Attachment 6.2-1

Comparison of
Lost Creek, Christensen Ranch, and Irigaray ISR Projects
with respect to
Aquifer Restoration

TECHNICAL MEMORANDUM

TO: UR Energy

FROM: Petrotek Engineering Corporation

DATE: 12/09/08

SUBJECT: Comparison of Lost Creek, Christensen Ranch and Irigaray ISR Projects, with Respect to Aquifer Restoration

UR Energy has applied for a permit to mine the Lost Creek ISR uranium project in Sweetwater County, Wyoming. A key component of the permit application is the requirement to restore aquifer water quality following mining. A comparison is made between the Lost Creek project, currently being permitted, and the COGEMA Irigaray and Christensen Ranch ISR uranium projects that have completed production and restoration operations. Similarities between Lost Creek and the COGEMA sites indicate that aquifer restoration at Lost Creek is achievable following ISR of uranium. Extenuating factors suggest that aquifer restoration can be accomplished at the Lost Creek project with less pore volumes (PVs) of treatment/reinjection/disposal than was required at the COGEMA sites.

The Irigaray site has received approval of aquifer restoration from the Wyoming Department of Environmental Quality (WDEQ) and the Nuclear Regulatory Commission (NRC). COGEMA has submitted a Wellfield Restoration Report for the Christensen Ranch project that is currently under review by WDEQ. These two ISR projects are located within a similar geologic trend as the Lost Creek Project. Hydrogeologic characteristics of Irigaray and Christensen Ranch are also similar to Lost Creek.

The geologic, hydrogeologic and water chemistry properties of the Irigaray, Christensen Ranch and Lost Creek ISR projects are summarized in Table 1. All three of the projects target uranium ore within fluvially deposited sands of Eocene age. Uranium ore within the COGEMA projects was produced from the Wasatch Formation in the Powder River Basin. The Lost Creek uranium deposits are located within the Great Divide Basin, within the Battle Springs Formation, which is laterally equivalent to the Wasatch Formation. Depths to the ore bearing units are similar in each site (100 to 500 feet below ground surface). Hydrologic properties of the sites are also similar, with transmissivity on the order of 50 to 150 ft^2/d and hydraulic conductivity generally between 0.5 and 1 ft/d. Porosity and hydraulic gradient are also in the same range, resulting in calculated groundwater velocity of similar magnitude.

Baseline water quality of the three projects are generally similar, although the Lost Creek site is more of a calcium-sulfate to calcium-bicarbonate water type whereas Irigaray and Christensen Ranch are predominately sodium-sulfate type water. TDS, sulfate and sodium levels tend to be lower at the Lost Creek project. Trace minerals arsenic and manganese, and radionuclides uranium and radium–226 are in the same range at all three

sites. Selenium tends to be lower at Lost Creek than at Irigaray and Christensen Ranch. Based on these similarities and the projected use of similar lixiviant, it is anticipated that mining impacts to Lost Creek water quality prior to restoration, will be similar to post-mining water quality at Christensen Ranch and Irigaray.

Based on the comparison of geologic, hydrologic and water chemistry properties of Irigaray, Christensen Ranch and Lost Creek, it is reasonable to expect that aquifer restoration can be achieved at Lost Creek. Furthermore, there are several reasons to expect that restoration can be achieved with fewer PV) of treatment and reinjection or disposal as described below.

Additional evaluation is provided with respect to the number of PVs of treatment that will be required to achieve restoration of the production zone aquifer. Table 2 presents a summary of the restoration schedule and volumes for Irigaray and Christensen Ranch. As shown on the table, the average number of PVs extracted and treated/reinjected/or disposed was 13.6 for Irigaray and 12.6 for Christensen Ranch. However, several points can be made that suggest that the number of PVs required to restore the aquifer at Lost Creek will be less than at Christensen Ranch and Irigaray. Circumstances at both those ISR projects resulted in increased PVs to achieve restoration goals including the following:

- Production and restoration were not conducted sequentially, and were hindered with extended periods of shut-in and standby, with delays of up to several years in some cases;
- During early production at Christensen Ranch, the lixiviant was an ammonium bicarbonate with hydrogen peroxide, which resulted in extensive additional restoration efforts;
- Groundwater sweep, the initial phase of restoration, was often largely ineffective and in some cases may have exacerbated the mining impacts to water quality; and
- RO was continued in some wellfields after it was apparent that little improvement in water quality was occurring.

Restoration was not performed immediately following the completion of production, and in some cases, there were long periods of inactivity during the production and restoration phases. At Irigaray, production was interrupted for a period of almost six years in MU1 through MU5 (Figure 1). Similarly, there was a three-year break in production in MU6 through MU9, when the operation was in standby status. Restoration did not commence at MU1 through MU3 until a year after production had ended. At MU4 and MU5, restoration operations did not begin until two years following production. Restoration commenced shortly after the end of production at MU6 through MU9. However the project was on standby status between the completion of groundwater sweep and the beginning of the RO phase of production, resulting in a break of one to two years, depending on the MU. Restoration was initiated sooner after the end of production at Christensen Ranch, with the exception of MU3 and MU4. However, there were periods of standby between groundwater sweep and RO treatment/injection of up to a year. These delays between and during production and restoration operations most likely

increased the number of PVs required to complete aquifer restoration. UR Energy will commence restoration activities immediately upon completion of production within a wellfield, thus eliminating this factor in prolonging aquifer restoration.

Results of the effectiveness of groundwater sweep (or lack of it) were clearly demonstrated in the Christensen Ranch Wellfield Restoration report (CRWR) (COGEMA 2008). Examples of plots from that report of mean wellfield water quality at the end of mining, groundwater sweep, RO and stabilization monitoring are attached. Plots of TDS for MU3, MU5 and MU6 (Figures 5-7, 5-8 and 5-7, from the respective Mine Unit Data Packages of the CRWR), indicate minimal improvement following groundwater sweep at MU3 and MU5 and an actual increase at MU6. Following application of RO, the TDS values at MU5 and MU6 decreased to levels below the target Restoration Goal. Uranium increased in MU5 and MU6 following groundwater sweep (Figures 5-12 and 5-13 from the respective Mine Unit Data Packages of the CRWR), and then was significantly lowered during RO. Approximately 1,8. 4.8 and 1.5 PVs of groundwater were removed from MU3, MU5 and MU6, respectively, during groundwater sweep. This water removal was totally consumptive by design, in that none of it was returned to the aquifer. Based on the results, minimal benefit, if any, was derived from this phase of restoration. Groundwater sweep is an unnecessary, ineffective and consumptive step in the restoration process. Eliminating, or at least reducing the groundwater sweep phase, will reduce the number of PVs required to reach aquifer restoration goals.

In some cases, RO was continued longer than necessary or at least longer than any improvements to water quality were occurring. A review of the uranium and conductivity trend plots from the Irigaray recovery wells during restoration (included in the Irigaray Mine Wellfield Restoration Report (COGEMA 2004) show this to be the case. Figures 4-4 through 4-7 from the Irigaray report show that RO was often continued for several PVs beyond the point that water quality had stabilized. The additional PVs of RO resulted in no direct benefit to aquifer water quality and only resulted in consumptive use of the groundwater resources. RO typically results in disposal of approximately 20 percent of the recovered groundwater with reinjection of the remaining 80 percent following treatment. Terminating RO once water quality has stabilized will minimize the consumptive use of groundwater and reduce the number of PVs of treatment.

In addition to the improvements to restoration methods described above, UR Energy intends to conduct RO concurrent with production operations. Rates of up to 200 gpm will be treated using RO within portions of the wellfield while production is ongoing. This action will result in better water quality at the termination of wellfield production. This means that the starting point for restoration will be closer to the target restoration goals for the project.

The net result of each of these strategies (implementation of RO during production operations, immediate restoration following production, elimination of groundwater sweep, terminating RO once restoration is achieved or water quality has stabilized) should reduce the number of PVs required to achieve aquifer restoration. It is difficult to quantify how effective each of these strategies will be until actual field measured data

become available. Substantial justification of the number of PVs estimated for restoration of Lost Creek following ISR mining using analytical methods or numerical modeling, given the degree of uncertainty that exists in many of the parameters that would be used in such a demonstration, does not seem appropriate at this time. The preferred approach is the one presented in this response; to use existing analogs to the site, and to adjust the PV approximation based on “lessons learned” from those sites.

Table 1. Geologic, Hydrologic, and Water Quality Properties- Lost Creek, Irigaray, and Christensen Ranch ISR Projects

	Lost Creek	Irigaray	Christensen Ranch
Permit Area	4,400 Acres	700 Acres	14,000 Acres
Wellfield Area	6 Mine Units - 235 Acres	9 Mine Units - 30 Acres	5 Mine Units - 200 Acres
Geology			
Basin	Greate Divide Basin	Powder River Basin	Powder River Basin
Location within basin	Northeast edge of basin	West central-east of basin axis	West central-east of basin axis
Deposi ional Set ing	Fluvial/alluvial fan deposits	Fluvial/channel sands	Fluvial/channel sands
Formation	Eocene-Battle Springs(Wasatch Equivalent)	Eocene-Wasatch	Eocene-Wasatch
Regional Dip		NW at 1 to 2 1/2 degrees	NW at 1 to 2 1/2 degrees
Formation Lithology	Interbedded sandstone, siltstone and shales	Interbedded sandstone, siltstone and mudstone with thin coal beds	Interbedded sandstone, siltstone and mudstone with hin coal beds
Primary Ore Bearing Unit	HJ Horizon	Upper Irigaray Sandstone	K Sandstone
Lithology of ore bearing unit	fine to crse gr, poorly srtd, arkosic sd	fine to crse gr, poorly srtd, arkosic sd	fine to crse gr, mod srtd, arkosic sd
Ore bearing unit thickness	100 - 160 ft	75-130 ft	50 to 210 ft
Ore type	Roll Front/Tabular Deposits	Roll Front	Roll Front
Ore thickness	5 to 28 ft	15-25 ft	15-25 ft
Depth to ore zone	300 to 450 feet	100 to 300 ft	250 to 500 ft
Porosity	25 - 30%	23-29%	26 - 29 %
Overlying confining unit thickness	5 to 45 ft	18-25 ft	5-150 ft
Underlying confining unit thickness	5 to 75 ft	10-30 ft	20-70 ft
Hydrology (Ore bearing unit)			
Groundwater Flow Direction	West-Sou hwest	Northwest	Northwest
Hydraulic Gradient	0.0035 - 0.0056 ft/ft	0.005 ft/ft	0.004 to 0 010 ft/ft
Transmissivity (ore bearing unit)	60 to 100 ft^2/d	40 to 136 ft^2/d	33 to 138 ft^2/d
Hydraulic Conductivity	0.2 to 3.0	0.37 to 1.4 ft/d	0.32 to 1.6 ft d
Storativity	3.3 E-05 to 9.1 E-04	2.70E-04	4.5E-05 to 1.3E-03
Groundwater Velocity	0.0025 to 0.054	0.019 to 0.03 ft/d	0 0088 to 0.043 ft/d
'Baseline Water Chemistry (Ore Bearing Unit)			
Water type	Calcium Sulfate to Calcium Bicarbonate	Sodium Sulfate	Sodium Sulfate
TDS (mg/l)	100 - 600	270-1050	400-1200
Sulfate (mg/l)	25 - 300	130-630	230-680
Calcium	5 - 150	1-34	10-50
Sodium (mg/l)	20 - 40	95-280	150-280
Bicarbonate (mg/l)	30 - 170	5-144	130-210
Manganese (mg/l)	0.01 - 0.03	0.05-0.19	0.01-0 05
Selenium (mg/l)	0 001 - 0.002	0.001-0.416	0.003-0.03
Arsenic (mg/l)	0.001 - 0.014	0.001-0.105	0.002-0.01
Uranium (mg/l)	0.001 - 0.844	0.0003-18.6	0 034-0 376
Radium (pCi/l)	0 - 550	0-250	83-430

Table 2. Production and Restoration Schedule and Volumes, Christensen Ranch and Irigaray ISL Uranium Projects

Christensen Ranch Production/Restoration

	Production[1]	GWS	RO	Recirculation	Stability Monitoring	Total Volume Restoration (million gallons)	Total PVs Restored	PV of GWS	PV of RO	PV of Recirc
MU2	Jul-93,May-97	May-97, Jul-98	Oct-00, Mar-02	Apr-03, Mar-04*	Apr-04, Jan-05	394	14.4	2.2	10 8	1.4
MU3	Mar-89-Jun-95	Mar-97, Sep 98	Feb-99, Aug-02	Feb-04, Sep-04*	Oct-04, Jul-05	443	19 8	1.8	16.4	1.6
MU4	Jun-94 Aug-97	Aug-97 Jul-98	Apr-01 Mar-03*	Mar-03 Apr-04	Apr-04 Jan-05	250	12 8	1.9	9.8	1.0
MU5	Jun-95, Mar-00	Aug-00, Jun-01	Feb-01, Nov-03	-	Nov-03, Aug-04	757	10.1	4.8	5.3	0.0
MU6	Jan-97, Jun-00	Sep-00, Feb-03	Oct-03,May-05	-	Jun-05, Mar-06	757	6	1.5	4.5	0.0
					Average	520 2	12 6	2.4	9.4	0.8

1 - 'Lixiviant was Sodium Bicarbonate with gaseous O2
* included H2S injection

Irigaray Production/Restoration

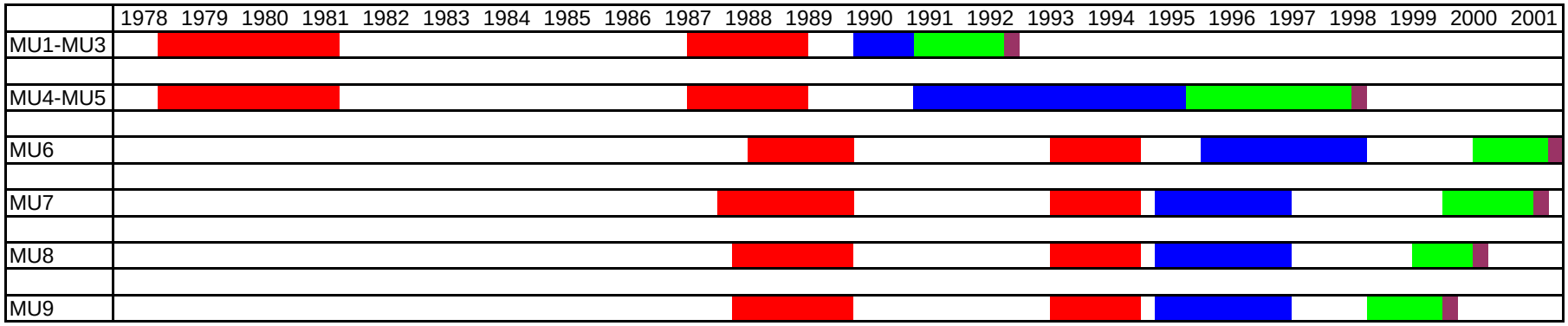
	Production[2]	GWS	RO	Recirculation	Stability Monitoring	Total Volume Restoration (million gallons)	Total PVs Restored	PV of GWS	PV of RO	PV of Recirc
MU1 - MU3	Oct-78, Oct-81 Aug-87, Jun-89	May-90, Apr-91	Apr-91, Oct-92	Oct-92, Nov-92	Dec-92, Sep-93	216	18.4		13 2	
MU4 - MU5	Oct-78, Oct-81 Aug-87, Jun-89	Jun-91, Oct-95	Oct-95, Aug-98	Aug-98, Sep-98	Oct-98, Jul-99	142	13 9		9.5	
MU6	Jun-88, Feb-90 Aug-93, Nov-94	Jan-96, Aug-98	Jul-00, Oct-01	Oct-01, Nov-01	Dec-01, Aug-02	127	9.5		7.1	
MU-7	Jan-88, Feb-90 Aug-93, Nov-94	Apr-95, Sep-97	Feb-00, Jul-01	Jul-01, Aug-01	Aug-01, Jun-02	189	14 3		11.7	
MU-8	Feb-88, Feb-90 Aug-93, Nov-94	Apr-95, Sep-97	Mar-99, Jun-00	Jul-00, Aug-00	Sep-00, Jun-01	55	12 5		10 2	
MU-9	Mar-88, Feb-90 Aug-93, Nov-94	Aor-95, Sep-97	Nov-98, Apr-00	May-00, May-00	Jun-00, Jan-01	110	13		10.7	
					Average	140	13 6		10.4	

2 - Liviant was Ammonium Bicarbonate with Hydrogen Perioxide in MU1 -MU5 from 1977 to May 1980. Thereafter Sodium Bicarbonate with gaseous O2 was utilized.

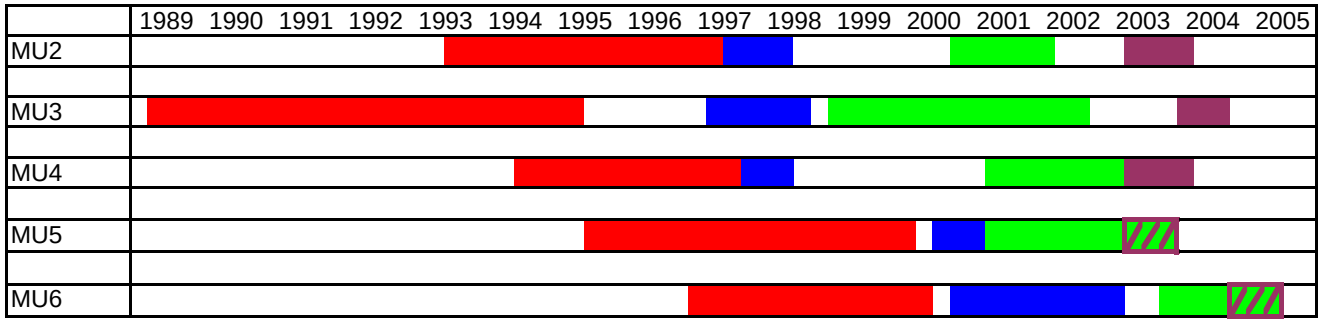
PV - Pore Volume
GWS - Groundwater Sweep
RO -Reverse Osmosis and Reinjection
Recirc - Recirculation

Figure 1. Production and Restoration Sequence, Irigaray And Christensen Ranch ISR Uranium projects

Irigaray Mine Units 1 through 9



Christensen Ranch Mine Units 2 through 6



Production
Groundwater Sweep
Reverse Osmosis/Reinjection
Recirculation
RO and Recirculation

Figure 5-7. Mean TDS Concentration-Post Mining Through 4th Stability Round
Mine Unit 3, Christensen Ranch, Wyoming, Cogema Mining, Inc.

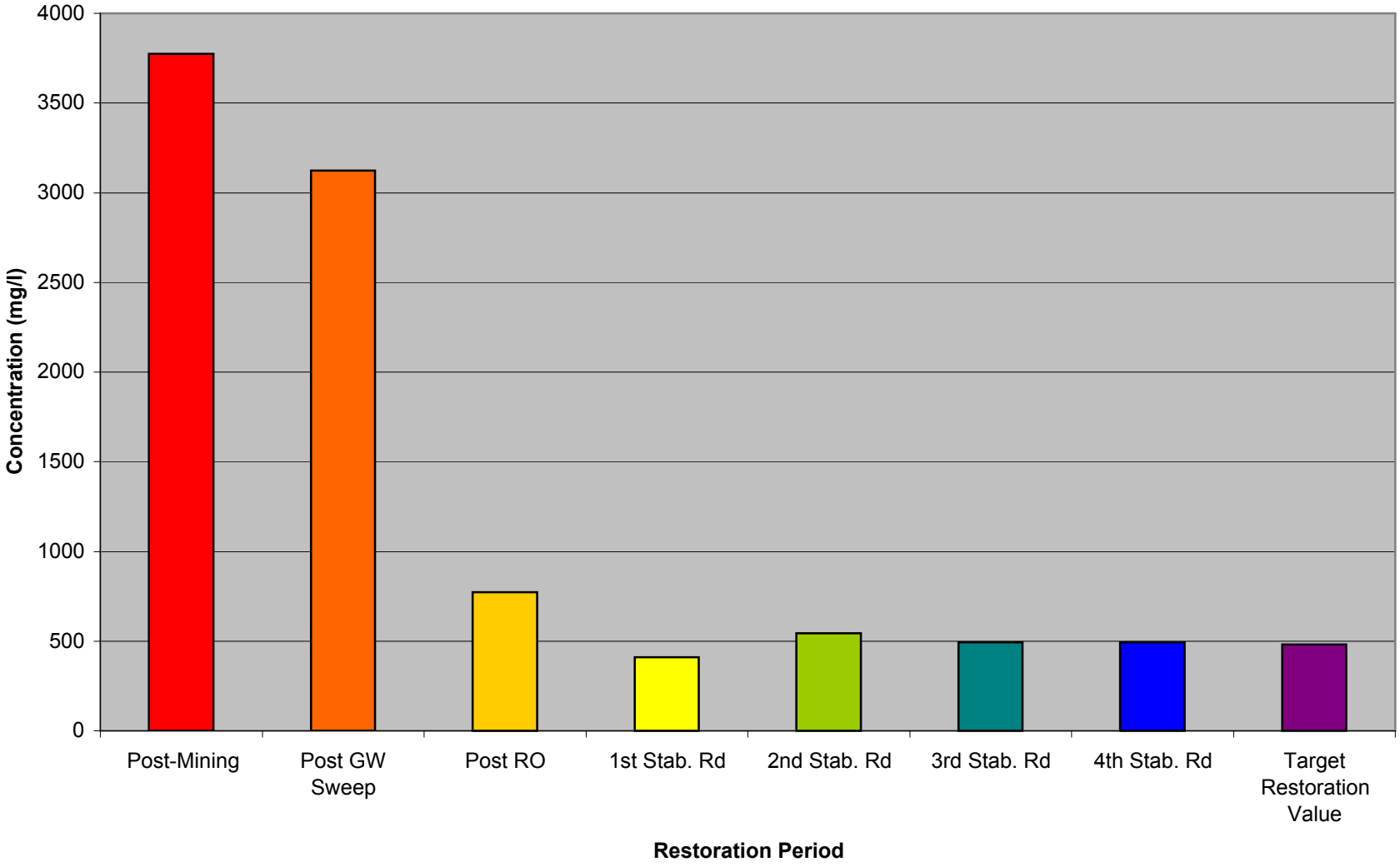


Figure 5-8. Mean TDS Concentration-Post Mining Through 4th Stability Round
Mine Unit 5, Christensen Ranch, Wyoming, Cogema Mining, Inc.

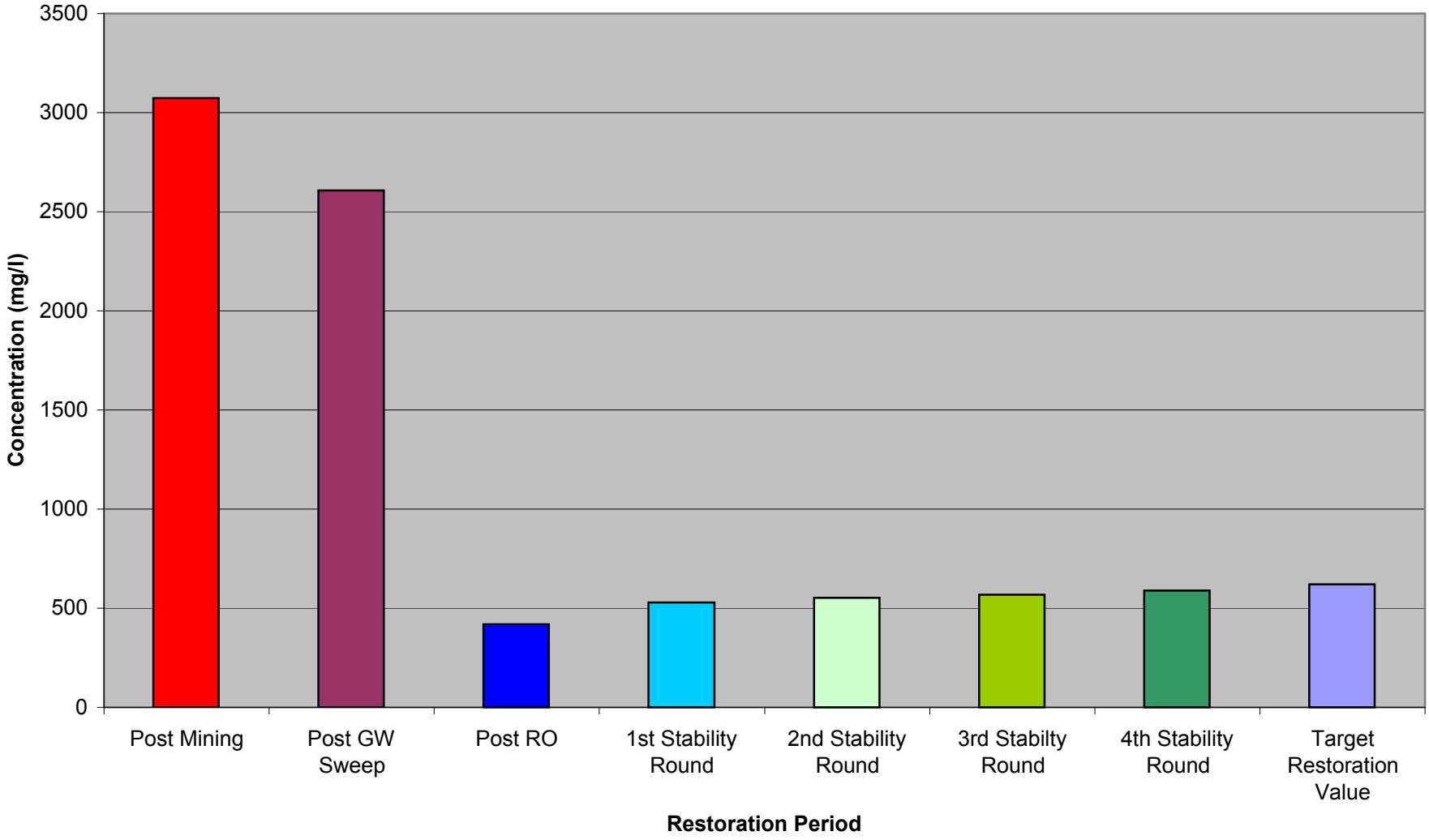
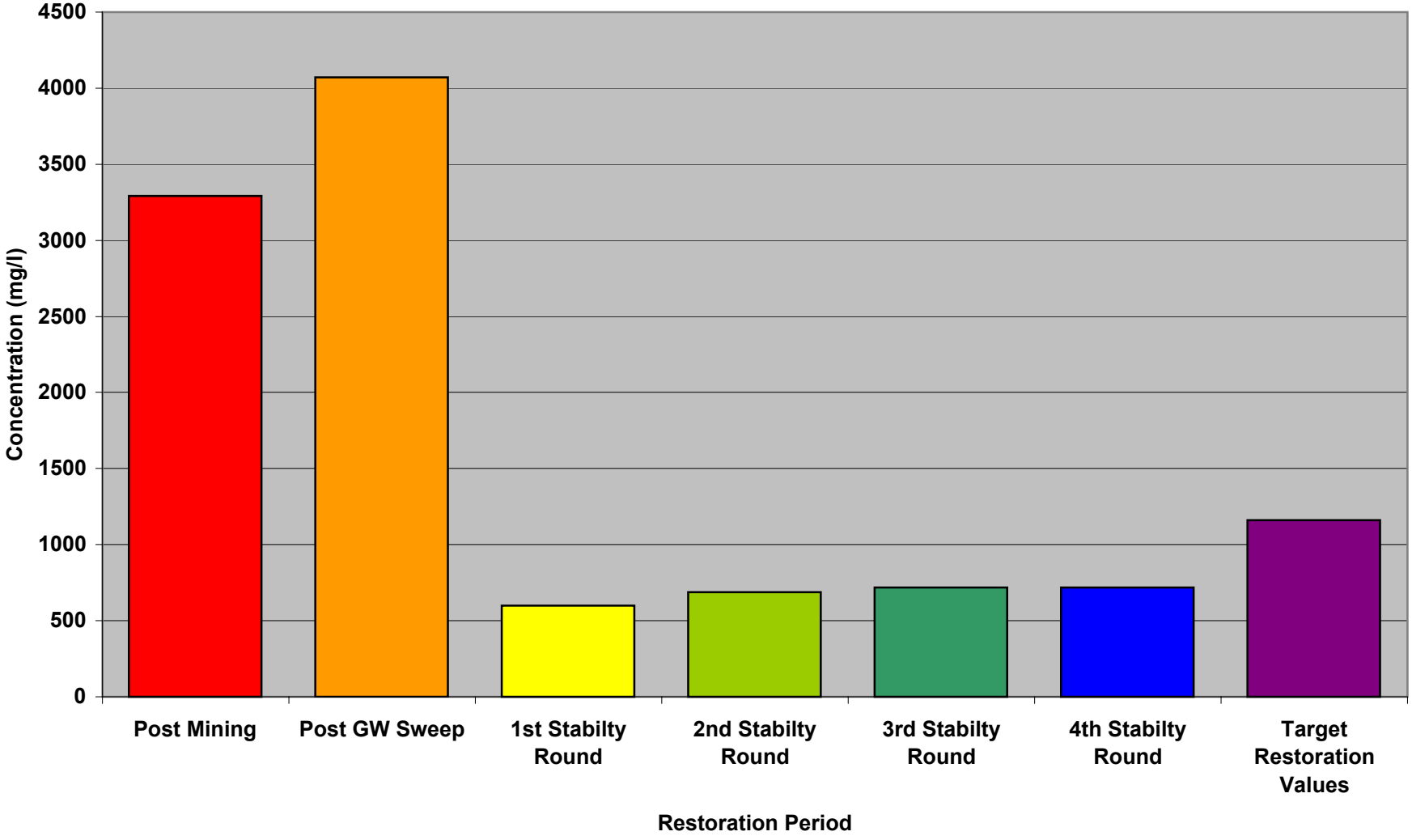


Figure 5-7 Mean Total Dissolved Solids Concentration-Post Mining Through 4th Stability Round
Mine Unit 6, Christensen Ranch, Wyoming, Cogema Mining, Inc.



Figuire 5-12. Mean Uranium Concentration-Post Mining Through 4th Stability Round Mine Unit 5, Christensen Ranch, Wyoming, Cogema Mining, Inc..

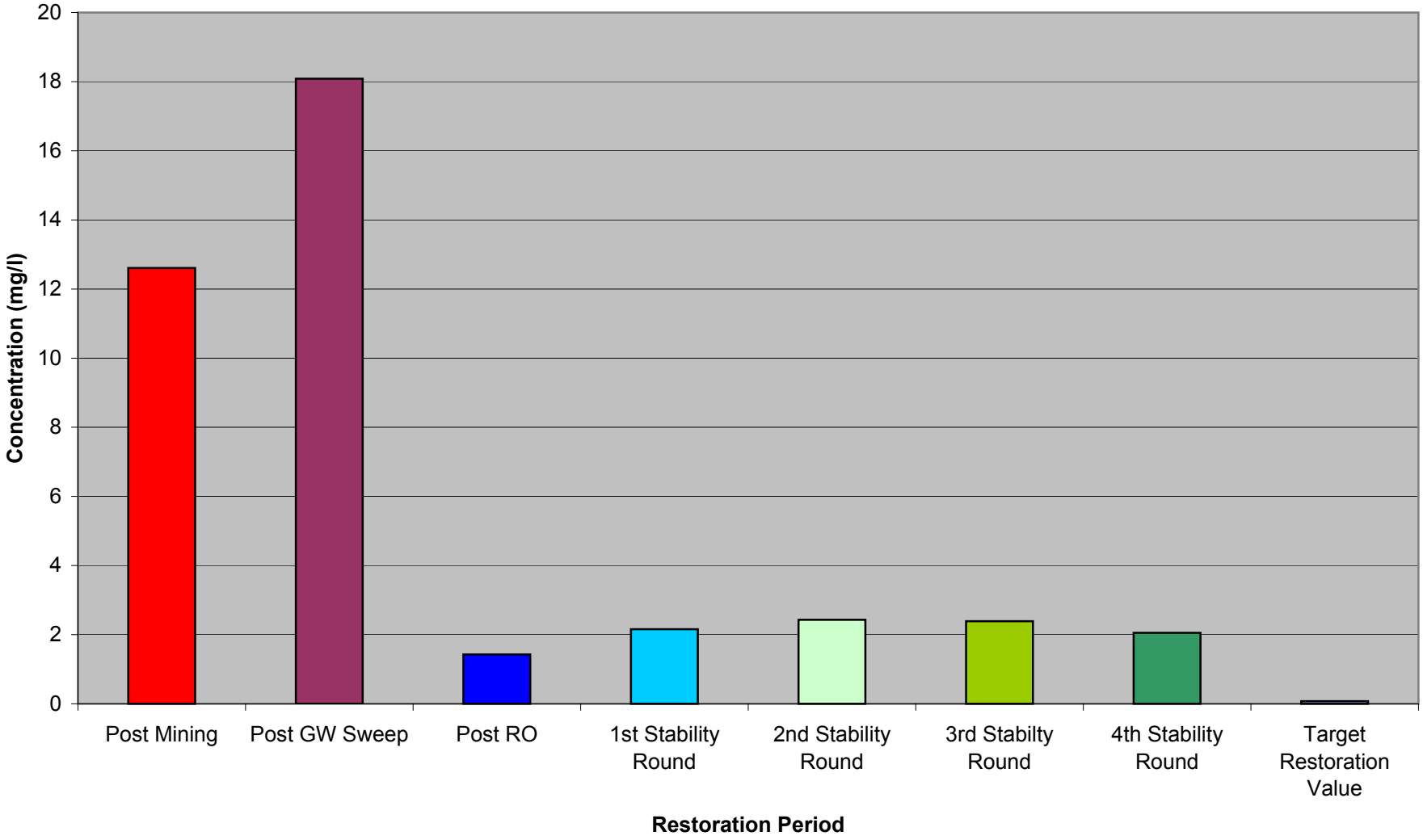


Figure 5-13 Mean Uranium Concentration-Post Mining Through 4th Stability Round
Mine Unit 6, Christensen Ranch, Wyoming, Cogema Mining, Inc.

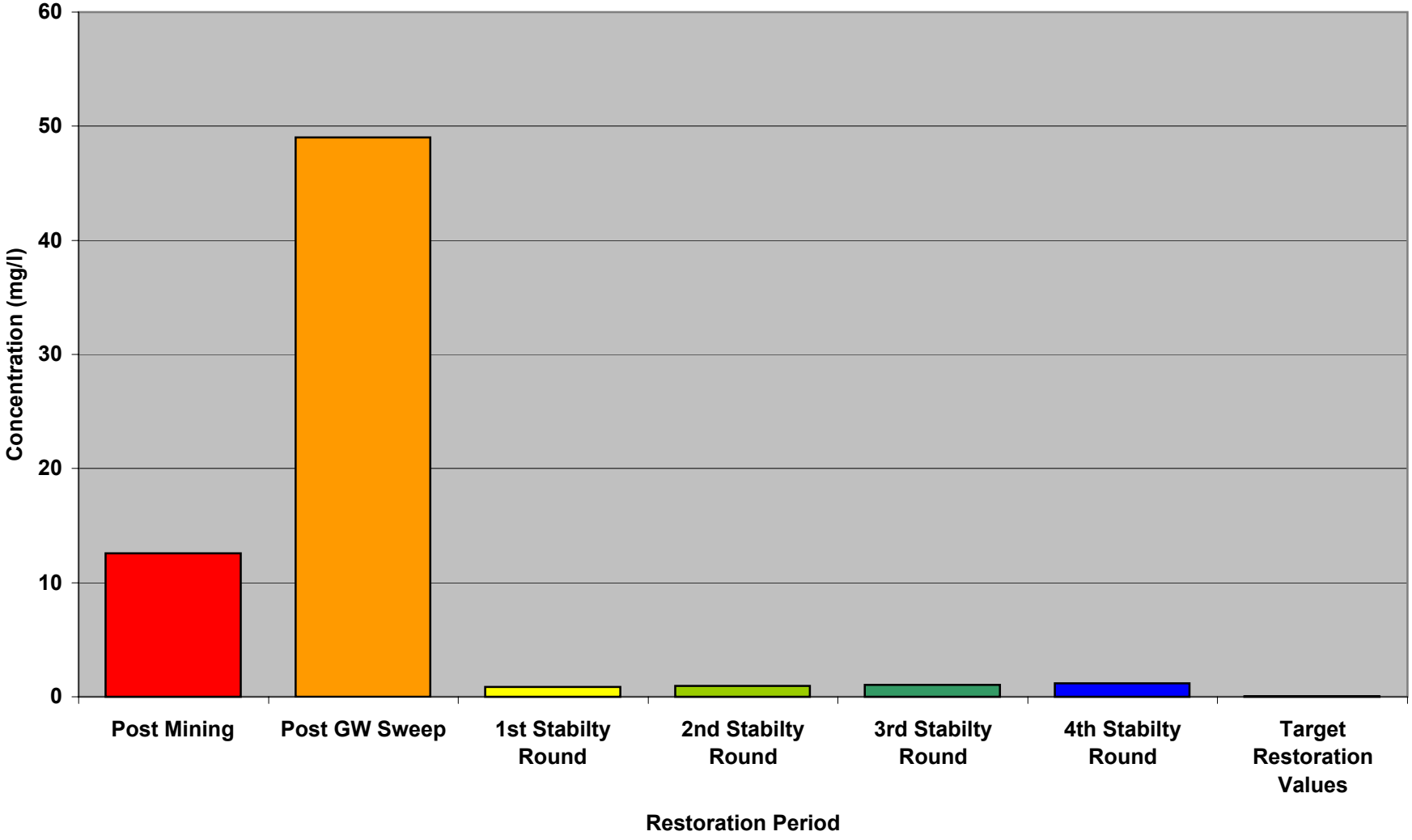


FIGURE 4-4
CONDUCTIVITY AND URANIUM TRENDS
PRODUCTION UNIT 6, RO PHASE
(MONTHLY RECOVERY WELL AVERAGES)

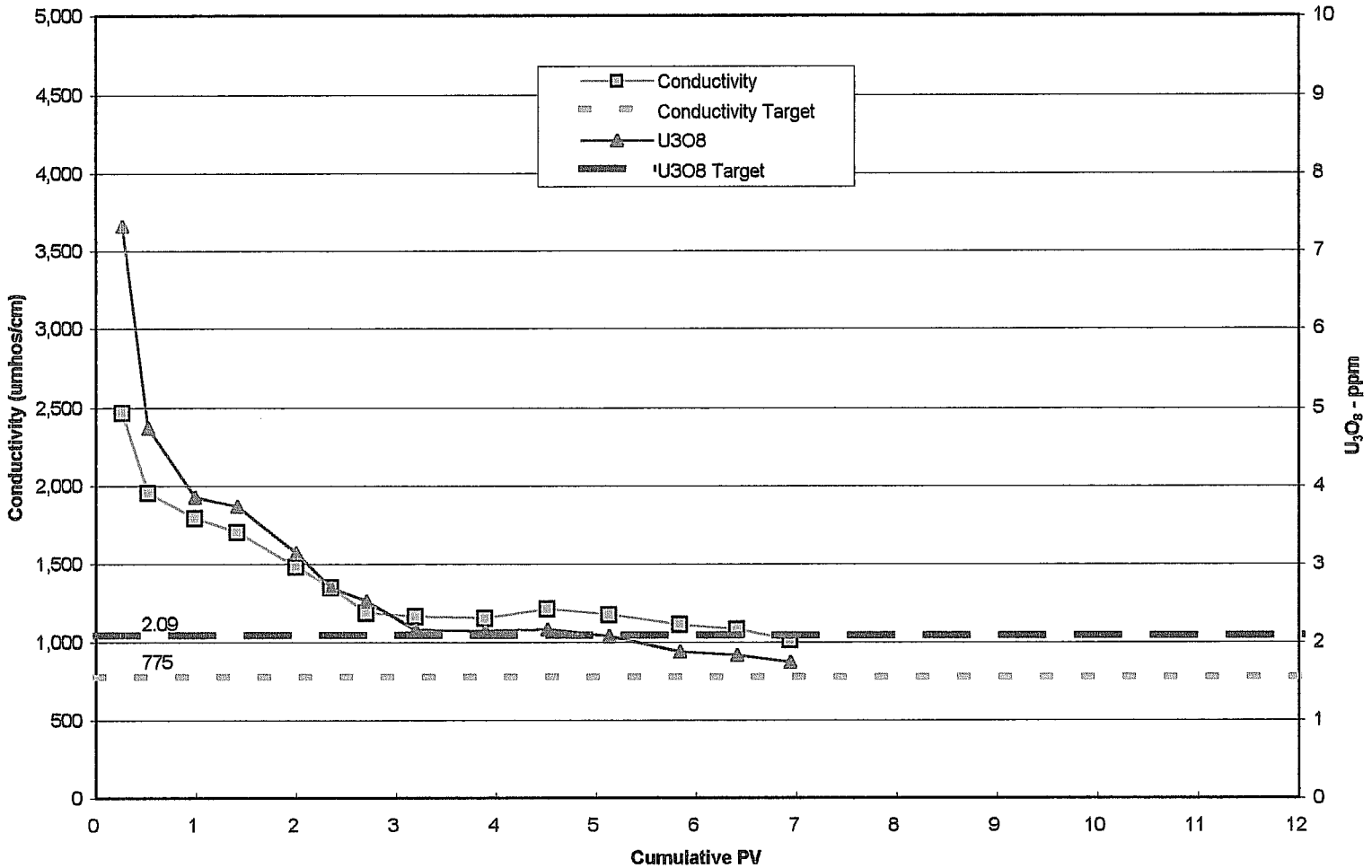


FIGURE 4-5
CONDUCTIVITY AND URANIUM TRENDS
PRODUCTION UNIT 7, RO PHASE
(MONTHLY RECOVERY WELL AVERAGES)

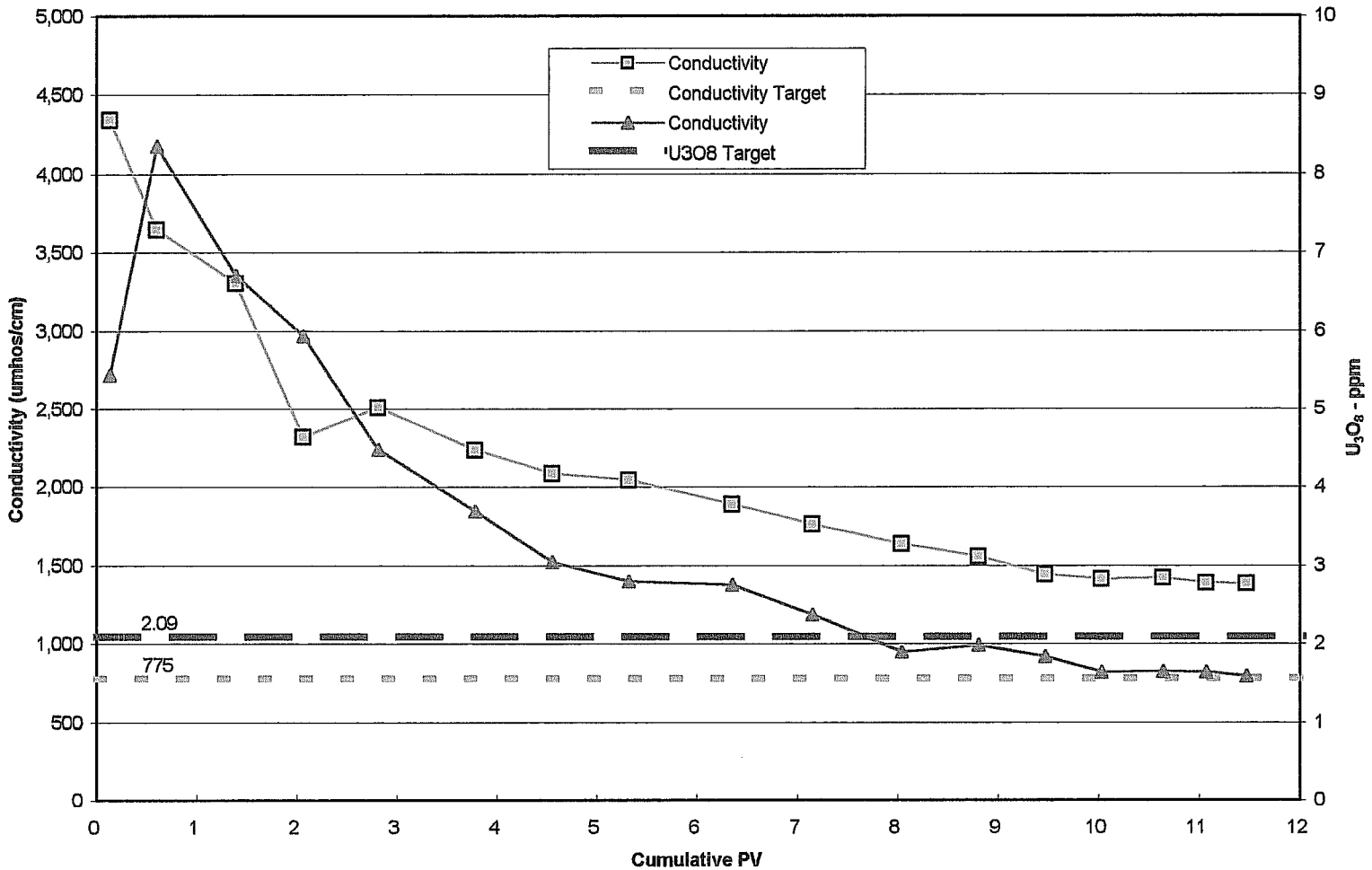


FIGURE 4-6
CONDUCTIVITY AND URANIUM TRENDS
PRODUCTION UNIT 8, RO PHASE
(MONTHLY RECOVERY WELL AVERAGES)

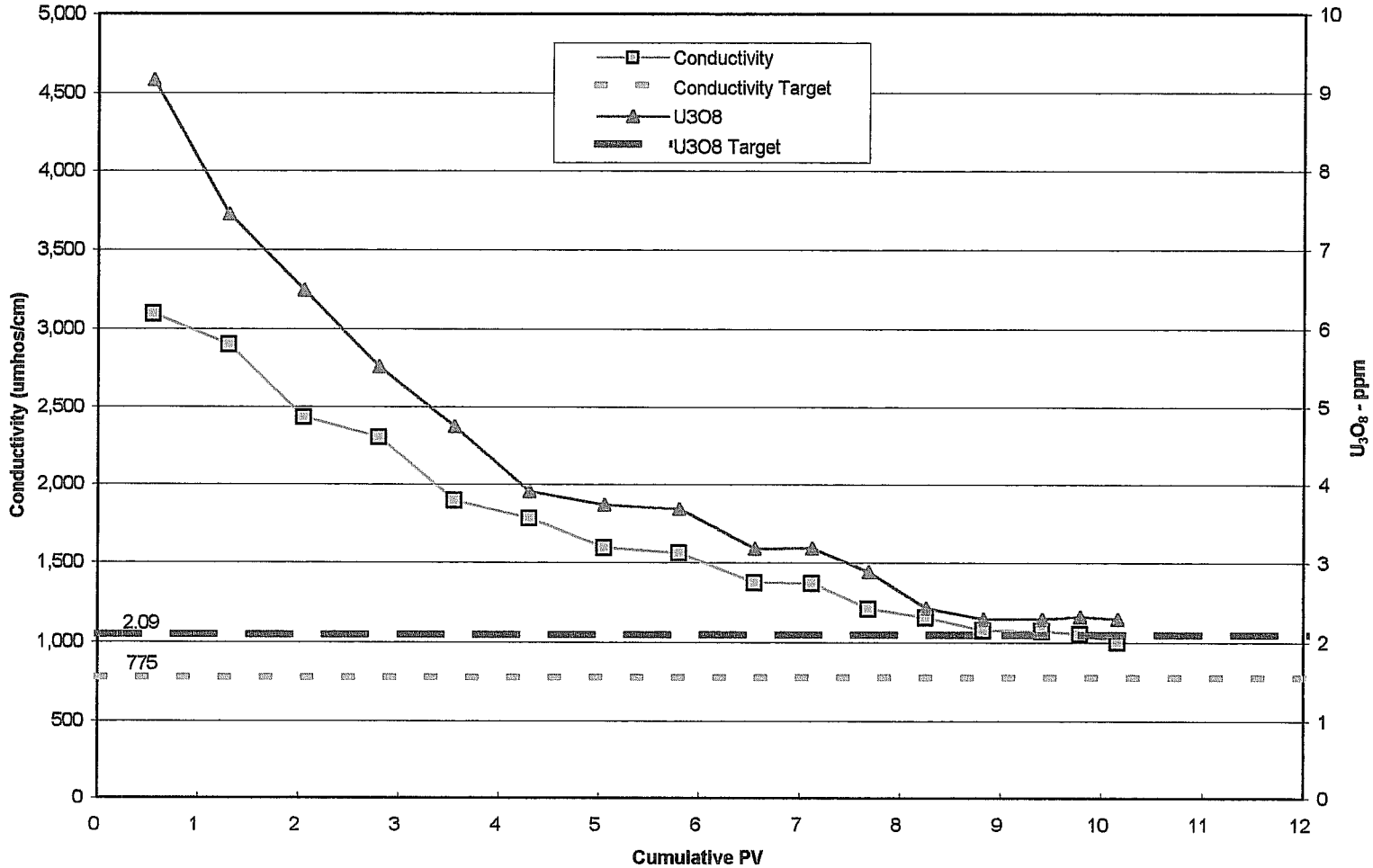
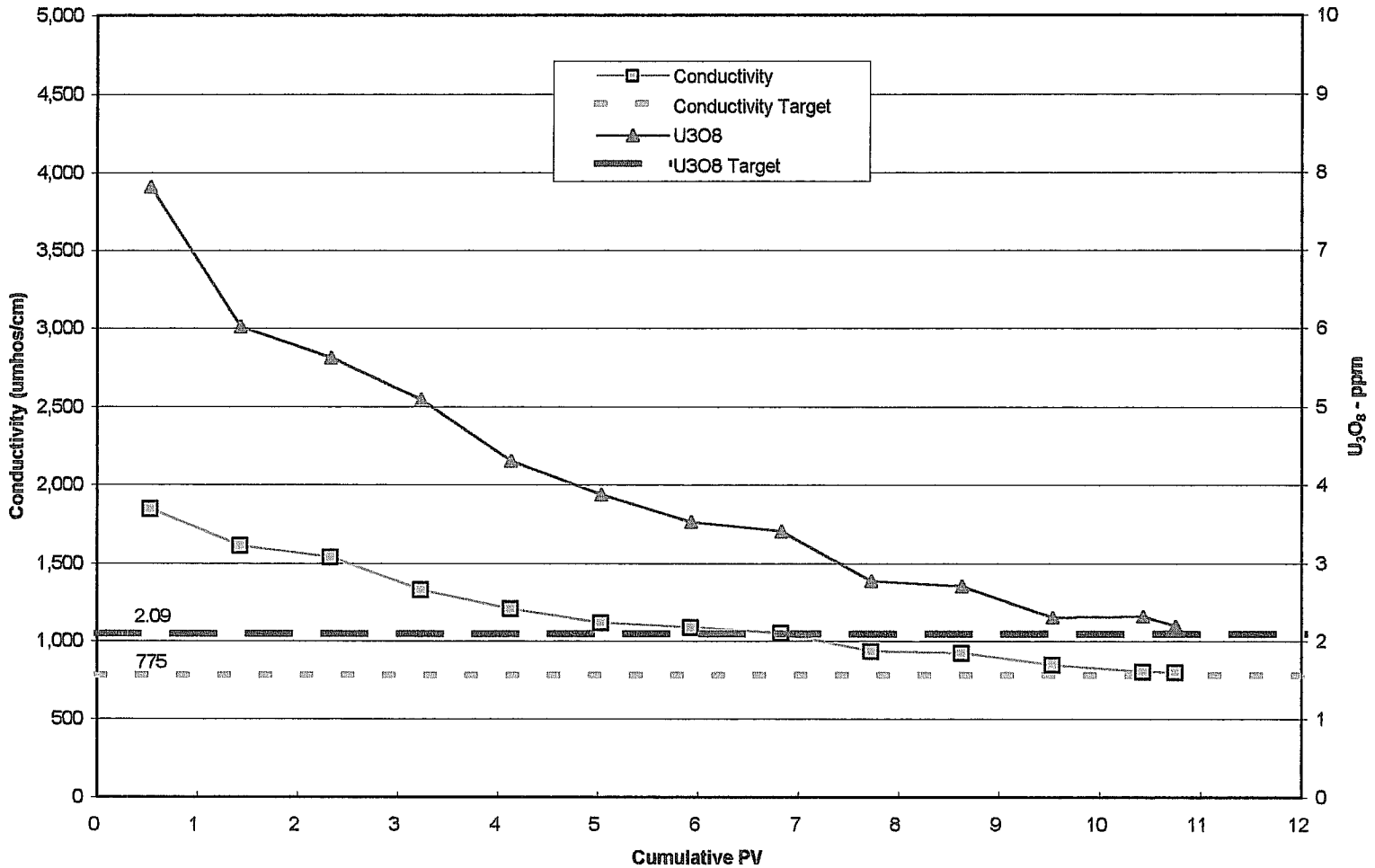



FIGURE 4-7
CONDUCTIVITY AND URANIUM TRENDS
PRODUCTION UNIT 9, RO PHASE
(MONTHLY RECOVERY WELL AVERAGES)