Department of Energy
Office of Legacy Management

MAR 1 4 2008

Gary Janosko, Chief
Fuel Cycle Facilities Branch
Mail Stop T-8A33
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Groundwater Compliance Action Plan (GCAP) for the Green River, Utah, Site

Dear Mr. Janosko:

Enclosed for your review and comment are four copies of the *Preliminary Final Groundwater Compliance Action Plan for the Green River, Utah, Disposal Site* (February 2008). This document incorporates U.S. Department of Energy (DOE) responses to comments by the state of Utah on the draft preliminary final GCAP (September 2005). Copies of this document have been submitted concurrently to the Utah Division of Radiation Control. Copies of DOE's responses to state of Utah comments are also enclosed with each copy of the GCAP.

Upon final approval, the GCAP will serve as the concurrence document for compliance with ground water cleanup standards in Subpart B of 40 CFR 192 for the Green River processing site. Because residual radioactive material is stabilized in an on-site disposal cell, the compliance strategy will also be applicable to Subpart A of 40 CFR 192, which prescribes initial disposal cell performance monitoring. The site Environmental Assessment will be finalized to incorporate the approved compliance strategy, and the site Long-Term Surveillance and Maintenance Plan will be revised and submitted to the Commission for concurrence prior to implementation of the strategy.

Please return your comments to me, and call me at (970) 248-6073 if you have any questions.

Sincerely,

Richard P. Bush

Richard P. Bush
Site Manager

Enclosures (4)

cc w/o enclosures:
P. Goble, UDEQ
T. Pauling, DOE-LM
D. Johnson, Stoller (e)
File: GRN 505.15(A) (Roberts)

DOE–LM/1584–2008

Office of Legacy Management

Preliminary Final Groundwater Compliance Action Plan for the Green River, Utah, Disposal Site

February 2008

U.S. Department of Energy

Office of Legacy Management

Work Performed Under DOE Contract No. DE–AC01–02GJ79491
for the U.S. Department of Energy Office of Legacy Management.
Approved for public release; distribution is unlimited.

DOE Responses to State of Utah Comments

Comments to the draft preliminary final groundwater compliance action plan (GCAP) for the Green River, Utah, disposal site (September 2005) were received from the State of Utah in a letter dated August 14, 2006. Below are summary statements of the State's comments followed by U.S. Department of Energy (DOE) responses. The responses have been incorporated where appropriate into the current *Preliminary Final Groundwater Compliance Action Plan for the Green River, Utah (UMTRCA Title I), Disposal Site* (February 2008).

The current draft of the GCAP also incorporates information collected and evaluated since the previous draft was submitted in September 2005. Risks have been reevaluated based on observations during frequent site visits (primarily to observe conditions associated with Browns Wash), additional research of hydrogeological data at the site, and the State's concerns. It is DOE's conclusion that contaminants at the disposal cell and in the Browns Wash alluvium do not pose unacceptable ecological or human health risks to the backwater area at the mouth of Browns Wash, the Green River alluvial system, or the Green River.

Proposed ACLs

1. **State Comment:** Implement a statistically based well-specific approach to alternate concentration limits (ACLs) instead of a site-wide approach because contaminated groundwater from the middle sandstone unit of the Cedar Mountain Formation could discharge into the Browns Wash alluvium and then into the Browns Wash backwater area.

   DOE Response: There is no evidence to confirm that contaminated groundwater from the middle sandstone unit discharges into the Browns Wash alluvium. A seep is present at a Cedar Mountain Formation outcrop upstream of the backwater area, which is along the crest of an anticline that is typified by vertical joints and fractures. However, at this location, well logs indicate that the middle sandstone unit is not present—it pinches out somewhere between the disposal cell and Browns Wash. The seep was observed during the winter of 2007 during an extended period of sub-freezing temperatures. Algae was growing in water that was significantly warmer than the ambient temperature (all other locations of standing water in the vicinity were frozen), indicating that the source of the water is from a deep aquifer.

   Although groundwater from the middle sandstone unit may migrate upward through joints and fractures and into the alluvium at other locations at the site, the contaminants already in the Browns Wash alluvium groundwater as a result of processing activities would mask any contaminants migrating from the cell.

   Well-specific ACLs would focus on the behavior of individual wells instead of addressing the overall risk if contaminants were to migrate to the Green River, which is assumed to be the eventual potential point of exposure. It is DOE's position that site-wide ACLs are more appropriate because there is no risk of exposure to the groundwater in the vicinity of the disposal cell or the point-of-compliance (POC) wells.

2. **State Comment:** Water protection standards for the backwater area at the mouth of Browns Wash should be based on surface water quality standards instead of drinking water MCLs.

   DOE Response: Agreed. The location will be monitored for ammonia, arsenic, nitrate, and selenium in accordance with the aquatic standards in Utah Rule R317-2, Table 2.14.2 (see Table 5 of the GCAP). Uranium will also be monitored.

Monitoring Frequency

1. **State Comment:** Do not average all well results because an average result could hide a bad well.

   DOE Response: Agreed. Each result from a sampling event will be compared to the respective ACL.

2. **State Comment:** Additional monitoring (quarterly) should occur when an individual well exceeds an ACL instead of a site-wide average exceeding an ACL. The additional monitoring should apply only to that well instead of the whole well field. This would apply to surface water sampling also.

   DOE Response: Agreed. Quarterly monitoring for a 1-year period will be applied to individual POC wells if an ACL is exceeded, and to the Green River and backwater surface locations if Utah surface water standards are exceeded at those locations (See Table 9 of the GCAP).

POC Well Locations

1. **State Comment:** Add well 0179 because it has historically high levels of uranium.

   DOE Response: Agreed. Monitor well MW–0179, located southeast of the disposal cell and completed in the middle sandstone unit of the Cedar Mountain Formation, has been added as a POC well. It is not known if the uranium concentrations in this well are influenced by the disposal cell or from underlying uranium-bearing formations.

2. **State Comment:** Add Browns Wash alluvial wells as POC wells because of the potential that the contaminated groundwater from the middle sandstone unit of the Cedar Mountain Formation could discharge into the Browns Wash alluvium and because of historic elevated selenium and uranium in some of the wells.

   DOE Response: The elevated contaminant concentrations in the alluvial monitor wells are the result of processing activities and are not from the disposal cell (unprotected mill tailings were stockpiled on the Browns Wash alluvial floodplain on the south side of the wash). DOE recommends application of supplemental standards for the Browns Wash alluvium because of its low yield and impracticability to treat the groundwater. Therefore, DOE does not recommend including the alluvial wells as POC wells.

   It is expected that the contaminants in the Browns Wash alluvium will eventually move downgradient and mix with the Green River alluvium groundwater and the river water. DOE intends to continue monitoring selected alluvial wells (MW-0188, 0189, 0192, and 0194) as a best management practice to observe this expected trend.

POC Surface Water Locations

1. **State Comment:** Apply surface water protective standards to the Green River and backwater surface water sampling locations because the middle sandstone unit crops out in Browns Wash.

   DOE Response: DOE agrees to apply surface water standards to the two surface water sampling locations as addressed above. For clarification, the middle sandstone unit does not crop out in Browns Wash. The lenses of rock that crop out in Browns Wash represent the complexly interbedded upper unit of the Cedar Mountain Formation.

2. **State Comment:** If the surface water standards are exceeded, then the need for additional monitoring and/or corrective action should be evaluated.

   DOE Response: See the response under "Monitoring Frequency" above.

Institutional Controls

1. **State Comment**: Expand water rights restrictions to include the Green River alluvial system to the Green River and an appropriate distance upstream and downstream of the mouth of Browns Wash because of the potential for contaminated groundwater to discharge into the Green River alluvial system.

   DOE Response: Because of the limited contribution of groundwater from the Browns Wash alluvium to the Green River alluvial aquifer, site-related contaminants will not pose an unacceptable risk to the Green River alluvial aquifer; therefore, DOE does not intend to expand water rights restrictions beyond the area proposed in the preliminary final GCAP.

2. **State Comment:** Expand the no-drilling area in all directions because the groundwater flow directions of the middle sandstone unit may be circuitous and because withdrawal of groundwater in units below the middle sandstone unit could reverse the upward groundwater gradient. Groundwater modeling is recommended to establish these boundaries.

   DOE Response: The relatively thin saturated thicknesses of the middle and basal sandstone units of the Cedar Mountain Formation in the vicinity of the site preclude agricultural or industrial use of these aquifers. No wells are completed in these aquifers in the area. If a domestic well were to be completed in the basal sandstone unit, it would influence only a small area in the immediate vicinity of the well.

   The next deepest groundwater bearing formation in the vicinity of the site that possibly has the potential for development is the Jurassic Entrada Sandstone. It is not used as a groundwater supply in the area and is an unlikely source of industrial or agricultural water. Regional geologic maps indicate that it is separated from the Cedar Mountain Formation by a minimum of 450 feet of materials consisting primarily of shale, siltstone, and lenticular sandstone units in the Jurassic Morrison and Curtis formations. Therefore, even if the

Entrada Sandstone was used as a groundwater supply in the vicinity of the site, the intervening geologic units would act as an aquitard and the hydraulic heads in the Cedar Mountain Formation aquifers would not be expected to be affected.

Insufficient data are available to develop realistic groundwater models of the Cedar Mountain and Entrada Sandstone aquifers. The absence of use of the aquifers in the vicinity of the disposal site, combined with the availability of Green River surface and alluvial water, suggests that the use of the bedrock aquifers is not a practical option. Therefore, DOE will not attempt to model these aquifers and does not intend to expand the no-drilling area beyond the boundaries presented in the preliminary final GCAP.

As a best management practice, DOE has initiated a monitoring program to continuously monitor the water levels in the middle sandstone and basal sandstone units of the Cedar Mountain Formation. This monitoring program is expected to provide information on aquifer flow directions in addition to hydraulic gradient.

DOE-LM/1584-2008

Preliminary Final

Groundwater Compliance Action Plan for the Green River, Utah, Disposal Site

February 2008

Work Performed by S.M. Stoller Corporation under DOE Contract No. DE–AC01–02GJ79491 for the U.S. Department of Energy Office of Legacy Management, Grand Junction, Colorado

This page intentionally left blank

Contents

1.0 Introduction 1
2.0 Assessment of Environmental Data 1
2.1 Hydrogeology 1
2.1.1 Browns Wash Alluvium 3
2.1.2 Cedar Mountain Formation 4
2.2 Groundwater Quality 8
2.2.1 General 8
2.2.2 Middle Sandstones Unit Aquifer 9
2.3 Surface Water Quality 10
3.0 Groundwater Compliance Strategy 11
3.1 Browns Wash Alluvium 13
3.2 Cedar Mountain Formation 14
3.2.1 Compliance Strategy 14
3.2.2 Basis for Alternate Concentration Limits 15
3.2.3 Alternate Concentration Limits 16
3.3 Human Health and Environmental Risk 17
4.0 Compliance Strategy Implementation 17
4.1 Monitoring Program 17
4.2 Institutional Controls 21
5.0 References 22

Figures

Figure 1. Location Map of the Green River, Utah, Disposal Site 2
Figure 2. Potentiometric Surface of the Middle Sandstone Unit Aquifer at the Green River Site (2007 Measurements) 6
Figure 3. Potentiometric Surface of the Basal Sandstone Unit Aquifer at the Green River Site (2007 Measurements) 7
Figure 4. Compliance Strategy Decision Framework 12
Figure 5. Monitoring Network and Institutional Controls Boundary at the Green River Site 19

Tables

Table 1. Groundwater Elevations in the Middle Sandstone Unit Aquifer at the Green River Site 5
Table 2. Groundwater Elevations in the Basal Sandstone Unit Aquifer at the Green River Site 5
Table 3. Maximum Concentrations of Contaminants in Groundwater at the Green River Site 8
Table 4. Ecological NOAELs and Browns Wash Alluvium Water Quality 11
Table 5. Surface Water Standards and Results 11
Table 6. Compliance Strategy Selection Process for Groundwater in the Browns Wash Alluvium 13
Table 7. Compliance Strategy Selection Process for Groundwater in the Cedar Mountain Formation 14
Table 8. Alternate Concentration Limits and Maximum Concentrations for the Green River Site 17
Table 9. Summary of Monitoring Requirements for the Green River Site 18

Appendixes

Appendix A	Application for Alternate Concentration Limits for the Green River, Utah, Disposal Site
Appendix B	Photos
Appendix C	Hydrograph and Time-Concentration Plots
Appendix D	Environmental Notice and Institutional Control

1.0 Introduction

This Groundwater Compliance Action Plan (GCAP) presents the compliance strategy for groundwater cleanup at the Green River, Utah, former uranium processing site (Figure 1) as mandated by the Uranium Mill Tailings Radiation Control Act (UMTRCA). The compliance strategy is based on the U.S. Department of Energy's (DOE's) evaluation of information included in the Site Observational Work Plan (SOWP) (DOE 2002), groundwater quality and elevation data to date, and field observations. This GCAP serves as a stand-alone modification to the Remedial Action Plan (RAP) (DOE 1991) and Modification No. 2 to the RAP (DOE 1998a) to address groundwater restoration and compliance with the U.S. Environmental Protection Agency (EPA) groundwater protection standards for the UMTRCA Title I processing sites (EPA 1995).

The U.S. Nuclear Regulatory Commission (NRC) concurrence document for compliance with groundwater cleanup standards in Subpart B of the *Code of Federal Regulations*, Title 40, Part 192 (40 CFR 192) for the Green River processing site will be this GCAP. Because residual radioactive material is stabilized in an on-site disposal cell, the compliance strategy will also be applicable to Subpart A of 40 CFR 192, which prescribes initial disposal cell performance monitoring.

This preliminary final version of the GCAP updates the draft version (June 2003) by addressing comments from the State of Utah Division of Radiation Control received in letters dated October 7, 2003, and August 14, 2006, and includes an appendix containing the application for alternate concentration limits (ACLs). Upon resolution of all issues, the GCAP will be finalized and submitted for regulatory concurrence with the compliance strategy. At that time, the Long-Term Surveillance Plan (LTSP) for the Green River site (DOE 1998b) will be revised accordingly and will be the document of record for implementation of long-term surveillance activities for the entire site.

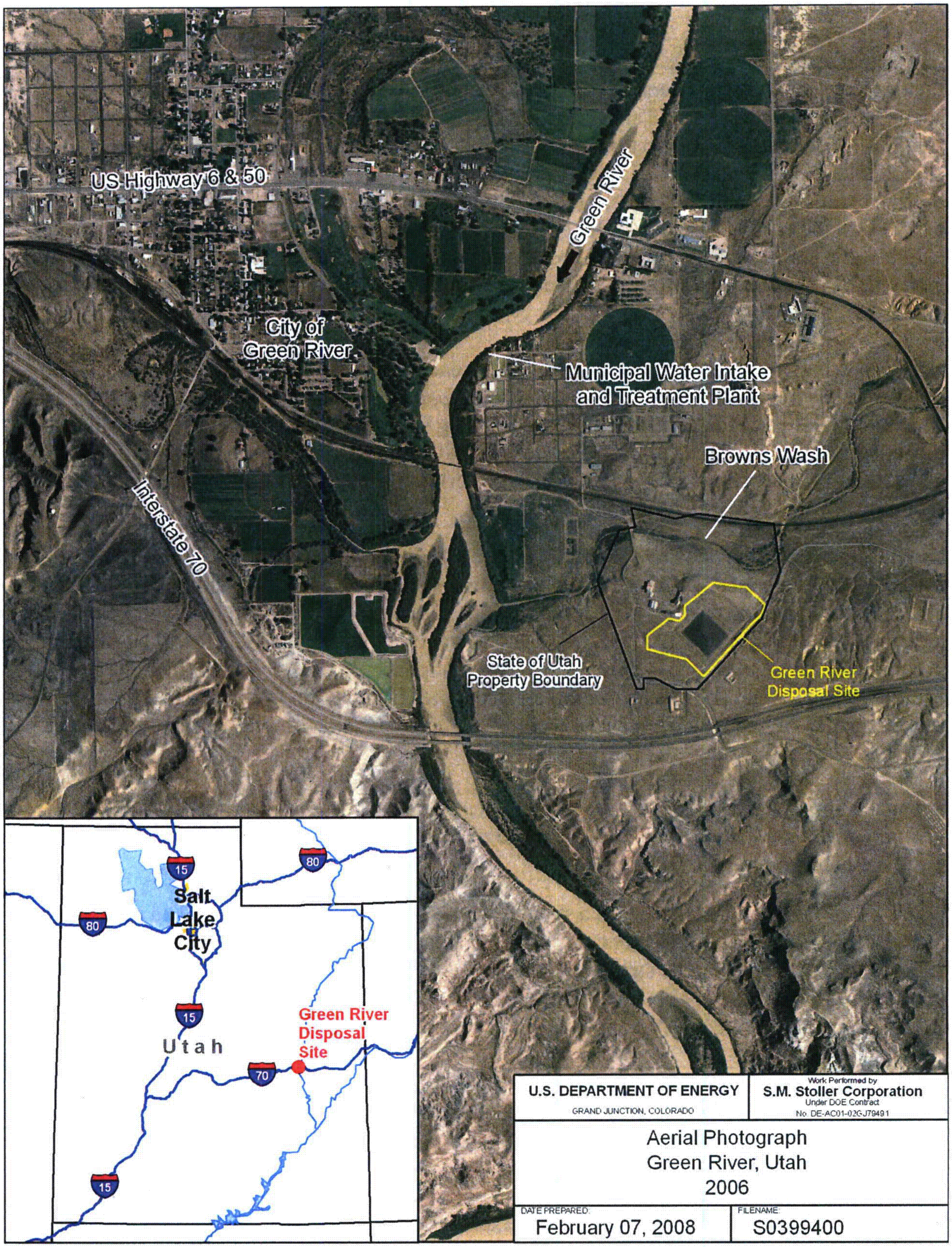
National Environmental Policy Act issues and environmental concerns are addressed in the Environmental Assessment, which will be made available to public officials and stakeholders for their review and comment.

Section 2.0 of this document provides a summary assessment of environmental data relevant to the development of the groundwater compliance strategy. Section 3.0 discusses the development of the groundwater compliance strategy, and Section 4.0 addresses the implementation of the compliance strategy. The application for ACLs for the Green River site, as required by EPA and NRC guidance, is included as Appendix A to this report and is summarized in Section 3.0.

2.0 Assessment of Environmental Data

2.1 Hydrogeology

Groundwater in the vicinity of the Green River site occurs in the Browns Wash alluvium of Quaternary age and in sandstone units of the Cretaceous Cedar Mountain Formation. Hydrogeologic data relevant to selection of a groundwater compliance strategy are summarized in this section; additional data are available in Modification No. 2 to the RAP (DOE 1998a) and the SOWP (DOE 2002).



M:\LTS\111\0009\13\000\S03994\S0399400.mxd carverh 2/7/2008 11:32:47 AM

Figure 1. Location Map of the Green River, Utah, Disposal Site

2.1.1 Browns Wash Alluvium

The Browns Wash channel is located north and west of the site, and is approximately 800 feet from the disposal cell at its nearest point. Groundwater in the Browns Wash alluvium is unconfined and is limited by the lateral extent of the alluvium, which extends up to 400 feet on either side of the wash. Depth to groundwater varies from 8 to 17 feet below ground surface in the existing alluvial wells, and saturated thickness ranges from 0 to 3 feet at the base of the alluvium. Groundwater in Browns Wash alluvium is classified as limited use on the basis of low yield and is not considered to be an aquifer (DOE 2002).

The minimal groundwater flow in the Browns Wash alluvium is east to west and mixes with the Green River alluvial aquifer and eventually the Green River down-gradient of the former millsite. Alluvial groundwater also discharges by means of evapotranspiration through deep-rooted plants such as tamarisk and saltbush. Discharge to bedrock appears to be minimal because of the low permeability of the underlying bedrock (primarily shale) and the upward hydraulic gradient in the water-bearing bedrock units.

Alluvial groundwater receives recharge from infiltration of precipitation and from surface water flow from Browns Wash when flowing after significant rainfall events (Appendix B, Photo 6). Apparently, the alluvial system adjacent to the former tailings pile received recharge during the milling operations and after tailings deposition over the alluvium on the south side of Browns Wash.

Some recharge is also possible from water-bearing units in underlying formations, including the Cedar Mountain Formation and deeper formations, as a result of the upward hydraulic gradient through vertical fractures. The site is located near the axis of a plunging anticline, and the axis is characterized by vertical fracturing of the associated formations. Several intermittent seeps have been identified in Browns Wash. The primary seep area occurs where the upper unit of the Cedar Mountain Formation (not an aquifer) outcrops in Browns Wash northwest of the disposal cell (Appendix B, Photo 5). The middle sandstone unit of the Cedar Mountain Formation does not exist beneath this location (well logs indicate that it pinches out somewhere between the disposal cell and Browns Wash), and the warm temperature of the water and algae growth observed during extended subfreezing surface conditions suggests that it originates from a formation deeper than the Cedar Mountain Formation (Appendix B, Photo 8).

Small ephemeral pools of water are often present following storm events at several locations in Browns Wash. The pools, usually less than 10 square feet in area, occur in scour holes that form as runoff crosses the bedrock outcrops of the upper unit of the Cedar Mountain Formation and behind boulders in the channel bed (Appendix B, Photo 7). Though temporary and depleted by evaporation, the pools may linger as the saturated banks and upstream alluvium dewater after a runoff event. Some pools may also be recharged from seeps at outcrop locations. Frequent observations during 2006, several of which occurred soon after a runoff event, indicate that wildlife do not use the pools as a source of drinking water. Even though animal trails cross Browns Wash next to two pool locations, few tracks were observed at the pools themselves; most of the pools had no tracks.

2.1.2 Cedar Mountain Formation

The middle sandstone unit of the Cedar Mountain Formation, which contains the uppermost bedrock aquifer beneath the site, occurs approximately 80 feet below land surface directly under the cell and ranges in thickness from 15 to 40 feet. It is overlain by an upper complexly interbedded unit that acts predominantly as an aquitard; however, the middle sandstone unit is not saturated at all locations (particularly south of the disposal cell) and vertical leakage apparently occurs through joints and fractures associated with a north-northwest plunging anticline whose axis occurs about one third mile west of the disposal site (DOE 2002).

Well logs indicate that the middle sandstone unit is not laterally continuous in the vicinity of the site. It pinches out south and west of the disposal site and apparently is not present under Browns Wash northwest of the site. The saturated portion of the unit is more predominant north and east of the disposal cell. Though only semi-confined along the crest of the anticline, the aquifer is confined along the northeast flank where the Cedar Mountain Formation is overlain by the Dakota Formation and the lower unit of the Mancos Shale Formation.

The basal sandstone unit of the Cedar Mountain Formation, also considered to be an aquifer, occurs approximately 160 feet below the land surface at the disposal cell. Groundwater is confined by an apparently impermeable sequence of claystone and shale; however, some upward leakage likely occurs through joints and fractures along the axis of the anticline.

Interpretation of the local groundwater flow component in the middle sandstone unit is complicated by both the structural and stratigraphic characteristics of the bedrock units. Uncertainties surrounding the complex hydrogeology and groundwater flow directions in units of the Cedar Mountain Formation in the vicinity of the Green River site are discussed in Section 5.1 of the SOWP (DOE 2002). Continuous water-level monitoring in wells completed in the middle and basal sandstone units was initiated in 2007 to provide a better understanding of flow characteristics (Appendix B, Photos 3 and 4).

Water levels of the middle sandstone unit aquifer have been measured in several monitor wells since completion of surface remediation in 1989, with continuous water-level monitoring commencing in February 2007. Water levels in wells adjacent to the disposal cell generally increased for about 3 years, declined for the next 11 years, and then began increasing again in late 2004 (Appendix C, Figure C–1). Initial transient drainage from the disposal cell may have caused a temporary increase in water levels in the early 1990s, followed by decreasing levels as drainage slowed. Some of the decrease, to levels below initial measurements, may also be attributable to drought conditions that persisted in the area for several years. Precipitation in the region has returned to normal or above-normal amounts, and current water levels are greater than historical measurements. Since 2004, water levels in the middle sandstone unit have increased approximately 8 feet, and levels in the basal sandstone unit have increased approximately 3 feet.

Quarterly water-level measurements for both Cedar Mountain Formation aquifers, obtained from continuous monitoring data collected in 2007, are provided in Table 1 and Table 2. Averages of those measurements are plotted on Figure 2 and Figure 3. The estimated potentiometric surface for the middle sandstone unit (Figure 2) indicates a general northwest flow direction. Figure 3 indicates a west-to-southwest flow direction in the basal sandstone unit. Monitor well 0817, completed in the middle sandstone unit, and well 0582, completed in the basal sandstone unit, are both adjacent to Browns Wash and are both flowing wells. The wells are capped, and elevations are recorded according to shut-in pressure.

Table 1. Groundwater Elevations in the Middle Sandstone Unit Aquifer at the Green River Site

Monitor Well	Groundwater Elevation[a]				
	3/1/07	6/1/07	9/1/07	12/1/07	Average
0171	4,087.73	4,087.45	4,086.89	4,087.10	4,087.29
0173	4,087.91	4,087.56	4,086.93	4,087.15	4,087.39
0176	4,089.94	4,089.36	4,088.63	4,089.24	4,089.29
0179	4,088.83	4,088.40	4,087.68	4,088.04	4,088.24
0183	4,090.17	4,089.65	4,088.51	4,089.18	4,089.38
0813	4,087.84	4,087.56	4,086.99	4,087.18	4,087.39
0817[b]	4,086.35	4,086.74	4,087.92	4,088.56	4,087.39

[a]Elevations recorded at 12:00 noon by continuous monitoring data loggers.
[b]Flowing well; elevation recorded by data logger according to well shut-in pressure.

Table 2. Groundwater Elevations in the Basal Sandstone Unit Aquifer at the Green River Site

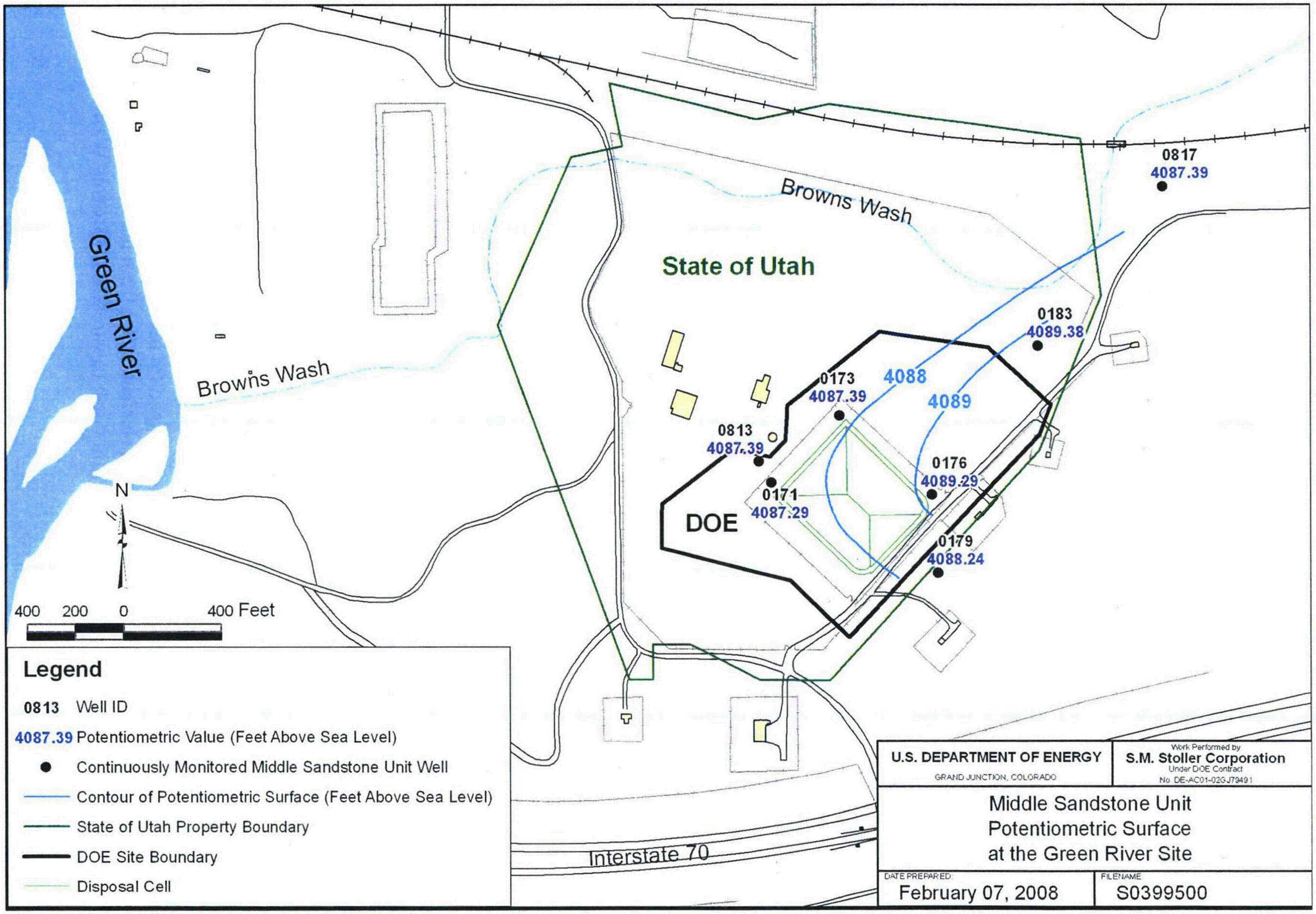
Monitor Well	Groundwater Elevation[a]				
	3/1/07	6/1/07	9/1/07	12/1/07	Average
0182	4,084.89	4,084.98	4,085.00	4,085.21	4,085.02
0184	4,085.47	4,085.59	4,085.66	4,085.80	4,085.63
0185	4,084.54	4,084.70	4,084.73	4,085.11	4,084.77
0582[b]	4,082.95	4,083.33	4,083.39	4,083.75	4,083.36
0588	4,084.35	4,084.44	4,084.50	4,084.83	4,084.53

[a]Elevations recorded at 12:00 noon by continuous monitoring data loggers.
[b]Flowing well; elevation recorded by data logger according to well shut-in pressure.

Water-level data indicate that the middle sandstone unit directly beneath the disposal cell is saturated (water-level elevations are above the top of the unit), and measurements in well 0817 have always demonstrated an upward hydraulic gradient at its location. Measurements in all of the basal sandstone unit wells have always indicated a strong upward hydraulic gradient in that aquifer.

Recharge to the middle sandstone unit of the Cedar Mountain Formation is from precipitation where this unit crops out (the nearest outcrop recharge area is about 2.5 miles southeast of the disposal site) and from vertical contributions of groundwater along the flow path. Discharge from the middle sandstone unit probably occurs through joints and fractures into the Green River alluvium and possibly Browns Wash alluvium; however, the flow path between the disposal cell and the discharge areas may be circuitous due to stratigraphic and structural discontinuities.

Groundwater from the middle sandstone unit is not being used and is not considered to be a significant source of water in the area. The underlying confined basal sandstone unit is a more likely source of groundwater in the site vicinity, though specific uses from this unit are not known. The major source of usable water in the area is surface water from the Green River and groundwater from the Green River floodplain alluvium north (upstream) of Browns Wash.



M:\LTS\111\0009\13\000\S03995\S0399500.mxd carverh 2/7/2008 11:22:03 AM

Figure 2. Potentiometric Surface of the Middle Sandstone Unit Aquifer at the Green River Site (2007 Measurements)

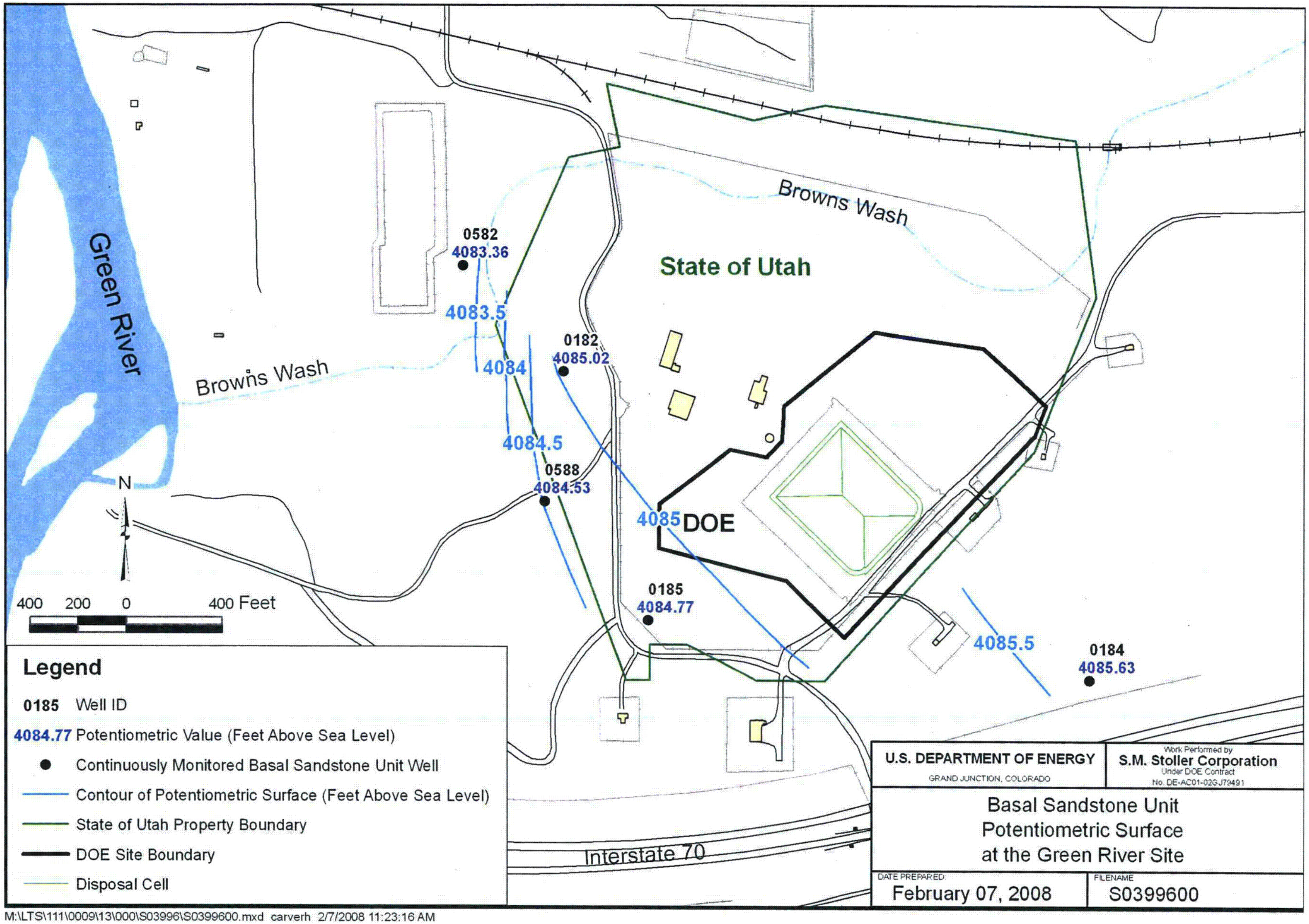


Figure 3. Potentiometric Surface of the Basal Sandstone Unit Aquifer at the Green River Site (2007 Measurements)

2.2 Groundwater Quality

2.2.1 General

Background water quality in both the Browns Wash alluvium and middle sandstone unit of the Cedar Mountain Formation is not well understood. Water quality in the alluvium appears to have naturally high dissolved solids content, though quality is quite variable (DOE 2002). Monitor well 0707, completed in the alluvium adjacent to Browns Wash and up-gradient from the former processing site and tailings storage area (near well 0817), is considered to be a background well. Monitor well 0817 is interpreted to be a background location for the middle sandstone unit (Figure 2); contaminant concentrations in this well are at or below their respective EPA and State of Utah groundwater quality standards for arsenic, nitrate, selenium, and uranium. Groundwater in the basal sandstone unit has not been affected by site-related contaminants because of the hydrogeologic isolation and upward vertical hydraulic gradient of this unit. Therefore, the basal sandstone unit will not be discussed further.

When compared to background groundwater-quality conditions, groundwater in the Browns Wash alluvium and the middle sandstone unit of the Cedar Mountain Formation beneath the Green River site appears to have been contaminated by former uranium processing activities. Constituents elevated above standards or relevant benchmarks in the Browns Wash alluvium groundwater include ammonia, arsenic, manganese, nitrate, selenium, sodium, sulfate, and uranium. With the exception of ammonia and manganese, these constituents are elevated above a standard or risk-based concentration (human health) in the middle sandstone unit aquifer of the Cedar Mountain Formation. Maximum concentrations for these constituents, obtained through sampling since the disposal cell was completed in 1989, are provided in Table 3.

Table 3. Maximum Concentrations of Contaminants in Groundwater at the Green River Site

Constituent	Human Health Benchmark (mg/L)	Browns Wash Alluvium		Middle Sandstone Unit	
		Maximum Concentration in Background Well 0707 (mg/L)	Maximum Concentration in Monitored Wells[a] (mg/L)	Maximum Concentration in Background Well 0817 (mg/L)	Maximum Concentration in the POC Wells[b] (mg/L)
Ammonia (as NH_4)	32[c]	0.3	45.3	0.3	1.0
Arsenic	0.05[d]	0.1	0.0014	0.01	0.191
Manganese	1.7[e]	0.26	3.15	0.01	0.936
Nitrate + Nitrite (as N)	10.0[d]	30.2	1,200	5.3	427
Selenium	0.05[f]	0.267	0.098	0.01	0.850
Sodium	120[g]	2050	13,000	594	5,000
Sulfate	500[h]	6620	38,000	137	9,100
Uranium	0.044[d]	0.029	9.5	0.003	0.229

Key: mg/L = milligrams per liter; POC = point of compliance
[a]Wells 0188, 0189, 0192, and 0194 since monitoring was initiated on July 11, 2002.
[b]Wells 0171, 0173, 0176, 0179, 0181, and 0813 since the disposal cell was completed in September 1989.
[c]EPA lifetime health advisory (EPA 2002a).
[d]EPA (40 CFR 192, Table 1).
[e]Risk-based concentration calculated from data in EPA IRIS database.
[f]The Utah groundwater standard for selenium (0.05 mg/L) is greater than the EPA MCL (0.01 mg/L) and is used as the benchmark because of elevated levels of naturally occurring selenium in the region.
[g]EPA benchmark value (non-enforceable; EPA 2002c).
[h]EPA health-based advisory for acute effects (EPA 2002b).

2.2.2 Middle Sandstones Unit Aquifer

Historical data suggest that site-related contamination in the middle sandstone unit of the Cedar Mountain Formation is not widespread and is restricted to the area adjacent to the disposal cell (DOE 2002). Concentrations of contaminants have varied over the period of time that monitoring has taken place. Time-concentration plots for arsenic, nitrate, selenium, and uranium in the point-of-compliance (POC) wells are provided in Appendix C.

Arsenic concentrations are exceeding the standard of 0.05 milligrams per liter (mg/L) only in well 0813. An overall downward trend has occurred in this well since 1994 (Figure C–2), and the June 2007 concentration was 0.084 mg/L.

As shown on Figure C–3, the nitrate standard of 10.0 mg/L is exceeded in five of the wells (0171, 0173, 0176, 0179, and 0181). Nitrate concentrations, highest in well 0173, have fluctuated greatly but indicate an overall downward trend since 2002. No significant trends are apparent in the other wells.

Selenium concentrations exceed the standard of 0.05 mg/L in wells 0171, 0173, 0176, and 0179. The highest selenium concentrations are in wells 0176 and 0179, but they have remained relatively steady in those wells since 1998 (Figure C–4).

Two wells, 0171 and 0179, have uranium concentrations in excess of the standard (0.044 mg/L) as indicated on Figure C–5. The highest uranium concentrations are in well 0179 (up-gradient or cross-gradient of the cell). Although the concentrations have fluctuated, there has been no significant trend in well 0179 since sampling was initiated in 1990. It is possible that the uranium in well 0179 is naturally occurring and may be caused by groundwater migrating upward (through joints and fractures) from deeper uranium-bearing formations. Uranium concentrations in well 0171 have indicated an overall upward trend since 1997; however, uranium is the only constituent of concern in well 0171 that has indicated an upward trend and no cause for the trend has been determined.

All of the wells have sodium and sulfate concentrations substantially above the human health benchmarks listed in Table 3 (neither EPA nor State of Utah groundwater standards have been established for these constituents). Sodium concentrations are greater than 1,000 mg/L in all the POC wells, and an overall upward trend has been occurring in well 0173 while concentrations have remained steady or decreased in the other wells. Sulfate concentrations are greater than 3,000 mg/L in all the wells and have increase substantially in well 0173 and to a lesser degree in well 0171; concentrations in the other wells have remained steady or decreased. Ammonia and manganese concentrations have never exceeded the human health benchmarks listed in Table 3.

Minor seepage from the disposal cell could have contributed to elevated concentrations of mill-related constituents in the middle sandstone unit of the Cedar Mountain Formation beneath the cell. However, the tailings did not contain appreciable moisture when they were encapsulated, and there has been no consistency or apparent correlation of contaminant concentrations. Processing-related contamination is believed to be primarily responsible for elevated concentrations in the aquifer.

No obvious correlations have been found between contaminant concentrations and well locations, sampling methods, precipitation rates, or any other single process, and no conclusions have been reached to explain the variations from well to well. The observed groundwater concentrations are most likely a manifestation of a number of factors in this complex subsurface system.

2.3 Surface Water Quality

The main surface water body at the site is the Green River, which is located 0.5 mile west of the disposal site. The drainage area for the river is about 24,900 square miles. The river also receives regional discharge from groundwater.

Browns Wash flows only after locally heavy rains. Runoff from the disposal site drains toward Browns Wash, which discharges into the Green River. Very small ephemeral pools often are present after runoff events, and several intermittent seeps occur in the wash. Most of the pooled or seep water evaporates or discharges into the Browns Wash alluvium; minor amounts reach the backwater area near the mouth of Browns Wash.

Wildlife benchmarks corresponding to No Observed Adverse Effects Level (NOAEL) were obtained from the literature and are presented in Table 4. NOAELs are risk-based values for wildlife that should present no adverse effects on wildlife if ingested at those concentrations. The NOAELs in Table 4 are for ingestion of contamination through water only; NOAEL values vary depending on the specific study, receptor species, and chemical form. Receptors used in the NOAEL studies include deer, mice, birds, and rabbits, among others. The development of the NOAELs assumes that all water ingested by the receptors is contaminated and that water is the only source of contamination in a receptor's diet. The water-ingestion NOAELs are appropriate for comparison to water quality in the pools in Browns Wash (as opposed to surface water standards for aquatic life) because of the ephemeral nature of the pools and because of the very limited use of the pools by potential receptors. Maximum concentrations of contaminants observed in Browns Wash alluvium are much lower than NOAELs with, perhaps, the exception of nitrate. Therefore, even if Browns Wash pools were fed exclusively by the most contaminated water from Browns Wash alluvium, it is highly unlikely that the water would pose an unacceptable risk to potential ecological receptors. The observation of only a few tracks leading to only one pool over a 3-month period of field observations (during a period of several runoff events and active pool formation) indicates that these pools do not serve as an important water source for terrestrial wildlife.

The State of Utah has surface water standards for the protection of aquatic wildlife. These standards apply to the Green River and the backwater area at the mouth of Browns Wash where water is pooled on a relatively permanent basis and where aquatic life is more likely to reside for longer periods. Surface water standards and monitoring results since sampling was initiated in 2001 are presented in Table 5. There is no surface water standard for uranium.

Table 4. Ecological NOAELs and Browns Wash Alluvium Water Quality

Constituent of Concern	NOAEL Range[a] (mg/L)	Maximum Concentration in Browns Wash Alluvium[b] (mg/L)
Arsenic	0.292–156.9	0.0014
Manganese	377–30,435	3.15
Nitrate[c]	2,719–10,369	1,200 (as N); 940 (as NO_3)
Selenium	0.857–40.662	0.098
Uranium	6.995–488.4	9.5

Key: mg/L = milligrams per liter; NOAEL = No Observed Adverse Effects Level
[a]Sample, et al., 1996.
[b]Wells 0188, 0189, 0192, and 0194, monitored since 2001.
[c]Source for NOAELs did not specify how nitrate values were reported.

Table 5. Surface Water Standards and Results

Constituent of Concern	Surface Water Standard[a] (mg/L)	Maximum Concentration Observed in the Backwater[b] (mg/L)	Maximum Concentration Observed in the Green River[c] (mg/L)
Ammonia (as N)	About 0.5 to 1.0 (pH and temperature dependent)	0.1	0.1
Arsenic	4-day 0.150 1-hr 0.340	0.0014	0.0014
Nitrate (as N)	4	0.14	0.34
Selenium	4-day 0.0046 1-hr 0.0184	0.0038	0.00078

Key: mg/L = milligrams per liter.
[a]Source: Utah Rule R317-2, Standards of Quality for Waters of the State, Table 2.14.2.
[b]Location 0847 in Browns Wash near its confluence with the Green River.
[c]Location 0846 downstream of the Browns Wash confluence with the Green River.

As Table 5 shows, the backwater area and Green River water quality meets surface water quality standards. Because of the low quantity of water discharging from the Browns Wash alluvium, and because it is diluted by the Green River alluvial aquifer prior to entering the backwater area or the Green River, it is likely that Browns Wash alluvium groundwater has very little, if any, influence on the quality of the backwater. Therefore, the Green River is likely the main influence on water quality in the backwater area.

3.0 Groundwater Compliance Strategy

The groundwater compliance strategy for the Green River processing site (Subpart B of 40 CFR 192) is based on the compliance strategy selection framework (Figure 4) following the steps presented in the Programmatic Environmental Impact Statement (PEIS) (DOE 1996). DOE's goal is to implement a cost-effective groundwater compliance strategy at the Green River site that is protective of human health and the environment and returns contaminated groundwater to its maximum beneficial use. Because the disposal cell is located at the Green River processing site, both Subparts A (disposal site) and B (groundwater cleanup) of 40 CFR 192 will be addressed by the groundwater compliance strategy.

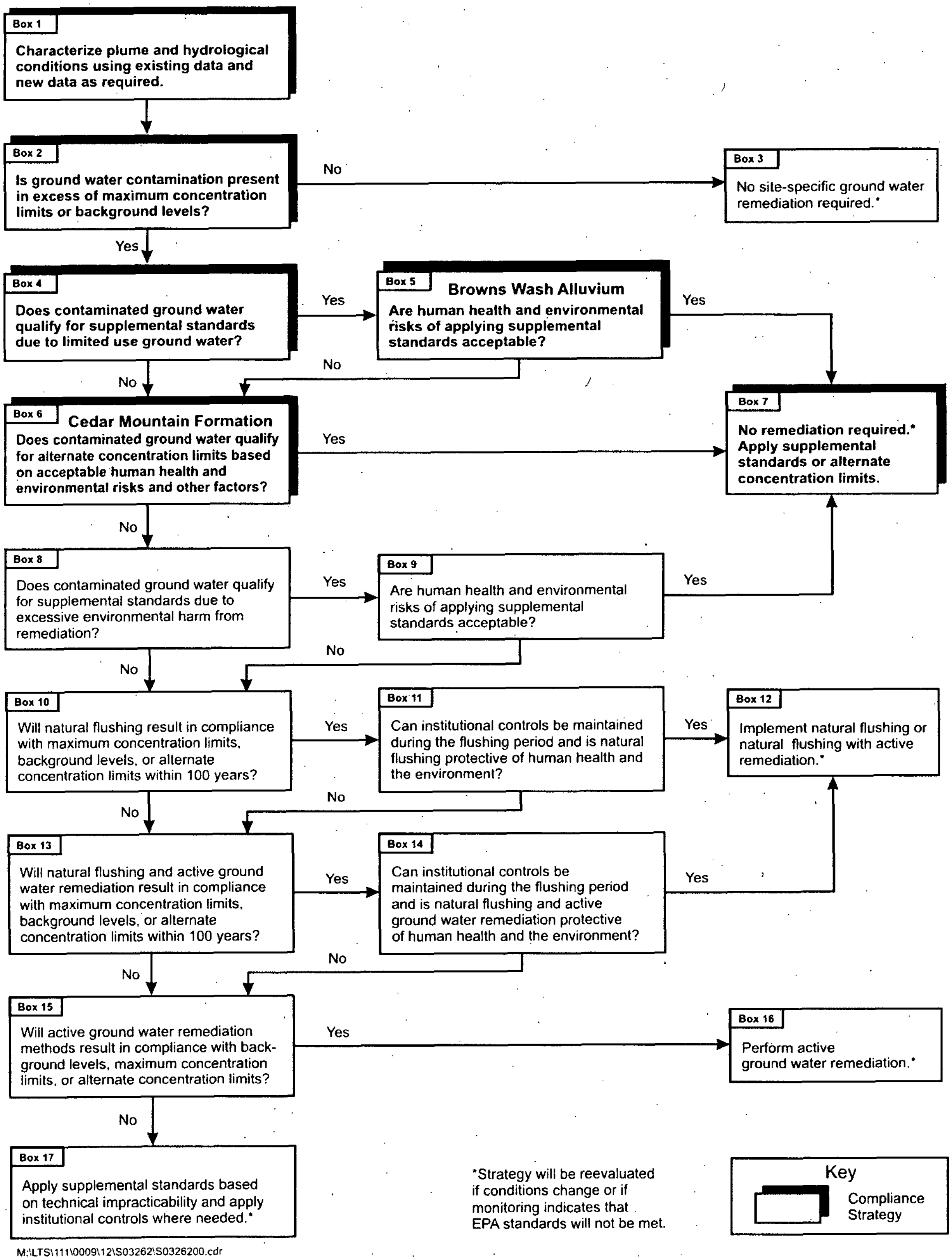


Figure 4. Compliance Strategy Decision Framework

Two distinct hydrostratigraphic units in the vicinity of the site that have been impacted by uranium processing activities—the Browns Wash alluvium and bedrock of the Cedar Mountain Formation. After evaluating existing site information and following the decision framework in the PEIS, the compliance strategy is:

1) No further remediation with the application of supplemental standards based on limited yield (sustained continuous flow of less than 150 gallons per day) for groundwater in the Browns Wash alluvium; and
2) No further remediation and application of ACLs for constituents with concentrations that exceed EPA maximum concentration limits (MCLs) and State of Utah groundwater quality standards for groundwater (Table 3) in the middle sandstone unit of the Cedar Mountain Formation.

The compliance strategy will be implemented in conjunction with groundwater and surface water monitoring to observe the effectiveness of the strategy, and institutional controls to provide adequate restriction of nearby land use and groundwater withdrawals. Updated risk assessments demonstrate that the compliance strategy will be protective of human health and the environment (DOE 2002 and DOE 2007).

3.1 Browns Wash Alluvium

The compliance strategy for groundwater in the Browns Wash alluvium is no further remediation with application of supplemental standards. This compliance strategy is based on the decision framework in Figure 4 and is explained in Table 6, and it fulfills the requirements for Subpart B of 40 CFR 192.

Table 6. Compliance Strategy Selection Process for Groundwater in the Browns Wash Alluvium

Box from Figure 4	Action or Question	Result or Decision
1	Characterize plume and hydrological conditions.	See conceptual site model presented in Section 5.0 and contaminant screening presented in Section 6.0 of the SOWP. Move to Box 2.
2	Is groundwater contamination present in excess of MCLs or background levels?	Ammonia, manganese, nitrate, selenium, sodium, sulfate, and uranium exceed the EPA MCLs or appropriate benchmarks at one or more monitoring points. Move to Box 4.
4	Does contaminated groundwater qualify for supplemental standards due to limited-use groundwater?	Yes. Groundwater in the Browns Wash alluvium qualifies for limited use because it is not capable of a sustained yield of 150 gallons per day. Move to Box 5.
5	Are human health and environmental risks of applying supplemental standards acceptable?	Yes. The quantity of groundwater available would not result in unacceptable exposures. Groundwater currently does not discharge to the surface in quantities sufficient to produce unacceptable environmental risks. Move to Box 7.
7	Compliance strategy	No remediation required. Apply supplemental standards.

Groundwater in Browns Wash alluvium qualifies for supplemental standards based on limited yield (less than 150 gallons per day) as demonstrated by observations of groundwater availability in the alluvial system during field investigations (DOE 2002) and sampling events. Groundwater levels in the Browns Wash alluvium are below the elevation of the wash. Monitoring will be performed as a best management practice in conjunction with the compliance strategy to track and evaluate trends of contaminant concentrations in the alluvium and to determine if the groundwater affects surface water quality. The monitoring also satisfies a State of Utah concern that supplemental standards consider potential effects on surface water.

3.2 Cedar Mountain Formation

3.2.1 Compliance Strategy

The compliance strategy for groundwater in the middle sandstone unit of the Cedar Mountain Formation is no further remediation with application of ACLs. The compliance strategy is based on the decision framework in Figure 4 and is explained in Table 7, and fulfills requirements for both Subpart A and Subpart B of 40 CFR 192. Implementation of this strategy is presented in this document and will be included in the revised LTSP that is the licensing document for the disposal site (Subpart A of 40 CFR 192).

Table 7. Compliance Strategy Selection Process for Groundwater in the Cedar Mountain Formation

Box from Figure 4	Action or Question	Result or Decision
1	Characterize plume and hydrological conditions.	See conceptual site model presented in Section 5.0 and contaminant screening presented in Section 6.0 of the SOWP. Move to Box 2.
2	Is groundwater contamination present in excess of MCLs or background levels?	Arsenic, nitrate, selenium, and uranium exceed groundwater standards at one or more monitoring points. Move to Box 4.
4	Does contaminated groundwater qualify for supplemental standards due to limited-use groundwater?	Groundwater in the Cedar Mountain Formation is not classified as limited use. Move to Box 6.
6	Does contaminated groundwater qualify for ACLs based on acceptable human health and environmental risks and other factors?	Yes. (1) A disposal cell is located above the contaminated area of the aquifer, (2) the State of Utah owns the surrounding land, (3) institutional controls (ICs) can be implemented that would prevent use of contaminated water, and (4) outside the IC boundary at the point of exposure, groundwater would be suitable for unrestricted use. Move to Box 7.
7	Compliance strategy	No remediation required. Apply ACLs.

Groundwater in the middle sandstone unit of the Cedar Mountain Formation qualifies for ACLs based on existing conditions at the processing/disposal site (DOE 2002). The application for ACLs for the Green River site, as required by EPA and NRC guidance, is included as Appendix A to this report and is summarized in this section.

At the Green River site, a disposal cell was built at the same location where processing of uranium ores took place. Although it is not clear if the contaminants detected in the Cedar Mountain Formation are a result of disposal cell seepage or if they pre-date cell construction, the fact that a cell exists at the site makes the use of ACLs as groundwater standards reasonable. EPA specifically retained the ACL provision in its final groundwater rule (40 CFR 192) "because it is clearly needed, if for no other reason than to deal with the possibilities of unavoidable minor projected seepage over the extremely long-term design life (1,000 years) of the disposal required . . ." (60 FR 2854). The ACL policy was developed for use at sites where concentration levels less stringent than MCLs would still be protective of human health and the environment.

Groundwater flow direction in the middle sandstone unit of the Cedar Mountain Formation is generally in the northwest direction. The groundwater flow velocity in the middle sandstone unit is apparently very low. The middle sandstone unit is not laterally continuous, especially to the south and west, and is not a significant source of groundwater. Water used for domestic purposes in the Green River area is predominantly surface water obtained from the Green River. The low groundwater flow velocity in the middle sandstone unit impedes the natural flushing of existing contamination from the groundwater system. Because of the limited extent of this unit and associated contamination, and the fact that use of water from this unit is unlikely, active remediation provides little, if any, benefit or risk reduction. Establishment of ACLs with no remediation, therefore, appears to be the most reasonable compliance strategy for the middle sandstone unit of the Cedar Mountain Formation. ACLs may be applied if the constituents will not pose a substantial present or potential hazard to human health and the environment as long as the ACLs are not exceeded. The factors specified in 40 CFR 192.02(c)(3)(ii)(B) have been considered for the Green River site and are included in Appendix A.

3.2.2 Basis for Alternate Concentration Limits

Constituents of potential concern (COPC) that require ACLs because concentrations exceed their respective EPA groundwater standards (EPA 1995, 40 CFR 192) are arsenic, nitrate, selenium, and uranium. Sodium and sulfate were also identified as COPCs in the SOWP because of elevated concentrations (DOE 2002); however, these constituents do not have groundwater standards or aquatic benchmarks and will not be monitored. Manganese concentrations—though they exceed aquatic benchmarks—are below human-health risk-based concentrations; therefore, manganese is not considered to be a COPC for the Cedar Mountain Formation groundwater and will not be monitored.

Based on a comparison of detected concentrations of analytes in groundwater with risk-based concentrations, arsenic is the constituent that makes up greater than 95 percent of the potential risks associated with groundwater use. Nitrate, selenium, and uranium make up most of the remaining risk. Because these four constituents are the only ones of concern at the Green River site for which EPA and the State of Utah have groundwater standards, they are identified as the contaminants for long-term compliance monitoring at the site.

In determining an appropriate method to establish numerical values for ACLs at the Green River site, the methodology used for other uranium mining and Comprehensive Environmental Response, Compensation, and Liability Act sites was reviewed. A case study provided in EPA guidance on groundwater remedial actions (EPA 1988) first considered the potential effect of groundwater discharge on surface water (the point of exposure, or POE). In that study of a former municipal landfill, a dilution factor of 40,000, even under low-flow conditions, led to the conclusion that groundwater discharge would have no impact at the POE. The ACL proposed was simply 10 times the groundwater concentrations observed at that time. In several other studies with surface water POEs, dilution factors were used to calculate the maximum permissible concentrations in groundwater that would still be protective of discharge to surface water (Umetco 2003; EPA 1990 and 1998). For most sites, it appears that one site-wide ACL was established for each constituent and that the ACL applied to all POC wells (EPA 1998). However, for one uranium-milling site, compliance was determined by comparing the average concentration of POC wells against the ACL. At some sites, individual ACLs were established for each constituent at each well, resulting in over 100 ACLs for a given site (EPA RODS database).

At the Green River site, it is not clear if groundwater actually discharges to the surface to any significant degree. However, if it does, the POE could be the Green River but, because the middle sandstone unit of the Cedar Mountain Formation appears to pinch out west of the site, the most likely POE would be Browns Wash. Because Browns Wash is only likely to contain water following a significant precipitation event, it is assumed that any groundwater discharging to the wash would be diluted. The Green River would also dilute any potential groundwater discharge. Average monthly discharge rates for the Green River range from 2,300 to 18,000 cubic feet per second (cfs) in the vicinity of the Green River site (USGS monitoring data), while groundwater discharge from the middle sandstone unit is estimated without empirical data at much less than 100 gallons per minute (0.2 cfs), resulting in a greater than 10,000-fold dilution at the lowest flow rate in the river. This means that to meet the benchmarks contained in Table 3, concentrations of constituents in groundwater could be hundreds to thousands of times higher than those currently observed.

Because DOE's ACL guidance indicates that ACLs should be established at levels that are as low as reasonably achievable, the ACLs are not based on maximum assumed dilution rates. Rather, ACLs were set at two orders of magnitude (100 times) the respective MCLs and are expected to be achievable based on observed site conditions (see Appendix A). As discussed in Section 2.2, constituent concentrations have fluctuated inexplicably at some of the monitor wells adjacent to the disposal cell. Depending on site conditions, some further variability may be expected. The ACLs will accommodate potential future increases and should be more than protective at the POEs, given the assumed dilution rates of the Green River.

The groundwater monitoring network for the ACL compliance strategy for the Cedar Mountain Formation consists of six POC wells adjacent to the disposal cell (0171, 0173, 0176, 0179, 0181, and 0813). These wells are completed in the contaminated middle sandstone unit of the Cedar Mountain Formation and are currently being monitored. The POC wells would monitor potential discharge of contaminants from the disposal cell into the middle sandstone unit of the Cedar Mountain Formation.

3.2.3 Alternate Concentration Limits

For simplicity and ease in implementation, and in accordance with EPA guidance (EPA 1992), site-wide ACLs will be applied to the POC wells. Table 8 presents the ACLs along with maximum analytical results through June 2007 for the six POC wells.

Standard concentration limits are derived from EPA MCLs established in 40 CFR 192 and from State of Utah groundwater quality standards established in Rule R317-6-2. The limits for arsenic (0.05 mg/L) and nitrate (10.0 mg/L) are the same for both sources. The State standard for selenium (0.05 mg/L) is greater than the EPA MCL (0.01 mg/L) and is used as the human health benchmark because of elevated levels of naturally occurring selenium in the region. The maximum background concentrations for selenium in both the Browns Wash alluvium groundwater and the middle sandstone unit aquifer equal or exceed the EPA MCL (Table 3). The EPA MCL of 0.044 mg/L is used as the human health benchmark for uranium.

Table 8. Alternate Concentration Limits and Maximum Concentrations for the Green River Site

Constituent[a]	Standard (mg/L)	ACL (mg/L)	Maximum Concentration Observed to Date in POC Wells[b] (mg/L)
Arsenic	0.05[c]	5.0	0.191
Nitrate + Nitrite as N	10.0[c]	1,000	427
Selenium	0.05[d]	5.0	0.850
Uranium	0.044[c]	4.4	0.229

Key: ACL = alternate concentration limit; mg/L = milligrams per liter; POC = point of compliance.
[a]Ammonia will be monitored in groundwater as a best management practice to compare with surface water concentrations.
[b]Wells 0171, 0173, 0176, 0179, 0181, and 0813.
[c]EPA MCL (40 CFR 192, Table 1).
[d]State of Utah groundwater quality standard (Rule R317-6-2, Table 1).

The methodology used for deriving ACLs in this GCAP differs from that originally proposed in the SOWP. The ACLs proposed in the SOWP were somewhat arbitrary (based on maximum observed concentrations) and considered achievable at the time. Since that time, it was recognized that higher ACLs would avoid needlessly triggering the corrective action process and would not increase the risk to human health and the environment. The current approach—using established standards and applying a multiplier (100) to account for geochemical attenuation and dilution—was developed to account for the widely variable concentrations observed at some POC wells.

3.3 Human Health and Environmental Risk

The human health risk assessment update in the SOWP and subsequent assessments concluded that there is no unacceptable risk from site-related contaminants in groundwater with the application of supplemental standards for the Browns Wash alluvial aquifer and ACLs for the middle sandstone unit aquifer of the Cedar Mountain Formation (DOE 2002 and DOE 2007). The ecological risk assessment determined that there is little potential for site-related constituents to affect surface water or sediments and, consequently, ecological receptors. As noted previously, dilution of any contamination potentially discharging to the surface is likely. In addition, any potential exposure of wildlife to contamination is expected to be infrequent and will not result in any unacceptable risks.

4.0 Compliance Strategy Implementation

The compliance strategy for Subparts A and B of 40 CFR 192 for the Green River site will be implemented in conjunction with groundwater and surface water monitoring and institutional controls.

4.1 Monitoring Program

Groundwater and surface water will be monitored at select locations annually to observe the effectiveness of the compliance strategy and ensure the long-term protection of human health and the environment. A summary of the monitoring requirements is presented in Table 9.

Table 9. Summary of Monitoring Requirements for the Green River Site

Location	Monitoring Purpose[a]	Analytes	Frequency
Groundwater			
0171, 0173, 0176, 0179, 0181[b], 0813	POC wells adjacent to the disposal cell and completed in the middle sandstone unit of the Cedar Mountain Formation; monitor cell performance.	Ammonia, arsenic, nitrate, selenium, uranium	Annually for 5 years beginning in 2007; reevaluate monitoring requirements at that time. If an ACL is exceeded, quarterly monitoring is triggered.
0188, 0189, 0192, 0194	Best management practice monitor wells completed in the Browns Wash alluvium; monitor processing-related contaminants.	Ammonia, arsenic, nitrate, selenium, uranium	Annually for 5 years beginning in 2007; reevaluate monitoring requirements at that time.
0171, 0173, 0176, 0179, 0182, 0183, 0184, 0185, 0582, 0588, 0813, 0817	Monitor wells completed in the basal and middle sandstone units of the Cedar Mountain Formation; confirm persistence of the upward hydraulic gradient and evaluate aquifer flow directions.	Water level only[c] unless gradient reverses	Continuous monitoring with automated data loggers for 5 years beginning in 2007; reevaluate monitoring requirements at that time.
Surface Water			
0846, 0847	Potential POE; monitor for degradation of water quality in the backwater area of Browns Wash and in the Green River immediately downstream of Browns Wash.	Ammonia, arsenic, nitrate, selenium, uranium	Annually for 5 years beginning in 2007; reevaluate monitoring requirements at that time. If a surface water standard is exceeded, quarterly monitoring is triggered.

Key: ACL = alternate concentration limit; POC = point of compliance; POE = point of exposure.
[a]Monitoring program addresses both Subparts A and B of 40 CFR 192.
[b]Monitor well 0181 was installed as an offset replacement well for monitor well 0172 due to unsatisfactory completion characteristics.
[c]Except for the POC wells.

The groundwater monitoring network for the ACL compliance strategy for the middle sandstone unit of the Cedar Mountain Formation consists of six POC wells adjacent to the disposal cell (0171, 0173, 0176, 0179, 0181, and 0813). The POC wells, shown on Figure 5, will be monitored for potential discharge of contaminants from the disposal cell into the middle sandstone unit of the Cedar Mountain Formation. DOE will compare annual sample results at each of the POC wells with the ACLs. If any constituent in any well exceeds the respective ACL, DOE will conduct quarterly monitoring for a year at the well in which the exceedance occurred. The four quarterly results will be evaluated, and the need for corrective action will be assessed.

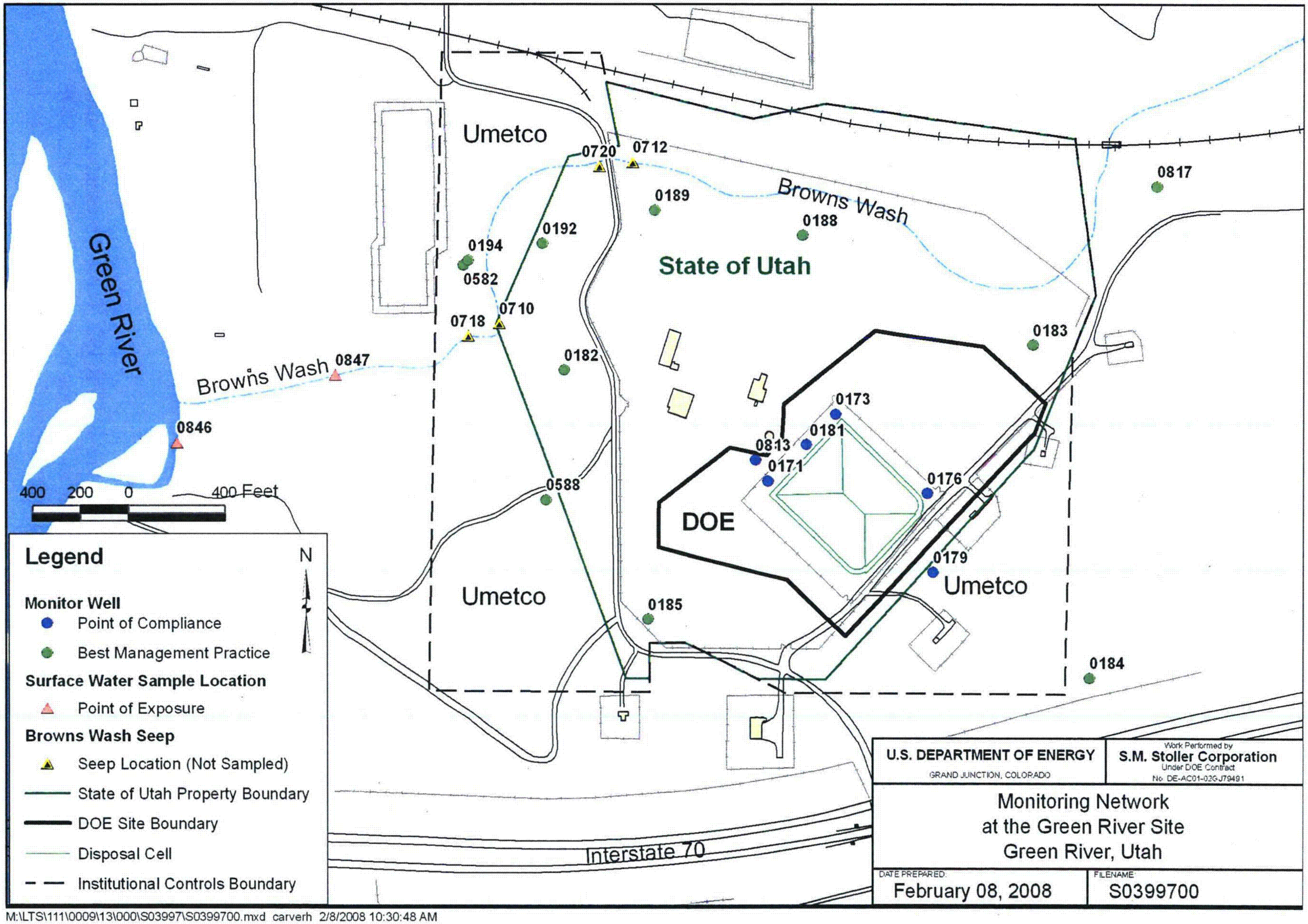


Figure 5. Monitoring Network and Institutional Controls Boundary at the Green River Site

Because the conceptual model of the site indicates that groundwater in the middle sandstone unit of the Cedar Mountain Formation could potentially discharge into the Browns Wash alluvial system via vertical fractures in the formation, alluvial wells 0188, 0189, 0192, and 0194 will be monitored as a best management practice to provide an indication of contaminant migration along this pathway. However, in the unlikely event that contaminated groundwater from the Cedar Mountain Formation discharges into the Browns Wash alluvium, the presence of additional contaminants probably would be masked by the existing processing-related contaminants in the alluvium. Also, groundwater that may seep upward through vertical fractures would be expected to include water of unknown quality from deeper aquifers. Therefore, the greatest benefit of monitoring the alluvium will be to track and evaluate trends of the processing-related contaminants to determine if contaminants are affecting surface water quality. Because application of supplemental standards is the compliance strategy for the Browns Wash alluvium, sample results will not be compared to ACLs and corrective action will not be triggered.

Groundwater in the underlying basal sandstone unit of the Cedar Mountain Formation has not been contaminated by site-related activities because there is a strong upward hydraulic gradient due to the hydrogeologic characteristics of the area. As long as this upward hydraulic gradient persists, which would not change under natural conditions, contamination from the middle sandstone unit is unlikely to migrate downward into the basal sandstone unit. In order to confirm that the upward hydraulic gradient persists, DOE will continuously measure static water levels in five basal sandstone unit monitor wells (0182, 0184, 0185, 0582, and 0588) and in seven middle sandstone unit monitor wells (0171, 0173, 0176, 0179, 0183, 0813, and 0817) as a best management practice. The potentiometric surfaces of both aquifers will be evaluated annually. In the unlikely event that the vertical gradient reverses, DOE will implement groundwater quality monitoring in the basal sandstone unit.

Two surface water monitoring locations are currently being sampled. One location, 0847, is in the backwater area of Browns Wash near its confluence with the Green River (Appendix B, Photo 9), and the other, 0846, is in the Green River immediately downstream of the mouth of Browns Wash. Monitoring occurs in June, at which time this habitat is most important to endangered fish species, specifically the Colorado pikeminnow (*Ptychocheilus lucius*). This is the time that follows spawning and when the river stage is declining. There are times when the backwater area is nearly filled with sediment from runoff events in Browns Wash, thus eliminating the backwater area as a fish habitat. DOE proposes to continue monitoring the surface water at these locations as a best management practice to verify that any contaminated groundwater discharging to the surface in Browns Wash or the Green River would not adversely affect ecological receptors near the confluence of Browns Wash and the Green River.

DOE will compare the surface water sampling results from the backwater area and from the Green River downstream of its confluence with Browns Wash with applicable State of Utah surface water standards (Table 5). If a result exceeds a respective surface water standard, quarterly monitoring will be conducted at that location for a year. The results will be evaluated in comparison to groundwater results to determine if there is any correlation with groundwater contaminants.

The monitoring program would satisfy requirements in 40 CFR 192. Table 9 presents a summary of the monitoring program, and Figure 5 shows the monitoring locations. After 5 years, DOE will reassess monitoring requirements and recommend modifications to NRC and the State of

Utah as necessary. The reassessment would include an evaluation of water quality trends to help determine the extent and duration of continued monitoring.

4.2 Institutional Controls

DOE, the State of Utah, and Umetco Minerals Corporation own property affected by groundwater contamination. Institutional controls will be placed on groundwater that is currently contaminated or that may be affected in the future. The institutional controls boundary (Figure 5), positioned along existing property boundaries and section lines for convenience, encompasses the area of groundwater withdrawal restrictions.

Groundwater in the Browns Wash alluvium is not used and is not ever expected to be used because of its low yield and naturally poor water quality. Also, because of the limited contribution of groundwater from the Browns Wash alluvium to the Green River alluvial aquifer, site-related contaminants will not pose an unacceptable risk to the Green River alluvial aquifer. Therefore, there is no need for restrictions west of the institutional controls boundary.

The relatively thin saturated thicknesses of the middle and basal sandstone units of the Cedar Mountain Formation in the vicinity of the site preclude agricultural or industrial use of these aquifers. No wells are completed in these aquifers in the area. If a domestic well were to be completed in the basal sandstone unit, it would influence only a small area in the immediate vicinity of the well. The next deepest groundwater bearing formation in the vicinity of the site that possibly has the potential for use is the Jurassic Entrada Sandstone, located a minimum of 450 feet below the Cedar Mountain Formation. It is not used as a groundwater supply in the area and is an unlikely source of industrial or agricultural water.

Known contamination in the middle sandstone unit of the Cedar Mountain Formation is limited to close proximity of the disposal cell. The middle sandstone unit pinches out west and south of the cell; therefore, drilling west or south of the institutional controls boundary would not encounter the aquifer. Water-level data indicate that the groundwater flow is in the northwest direction from the cell; therefore, potential groundwater withdrawal east of the boundary would be up-gradient of the contaminated portion of the aquifer, and it is unlikely that it would influence the flow direction due to the very low flow rate in the middle sandstone unit aquifer. Because of the distance from the cell, low flow rate, and lateral discontinuities in the middle sandstone unit aquifer, it is unlikely that potential groundwater withdrawal north of the boundary would draw contaminated groundwater that far.

Utah Senate Bill 84, "Real Property Voluntary Environmental Restrictive Covenants," passed in March 2003, contains provisions for creating perpetual environmental covenants that place restrictions on groundwater access, including drilling and the pumping of groundwater from the land where remedial actions have been completed and contamination has been left in place. These covenants are legally enforceable restrictions on land and groundwater use and therefore meet the definition of institutional controls under UMTRCA.

An environmental covenant will be implemented to prohibit the use of groundwater for any purpose, without the permission of both DOE and the State of Utah, on the land within the institutional controls boundary. This restriction would be perpetual, although it could be lifted if concentrations decrease to levels that permit unrestricted use. DOE would work with the Utah

Department of Environmental Quality to establish the covenants and to ensure that they remain in force as long as necessary. A draft *Environmental Notice and Institutional Control* document for the affected private landowner (Umetco) is provided in Appendix D.

5.0 References

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations*, July 1, 2007.

60 FR 2854. U.S. Environmental Protection Agency, "Ground Water Standards for Remedial Actions at Inactive Uranium Processing Site; Final Rule," *Federal Register*, January 11, 1995.

DOE (U.S. Department of Energy), 1991. *Remedial Action Plan and Final Design for Stabilization of the Inactive Uranium Mill Tailings at Green River, Utah*, Final, UMTRA-DOE/AL-050510.GRN0, March.

DOE (U.S. Department of Energy), 1996. *Final Programmatic Environmental Impact Statement for the Uranium Mill Tailings Remedial Action Groundwater Project*, DOE/EIS-0198, October.

DOE (U.S. Department of Energy), 1998a. *Modification No. 2 to the Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Site at Green River, Utah*, Final, DOE/AL/62350-050510, March.

DOE (U.S. Department of Energy), 1998b. *Long-Term Surveillance Plan for the Green River, Utah Disposal Site*, DOE/AL/62350-89, Rev. 2, July.

DOE (U.S. Department of Energy), 2002. *Final Site Observational Work Plan for the Green River, Utah, UMTRA Project Site,* GJO-2002-356-TAC, September.

DOE (U.S. Department of Energy), 2007. *Draft Environmental Assessment of the Ground Water Compliance at the Green River, Utah, Disposal Site,* DOE/EA–1511, August.

EPA (U.S. Environmental Protection Agency), 1988. Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites, OSWER Directive 9283.1-2, EPA 540 G-88 003, December.

EPA (U.S. Environmental Protection Agency), 1990. EPA Superfund Record of Decision: Pickettville Road Landfill, EPA/ROD/R04-90/075, September.

EPA (U.S. Environmental Protection Agency), 1992. Methods for Evaluating the Attainment of Cleanup Standards Vol. 2. Groundwater, EPA 230-R-92-014, July.

EPA (U.S. Environmental Protection Agency), 1995. Groundwater Standards for Remedial Actions at Inactive Uranium Processing Sites, Final Rule, 60FR2854, January 11, 1995.

EPA (U.S. Environmental Protection Agency), 1998. EPA Superfund Record of Decision: Murray Smelter, EPA/ROD/R08-98/078, April.

EPA (U.S. Environmental Protection Agency), 2002a. Announcement of Preliminary Regulatory Determinations for Priority Contaminants on the Drinking Water Contaminant Candidate list, 67 FR 38222, June 3, 2002.

EPA (U.S. Environmental Protection Agency), 2002b. 2002 Editions of the Drinking Water Standards and Health Advisories, EPA822-R-02-038, Summer.

EPA (U.S. Environmental Protection Agency), 2002c. National Recommended Water Quality Criteria: 2002. EPA 822-R-02-047, November.

Sample, B.E., D.M. Opresko, and G.W. Suter II, 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision,* Lockheed Martin Energy Systems, Inc., ES/ER/TM-86/R3.

Umetco Minerals Corporation, (Umetco) 2003. Application for Alternate Concentration Limits, Uravan Project Site, July.

End of current text

Appendix A

Application for Alternate Concentration Limits for the Green River, Utah, Disposal Site

This page intentionally left blank

Contents

1.0 Introduction A–1
1.1 Purpose A–1
1.2 Site Background A–1
2.0 Proposed ACLs A–3
2.1 ACL Applicability A–3
2.2 ACLs and Compliance Assessment A–5
2.2.1 Constituents of Potential Concern A–5
2.2.2 Point of Compliance and Point of Exposure A–6
2.2.3 Rationale and Implementation A–6
3.0 Factors Considered in Making Present and Potential Hazard Findings A–8
3.1 Potential Adverse Effects on Groundwater Quality A–8
3.2 Potential Adverse Effects on Hydraulically Connected Surface Water Quality .. A–10
4.0 Roadmap to the SOWP and Additional Information A–11
4.1 General Information A–11
4.2 Results of Corrective Action Program A–11
4.3 Feasibility of Alternative Corrective Actions A–12
4.4 Corrective Action Costs and Benefits A–12
4.5 ALARA Demonstration A–12
4.6 Proposed Alternate Concentration Limits A–12
5.0 References A–12

Figure

Figure A–1. Location Map of the Green River, Utah, Disposal Site A–2

Tables

Table A–1. Maximum Groundwater Concentrations in the Cedar Mountain Formation and Relevant Benchmarks for the Green River Site A–5
Table A–2. Proposed Alternate Concentration Limits for the Green River Site A–8

End of current text

1.0 Introduction

1.1 Purpose

The purpose of this document is to fulfill the U.S. Nuclear Regulatory Commission (NRC) requirements for an application for alternate concentration limits (ACL) for uranium and other constituents of potential concern (COPCs) at the Uranium Mill Tailings Radiation Control Act (UMTRCA) Title I disposal site at Green River, Utah. The focus is on groundwater in bedrock of the Cedar Mountain Formation beneath and down-gradient from the disposal cell. Much of the information required by NRC for an ACL application (the *Code of Federal Regulations*, Title 10, Part 40 [10 CFR 40]; Appendix A; and NRC 1996) has been compiled in the Baseline Risk Assessment (DOE 1995), Modification No. 2 to the Remedial Action Plan (DOE 1998a), the Site Observational Work Plan (SOWP) (DOE 2002) for the Green River site, and the Groundwater Compliance Action Plan (GCAP).

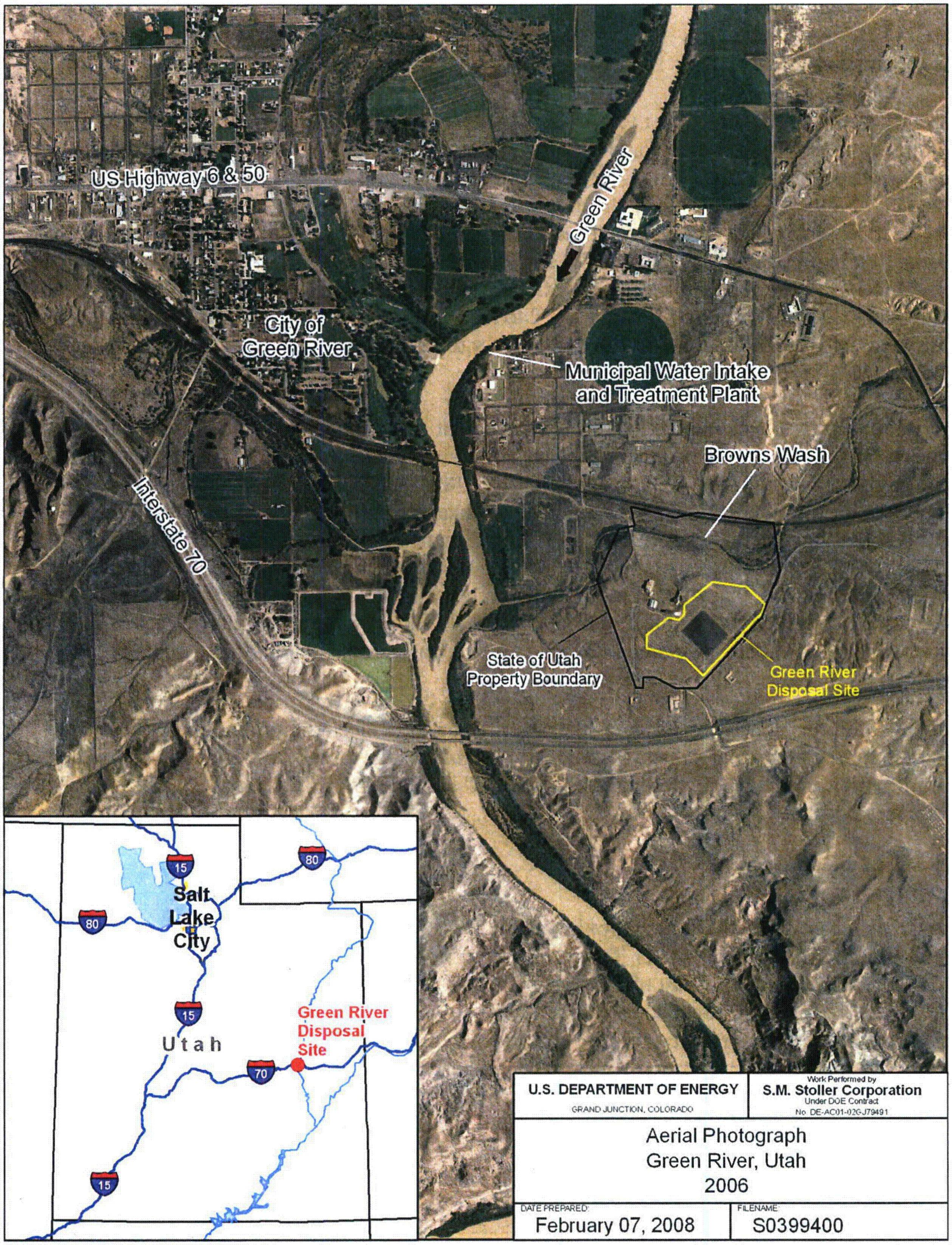
This document is an appendix to the GCAP. The intent of this document is to provide a link between NRC evaluation criteria and relevant discussion of those criteria in previous documents. NRC guidance for preparing ACL applications for UMTRCA Title II sites (NRC 1996) was used as a model for this application. This document summarizes pertinent information from the SOWP regarding "Factors Considered in Making Present and Potential Hazard Findings" (Table 1 in NRC 1996; also specified in 40 CFR 192 with slight modifications). It also identifies sections of the SOWP that contain information corresponding to sections listed in the "Standard ACL Application Format" (Table 2 in NRC 1996). This approach ensures that all factors and information related to the proposed ACLs have been considered and minimizes the duplication of effort.

Section 2.0 of this document discusses the constituents for which ACLs are proposed and the rationale for the numerical values. Section 3.0 summarizes the factors considered in making hazard findings. Section 4.0 presents the "roadmap" to the SOWP, following the standard ACL application format.

1.2 Site Background

The Green River disposal site is approximately 1.5 miles southeast of the city of Green River, in Grand County, Utah (Figure A–1). The site is immediately south of the ephemeral Browns Wash and approximately 0.5 mile east of the Green River, with elevations ranging from 4,075 to 4,140 feet. The site is surrounded by State of Utah property that is bounded on the north by U.S. Army and private property, on the south by U.S. Army property, and on the east and west by Umetco Minerals Corporation (Umetco) property. The U.S. Army property is part of the Utah Launch Complex of the White Sands Missile Range.

The city of Green River is a community of approximately 1,000 residents on the border of Emery and Grand counties, Utah. The economy of the area depends mainly on agriculture and tourism. The former uranium-ore processing site is currently owned by the State of Utah, and the disposal cell area is owned by the U.S. Department of Energy (DOE) (Figure A–1). There is no current use of the former processing site area. Several of the mill buildings were decontaminated and remain on State property. These buildings are currently abandoned and in a state of disrepair. There is also an abandoned water tower on State property immediately northwest of the disposal cell.



M:\LTS\111\0009\13\000\S03994\S0399400.mxd carverh 2/7/2008 11:32:47 AM

Figure A–1. Location Map of the Green River, Utah, Disposal Site

Groundwater is not a current source of drinking water in the area of the Green River site because of the availability of good-quality water from the Green River municipal water-supply system (DOE 1995). The source of water for the municipal system is the Green River; the water-intake station and treatment plant are located on the east side of the Green River, approximately 0.75 mile upstream of the mouth of Browns Wash. Residents of the city of Green River are connected to the municipal water system. One residence west of the site is reportedly not connected to the system, but the owner hauls water for domestic purposes from the city water-supply system and stores it in a water tank. The nearest domestic wells in the area are north of U.S. Highway 6 and 50, and south of Interstate Highway 70. Groundwater from these wells is used for irrigation (DOE 1995). There are no known current uses of surface water or groundwater along Browns Wash in the vicinity of the site.

The uranium mill at the Green River site was constructed in 1957 and operated from March 1958 through January 1961 by Union Carbide Corporation. The plant was operated for upgrading uranium ore from the Temple Mountain mining district area approximately 60 miles southwest of the site. During its 3 years of operation, the mill processed 183,000 tons of ore with an average grade of 0.29 percent uranium oxide (FBDU 1981). The upgraded ore concentrate was shipped by rail to Rifle, Colorado, for further processing. The former Green River plant generated an estimated 137,000 tons of tailings, which covered approximately 9 acres to an average depth of 7 feet. After milling operations were completed, Union Carbide leased the site to a company under contract with the U.S. Department of Defense, which used the mill buildings for missile testing and assembly. Union Carbide owned the uranium millsite until the State of Utah acquired ownership in 1988.

The processing site was remediated from November 1988 through September 1989, and all mill tailings and residual radioactive material were stabilized in a partially below-grade disposal cell in the area just southeast of the former mill buildings (Figure A–1). The disposal cell base is about 35 feet below grade, and contaminated materials were emplaced in the cell to about 40 feet above grade. The disposal cell, closed on September 15, 1989, covers approximately 6 acres. The area of the former tailings pile and all areas disturbed at the site during the remedial action were backfilled, graded to promote surface drainage, and revegetated.

2.0 Proposed ACLs

2.1 ACL Applicability

The U.S. Environmental Protection Agency (EPA) provided guidance for applying ACLs at Resource Conservation and Recovery Act (RCRA) hazardous waste facilities (EPA 1987). The NRC used this guidance as a basis for developing ACL guidance for UMTRCA Title II uranium mills (NRC 1996). EPA further indicated that ACLs could similarly apply to UMTRCA Title I processing sites, particularly in instances where a disposal cell is present. As noted in the preamble to the final rule for Title I sites (60 FR 2854), "EPA has decided not to delete the ACL provision because it is clearly needed, if for no other reason than to deal with the possibilities of unavoidable minor seepage over the extremely long-term design life (1,000 years) of the disposal required . . ." Both EPA RCRA ACL guidance and NRC Title II ACL guidance were referenced in these regulations as providing criteria for assessing the appropriateness of using ACLs at a given site.

The ACL policy was developed for use at sites where concentration levels less stringent than EPA maximum concentration limits (MCLs) or background would still be protective of human health and the environment or for application to constituents for which MCLs have not been developed. A further function of an ACL is to serve as a "trigger" to evaluate whether corrective action is required (EPA 1987). For UMTRCA Title I sites, exceedence of an ACL initiates the corrective action process (40 CFR 192.04). Furthermore, ACLs for UMTRCA Title II sites are supposed to be established at levels "as low as reasonably achievable" (ALARA) (NRC 1996).

In the case of the Green River site, a disposal cell was built at the same location where uranium ores were processed. Minor seepage from the disposal cell may have resulted in somewhat elevated concentrations of mill-related constituents in the uppermost aquifer (middle sandstone unit of the Cedar Mountain Formation) below the cell, though tailings did not contain appreciable moisture when they were disposed of. Estimates are that the tailings at the Green River site were 15 to 25 percent saturated when placed in the cell (DOE 1991); no slimes were present.

If any transient drainage continues, it should be minimal and probably confined to the immediate vicinity of the disposal cell. Although it is not clear if the contaminants detected in the Cedar Mountain Formation are a result of disposal cell seepage or if they pre-date cell construction, the fact that a cell exists at the site makes the use of ACLs as groundwater standards reasonable.

Water levels in wells adjacent to the disposal cell generally increased for about 3 years, declined for the next 11 years, and then began increasing again in late 2004 (Appendix C, Figure C–1). Initial transient drainage from the disposal cell may have caused a temporary increase in water levels in the early 1990s, followed by decreasing levels as drainage slowed. Some of the decrease, to levels below initial measurements, may also be attributable to drought conditions that persisted in the area for several years. Precipitation in the region has returned to normal or above-normal amounts, and current water levels are greater than historical measurements. Since 2004, water levels in the middle sandstone unit have increased approximately 8 feet.

Groundwater flow direction in the middle sandstone unit of the Cedar Mountain Formation is to the northwest, and the flow velocity is apparently very low. Contamination is confined to the immediate vicinity of the cell. The middle sandstone unit is not laterally continuous, especially to the south and west, and is not a significant source of groundwater. Although there are no data to verify it, some groundwater from the middle sandstone unit of the Cedar Mountain Formation may discharge through joints and fractures to the alluvium in Browns Wash, which qualifies for supplemental standards due to low groundwater yield, or to the Green River alluvium (DOE 2002).

Water used for domestic purposes in the Green River area is predominantly surface water obtained from the Green River and withdrawn upstream of the Browns Wash confluence. Most of the groundwater used in the area is obtained from the Green River alluvium (DOE 1995). The low groundwater flow velocity in the middle sandstone unit impedes the natural flushing of existing contamination from the groundwater system. However, because of the limited extent of this unit and associated contamination, and the fact that use of water from this unit is unlikely, active remediation provides little, if any, benefit or risk reduction. Establishment of ACLs with no remediation appears to be the most reasonable compliance strategy for the middle sandstone unit of the Cedar Mountain Formation.

2.2 ACLs and Compliance Assessment

2.2.1 Constituents of Potential Concern

Table A–1 shows the maximum concentrations of various contaminants in the Cedar Mountain Formation. Provided for comparison are relevant human health and aquatic benchmarks.

Table A–1. Maximum Groundwater Concentrations in the Cedar Mountain Formation and Relevant Benchmarks for the Green River Site

Constituent	Human Health Benchmark (mg/L)	Aquatic Benchmark (mg/L)	Maximum in Cedar Mountain Formation[a] (mg/L)
Ammonia	30 (total as NH_3) 32 (total as NH_4)[b]	<6 (total as N) <7.7 (total as NH_4)[c]	1.0
Arsenic	0.05[d]	0.150[c]	0.191
Manganese	1.7[e]	0.08[f]	0.936
Nitrate + Nitrite (as N)	10.0[d]	NA	427
Selenium	0.05[g]	0.005[c]	0.850
Sodium	120[h]	NA	5,000
Sulfate	500[i]	NA	9,100
Uranium	0.044[d]	0.0026—0.455[j]	0.229

Key: mg/L = milligrams per liter; NA = not applicable
[a]Wells 0171, 0173, 0176, 0179, 0181, and 0813 since the disposal cell was completed in September 1989.
[b]EPA lifetime health advisory (EPA 2002c).
[c]National Recommended Water Quality Criteria (EPA 2002d).
[d]EPA (EPA 1995; 40 CFR 192, Table 1).
[e]Risk based concentration calculated from data in EPA IRIS database.
[f]EPA Ecotox Threshold (EPA 1996).
[g]The Utah groundwater standard for selenium (0.05 mg/L) is greater than the EPA MCL (0.01 mg/L) and is used as the benchmark because of elevated levels of naturally occurring selenium in the region.
[h]EPA benchmark value (nonenforceable; EPA 2002b).
[i]EPA health-based advisory for acute effects (EPA 2002a).
[j]Suter and Tsao 1996.

COPCs that require ACLs because concentrations exceed their respective EPA (EPA 1995; 40 CFR 192) or State of Utah (Rule R317-6-2) groundwater standards are arsenic, nitrate, selenium, and uranium. Sodium and sulfate were also identified as COPCs in the SOWP (DOE 2002); concentrations are substantially elevated above human health benchmarks, but no MCLs have been established for these constituents and no ACLs are proposed for them. Manganese concentrations, though they exceed an aquatic benchmark, are below human-health risk-based concentrations; therefore, manganese is not considered to be a COPC for the Cedar Mountain Formation groundwater. Ammonia concentrations have never exceeded human health or aquatic benchmarks in Cedar Mountain Formation groundwater samples.

Based on a comparison of detected concentrations of analytes in groundwater with risk-based concentrations, arsenic is the constituent that makes up greater than 95 percent of the potential risks associated with groundwater use. Nitrate, selenium, and uranium make up most of the remaining risk. Because these four constituents are the only ones of concern at the Green River site for which EPA and Utah have groundwater standards, they are proposed as the contaminants for long-term compliance monitoring at the site.

2.2.2 Point of Compliance and Point of Exposure

In establishing an ACL, two locations must be defined—the point of compliance (POC) and point of exposure (POE). The POC is defined as the site-specific locations in the uppermost aquifer where the groundwater protection standards must be met. In contrast, the POE is defined as the locations where humans, wildlife, or other environmental species could reasonably be exposed to hazardous constituents from the groundwater (NRC 1996). In the ACL guidance for UMTRCA Title II sites, NRC notes "The POE, in most situations, will be located at the down-gradient edge of the land that will be transferred to either the Federal government or the State where the site is located for long-term institutional control . . ."

In the case of the Green River site, the disposal site itself is currently owned by DOE, and the State of Utah owns the land surrounding the disposal cell. Six monitor wells completed in the middle sandstone unit and located adjacent to the disposal cell are currently being monitored as POC wells for Subpart A compliance. Borehole data indicates that the middle sandstone unit is not present in any significant extent south and west of the perimeter of the state-owned property, and groundwater-level monitoring data indicate that the groundwater flow direction in the middle sandstone is to the northwest from the cell. Based on information presented in the SOWP (DOE 2002), Browns Wash and the Green River are the most likely discharge areas for groundwater in the middle sandstone unit. Therefore, these will be considered as potential POEs.

DOE currently monitors two surface water locations to be evaluated as POEs: in the backwater area of Browns Wash near its confluence with the Green River (location 0847) and in the Green River immediately downstream of the confluence of Browns Wash (location 0846). Because of the uncertainty of the discharge location for the middle sandstone unit, however, elevated contaminant levels at the POE locations may not be able to be correlated with the POC sample results and no corrective action will be triggered.

Revision 2 of the Long-Term Surveillance Plan (LTSP), which is the regulatory document required by NRC when the disposal site was licensed (DOE 1998b), addresses only Subpart A of 40 CFR 192 and consists of monitoring four POC wells adjacent to the disposal cell. This proposed monitoring program, consisting of six POC wells and two POE surface locations to address disposal cell performance and contaminated groundwater from the former processing site, would satisfy requirements for both Subpart A and Subpart B of 40 CFR 192 and would be incorporated into Revision 3 of the LSTP.

2.2.3 Rationale and Implementation

In establishing ACLs for the Green River site, DOE evaluated historical trends in groundwater quality. Time-concentration plots for arsenic, nitrate, selenium, and uranium in monitor wells adjacent to the disposal cell are shown in Appendix C of the GCAP (Figures C–2 through C–5). Many of these plots show erratically fluctuating changes in concentration over time and, for some constituents in some wells, concentrations show an upward trend while others show a downward trend. The fluctuating constituent concentrations in the groundwater have not been correlated to any natural event.

In determining an appropriate method to establish numerical values for ACLs at the Green River site, the methodology used for other uranium mining and Comprehensive Environmental Response, Compensation, and Liability Act sites was reviewed. One case study on groundwater remedial actions (EPA 1988) first considered the potential effect of groundwater discharge on surface water (POE). In that study of a former municipal landfill, a dilution factor of 40,000, even under low-flow conditions, led to the conclusion that groundwater discharge would have no impact on water quality at the POE. The ACL proposed was simply 10 times the groundwater concentrations observed at that time. In several other studies with surface water POEs, dilution factors were used to calculate the maximum permissible concentrations in groundwater that would still be protective of discharge to surface water (Umetco 2003; EPA 1990 and 1998) and those were used as the ACLs. For most sites, one site-wide ACL was established for each constituent, and the ACL was applied to all POC wells (EPA 1998). However, for one uranium-milling site, compliance was determined by comparing the average concentration of POC wells against the ACL (Umetco 2003). At some sites, individual ACLs were established for each constituent at each well, resulting in over 100 ACLs for a given site (EPA RODS database). As explained below, DOE proposes that ACLs for the Green River site be 100 times the respective EPA and State of Utah standards and that they be applied to each of the POC wells.

If the middle sandstone unit aquifer of the Cedar Mountain Formation has a surface exposure, it is likely to be the Green River. Average monthly discharge rates for the Green River, based on U.S. Geological Survey monitoring data, range from 2,300 to 18,000 cubic feet per second (cfs) in the vicinity of the Green River site. Assuming a conservative groundwater discharge rate of 100 gallons per minute (0.2 cfs), the dilution would be greater than 10,000-fold during low flows in the river. This means that to meet the benchmarks contained in Table A–1, concentrations of constituents in groundwater at the POC wells could be hundreds to thousands of times higher than those currently observed.

Because DOE's ACL guidance indicates that ACLs should be established at levels that are ALARA, DOE did not base the proposed ACLs on maximum assumed dilution rates. Rather, ACLs are proposed to be two orders of magnitude (100 times) the respective standards and are expected to be achievable based on observed site conditions. Constituent concentrations have fluctuated inexplicably at some of the monitor wells adjacent to the disposal cell and, depending on site conditions, some further variability may be expected. The proposed ACLs are high enough to accommodate potential future increases and should be more than protective at the POEs given the assumed dilution rates of the Green River.

For simplicity and ease in implementation, and in accordance with EPA guidance (EPA 1992), site-wide ACLs will be applied to each of six POC wells adjacent to the disposal cell. Table A–2 presents the proposed ACLs along with maximum analytical results through June 2007. Analytical results for the POC wells are discussed in Section 2.2 of the GCAP and are shown as time-concentration plots in Appendix C.

The proposed groundwater monitoring network for the ACL compliance strategy for the middle sandstone unit of the Cedar Mountain Formation will consist of six POC wells adjacent to the disposal cell (0171, 0173, 0176, 0179, 0181, and 0813). The POC wells will monitor potential discharge of contaminants from the disposal cell into the middle sandstone unit of the Cedar Mountain Formation. If any constituent in any well exceeds the respective ACL, DOE proposes to conduct quarterly monitoring for a year at the well in which the exceedance occurred. The four quarterly results would be evaluated to assess the need for additional monitoring and/or modifying institutional controls.

Table A-2. Proposed Alternate Concentration Limits for the Green River Site

Constituent	Standard (mg/L)	Proposed ACL (mg/L)	Maximum Concentration Observed to Date in proposed POC Wells[a] (mg/L)
Arsenic	0.05[b]	5.0	0.191
Nitrate + Nitrite (as N)	10.0[b]	1,000	427
Selenium	0.05[c]	5.0	0.850
Uranium	0.044[b]	4.4	0.229

Key: ACL = alternate concentration limit; mg/L = milligrams per liter; N = nitrogen; POC = point of compliance
[a]Wells 0171, 0173, 0176, 0179, 0181, and 0813 since the disposal cell was completed in September 1989.
[b]EPA (EPA 1995; 40 CFR 192, Table 1).
[c]State of Utah groundwater quality standard (R317-6-2, Table 1).

3.0 Factors Considered in Making Present and Potential Hazard Findings

The list of factors below is from the UMTRCA Title I regulations [40 CFR 192.02(c)(3)(ii)(B)(1) and (2)], which differ slightly from those in the NRC Title II guidance, and adds another factor to the groundwater quality list.

3.1 Potential Adverse Effects on Groundwater Quality

3.1.1 Physical and chemical characteristics of constituents in the residual radioactive material at the site, including their potential for migration. The processing site was remediated from November 1988 through September 1989, and all uranium mill tailings and residual radioactive material were stabilized in a partially below-grade disposal cell on site. Uranium is the principal COPC in groundwater in the uppermost aquifer; migration in groundwater is limited (see Sections 3.4, 5.2, and 5.3 of the SOWP).

3.1.2 Hydrogeological characteristics of the site and surrounding land. Groundwater occurs in the Browns Wash alluvium and bedrock units of the Cretaceous Cedar Mountain Formation. Characterization of the site hydrogeology is explained in Section 3.5 of Mod No. 2 of the RAP, Section 5.1 of the SOWP, and Section 2.1 of the GCAP.

3.1.3 Quantity of groundwater and the direction of groundwater flow. Groundwater flow in the Browns Wash alluvium is minimal and generally to the west toward the Green River. Groundwater flow in the middle sandstone unit of the Cedar Mountain Formation (uppermost bedrock aquifer) is to the northwest (see Section 2.1 of the GCAP). The volume of contaminated groundwater is minimal and restricted in lateral area.

3.1.4 Proximity and withdrawal rates of groundwater users. There is no known groundwater withdrawal in the vicinity of the site. The nearest wells, located more than a mile away from the site, are completed in the Green River alluvium (unassociated with Browns Wash) and are used for irrigation.

3.1.5 Current and future uses of groundwater in the region surrounding the site. There are no known current uses of groundwater along Browns Wash in the vicinity of the site. The wash flows only in response to storm runoff, and its groundwater is of poor quality and classified as limited use.

Groundwater from the Cedar Mountain Formation is not a current or potential source of drinking water in the area of the Green River site because of the low yield of the aquifer in the region and the generally poor water quality (several constituents exceed Safe Drinking Water Act standards) compared to the Green River municipal water-supply system. The municipal system derives its water from the Green River; the intake and treatment plant are located approximately 0.75 mile upstream of the Browns Wash confluence and, therefore, are unaffected by groundwater that is emitted from the Browns Wash alluvium.

3.1.6 Existing quality of groundwater, including other sources of contamination and their cumulative impact on groundwater quality. Background groundwater quality in the Browns Wash alluvium is variable but generally poor due to the presence of elevated concentrations of nitrate, sodium, and sulfate unrelated to processing activities. Selenium and uranium are also present at elevated concentrations. Elevated contaminant concentrations may be affected by septic and agricultural waste, but they are most likely due to natural sources. The background concentrations are insignificant compared to the elevated concentrations of contaminants in the reach of Browns Wash alluvium affected by processing activities.

Background groundwater quality in the Cedar Mountain Formation aquifers in close proximity (up-gradient) of the site is generally consistent and meets EPA groundwater standards, and there are no known sources of contamination outside of the former processing site (see Section 5.3.1 of the SOWP). If lateral groundwater flow occurs at the site, and if some vertical leakage occurs from the uncontaminated basal unit aquifer due to the upward hydraulic gradient, then it is possible that dilution of the contaminated middle sandstone unit aquifer could occur over a long but undetermined period of time.

3.1.7 Potential for health risks caused by human exposure to constituents. There are no unacceptable risks to human health associated with the site because there is no human exposure to the groundwater, and the groundwater is not being used, or projected to be used, for any purpose (see Section 6.1 of the SOWP).

3.1.8 Potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to constituents. The Green River site is highly disturbed from past use and subsequent remediation activities. The overall potential risk to all receptors was determined to be very low [Section 6.2 of the SOWP (DOE 2002) and Section 4.0 of the draft environmental assessment (DOE 2007)].

3.1.9 Persistence and permanence of potential adverse effects. Contaminant levels in groundwater in the Cedar Mountain Formation could remain elevated for a number of years, particularly uranium levels. However, no adverse effects from existing contamination have been observed, and no adverse effects are expected as groundwater contamination concentrations will likely attenuate over time.

3.1.10 Presence of underground sources of drinking water and exempted aquifers identified under 40 CFR 144.7. There are no current sources of drinking water or exempted aquifers that can be affected by contamination at the site. The main source of domestic water is surface water from the Green River, which is unaffected by site-related contamination.

3.2 Potential Adverse Effects on Hydraulically Connected Surface Water Quality

3.2.1 Volume and physical and chemical characteristics of the residual radioactive material at the site. The stabilized disposal cell at the site contains 382,000 cubic yards of compacted uranium mill tailings and residual radioactive material. The calculated total activity of radium-226 in the cell is 30 curies.

3.2.2 Hydrogeological characteristics of the site and surrounding land. See Section 3.1.2 above.

3.2.3 Quantity and quality of groundwater and the direction of groundwater flow. The quality of groundwater in Browns Wash is affected by residual contamination from the former mill tailings pile. This effect is expected to continue for an indeterminate period of time due to the low groundwater flow velocity in the alluvial groundwater flow system. Browns Wash is an ephemeral stream that flows only as a result of heavy rainstorms. The effect that contaminated alluvial groundwater has on surface water is proportional to the quantity of surface water flow in Browns Wash.

Groundwater from the middle sandstone unit of the Cedar Mountain Formation may discharge to the Green River alluvium. Average monthly surface water discharge in the Green River ranges from 2,300 to greater than 18,000 cfs near the city of Green River. Because of the high dilution rate, neither the former millsite nor the disposal cell have had any measurable impact on the quality of water in the Green River. (Section 3.6, Mod. No. 2 RAP).

3.2.4 Patterns of rainfall in the region. Annual precipitation averages approximately 6 inches. Rainfall occurs during the summer and fall in high-intensity, short-duration thunderstorms that are conducive to runoff. Winter precipitation occurs primarily as snowfall.

3.2.5 Proximity of the site to surface waters. The ephemeral Browns Wash is north of the site and discharges into the Green River. The Green River is approximately 0.5 mile west of the site.

3.2.6 Current and future uses of surface waters in the region surrounding the site and any water-quality standards established for those surface waters. The Green River is the primary source of drinking water for the city of Green River area. The water intake station and treatment plant are approximately 0.75 mile upstream of the confluence of Browns Wash; consequently, the municipal water supply is not affected by contaminants at the Green River site. State water-rights records indicate that there are several irrigation surface diversion points a short distance upstream and downstream of the Browns Wash confluence. Surface water standards for the river are established by the State of Utah, and the river meets these standards in the vicinity of the site.

3.2.7 Existing quality of surface water, including other sources of contamination and the cumulative impact on surface water quality. Water in the Green River in the vicinity of the site is designated high quality by the State of Utah. The site has no measurable effect on the surface water quality of the Green River.

3.2.8 Potential for health risks caused by human exposure to constituents. There are no unacceptable risks to human health associated with the site because of the intermittent nature of water in Browns Wash and the lack of use. Neither is there any excess human health risk associated with site-derived contamination impacting surface water in the Green River.

3.2.9 Potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to constituents. There is no potential damage as site contamination has no impact on water quality of the Green River. The ecological risk assessment showed that the potentially elevated concentrations in pooled water in Browns Wash from storm runoff or groundwater seeps would have no adverse effect on potential receptors, including wildlife and vegetation [Section 6.2 of the SOWP (DOE 2002) and Section 4.0 of the draft environmental assessment (DOE 2007)].

3.2.10 Persistence and permanence of the potential adverse effects. No adverse effects are currently present in the Green River or in Browns Wash, and none are expected in the future.

4.0 Roadmap to the SOWP and Additional Information

4.1 General Information

Introduction—Section 1.0 of SOWP

Facility Description—Section 3.0 of SOWP

Extent of Groundwater Contamination—Sections 5.2 and 5.3 of SOWP

Proposed Alternate Concentration Limits—Section 3.2 of GCAP

Hazard Assessment—Generally corresponds to Section 6 of the SOWP, which contains human health and ecological risk assessments

Source and Contamination Characterization—Sections 5.2 and 5.3 of SOWP

Transport Assessment—Section 5.3.5 of SOWP

Exposure Assessment—Section 6.1 of SOWP for human health; Section 6.2 of SOWP for ecological risk

Corrective Action Assessment—Included in this Appendix to GCAP

4.2 Results of Corrective Action Program

Surface remediation at the Green River site commenced in November 1988 and was completed in September 1989. Tailings and other contaminated surface materials totaling approximately 382,000 cubic yards were placed in a disposal cell located on site.

DOE, the State of Utah, and Umetco Minerals Corporation currently own property underlain by site-related groundwater contamination. An environmental covenant will be implemented for the land affected by site contamination that prohibits use of groundwater for any purpose, without the permission of both DOE and the State of Utah, on the land affected by groundwater contamination. This restriction is essentially perpetual, though it can be lifted once concentrations have decreased to levels that permit unrestricted use.

4.3 Feasibility of Alternative Corrective Actions

DOE has performed remedial action at the Green River site to mitigate exposures to contaminated soil. The corrective-action assessment in this Appendix to the GCAP indicates that active remediation of contaminated groundwater would be complicated and expensive and would provide no economic benefit or reduction in risk to human health and the environment. The disposal cell at the site will remain indefinitely and ensures that institutional controls will be observed. Therefore, ACLs are proposed for constituents monitored at the POC wells that have concentrations that could remain elevated for the life of the disposal cell.

4.4 Corrective Action Costs and Benefits

Corrective action cleanup costs were not estimated for the Green River site because there was no reasonable scenario for active groundwater remediation. Generally, active remediation of the uppermost aquifer would be complicated and expensive because of the thinness of the aquifer and the overall lack of water. The limited extent of the aquifer makes it a limited resource as well. No one is currently using the aquifer, and there are no plans to use it in the future. Therefore, remediation of the uppermost aquifer to reduce concentrations of contaminants provides no real benefit.

4.5 ALARA Demonstration

The general aim of achieving a cleanup goal that is ALARA is satisfied by applying ACLs that are more conservative than permissible based on likely dilution at the POE. It would not be reasonable to pursue active remediation of groundwater for the negligible risk reduction that could be realized, particularly considering the availability of an alternative water source (the Green River), that groundwater in the vicinity of the site is not used as a water source, and that environmental covenants will prohibit groundwater use.

4.6 Proposed Alternate Concentration Limits

Proposed Alternate Concentration Limits—Section 3.2 of GCAP; Section 2.2 of GCAP Appendix A

Proposed Implementation Measures—Section 4.0 of GCAP

References—Section 8.0 of SOWP; Section 5.0 of GCAP Appendix A

Appendixes and Supporting Information—Appendixes A through G of SOWP; Appendix C of GCAP

5.0 References

10 CFR 40. U.S. Nuclear Regulatory Commission, "Domestic Licensing of Source Material," *Code of Federal Regulations*, January 1, 2007.

40 CFR 144.7. U.S. Environmental Protection Agency, "Identification of Underground Sources of Drinking Water and Exempted Aquifers," *Code of Federal Regulations*, July 1, 2007.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations*, July 1, 2007.

60 FR 2854. U.S. Environmental Protection Agency, "Ground Water Standards for Remedial Actions at Inactive Uranium Processing Site; Final Rule," *Federal Register*, January 11, 1995.

DOE (U.S. Department of Energy), 1991. *Remedial Action Plan and Final Design for Stabilization of the Inactive Uranium Mill Tailings at Green River, Utah*, Final, UMTRA-DOE/AL-050510.GRN0, March.

DOE (U.S. Department of Energy), 1995. *Baseline Risk Assessment of Groundwater Contamination at the Uranium Mill Tailings Site Near Green River, Utah*, DOE/AL/62350-116, Rev. 1, September.

DOE (U.S. Department of Energy), 1998a. *Modification No. 2 to the Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Site at Green River, Utah*, Final, DOE/AL/62350-050510, March.

DOE (U.S. Department of Energy), 1998b. *Long-Term Surveillance Plan for the Green River, Utah Disposal Site*, DOE/AL/62350-89, Rev. 2, July.

DOE (U.S. Department of Energy), 2002. *Final Site Observational Work Plan for the Green River, Utah, UMTRA Project Site,* GJO-2002-356-TAC, September.

DOE (U.S. Department of Energy), 2007. *Draft Environmental Assessment of the Ground Water Compliance at the Green River, Utah, Disposal Site,* DOE/EA–1511, August.

EPA (U.S. Environmental Protection Agency), 1987. *Alternate Concentration Limit Guidance*, Part I, ACL Policy and Information Requirements, OSWER Directive 9481.00-6C, EPA/530-SW-87-017, July.

EPA (U.S. Environmental Protection Agency), 1988. Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites, OSWER Directive9283.1-2, EPA 540 G-88 003, December.

EPA (U.S. Environmental Protection Agency), 1990. EPA Superfund Record of Decision: Pickettville Road Landfill, EPA/ROD/R04-90/075, September.

EPA (U.S. Environmental Protection Agency), 1992. Methods for Evaluating the Attainment of Cleanup Standards: Vol. 2 Groundwater, EPA 230-R-92-014, July.

EPA (U.S. Environmental Protection Agency), 1995. Groundwater Standards for Remedial Actions at Inactive Uranium Processing Sites, Final Rule, 60FR2854, January 11, 1995.

EPA (U.S. Environmental Protection Agency), 1996, ECO Update, Ecotox Thresholds, Volume 3, Number 2, EPA540/F-95/038, January.

EPA (U.S. Environmental Protection Agency), 1998. EPA Superfund Record of Decision: Murray Smelter, EPA/ROD/R08-98/078, April.

EPA (U.S. Environmental Protection Agency), 2002a. Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Sulfate, EPA 822-R-02-033, April.

EPA (U.S. Environmental Protection Agency), 2002b. Announcement of Preliminary Regulatory Determinations for Priority Contaminants on the Drinking Water Contaminant Candidate list, 67 FR 38222, June 3, 2002.

EPA (U.S. Environmental Protection Agency), 2002c. 2002 Editions of the Drinking Water Standards and Health Advisories, EPA822-R-02-038, Summer.

EPA (U.S. Environmental Protection Agency), 2002d. National Recommended Water Quality Criteria: 2002. EPA 822-R-02-047, November.

Ford, Bacon & Davis Utah Inc. (FBDU), 1981. *A Summary of the Engineering Assessment of Inactive Uranium Mill Tailings, Green River Site, Green River, Utah,* DOE/UMT-0114S, FBDU 360-14S, UC 701 prepared by Ford, Bacon & Davis Utah, Salt Lake City, Utah, for the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

NRC (U.S. Nuclear Regulatory Commission), 1996. *Alternate Concentration Limits for Title II Uranium Mills*, Staff Technical Position, January.

Suter, G.W., II, and C.L. Tsao, 1996. Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota, 1996 Revision, prepared by the Risk Assessment Program Health Sciences Research Division, Oak Ridge, Tennessee, ES/ER/TM-96/R2, June.

Umetco (Umetco Minerals Corporation), 2003. Application for Alternate Concentration Limits, Uravan Project Site, July.

Appendix B

Photos

This page intentionally left blank

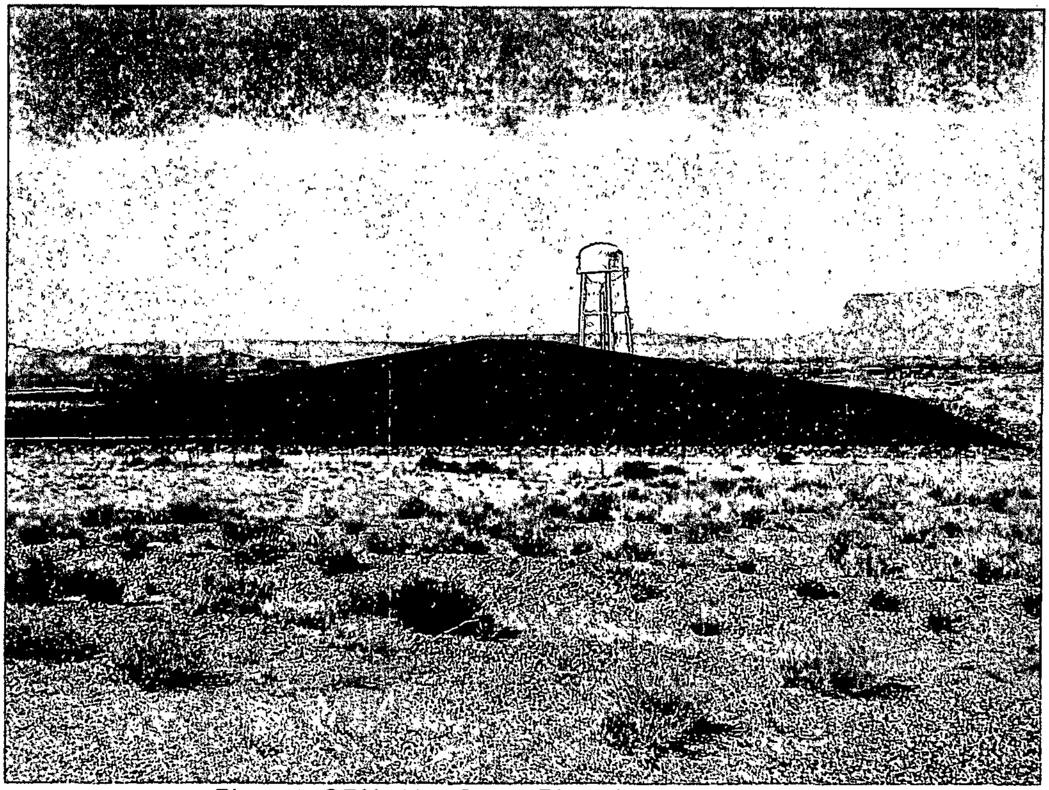


Photo 1. GRN_425. Green River, Utah, disposal cell.

Photo 2. GRN_420. Granite site marker near the base of the disposal cell.

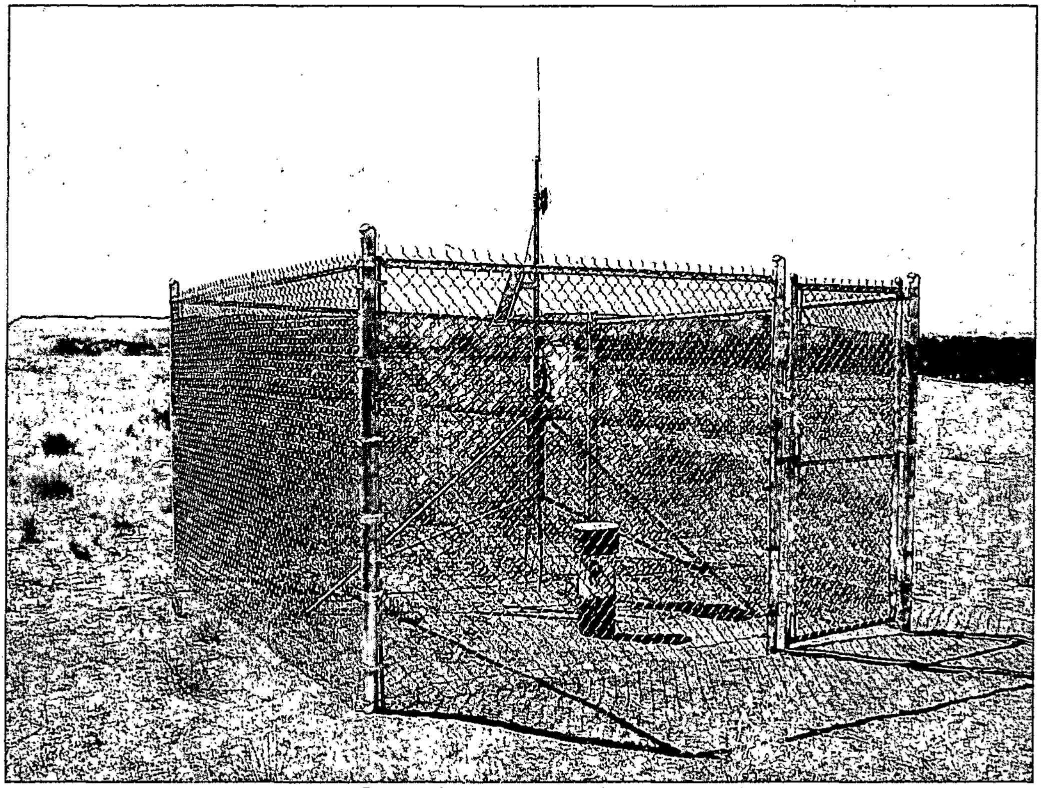


Photo 3. 100_1507. Groundwater level telemetry station at well 0588.

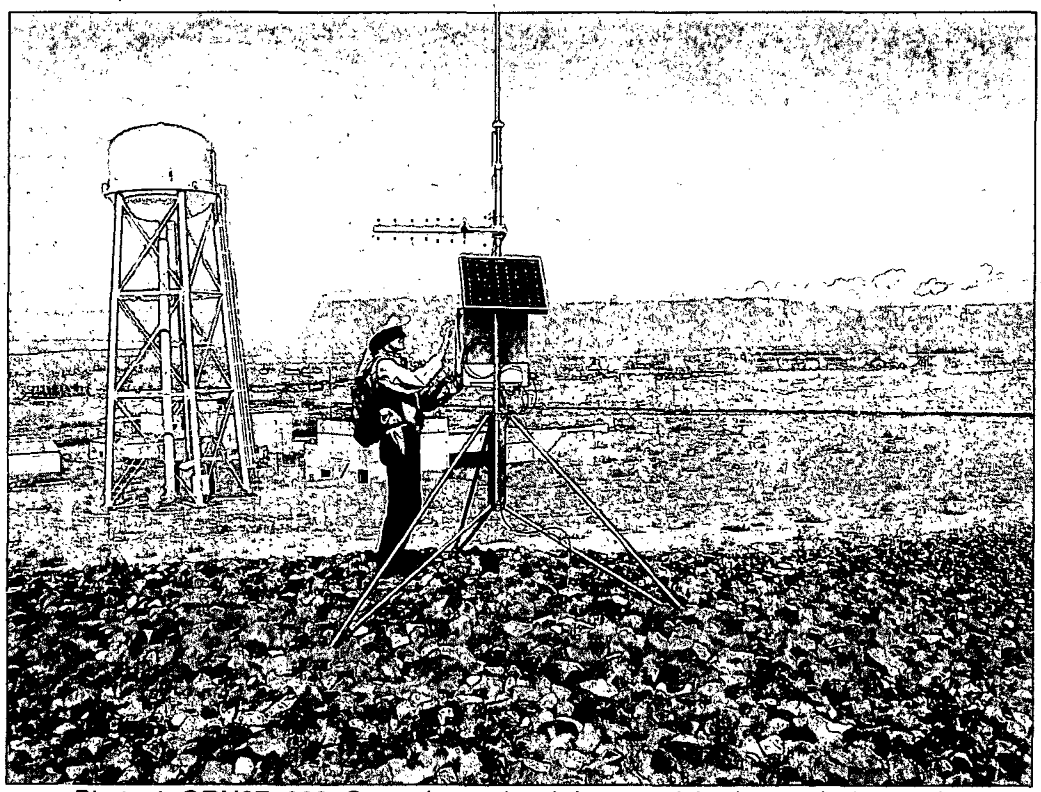


Photo 4. GRN07_003. Groundwater level data receiving/transmission station on top of the disposal cell.

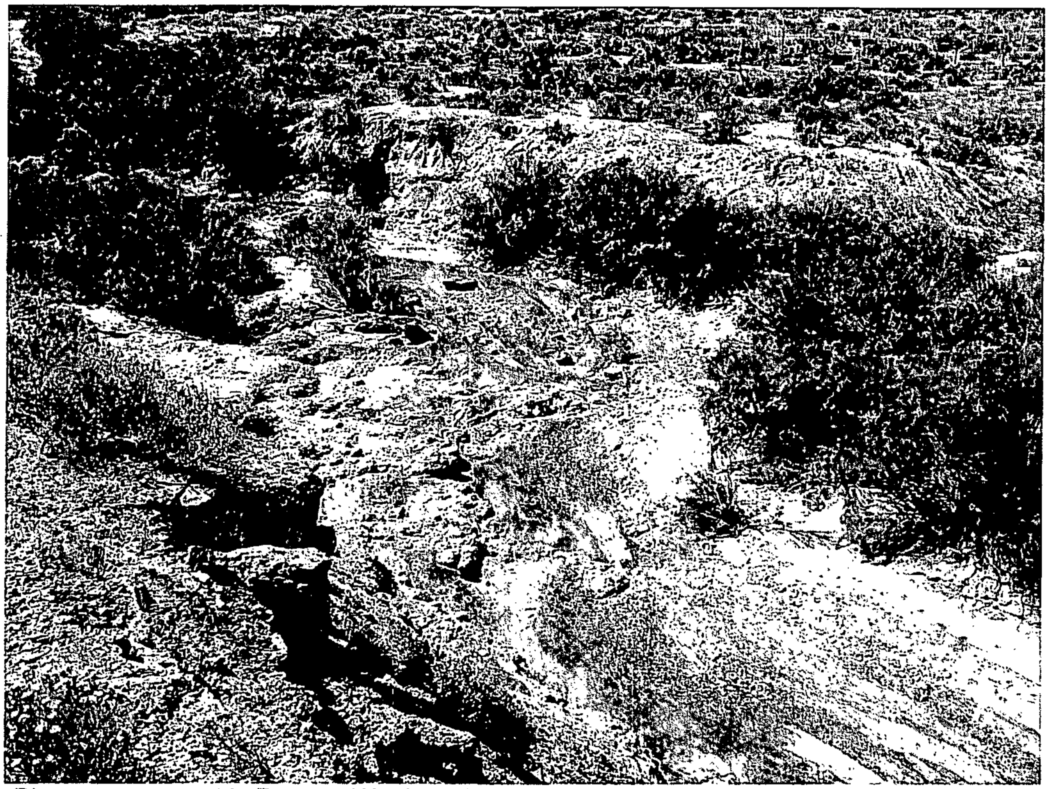


Photo 5. 100_1510. Browns Wash at the Cedar Mountain Fm outcrop area (upper unit) and location of seep 0718. No pools were present in the wash on this day (9/7/07).

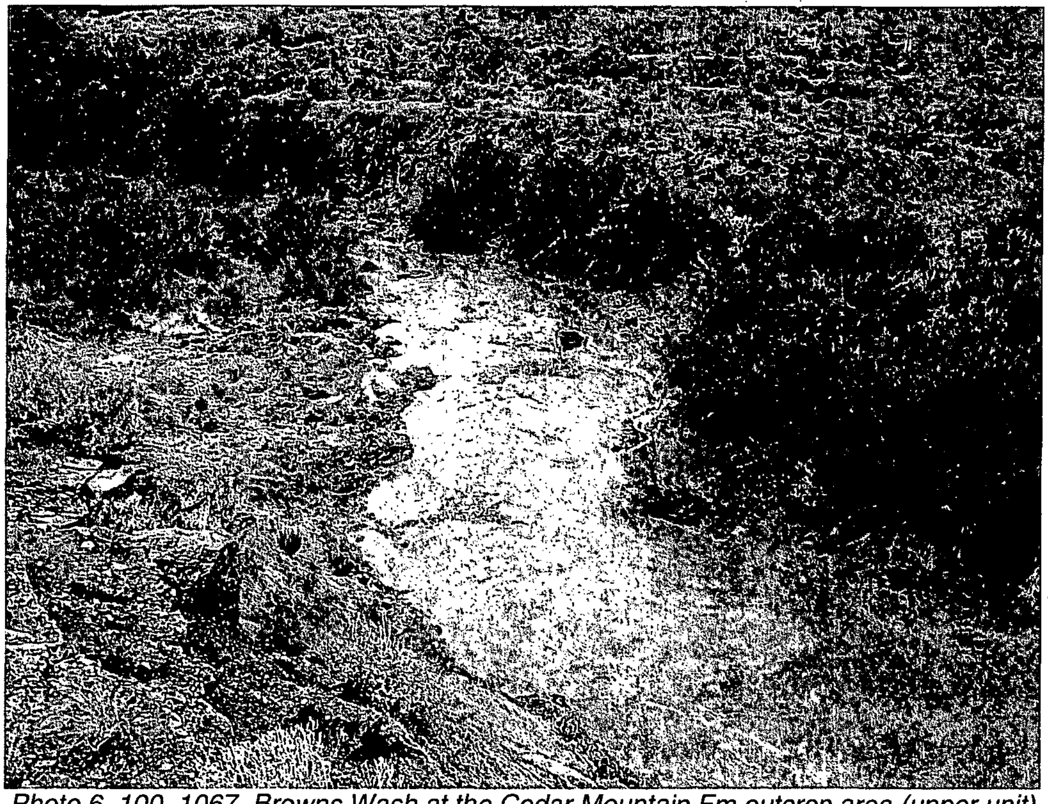


Photo 6. 100_1067. Browns Wash at the Cedar Mountain Fm outcrop area (upper unit) immediately after a storm event (9/15/06).

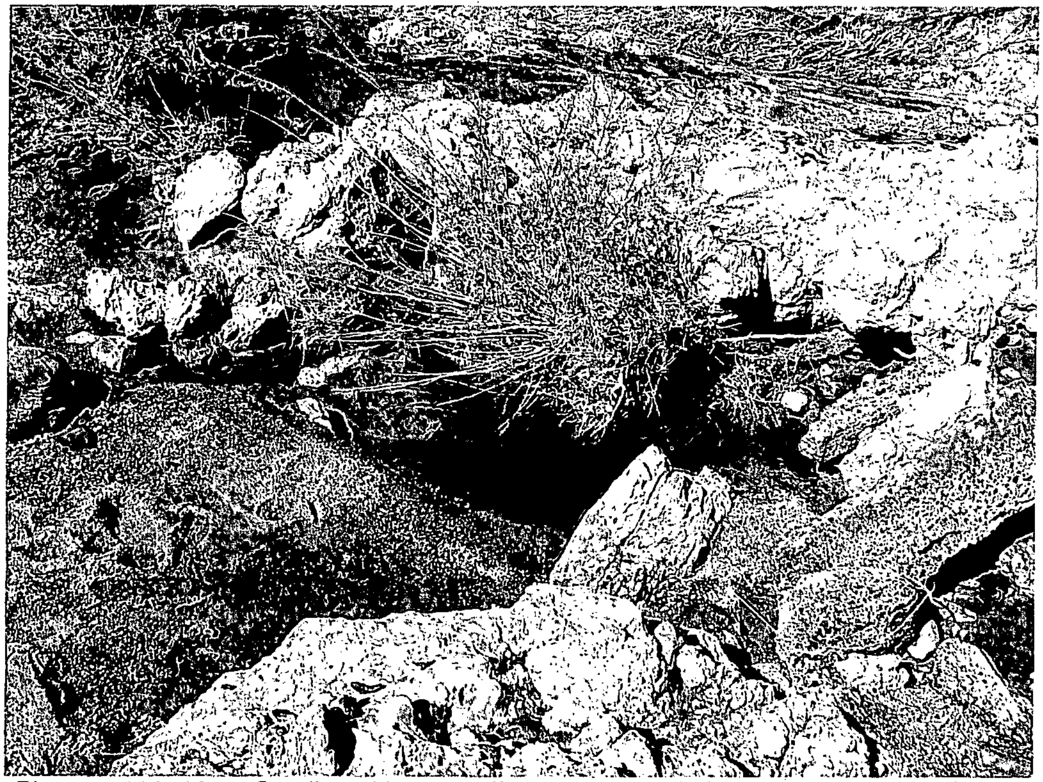


Photo 7. 100_1096. Small pool in a runoff-caused scour hole at seep 0718 on 9/30/06. Most recent runoff event occurred on 9/22/06.

Photo 8. 100_1219. Algae at seep 0718 during extended period of sub-freezing temperatures (1/31/07).

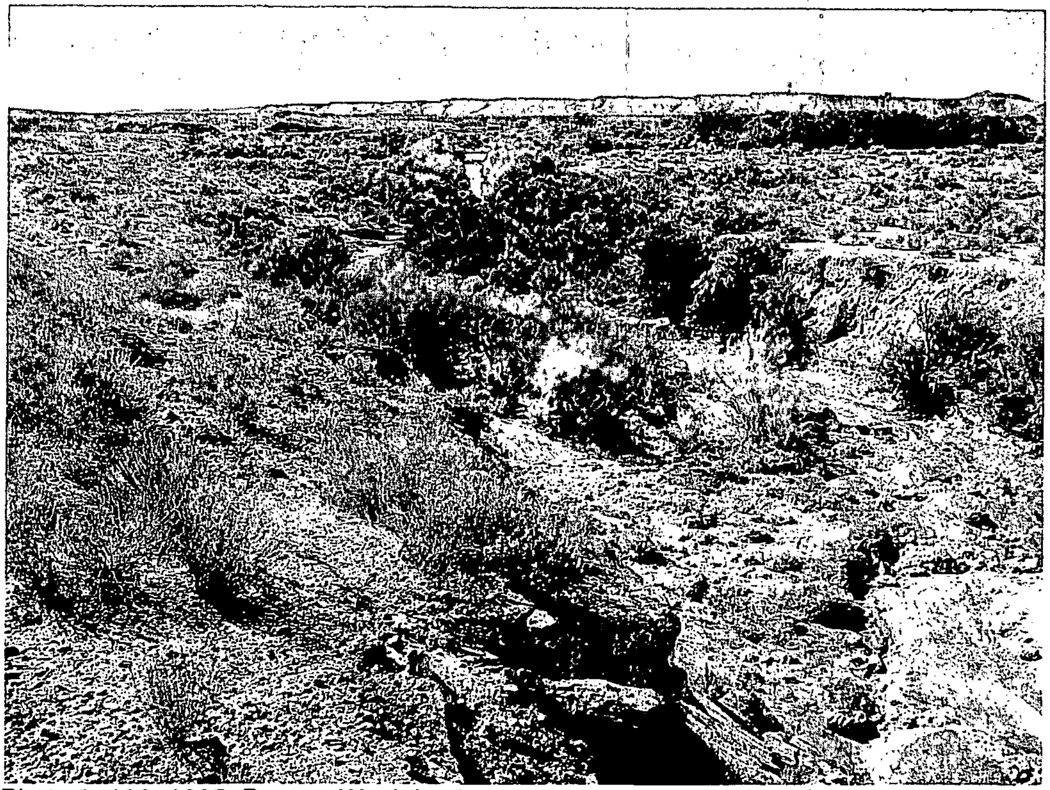


Photo 9. 100_1095. Browns Wash backwater area—upper portion of the photo (9/30/06).

Photo 10. 100_1515. Backwater area completely filled with sediment at surface sampling location 0847 (9/7/07).

End of current text

Appendix C

Hydrograph and Time-Concentration Plots

This page intentionally left blank

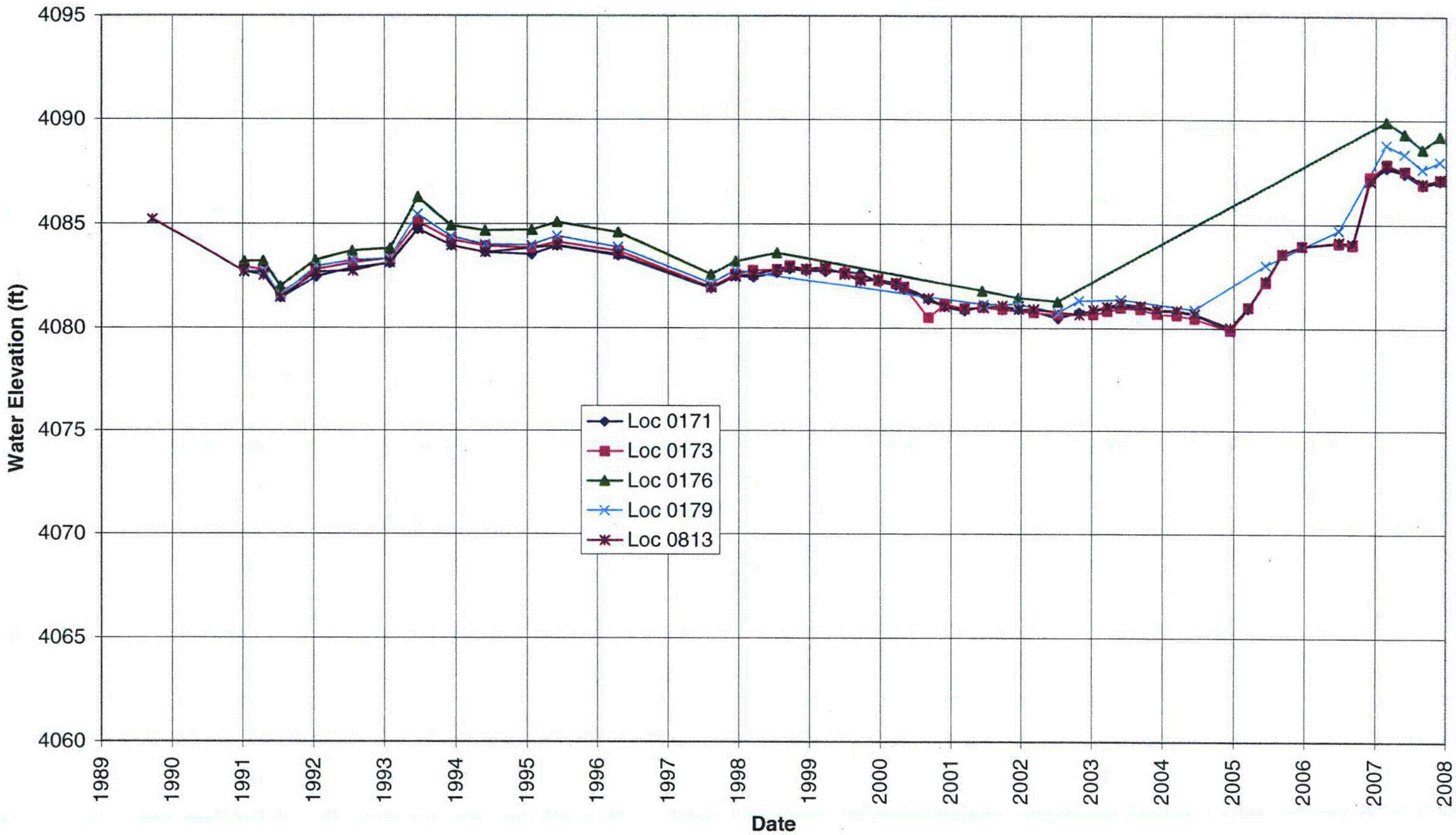


Figure C–1. Hydrograph of the Middle Sandstone Unit of the Cedar Mountain Formation at the Green River, Utah, Disposal Site

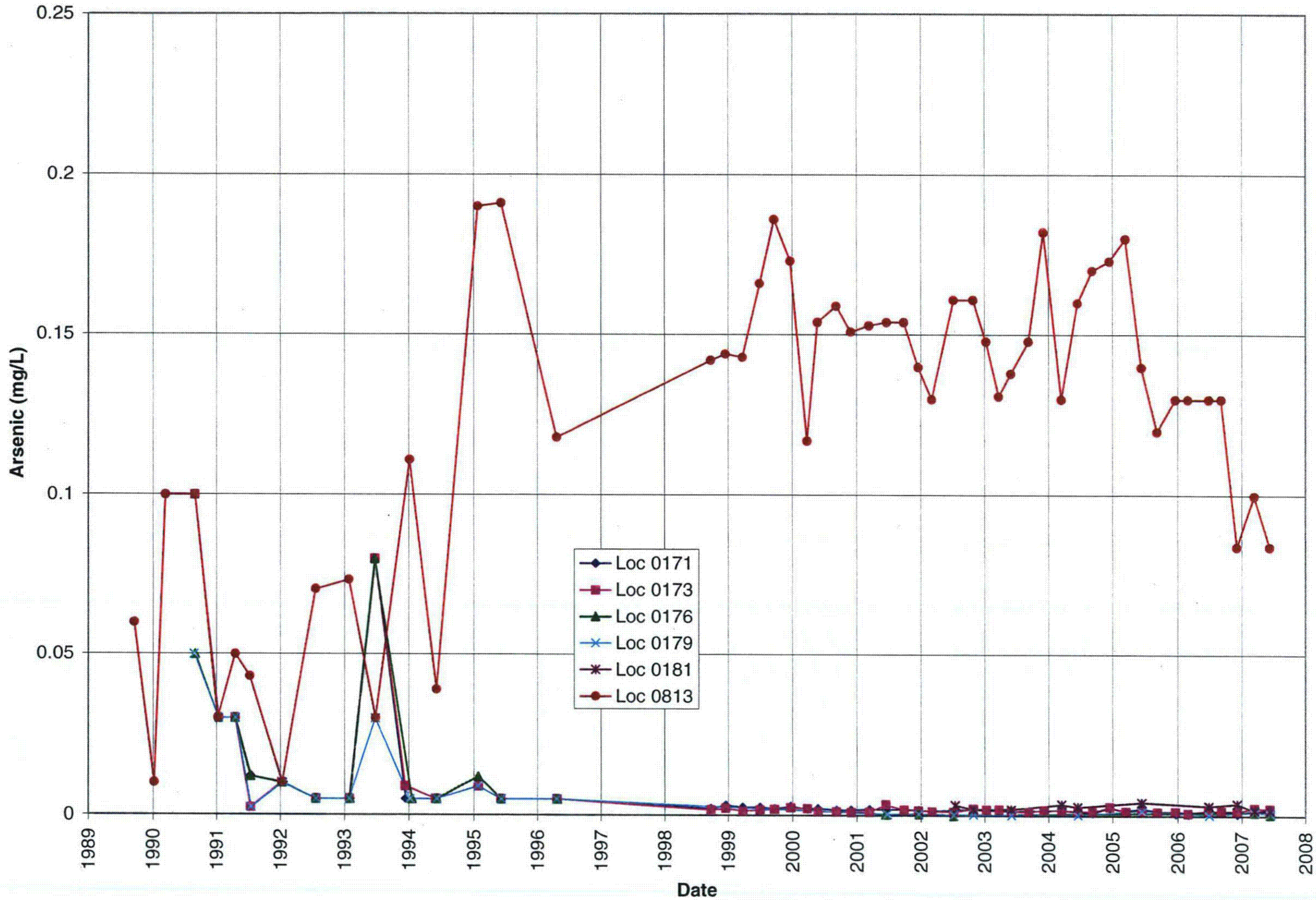


Figure C–2. Time-Concentration Plots of Arsenic in Groundwater at the Green River, Utah, Disposal Site

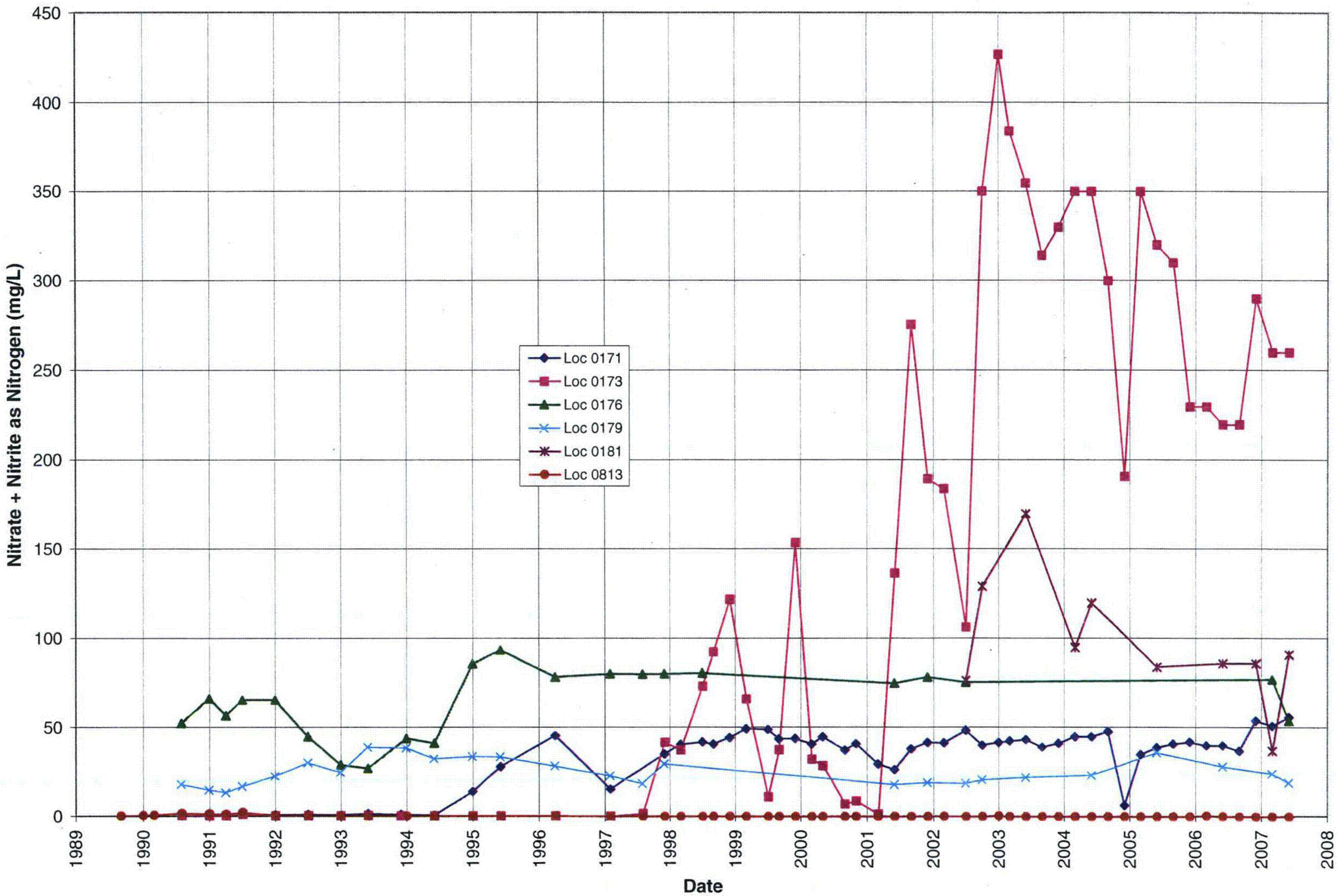


Figure C–3. Time-Concentration Plots of Nitrate (as N) in Groundwater at the Green River, Utah, Disposal Site

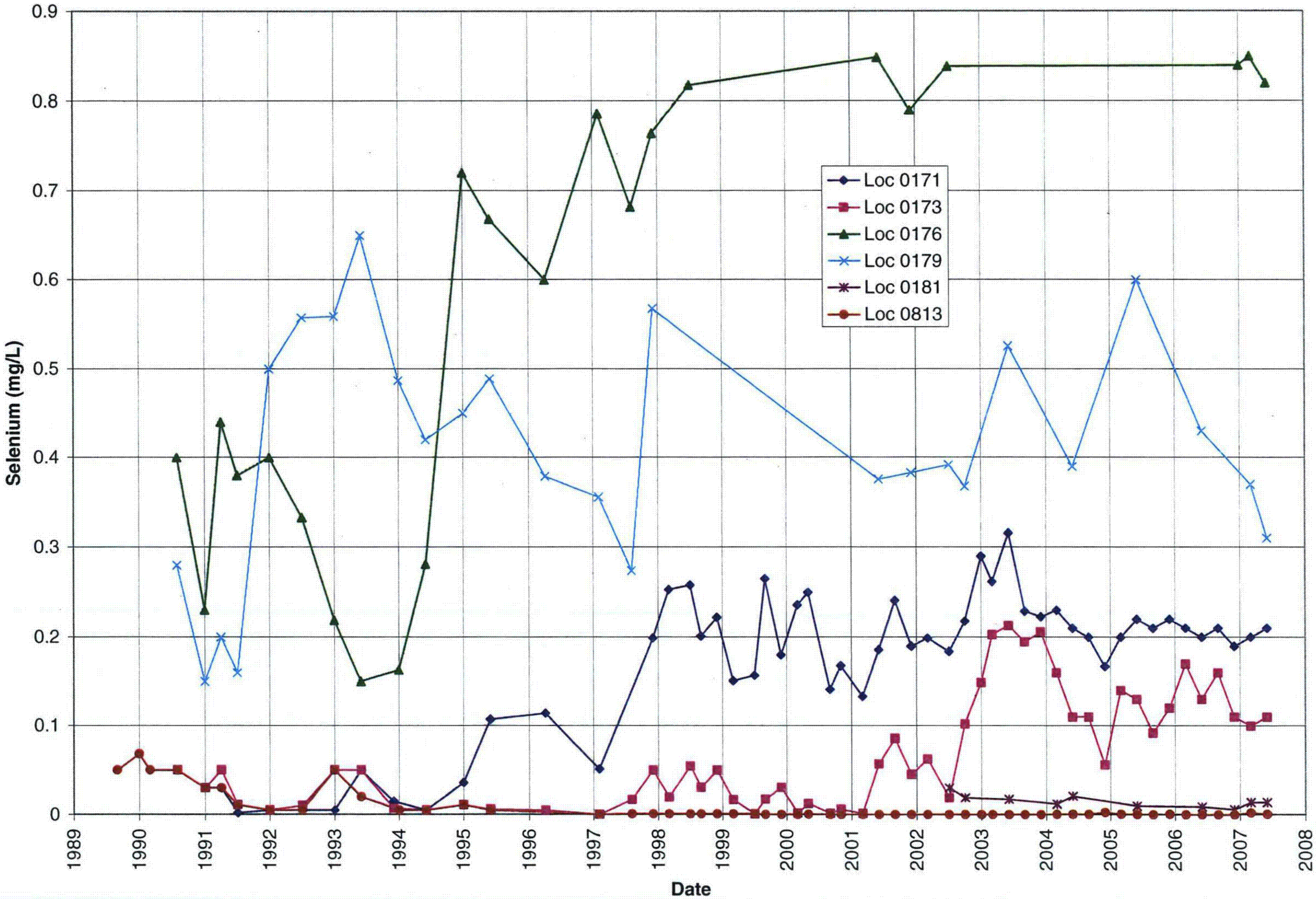


Figure C–4. Time-Concentration Plots of Selenium in Groundwater at the Green River, Utah, Disposal Site

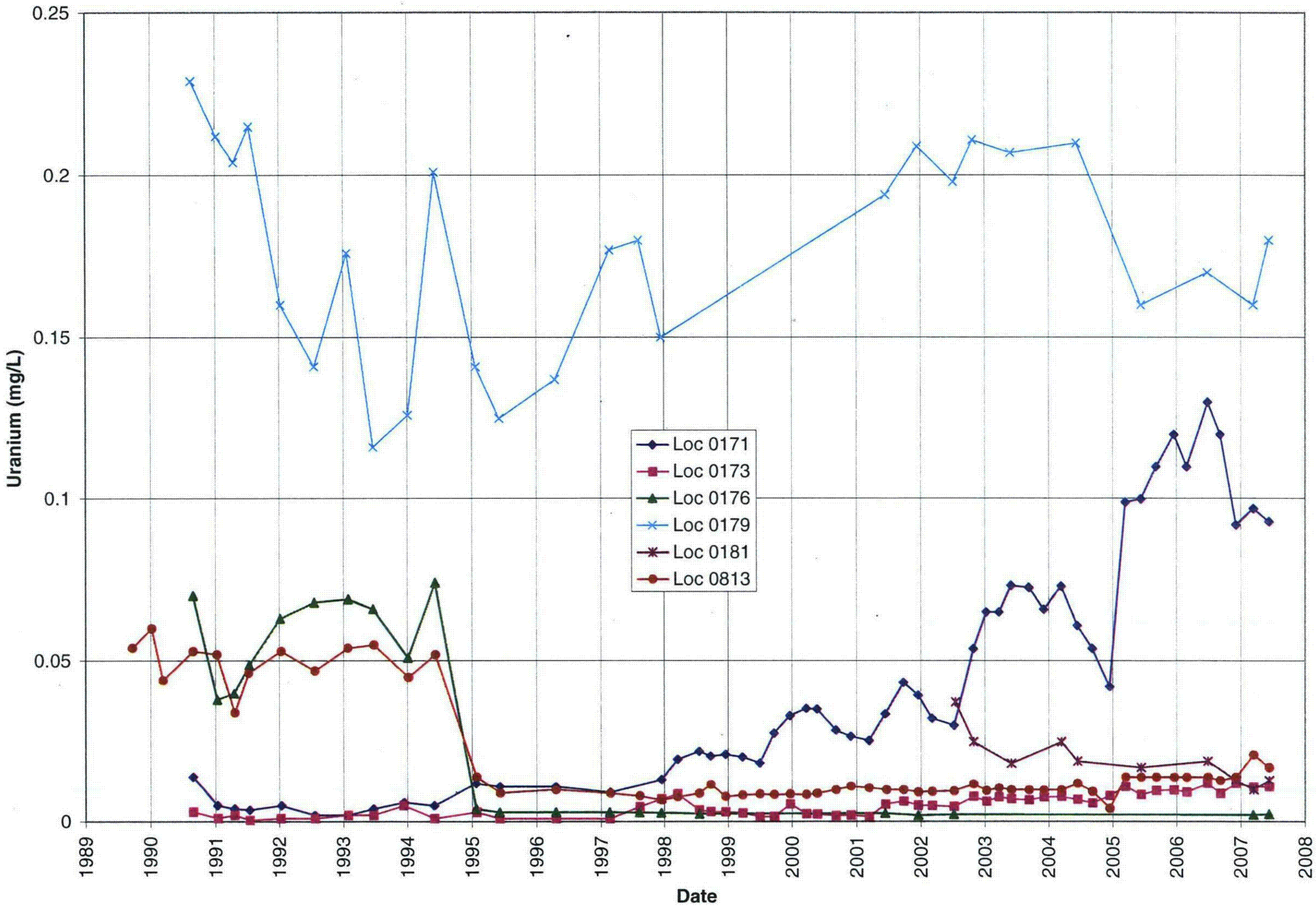


Figure C–5. Time-Concentration Plots of Uranium in Groundwater at the Green River, Utah, Disposal Site

End of current text

Appendix D

Environmental Notice and Institutional Control

This page intentionally left blank

After recording, return to:

Mr. Rahe Junge
Umetco Minerals Corporation
2754 Compass Drive, Suite 280
Grand Junction, CO 81506

With copies to:

Division Director
Division of Environmental Response and Remediation
Utah Department of Environmental Quality
168 North 1950 West
P.O. Box 144840
Salt Lake City, UT 84114-4840
Facility No.________________
Location:__________________

Richard P. Bush
Green River Site Manager
U.S. Department of Energy
2597 B ¾ Road
Grand Junction, CO 81503

ENVIRONMENTAL NOTICE AND INSTITUTIONAL CONTROL

Pursuant to the Utah Environmental Institutional Control Act (Utah Code Sections 19-10-101, et seq.), Umetco Minerals Corporation (Owner), owner of property adjacent to the former Green River processing site (Property) in Grand County, State of Utah; more particularly described on Attachment A which is attached hereto and by this reference made a part hereof, hereby makes and imposes upon the Property the following described Institutional Controls, subject to the terms and conditions herein stated:

1. Notice is hereby given that the Property is or may be contaminated with the radioactive and other contaminants of concern as described below and, therefore, Institutional Controls must be imposed to mitigate the risk to the human health, safety, and/or the environment:

The uranium mill at the Green River site was constructed in 1957 and operated until 1961. The estimated 137,000 tons of tailings generated from the milling process were originally deposited on site on the Browns Wash alluvial floodplain in a 7-foot-thick pile covering approximately 9 acres.

Remedial action began in 1988 and was completed in 1989 under the Uranium Mill Tailings Radiation Control Act (42 U.S.C. 7901-7942). Approximately 382,000 cubic yards of compacted residual radioactive material from the original tailings pile, from demolished or decontaminated buildings, and from contaminated vicinity properties were placed in a 6-acre unlined engineered disposal cell located on a bedrock terrace immediately south of the original tailings pile. The U.S. Department of Energy (DOE) owns 26 acres of land on which the disposal cell is located. The remainder of the former millsite is owned by the State of Utah, and the State property encompasses the DOE property.

Former uranium processing activities and the disposal cell appear to have contaminated the groundwater in the Browns Wash alluvium and the middle sandstone unit of the Cedar Mountain Formation beneath the former millsite. Constituents with concentrations above U.S. Environmental Protection Agency standards or relevant benchmarks in the Browns Wash alluvium include ammonia, manganese, nitrate, selenium, sodium, sulfate, and uranium. With the exception of ammonia and manganese, these constituents are elevated above a standard or risk-based concentration for human health in the groundwater aquifer of the middle sandstone unit of the Cedar Mountain Formation (the uppermost aquifer). Arsenic also occurs in elevated concentrations in this aquifer. Groundwater monitoring indicated that there is contamination present beneath properties owned by DOE, the State of Utah, and Umetco Minerals Corporation. Attachment B shows the properties subject to the Institutional Controls under this Notice.

2. Use of the Property is hereby restricted by the following Institutional Controls:

Within the Institutional Controls boundary shown on Attachment B, no wells will be drilled for any purpose and groundwater will not be used for any purpose without the expressed written consent of the State of Utah Department of Environmental Quality (UDEQ) and DOE.

At least 30 days prior to commencement of any construction on the Property or any improvements to the Property, the Owner shall provide written notification of such activity to the Director, UDEQ Division of Environmental Response and Remediation (DERR). Such notification shall describe in detail any construction or improvement plans and a schedule of the activities to take place on the Property. Within 30 days after receipt of such notification, the Director of DERR shall notify the Owner whether the proposed activities meet the requirements of the Institutional Controls and are, therefore, approved or whether the plans must be redesigned to meet the requirements of the Institutional Controls. Construction, improvements, or drilling shall not commence until the Director of DERR has approved the activities. Upon completion of activities, the Owner shall submit a certificate of completion stating that all activities were conducted in accordance with the Institutional Controls described above.

3. The Institutional Controls described above shall be maintained in perpetuity as follows unless terminated or modified as provided in Utah Code Section 19-10-105:

The Property within the Institutional Controls boundary will be visually inspected by DOE at the time of the annual disposal site inspection for evidence of unauthorized well drilling or groundwater use. In addition, DOE will contact the State of Utah Division of Water Rights on an annual basis to verify that no drilling permits have been issued without the approval of UDEQ and DOE. Results of these activities will be included in the annual compliance report that DOE prepares for the U.S. Nuclear Regulatory Commission, a copy of which is provided to UDEQ.

4. The Institutional Controls run with the land and are binding on all successors in interest of the Owner unless or until they are removed as provided in Utah Code Section 19-10-105 and the following stipulation:

If concentrations of the constituents have decreased to allow other uses, this restriction can be altered or terminated at the request of the property owner. Such request must be approved by UDEQ and DOE.

5. The Executive Director of UDEQ, or a designated representative, shall have access to the Property at all reasonable times to verify that these Institutional Controls are being maintained and that the Party or Parties in possession of the Property are complying with the Institutional Controls.

6. These Institutional Controls may be enforced and/or protected as provided in Utah Code Section 19-10-106.

7. Instruments that convey any interest in the Property (fee, leasehold, easement, etc.) shall contain a notification to the person or entity that acquires the interest that the Property is subject to this *Environmental Notice and Institutional Control* and shall identify the specific place at which it is recorded.

8. This *Environmental Notice and Institutional Control* may be terminated in accordance with the provisions if Utah Code Section 19-10-105 and with prior written approval of the Executive Director of UDEQ and of DOE.

EXECUTED as of the _____ day of _______________, 20__.

____
Owner

Signature boilerplate follows

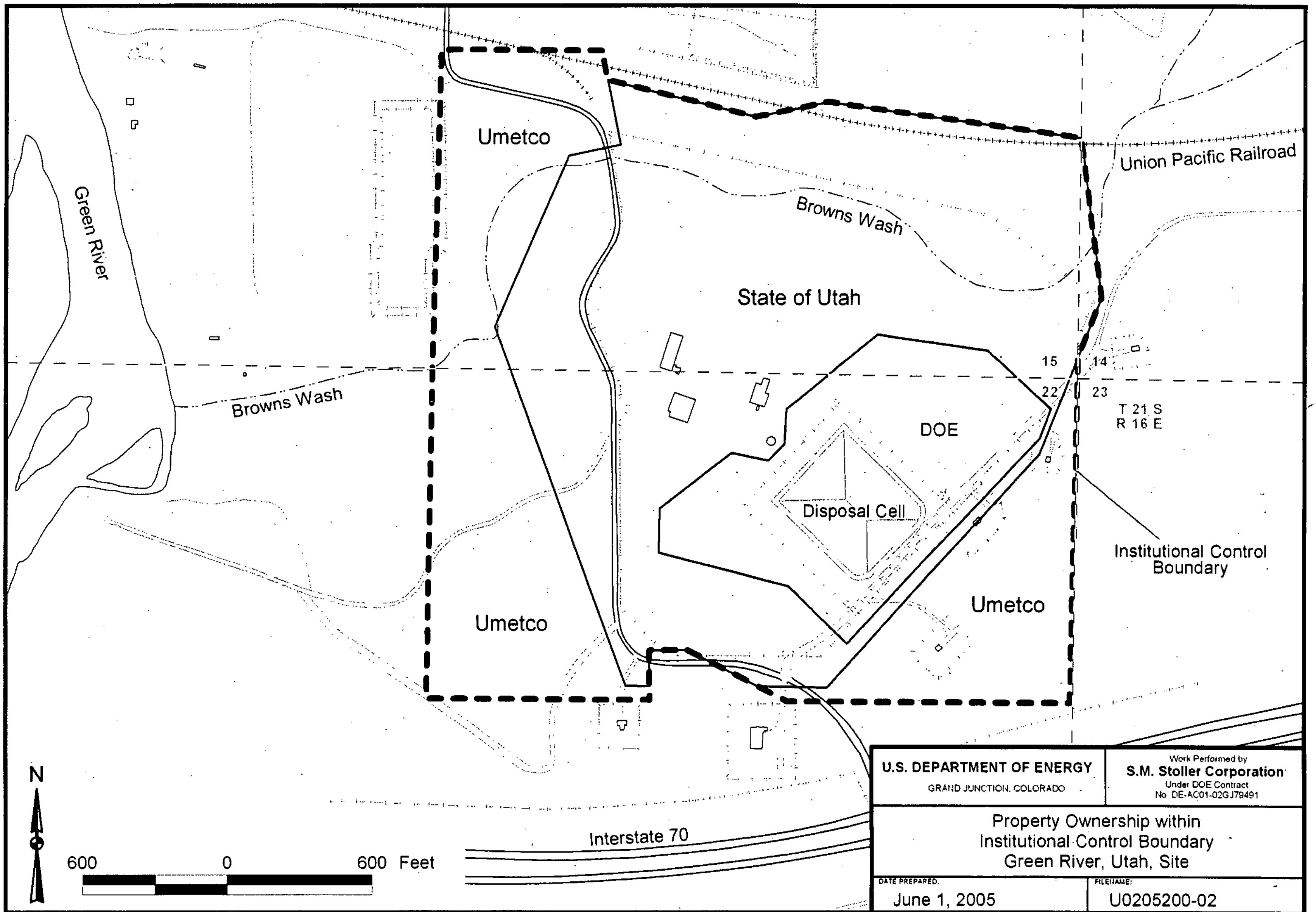
Attachment A

The following property parcels, owned by Umetco Minerals Corporation and successor owners, are subject to this Environmental Notice and Institutional Control:

Township 21 South, Range 16 East, Section 15, Lots 1, 10, and 11; and

Township 21 South, Range 16 East, Section 22, Lots 8 and 9.

Attachment B



m:\ugw\511\0009\11\u02052\u0205200.apr smithw 6/1/2005, 13:56

End of current text