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November 9, 2010

Glenn Mooney
Senior Geologist
Wyoming Department of Environmental Quality
Land Quality Division
2100 West 5th, Street
Sheridan, WY 82801

Re: Mine Unit 5 Response, Irigaray–Christensen Ranch In Situ Operations, Permit No. 478

Dear Mr. Mooney:

Uranium One Americas (Uranium One) has prepared this excursion status report for Monitor Well 5MW66 at the Irigaray–Christensen Ranch Project. As per discussions with you on October 29, the attached report presents the modeling evaluation prepared by Petrotek Engineering for a number of different excursion recovery scenarios for 5MW-66. As identified in previous reports sent to the WDEQ-LQD, the hydrologic conditions surrounding 5MW-66 do not represent what would be considered typical excursion conditions. The Petrotek Engineering model evaluated multiple recovery scenarios and evaluated the probable success of each to facilitate removing 5MW-66 from excursion status. Only the last scenario presented in the report represented an option that could be implemented and potentially provide information that would further advance successful removal of 5MW-66 from excursion status.

Uranium One proposes to start a recovery pumping program utilizing one well to the north of 5MW-66 at 5 gpm, one well to the south of 5MW-66 at 5 gpm and 5MW-66 at 10 gpm. The pumping of the north and south wells is proposed to maintain balance from the restored wellfields while 5MW-66 is pumped simultaneously. Weekly samples will be collected from all three wells and analyzed for the UCL parameters including Uranium and pH, water levels will also be measured during each sample round and reported with the water quality results to the WDEQ-LQD on a monthly basis. Water from the three wells will be pumped to one of three existing lined evaporation ponds (ponds one, two, or three).

On a parallel path Uranium One will be evaluating this area for future ISR development. The area in which 5MW-66 is located is likely within an ore body and mineral trends will

Uranium One USA, Inc.
A Member of the Uranium One Inc. Group of Companies
tel +1 307-234-8235 • **fax** +1 307-237-8235
907 N. Poplar Street, Suite 260
Casper, Wyoming 82601
www.uranium1.com

be evaluated to determine if future uranium recovery is economic. The original Mine Unit 5 wellfield design was developed when uranium prices were considerably lower than the current market price, thus the current market price could render recoverable uranium in areas not previously developed when the Mine Unit 5 wellfields were originally designed and mined in the mid 1990's. Uranium One will evaluate these future mining options and discuss any future mining plans and potential interim mine stabilization status with the state.

If you have any questions please do not hesitate to contact me at 307-234-8235 ext. 331, or at jon.winter@uranium1.com.

Sincerely,

Jon Winter
Manager: Wyoming Environmental and Regulatory Affairs
Uranium One Americas

Cc: Ron Linton – NRC
Errol Lawrence - Petrotek

Enclosures: Numerical Assessment of Excursion Recovery, Mine Unit 5, Christensen Ranch ISR Uranium Project,

Technical Memorandum

Prepared for: Uranium One, Americas

Prepared by: Petrotek Engineering Corporation

Date: 11/3/10

Subject: Numerical Assessment of Excursion Recovery, Mine Unit 5, Christensen Ranch, ISR Uranium Project, Wyoming

Introduction

At the request of Uranium One, Americas, Petrotek Engineering Corporation (Petrotek) conducted an assessment of hydraulic recovery alternatives for the excursion detected at monitor ring well 5MW66, located within Mine Unit 5 (MU5) of the Christensen Ranch Insitu Recovery (ISR) Uranium Project in Johnson County, Wyoming. The assessment was performed using a numerical model and is limited to the simulation of various pumping scenarios to determine if extraction is plausible for the recovery of the excursion detected at monitor well 5MW66.

Previous investigation has not conclusively identified the source of the excursion. Although it is apparent that Well 5MW66 has been affected by ISR activities in the immediate area of the monitor well, it is important to note that the Class of Use of this well has not been changed by the excursion. Additional monitoring at downgradient monitor ring wells 5MW68, 5MW64 and 5MW2 indicates that the area of elevated uranium does not extend to these wells.

Site Conceptual Model

A conceptual model of site conditions in the vicinity of monitor well 5MW66 has been developed based on data collected during the delineation, production, restoration and monitoring of MU5. Additional data have recently been collected to better characterize the nature and extent of the excursion detected at monitor well 5MW66. Results of the additional investigation have been reported in status reports to the Wyoming Department of Environmental Quality–Land Quality Division (WDEQ-LQD). A summary of the site conceptual model used as the basis for the numerical modeling is provided below.

Monitor well 5MW66 is located downgradient of Module 5-5 in the northeastern portion of MU5. The production zone aquifer within MU5 is the K Sandstone. Production in Module 5-5 was within the "K2" and "K3" subunits of the K Sandstone. The nearest production to 5MW66 was in the "K2" and "K3" Sands approximately 200 feet to the south and in the "K3" Sand approximately 300 feet to the northeast (Figure 1). The monitor well is essentially surrounded on three sides by historic ISR mining activities and is completed within a uranium ore-body.

The top of the "K2" Sand is approximately 260 feet below ground surface (ft bgs) in 5MW66. An electric log for 5MW66 is shown on Figure 2. The base of that unit is at 346 ft bgs giving a total thickness of 86 feet for the "K2" sand. The top of the "K3" Sand is approximately 365 feet below ground surface (ft bgs) and the base of the "K3" Sand is at 450 ft bgs for a total thickness of 85 feet. Monitor well 5MW66 is completed across both the "K2" and "K3" sands.

Potentiometric surface data collected in September 2010 indicates that the hydraulic gradient in the vicinity of 5MW66 is approximately 0.008 ft/ft, generally to the west. The potentiometric data do not clearly indicate that either the wellfield to the south or the northeast is the source of elevated constituents observed in well 5MW66.

Results of hydrologic tests conducted in the vicinity of MU5 were summarized in a report by Aqua Terra Consultants in 1995. The report indicates that the K Sand has an average transmissivity of approximately 651 gpd/ft (87 ft^2/d), an average hydraulic conductivity of 3.43 gpd/ft^2 (0.46 ft/d) and an average storativity of 4.8 x 10^{-04}. The hydraulic conductivity was calculated using an average (total) thickness of 193 feet.

Water quality data collected in the area of 5MW66 were reviewed in an attempt to identify the source and extent of the excursion. The data indicate that chloride and conductivity are higher at monitor well 5MW66 than at any of the surrounding wells, including wells within the mined and restored area. Uranium and alkalinity were elevated in well 5MW66 and in wells to the northeast and to the south. The pH at well 5MW66 was lower than all surrounding wells. The water quality data suggest that impacts away from the wellfields are generally limited to the area immediately around well 5MW66. The water quality and water level data do not clearly indicate the source of the excursion as being either the wellfield to the northeast or the south. Water quality with the "K2" Sand is generally better than the "K3" Sand, at least with respect to the constituents previously discussed. Therefore, it is assumed that the source of the excursion is most likely derived from the "K3" Sand.

Model Code

Three-dimensional analysis of groundwater flow in the K Sand aquifer system was performed with the finite difference groundwater flow model (MODFLOW), developed by the U.S. Geological Survey (USGS) (McDonald 1988, 1996). A particle-tracking code MODPATH, Version 3 (Pollack, 1994), was used to provide computations of groundwater seepage velocities and groundwater flow directions at the site. The pre/post-processor Groundwater Vistas (Environmental Simulations, Version 5, 2007) was used to assist with input of model parameters and output of model results. Groundwater Vistas serves as a direct interface with MODFLOW and MODPATH.

Model Domain and Grid

The model domain encompasses an area of 5.6 square miles with north-south and east-west dimensions of 12,500 ft (2.4 miles). The model grid is centered at the location of monitor well 5MW66. The extent of the model domain is illustrated in Figure 3. The model grid was extended a considerable distance from the wellfield boundaries to minimize impacts of exterior boundary conditions on the model solution in the area of interest.

The model is constructed with three layers. The uppermost layer (layer 1) represents the "K2" Sand. Layer 2 is the clayey unit beneath the K2 Sand, and Layer 3, the bottom layer represents the "K3" Sand. The base of the model and the top of the model are no flow boundaries that simulate the overlying and underlying confining units. The top and bottom elevations of the "K2" in the model are 4,490 and 4,405 ft amsl, respectively. The top and bottom elevations of the "K3" in the model are 4,390 and 4,300 ft amsl, respectively.

Cell dimensions within the vicinity of 5MW66 are 12.5 feet by 12.5 feet. Cell dimensions are increased to a maximum size of 25 feet by 25 feet toward the edges of the model. The model consists of 550 rows and 550 columns and contains 907,500 active cells. The model origin (southwest corner) corresponds to Wyoming State Plane Central NAD 83 easting and northing coordinates of 8,451,110 ft and 1,133,640 ft, respectively.

Boundary Conditions

Boundary conditions imposed on a numerical model define the external geometry of the groundwater flow system being studied as well as internal sources and sinks. Boundary conditions assigned in this model were determined from observed conditions. Descriptions of the types of boundary conditions that can be implemented with the MODFLOW code are found in McDonald and Harbaugh (1988). Boundary conditions used to represent hydrologic conditions at the Christensen Ranch site included general-head (GHB) and wells. The location of the GHBs within the model is illustrated in Figure 3. Discussion of the placement and values for these boundary conditions is provided below. The placement and values for the well boundary conditions are described under the simulation discussion.

The GHB was used in the model to account for inflow and outflow from the model domain and to establish the regional groundwater gradient across the model domain. In the model, GHBs were assigned along the perimeter of the model domain. The values of head assigned to the GHBs represent the regional potentiometric surface, and ranged from 4,681.79 ft along the east edge of the model to 4,581.91 ft along the west edge to establish the regional hydraulic gradient.

The model domain was extended a suitable distance from the location of the proposed production wellfields to minimize perimeter boundary effects on the interior of the model where the hydraulic stresses were applied.

Aquifer Properties

Input parameters used in the model to simulate aquifer properties are consistent with site-derived data including; top and bottom elevations of the K Sand, hydraulic gradient, hydraulic conductivity, storage coefficient and porosity.

The top and bottom elevations of the "K2" and "K3" sands were determined from electric logs of monitor well 5MW66. For purposes of this modeling effort, the "K2" and "K3" Sands were assumed to be flat lying and uniform in thickness.

As previously described, the regional hydraulic gradient of 0.008 ft/ft was incorporated into the model through the use of GHB along the east and west margins of the model.

The average value for hydraulic conductivity of the combined "K2" and "K3" Sands, as reported by Aqua Terra Consultants, Inc. (1995), was 3.4 gpd/ft^2 (0.45 ft/d). The value used in the model was rounded off to 0.5 ft/d. Aqua Terra Consultants, Inc. (1995) also reported the average storativity calculated from site pumping tests was from 4.8×10^{-4}. A value of 5.0×10^{-4} was used for the model simulations.

Porosity of the aquifer is used in the model to estimate groundwater velocity. Groundwater velocity is calculated from the Darcy equation as follows:

$$v = ki/n$$

where

v = average interstitial groundwater velocity
k = hydraulic conductivity
i = hydraulic gradient
n = porosity (effective)

The porosity for the "K" Sand has been reported as 30 percent.

Excursion Recovery Simulations

Several alternatives were simulated to evaluate the plausibility of extraction as a means of excursion recovery for 5MW66. As previously described, the source of the excursion has not been clearly identified. Furthermore, the distance the excursion has migrated beyond 5MW66 can only be estimated and is not known with any certainty. The assumption made for this modeling exercise is that the excursion has migrated approximately 50 feet downgradient (west) of 5MW66. Therefore simulated "successful recovery" of the excursion will require groundwater within 50 feet of 5MW66 be brought back to that well within a one year period.

One scenario included simulation of extraction from a single well located in the wellfield northeast of 5MW66. The extraction well is only completed within the "K3" Sand. An extraction rate of 20 gallons per minute (gpm) was simulated for a period of one year (365 days). The drawdown resulting in the "K3" Sand from that simulation is shown in Figure 4. As the figure shows, there is over 20 feet of drawdown at monitor well 5MW66 and a gradient to the northeast (toward the pumping well) is imposed. Particle tracking is used to illustrate the capture zone of the extraction well over the one year simulation period. The particles are tracked in reverse, starting from the extraction well. Results of the simulation show that the radius of recovery (groundwater physically removed from the aquifer in one year of pumping) extends approximately 125 ft from the extraction well. Particles located 50 ft downgradient of 5MW66 move a distance of approximately 12 to 15 ft toward the extraction well and only move 5 to 6 feet closer to 5MW66 (Figure 5) within the one year of pumping. Based on the results of this simulation, the excursion would be hydraulically controlled under this scenario, but it would likely take more than 10 years to pull the excursion back to 5MW66 and much longer to physically recover the impacted groundwater at the northeast extraction well.

A second simulation was conducted with an extraction well in the wellfield south of 5MW66, also completed in the "K3" Sand and operating for a period of one year at a rate of 20 gpm. The extraction well is actually located slightly west of south from monitor well 5MW66. The results were similar to the previous simulations (Figure 6) with a radius of recovery of approximately 125 feet after one year of pumping. However, in this simulation, the particles 50 ft downgradient of well 5MW66 are pulled away from 5MW66 to the southwest (Figure 7). This scenario was not considered practical because it may actually cause flow of impacted groundwater toward the direction of another monitor well, 5MW64.

A third scenario was simulated with extraction from one well in the wellfield to the northeast and one in the wellfield to the south. Each well was simulated with an extraction rate of 10 gpm for a period of one year. The same volume was removed from the aquifer as in the previous scenarios. Results of the simulation indicate that the radius of recovery for the extraction wells after one year of operation is approximately 90 feet from each well (Figure 8). Although there is considerable drawdown at 5MW66 (over 20 feet), illustrating hydraulic capture, groundwater in the area downdip of 5MW66 moves less than 5 feet during the one year simulation and generally moves to the south-southwest. Well interference between the two extraction wells creates an area of almost stagnant flow around 5MW66.

A fourth scenario was simulated with extraction from well 5MW6, and concurrent extraction from the wellfields to the northeast and to the south. The extraction rate for 5M66 is 10 gpm and the rate for the other two extraction wells is 5 gpm per well. This maintains the same total rate as used in the prior simulations. The simulation was run for a period of one year. The radius of recovery for impacted groundwater around 5MW66 is approximately 70 feet (Figure 9). In other words, groundwater within 70 feet of the 5MW66 is pulled into the well within the one year period. This exceeds the 50 ft threshold previously identified as representing simulated recovery of the excursion. Operating the extraction wells to the northeast and south-southwest creates a hydraulic divide between the wellfields and monitor well 5MW66 during the excursion recovery. This reduces the potential for groundwater from the wellfields to migrate toward 5MW66 during the excursion recovery simulation. While extraction from a monitor well is not typically the preferred alternative (because of the risk of pulling additional impacted groundwater toward the well), in this scenario, the use of three extractors, including the excursion monitor well, appears to be more effective for recovery of the excursion (compared to extraction from only the wellfields).

Note that these simulations are based solely on advective flow and do not account for any geochemical reactions that have or may occur within the aquifer system. Also, the assumptions are made that each aquifer layer is homogeneous and isotropic and that the primary source of the excursion is from the "K3" Sand, although the data are not conclusive in that regard.

Summary

Numerical modeling was performed to assess potential recovery of an excursion from MU5 in the area of monitor well 5MW66 using groundwater extraction. The model is based on average site specific aquifer properties, as reported by Aqua Terra Consultants, Inc. in 1995.

Results of the model simulations indicate that pumping from either the wellfield to the northeast or to the south of well 5MW66 would probably not be effective in recovering the excursion in a reasonable time frame. Simulation of concurrent pumping from both wellfields also does not show effective recovery of the excursion.

A simulation with extraction from the well on excursion (5MW66) combined with pumping from the wellfield northeast and south of that monitor well, appears to provide the best alternative for effective recovery of the excursion. This scenario minimizes the potential for additional migration from the wellfields during excursion recovery and results in the relatively rapid recovery of the potentially affected groundwater downgradient from 5MW66.

These simulation results are based on average aquifer properties estimated from hydrologic tests. Heterogeneity within the K Sand may result in hydraulic impacts considerably different than those simulated. As previously described, it is assumed that the groundwater impacts are primarily concentrated in the "K3" Sand. However, the exact source of the excursion has not been conclusively identified. If the source is from the "K2" Sand, or is not related to historic operations from MU5 upgradient of monitor well 5MW66, then these simulations may not provide a reasonable assessment of the suitability of extraction for excursion recovery at 5MW66.

References

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Environmental Simulations, Inc. 2007. *Guide to Using Groundwater Vistas, Version 5.* pp 372. Prepared by Environmental Simulations, Inc., Reinholds, VA

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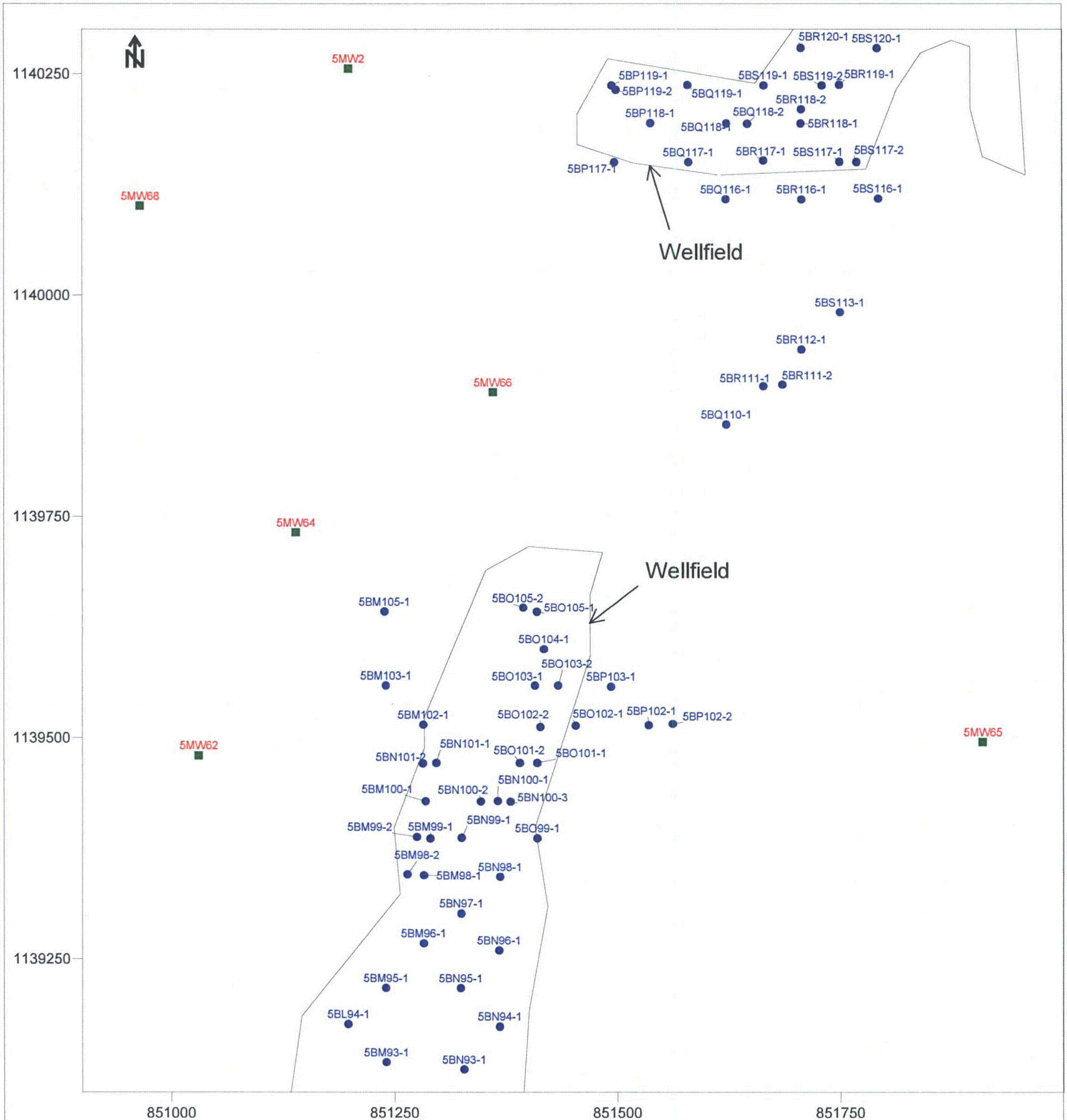
Pollack, D.W. 1994. *Users Guide for MODPATH/MODPATH-PLOT, Version 3: A particle tracking post-processing package for MODFLOW, the U.S. Geological Survey finite-difference ground-water flow model.* Open-File Report 94-464. U.S. Geological Survey, Reston VA.



■ Monitor Ring Wells

● Mine Unit 5 Production/Injection Wells

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Figure 1. 5MW66 Area
Mine Unit 5
Christiansen Ranch, Wyoming

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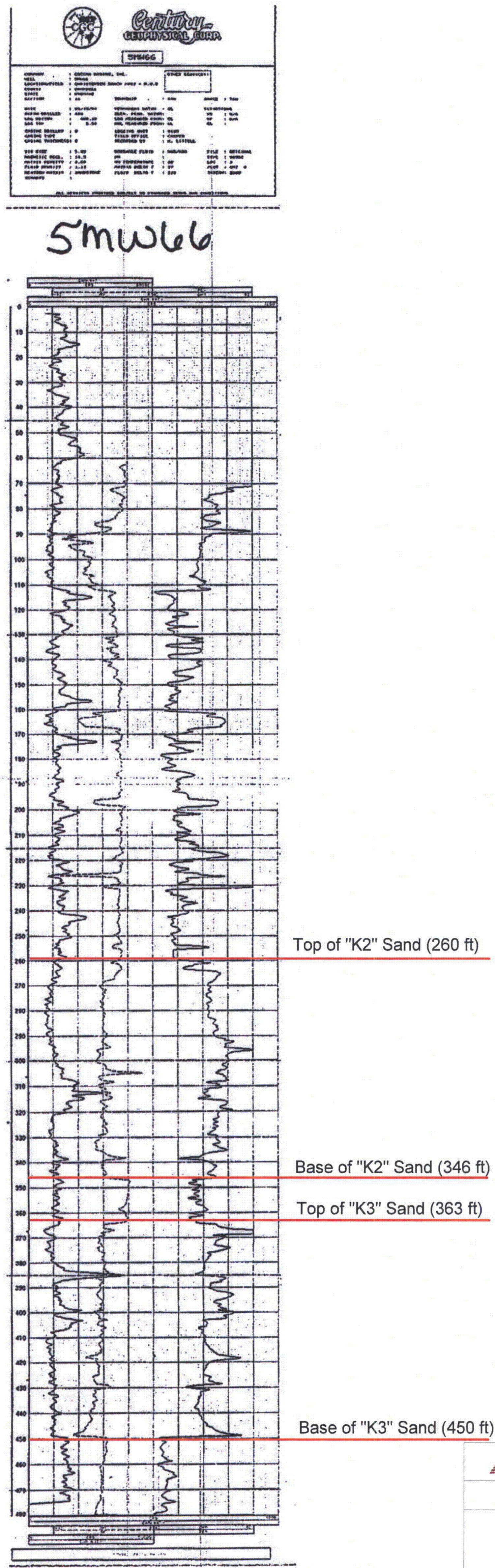

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Figure 2. Electric Log - 5MW66
Mine Unit 5
Christiansen Ranch, Wyoming

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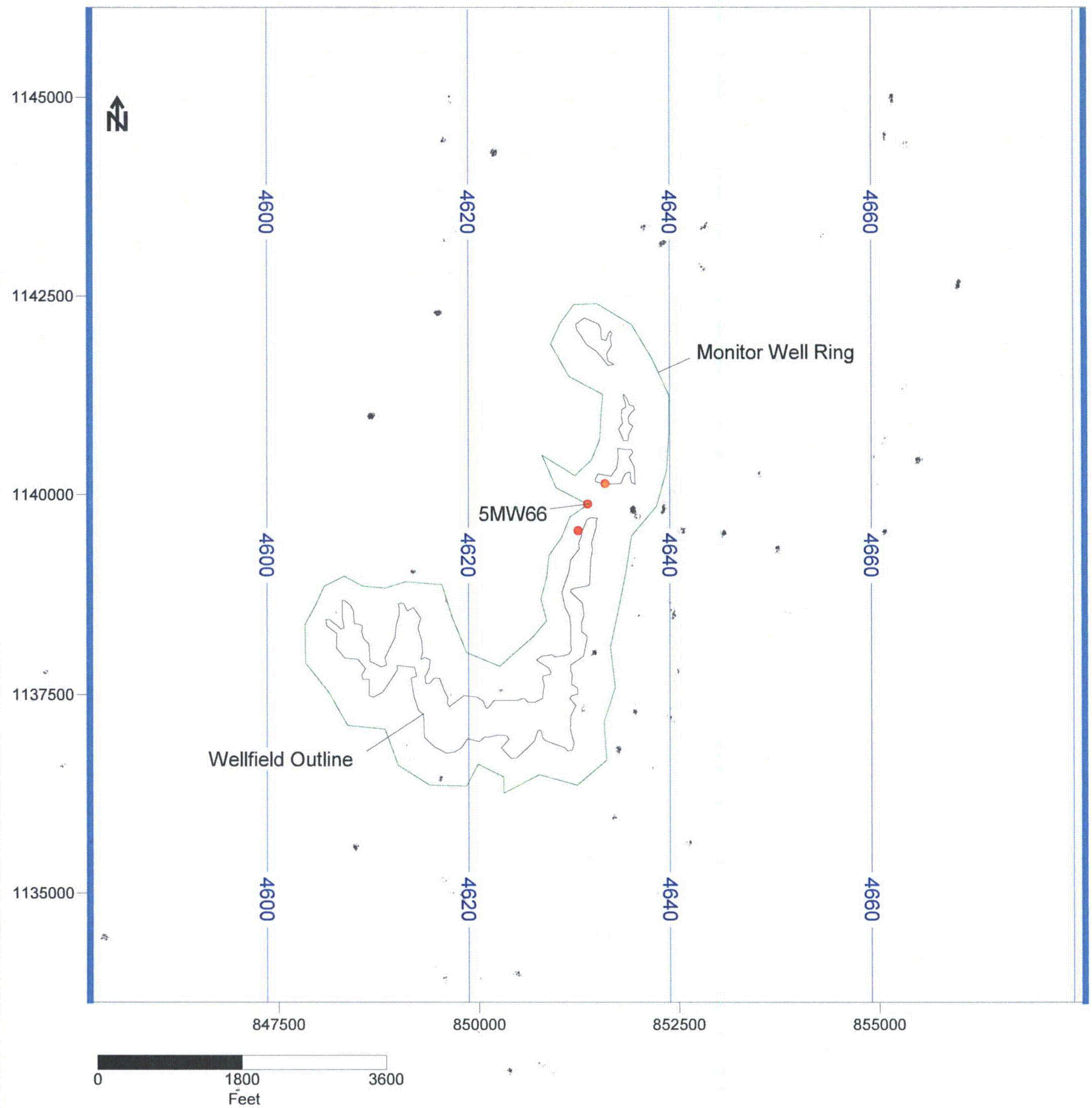

General Head Boundary

Simulated Extraction Well

Simulated Potentiometric Contour, ft amsl)
CI =20 ft

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Figure 3. Model Domain, Boundary Conditions, and Initial Heads, Simulated Excursion Recovery Christensen Ranch, Wyoming

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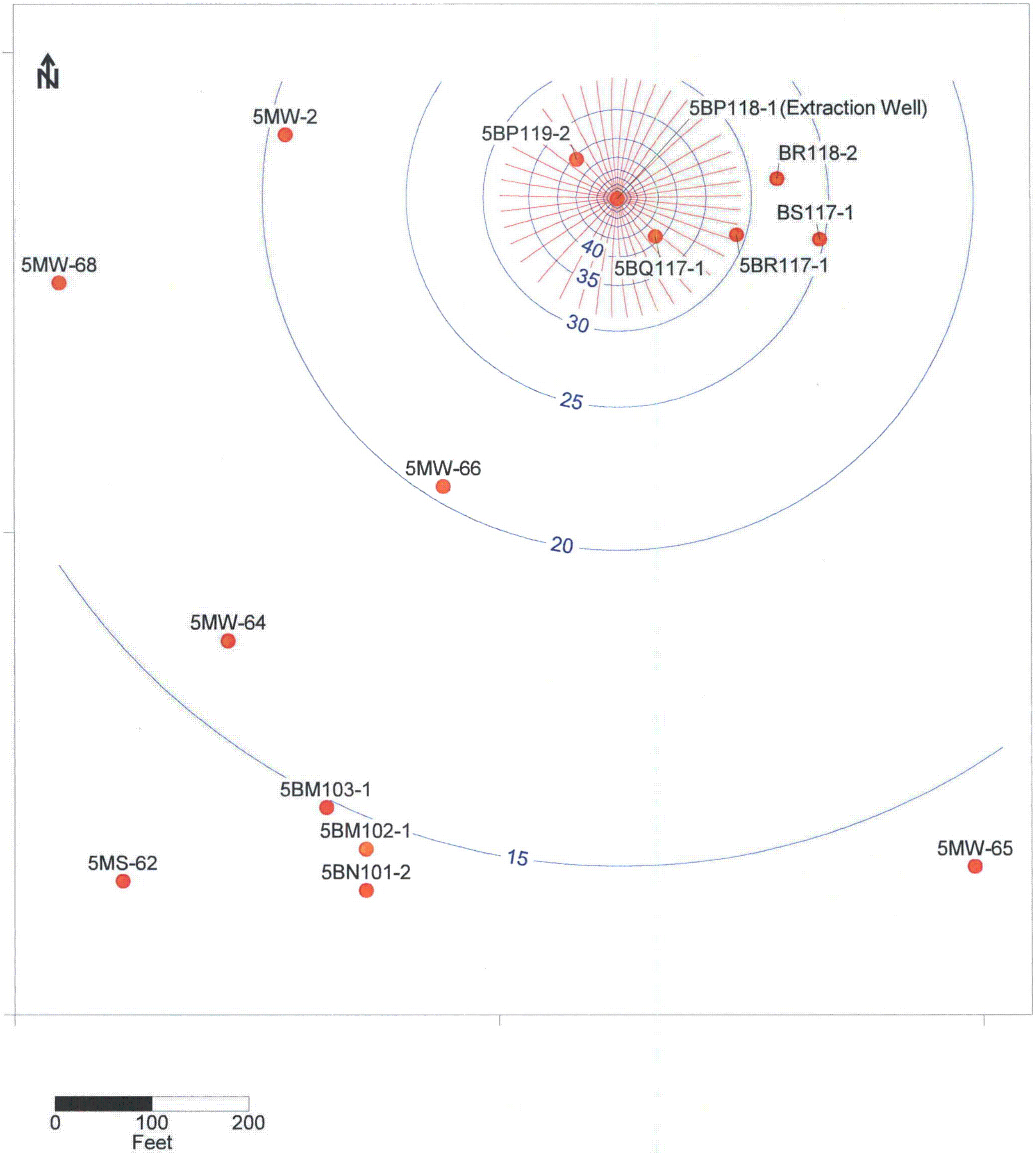

Well

Simulated Drawdown Contour, CI = 5 ft

Particle Track (1 year travel time)

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Figure 4. Simulated Drawdown-One North Recovery Well, MU5 Excursion Recovery Model Christensen Ranch, Wyoming

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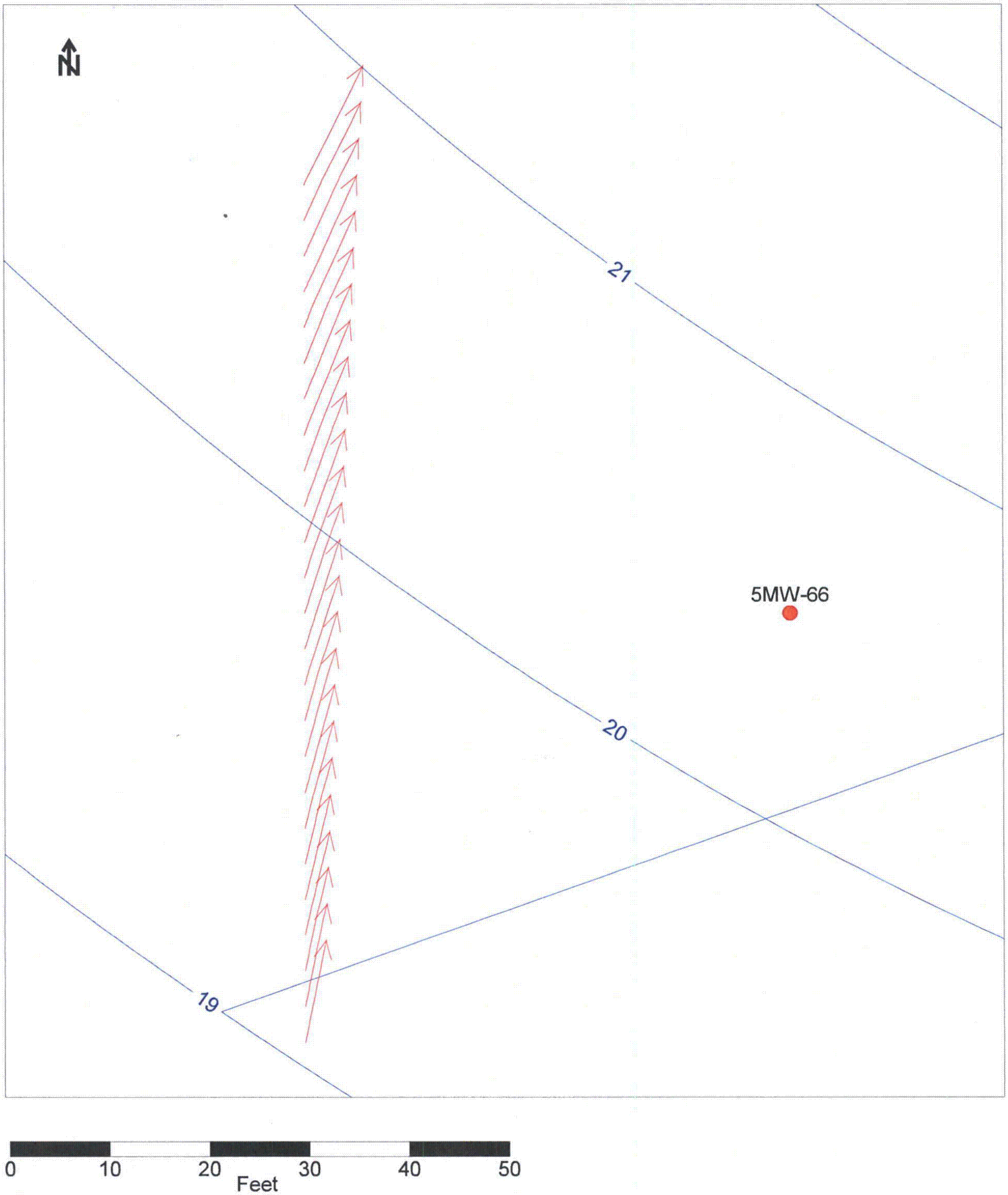

● Well

Simulated Drawdown Contour, CI = 1 ft

Particle Track (1 year travel time)
Arrows Point in Direction of Groundwater Flow

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Figure 5. Close-up of Simulated Groundwater Flowpath One North Recovery Well, MU5 Excursion Recovery Model Christensen Ranch, Wyoming

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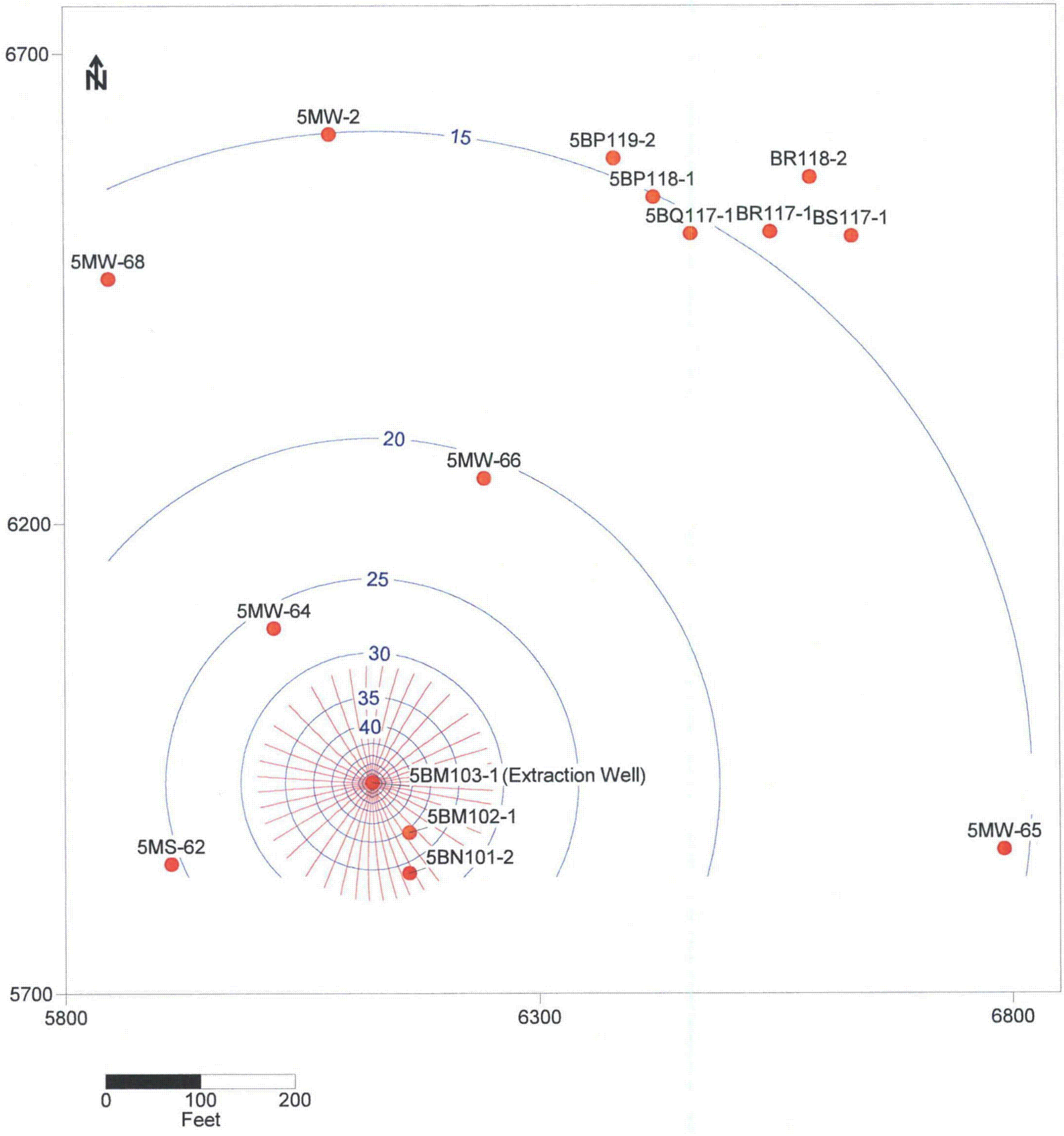

● Well

Simulated Drawdown Contour, CI = 5 ft

Particle Track (1 year travel time)

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Figure 6. Simulated Drawdown-One South Recovery Well, MU5 Excursion Recovery Model Christensen Ranch, Wyoming

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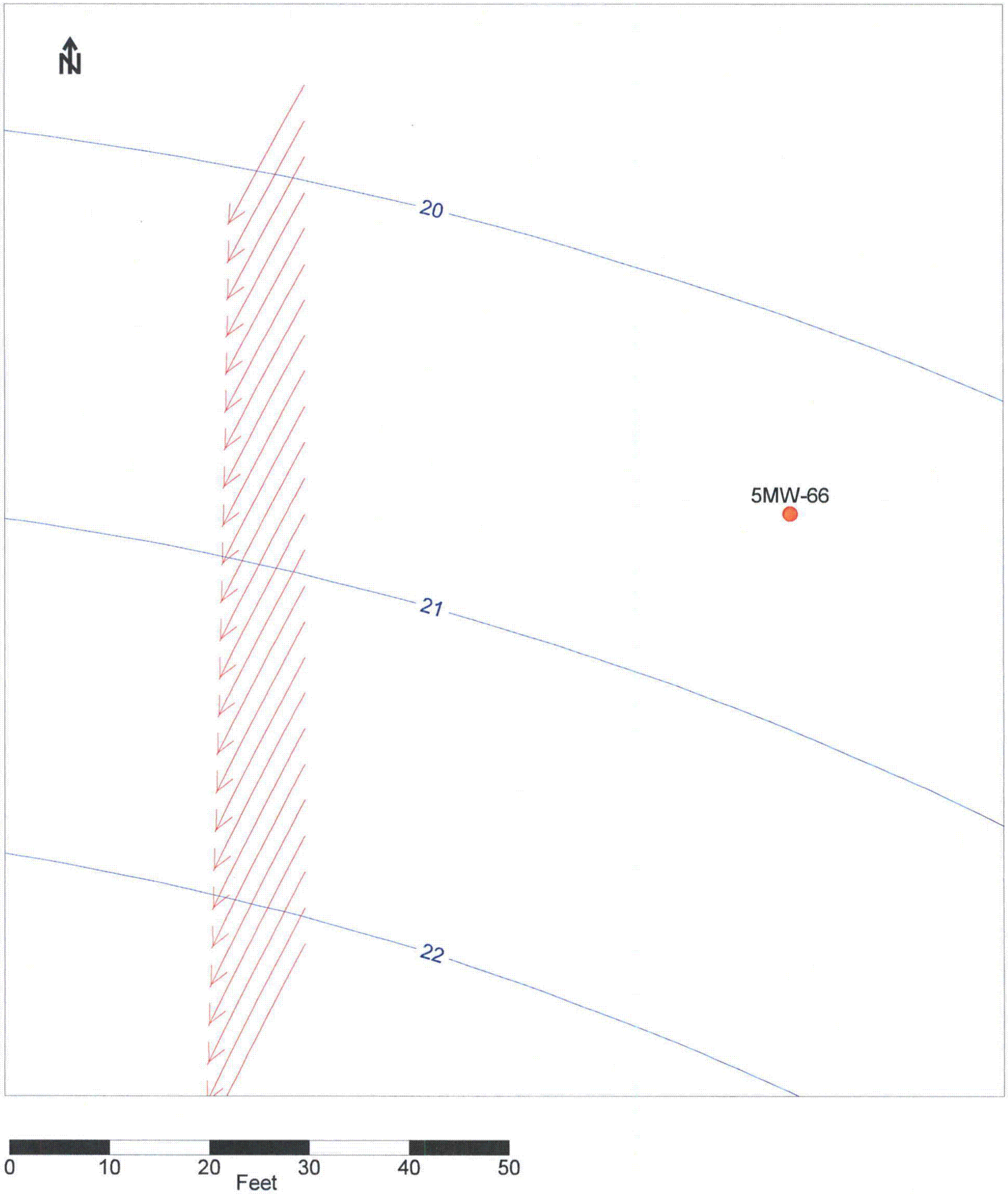

● Well

Simulated Drawdown Contour, CI = 1 ft

Particle Track (1 year travel time)
Arrows Point in Direction of Groundwater Flow

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Figure 7. Close-up of Simulated Groundwater Flowpath One South Recovery Well, MU5 Excursion Recovery Model Christensen Ranch, Wyoming

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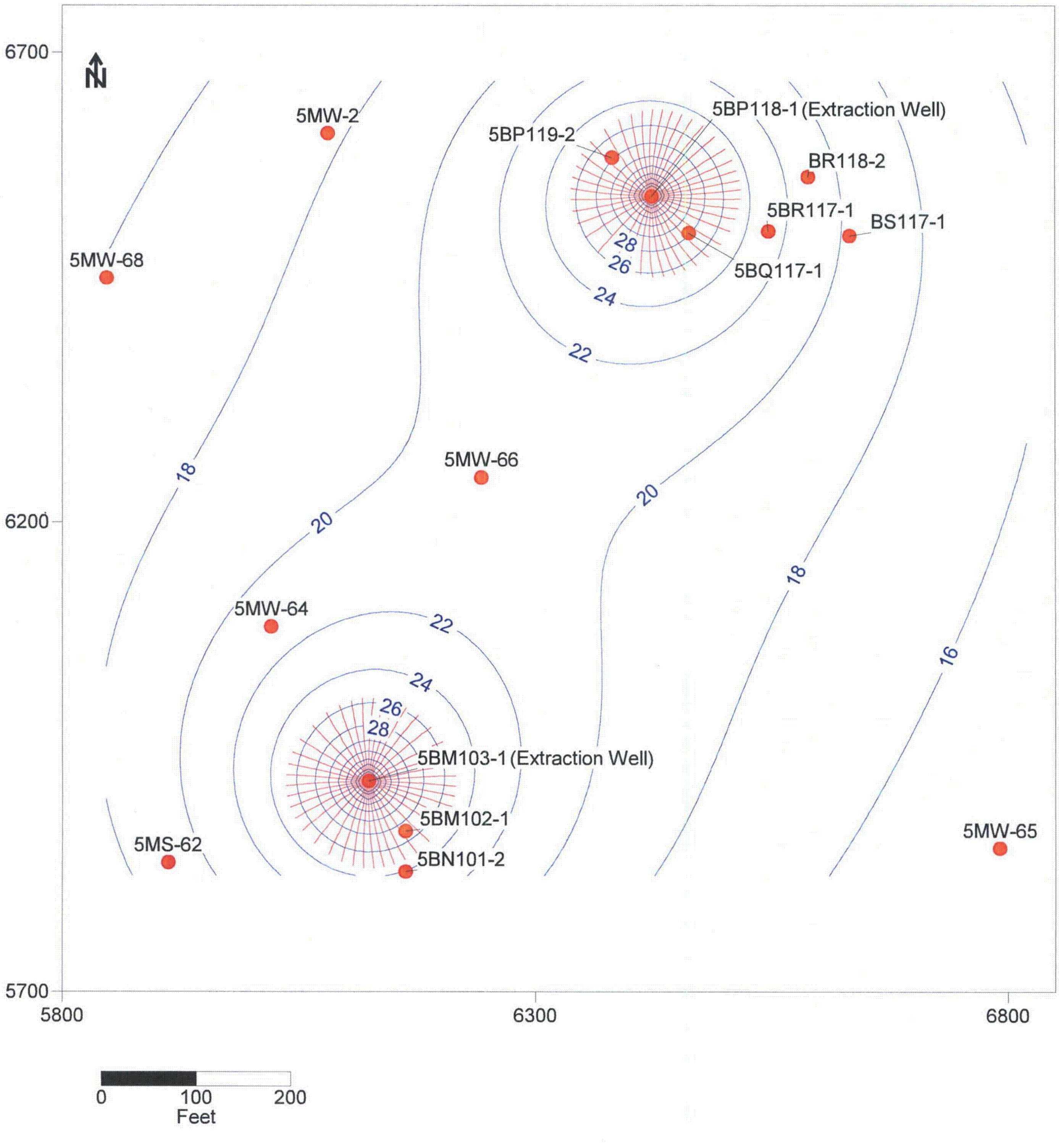

● Well

Simulated Drawdown Contour, CI = 2 ft

Particle Track (1 year travel time)

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Figure 8. Simulated Drawdown-One South and One North Recovery Well, MU5 Excursion Recovery Model Christensen Ranch, Wyoming

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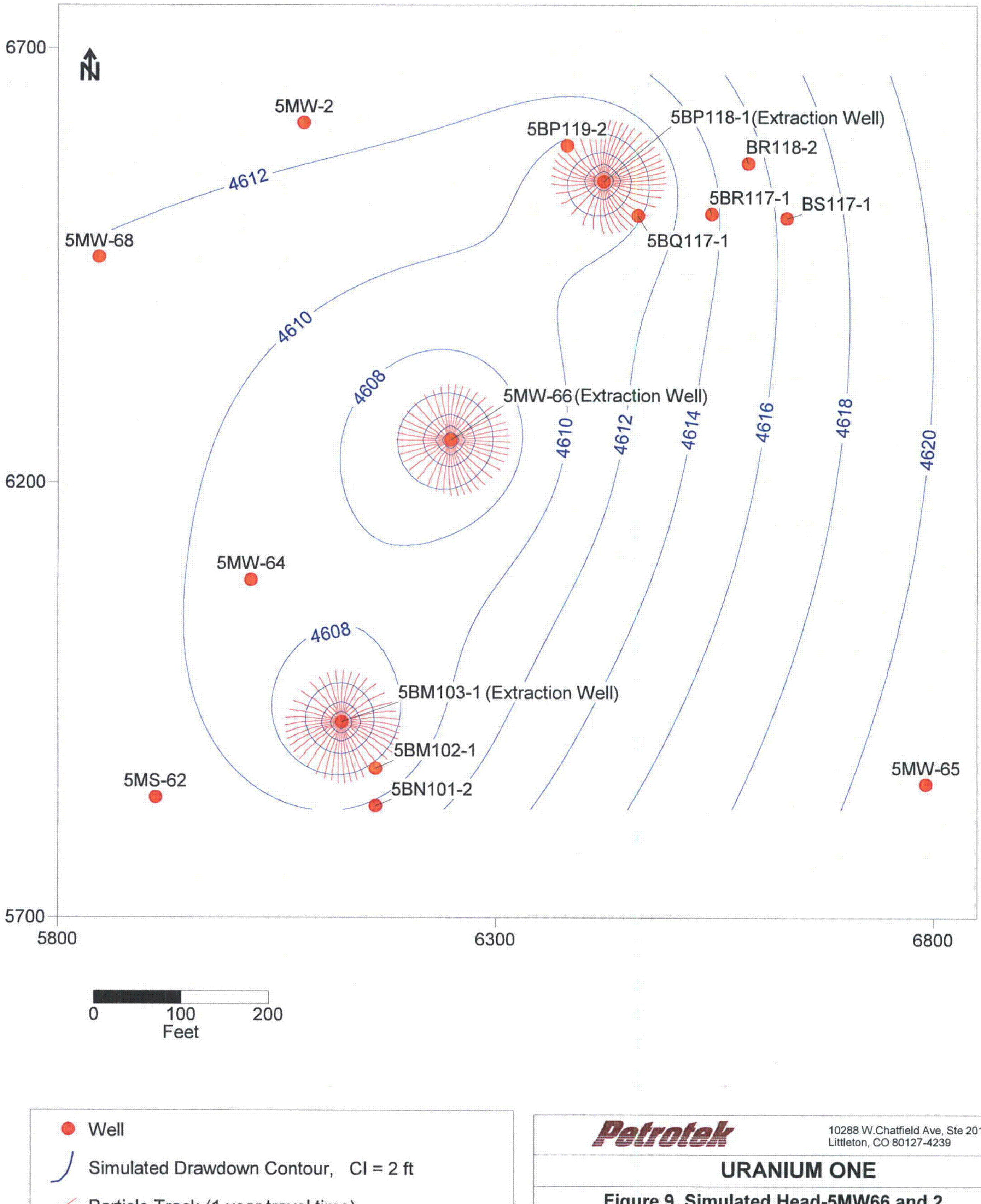

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Figure 9. Simulated Head-5MW66 and 2 Recovery Wells, MU5 Excursion Recovery Model Christensen Ranch, Wyoming

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