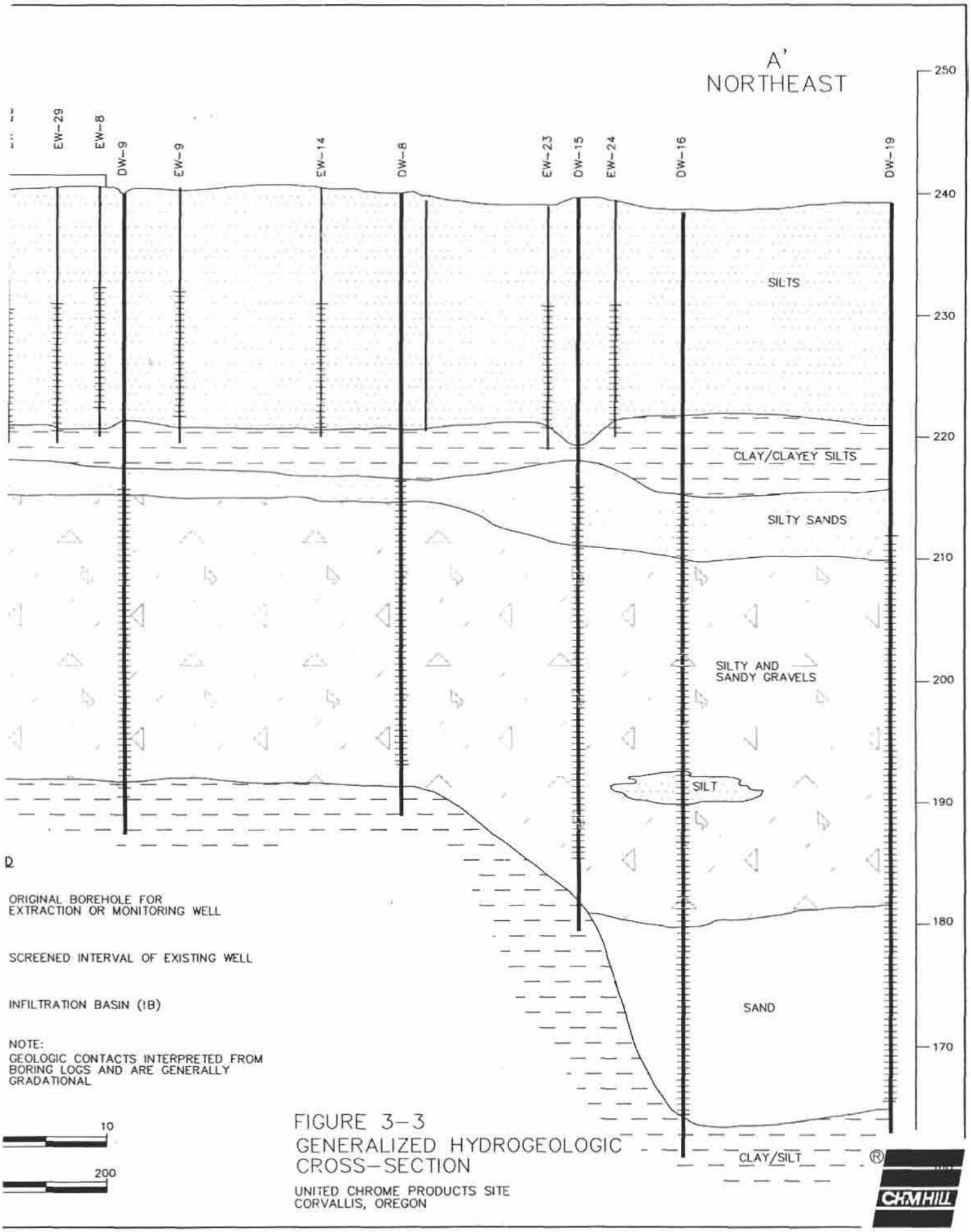
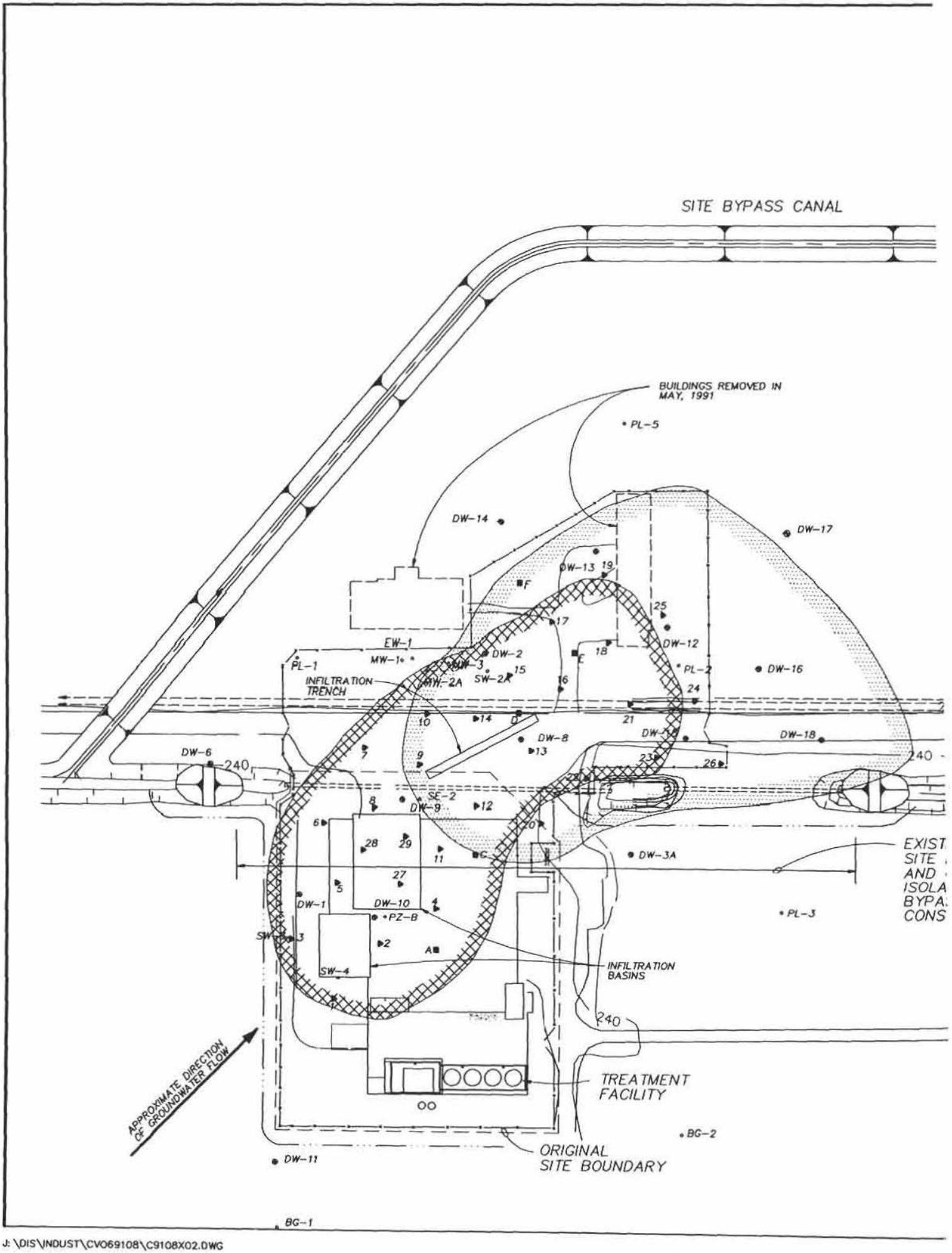


FIGURE 3-3
GENERALIZED HYDROGEOLOGIC
CROSS-SECTION

UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON



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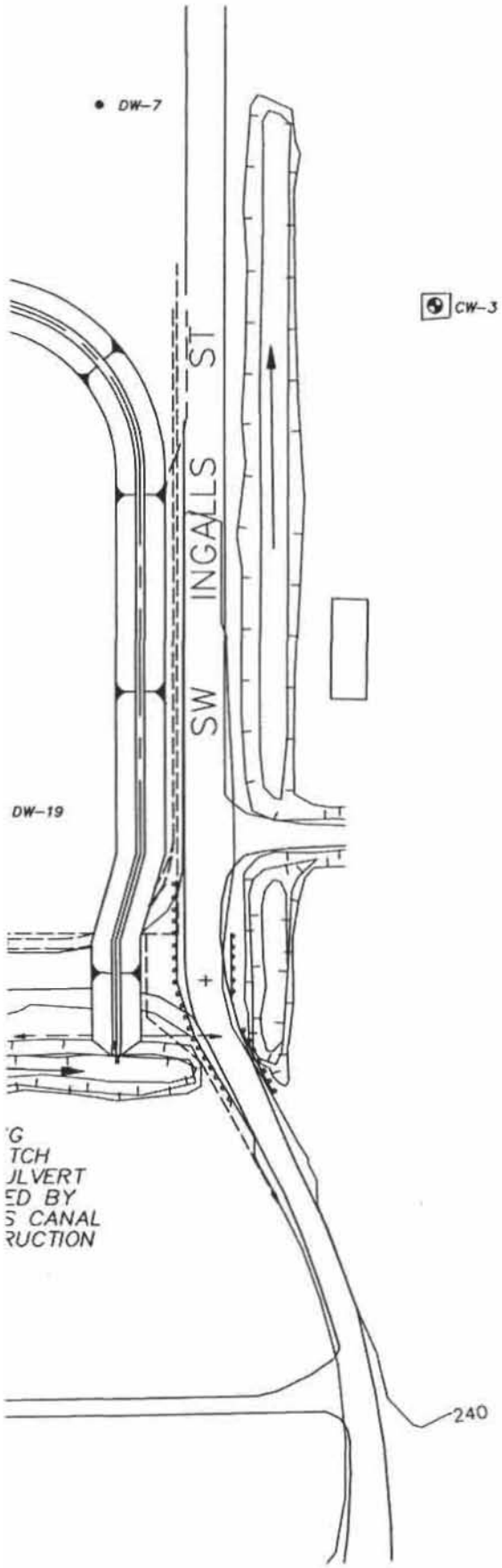


LEGEND:

EXISTING DEEP AQUIFER WELLS

	CW-3	MONITORING WELLS (CITY WELLS)
	DW-1	EXTRACTION/MONITORING WELLS

EXISTING UPPER ZONE WELLS

	PIEZO-B	MONITORING WELLS
	EW-3	EXTRACTION WELLS
	MW-1	MONITORING WELLS
	PL-3	MONITORING WELLS
	BG-2	MONITORING WELLS

ESTIMATED EXTENT OF UPPER ZONE GROUNDWATER CHROMIUM CONTAMINATION

ESTIMATED EXTENT OF DEEP AQUIFER GROUNDWATER CHROMIUM CONTAMINATION

0 50 100 150 200

SCALE: FEET

N

FIGURE 3-4

INITIAL DISTRIBUTION OF Cr(Vi) IN UPPER ZONE AND DEEP AQUIFER

UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

CH2M HILL

4. Remedial Actions

4. Remedial Actions

This chapter discusses implementation of the United Chrome remedy beginning with the description presented in the ROD and continuing through design, construction, and remedial action.

4.1 Remedy Selection

The ROD is the regulatory instrument EPA uses to select a remedy to address risk to human health and the environment posed by hazardous substances, such as the chromium-contaminated soil and groundwater present at the United Chrome Products site. The United Chrome ROD was signed on September 12, 1986, by the EPA Region 10 Regional Administrator.

4.1.1 ROD Amendments or Explanation of Significant Differences

No ROD amendments have been prepared to date. An Explanation of Significant Differences (ESD) was completed on December 17, 1991.

4.1.2 Remedial Action Objectives

Three primary public health and environmental objectives were developed (ROD, EPA 1986) for the United Chrome site:

- Adequately protect the public against contact with and ingestion of contaminated groundwater.
- Minimize threats from and adequately protect the environment against the spread of contaminated groundwater.
- Adequately protect the public against contact with and ingestion of contaminated soil and sediments.

The purpose for remedial action at the United Chrome site, as described in the ROD, was to:

> *"remove contamination from the confined zone (deep aquifer) and control further migration of contamination from the upper unconfined zone (upper zone)."*

The ROD states further that:

> *"The cleanup criteria for the confined aquifer (deep aquifer) is 0.05 mg/L chromium, the drinking water standard, because this aquifer is considered a drinking water source and in direct hydraulic connection with the local drinking water supply wells. The cleanup criteria for the unconfined zone (upper zone) is 10 mg/L chromium. This concentration represents the minimum cleanup required to protect the local drinking water supply. The drinking water standard of 0.05 mg/L was not used because the unconfined zone (upper zone) is not used as a drinking water source anywhere in the area and because the present level of contamination would likely make it technologically or economically infeasible to achieve this standard."*

4.1.3 Remedy Description

The major components of the selected remedy described in the ROD included:

1. Installation of approximately 15 shallow wells (15 to 20 feet) to extract chromium-contaminated groundwater from the upper (unconfined) zone.
2. Installation of approximately five deep wells (35 to 40 feet) to extract chromium-contaminated groundwater from the deep (confined) aquifer.
3. Installation of onsite treatment equipment (chemical reduction and precipitation) to remove chromium contamination from extracted groundwater prior to discharge to Muddy Creek or the City of Corvallis wastewater treatment facility.
4. Construction of two percolation basins in the areas of the former dry well and plating tanks to flush the contaminated soil above the shallow groundwater table. Approximately 350 tons of contaminated soil excavated during the construction of these basins was to be disposed at a permitted land disposal facility.
5. Installation of culverts in the adjacent open drainage ditch to isolate the surface drainage system from the inflow of contaminated surface water and groundwater from the site.

4.2 Remedy Implementation

On September 8, 1987, EPA and DEQ entered into a State Superfund Contract to proceed with remedial design and construction. This agreement separated the work into two phases. Phase I included design and construction of all upper zone related facilities, while Phase II included the surface drainage and deep aquifer extraction facilities. The estimated costs (Interim Closeout Report, EPA, 1991) for the Phase I and Phase II work were $2.4 million and $2.0 million (total of $4.4 million) versus $2.57 million estimated in the ROD.

Largely as a result of information developed during remedial design, several changes were made to the remedy. Theses changes, described in the December 17, 1991, ESD (EPA 1991) included:

- Demolition of the United Chrome Products building. At the time of the ROD it was decided to postpone a decision on the building's status until the remedial design phase.
- Rerouting of the surface drainage ditch in lieu of culvert installation.
- Installation of an infiltration trench, injection wells, and eight additional upper zone and two additional deep aquifer extraction and monitor wells.
- Discharge of treated water to the City of Corvallis publicly owned treatment works (POTW) and increased reliance on the POTW as a final treatment facility for extracted groundwater from the site.
- Modification of the deep aquifer groundwater cleanup standard from 0.05 mg/L to 0.1 mg/L to be consistent with the National Primary Drinking Water Regulation or maximum contaminant level (MCL).

A brief summary of the Phase I and Phase II work is provided in the following subsections.

4.2.1 Phase I Design and Construction

Phase I design and remedial construction included the following:

- Decontamination and demolition of the vacant United Chrome Products building (Photograph 1). Decontamination water was collected and stored in a temporary storage tank for treatment in the onsite treatment system. Demolition debris was transported to Valley Landfill's Coffin Butte facility in Corvallis, Oregon.

Photograph 1 – Demolition of the United Chrome Products building.

- Excavation and disposal of highly contaminated soil from the former dry well and plating tank areas. Approximately 800 tons (400 cubic yards) of soil was removed and transported to the Chemical Waste Management facility in Arlington, Oregon.
- Installation of 23 extraction wells (versus the 15 proposed in the ROD) and associated conveyance piping and well controls (Photograph 2) to pump contaminated groundwater from the upper zone to the onsite pretreatment system. Six piezometers and six monitor wells (non-pumping extraction wells) were also installed to allow for monitoring of remedial action progress.
- Construction of extracted groundwater influent and effluent holding tanks, installation of a skid-mounted chemical reduction and precipitation pretreatment system (Photograph 3), and setup of an office/laboratory trailer for use by operations and maintenance (O&M) staff. The City of Corvallis later modified the treatment system to add two 6,000-gallon sludge thickening tanks.

Photograph 2- Typical upper zone groundwater extraction well and onsite treatment system. Black tanks used for influent (groundwater) storage and white tanks for effluent (treated groundwater) storage.

Photograph 3 – Chemical reduction and precipitation treatment tank with totes containing treatment chemicals.

The Phase I design and construction work was performed between March 1987 and August 15, 1988, by EPA's contractor CH2M HILL, with support from Reidel Environmental Systems (civil, electrical, and mechanical), Wastewater Treatment Systems (treatment tank), and Geotech Explorations (well installation).

4.2.2 Phase II Design and Construction

Phase II design and remedial construction included:

- Installation of seven (versus five proposed in the ROD) deep aquifer extraction wells (DW-2, DW-8, DW-12, DW-13, DW-14, DW-15 and DW-16) and associated conveyance piping and well controls.
- Installation of two injection wells (DW-9 and DW-10) and two monitor wells (DW-18 and DW-19).
- Reconstruction of well DW-3 (DW-3A) and replacement of upgradient wells DW-4 and DW-5 with a new well DW-11.
- Construction of the bypass ditch (Photograph 4) to reroute surface water drainage around the site.
- Construction of a chemical storage building to house onsite treatment system chemicals.

Photograph 4 – Surface drainage bypass ditch shown on left. Infiltration basins at right-center of photograph.

The Phase II design and construction work was performed between November 1989 and August 15, 1991, by EPA's contractor CH2M HILL, with support from Onwego Drilling (well installation), Green and White (bypass ditch), Trico Electric (electrical), and Beaver Plumbing (mechanical).

4.2.3 Supplemental Engineering and Institutional Controls

The primary engineering controls at United Chrome are a chain-link site boundary fence enclosed by a chain-link airport property fence recently installed by the Federal Aviation Administration. Access to the site is available through the double, locked gates placed along the access road.

The Consent Decree between EPA and the City of Corvallis required the City to establish an approximate 40-acre groundwater pumping exclusion zone around the site. The purpose for the exclusion zone is to prevent installation and operation of water supply wells that could adversely affect groundwater remediation.

4.3 System Description and Operations

This section summarizes general information related to operation of the groundwater extraction wells, infiltration basins, and trench and injection wells, and the onsite treatment system. A majority of this information relates to historical site operations. At the time of this five-year review, site activity is limited to operation of a single upper zone well (EW-9) and two deep aquifer wells (DW-8 and DW-9).

4.3.1 Groundwater Extraction Wells

Upper Zone Well Description

The upper zone extraction system (Figure 4-1) was initially comprised of 23 wells. Each well is 5 inches in diameter and approximately 20 feet deep. The wells are equipped with electric submersible pumps for groundwater extraction and high and low water level sensors to control pump operation (Figure 4-2). A control panel adjacent to the well enclosure contains an hour meter to record the amount of time the pump operates and a cycle counter to record the number of times the pump cycles on and off. The wellhead is housed in an insulated enclosure to provide weather protection. The extraction wells are manifolded together with above ground, high-density polyethylene (HDPE) piping to convey groundwater from the wells to the onsite treatment facility.

Upper Zone Operations

Following 14.4 years of operation, the upper zone extraction system has yielded 30.6 million gallons of groundwater. Monthly groundwater extraction rates have varied from zero (July to September 2002) to 593,740 gallons (16 gallons per minute). The monthly extraction rate has declined steadily since May 1991 (Figure 4-3) as individual wells have been turned off after reaching the 10 mg/L chromium ROD performance standard. Shutting wells down in an incremental manner made recharge available to other well locations, thereby accelerating the overall cleanup rate.

Deep Aquifer Well Description

The deep aquifer system was initially comprised of seven extraction wells. Each well is 5 inches in diameter and varies in depth between 40 and 75 feet. The wells are equipped with electric submersible pumps for groundwater withdrawal, flow meters to show instantaneous flow rates and record total flow volume, and flow control valves to regulate

flow rates. The wells are housed in insulated enclosures to provide weather protection. The extraction and monitor wells are manifolded together (Figure 4-4) with above ground, HDPE piping to convey groundwater to the discharge point located at the northeast corner of the onsite treatment plant. Because of the low chromium concentration present in deep aquifer groundwater, treatment is not required. The deep aquifer conveyance piping also contains a side lateral that enables all, or a portion of the flow to be diverted to the upper zone infiltration basins. This capability has never been used.

One other feature that distinguishes the deep aquifer extraction well design from the upper zone is placement of the pumps, which were set high in the well casing near the top of the well screen at depths between 25 and 35 feet. The rationale for this action was to focus groundwater withdrawals at the top of the deep aquifer where chromium concentrations are highest.

Deep Aquifer Operations

After 11.5 years of operation, the deep aquifer extraction system has yielded 48.1 million gallons of groundwater. Monthly groundwater extraction rates (Figure 4-3) have varied from 123,970 to 778,840 gallons (2.8 to 17.4 gallons per minute). Extraction rates were highest when all seven wells were in operation and have gradually declined as individual wells met the 0.1 mg/L ROD performance standard and were turned off. By February 1997, well DW-8 was the only extraction well still in operation. Well DW-9 was brought online in February 2001 when it was discovered that chromium concentrations at this well had risen above the ROD performance standard.

The extraction system has operated full-time since the August 1991 startup except for a temporary shutdown between October 2000 and January 1, 2001, during the upper zone source removal action (see Section 4.4).

4.3.2 Infiltration System

Several different technologies were used at the site to introduce tap water to the upper zone and deep aquifer to accelerate the overall remediation effort. In the upper zone, two infiltration basins and an injection trench were employed, and in the deep aquifer two injection wells were used as described in the following subsections.

Upper Zone - Infiltration Basin Description

To facilitate flushing of soluble chromium from upper zone soil to the extraction system for recovery and treatment, two infiltration basins were constructed. Basin 1, the larger of the two at 4,500 square feet (80 x 56 feet) was constructed over the site of the former plating tanks (Figure 4-1). Highly contaminated soil from this area was excavated to a depth of 8 feet and the excavation backfilled with concrete rubble and pea gravel, providing a "root system" to more effectively deliver flushing water to subsurface soil. Infiltration Basin 2, with an area of 2,000 square feet (50 x 40 feet), was constructed over the site of the former dry well. In addition to flushing soluble chromium from upper zone soil, the infiltration basins helped sustain upper zone pumping during the summer and fall months when there is no natural recharge.

The basin walls (Photograph 5) were constructed of 30-inch-high concrete curbing lined with geotextile. The curbing was glued to a concrete footing, resulting in a leak-proof construction. Tap water was pumped into the basins through a 2-inch spigot and the water level maintained by a float valve. The water level inside the basins was initially maintained at a height 2 feet above ground surface but was subsequently lowered to a ground surface level to reduce vertical gradients between the upper zone and deep aquifer.

Photograph 5 – Upper zone infiltration basin Number 1.

Upper Zone – Infiltration Trench Description

In September 1990, the City constructed a 100-foot-long infiltration trench northeast of Basin 1 (Figure 4-1) to provide supplemental recharge to this area of the upper zone. The trench was placed at a depth of 6 feet and constructed of 4-inch-diameter slotted polyvinyl chloride (PVC) drain pipe encompassed by pea gravel. Tap water was pumped to the trench through a 4-inch-diameter riser, and the water level maintained at ground surface elevation by a float valve. The trench was used primarily during the summer and early fall months and was shut down in November 1994 following cleanup of this area.

Upper Zone - Infiltration Basin and Trench Operations

Between August 1988 and September 2000, 17.2 million gallons of tap water was flushed through upper zone soil using the infiltration basins and trench. This amount is equivalent to 56 percent of all groundwater pumped from the upper zone. Of the 17.2 million gallons of injection water, 59 percent (10.2 million gallons) was delivered through Basin 1, 22 percent (3.8 million gallons) through Basin 2, and 19 percent (3.2 million gallons) through the infiltration trench.

During the early phases of upper zone remediation, when all 23 extraction wells were in operation, infiltration rates varied from a low of 105,300 gallons per month during the winter months to as much as 548,664 gallons during the summer. However, as individual

extraction wells were shut down, the monthly infiltration rate has gradually declined (Figure 4-3). The infiltration basins were decommissioned in September 2000 in conjunction with a soil removal action. An attempt to reuse the Basin 1 footprint in January 2001 was unsuccessful due to the low permeability of material used to backfill the excavation (see Section 4.4). The infiltration trench was also temporarily restarted in September 2001 but was turned off once it was determined that the recharge did not benefit extraction at well EW-9.

Deep Aquifer - Injection Well Description

Deep aquifer wells DW-9 and DW-10, which initially did not contain chromium concentrations above the 0.1 mg/L ROD performance standard, were configured as injection wells during the Phase II construction. The design objective for the injection wells was to inject enough water to maintain a neutral vertical hydraulic gradient between the upper zone and deep aquifer to prevent recontamination of deep aquifer groundwater by upper zone groundwater that had met the 10 mg/L ROD performance standard. Wells DW-9 and DW-10 were designed primarily as monitor wells, and as such, the wells experienced frequent clogging problems even though clean tap water was used. The deep aquifer injection system was shut down in February 1994.

Deep Aquifer - Injection Well Operations

Between August 1991 and February 1994, 5.5 million gallons of groundwater was injected into the deep aquifer through wells DW-9 and DW-10; an amount equivalent to 11 percent of all groundwater pumped from the deep aquifer. An attempt was made to maintain injection rates at approximately 5 gallons per minute (gpm). However, the injection rate had to be decreased during the winter months to prevent artesian conditions. Monthly deep aquifer injection rates are shown on Figure 4-3.

4.3.3 Groundwater Treatment System

The groundwater treatment system was purchased as a package unit from Wastewater Treatment Systems in 1988 and installed during the Phase I construction effort. A process flow diagram for the system is shown in Figure 4-5. In 1992, after several years of upper zone pumping, treatment system operations were scaled back to eliminate the precipitation (sludge forming) step. All pretreatment of extracted groundwater was discontinued on March 2, 1995, and the treatment system decommissioned between March and April 1999.

While the treatment system was in operation, chromium removal from the groundwater influent stream was performed as follows:

- Step 1. Groundwater stored in the influent holding tanks was pumped to the first reaction chamber where sulfuric acid (acidification) was added to lower the pH to approximately 2.5. Sodium metabisulfite was also added in the acidification chamber to reduce the hexavalent chromium (Cr^{+6}) to trivalent chromium (Cr^{+3}).
- Step 2. Water then flowed into a second chamber (neutralization) where sodium hydroxide was added to raise the pH to 8.5, resulting in the formation of chromium hydroxide particles.

- Step 3. From the neutralization chamber water flowed into a third chamber that housed the lamella clarifier. Prior to entering the clarifier, anionic polymer was added to help the smaller chromium hydroxide particles aggregate into larger settable floc. The floc settled to the bottom of the lamella where it was then pumped to a thickening tank. The treated effluent was pumped from the clarifier to a clear well and through a bag filter (effluent polishing) into the effluent holding tanks.
- Step 4. Sludge formed in the thickening tanks was then pumped to a filter press, resulting in the formation of a blue-colored dry solid (Photograph 6). The dry solid was placed in a drum and transferred to a roll-off box for shipment to the Chemical Waste Management facility in Arlington, Oregon. Water removed by the filter press was returned to the influent holding tanks.

After several months of operations, the City, in cooperation with EPA, identified several process modifications to improve the treatment system throughput rate. These modifications are summarized in Table 4-1.

Photograph 6 – Chromium hydroxide precipitate collected from the filter press.

System Operations

Through March 1992 the groundwater treatment system was operated in a batch mode. During this phase of operations, extracted groundwater was accumulated in the influent tanks (the effluent tanks were converted to influent tanks in February and July 1991). When the tanks were completely full (48,000 gallons) the operators would process the water through the plant at rates up to 75 gpm.

In July 1991, the City of Corvallis proposed a 10-pound-per-day discharge limit (local limit) for the United Chrome site in accordance with National Categorical Pretreatment Limits

(40 CFR Chapter I, Subchapter N Part 403). In January 1992, EPA approved a 7-pound per day discharge limit. Under the local limit operations phase, up to 7 pounds per day of partially treated groundwater (14,000 gallons of upper zone groundwater or 3.8 million gallons of deep aquifer groundwater) could be discharged to the City of Corvallis publicly owned treatment works (POTW) for treatment. In March 1992, the treatment plant was modified to allow for full or partial (hexavalent to trivalent chromium reduction step) treatment and the plant operated in this mode until March 1995. On March 2, 1995, the reduction step was discontinued and all groundwater discharged directly to the POTW for treatment.

The chromium concentration in upper zone groundwater processed through the treatment plant dropped steadily during the first several years of operation from 1923 mg/L in August 1988 to 59 mg/L in March 1992. Between March 1992 and March 1995, when the treatment plant was operated primarily in the reduction only mode, chromium concentrations declined from 59 mg/L to 17 mg/L (Figure 4-6). Between March 1995 and December 2002, when no onsite pretreatment was performed, chromium concentrations generally varied between 10 and 15 mg/L.

Deep aquifer groundwater was treated onsite between August 1991 and March 1992. However, due to low chromium concentrations and higher volumes, deep aquifer groundwater was the primary benefactor of the 7-pound-per-day local discharge limit, and in March 1992, all deep aquifer groundwater was discharged to the POTW for treatment. As shown in Figure 4-6, chromium concentrations in deep aquifer groundwater dropped steadily from 1.6 mg/L in November 1991 to 0.06 mg/L in July 1996. However, concentrations began to increase, rising to 0.6 mg/L in January 2001. In February 2001, following startup of extraction well DW-9, the concentration dropped abruptly to 0.15 mg/L. Chromium concentrations had risen steadily to 0.35 mg/L by December 2002 (see Figure 4-6).

4.3.4 Performance Monitoring Program

Groundwater extraction and treatment system performance monitoring is conducted in accordance with the requirements of a pumping plan. The pumping plan has been revised five times since 1988. As experience with operation of the groundwater extraction and treatment system has grown, monitoring frequencies have generally been reduced. Additionally, when performance monitoring has shown that an extraction or monitor well has achieved the ROD performance standard, the monitoring frequency has been reduced or eliminated altogether.

The current performance monitoring program (*Pumping Plan*, CH2M HILL, May 2001) is summarized in Table 4-2 and Table 4-3.

4.4 Responsible Party Lead Actions

The City of Corvallis has also undertaken several actions to accelerate and improve the overall cleanup effort. These actions have included:

- Construction of a 100-foot-long infiltration trench in 1990 to deliver additional recharge to the upper zone northeast of Basin 1 (Photograph 7).

Photograph 7 – Construction of upper zone infiltration trench in June 1990 by the City.

- Removal of two abandoned buildings in April 1990 and May 1991 (yellow and green buildings in Photograph 4).
- Removal of chromium-contaminated sediment from the onsite culvert in 1991 (Photograph 8). The culvert was also plugged at each end to prevent recontamination. The sediment was eventually transported to the Chemical Waste Management facility in Arlington, Oregon.
- In March 1999 the City retained a Contractor to remove the chemical storage building, the influent and effluent storage tanks, treatment plant, filter press and treatment building.
- As resources permit, the City has also decommissioned a number of inactive extraction and monitor wells (Table 4-4).

Following an EPA investigation performed between June 1998 and July 2000 to verify the infiltration basin's soil flushing effectiveness, the City implemented a removal action that resulted in the excavation of 1,956 tons of soil containing chromium concentrations greater than 6,000 mg/kg. This material was transported to the Chemical Waste Management facility in Arlington, Oregon. Concrete rubble removed from the excavation was supplemented with 1700 tons of clean fill material, compacted, and leveled to match the existing grade.

Photograph 8 – Chromium-contaminated sediment removed from onsite culvert in September 1991. The City attempted to stabilize the sediment with concrete to permit disposal at Subtitle D (nonhazardous) landfill, but was unable to blend the concrete and sediment into a stable solid.

4.5 Operation and Maintenance Costs

O&M costs were estimated in the Feasibility Study at $261,000 per year for a five-year period. Based on cost information obtained from the City of Corvallis, actual operation and maintenance costs for United Chrome have declined from $247,000 per year in 1990 to $25,000 per year in year 2001, with the lower costs in proportion to a reduced level of site activity. An additional, one-time cost of approximately $400,000 was incurred in year 2000 in conjunction with the upper zone soil removal.

TABLE 4-1
Treatment System Improvements
United Chrome Products Corvallis, OR

Date	Modification	Description
Process Equipment		
July 1989	Filter Press	Original 6-cubic-foot press removed, replaced with new 12-cubic-foot press.
July 1989	Sludge Pump	Original Wilden M-4 sludge pump replaced with Wilden M-8 to increase capacity.
Oct. 1989	Filter Press	Filter press filtrate line replumbed from the sludge thickening tank to the clarifier.
Dec. 1989	Air Compressor	Original compressor removed, replaced with larger unit to accommodate the new press.
Dec. 1989	Air Drier	Regenerative air drier added to dry process air, address freezing problems with wet process air.
Aug. 1990	Sludge Thickening	Replaced two 900-gallon sludge thickening tanks with two 6,000-gallon tanks.
Ancillary Equipment		
Jan. 1989	Polishing Filters	Damaged by freezing, removed from process.
April 1989	Influent Flow Measurement	Reduced meter size to provide more accurate measurement.
Dec. 1989	Caustic Storage	NaOH/KOH mixtures are now used during cold months to inhibit freezing of caustic solution.
May 1990	Influent/Effluent Tank Area	Added permanent ladders, catwalks, and rails over the tanks. Installed analog level measurement on all four tanks.
Jan. 1991	Influent/Effluent Pumps	Changed from 1-1/2- to 2-hp pumps.
Feb. 1991	Influent/Effluent Tanks	Tank No. 3 replumbed to use for influent rather than effluent storage.
July 1991	Influent/Effluent Tanks	Tank No. 4 replumbed to use for influent rather than effluent storage. Treatment plant effluent discharged directly to the sewer.
Facilities		
May 1990	Chemical Storage Building	Building designed and constructed.
May 1990	Locker Room	Building designed and constructed.

TABLE 4-2
Upper Zone Remedial Action Monitoring and Reporting Schedule
United Chrome Products, Corvallis, OR

Component	Task	Locations	Frequency	Reporting Requirements[a]
Extraction System	Water levels in select wells	EW-01, EW-02, EW-03, EW-04, EW-05, EW-06, EW-07, EW-09, EW-10, EW-11, EW-12, EW-13, EW-14, EW-15, EW-16, EW-23, EW-27, PZ-B, SE-2A, MW-3	Quarterly	Quarterly
	Wellhead measurements[b]	All active extraction wells	Monthly	Quarterly
	Water quality – hexavalent chromium	All active extraction wells	Monthly	Monthly
	Flow rate, line pressure, effluent chromium conc[e]	At City POTW discharge point	Monthly	Quarterly
	Calculated flow rate and corrected[c] volume through well[f]	All active extraction wells	Monthly	Quarterly
Monitor Wells	Water quality – hexavalent chromium	EW-01, EW-02, EW-03, EW-04, EW-05, EW-06, EW-07, EW-09, EW-10, EW-11, EW-12, EW-13, EW-14, EW-15, EW-16, EW-23, EW-27, PZ-B, SE-2A, MW-3	Semiannually[d]	Semiannually
Infiltration Trench (Phase 2 only)	Flow (gal), water elevation and vertical gradients	Vertical Gradient Clusters: SE-2A/DW-9, MW-3/DW-2	Quarterly	Quarterly
	Water Balance[g]	EW-2, EW-6, EW-10, EW-11, EW-12, EW-13, EW-14, EW-16	Monthly	Quarterly

Notes:

[a]All results may be requested at any time by the technical assistant in verbal format or draft.
[b]Pump cycles, pump hours, line pressure. Functional inspections will be performed more frequently.
[c]Corrected volume = [calculated volume at well]* $\frac{\text{total measured flow (POTW Discharge Point)}}{\text{total calculated flow (all extraction wells)}}$.
[d]Sampling will be conducted in December and June of each year.
[e]Sample shall be a grab sample.
[f]If difference between calculated vs. measured flow exceeds 20%: 1) Influent flow meter, 2) Extraction well line pressures, and 3) orifice plate erosion will be checked and appropriate corrective measures implemented.
[g]Infiltration rates shall be adjusted, as necessary, to maintain an infiltration/extraction ratio of 0.6 to 0.7.

TABLE 4-3
Deep Aquifer Remedial Action Monitoring and Reporting Schedule
United Chrome Products, Corvallis, OR

	Task	Locations	Frequency[b]	Reporting Requirement
Extraction System	Well head measurements/inspection[a]	Active extraction wells	Monthly	Monthly
	Water quality sampling			
Monitor Wells and Inactive Extraction Wells	Water level measurements	DW-2, DW-8, DW-9, DW-10, DW-12, DW-13, DW-15	Quarterly	Quarterly
	Water quality sampling [Cr(VI)]	DW-2, DW-10, DW-12, DW-13, DW-15	Semiannually	Semiannually

Notes:

[a]Measurements include flow rate (gpm) and flow totalizer (gallons). Functional inspection to be performed weekly.
[b]Scheduled tasks will be performed at uniformly spaced intervals; semiannual = March and September.

TABLE 4-4
Well Abandonment History
United Chrome Products, Corvallis, OR

Abandonment Event	Date Performed	Wells Abandoned	
		Upper Zone	Deep Aquifer
Phase 1	June 1996	EW-1, PL-2, PL-3,PL-4, PL-5, BG-2, MW-2A	DW-7
Phase 2	May 1997	EW-19, EW-22, EW-24, EW-25, EW-26, SW-3, PZ-A, PZ-C, PZ-E	
Phase 3	May 1998	SW-2A, SW-4	DW-3A, DW-6, DW-19
Phase 4	September 1990	EW-8, EW-28, EW-29	
Phase 5	June 2001	EW-17, EW-18, EW-21, EW-20, BG-1, MW-1, PL-1, PZ-D, PZ-F	DW-11, DW-14, DW-16, DW-17

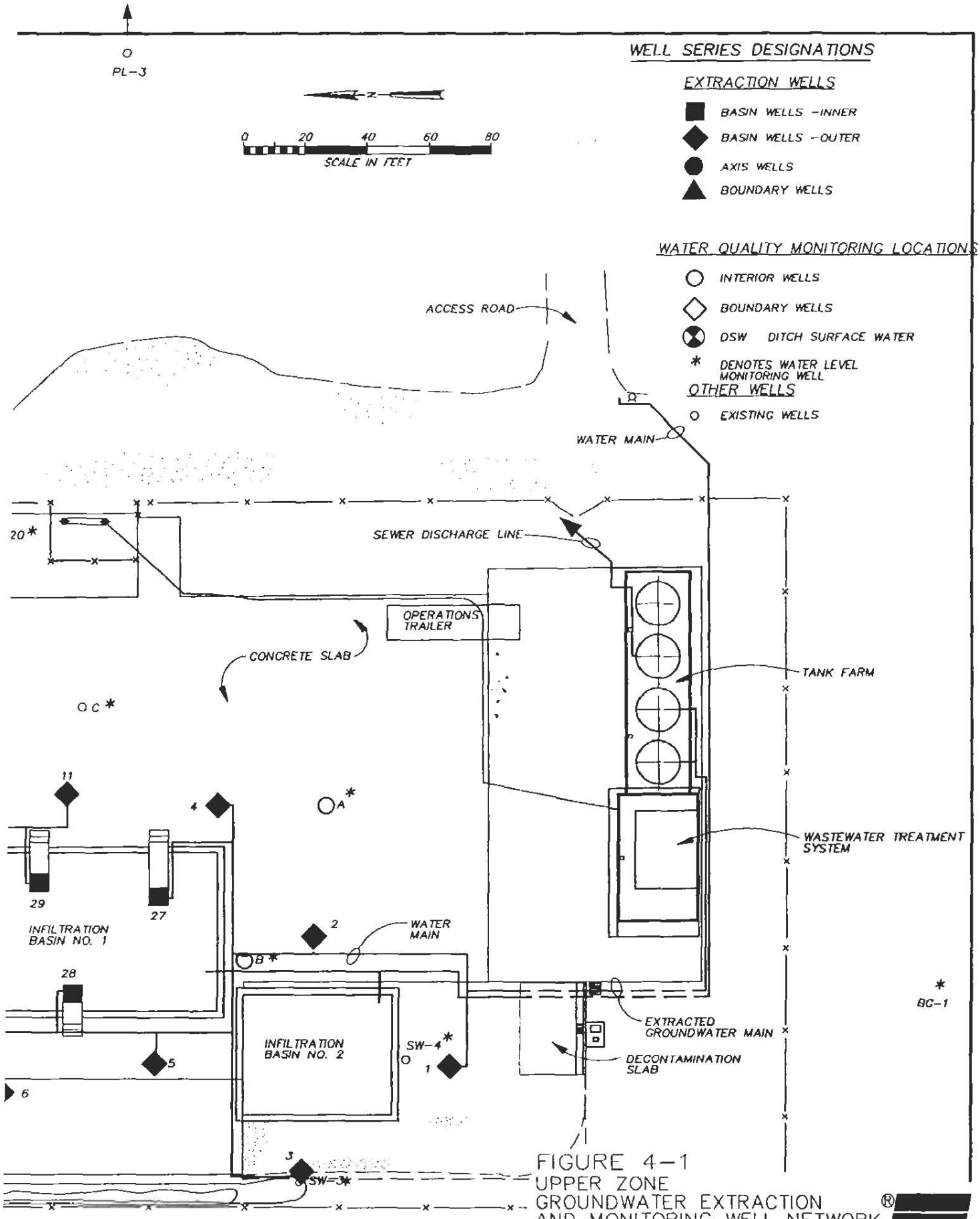
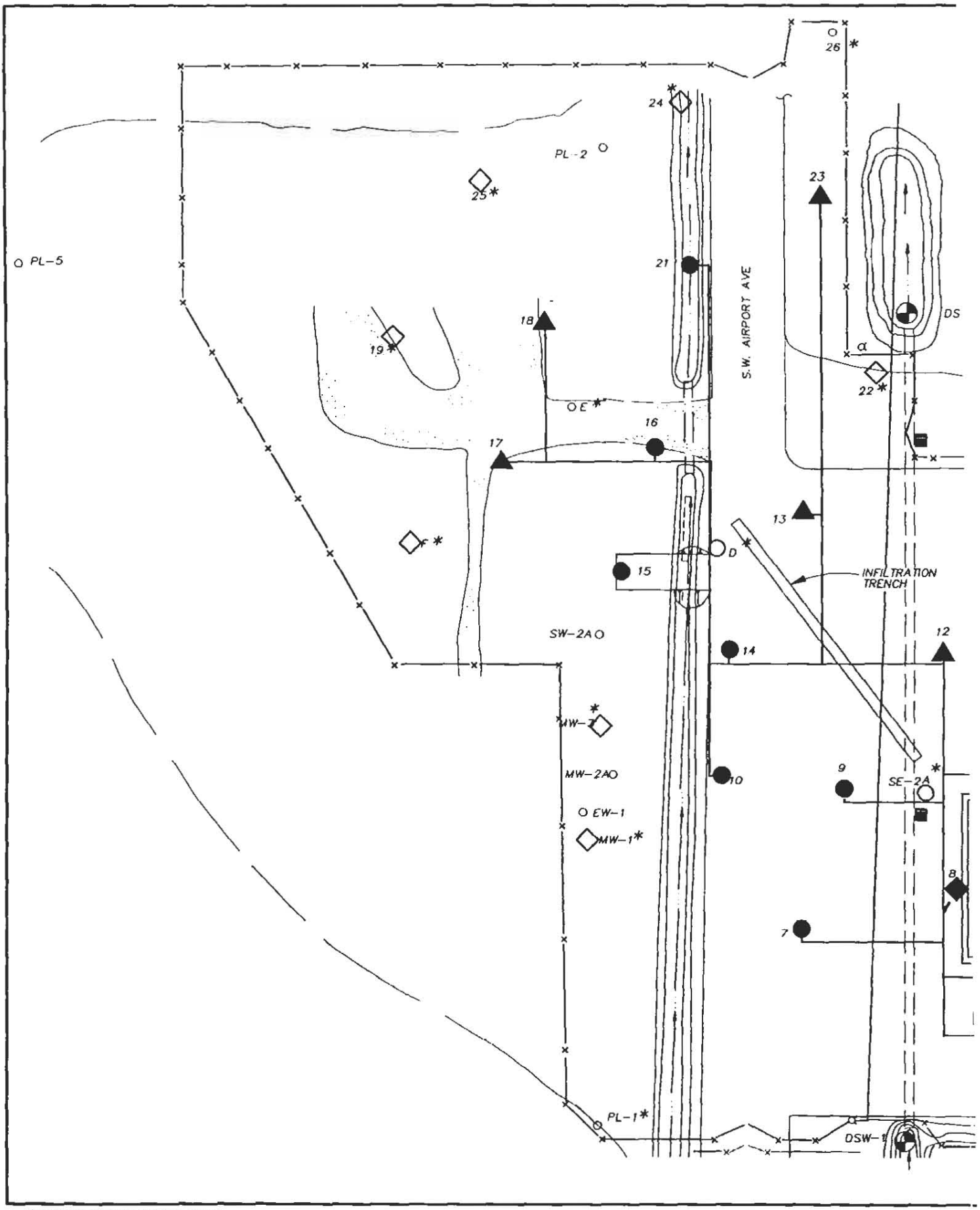


FIGURE 4-1
UPPER ZONE
GROUNDWATER EXTRACTION
AND MONITORING WELL NETWORK
UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

CH2M HILL

NAME FILENAME



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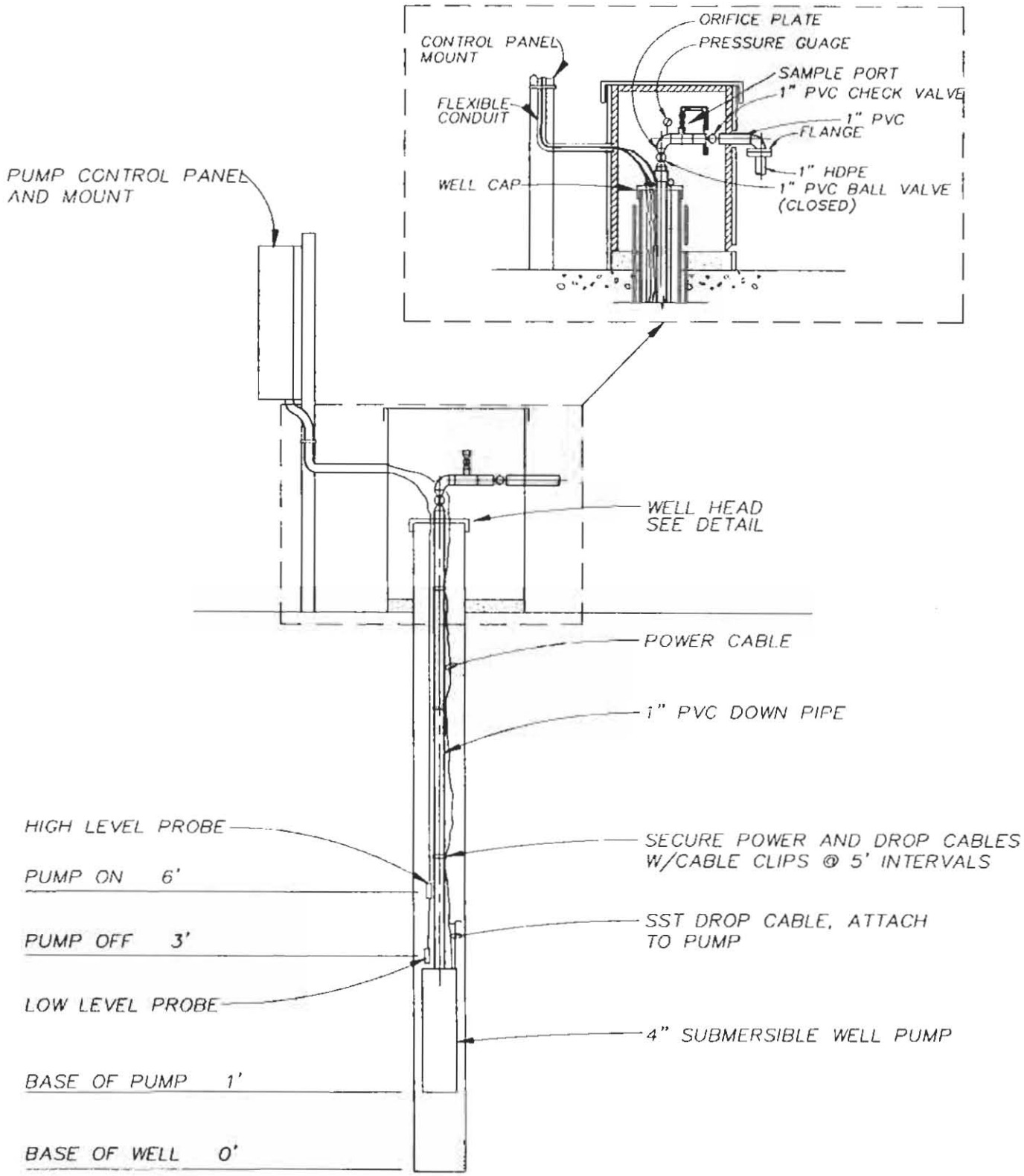


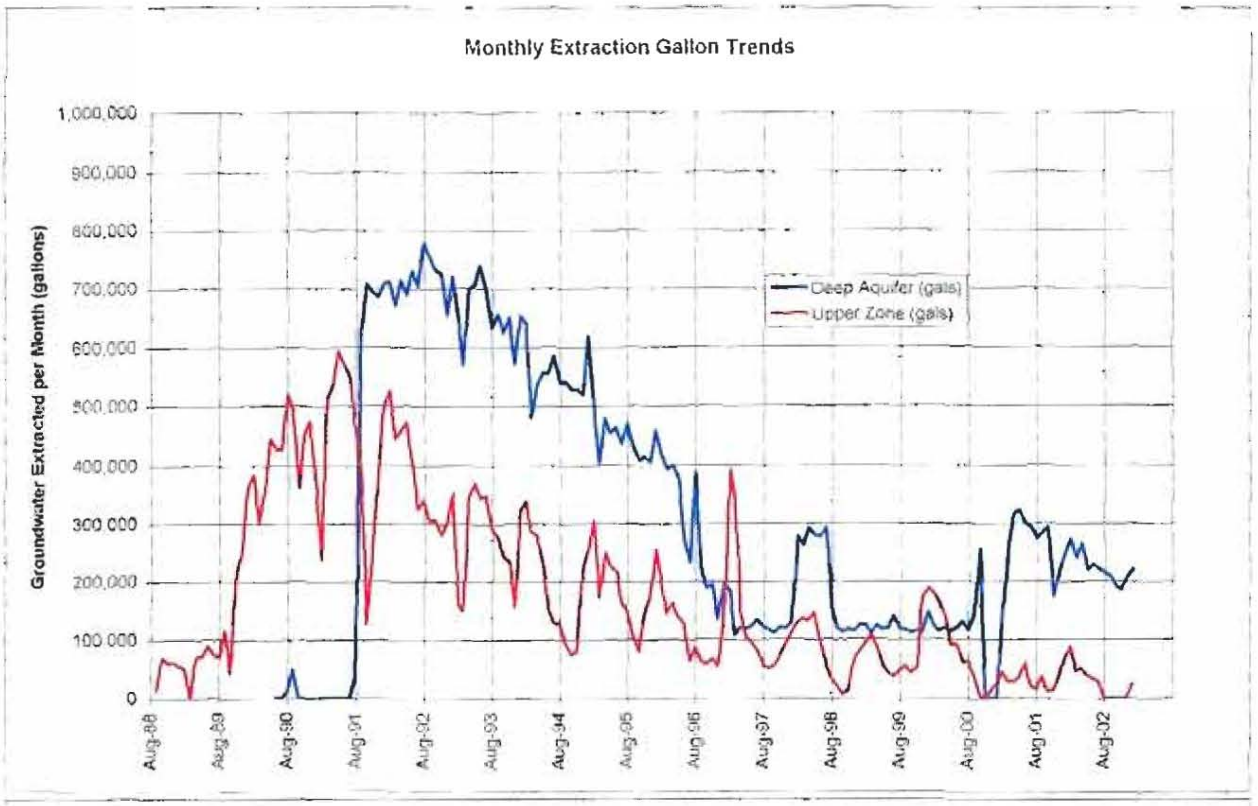
NOTE: PROBE SETTINGS SHOWN REPRESENT INITIAL CONDITIONS AND HAVE BEEN CHANGED TO OPTIMIZE WELL YIELDS.

FIGURE 4-2

UPPER ZONE EXTRACTION WELL INSTALLATION DETAIL

UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

CH2M HILL



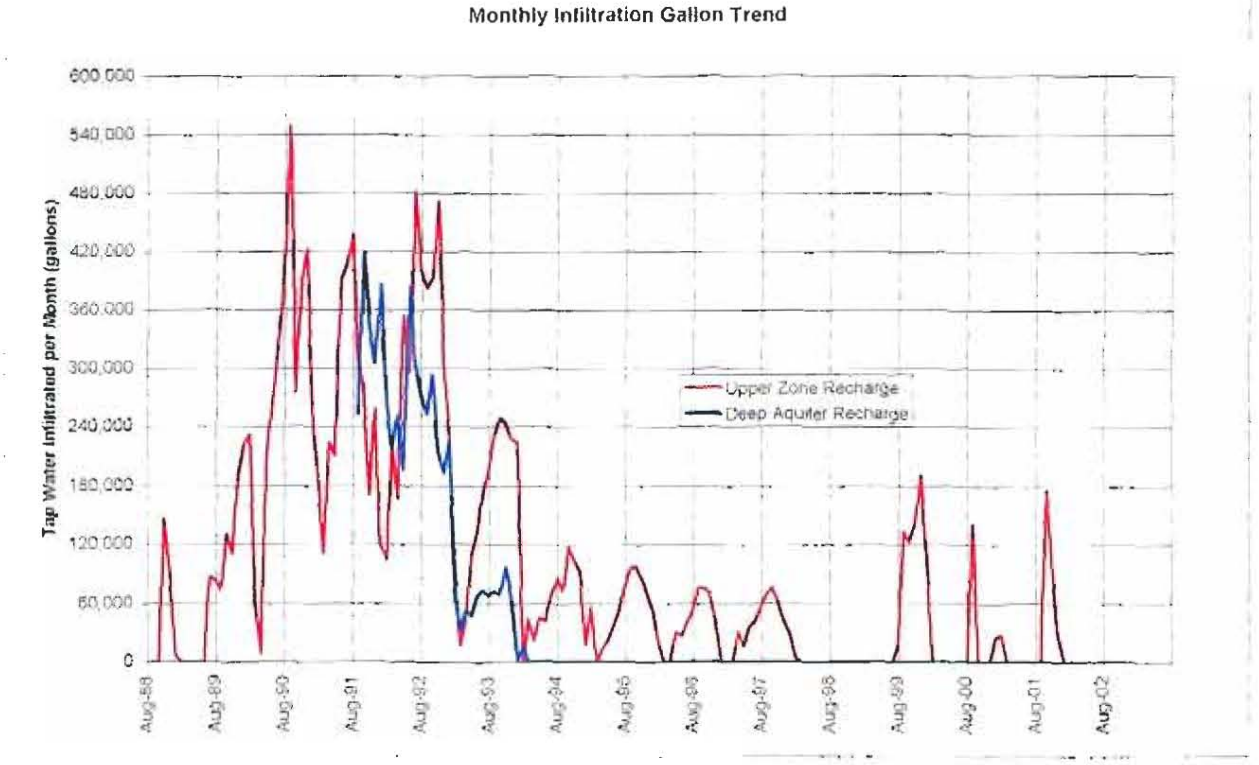


Figure 4-3
General Operations Data
United Chrome Products Superfund Site
Corvallis, Oregon

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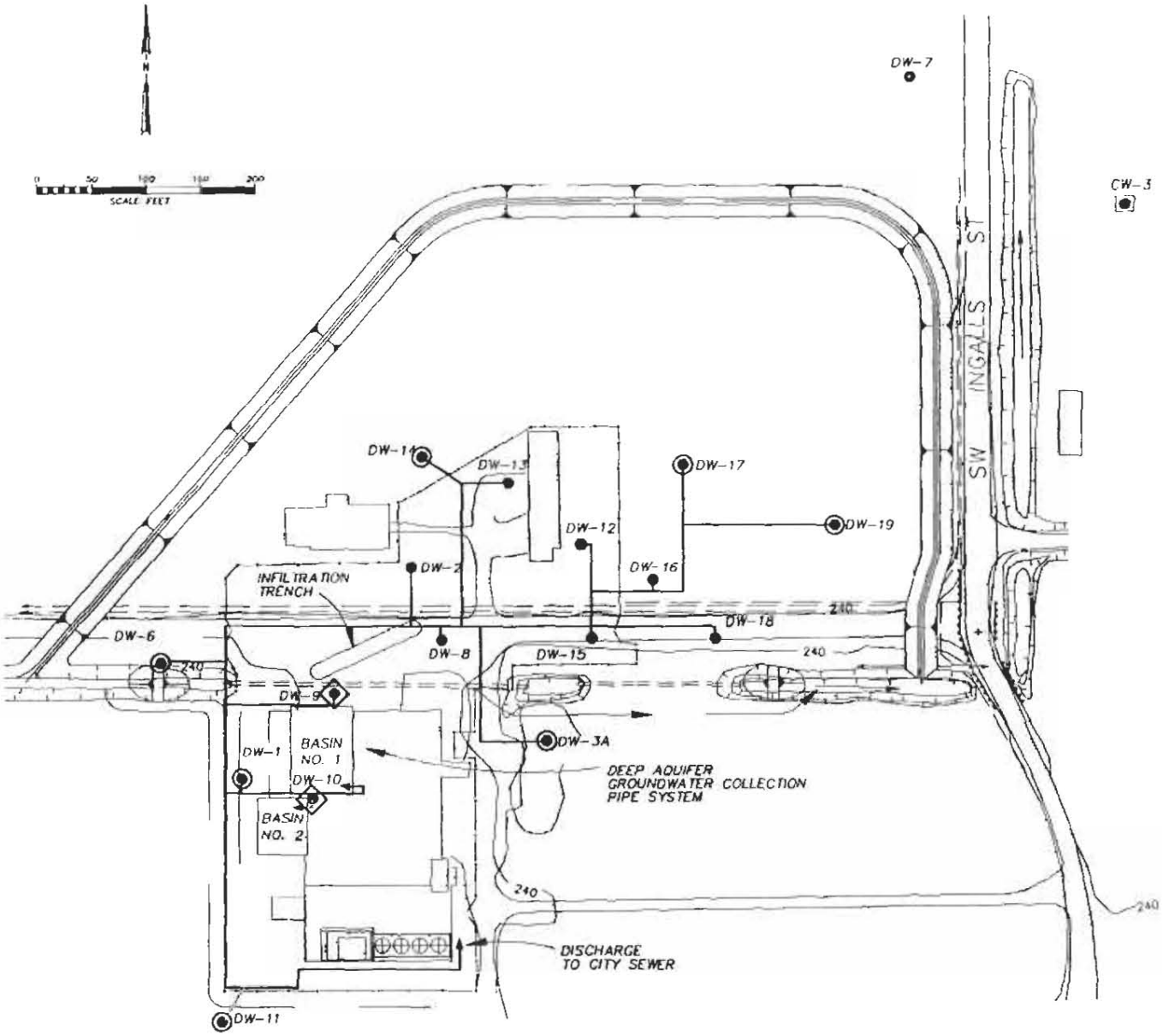

LEGEND:

DW-8 ● DEEP AQUIFER EXTRACTION WELL

◉ DEEP AQUIFER MONITORING WELL

◈ DEEP AQUIFER INJECTION WELL

◄ DISCHARGE POINTS

FIGURE 4-4
DEEP AQUIFER GROUNDWATER EXTRACTION AND MONITOR WELL NETWORK

UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

CH2M HILL

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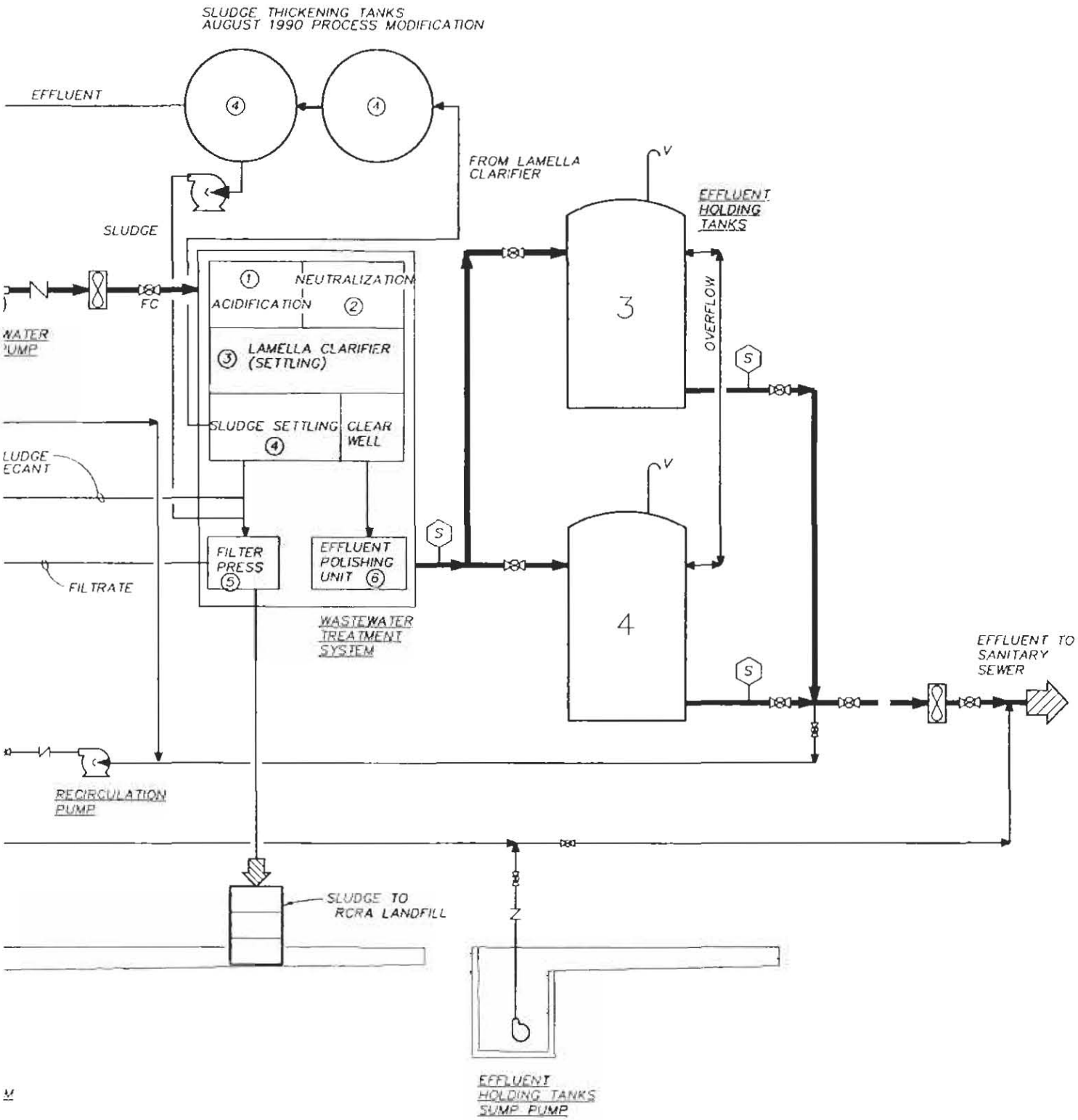

FIGURE 4-5
GROUNDWATER TREATMENT SYSTEM
UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

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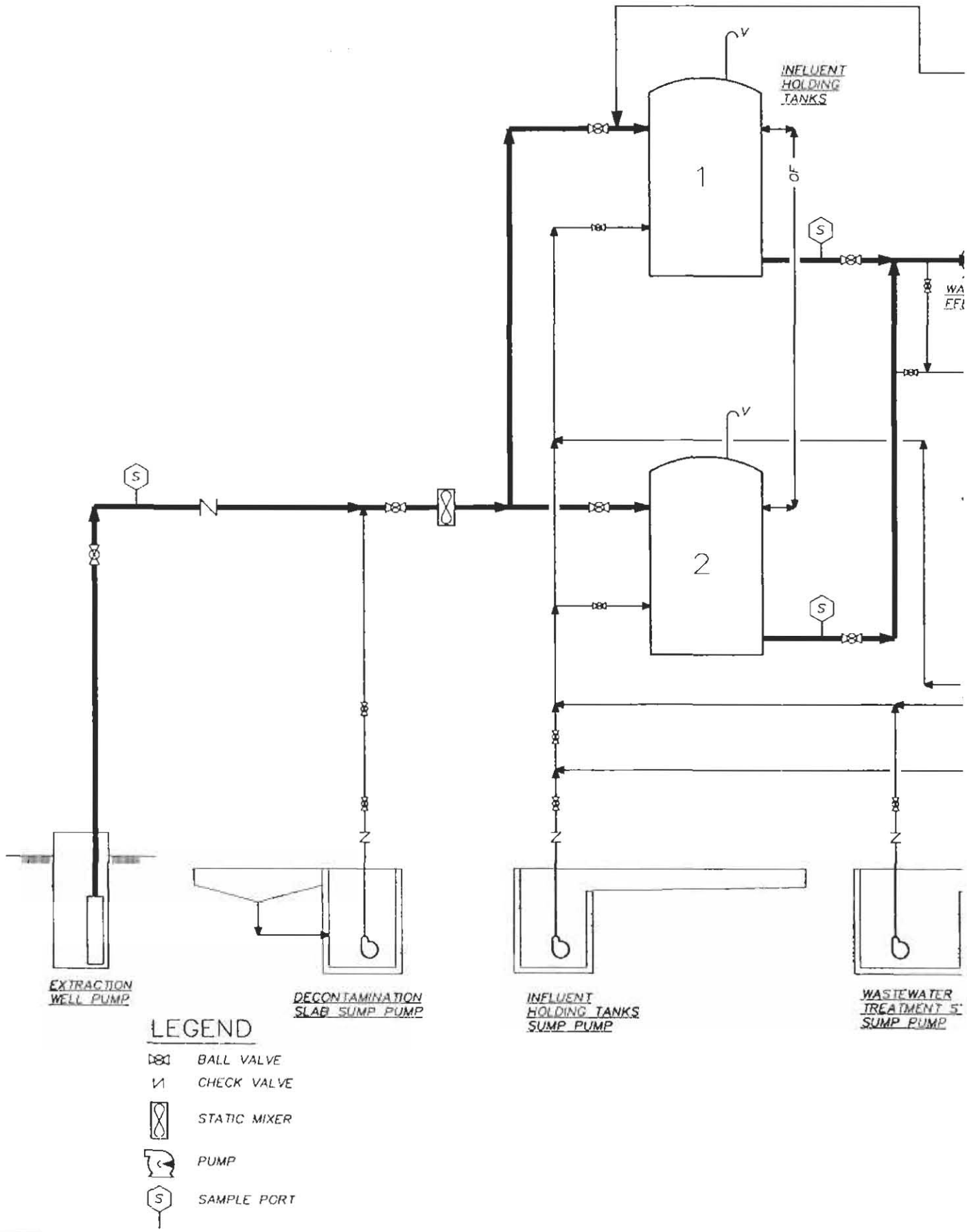
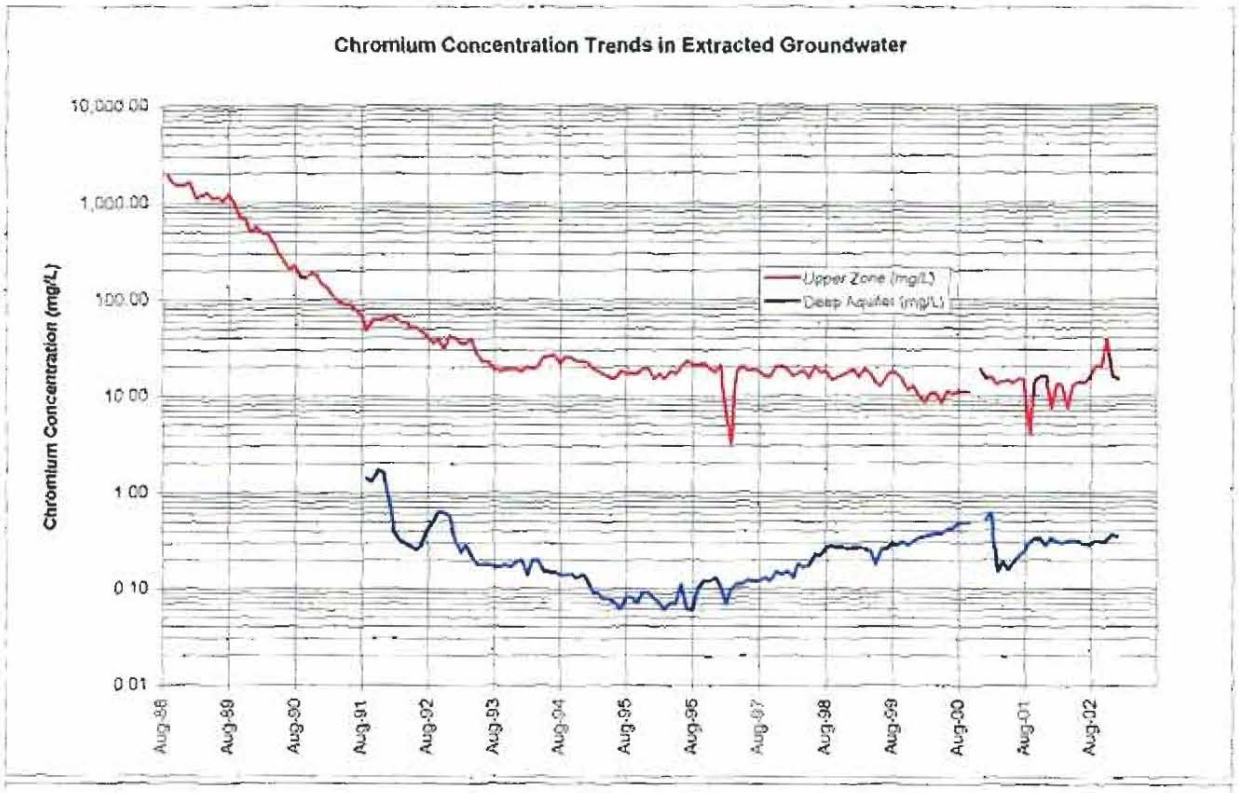




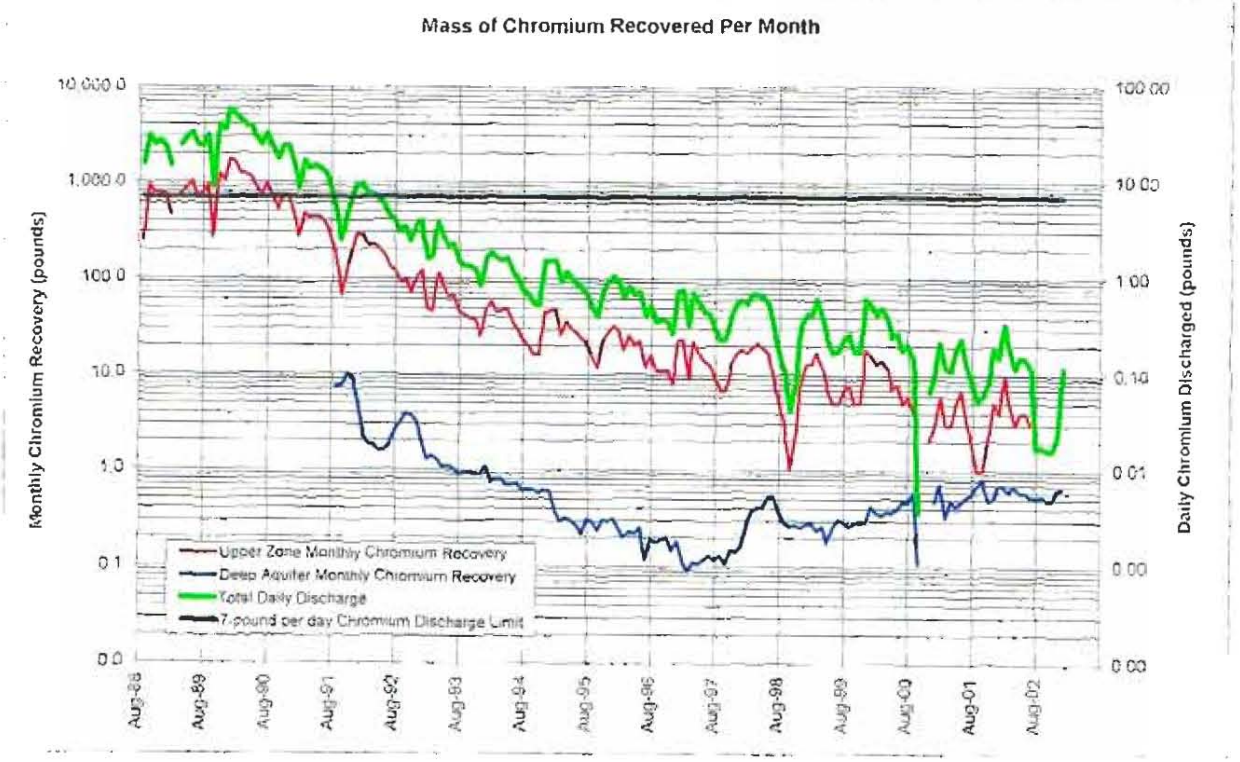


Figure 4-6
General Treatment System Operations Data
United Chrome Products Superfund Site
Corvallis, Oregon

5. Progress Since the Last Five-Year Review

5. Progress Since the Last Five-Year Review

The second five-year review (*United Chrome Products Superfund Site Corvallis, Oregon Five-Year Review* Report, EPA, 1998) concluded that the United Chrome remedy was performing as designed, that all necessary O&M was being performed, and that continued operations would ensure protection of human health and the environment. Although no current protectiveness issues were identified, several with the potential to affect the remedy's ability to achieve cleanup levels and, therefore, long-term protectiveness were listed. These issues included:

1. Determine the effectiveness of soil flushing for chromium removal from the plating tank and dry well areas.
2. Delineate the extent of chromium-contaminated soil that continues to act as a groundwater contaminant source.
3. Evaluate methods for enhancing the existing groundwater remedy, or undertaking an alternate remedy, in order to attain the groundwater performance standards specified in the ROD.
4. Reevaluate surface water and sediments in the drainage ditches downstream of the site and within the Booneville Slough to ensure protectiveness of ecological resources.
5. Prior to closeout of the site and proposed deletion of the site from the NPL, review the levels of chromium remaining in soil on the site to ensure that any residual levels of contamination are protective of expected future site use.

Each of these recommendations (Table 5-1), except for the surface drainage sampling, has been addressed. The surface drainage sampling work had been completed at the time of this five-year review but the results had not been presented to EPA. Additional information relevant to these issues is provided in Chapter 7.

TABLE 5-1
Status of Recommendations Provided in Second (1998) Five-Year Review
United Chrome Products, Corvallis, OR

Issues from Previous Review	Recommendation	Party Responsible	Action Taken and Outcome	Action Completed
Ongoing upper zone groundwater contaminant source	Evaluate effectiveness of soil flushing	EPA	Phase I soil investigation performed, resulting in collection of 220 soil samples for total chromium, TCLP, and SPLP chromium analysis. Investigation revealed that high levels of chromium remain in soil. Phase 2 investigation recommended.	October 1998
	Delineate extent of chromium-contaminated soil	EPA	Phase II soil investigation performed, resulting in collection of 72 soil samples for total chromium analysis. Extent of contamination delineated to 6,000 mg/kg level obtained from Phase 1 TCLP testing.	August 2000
	Evaluate alternate methods for remedy enhancement	EPA	Removal action recommended. Design Criteria Report prepared to guide removal action.	August 2000
		City of Corvallis	Removed 1,926 tons of contaminated soil with chromium concentrations in excess of 6,000 mg/kg. Work documented in a construction report prepared by the City and in an EPA closeout report.	October 2000
Offsite chromium-contaminated surface water and sediment	Reevaluate surface water drainages and Booneville Slough to ensure protectiveness	Oregon DEQ	Oregon DEQ evaluated historical surface water and sediment data and concluded that a DEQ Ecological Level I Risk Scoping and Level II Risk Screening should be performed. DEQ recommended surface water and sediment sample locations and laboratory analysis requirements.	July 2002
		City of Corvallis	Sediment samples collected	Oct 2002
			Ecological Level 1 Scoping Report	Nov 2002
			Surface water samples collected	Jan 2003
			Additional background sediment samples collected	Feb 2003
Chromium concentrations remaining in onsite soil	Screening level risk assessment	DEQ	DEQ performed a human health risk screening that concluded offsite soil is protective of residential use and onsite soil protective for industrial use with institutional controls.	August 2002

6. Five-Year Review Process

6. Five-Year Review Process

This chapter describes activities associated with completion of the five-year review.

6.1 Administrative Components

The approach used to conduct the five-year review followed the *Work Plan for Work Assignment No. 102-FR-FE-1032* (CH2M HILL, October 30, 2002). Specific work plan tasks included:

- Review of applicable or relevant and appropriate requirements (ARARs) (Task 3)
- Site interviews (Task 4)
- Site inspection (Task 5)
- Preparation and review of the five-year review report (Task 6)

The overall five-year review effort was led by the EPA Region 10 remedial project manager (RPM), Alan Goodman. Mr. Goodman was assisted by the EPA community involvement coordinator (CIC), Ms. Deborah Neal, and by EPA Region 10's Remedial Action Contract (RAC) contractor CH2M HILL. The five-year review work was performed between December 1, 2002, and February 24, 2003.

6.2 Community Involvement

Community involvement is an important component of the five-year review process. Steps taken to involve the community in this five-year review included preparation and distribution of an updated fact sheet by EPA providing specific information on the five-year review and its objectives, interviews with community leaders, and interviews with private citizens who may have a potential interest in the cleanup.

6.3 Review of Applicable or Relevant and Appropriate Requirements

The remedy selected in the ROD is intended to protect human health and the environment and to comply with ARARs. The objective for the ARARs review was to identify any newly promulgated federal or state regulatory standards that might affect the protectiveness of the remedy. Although ARARs are "frozen" at the time of ROD signature, EPA's *Comprehensive Five-Year Review Guidance* (EPA 2001) specifies that newly promulgated or revised regulatory standards that bear on the protectiveness of the remedy be identified and evaluated during the five-year review.

Summaries of newly promulgated and revised regulatory standards identified during the course of the five-year review are discussed in Chapter 7.

6.4 Document and Data Review

Although no formal document and data review was performed, CH2M HILL has an extensive file for the United Chrome project. Information contained in this file was used to prepare the five-year review report.

6.5 Site Inspection

Summary of Site Conditions

The site inspection was performed by the CH2M HILL site manager on December 5, 2002, and January 11, 2003, in accordance with the checklist contained in the five-year review guidance. The site inspection was also used to update the site's base map to reflect changes that have taken place over the past 10 years. A copy of the revised base map is shown in Figure 6-1.

Two security fences (Photograph 10) enclose the United Chrome site, with access obtained through gates located off Airport Place. The outer fence, maintained by the Federal Aviation Administration, encloses the Corvallis Airport and is labeled with no trespassing and warning signs approximately every 100 feet along its entire length. The inner fence encloses the United Chrome and CoEnergy sites (Figure 6-1), which lie within the Corvallis Airport property. A third fence separates the United Chrome and CoEnergy sites from one another, and separate locking gates control entry and egress from each. CoEnergy also uses two guard dogs to patrol their facility.

Photograph 10 – FAA security fence outside United Chrome site fence.

Although the City maintains the groundwater extraction equipment in good working order, the site receives only a nominal amount of landscaping maintenance, and therefore appears unkempt. Herbicide applied in October 2002 has killed much of the groundcover vegetation present at the site, and its decayed nature contributes to the site's lowly appearance. Additionally, following removal of the treatment system infrastructure, the City no longer has a covered area to store equipment associated with past well conversion and well abandonment work. This equipment has replacement and salvage value, and is currently stored on an asphalt surface near wells EW7 and EW10, and the decontamination pad.

Land use in the immediate vicinity of the site remains airport services (maintenance and parking), propane fueling (Ferril Gas and CoEnergy), and agricultural (grass seed farming). The United Chrome site is zoned under the City of Corvallis Comprehensive Land Use Plan as general industrial.

6.5.2 Site Cover

Although not widely discussed in prior documents, large areas of the site are covered with asphalt and concrete (Photograph 11). The main portion of the site is overlain with reinforced concrete approximately 25,000 square feet in area and 12 inches thick. This cover represents the floor of the former United Chrome Products building. An extensive floor trench system varying in depth from 4 to 12 inches is recessed within the floor. The trench is filled with gravel but appears to drain toward the southwest corner. The gravel was removed at one location and the trench inspected. The concrete floor and walls of the trench were in good condition and showed no evidence of chemical or physical degradation. There are also several drain openings in the floor, just south of the power transformer, that most likely discharge to an inactive septic system. An asphalt roadway (former County road) and parking area border the concrete to the north. Along the west, south, and east sides of the concrete, the surface is unpaved.

EPA and the DEQ have expressed concerns in the past about potential chromium contamination beneath the concrete slab. The results of this site inspection, and soil sampling performed in May 2000 indicate these concerns are probably not warranted. Additional information on this issue is presented in Chapter 7.

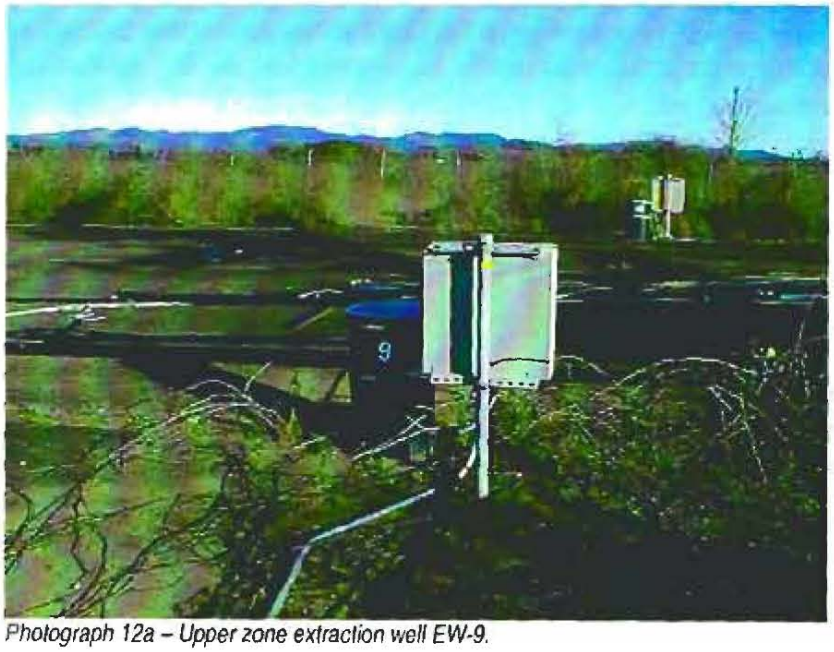
6.5.3 Groundwater Remedy

Groundwater Extraction System

The only extraction wells still in operation are upper zone well EW-9 and deep aquifer wells DW-8 and DW-9 (Photographs 12a and 12b). All other extraction wells have been converted to monitor wells, or have met the ROD performance standard and been abandoned per EPA approval. The status of all wells present at the start of the remedial action in 1988 is shown in Table 6-1. Wells still present at the site are shown on Figure 6-1. At the time of the inspection, wells EW-9, DW-8, and DW-9 were operating satisfactorily.

Insulated shelters enclose the upper zone and deep aquifer extraction wells. The shelters are in good condition and provide adequate weather protection. Although some evidence that the shelters have been used recently as nesting sites by birds or small animals was observed, this has been a recurring condition, and does not affect extraction well operation or groundwater monitoring activities.

Photograph 11 – Concrete cover and floor of former United Chrome Products building.



Photograph 12a – Upper zone extraction well EW-9.

c

Photograph 12b – Deep aquifer extraction well DW-8.

The above ground piping that conveys groundwater from extraction wells EW-9, DW-8, and DW-9 to the discharge point is in good shape. However, the bridge near wells EW-5 and DW-1 (Photograph 13), which allows vehicles to drive safely over the pipe, is in poor condition and should be repaired if future vehicle traffic through this area is required. The bridge was damaged by heavy truck traffic during the October 2000 upper zone source removal project.

Photograph 13 – HDPE aboveground pipe bridge near DW-1.

TABLE 6-1
United Chrome Well Inventory - January 2003
United Chrome Products, Corvallis, OR

Upper Zone Wells					
Extraction Wells			**Monitor Wells**		
Active	Inactive	Abandoned	Active	Inactive	Abandoned
EW-09		EW-08	EW-01	EW-20	MW2A
		EW-19	EW-02		EW1(a)
		EW-22	EW-03		PZ-A
		EW-24	EW-04		PZ-C
		EW-25	EW-05		PZ-E
		EW-26	EW-06		PL5
		EW-28	EW-07		PL3
		EW-29	EW-10		PL4
		EW-17	EW-11		SW-3
		EW-18	EW-12		SW-4
		EW-21	EW-13		MW1
			EW-14		MW3
			EW-15		PZ-F
			EW-16		PL1
			EW-23		PL2
			EW-27		SW-2A
			MW-3		BG1
			PZ-B		PZ-D
			SE-2A		PZ-F
Total Number of Wells Initially Present		**51**			
Total Number of Wells Currently Present		**21**			

Deep Aquifer Wells					
Extraction Wells			**Monitor Wells**		
Active	Inactive	Abandoned	Active	Inactive	Abandoned
DW-8			DW-2	DW-1	DW-03A
DW-9			DW-10		DW-4
			DW-12		DW-5
			DW-13		DW-6
			DW-15		DW-7
					DW-11
					DW-14
					DW-16
					DW-17
					DW-18
					DW-19
Total Number of Wells Initially Present		**25**			
Total Number of Wells Currently Present		**8**			

Infiltration System

The infiltration basins (Basin 1 and Basin 2) were decommissioned in August 2000 in conjunction with the upper zone source removal work (Photograph 14). The decommissioning effort included removal of geotextile material, above-grade concrete walls, plumbing and valve controls. The infiltration trench is still operational but has not been used since January 1993, except for a short trial between August and October 2001. Given the limited nature of current upper zone pumping operations, it is unlikely the trench will be required in the future.

Photograph 14 – Footprint of former infiltration basin number 2.

Groundwater Monitoring Network

All of the groundwater monitor wells/piezometers shown on Figure 6-1 were located and appear to be in satisfactory condition for continued use as required by the Pumping Plan – Version 5 (CH2M HILL, May 2001). CH2M HILL had scheduled the site inspection for December 5, 2002, to correspond with the City's semiannual sampling of the upper zone monitor wells. Unfortunately, the City's sampling pump failed to operate as a result of freeze damage, and the sampling was not performed on this date.

Treatment System

The groundwater treatment system was removed between March and April 1999. The only components remaining are the secondary containment wall that enclosed the influent tank storage and treatment system areas, the partially enclosed shop, the electrical control panel, the decontamination pad, and the containment cell for the sludge thickening tanks. The secondary containment wall has been intentionally breached (Photograph 15) along the north side to prevent accumulation of large amounts of rainwater. The metered discharge point where extracted groundwater is discharged to the sanitary sewer is in satisfactory condition (Photograph 16).

Photograph 15 – Breach of secondary containment wall at site of former wastewater treatment system.

Photograph 16 – Upper zone and deep aquifer extracted groundwater discharge point.

Office and Laboratory Trailer

An office and laboratory trailer and locker room trailer, constructed as part of the groundwater remedial construction effort, are still maintained by the City of Corvallis (Photograph 17). All onsite testing is done in the laboratory trailer, but most document/data management is performed at the City of Corvallis POTW. The laboratory equipment appeared to be in good working condition, and the City provides copies of all calibration and quality assurance checks with the quarterly progress reports. Copies of the O&M manuals, health and safety plan, and historical site-related documents are also kept onsite. The O&M manual has not been updated since the treatment system was decommissioned in April 1999. However, to support an update to the site Health and Safety Plan, the City prepared a summary of significant site events (see Attachment 4 in Appendix A).

Photograph 17 – Office and laboratory trailer.

6.5.4 Onsite Drainage

Although the surface drainage ditch has been re-routed around the United Chrome site, portions of the former ditch are still visible and accumulate surface water during the winter months (Photograph 18).

6.5.5 Site Safety

United Chrome O&M personnel are 40-hour trained, in accordance with 40 CFR 1910.120, and are current with respect to 8-hour refresher training and annual medical examinations. Because of the limited nature of current site operations, a facility safety inspection was not performed.

Photograph 18 – Isolated portion of former site drainage ditch near United Chrome site.

6.6 Community Interviews

CH2M HILL personnel interviewed site operations and maintenance (O&M) personnel, selected community leaders, and local residents who live within 1.5 miles of the United Chrome site. CH2M HILL also mailed questionnaires to non-governmental and non-media affiliated individuals on the United Chrome mailing list. A brief summary of the interview findings is provided in the following subsections. Copies of the interview questionnaires are provided in Appendix A, Attachment 3.

6.6.1 Site Operations Personnel

CH2M HILL interviewed Bruce Curtis, the City of Corvallis Public Works employee responsible for site operations and maintenance. Mr. Curtis has had this responsibility since the cleanup work was initiated in August 1988, and worked full time at the site through 1995. With the reduced level of operations over the past several years, Mr. Curtis now spends between 4 and 8 hours per week at the site.

Mr. Curtis believes the cleanup effort has been very successful. As a result of his day-to-day experience, he has observed many changes at the site, most notably elimination of chromium discharge to surface water and overall improvements in groundwater quality. Mr. Curtis did not report any problems with the cleanup that would compromise its overall protectiveness.

6.6.2 Community Organizations

CH2M HILL conducted personal and telephone interviews with three community representatives as follows:

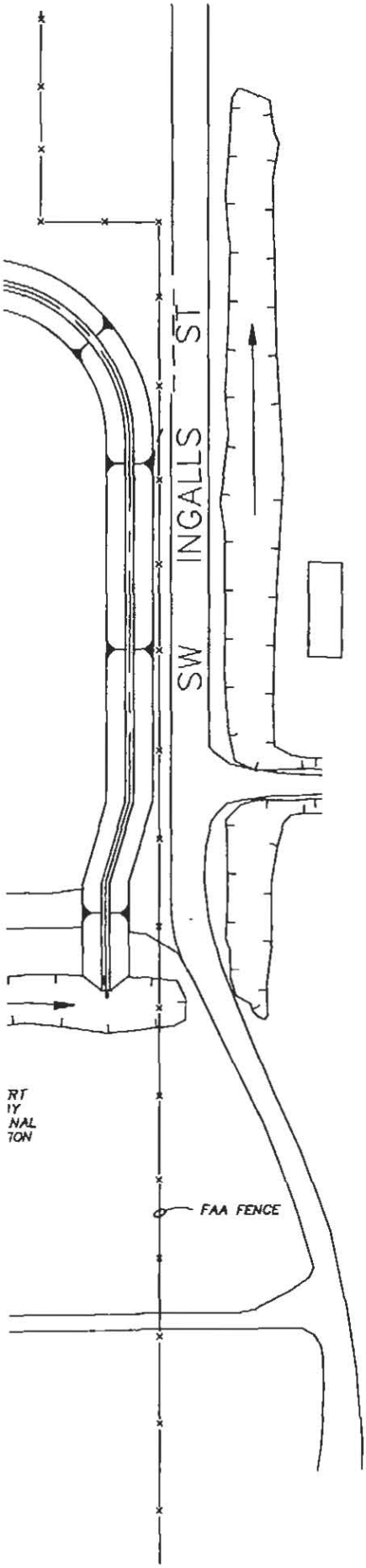
- Corvallis – Benton County Economic Development Council (Doug Sweetland – Manager). This organization was selected for an interview because it has expressed the greatest interest in the site in conjunction with its efforts to develop the property surrounding the airport. Doug Sweetland is the current manager and has been so since 1995. Mr. Sweetland praised the overall cleanup effort and believes the City of Corvallis has done a good job of performing the work. He did not identify any community concerns and feels well informed on cleanup progress.
- City of Corvallis Municipal Airport (Buck Taylor – Manager). The United Chrome site lies within the City of Corvallis Municipal Airport property. Accordingly, this organization was interviewed because it will oversee future development of the site. Buck Taylor is the current manager and has been so since 1998. Mr. Taylor believes the cleanup has been very successful and offered as evidence the lack of concern expressed by Ferril Gas and CoEnergy, who lease property adjacent to the site. Mr. Taylor indicated that the Airport Master Plan designates the United Chrome site as the location of a future fuel farm. According to Mr. Taylor, Ferril Gas, a commercial propane distributor, will most likely relocate onto the United Chrome site when the cleanup is complete.
- Benton County Health Department – Environmental Health Division (Bill Emminger – Deputy Administrator). This organization, which has responsibility for public drinking water protection in the rural areas of Benton County, was interviewed to determine if any concerns or inquiries about the United Chrome cleanup had been received. Mr. Emminger, who has been the Deputy Administrator for the past 8 months, was not familiar with United Chrome and returned CH2M HILL's telephone call after consulting with his staff. Although they still have a file on United Chrome, Mr. Emminger said there were no outstanding issues relevant to the cleanup.

6.6.3 Mailed Questionnaires

CH2M HILL obtained a copy of the most recent mailing list from the City of Corvallis and mailed questionnaires to individuals on the list with no governmental or media affiliation. Seven questionnaires accompanied by a transmittal letter and the November 2002 United Chrome Superfund Fact Sheet were mailed on December 6, 2002 (see Appendix A, Attachment 3). Over a 30-day period, two of the questionnaires were returned as undeliverable, and no response was received for the other five. The telephone directory showed current listings for only three of the seven people on the mailing list, all with the same address used to mail the questionnaires. No attempt was made to telephone these individuals.

6.6.4 Local Residents

Four local residents, who live approximately 1.5 miles northeast of the site, were also interviewed. Three of the four residents, who were interviewed in person, were selected at random to provide geographic coverage for this area. The fourth individual, who works at CH2M HILL, was interviewed over the telephone. Although the residents had heard of United Chrome through historical newspaper coverage, none were familiar with the current situation and did not have a favorable or unfavorable opinion on the cleanup effort.



LEGEND:

ACTIVE DEEP AQUIFER WELLS

⊕	CW-3	MONITORING WELLS (CITY WELLS)
	DW-8	EXTRACTION/MONITORING WELLS

ACTIVE UPPER ZONE WELLS

▫	PIEZO-8	MONITOR WELL
▲	EW-3	EXTRACTION WELL
•	MW-1	MONITOR WELL
•	PL-3	MONITOR WELL
•	BG-2	MONITOR WELL
— · · · —		SURFACE DRAINAGE DITCH
■		BLUE COLORED WELLS INDICATE ACTIVE UPPER ZONE (EW) OR DEEP AQUIFER (DW) EXTRACTION WELLS
▨		AREA WHERE CONTAMINATED SOIL, WITH CHROMIUM CONCENTRATIONS GREATER THAN 6,000 mg/kg, EXCAVATED IN SEPTEMBER 2000
—2002—		ESTIMATED EXTENT OF CHROMIUM IN DEEP AQUIFER GROUNDWATER EXCEEDING 0.1 mg/L CLEANUP GOAL
- - -2002- - -		ESTIMATED EXTENT OF CHROMIUM IN UPPER ZONE GROUNDWATER EXCEEDING 10 mg/L CLEANUP GOAL

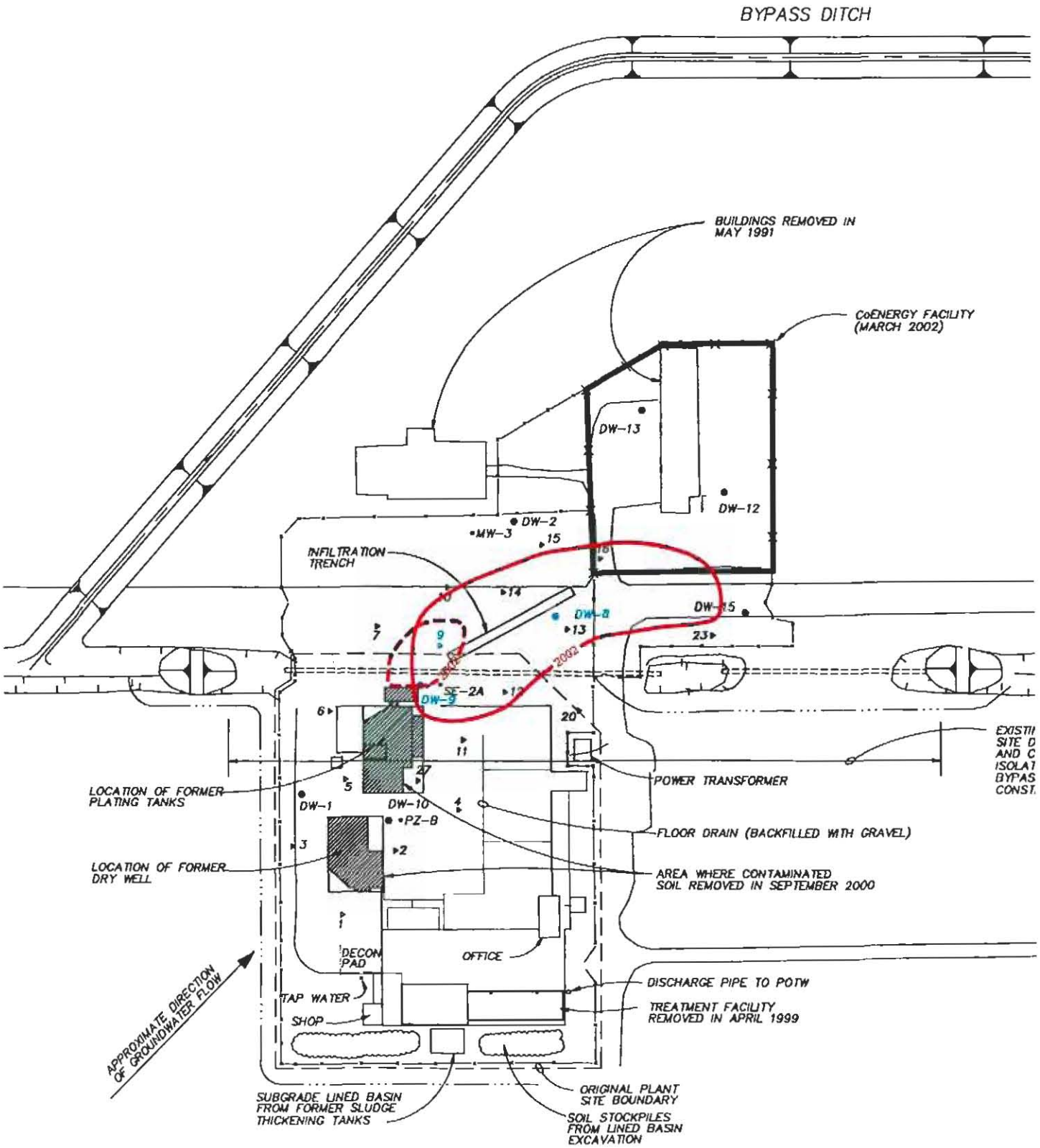
NOTE: INACTIVE MONITOR/EXTRACTION WELLS ARE SHADED GRAY.

0 50 100 150 200
SCALE: FEET

N

FIGURE 6-1
SITE PLAN – DECEMBER 2002
UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

CH2M HILL



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7. Technical Assessment

7. Technical Assessment

This chapter presents a technical assessment of the remedy performance as implemented at the United Chrome Products site. This assessment was prepared to answer the following questions:

- Is the remedy functioning as intended by the decision documents?
- Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives used at the time of remedy selection still valid?
- Has any other information come to light that could call into question the protectiveness of the remedy?

Information used to answer the above questions is discussed in the following sections.

7.1 Is the Remedy Functioning as Intended?

As EPA's design engineer, construction manager, and oversight contractor for the United Chrome Products remedial action, CH2M HILL has developed a comprehensive understanding of site conditions, facility operations and overall cleanup progress. Most of this knowledge has been acquired through 15 years of observing the remedial action and reviewing monthly, quarterly and annual performance monitoring data published by the City of Corvallis.

As described in the ROD, the primary objective for the remedial action was: *"to remove contamination from the confined zone (deep aquifer) and to control further migration of contamination from the upper unconfined zone (upper zone)."* The ROD also defined a cleanup level of 10 mg/L chromium for upper zone groundwater and 0.05 mg/L chromium for deep aquifer groundwater. As described in Section 7.2, the deep aquifer ROD performance standard was changed to 0.1 mg/L in 1992 to align with the new EPA drinking water MCL.

7.1.1 Remedial Action Performance

Control of Upper Zone Contaminant Migration

Control of contaminant migration in upper zone groundwater has been achieved through operation of 23 groundwater extraction wells. This system, which through December 2002 had removed 30.5 million gallons of groundwater containing 31,882 pounds of chromium, has resulted in a significant reduction in the magnitude and size of the chromium plume. Average chromium concentrations in upper zone groundwater decreased from 1923 mg/L in 1988 to 15 mg/L in 2002. The size of the chromium plume, as defined by the 10 mg/L upper zone groundwater ROD performance standard, has decreased from 70,000 square feet to 2,500 square feet (Figure 7-1).

Upper Zone Groundwater Cleanup Progress

Groundwater cleanup progress with respect to the 10 mg/L ROD performance standard has generally been good, although the rate of cleanup has been slower than the five year timeline suggested in the ROD. Cleanup levels have been achieved at all locations except wells EW-5 and EW-9, where chromium concentrations of 12 mg/L and 15 mg/L were observed in December 2002. As shown in Figure 7-2a, chromium concentrations at EW-5 have remained at or slightly above 10 mg/L since November 1999. At well EW-9, chromium concentrations have remained above 10 mg/L since April 2002.

Containment of the Upper Zone Plume

To confirm containment of the upper zone plume, chromium concentrations were initially tracked at wells EW-17, EW-18, EW-21 and EW-23 located along the plume's northeast (downgradient) boundary. As shown in Figure 7-1 the plume boundary has contracted significantly since 1988. Therefore, wells EW-17 and EW-18 were replaced by EW-10, EW-13, EW-14 and EW-15, which are located further upgradient (southwest).

As shown on Figure 7-2b, chromium concentrations in the first set of boundary wells have remained below the 10 mg/L ROD performance standard for the past 12 years. Based on these results, wells EW-17 and EW-18 were abandoned in 2001. The current boundary well group shows that chromium concentrations have remained below the 10 mg/L ROD performance standard at each location since 1998, except for well EW-15, where chromium concentrations temporarily rose above the 10 mg/L ROD performance standard between June 2001 and August 2002. This increase most likely resulted from the August and October 2001 infiltration trench trial.

Contaminant Removal from the Deep Aquifer

Contaminant removal from the deep aquifer has been achieved through operation of a seven well groundwater extraction system. Through December 2002, this system has removed 48.1 million gallons of groundwater containing 122.5 pounds of chromium.

The reduction in contaminant mass is reflected in the reduced size of the plume (Figure 7-3) and the overall decline in the average groundwater concentration from 1.9 mg/L in August 1991 to 0.35 mg/L in December 2002.

Deep Aquifer Cleanup Progress

Groundwater cleanup progress with respect to the 0.1 mg/L ROD performance standard was initially very good. Following the August 1991 startup, chromium concentrations declined fairly rapidly at all locations except for DW-8 (Figure 7-5). At DW-8, the chromium concentration declined steadily from 0.72 mg/L in July 1993 to 0.1 mg/L in December 1996. However, beginning in January 1997, chromium concentrations began to increase, rising to 0.28 mg/L by August 1998. Chromium concentrations remained stable between August 1998 and June 1999, but began to rise again reaching 0.61 mg/L in January 2001.

In February 2001 pumping at well DW-9 was initiated. This action was taken to intercept contaminated pore water believed to be seeping from the upper aquitard between DW-8 and DW-9 resulting in recontamination of DW-8. Routine monitoring of DW-9 has revealed

increasing chromium concentrations, which have risen from 0.13 mg/L to as high as 0.47 mg/L. Additional information on this issue is provided in Section 7.4.

7.1.2 System Operations

Site operation, maintenance and monitoring requirements are prescribed in the *Scope of Work* (CH2M HILL, 1995) and *Pumping Plan* (CH2M HILL, 2001) included as attachments to the Consent Decree. The procedures given in these documents were designed to provide City personnel with the information necessary to assure the remedial action's effectiveness. The overall scope of the monitoring program has been revised on five occasions to reflect changes in site operations. The most recent revision to the Scope of Work was completed in 1995. The Pumping Plan was last revised in 2001.

Compliance with the procedures specified in these documents is assessed through quarterly meetings at the site and through review of monthly, quarterly and annual progress reports prepared by the City. Monitoring activities currently performed at the site are listed in Tables 4-2 and 4-3.

Cost of System Operations

Exclusive of the costs associated with the upper zone soil removal, monthly O&M costs have varied between $25,141 and $34,809 per year over the past five years. These costs are not expected to decline further, and may rise towards the upper end of this range once the performance monitoring programs shifts into the compliance phase.

To assess overall O&M cost with respect to mass of chromium recovered, historical O&M cost information for the 1988 to 2001 timeframe was compiled and compared to the mass of chromium recovered each year. All O&M costs, including those provided in the feasibility study, were converted to year 2001 dollars. These comparisons (Table 7-1) show that although the O&M timeframe has been significantly longer than the five-year timeline estimated in the feasibility study, total O&M costs of $2.67 million are approximately 10 percent lower than the $3.07 million estimate provided in the feasibility study. Annual O&M costs per pound of chromium recovered, in year 2001 dollars, varied from a low of $18 in 2000, when the upper zone soil removal work was performed, to a high of $515 in 2001, when only 49 pounds of chromium was recovered at an O&M cost of $25,141.

7.1.3 Implementation of Institutional Controls and Other Measures

Institutional controls were instituted at the site in 1989 and have continued to date. These controls include securing the site with a 6-foot chain link fence and locking security gate to prevent unauthorized access to the site. Additional fencing recently installed by the FAA, which encloses the entire airport complex, provides additional security to guard against unauthorized entry. In accordance with the consent decree, in 1992 the City placed a deed restriction on the United Chrome property, which is owned by the City, to restrict groundwater use and well pumping (see Appendix D). The deed restriction runs with the land. The groundwater use restriction easement areal extent includes all upper zone and deep aquifer groundwater which exceeds the chromium drinking water MCL.

TABLE 7-1
Comparison of Annual O&M Costs
United Chrome Products, Corvallis, OR

Year	FS Cost ($)[1]		Actual Cost ($)				Pounds of Chromium Removed	Cost per Pound of Chromium Removed
			Costs Estimated by CH2M HILL[2]		Costs Reported by the City of Corvallis[3,4]			
	1985	2001[5]	Annual	2001[5]	Annual	2001[5]		
1985	261,000							
1988	118,968	214,331	92,580	158,343			3501	$45
1989	317,247	569,730	246,880	422,249			9875	$43
1990	333,109	569,730	246,880	422,249			10,940	$39
1991	349,765	569,730	246,880	402,142			3579	$112
1992	367,253	569,730	246,880	382,992			1868	$205
1993	385,616	569,730			100,985	149,201	677	$220
1994					46,948	66,061	434	$152
1995					49,292	66,056	324	$204
1996					25,000	31,907	206	$155
1997					26,084	31,706	170	$187
1998					34,809	40,296	140	$287
1999					25,507	28,121	121	$232
2000					424,124	445,330	24,618	$18
2001					25,141	25,141	49	$515
Total (2001		**$3,072,983**				**$2,671,792**	**56,542 lbs.**	
Average								**$172**

References:
1. ROD, EPA, 1986.
2. Performance Evaluation for Upper Zone Operations 1989 to 1991, CH2M HILL, 1991.
3. United Chrome Process Modification Request, City of Corvallis, 1994.
4. Personal communication, CH2M HILL, 2002.
5. Year 2001 cost assumes 5% interest rate.

7.1.4 Opportunities for Optimization

Optimization has been a constant focus for EPA and the City operations staff. The City has pursued measures that have permitted greater control over operation costs. Treatment system modifications (Table 4-1) increased the throughput rate allowing more groundwater to be treated in less time, thereby reducing the number of labor hours per gallon of groundwater treated. Development of the 7-pound-per-day local limit, and installation of a

man-down alarm, allowed the City to staff the site with one person further reducing operation costs. These savings are evident by reduced O&M costs, which declined from an estimated $247,000 in 1989 to $25,000 in 2001.

Although EPA has also supported cost saving optimization efforts, most notably those available through reduced monitoring frequencies, EPA's primary focus has been to find opportunities for accelerating and achieving a more thorough cleanup effort. The EPA sponsored upper zone source investigation was the most important of these efforts. This action, which resulted in the excavation of 1956 tons of contaminated soil, is believed to have removed 24,540 pounds[1] of sparingly soluble chromium. Based on the chromium recovery rate of 75 pounds per year observed between January and December 2000, it would have taken over 300 years to recover this amount of chromium from the upper zone groundwater extraction system.

7.1.5 Indicators of Potential Remedy Problems

Upper Zone

In June 1998, following several years with no measurable decline in upper zone and deep aquifer chromium concentrations, EPA conducted an investigation to assess the effectiveness of soil flushing operations. This investigation revealed the presence of solid phase chromium at concentrations up to 23,200 mg/Kg in upper zone soil despite 12 years of infiltration basin flushing. Toxicity characteristic leaching procedure (TCLP) and synthetic precipitation leaching procedure (SPLP) testing indicated that if soil containing chromium concentrations greater than 6,000 mg/Kg were removed the upper zone groundwater ROD performance standard of 10 mg/L could be achieved. Based on the findings of this investigation, in October 2000 the City excavated 1,956 tons of soil from the upper zone adjacent to and underlying the former dry well and plating tank sites.

Despite the excavation effort, chromium concentrations at two wells EW-5 and EW-9 continue to hover at or slightly above the 10 mg/L upper zone ROD performance standard. Initially it was believed that small amounts of dissolved phase chromium remained in the area between the excavation boundaries and the well, and this contamination would eventually be flushed out with continued pumping. While pumping at EW-9 continues, it's possible that small pockets of contaminated soil (Figure 7-4) present in the vicinity of soil borings PT-18 (5810 mg/Kg) and PT-25 (5700 mg/Kg), with chromium concentrations slightly below the 6000 mg/Kg upper zone groundwater protective level, may be inhibiting attainment of the groundwater cleanup standard at these two well locations.

Deep Aquifer

In the deep aquifer, the cleanup standard has been achieved at all wells except DW-8 and DW-9. After approaching the 0.1 mg/L ROD performance standard in January 1997, chromium concentrations at these two wells have trended up (see Figure 7-5) and are currently at 0.24 mg/L and 0.44 mg/L respectively. This trend coupled with laboratory analysis of samples collected in 1991 indicates that chromium contaminated pore water is draining from the upper aquitard into the deep aquifer. Current information indicates that approximately 0.5 pounds of chromium are discharged from the upper aquitard and

[1] Pounds of chromium = 1956 tons * 2000 lbs/ton * 1 kg/2.2 lbs * 6265 mg chromium/Kg * 1 lb/454,000 mg = 24,540 lbs.

recovered by deep aquifer pumping each month. The estimated concentration of the pore water after mixing with deep aquifer groundwater is 3.2 mg/L. This estimate, obtained from Figure 4-5 of the *Deep Aquifer Performance Evaluation Report* (CH2M HILL 1995), is similar to recent depth discrete groundwater sampling results collected by the City from wells DW-8 and DW-9 which revealed chromium concentrations of 2.3 and 1.2 mg/L in samples collected at depths corresponding to the boundary between the upper aquitard and deep aquifer.

7.2 Have the Assumptions on Which the Remedy was Based Changed?

7.2.1 Changes in Standards and to be Considered

Federal regulations identified in the ROD included the Safe Drinking Water Act (SDWA), the Resource Conservation and Recovery Act (RCRA), and the Clean Water Act (CWA). State of Oregon guidelines referenced in the ROD included the Oregon Groundwater Quality Protection policy.

The SDWA has been revised on several occasions since 1986 to incorporate changes associated with regulation of additional contaminants, and to incorporate new information developed from toxicity studies. In 1991 the drinking water MCL for chromium was revised upward from 0.05 mg/L to 0.1 mg/L. The basis for this change is not known, but it may have been related to studies showing that hexavalent chromium has a reduced toxicity through the ingestion pathway. This change does not have a measurable effect on the protectiveness of the deep aquifer cleanup.

The primary changes in RCRA that have occurred since the ROD, that have affected removal actions at the site, were the land disposal restrictions which require treatment of chromium contaminated soil excavated after May 8, 1992, to a level of 0.6 mg/L (measured as TCLP chromium) prior to landfill placement.

The Oregon Groundwater Quality Protection Policy was promulgated in 1989 as Oregon Administrative (OAR) 340-40 Groundwater Quality Protection. Although the rule contains a chromium standard of 0.05 mg/L, removal and remedial actions administered under other State programs are not subject to the rule.

In 1995 the State of Oregon implemented the Hazardous Substance Remedial Rules (OAR 340-122), which require remedial actions to achieve acceptable risk levels for human and ecological receptors. Based on existing information, the current site cleanup goals for upper zone and deep aquifer groundwater meet the acceptable risk level requirement (see Table 7-2).

TABLE 7-2
Comparison of Groundwater and Soil Cleanup Levels
United Chrome Products, Corvallis, OR

	MCL		Site Specific[2]		Year 2002 PRGs[3]	
Media	**1985**	**2002**	**1985**	**2002**	**Residential**	**Industrial**
Groundwater (mg/L)						
- Upper Zone	NA[1]	NA	10	10	NA	NA
- Deep Aquifer	0.05	0.1	NA	NA	0.11	NA
Soil (mg/kg)	NA	NA	NA	428	210	450

Notes:
1. NA = not applicable
2. Site-specific upper zone groundwater cleanup level from ROD (EPA 1986). Soil cleanup level calculated by DEQ (2002) based on site-specific hexavalent chromium to total chromium ratio.
3. PRG = Region 9 preliminary remediation goals are risk-based screening concentrations corresponding to a 1.0E-06 human health cancer risk or non-cancer hazard index of 1.0. The PRGs are based on conservative assumptions, which may differ from site conditions.

7.2.2 Changes in Cleanup Levels

The 0.05 mg/L deep aquifer groundwater cleanup level specified in the ROD was set based on the drinking water MCL applicable in 1986. A cleanup level of 10 mg/L was specified for upper zone groundwater, because due to low and unreliable yield, it did not represent a drinking water source. The 10 mg/L cleanup level, is a site-specific standard designed to protect deep aquifer groundwater at a water supply well located 3000 feet northeast of the site.

On January 31, 1991, EPA revised the drinking water MCL from 0.05 mg/L to 0.1 mg/L (56 FR 3526, USEPA, 1991). Accordingly the deep aquifer cleanup level was changed to 0.1 mg/L in 1991 to align with the new MCL (Interim Closeout Report, EPA 1991). No corresponding change was made to the 10 mg/L upper zone cleanup level.

No further changes to the chromium drinking water MCL have been made since 1991.

7.2.3 Changes in Exposure Pathways

A baseline risk assessment for the United Chrome site was not completed in conjunction with preparation of the RI/FS report. However, from language contained in the ROD, ingestion of contaminated groundwater was the primary exposure pathway of concern. Drinking water for the airport industrial park is now obtained from the City of Corvallis Taylor Water Treatment Plant. Therefore, there are no current groundwater users. Additionally, local ordinances and the groundwater pumping exclusion zone (see Appendix D) established around United Chrome by the Consent Decree would prevent installation of future drinking water wells within the airport industrial park.

Exposure to contaminated soil through ingestion, inhalation and dermal contact was not addressed in the ROD. To determine if residual risk associated with contaminated soil

remaining at the site is present, the Oregon DEQ conducted a screening level risk assessment in 2002. In their risk screening, the DEQ evaluated the following exposure scenarios:

- Industrial /Commercial Worker. Future workers engaged in site activity could come in contract with contaminated surface soil (0-3ft bgs). These workers are assumed to be on-site for 250 days a year for 25 years.
- Excavation Worker. Future excavation workers could come in contact with contaminated surface and subsurface soil (0 to 12.5-ft bgs) during maintenance or alteration of existing landscape, or to install and repair underground utilities and building foundations. These workers are assumed to be on-site for 9 days for one year.
- Residential Scenario. To evaluate an "unrestricted use scenario", it is assumed that the United Chrome Products site could become a residential setting in the future. Children and adults were assumed to be exposed to contaminated surface soil for 350 days per year over a 30-year timeframe.

The results from DEQ's risk screening are summarized below. The risk calculations are based on DEQ exposure assumptions and exposure concentrations of 4040 mg/kg chromium (onsite surface soil) and 4962 mg/kg (onsite subsurface soil).

Industrial/Commercial Worker

Cancer and noncancer risks associated with exposure to the chromium reasonable maximum exposure (RME) concentration in surface soil by an industrial/commercial worker are 6E-05 and 0.7, respectively. Thus, noncancer risks are within the acceptable levels (less than 1.0) for Oregon. However, cancer risks exceed the acceptable risk level of 1E-06. The cancer and noncancer risk levels are acceptable per EPA requirements.

Excavation Worker

Cancer and noncancer risks associated with exposure to the chromium RME concentration in subsurface soil by a future industrial/commercial worker are 5E-08 and 0.06, respectively. Thus, the cancer and noncancer risks are within the acceptable levels for Oregon. They would also be acceptable under EPA requirements.

Resident

To assess United Chrome site risk under an unrestricted use and unrestricted exposure scenario, cancer and noncancer risks associated with exposure to the chromium RME concentration in onsite surface soil by a resident were calculated resulting in a cancer and noncancer risk of 1E-04 and 18, respectively. The cancer risk exceeds Oregon requirements and is at the lower end of that preferred by EPA. The noncancer risk exceeds both Oregon and EPA requirements.

7.3 Has Any Other Information Come to Light that Could Effect the Remedy's Protectiveness?

Although the surface water monitoring program was discontinued in 1991 following construction of the bypass ditch and review of monitoring data collected between 1989 and 1991 (*Performance Evaluation of Site Remediation for the United Chrome Products Site April 1989 to May 1991*, CH2M HILL 1991) concerns about residual chromium in the drainage ditch sediment remain.

In July 2002 the DEQ completed a review of surface water data collected in the vicinity of the United Chrome Products site in 1984, 1989, 1991, and 1993 (*Recommendations for Evaluating Ecological Risk at the United Chrome Superfund Site, Corvallis, Oregon*, DEQ 2002). This review concluded that:

- Surface water samples collected in 1984 showed aluminum, barium, chromium, copper, iron, lead, manganese, mercury, and vanadium concentrations above DEQ's Level II Aquatic Screening Benchmark Values (SBVs) (DEQ, 1998).
- Surface water samples collected between April 1989 and March 1991, prior to completion of the bypass ditch, showed elevated levels of hexavalent chromium at locations between the site culvert, Dry Creek, and the Booneville Slough.
- Surface water samples collected adjacent to and downstream of the site in June 1993 showed cadmium, chromium, hexavalent chromium, copper, lead, and zinc in surface water at concentrations greater than the DEQ aquatic SBVs.

Surface water, sediment, flora, and fish tissue data were also collected by DEQ in 1988 as part of the "Drinking Water Impact Investigation" (DEQ, 1988). This investigation analyzed for dissolved chromium and hexavalent chromium in surface water, and total chromium and lead in surface water, sediment, vegetation, and fish. Sample locations SWS19, SWS12 in Dry Creek contained elevated levels of chromium and lead in surface water. Chromium was detected in sediments at concentrations above the Threshold Effect Level (TEC) (MacDonald, 2000) at all locations along the West Fork Booneville Channel (SWS12, SWS13, SWS14, and SWS16).

7.3.1 DEQ Recommendations

Based on the existing surface water and sediment data, DEQ concluded that site related metal contamination once extended from United Chrome to the West Fork Booneville Channel. However, the current extent and magnitude of this contamination, approximately 12 years after the construction of the by-pass ditch, is unknown. To determine if ecological risk is still present, DEQ recommended the following:

- Conduct a Level I Risk Scoping per current DEQ guidance (DEQ, 1998).
- Conduct a Level II Risk Screening per current DEQ guidance. This would include sampling to determine the current extent and magnitude of the surface water and sediment contamination. Proposed sampling locations and analysis parameters are described in *Recommendations for Evaluating Ecological Risk at the United Chrome Superfund Site, Corvallis, Oregon* (DEQ, 2002).

These recommendations were communicated to the City in an August 22, 2002 meeting. At the time of this review, the Level I Scoping Report had been completed, and surface water and sediment samples collected and analyzed in accordance with DEQ's recommendations. The scope of further ecological risk evaluation work will be determined following EPA review of the City's surface water and sediment analysis results.

7.4 Technical Assessment Summary

The United Chrome Products remedy has been very successful. Through December 2002, groundwater cleanup standards have been achieved at 47 of 49 upper zone and 15 of 17 deep aquifer well locations. Unfortunately, remediation of a small portion of the upper zone plume in the vicinity of well EW-9, and a low-volume, natural discharge of chromium contaminated pore water from the upper aquitard to the deep aquifer have prevented cleanup levels from being attained at the remaining well locations.

Verification sampling performed during the October 2000 source removal work indicates that residual chromium contamination between 20 mg/Kg (background) and 6000 mg/Kg remains in upper zone soil. Although this material is not expected to prevent the upper zone groundwater 10 mg/L ROD performance standard from being achieved, it will prevent the site from attaining an unrestricted use and unrestricted exposure status under both Federal and State regulations.

Long-term management of waste material, such as that remaining in the upper zone and upper aquitard, was not foreseen in the ROD. The description of the selected remedy, which was a combination of feasibility study alternatives 5 and 9, indicates that "these two remedial activities [soil flushing/unconfined zone groundwater extraction] will complement each other to remove **all sources** of confined aquifer contamination".

Given sufficient time, natural flushing and elements of the remedy still in operation at the site will most likely restore chromium concentrations in upper zone and upper aquitard soil and deep aquifer groundwater to levels that would be protective under most reasonable exposure scenarios. However, the rate of remediation will be slow and the cost potentially disproportional to the overall environmental benefit.

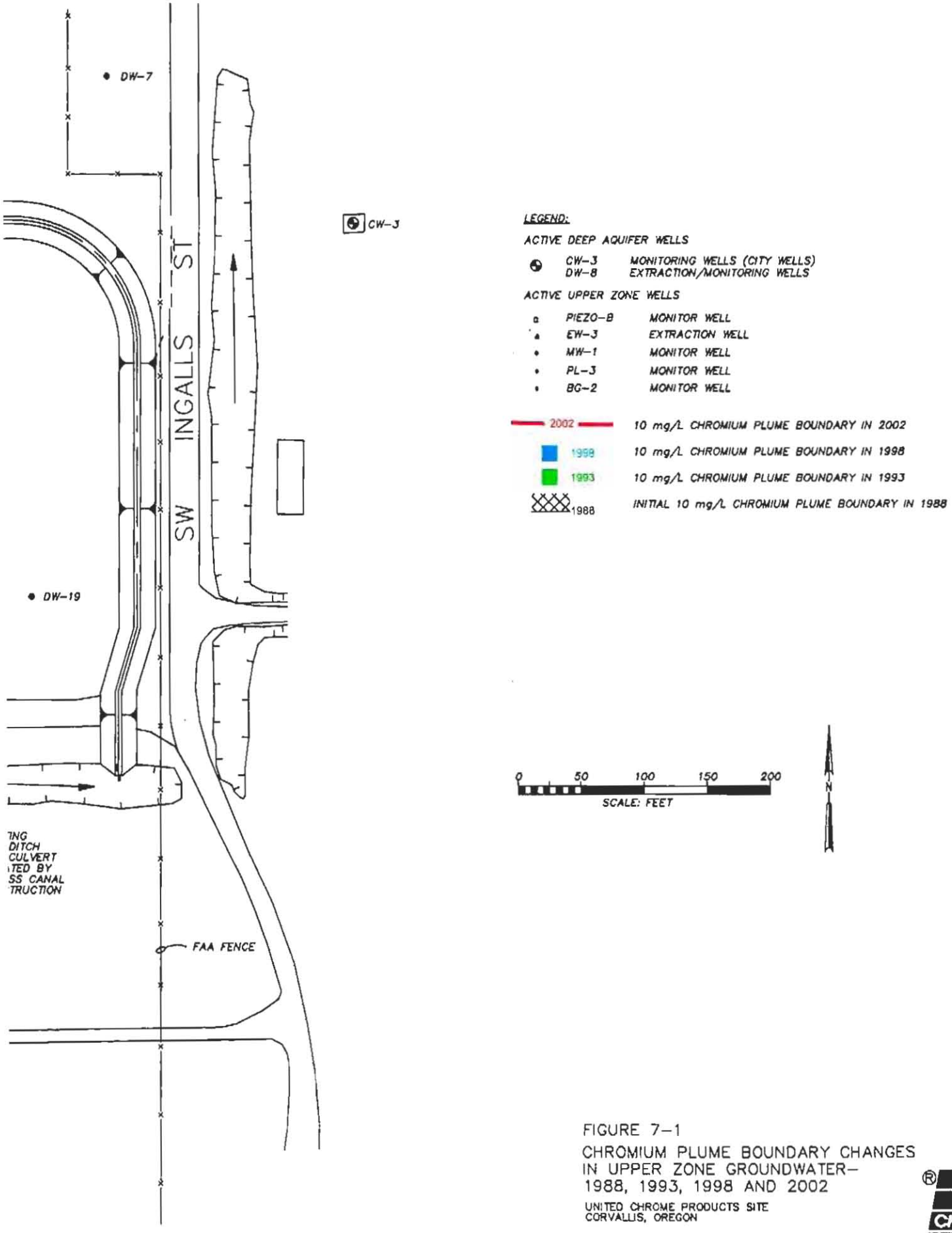
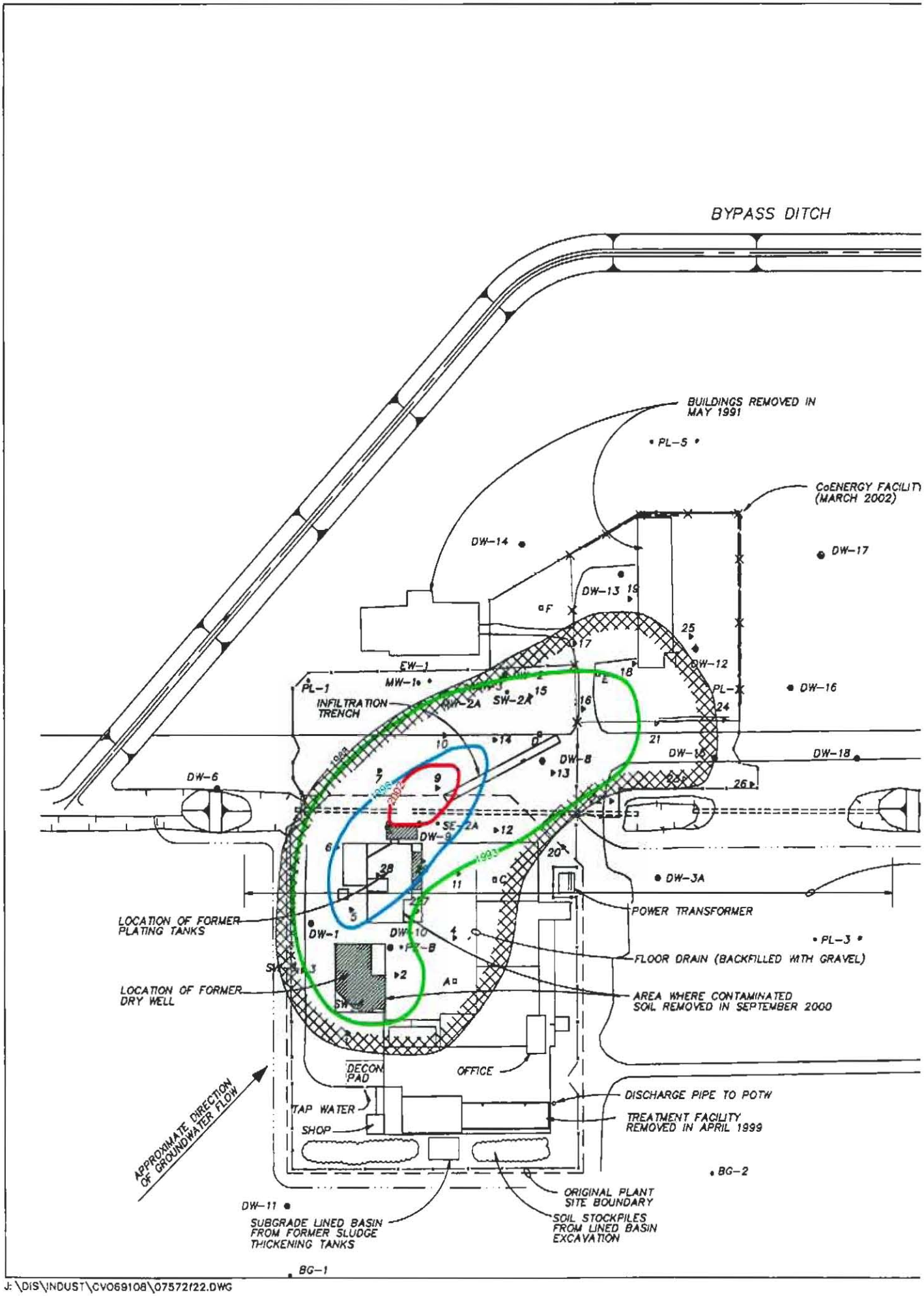


FIGURE 7-1

CHROMIUM PLUME BOUNDARY CHANGES IN UPPER ZONE GROUNDWATER-1988, 1993, 1998 AND 2002

UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

CH2M HILL



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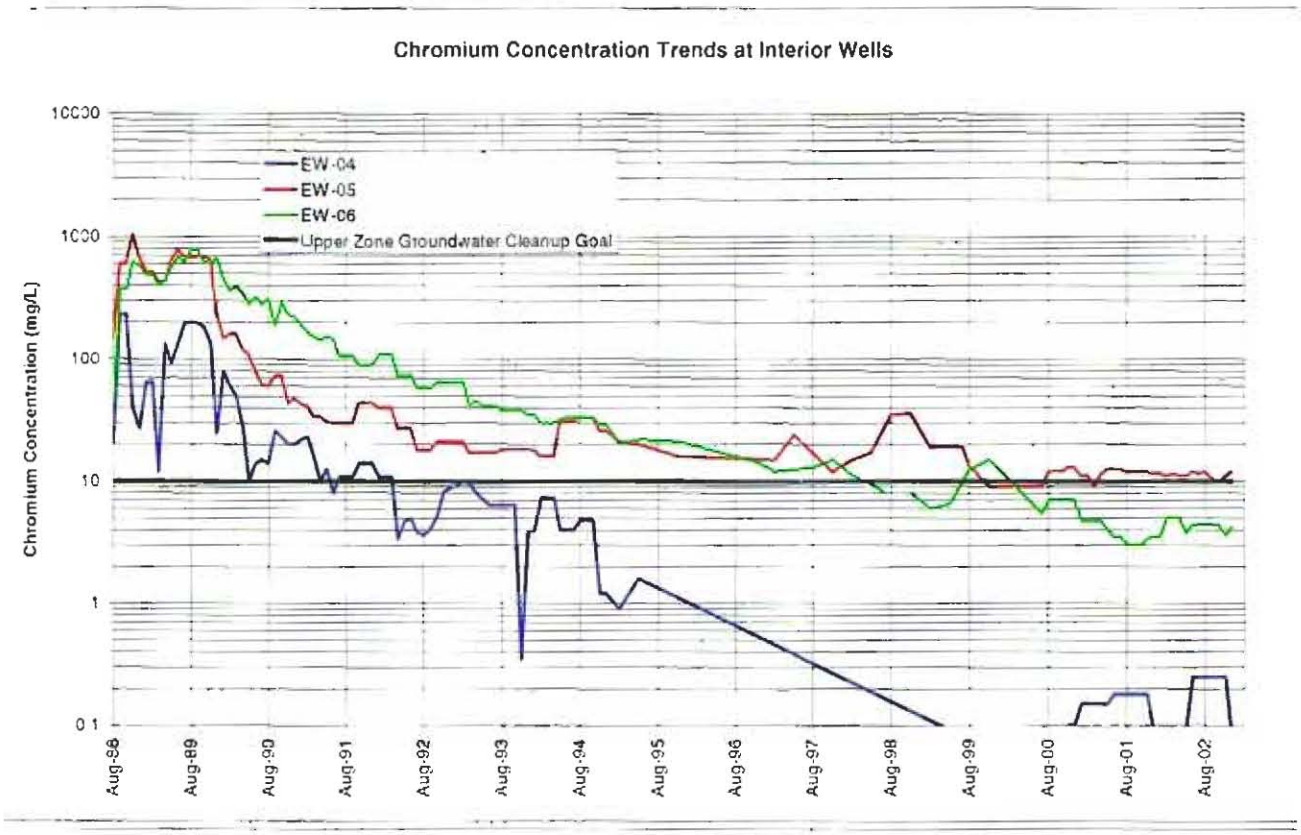


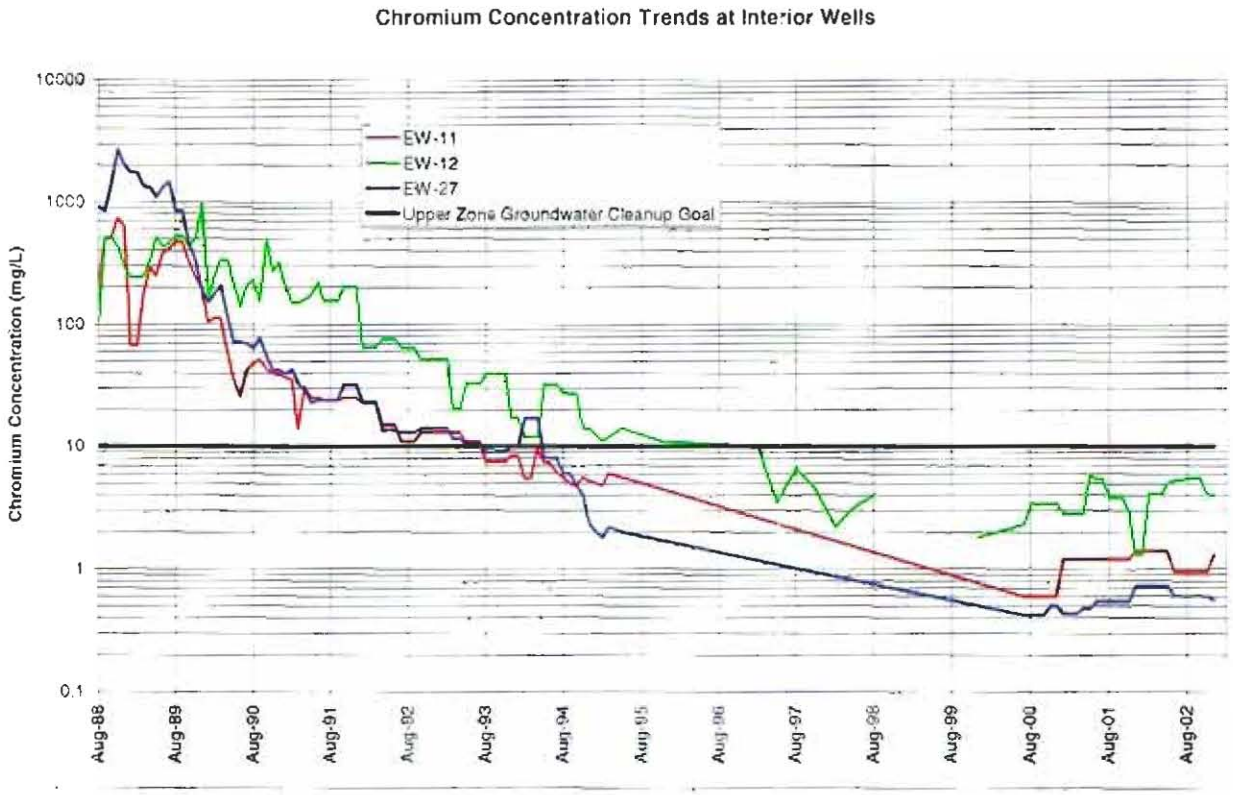
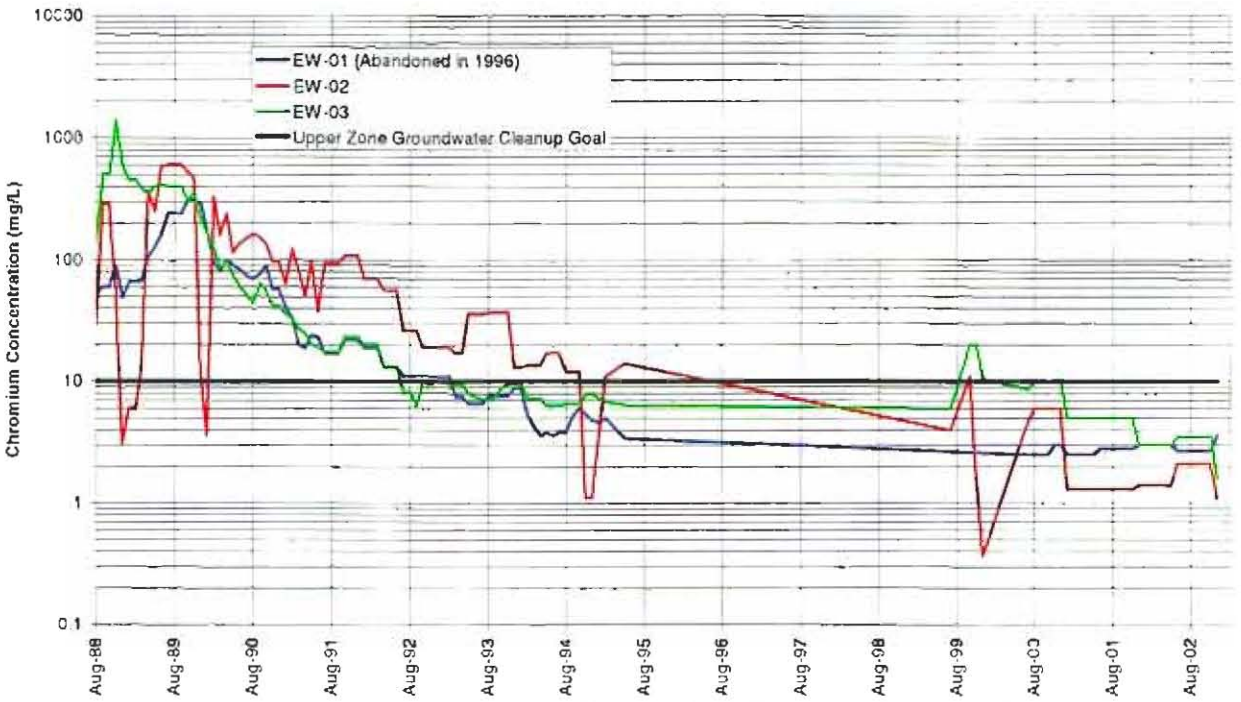
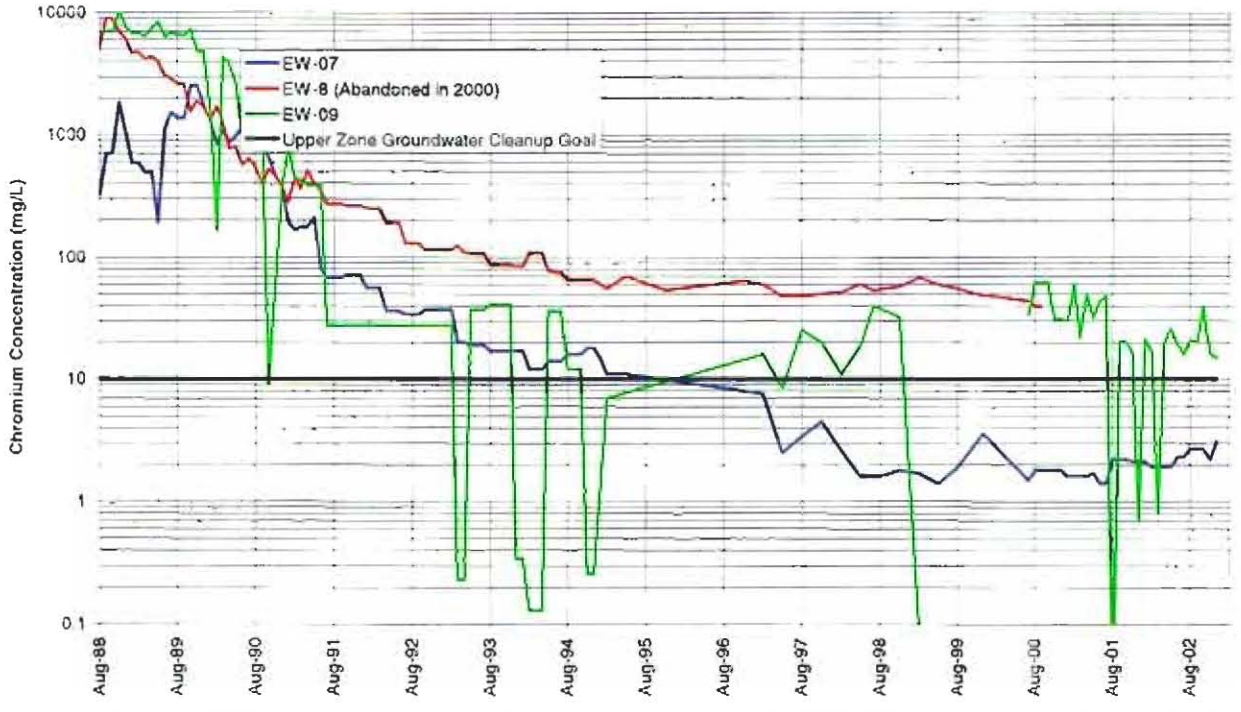


Figure 7-2a
Upper Zone Groundwater Chromium Concentration Trends
United Chrome Products Site
Corvallis, Oregon

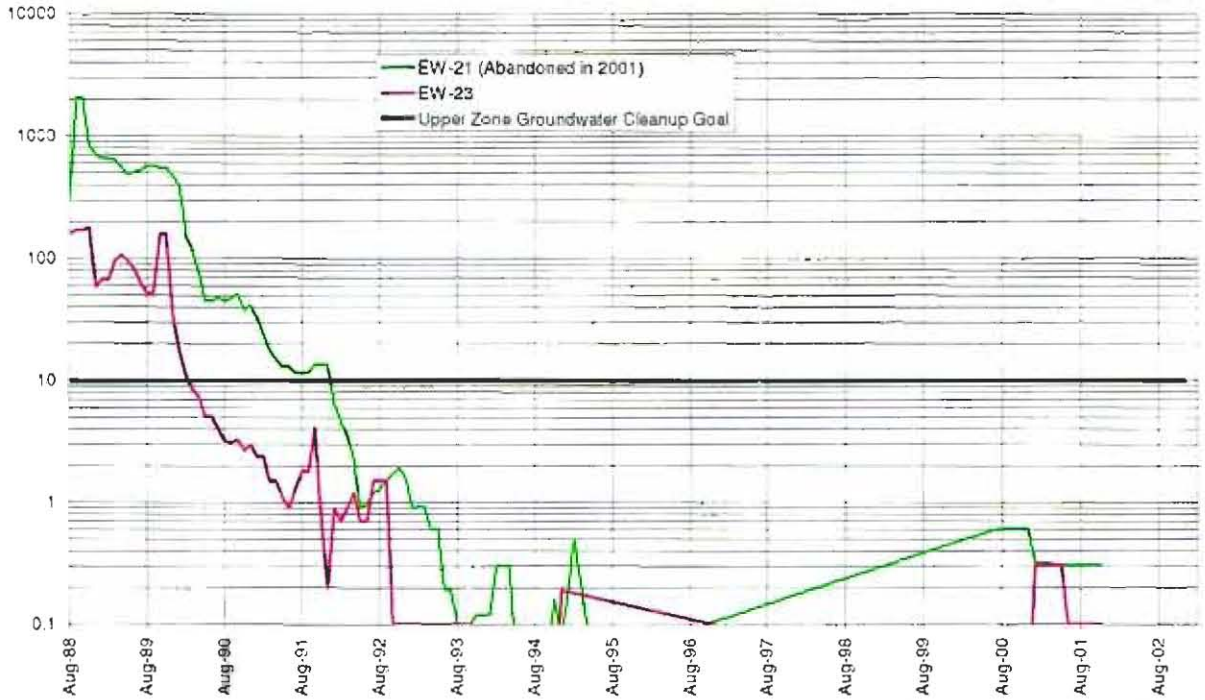
Chromium Concentration Trends at Interior Wells



Chromium Concentration Trends at Interior Wells



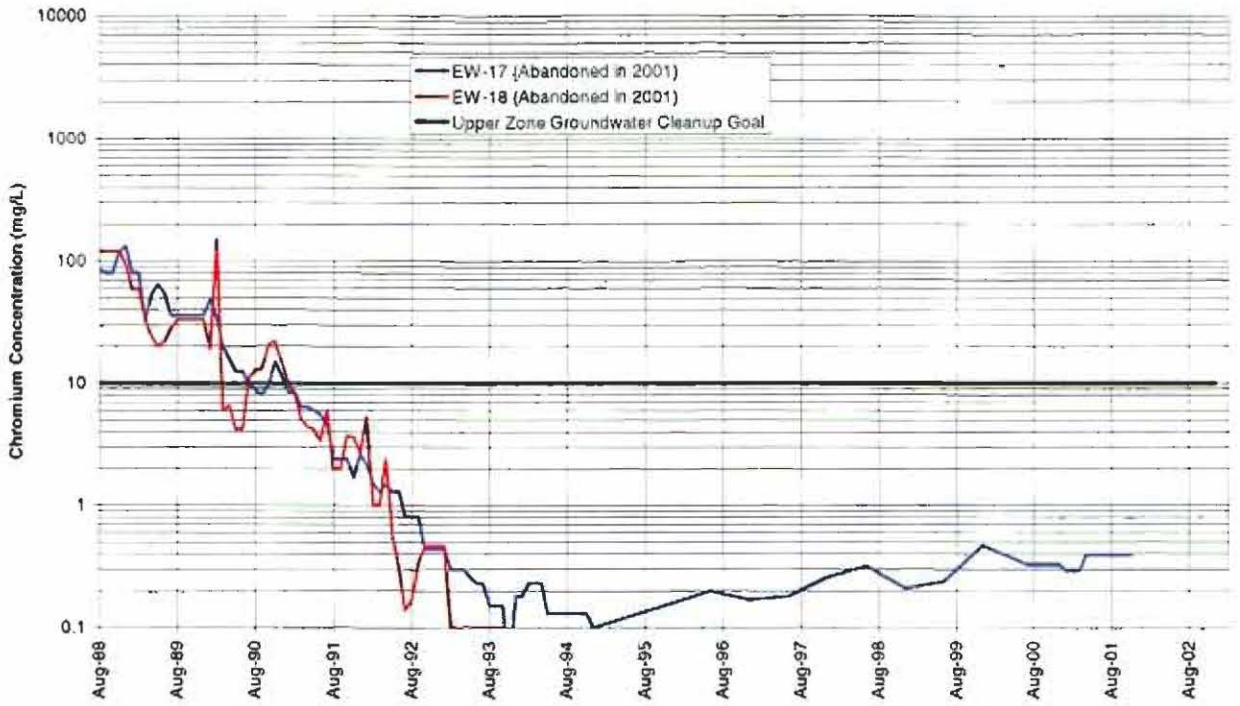
Chromium Concentration Trends at Year 1992 to 2000 Boundary Wells



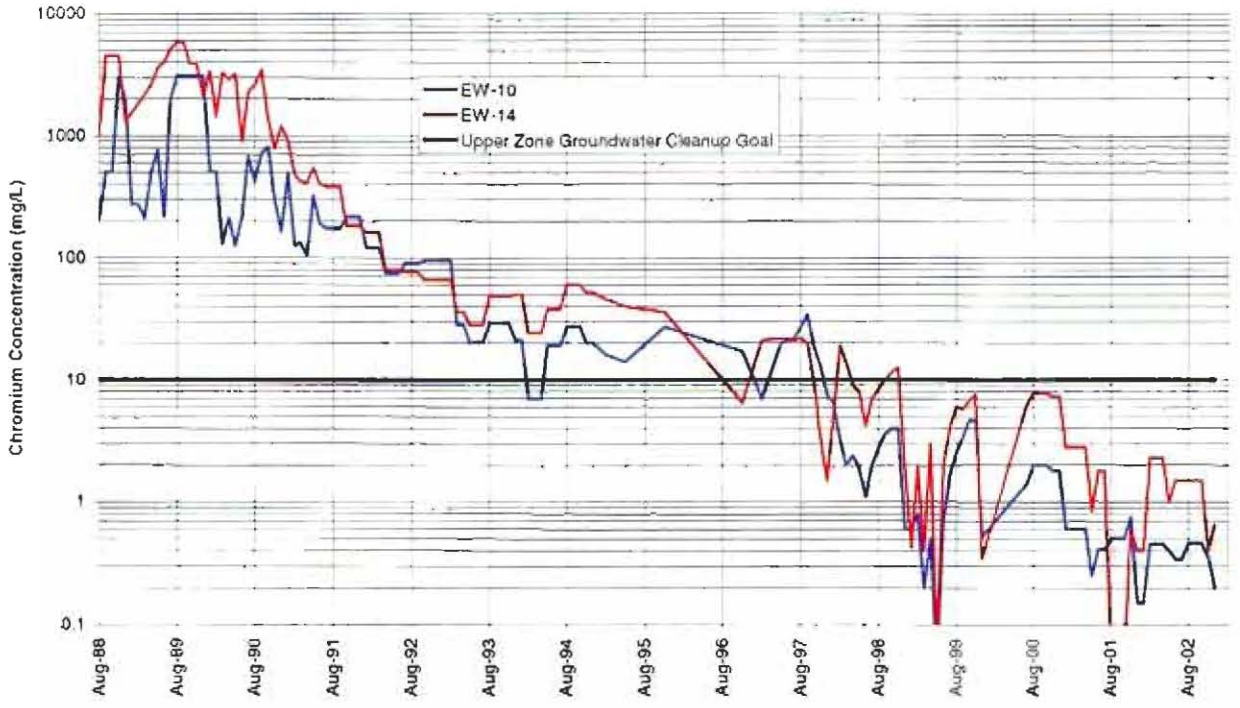
Chromium Concentration Trends at Year 2000 to 2002 Boundary Wells

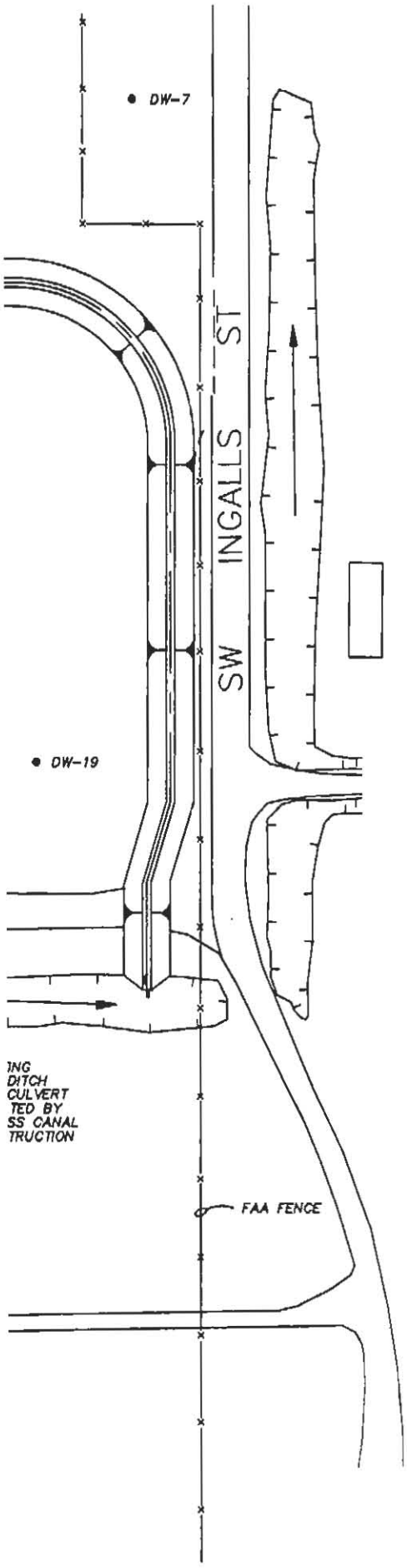
Figure 7-2b
Upper Zone Groundwater Chromium Concentration Trends
United Chrome Products Site
Corvallis, Oregon

Chromium Concentration Trends at Year 1992 to 2000 Boundary Wells



Chromium Concentration Trends at Year 2000 to 2002 Boundary Wells





LEGEND:

ACTIVE DEEP AQUIFER WELLS

⊕	CW-3	MONITORING WELLS (CITY WELLS)
	DW-8	EXTRACTION/MONITORING WELLS

ACTIVE UPPER ZONE WELLS

▫	PIEZO-B	MONITOR WELL
▲	EW-3	EXTRACTION WELL
•	MW-1	MONITOR WELL
•	PL-3	MONITOR WELL
•	BG-2	MONITOR WELL

2002	0.1 mg/L CHROMIUM PLUME BOUNDARY IN 2002
1998	0.1 mg/L CHROMIUM PLUME BOUNDARY IN 1998
1993	0.1 mg/L CHROMIUM PLUME BOUNDARY IN 1993
1988	INITIAL 0.1 mg/L CHROMIUM PLUME BOUNDARY IN 1988

0 50 100 150 200

SCALE: FEET

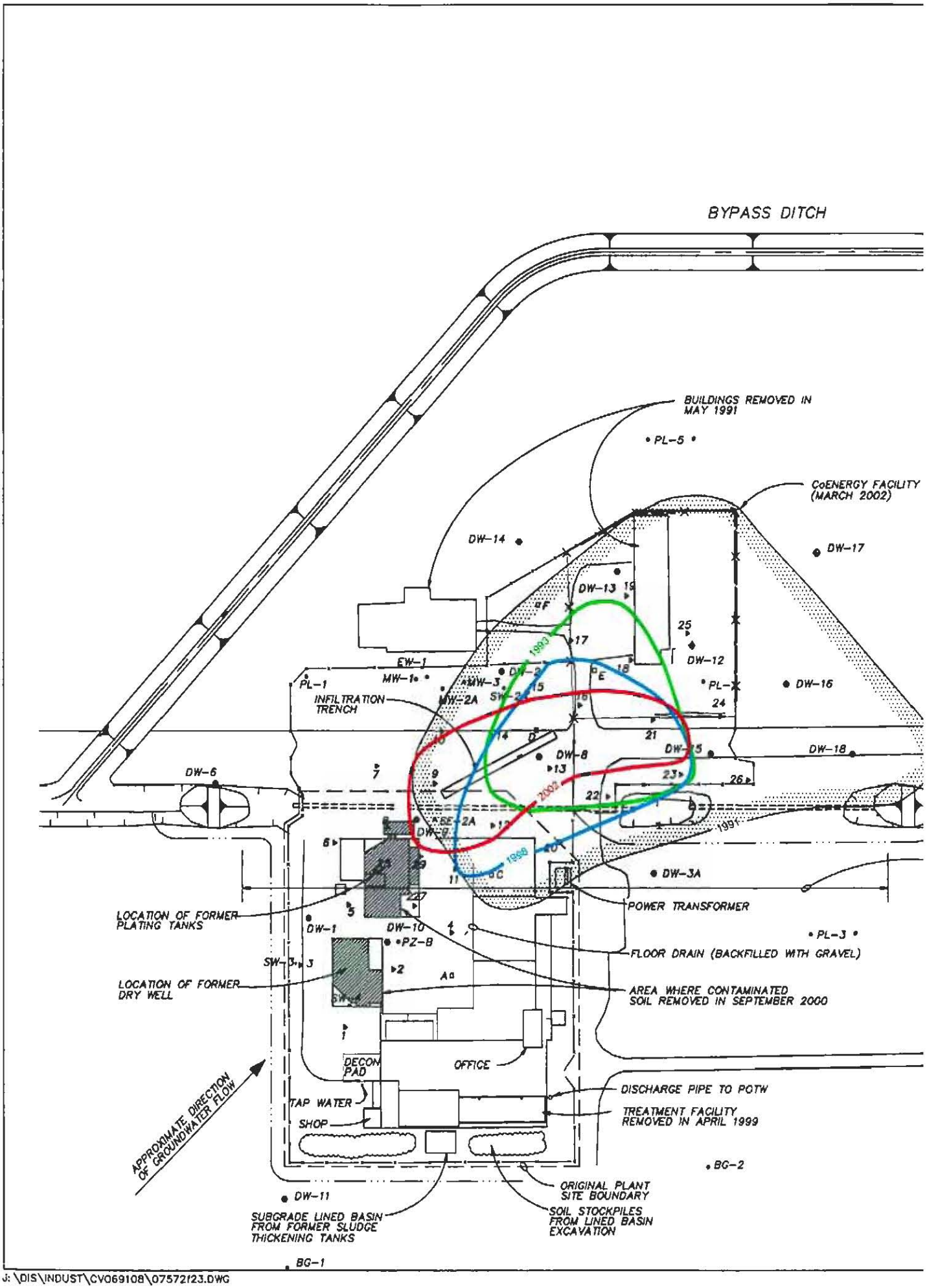
N

FIGURE 7-3

CHROMIUM PLUME BOUNDARY CHANGES IN DEEP AQUIFER GROUNDWATER-1991, 1993, 1998 AND 2002

UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

CH2M HILL



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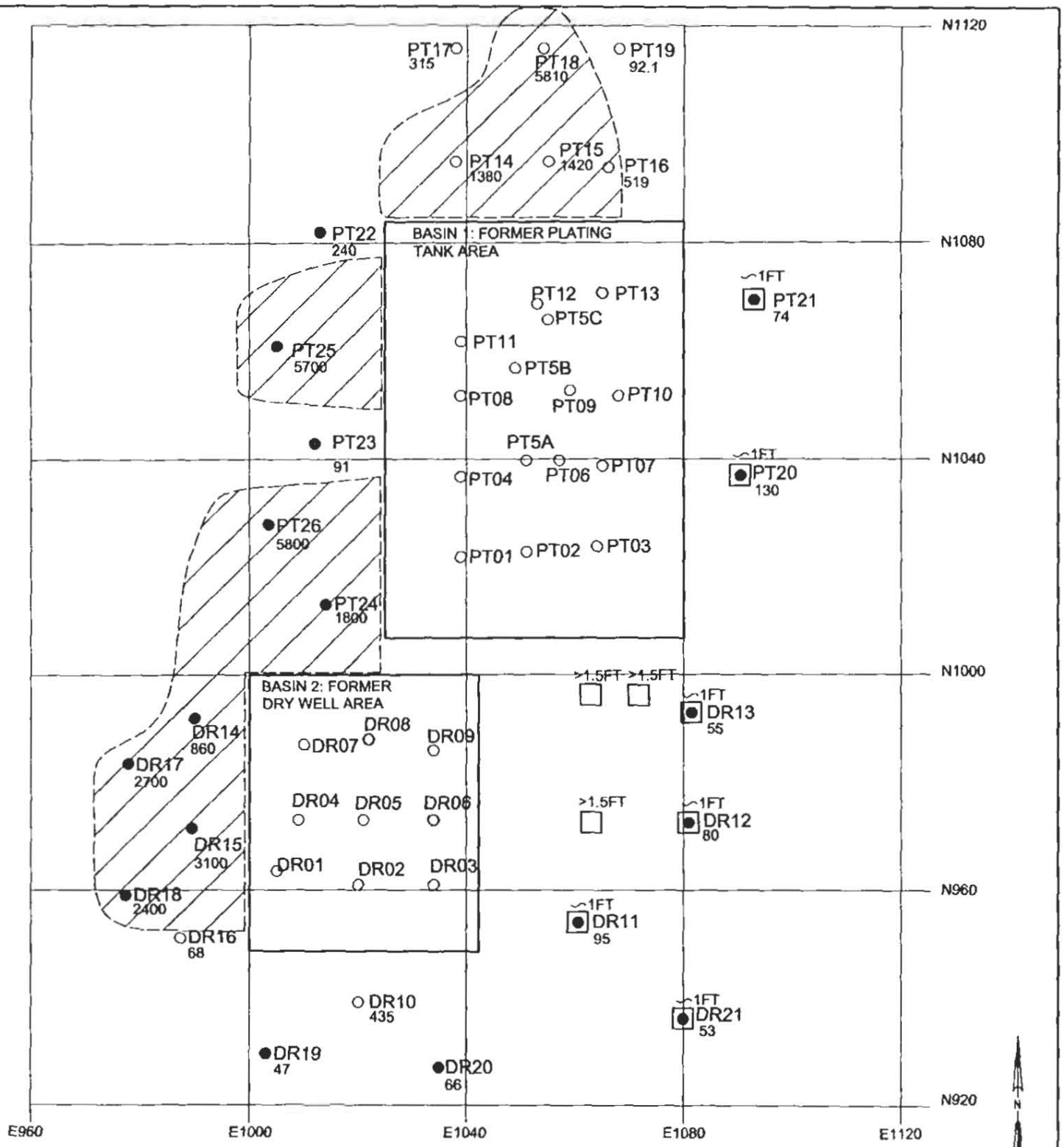


>1.5FT LOCATIONS WHERE CONCRETE CORING OCCURRED AND THICKNESS OF CONCRETE OBSERVED

○ PHASE I GEOPROBE BORING

● PHASE II GEOPROBE BORING AND MAXIMUM OBSERVED CHROMIUM CONCENTRATION

ESTIMATED AREA WITH CHROMIUM CONCENTRATION IN SOIL GREATER THAN 428 mg/kg

0 10 20 30 40
SCALE IN FEET

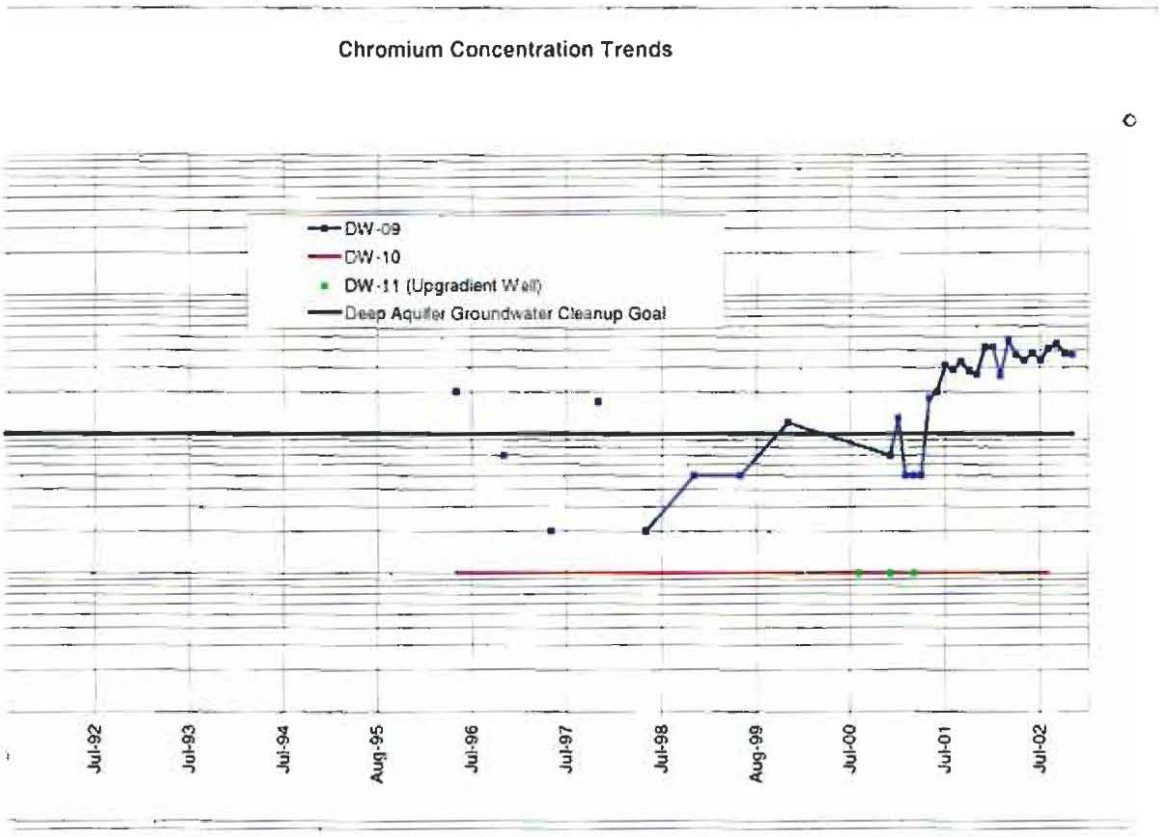
FIGURE 7-4

AREAS OF UPPER ZONE SOIL WITH CHROMIUM CONCENTRATIONS GREATER THAN 1.0E-06 PROTECTIVE LEVEL FOR RESIDENTIAL EXPOSURE

UNITED CHROME PRODUCTS SITE
CORVALLIS, OR

K:\PRJ\NDMMISC\U_CHROME\107572f13.DWG

CH2MHILL



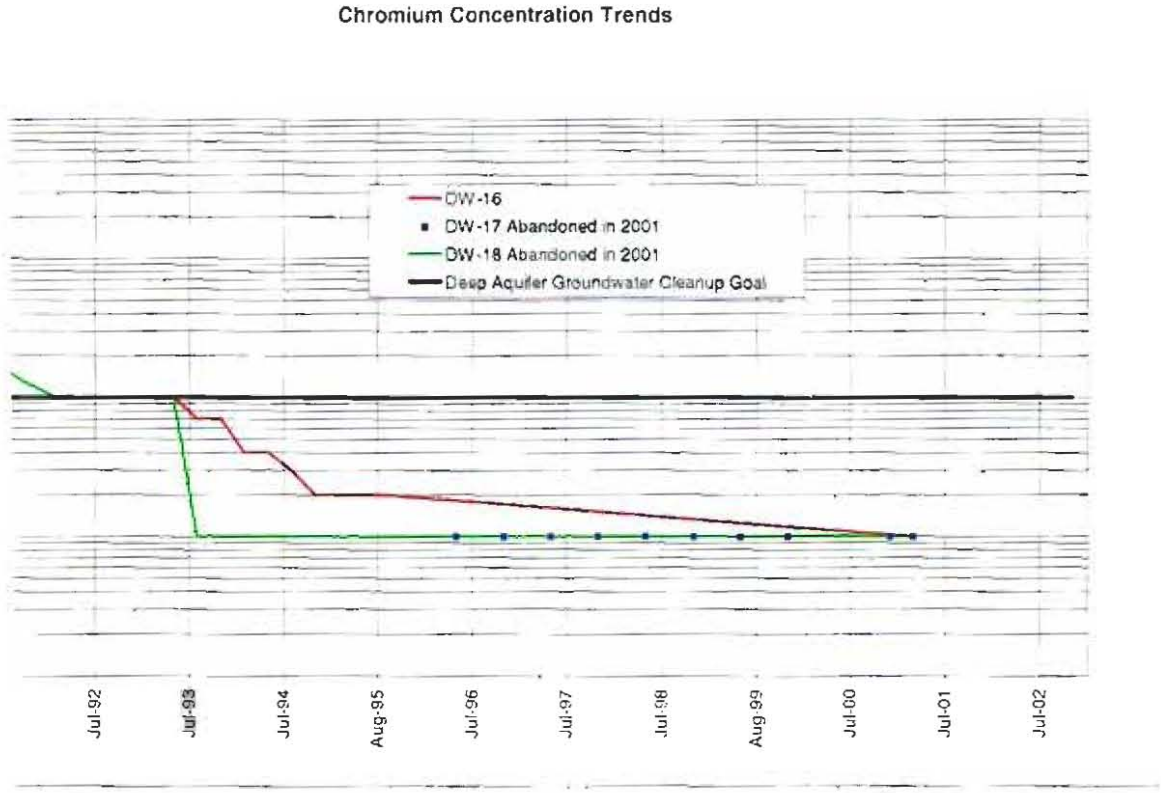
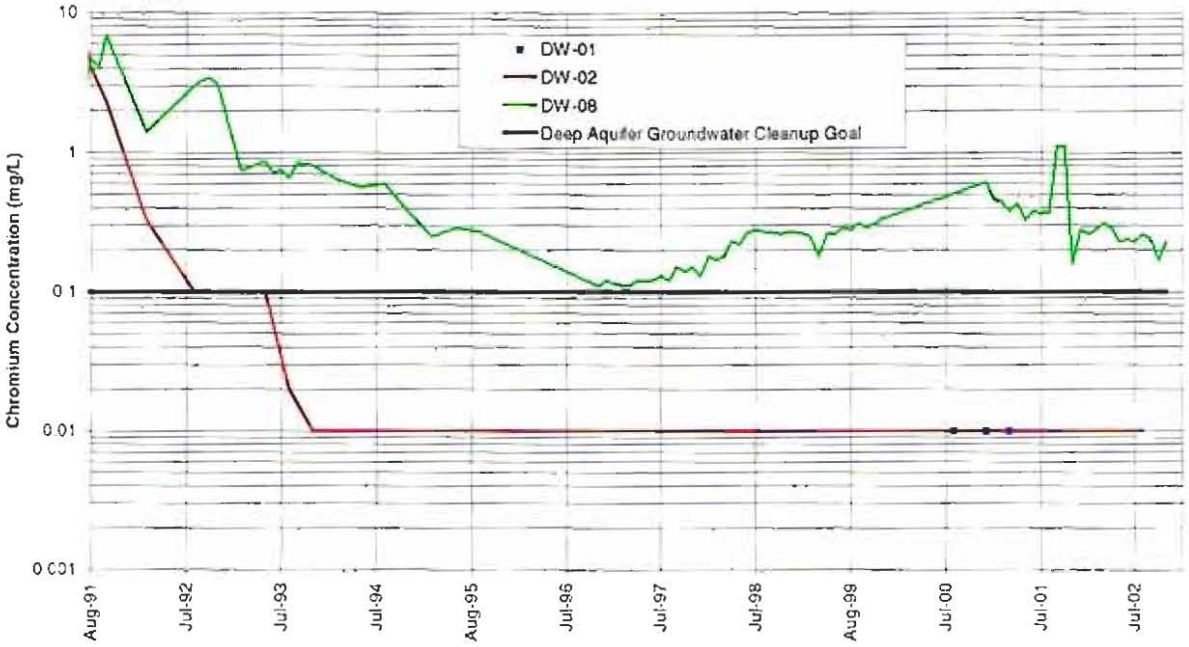
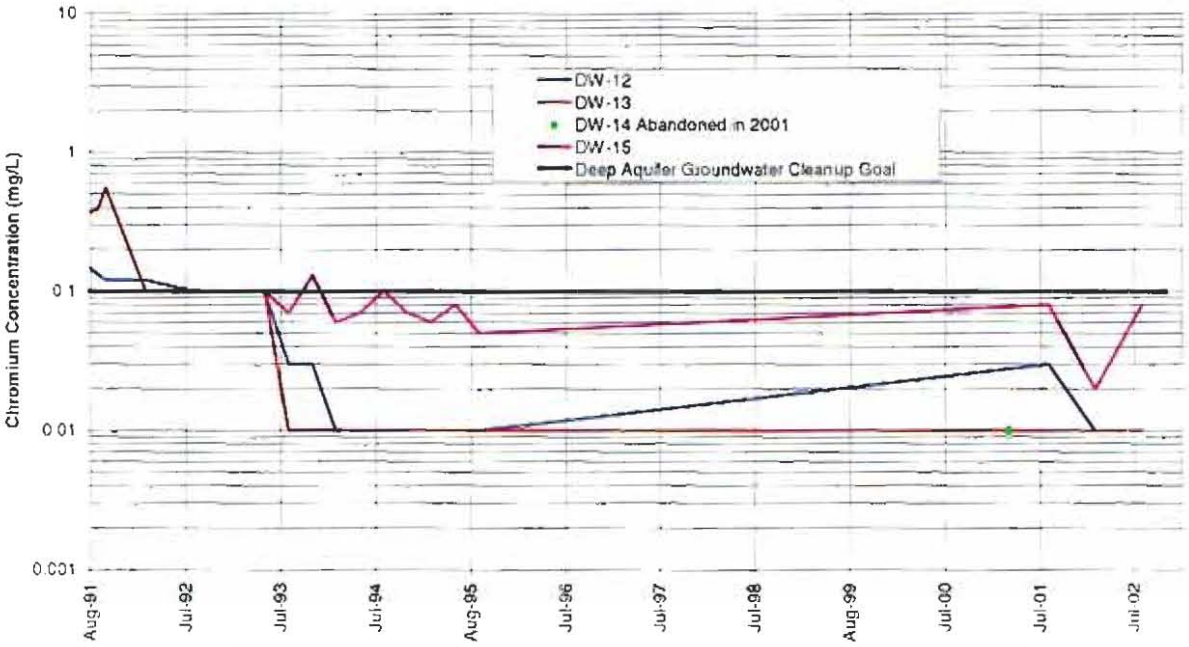


Figure 7-5
Deep Aquifer Groundwater Chromium Concentration Trends
United Chrome Products Site
Corvallis, Oregon

Chromium Concentration Trends



Chromium Concentration Trends



8. Issues

8. Issues

Three issues were identified that may affect the remedy's ability to achieve the performance standards specified in the ROD, and therefore, its future protectiveness. In addition, the third issue needs to be addressed before EPA can determine whether the remedy is protective in the short-term. These issues (see Table 8-1) include:

1. Chromium concentrations in upper zone soil are higher than considered protective for direct contact for industrial land uses.
2. Chromium concentrations in the lower aquifer are increasing in two wells in the source area, after decreasing for many years.
3. It is not known whether or not there is an unacceptable ecological risk from chromium in downgradient drainage ditch sediment.

Issues number 1 and 2 do not affect current protectiveness and will not affect future protectiveness because no one is drinking groundwater from the lower aquifer within the affected area and the site is not currently being used for industrial land uses.

TABLE 8-1
Issues Potentially Affecting Remedy's Current or Future Protectiveness
United Chrome Products, Corvallis, OR

Issue	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. Chromium concentrations in upper zone soil are higher than considered protective for direct contact for industrial land uses.	No	Yes
2. Chromium concentrations in the lower aquifer are increasing in two wells in the source area, after decreasing for many years.	No	Yes.
3. It is not known whether or not there is an unacceptable ecological risk from chromium in downgradient drainage ditch sediment.	Yes	Yes

9. Recommendations and Follow-up Actions

9. Recommendations and Follow-up Actions

The following recommended actions address the issues identified in Section 8.

Recommendations/Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Follow-up Actions: Affects Protectiveness (Y/N)	
				Current	Future
1. Evaluate the hydrogeology and contaminant transport between the soil, upper zone, upper aquitard, and lower aquifer as necessary to understand the causes of the recent groundwater contaminant trends (addresses issue 2)	EPA	EPA	October 1, 2003	no	yes
2. Based on the results of the above evaluation, re-evaluate the clean-up levels and current remedial approach (addresses issue 2)	EPA and City of Corvallis	EPA	March 31, 2004	no	yes
3. Place additional institutional controls for land use restrictions as needed (addresses issue 1)	City of Corvallis	EPA and DEQ	March 31, 2004	no	yes
4. Collect data on site-related contamination in the down-gradient drainage ditches and water bodies, and then evaluate the ecological risks posed by these sediments (addresses issue 3)	City of Corvallis	EPA and DEQ	October 1, 2003	yes	yes

Work has already begun to address these recommendations. For example, the City of Corvallis has collected and analyzed data on the surface water and sediment quality in the drainage ditches as requested by Oregon DEQ, though this information has not been published yet nor presented to DEQ or EPA. In addition, EPA's consultant, CH2M Hill has prepared a preliminary memorandum to consider some of the issues in the second recommendation.

Some of the questions that may be addressed as part of the re-evaluation in the second recommendation include:

- Are the clean-up levels established in the ROD and related decision documents for the upper soil and groundwater sufficient to protect the lower aquifer?

- Should the current groundwater pumping approach/regime be changed?

10. Protectiveness Statement

10. Protectiveness Statement

A protectiveness determination of the remedy at the United Chrome Products site cannot be made at this time until further information is obtained. Further information to determine whether the remedy currently protects human health and the environment will be obtained by the data collection and ecological evaluation of the down-gradient drainage ditches and surface water. It is expected that these actions will take six months to complete, at which time a protectiveness determination will be made. The soil and lower aquifer remedy currently protects human health and the environment because the site is fenced and not being used and the area of the lower aquifer with contamination above the MCL is not being used for drinking water. Additional actions described in the recommendations above are needed to ensure long-term protectiveness.

11. Next Review

11. Next Review

The next review will be conducted prior to March 2008.

12. References

12. References

CH2M HILL. 1999a. United Chrome Site Inspection. CH2M HILL memorandum, July 30, 1999, Corvallis, Oregon.

CH2M HILL. 1995b. Scope of Work (Attachment to the Consent Decree)

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CH2M HILL. 2002b. Re-Evaluation of United Chrome Cleanup Goals and Selected Remedy. Draft memorandum, December 9, CH2M HILL, Corvallis, Oregon.

CH2M HILL. 2003. Site Inspection and Interview Report. CH2M HILL memorandum, January 29, 2003, Corvallis Oregon. Appendix A, this document.

City of Corvallis, Corvallis General Flood Hazard Map. 2000.

EPA. 1986. United Chrome Record of Decision.

EPA. 1991a. United Chrome Explanation of Significant Differences.

EPA 1991b. Interim Closeout Report.

EPA. 1998. United Chrome Products Superfund Site, Corvallis, Oregon, Five-Year Review.

EPA. 2001. Comprehensive Five-Year Review Guidance. EPA/540/R-01/007. OSWER Directive 9355.7-03B, June 2001.U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. http://www.epa.gov/superfund/resources/5year/index.htm.

National Wetlands Inventory. 2000. Wetlands and Hydric Soils, Southern Corvallis. Oregon Division of Lands.

Appendix A
Site Interview and Inspection Summary

United Chrome Site Inspection and Interview Summary

TO: Alan Goodman/EPA Region 10

COPIES: Nancy Gramlich/Oregon DEQ

FROM: Scott McKinley

DATE: January 29, 2003

This memorandum summarizes findings from an inspection of the United Chrome site and community interviews performed in conjunction with the third Five-Year review. The work was conducted between December 5 and January 21, 2003 in accordance with information provided in the *Comprehensive Five-Year Review Guidance* (EPA, April 1999) and individuals listed in *Interview Candidates for the United Chrome Five-Year Review* (CH2M HILL Memorandum November 26, 2002). An updated site map (Attachment 1), site inspection form (Attachment 2), community interview forms and selected interview correspondence (Attachment 3), and a summary of significant site events are provided as attachments to this memorandum. Site photographs will be included with the five-year review report.

1.0 Site Inspection

Two security fences enclose the United Chrome site, with access obtained through gates located off Airport Place. The outer fence, maintained by the Federal Aviation Administration, encloses the Corvallis Airport and is labeled with no trespassing and warning signs approximately every 100-feet along its entire length. The inner fence encloses the United Chrome and CoEnergy sites (see Figure 2), which lie within the Corvallis Airport property. A third fence separates the United Chrome and CoEnergy sites from one another, and separate locking gates control entry and egress from each. CoEnergy also uses two guard dogs to patrol their facility 24-hours per day.

Although the City of Corvallis (the City) maintains the groundwater extraction equipment in good working order, the site receives only a nominal amount of landscaping maintenance, and therefore, appears unkempt. Herbicide applied in October 2002 has killed much of the blackberry type vegetation present at the site, and its decayed nature contributes to the site's marginal appearance. Additionally, following removal of the treatment system infrastructure, the City no longer has a covered area to store equipment associated with past well conversion and well abandonment work. This equipment has replacement or salvage value and is currently being stored on an asphalt surface near wells EW7 and EW10, and near the decontamination pad.

Land use in the immediate vicinity of the site remains airport services (maintenance and parking, propane fueling (Ferril Gas and CoEnergy) and agricultural (grass seed farming). The United Chrome site is zoned under the City of Corvallis Comprehensive Land Use Plan

as general industrial. The City of Corvallis Airport Manager reports that Ferril Gas will most likely relocate onto the United Chrome site following completion of the remedial action.

1.1 Site Cover

Although not widely discussed in prior documents, large portions of the site are covered with asphalt and concrete. The main portion of the site is overlain with reinforced concrete approximately 25,000 square feet in area and 12-inches thick. This cover represents the floor of the former United Chrome Products building. An extensive floor trench system varying in depth from 4 to 12 inches is recessed within the floor. The trench has been filled with gravel but appears to drain towards the southwest corner. I removed the gravel at one location to inspect the trench and it appeared to be in very good condition. There are also several drain openings in the floor, just south of the power transformer, that most likely discharge to an inactive onsite septic system.

An asphalt roadway (former County Road) and parking area border the concrete to the north. Along the west, south and east sides of the concrete, the surface is unpaved.

1.2 Groundwater Remedy

Groundwater Extraction System

The only extraction wells still in operation are upper zone well EW-9 and deep aquifer wells DW-8 and DW-9. The remaining extraction wells have been converted to monitor wells, or have met the cleanup standard and been abandoned per EPA approval. The status of all wells initially present at the start of the remedial action in 1988 is shown on Table 1. Only those wells still present are shown on Figure 2. At the time of the inspection, wells EW-9, DW-8 and DW-9 were operating satisfactorily.

Insulated shelters enclose the upper zone and deep aquifer extraction wells. The shelters are in good condition and provide adequate weather protection. Although there was some evidence that the shelters have been recently used as nesting sites by birds or other small animals, this has been a re-occurring condition, and does not affect extraction well operation, or ground water monitoring activities.

The above ground piping that conveys groundwater from extraction wells EW-9, DW-8 and DW-1 to the discharge point is in good shape. However, the bridge near DW-1, which allows vehicles to drive safely over the pipe, is in poor condition and should be repaired if future vehicle traffic through this area is required. The bridge was damaged by heavy truck traffic during the October 2000 upper zone source excavation work.

Injection System

Infiltration basins (Basin 1 and Basin 2) were decommissioned in August 2000 in conjunction with the upper zone source excavation work. The decommissioning work included removal of geotextile material, above-grade concrete walls, plumbing and valve controls. The injection trench is still operational but has not been used, except for a short trial in November 2000, since January 1993. Given the limited nature of current upper zone pumping operations, it's unlikely the trench will be required in the future.

Groundwater Monitoring Network

All of the groundwater monitor wells/piezometers shown on Figure 2 were located and all appear to be in satisfactory condition for continued use as required by the Pumping Plan – Version 5 (CH2M HILL, May 2001). CH2M HILL had scheduled the site inspection for December 4, 2002 to correspond with the City's semiannual sampling of the upper zone monitor wells. Unfortunately, the City's sampling pump failed to operate due to freeze damage, and therefore, the sampling was not performed on this date.

Treatment System

The ground water treatment system was removed in April 1999. The only components remaining are the secondary containment wall which enclosed the tank storage and treatment system areas, the partially enclosed shop, the electrical control panel, the decontamination pad, and the containment cell for the sludge thickening tanks. The secondary containment wall has been intentionally breached along the west and north walls to prevent accumulation of large amounts of rainwater. The metered discharge point, where extracted ground water is discharged to the sanitary sewer is in satisfactory condition.

Office and Laboratory Trailer

An office and laboratory trailer and locker room trailer, constructed as part of the groundwater remedial construction effort, are still maintained by the City of Corvallis. All onsite testing is done in the laboratory trailer, but most document/data management is performed at the City of Corvallis wastewater treatment plant. The laboratory equipment appeared to be in good working condition, and the City provides copies of all calibration and quality assurance checks with the quarterly progress reports. Copies of the O&M Manuals, health and safety plan, and historic site related documents are also kept onsite. The O&M manual has not been updated since the treatment system was decommissioned in April 1999. However, to support an update to the site Health and Safety Plan, the City prepared a summary of significant site events. This summary is provided in Attachment 4.

2.0 Community Interviews

Telephone and personal interviews were conducted, and questionnaires mailed to the individuals as shown in Table 2. In general, many of the interviewee's with current knowledge about the cleanup effort were complimentary. Of the local residents interviewed, each had very little knowledge of the site and did not have a favorable or unfavorable opinion on cleanup progress or protectiveness.

Table 1

United Chrome Well Inventory – January 2003

Upper Zone Wells					
Extraction Wells			**Monitoring Wells**		
Active	Inactive	Abandoned	Active	Inactive	Abandoned
EW-09		EW-08	EW-01	EW20	BG-1
		EW-17	EW-02		EW1(a)
		EW-18	EW-03		MW-1
		EW-19	EW-04		MW-2A
		EW-21	EW-05		MW-3
		EW-22	EW-06		PL1
		EW-24	EW-07		PL2
		EW-25	EW-10		PL3
		EW-26	EW-11		PL4
		EW-28	EW-12		PL5
		EW-29	EW-13		PZ-A
			EW-14		PZ-C
			EW-15		PZ-D
			EW-16		PZ-E
			EW-23		PZ-F
			EW-27		PZ-F
			MW-3		SW-2A
			PZ-B		SW-3
			SE-2A		SW-4
Total Number of Wells Initially Present			51		
Total Number of Wells Currently Present			21		

Table 1 (continued)

United Chrome Well Inventory - January 2003

Deep Aquifer Wells					
Extraction Wells			**Monitoring Wells**		
Active	Inactive	Abandoned	Active	Inactive	Abandoned
DW-8			DW-2	DW-1 (a)	DW-03A
DW-9			DW-10		DW-4
			DW-12		DW-5
			DW-13		DW-6
			DW-15		DW-7
					DW-11
					DW-14
					DW-16
					DW-17
					DW-18
					DW-19
Total Number of Wells Initially Present			**19**		
Total Number of Wells Currently Present			**8**		

Notes:

(a). This well approved for abandonment during June 2001 (Phase 5) work. However, due to diameter of conductor casing, the drilling contractor was unable to complete the work.

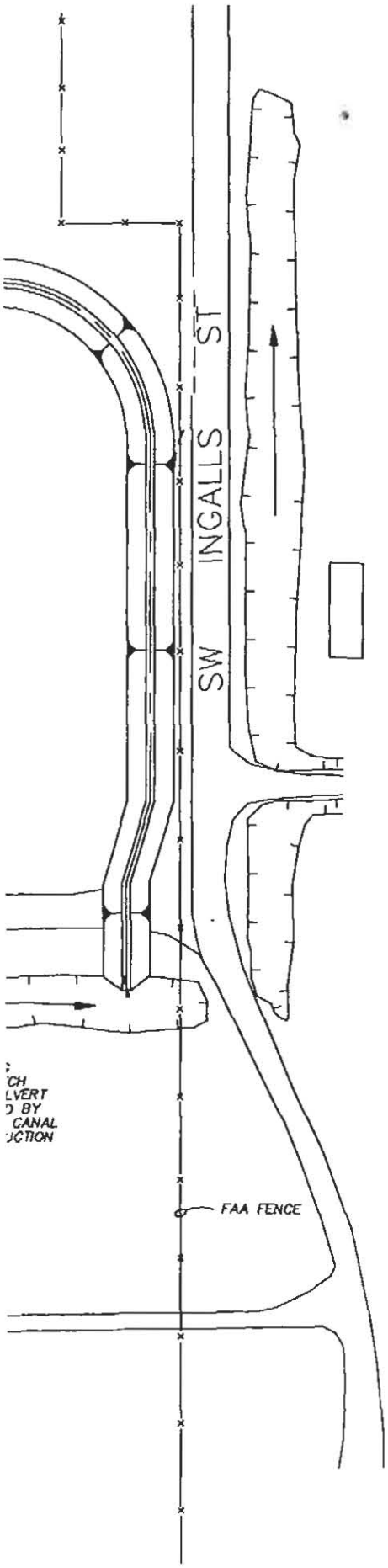
Table 2

Interview List

United Chrome Third Five-Year Review

Name	Title and Affiliation	Interview Date	Interview Method
Bruce Curtis	United Chrome Site Operations – City of Corvallis	12/11/2002	Personal interview conducted at United Chrome site
Buck Taylor	Airport Manager – City of Corvallis	01/10/03	Telephone interview
Doug Sweetland	Manager - Corvallis and Benton Economic Development Council	1/10/03	Personal interview conducted at CH2M HILL Corvallis office
Bill Emminger	Manager – Benton County Health Department	1/9, 1/21/2003	Telephone interview
Lyman Larrabee	On Mailing List	12/16/2003	Mailed Questionnaire – did not respond
Margaret Melvin	On Mailing List	12/16/2003	Mailed Questionnaire – returned as undeliverable
William Dorsey	On Mailing List	12/16/2003	Mailed Questionnaire – did not respond. Not listed in telephone directory.
William Gilbert	On Mailing List	12/16/2003	Mailed Questionnaire – returned as undeliverable
Randall Heide	On Mailing List	12/16/2003	Mailed Questionnaire – did not respond. Not listed in telephone directory.
Rochelle Murphy	On Mailing List	12/16/2003	Mailed Questionnaire – did not respond. Not listed in telephone directory.
Carl Weltzin	On Mailing List	12/16/2003	Mailed Questionnaire –did not respond.
Tom Ossoski	Resident – 580 SE Corliss	12/04/2002	Telephone interview
Marvin Brown	Resident – 4615 Booneville Drive	1/11/2003	Personal Interview
Confidential	Resident – 4680 Hwy 99W	01/11/2003	Personal Interview
Confidential	Resident – 4770 Hwy 99W	01/11/2003	Personal Interview

Attachment 1 - Updated Base Map



LEGEND:

ACTIVE DEEP AQUIFER WELLS

◉	CW-3	MONITORING WELLS (CITY WELLS)
	DW-8	EXTRACTION/MONITORING WELLS

ACTIVE UPPER ZONE WELLS

▫	PIEZO-8	MONITOR WELL
▲	EW-3	EXTRACTION WELL
•	MW-1	MONITOR WELL
•	PL-3	MONITOR WELL
•	BG-2	MONITOR WELL
— · · · —		SURFACE DRAINAGE DITCH

BLUE COLORED WELLS INDICATE ACTIVE UPPER ZONE (EW) OR DEEP AQUIFER (DW) EXTRACTION WELLS

ESTIMATED EXTENT OF UPPER ZONE GROUNDWATER CHROMIUM CONTAMINATION – AUGUST 1988

ESTIMATED EXTENT OF DEEP AQUIFER GROUNDWATER CHROMIUM CONTAMINATION – AUGUST 1992

ESTIMATED EXTENT OF CHROMIUM IN UPPER ZONE GROUNDWATER EXCEEDING 10 mg/l REMEDIATION GOAL – JANUARY 2003

ESTIMATED EXTENT OF CHROMIUM IN DEEP AQUIFER GROUNDWATER EXCEEDING 0.1 mg/l REMEDIATION GOAL – JANUARY 2003

AREA WHERE CONTAMINATED SOIL, WITH CHROMIUM CONCENTRATIONS GREATER THAN 6,000 mg/kg, EXCAVATED IN SEPTEMBER 2000

NOTE: INACTIVE MONITOR/EXTRACTION WELLS ARE SHADED GRAY.

0 50 100 150 200

SCALE: FEET

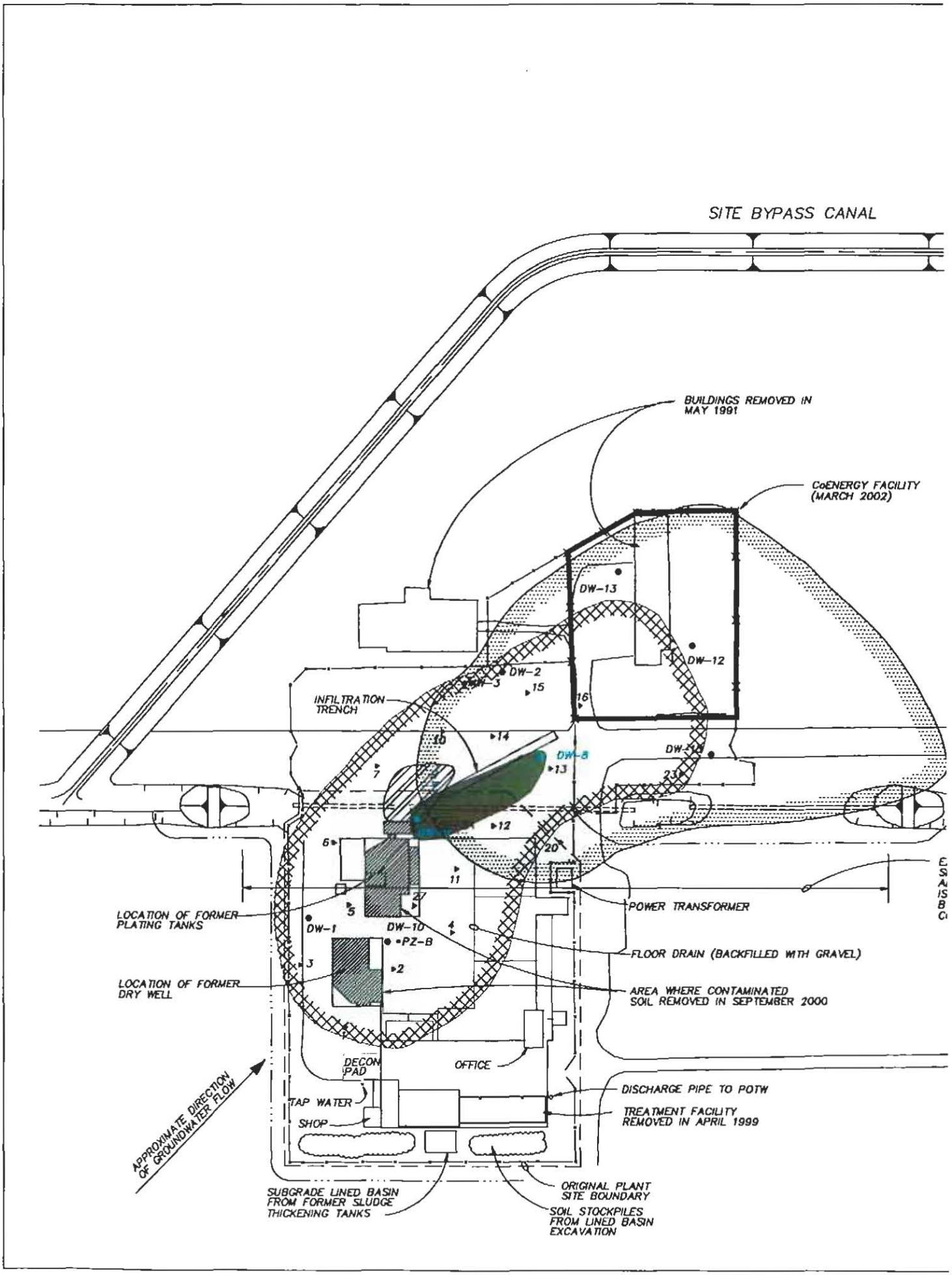
N

FIGURE 2

SITE PLAN

UNITED CHROME PRODUCTS SITE
CORVALLIS, OREGON

CH2M HILL


SITE BYPASS CANAL
BUILDINGS REMOVED IN MAY 1991
CoENERGY FACILITY (MARCH 2002)
DW-13
DW-12
DW-2
DW-3
15
16
INFILTRATION TRENCH
14
DW-8
13
DW-14
23
7
12
6
20
11
POWER TRANSFORMER
LOCATION OF FORMER PLATING TANKS
5
2
DW-1
DW-10
PZ-B
4
FLOOR DRAIN (BACKFILLED WITH GRAVEL)
3
2
LOCATION OF FORMER DRY WELL
AREA WHERE CONTAMINATED SOIL REMOVED IN SEPTEMBER 2000
DECON PAD
OFFICE
DISCHARGE PIPE TO POTW
TAP WATER
SHOP
TREATMENT FACILITY REMOVED IN APRIL 1999
APPROXIMATE DIRECTION OF GROUNDWATER FLOW
SUBGRADE LINED BASIN FROM FORMER SLUDGE THICKENING TANKS
ORIGINAL PLANT SITE BOUNDARY
SOIL STOCKPILES FROM LINED BASIN EXCAVATION

Attachment 2 - Site Inspection Form

Please note that "O&M" is referred to throughout this checklist. At sites where Long-Term Response Actions are in progress, O&M activities may be referred to as "system operations" since these sites are not considered to be in the O&M phase while being remediated under the Superfund program.

Five-Year Review Site Inspection Checklist (Template)

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

I. SITE INFORMATION	
Site name: United Chrome	**Date of inspection:** 1/11/03
Location and Region: Corvallis, OR/Region 10	**EPA ID:** ORD009043001
Agency, office, or company leading the five-year review: CH2M Hill	**Weather/temperature:** Raining 40°F

Remedy Includes: (Check all that apply)

- ☐ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other Institutional controls include a groundwater pumping exclusion zone. Access controls include locked site fence and second, locked FAA fence
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☒ Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Bruce Curtis (Name) Site Manager (Title) 12/5/02 (Date)
   Interviewed ☒ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☒ Report attached _____

2. **O&M staff** Same as #1 above (Name) _____ (Title) _____ (Date)
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency Benton County Health Dept
Contact Bill Emminger — Manager — 1/13/03 — 766-6835
Name — Title — Date — Phone no.
Problems; suggestions; ☒ Report attached

Agency City of Corvallis - Airport Manager
Contact Buck Taylor — Manager — 1/16/03 —
Name — Title — Date — Phone no.
Problems; suggestions; ☒ Report attached

Agency Corvallis-Benton County Economic Development Council
Contact Doug Sweetland — Manager — 1/16/03 —
Name — Title — Date — Phone no.
Problems; suggestions; ☒ Report attached

Agency
Contact
Name — Title — Date — Phone no.
Problems; suggestions; ☐ Report attached

4. **Other interviews** (optional) ☒ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**
   - ☒ O&M manual — ☒ Readily available — No ☐ Up to date — ☐ N/A
   - ☐ As-built drawings in O&M Manual — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☒ Maintenance logs — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks: Site map and facility drawings not updated

2. **Site-Specific Health and Safety Plan** — ☒ Readily available — ☒ Up to date — ☐ N/A
   - ☒ Contingency plan/emergency response plan — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks: City currently updating plan to remove "dead-man" alarm requirement.

3. **O&M and OSHA Training Records** — ☐ Readily available — ☒ Up to date — ☐ N/A

   Remarks: Not kept onsite. On file at Wastewater Treatment plant.

4. **Permits and Service Agreements**
   - ☐ Air discharge permit — ☐ Readily available — ☐ Up to date — ☒ N/A
   - ☐ Effluent discharge — ☐ Readily available — ☐ Up to date — ☒ N/A
   - ☐ Waste disposal, POTW — ☐ Readily available — ☐ Up to date — ☒ N/A
   - ☐ Other permits ____ — ☐ Readily available — ☐ Up to date — ☐ N/A

   Remarks: Although the United Chrome groundwater discharge is subject to EPA's National Pretreatment Regulations, the City of Corvallis as the RP does not maintain a pretreatment permit.

5. **Gas Generation Records** — ☐ Readily available — ☐ Up to date — ☒ N/A

   Remarks:

6. **Settlement Monument Records** — ☐ Readily available — ☐ Up to date — ☒ N/A

   Remarks:

7. **Groundwater Monitoring Records** — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks:

8. **Leachate Extraction Records** — ☐ Readily available — ☐ Up to date — ☒ N/A

   Remarks:

9. **Discharge Compliance Records**
   - ☐ Air — ☐ Readily available — ☐ Up to date — ☐ N/A
   - ☒ Water (effluent) — ☒ Readily available — ☒ Up to date — ☐ N/A

   Remarks:

10. **Daily Access/Security Logs** — ☐ Readily available — ☐ Up to date — ☐ N/A

    Remarks: Due to low activity level sign-in log sheets are no longer maintained.

IV. O&M COSTS

1. **O&M Organization**
   - ☐ State in-house
   - ☒ PRP in-house
   - ☐ Federal Facility in-house
   - ☐ Other
   - ☐ Contractor for State
   - ☐ Contractor for PRP
   - ☐ Contractor for Federal Facility

2. **O&M Cost Records**
   - ☒ Readily available ☒ Up to date
   - ☒ Funding mechanism/agreement in place ①
   - Original O&M cost estimate $261,000 (1985) ☐ Breakdown attached
   - ① This cost based on 5 year lifetime.

   Total annual cost by year for review period if available

Date	Date	Total cost	
From July 97	To June 98	$26,084.23	☐ Breakdown attached
From July 98	To June 99	$34,809.17	☐ Breakdown attached
From July 99	To June 00	$25,506.60	☐ Breakdown attached
From July 00	To June 01	$424,123.76	☐ Breakdown attached
From July 01	To June 02	$25,141.04	☐ Breakdown attached

3. **Unanticipated or Unusually High O&M Costs During Review Period**
   Describe costs and reasons: An additional cost of $397,051.25 was incurred in October 2000 in conjunction with the upper zone soil/source excavation project.

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☒ Location shown on site map ☒ Gates secured ☐ N/A
   Remarks Double fence - site fence and FAA fence

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A
   Remarks Sign present at gate, but does not warn or advise against trespass, or identify a contact person. No trespass signs on FAA fence.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by) Self-monitoring
Frequency Weekly
Responsible party/agency City of Corvallis
Contact Dan Hawthorne (Name) WWTD Manager (Title) 1/8/03 (Date) 541-754-1757 (Phone no.)

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☐ No ☒ N/A
Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A

Remarks Question has been raised by oversight contractor on whether IC needs to be modified to control potential exposure to soil/sediment contamination remaining onsite and in nearby drainage ditch

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks

2. **Land use changes on site** ☐ N/A

Remarks Onsite land use limited to airport and propane facilities according to Airport Master Plan

3. **Land use changes off site** ☐ N/A

Remarks no

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks

B. Other Site Conditions

Remarks At this time general site appearance is poor. Herbicide was applied in Oct 2002 to control briars (blackberry) which have taken root within unpaved areas of the site. Much of the facility above-ground infrastructure (i.e. bldgs) was decommissioned in Mar/Apr 1999. Consequently, there is no place to store equipment onsite. Unused pumps and piping from abandoned wells is stored uncovered.

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
   Lengths_____ Widths_____ Depths_____
   Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Areal extent_____ Depth_____
   Remarks_____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
   ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks_____

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
   Remarks_____

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
   Areal extent_____ Height_____
   Remarks_____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks_____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay
Remarks_____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay
Remarks_____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay
Remarks_____

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map ☐ No evidence of settlement
Areal extent_____ Depth_____
Remarks_____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
Areal extent_____ Depth_____
Remarks_____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____

5. **Obstructions** Type_____ ☐ No obstructions
☐ Location shown on site map Areal extent_____
Size_____
Remarks_____

6. **Excessive Vegetative Growth** Type_____
☐ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____

D. Cover Penetrations ☐ Applicable ☒ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance
☐ N/A
Remarks_____

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A
Remarks_____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**
   ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____

2. **Gas Collection Wells, Manifolds and Piping**
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
   ☐ Good condition ☐ Needs Maintenance ☐ N/A
   Remarks_____

F. Cover Drainage Layer ☐ Applicable ☒ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
   Remarks_____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
   Remarks_____

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
   ☐ Siltation not evident
   Remarks_____

2. **Erosion** Areal extent_____ Depth_____
   ☐ Erosion not evident
   Remarks_____

3. **Outlet Works** ☐ Functioning ☐ N/A
   Remarks_____

4. **Dam** ☐ Functioning ☐ N/A
   Remarks_____

H. Retaining Walls ☐ Applicable ☒ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
Horizontal displacement_____ Vertical displacement_____
Rotational displacement_____
Remarks_____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
Remarks_____

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A

1. **Siltation** ☒ Location shown on site map ☒ Siltation not evident
Areal extent_____ Depth_____
Remarks Bypass ditch constructed around site in 1989 to re-route surface water flow.

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent_____ Type_____
Remarks Vegetation has taken root in bypass ditch constructed around site in 1989. Does not impede flow.

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent_____ Depth_____
Remarks_____

4. **Discharge Structure** ☐ Functioning ☒ N/A
Remarks_____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
Areal extent_____ Depth_____
Remarks_____

2. **Performance Monitoring** Type of monitoring_____
☐ Performance not monitored
Frequency_____ ☐ Evidence of breaching
Head differential_____
Remarks_____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
   ☐ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A
   Remarks

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   ☒ Good condition ☐ Needs Maintenance
   Remarks Pipe bridges which protect deep aquifer above ground pipes in marginal condition at road crossings near D.W.-1.

3. **Spare Parts and Equipment**
   ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
   Remarks

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps, and Electrical**
   ☐ Good condition ☐ Needs Maintenance
   Remarks

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   ☐ Good condition ☐ Needs Maintenance
   Remarks

3. **Spare Parts and Equipment**
   ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
   Remarks

C. Treatment System ☐ Applicable ☒ N/A

1. **Treatment Train** (Check components that apply)
   ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
   ☐ Air stripping ☐ Carbon adsorbers
   ☐ Filters_____
   ☐ Additive (*e.g.*, chelation agent, flocculent)_____
   ☐ Others_____
   ☐ Good condition ☐ Needs Maintenance
   ☐ Sampling ports properly marked and functional
   ☐ Sampling/maintenance log displayed and up to date
   ☐ Equipment properly identified
   ☐ Quantity of groundwater treated annually_____
   ☐ Quantity of surface water treated annually_____
   Remarks Treatment System removed in April 1999.

2. **Electrical Enclosures and Panels** (properly rated and functional)
   ☐ N/A ☒ Good condition ☐ Needs Maintenance
   Remarks Not protected from weather. [Control panel for extraction wells].

3. **Tanks, Vaults, Storage Vessels**
   ☒ N/A ☐ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
   Remarks_____

4. **Discharge Structure and Appurtenances**
   ☐ N/A ☒ Good condition ☐ Needs Maintenance
   Remarks_____

5. **Treatment Building(s)**
   ☒ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair
   ☐ Chemicals and equipment properly stored
   Remarks Blgs removed (except office/laboratory/locker blg)

6. **Monitoring Wells** (pump and treatment remedy)
   ☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition
   ☒ All required wells located ☐ Needs Maintenance ☐ N/A
   Remarks Wells are not locked, but are located within a locked and fenced area.

D. Monitoring Data

1. Monitoring Data
   ☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:
   ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☒ N/A
Remarks

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Upper Zone remedy designed to flush Chromium from soil to extraction system for removal, and to remove soluble Chromium already present and that dissolved/desorbed from soil and hexavalent chromium solid phase. Remedy to restore groundwater Chromium concentrations to 10 mg/L in upper zone and 0.1 mg/L in deep aquifer. Upper Zone remediation has been very successful. Deep aquifer remediation has been slowed by chromium contaminated pore water draining from upper aquifer.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Despite site appearances, City's O-M program has been satisfactory. All extraction wells are operable and excellent progress has been made to date.

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None noted
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Optimization has been ongoing and these opportunities have been implemented where possible, and where remedy protectiveness can be maintained.

Attachment 3 - Interview Forms

United Chrome Five-Year Review Interview Record

Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330	**EPA ID No.** ORD009043001
Interview Type: Telephone (Visit) Other **Location of Visit:** United Chrome	**Date:** 12/11/02 **Time:** 1000

Contact Made By Scott McKinley

Name:	**Title:** Project Manager	**Organization:** CH2m Hill

Individual Contacted

Name: Bruce Curtis	**Title:** United Chrome Site Operations Manager	**Organization:** City of Corvallis
Telephone:	**Address:**	

Summary of Conversation

1) What is your overall impression of the project?

Personally, very interesting project. Cleanup is consistent with desire to protect/restore the environment. Wants to see cleanup complete. United Chrome projects is area of expertise.

2) What affects have site operations (cleanup) had on the surrounding community?

None to his knowledge.

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

No. Remote site location makes the cleanup less visible. Not much media attention

4) Do you feel well informed about the site's activities and progress?

Yes.

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

City has always felt that EPA has encouraged feedback.

Additional questions for Bruce Curtis

6) Is the remedy functioning as expected? How well is the remedy performing?

Yes. Upper Zone performing well. Disappointed that provisions for addressing ditch were not done in ROD, saving it to end.

7) Have there been opportunities to optimize O&M or sampling efforts? If so please described?

Yes. Modified PLTS, discharge to POTW. Have mutually agreed to sampling reductions and well abandonments

8) Have there been unexpected O&M difficulties or costs at the site since start-up or in the last five-years? If so please explain.

Exposed piping/wellheads, risk of freeze damage. Wellhead PVC components most vulnerable.

United Chrome Five-Year Review Interview Record

Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330	**EPA ID No.** ORD009043001

Interview Type: (Telephone) Visit Other: Mail **Location of Visit:**	**Date:** 1/10/03	**Time:** First 1000 AM Left Msg

Contact Made By

Name: Scott McKinley	**Title:** Project Manager	**Organization:** CH2M HILL

Individual Contacted

Name: Buck Taylor	**Title:** Manager - Airport	**Organization:** City of Corvallis
Telephone: 766-6783	**Address:**	

Summary of Conversation

1) What is your overall impression of the project?

long-time coming, doing, well

2) What affects have site operations (cleanup) had on the surrounding community?

none what so-ever

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

no

The people who were aware of the site have moved on. Master Plan calls for use as fueling area excellent site. Likes gates and roads.

4) Do you feel well informed about the site's activities and progress?

Yes

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Went very well, in his view.

United Chrome Five-Year Review Interview Record

Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330		**EPA ID No.** ORD009043001
Interview Type: Telephone (Visit) Other: Mail **Location of Visit:** CH2M Hill/CVO Doug was in the office	**Date:** 1/10/03	**Time:** 930

Contact Made By

Name: Scott McKinley	**Title:** Project Manager	**Organization:** CH2M HILL

Individual Contacted

Name: Doug Sweetland	**Title:** Manager	**Organization:** Benton Co. Economic Development
Telephone: 757-1507	**Address:**	

Summary of Conversation

1) What is your overall impression of the project?

Gone well, very detailed. Co Energy not concerned at all with being next to NPL site

2) What affects have site operations (cleanup) had on the surrounding community?

None

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

None.

4) Do you feel well informed about the site's activities and progress?

Yes.

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

None.

United Chrome Five-Year Review Interview Record

Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330	**EPA ID No.** ORD009043001

Interview Type: (Telephone) Visit Other: Mail **Location of Visit:**	**Date:** 1/9/03	**Time:** 10 15 AM

left message 1/21/03 completed interview.

Contact Made By

Name: Scott McKinley	**Title:** Project Manager	**Organization:** CH2M HILL

Individual Contacted

Name: Bill Emminger	**Title:** Manager	**Organization:** Benton County Health Dep
Telephone: 766-6835	**Address:**	

Summary of Conversation

1) What is your overall impression of the project?

Don't know much about it. Only been on the job for 8-months. Will discuss with other staff and call back.

2) What affects have site operations (cleanup) had on the surrounding community?

No concerns.

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

No complaints or concerns expressed. File indicates chromium has been detected in surface water

4) Do you feel well informed about the site's activities and progress?

No, but ok he's new to his position.

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Would like to have a copy of the five-year review report.

United Chrome Five-Year Review Interview Record

Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330	**EPA ID No.** ORD009043001

Interview Type: (Telephone) Visit Other: Mail **Location of Visit:**	**Date:** 12/4/02	**Time:** 300

Contact Made By

Name: Scott McKinley	**Title:** Project Manager	**Organization:** CH2M HILL

Individual Contacted

Name: Tom Ossoski	**Title:** Resident	**Organization:**
Telephone: 752-4271	**Address:** 560 SE Corliss Ave	

Summary of Conversation

1) What is your overall impression of the project?

Has heard of it, but Knows very little about the cleanup effort.

2) What affects have site operations (cleanup) had on the surrounding community?

Not aware of any.

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

No.

4) Do you feel well informed about the site's activities and progress?

Site has not received much media coverage. Not aware of EPA's Superfund web site

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

None

United Chrome Five-Year Review Interview Record

Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330		**EPA ID No.** ORD009043001
Interview Type: Telephone (Visit) Other: Mail **Location of Visit:** in field	**Date:** 1/11/03	**Time:** 1445

Contact Made By

Name: Scott McKinley	**Title:** Project Manager	**Organization:** CH2M HILL

Individual Contacted

Name: Marvine Brown	**Title:** Resident	**Organization:**
Telephone: NA	**Address:** 4615 Booneville Dr	

Summary of Conversation

1) What is your overall impression of the project?

Has heard about the site from time-to-time in Gazette-Times. No impression/opinion

2) What affects have site operations (cleanup) had on the surrounding community?

Not aware of any

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

No

4) Do you feel well informed about the site's activities and progress?

Satisfactory

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

No

United Chrome Five-Year Review Interview Record

Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330	**EPA ID No.** ORD009043001

Interview Type: Telephone (Visit) Other: Mail **Location of Visit:** in field	**Date:** 1/11/03	**Time:** 1530

Contact Made By

Name: Scott McKinley	**Title:** Project Manager	**Organization:** CH2M HILL

Individual Contacted

Name: Confidential	**Title:** Resident	**Organization:**
Telephone: NA	**Address:** 4680 Hwy 99W	

Summary of Conversation

1) What is your overall impression of the project?

Not familiar with the site

2) What affects have site operations (cleanup) had on the surrounding community?

NA

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

No

4) Do you feel well informed about the site's activities and progress?

No

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

No

United Chrome Five-Year Review Interview Record

Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330		**EPA ID No.** ORD009043001
Interview Type: Telephone (Visit) Other: Mail **Location of Visit:** in field	**Date:** 1/11/03	**Time:** 1545

Contact Made By

Name: Scott McKinley	**Title:** Project Manager	**Organization:** CH2M HILL

Individual Contacted

Name: Confidential	**Title:** Resident	**Organization:**
Telephone:	**Address:** 4770 Hwy 99 W	

Summary of Conversation

1) What is your overall impression of the project?

Not familiar with cleanup

2) What affects have site operations (cleanup) had on the surrounding community?

Unaware of any

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

No

4) Do you feel well informed about the site's activities and progress?

No

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

NA

Interview Candidates for United Chrome Five-Year Review

TO: Alan Goodman/EPA Region 10

COPIES: Paul "Max" Rosenberg

FROM: Scott McKinley

DATE: November 26, 2002

This memorandum presents a proposed list of community representatives to be interviewed by CH2M HILL as part of the United Chrome March 2003 five-year review report. The overall purpose of these interviews is to obtain a third party perspective on cleanup progress and protectiveness.

Background

The five-year review guidance recommends that interviews be conducted to complement information obtained from the site inspection and other sources. Interviews should include the operation and maintenance (O&M) site manager, O&M staff, local regulatory authorities and response agencies, community action groups or associations, site neighbors, and other stakeholders. Interviews can be conducted over the telephone, face-to-face of via mail.

List of Interview Candidates

CH2M HILL proposes that the following individuals be interviewed:

- Corvallis - Benton County Economic Development Partnership (Doug Sweetland). This organization's primary mission is to attract new business to the Corvallis and Benton County areas. I assisted them several years ago in describing potential long-term environmental affects associated with the United Chrome site. This information was used to address concerns raised by Federal Express when they were screening sites near the airport for a new shipping facility. This organization should provide a good perspective on the cleanup relative to the site's development potential. A telephone interview (telephone: 541- 757-1507) is proposed.
- City of Corvallis Airport Manager (Buck Taylor). The Airport Manager is the primary custodian of the United Chrome property, and as such, can provide information on how the cleanup, when complete, will fit into the airport's long-term master plan. A telephone interview (telephone: 541-766-6783) is proposed.
- Benton County Environmental Health Department (Bill Emminger). This organization has overall responsibility for public health in the vicinity of the airport complex and rural areas of Benton County, and should provide a community perspective on cleanup protectiveness. A telephone interview (telephone: 541- 766-6835) is proposed.
- City of Corvallis Public Works (Bruce Curtis). Although the City of Corvallis is the PRP and O&M operator, I believe Bruce will provide candid feedback on the remedial

design, its operation and effectiveness. Bruce has been involved with site operations since startup and has unique knowledge of the site. A face-to-face interview is proposed.

- Local Residents. The nearest private residences are located approximately 1.5 miles northeast of the United Chrome site, along Highway 99 and the streets (Corliss Avenue, Meda Street and 3 Mile Avenue) extending off Highway 99. Because it's been a number of years since the United Chrome site has received any media coverage, its unknown if the nearby residents have any knowledge of the cleanup effort. If desired, CH2M HILL will contact 3-5 residents in this area via a door-to-door survey.

A copy of the current United Chrome mailing list was also obtained from the City of Corvallis. A majority of the individuals on the list are either City of Corvallis employees, Council members or media representatives. Seven individuals with no known City of Corvallis affiliation appear on the list. These individuals and their last known address are shown in Table 1. If desired questionnaires can be mailed to these individuals.

Table 1

List of Individuals on United Chrome Mailing List with No City of Corvallis or Media Affiliation

Name	Address (all in Corvallis, Oregon)
Lyman Larrabee	2900 NW Elmwood Drive
Margaret Melvin	5311 SW Airport PL
Bertea Aviation	PO Box 606
William Dorsey	PO Box 968
William Gilbert	PO Box 863
Randall Heide	PO Box 1694
Rochelle Murphy	PO Box 1679
Carl Weltcin	2800 SW Herbert St

Interview Questions

An interview questionnaire (see Attachment 1) will be used to guide each interview and the responses documented on the questionnaire form. The questions shown on the questionnaire were selected from samples provided in the five-year review guidance.

United Chrome Five-Year Review Interview Record		
Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330	**EPA ID No.** ORD009043001	
Interview Type: Telephone Visit Other: Mail **Location of Visit:**	**Date:**	**Time:**

Contact Made By		
Name: Scott McKinley	**Title:** Project Manager	**Organization:** CH2M HILL

Individual Contacted		
Name:	**Title:**	**Organization:**
Telephone:	**Address:**	

Summary of Conversation

1) What is your overall impression of the project?

2) What affects have site operations (cleanup) had on the surrounding community?

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

4) Do you feel well informed about the site's activities and progress?

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

Returned undeliverable 12/30/02

CH2M HILL
2300 NW Walnut Blvd.
Corvallis, OR
97330-3538
Mailing address:
P.O. Box 428
Corvallis, OR
97339-0428
Tel 541.752.4271
Fax 541.752.0276

CH2MHILL

December 16, 2002

175923.SV.01

Margaret Melvin
5311 SW Airport Pl.
Corvallis, OR 97333

Subject: United Chrome Five-Year Review

Dear Ms. Melvin:

I am assisting the United States Environmental Protection Agency (EPA) in conducting a review to evaluate the protectiveness of groundwater and soil cleanup activities completed at the United Chrome Superfund site located near the Corvallis Airport. This is the third such review and follows others completed in 1993 and 1998.

An important element of the review process is to seek input from community representatives who have expressed a prior interest in cleanup activities at the site. Because your name appears on EPA's mailing list, I am contacting you to seek your feedback. Your participation is entirely voluntary and your name will not appear in any published document unless requested by you.

Attached for your consideration is a questionnaire and a recent fact sheet on United Chrome cleanup activities. Please feel free to respond to the questions provided on the questionnaire or to provide any other feedback. If you elect to participate, please return the questionnaire to me by January 3, 2003, using the enclosed stamped self-addressed envelope. If you would like to complete the interview over the telephone, please feel free to contact me at 758-0235 extension 3514.

Sincerely,
CH2M HILL

Scott McKinley

Scott McKinley, P.E.

Enclosure

CVO\023500013

United Chrome Five-Year Review Interview Record			
Site Name: United Chrome Products, 2000 Airport Rd. Corvallis, OR 97330		**EPA ID No.** ORD009043001	
Interview Type: Telephone Visit Other: Mail **Location of Visit:**		**Date:**	**Time:**
Contact Made By			
Name: Scott McKinley	**Title:** Project Manager	**Organization:** CH2M HILL	
Individual Contacted			
Name:	**Title:**	**Organization:**	
Telephone:	**Address:**		
Summary of Conversation			

1) What is your overall impression of the project?

2) What affects have site operations (cleanup) had on the surrounding community?

3) Are you aware of any community concerns regarding the site or its operation? If so, please summarize your concerns.

4) Do you feel well informed about the site's activities and progress?

5) Do you have any comments, suggestions, or recommendations regarding the site's management or operation?

SUPERFUND
United Chrome Products, Inc.
Corvallis, Oregon
EPA U.S. ENVIRONMENTAL PROTECTION AGENCY November 2002

EPA To Review United Chrome Cleanup

During the next five months, the U.S. Environmental Protection Agency (EPA) will review the cleanup at the United Chrome Products, Inc. Superfund site. This review will make sure the cleanup is effective, and that people and the environment are protected as the cleanup continues. The review will also help EPA develop a transition plan for discontinuing EPA involvement after cleanup goals are met.

During the review, EPA will answer these kinds of questions:

- Are groundwater extraction, treatment and monitoring systems operating as planned?
- Is fencing at the site continuing to keep people from walking across the property so they are not exposed to contamination?
- Do the cleanup goals still make sense?
- Is there new information that should cause EPA to rethink parts of the cleanup?

EPA's review will include inspecting the site, interviewing site contacts and reviewing technical data and documents, such as operation and maintenance reports. Some of this work will be done by EPA's contractor, CH2M Hill.

The upcoming review is the third "Five-Year Review" since the groundwater extraction and treatment system was installed in 1988. EPA will review the cleanup at United Chrome every five years until contamination levels are low enough to allow for unlimited and unrestricted use of the property.

EPA Welcomes Your Comments

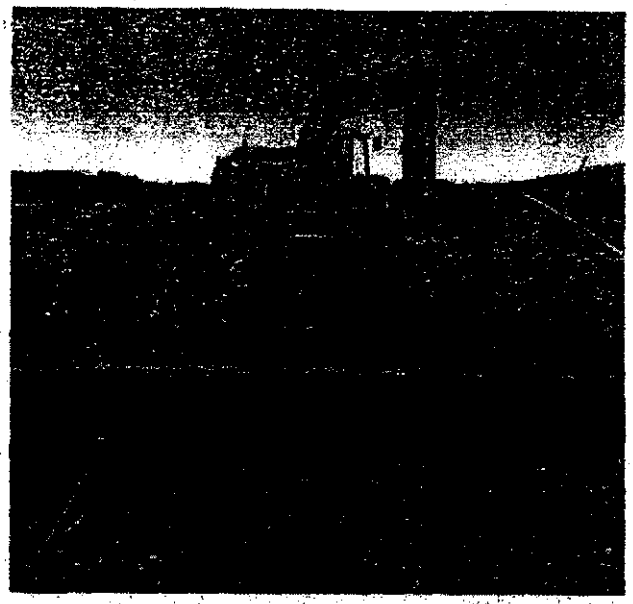
EPA welcomes citizen participation and comments during the Five-Year Review process. If you would like to review draft reports, meet with EPA staff, or get involved in other ways, please contact the EPA staff listed at the end of this fact sheet.

In This Issue . . .

EPA Welcomes Your Comments 1
Site Background 2
Cleanup Moves Forward 3
Do Cleanup Goals Still Make Sense? ... 3
Future Site Use 3
Site Contacts 3
Visit the EPA Website 3

United Chrome Products Site Background

The United Chrome site is a former chrome-plating facility three miles south of Corvallis in the Airport Industrial Research Park. The City of Corvallis owns the 1.5 acre site, but previously leased the property to United Chrome Products, Inc. The company did electroplating at the site from 1956 to 1985. During this time, plating tanks and a disposal pit leaked large amounts of hexavalent chromium to soil, and shallow and deep groundwater aquifers. In 1984, after determining the site posed a threat to human health and the environment, EPA placed the site on the National Priorities List, EPA's list of the nation's most contaminated sites.



Soil is excavated from the location of former plating tanks, September 18,2000.

In 1987, EPA began an extensive cleanup at the United Chrome site, including removing contaminated debris and hazardous soils, extracting and treating groundwater, and re-routing a drainage ditch to keep contaminated water from entering the local surface water drainage network.

Following removal of 1,956 tons of contaminated soil, the excavations are backfilled with clean soil, September 29, 2000.

In 1988, the City of Corvallis began managing cleanup activities at the site under legal agreements with EPA. In 2000, after further studies revealed two additional hot spots with high chromium levels, the City removed 1,956 tons of soil and disposed of it at a permitted hazardous waste landfill. Since this removal, contamination levels in the upper aquifer have further declined.

In 1992, the U.S. District Court, EPA, the state of Oregon and the City of Corvallis signed a consent decree which legally binds the City to perform cleanup actions and to continue extracting and treating groundwater until cleanup goals are met.

In addition to treating groundwater, the City is also evaluating off-site sediments in nearby drainage ditches. The purpose of this evaluation is to make sure birds, fish and plants are not being harmed by contamination from the site. If the City finds that unacceptable risks exist, EPA may require additional cleanup actions.

Cleanup Moves Forward

"The City has done an excellent job managing the site," says EPA Project Manager Alan Goodman. "Cleanup goals will be met around 2004, if all goes as planned."

To date, the City of Corvallis has extracted about 32,000 pounds of chromium and 30.5 million gallons of contaminated groundwater from the shallow aquifer beneath the site. About 120 pounds of chromium and 47 million gallons of groundwater have been extracted from the deep aquifer. As a result, all but three of the 23 upper zone groundwater extraction wells have met cleanup goals, and all but two of the lower zone extraction wells have met cleanup goals.

Because so much of the cleanup has been completed, the City has decommissioned major portions of the groundwater treatment system. The on-site treatment plant has been removed and 39 extraction and monitoring wells have been decommissioned. The remaining portions of the groundwater extraction system are in good condition and have several years of serviceable life.

Do Cleanup Goals Still Make Sense?

Since EPA signed the cleanup plan, or Record of Decision (ROD), in 1986, many things have changed: the federal drinking water standard for chromium has changed from 0.05 parts per million (ppm) to 0.1 ppm; the site conditions and use have changed; and the Airport Industrial Research Park no longer relies on a private well, as public water and sewer were extended to the site in 1988.

Due to these and other changes, as part of the Five-Year Review, EPA will re-evaluate whether the cleanup plan and goals still make sense. EPA will focus on how and where groundwater cleanup goals need to be met, and whether cleanup goals should be changed. One issue up for discussion is whether to measure cleanup success using average, site-wide chromium concentrations or well-by-well concentrations. If major changes are needed, EPA will notify the public and take steps to revise the Record of Decision.

Future Site Use

The United Chrome site is included in the Corvallis Airport 20-Year Master Plan, and is zoned for general industrial use. Airport planners see the site as a prime location for additional fuel storage in the future. A propane storage and distribution terminal was recently constructed on the northeast portion of the site.

Site Contacts

Alan Goodman
EPA Project Manager
503 326-3685 or toll free at 800 424-4372
goodman.alan@epa.gov

Deborah Neal
EPA Community Involvement Coordinator
206 553-0115 or toll free at 800 424-4372
neal.deborah@epa.gov

Dan Hanthorn
City of Corvallis Project Manager
541 754-1757
dan.hanthorn@ci.corvallis.or.us

Visit the EPA Website:

EPA Region 10 website:
www.epa.gov/r10earth/
click on "Index"
click on "U" for United Chrome

For people with disabilities: Please contact Deborah Neal at 1 800 424-4372, extension 0115 (voice), if you have any special requests for reasonable accommodations. For TTY users, please call the Federal Relay Service at 1 800 877-8339 and give the operator Deborah Neal's phone number. Please provide one week notice for special requests not related to ongoing programs and services.

Attachment 4 - Summary of Significant Site Events

UNITED CHROME SITE
CITY of CORVALLIS

CHANGES IMPACTING SITE SAFETY PLAN

WELLS/WELL FIELD

1990- installed infiltration trench NE of Basin #1(June)

1990- Contractor drilled deep wells, networked discharges from wells. No treatment; discharge direct to sewer after metering. Initially pumping 7 wells. Abandoned 2 wells.

Drilled DW-8, DW-9, DW-10, DW-11, DW-12, DW-13, DW-14, DW-15, DW-16, DW-17, DW-18, DW-19. DW-9 and DW-10 set up as injection wells with City water.

Abandoned DW-4, DW-5

Overdrilled/reconstructed SE-2A

1994-Infiltration Basin #2 o/s. (April)

1996- Abandoned 7 upper zone monitoring wells and 1 deep aquifer monitoring well.

Abandoned EW-1, PL-2, PL-3,PL-4, PL-5, BG-2, MW-2A, DW-7. (June)

Converted DW-9, DW-10 to extraction wells; plumbed into deep aquifer network.

1997- Abandoned 9 upper zone monitoring wells.

Abandoned EW-19, EW-22, EW-24, EW-25, EW-26, SW-3, PZ-A, PZ-C, PZ-E (May)

1998- Abandoned 2 upper zone monitoring wells and 3 deep aquifer monitoring wells.

Abandoned SW-2A, SW-4, DW-3A, DW-6, DW-19. (May)

2000- Abandoned 3 upper zone extraction wells as part of the contaminated soil removal project.

Abandoned EW-8, EW-28, EW-29.

Demolished concrete walls forming infiltration basins. Both basins o/s.

2001- Abandoned 3 upper zone extraction wells, 6 upper zone monitoring wells, and 4 deep aquifer monitoring wells.

Abandoned EW-17, EW-18, EW-21, EW-20, BG-1, MW-1, PL-1, PZ-D, PZ-F, DW-11, DW-14, DW-16, DW-17. (June)

2002-Modified wellfield for CoEnergy leasing portion of site

Lowered EW-16, DW-12, DW-13 well casings to below grade.

Removed EW-16, EW-23, DW-12, DW-13, DW-15 from pipe networks.

Modified fencing for access/security.

TREATMENT AREA

1989- installed larger air compressor and air dryer in a shed attached to the West end of the treatment building. Then the sludge press was doubled in size with longer rails and more plates. (December)

1990- installed sludge age tanks behind treatment building w/containment, access walkway, piping from treatment plant, to sludge press.(June)

1990- Started getting chemicals in totes, storing reserves in chemical storage building. Feeding sulfuric acid directly from tote; abandoned sulfuric acid day tank.

Pump and treat begins 1/9/92, as permitted by new local limits. By end of 1992, no sludge is being generated.

Person-down alarm (day)/treatment alarm (night) installed 3/2/1992. **Modifies the buddy system.**

Pump and discharge OK'd 2/28/1995. Used remaining chemical stocks, then pump and discharge implemented 3/2/1995. No treatment, no chemicals, storage tanks o/s.

GENERAL SITE

1988- Ditch sampling started (December). Requires 2 people.

1989-Bypass ditch dug around site by EPA contractor. (November)

1990- Installed catwalk over tank farm with fall protection on access ladder. (March)

1990- built locker/shower facilities. (May)

1990- built chemical storage building. (May)

1991-Ditch sampling discontinued (March)

1991-Removed yellow building (April)

1991-Removed green building (May)

1992- WWRP local limits revised, allowing 7 lb/day chromium allocation from United Chrome.

1992- drainage culvert cleaned out. Culvert plugged at each end to prevent recontamination.

1994- Storage tank catwalk removed, taken to WWRP. (February)

1995- Forklift no longer onsite. (November)

1999- Contractor removed unused equipment/buildings (March, April)
- -chemical building
- -storage tanks
- -treatment plant, sludge press
- -treatment building

2000- Soil removal project removed 1,956 tons of contaminated soil (>6000 mg/kg), transported to a Hazardous Waste landfill in Arlington, OR. Material removed from the site was replaced with concrete from infiltration basins and 1700 tons of clean fill compacted and leveled at grade. (September)

2003- **Person-down alarm discontinued due to reduction in risks** (January)

No treatment
No treatment chemicals onsite.
No ladders; fall risk greatly reduced.
Fall risk further reduced by a simpler well field; no infiltration basins, 40 fewer wells, and a simpler piping network.

PERSONNEL

A log of personnel with 40-hour hazardous material training and specific site training. Dates represent start of work/visits to the site and end of visits to the site for whatever reason.

NAME	BEGIN	END
Bruce Curtis	7/6/88	
Mike Clark	7/6/88	10/22/89
Dennis Pollock	7/6/88	12/91
Don Boone	7/6/88	12/96
Ed Sutton	7/22/88	2/28/91
Dan Hanthorn	3/89	
Kent Hansen	9/25/89	7/10/93
Mary Camarata	10/22/89	7/3/90
Guy Allen	10/22/89	

Appendix B
Upper Zone Groundwater Pumping Data

Date	Zone/Area	Rainfall	Days in Month	Days of Operation	Total Hours System On	Total Gallons Pumped	Total Gallons Extracted	Crude Oil Removed	[illegible]
Aug-88	Upper	0	16	8	29	13390	15523	249	0
Sep-88	Upper	0.73	30	15	159	75390	70044	924	0
Oct-88	Upper	0.14	31	15	97	64360	61353	773	0
Nov-88	Upper	10.87	30	15	83.8	55050	62139	800	0
Dec-88	Upper	3.92	31	13	71.3	72370	55560	755	0
Jan-89	Upper	4.18	31	12	57.7	59840	50112	464	0
Feb-89	Upper	3.21	28	0	0	0	0	0	0
Mar-89	Upper	6.8	31	13	79.7	92680	70390	761	0
Apr-89	Upper	1.42	30	16	107	85020	73240	865	0
May-89	Upper	1.46	31	18	131.2	88390	89750	1008	0
Jun-89	Upper	1.14	30	14	88.8	98547	74760	756	0
Jul-89	Upper	0.33	31	10	120.9	53490	71940	751	0
Aug-89	Upper	0.87	31	11	204	135860	116060	950	0
Sep-89	Upper	0.6	30	9	194.7	64350	44580	269	0
Oct-89	Upper	2.66	31	27	618.8	264400	218480	1232	0
Nov-89	Upper	3.9	30	28	651.7	271900	253880	1059	0
Dec-89	Upper	3.07	31	30	613.1	344090	366210	1760	0
Jan-90	Upper	9.5	31	29	519	385810	384350	1615	0
Feb-90	Upper	5.79	28	20	423.5	310720	302490	1229	0
Mar-90	Upper	2.21	31	25	565.9	356980	357500	1210	0
Apr-90	Upper	2.38	30	30	716.1	423110	444720	1137	0
May-90	Upper	1.43	31	30	690.6	410730	427800	893	0
Jun-90	Upper	1.53	30	30	675.9	461290	427240	739	0
Jul-90	Upper	0.45	31	31	707.7	582650	520650	978	0
Aug-90	Upper	1.72	31	31	727.8	507880	490740	722	0
Sep-90	Upper	0.83	30	30	694.9	372230	363840	520	0
Oct-90	Upper	4.56	31	31	723.9	441690	454100	728	0
Nov-90	Upper	4.87	30	28	561.2	470080	474330	717	0
Dec-90	Upper	3.59	31	19	398.7	350010	370540	452	0
Jan-91	Upper	2.68	31	20	318.7	345250	240340	270	0
Feb-91	Upper	3.22	28	28	640.7	560530	513290	468	0
Mar-91	Upper	5.85	31	31	608.8	550450	537150	431	0
Apr-91	Upper	3.47	30	30	637.1	629160	593740	443	0
May-91	Upper	3.91	31	29	595.5	596990	573970	431	0
Jun-91	Upper	1.52	30	30	670.9	548300	551960	373	0
Jul-91	Upper	0.38	31	31	740.3	488870	467360	272	0
Aug-91	Upper	0.72	31	31	744	402660	384280	157	0
Sep-91	Upper	0.19	30	30	719.4	154090	126550	67	0
Oct-91	Upper	2.55	31	31	745.4	235780	261310	134	0
Nov-91	Upper	5.12	30	30	693.7	321740	383820	205	0
Dec-91	Upper	4.38	31	30	715.4	478110	502730	289	0
Jan-92	Upper	4.52	31	31	736.3	510560	526120	283	0
Feb-92	Upper	4.54	29	29	691	445830	445910	218	0
Mar-92	Upper	1.04	31	31	742.6	481740	458270	225	0
Apr-92	Upper	1.52	30	30	718.8	439940	471260	202	0
May-92	Upper	0	31	31	745.5	417100	405360	174	0
Jun-92	Upper	1.18	30	30	719.6	346010	327000	130	0
Jul-92	Upper	1.18	31	31	746	340170	340170	119	0
Aug-92	Upper	0.44	31	31	741	304950	304950	92	0
Sep-92	Upper	0.55	30	30	717.8	307030	307030	99	0
Oct-92	Upper	3.52	31	31	744.3	281410	281410	72	0
Nov-92	Upper	4.99	30	30	718.9	300380	300380	105	0
Dec-92	Upper	7.38	31	29	671.4	351950	351950	120	0
Jan-93	Upper	4.15	31	15	328.6	161140	161140	48	0
Feb-93	Upper	2.2	28	15	345.3	151960	151960	46	0
Mar-93	Upper	4.05	31	31	742.9	348790	348790	113	0
Apr-93	Upper	5	30	30	717.3	370740	370740	87	0
May-93	Upper	4.25	31	31	744.5	344880	344880	66	0
Jun-93	Upper	1.25	30	30	723.5	348740	348740	67	0
Jul-93	Upper	1.25	31	31	736.3	292780	292780	46	0

er Pumping Data

0				45820		1923.00	8.90	29	33.4
594				153090		1573.00	7.30	159	113
115				113660		1512.00	10.50	97	53.6
200				137550		1543.00	12.30	83.8	87.1
0				125700		1629.00	13.00	71.3	71.1
0				115210		1110.00	14.50	58	70.1
0				0		1203.00	0.00	0	0
0				145360		1296.00	14.70	79.7	81
0				148230		1131.00	11.40	107	75.9
384				179630		1147.00	11.40	131.2	77.4
316				120660		1058.00	14.00	88.8	65.2
700				88210		1239.00	9.90	120.9	48.1
000				151690		981.00	9.50	204	74.1
200				52940		724.00	3.80	194.7	28.4
900				288480		676.00	5.90	618.8	137.9
100				290680		500.00	6.50	651.7	153.8
575				361330		576.00	10.00	613.1	201.9
200				400820		504.00	12.30	519	201.4
140				308220		487.00	11.90	423.5	146.3
075				348760		406.00	10.50	565.9	161.4
300				430800		306.00	10.40	716.1	195.5
750				410410		250.00	10.30	690.6	183.6
506				459120		207.00	10.50	675.9	206
364				563130		225.00	12.30	707.7	253.3
828				487760		176.00	11.20	727.8	207.3
875				344250		171.00	8.70	694.9	132.5
015				425880		192.00	10.50	723.9	188.8
000				453610		181.00	14.10	561.2	187.9
000				332840		146.00	15.49	398.7	116.7
775				371500		134.00	12.57	318.7	111
425				515700		110.00	13.40	640.7	149
925				511230		96.00	14.70	608.8	135.2
300				582830		89.00	15.50	637.1	137
200				561890		90.00	16.06	595.5	128.9
850				514190		81.00	13.71	670.9	118
450				479630		70.00	10.52	740.3	108
450				376060		49.00	8.61	744	83.3
375				141980		63.00	2.93	719.4	34.7
225				207900		61.49	5.84	745.4	48.4
245				302900		64.04	9.22	693.7	71
300				456610		68.93	11.71	715.4	106.6
060				477810		64.50	11.91	736.3	114
635				422420		58.62	10.76	691	94.2
350				481740		58.87	10.29	742.6	632.1
025				439940		51.40	10.93	718.8	636.3
925				417100		51.47	9.06	745.5	727.5
850				346010		47.67	7.57	719.6	719.6
850				340170		41.95	7.60	746	746
575				304950		36.00	6.86	741	741
375				307030		38.66	7.13	717.8	717.8
150				281410		30.68	6.30	744.3	744.1
325				300380		41.91	6.96	718.9	718.9
050				351950		40.88	8.74	671.4	671.4
100				161140		36.00	8.17	328.6	328.6
650				151960		36.00	7.33	345.3	345.3
675				348790		39.00	7.82	742.9	742.9
275				370740		28.00	8.61	717.3	717.3
975				344880		23.00	7.72	744.5	744.5
475				348740		23.00	8.04	723	723
675				292780		19.00	6.63	736.3	736.3

Date	Zone/Area	Rainfall	Days in Month	Days of Operation	Total Hours System On	Total Gallons Pumped	Total Gallons Injected	Total Gallons Recovered	Total Gallons Injected
Aug-93	Upper	0.2	31	31	747.4	276860	276860	42	0
Sep-93	Upper	0	30	30	722.5	243360	243360	39	0
Oct-93	Upper	0.7	31	31	740.4	235240	235240	37	0
Nov-93	Upper	1	30	20	438.7	157630	157630	25	0
Dec-93	Upper	6.1	31	31	735.6	323820	323820	49	0
Jan-94	Upper	3.4	31	31	745.5	338480	338480	56	0
Feb-94	Upper	4.05	28	28	674.4	285940	285940	45	0
Mar-94	Upper	3.15	31	31	744.2	280780	280780	47	0
Apr-94	Upper	1.3	30	30	715.3	230970	230970	48	0
May-94	Upper	0.7	31	28	668.5	159470	159470	35	0
Jun-94	Upper	0.7	30	25	583	130300	130300	29	0
Jul-94	Upper	0	31	31	744.7	127300	127300	23	0
Aug-94	Upper	0	31	31	741.4	93670	93670	20	0
Sep-94	Upper	0.65	30	30	720	75880	75880	16	0
Oct-94	Upper	6.65	31	31	745.2	81840	81840	16	0
Nov-94	Upper	7.25	30	30	724.2	226850	226850	44	0
Dec-94	Upper	5.9	31	31	738.3	258860	258860	47	0
Jan-95	Upper	10.85	31	31	744.2	304840	304840	48	0
Feb-95	Upper	2.9	28	20	459.4	175150	175150	26	0
Mar-95	Upper	5.05	31	31	761.7	250410	250410	36	0
Apr-95	Upper	5.3	30	30		227090	227090	30	0
May-95	Upper	1.43	31	31		217160	217160	27	0
Jun-95	Upper	2.36	30	28		163200	163200	24	0
Jul-95	Upper	0.52	31			150520	150520	21	0
Aug-95	Upper	0.82	31			105020	105020	15	0
Sep-95	Upper	3.14	30			81200	81200	12	0
Oct-95	Upper	3.96	31			140100	140100	22	0
Nov-95	Upper	7.72	30			176380	176380	28	0
Dec-95	Upper	10.12	31			254350	254350	32	0
Jan-96	Upper	10.37	31			194400	194400	28	0
Feb-96	Upper	13.63	29			145720	145720	18	0
Mar-96	Upper	3.54	31			163380	163380	25	0
Apr-96	Upper	4.93	30			138430	138430	20	0
May-96	Upper	3.98	31			129850	129850	22	0
Jun-96	Upper	0.85	30			63990	63990	12	0
Jul-96	Upper	0.92	31			87320	87320	16	0
Aug-96	Upper	0.14	31			63700	63700	11	0
Sep-96	Upper	2.22	30			58570	58570	11	0
Oct-96	Upper	5.32	31			67690	67690	11	0
Nov-96	Upper	10.2	30			55640	55640	8	0
Dec-96	Upper	17.11	31			127730	127730	22	0
Jan-97	Upper	9.08	31	30	711.6	391820	391820	23	
Feb-97	Upper	2.2	28	28	676.5		336840	9	
Mar-97	Upper	6.43	31	31	740		148960	22	
Apr-97	Upper	3.6	30	30	723		104450	17	
May-97	Upper	2.2	31	31	739.6		95440	14	
Jun-97	Upper	2.42	30	30	718.7		81800	13	
Jul-97	Upper	0.38	31	31	744.1		57760	9	
Aug-97	Upper	1.25	31	31	742.4		52080	7	
Sep-97	Upper	3.39	30	30	720.8		56080	7	
Oct-97	Upper	5.5	31	31	747.5		75100	13	
Nov-97	Upper	5.18	30	30	720.1		93060	16	
Dec-97	Upper	3.02	31	31	742		111640	18	
Jan-98	Upper	8.8	31	31	746		128590	17	
Feb-98	Upper	8.35	28	28	671.7		135450	19	
Mar-98	Upper		31	31	745.3		134060	21	
Apr-98	Upper		30	30	719.6		146430	19	
May-98	Upper		31	31	744.6		97480	17	
Jun-98	Upper	0.75	30	30	720.4		61120	9	
Jul-98	Upper		31	31	739		35820	5	

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100				276860		18.00	6.17	747.4	747.4
300				243360		19.00	5.61	722.5	722.5
500				235240		19.00	5.30	740.4	740.4
375				157630		19.00	5.99	438.7	438.7
0				323820		18.00	7.34	735.6	735.6
350				338480		20.00	7.57	745.5	745.5
250				285940		19.00	7.07	674.4	674.4
350				280780		20.00	6.29	744.2	744.2
000				230970		25.00	5.38	715.3	715.3
000				159470		26.00	3.98	668.5	668.5
300				130300		27.00	3.72	583	583
300				127300		22.00	2.85	744.7	744.7
900				93670		26.00	2.11	741.4	741.4
900				75880		25.00	1.76	720	720
200				81840		23.00	1.83	745.2	745.2
800				226850		23.00	5.22	724.2	724.2
500				258860		22.00	5.84	738.3	738.3
0				304840		19.00	6.83	744.2	744.2
100				175150		18.00	6.35	459.4	459.4
200				8080		17.00	5.48	761.7	24
900				0		16.00	5.22	725	0
900				0		15.00	4.90	738.9	0
700				0		18.00	4.05	671.4	0
700				0		17.00	3.18	789.9	0
000				0		17.00	2.33	750.6	0
000				0		17.00	1.89	717	0
400				0		19.00	3.16	738.9	0
400				0		19.00	4.06	723.6	0
625				0		15.00	5.72	740.8	0
0				0		17.00	4.35	744.7	0
0				0		15.00	4.63	524.8	0
375				0		18.00	3.65	745.3	0
800				0		17.00	3.21	717.9	0
200				0		20.00	2.91	742.7	0
600				0		23.00	2.46	433.9	0
900				0		21.50	1.95	748	0
300				0		20.50	1.43	742.7	0
600				0		22.50	1.35	721.4	0
200				0		19.50	1.52	743.3	0
500				0		18.00	1.90	489	0
0				0		21.00	2.99	711	0
0	0				0	7.00			
670	30670				30670	3.20			
300	17300				17300	18.00			
300	36300				36300	20.00			
900	41900				41900	18.00			
900	55900				55900	19.00			
400	68400				68400	18.00			
500	75500				75500	16.00			
200	63200				63200	16.00			
200	43200				43200	20.00			
800	29800				29800	20.00			
800	4800				4800	19.00			
0	0				0	16.00			
0	0				0	17.00			
0	0				0	18.50			
0	0				0	15.50			
0	0				0	20.50			
0	0				0	18.00			
0	0				0	18.00			

Date	Zone/Area	Rainfall	Days in Month	Days of Operation	Total Hours System On	Total Gallons Pumped	Total Gallons Extracted	Crew hrs Removed	pH	
Aug-98	Upper		31	31	749.5		21370	3		
Sep-98	Upper	0.6	30	30	593.2		8010	1		
Oct-98	Upper	1.35	31	31	744		14200	2		
Nov-98	Upper	13.4	30	30	719.7		68470	10		
Dec-98	Upper		31	31	455.8		83370	13		
Jan-99	Upper	9.2	31	31	742.8		96630	13		
Feb-99	Upper	12.5	28	28	673		108550	17		
Mar-99	Upper	4.4	31	31	745		87840	12		
Apr-99	Upper	0.5	30	30	713		56800	7		
May-99	Upper	2.05	31	31	743.3		45030	5		
Jun-99	Upper	0.55	30	30	717.6		38350	5		
Jul-99	Upper		31	31	745.6		47250	7		
Aug-99	Upper	0.85	31	31	745.9		55500	8		
Sep-99	Upper		30	30	723.8		44720	5		
Oct-99	Upper	2.5	31	31	742		51260	5		
Nov-99	Upper	7.3	30	30	719.6		173170	18		
Dec-99	Upper	6	31	31	744.3		187820	16		
Jan-00	Upper		31	31	744.1		178570	13		
Feb-00	Upper	5.65	29	29	696.2		162360	14		
Mar-00	Upper	2.75	31	31	740		142050	12		
Apr-00	Upper	1.55	30	30	718.4		92080	7		
May-00	Upper	1.95	31	31	747.3		91660	8		
Jun-00	Upper	0.7	30	30	719.5		62040	5		
Jul-00	Upper	0.1	31	31	740		62310	6	7	
Aug-00	Upper	0	31	31	742.1		40660	4	7.4	
Sep-00	Upper	0.85	30	7	152.4		5170	0	7.2	
Oct-00	Upper	2.7	31	0	0		0	0	0	
Nov-00	Upper	2.1	30	28	679.3		13594	2	6.6	
Dec-00	Upper	4.75	31	24	585.1		25912	3	6.8	
Jan-01	Upper	2.25	31	31	739.1		45178	6	7	
Feb-01	Upper	1.45	28	28	673.1		28593	3	6.5	
Mar-01	Upper	2.75	31	31	740		28493	3	6.8	
Apr-01	Upper	1.55	30	30	723		37905	5	7	
May-01	Upper	0.95	31	31	739.7		59653	7	6.6	
Jun-01	Upper	1.8	30	30	715.9		21360	3	6.9	
Jul-01	Upper	0.35	31	31	747.5		15790	2	7.1	
Aug-01	Upper	0.8	31	31	741.9		37550	1	7.2	
Sep-01	Upper	0.85	30	30	725		11520	1	7.3	
Oct-01	Upper	2.85	31	31	741		13770	2	7	
Nov-01	Upper	6.7	30	32	768.2		36970	5	6.9	
Dec-01	Upper	7.6	31	29	692.7		69550	4	7.1	
Jan-02	Upper	7.4	31	31	745.4		87640	10	7.1	
Feb-02	Upper	3.3	28	28	674.5		47590	5	7.4	
Mar-02	Upper	5.15	31	31	740.6		52000	3	7	
Apr-02	Upper	1.95	30	30	713.2		39960	4	7	
May-02	Upper	1.15	31	31	744		33920	4	6.6	
Jun-02	Upper	0.55	30	30	719.8		29040	3	6.9	
Jul-02	Upper	0	31	31	744.7		1080	0	7	
Aug-02	Upper	0	31	31	741.3		1420	0	7.4	
Sep-02	Upper	0.95	30	30	723.9		60	0	7.2	
Oct-02	Upper	0.25	31	30	719.8		10	0	6.8	
Nov-02	Upper	4.3	30	31	740.5		1840	0	6.7	
Dec-02	Upper	13.25	31	31	744.6		24675	3	6.8	

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0	0				0	14.50			
0	0				0	15.50			
0	0				0	16.50			
0	0				0	17.50			
0	0				0	19.00			
0	0				0	16.00			
0	0				0	19.00			
0	0				0	17.00			
0	0				0	14.00			
0	0				0	12.50			
25	0	17325			17325	16.00			
00	132900	0			132900	18.00			
00	123500	0			123500	16.50			
00	141900	0			141900	14.50			
25	130200	60225			190425	11.50			
75	82800	26775			109575	12.50			
0	0	0			0	10.00			
0	0	0			0	8.60			
0	0	0			0	10.50			
0	0	0			0	10.50			
0	0	0			0	8.50			
0	0	0			0	11.00			
0	0	0			0	10.50			
150	82200	58950	0		179210	11.00			
0	0	0	0		181160	11.00			
0	0	0	0		260770	11.00			
0	0	0	0		0	0.00			
750	24750	0	0		24750	19.00			
300	27300	0			27300	15.00			
0	0	0	0		188078	15.50			
0	0	0	0		291793	13.00			
0	0	0	0		346793	14.00			
0	0	0	0		359905	14.50			
0	0	0	0		360753	13.50			
0	0	0	0		315660	15.00			
0	0	0	0		290690	14.50			
410	0	0	174410		321950	4.00			
570	0	0	100570		304720	14.50			
450	0	0	28450		189370	16.00			
0	0	0	0		256870	16.00			
0	0	0	0		318650	7.50			
0	0	0	0		359940	13.50			
0	0	0	0		289390	13.00			
0	0	0	0		317100	7.50			
0	0	0	0		260860	13.00			
0	0	0	0		263920	14.00			
0	0	0	0		250040	13.50			
0	0	0	0		216680	16.00			
0	0	0	0		210520	20.50			
0	0	0	0		192760	20.00			
0	0	0	0		187210	39.00			
0	0	0	0		211540	16.00			
0	0	0	0		246375	15.00			

Aug-88	53	31	144	21	148	45	320	5220	6860	205	197	107	1050	1010	2750	3220	86	120
Sep-88	60	290	500	230	600	370	700	9000	7000	500	500	510	500	4500	3050	2950	80	120
Oct-88	60	290	500	230	600	370	700	9000	7000	500	500	510	500	4500	3050	3100	80	120
Nov-88	90	60	1400	40	1033	620	1850	7000	10500	3000	730	430	720	4500	4000	3100	120	120
Dec-88	49	3.1	587	27	675	575	1033	6125	7625	2000	633	290	660	1300	4100	3600	133	95
Jan-89	66	6	450	64	513	488	583	4700	6750	270	68	240	780	0	3800	3400	80	59
Feb-89	66	6	450	64	513	488	583	4700	6750	270	68	240	780	0	3800	3400	80	59
Mar-89	67.5	13	380	12	430	400	490	4200	6333	210	175	245	1034	0	2400	3200	32	34
Apr-89	107	365	350	133	433	440	500	4333	7500	500	290	340	1220	2600	2200	3100	54	24
May-89	130	250	400	93	630	560	190	4000	8333	767	250	510	1150	3600	1950	3000	64	20
Jun-89	163	580	410	134	783	683	1117	3100	6333	217	380	425	900	4000	2150	2900	54	22
Jul-89	240	600	400	196	680	617	1533	2900	6833	2000	410	460	750	5100	3100	3200	36	28
Aug-89	240	600	400	196	680	780	1367	2600	6500	3100	470	525	580	5833	3400	2900	36	33
Sep-89	240	600	400	196	680	780	1367	2600	6500	3100	470	525	580	5833	3400	2900	36	33
Oct-89	310	533	310	183	683	617	2550	1550	7250	3100	330	430	370	3900	3400	3500	36	33
Nov-89	310	467	350	135	650	600	2550	1900	4833	3100	250	500	370	3900	3400	3500	36	33
Dec-89	290	12	210	25	238	662	1750	1700	4800	3100	200	960	280	2100	3400	3300	36	33
Jan-90	170	3.6	165	80	150	450	1300	1350	1600	500	105	160	483	3400	2800	2800	50	19
Feb-90	95	330	127	60	160	360	833	1700	167	500	113	260	550	1450	2000	2100	34	150
Mar-90	82	160	87	50	160	390	1100	1267	4300	130	113	340	430	3300	1450	1950	20	6
Apr-90	100	240	96	27.5	120	340	875	775	3800	210	60	330	360	2900	1700	1700	15.6	6.6
May-90	90	115	76	10.2	110	280	975	800	2700	125	36	220	460	3200	1350	1550	12.4	4.2
Jun-90	83	137	60	14	80	320	1200	567	900	216	26	140	310	900	1300	1233	12.4	4.2
Jul-90	74	150	52	15	63	280	1133	640	900	680	42	210	550	2300	1500	1600	10	11
Aug-90	70	163	44	14	60	310	1200	540	0	417	48	230	640	2600	1000	650	8.8	12.8
Sep-90	76	155	64	26	73	190	950	400	1175	720	52	155	260	3500	1150	1500	8	13.2
Oct-90	90	137	56	23	74	290	640	520	9.2	800	44	490	320	1350	1150	1350	9.8	20.8
Nov-90	57	97	42	20	44	230	460	460	60	300	40	270	630	780	1280	1160	15	22
Dec-90	57	97	42	20	48	220	380	383	360	163	39	320	350	1200	650	950	11.6	15
Jan-91	41	63	36	22	43	190	190	280	800	480	37	200	180	900	1117	900	8.4	10
Feb-91	33	123	33	23	41	165	165	450	425	125	35	150	350	480	860	760	8.4	8
Mar-91	20	83	27	16.3	34	155	175	360	425	133	14	150	210	420	520	700	6.4	5.2
Apr-91	18.8	50	25	10	34	143	175	510	380	105	31	160	130	410	400	700	6.4	4.4
May-91	24	98	20	12.5	31	153	210	400	380	320	25	173	123	540	400	488	6	4.2
Jun-91	23	38	19	8	30	145	80	340	380	186	25	220	285	400	370	525	5.6	3.4
Jul-91	17	94	17.5	10.8	30	107	68	270	27.5	173	24	155	117	380	260	320	4.6	6
Aug-91	17	94	17.5	10.8	30	107	68	270	27.5	173	24	155	117	380	260	320	2.4	2
Sep-91	17	94	17.5	10.8	30	107	68	270	27.5	173	24	155	117	380	260	320	2.4	2
Oct-91	22	108	23	14	44	90	72	260	27.5	215	25	200	70	180	240	120	2.4	3.7
Nov-91	22	108	23	14	44	90	72	260	27.5	215	25	200	70	180	240	120	1.7	3.6
Dec-91	22	108	23	14	44	90	72	260	27.5	215	25	200	70	180	240	120	2.6	2.7
Jan-92	19	70	20	10.8	40	110	56	250	27.5	120	23	65	78	160	170	220	2.2	5.3
Feb-92	19	70	20	10.8	40	110	56	250	27.5	120	23	65	78	160	170	220	1.5	1
Mar-92	19	70	20	10.8	40	110	56	250	27.5	120	23	65	78	160	170	220	1.3	1
Apr-92	13	56	13	3.4	27	73	36	190	27.5	75	15	76	56	80	120	110	1.5	2.4
May-92	13	56	13	4.7	27	73	36	190	27.5	75	15	76	56	80	120	110	1.3	0.6
Jun-92	13	56	13	5	27	73	36	190	27.5	75	15	76	56	80	120	110	1.3	0.31
Jul-92	11	26	8	3.8	18	58	34	130	27.5	90	11	64	32	76	90	63	0.8	0.14
Aug-92	11	26	8.2	3.6	18	58	34	130	27.5	90	11	64	32	76	90	63	0.8	0.17
Sep-92	11	26	6.4	4.1	18	58	34	130	27.5	90	11	64	32	76	90	63	0.8	0.34
Oct-92	11	19	9.8	5.2	21	64	37	115	27.5	95	13	52	24	66	110	56	0.44	0.46
Nov-92	11	19	9.6	8.2	21	64	37	115	27.5	95	13	52	24	66	110	56	0.44	0.46
Dec-92	11	19	9.8	8.8	21	64	37	115	27.5	95	13	52	24	66	110	56	0.44	0.46
Jan-93	11	19	9.8	9.2	21	64	37	115	27.5	95	13	52	24	66	110	56	0.44	0.46
Feb-93	11	19	9.6	10	21	64	37	115	27.5	95	13	52	24	66	110	56	0.3	0.1
Mar-93	7.5	17	9.4	9.6	17	42	20	125	0.23	28	13	20	20	36	56	38	0.3	0.1
Apr-93	7.5	17	9.4	8	17	45	20	110	0.23	28	13	20	20	36	56	38	0.3	0.1
May-93	6.6	36	8	7.2	17	41	19	107	37	20	11	33	16	28	38	26	0.26	0.1
Jun-93	6.6	36	7.5	6.4	17	41	19	107	37	20	11	33	16	28	38	26	0.23	0.1
Jul-93	6.6	36	7.2	6.4	17	41	19	107	37	20	11	33	16	28	38	26	0.23	0.1
Aug-93	7.6	37	7	6.4	18	38	17	87	41	29	7.6	39	11	49	29	18	0.15	0.1
Sep-93	7.6	37	7.5	6.4	18	38	17	87	41	29	7.6	39	11	49	29	18	0.15	0.1
Oct-93	7.6	37	8.8	6.4	18	38	17	87	41	29	7.6	39	11	49	29	18	0.15	0.1
Nov-93	7.6	37	9.5	0.35	18	38	17	87	41	29	7.6	39	11	49	29	18	0.05	0.04
Dec-93	8.8	13	9.5	3.9	18	35	17	85	0.34	21	8.4	17	9.5	50	30	17	0.18	0.04
Jan-94	8.8	13	9.5	3.9	18	35	17	85	0.34	21	8.4	17	9.5	50	30	17	0.18	0.04
Feb-94	5.3	13.5	7.3	7.3	16	30	12	108	0.13	7	5.5	12	10	24	25	18	0.23	0.04
Mar-94	4.3	13.5	7.3	7.3	16	30	12	108	0.13	7	5.5	12	10	24	25	18	0.23	0.04
Apr-94	3.6	13.5	7.3	7.3	16	30	12	108	0.13	7	9.6	12	10	24	25	18	0.23	0.04
May-94	3.8	17	6.4	4	31	32	14	78	36	19	7.5	32	5	38	21	12	0.13	0.02
Jun-94	3.6	17	6.4	4	31	33	14	75	36	19	7.3	32	5	38	21	12	0.13	0.02
Jul-94	3.8	17	6.4	4	31	33	14	75	36	19	6.2	32	5	38	21	12	0.13	0.02
Aug-94	3.8	12	6.5	4.8	33	33	16	65	12	27	5.6	27	0.9	60	22	4	0.13	0.01
Sep-94	5.2	12	6.5	4.8	33	33	16	65	12	27	5	27	0.9	60	22	4	0.13	0.01
Oct-94	6	12	6.5	4.8	33	33	16	65	12	27	4.8	27	1.3	60	22	4	0.13	0.01
Nov-94	5.4	1.1	7.8	1.2	26	29	18	65	0.26	20	5.6	14	3	52	24	11.5	0.13	0.03
Dec-94	4.8	1.1	7.8	1.2	26	29	18	65	0.26	20	5.2	14	2.4	52	24	11.5	0.1	0.01
Jan-95	4.6	0	0	0	23.5	24.5	14.5	60	0	0	5	0	2.5	0	0	0	0	0
Feb-95	5	11	6.8	0.9	21	20	11	55	7	16	4.8	11	2.4	46	15	6	0	0
Mar-95	0	0	0	0	20.7	20.7	11	60	0	0	6	0	2.6	0	0	0	0	0
Apr-95	0	0	0	0	20.3	21.4	11	65	0	0	0	0	0	0	0	0	0	0
May-95	3.4	14	6.4	1.6	20	22	11	70	0	14	5.6	14	2.2	40	12	4	0	0
Jun-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jul-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aug-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Oct-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nov-95	0	0	0	0	16	21	0	54	0	27	0	11	0	36	0	0	0	0
Dec-95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jun-96													2.1			4.2	0.2	
Nov-96						14.5		64		17				6.5				
Dec-96													2.1			4.6	0.17	
Feb-97					15	12	7.6	60	16	7		10		21	10.5			
May-97					24	12.5	2.5	48	8.5	20		3.5		22	8			
Jun-97													1.8			3.6	0.18	
Jul-97										22				21				
Aug-97					17	13	3.4	48	25	27		6.6		22	6			

ation Results (mg/L)

315	163	922	706	4310											
2050	170	850	1400	3700											
2050	170	1400	1900	4300											
850	180	2700	1350	2900											
700	60	2000	1000	2100											
657	67	1750	1567	1850											
657	67	1750	1567	1850											
640	96	1350	1300	1400											
563	108	1320	1325	1650											
486	97	1100	1367	1700											
513	83	1333	1100	1300											
525	64	1467	633	1100											
563	52	840	525	760											
563	52	840	525	760											
550	160	450	325	383											
550	150	340	290	390											
470	33.3	190	160	190											
390	17	153	100	150											
150	10.8	180	105	145											
123	8.5	206	117	165											
80	7.4	116	63	83											
45	5.1	72	68	60											
45	5.1	72	68	60											
48	4	70	42	72											
45	3.2	64	43	66											
47.5	3.1	76	42	66											
51	3.3	56	66	66											
38	2.7	42	44	62											
41	3	42	42	48											
33	2.4	40	35	51											
24	2.4	43	48	54											
18	1.5	33	33	32											
15	1.5	29	35	36											
13	1.1	25	31	45											
13	0.9	24	40	36											
11.5	1.3	24	40	34											
11.5	1.8	24	40	34											
11.5	1.8	24	40	34											
13.5	4.1	32	37.5	27.5											
13.5	0.7	32	37.5	27.5											
13.5	0.2	32	37.5	27.5											
5.6	0.9	23	43	52											
4.6	0.7	23	43	52											
3.6	0.9	23	43	52											
2.3	1.2	13.5	25	23											
0.9	0.7	13.5	25	23											
0.95	0.7	13.5	25	23											
1.2	1.5	13	20	16											
1.3	1.5	13	20	16											
1.5	1.5	13	20	16											
1.7	0.1	14	23	16											
1.8	0.1	14	23	16											
1.6	0.1	14	23	16											
0.9	0.1	14	23	16											
0.9	0.1	14	23	16											
0.9	0.1	11.5	24	19.5											
0.6	0.1	11.5	24	19.5											
0.6	0.1	10.5	21	17.5											
0.19	0.1	10.5	21	17.5											
0.19	0.1	10.5	21	17.5											
0.1	0.1	9	19	12											
0.1	0.1	9	19	12											
0.1	0.1	9	19	12											
0.12	0.01	9	19	12											
0.12	0.01	10	17	15											
0.12	0.01	10	17	15											
0.3	0.03	17	27	22											
0.3	0.03	17	27	22											
0.3	0.03	17	27	22											
0.06	0.03	8	17	12											
0.09	0.02	8	10	12											
0.09	0.02	8	10	12											
0.07	0.02	6	9	8.5											
0.07	0.02	6	9	8.5											
0.07	0.02	4.8	9	8.5											
0.16	0.02	4	11.5	8.5											
0.07	0.19	2.3	11.5	8.5											
0	0	2	0	0											
0.49	0	1.8	15	9											
0	0	2.2	0	0											
0	0	0	0	0											
0.05	0	2	19	11											
0	0	0	0	0											
0	0	0	0	0											
0	0	0	0	0											
0	0	0	0	0											
0	0	0	0	0											
0	0	0	15	0											
0	0	0	0	0											
					0.01	0.02					0.02				
			17	11											
					0.01	0.01					0.05				
			20	14.5											
			18	12.5											
					0.02	0.01					0.04				
			17	10											

Sep-97										34				20				
Oct-97										19				10				
Nov-97					12	15	4.5	50	20	13		4.5		3.5	4			
Dec-97										7.5			2	1.5	-	3.2	0.26	
Jan-98										6.5				5				
Feb-98					15	11	2.6	52	11	3.2		2.2		19	9			
Mar-98										2				14				
Apr-98										2.4				9				
May-98					17	9.5	1.6	60	18.5	1.9		3.2		8	10.8			
Jun-98										1.1			2.2	4.2		4.4	0.32	
Jul-98						8		54	40	2				7				
Aug-98					35		1.6			2.8		4		8.4	8.6			
Sep-98										3.6				10				
Oct-98										4				11.5				
Nov-98					36	8	1.8	58	32	4		4.6		12.5	8.5			
Dec-98										0.6			1.8	2		0.03	0.21	
Jan-99										0.6				0.43				
Feb-99					19	6	1.7	68	0.09	0.8		1.6		2	7.5			
Mar-99										0.2				0.4				
Apr-99										0.5				3				
May-99					19	6.5	1.4	60	35	0.04		2.7		0.06	10			
Jun-99										0.7			1.8	2		2	0.24	
Jul-99		4	6		19					1.7				4.1				
Aug-99					13.5	12.5	1.9	56	29	2.5		5		6	9.4			
Sep-99										3.4				5.8				
Oct-99		11	20							4.7				6.8				
Nov-99		1.6	20		9	15		50	54	4.6				7.6				
Dec-99		0.37	10.5				3.6			0.52		1.8	1.9	0.35	5.2	2.8	0.47	
Jul-00	2.5	4.6	8.6	0.04	9	5.5	1.5	44	34	1.4	0.6	2.3	2	6.2	11.5	2.6	0.33	0.09
Aug-00	2.5	6	10	0.04	12	7	1.8	40	62	2	0.6	3.4	2	7.8	10.4	2.6	0.33	0.09
Sep-00	2.5	6	10	0.1	12	7	1.8	40	62	2	0.6	3.4	2	7.8	10.4	2.6	0.33	0.09
Oct-00	2.5	6	10	0.04	12	7	1.8		62	2	0.6	3.4	2	7.8	10.4	2.6	0.33	0.09
Nov-00	3	6	10	0.1	13	7	1.8		31	1.8	0.6	3.4	2	7.3	10.4	2.6	0.33	0.09
Dec-00	3	6	10	0.1	13	7	1.8		31	1.8	0.6	3.4	2	7.3	10.4	2.6	0.33	0.09
Jan-01	2.5	1.3	5	0.15	11	4.75	1.6		30	0.6	1.2	2.8	2.1	2.8	6	3	0.29	0.08
Feb-01	2.5	1.3	5	0.15	11	4.75	1.6		60	0.6	1.2	2.8	2.1	2.8	6	3	0.29	0.08
Mar-01	2.5	1.3	5	0.15	9	4.75	1.6		22	0.6	1.2	2.8	2.1	2.8	6	3	0.29	0.08
Apr-01	2.5	1.3	5	0.15	11.5	4.75	1.6		50	0.6	1.2	2.8	2.1	2.8	6	3.4	0.39	0.08
May-01	2.5	1.3	5	0.15	12.5	4	1.7		32	0.25	1.2	5.9	2.1	0.85	7.6	3.4	0.39	0.08
Jun-01	2.8	1.3	5	0.18	12.5	3.5	1.4		44	0.41	1.2	5.4	2.1	1.8	10.5	3.8	0.39	0.08
Jul-01	2.8	1.3	5	0.18	12.5	3.5	1.4		48	0.41	1.2	5.4	2.1	1.8	12.5	3.8	0.39	0.08
Aug-01	2.8	1.3	5	0.18	12	3	2.2		0.02	0.5	1.2	3.8	2.1	0.05	14	3.8	0.39	0.08
Sep-01	2.8	1.3	5	0.18	12	3	2.2		20	0.5	1.2	3.8	2.1	0.05	15	3.8	0.39	0.08
Oct-01	2.8	1.3	5	0.18	12	3	2.2		20	0.5	1.2	3.8	2.1	0.05	17	3.8	0.39	0.08
Nov-01	2.8	1.3	5	0.18	12	3.4	2.1		17	0.75	1.2	2.9	2.1	0.59	18.5	3.8	0.39	0.08
Dec-01	3	1.4	3	0.09	11.5	3.5	2.1		0.7	0.15	1.4	1.3	1.6	0.4	9.5	2.2		
Jan-02	3	1.4	3	0.09	11.5	3.5	2.1		21	0.15	1.4	1.3	1.6	0.4	14	2.2		
Feb-02	3	1.4	3	0.09	11	5	1.9		17	0.45	1.4	4.1	1.6	2.3	12	2.2		
Mar-02	3	1.4	3	0.09	11.5	5	1.9		0.8	0.45	1.4	4.1	1.6	2.3	11.5	2.2		
Apr-02	3	1.4	3	0.09	11	5	1.9		19.5	0.45	1.4	4.1	1.6	2.3	12.5	2.2		
May-02	3	1.4	3	0.09	11	3.8	1.9		26	0.4	1.4	5	1.6	1	13	2.2		
Jun-02	2.7	2.1	3.5	0.25	12	4.4	2.3		19.5	0.34	0.95	5.3	1.7	1.5	13	0.02		
Jul-02	2.7	2.1	3.5	0.25	11.5	4.4	2.3		16	0.34	0.95	5.3	1.7	1.5	13.5	0.02		
Aug-02	2.7	2.1	3.5	0.25	12	4.4	2.7		20.5	0.46	0.95	5.5	1.7	1.5	10	0.02		
Sep-02	2.7	2.1	3.5	0.25	10.5	4.4	2.7		20	0.46	0.95	5.5	1.7	1.5	8	0.02		
Oct-02	2.7	2.1	3.5	0.25	10	4.4	2.7		39	0.46	0.95	5.5	1.7	1.5	5	0.02		
Nov-02	2.7	2.1	3.5	0.25	11	3.6	2.2		16	0.35	0.95	4	1.7	0.4	1.8	0.02		
Dec-02	3.6	1.1	1.6	0.08	12	4.2	3.1		15	0.2	1.3	4	1.6	0.65	3.2	0.04		

ition Results (mg/L)

			17	7											
					0.01	0.02					0.05				
			18	10											
			18	12											
					0.01	0.01					0.04				
			18	13											
			22	14.5											
					0.01	0.01					0.04				
			20.5	12											
			19	13											
					0.01	0.01					0.04				
			13.5	5.5											
			12	6											
					0.01	0.14					0.05				
0.6	0.03	0.42	16.5	9.5										11	
0.6	0.03	0.42	13	9.5										11	
0.6	0.03	0.42	15	9.5			0.04		1.1					11	
0.6	0.03	0.42													
0.6	0.03	0.5												19	
0.6	0.03	0.5												15	
0.32	0.31	0.43			0.01	0.02	0.01	0.56	1.1		0.05			15.5	
0.32	0.31	0.43												13	
0.32	0.31	0.43												14	
0.31	0.31	0.47					0.01			0.19	0.03		14.5		
0.31	0.31	0.47			0.01			0.47					13.5		
0.31	0.1	0.54				0.03			0.44			5.3	15		
0.31	0.1	0.54											14.5		
0.31	0.1	0.54											4		
0.31	0.1	0.54											14.5		
0.31	0.1	0.54											16		
0.31	0.1	0.54											16		
	0.01	0.72				0.02			0.6			1.8	7.5		
	0.01	0.72												13.5	
	0.01	0.72												13	
	0.01	0.72												7.5	
	0.01	0.72												13	
	0.01	0.72												14	
	0.01	0.6				0.02			1.1			3.3		13.5	
	0.01	0.6												16	16
	0.01	0.6												20.5	20.5
	0.01	0.6												20	20
	0.01	0.6												39	39
	0.01	0.6												16	16
	0.01	0.56												15	15

Appendix C – Deep Aquifer Pumping Data

Date	Aquifer	Rainfall	Days in Month	Days of Operation	Total Hours System on	Total Gallons Pumped	Total Gallons Extracted	Gal/Hr Removed	Gal/Hr
May-90	Deep	1.43	31	30			0		0
Jun-90	Deep	1.53	30	30			0		0
Jul-90	Deep	0.45	31	31			11781		0
Aug-90	Deep	1.72	31	31			48305		0
Sep-90	Deep	0.83	30	30			0		0
Oct-90	Deep	4.56	31	31			0		0
Nov-90	Deep	4.87	30	28			0		0
Dec-90	Deep	3.59	31	19			0		0
Jan-91	Deep	2.68	31	20			0		0
Feb-91	Deep	3.22	28	28			0		0
Mar-91	Deep	5.85	31	31			0		0
Apr-91	Deep	3.47	30	30			0		0
May-91	Deep	3.91	31	29			0		0
Jun-91	Deep	1.52	30	30			0		0
Jul-91	Deep	0.38	31	31			36500		0
Aug-91	Deep	0.72	31	31	745.8		628350	7.39	0
Sep-91	Deep	0.19	30	30	717.2		707150	7.5	0
Oct-91	Deep	2.55	31	31	740		694100	10.06	0
Nov-91	Deep	5.12	30	30	719.2		686670	9.28	0
Dec-91	Deep	4.38	31	30	740.1		707380	5.11	0
Jan-92	Deep	4.52	31	31	742		711050	2.3	0
Feb-92	Deep	4.54	29	29	690.3		671200	1.83	0
Mar-92	Deep	1.04	31	31	743.6		714200	1.78	0
Apr-92	Deep	1.52	30	30	718.6		689900	1.6	0
May-92	Deep	0	31	31	745.4		731300	1.6	0
Jun-92	Deep	1.18	30	30	722.5		705800	1.73	0
Jul-92	Deep	1.18	31	31	746.5		778840	2.62	0
Aug-92	Deep	0.44	31	31	737.3		755750	3.14	0
Sep-92	Deep	0.55	30	30	717.8		733510	3.87	0
Oct-92	Deep	3.52	31	31	744.1		727200	3.67	0
Nov-92	Deep	4.99	30	30	718.9		656000	3.17	0
Dec-92	Deep	7.38	31	29	744.1		720400	2.03	0
Jan-93	Deep	4.15	31	15	744		647700	1.3	0
Feb-93	Deep	2.2	28	15	672		573000	1.39	0
Mar-93	Deep	4.05	31	31	742.7		698400	1.28	0
Apr-93	Deep	5	30	30	717.3		705900	1.06	0
May-93	Deep	4.25	31	31	744.4		740400	1.11	0
Jun-93	Deep	1.25	30	30	723.1		699800	1.05	0
Jul-93	Deep	1.25	31	31	736.1		635200	0.9	0
Aug-93	Deep	0.2	31	31	747.6		655800	0.93	0
Sep-93	Deep	0	30	30	722.3		625700	0.94	0
Oct-93	Deep	0.7	31	31	740.6		652000	0.92	0
Nov-93	Deep	1	30	20	720		573600	0.91	0
Dec-93	Deep	6.1	31	31	735.8		653700	1.09	0
Jan-94	Deep	3.4	31	31	745.4		640100	0.75	0
Feb-94	Deep	4.05	28	28	674.4		481100	0.8	0
Mar-94	Deep	3.15	31	31	744		535900	0.8	0
Apr-94	Deep	1.3	30	30	715.1		557400	0.7	0
May-94	Deep	0.7	31	28	743.6		557600	0.7	0
Jun-94	Deep	0.7	30	25	721.5		585500	0.73	0
Jul-94	Deep	0	31	31	744.5		540300	0.63	0
Aug-94	Deep	0	31	31	741.1		542300	0.63	0
Sep-94	Deep	0.65	30	30	720.1		529900	0.62	0
Oct-94	Deep	6.65	31	31	745.2		529200	0.57	0
Nov-94	Deep	7.25	30	30	724.3		521000	0.61	0

ater Pumping Data

...ged	Recharged to Basin 1	Recharged to Basin 2	Recharged to Trench	Total Gallons Injected	Total Gallons Discharged	Cr6+ mg/l	Rate of Extraction	Total Extraction Hrs Operated	Treatment Hrs
760						1.40	14.00		
580						1.30	16.40		
230						1.70	15.60		
510						1.60	15.90		
150						0.90	15.90		
400						0.39	16.00		
220						0.33	16.20		
950						0.30	16.00		
580						0.28	16.00		
680						0.26	16.40		
210						0.29	16.30		
250						0.40	17.40		
620						0.50	17.10		
420						0.63	17.00		
750						0.61	16.30		
990						0.58	15.20		
690						0.34	16.10		
090						0.24	14.50		
370						0.29	14.20		
950						0.22	15.70		
270						0.18	16.40		
560						0.18	16.60		
260						0.18	16.10		
580						0.17	14.40		
770						0.17	14.60		
100						0.18	14.40		
670						0.17	14.70		
660						0.19	13.30		
090						0.20	14.80		
000						0.14	14.30		
0						0.20	11.90		
0						0.20	12.00		
0						0.15	13.00		
0						0.15	12.50		
0						0.15	13.50		
0						0.14	12.10		
0						0.14	12.20		
0						0.14	12.30		
0						0.13	11.80		
0						0.14	12.00		

Date	Zone	Days in Month	Days of Operation	Total Hours System Ran	Gallons Pumped	Gallons Extracted	Lbs Removed	Lbs/Day
Dec-94	Deep	5.9	31	31	739.7	619000	0.62	0
Jan-95	Deep	10.85	31	31	745.7	493100	0.37	0
Feb-95	Deep	2.9	28	20	651.8	404100	0.3	0
Mar-95	Deep	5.05	31	31	762.2	478800	0.32	0
Apr-95	Deep	5.3	30	30	725	455000	0.3	0
May-95	Deep	1.43	31	31	738.9	463200	0.27	0
Jun-95	Deep	2.36	30	28	672	436400	0.22	0
Jul-95	Deep	0.52	31		789.9	469700	0.31	0
Aug-95	Deep	0.82	31		750.8	430600	0.29	0
Sep-95	Deep	3.14	30		717.2	409100	0.24	0
Oct-95	Deep	3.96	31		739	414700	0.31	0
Nov-95	Deep	7.72	30		723.6	405600	0.3	0
Dec-95	Deep	10.12	31		740.8	458700	0.31	0
Jan-96	Deep	10.37	31		745	417100	0.24	0
Feb-96	Deep	13.63	29		526.7	392700	0.2	0
Mar-96	Deep	3.54	31		745.1	399100	0.23	0
Apr-96	Deep	4.93	30		717.9	377800	0.22	0
May-96	Deep	3.98	31		742.7	271100	0.25	0
Jun-96	Deep	0.85	30		433.9	232700	0.12	0
Jul-96	Deep	0.92	31		747.7	387400	0.19	0
Aug-96	Deep	0.14	31		742.8	215100	0.18	0
Sep-96	Deep	2.22	30		721.4	188800	0.19	0
Oct-96	Deep	5.32	31		738.7	194900	0.2	0
Nov-96	Deep	10.2	30		489.4	134000	0.15	0
Dec-96	Deep	17.11	31		712.6	194900	0.18	0
Jan-97	Deep	9.08	31	30	716.5	186300	0.11	
Feb-97	Deep	2.2	28	28	676.6	110000	0.09	
Mar-97	Deep	6.43	31	31	739.7	120600	0.11	
Apr-97	Deep	3.6	30	30	723.1	119760	0.11	
May-97	Deep	2.2	31	31	739.9	123400	0.12	
Jun-97	Deep	2.42	30	30	718.6	133600	0.13	
Jul-97	Deep	0.38	31	31	744	122400	0.12	
Aug-97	Deep	1.25	31	31	713	116900	0.13	
Sep-97	Deep	3.39	30	30	720.7	112100	0.11	
Oct-97	Deep	5.5	31	31	747.5	121900	0.15	
Nov-97	Deep	5.18	30	30	720.2	119200	0.14	
Dec-97	Deep	3.02	31	31	742	128900	0.16	
Jan-98	Deep	8.8	31	31	745.7	276600	0.3	
Feb-98	Deep	8.35	28	28	671.8	262900	0.39	
Mar-98	Deep		31	31	745.3	291700	0.41	
Apr-98	Deep		30	30	719.6	280600	0.42	
May-98	Deep		31	31	721.8	278700	0.53	
Jun-98	Deep	0.75	30	30	720.2	292900	0.54	
Jul-98	Deep		31	31	739	161500	0.36	
Aug-98	Deep		31	31	749.6	120300	0.28	
Sep-98	Deep	0.6	30	30	714.6	113500	0.26	
Oct-98	Deep	1.35	31	31	744	117800	0.27	
Nov-98	Deep	13.4	30	30	719.7	114900	0.26	
Dec-98	Deep		31	31	743.8	125500	0.28	
Jan-99	Deep	9.2	31	31	742.6	123970	0.28	
Feb-99	Deep	12.5	28	28	673.1	111500	0.24	
Mar-99	Deep	4.4	31	31	746.3	123000	0.26	
Apr-99	Deep	0.5	30	30	716.2	117300	0.18	
May-99	Deep	2.05	31	31	743.7	120600	0.26	
Jun-99	Deep	0.55	30	30	717.4	141200	0.31	

ater Pumping Data

Hrs Operated	Recharged to Basin 1	Recharged to Basin 2	Recharged to Trench	Total Gallons Treated	Total Gallons Discharged	Cr6 mg/L	Ratio of Extraction	Total Extraction Hrs Operated	Treatment Hrs
0						0.12	13.90		
0						0.09	11.00		
0						0.09	10.30		
0						0.08	10.50		
0						0.08	10.50		
0						0.07	10.40		
0						0.06	10.80		
0						0.08	9.90		
0						0.08	9.60		
0						0.07	9.50		
0						0.09	9.40		
0						0.09	9.30		
0						0.08	10.30		
0						0.07	9.30		
0						0.06	12.40		
0						0.07	8.90		
0						0.07	8.80		
0						0.11	6.10		
0						0.06	8.90		
0						0.06	8.60		
0						0.10	4.80		
0						0.12	4.40		
0						0.12	4.40		
0						0.13	4.60		
0						0.11	4.60		
						0.07			
						0.10			
						0.11			
						0.11			
						0.12			
						0.12			
						0.12			
						0.13			
						0.12			
						0.15			
						0.14			
						0.15			
						0.13			
						0.18			
						0.17			
						0.18			
						0.23			
						0.22			
						0.27			
						0.28			
						0.27			
						0.27			
						0.26			
						0.27			
						0.27			
						0.26			
						0.25			
						0.18			
						0.26			
						0.26			

Date	Zone/Area	Rainfall	Days in Month	Days of Operation	Total Hours System Ran	Total Gallons Pumped	Total Gallons Extracted	Total Lbs Removed	[illegible]	[illegible]
Jul-99	Deep		31	31	745.4		119300	0.29		
Aug-99	Deep	0.85	31	31	745.9		117400	0.27		
Sep-99	Deep		30	30	723.8		112600	0.29		
Oct-99	Deep	2.5	31	31	744.1		115300	0.28		
Nov-99	Deep	7.3	30	30	719.8		112500	0.29		
Dec-99	Deep	6	31	31	745.3		147400	0.42		
Jan-00	Deep		31	31	743.1		122400	0.36		
Feb-00	Deep	5.65	29	29	696.1		114100	0.34		
Mar-00	Deep	2.75	31	31	740		120000	0.37		
Apr-00	Deep	1.55	30	30	718.5		115300	0.36		
May-00	Deep	1.95	31	31	747.2		120500	0.41		
Jun-00	Deep	0.7	30	30	719.7		130300	0.47		
Jul-00	Deep	0.1	31	31	740		116900	0.47	7.3	
Aug-00	Deep	0	31	31	743.6		140500	0.57	7.8	
Sep-00	Deep	0.85	30	7	336		255600	0.11	7.5	
Oct-00	Deep	2.7	31	0	0		0	0	0	
Nov-00	Deep	2.1	30	28	0		0	0	0	
Dec-00	Deep	4.75	31	24	508.6		106410	0.47	7.2	
Jan-01	Deep	2.25	31	31	740.8		142900	0.72	7.9	
Feb-01	Deep	1.45	28	28	673		263200	0.33	7.4	
Mar-01	Deep	2.75	31	31	738.6		318300	0.5	7.5	
Apr-01	Deep	1.55	30	30	724.5		322000	0.43	7.9	
May-01	Deep	0.95	31	31	739.7		301100	0.48	7.7	
Jun-01	Deep	1.8	30	30	715.5		294300	0.54	7.6	
Jul-01	Deep	0.35	31	31	747.6		274900	0.57	7.7	
Aug-01	Deep	0.8	31	31	733.7		284400	0.71	7.7	
Sep-01	Deep	0.85	30	30	724.9		293200	0.8	7.6	
Oct-01	Deep	2.85	31	31	741		175600	0.48	7.8	
Nov-01	Deep	6.7	30	32	768.2		219900	0.51	7.6	
Dec-01	Deep	7.6	31	29	694.8		249100	0.71	7.8	
Jan-02	Deep		31	31	744.7		272300	0.7	7.7	
Feb-02	Deep		28	28	674.4		241800	0.6	7.9	
Mar-02	Deep		31	31	740.8		265100	0.69	7.6	
Apr-02	Deep		30	30	713.1		220900	0.59	7.9	
May-02	Deep		31	31	743.8		230000	0.59	7.7	
Jun-02	Deep		30	30	720.1		221000	0.53	7.6	
Jul-02	Deep		31	31	744.6		215600	0.52	7.3	
Aug-02	Deep		31	31	741.3		209100	0.54	7.8	
Sep-02	Deep		30	30	725.3		192700	0.5	7.5	
Oct-02	Deep		31	30	718.7		187200	0.5	7.5	
Nov-02	Deep		30	31	741		209700	0.63	7.3	
Dec-02	Deep		31	31	744.5		221700	0.65	7.4	

ater Pumping Data

						0.29			
						0.28			
						0.31			
						0.29			
						0.31			
						0.34			
						0.35			
						0.36			
						0.37			
						0.37			
						0.41			
						0.43			
						0.48			
						0.49			
						0.49			
0									
0						0.53			
						0.60			
						0.15			
						0.19			
						0.16			
						0.19			
						0.22			
						0.25			
						0.3			
						0.33			
						0.33			
						0.28			
						0.34			
						0.31			
						0.30			
						0.31			
						0.32			
						0.31			
						0.29			
						0.29			
						0.31			
						0.31			
						0.32			
						0.36			
						0.35			

Deep Aquifer Chromium (

Month-Year	DW-01	DW-02	DW-03	DW-09	DW-10	DW-11	DW-12	DW-13	DW-1
Jul-91		7.35	2.23				0	0	
Aug-91		4.12	4.7				0.145	0.37	
Sep-91		0	4.1				0	0.39	
Oct-91		2.3	6.9				0.12	0.55	
Nov-91		0	0				0	0	
Dec-91		0	0				0	0	
Jan-92		0	0				0	0	
Feb-92		0	0				0	0	
Mar-92		0.33	1.4				0.12	0.1	
Apr-92		0	0				0	0	
May-92		0	0				0	0	
Jun-92		0	0				0	0	
Jul-92		0	0				0	0	
Aug-92		0	0				0	0	
Sep-92		0.1	3				0.1	0.1	
Oct-92		0.1	3.3				0.1	0.1	
Nov-92		0.1	3.4				0.1	0.1	
Dec-92		0.1	3.1				0.1	0.1	
Jan-93		0	0				0	0	
Feb-93		0	0				0	0	
Mar-93		0.1	0.74				0.1	0.1	
Apr-93		0	0				0	0	
May-93		0	0				0	0	
Jun-93		0.1	0.86				0.1	0.1	
Jul-93		0	0.72				0	0	
Aug-93		0	0.74				0	0	
Sep-93		0.02	0.66				0.03	0.01	
Oct-93		0	0.84				0	0	
Nov-93		0	0				0	0	
Dec-93		0.01	0.8				0.03	0.01	
Jan-94		0	0				0	0	
Feb-94		0	0				0	0	
Mar-94		0	0.64				0.01	0	
Apr-94		0	0				0	0	
May-94		0	0				0	0	
Jun-94		0.01	0.56				0.01	0	
Jul-94		0	0				0	0	
Aug-94		0	0				0	0	
Sep-94		0	0.6				0.01	0	
Oct-94		0	0				0	0	
Nov-94		0	0				0	0	
Dec-94		0.01	0.38				0.01	0.01	
Jan-95		0	0				0	0	
Feb-95		0	0				0	0	
Mar-95		0	0.25				0.01	0	
Apr-95		0	0				0	0	
May-95		0	0				0	0	
Jun-95		0.01	0.29				0.01	0.01	

centration Results (mg/L)

DW-15	DW-16	DW-17	DW-18	DW-Combined	Deep	Deep aquifer discharged	Deep aquifer discharged/ DW-08	Deep/DW-09
0	0		0	0				
0.1	0.1		0.18	1.9				
0.1	0.1		0.16	1.2				
0.1	0.1		0.14	1.6				
0	0		0	1.4				
0	0		0	0.8				
0	0		0	0.38				
0	0		0	0.34				
0.1	0.1		0.1	0.29				
0	0		0	0.29				
0	0		0	0.27				
0	0		0	0.27				
0	0		0	0.39				
0	0		0	0.44				
0.1	0.1		0.1	0.56				
0.1	0.1		0.1	0.6				
0.1	0.1		0.1	0.6				
0.1	0.1		0.1	0.26				
0	0		0	0.24				
0	0		0	0.29				
0.1	0.1		0.1	0.22				
0	0		0	0.18				
0	0		0	0.18				
0.1	0.1		0.1	0.18				
0	0		0	0.17				
0	0		0	0.17				
0.07	0.07		0.01	0.18				
0	0		0	0.17				
0	0		0	0.19				
0.13	0.07		0.01	0.2				
0	0		0	0.14				
0	0		0	0.2				
0.06	0.04		0	0.18				
0	0		0	0.15				
0	0		0	0.15				
0.07	0.04		0.01	0.15				
0	0		0	0.14				
0	0		0	0.14				
0.1	0.03		0	0.14				
0	0		0	0.13				
0	0		0	0.14				
0.07	0.02		0.01	0.12				
0	0		0	0.09				
0	0		0	0.09				
0.06	0.02		0	0.08				
0	0		0	0.08				
0	0		0	0.07				
0.08	0.02		0.01	0.06				

Deep Aquifer Chromium C

Mo Year	DW-06	DW-09	DW-08	DW-06	DW-10	DW-11	DW-2	DW-13	DW-1
Jul-95		0	0				0	0	
Aug-95		0	0				0	0	
Sep-95		0	0.27				0.01	0	
Oct-95		0	0				0	0	
Jun-96				0.2	0.01			0.01	
Dec-96			0.11	0.07	0.01			0.01	
Jan-97			0.12						
Mar-97			0.11						
Apr-97			0.11						
May-97			0.12						
Jun-97			0.12	0.02	0.01			0.01	
Jul-97			0.12						
Aug-97			0.13						
Sep-97			0.12						
Oct-97			0.15						
Nov-97			0.14						
Dec-97			0.15	0.17	0.01			0.01	
Jan-98			0.13						
Feb-98			0.18						
Mar-98			0.17						
Apr-98			0.18						
May-98			0.23						
Jun-98			0.22	0.02	0.01			0.01	
Jul-98			0.27						
Aug-98			0.28						
Sep-98			0.27						
Oct-98			0.27						
Nov-98			0.26						
Dec-98			0.27	0.05	0.01			0.01	
Jan-99			0.27						
Feb-99			0.26						
Mar-99			0.25						
Apr-99			0.18						
May-99			0.26						
Jun-99			0.26	0.05	0.01			0.01	
Jul-99			0.29						
Aug-99			0.28						
Sep-99			0.31						
Oct-99			0.29						
Nov-99			0.31						
Dec-99			0.34	0.12	0.01			0.01	
Jul-00									
Aug-00									
Sep-00	0.01					0.01			
Dec-00									
Jan-01	0.01		0.61	0.07	0.01	0.01		0.01	
Feb-01			0.46	0.13					
Mar-01			0.45	0.05					

centration Results (mg/L)

DW-15	DW-16	DW-17	DW-18	DW-Combined	Deep	Deep aquifer discharged	Deep aquifer discharged/ DW-08	Deep/DW-09
0	0		0	0.08				
0	0		0	0.08				
0.05	0.02		0	0.07				
0	0		0	0.09				
		0.01	0.01					
		0.01	0.01					
		0.01	0.01					
		0.01	0.01					
		0.01	0.01					
		0.01	0.01					
		0.01	0.01					
							0.48	
							0.49	
							0.49	
							0.53	
		0.01	0.01				0.6	
						0.15		
						0.19		

Deep Aquifer Chromium C

Month-Yr	DW-01	DW-03	DW-08	DW-09	DW-10	DW-12	DW-13	DW-18	DW-
Apr-01	0.01		0.38	0.05		0.01		0.01	0.
May-01			0.43	0.05					
Jun-01			0.33	0.18					
Jul-01			0.38	0.2					
Aug-01			0.37	0.31					
Sep-01		0.01	0.37	0.29	0.01		0.03	0.01	
Oct-01			1.1	0.33					
Nov-01			1.1	0.28					
Dec-01			0.16	0.27					
Jan-02			0.28	0.42					
Feb-02			0.26	0.42					
Mar-02		0.01	0.28	0.26	0.01		0.01	0.01	
Apr-02			0.31	0.47					
May-02			0.29	0.37					
Jun-02			0.23	0.34					
Jul-02			0.24	0.38					
Aug-02			0.23	0.34					
Sep-02		0.01	0.26	0.41	0.01		0.01	0.01	
Oct-02			0.24	0.44					
Nov-02			0.17	0.38					
Dec-02			0.23	0.37					

centration Results (mg/L)

DW-15	DW-16	DW-17	DW-B	DW-Combined	Deep	Deep aquifer discharged	Deep aquifer discharged/ DW-08	Deep/DW-09
	0.01	0.01	0.01		0.16			
					0.19			
					0.22			
					0.25			
					0.3			
0.08					0.33			
								0.33
								0.28
					0.34			
						0.31		
						0.3		
0.02						0.31		
						0.32		
						0.31		
						0.29		
						0.29		
						0.31		
0.08						0.31		
						0.32		
						0.36		
						0.35		

Appendix D - United Chrome Groundwater Use Deed Restriction

CORVALLIS
ENHANCING COMMUNITY LIVABILITY

Public Works
1245 NE 3rd Street
P.O. Box 1083
Corvallis, OR 97339-1083
(503) 757-6916
FAX (503) 757-6920

April 2, 1993

Allan Goodman
Oregon Operations Office
Environmental Protection Agency
811 S.W. Sixth Avenue, 3rd Floor
Portland, Oregon 97204

UNITED CHROME DEED RESTRICTION

Attached is the United Chrome deed restriction required by United Chrome Consent Decree, Civil Action No. 92-6232-HO. Please review the deed restricting groundwater use or pumping wells and approve it as required by the Decree.

If you have any questions, please contact me 757-6916. Thank you.

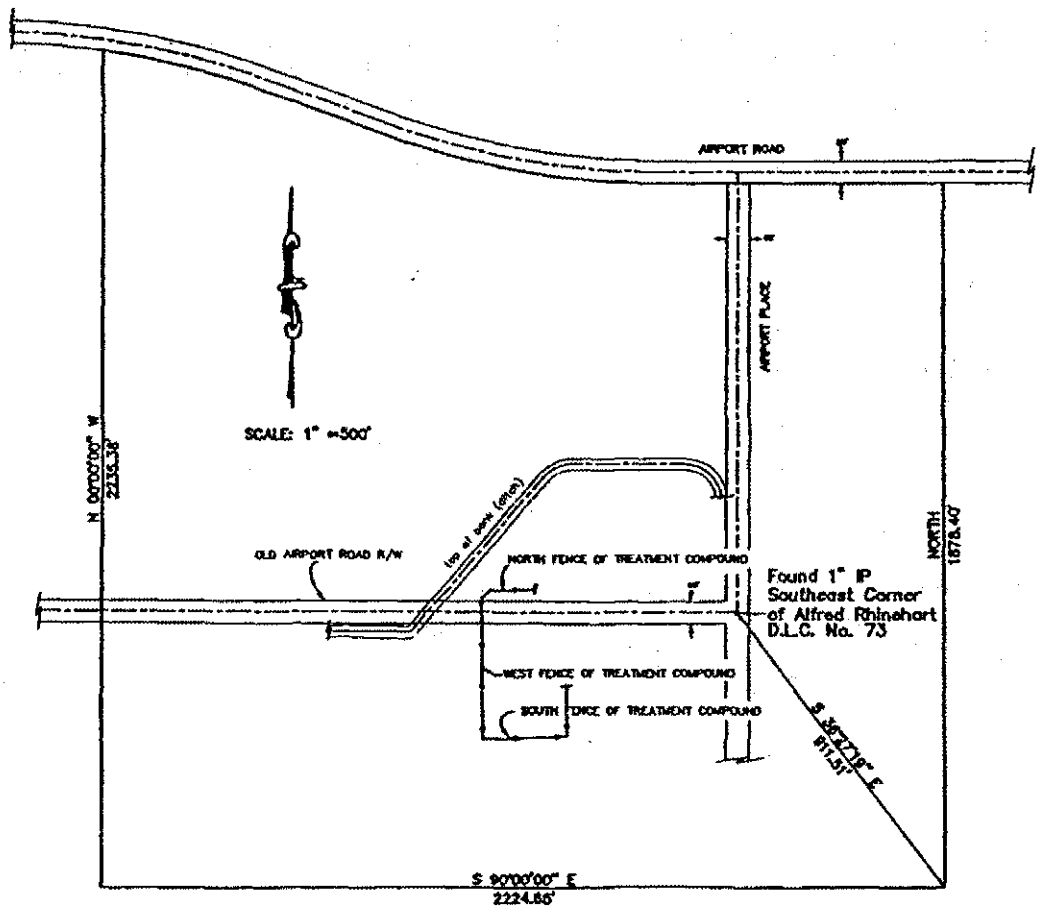
Norman Hepner
Environmental Engineer

NH/ms

cc: Rolland Baxter, Public Works Director
Tom Penpraze, Operations Division Manager
Scott McKinley, CH2M Hill
Paul Burnett, ODEQ

CITY OF CORVALLIS AIRPORT CHROME TREATMENT SITE
OFFSITE GROUNDWATER USE RESTRICTION EASEMENT

Beginning at the southeast corner of the Alfred Rhinehart Donation Land Claim No. 73, located in Township 12 South, Range 5 West of the Willamette Meridian, Benton County, Oregon; thence S 36°27'19"E, 911.51 feet to the TRUE POINT OF BEGINNING; thence WEST, 2224.65 feet; thence NORTH, 2235.38 feet to the south right of way of Airport Road; thence along said south right of way in and easterly direction to a point that is NORTH of the TRUE POINT OF BEGINNING; , thence SOUTH, 1878.40 feet to the TRUE POINT OF BEGINNING.



FILE: \FORM\ENG\SURVEY\PUBWRKS\CHROME.DWG
DATE: FEB, 1993
BY: W DECLOW