WMP-29491
Revision 0

Design Criteria for the KW Pump and Treat

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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P.O. Box 1000
Richland, Washington

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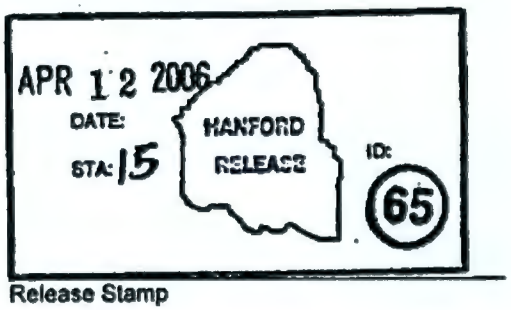

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GROUNDWATER REMEDIATION PROJECT

DESIGN CRITERIA

FOR THE

KW PUMP AND TREAT

Revision 0

INTERNAL REVIEW							
Maint. Mgr. 4/4/06	Quality Assurance 4/3/06	Environmental Protection 4/3/06	Geo Sciences 4/3/2006	Chief Eng. 3/30/06	Fire sys. Maintenance 3/30/06	Addl.	Addl.
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Fluor Hanford Richland	Groundwater Remediation Project	JOB NO. WMP-29491					
		DESIGN CRITERIA NO. HNF-EDC-06-29478					
		SHEET 1 OF 15					

CONTENTS

ACRONYM	ACRONYM DESCRIPTION
ACGIH	AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS
ACI	AMERICAN CONCRETE INSTITUTE
AIChE	AMERICAN INSTITUTE OF CHEMICAL ENGINEERS
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
ANS	AMERICAN NUCLEAR SOCIETY
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ASME	AMERICAN SOCIETY OF MECHCANICAL ENGINEERS
ASCE	AMERICAN SOCIETY OF CIVIL ENGINEERS
AWS	AMERICAN WELDING SOCIETY
CERCLA	COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT
DOE	U.S DEPARTMENT OF ENERGY
IES	ILLUMINATING ENGINEERING SOCIETY OF AMERICA
IEEE	INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS
ICBO	INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS
ICC	INTERNATIONAL CODE COUNCIL
IRM	INTERIM REMEDIAL MEASURE
ISA	INSTRUMENT SOCIETY OF AMERICA
MCL	MAXIMUM CONTAINMENT LEVEL
NEMA	NATIONAL ELECTRICAL MANUFACTURING ASSOCIATION
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
OSHA	OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970
RDR/RAWP	REMEDIAL DESIGN REPORT AND REMEDIAL ACTION WORK PLAN
ROD	RECORD OF DECISION
SOW	STATEMENT OF WORK
UBC	UNIFORM BUILDING CODE
UL	UNDERWRITER LABORATORIES

1.0 INTRODUCTION

1.1 Background: During the years of reactor operations, large volumes of reactor coolant water containing chromium and radionuclides were discharged to retention basins for ultimate disposal in the Columbia River through outfall pipelines. Liquid wastes, containing significant quantities of chromium from reactor operations, were also discharged to the soil column at cribs, trenches, and French drains. As a result of the discharge of groundwater from the operable units into the river, chromium, a metal that is toxic to aquatic organisms in low concentrations, poses a risk to aquatic organisms in the Columbia River. (see Attachment 3 for a sketch of the chromium plume to be remediated). This document is intended to be dynamic and is expected to undergo periodic revisions as project scope and design criteria are further defined and modified.

1.2 Facility Type: Non-Nuclear Category: Commercial

1.3 Scope: The key components of the work are the extraction and injection wells, the facility building with treatment skid module and the balance of plant. The conceptual and final design work shall produce the following project deliverables:

Phase 1: Conceptual Design:

- Process and instrumentation diagram and selected piping drawings
- Preliminary results of cultural resource survey (s)
- Hazard classifications, site evaluations, and safety assessments
- Preliminary construction cost estimate and schedule.
- Extraction and injection well design and locations

Phase 2: Final Design:

- Detailed drawings and specifications for balance of plant (BOP)
- Treatment skid Specifications
- Procurement packages
- Statement of Work (SOW)
- Construction cost estimates
- Pump-and-treat system design description
- Extraction and injection wells design and final location
- Data Quality Objectives for sampling

Narrative: A new facility will be designed which will house a pump and treat system to process extracted water and remove hexavalent chromium. The new building will consist of a self-supporting metal structure similar in size to the buildings at existing pump and treatment systems. Three (3) new extraction wells and one (1) new injection well will be drilled to capture the KW Chromium plume (Attachment 1). Design through put objectives are to maintain an annual average flow of 70-75 gpm with a maximum flow of one (1) Ion Exchange treatment unit (100 gpm maximum capacity). The design of the building, piping and equipment

arrangement will allow for future expansion of the system. (See Section 4.1.3 & 4.2).

1.4 Site Location: The new site location is on the (Plant West) side of the Cold Vacuum Drying facility at K-Basin. The process building will be located outside of the K-Basin exclusion fence and at a distance to not affect the KW authorization basis. (a minimum of 175 meters outside of the exclusion fence. See Proposed Site Plan Attachment 2)

1.5 Data/requirements: This work scope was derived from the Basis of Estimate (BoE), provided by the Groundwater Project 100 Area Task lead and Vista Engineering, an RL Prime Contractor.

2.0 FUNCTIONS

2.1 Production requirements: Three (4) new extraction wells and two (2) injection wells will be used to extract and inject processed water. Three extraction wells will be connected to the process system while a fourth extraction well will have all electrical and stanchions in place except HDPE piping. This fourth well will be used as a monitoring well until authorized to use for process extraction. The designed system will process an annual average flow of 70-75gpm. The expected Cr^{+6} concentrations is 200 ppb or less at the extraction wells. The re-injection concentration design goal will be 10 ppb in order to meet the RDR/RAWP of 22ppb at the compliance wells by 2012. Future expansion of the system up to 140 gpm annual average flow (200 gpm maximum) will be designed in (See Section 4.1.3 for Over Design Specifications).

2.2 Preferred Technology: The process currently used and proven at 100-KR-4 to remove Chromium will be the selected treatment process. Extraction wells have been located to capture the chromium plume to meet the remedial action objectives by 2011. Ion Exchange (Dowex Resin) is the chosen method with the spent resin being sent off site for regeneration. A sacrificial vessel is used to saturate resin beads with a higher concentrations of chromium and natural uranium. The saturated beads will then be sent to ERDF, a low level waste disposal site. Lead, lag and polish vessels will be changed at a more frequent rate and the resin sent off site for regeneration at an approved TSD. Prior to sending offsite, an offsite determination will be obtained. Resin in the sacrificial vessel will be changed at a frequency required to capture maximum Cr^{+6} and prevent the natural uranium ions to migrate to the lead, lag and polish vessel resins. The new resin purchase price is currently at $235.00 per cubic foot. Resin in the lead, lag and polish vessels should average a change out of once per week or as necessary to maintain less than 10 ppb Cr^{+6} in the re-injected treated water. This spent resin will be sent off site for regeneration and when returned will be reused. Regeneration of resin is at a current rate of $66.00 per cubic foot. This will show significant savings in new resin purchases. Evaluations are being performed to determine the removal of other contaminants aside from the treatment of chromium to be extracted from the wells.

At this time it is understood that Carbon 14 and Strontium 90 will not attach to the Dowex 21 resin and pass through the Ion exchange.

2.3 Construction Work Requirements:

Construction requirements shall be scoped as part of the RDR/RAWP with guidance provided by and as approved by EPA and Ecology. This work plan shall include at least the following elements:

- Construction is expected to comply with appropriate worker safety
- In coordination with wildlife and other resource management agencies, activities should avoid or minimize disruption to local wildlife and other natural resources to the extent practicable.
- Design should provide flexibility following startup to accommodate changes in plume characteristics, or different understandings of actual or perceived responses of the aquifer/plume to the pump and treat activity.
- To the extent practicable, facilities are expected to be designed and located in a manner that minimizes interference with and interference by remedial actions for waste sites.
- For areas that are disturbed during construction and operation, it is expected that the land will be re-vegetated following construction in those areas that are not needed for operation and maintenance of the treatment system and where the land is also not expected to be re-disturbed within the next few years by other site activities.
- The Pump & Treat system should be winterized such that winter weather or preparation for winter weather does not cause extended shut-down of the system and compromise the remedial action objectives.

2.4 Operational Requirements:

The pump and treat portion of the interim remedial action will continue until the selection of a final action or it is demonstrated to EPA's and Ecology's satisfaction that termination (or intermittent operation) is appropriate.

2.5 Project Schedule:

- Design criteria approval: March 16, 2006
- Statement of work: April 3, 2006
- Decisional draft for the RDR/RAWP: 8/1/2006
- Design: February 1, 2006 – April 25,2006
- Request for Proposal: April 26, 2006 – May 31, 2006
- Bid Acceptance/Review/Submittals: June 1, 2006 – June 15, 2006
- Award Contract/NTP: July 20, 2006
- Construction: August 1, 2006 – November 30, 2006
- Startup/Testing/Ops. turnover: December 1, 2006 – December 14, 2006

2.6 Environmental protection requirements: All water lines, extraction and injection lines will be designed to allow for routine visual monitoring for leaks. Spills and leaks regardless of size must be reported to the appropriate manager.

2.7 Waste management: Solid waste (Spent Resin) from the sacrificial vessel will be disposed at ERDF. Waste material will be handled, stored, and disposed in accordance with the HR-3/KR-4 waste management plan and FH waste management procedures.

2.8 Unique testing requirements: An acceptance test procedure (ATP) will be written prior to completion of construction. Ion Exchange vessels will be loaded with Dowex 21 resin. Extraction pumps will be energized and the treatment system pressure and leak tested prior to operation.

2.9 Chemical Storage and Management: A metal flammable cabinet will be available for storage of flammable materials. The cabinet will be 4'H x 5'W x 2'D. Floor space will be provide in the layout for cabinet and an additional storage unit. Evaluations will be made for proper ventilation of chemical fumes and fumes from forklifts.

2.10 Design Life Expectancy: Life expectancy will be a minimum of 10 years.

2.11 Special operation and Maintenance requirements: The pump and treat will be designed to operate twenty four (24) hours per day seven days (7) per week and manned periodically to perform routine surveillance and maintenance. The system design will require minimal maintenance and use "off-the-shelf" parts for maintenance. Well design will include 8" wells based on process knowledge from 100-KR-4.

3.0 PROJECT INPUTS

3.1 Existing equipment and design baselines: This will be new construction of a newly designed building and Pump-and-Treat system. This treatment system will be based on the current proven technology and equipment currently in operation at KR-4/HR-3/DR-5.

3.2 Organizational/Technical interfaces: A USQ will be performed by K-Basins nuclear safety and electrical utilities for power to the site location. Site access to extraction/injection wells will be provided by the Washington Closure Group and FH Spent Fuel K-Basins Project to allow for pump and treat operations and daily routines.

3.3 Constraints:

- Location of extraction/injection wells in and around the K-basins facility.

- Coordination with the K-Basins "hose-in-hose" sludge transfer activities and future movement of fuel from the area.
- Existing Hazards: Biological hazards

4.0 DESIGN CRITERIA

4.1 General Criteria

4.1.1 Design-specific quality assurance requirements: The Graded approach as described in HNF-PRO-259 shall be applied with regards to equipment that is quality level 0 (QL0) and General Service (GS). The statement of work which will be provided to procure the Ion Exchange System will be quality level 3 (QL3) and General Service. Any other QA requirements shall be in accordance with the codes and standards defined in Section 5.0.

4.1.2 Evaluations:

- Imminent hazards to personnel or the environment: Hazards are assumed the same as KR-4/HR-3 pump and treat systems. A new site specific Health and Safety Plan (HASP) will be developed for Operations turnover. A Job safety analysis (JSA) will be used during construction phase

- Radiological impacts on personnel and the environment: The Radiological conditions are assumed to be the same as those for the KR-4 /HR-3 pump and treat systems where the groundwater contains small quantities of tritium, unranium, C-14 and Sr-90. The radiological risk from these contaminates will be evaluated and appropriate controls implemented.

- Hazard Identification summary and environmental description: All road crossings must have HDPE weld joints kept to outer edges of pipe encasements to verify piping integrity during operation. Rad levels or other contaminants in the ground water that will be in the facility.

- Fire Protection Requirements
  An Equivalency Request has been submitted to DOE to request relief from the requirement in SCRD 420.1A (Rev. 2),Section B.6).b.4 which requires that a minimum of two operational fire hydrants be within 350 feet of a newly constructed building.

  Note: Design and Construction will remain on schedule but operability of the pump and treat will not commence until a

resolve has been given by DOE in accordance to the SCRD listed in the bullet above.

- Environmental compliance:
  Dangerous waste standards for tank system units (WAC 173-303-640) are to be observed. The substantive requirements of this are relevant and appropriate to the construction, operation, maintenance and closure of any tanks and associated components that contain dangerous waste associated with both the water treatment system and the resin stabilization system.

- **Required Permits will include**:
  - Excavation
  - Cultural /Eco
  - Building Number/Permits
  - USQ Screening
  - Radiological Screening
  - Railroad crossings
  - NEPA Screening
  - Site Evaluation

- **Required Procedures**:
  - Operations procedures
  - System Design Description
  - Maintenance PM's as required for start-up

Reference: EPA, 1996, Declaration of the Record of Decision for the 100-HR-3 and 100-KR-4 operable units, U.S Environmental Protection Agency, Washington, D.C. and DOE-RL, 1997, Interim Action Waste Management Plan for the 100-HR-3 and 100-KR-4 operable units, DOE/RL-97-0001 Rev. 5, U.S. Department of energy , Richland Washington.

4.1.3 Over Design:

Design includes expansion of the pump and treat system to install an additional ion exchange skid, with the ability to install a total of six (6) extraction wells and up to three (3) injection well. Current design is to install three (3) extraction wells during the first phase of treatment and two injections wells (2) injection wells. By the addition of a second Ion Exchange treatment unit, Water treatment can be expanded up to140 gpm annual average flow rate. This flow rate will enable a 70% efficiency rating for scheduled and unscheduled maintenance. Process piping will be designed to handle pressures and flows up to 300gpm.

4.2 Process Design Criteria

4.2.1 Electrical Engineering Conceptual Design will provide:

- Required drawings
- Evaluation of power loads and compatibility with power source
- Preliminary equipment/ instrumentation layout
- Identify interfaces and initiate a memo of understanding with the affected organizations
- Safety evaluation as required
- Interface with electrical utilities and other organizations as required to meet project schedule
- PLC logic
- Parameters for software control

4.2.2 Mechanical Engineering Conceptual Design will provide:

- Required drawings
- Identify Impacts on existing systems
- Equipment Sizing
- Building/Equipment specifications
- Preliminary equipment layout
- Initiate a memo of understanding with KW/Washington closure group.
- Evaluate need for any site alarms/emergency response, telephone, LAN, radio equipment
- Evaluate need for a fire detection/protection system to meet the DOE guide lines.
- Safety evaluation as required

4.2.3 Civil/structural Conceptual Design will provide:

- Required drawings available
- Identify Impacts on existing systems
- Building sizing
- Road and Railroad crossings
- Facility entry

4.2.4 Support operations trailer

- No sewer/running water
- Trailer size to be determined (10x30)
- Provided with underground power
- No landline

4.3 Attachments

4.3.1 Attachment 1 (KW Pump & Treat Well Locations)
4.3.2 Attachment 2 (KW Proposed Site Plan)
4.3.3 Attachment 3 (KW Treatment Area Chromium Plume)
4.3.4 Attachment 4 (KW Piping Layout)
4.3.5 Attachment 5 (KW Electrical and Telecomm Layout)

5.0 CODES AND STANDARDS

Electrical:

- NFPA 70, National Electrical Code
- IEEE C2-2002 National Electrical Safety Code
- Lightning Protection Institute – LPI-175, Standard of Practice, and Underwriters Laboratory- UL-96A, Installation requirements for lightning protection systems.
- NFPA 780; IES Lighting handbook

Mechanical:

- International Conference of Building Officials- Uniform Building Code.
- International Association of Plumbing and Mechanical Officials – Uniform Plumbing Code
- ASME B31.1, Power Piping, or ASME B31.3, Process Piping
- ASME Boiler and Pressure Vessel Code, Section III and Section VIII.
- ASME B16.5, Pipe Flanges and Flanged Fittings NPS ½ through NPS 24

Civil/Structural:

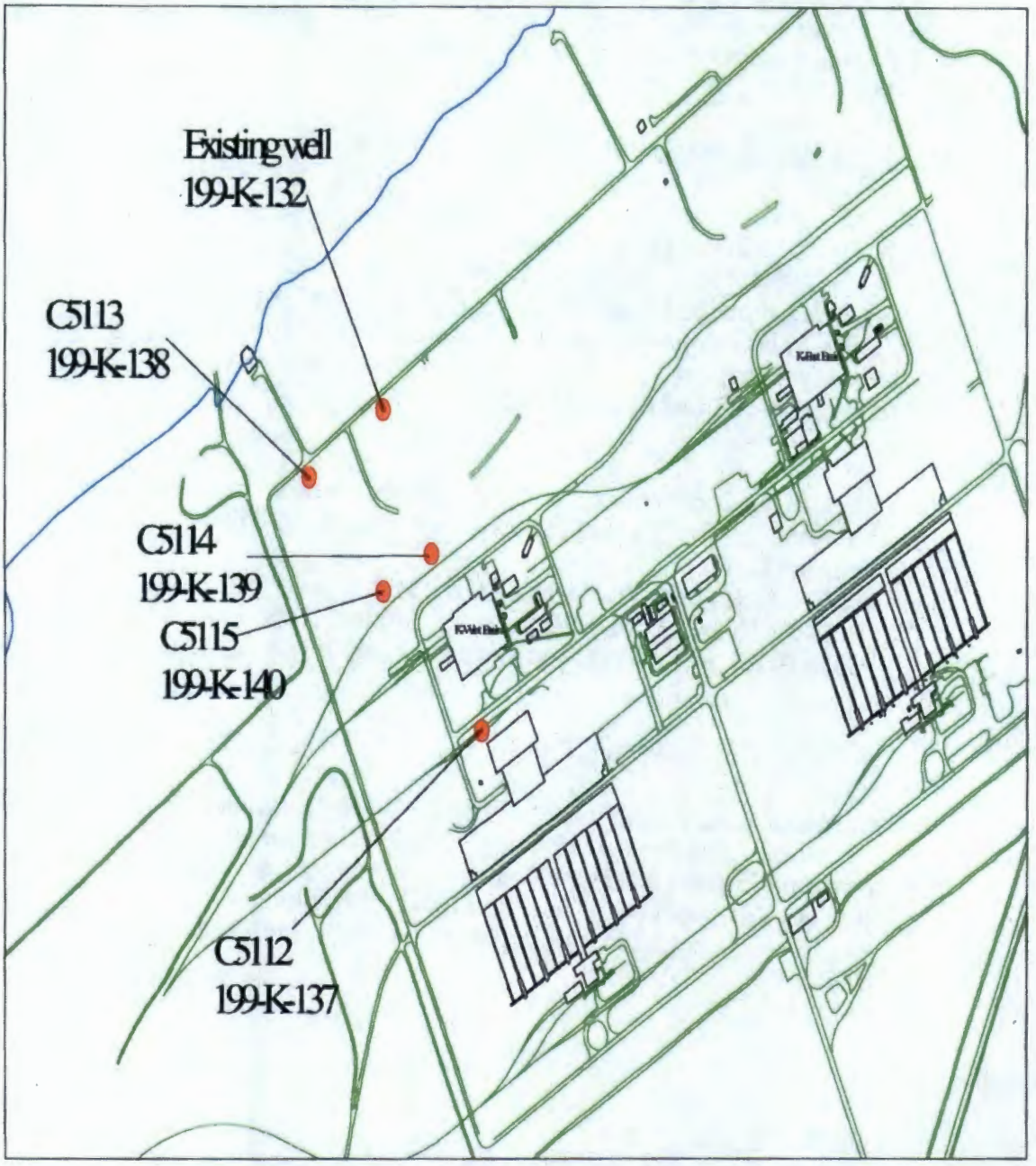
- American institute of Steel Construction- ASD Manual of Steel Construction (MO21)
- American Concrete Institute- Building Code and Commentary.
- International Conference of Building Officials- Uniform Building Code
- American Institute of Timber Construction- Timber Construction Manual and current publications of the American plywood Association.
- Road Design- American Association of State Highway and Transportation Officials.
- WAC 173-160

Fire Protection:

- CRD 420.1A, Facility Safety
- Uniform Building Code
- National Fire Protection Association (NFPA) standards (e.g., NFPA 101, Code for safety to life from fire in buildings and structures)

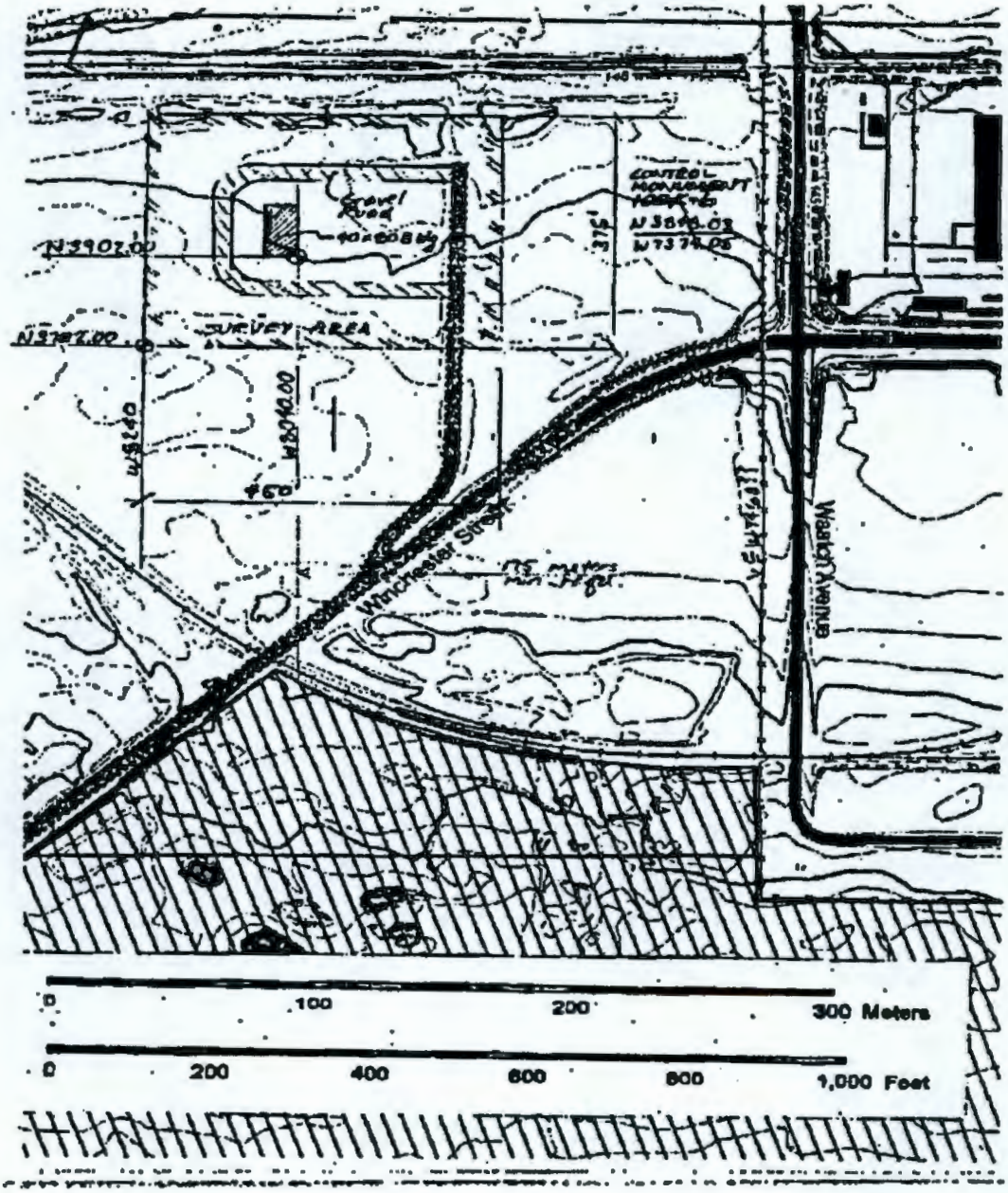
Attachment 1

KW Pump & Treat Well locations



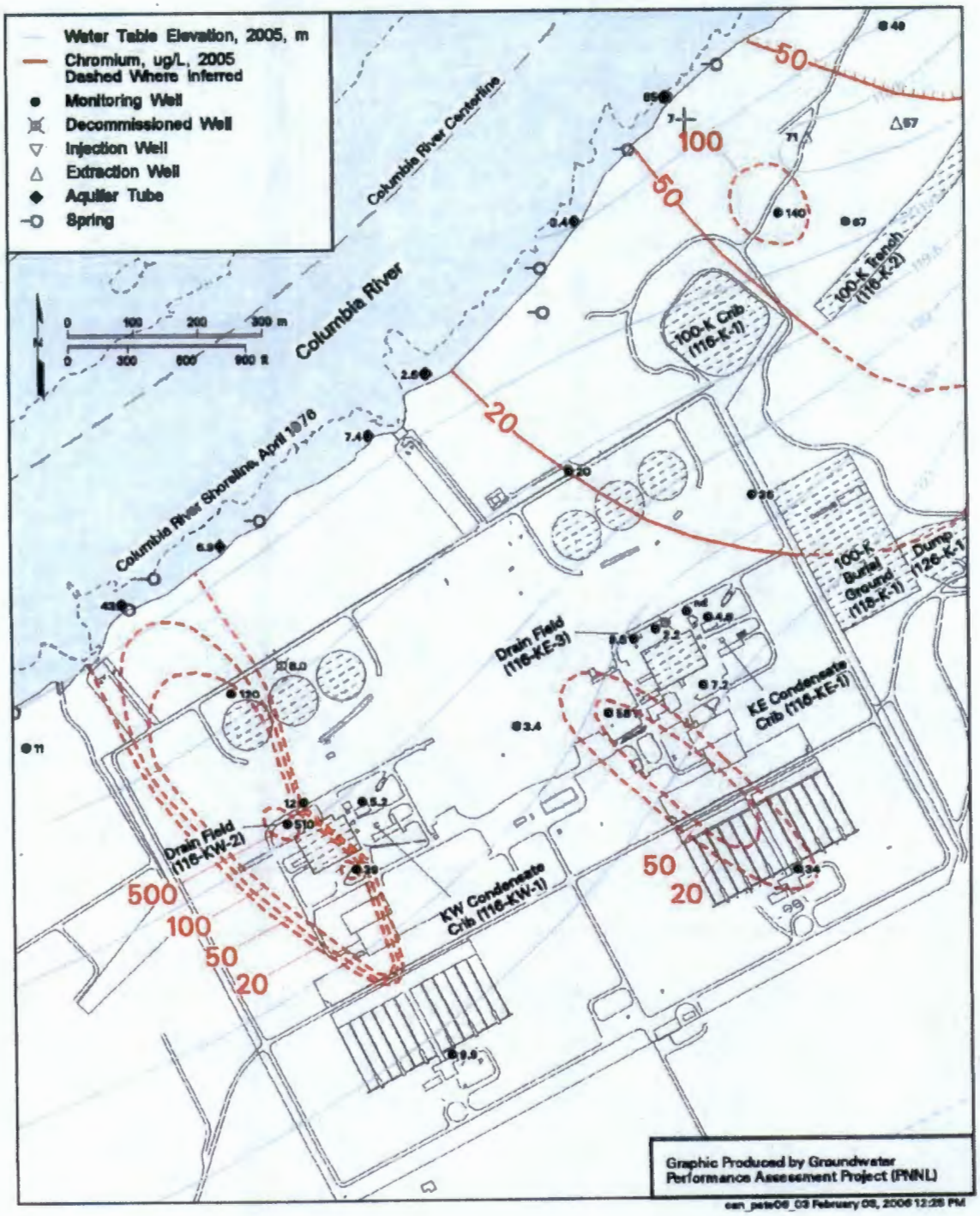
Attachment 2

KW Proposed Site Plan



Attachment 3

KW Treatment Area Chromium Plume



Attachment 4

KW Piping Layout

Attachment 5

KW Electrical and Telecomm layout