State of California—Health and Human Services Agency

California Department of Public Health

MARK B HORTON, MD, MSPH
Director

ARNOLD SCHWARZENEGGER
Governor

December 21, 2009

Mr. Peter Kavounas
Assistant General Manager – Water Service
Glendale Water and Power
141 N. Glendale Avenue
Level 4
Glendale, CA 91206

Dear Mr. Kavounas:

SYSTEM NO. 1910043 – WATER SUPPLY PERMIT AMENDMENT 1910043-PA-001

Enclosed is a copy of the domestic water supply permit amendment and accompanying engineering report, dated December 17, 2009, issued to Glendale Water and Power for the operation of the Weak Base Anion Demonstration for the removal of chromium at the GS-3 well site.

Please acknowledge receipt of this permit amendment. If you have any questions, please call Alan Sorsher at (213) 580-5777.

Sincerely,

Jeff O'Keefe, P.E.
District Engineer
Metropolitan District

Enclosure

Department of Public Health
Drinking Water Field Operations Branch

PERMIT AMENDMENT 1910043PA-001

CITY OF GLENDALE

Los Angeles County

System No. 1910043

December 21, 2009

California Department of Public Health
Drinking Water Field Operations Branch

PERMIT AMENDMENT 1910043PA-001

CITY OF GLENDALE

Los Angeles County

System 1910043

December 21, 2009

STATE OF CALIFORNIA

AMENDMENT TO THE

DOMESTIC WATER SUPPLY PERMIT ISSUED TO

City of Glendale

Public Water System – 1910126

ORIGINAL PERMIT: ***04-15-99P-006*** DATE OF ISSUE: ***03/25/99***

PERMIT AMENDMENT: ***04-15-00PA-000*** EFFECTIVE DATE: ***07/28/00***

PERMIT AMENDMENT: ***04-15-02PA-000*** EFFECTIVE DATE: ***05/24/02***

PERMIT AMENDMENT: 1910043PA-001 EFFECTIVE DATE: ***12/21/09***

WHEREAS:

I. The ***City of Glendale (hereinafter, City)*** submitted an application to the California Department of Public Health on ***May 14, 2009*** for an amendment to the Domestic Water Supply Permit issued to the ***City*** on ***March 25, 1999, revised July 28, 2000 and revised May 24, 2002.***

II. The purpose of the amendment, as stated in the application, is to allow the ***City*** to make the following modifications to the public water system:

Install a Weak Base Anion (WBA) – Chromium removal demonstration facility at the Glendale North Operable Unit GS-3 Well site (4041-1/2 Goodwin Ave, Los Angles, CA) before the groundwater is treated for VOC removal at Glendale Water Treatment Plant.

III. ***The City*** has submitted all of the supporting information required to evaluate the application.

IV. The California Department of Public Health has evaluated the application and the supporting material and has determined that the proposed modifications comply with all applicable State drinking water requirements.

THEREFORE:

I. The California Department of Health Public hereby approves the application submitted by the ***City*** for a permit amendment. The Domestic Water Supply Permit issued to the ***City*** on ***March 25, 1999*** is hereby amended as follows:

The City may include operation of the chromium removal demonstration facility at the Glendale North Operable Unit GS-3 Well site (4041-1/2 Goodwin Ave, Los Angles, CA) before the groundwater from GS-3 is treated for VOC removal at Glendale Water Treatment Plant.

II. This permit amendment is subject to the following conditions:

GENERAL

1. The previously issued water system permit and subsequent amendments remain in effect except where specifically modified by this amendment.

2. The City shall comply with all State laws applicable to public water systems and any regulation, standard or orders adopted thereunder.

3. All water treated by the City and distributed for domestic use shall meet the Maximum Contaminant Levels (MCLs) established by the California Department of Public Health.

4. The only approved sources of domestic water supply are listed in Tables 1 and 2.

Table 1. Approved Groundwater Sources

Source	PS Code	Depth	Average Capacity* (gpm)	Status
GN-1	1910043-025	210	565	Active
GN-2	1910043-026	210	565	Active

GN-3	1910043-027	200	565	Active
GN-4	1910043-028	400	1,600	Active
GS-1	1910043-029	171	425‡	Active
GS-2	1910043-030	183	425	Active
GS-3	1910043-031	199	425	Active
GS-4	1910043-032	198	425	Active
GLORIETTA WELL NO. 3	1910043-001	170	500	Active
GLORIETTA WELL NO. 4	1910043-002	185	500	ACTIVE
GLORIETTA WELL NO. 6	1910043-003	180	1,000	ACTIVE
VERDUGO PARK TREATMENT PLANT INFLUENT (PICKUP SYSTEM, WELLS A AND B)	1910043-019	VARIES	1100	Active

* Capacity may vary up to 800 gpm for GN-1, GN-2 and GN-3, and up to 1,800 gpm for GN-4.Capacity may vary up to 700 gpm for GS-2, GS-3 and GS-4. ‡GS-1 is limited to 425 gpm.

Table 2. Other Sources

Source	Status	Capacity (gpm)	Location
MWD-G1 CONNECTION	ACTIVE	21,600	1111 E. GLENOAKS BLVD.
MWD-G2 CONNECTION	ACTIVE	4500	440 EDWARDS PLACE
MWD-G3 CONNECTION	ACTIVE	9000	1655 KENNETH RD
BURBANK, CITY OF	ACTIVE AND EMERGENCY	1300	GLENOAKS BLVD. SOUTH OF ALAMEDA

5. The only approved treatment facilities are listed in Table 3.

Table 3. Approved Treatment Facilities

Treatment Facility	Treatment Process
Glendale Water Treatment Plant (GWTP)/Grandview Basins	Water from wells GN-1, GN-2, GN-3, GN-4, GS-1, GS-2, GS-3, and GS-4 undergoes air stripping and granular activated carbon treatment for VOC removal and hypochlorination. Chloramination and blending with MWD water at Grandview Basins.
WBA Anionic Exchange at GS-3 Wellhead at Goodwin Avenue	Ion exchange to remove chrome 6 with PWA-7 anionic resin.
Glorietta Reservoir	Hypochlorinated water from Glorietta Wells is blended with MWD water
Verdugo Park Water Treatment Plant	Diatomaceous earth filtration and disinfection

6. No additions, changes or modifications to the sources of water supply or water treatment facilities outlined in Provisions 4 and 5 shall be made without prior receipt of an amended domestic water supply permit from this Department.

7. All treatment facilities shall be operated by personnel who have been certified in accordance with the Regulations relating to Certification of Water Treatment Facility Operation, CCR, Title 22. The classifications for all applicable treatment facilities are listed in Table 4. The designated chief treatment operator for the GWTP/GS-3 Wellhead Treatment shall obtain a Grade T4 certificate by January 1, 2012 and the Shift Operator shall hold a T3 certificate.

Table 4. Treatment Facility Classifications

Treatment Facility	Treatment Facility Classification	Min. Treatment Grade Required	
		Chief Operator	Shift Operator
GWTP/WBA Facility	T4	T4	T3
GVPS	T3	T3	T2

8. The City shall maintain an active cross-connection control program in accordance with the California Code of Regulations (CCR) to prevent the water system and treatment facilities from contamination as a result of cross-connections. All cross-connections shall be abated within 30 days of their identification. Annual cross-connection surveys shall be conducted. Backflow prevention devices shall be tested at least annually.

9. The City shall monitor all active groundwater and surface water sources in accordance with the Vulnerability Assessment and Monitoring Guidelines issued by the Department and specific permit provisions.

10. The City shall only use additives that have been tested and certified as meeting the specification of American National Standard Institute/National Sanitation Foundation (ANSI/NSF) Standard 60. This requirement shall be met under testing conducted by a product certification organization accredited by the ANSI for this purpose.

WBA FACILITY

Ion Exchange Treatment

11. The City shall operate the WBA Demonstration Facility with the goal of reducing the chromium concentration in the effluent to below 5 µg/L (5 parts per billion). In addition, the City should evaluate the technical feasibility and costs of treatment to 1 µg/L and below, if possible.

12. Each ion exchange vessel shall be operated at a flowrate not to exceed 600 gallons per minute (gpm) at any time, and with sufficient CO_2 to maintain pH control, unless written permission to operate at a greater rate is obtained from the Department.

13. At all times when the WBA facility effluent is sent to the GWTP for volatile organic chemicals removal prior to introduction to the distribution system, the WBA vessels shall operate in the lead-lag (i.e. series) configuration.

14. The City shall inspect and maintain the WBA Facility daily and as needed to maintain efficient operation.

15. Both vessels shall be taken out of service and the resin in the lead vessel shall be replaced in accordance with the approved Operation and Maintenance Manual (O&MM). The City shall anticipate when this may occur and have an adequate amount of virgin resin available for replacement when needed.

16. Each time an ion exchange vessel is emptied, the vessel internals shall be inspected for evidence of damage, looseness, clogging or other problems. The condition of the lining shall be noted. Records of maintenance inspections shall be kept on file at the WBA Facility as specified in Provision 28.

17. If entry into an empty vessel is necessary to inspect a vessel, confined space safety procedure shall be followed. After inspection, the vessel shall be disinfected with a free chlorine solution of 50 mg/L and held for two (2) hours. The vessel shall be flushed to a residual of less than 1 mg/L prior to installing the fresh resin.

18. Replacement resin shall be Rohm and Haas (Dow) Amberlite PWA-7. Only NSF 61 certified, virgin resin is permitted. If an alternate resin is proposed, it shall be approved in writing by the Department prior to installation.

19. Fresh resin shall be adequately flushed to waste until the concentration of all nitrosamines in the effluent stream are below 10 ng/L.

MONITORING

20. The City shall monitor the WBA Facility in accordance with the approved O&MM. Samples shall be taken weekly at the effluent of the lag vessel (SP-6 in the O&MM) and analyzed for total chrome and hexavalent chrome. Analytical results for these contaminants along with field pH shall be transmitted to the Department via electronic data transfer (EDT) using the station code 1910043-085.

21. The concentration of Chrome 6 in treated water shall be reported down to 0.10 µg/L as specified in the Demonstration Scale Project Quality Assurance Project Plan. A lower reporting limit may be approved by the Department if supporting information is provided.

22. In order to attempt to track any accumulation of uranium in the resin beds, both the raw well water and the effluent of the lead vessel shall be tested for uranium monthly. If uranium is detected at the lead vessel effluent, the lag vessel effluent shall also be tested monthly.

23. The City shall investigate the presence of aldehydes and ketones using EPA method 556, and for semi-volatile organic chemicals including reporting of tentatively identified compounds. Any detections shall trigger similar monitoring at the South OU transmission pipe at the GWTP. Any detections at the GWTP inlet shall trigger similar monitoring at the GWTP plant effluent.

24. The City shall comply with any additional conditions which the Department deems necessary based on any newly identified constituents.

25. If necessary, the Department may modify the monitoring provisions specified herein based on additional information. The City may request a modification of any monitoring provision based upon substantiating data at any time.

RECORDS AND REPORTING

26. A monthly report of the operation of the WBA Facility shall be included with the monthly report on other Glendale OU operations which is submitted to the local office of the Department. This operational report shall be submitted by the 20th day of the following month unless otherwise specified. This report is required regardless if the treatment plant is furnishing water to the distribution system or not. As a minimum, the report shall include:

    a. A summary table of analytical results of all samples related to the WBA treatment received by the City the prior calendar month.

    b. A description of the monthly operation, maintenance work, resin changeouts, and problems, both scheduled interruptions and any unscheduled interruption.

    c. The daily flowrate in gallons per day or bed volumes of water processed by the WBA Facility and the monthly and cumulative bed volumes processed by each resin bed.

27. Any change in the monitoring and reporting requirements shall be approved by the Department in writing.

28. Copies of reports, inspections and all records shall be kept for at least five (5) years. Water quality records shall be kept for 10 years.

29. The City shall include the WBA Demonstration Facility in the GOU annual report to the Department, which shall include compliance with the permit provisions, the treatment plant's status, condition, and performance and any problems or difficulties. This report shall be due by March 30th of the following year.

30. The City shall immediately inform the Department by telephone or e-mail and fax, of any exceedence of any MCL or Notification Level in the effluent of the WBA Facility. If the Department is closed at the time, it shall be notified by telephone by 8:15 a.m. of the next day.

COMPLIANCE SCHEDULE

31. Within 90 days after the anniversary of the WBA Demonstration Facility startup, the City shall submit for approval, an updated O&MM to reflect any operational and maintenance changes deemed necessary during the first year of operation.

This amendment shall be appended to and shall be considered to be an integral part of the Domestic Water Supply Permit issued to the ***City of Glendale*** on ***March 25, 1999, and revised July 28, 2000 and May 24, 2002.***

FOR THE CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

December 21, 2009
Date

Jeff O'Keefe, P.E., District Engineer
Metropolitan District
Los Angeles Region

Engineering Report

For Consideration of the Permit Amendment Application from
The City of Glendale Department of Water and Power
Serving the City of Glendale, Los Angeles County

December 17, 2009

Drinking Water Field Operations Branch
California Department of Public Health

Prepared By

Alan Sorsher, P.E., Associate Sanitary Engineer
Metropolitan District

REGISTERED PROFESSIONAL ENGINEER
ALAN SORSHER
No-4405
Exp. 9/30/11
CHEMICAL
STATE OF CALIFORNIA

Reviewed and Approved By

Jeff O'Keefe, P.E., District Engineer
Metropolitan District

I. INTRODUCTION

1.1 Purpose of Report

The City of Glendale (hereinafter, City), has submitted an application dated May 14, 2009, for a permit amendment to install and operate the Weak Base Anion (WBA) Chromium Removal Demonstration Facility (hereinafter referred to as the WBA Facility). This ion exchange treatment equipment at its GS-3 well site is intended to demonstrate the removal of hexavalent chromium using an anionic resin. A copy of the application is included in Appendix A of this report. The GS-3 well site is located at 4041 ½ Goodwin Avenue in the City of Los Angeles.

The majority of the chromium in the San Fernando Basin is in the form of hexavalent chromium also known as chrome 6. In addition, at the concentrations and pH levels involved with the well and the treatment, the chrome 6 cation is present as a mixture of $HCrO_4^-$ (bichromate) or CrO_4^{-2} (chromate) anions. Thus the contaminant is amenable to anionic ion exchange treatment as shown by bench tests and small column pilot testing.

The purpose of this report is to document the sanitary engineering review, to evaluate the plans and specifications and proposed operation of the ion exchange demonstration facility, make a sanitary engineering review of the City's new facility, and make recommendations regarding the issuance of an amended domestic water supply permit to the City.

1.2 Brief Description of System

The City is bordered by the Cities of Los Angeles and Burbank to the west, Eagle Rock and Pasadena to the east, and La Canada-Flintridge, La Crescenta and the San Gabriel Mountains to the north. The service area extends southward near Los Feliz Road, eastward to approximately Allen Avenue, and northward to around Markridge Road. The eastern boundary runs through canyons separating Pasadena from Glendale. The service area covers approximately 30.6 square miles and varies in elevation from 416 feet to 5,503 feet above mean sea level. The City's office is located on the corner of Wilson and Glendale Avenues, at 141 North Glendale Avenue, 4th floor, Glendale, California 91206-4496.

The City currently operates under a revised public water system permit issued by the State Department of Health Services (DHS) on March 25, 1999 amended on July 28, 2000 and on May 24, 2002. The City's local water sources currently includes the three (3) Glorietta wells in the Verdugo basin with a maximum capacity of 2,000 gpm, and a shallow groundwater source in the same basin. This shallow groundwater comes from a shallow infiltration (pick-up system) and two shallow wells together considered one source and treated as surface water at a diatomaceous earth filtration plant with a capacity of 1,150 gpm.

The July 28, 2000 amendment to the City's water supply permit added seven (7) new operable unit extraction wells (GN-1, GN-2, GN-3, GN-4, GS-2, GS-3, and GS-4) on the west side of the City as part of the Glendale Operable Unit (GOU) Superfund remedial action in the San Fernando Basin. The extracted water from the wells produce approximately 4600 gpm which is treated at the Glendale Water Treatment Plant to remove volatile organic chemicals (principally tetrachloroethylene, trichloroethylene and 1,2,3-trichloropropane). The treated water from this plant is chloraminated at the basins of the Grandview Pump Station and blended with water purchased from the Metropolitan Water District (MWD) as it enters the City's distribution system. The May 2002 amendment added an eighth extraction well, GS-1 increasing the GOU extraction rate to 5,000 gpm.

The remainder of the City's demand is supplied through three (3) connections to the MWD system.

The distribution system is comprised of seven (7) pressure zones utilizing 30 storage reservoirs and tanks with a total capacity of approximately 185 million gallons and 25 booster pumping stations. Appendix B includes a copy of the City's water system schematic diagram.

1.3 Background Information - Chromium and the Glendale System

While the combined effluent from the GWTP and GVPS has easily met the MCL for total chromium (0.050 mg/L), wells GN-3 and GS-3 have at times exceeded the total chromium MCL.

The health effects of ingestion of chrome 6 have been the subject of much investigation and studies, and the City has endeavored to operate the wells and GWTP in a manner to minimize the levels of total chromium and chrome 6, and at the same time, meet their commitment to USEPA to extract VOC-contaminated water and control the spread of the VOC contaminant plume.

Furthermore, California's Health and Safety Code guides the development of an MCL for chromium-6 and §116365.5 requires the adoption of an MCL for chromium-6 by January 1, 2004. The Office of Environmental Health Hazard Assessment (OEHHA) has not yet established a final Public Health Goal (PHG) for chromium-6, so CDPH cannot proceed with the MCL process. Since the GOU extraction wells and the GWTP provide approximately 23% of the City's water supply, loss of these sources due to potential exceedences of the total chromium MCL or the future chrome 6 MCL would result in water supply problems. In 2001, the City took action in marshalling local, state and federal resources as well as the American Waterworks Association to select and develop ways to remove chrome 6 down to low levels.

A substantial amount of research work on low level chromium removal has been funded by the U.S. Environmental Protection Agency and by the Cities of Los Angeles, Glendale, Burbank and San Fernando, and the American WaterWorks Association Research Foundation (AWWARF). Consultants initiated bench scale testing in 2002 followed by pilot scale testing initiated in the summer of 2003. This demonstration plant follows the bench scale and pilot scale studies and is part of a three-phase effort which has been funded by multiple grants from the U.S. Environmental Protection Agency (EPA), the American Waterworks Association Research Foundation (AwwaRF), and by the cities of Los Angeles, Glendale, Burbank and San Fernando. The City has also applied for $2.5 million of Proposition 50 funds for the ion exchange treatment facility described in this report, as well as a Reduction, Coagulation and Filtration (RCF) demonstration plant and a funding agreement has been signed. Approximately 75% of the Proposition 50 funds will be applied toward construction costs, 15% to the earlier research and the balance to engineering and administration. Technical Updates #1 and #2 in Appendix C give further background details on the chromium removal studies.

In the first part of 2007, additional work was performed by the Civil and Environmental Engineering Department of Lehigh University to better understand the chromium removal mechanism and behavior of two weak base anionic resins, SIR-700 from ResinTech Co. and Duolite A-7 (now called PWA-7) from Rohm and Haas. A copy of the executive summary of this work is also in Appendix C.

1.4 Sources of Information

Information used to prepare this report was obtained from California Department of Public Health (CDPH or the Department) files, Glendale Water and Power personnel, and visits to the Goodwin Street site. On behalf of the City, Malcolm Pirnie, Inc. has prepared and submitted a Preliminary Design Report (PDR) dated May 27, 2008. Earth Tech of Long Beach, California (part of AECOM Technology Corporation) has prepared final detailed construction plans and has overseen the construction work. Earth Tech has also prepared a draft Operation and Maintenance Manual (O&MM) and a Startup Testing Plan.

Glendale personnel have also submitted a project technical report to supplement the Glendale Operable Unit 97-005 documentation addressing chromium contamination in the San Fernando Basin and to support operation of the WBA facility and for the Reduction Coagulation and Filtration (RCF) facility located near the Glendale Water Treatment Plant. A copy of this report is included in Appendix D.

The investigation, analysis and preparation of this report were conducted by Alan Sorsher, P.E., Associate Sanitary Engineer with the Department's Drinking Water Field Operations Branch under the supervision of Jeff O'Keefe, P.E., District Engineer, both with the Department's Metropolitan District.

2. INVESTIGATIVE FINDINGS

2.1 Groundwater concentrations of total and hexavalent chromium

Appendix D includes charts showing the concentration of hexavalent chromium in the four Glendale North OU wells and the four Glendale South OU wells. In the South OU, GS-3 has consistently been the well with the highest concentration of this contaminant, recently in the range of 24 to 69 µg/L. The other three south OU wells have been consistently well below 5 µg/L.

Concerns about chromium contamination and its potential to disrupt the VOC remediations at the Glendale and Burbank Operable Units prompted the USEPA Superfund to have their environmental consultant, CH2M-Hill, prepare a technical memorandum, Burbank and Glendale Operable Units, Focused Chromium Trend Study, dated June 10, 2005. The memorandum attempted to estimate potential peak chromium concentrations which may be encountered by the extraction wells in the future. A copy of the executive summary of this memorandum is in Appendix D.

The supplement to the 97-005 document mentioned above references this 2005 memorandum with respect to the prediction of chromium levels in the north and south OU well fields:

"The CH2MHill Report projected future chromium 6 levels in all of the Glendale OU extraction wells based on analysis of spatial and temporal trends of chromium contamination and geochemical conditions. The forecast for each of the extraction wells is described as follows. Please note that the forecasts presented here are subject to significant uncertainty and should be used with caution.

- *GN-1 – Total chromium and chromium 6 concentrations at extraction well GN-1 are not predicted to increase above 15 ppb in the foreseeable future because of the depth of the well and low upgradient concentrations of chromium 6 in the southwest part of the Glendale North OU, assuming that no significant changes to the hydraulic regime in the area (such as pumping rates at the extraction wells) occur.*
- *GN-2 – Total chromium and chromium 6 concentrations could reach a peak of 170 ppb, assuming that high chromium concentrations observed at monitoring well CS-VPB-04 (~ 1,000 ppb) in 2000 reaches the well.*
- *GN-3 – Total chromium and chromium 6 concentrations might significantly increase in the future, with a possible peak concentration of 170 ppb, assuming that high chromium concentrations observed at monitoring wells CS-VPB-04 (~ 1,000 ppb) in 2000 reaches the well.*
- *GN-4 – Total chromium and chromium 6 concentrations at GN-4 well are forecast to remain below 10 ppb in the foreseeable future because of the depth of the well and low upgradient concentrations of chromium 6 in the southwest part of the Glendale North OU, assuming that no significant changes to the hydraulic regime in the area (such as pumping rates at the extraction wells) occur.*
- *GS-1 – Total chromium and chromium 6 concentrations at GS-1 are not forecast to increase above 5 ppb in the foreseeable future because of the low upgradient chromium concentrations.*
- *GS-2 – Total chromium and chromium 6 concentrations at GS-2 are not forecast to increase above 10 ppb in the foreseeable future because of the low upgradient chromium concentrations.*
- *GS-3 – Total chromium and chromium 6 concentrations should not change substantially from past reported levels. Chromium 6 concentration at approximately 70 ppb was reported in 2007. Right now, chromium 6 concentrations fluctuate between 40 to 60 ppb. However, future changes in hydrogeologic conditions could mobilize large concentrations of chromium in the upgradient areas, which would impact extraction well GS-3.*
- *GS-4 – Similar to concentrations in well GS-3, total chromium and chromium 6 concentrations should not change substantially from past reported levels. However, because the capture zone for well GS-4 includes upgradient areas with known high chromium concentrations, it is possible that future chromium concentrations will increase to levels similar to those that have occurred at extraction well GS-3, 30 to 50 ppb.*

Table 1 below lists chromium 6 concentrations measured in 2000, October 2008 (the latest data available), and the CH2MHill's 2005 predicted maximum value in the Glendale OU.

Table 1. Chromium 6 Concentration Level (ppb) in the Glendale OU

	GS-1	GS-2	GS-3	GS-4	GN-1	GN-2	GN-3	GN-4	GWTP Combined Effluent
2000	0	1	50	1	5	10	50	2	12.4
Oct. 2008	0	1.7	44	1.7	4.5	12	46	3.5	6.5*
CH2MHill Projection	5	10	50	50	15	170	170	10	53.2

**. This concentration reflects the operation practice of alternating GN-3 and GS-3 wells to avoid exceeding the 8 ppb LA River discharge limit."*

In addition to chromium, Well GS-3 has been tested monthly since 2000 for inorganic metals and secondary standard metals including cadmium, zinc, copper and nickel. Except for one detection of nickel at 41 µg/L (MCL is 100 µg/L) in 2004, all results except for chromium have been below the detection levels.

2.2 Description of WBA Facility Treatment Equipment

The major components for the removal of chrome 6 at this facility are the two vessels holding the ion exchange resin, and the system for storing and supplying carbon dioxide to the water prior to contact with the resin. During bench-scale and pilot testing performed by Malcolm Pirnie, it was found that reducing the influent pH to around 6 resulted in greater chrome 6 reduction to chrome 3 and removal by the resin. Dissolving carbon dioxide in the water produces carbonic acid resulting in the drop in pH. Appendix E includes a plot plan of the equipment as well as isometric drawings showing the equipment layout. Also included in Appendix E is a technical report from the City which summarizes the WBA design parameters and includes a proposed monitoring plan and data sheets for the ion exchange vessels.

In order to lower the pH of the well water from approximately 6.8 to 6.0, the City has purchased a packaged CO_2 storage and injection system manufactured by the Tomco Equipment Company capable of delivering 86 pounds of CO_2 per hour. This skid mounted system includes a horizontal tank to store 28,000 pounds of liquid CO_2, and the necessary vaporizer, vapor heater, and vaporizer controls. A separate steel panel contains equipment where a controlled amount of CO_2 vapor is dissolved into carrier water (a side stream from the well water) using venturi and static mixers to form carbonic acid. This mixture is then mixed with raw well water in another venturi/static mixer combination.

After mixing with the CO_2, the well water is filtered through a 20 micron bag filter. The filter system is skid mounted and consists of two 22 inch diameter filter housings, each capable of filtering 600 gpm, allowing a clean filter housing to be on standby.

The two resin vessels were originally purchased to treat GS-3 water using granular activated carbon, but were never placed in service. The interior was lined with Plasite 4110 (NSF-61 certified lining) at 35 mil. Earth Tech has spark tested and touched up the lining before loading the resin. The vessels are equipped with sampling ports, one of which will be at approximately 50 percent of the bed depth of the resin.

The well was initially capable of producing 600 gpm. The ion exchange vessels and the well pump and are rated at 500 gpm (taking into account the head loss expected through the ion exchange media), but the design flow for chromium removal is 425 gpm, which was the operating rate for the well since it began operation in 2000. Each vessel is 96 inches in diameter with 84 inch side shells and equipped with stainless steel underdrains. The vessels will be operated in a lead-lag configuration.

The resin utilized is Duolite PWA-7 manufactured by Rohm and Hass. Each vessel is loaded with 170 cubic feet of resin (an additional 15 cubic feet is below the underdrain and is considered not used) (1 bed volume (BV) equals 1272 gallons). At 425 gpm the water throughput is 20 BV/hr, which is well within the product specification of 8-40 BV/hr. A product data sheet on the resin is included in Appendix F, along with a copy of the NSF/ANSI-61 certification listing from the Water Quality Association.

Phase II column testing of this resin with about 100 µg/L chrome 6 influent concentration and an empty bed contact time (EBCT) of 1.9 minutes achieved about 38,000 BV before consistent breakthrough above 5 ppb occurred (see Appendix F). For this 425 gpm facility, the EBCT is about 3 minutes and the inlet concentration is around 50 µg/L, so the useful life of the lead bed could be in the range of 6 to 12 months. After a lead bed is exhausted, it will be replaced with virgin resin and that vessel will be valved so that it is in the lag position. During 2007, four quarterly samples from Well GS-3 were analyzed for uranium and averaged to 3.47 µg/L. The resin will need to be monitored for accumulation of uranium and replaced before the threshold for radioactive waste is reached.

The treatment facility includes a 3,000 gallon backwash/waste tank which can drain to the sanitary sewer. The City can bring in additional Baker temporary storage tanks if necessary.

2.3 Ion Exchange Treatment Process for Chrome 6

The ion exchange vessels are equipped with manual flow control valves and meters and will operate in a lead-lag series configuration so all the flow from the GS-3 well will be treated. Flow is downward through both ion exchange beds. The treated water leaving the lag ion exchange vessel flows into the transmission line along with water from the three other South OU wells northward to the GWTP where VOC removal treatment occurs.

When total or chrome 6 is detected above 5 µg/L at the cross over port representing the effluent from the lead bed, the system may be shut down and the lead resin bed replaced with fresh resin and valving adjusted so that the fresh bed is in the lag position.

However the City may decide to run the lead bed to approximately 15 µg/L for the purpose of demonstration.

Common applications of ion exchange treatment for nitrate and perchlorate removal have utilized a resin substrate consisting of a styrene-divinyl benzene copolymer, with the amount of divinyl benzene controlling the amount of cross-linking between styrene polymer chains. The degree of cross-linking determines if the resin bead is considered "macroporous" (more cross-linking) or "gel" type (less cross-linking). In contrast, PWA-7 uses a phenol-formaldehyde polymer. It is hypothesized that this polymer is responsible for the reduction of chrome 6 to chrome 3, which is less soluble and accumulates in and on the polymer substrate (see Appendix C). This is the assumed explanation for the extraordinary run lengths seen in the pilot testing which are beyond those expected by ion exchange alone. Since a different polymer substrate is used with PWA-7, the effluent will have been tested for any additional by-products, such as aldehydes and ketones by EPA method 556, that may be associated with phenol or formaldehyde.

In addition the PWA-7 resin uses the chloride salt of a secondary amine (or a mixture of such salts) as its ion exchange functional group. When placing fresh resin into service, resins for nitrate and perchlorate removal using various quaternary ammonium salts as functional groups are known to produce nitrosamines corresponding to the amine salt used. Both dimethylamine and piperidine are secondary amines, and during the bench-scale study it was demonstrated that PWA-7 has the potential to produce NDMA (N-nitrosodimethylamine) and N-PIP (N-nitrosopiperidine). Therefore, the effluent from these fresh resin beds must be thoroughly flushed to waste prior to its introduction into the water supply and a plan to backwash and forward flush a total of approximately 67 BV has been submitted.

The bag filter is expected to protect the resin beds from clogging due to any potential particulates in the water. However, if a high differential pressure is detected across the resin beds or flow through the beds is restricted due to solids or compaction of the beds, the resin beds can be backflushed to waste as needed to restore flow. Backwash and backflushing rates are manually controlled.

Operators will be visiting the facilities daily to ensure that the equipment is functioning properly. Operating procedures for installing, backwashing, and backflushing resin beds are provided in the O&MM developed for the WBA Facility.

2.4 Monitoring and Reliability

As mentioned above, previous bench scale and small column pilot studies have indicated that the PWA-7 resin with proper pH control can reduce concentrations of chrome 6 from 100 ppb to below 5 ppb in a lead bed for approximately 38,000 BV. When coupled with a lag bed, effluent concentrations dropped to ND to approximately 2 ppb for up to 80,000 BV. See sheets from column testing report in Appendix F.

Within the O&MM, the City has proposed the following routine monitoring plan:

Analytical Measurement	Monitoring Locations							
	SP1 Raw Water (before CO_2	SP2 WBA Influent (after CO_2 addition)	SP3 Lead Vessel 50% Bed Depth	SP4 Lead Vessel Effluent	SP5 Lag Vessel 50% Bed Depth	SP6 Lag Vessel (Plant) Effluent	Residuals Spent Resin	Residuals Backwash Water
Cr(VI)	Monthly	Weekly	Weekly	Weekly	Weekly[1]	Weekly	–	Annually
Total Cr	Monthly	Weekly	Weekly	Weekly	Weekly[1]	Weekly	–	–
pH	–	–	–	Weekly	–	Weekly	–	–
Bac-t	Monthly	Monthly	–	Weekly		Weekly	–	–
Temperature	–	–	–	Weekly	–	Weekly	–	–
Sulfate (SO_4^{-2})	–	Monthly	–	–	–	Monthly	–	–
Nitrate (NO_3)	–	Monthly	–	–	–	Monthly	–	–
Phosphate (PO_4^{-3})	–	Monthly	–	–	–	Monthly	–	–
Silicon Dioxide (SiO_2)	–	Monthly	–	–	–	Monthly	–	–
Iron (Fe)	–	Monthly	–	–	–	Monthly	–	–
Alkalinity	–	Monthly	–	–	–	Monthly	–	–
Conductivity	–	Monthly	–	–	–	Monthly	–	–
Turbidity	–	Monthly	–	–	–	Monthly	–	–
Nitrosamines [2,3]	–	Start of test	–	Start of test	–	Start of test and Montly thereafter	–	–
BNA SVOC	–	Start of test	–	Start of test	–	Start of test and Montly thereafter	–	–
Aldehydes/ketones	–	Start of test	–	Start of test	–	Start of test and Montly thereafter	–	–
TCLP, CWET	–	–	–	–	–	–	Annually	–
Uranium	–	–	Every 10,000 BV (approx. 21 days)	–	–	Annually	Annually	–

Notes:
%=percent
µg/L=micrograms per liter
approx.=approximately
BNA SVOC=base, neutral, acid semi-volatile organic compounds including phenol and tentatively identified compounds (TIC)
BV=bed volume (1,272 gallons)
CDPH = California Department of Public Health
CO_2=carbon dioxide
Cr=chromium
CWET=California Waste Extraction Test
pH=negative log of the hydrogen ion concentration
TCLP=Toxicity Characteristic Leaching Procedure
[1]Samples collected only when the lead vessel effluent exceeds 5 µg/L
[2]Nitrosamines will be analyzed at a frequency required by the CDPH permit.

In addition to SCADA control and reporting of the well pump motor, and magnetic flowmeter, if a high differential pressure occurs across the inlet water bag filters, the media trap on the treated effluent, or a high liquid level in the bag filter's concrete containment area, an alarm will trigger on the SCADA system. To ensure the CO_2 system is working properly, the pH of the water entering the lead resin vessel is analyzed and transmitted to the SCADA system along with the level and pressure of CO_2 in the storage tank.

Appendix E includes Table 5-1 from the draft O&MM, which summarizes the instrumentation and control functions built into the WBA Facility.

In addition, the equipment shall be inspected daily for leaks, vibrations or unusual noises and that all local instrument readouts are normal.

The 425 gpm produced by Well GS-3 and treated by ion exchange represents only 8.5 percent of the total nominal 5,000 gpm flow through the GWTP. This water is further blended with MWD water such that water from Well GS-3 represents 4-5% of the total flow before it reaches the first distribution connection.

2.5 Operation and Maintenance

The GS-3 ion exchange facility shall be operated in accordance with operational procedures established in an approved draft OM&MP. After one (1) year of operation, the O&MM shall be updated based on the first year's operational experience. The O&MM shall include a daily checklist of inspected items for each treatment process.

If there is any conflict between the O&MM and the City's water system permit, the permit and its amendments shall take precedent.

The Draft O&MM provided shall be revised and updated to more accurately describe the operational experiences and emergency procedures, monitoring program and reporting requirements. The updated plan shall be submitted within 15 months after receipt of this water system permit amendment. The City shall provide the Department with a revised O&MM for approval. The City may modify the O&MM at any time to accommodate changing conditions; however, any modifications made must be submitted to and be approved by the Department prior to implementation. At any time, the Department can require the City to modify the O&MM due to changing conditions, laws or regulations, or concerns of the public.

As part of preventive maintenance, periodic inspection of the ion exchange vessel internal parts should be made to ensure that the underdrain, vessel lining and nozzles are in good condition. As a minimum, each vessel should be inspected once per year, or at the time of resin replacement, if the on-line period exceeds one year. The City should maintain records of all service or inspection of equipment performed. All malfunctions and corrective actions taken should be documented. Maintenance performed on equipment should also be adequately documented.

2.6 California Environmental Quality Act (CEQA) Clearance

As lead agency under the California Environmental Quality Act (CEQA), the City filed an Initial Study and Negative Declaration for the Chromium 6 Demonstration Sites Project (covering both the WBA facility at the GS-3 wellhead and the RCF facility adjacent to the GWTP) in the summer of 2008. On September 9, 2008 the City approved the project and filed a Notice of Determination with the State Clearinghouse (SCH 2007091036). On September 16, 2008, the Notice of Determination was also filed with Los Angeles County. A copy of the Notice of Determination is included in Appendix A. The City has complied with the requirements set forth in CEQA and the project will not have a significant effect on the environment.

2.7 Start-up Confirmation Testing

After installing the ion exchange resin in the vessels, the City has backwashed and forward flushed the resin beds for approximately 35 bed volumes while collecting the water and discharging it to the sanitary sewer. During this time, a series of water samples was collected from the lag bed effluent. After the final sample was collected and rushed to the laboratory, the system was shut down pending the results. The laboratory has confirmed that the ion exchange system is removing hexavalent chrome as low as 0.042 µg/L. Laboratory results provided by the City confirm that the resin is adequately removing the chromium and that nitrosamine levels dropped below the reporting level of 2 ng/L.

During the start-up testing, low levels of formaldehyde, acetaldehyde and semi-volatiles and semi-volatile TICs were reported. The source of these should be investigated and monitoring of these compounds should continue to confirm their removal in the downstream treatment processes.

Since the resin beds have been idle pending the laboratory reports, the City should flush the beds for an additional 30 BVs before directing the water to the GWTP and ultimately to the distribution system.

3. ENGINEERING APPRAISAL OF SANITARY HAZARDS AND SAFEGUARDS

On September 29, 2009 the WBA Facility was inspected to verify that the equipment installed was complete and ready for operation. No deficiencies or sanitary hazards were noted during the inspection.

Based on the laboratory and small column testing work done with this particular resin, the design and proposed operation of the chromium removal treatment equipment is expected to be successful. Startup confirmation testing has demonstrated the equipment can successfully remove hexavalent chromium.

4. CONCLUSIONS AND RECOMMENDATIONS

Issuance of an amended domestic water supply permit by the Department of Public Health to the City of Glendale for the operation of the WBA Facility at the GS-3 Goodwin Avenue site is recommended subject to the following provisions:

GENERAL

1. The previously issued water system permit and subsequent amendments remain in effect except where specifically modified by this amendment.

2. The City shall comply with all State laws applicable to public water systems and any regulation, standard or orders adopted thereunder.

3. All water treated by the City and distributed for domestic use shall meet the Maximum Contaminant Levels (MCLs) established by the California Department of Public Health.

4. The only approved sources of domestic water supply are listed in Tables 1 and 2.

Table 1. Approved Groundwater Sources

Source	PS Code	Depth	Average Capacity* (gpm)	Status
GN-1	1910043-025	210	565	Active
GN-2	1910043-026	210	565	Active
GN-3	1910043-027	200	565	Active
GN-4	1910043-028	400	1,600	Active
GS-1	1910043-029	171	425‡	Active
GS-2	1910043-030	183	425	Active
GS-3	1910043-031	199	425	Active
GS-4	1910043-032	198	425	Active
GLORIETTA WELL NO. 3	1910043-001	170	500	Active
GLORIETTA WELL NO. 4	1910043-002	185	500	ACTIVE
GLORIETTA WELL NO. 6	1910043-003	180	1,000	ACTIVE
VERDUGO PARK TREATMENT PLANT INFLUENT (PICKUP SYSTEM, WELLS A AND B)	1910043-019	VARIES	1100	Active

* Capacity may vary up to 800 gpm for GN-1, GN-2 and GN-3, and up to 1,800 gpm for GN-4.Capacity may vary up to 700 gpm for GS-2, GS-3 and GS-4. ‡GS-1 is limited to 425 gpm.

Table 2. Other Sources

Source	Status	Capacity (gpm)	Location
MWD-G1 CONNECTION	ACTIVE	21,600	1111 E. GLENOAKS BLVD.
MWD-G2 CONNECTION	ACTIVE	4500	440 EDWARDS PLACE

MWD-G3 CONNECTION	ACTIVE	9000	1655 KENNETH RD
BURBANK, CITY OF	ACTIVE AND EMERGENCY	1300	GLENOAKS BLVD. SOUTH OF ALAMEDA

5. The only approved treatment facilities are listed in Table 3.

Table 3. Approved Treatment Facilities

Treatment Facility	Treatment Process
Glendale Water Treatment Plant (GWTP)/Grandview Basins	Water from wells GN-1, GN-2, GN-3, GN-4, GS-1, GS-2, GS-3, and GS-4 undergoes air stripping and granular activated carbon treatment for VOC removal and hypochlorination. Chloramination and blending with MWD water at Grandview Basins.
WBA Anionic Exchange at GS-3 Wellhead at Goodwin Avenue	Ion exchange to remove chrome 6 with PWA-7 anionic resin.
Glorietta Reservoir	Hypochlorinated water from Glorietta Wells is blended with MWD water
Verdugo Park Water Treatment Plant	Diatomaceous earth filtration and disinfection

6. No additions, changes or modifications to the sources of water supply or water treatment facilities outlined in Provisions 4 and 5 shall be made without prior receipt of an amended domestic water supply permit from this Department.

7. All treatment facilities shall be operated by personnel who have been certified in accordance with the Regulations relating to Certification of Water Treatment Facility Operation, CCR, Title 22. The classifications for all applicable treatment facilities are listed in Table 4. The designated chief treatment operator for the GWTP/GS-3 Wellhead Treatment shall obtain a Grade T4 certificate by January 1, 2012 and the Shift Operator shall hold a T3 certificate.

Table 4. Treatment Facility Classifications

Treatment Facility	Treatment Facility Classification	Min. Treatment Grade Required	
		Chief Operator	Shift Operator
GWTP/WBA Facility	T4	T4	T3
GVPS	T3	T3	T2

8. The City shall maintain an active cross-connection control program in accordance with the California Code of Regulations (CCR) to prevent the water system and treatment facilities from contamination as a result of cross-connections. All cross-connections shall be abated within 30 days of their identification. Annual cross-connection surveys shall be conducted. Backflow prevention devices shall be tested at least annually.

9. The City shall monitor all active groundwater and surface water sources in accordance with the Vulnerability Assessment and Monitoring Guidelines issued by the Department and specific permit provisions.

10. The City shall only use additives that have been tested and certified as meeting the specification of American National Standard Institute/National Sanitation Foundation (ANSI/NSF) Standard 60. This requirement shall be met under testing conducted by a product certification organization accredited by the ANSI for this purpose.

WBA FACILITY

Ion Exchange Treatment

11. The City shall operate the WBA Demonstration Facility with the goal of reducing the chromium concentration in the effluent to below 5 µg/L (5 parts per billion). In addition, the City should evaluate the technical feasibility and costs of treatment to 1 µg/L and below, if possible.

12. Each ion exchange vessel shall be operated at a flowrate not to exceed 600 gallons per minute (gpm) at any time, and with sufficient CO_2 to maintain pH control, unless written permission to operate at a greater rate is obtained from the Department.

13. At all times when the WBA facility effluent is sent to the GWTP for volatile organic chemicals removal prior to introduction to the distribution system, the WBA vessels shall operate in the lead-lag (i.e. series) configuration.

14. The City shall inspect and maintain the WBA Facility daily and as needed to maintain efficient operation.

15. Both vessels shall be taken out of service and the resin in the lead vessel shall be replaced in accordance with the approved Operation and Maintenance Manual (O&MM). The City shall anticipate when this may occur and have an adequate amount of virgin resin available for replacement when needed.

16. Each time an ion exchange vessel is emptied, the vessel internals shall be inspected for evidence of damage, looseness, clogging or other problems. The condition of the lining shall be noted. Records of maintenance inspections shall be kept on file at the WBA Facility as specified in Provision 28.

17. If entry into an empty vessel is necessary to inspect a vessel, confined space safety procedure shall be followed. After inspection, the vessel shall be disinfected with a free chlorine solution of 50 mg/L and held for two (2) hours. The vessel shall be flushed to a residual of less than 1 mg/L prior to installing the fresh resin.

18. Replacement resin shall be Rohm and Haas (Dow) Amberlite PWA-7. Only NSF 61 certified, virgin resin is permitted. If an alternate resin is proposed, it shall be approved in writing by the Department prior to installation.

19. Fresh resin shall be adequately flushed to waste until the concentration of all nitrosamines in the effluent stream are below 10 ng/L.

MONITORING

20. The City shall monitor the WBA Facility in accordance with the approved O&MM. Samples shall be taken weekly at the effluent of the lag vessel (SP-6 in the O&MM) and analyzed for total chrome and hexavalent chrome. Analytical results for these contaminants along with field pH shall be transmitted to the Department via electronic data transfer (EDT) using the station code 1910043-085.

21. The concentration of Chrome 6 in treated water shall be reported down to 0.10 µg/L as specified in the Demonstration Scale Project Quality Assurance Project Plan. A lower reporting limit may be approved by the Department if supporting information is provided.

22. In order to attempt to track any accumulation of uranium in the resin beds, both the raw well water and the effluent of the lead vessel shall be tested for uranium monthly. If uranium is detected at the lead vessel effluent, the lag vessel effluent shall also be tested monthly.

23. The City shall investigate the presence of aldehydes and ketones using EPA method 556, and for semi-volatile organic chemicals including reporting of tentatively identified compounds. Any detections shall trigger similar monitoring at the South OU transmission pipe at the GWTP. Any detections at the GWTP inlet shall trigger similar monitoring at the GWTP plant effluent

24. The City shall comply with any additional conditions which the Department deems necessary based on any newly identified constituents.

25. If necessary, the Department may modify the monitoring provisions specified herein based on additional information. The City may request a modification of any monitoring provision based upon substantiating data at any time.

RECORDS AND REPORTING

26. A monthly report of the operation of the WBA Facility shall be included with the monthly report on other Glendale OU operations which is submitted to the local office of the Department. This operational report shall be submitted by the 20th day of the following month unless otherwise specified. This report is required regardless if the treatment plant is furnishing water to the distribution system or not. As a minimum, the report shall include:

    a. A summary table of analytical results of all samples related to the WBA treatment received by the City the prior calendar month.

    b. A description of the monthly operation, maintenance work, resin changeouts, and problems, both scheduled interruptions and any unscheduled interruption.

    c. The daily flowrate in gallons per day or bed volumes of water processed by the WBA Facility and the monthly and cumulative bed volumes processed by each resin bed.

27. Any change in the monitoring and reporting requirements shall be approved by the Department in writing.

28. Copies of reports, inspections and all records shall be kept for at least five (5) years. Water quality records shall be kept for 10 years.

29. The City shall include the WBA Demonstration Facility in the GOU annual report to the Department, which shall include compliance with the permit provisions, the treatment plant's status, condition, and performance and any problems or difficulties. This report shall be due by March 30th of the following year.

30. The City shall immediately inform the Department by telephone or e-mail and fax, of any exceedence of any MCL or Notification Level in the effluent of the WBA Facility. If the Department is closed at the time, it shall be notified by telephone by 8:15 a.m. of the next day.

COMPLIANCE SCHEDULE

31. Within 90 days after the anniversary of the WBA Demonstration Facility startup, the City shall submit for approval, an updated O&MM to reflect any operational and maintenance changes deemed necessary during the first year of operation.

APPENDIX A

PERMIT AMENDMENT APPLICATION

CEQA DOCUMENTATION

STATE OF CALIFORNIA
APPLICATION
FOR
DOMESTIC WATER SUPPLY PERMIT AMENDMENT
FROM

Applicant: Glendale Water and Power
(Enter the Name of legal owner, person(s) or organization)

Address: 141 N. Glendale Ave. Level 4, Glendale, CA 91206

System Name: City of Glendale – Glendale Operable Unit

System Number: 1910043

TO: Jeff O'Keefe
Southern California District Engineer
Drinking Water Field Operations Branch
California Department of Public Health
1449 W Temple St. Rm 202,
Los Angeles, CA 90026

Pursuant and subject to the requirements of the California Health and Safety Code, Division 104, Part 12, Chapter 4 (California Safe Drinking Water Act), Article 7, Section 116550, relating to changes requiring an amended permit, application is hereby made to amend an existing water supply permit to install a Weak Base Anion (WBA) – Chromium removal demonstration facility at the Glendale North Operable Unit GS-3 Well site (4041 ½ Goodwin Ave, Los Angeles, CA) before the groundwater is treated for VOC removal at Glendale Water Treatment Plant.

I (We) declare under penalty of perjury that the statements on this application and on the accompanying attachments are correct to my (our) knowledge and that I (we) are acting under authority and direction of the responsible legal entity under whose name this application is made.

Signed By: P. Kavounas

Print Name: Peter Kavounas

Title: Assistant General Manager – Water Service

Address: 141 N. Glendale Ave. Level 4, Glendale, CA 91206

Telephone: 818-548-2137

Dated: 5/14/09

NOTICE OF DETERMINATION

TO: ☒ Los Angeles County Clerk
Business & Filing Dept. #1101
12400 E. Imperial Hwy.
Norwalk, CA 90650

☒ State Clearinghouse
Office of Planning and Research
1400 Tenth Street Room 121
Sacramento, CA 95814

FROM: City of Glendale
Planning Department
633 E. Broadway Rm. 103
Glendale, CA 91206-4386

The following Notice of Determination has been prepared in accordance with the California Environmental Quality Act of 1970 as amended, the State Guidelines, and the Environmental Guidelines and Procedures of the City of Glendale. Filing of this notice starts a 30-day statute of limitations on court challenges to project approval (Public Resources Code Sec. 21167).

Project Title/Common Name: Chromium 6 Demonstration Sites

2007091036	Erik Krause, Senior Planner	(818) 548-2140
State Clearinghouse Number *(If submitted to Clearinghouse)*	Lead Agency Contact Person	Area Code/Telephone/Extension

Project Type: ☐ Private Project ☒ Public Project

Project Location: 800 Flower Street, Glendale and 4041 ½ Goodwin Avenue, Los Angeles, Los Angeles County.

Project Description: The proposed project includes the construction of two different viable chromium 6 demonstration water treatment facilities using two different technologies. The sites for these facilities will be at the existing Well Site GS-3 in the City of Los Angeles on Goodwin Street near San Fernando Road, and the other in the Glendale Water and Power Field Operations Center adjacent to the existing Glendale Water Treatment Plant (GWTP) on Flower Street. Well Site GS-3 and the Glendale Water Treatment Plant (GWTP) are part of a U.S. Environmental Protection Agency (EPA) federal Superfund project and the chromium 6 demonstration facilities would be added to the existing water facilities at these sites.

Decision-Making Body of Lead Agency: City of Glendale City Council

This is to advise that the City of Glendale as Lead Agency has approved the above described project on September 9, 2008 and has made the following determinations regarding the project:

1. The project [☐ will ☒ will not] have a significant effect on the environment.
2. ☐ An Environmental Impact Report was prepared for this project pursuant to the provisions of CEQA.

   ☒ A Negative Declaration was prepared for this project pursuant to the provisions of CEQA.
3. Mitigation measures [☒ were ☐ were not] made a condition of approval of the project.
4. A mitigation monitoring reporting plan [☒ was ☐ was not] adopted for this project.
5. A statement of Overriding Considerations [☐ was ☒ was not] adopted for this project.
6. Findings [☐ were ☒ were not] made pursuant to the provisions of CEQA.

This is to certify that the final [☒ Negative Declaration ☐ Environmental Impact Report] with comments and responses and record of project approval is available to the General Public at:

City of Glendale, 633 E. Broadway Rm. 103, Glendale, CA 91206-4386, Phone (818) 548-2140

Contact Person: Hassan Haghani
Director of Planning, City of Glendale

Erik Krause, Senior Planner

Date 9/11/08

ORIGINAL FILED

SEP 1 6 2008

LOS ANGELES, COUNTY CLERK

Date Received for filing at OPR:

NOTICE OF DETERMINATION

TO: Office of Planning and Research
P.O. Box 3044
Sacramento, CA 958112-3044

FROM: California Dept. of Public Health
1616 Capitol Avenue, MS 7418
P.O. Box 997413
Sacramento, CA 95899-7413

SUBJECT: Filing of Notice of Determination in compliance with Section 21108 of the Public Resources Code.

PROJECT TITLE: City of Glendale – Chromium 6 Demonstration Project – Project # P50-1910043-054

SCH#: 2007091036 **LEAD AGENCY:** City of Glendale

CONTACT PERSON: Erik Krause, Senior Planner **PHONE NUMBER:** 818-548-2140

PROJECT LOCATION: 800 Flower Street and 4041½ Goodwin Avenue, Los Angeles County

PROJECT DESCRIPTION: The proposed project includes the construction of two different viable chromium 6 demonstration water treatment facilities.

FINDINGS:
This is to advise that the California Department of Water Resources, approved a grant for the project described above in the amount of $5,000,000 on December 5, 2008, from Chapter 6b, Proposition 50, the WATER SECURITY, CLEAN DRINKING WATER, COASTAL AND BEACH PROTECTION ACT OF 2002.

The Department has made the following determinations regarding the project:

1. The project will not have significant effects on the environment.
2. A Mitigated Negative Declaration was prepared for this project by the Lead Agency.
3. Mitigation measures were incorporated into the final environmental document but were not made a condition of the Proposition 50 Funding Agreement.
4. A Statement of Overriding Considerations was not adopted for this project.

The California Department of Public Health is a "Responsible Agency" not a "Lead Agency" for this project and, as such, is not responsible for Department of Fish and Game filing fees.

Signature: Veronica L. Malloy Date: 12/16/08

Name: Veronica L. Malloy Title: Snr. Env. Scientist Phone: 449-5641

DATE RECEIVED FOR FILING AND POSTING AT OPR:

RECEIVED
DEC 16 2008
STATE CLEARING HOUSE

CDHS – Proposition 50 - Environmental Review Unit
Updated 8/24/2006
DHS CEQA Responsible

Chromium 6 Demonstration Sites

SCH Number: 2007091036

Type: NOD - Notice of Determination

Project Description

The proposed project includes the construction of two different viable chromium 6 demonstration water treatment facilities.

Project Lead Agency

Glendale, City of

Contact Information

Primary Contact:
Veronica Malloy
Department of Water Resources
916-449-5641
Public Health
1616 Capitol Avenue, MS 7418
Sacramento, CA 95899-7413

Project Location

County: Los Angeles
City: Glendale, Los Angeles, City of
Region:
Cross Streets: San Fernando Road and Flower Street
Latitude/Longitude:
Parcel No:
Township:
Range:
Section:
Base:
Other Location Info:

Determinations

This is to advise that the [ ] Lead Agency [X] Responsible Agency Department of Water Resources has approved the project describ(12/5/2008 and has made the following determinations regarding the project described above.

1. The project [ ] will [X] will not have a significant effect on the environment.

2. [ ] An Environmental Impact Report was prepared for this project pursuant to the provisions of CEQA.

   [X] A Negative Declaration was prepared for this project pursuant to the provisions of CEQA.

3. Mitigation measures [X] were [ ] were not made a condition of the approval of the project.

4. A Statement of Overriding Considerations [ ] was [X] was not adopted for this project.

5. Findings [ ] were [ ] were not made pursuant to the provisions of CEQA.

Final EIR Available at:

Date Received: 12/16/2008

Chromium 6 Demonstration Sites

SCH Number: 2007091036

Type: NOD - Notice of Determination

Project Description

The proposed project includes the construction of two different viable chromium 6 demonstration water treatment facilities using two different technologies. The sites for these facilities will be at the existing Well Site GS-3 in the City of Los Angeles on Goodwin Street near San Fernando Road, and the other in the Glendale Water and Power Field Operations Center adjacent to the existing Glendale Water Treatment Plant (GWTP) on Flower Street. Well Site GS-3 and the Glendale Water Treatment Plant (GWTP) are part of a U.S. Environmental Protection Agency (EPA) federal Superfund project and the chromium 6 demonstration facilities would be added to the existing water facilities at these sites.

Project Lead Agency

Glendale, City of

Contact Information

Primary Contact:
Erik Krause
City of Glendale
(818) 548-2140
633 E. Broadway, Room 103
Glendale, CA 91206

Project Location

County: Los Angeles
City: Glendale, Los Angeles, City of
Region:
Cross Streets: San Fernando Road and Flower Street
Latitude/Longitude:
Parcel No:
Township:
Range:
Section:
Base:
Other Location Info:

Determinations

This is to advise that the ☒ Lead Agency ☐ Responsible Agency City of Glendale has approved the project described above on 9/9/2008 and has made the following determinations regarding the project described above.

1. The project ☐ will ☒ will not have a significant effect on the environment.

2. ☐ An Environmental Impact Report was prepared for this project pursuant to the provisions of CEQA.

☒ A Negative Declaration was prepared for this project pursuant to the provisions of CEQA.

3. Mitigation measures ☒ were ☐ were not made a condition of the approval of the project.

4. A Statement of Overriding Considerations ☐ was ☒ was not adopted for this project.

5. Findings ☐ were ☒ were not made pursuant to the provisions of CEQA.

Final EIR Available at: Cit. Glendale 633 E. Broadway Rm. 103 Glendale, CA 91206-4386

Date Received: 12/16/2008

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Monday, August 17, 2009

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Chromium 6 Demonstration Sites

SCH Number: 2007091036

Type: MND - Mitigated Negative Declaration

Project Description

The proposed project includes the construction of two different viable chromium 6 demonstration water treatment facilities using two different technologies. The sites for these facilities will be at the existing Well Site GS-3 in the City of Los Angeles on Goodwin Street near San Fernando Road, and the other in the Glendale Water and Power Field Operations Center adjacent to the existing Glendale Water Treatment Plant (GWTP) on Flower Street. Well Site GS-3 and the Glendale Water Treatment Plant (GWTP) are part of a U.S. Environmental Protection Agency (EPA) federal Superfund project and the chromium 6 demonstration facilities would be added to the existing water facilities at these sites.

Project Lead Agency

Glendale, City of

Contact Information

Primary Contact:
Erik Krause
City of Glendale
(818) 548-2140
633 E. Broadway, Room 103
Glendale, CA 91206

Project Location

County: Los Angeles
City: Glendale, Los Angeles, City of
Region:
Cross Streets: San Fernando Road and Flower Street
Latitude/Longitude:
Parcel No:
Township:
Range:
Section:
Base:
Other Location Info:

Proximity To

Highways: SR-134, I-5
Airports:
Railways:
Waterways: Los Angeles River
Schools:
Land Use: Industrial (City of Glendale) Northeast Los Angeles Planning Area - Industrial (City of Los Angeles)

Development Type

Water Facilities

Local Action

Other Action

Project Issues

Archaeologic-Historic, Biological Resources, Toxic/Hazardous, Water Quality, Water Supply, Wetland/Riparian, Wildlife

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Reviewing Agencies (Agencies in **Bold Type** submitted comment letters to the State Clearinghouse)

Caltrans, District 7; California Highway Patrol; Department of Water Resources; Department of Fish and Game, Region 5; Department of Health Services; Office of Historic Preservation; **Native American Heritage Commission**; Department of Parks and Recreation; Regional Water Quality Control Board, Region 4; Resources Agency; State Lands Commission; State Water Resources Control Board, Division of Water Rights; Department of Toxic Substances Control

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Date Received: 9/7/2007 **Start of Review:** 9/7/2007 **End of Review:** 10/9/2007

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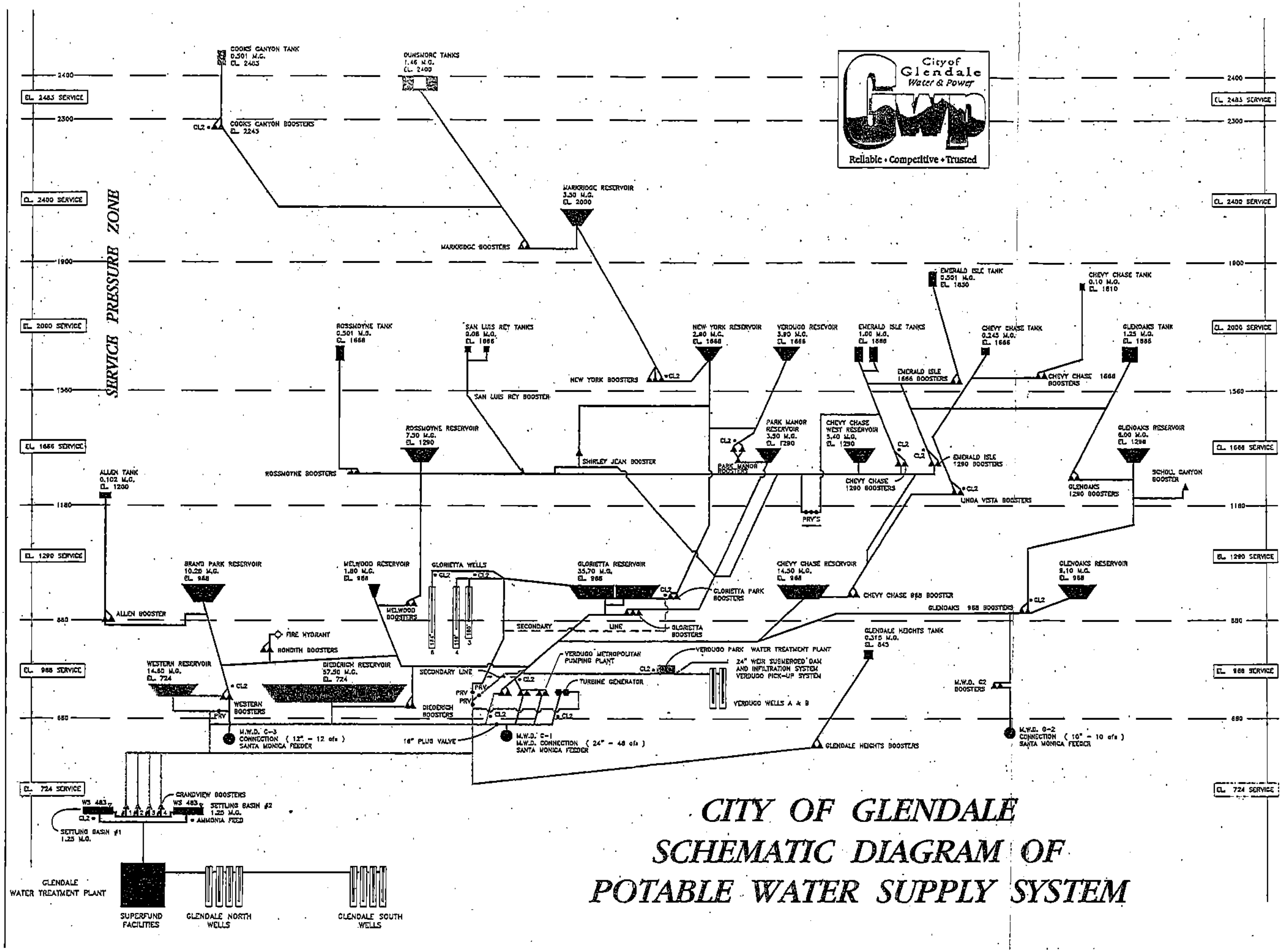
APPENDIX B

SYSTEM SCHEMATIC



CITY OF GLENDALE SCHEMATIC DIAGRAM OF POTABLE WATER SUPPLY SYSTEM

APPENDIX C

TECHNICAL UPDATE #1

TECHNICAL UPDATE #2

EXECUTIVE SUMMARY OF STUDY BY LEHIGH UNIVERSITY OF WEAK BASE ANION UNDERLYING MECHANISM

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Technical Update #1
SUMMARY OF BENCH AND PILOT SCALE

Phase I. Bench-Scale Study

The focus of this surdy was to improve the understanding of fundamental chromium chemistry and to screen a large number of promising treatment technologies for their abilities to treat and remove Chromium 6 to very low levels.

The screening of numerous technologies for low level chromium control has successfully identified technologies that are most promising for utility application. Subsequent study of these technologies listed below is necessary to characterize their performance under larger scale flow-through conditions:

- **Anion exchange** (both as fixed-bed and dispersed contactor applications). The effect of regeneration on anion exchange performance, and the feasibility of operating anion exchange on a "throw-away" basis are questions that are addressed in Phase II work.
- **Adsorptive media.** While the removal of Chromium 6 was effective with select adsorptive media in the bench-scale study, the mechanisms of Chromium 6 control by these technologies need to be better understood. Post-treatment requirements for iron control in some of these technologies also need to be investigated.
- **Membrane treatment of NF/RO.** Rejection of Chromium 6 by membrane technologies has been shown to be excellent, but the operational conditions affecting the feasibility of this technology may require further evaluation (e.g. productivity, fouling, and membrane life). Membrane treatment will not be carried forward to Phase II studies due to the large loss of water associated with this technology.
- **Coagulation and Precipitation of Reduced Chromium 6.** The reduction and removal of chromium as Chromium 3 was found to achieve reasonably low concentrations of chromium in the treated water. In combination with the post-treatment and disinfectant regime, this could prove very effective for Chrimium 6 control at very low levels. Further study of mixing conditions and process kinetics is required for optimization of this process to remove Chromium 6 to very low levels.

Phase II. Pilot-Scale Treatment Technologies

The objectives of Phase II were to demonstrate two categories of treatment technologies at pilot-scale. These categories included a) mature industrial Chromium 6 treatment technologies that may be effective for drinking water treatment and b) treatment technologies identified by the Phase I Bench-Scale Study as being effective, although the technology may not be fully mature. The results of the Phase I Bench-Scale Study were used to select treatment methods and materials for Phase II. The sutdy was performed by the City of Glendale with the assistance of Utah State University, University of California at Los Angeles, and the University of Colorado at Boulder.

The category A studies resulted in a mix of findings for effective Chromium 6 control. Strong base anion exchange resins showed effective performance from several vendors. US Filter/Rohm and Haas and Calgon tested strong base resins that removed Chromium 6 efficiently to the extent expected in bench-scale testing. The MIEX resin system was successful in demonstrating its ability to remove 95% of the influent Chromium 6 concentration about half of the time during a trial run. The category B studies built upon these findings to demonstrate that multiple regenerations of strong base anion exchange resins using recycled brine can be effective in Glendale water.

Extended life for a weak base anion exchange resin from US Filter/Rohm and Haas was an unexpected finding from category A. More work is needed with this product especially when the resin is coupled with an effective and reliable pH reduction system.

Category A also included testing of a WRT zeolite-based adsorptive media, which was found to be effective at removing Chromium 6. However, this media required a long contact time and only achieved a small number of bed volumes before the media required replacement.

One technology by Filtronics was ineffective the Chromium 6 removal, which included a reduction-filtration approach. Filtronics attempted to reduce Chromium 6 with high doses of sodium metabisulfite, then oxidize the water to a politive oxidation—reduction potential with chlorine to avoid reducing the filter med media.

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TECHNICAL UPDATE #1 (continued)

Phase II. Pilot Scale

The high concentrations of sodium metabisulfite and hypochlorite required combined with less than stellar results for Chromium 6 and Chromium 3 removal made this technology impractical.

Category B work also included the demonstration of reduction/coagulation/filtration technology (the "Hinkley" process) for Chromium 6 control. More work and data interpretation is needed on this pilot plant unit before conclusions are drawn, but the process appears to have been effective at removing Chromium 6 to very low levels.

Unit costs are being developed for each of the successful technologies to determine treatment systems likely to be cost-effective at full-scale. This cost development will be useful for comparing the successful technologies, including those that were effective (like WRT's adsorptive media) but only achieved a small number of bed volumes for effective Chromium 6 treatment.

Phase III.

Demonstration Technologies

The City of Glendale *Water & Power* has issued a request for Statement of Qualifications (SOQ) to various consultants to perform the work funded under the Environmental Protection Agency's $447,100 Science and Technology Grant to the City. The work on this initial Phase III effort is scheduled to begin soon. Based on the results of the Phase II pilot-scale studies, one or more of the technologies will be recommended for demonstration-scale testing under Phase III.

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Technical Update #2

SUMMARY OF DEMONSTRATION-SCALE CHROMIUM 6 REMOVAL STUDIES

Background

With completion of the bench-scale and pilot-scale removal studies, work on the demonstration-scale testing in Phase III has started. The objective of the Phase III effort is to finalize the chromium 6 removal research effort and to construct demonstration facilities. These facilities will have a capacity of 1,000 gallons per minute (gpm), either as two 500 gpm facilities or a single 1,000 gpm facility, to test either one or two technologies. Additionally, this information will be used to assist the California Department of Health Services (DOHS) in reviewing and approving technologies to remove chromium 6 from water supplies, and determining cost information that is required by State law for setting a specific Maximum Contaminant Level (MCL) for chromium 6 in drinking water supplies.

Funding

The total cost of the three-phase effort is $3 million which has been funded by multiple grants from the U.S. Environmental Protection Agency (EPA), the American WaterWorks Association Research Foundation (AwwaRF), and by the cities of Los Angeles, Glendale, Burbank and San Fernando.

The estimated cost of the Phase III demonstration testing is $2 million. To date, funding consists of $900,000 provided by two grants from EPA and a $100,000 grant from AwwaRF. The financial assistance from AwwaRF recognizes the value of this research effort to all water utilities throughout the United States, and supplements their earlier participation in the bench-scale testing.

Proposition 50

Proposition 50 funding is required to complete the Phase III demonstration research effort. An application for $1 million has been submitted to the State of California.

Research

The Phase III effort includes a research component of $547,100 referred to as the "Bridge Project". This project will test the performance of the most cost-effective treatment technologies for chromium 6 removal. Building on knowledge gained from the bench-scale and pilot-scale studies, weak-base anion exchange will be the technology receiving additional focus. McGuire Malcolm Pirnie, Inc. is performing the research.

Expert Panel

When the "Bridge Project" is complete, a panel of experts consisting of members of the Project Advisory committee (PAC) and other technology professionals will be convened. This PAC is comprised of representatives from the Metropolitan Water District of Southern California, Los Angeles Department of Water and Power, EPA, and the California DOHS. Academic support will be provided by the University of California at Los Angeles, Utah State University, and the University of Colorado at Boulder. These professionals will review all the technical information and recommend to the City of Glendale the technology(s) to be implemented as part of the demonstration project.

Urgency of Research Effort

Recognizing the significant presence of chromium 6 in the San Fernando Valley groundwater supplies and the potential to cause a violation of California's MCL standard for total chromium, EPA retained CH2MHill consulting engineers to forecast the near-term chromium 6 concentration in water supplies for the EPA's Burbank and Glendale Operable Units (GOU).

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Urgency of Research Effort

(continued from other side)

The study projected that the chromium 6 concentration will increase significantly within the next three to five years in four of Glendale's eight GOU wells. Projections are that chromium 6 levels will increase to 170 parts per billion (ppb) in two wells, and to 50 ppb in another two wells. Using the projected chromium levels for the GOU wells, the total chromium in the GOU effluent, even with blending with other water supplies, could exceed the current California MCL of 50 ppb for total chromium and jeopardize the continued use of this water supply.

If the MCL for chromium 6 is set by California DOHS at less than the current MCL for total chromium (50 ppb), the problems faced by Glendale and the water industry could be even more significant.

It is essential that the successful bench-scale and pilot-scale research is followed by the proposed demonstration testing to ensure that large-scale treatment technologies are capable of removing chromium 6 to very low concentrations in real-world treatment operations.

While the focus is currently on the City of Glendale, the outcome of the research effort will assist other water utilities that have also expressed concerns with chromium 6 in their drinking water supplies.

Identification of Industries Causing Chromium 6 Contamination

In a parallel effort, the cities of Glendale, Burbank and Los Angeles, the San Fernando Valley Watermaster, and EPA have a number of initiatives underway to identify the industries causing the chromium 6 contamination with the objective that these industries fund the required full-scale chromium 6 removal facilities.

Identification of Industries

(continued)

These efforts include:

> **Investigation of sites in the San Fernando Valley where heavy metals were used by industries.** Jointly funded by the cities of Glendale, Burbank, and Los Angeles, and EPA, a consultant was retained to accelerate the investigation by the Los Angeles Regional Water Quality Control Board of industries potentially responsible for causing the chromium 6 contamination.

> **Urge the U.S. Environmental Protection Agency to review legal options to require industries causing the chromium 6 groundwater contamination to construct and operate chromium 6 removal systems in order to provide the highest quality of water to the public.**

Conclusion

Chromium 6 continues to be a major concern to the cities of Los Angeles, Burbank and Glendale. The CH2MHill report on future chromium 6 concentration levels in the groundwater supplies underscores the importance of the Phase III demonstration effort. Proposition 50 funding is necessary to ensure that practical water treatment methodologies are available to remove this contaminant to very low concentrations.

Trace Cr(VI) Removal by Weak Base Duolite A-7 and SIR-700 from Groundwater in Glendale, CA : Underlying Mechanism

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Executive Summary

During the last six months, we carried out a series of laboratory experimental studies using two weak-base anion exchange resins: Duolite A-7 from Rohm and Haas Co., and SIR-700 from ResinTech Co. Chromium-contaminated Glendale water, spiked Glendale water and synthetic water were used in the study. For comparison and appropriate understanding of underlying Cr(VI) removal mechanism, a strong-base anion-exchange resin was also included in the investigation. Major conclusions resulting from the study can be summarized as follows:

1. Cr(VI) removal by Duolite A-7 and SIR-700 takes place by selective anion exchange followed by Cr(VI) reduction to Cr(III) which is insoluble and retained within the resin phase.
2. At neutral or above-neutral pH, Cr(VI) removal by Duolite A-7 and SIR-700 diminishes drastically due to the lack of protonated anion exchange sites. At acidic pH, conventional strong-base anion exchange resins exhibit relatively poor removal of Cr(VI) because of their inability to reduce Cr(VI) to Cr(III). Thus, both anion exchange sites and reductive potential are simultaneously needed for an ion exchange resin to achieve efficient Cr(VI) removal. Duolite A-7 as well as SIR-700 satisfy these requirements at slightly acidic pH following adequate protonation of weak-base exchange sites. Also, the process is operationally simple; any fluctuation in the influent Cr(VI) concentration has no noticeable effect on the treated water quality.
3. During lengthy column runs, chromium appearing at the exit of the column is only Cr(VI) i.e., $HCrO_4^-$ and/or CrO_4^{2-}. Cr(III) is essentially absent in the treated water. Inside the exhausted Duolite A-7 and SIR-700, however, only Cr(III) is present.

4. Removal of copper from Glendale water has no favorable impact on Cr(VI) removal. Thus, even in the absence of copper, Cr(VI) removal by Duolite A-7 and SIR-700 is very efficient. However, both Duolite A-7 and SIR-700 have the ability to remove copper(II) and other transition metal cations due to the presence of nitrogen-containing functional groups.
5. All other conditions remaining identical, Cr(VI) removal is enhanced by lower influent pH and longer empty bed contact time (EBCT).
6. During the field trial of SIR-700 by Malcolm Pirnie, it was observed that Cr(VI) removal for the first few thousand bed volumes was relatively poor. Inadequate protonation of SIR-700 was the underlying reason for inefficient Cr(VI) removal. Both Duolite A-7 and SIR-700 should be equilibrated at slightly acidic pH (3-4) prior to starting the column run for Cr(VI) removal.
7. It is hypothesized that repeating organic groups (Phenol formaldehyde in Duolite A-7 and epoxy in SIR-700) are responsible for reducing Cr(VI) and the resulting organic substances are retained within the ion exchange resins following oxidation. More widely used anion exchange resins with polystyrene matrices are unable to reduce Cr(VI).
8. Results of our laboratory experiments and the earlier findings from the field trials performed by Malcolm Pirnie provide suggestive evidence that intraparticle diffusion within the ion exchangers is the rate limiting step for Cr(VI) removal.

APPENDIX D

SUPPLEMENT TO GLENDALE OPERABLE UNIT 97-005 DOCUMENT

TIME SERIES CHARTS OF CHROMIUM LEVELS IN OPERABLE UNIT WELLS

City of Glendale Water & Power

PROJECT TECHNICAL REPORT TO SUPPLEMENT THE GLENDALE OPERABLE UNIT 97-005 DOCUMENTATION FOR OPERATION OF THE WBA CHROMIUM REMOVAL DEMONSTRATION FACILITY AND THE RCF CHROMIUM REMOVAL DEMONSTRATION FACILITY

Prepared by

City of Glendale Water and Power

Revision Submitted to California Department of Public Health on

May 28, 2009

1 BACKGROUND

In 2000, the City of Glendale started operating and taking the delivery of water from the EPA's Glendale Operable Unit (GOU) and distributing the treated water to its customers. Because the source of water to be treated was considered by the California Department of Public Health (CDPH) to be an extremely impaired source as defined in Policy Memo 97-005 *Policy Guidelines for Direct Domestic Use of Extremely impaired Sources*, the City (via the Glendale Respondents Group-GRG) prepared a report entitled "City of Glendale Water Supply Permit Policy 97-005 Documentation" dated May 2000 (Documentation), as part of amending the City's Water Supply Permit for the GOU. That Documentation covered the eight extraction wells, Glendale Water Treatment Plant (GWTP), and other facilities associated with the removal of the VOCs from the groundwater. The chemical constituent of concern in the Documentation was the presence of a wide variety of volatile organic compounds (VOCs) in the San Fernando Valley (SFV) groundwater supplies.

Although chromium 6 was detected in the SFV groundwater samples, the GWTP was not designed to remove chromium 6 as the levels in the extraction wells were below the total Cr maximum contaminant level (MCL) of 50 parts per billion (ppb) in California. The GWTP has successfully operated for the past eight years in removing VOCs. However, the community continued to have concerns with the presence of chromium 6 in the drinking water supplies even thought the concentrations are far below any drinking water standard. As a result Glendale, working with the cities of Los Angeles and Burbank, implemented a major research effort to develop the technology to remove chromium 6 from the SFV groundwater supplies.

Phase I Bench Study and Phase II Pilot Study of the research program have been completed. The next phase (Phase III) of the multi-million dollar effort is the construction of demonstration scale facilities using technologies that have gone through the bench- and pilot-scale efforts. As a result of the research program, two technologies, the weak base anion exchange resin (WBA) and reduction with ferrous sulfate, coagulation, and filtration (RCF), were identified as the two most promising technologies. The City's plan is to install the WBA-Chromium Removal Demonstration (WBA-CRD) facility at GOU Well Site GS-3, and the RCF-CRD facility adjacent to the Glendale Water Treatment Plant to test two different promising chromium 6 removal technologies. The WBA-CRD is expected to be operational indefinitely while the RCF-CRD will be operated for 12 months and removed afterwards. Based on performance of these two facilities, the City may install one or both chromium 6 removal systems at full or partial scale to address the continuing public concern with chromium 6 in drinking water supplies and future changes in the drinking water quality standard for chromium 6.

2 TECHNICAL REPORT

2.1 97-005 COMPLIANCE

As treated water from the WBA-CRD and RCF-CRD facilities will be blended at the GWTP and eventually served to the public, the question came up in working with CDPH as to the application of and compliance with the 97-005 policy that would be part of amending the City's Water Supply Permit for construction and operation of the two chromium 6 removal demonstration facilities. The CDPH in evaluating this situation has concluded that a formal amendment to the year 2000 97-05 Documentation Report is not needed because chromium 6 was discussed in that Documentation, but requested a brief technical report. In an e-mail to the City dated November 21, 2007, the CDPH requested the City address the following four issues in the technical report:

1. A description and inventory of sources of chromium contamination within the well's capture zone;
2. An evaluation and summary of the levels of chromium at or near the source areas or plume hot spots;
3. An estimation of the typical and peak chromium levels that will reach the extraction well in question;
4. A discussion and evaluation of the treatment design, as to how well it is expected to handle these chromium concentrations, along with reliability features.

The purpose of this report is to provide detailed information on these four issues.

2.2 SOURCE OF DATA FOR RESPONDING TO THE FOUR CDPH ISSUES

The first three questions require further information on the source, presence, and quantification of chromium 6 in the groundwater supplies close to the two demonstration facilities. Fortunately, the City has a long-period of operational records relative to the concentration of chromium 6 in water produced from the eight wells as well as the other monitoring/early warning wells. Because of the concern with future levels of chromium 6 in the SFV groundwater supplies, in year 2004, the EPA requested that their consultant CH2MHill evaluate and identify the future concentrations of chromium 6 in water produced from Glendale's eight production wells. After extensive data collection, research, and modeling efforts, CH2MHill prepared a final technical memorandum entitled "Burbank and Glendale Operable Units, Focused Study" dated June 10, 2005[1]. The CH2MHill Report provides a significant amount of information on the past and current chromium 6 levels in the SFV groundwater supplies and the projected chromium 6 levels in the eight GOU wells over the next "few" years. In addition, the City has been operating and sampling the water produced from these wells for the past eight years.

[1] CH2MHill. 2005. *Final Technical Memorandum – Burbank and Glendale Operable Units, Focused Chromium Trend Study.*

This has provided information on the trends with respect to chromium 6 concentration. The CH2MHill Report and Glendale's routine analysis of the water supplies will be the primary data source to respond to the first three questions. Reports from the Upper Los Angeles River Area (ULARA) Watermaster are also used to supplement the necessary information[2,3]. The last question pertains to the chromium 6 removal facilities to be constructed. As of today, Malcolm Pirnie, the City's consultant, has prepared experimental plans and quality assurance project plans (QAPPs) for the demonstration-scale WBA and RCF treatment studies[4,5,6,7]. Those four documents will be the basis for answering the last question. It should be noted that those four documents are in the draft form and will be updated once the design is finalized.

This report summarizes all relevant information from various sources to address the four issues raised by CDPH. Please refer to the actual reports for more detailed information.

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[2] Upper Los Angeles River Area Watermaster. 2003. *Watermaster Special Report Concerning the History and Occurrence of Hexavalent Chromium Contamination in the San Fernando Basin and Related Watermaster Conclusions and Recommendations.*

[3] Upper Los Angeles River Area Watermaster. 2008. *Watermaster Service in the Upper Los Angeles River Area,, Los Angeles County, California. 2006-07 Water Year, October 1, 2006 – September 30, 2007.*

[4] Malcolm Pirnie. 2007. *The Treatment of Hexavalent Chromium (Cr(VI)) in the City of Glendale, California Ground Water Supply: Phase III Demonstration-Scale WBA Resin Treatment Technology Evaluation, Quality Assurance Project Plan (Draft).*

[5] Malcolm Pirnie. 2007. *Experimental Design and Operations Plan for Hexavalent Chromium Removal using Weak-Base Anion Exchange Resin: A Demonstration-Scale Study (Draft).*

[6] Malcolm Pirnie. 2008. *The Treatment of Hexavalent Chromium (Cr(VI)) in the City of Glendale, California Ground Water Supply: Phase III Demonstration-Scale Reduction with Ferrous Sulfate, Coagulation, Filtration (RCF) Treatment Technology Evaluation, Quality Assurance Project Plan (Draft).*

[7] Malcolm Pirnie. 2008. *Experimental Design for Hexavalent Chromium Removal using Reduction with Ferrous Sulfate, Coagulation, and Filtration (RCF) Process: A Demonstration-Scale Study (Draft).*

3 RESPONSES TO ISSUES IN SUPPORT OF PERMIT AMENDMENT AT GOU

3.1 Description and Inventory of Sources of Chromium Contamination within the Wells Capture Zone

According to a report issued by the ULARA Watermaster in 2003[2], the extensive use and discharge of chromium 6 occurred within the San Fernando Basin. Historical data confirmed the use of chromium 6 in the Basin by the following industries: aircraft, metal pickling and plating operations; in anodizing aluminum; in the leather industry as a tanning agent; in the manufacture of paints, dyes, explosives, ceramics, paper, and many other substances. The release of chromium 6 by these industries was caused by spills, leaks, return wells, and discharges to storm drains. By November 2002, the Los Angeles Regional Water Quality Control Board (RWQCB) had investigated 255 suspected chromium and chromium 6 sites located in or near the Superfund areas within the Basin. As of March 2005, 32 sites in the Glendale Operable Unit (OU) vicinity had possible chromium contaminations that required further assessment. The CH2MHill 2005 Report identifies the following potential source areas of chromium and chromium 6 contamination within the Glendale North and South OU (see Figure ES-2 of the report for more information).

Glendale North OU

B.F. Goodrich (formerly Menasco/Coltec Industries, Inc.) 100 E. Cedar Ave., Burbank

This facility has been named a Responsible Party by the USEPA for discharging contaminants to the Glendale North OU. Industrial activities at this site involved machining, manufacturing, metal plating, anodizing of parts and equipment for various aerospace applications. TCE, PCE, DCE, 1,1,1-TCA and chromium 6 have been detected on this site. The amended General Waste Discharge Requirement was approved and the facility began a pilot study for the remediation of chromium 6 in the soil and groundwater. Groundwater monitoring continues on a semi-annual basis.

ITT/Home Depot (formerly ITT Aerospace), 1200 S. Flower St., Burbank

Home Depot has completed construction of a store and parking lot on part of the former ITT Aerospace Controls site. ITT Aerospace Controls manufactured parts and conducted metal finishing and plating. Contaminants detected at this site include VOCs, petroleum hydrocarbons, nickel, and chromium 6. A naturally occurring low-permeability zone located 50 feet below the ground surface is expected to reduce vertical migration of contaminants. ITT is responsible for cleanup of the area outside the Home Depot's slurry wall barrier. Groundwater monitoring continues on a semi-annual basis.

Glendale South OU

DriLube, 711 W. Broadway and 718 W. Wilson, Glendale

DriLube Company, a plating facility in Glendale, was named a Responsible Party by the USEPA for discharging contaminants to the Glendale South OU from its site. The results of subsurface investigations have detected soil and groundwater contaminated with chlorinated solvents, petroleum hydrocarbons, PCBs, and heavy metals including chromium. On November 15, 2002 a fire at the DriLube Company totally destroyed the Plant 1 facility and records. USEPA now manages the DriLube site, and has issued a Unilateral Administrative Order for cleanup.

PRC-DeSoto (formerly Courtaulds Aerospace), 5430 San Fernando Road, Glendale

The RWQCB issued a CAO to PRC-DeSoto on August 22, 2002. This facility has been named a Responsible Party by USEPA for releasing chlorinated organic solvents within the Glendale South OU. The facility's principal industrial activities involved chemical formulation of adhesives and sealants used by the U.S. Department of Defense for various aerospace applications. 1,1,1-TCA, DCA, TCD, PCE, chromium, chromium 6, and nickel have been found in soil and groundwater beneath the site. Three down-gradient wells were completed in May 2006. PRC-DeSoto has submitted a Remedial Action Plan (RAP) for the in-situ reduction of chromium 6 that is under review by the RWQCB. Furthermore, the facility is applying for a General Waste Discharge Requirement permit for the remediation of chromium 6. Groundwater monitoring continues on a quarterly basis.

Excello Plating, 4057 Goodwin Ave., Los Angeles

Excello Plating is immediately adjacent to the Glendale South OU extraction wellfield (next to the Well GS-3). On June 20, 2003 the RWQCB issued a CAO to Excello Plating. The CAO was revised and reissued on June 2, 2005. The facility's owners have been named a Responsible Party under CERCLA for releasing VOCs, chromium 6, nickel, cadmium, zinc and lead. The facility has completed onsite soil and groundwater assessment and has submitted a RAP for the remediation of heavy metals including chromium 6. The Excello site completed the drilling of three additional groundwater monitoring wells for the delineation of the contaminant plumes that may have migrated offsite. Groundwater monitoring continues on a semi-annual basis.

3.2 Levels of Chromium at or near the Source Areas or Plume Hot Spots

The USEPA has been reporting on a quarterly basis the concentration of chromium 6 in the various GOU production wells, and various monitoring locations through out the SFV. The record of information goes back many years.

Glendale North OU

The highest total chromium and chromium 6 concentrations in groundwater at the Glendale North OU presently occur in the industrial area between the Menasco site and the Glendale North OU extraction wellfield (see Figures 7 and 8 in the CH2MHill Report). This zone of high chromium concentrations appears to be long, narrow, and limited to shallow depths.

The total chromium reported for many of the Menasco and ITT facility monitoring wells exceed the MCL of 50 ppb, and several exceed 1,000 ppb or more. Chromium 6 concentrations are also high at Menasco and ITT facility monitoring wells, with several monitoring wells at these facilities showing concentrations in the hundreds of ppb, and maximum concentrations up to 1,600 ppb. Chromium 6 concentrations at shallow monitoring wells that are located downgradient from the Menasco and ITT facilities but upgradient from the Glendale North OU extraction wellfield (e.g., CS-VPB-04, CS-C03-100, CS-VPB-05) have exceeded 100 ppb. There are indications that chromium 6 concentrations continue to increase at several shallow monitoring wells between the Menasco site and the Glendale North OU extraction wells. The list below shows some examples of extreme total chromium and chromium 6 concentrations that were observed in monitoring wells located near the Glendale North OU:

- V13ITT30: about 15,000 ppb total chromium
- V13ITT34: about 1,700 ppb total chromium and 1,600 ppb chromium 6
- V13ITTS2: about 1,600 ppb total chromium and 1,600 ppb chromium 6
- V13MODG2: about 20,000 ppb total chromium and 4,500 ppb chromium 6
- V13MODG6: about 2,000 ppb total chromium and 2,000 ppb chromium 6
- V13MOPZ4: about 1,200 ppb total chromium and 1,200 ppb chromium 6

It should be noted that for water samples collected between January 2000 and August 2004, the total chromium and chromium 6 concentrations that are greater than 50 ppb occurred in samples from wells screened in the upper 100 feet of the saturated zone. Samples collected from deeper monitoring wells in this area contain much lower concentrations of total chromium and chromium 6, typically less than 10 ppb. In general, concentrations in the monitoring wells decrease with increasing depth of the screened interval below land surface. Since the Glendale North OU extraction wells withdraw groundwater mostly from deeper aquifer zones with little evidence of chromium contamination, chromium concentrations at these wells are not expected to be as high as nearby or upgradient shallow monitoring wells. Since the RCF-CRD is supposed to operational for one year, chromium 6 concentration in the GOU North Wells is not expected to rise dramatically in the near future based on past monitoring results.

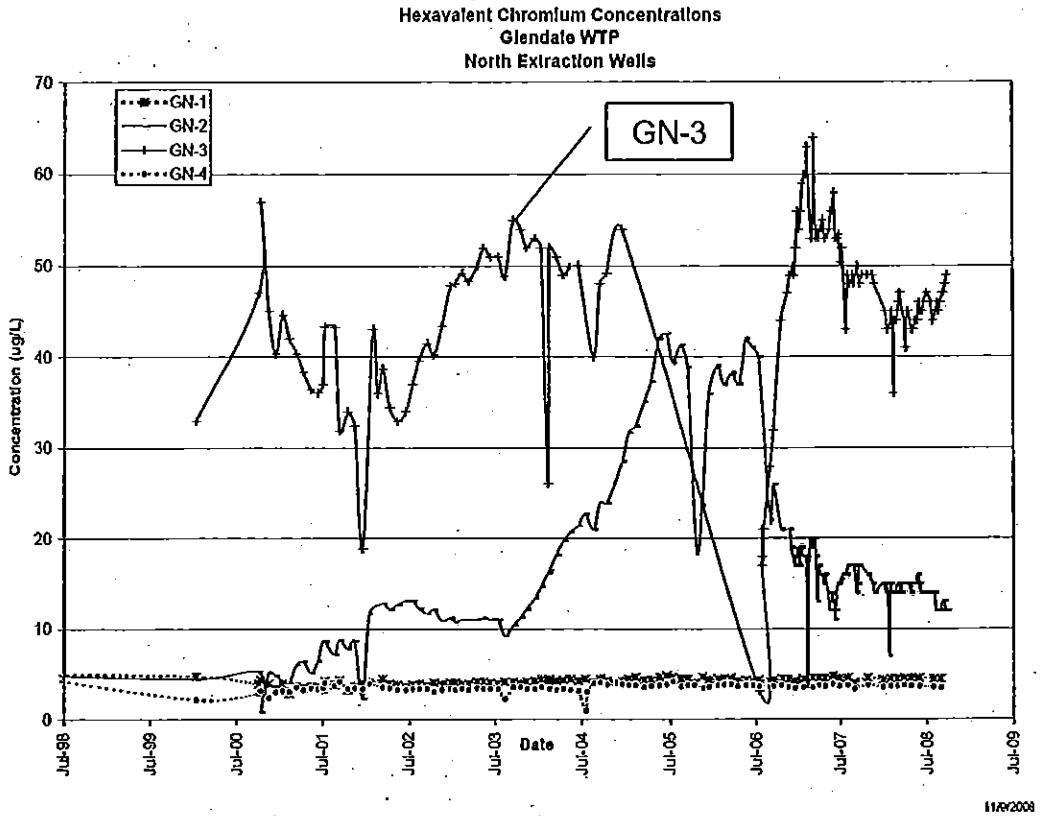
Glendale South OU

Most of the chromium data available for the Glendale South OU are from wells within approximately 0.25 mile of the PRC-DeSoto, DriLube, and Excello sites. Total chromium and chromium 6 concentrations above 13,000 ppb have been reported in groundwater between the DriLube site and the Glendale South OU extraction wellfield.

Figure 7 in the CH2MHill Report shows that total chromium concentrations reported in monitoring wells located near the PRC-DeSoto, DriLube, and Excello sites exceed the MCL of 50 ppb, and commonly exceed 1,000 ppb. Figure 8 in that report shows that the highest chromium 6 concentrations occurred near the DriLube site, with several DriLube wells containing more than 100 ppb chromium 6. Chromium 6 concentrations also exceed the MCL for total chromium (50 ppb) at the Excello site. Note that for water samples collected between January 2000 and August 2004, all the total chromium and chromium 6 concentrations higher than 50 ppb reported in the database for the Glendale South OU occurred in wells screened in the upper 25 feet of the saturated zone. Similar to the Glendale North OU extraction field, the Glendale South OU extraction wells withdraw groundwater mostly from deeper aquifer zones with little evidence of chromium contamination; therefore, chromium concentrations at these wells are not expected to be as large as at nearby or upgradient shallow monitoring wells.

3.3 Typical and Peak Chromium Levels that will Reach the Extraction Wells

As part of the routine operation of the Glendale Water Treatment Plant (WTP), chromium 6 concentrations are monitored in the Glendale OU extraction wells on a monthly basis. Figure 1 presents the chromium 6 concentrations in these extraction wells from late 1990s to October 2008.



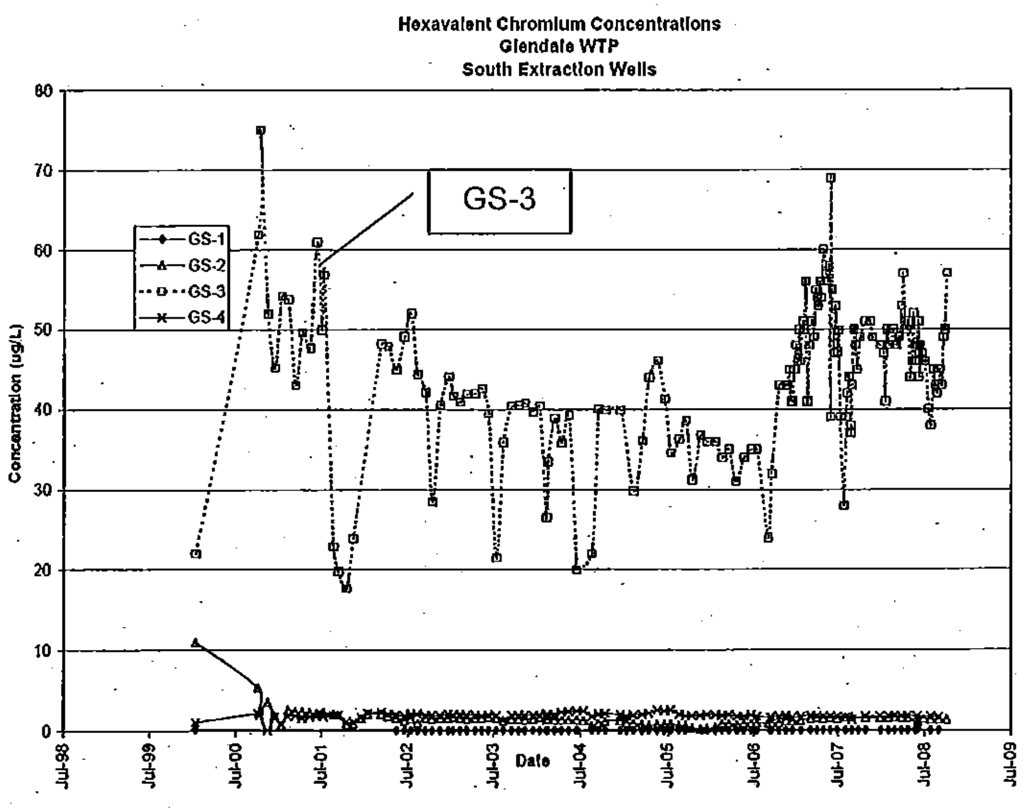


Figure 1. Chromium 6 concentrations in Glendale OU extraction wells

The CH2MHill Report projected future chromium 6 levels in all of the Glendale OU extraction wells based on analysis of spatial and temporal trends of chromium contamination and geochemical conditions. The forecast for each of the extraction wells is described as follows. Please note that the forecasts presented here are subject to significant uncertainty and should be used with caution.

- GN-1 – Total chromium and chromium 6 concentrations at extraction well GN-1 are not predicted to increase above 15 ppb in the foreseeable future because of the depth of the well and low upgradient concentrations of chromium 6 in the southwest part of the Glendale North OU, assuming that no significant changes to the hydraulic regime in the area (such as pumping rates at the extraction wells) occur.
- GN-2 – Total chromium and chromium 6 concentrations could reach a peak of 170 ppb, assuming that high chromium concentrations observed at monitoring well CS-VPB-04 (~ 1,000 ppb) in 2000 reaches the well.
- GN-3 – Total chromium and chromium 6 concentrations might significantly increase in the future, with a possible peak concentration of 170 ppb, assuming that high chromium concentrations observed at monitoring wells CS-VPB-04 (~ 1,000 ppb) in 2000 reaches the well.
- GN-4 – Total chromium and chromium 6 concentrations at GN-4 well are forecast to remain below 10 ppb in the foreseeable future because of the depth of the well and low upgradient concentrations of chromium 6 in the southwest part of the Glendale North OU, assuming that no significant changes to the hydraulic regime in the area (such as pumping rates at the extraction wells) occur.
- GS-1 – Total chromium and chromium 6 concentrations at GS-1 are not forecast to increase above 5 ppb in the foreseeable future because of the low upgradient chromium concentrations.
- GS-2 – Total chromium and chromium 6 concentrations at GS-2 are not forecast to increase above 10 ppb in the foreseeable future because of the low upgradient chromium concentrations.
- GS-3 – Total chromium and chromium 6 concentrations should not change substantially from past reported levels. Chromium 6 concentration at approximately 70 ppb was reported in 2007. Right now, chromium 6 concentrations fluctuate between 40 to 60 ppb. However, future changes in hydrogeologic conditions could mobilize large concentrations of chromium in the upgradient areas, which would impact extraction well GS-3.
- GS-4 – Similar to concentrations in well GS-3, total chromium and chromium 6 concentrations should not change substantially from past reported levels. However, because the capture zone for well GS-4 includes upgradient areas with known high chromium concentrations, it is possible that future chromium concentrations will increase to levels similar to those that have occurred at extraction well GS-3, 30 to 50 ppb.

Table 1 below lists chromium 6 concentrations measured in 2000, October 2008 (the latest data available), and the CH2MHill's 2005 predicted maximum value in the Glendale OU.

Table 1. Chromium 6 Concentration Level (ppb) in the Glendale OU

	GS-1	GS-2	GS-3	GS-4	GN-1	GN-2	GN-3	GN-4	GWTP Combined Effluent
2000	0	1	50	1	5	10	50	2	12.4
Oct. 2008	0	1.7	44	1.7	4.5	12	46	3.5	6.5*
CH2MHill Projection	5	10	50	50	15	170	170	10	53.2

*. This concentration reflects the operation practice of alternating GN-3 and GS-3 wells to avoid exceeding the 8 ppb LA River discharge limit.

3.4 Evaluation of the Reliability Features of the Treatment Processes

The sections below will briefly describe the treatment process and sampling schedules for both WBA-CRD and RCF-CRD facilities. The reliability features of each demonstration facility will then be discussed to evaluate potential vulnerability issues. More detailed information on treatment design and sampling procedures for the two demonstration facilities can be found in Ref. 4 – 7.

WBA-CRD

The City is proposing to construct and operate the WBA-CRD facility at the GS-3 well. This well was selected because the high chromium 6 concentration of the well water makes it ideal for this effort. This facility is anticipated to be operated indefinitely, subject to funding, following the completion of the demonstration study.

The capacity of the proposed WBA-CRD is 425 gpm, equivalent to the maximum production capacity of Well GS-3. In 2002, the City constructed two GAC vessels at the site to remove VOCs from the GS-3 well water, which could then be sent to the City's reclaimed water system. The purpose of that project was to reduce chromium 6 concentration in the water delivered to the customers by diverting the GS-3 water (with high chromium 6 levels) to a non-potable system. However, those vessels were never used since alternative approaches were selected to achieve a similar result. Now the plan is to use WBA resins in those existing vessels by making certain modifications. The treatment system will consist of a pair of lead/lag vessels with upstream carbonic acid addition. Due to its high capacity and difficulty in regeneration, WBA resin will be used as a once-through, nonregenerable media. This process will remove chromium 6 in the well water and the water will then be discharged into the collector pipe system in Goodwin Street for conveyance along with untreated water from wells GS-1, GS-2, and GS-4 to the GWTP for VOC removal via air-stripping towers and granular activated carbon treatment. After blending with water from Metropolitan Water District (MWD), the treated water is delivered to the City's customers. Figure 2 shows a flow schematic of the WBA-CRD.

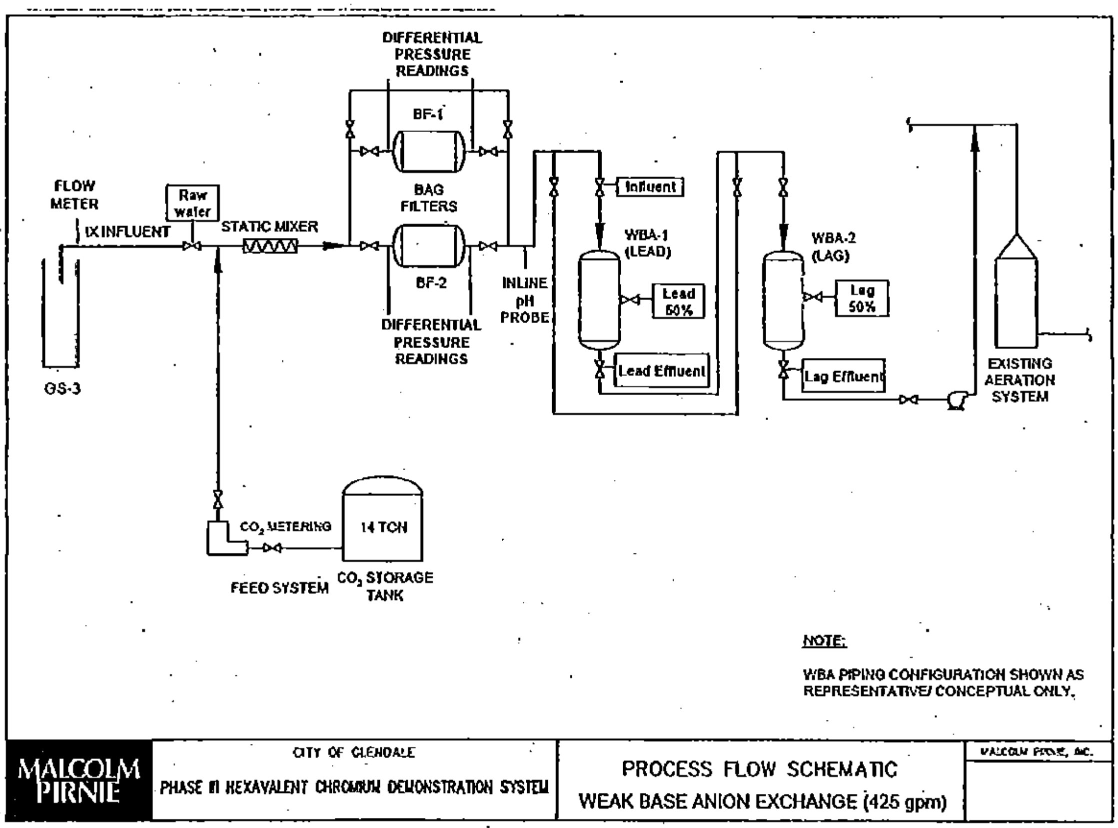


Figure 2. Schematic of the WBA-CRD (with water quality sampling ports highlighted in red)

The maximum expected concentration of chromium 6 at Well Site GS-3 is approximately 50 ppb. During the Phase II Pilot Study, the WBA technology was tested using an influent chromium 6 concentration of 100 ppb to demonstrate the adequacy of the treatment process to remove chromium. The question becomes what are the reliability factors and possibilities for delivering a water of impaired water quality from the WBA-CRD.

The redundancy design of the treatment system (i.e., lead-lag vessels), along with weekly monitoring of total Cr and chromium 6 from various sampling ports and daily monitoring of process-related parameters (see Ref. 4 for detailed sampling plan), is intended to provide an adequate safety margin for the domestic water supply. It is also important to note that the 425 gpm of water processed at the WBA-CRD will be combined with 4,575 gpm of effluent from the other seven OU wells at the GWTP. The combined effluent from the GWTP will blend with approximately 5,000 gpm of water (with chromium 6 concentration generally less than 0.5 ppb) purchased from the MWD at the Grandview Pumping Station before the water is served to the public. In comparison to a total of 10,000 gpm of water, the 425 gpm from the WBA-CRD represents less than 5 percent of the supply delivered to the Glendale residents. Therefore, any malfunction in the WBA-CRD system will have minimal impact on the quality of water delivered to customers.

Below is a list of possible vulnerability issues associated with the WBA-CRD and ways to address those issues.

- **The resin is exhausted and the chromium is not removed from the well water.** This is a possibility. However, the weekly monitoring of total chromium and chromium 6 from 50% depth of the lead vessel, lead vessel effluent and lag vessel effluent will provide early warning that the resin is becoming exhausted. Once breakthrough occurs such that the lead vessel effluent chromium concentration exceeds 5 ppb, the lag vessel 50% depth location will be added to the list of sampling points monitored weekly and the lead vessel 50% depth sampling curtailed (until the new resins are in place and the lead and lag vessel order is changed). This comprehensive monitoring schedule is similar to the one currently used at the GWTP to ensure adequate VOC removal by timely replacing the activated carbon. Also, it is critical that the number of "bed volumes" before replacement of the resin be closely monitored to assure the concentration of uranium deposited on the resin is limited so as not to create a low-level radioactive hazardous waste. A pilot study during the Phase III study showed the necessity of replacing the resin long before the resin's chromium 6 removal capacity was exhausted. In other words, it is the presence of uranium that will impact the replacement interval of the resin. Even if the resin is exhausted before it is replaced, the concentration of chromium will be no different from the current operation where untreated GS-3 well water goes into the collection pipeline to the GWTP.
- **The chromium 6 on the resin could slough off in the vessels producing a high concentration of chromium 6 in the water after process.** There have been discussions with the resin vendor (Rohm and Haas) regarding this issue. The expert opinion is that this is not a possibility because the type of resin used in the WBA-CRD works on a different removal mechanism from the traditional anion exchange resins, where the presence of higher effluent contaminant concentration than the influent concentration (a phenomenon called "chromatographic peaking") is possible. No signs of chromatographic peaking were observed during the Phase III WBA pilot study.
- **The chemical feed for the addition of carbonic acid could shut off.** This would not have any impact on the removal of chromium 6 by the resin. If this were to occur, it could cause a premature exhaustion of the resin. The WBA-CRD is designed with alarms that notify the plant personnel when the chemical feed system is not operating properly. The operators will also check the carbonic acid feed system on a daily basis. Therefore, any chemical feed issues will be handled within 24 hours.
- **The chemical feed for the addition of carbonic acid could over or under feed.** If there is an over-feed or under-feed of the acid into the water, it could change the desired pH for optimal chromium removal by the treatment system. The WBA-CRD will be designed with an online pH probe and an alarm system to continuously monitor the pH that enters the vessel. The plant operators will be immediately notified of the over-feed or underfeed situation and make necessary adjustments as soon as possible.

- **Nitrosamine compounds could leach from the resin during the startup of WBA-CRD.** One potential health risk associated with the use of WBA resin is the leaching of nitrosamine compounds into drinking water systems. A comprehensive nitrosamine mitigation and monitoring plan has been developed to address this issue. See Appendix 1 for the detail plan.

RCF-CRD

The RCF-CRD facility is proposed to be located adjacent to the GWTP to treat water from Well GN-3. Well GN-3 has a maximum capacity of 567 gpm, of which 100 gpm of the produced water will be diverted via a dedicated pipeline from the well to the RCF-CRD facility with the remainder delivered to the collector pipeline currently used to deliver water from the four GN wells to the GWTP. This facility is expected to be operational for about one-year as it is anticipated that all of the research value of this facility should be completed by this time. Following the one year period of operation, the facility will be decommissioned.

In the RCF process, chromium 6 is first reduced to chromium 3 with the addition of ferrous iron. The ferrous iron is oxidized to ferric iron by the electron transfer during the reduction of chromium 6 and by dissolved oxygen present in the water. During the Phase II testing, ferrous iron doses from 1.5 to 2.5 mg/L reduced 100 ppb of chromium 6 to less than 5 ppb. Chromium 3 either precipitates, forms a co-precipitate with the ferric iron, or adsorbs onto the ferric floc. The ferric iron/Chromium 3 particles form larger floc during subsequent aeration and coagulation (with the use of a polymer) stages. The particles are then removed by the filtration process. The majority of filtered water produced from the RCF-CRD will blend with water from other seven GOU wells and undergo further VOC treatment at the GWTP. A small portion of filtered water will be diverted to a product water storage tank for backwash or product water from the GWTP will be used for backwash. Figure 3 shows a flow schematic of the RCF-CRD.

The maximum expected concentration of chromium 6 at Well GN-3 is 170 ppb based on CH2MHill's projection. Since the RCF-CRD is only designed to be in operation for about one year, the chromium 6 concentration in GN-3 is not expected to increase dramatically to 170 ppb from the current level of approximately 50 ppb in the near future (i.e., within two or three years when the RCF-CRD system is designed and built). Both Phase II and Phase III pilot studies demonstrated that the RCF technology can effectively treat water containing 100 ppb of chromium 6. The paragraphs below present a discussion of reliability features associated with the RCF-CRD.

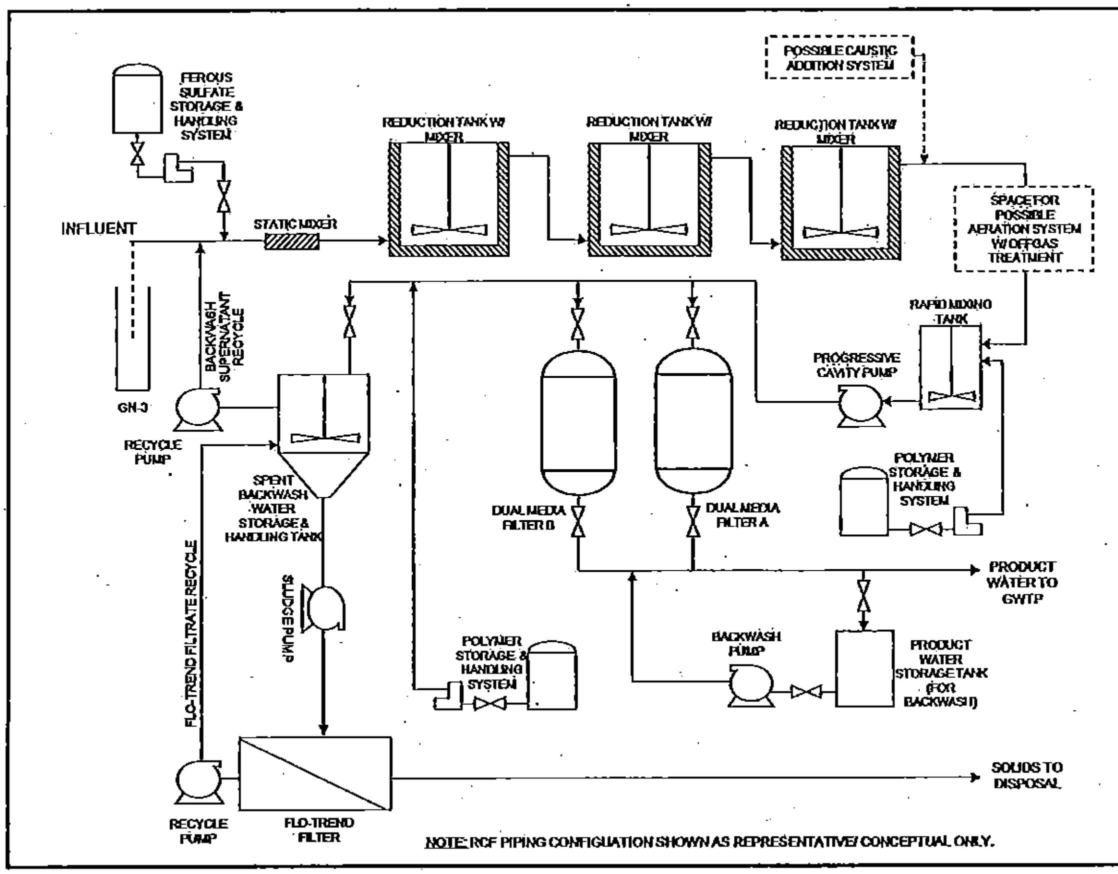


Figure 3. Schematic of the RCF-CRD

The redundancy design of the RCF treatment system (i.e., three reduction tanks in series and two media filters in parallel), along with weekly water quality monitoring of total Cr and chromium 6 from various sampling ports and daily monitoring of process-related parameters, is intended to provide an adequate margin of safety for the domestic water supply. It is also important to note that the water supply processed at the RCF-CRD is 100 gpm. In comparison to a total of 10,000 gpm of water supply distributed to the system from the Grandview Pumping Station (5,000 gpm processed at GWTP blended with approximately 5,000 gpm MWD water), the 100 gpm from the RCF-CRD represents about 1 percent of the supply delivered to the Glendale residents. Any malfunction in systems will have minimal impact on the quality of water delivered to customers.

Below is a list of the possible vulnerability issues associated with the RCF-CRD and ways to address those issues.

- **Chromium 6 concentration in the raw water could dramatically increase to 170 ppb.** According to CH2MHill's projection in 2005, the maximum expected concentration of chromium 6 at Well GN-3 is 170 ppb. Although the RCF-CRD is only designed to be in operation for about one year and the current chromium 6 concentration is less than 60 ppb, there is still a chance that chromium 6 will reach 170 ppb in GN-3 by the time the demonstration facility is built and in operation. In that case, several measures will be taken to address the high influent chromium 6 concentration. Ferrous sulfate dosage will be immediately increased to maintain the 25:1 ferrous iron to chromium 6 ratio. At the same time, we will increase the chromium 6 monitoring frequency at the RCF system effluent to once per day from once per week. CDPH will be informed about the change in operations and a coordinated effort will be carried out among operators, consulting engineers, and regulatory agencies to optimize system performances under high influent chromium 6 concentrations.

- **The ferrous sulfate feed could shut off or under feed.** Ferrous sulfate feed is critical in reducing chromium 6 to chromium 3 and the shut-off or under-feed of ferrous sulfate would reduce the chromium 6 removal efficiency. The RCF-CRD is designed with alarms that would notify the plant personnel via SCADA system that the chemical feed system is not operating properly. The operators will also check the chemical feed system on a daily basis. Therefore, any chemical feed issues will be handled within 24 hours. During that period, the concentration of chromium will be no different from the current operation where untreated GN-3 well water goes into the collection pipeline to the GWTP.
- **The ferrous sulfate feed could over feed.** Over-feed of ferrous sulfate is of less concern than under-feed. The excess ferrous sulfate will be oxidized and filtered in the subsequent reduction, aeration, and filtration processes. In addition, the plant operators will check the chemical feed system on a daily basis so that any chemical feed issues will be handled within 24 hours.
- **The mixer in the reduction tank could malfunction.** The RCF-CRD has three identical reduction tanks piped in series, each equipped with a mechanical mixer. If one mixer malfunctions, the reduction tank could be bypassed while the mixer is being repaired. The Phase III pilot study demonstrated that a 30-minute detention time provided by the remaining two reduction tanks would be effective in removing chromium 6. If two or more mixers malfunction simultaneously, the RCF-CRD should be shut down. Under that scenario, the concentration of chromium will be no different from the current operation where untreated GN-3 well water goes into the collection pipeline to the GWTP.
- **Insufficient backwash could cause the filter performance to deteriorate over time.** The filter performance is monitored by the headloss and filter effluent turbidity. According to the RCF experimental plan, the proposed upper limit for the filter effluent turbidity and headloss are 0.3 NTU, and 100 inch, respectively before a backwash cycle is initiated. The Phase III pilot study demonstrated that those criteria would ensure a good chromium removal performance. Insufficient backwash could result in more frequent backwash cycles and reduced production. Nonetheless, the effluent chromium concentration would remain low compared to the influent concentration.

4 CONCLUSION

In a continuing effort to address the public concerns of trace levels of chromium 6 in the drinking water, the City of Glendale is planning to test two promising chromium 6 removal technologies at demonstration scale. The WBA-CRD facility will be located at GOU Well Site GS-3, and the RCF-CRD facility located adjacent to the GWTP. Treated water from the two demonstration facilities, combined with raw water from other GOU wells, will undergo air stripping and GAC filtration at the GWTP, blend with water purchased from the MWD, and will ultimately be served to the public. As part of the effort to safeguard the public water supply, the CDPH requested that the City evaluate four relevant issues before the City's Water Supply Permit for construction and operation of the two chromium 6 removal demonstration facilities can be amended.

The first three issues focused on the source and quantification of chromium 6 near the two demonstration facilities and projected chromium 6 levels in the source water of those facilities. The work performed by CH2MHill and the ULARA Watermaster provided a comprehensive review of these factors. Both Glendale North OU and South OU wells are located near known chromium 6 contamination sources. Chromium 6 concentrations up to 1,600 ppb have been reported in the monitoring wells near the Glendale North OU wells, and up to 13,000 ppb in monitoring wells near the Glendale South OU wells. Fortunately, those high chromium concentrations, or "hot spots" mostly occur in the upper 25 feet of the saturated zone. As both North OU and South OU wells withdraw groundwater from deeper aquifer zones with little evidence of chromium contamination, chromium levels in the extraction wells are not expected to be as high as nearby or upgradient shallow monitoring wells. According to the estimates in the 2005 CH2MHill report and Glendale's routine water quality analyses, chromium 6 concentrations in GS-3 well, the source water of the WBA-CRD facility, will fluctuate between 40 to 60 ppb. The projection in the CH2MHill report of 50 ppb seems to be a reasonable design criterion for the proposed WBA-CRD facility. With respect to the GN-3 well, the source water of the RCF-CRD facility, the maximum expected concentration of chromium 6 is 170 ppb based on CH2Mhill's projection. Since the RCF-CRD is only designed to be in operation for about one year, the chromium 6 concentration in GN-3 is not expected to increase to 170 ppb from the current level of approximately 50 ppb in the near future.

As both Phase II and Phase III pilot studies demonstrated that the WBA and RCF technologies can effectively treat water containing up to 100 ppb of chromium 6, the question becomes what are the reliability factors and possibilities for delivering a water of impaired water quality from the two demonstration facilities, which is also CDPH's last question to Glendale. The redundancy design of the treatment systems (i.e., lead-lag vessels for the WBA-CRD, and multiple tanks and filters for the RCF-CRD), along with weekly water quality monitoring of total Cr and chromium 6 from various sampling ports and daily monitoring of process-related parameters, is intended to provide an adequate safety margin for the domestic water supply.

It is also important to point out that currently the chromium 6 concentration in the combined GWTP effluent (a blend of all eight GOU extraction wells) is less than 11 ppb without any chromium 6 removal facilities when all wells were operated at design capacity. As shown in Table 1, chromium 6 concentration in combined GWTP effluent is kept below 6.5 ppb to meet the LA River discharge requirement. The 5,000 gpm effluent produced from the GWTP further blends with approximately 5,000 gpm MWD water supplies at the Grandview Pumping Station so that the water served to the public contains less than 6 ppb of chromium 6, which is much lower than the current California MCL of 50 ppb and federal MCL of 100 ppb for total chromium, respectively. Compared to a total of 10,000 gpm flow leaving the Grandview Pumping Station, the 425 gpm from the WBA-CRD plus the 100 gpm from the RCF-CRD represents less than 6% of the supplies delivered to the Glendale residents. Even if both demonstration facilities fail to remove chromium 6 at the same time, a "worst-case scenario," the chromium 6 concentration in the water delivered to the customers will be no different from that of the current operation. In addition, nitrosamine leaching from the new WBA resin during system startup should be minimized by adequate soaking and rinsing of the resin. Therefore, the installation of WBA-CRD and RCF-CRD facilities will have minimal impact on the quality of water delivered to customers.

Appendix 1

Nitrosamines Mitigation and Sampling Plan

for the Startup of WBA Chromium Removal

Demonstration Facility at Glendale GS-3 Well Site

1.0 Background

The City of Glendale is proposing to install a 425 gpm chromium 6 removal facility using the WBA resin at GS-3 well site. The resin to be used in this treatment facility is the Amberlite™ PWA7 resin provided by Rohm & Haas. This will be the first full-scale application of such technology for chromium 6 removal among public water systems in the entire nation.

One potential health risk associated with the use of this PWA 7 resin is the leaching of nitrosamine compounds into drinking water systems. Some nitrosamine compounds have been classified by USEPA as probable human carcinogens. In California, "NDMA and other nitrosamines are among the chemicals known to the state to cause cancer [Title 22, California Code of Regulations, Section 12000], pursuant to California's Safe Drinking Water and Toxic Enforcement Act of 1986 ("Proposition 65")." As of June 2007, California Department of Public Health (CDPH) has established Notification Levels for NDMA, NDEA, and NDPA at 10 ng/L. Notification Levels for N-Nitrosomorpholine, NDBA, NPIP, NYPR, and NMEA have not been published yet. However, the California Office of Environmental Health Hazard Assessment (OEHHA) established the one-in-a-million cancer risk levels of 3 ng/L for NDBA, 5 ng/L for NMOR, 3.5 ng/L for NPIP, 15ng/L for NYPR, and 1.5 ng/L for NMEA, respectively. Table A lists the risk levels, notification levels and response levels for eight nitrosamine compounds.

Table A. Risk levels, notification levels, and response levels for nitrosamine compounds

Nitrosamine	10^{-6} Risk Level (ng/L)	Notification Level[1] (ng/L)	Response Level[2] (ng/L)
N-Nitrosodiethylamine (NDEA)	1	10	100
N-Nitrosodimethylamine (NDMA)	3	10	300
N-Nitrosodi-n-propylamine (NDPA)	5	10	500
N-Nitrosodi-n-butylamine (NDBA)	3	--	--
N-Nitrosomethylethylamine (NMEA)	1.5	--	--
N-Nitrosomorpholine (NMOR)	5	--	--
N-Nitrosopiperidine (NPIP)	3.5	--	--
N-Nitrosopyrrolidine (NYPR)	15	--	--

1 - Notification levels for NDEA, NDMA, and NDPA are established at 10 ng/L, somewhat above the de minimis level, to take into account the very low detection limits and their potential presence in association with drinking water treatment.
2 - "Response levels" are levels at which CDPH recommends removing the source from service. They correspond to a 10^{-4} risk, 100 times the de minimis (10^{-6}) value.

Reference: http://www.cdph.ca.gov/CERTLIC/DRINKINGWATER/Pages/NDMA.aspx

In a previous study[8], bench-scale nitrosamine leaching test was conducted to determine whether nitrosamines could leach from the PWA7 resin. Among seven nitrosamine species (NDMA, NDEA, NDPA, NDBA, NMWA, NPIP, and NYPR) analyzed, only two were detected in the leachate: NDMA at 22 ng/L and NPIP at 42 ng/L. Therefore, the authors of that study stated "nitrosamines monitoring is recommended for full-scale operations and initial flushing or preconditioning of the resins may be necessary for nitrosamine removal."

2.0 Purpose

The purpose of this document is to develop a plan that mitigates and monitors the nitrosamines leaching problems during the start-up of the WBA Chromium Removal Demonstration (WBA-CRD) facility at Glendale GS-3 well site. This plan does not apply to resin change-out of the WBA-CRD facility. A separate mitigation and monitoring plan will be prepared for scheduled resin change-out events and submitted to CDPH for approval.

As the PWA7 resin has never been used in the California drinking water systems before, there are no nitrosamine mitigation and monitoring plans for its application. This plan is developed based on an approved nitrosamine sampling plan for perchlorate-selective resins at California Domestic Water Company[9] and subject to revisions after consultation with CDPH.

3.0 Nitrosamines Leaching Mitigation and Monitoring Plan

During the startup period of the WBA-CRD facility, the following measures will be taken to minimize the leaching of nitrosamine compounds from the resin to the public water system and water samples from various sampling taps in the WBA-CRD system will be collected to monitor how nitrosamine compound levels dissipate overtime. Table B summarizes the samples to be collected during the WBA-CRD startup.

1. Load the two ion exchange (IX) vessels with new PWA7 resin with chlorine-free water (preferably with GS-3 water)
2. Configure the valves of the IX system to "Backwash (upflow)" mode
3. Connect the backwash effluent to one or two onsite temporary water storage tanks that discharge to the sanitary sewer
4. Backwash the first vessel with GS-3 water at a flow rate of approximately 190 gpm[10] (3.8 gpm/sf) for 22 minutes

[8] Malcolm Pirnie and City of Glendale. 2007. *Hexavalent Chromium Removal Using Anion Exchange and Reduction with Coagulation and Filtration.* Denver, Colo.: AwwaRF.
[9] California Domestic Water Company. 2006. *Nitrosamine Sampling Plan for Startup of New Perchlorate Resins.* Submitted to CDPH on June 26, 2006.
[10] Rohm & Haas representative suggests we perform backwash (upflow) during startup to reclassify the resin bed. The backwash rate of 3.8 gpm/sf corresponds to approximately 80% bed expansion at 70°F.

5. Discharge backwash water (approximately 4,180 gallons, which equals 3 BV[11]) to the sanitary sewer through the temporary tank
6. At the end of 22 min. backwash, collect Sample #1 from the temporary tank sample tap
7. Isolate the first IX vessel
8. Backwash the second vessel with GS-3 water at a flow rate of approximately 190 gpm for 22 minutes
9. Discharge backwash water to the sanitary sewer through the temporary tank
10. Isolate the second IX vessel
11. Soak the PWA7 resin in both vessels overnight (i.e., 12 hours or longer)
12. Continue draining the backwash tank to the sanitary sewer by gravity
13. The next morning, configure the valves of the IX system to "Normal Lead-Lag Operation" mode
14. Discharge the vessel effluent to the onsite temporary tank(s) that connect to the sanitary sewer
15. Start the WBA-CRD facility with a flow rate of 425 gpm
16. Collect Sample #2 from GS-3 Well at time = 0 min.
17. Collect Sample #3 from the lag vessel effluent at time = 0 min.
18. Collect Sample #4 from the lag vessel effluent at time = 17 min. (corresponding to 5.2 BV at 425 gpm)
19. Collect Sample #5 from the lag vessel effluent at time = 33 min. (corresponding to 10.1 BV at 425 gpm)
20. Collect Sample #6 from the lag vessel effluent at time = 49 min. (corresponding to 15.0 BV at 425 gpm)
21. Collect Sample #7 from the lag vessel effluent at time = 65 min. (corresponding to 20.0 BV at 425 gpm)
22. At the end of 65 min. since startup, turn the valves so that the vessel effluent is discharged to the collector piping that goes to the Glendale Water Treatment Plant
23. Collect Sample #8 from the lag vessel effluent at time = 98 min. (corresponding to 30.1 BV at 425 gpm)
24. Collect Sample #9 from the lag vessel effluent at time = 130 min. (corresponding to 39.9 BV at 425 gpm)
25. Collect Sample #10 from GWTP combined effluent at the end of business hour
26. Collect Sample #11 from the lag vessel effluent at 24 hrs since startup (corresponding to 442 BV at 425 gpm)

[11] Each vessel will contain 185 cf (170 cf of usable resin plus 15 cf of unusable resin below nozzle) of WBA resin (1BV = 185 cf = 1,384 gallons).

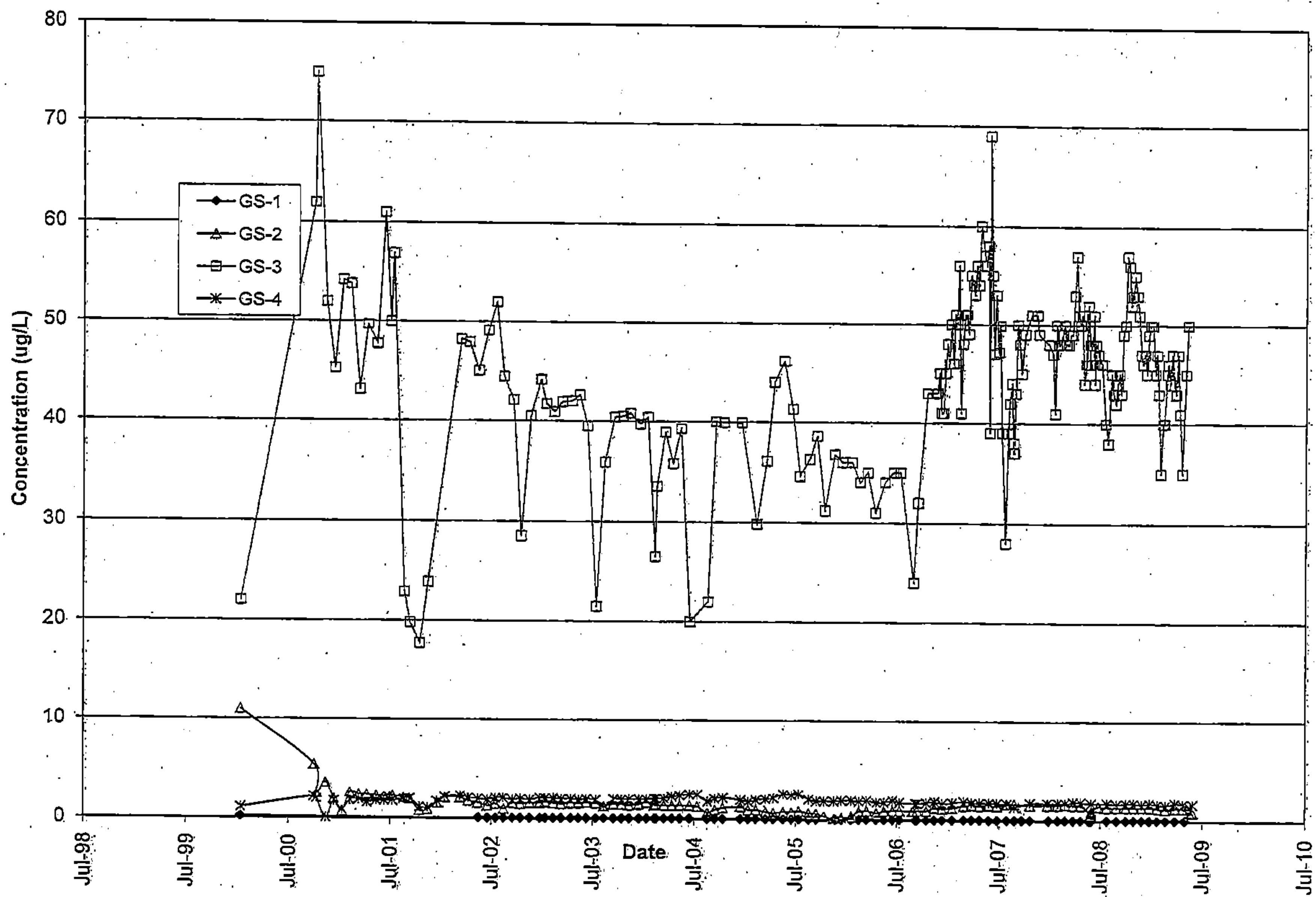
Table B. Samples to be collected during WBA-CRD startup

Sample Number	Sampling Time	Sample Location
1	After 22 min. backwash of the first vessel	Temporary tank sample tap
2	0 min. (since startup)	Well GS-3
3	0 min. (since startup)	Lag vessel effluent (@ 0 BV)
4	17 min. (since startup)	Lag vessel effluent (@ 5.2 BV)
5	33 min. (since startup)	Lag vessel effluent (@10.1 BV)
6	49 min. (since startup)	Lag vessel effluent (@ 15.0 BV)
7	65 min. (since startup)	Lag vessel effluent (@ 20.0 BV)
8	98 min. (since startup)	Lag vessel effluent (@ 30.1 BV)
9	130 min. (since startup)	Lag vessel effluent (@ 39.9 BV)
10	End of business hour on the first of startup	GWTP combined effluent
11	24 hr. (since startup)	Lag vessel effluent (@ 442 BV)

The nitrosamine samples will be shipped to MWH Laboratories (Monrovia, California) for analysis. Seven nitrosamine species (NDMA, NDEA, NDPA, NDBA, NMEA, NPIP, and NYPR) will be analyzed using the EPA Method 521 (MWH Laboratories test code: @UCMR521). Method 521 was developed to determine nitrosamines in drinking water by solid phase extraction and capillary column gas chromatography with large volume injection and chemical ionization tandem mass spectrometry[12]. According to MWH Laboratories, the holding time on nitrosamine samples is 14 days, and data turnaround time is 7 days for rapid turnaround and 21 days for regular turnaround.

[12] USEPA. 2004. *Method 521: Determination of nitrosamines in drinking water by solid phase extraction and capillary column gas chromatography with large volume injection and chemical ionization tandem mass spectrometry (MS/MS).* EPA Document #: EPA/600/R-05/054

Hexavalent Chromium Concentrations
Glendale WTP
South Extraction Wells



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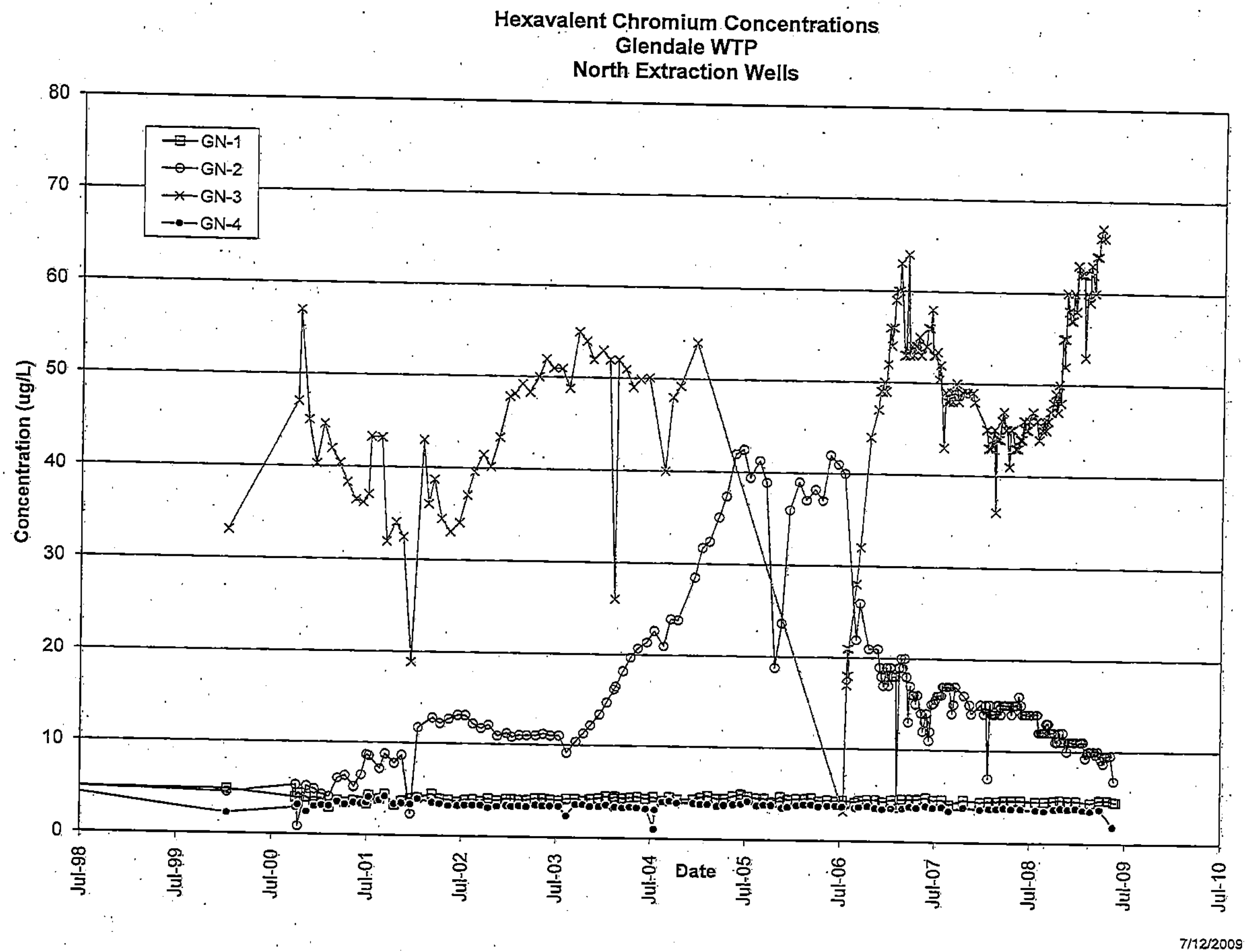

Hexavalent Chromium Concentrations
Glendale WTP
North Extraction Wells
GN-1
GN-2
GN-3
GN-4
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
Jul-98
Jul-99
Jul-00
Jul-01
Jul-02
Jul-03
Jul-04
Jul-05
Jul-06
Jul-07
Jul-08
Jul-09
Jul-10
Date
7/12/2009

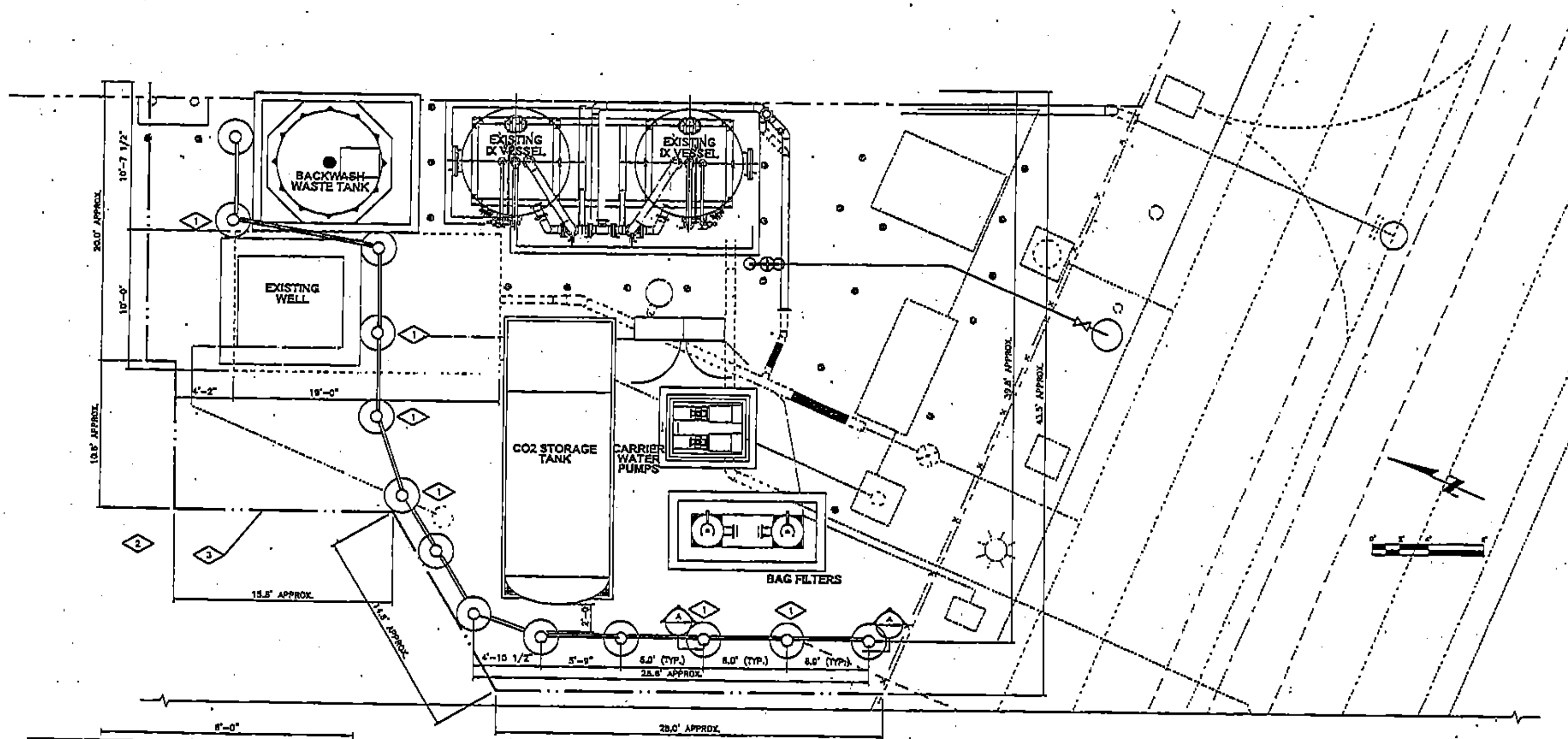
APPENDIX E

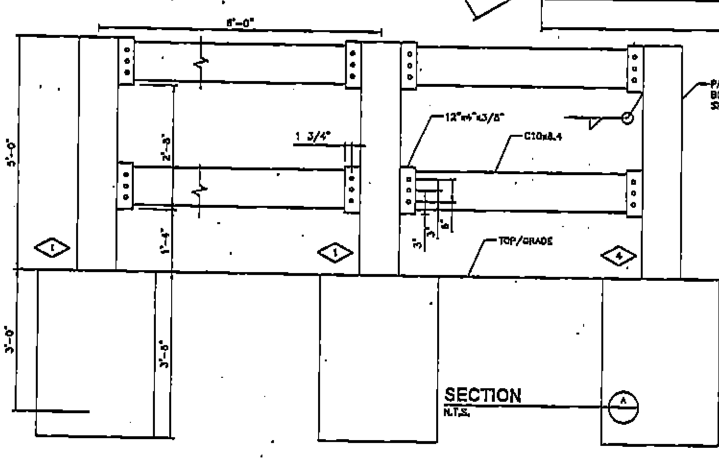
EQUIPMENT DRAWINGS

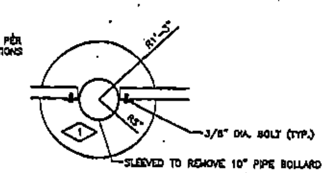
SUPPLEMENTAL EQUIPMENT INFORMATION

ION EXCHANGE DATA SHEET

TREATMENT CLASSIFICATION WORKSHEET







SECTION
N.T.S.

NOTE:
THE LOCATION OF BOLLARDS ARE PRELIMINARY. THE EXACT LOCATION WILL BE DETERMINED IN THE FIELD AFTER THE WBA FACILITIES ARE INSTALLED. FINAL LOCATION WILL BE IDENTIFIED AFTER WRITTEN APPROVAL BY RALPH GROCERY COMPANY.

PLAN NOTES

1. REMOVABLE BOLLARDS MARKED.
2. TEMPORARY CONSTRUCTION FENCE
3. PROPOSED EASEMENT BOUNDARY
4. FILL PERMANENT POSTS WITH CONCRETE AND PROVIDE SMOOTH CAP AT TOP

AECOM

WBA CHROMIUM REMOVAL DEMONSTRATION FACILITY LOS ANGELES, CALIFORNIA

FENCING PLAN AND CIVIL DETAILS

PROJECT START DATE (M/Y) 04/2008
PROJECT NO. 106580
FILENAME
SHEET NO.
DRAWING NO. CF-01

Plotted By: jeff.vandi
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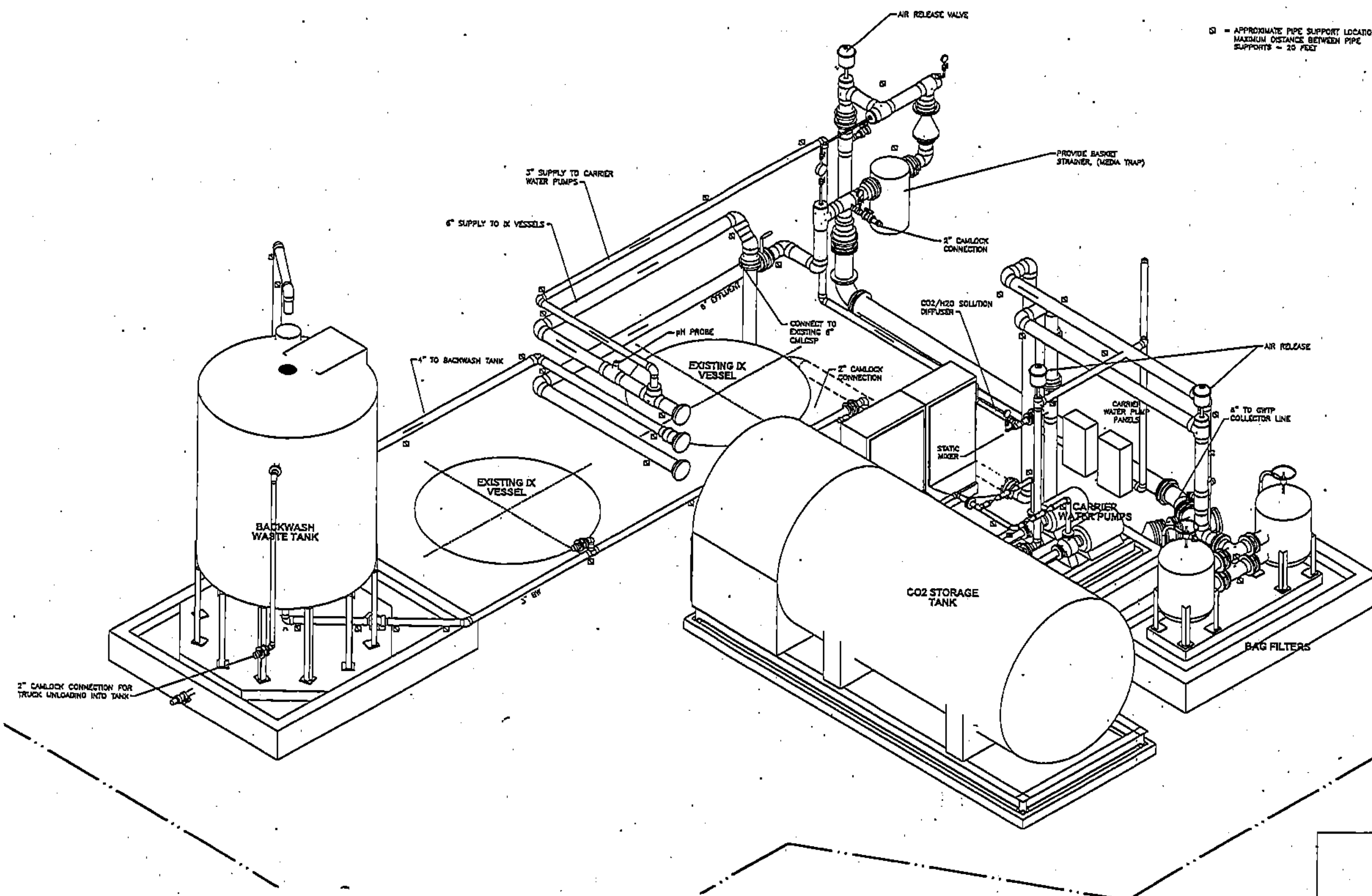

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300 OCEANGATE SUITE 700
LONGBEACH, CA 90802
T 562.951.2000 F 562.951.2157
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WBA CHROMIUM REMOVAL DEMONSTRATION FACILITY LOS ANGELES, CALIFORNIA

ISO VIEW

PROJECT START DATE (M/Y)	04/2009
PROJECT NO.	106580
FILENAME	
SHEET NO.	
DRAWING NO.	M-04

Plotted By: jeff.rosa
Plot File Date Created: Apr/21/2009 10:31 AM
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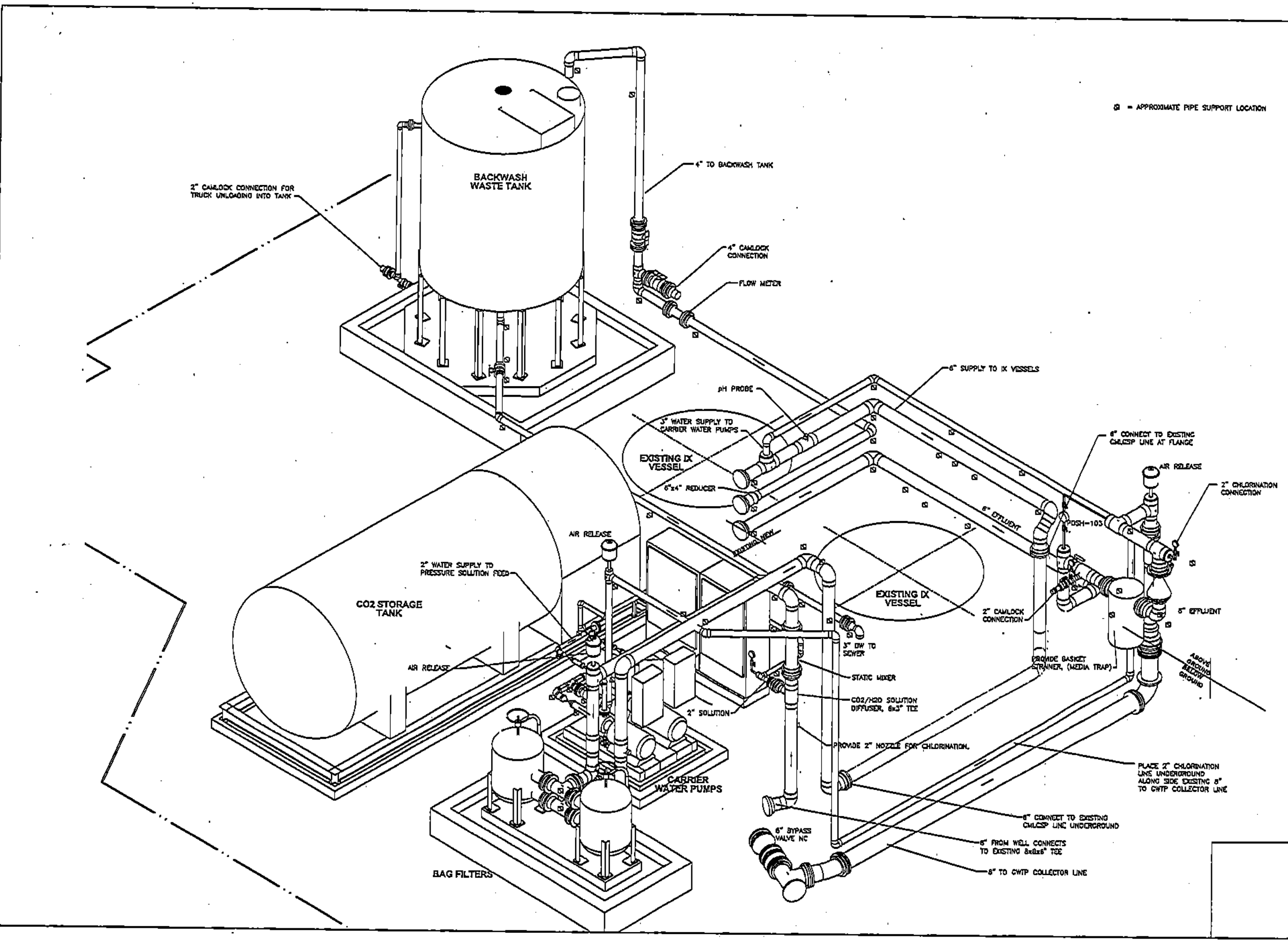

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WBA CHROMIUM
REMOVAL DEMONSTRATION FACILITY
LOS ANGELES, CALIFORNIA

ISO VIEW

PROJECT START DATE (M/Y)	04/2008
PROJECT NO.	106560
FILENAME	106401-ALT.dwg
SHEET NO.	
DRAWING NO.	M-05

REV	DESCRIPTION	DRN	CHK	DATE (MM/YY)

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Plot File Date Created: Apr/21/2009 10:31 AM
Layout-Sheet Name: WBA_M-05.
Filename: L:\WORK\PROJECTS\106560\DRA\WBA\106401-ALT.DWG

SUPPLEMENTAL INFORMATION ON THE WBA CHROMIUM REMOVAL DEMONSTRATION FACILITY

Prepared by

City of Glendale Water and Power

Submitted to California Department of Public Health on

July 20, 2009

PURPOSE

The purpose of this document is to provide supplemental information on the WBA Chromium Removal Demonstration facility in response to an email request from the California Department of Public Heath (CDPH) on July 9, 2009. This document includes a brief summary of design parameters and proposed monitoring plan for the WBA system.

WBA DESIGN PARAMETERS

The WBA system will consist of a pair of lead/lag pressure vessels installed in series with upstream acid addition. The design capacity of the system is 425 gpm and the required operating pH is approximately 6.0. The vessels will be loaded with PWA7 resin manufactured by Rohm&Haas. Detailed information on the WBA design parameters can be found in the "100% WBA Design Drawings" prepared by AECOM and the "Preliminary Design Report: Well GS-3 WBA Chromium 6 Removal Facility" prepared by Malcolm Pirnie.

This list below shows all major components of the WBA system:

1. Prefilter skid
    a. Manufacturer: Filtrek
    b. Type: bag filter housings
    c. 2-filter housings, each containing 6 - #2 filter bags
    d. Design flow per housing – 600 gpm
    e. Materials of construction – 304 stainless steel
    f. Vessel diameter: 22-5/16" ID
    g. Lids secured by wing nuts, davit opening
    h. Nominal filter bag rating: 10 micron
2. CO_2 system
    a. Manufacturer: Tomco Equipment Company
    b. CO_2 storage capacity: 28,000 lb
    c. Delivery capacity: 86 lb/hr
    d. pH probe: insertion type
    e. pH setpoint: 6.0
3. CO_2 carrier water pumps (2)
    a. Type: End suction centrifugal
    b. 10 HP each
    c. 86 gpm @ 138 ft TDH
4. Backwash tank
    a. Manufacturer: Snyder
    b. Type: Covered cone bottom
    c. Materials of construction: XLPE
    d. Capacity: 3,000 gallons

   e. Height: 167 inches
   f. Diameter: 90"
   g. Access manway diameter: 15"
5. Backwash influent flow meter
   a. Manufacturer: Sparling
   b. Type: Magnetic flow meter
   c. Size: 4"
6. Resin vessels (2)
   a. Vessel diameter: 96"
   b. Side shell height: 84"
   c. Overall height (Approx.): 15'-5"
   d. Working pressure: 160 psi@ 150 °F
   e. Vessel volume: 3,934 gallons
   f. Maximum Flow: 500 gpm
   g. Design criteria: ASME
   h. Material: Carbon steel
   i. Underdrains Lateral: 304L stainless steel
   j. Underdrains screens: 304L stainless steel V-Wire screens 3" diameter x 2" (26) SS screens per vessel
   k. Process piping: 6" Schedule 40 carbon steel
   l. Resin transfer piping: 4" Schedule 10 304L stainless steel
   m. Process valves: 6" butterfly, cast iron body w/AL-Brnz disk, gear operator
   n. Resin transfer valve: 4" fanged 316 stainless steel ball valve
   o. Vent/Wash valve: 2" bronze Apollo ball valve
   p. Sample ports valve (3): 1/2" bronze Apollo ball valve

PROPOSED MONITORING PLAN

The WBA experimental plan and the quality assurance project plan prepared by Malcolm Pirnie described the proposed monitoring plan for routine operation of the WBA system. Figures 1 and 2 provide a quick summary of the WBA monitoring plan during routine operations. It is anticipated that more frequent (i.e., daily instead of weekly) chromium sampling will be necessary during the first week to detect any possible chromium leakage due to startup and/or operational issues.

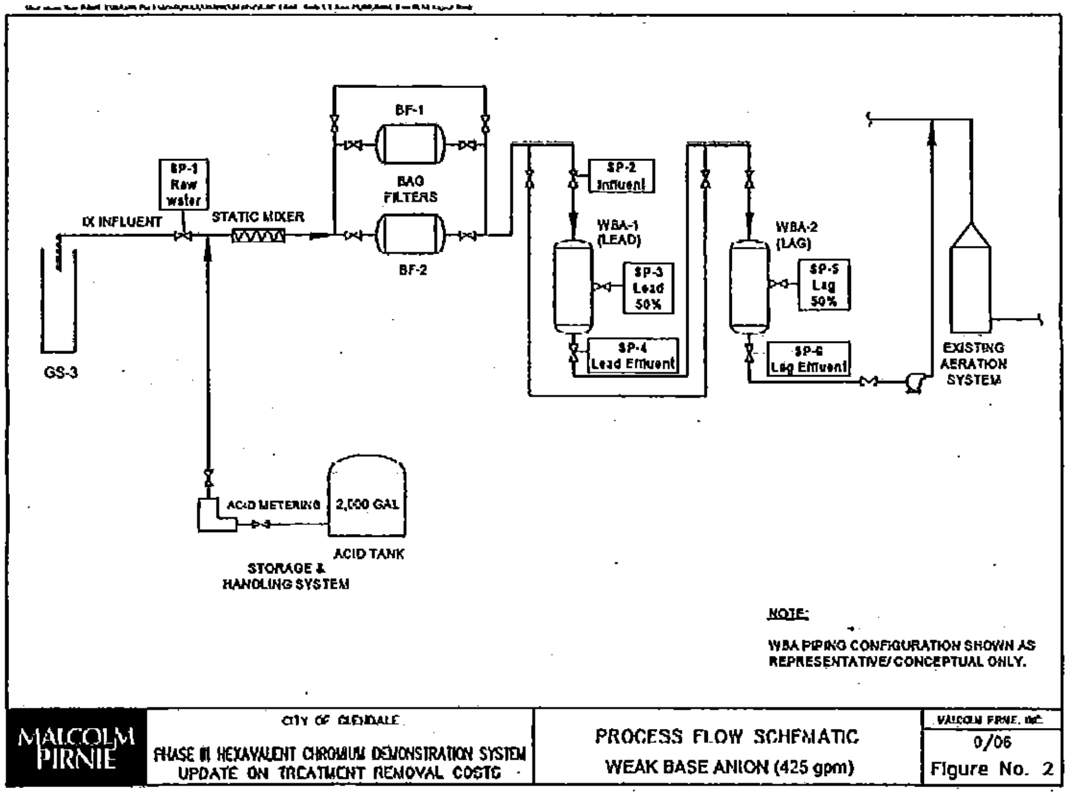


Figure 1. Simplified schematic of the WBA system

Analytical Measurements	Monitoring Locations and Frequency					
	SP-1: Raw water (before acid addition)	SP-2: WBA influent (after acid addition)	SP-3: Lead vessel 50% bed depth	SP-4: Lead vessel effluent	SP-5: Lag vessel 50% bed depth	SP-6: Lag vessel effluent
Cr(VI)	Monthly	Weekly	Weekly	Weekly	Weekly*	Weekly
Total Cr	Monthly	Weekly	Weekly	Weekly	Weekly*	Weekly
pH	/	Continuously	/	Weekly	/	Weekly
Temperature	/	Continuously	/	Weekly	/	Weekly
SO_4^{2-}	/	Monthly	/	/	/	Monthly
NO_3^-	/	Monthly	/	/	/	Monthly
PO_4^{3-}	/	Monthly	/	/	/	Monthly
SiO_2	/	Monthly	/	/	/	Monthly
Alkalinity	/	Monthly	/	/	/	Monthly
Conductivity	/	Monthly	/	/	/	Monthly
Turbidity	/	Monthly	/	/	/	Monthly
Nitrosamines	/	Start of test[a]	/	Start of test	/	Start of test

Figure 2. Proposed monitoring frequency for the WBA system

State of California
DEPARTMENT OF PUBLIC HEALTH
Drinking Water Field Operations Branch
Metropolitan District

ION EXCHANGE (FIXED BED) TREATMENT PLANT DATA

System Name: City of Glendale — No. 1910043
Source of Information: Leighton Fong
Collected by: Leighton Fong , Alan Sorsher — Date: 9/29/09
Name of water treatment plant: WBA Chromium Reduction Demonstration Facility
Plant flow and variations: 425 gpm
Design flow: 425 gpm — Frequency plant checked: Daily
Year operation began: 2009

Raw Water Quality (MG/L)

Perchlorate	max. ND	min.
Nitrate:	max. 38 NO3	min. 35
Sulfate:	max. 110	min. 98
Other Specify: Cr6	max. .069	min. .024

VESSEL DESCRIPTION

Inside dimensions of vessels: 8 ft diameter by 7 ft side shell; No internal cone, stainless steel wirewound internal header
Flow arrangement: downflow
Media area per vessel: 50.26 sf — Total media area 100.53
Media volume per vessel 185 cf — Total media volume 370 cf
Underdrain type: laterals with screens
Raw Water Inlet (Include internal water distributor) 6-inch
Type and method of flow control: VFD on well pump, mag meter, plc for control

ION EXCHANGE MEDIA

Type: WBA (Rohm & Haas PWA7) — Number of vessels; 2
How often is the media replaced?: expect 9 months
Describe cycle: Single-pass ion exchange
Describe media maintenance: . Media should not require backwashing, but capability is provided if necessary.
Flow Rate per cell (gpm/sf) at Design Flow:
All cells in service: 425 gpm — One cell not in service N/A, operation will be lead/lag
Maximum flow rate per vessel (gpm): 500 gpm I
How is flow rate controlled: plc controls vfd on well pump based on flow from mag meter
Alarms/SCADA: high diff press across bag filter and media trap; high level in containment

REGENERANT (BRINE) DATA

Type: N/A – no regeneration — Dosage:
Regenerant flow rate:
Is the regenerant added cocurrently or countercurrently?

Feeding and Injection Equipment

Type: — Capacity:
What determines the dose that will be used?

Regenerant Storage

Capacity: — Days of storage
Points of application:

Backwash/Regeneration

What determines the time or interval of backwashing? low flow
Run to waste capability? Backwash holding tank with sewer connection
Source of backwash water: Transmission header from other GS wells, especially GS-4 well

Maximum backwash rate: 191 gpm ______
Percent expansion during backwash: 80%______
Describe backwash cycle: stop well, valve for bkwsh, run 191 gpm 10-15min to bkwsh tk, return to svc
What is the leakage of contaminant immediately after backwash: None expected due to strong IX resin bond with Cr

BRINE DISPOSAL
Type of basin: N/A______
Number of basins: ______Detention time: ______
Volume of wastewater per backwash: ______
Washwater disposal or recycling: ______Disposal: ______
CLEARWELL Type: ______Capacity Detention time____

RELIABILITY FEATURES: INSTRUMENTATION AND MONITORING

Parameter	Location	Grab Sample (frequency)	Continuous Monitoring	Recording	Alarm	Shutdown
Flow	Influent		x	x	x	x
Flow	Effluent					
Perchlorate	Influent					
Perchlorate	Effluent					
Perchlorate	Each Vessel					
Nitrate	Influent					
Nitrate	Effluent					
Nitrate	Each Vessel					
Chlorine Residual	Effluent					
Conductivity	Each Vessel					
Temperature						
pH			x	x	x	x

Standby equipment (incl valves): ______
Standby valves that control flow to cells: ______
Standby power: none

TREATED WATER QUALITY
Average effluent concentration: 1 - 5 ppb
Maximum effluent concentration: Expect less than 5 ppb Cr6
OPERATIONS
Describe records maintained: ______
Is operations plan adequate, if not describe needed changes: Required level of certification: shift operator, chief operator
Number and level of certified operators:
Charles Cron Plant Manager, T-3, operator # 6027
Steve Lee Senior Operator, T-3, operator # 27140
Steve Glazier T-1, operator # 27330
Sergio Salcido T-1, passed exam, certification pending

Overall appraisal: New Installation______

Treatment Classification

Section 64413.1 Classification of Water Treatment Facilities

Table 64413.1-A Water Treatment Facility Class Designation

Total Points	Class
Less than 20	T1
20 though 39	T2
40 through 59	T3
60 through 79	T4
80 or more	T5

Section 64413.1(b). The calculation of total points for each water treatment facility shall be the sum of the points derived in each of paragraphs (1) through (13) except where a treatment facility treats more than one source, in which case the source with the highest average of each contaminant shall be used to determine the point value in paragraphs (2) through (5).

Section 63750.85. "Water treatment facility" means a group or assemblage of structures, equipment, and processes that treat or condition a water supply, affecting the physical, chemical, or bacteriological quality of water distributed or otherwise offered to the public for domestic use by a public water system as defined in Health and Safety Code Section 116275. **Facilities consisting of only disinfection for which no *Giardia* or virus reduction is required pursuant to Section 64654(a) are not included as water treatment facilities.**

INSTRUCTIONS: For each paragraph item that applies to the system, place the proper Point Value in the calculation box. For paragraphs (1), (2), (3), (4), (7), (8), (9), (12), and (13), select one calculation only (whichever is higher) for each paragraph. For paragraphs (5), (6), (10), and (11), select all calculations that apply for each paragraph. Total the calculations and determine the system's classification.

Paragraph	Point Value	Calculation
(1) Source Water Used by Facility		
Groundwater and/or purchased treated water meeting primary and secondary drinking water standards, as defined in Section 116275 of the HSC	2	
Water that includes any surface water or groundwater under the direct influence of surface water	5	
(2) Influent Water Microbiological Quality, Median Coliform Density, Most Probable Number Index (MPN) (a)		
Less than 1 per 100 mL	0	
1 through 100 per 100 mL	2	
Greater than 100 through 1,000 per 100 mL	4	
Greater than 1,000 through 10,000 per 100 mL	5	
Greater than 10,000 per 100 mL	8	
(3) Influent Water Turbidity, Maximum Influent Turbidity Level, Nephelometric Turbidity Units (NTU) (b)		
Less than 15	0	
15 through 100	2	
Greater than 100	5	
(4) Influent Water Nitrate and Nitrite, Nitrate and Nitrite Data Average		
Less than or equal to the MCL as specified in Table 64431-A	0	
Greater than the MCL	5	
(5) Influent Water Chemical and Radiological Contamination, Contaminant Data Average (c)		
Less than or equal to the MCL	0	
Greater than the MCL *Chrome from GN-3*	2	2
5 times the MCL or greater *TCE, PCE*	5	10
(6) Surface Water Filtration Treatment		
Conventional, direct, or inline	15	
Diatomaceous earth	12	
Slow sand, membrane, cartridge, or bag filter	8	
Backwash recycled as part of process	5	
(7) The points for each treatment process utilized by the facility and not included in paragraph (6) that is used to reduce the concentration of one or more contaminants for which a primary MCL exists, pursuant to Table 64431-A, Table 64444-A, and Table 4 of Section 64443, shall be 10. Blending shall only be counted as a treatment process if one of the blended sources exceeds a primary MCL. *Air stripping, GAC treatment and blending for chrome at GWTP. Ion exchange for Chrome at GS-3.*	10	40
(8) The points for each treatment process not included in paragraphs (6) or (7) that is used to reduce the concentration of one or more contaminants for which a secondary MCL exists, pursuant to Tables 64449-A and 64449-B, shall be 3. Blending shall only be counted as a treatment process if one of the	3	

blended sources exceeds a secondary MCL.		
(9) The points for each treatment process not included in paragraphs (6), (7), or (8) that is used for corrosion control or fluoridation shall be 3.	3	
(10) Disinfection Treatment		
Ozone	10	
Chlorine and/or chloramine	10	
Chlorine dioxide	10	
Ultra violet (UV)	7	
(11) Disinfection/Oxidation Treatment without Inactivation Credit		
Ozone	5	
Chlorine and/or chloramine *at GWTP*	5	5
Chlorine dioxide	5	
Ultra violet (UV)	3	
Other oxidants	5	
(12) The points for any other treatment process that alters the physical or chemical characteristics of the drinking water and that was not included in paragraphs (6), (7), (8), (9), (10), or (11) shall be 3. *pH control at GS-3*	3	3
(13) The points for facility flow shall be 2 per million gallons per day or fraction thereof of maximum permitted treatment facility capacity, up to a maximum of 50 points; except that for facilities utilizing only blending, the points shall be based on the flow from the contaminated source and the dilution flow required to meet the MCL(s) specified in Tables 64431-A, 64444-A, 64449-A, 64449-B, and Table 4 of Section 64443. *7.2 MGD at GWTP*	50 max	16
Total Points		76

(a) Median of all total coliform analyses completed in the previous 24 months.

(b) For facilities treating surface water or groundwater under the direct influence of surface water, based on the previous 24 months of data, except that if turbidity data is missing for one or more of the months, the points given for turbidity shall be 5. The maximum influent turbidity sustained for at least one hour according to an on-line turbidimeter shall be used unless such data is not available, in which case, the maximum influent turbidity identified by grab sample shall be used. For facilities that have not been in operation for 24 months, the available data shall be used. For facilities whose permit specifies measures to ensure that influent turbidity will not exceed a specified level, the points corresponding to that level shall be assigned.

(c) The points for other influent water contaminants with primary MCLs shall be a sum of the points for each of the inorganic contaminants (Table 64431-A); organic contaminants (Table 64444-A) and radionuclides (Table 4, Section 64443). The points for each contaminant shall be based on an average of the three most recent sample results. If monitoring for a contaminant has been waived pursuant to Sections 64432(k), 64432.2(c) or 64445(d), the points shall be zero for that contaminant.

APPENDIX F

RESIN PRODUCT DATA SHEET

NSF 61 LISTING FOR RESIN

SLIDES OF RESIN PERFORMANCE IN PILOT TESTING COLUMNS

ROHM AND HAAS | Drinking Water

PRODUCT DATA SHEET

AMBERLITE™ PWA7 Resin

Drinking Water Grade

Chromate Selective

AMBERLITE PWA7 resin is an anion exchange resin designed for the removal of chromate from drinking water. Its high capacity makes AMBERLITE PWA7 resin the perfect choice for a simple, once through chromate removal process for municipal water treatment systems.

PROPERTIES

Matrix	Cross linked polycondensate	
Physical form	Cream coloured granules	
Total exchange capacity	≥ 1.9 eq/L	
Moisture holding capacity	58 – 68%	
Shipping weight	610 kg/m^3	(38 lb/ft^3)
Particle Size		
Screen grading	0.3 – 1.2 mm	(16 – 50 mesh US Std Screens)
Fines content	<0.300 mm: 3% max	

SUGGESTED OPERATING CONDITIONS

Please contact your Rohm and Haas representative for system design and application testing details.

pH range	< 6.5	
Maximum operating temperature	40 °C	(105 °F)
Minimum bed depth	610 mm	(24 inches)
Typical service flow rate	8 – 40 BV/hr*	(1 – 5 gpm/ft^3)

** 1 BV (Bed Volume) = 1 m^3 solution per m^3 resin*

COMMISSIONING AND LIMITS OF USE

AMBERLITE PWA7 resin is suitable for use in potable water applications after an initial commissioning upflow rinse of 20 bed volumes of water at ambient temperature at service flow rate.

The operating capacity of AMBERLITE PWA7 resin depends on the operating conditions and the feed water conditions.

REGULATORY

AMBERLITE PWA7 resin is certified to ANSI / NSF Standard 61 for drinking water components drinking water components for applications with minimum flow rates greater than or equal to 1.1 gpm/ft^3. Please contact your Rohm and Haas representative for additional certification information.

Resin products are manufactured in ISO 9001 certified facilities.

HYDRAULIC CHARACTERISTICS

Figure 1 and Figure 2 show the pressure drop data for AMBERLITE PWA7 resin as a function of flow rate and water temperature. Pressure drop data are valid at the start of the service run with clean water and a correctly classified bed. Figure 3 and Figure 4 show the bed expansion of AMBERLITE PWA7 resin as a function of backwash flow rate and water temperature.

Figure 1 Pressure Drop (metric)

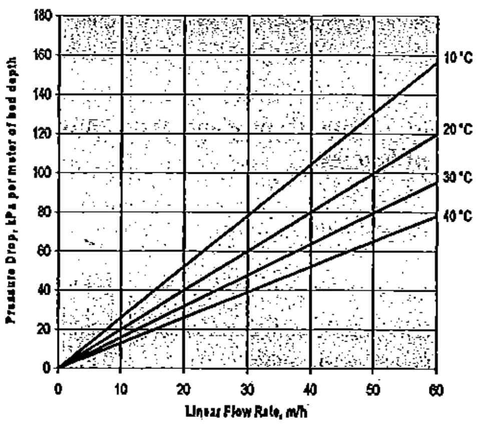


Figure 2 Pressure Drop (US units)

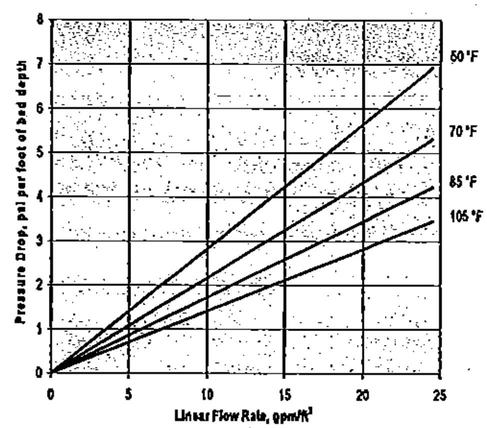


Figure 3 Bed Expansion (metric)

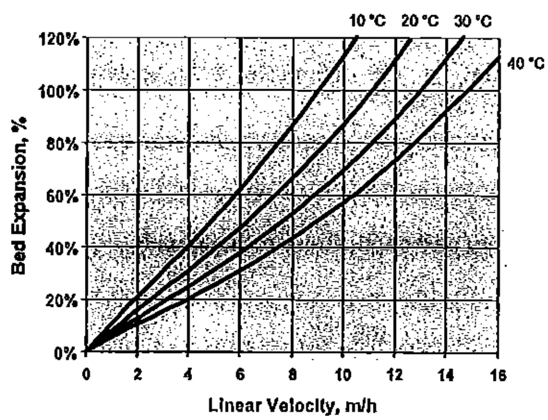
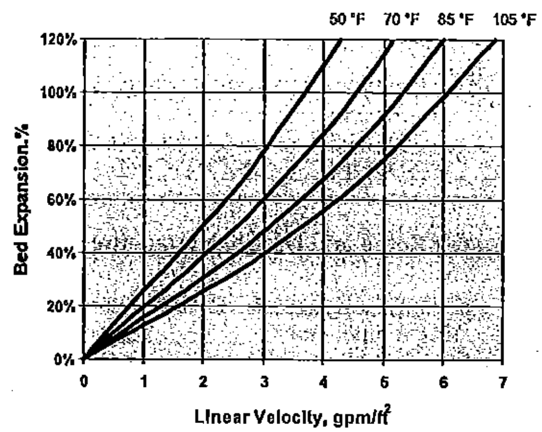


Figure 4 Bed Expansion (US units)



Rohm and Haas/Ion Exchange Resins - Philadelphia, PA - Tel. (800) RH AMBER - Fax (215) 409-4534
Rohm and Haas/Ion Exchange Resins - 75579 Paris Cedex 12 - Tel. (33) 1 40 02 50 00 - Fax : 1 43 45 28 19

ROHM HAAS

Water Quality Association

08/05/2009

NSF/ANSI-61 International Standard for Drinking Water Additives

NSF/ANSI-61 Drinking Water System Components - Health Effects

This Standard establishes minimum health effects requirements for the chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems. This Standard does not establish performance, taste and odor, or microbial growth support requirements for drinking water systems products, components, or materials.

Rohm and Haas Chemicals LLC
100 Independence Mall West
Philadelphia, PA 19106-2399
Phone: (215) 619-5531

Product Type: Carbonaceous Adsorbent

Brand Name	*Model*	*Size*	*Water Contact Temp*	*Water Contact Material*	*CA AB1953 Compliant*
N/A	AMBERSORB 563 Adsorbent	20 - 50 mesh	CLD 23	SYN	Not Evaluated

Product Type: Ion Exchange Resin

Brand Name	*Model*	*Size*	*Water Contact Temp*	*Water Contact Material*	*CA AB1953 Compliant*
N/A	AMBERLITE PWA10 Resin	16-50 mesh	CLD 23	SYN	Not Evaluated
N/A	AMBERLITE PWA15 Resin [7]	16-50 mesh	CLD 23	SYN	Not Evaluated

Facility: Rue des Grands Navoris, Prolongee Chauny Cedex

Product Type: Ion Exchange Resin

Brand Name	*Model*	*Size*	*Water Contact Temp*	*Water Contact Material*	*CA AB1953 Compliant*
N/A	Amberlite PWA2	N/A	CLD	Various	Not Evaluated
N/A	AMBERLITE PWA4 [7]	16-50 mesh	CLD 23	SYN	Not Evaluated
N/A	AMBERLITE PWA5 Resin [8]	16-50 mesh	CLD 23	SYN	Not Evaluated
N/A	AMBERLITE PWA6 Resin	16-50 mesh	CLD 23	SYN	Not Evaluated
N/A	AMBERLITE PWA7 Resin [7] 120 47	16-50 mesh	CLD 23	SYN	Not Evaluated

Facility: Shanghai

Product Type: Ion Exchange Resin

Brand Name	*Model*	*Size*	*Water Contact Temp*	*Water Contact Material*	*CA AB1953 Compliant*
N/A	Amberlite PWA9 [47]	0.3 - 1.18 mm	CLD	SYN	Not Evaluated

[7]: Anion Resin

[8]: The Certification of this media is only for applications with minimum flow greater than or equal to 1.87 gpm per cubic foot of resin.

[47]: Certified for water treatment plant applications. This product has not been evaluated for point of use applications.

[120]: This resin has a minimum flow rate requirement of 1.1 gpm per cubic foot.

Back

Disclaimer:

Water Quality Association: Back

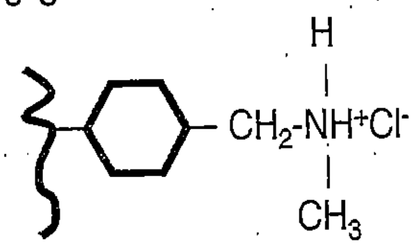
Wed, Aug 05, 2009

Water Quality Association
International Headquarters & Laboratory
4151 Naperville Road
Lisle, IL 60532-3696
USA
630 505 0160, Fax 630 505 9637
info@wqa.org, www.wqa.org

Disclaimers

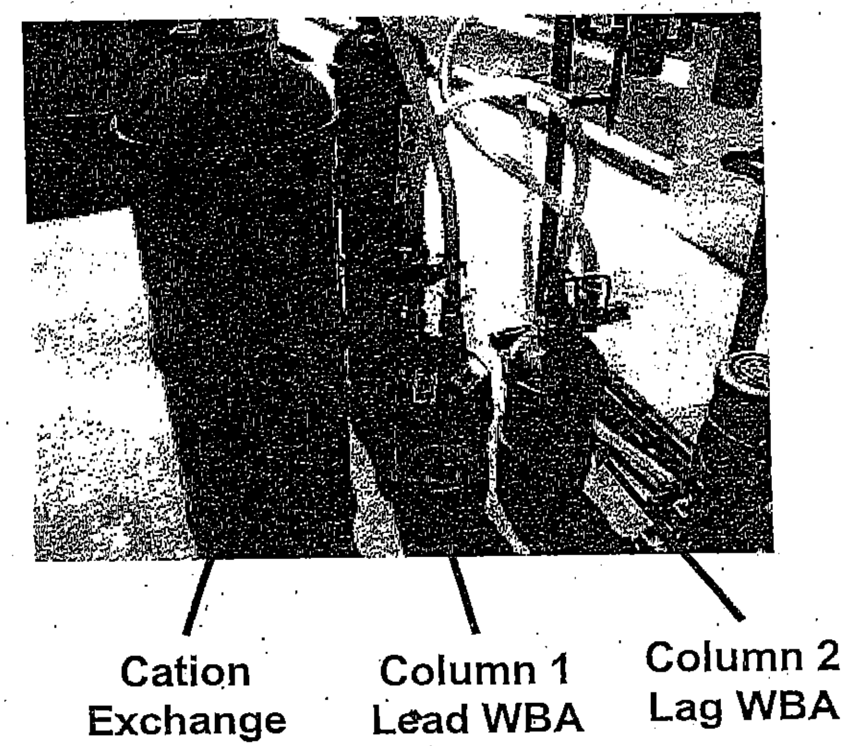
Fixed Bed Anion Exchange: USF/R&H Weak Base IX

- US Filter in partnership with Rohm and Haas supplied a new weak-base anion exchange resin
- Cation exchange for pH depression
- Duolite® A7
  - Crosslinked phenol-formaldehyde polycondensate
  - Exchange capacity: 2.1 meq/mL (free base)
  - Suggested operating range of pH 0-6

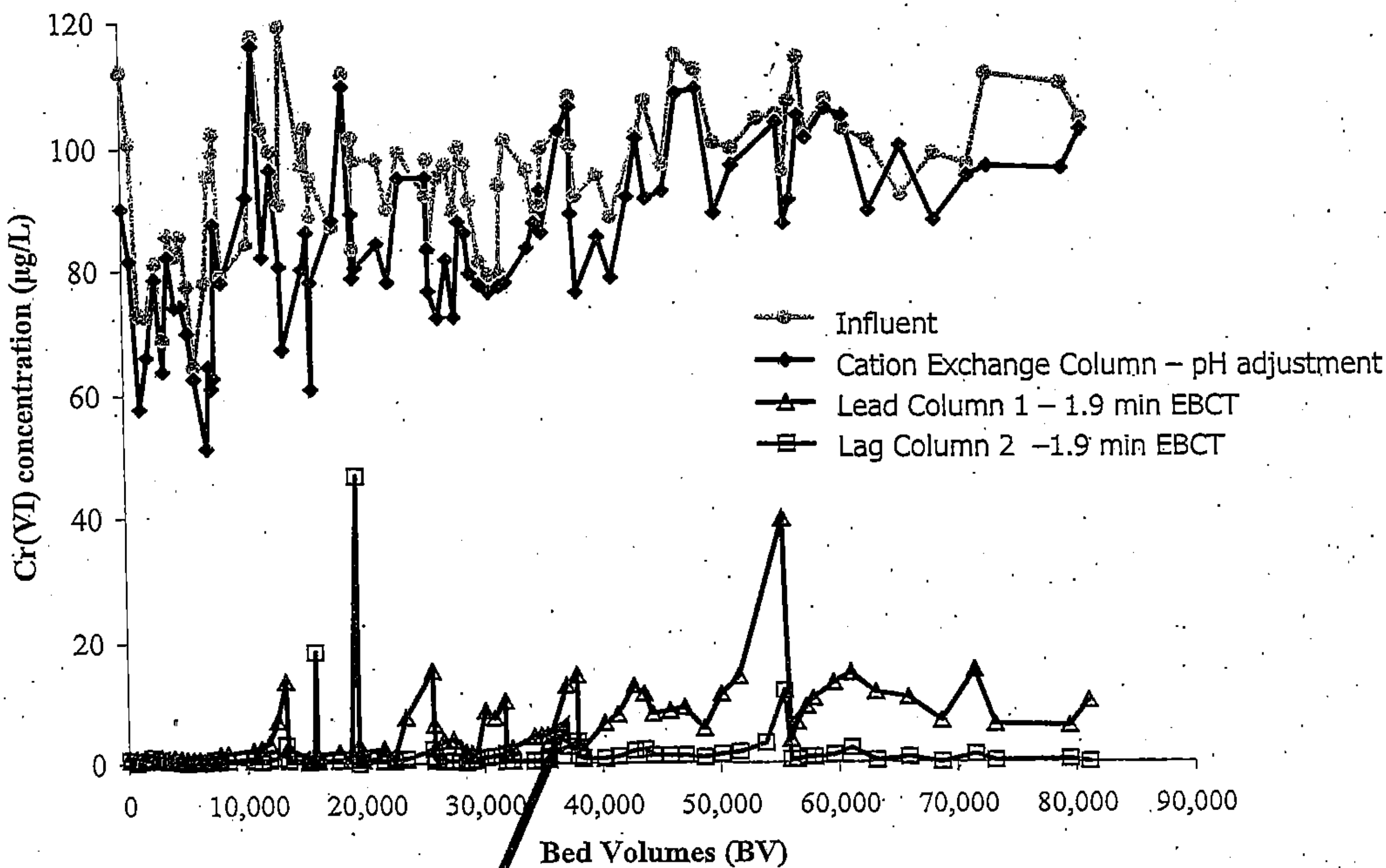


Low pH

Weak base anion exchange
Duolite A7



Fixed Bed Anion Exchange: USF/R&H Weak Base IX



Consistent 5 µg/L breakthrough occurred at approximately 38,000 BV

Fixed Bed Anion Exchange: Summary of USF/R&H Weak Base IX

- Cr Removal
  - Cr(VI) breakthrough (>5 µg/L) occurred at approx. 38,000 BVs (112,000 Gallons) for the lead column
  - Occasional Cr(VI) peaks before 38,000 BVs were caused by pH excursions to greater than 6.5
  - No Cr(VI) breakthrough was observed for the lag column up to 80,000 BVs
  - pH significantly influenced system performance
  - The differences between Cr(VI) and total Cr in the effluent (data not shown here) might indicate an oxidation-reduction mechanism and was further investigated in Phase III Bridge Project