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January 5, 2004

Mr. Gary S. Janosko, Chief
U.S. Nuclear Regulatory Commission
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards
Mail Stop T-8-A-33
Two White Flint North, 11545 Rockville Pike
Rockville, Maryland 20852-2738

Attn: Ms. Elaine Brummett, Project Manager

Subject: **License Amendment Request**

Reference: **Material License SUA-648, Docket No. 40-0299**

Dear Mr. Janosko:

Umetco is requesting amendment of eight license conditions contained in NRC Materials License SUA-648. The purpose of this request is to remove language that is redundant or no longer applicable at the site, to update target completion dates, and modify groundwater model target values.

The following is a list of license conditions and a brief summary of requested modifications that are affected by this request:

LC 10. C. Modification of monitoring requirements for Gas Hills Pond No. 2 (GHP No. 2)

LC 30. C. Deletion of redundant language associated with disposal of mill debris.

LC 35. A. Modification of groundwater validation target values based on recent monitoring data.

LC 36 Deletion of redundant and non-applicable language.

LC 49 Deletion of redundant and non-applicable language.

LC 54 Deletion of redundant and non-applicable language.

LC 58 Deletion of redundant and non-applicable language.

LC 59 Modification of target completion dates

NMSS01

The attachments to this license amendment request include a rationale document providing justification specific to each proposed license condition modification and a revised groundwater monitoring plan (Appendix M of Umetco's ACL Application). Also included with this submittal is a video showing 2003 reclamation construction activities at Umetco's Gas Hills site. This video is included as supporting information to the proposed modification to the target completion dates requested for License Condition 59.

If you have any questions or comments concerning this license amendment request, please contact Mr. Tom Gieck of my staff at (970) 256-8889 or by e-mail at gieckte@dow.com.

Sincerely,

Curtis O. Sealy
General Manager

COS:TEG:ses

Attachments:
(1) Rationale Document
(2) Revised Groundwater Monitoring Plan (Appendix M of ACL Application)
(3) 2003 Reclamation Construction Activities

c: Gas Hills distribution list and Mark Moxley

Gas Hills License Amendment Request

Rationale for Proposed Change to License Condition 10. C.

GHP No. 2 was constructed to contain and evaporate groundwater extracted under the NRC approved groundwater corrective action plan. Alternate Concentration Limits (ACLs) have been approved (Amendment No. 48, March 29, 2002), and groundwater extraction at the Gas Hills site has been terminated. The elevation of remaining solutions is extremely low, approximately 4 million gallons, and cover only a portion of the bottom of the lined pond as shown on Figure 3. The south and west slopes of GHP No. 2 are the only above grade constructed slopes, i.e., remaining solutions are contained in the portions of the pond excavated below grade. The south and west slopes of GHP No. 2 are the only above grade constructed slopes that could be inspected for signs of slope failure. Current water levels in the pond do not contact the interior of the south or west slopes of the pond. Because these current pond solution levels are extremely low and no additional solutions are being transferred into the pond, the potential for slope failure is minimal. The NRC has reviewed and approved the final reclamation plan for GHP No. 2 (Amendment 52, November 10, 2003). This plan requires solidification of remaining liquids when evaporation reduces liquid volume to less than 1.5 million gallons, removal of the lining system, and covering (11e.(2) cover system) the entire pond area. Accordingly, Umetco is requesting the following revisions (shown with strikethrough and underline edits) to License Condition 10. C.:

10. C. Perform a ~~quarterly~~ semi annual documented visual inspection of the evaporation pond. If pond solution levels increase to contact the south or west embankment, quarterly inspections will be performed. ~~During periods when~~ If solutions are actively being transferred into the pond, ~~or if solution levels are within five feet of the freeboard limit,~~ weekly inspections will be performed, but may be postponed due to adverse weather conditions. Pond inspections may be terminated once GHP No. 2 reclamation activities are initiated.

Rationale for Proposed Change to License Condition 30. C.

This license condition refers to conditional approval of the 1990 decommissioning and demolition plan for the mill facility and sets requirements for placing debris in the A-9 Repository. The Gas Hills mill facility has been demolished and disposed of in the Heap Leach (LC 61) and A-9 Repository (LC 58) in accordance with revised plans approved subsequent to the 1990 decommissioning and demolition plan. Placing mill debris has been accomplished in accordance with placement specifications for debris specific to the Heap Leach reclamation plan and the enhanced reclamation plan for the A-9 Repository. Consequently, the requirements of this license condition have been superceded by reclamation plans and specifications approved by License Conditions 58 and 61. Therefore, Umetco is requesting deletion of License Condition 30.C. to avoid confusion pertaining to approved specifications for placement of mill debris.

30. C. Deleted by Amendment No. ?? ~~All mill debris shall be disposed of in accordance with the January 10, 1991, submittal. Additionally, all debris shall be placed in a manner that avoids nesting and minimizes voids. Fill material must be placed in and around each lift of debris in sufficient volume to form a coherent mass.~~

~~All debris not specifically addressed in the May 2, 1990, submittal shall have a maximum dimension of 30 feet and a maximum volume of 30 cubic feet. Debris not meeting these requirements shall be reduced in size. Empty drums, tanks, or other objects with hollow volumes greater than 5 cubic feet shall be reduced in volume by at least 70 percent.~~

Rationale for Proposed Change to License Condition 35. A.

License Condition 35. A. established the post-ACL groundwater monitoring program to be conducted at the Gas Hills site. The target levels for chloride and sulfate were exceeded at Monitor Well MW28 during the November 2002 sampling event. MW28 is a model validation well for the Western Flow Regime, as approved by the NRC, in the *Groundwater Monitoring Plan* (Appendix M) of the ACL Application, March 4, 2002. The target levels are designed to validate the numerical groundwater flow and transport model simulations used in support of the Gas Hills ACLs (Appendices B and C). The exceedance of the sulfate and chloride target levels at the model validation wells does not constitute non compliance with ACLs that have been set for the Gas Hills site because the ACLs do not apply to sulfate and chloride and the model validation wells are not POC wells. Chloride and sulfate are dominated by advective transport resulting in minimal attenuation along the flowpath. Accordingly, these constituents are used to validate the groundwater model.

At the time the model was developed (2001 - 2002), the location and nature of the sulfate and chloride plume fronts were unknown. It could only be stated that the leading edges of the plumes were located between MW28 and MW25. The arrival of higher than predicted levels of sulfate and chloride at MW28 indicate the plume fronts had been closer to MW28 then estimated in the model.

These observations and data have been incorporated into modifications of the model. The initial conditions (chloride and sulfate distributions) were modified in the Gas Hills groundwater flow and transport model to improve the match between simulated and observed results. No parameters in the model were changed other than the initial concentration distribution for chloride and sulfate. A detailed explanation of this modification has been provided in the 2003 Gas Hills annual report.

Accordingly, Umetco is requesting modification of target levels in MW28 for chloride and sulfate. Attachment A to this amendment request contains a revised *Groundwater Monitoring Plan* (Appendix M or the ACL Application) with the following changes.

Table 3	Derived Target Values for Western Flow Regime, Well MW28
Figure 2a	Simulated Chloride Trends at MW28 (10 Years) - Western Flow Regime
Figure 2b	Simulated Chloride Trends at MW28 (50 Years) - Western Flow Regime

Figure 6a	Simulated Sulfate Trends at MW28 (10 Years) - Western Flow Regime
Figure 6b	Simulated Sulfate Trends at MW28 (50 Years) - Western Flow Regime

35. A. Conduct monitoring as described in the Groundwater Monitoring Plan (Appendix M in the ~~March 4, 2002,~~ January 2004 submittal. The validation of ACL exceedance will be in accordance with Section 4 of Appendix M. The licensee shall submit this monitoring data to the NRC by September 30th of each year.

Rationale for Proposed Change to License Condition 36

This license condition requires the licensee to minimize ponding on the A-9 Repository and is intended to manage liquids on the below grade repository prior to final grading and reclamation. The final grading, radon barrier, and frost protection layer for the A-9 have now been completed in accordance with the NRC approved plan. Accordingly, this license condition is no longer applicable and Umetco is requesting deletion of License Condition 36.

36. ~~In accordance with the submittal dated September 23, 1998, the licensee shall minimize, to the extent practicable, ponding of water on the A-9 repository. This shall be accomplished by best management practices.~~ Deleted by Amendment No. ??

Rationale for Proposed Change to License Condition 49

This license condition was originally issued for the former North and South evaporation ponds, which have been removed. The license condition was subsequently modified (Amendment 35, July 1997) to apply to any operating evaporation pond. The only remaining evaporation pond at the Gas Hills site is GHP No. 2. License Condition 10 C controls freeboard and monitoring requirements for GHP NO. 2., as discussed above. Accordingly, Umetco is requesting deletion of LC 49 to eliminate duplication of license requirements.

49. ~~The licensee shall maintain at least five (5) feet of freeboard between the embankment crest of any evaporation pond and the maximum operating level of the ponded liquid.~~ Deleted by Amendment No. ??

Rationale for Proposed Change to License Condition 54

The language used in LC 54.A. through 54.F. is a condition imposed on the "previously approved" reclamation plan for the Above-Grade Tailings Impoundment (December 18, 1980, April 19, 1979, and May 13, 1982). In the August 2, 1991 letter, the NRC requested that Umetco review the reclamation plan for the Above-Grade Tailings Impoundment to evaluate compliance with the current reclamation criteria contained 10 CFR 40, Appendix A. Subsequent to NRC's *Final Position on Previously Approved Reclamation Plans* (July 18, 2995), Umetco submitted an enhanced reclamation design that contained technical support for the portions of completed reclamation incorporated into the final design and design enhancements necessary to provide a final design consistent with current criteria. The enhanced design was approved by license Amendment 41, July 16, 1999. Approval of the enhanced design renders License

Conditions 54.A. through 54.F. not applicable because that approval is inclusive of technical support for portions of the previously completed reclamation as discussed in detail below. Accordingly, Umetco is requesting deletion of the language in License Conditions 54.A. though 54.F. to avoid confusion associated the specifications contained in the enhanced reclamation design.

License Condition 54. A.

This license condition selects slope alternatives that were presented in the previously approved (1980) reclamation plan. The language in this license condition is no longer applicable because the previously constructed (as constructed prior to submittal of the enhanced design) configuration was evaluated in the enhanced design. This evaluation included seismic design (slope stability and liquefaction potential), settlement analysis, and radon barrier cracking potential. Consequently the language in LC 54.A. that selects slope alternatives from the "previously approved (1980)" reclamation plan is no longer applicable or necessary.

License Condition 54.B.

This license condition specifies layer configuration, layer thickness, topsoil requirements, and erosion protection requirements from the "previously approved" reclamation plan. Prior to the 1995 NRC *Final Position on Previously Approved Reclamation Plans* and Umetco's submittal of the enhanced design, a significant portion of the reclamation cover had been constructed. The previously constructed features included portions of the radon barrier, filter layer, and frost protection layer. Because the "previously approved" reclamation plan and associated license conditions inadequately addressed current criteria for construction specifications and QC requirements, Umetco conducted the necessary field investigations to demonstrate the adequacy of previously constructed portions of the cover to be retained in the enhanced final design. Investigation and testing of the previously constructed cover consisted of density, layer thickness measurements, moisture content and field permeability of radon and filter layers. The as-constructed layer characteristics were subsequently incorporated into the applicable design models, i.e., radon attenuation, geotechnical stability, etc., of the final design. License Conditions 54.B.4) and 54.B.5) specify topsoil and thickness and erosion protection requirements. Because the enhanced design includes a rock erosion protection design for the entire cover, this language is also superceded by the enhanced reclamation design. Accordingly, the specifications established in LC 54.B. have been superceded by the enhanced design.

License Condition 54.C.

This license condition specifies placement methods for topsoil for the vegetative cover required by the "previously approved" reclamation plan. The enhanced reclamation design requires a rock erosion protection layer over the entire impoundment. Consequently, requirements of this license condition are no longer applicable.

License Condition 54.D.

The water retention structure discussed in this license condition involved a retention structure constructed around a catchment sump associated with the former Above-Grade Impoundment leak detection/drain system. The enhanced design provided an evaluation of the leak detection system and specifications for grout sealing of the system, which resulted in approval to seal the leak detection/drain system. The extended cover required by the enhanced design covers the entire area where the water retention structure was located. Accordingly, the requirements of this license condition are no longer applicable and should be deleted to avoid confusion associated with the reclamation requirements for the Above-Grade Impoundment.

License Condition 54.E.

Deleted by Amendment 45.

License Condition 54.F.

This license condition specifies compaction and quality control testing requirements for construction of the previously approved reclamation plan. The investigation contained in the enhanced design was used to evaluate the "as constructed" properties of the cover as it existed prior to construction of the design enhancements. Evaluation based on results of the investigation included seismic design (slope stability and liquefaction potential), settlement analysis, radon barrier cracking potential, and radon attenuation (refer to NRC TER, License Amendment 41). Therefore, the requirements of this license condition are no longer applicable.

The proposed change to License Condition 54 is the deletion of language as shown below with strikethrough/underline formatting.

54. The final reclamation of the inactive above-grade tailings impoundment (includes experimental heap leach site) shall be in accordance with the December 18, 1980, Reclamation Plan and the April 19, 1979, and May 13, 1982, letters, except as superceded by the *Design for Enhancement of the Previously Approved Reclamation Plan for the Above-Grade Inactive Tailings Design Report* of October 6 and October 28, 1997, as modified by submittals dated May 22, June 26, July 20, July 28, September 8, September 15, and November 23, 1998, as well as April 9 and June 7, 1999, and December 20, 2000.

~~The following modifications shall be required in lieu of statements made in the above referenced 1980-1982 documents:~~

~~A. The alternate reclamation plan that provides for 10H:1V embankment slopes as presented in Section 4.1 of the D'Appolonia report shall be required.~~ Deleted by Amendment ??

~~B. The entire reclaimed tailings and heap leach areas shall be covered with a minimum of 10 feet of cover material which meets the following requirements:~~ Deleted by Amendment ??

1) ~~A clay cap of a minimum of 1 foot thickness.~~

2) ~~A suitable filter material of a minimum 1 foot thickness to be placed directly over the clay cap. The licensee shall document and submit to the NRC the soils testing data for the filter materials which demonstrates a permeability differential of at least two orders of magnitude grater than the clay cap materials.~~

3) ~~A minimum of 7.5 feet of additional overburden and spoils materials. The licensee may use a thickness of 6.5 feet over areas specified to be covered by cobble rock riprap.~~

4) ~~A minimum of 0.5 feet of topsoil.~~

5) ~~A minimum of 1.5 feet of cobble rock riprap on slopes greater than 10H:1V over reclaimed areas. The rock riprap shall have the following gradation as a minimum.~~

~~% Passing by Weight~~	~~Rock Size (inches)~~
~~100~~	~~8 - 12~~
~~50~~	~~6 - 8~~
~~15~~	~~3 - 4~~

C. ~~The licensee shall not rip the topsoil into the spoils materials as proposed in the reclamation plan.~~ Deleted by Amendment ??

~~D. Prior to completion of reclamation, the licensee shall assure that the water retention structure adjacent to the spoils area, lying east of the above ground impoundment, has been reestablished.~~ Deleted by Amendment ??

E. Deleted by Amendment 45

~~F. Construction of the reclamation cover shall be as specified in the licensee's submittal dated June 16, 1983, with the following exceptions:~~ Deleted by Amendment ??

1) ~~The clay cap material shall be compacted to at least 90 percent of its standard Proctor maximum density (ASTM D698) at a moisture content between optimum and two (2) percent higher. If a lower degree of compaction is desired, permeability tests on samples of the clay material compacted to the desired density shall be performed to document that the permeability would not exceed 1 foot/year and the results submitted to the NRC for review and approval prior to construction.~~

2) ~~An Atterberg Limits and laboratory moisture density test shall be performed on a composite sample from each clay borrow area to be used during a particular construction phase prior to initiation of work. In addition, four field density and four field moisture content tests shall be performed for each layer of clay placed. These tests shall be performed prior to placing cover material over the clay. The results of the field tests shall be correlated using the results of the laboratory tests.~~

3) ~~The cover material shall be compacted to between 85 and 90 percent of its standard Proctor maximum density (ASTM D698). The soil cover shall be placed and compacted in two approximately equal lifts. Four field density tests shall be performed for each lift of soil cover material placed.~~

4) ~~A report summarizing construction activities for each phase of reclamation work and contain the results of all quality assurance testing shall be submitted to the NRC within 60 days of completion of the activities.~~

5) ~~Following completion of the interim stabilization cover, the licensee shall thereafter perform documented inspections of the cover. The licensee shall, within 30 days of~~

~~these inspections, weather permitting provide for the repair of any area that could result in ponding of surface water due to settlement or exposure of tailings due to erosion.~~

Rationale for Proposed Change to License Condition 58

Paragraph 1 of this license condition allows and controls disposal of byproduct material sources from the Gas Hills site and up to 10,000 cubic yards per year of other byproduct material in the A-9 Repository. The earthen portions of the A-9 reclamation cover (i.e., radon barrier and frost protection layer) were completed during the 2003 construction season. Accordingly, disposal of waste materials in the A-9 from either on-site or other sources is now not applicable.

Paragraph 2 of this license condition sets requirements for controlling the radium activity of waste materials in the upper 12 feet of the A-9 contaminated material embankment to verify design assumptions contained in the enhanced design (Amendment 42). This evaluation was last performed when Umetco requested approval to receive and dispose the non-11e.(2) byproduct material from the IMC site, License Condition 62, Amendment 46. Although the IMC materials were disposed of in the A-9 Repository at a depth greater than 12 feet and verified by field surveys, an evaluation of the ^{226}Ra in the upper portion of the A-9 contaminated material embankment has been completed as documented in the NRC TER (Amendment 46, August 18, 2001). The NRC TER associated with Amendment 46 states:

"Acceptance of the IMC material will not result in change to the material volumes anticipated by the approved enhanced design for the A-9. The IMC material will be placed below the upper 10 feet of contaminated material in the A-9 Repository and compacted in accordance with the approved specifications for placement of A-9 contaminated materials. Surveys will be performed to verify that IMC materials are placed at this depth.

Should unforeseen circumstances (e.g., delay in regulatory approval) warrant placement in the upper 10 feet of contaminated material, the impact to the cover design would be negligible. The approved enhanced design for the A-9 cover assumes an average ^{226}Ra value of 127 pCi/g for the RADON model, which resulted in a calculated cover radon flux of 5.7 pCi/m^2/sec. This is well below the regulatory standard of 20 pCi/m^2/s averaged over the entire cover. To date, approximately 50 percent of the A-9 radon barrier has been constructed with the average ^{226}Ra concentration of the upper 10 feet of contaminated material less than 50 pCi/g. The volume of the upper 10 feet of contaminated material in the A-9 Repository is 826,000 CY. Accordingly, placement of the estimated 2000 CY of IMC material will have a negligible impact on the cover design since it would represent only 0.24 percent of the upper ten feet of contaminated material in the A-9 Repository and less than 0.06 percent of the total A-9 contaminated material volume."

Accordingly, Umetco is requesting deletion of the non-applicable portions of License Condition 58. The proposed changes to this license condition are shown below in a strikethrough format.

~~58. Wastes which may be disposed of in the A-9 pit may be from onsite sources (e.g. evaporation pond materials), licensed in situ leach facilities, and up to 10,000 cubic yards per year of other byproduct material provided that NRC approves the waste characteristics and disposal procedures for this other material. The maximum dimension of scrap material disposed shall be limited to 10 feet. Materials shall be placed to prevent nesting that could create large voids.~~

~~Waste and fill disposed in the upper 12 feet of the A-9 repository shall be mapped as to the location, placement density, and radium activity. The potential impact of this material on the required radon cover shall be evaluated in a report (final radon flux estimate) submitted for NRC review and approval at least 3 months prior to initiation of the clay radon cover placement.~~

For the A-9 cover, the top 2 feet of frost protection soil will contain an average Ra-226 that does not exceed the NRC-approved Ra-226 value based on data for surface soil surrounding the site. Reclamation of the A-9 repository, C-18 pit, and of the north and south evaporation ponds, and the site grading shall be in accordance with the "Design for Enhancement of the Previously Approved Reclamation Plan for the A-9 Repository" in the licensee's submittal dated October 27, 1998, as modified by submittals dated December 10, 1998 and March 29, 1999.

Rationale for Proposed Change to License Condition 59

Umetco is requesting modification of License Condition 59 to reflect completed work and to request partial deviation of the milestone date associated with placement of erosion protection on the A-9 reclamation cover. The specific rationale for each proposed modification is provided below:

License Condition 59.A.(1)

This license condition is associated with cleanup of significant volumes of contaminated material from the site, specifically 11e.(2) affected materials from the North and South Evaporation Ponds.

The NRC TER for Amendment 40, November 2, 1998 states:

"...The staff determined that the described windblown tailings retrieval had been performed based on Inspection Report 40-0299/94-01, dated October 28, 1994. However, the verification data was not formally reviewed by the NRC, and data should be provided in the site cleanup completion report.

The proposed replacement wording concerning the schedule for final site soils/debris cleanup is acceptable to the staff because final cleanup would include reclamation of the north and south evaporation ponds, and this cannot be performed until the proposed plan has been submitted and approved by the NRC. To allow sufficient time for review of the pond reclamation plan (associated with the revised plan for the A-9 impoundment),

needed revisions, and construction, the staff recommends the date of December 31, 2001, as the deadline of site soil cleanup...."

License Condition 59, prior to Amendment 40, stated windblown tailing retrieval and placement were completed. Subsequent to Amendment 40, an evaluation of soil radiological characteristics and site background were completed, Amendment 44, (2001). This evaluation resulted in additional off-site windblown cleanup and verification. License Condition 59.A.(1) was not modified by Amendment 44 since the license condition was associated with on-site contaminated soil and debris from the North and South Evaporation Ponds.

At the present time, contaminated 11e.(2) materials have been removed from the North and South Evaporation Ponds and placed in the A-9 Repository along with all known on-site soils and debris with the exception of the site decontamination facility which will be placed in GHP No. 2 (Amendment 52). The radon barrier and frost protection layers of the A-9 reclamation cover have been completed. Additional windblown cleanup (Amendment 44) was completed in 2002. The *Final Status Survey* has been submitted to NRC and is currently under review.

Accordingly, Umetco is requesting modification to LC 59.A.(1), associated with placement of contaminated materials in A-9, to reflect the completed status of the work as shown below. Figure 2 shows the completed Frost Protection Layer and completed portions of the erosion protection layer as of August 27, 2003. QC test data for this work will be included in the *Completion Report* and are available for review.

License Condition 59.A.(3)

Construction of the final radon barrier and frost protection layer of the A-9 reclamation cover was completed in 2003. Umetco is therefore requesting modification of this license condition to reflect the completed work. QC test data for this work will be included in the *Completion Report* and are available for review. A video summarizing 2003 construction activity has been included showing construction of the Radon Barrier and Frost Layers.

License Condition 59.B.(1)

Umetco is requesting modification to the milestone date associated with placement of erosion protection on the A-9 Repository Cover. Placing erosion protection on the A-9 cover is scheduled to be completed during the 2004 construction season. However, suitable cover soils have been identified in the required grading excavation associated with the A-9 reclamation plan. Considering the radiological and geotechnical and radiological suitability of soils from required A-9 excavation, Umetco intends to use these materials in constructing the GHP No. 2 frost protection layer. The most cost effective manner for Umetco to use for this work is to complete the required A-9 excavation at the same time the GHP No. 2 cover is being constructed to avoid double handling of the material. Umetco would also like to utilize a haul route on the east side of the A-9 cover to transport frost protection soils to the GHP No. 2 cover. This will

facilitate a much shorter and safer haul route than transporting the soils over the steeper, longer routes located on either side of the A-9 Repository.

Final reclamation construction of the GHP No. 2 pond area is dependent upon the rate of evaporation of remaining pond liquids. The Gas Hills site has experienced above normal precipitation events in recent months. Consequently, Umetco is predicting evaporation of residual liquids to a point which final reclamation can occur in late fall of 2004, indicating final reclamation construction in 2005.

Accordingly, Umetco is requesting modification of the milestone date for placement of erosion protection to exclude select areas of erosion protection placement as illustrated on Figure 1. The areas excluded from erosion protection placement are only those areas where required excavation is necessary prior to placement of erosion protection and the haul route on the east side of the A-9 cover as shown on Figure 1. Final placement of erosion protection material on excluded areas will occur with construction of the GHP No. 2 reclamation cover.

This modification will not result in increased risk to public health and safety because:

- A-9 radon flux measurements taken at the end of the 2003 construction season show an average exit rate of 3.5 pCi/m^2/sec, which is below the 20 pCi/m^2/sec standard. Delay in placing erosion protection on excluded portions of the reclamation cover will not increase radon flux rates and therefore will not pose any added risk to the public health, safety, or environment.

- The A-9 is located within the licensee's restricted area and access by the general public is controlled through the use of physical barriers and use of site personnel during regularly scheduled work hours.

The licensee uses controls through best management practices to minimize erosion damage to the portions of the A-9 reclamation cover excluded from erosion protection placement. Stormwater controls currently in place at the site will minimize transport of sediment from the A-9 cover. Umetco site personnel will actively maintain this portion of the A-9 cover to ensure cover degradation will not occur.

Umetco is requesting changes (shown in strikethrough/underline edit format) to the license condition as shown below.

59. The licensee shall complete site reclamation in accordance with the approved reclamation plan, as authorized by License Conditions Nos. 54, and 58, in accordance with the following schedules.

A. To ensure timely compliance with target completion dates established in the Memorandum of Understanding with the Environmental Protection Agency (56 FR 554432, October 25, 1991), the licensee shall complete reclamation to control radon emissions as expeditiously as practicable, considering technological feasibility, in accordance with the following schedule:

(1) Remaining contaminated material retrieval and placement in the A-9 impoundment - ~~December 31, 2002~~. complete

(2) Placement of the interim cover to decrease the potential for tailings dispersal and erosion:

For the Inactive Impoundment - complete

For the A-9 Impoundment - complete

For the Heap Leach Impoundment - complete

(3) Placement of final radon barrier designed and constructed to limit radon emissions to an average flux of no more than 20 pCi/m^2/s above background:

For the Inactive Impoundment - complete

For the A-9 Impoundment - ~~December 31, 2003~~ complete

For the Heap Leach Impoundment - complete

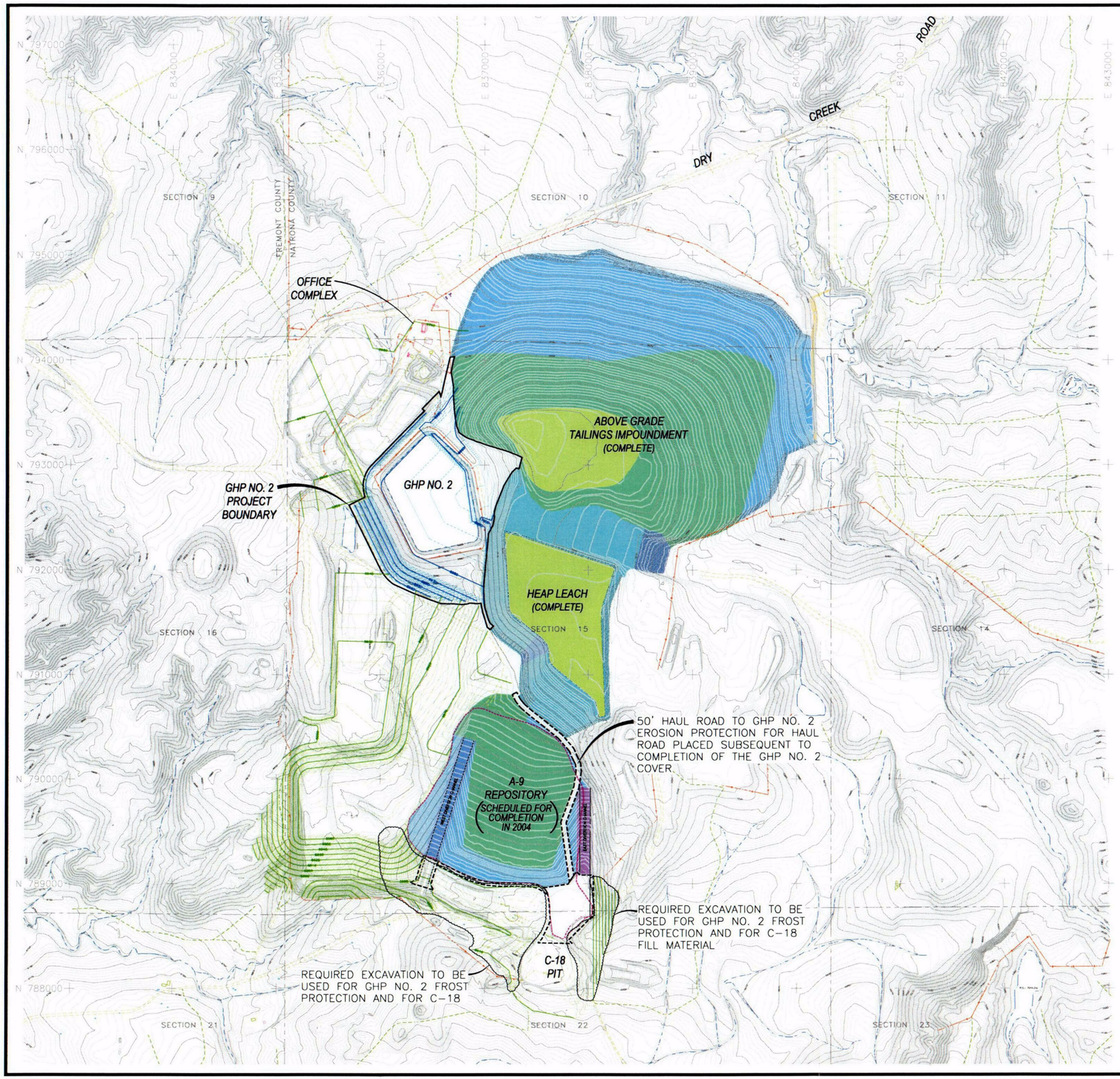
B. Reclamation, to ensure required longevity of the covered tailings and ground-water protection, shall be completed as expeditiously as is reasonably achievable, in accordance with the following target dates for completion:

(1) Placement of erosion protection as part of reclamation to comply with Criterion 6 of Appendix A of 10 CFR Part 40:

For the Inactive Impoundment - complete

For the A-9 Impoundment - December 31, 2004, except portions modified by Amendment ?? This work will be performed upon completion of the GHP No. 2 Reclamation Cover.

For the Heap Leach Impoundment - complete



LEGEND

- EXISTING TOPOGRAPHY
- FINAL GHP NO. 2 SURFACE
- FINAL RECLAMATION SURFACE
- EROSION PROTECTION
- A-9 REPOSITORY RADON BARRIER LIMITS (THE RADON BARRIER AND THE FROST PROTECTION COVER WAS COMPLETED IN 2003)
- RIPRAP AREAS TO REMAIN OPENED FOR EXCAVATION OF FROST PROTECTION AND HAUL ROADS FOR GHP NO. 2 COVER

N

1000' 0 1000'

SCALE IN FEET

CONTOUR INTERVAL : 2'

UMETCO MINERALS CORPORATION

EAST GAS HILLS

RECLAMATION SITE

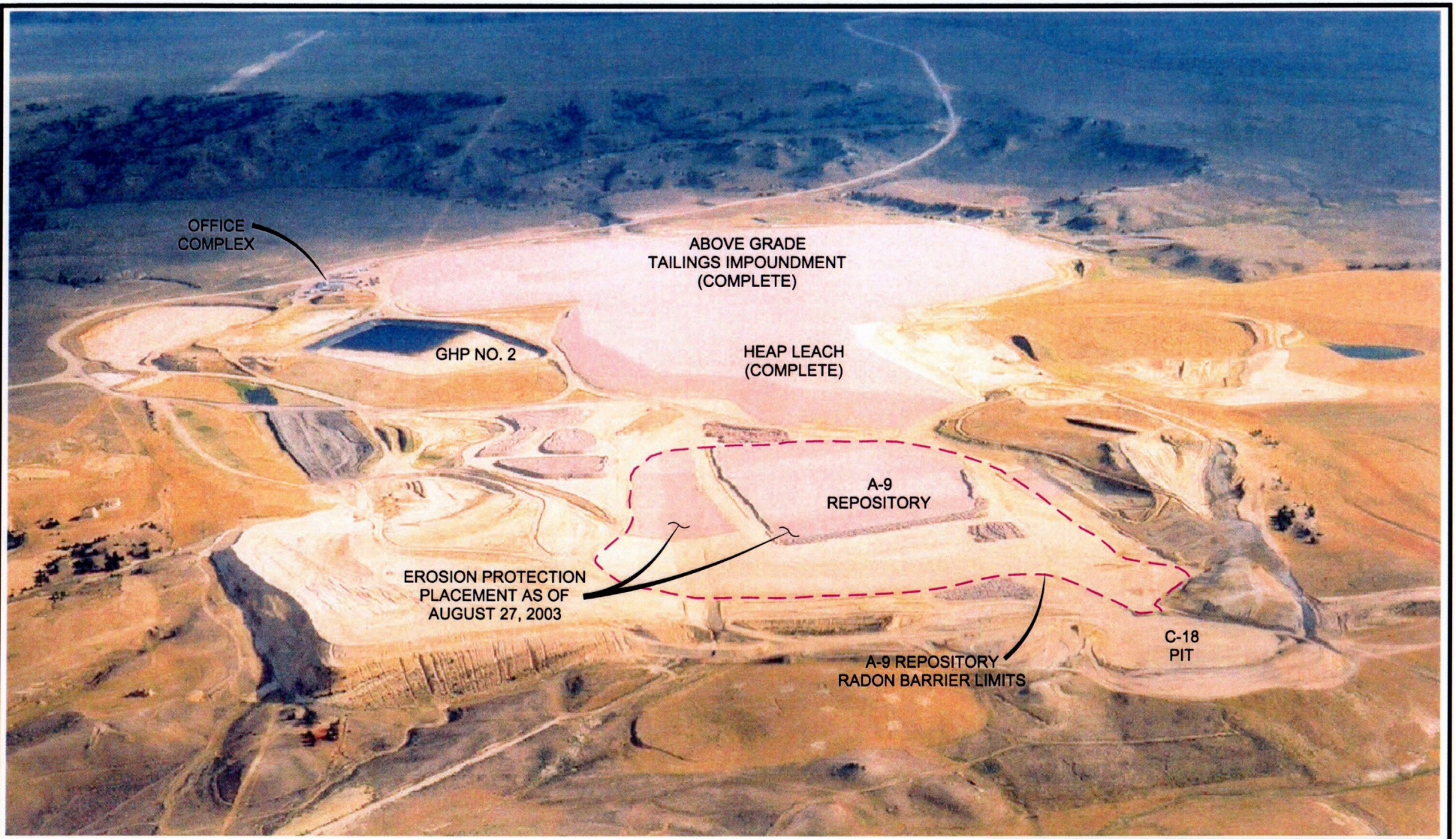
GAS HILLS, WYOMING

JANUARY 2004 FIGURE 1

A9-NRC-SITE2003.dwg

C01

A-9 Oblique.dwg



LEGEND

— — — A-9 REPOSITORY RADON BARRIER LIMITS (THE RADON BARRIER AND THE FROST PROTECTION COVER WAS COMPLETED IN 2003)

PHOTOGRAPH TAKEN
AUGUST 27, 2003

UMETCO MINERALS CORPORATION

EAST GAS HILLS
RECLAMATION SITE
AS OF AUGUST 27, 2003

GAS HILLS, WYOMING

JANUARY 2004 FIGURE 2

C02

GHP-2 Oblique.dwg

LEGEND

- - - - GHP NO. 2 POND LINER LIMITS

-·-·-·- GHP NO. 2 LIQUID LEVEL AS OF AUGUST 27, 2003

——— GHP NO. 2 RECLAMATION COVER

UMETCO MINERALS CORPORATION

EAST GAS HILLS
RECLAMATION SITE
AS OF AUGUST 27, 2003

GAS HILLS, WYOMING

JANUARY 2004

FIGURE 3

S02

Appendix M

Groundwater Monitoring Plan
Gas Hills, Wyoming

Umetco Minerals Corporation
2754 Compass Drive, Suite 280
Grand Junction, Colorado 81506

March 2002
Revised January 2004

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M-1 Gas Hills Site Groundwater Compliance Monitoring Wells

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M-3 Exceedance Identification and Action Approaches

** Sulfate and chloride target levels for non-POC model validation wells are provided in Attachment M-1, Tables 2 through 5.*

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M-1 Monitoring Locations

Also see Attachment M-1 Figures 1.a through 8.b.

Attachments

Attachment M-1 Target Level Derivation and Model Validation Approach for Chloride and Sulfate

1.0 INTRODUCTION

This groundwater monitoring plan was developed in support of (revised) License Condition (LC) 35, which stipulates that Umetco implement a groundwater compliance monitoring program and identify appropriate actions to be taken if the Alternate Concentration Limits (ACLs) for groundwater are exceeded. In accordance with LC 35, this appendix identifies the groundwater monitoring locations for each flow regime, presents the associated monitoring plan, and describes how Umetco will define and address potential exceedances of ACLs and/or target levels established for non-licensed indicator constituents.

2.0 MONITORING APPROACH

Three types of monitoring wells are included in the Gas Hills site groundwater compliance monitoring program:

(1) the existing point of compliance (POC) wells;

(2) non-POC wells for the purposes of tracking any future (unexpected) downgradient and/or vertical contaminant migration; and

(3) a subset of the downgradient non-POC wells defined above, for the purposes of validating the site geochemical and groundwater flow model and to ensure that sulfate and chloride—non-licensed constituents regulated by the Wyoming Department of Environmental Quality (WDEQ)—do not exceed model predictions and/or WDEQ standards.

Table M-1 defines the POC and non-POC monitoring wells and summarizes the corresponding monitoring approach, including the sampling frequency and the specific analytes to be monitored. Groundwater monitoring locations are shown on Figure M-1 for both the Western and Southwestern flow regimes.

2.1 Point of Compliance Wells

The four existing POC wells—Western Flow Regime (WFR) wells MW1 and MW21A and Southwestern Flow Regime (SWFR) wells GW7 and GW8—will be sampled annually with analysis for ACL constituents. In addition, MW21A and GW7—located at or near the leading edge of the plume in their respective flow regimes—will be sampled semi-annually with analysis for sulfate, chloride, and natural uranium. GW7 has consistently had the highest observed concentrations of several licensed constituents, and is considered a "hot spot" within the SWFR contaminant plume.

2.2 Non-POC Wells

Non-POC monitoring wells were selected to provide early detection of any future downgradient or vertical contaminant migration, and/or to verify the groundwater flow and geochemical modeling results presented in the ACL application. These wells are identified in Table M-1 and shown on Figure M-1. Rationales supporting their selection are documented in Table M-2.

Table M-1 Gas Hills Site Groundwater Compliance Monitoring Wells

Well Type	Western Flow Regime Wells[1]	Southwestern Flow Regime Wells[2]	Monitoring Approach[3]
Point of Compliance (POC) Wells	MW1 MW21A*	GW7* GW8	Wells to be sampled annually for ACL constituents. Sampling to be conducted every June until license termination, with results to be submitted to the NRC by September 30 of the same year. ——— *Asterisked wells—MW21A and GW7—to be sampled semi-annually for natural uranium (U-nat), sulfate, and chloride.
Non-POC Wells	MWI64 MW70A MW25 MW71B** MW28** MW77 Iron Spring	PW4 MW72** MW82** Note: MW82 is proposed new well, to be installed in Spring 2002.	Sampling of these non-POC wells will be conducted semi-annually with analyses for sulfate, chloride, and U-nat. Except for chloride and sulfate monitoring at the four model validation wells (explained below), *this sampling will be conducted for information and tracking purposes only*—i.e., results will not be assessed for exceedances. ——— **Results for asterisked wells—MW71B, MW28, MW72, and MW82—will be used to verify model results (see below).
Model Validation Wells *(subset of above non-POC wells)*	MW71B MW28	MW72 MW82	Semi-annual sampling for chloride and sulfate as described above. Results will be compared with the target levels derived for the applicable timeframe. See Section 3.0 and **Attachment M-1 Tables 2 through 5.**

[1] Alternate Concentration Limits (ACLs) established for the Western Flow Regime POC wells MW1 and MW21A are as follows: Arsenic = 1.8 mg/l; Beryllium = 1.64 mg/l; Lead-210 = 35.4 pCi/l; Nickel = 13.0 mg/l; combined Radium-226 and -228 = 250 pCi/l; Selenium = 0.161 mg/l; Thorium-230 = 57.4 pCi/l; and Uranium-natural (U-Nat) = 11.9 mg/l. Action levels for chloride and sulfate are listed in Table M-3.

[2] ACLs established for the Southwestern Flow Regime POC wells GW7 and GW8 are: Arsenic = 1.36 mg/l; Beryllium = 1.70 mg/l; Lead-210 = 46.7 pCi/l; Nickel = 9.34 mg/l; combined Radium-226 and -228 = 353 pCi/l; Selenium = 0.53 mg/l; Thorium-230 = 44.8 pCi/l; and Uranium-natural = 34.1 mg/l. Action levels for chloride and sulfate are listed in Table M-3.

[3] Results of monitoring will be provided in the Groundwater Monitoring Review as required by License SUA-648.

Table M-2 Rationales Supporting Selection of Non-POC Monitoring Wells

WESTERN FLOW REGIME	
Monitoring Well	**Basis for Selection**
MWI64	This well is located at the downgradient edge of the Above-Grade Tailings Impoundment (AGTI) and exhibits some of the highest observed values for beryllium, nickel, lead-210, radium 226+228, natural uranium, gross alpha, chloride and sulfate. This well is within the "hot spot" area of the plume.
MW70A	This location is approximately 1,700 feet to the northwest of the restricted area. This well is screened in the upper portion of the Western Flow Regime and will monitor radial flow from the AGTI.
MW25	Water quality data and isoconcentration plots indicate this well, located approximately 1,500 feet hydraulically downgradient of the AGTI, would be appropriately located to monitor the leading edge of the plume.
MW71B**	This well is approximately 2,500 feet downgradient of the AGTI. It is screened in the lower portion of the Western Flow Regime and will indicate potential vertical migration.
MW28**	This well is located 2,500 feet hydraulically downgradient of the AGTI. Water quality data and isoconcentration plots indicate that there has been no impact from site-derived constituents. This location is a few hundred feet in advance of the groundwater plume and will provide the earliest indication of migration.
MW77	This location is near the proposed land transfer boundary, 4000 feet hydraulically downgradient of the AGTI, and is representative of water quality at the Point of Exposure (POE). Modeling indicates that site-derived constituents will reach this location in 70 to 80 years but will not degrade water quality to less than its current Class III status.
Iron Spring	This spring, approximately 10,000 feet from the AGTI, is the closest discharge point for groundwater migrating from the site. Groundwater modeling indicates no significant impacts to water quality resulting from site-derived constituents.
SOUTHWESTERN FLOW REGIME	
Monitoring Well	**Basis for Selection**
PW4	PW4 – This well is located 200 feet south of POCs GW7 and GW8. Once extraction is terminated, groundwater will migrate from GW7 toward PW4. Water quality data and isoconcentration plots indicate this well has been marginally impacted from site-derived constituents and is near the downgradient edge of the plume. This location will provide early monitoring within the Southwestern Flow regime plume.
MW72**	MW72 – Water quality data and isoconcentration plots indicate this well, located 1,000 feet southwest of the A-9 Repository, may be impacted from site derived constituents and is located near the downgradient edge of the groundwater plumes migrating from the site.
MW82**	MW82 – This proposed well is the furthest downgradient location from the A-9 repository (approximately 1,200 feet). The well location was selected based on its position along the modeled axis of the plume and also because it is upgradient of PRI's proposed Mine Unit 5.

Note: All wells listed above will be sampled semi-annually for analysis of sulfate, chloride, and U-nat. Sulfate and chloride results for asterisked (**) wells—MW71B, MW28, MW72, and MW82—will also be used to verify model results.

The non-POC monitoring locations listed in Table M-2 were selected on the basis of one or more of the following criteria, with input from the U.S. Nuclear Regulatory Commission:

- location within the plume and in "hot spot" locations;
- location proximal to extraction wells;
- location at downgradient edge of the plume;
- downgradient of site impacts; and/or
- a discharge point for groundwater (e.g., springs).

Sampling of non-POC wells will be conducted semi-annually with analyses for sulfate, chloride, and natural uranium as indicated in Table M-1.

3.0 MODEL VALIDATION COMPONENT OF COMPLIANCE MONITORING: CHLORIDE AND SULFATE

A subset of the non-POC wells defined above—WFR wells MW71B and MW28 and SWFR wells MW72 and MW82 (proposed new well; see below)—will be compared with target levels established for chloride and sulfate (see Attachment M-1). Although chloride and sulfate are not licensed constituents, they do have groundwater protection standards set by the Wyoming Department of Environmental Quality (WDEQ). More importantly, these constituents are minimally attenuated and therefore should provide the earliest indication of site-derived contaminant migration along groundwater flowpaths. As such, target levels were derived for the purposes of validating the sulfate and chloride model simulations. The monitoring approach is summarized in Table M-1, and detailed supporting information is provided in Attachment M-1. Target levels established for individual model validation wells are documented in Attachment M-1, Tables 2 through 5.

Proposed New Monitoring Well MW82

MW82, the proposed new well, will be located along the axis of the modeled chloride and sulfate plumes migrating from the A-9 Repository. No existing wells are suitably located for this purpose. The well will be incorporated into the groundwater monitoring plan, designed to support License Condition 35.

MW82 will be completed within the Upper Wind River aquifer (above the mudstone unit that separates the Upper and Lower Wind River aquifers), near existing well MW30 (a Lower Wind River aquifer completion). Approximate coordinates of MW82 are N 788300 and E 835800. This location was selected because it is downgradient of the A-9 Repository and along the flowpath of groundwater migrating from that impoundment. The location is also hydraulically upgradient of the Power Resources, Inc. (PRI) proposed Mine Unit No. 5 and the underground Thunderbird and ROX mines. The elevation of the water table beneath the proposed well location is projected to be at 6790. Ground surface elevation is approximately 6840. Depth to water will be approximately 50 feet. The well will be constructed similar to previous monitoring wells MW72 and MW74 and will be screened across the upper 15-20 feet of the Upper Wind River aquifer. MW30 already provides sufficient monitoring at that location for the deeper hydrologic flow system within the Lower Wind River.

4.0 EXCEEDANCE IDENTIFICATION AND VERIFICATION RESAMPLING

The monitoring approach described above and in Table M-1 was developed to ensure that the groundwater ACLs are met, as well as to provide early detection of downgradient or vertical migration of site contaminants. As such, a mechanism for identifying exceedances and implementing appropriate responses to those exceedances, must be identified.

4.1 General Approach to Identifying Exceedances

In identifying exceedances, the overall intent is to allow early detection of potential ACL or target level exceedances, while minimizing the probability of false positive results—e.g., exceedances attributable to laboratory error or transient anomalous increases. Prediction limits are already built into both the ACLs and the target levels established for non-ACL (indicator) constituents. Therefore, comparison of the single values (e.g., ACL vs. monitoring result) should suffice. However, several factors must be accounted for when evaluating results and identifying exceedances. These factors are discussed below.

Significant Figures

Significant figures must be accounted for when comparing predicted values with measured values. The following general approach should be employed. For results less than 1000 mg/l, comparisons between measured values and predicted values should be based on 2 significant figures. For results exceeding 1000 mg/l, comparisons should be made on the basis of 3 significant figures. [Refer to Attachment M-1, Table 2 for a useful example.]

Verification Resampling

Verification resampling is an integral component of exceedance identification. To avoid "false positives" due to laboratory error and/or transient increases, a statistically significant exceedance will not be declared or reported until the results of verification resampling are known. Umetco's proposed approach to verification sampling is discussed below and in Table M-3.

4.2 ACL Constituents at Point of Compliance Wells

If any POC sample exceeds the ACL for one or more constituents, another sample will be analyzed within 3 months of obtaining the results, for the constituent(s), to rule out laboratory error or transient increase. If the first verification (re)sample also results in an exceedance of the same ACL, Umetco will notify the NRC within 30 days of receiving the second results. Contingent upon NRC approval, an additional verification sample may be collected before corrective action measures are considered (within 3 months of obtaining the second result).

If the second verification (re)sample also results in an exceedance, Umetco will provide an "action plan" to the NRC within 60 days of receiving the second verification sample results. This action plan will describe appropriate corrective action(s), if necessary, and/or further analysis to ensure that no risk will be incurred at point of exposure (POE) locations. Such an analysis may require reassessment of model simulations and assumptions. This approach is detailed in Table M-3.

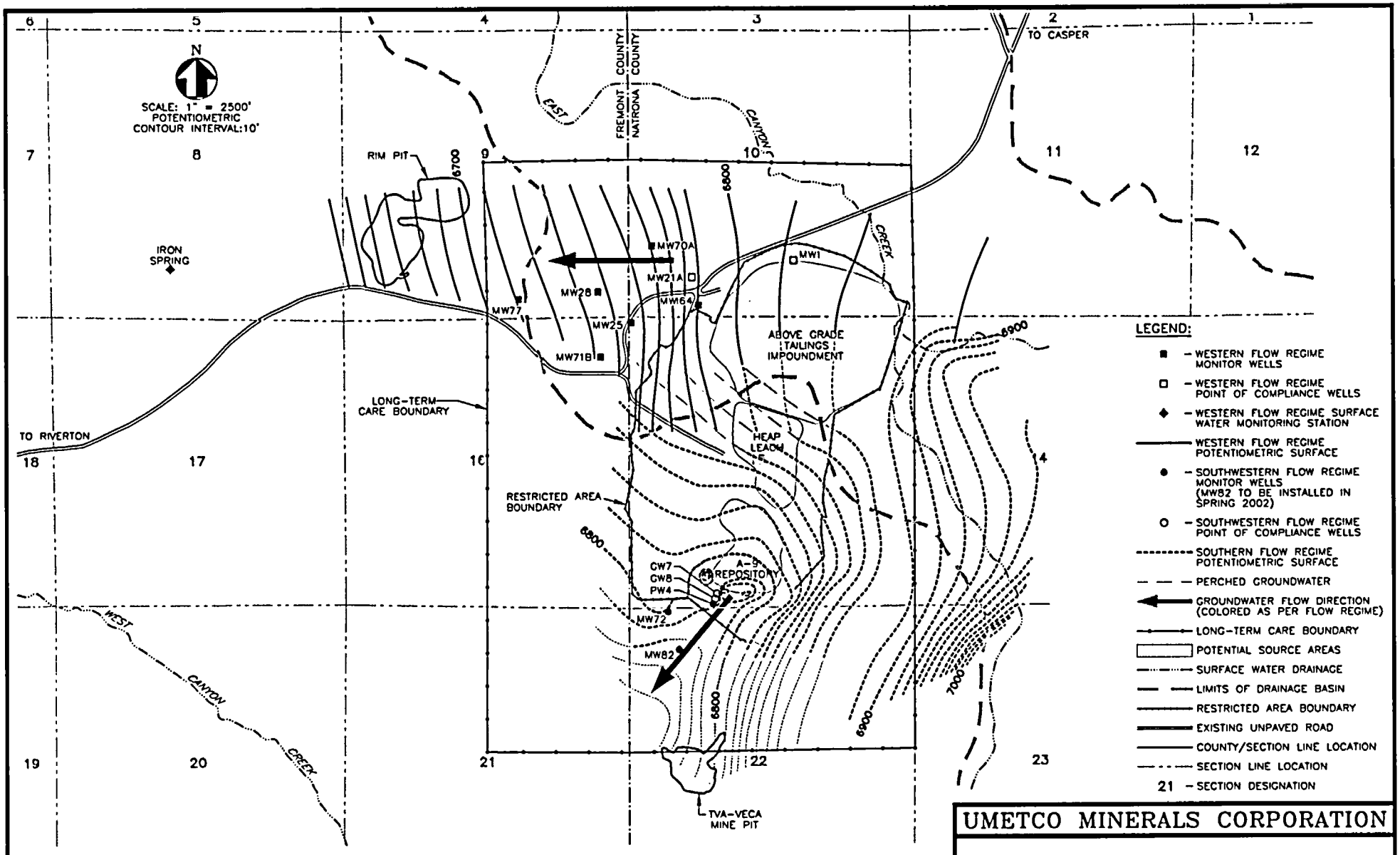
4.3 Chloride and Sulfate at Model Validation Wells

As discussed above, chloride and sulfate are included in the monitoring plan for a subset of the non-POC wells to evaluate the predictions made by modeling and/or to track the downgradient migration of site-related constituents. As described in Table M-3, exceedance of the chloride and/or sulfate target levels will trigger additional response, including, but not limited to, confirmation sampling and/or reassessment of the model simulations and assumptions. Consideration will be given to the degree of the exceedance and the potential impacts to water quality at the POE. . The potential for non-site related factors (e.g., mining impacts) must also be considered when identifying potential exceedances for these indicator parameters, in particular for sulfate. Response actions for exceedance of these parameters will be less rigorous than those discussed above for ACL constituents due to the conservatism already built into the model and the low probability that target level exceedances would adversely impact potential risks at POE locations.

Table M-3 Exceedance Identification and Action Approaches

Monitoring Endpoint	Exceedance Identification and Verification Resampling Approach	Actions to be Implemented if Exceedances are Verified
ACL Constituents at POC Wells	If any POC sample exceeds the ACL for one or more constituents (accounting for significant figures), another sample will be analyzed within 3 months of obtaining the results for the constituent(s). [*Re-analysis is only necessary for the constituent(s) exceeding the ACLs.*]	If the first verification (re)sample also results in an exceedance of the same ACL, Umetco will notify the NRC within 30 days of receiving the second results. Contingent upon NRC approval, an additional verification sample may be collected before corrective action measures are considered (within 3 months of obtaining the second result). If the second verification (re)sample also results in an exceedance, Umetco will provide an "action plan" to the NRC within 60 days of receiving the second verification sample results. This action plan will describe appropriate corrective action(s), *if necessary*, and/or further analysis to ensure that no risk will be incurred at point of exposure (POE) locations. Such an analysis may require reassessment of model simulations and assumptions.
Chloride and Sulfate in Model Validation Wells MW71B, MW28, MW72, and MW82	If any sample exceeds the corresponding target level for chloride or sulfate (see Attachment M-1 tables), another sample will be analyzed within 3 months of obtaining the results. If the first verification sample also exceeds the target level(s), another verification sample will be collected (within 3 months of the first).	Exceedance of three consecutive samples—the semi-annual sample, followed by two verification samples—is required before an exceedance of sulfate and chloride target levels is declared. NRC reporting requirements are the same as those identified above. Exceedances of chloride and/or sulfate target levels will trigger additional response, including but not limited to reassessment of the model simulations and assumptions. Corrective actions are not anticipated for these parameters, however, as exceedance of the target levels is expected to have a negligible impact on potential risks at the POE.
Chloride, Sulfate, and U-Nat at Remaining Non-POC Wells	None required. As indicated in Table M-2, *this sampling will be conducted for information and tracking purposes only*—i.e., results will not be assessed for exceedances.	Not Applicable.

FIGM-1S B & W.DWG



UMETCO MINERALS CORPORATION

MONITORING LOCATIONS

EAST GAS HILLS, WYOMING

FEBRUARY 2002

FIGURE M-1

Attachment M-1

Target Level Derivation and Model Validation Approach for Chloride and Sulfate

Gas Hills, Wyoming

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March 2002
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Tables

Table 1 Calculation of Standard Deviation for Sulfate and Chloride Data Sets for MW28, MW71B, and MW72: 1997 through 2001

Table 2 Target Levels Derived for Western Flow Regime Well MW71B

Table 3 Target Levels Derived for Western Flow Regime Well MW28

Table 4 Target Levels Derived for Southwestern Flow Regime Well MW72

Table 5 Target Levels Derived for Southwestern Flow Regime Well MW82

Figures

Figure 1a. Simulated Chloride Trends at MW71B (10 Years) – Western Flow Regime
Figure 1b. Simulated Chloride Trends at MW71B (50 Years) – Western Flow Regime

Figure 2a. Simulated Chloride Trends at MW28 (10 Years) – Western Flow Regime
Figure 2b. Simulated Chloride Trends at MW28 (50 Years) – Western Flow Regime

Figure 3a. Simulated Chloride Trends at MW72 (10 Years) – Southwestern Flow Regime
Figure 3b. Simulated Chloride Trends at MW72 (50 Years) – Southwestern Flow Regime

Figure 4a. Simulated Chloride Trends at MW82 (10 Years) – Southwestern Flow Regime
Figure 4b. Simulated Chloride Trends at MW82 (50 Years) – Southwestern Flow Regime

Figure 5a. Simulated Sulfate Trends at MW71B (10 Years) – Western Flow Regime
Figure 5b. Simulated Sulfate Trends at MW71B (50 Years) – Western Flow Regime

Figure 6a. Simulated Sulfate Trends at MW28 (10 Years) – Western Flow Regime
Figure 6b. Simulated Sulfate Trends at MW28 (50 Years) – Western Flow Regime

Figure 7a. Simulated Sulfate Trends at MW82 (10 Years) – Southwestern Flow Regime
Figure 7b. Simulated Sulfate Trends at MW82 (50 Years) – Southwestern Flow Regime

Figure 8a. Simulated Sulfate Trends at MW72 (10 Years) – Southwestern Flow Regime
Figure 8b. Simulated Sulfate Trends at MW72 (50 Years) – Southwestern Flow Regime

Target Level Derivation and Model Validation Approach for Chloride and Sulfate

Introduction

A methodology is presented for validation of the Gas Hills groundwater flow and contaminant transport simulations of sulfate and chloride. These constituents are minimally attenuated and should provide the earliest indication of site-derived contaminant migration along groundwater flowpaths. Model results for selected wells that are included in the long-term groundwater monitoring are provided as graphs to allow for comparison with analytical measurements. A 95% UCL is included in the graphs that accounts for the variability in the analytical data. Future analytical measurements at observation wells MW28, MW71B, MW72, and proposed well MW82 should remain less than the 95% UCLs, herein referred to as target levels, for corresponding simulation times.

This attachment describes the selection and development of the concentration targets to be used for validating the sulfate and chloride model simulations. As indicated in the preceding appendix text, exceedance of the target levels will trigger additional response, including, but not limited to, confirmation sampling and/or reassessment of the model simulations and assumptions.

Methodology

Peak concentrations of sulfate and chloride at the Points of Exposure (POE) for the Western Flow Regime (WFR) and Southwestern Flow Regime (SWFR) are anticipated to occur in approximately 80 and 100 years, respectively. To provide a shorter frame of reference to compare model results to measured concentrations, intermediate observation points were selected. The monitor wells selected for short-term model validation results are listed below:.

Model Validation Well	Flow Regime	Nearest Impoundment	Distance from Impoundments (ft)
MW28	WFR	AGTI	2000
MW71B	WFR	AGTI	2000
MW72	SWFR	A-9 Repository	1000
MW82	SWFR	A-9 Repository	1200

*MW82 is proposed monitoring well location (see preceding Appendix M text).

The model results for chloride and sulfate are plotted for each of the observation wells. Initial conditions in the model represent the chloride and sulfate plume configuration at the beginning of the year 2000. Plots were constructed to show simulation results for 10 years and 50 years. The 10-year plots represent changes in concentration at the specified well from the year 2000 to 2010 and provide sufficient detail to allow comparison of measured (actual) data with the simulated results. Measured analytical data for 2000 and 2001 are also included on the 10-year plots. The 50-year plots provide a view of the long-term trends in concentration and compare the simulated data to WDEQ water quality standards.

Uncertainty or variability in analytical data is addressed through the use of upper confidence limits (UCLs). The 95% UCL is presented on each of the 10-year plots and was derived as follows. A standard deviation was calculated for the analytical data reported for each well from 1997 through 2001 for sulfate and chloride (Table 1). The standard deviation was multiplied by 1.96. The product of the standard deviation and 1.96 for each well was then added to the simulated results for that well to represent the 95% UCL. A standard deviation could not be calculated for MW82 because that well has not been drilled. Therefore, the standard deviation calculations for MW72 for chloride and sulfate were applied to MW82.

The 95% UCL plotted on the 10-year simulation figures should be used as the target for comparing analytical measurements to the model results. For example, as shown in Figure 1a, analytical measurements of chloride collected in January 2000 and January 2001 for observation well MW71B fall beneath the 95% UCL for the corresponding simulation times. This indicates that the model has over-predicted chloride values at that location, further evidence of the conservatism of the model. In the event that analytical measurements exceed the 95% UCL for corresponding simulation times, a confirmatory sampling event will be conducted as described in Table M-3 (see previous). Consideration will be given to the degree of the exceedance and the potential impacts to water quality at the POE.

For example, the 95% UCL for chloride at MW28 in 2005 is 14.3 mg/L. If an analytical measurement in 2005 for chloride at MW28 was 16.0 mg/L, then that would be an exceedance. However, the maximum simulated chloride value at MW28 occurs in 2036 at 73 mg/L and the maximum simulated value at the POE is 76 mg/L in 2055. Both values are significantly below the WDEQ Class I standard of 250 mg/L. Therefore, a slight exceedance of the 95% UCL for chloride at MW28 is not likely to pose a threat to human health or the environment.

Model Results

Results of the model simulations for chloride transport for each of the observation points are provided in Figures 1a through 4b. Graphs of chloride concentration versus time are shown for simulation periods of 10 years and 50 years. The figures show generally increasing trends in chloride concentration during early years, with concentrations peaking at about 30 to 35 years in the WFR wells (Figures 1a, 1b, 2a and 2b). Chloride concentration reaches a maximum within 3 to 4 years at MW72 (Figures 3a and 3b), and in about 45 years at MW82 (Figures 4a and 4b). All simulated values remain below the WDEQ Class I chloride standard of 250 mg/L as shown on the 50-year graphs. Also note that the 2000 and 2001 analytical chloride measurements (plotted on the 10-year graphs) fall below the plot of the 95% UCL.

Results of the model simulations for sulfate transport for each of the observation points are provided in Figures 5a through 8b. Again, graphs are shown for simulation periods of 10 years and 50 years. The figures are similar to the chloride results, showing generally increasing trends in sulfate concentrations during early years, with concentrations peaking at about 30 to 35 years in the WFR wells (Figures 5a, 5b, 6a and 6b). Sulfate concentration reaches a maximum at 10 years at MW72 (Figures 7a and 7b). At MW82, the sulfate concentration levels off at approximately 750-800 mg/L after 45 years (Figure 7b). Note that all simulated values remain below the WDEQ Class III sulfate standard of 3,000 mg/L, and that the 2000 and 2001 analytical sulfate measurements fall below the plots of the 95% UCL. **Corresponding target levels derived for the 10-year simulation period (2000-2010) are provided in Tables 2 through 5.**

Tables

Table 1. Calculation of Standard Deviation for Sulfate and Chloride Data Sets for MW28, MW71B, and MW72: 1997 through 2001. Gas Hills, Wyoming.

MW28	Measurement Date	Chloride	Sulfate
	2/3/1997	4	359
	4/30/1997	6	388
	7/25/1997	5	374
	10/8/1997	6	407
	1/28/1998	6	435
	4/28/1998	6	432
	7/29/1998	6	445
	10/20/1998	5	435
	1/19/1999	6	479
	1/20/2000	5.8	500
	1/15/2001	7.5	540
	Standard Deviation	0.87	54.57
	1.96 x Std Dev	1.71	106.96

MW71B	Measurement Date	Chloride	Sulfate
	8/12/1997	8	379
	11/17/1997	8	361
	1/27/1998	8	377
	5/5/1998	9	384
	8/12/1998	9	395
	11/3/1998	9	367
	1/26/1999	9	413
	1/20/2000	11	410
	1/16/2001	14	430
	Standard Deviation	1.94	23.04
	1.96 x Std Dev	3.81	45.15

MW72	Measurement Date	Chloride	Sulfate
	8/14/1997	108	569
	8/27/1997	101	599
	11/18/1997	99	492
	3/17/1998	109	607
	5/21/1998	105	641
	8/20/1998	121	668
	11/11/1998	106	664
	1/11/1999	110	835
	2/29/2000	120	1000
	1/16/2001	110	1100
	Standard Deviation	7.13	197.27
	1.96 x Std Dev	13.97	386.65

Table 2. Target Values Derived for Western Flow Regime Well MW71B

Year	Chloride (mg/l)		Sulfate (mg/l)	
	Annual Target Range	June Target	Annual Target Range	June Target
2000	14 – 19 (actual = 11)	--	470 – 533 (actual = 410)	--
2001	20 – 25 (actual = 14)	--	535 – 625 (actual = 430)	--
2002	25 – 31	28	633 – 738	683
2003	31 – 37	34	740 – 837	792
2004	38 – 45	41	846 – 945	889
2005	45 – 51	48	947 – 1,036	994
2006	52 – 58	54	1,042 – 1,130	1,081
2007	58 – 64	61	1,132 – 1,208	1,173
2008	64 – 70	67	1,214 – 1,289	1,247
2009	70 – 76	73	1,291 – 1,361	1,326
2010	76 (January 2010)	--	1,361 (Jan-10)	--

Note:

Significant figures must be accounted for when comparing predicted values with measured values. A general rule is as follows: For results less than 1000 mg/l, comparisons between measured values and predicted values should be based on 2 significant figures. For results exceeding 1000 mg/l, comparisons should be made on the basis of 3 significant figures. For example, a June 2009 sulfate result of 1,334 mg/l at MW71B would not be considered an exceedance of the corresponding 1,326 mg/l target level. Also note that the target levels shown above reflect the 95% upper confidence limits (UCLs) about the actual predicted values, a factor that must be accounted for when reviewing the synopses of predicted trends provided below.

MW71B, Predicted Chloride Trends:*

Increasing through approximately 2025, with 10-yr plateau of about 100-110 mg/l, followed by subsequent slight gradual attenuation (Figures 1.a and 1.b). All predicted values are well below the WDEQ Class I groundwater standard of 250 mg/l.

MW71B, Predicted Sulfate Trends:

Increasing through approx. 2025, with 10-yr plateau of approx. 2000 mg/l, followed by subsequent attenuation (Figures 5.a and 5.b). All predicted values are well below the WDEQ Class III groundwater standard of 3,000 mg/l.

Table 3. Target Values Derived for Western Flow Regime Well MW28

Year	Chloride (mg/l)		Sulfate (mg/l)	
	Annual Target Range	June Target	Annual Target Range	June Target
2000	25 – 26 (actual = 5.8)	--	830 – 856 (actual = 500)	--
2001	26 – 35 (actual = 7.7)	--	856 – 1001 (actual = 540)	--
2002	35 – 51 (actual = 14)	--	1001 – 1239 (actual = 610)	757
2003	51 – 69 (actual = 35)	--	1239 – 1484 (actual = 1010)	816
2004	69 – 83	75	1484 – 1695	1590
2005	83 – 94	88	1695 – 1846	1771
2006	94 – 100	97	1847 – 1947	1897
2007	100 – 104	102	1947 – 2006	1977
2008	104 – 106	105	2006 – 2036	2021
2009	106 – 106	106	2036 – 2049	2043
2010	106 – 106	106	2049 – 2053	2051

See notes following Table 2.

MW28, Predicted Chloride Trends:

Increasing through approx. 2030, with plateau at approx. 75 mg/l, followed by subsequent gradual attenuation (Figures 2.a and 2.b). All predicted values are well below the WDEQ Class I groundwater standard of 250 mg/l.

MW28, Predicted Sulfate Trends:

Increasing through approx. 2030, peaking at approx. 1500 mg/l, followed by subsequent attenuation (Figures 6.a and 6.b). All predicted values are well below the WDEQ Class III groundwater standard of 3,000 mg/l.

Table 4. Target Values Derived for Southwestern Flow Regime Well MW72

Year	Chloride (mg/l)		Sulfate (mg/l)	
	Annual Target Range	June Target	Annual Target Range	June Target
2000	139 – 160 (actual = 120)	--	1,388 – 1,550 (actual = 1,000)	--
2001	161 – 173 (actual = 110)	--	1,552 – 1,606 (actual = 1,110)	--
2002	174 – 179	177	1,609 – 1,644	1,629
2003	179 – 180	180	1,644 – 1,660	1,654
2004	174 – 179	177	1,661 – 1,674	1,668
2005	169 – 174	172	1,674 – 1,684	1,679
2006	164 – 169	167	1,684 – 1,689	1,686
2007	160 – 164	162	1,689 – 1,691	1,690
2008	158 – 160	159	1,691 – 1,693	1,692
2009	157 – 158	157	1,693 – 1,695	1,694
2010	156 (January 2010)	--	1,695 (Jan-10)	--

See notes following Table 2.

MW72, Predicted Chloride Trends:

Slightly increasing through 2003, peaking at about 165 mg/l, and subsequent slight attenuation to ≤ 100 mg/l (Figures 3a and 3b). All predicted values are well below the WDEQ Class I groundwater standard of 250 mg/l.

MW72, Predicted Sulfate Trends:

Increasing very gradually through about 2010 (with negligible increase after 2005), followed by plateau of about 1300 mg/l (through approx. 2015-2020), followed by subsequent gradual attenuation (Figures 8.a and 8.b). All predicted values are well below the WDEQ Class III groundwater standard of 3,000 mg/l.

Table 5. Target Values Derived for Southwestern Flow Regime Well MW82

Year	Chloride (mg/l)		Sulfate (mg/l)	
	Annual Target Range	June Target	Annual Target Range	June Target
2000	39.0 – 59.7	--	887 – 908	--
2001	59.7 – 77.2	--	908 – 972	--
2002	77.2 – 90.9	84	972 – 1055	1014
2003	90.9 – 98.7	95	1055 – 1130	1093
2004	98.7 – 100.8	100	1130 – 1186	1158
2005	100.8 – 99.5	100	1186 – 1223	1205
2006	99.5 – 97.4	99	1223 – 1252	1239
2007	97.4 – 96.4	97	1252 – 1284	1268
2008	96.4 – 97.2	97	1284 – 1323	1304
2009	97.2 – 99.3	98	1323 – 1367	1345
2010	99.3	99	1367	1367

MW82 installed in Spring 2002; see notes following Table 2. **These estimates are based on model predictions, and assume no impacts from surrounding PRI activities and/or naturally occurring mineralization.**

MW82, Predicted Chloride Trends:

Sharply increasing until approximately 2005 (with assumed baseline at 25 mg/l), then gradually increasing to a maximum of 130 mg/l by 2033 followed by a steady decline. All predicted values are well below the WDEQ Class I groundwater standard of 250 mg/l.

MW82, Predicted Sulfate Trends:

Steadily increasing until 2023, reaching a maximum value of 1850 mg/l (with assumed baseline of 500 mg/l), then gradually decreasing. All predicted values are well below the WDEQ Class III groundwater standard of 3000 mg/l.

Figures

Figure 1a. Simulated Chloride Trends at MW71B (10 Years)-Western Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation

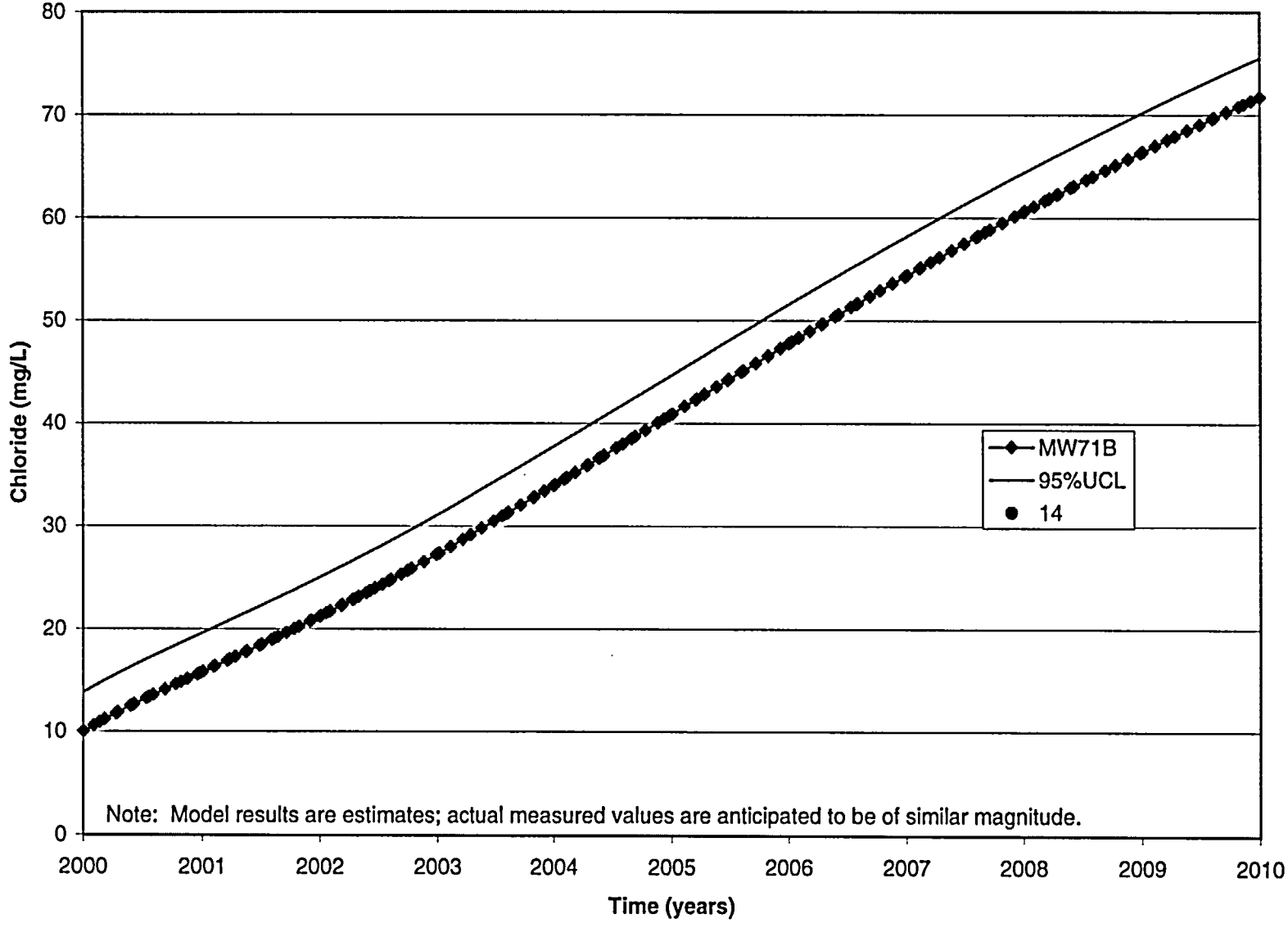


Figure 1b. Simulated Chloride Trends at MW71B (50 Years)- Western Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation

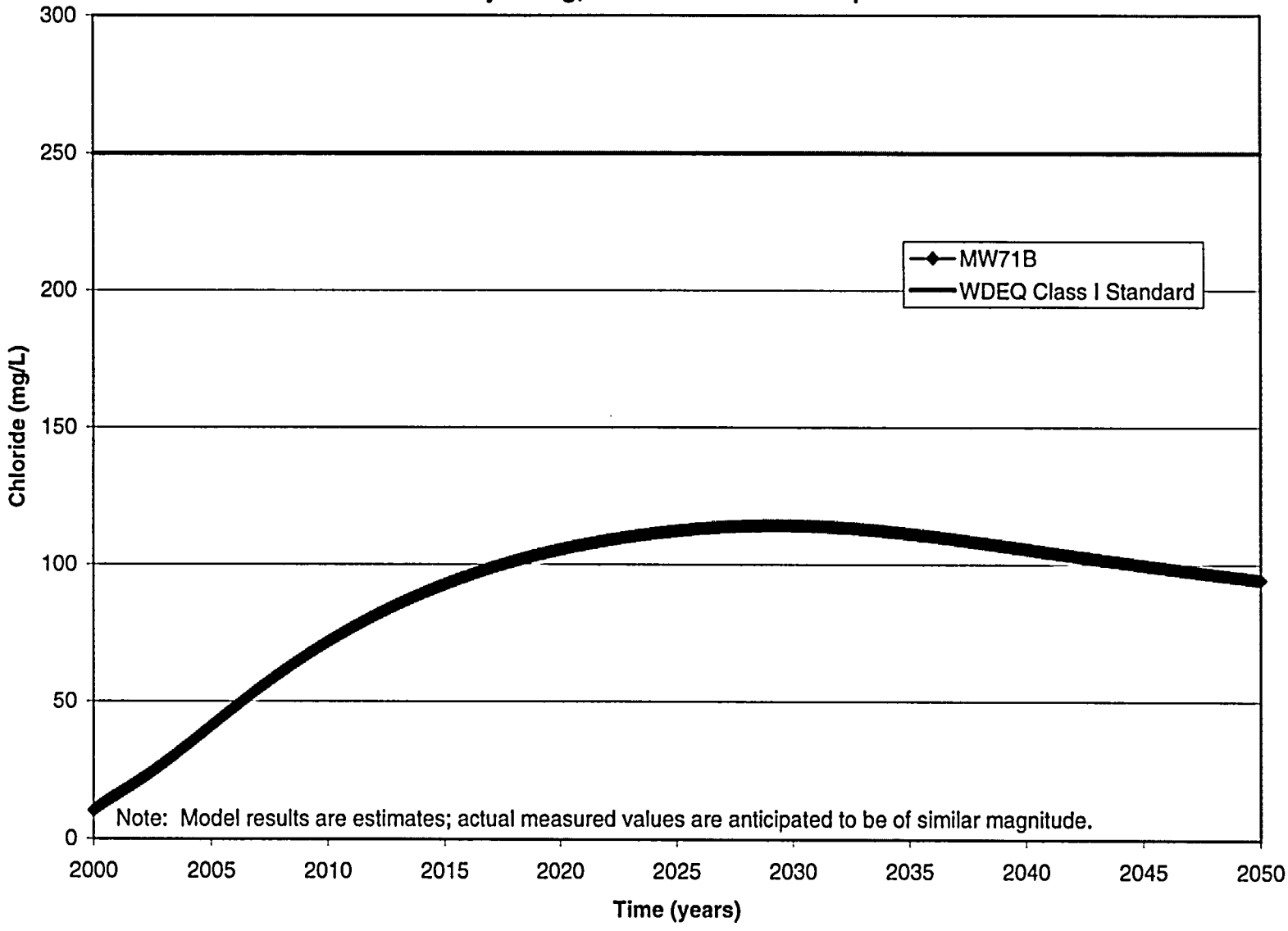
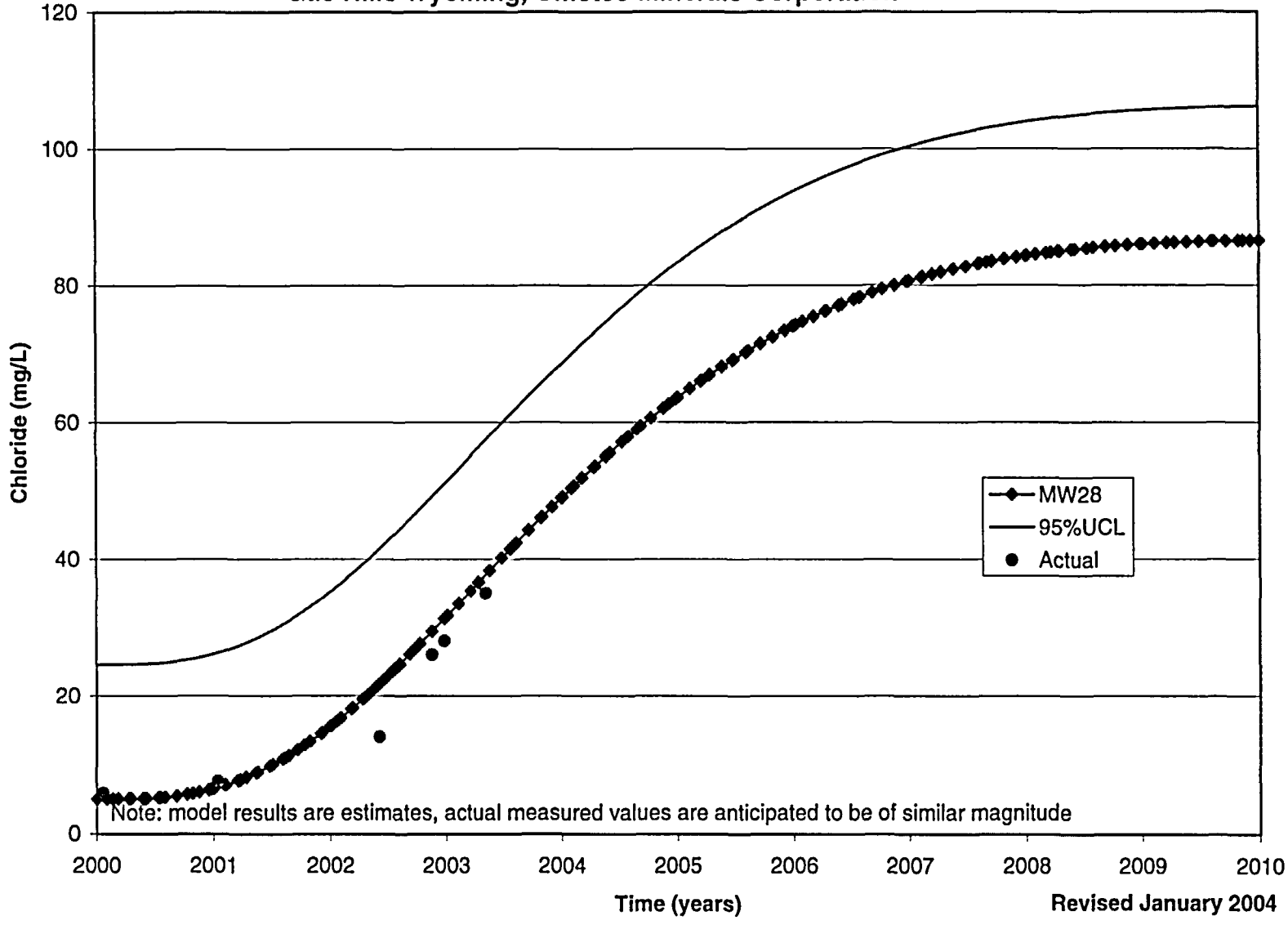
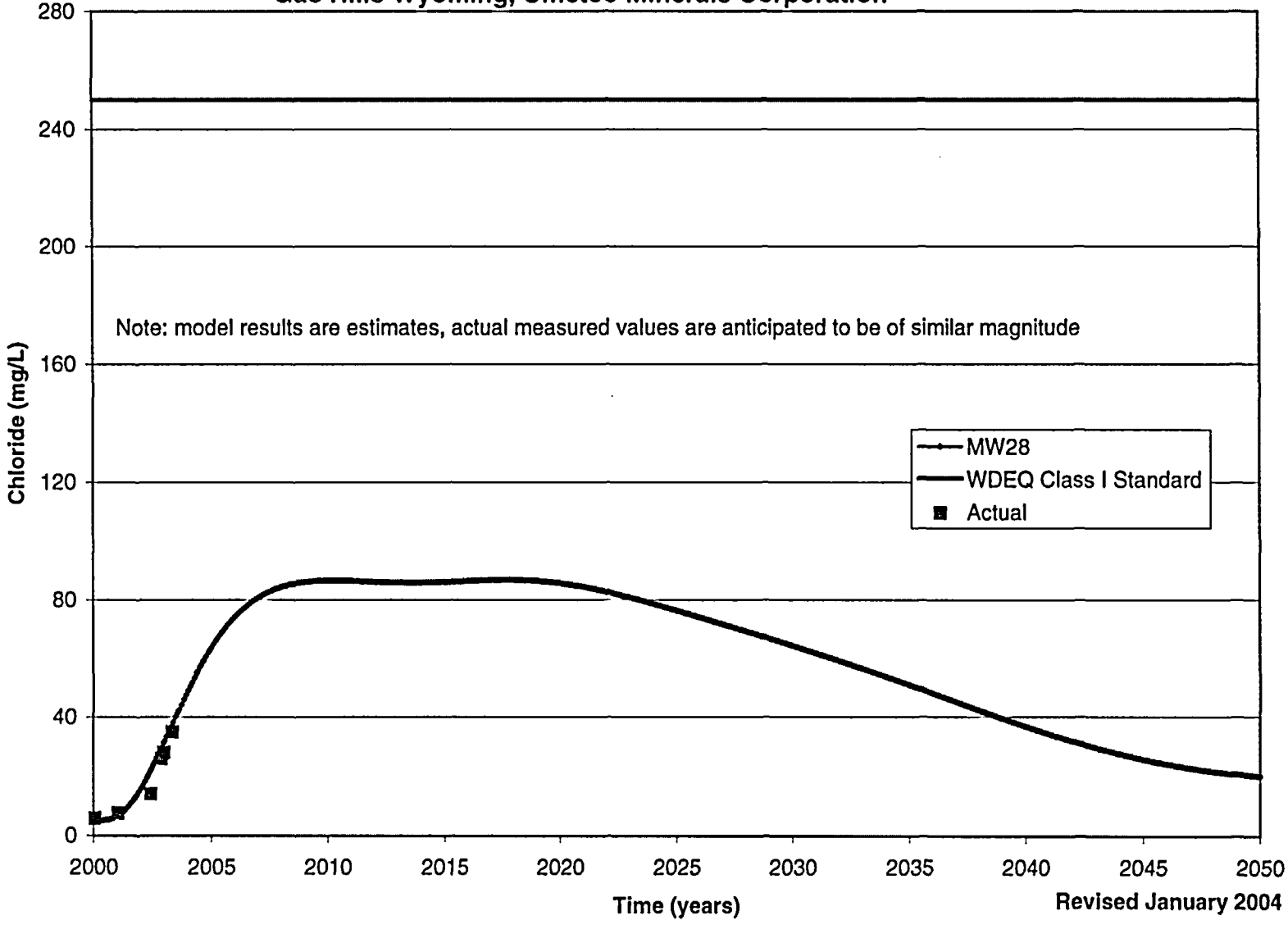


Figure 2a. Simulated Chloride Trends at MW28 (10 Years)-Western Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation



Revised January 2004

Figure 2b. Simulated Chloride Trends at MW28 (50 Years)-Western Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation



Revised January 2004

Figure 3a. Simulated Chloride Trends at MW72 (10 Years)-Southwestern Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation

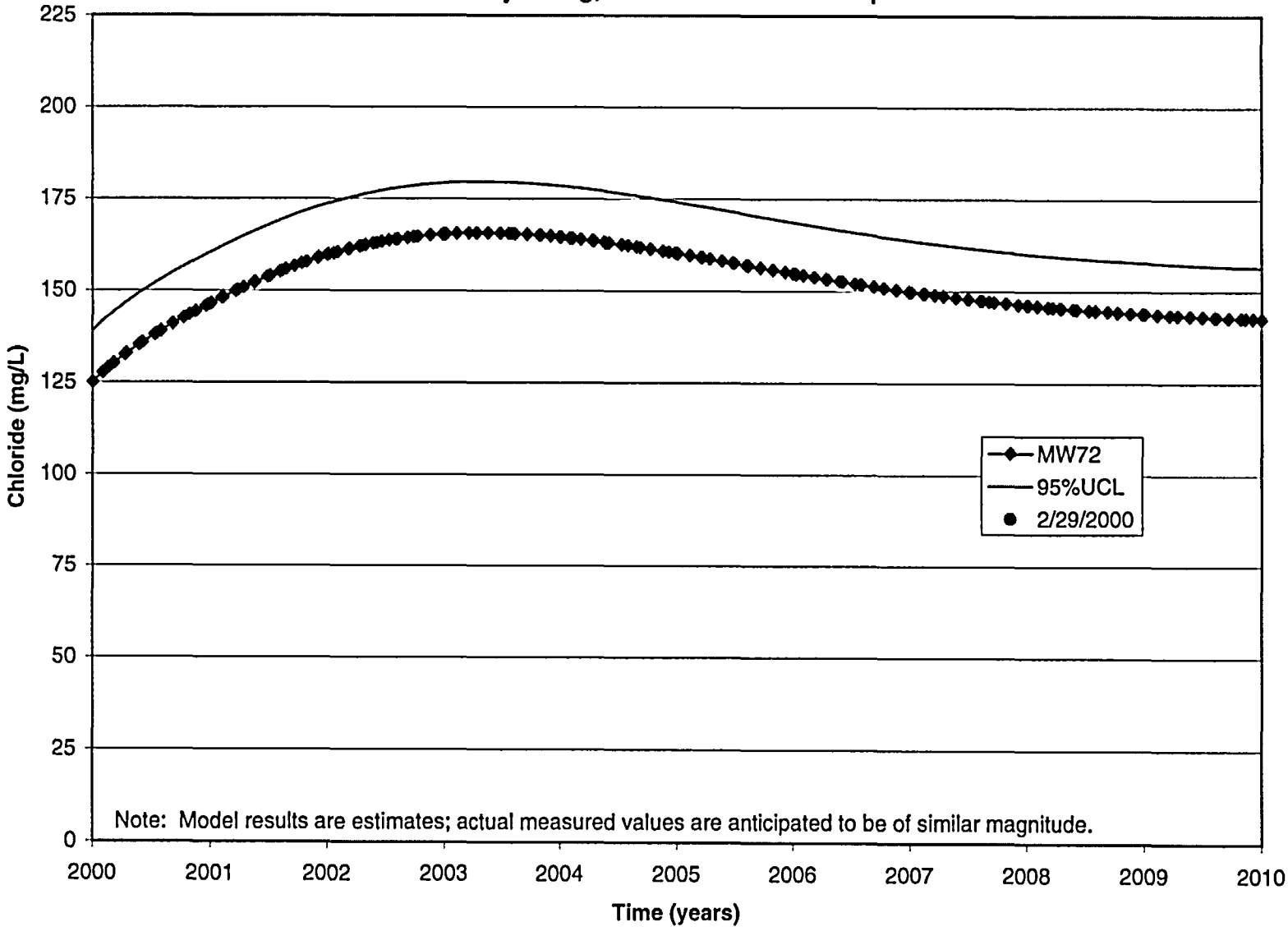


Figure 3b. Simulated Chloride Trends at MW72 (50 Years)-Southwestern Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation

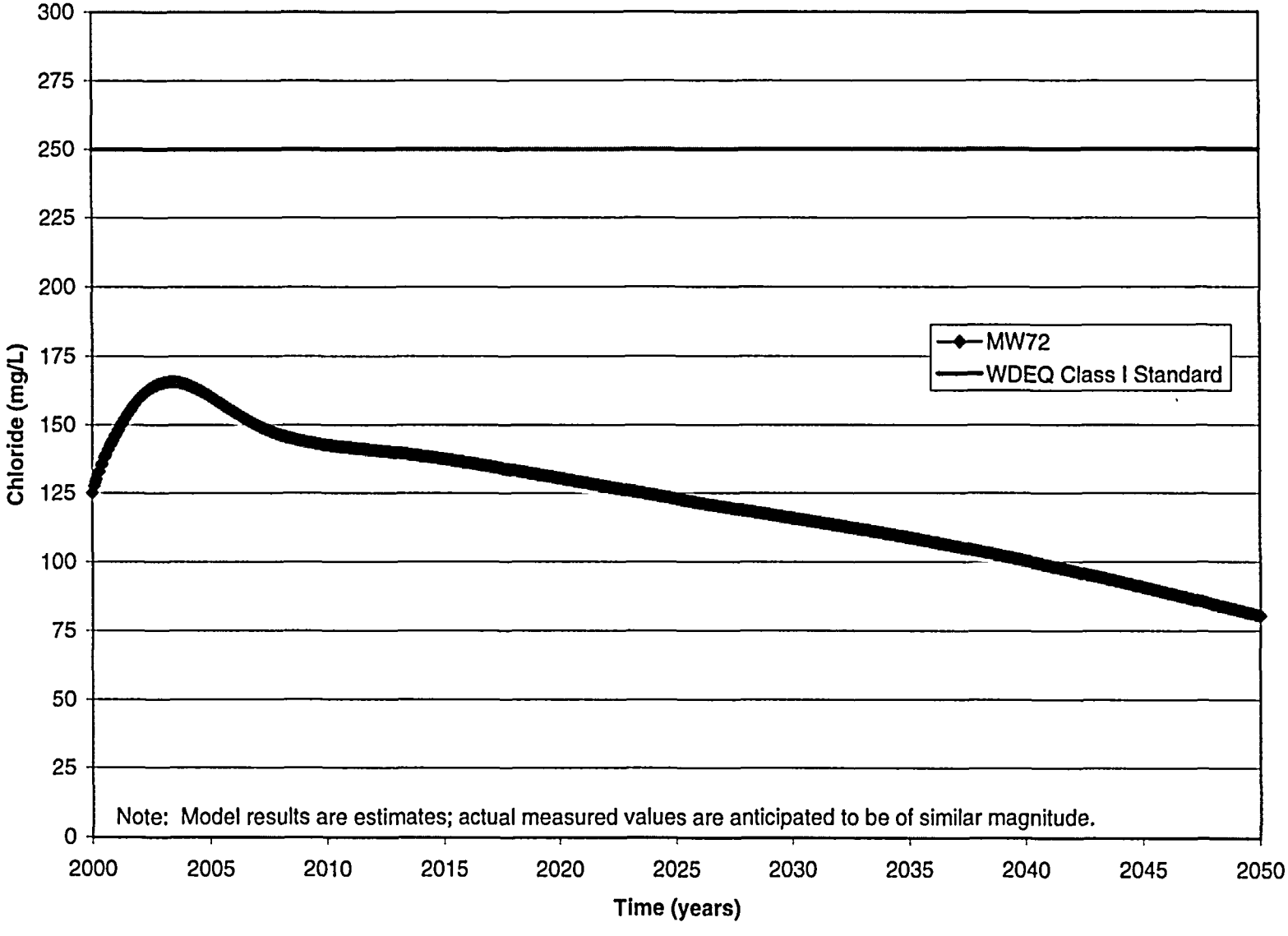


Figure 4a(r). Simulated Chloride Trends at MW82 (10 Years)-Southwestern Flow Regime Gas Hills Wyoming, Umetco Minerals Corporation

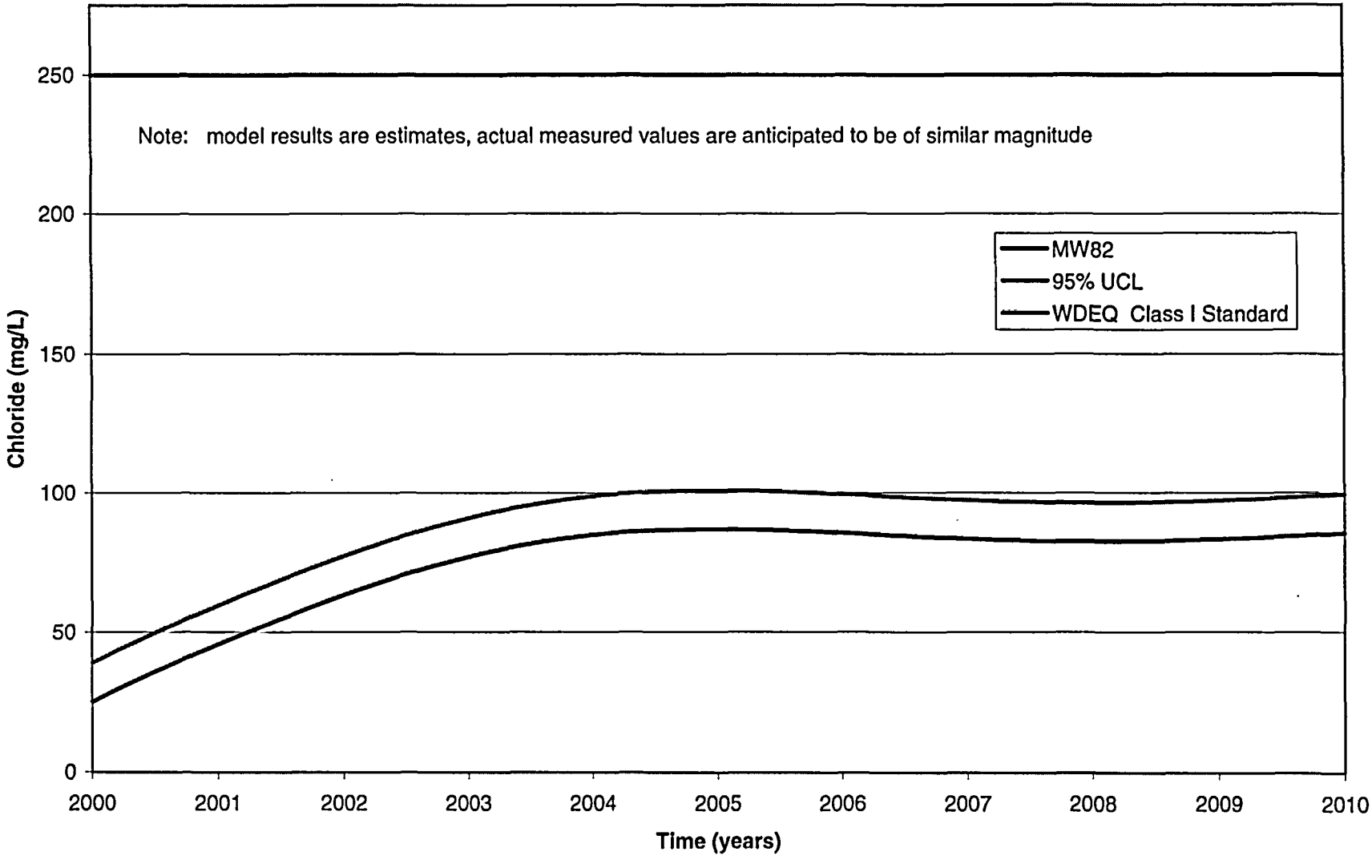


Figure 4b(r). Simulated Chloride Trends at MW82 (50 Years)-Southwestern Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation

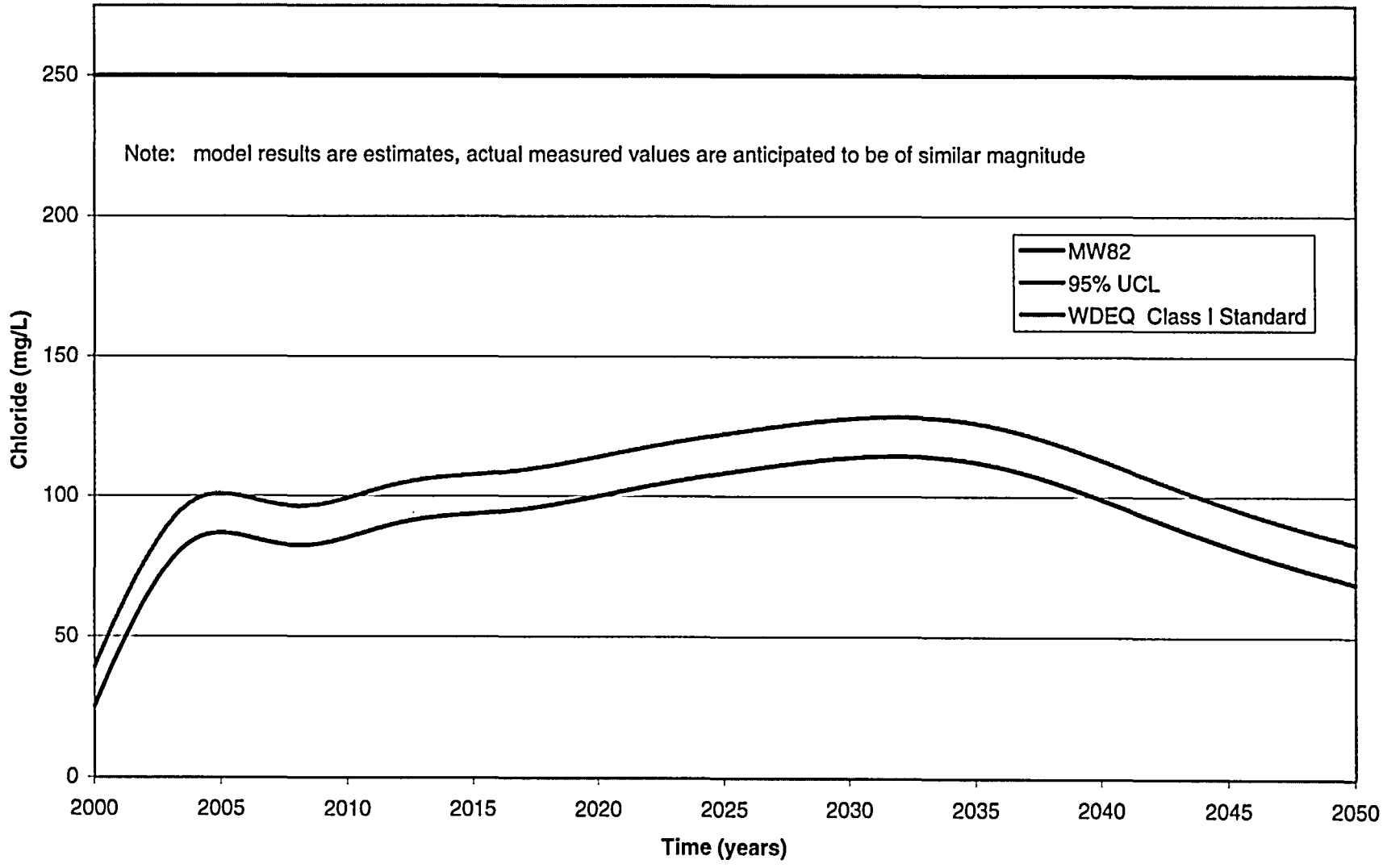


Figure 5a. Simulated Sulfate Trends at MW71B (10 Years)-Western Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation

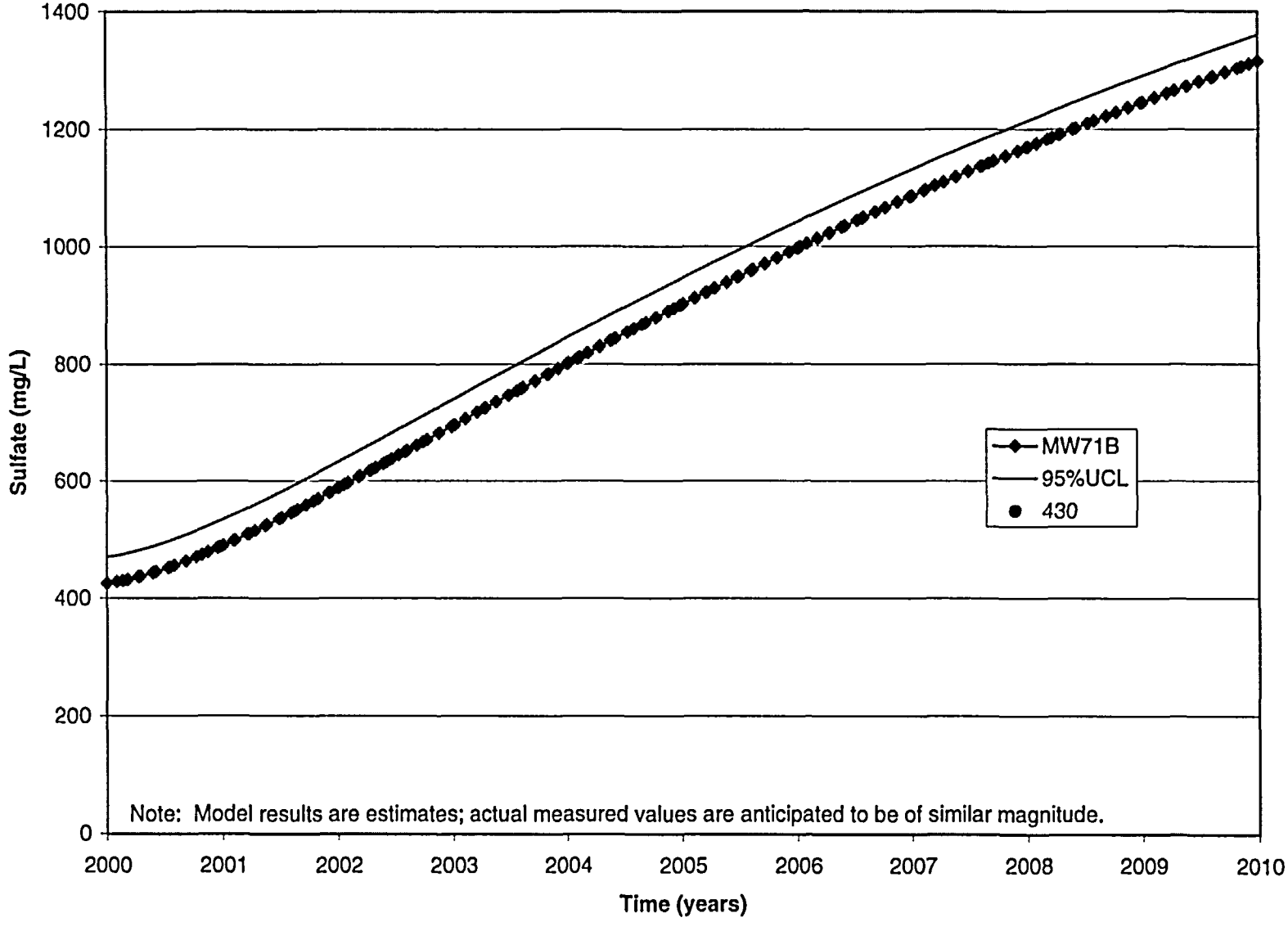


Figure 5b. Simulated Sulfate Trends at MW71B (50 Years)-Western Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation

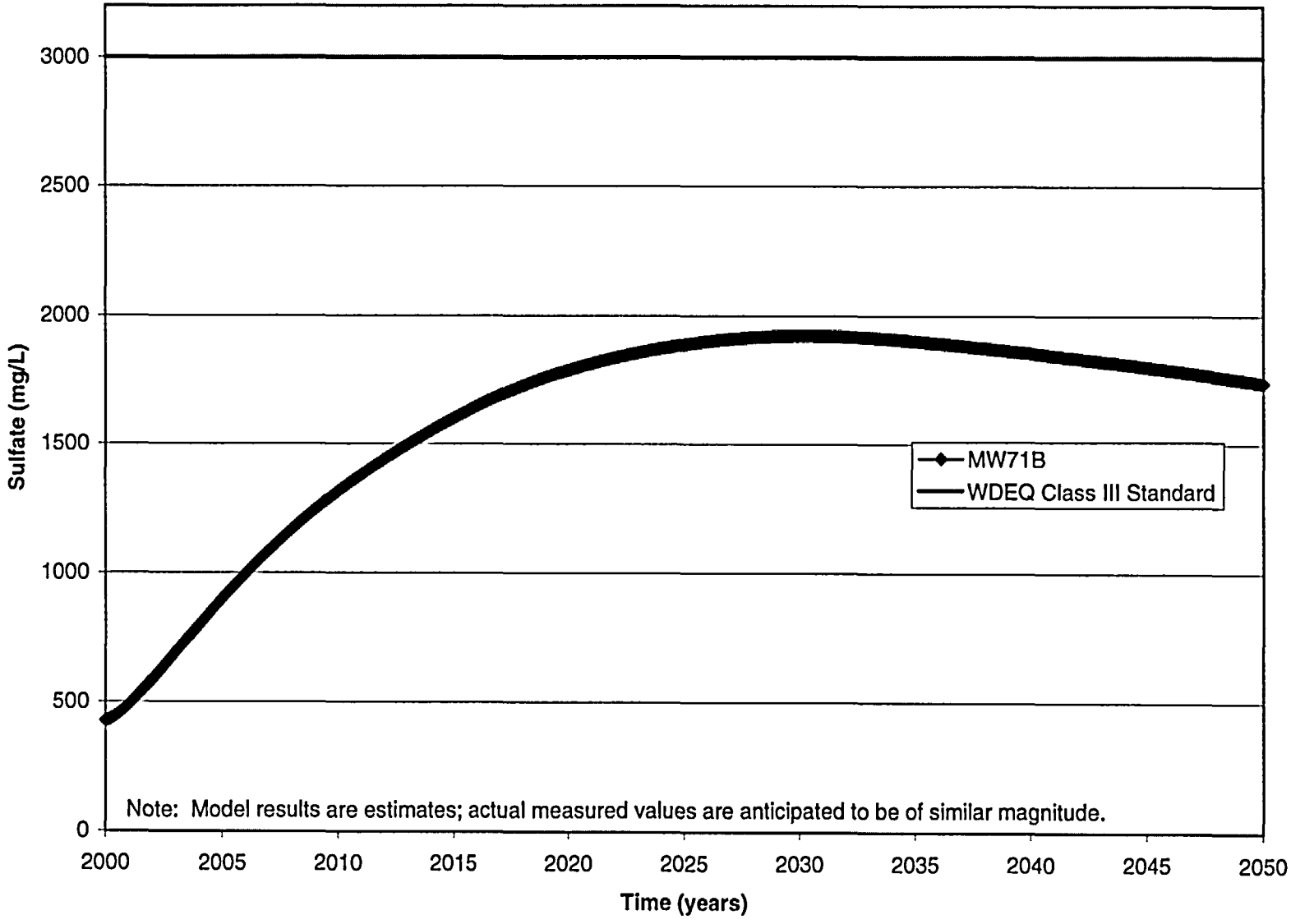
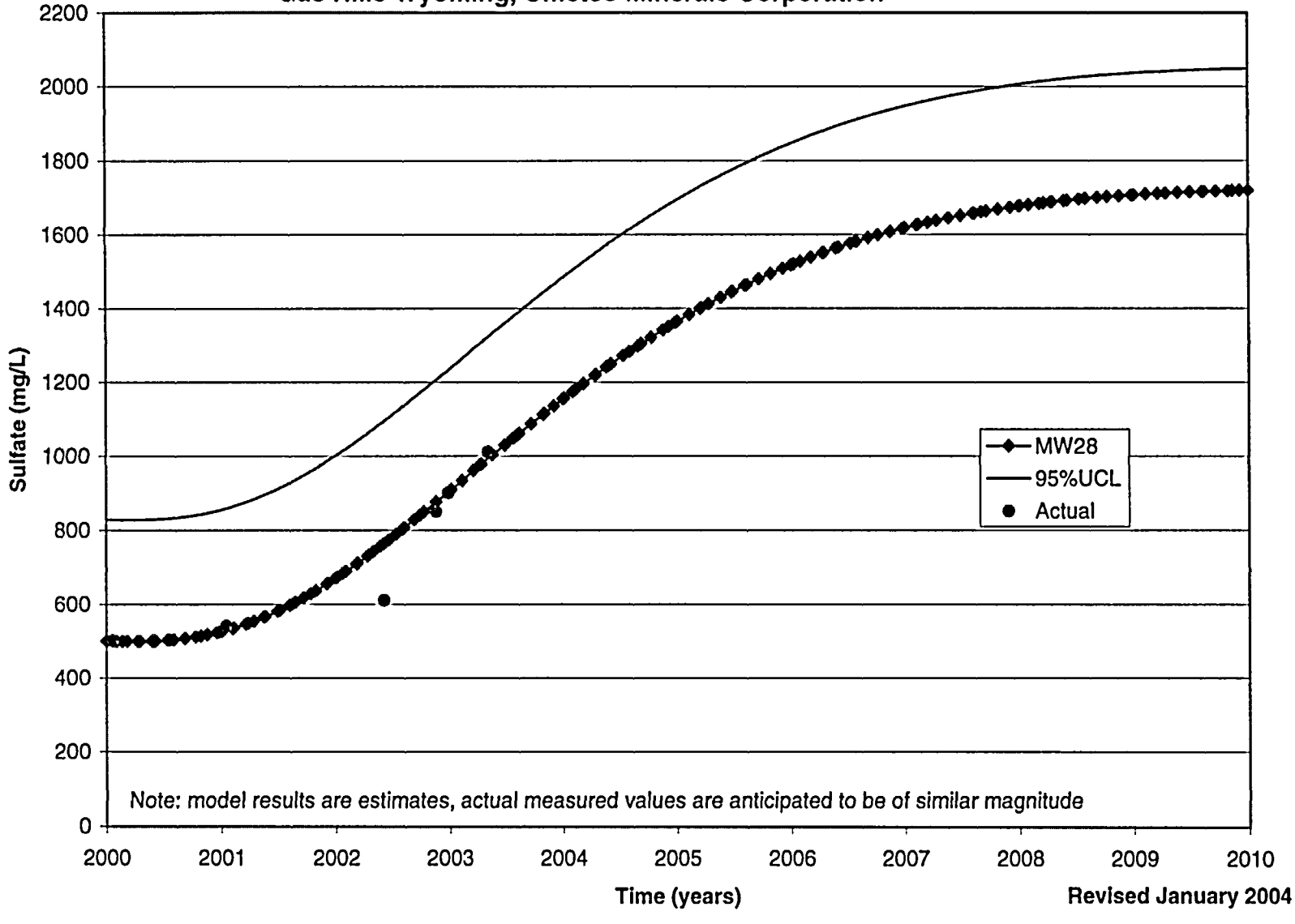
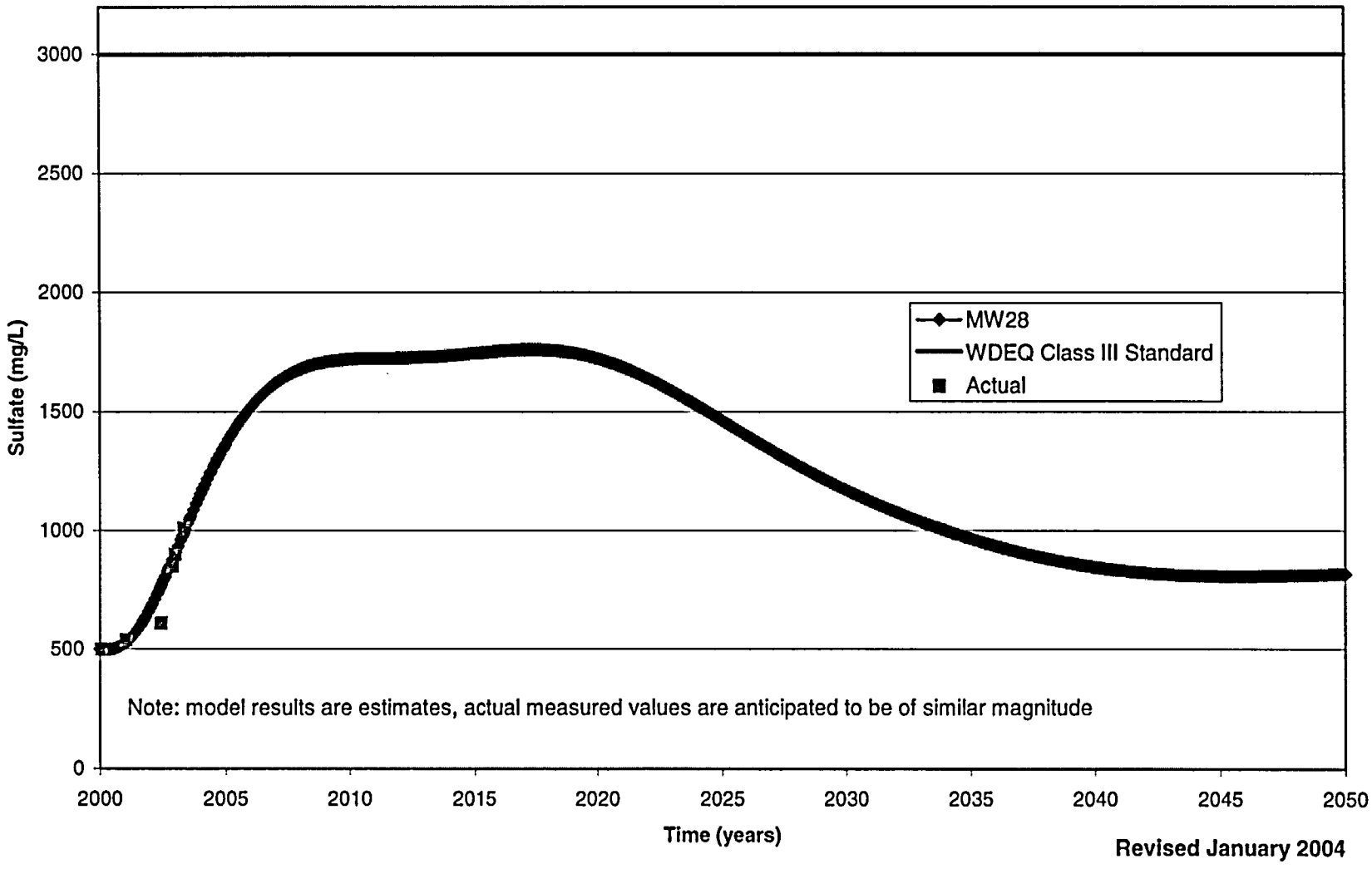


Figure 6a. Simulated Sulfate Trends at MW28 (10 Years)-Western Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation



Revised January 2004

Figure 6b. Simulated Sulfate Trends at MW28 (50 Years)-Western Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation



Revised January 2004

Figure 7a(r). Simulated Sulfate Trends at MW82 (10 Years)-Southwestern Flow Regime Gas Hills Wyoming, Umetco Minerals Corporation

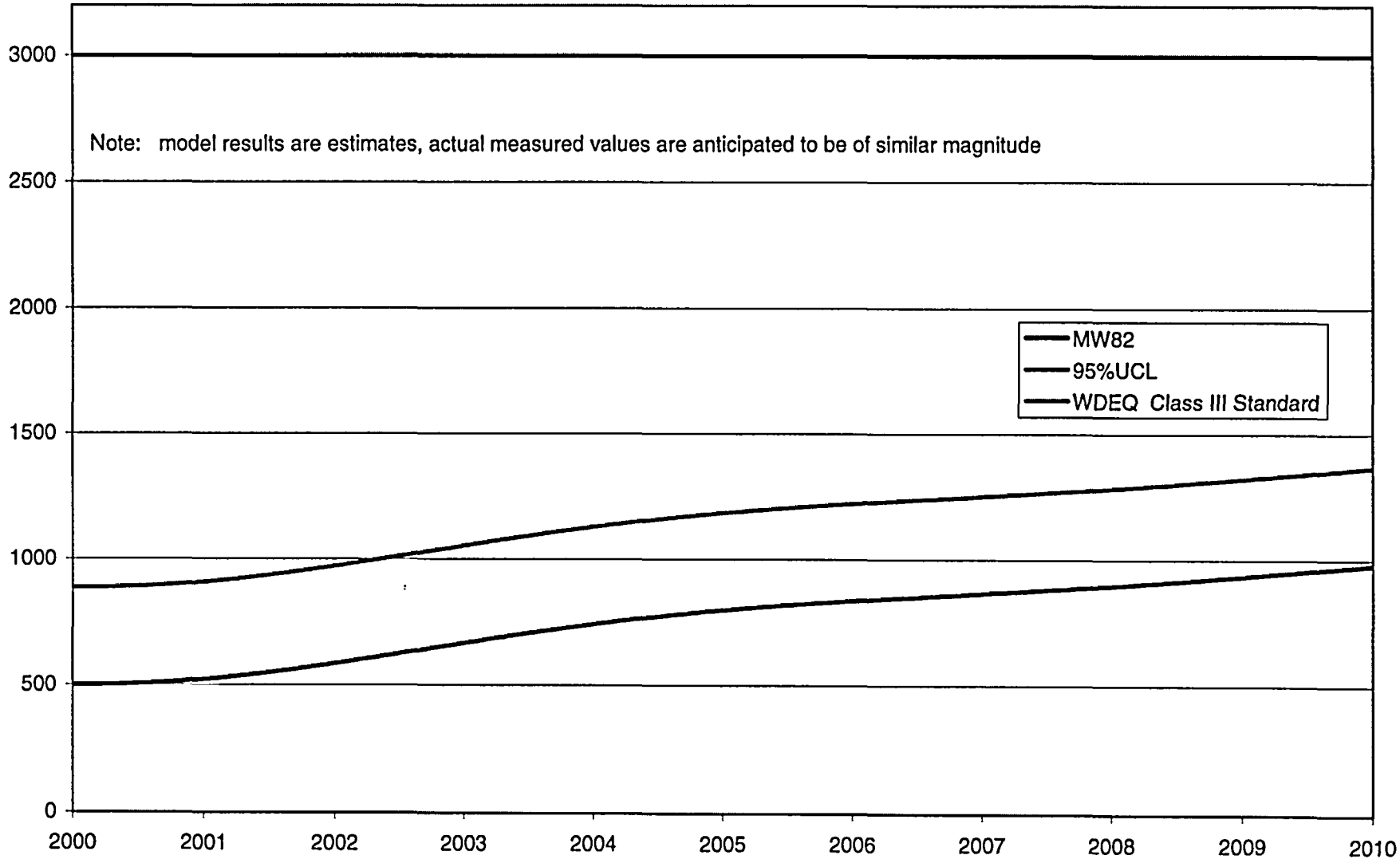


Figure 7b(r). Simulated Sulfate Trends at MW82 (50 Years)-Southwestern Flow Regime Gas Hills Wyoming, Umetco Minerals Corporation

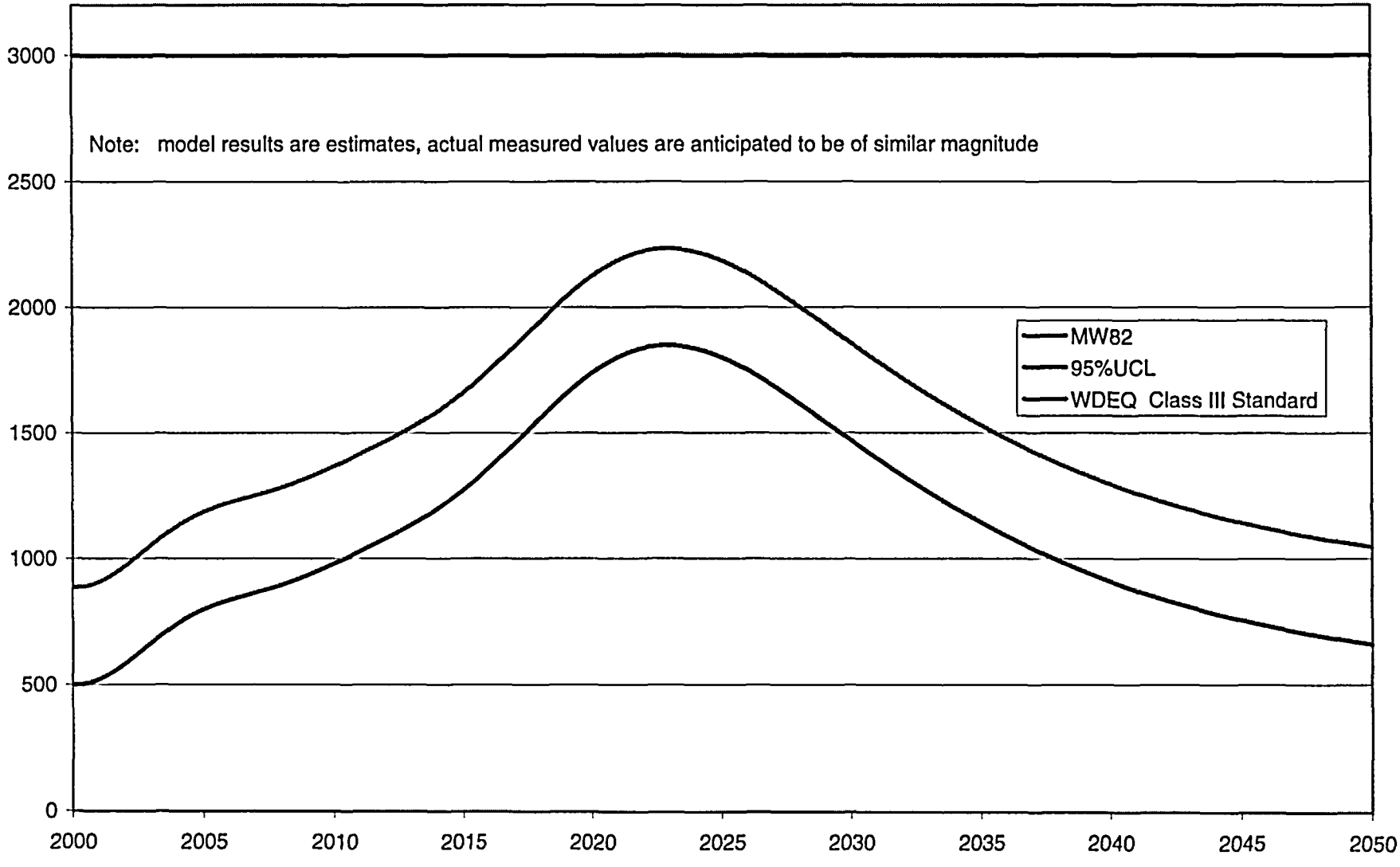


Figure 8a. Simulated Sulfate Trends at MW72 (10 Years)-Southwestern Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation

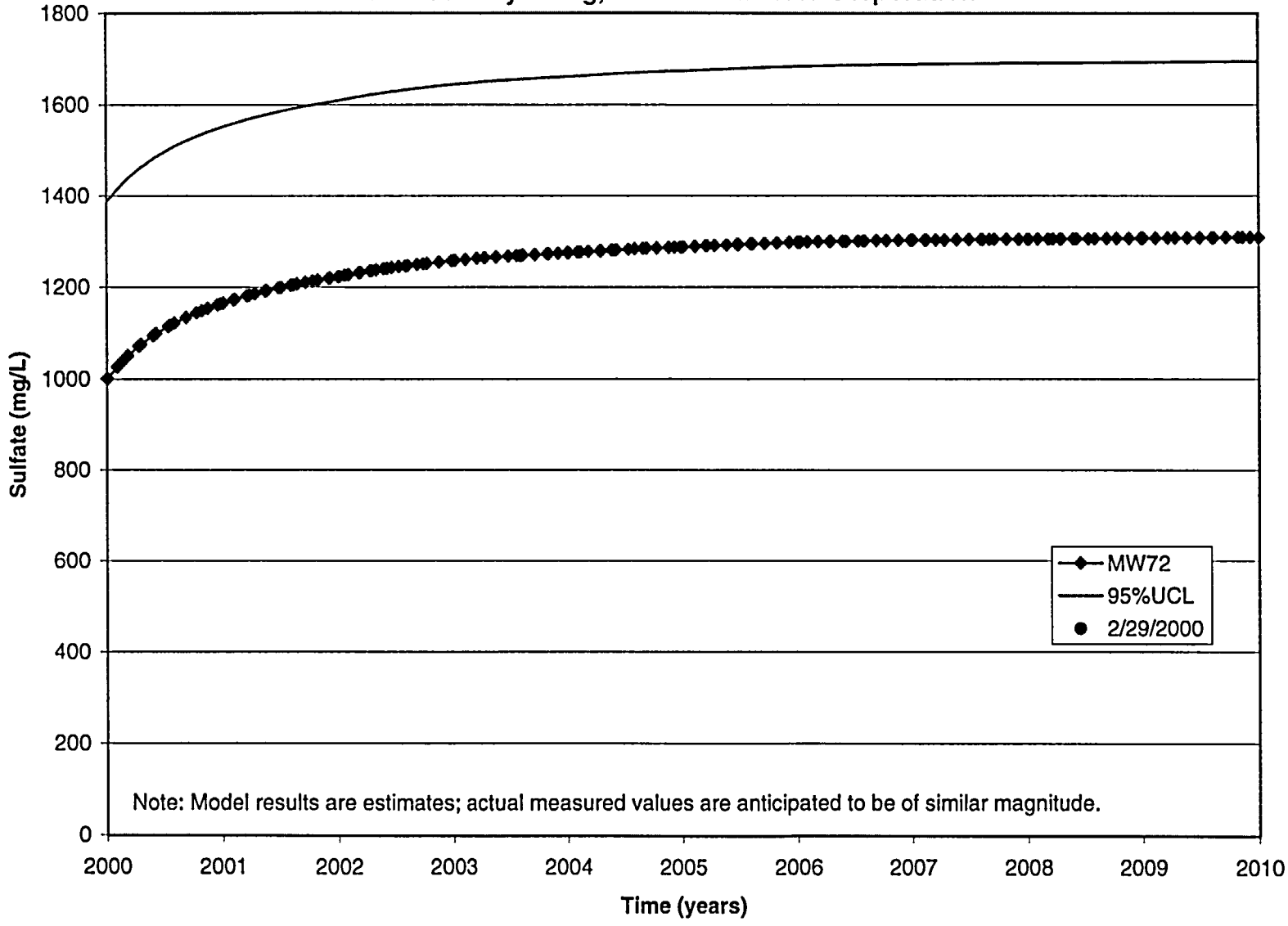
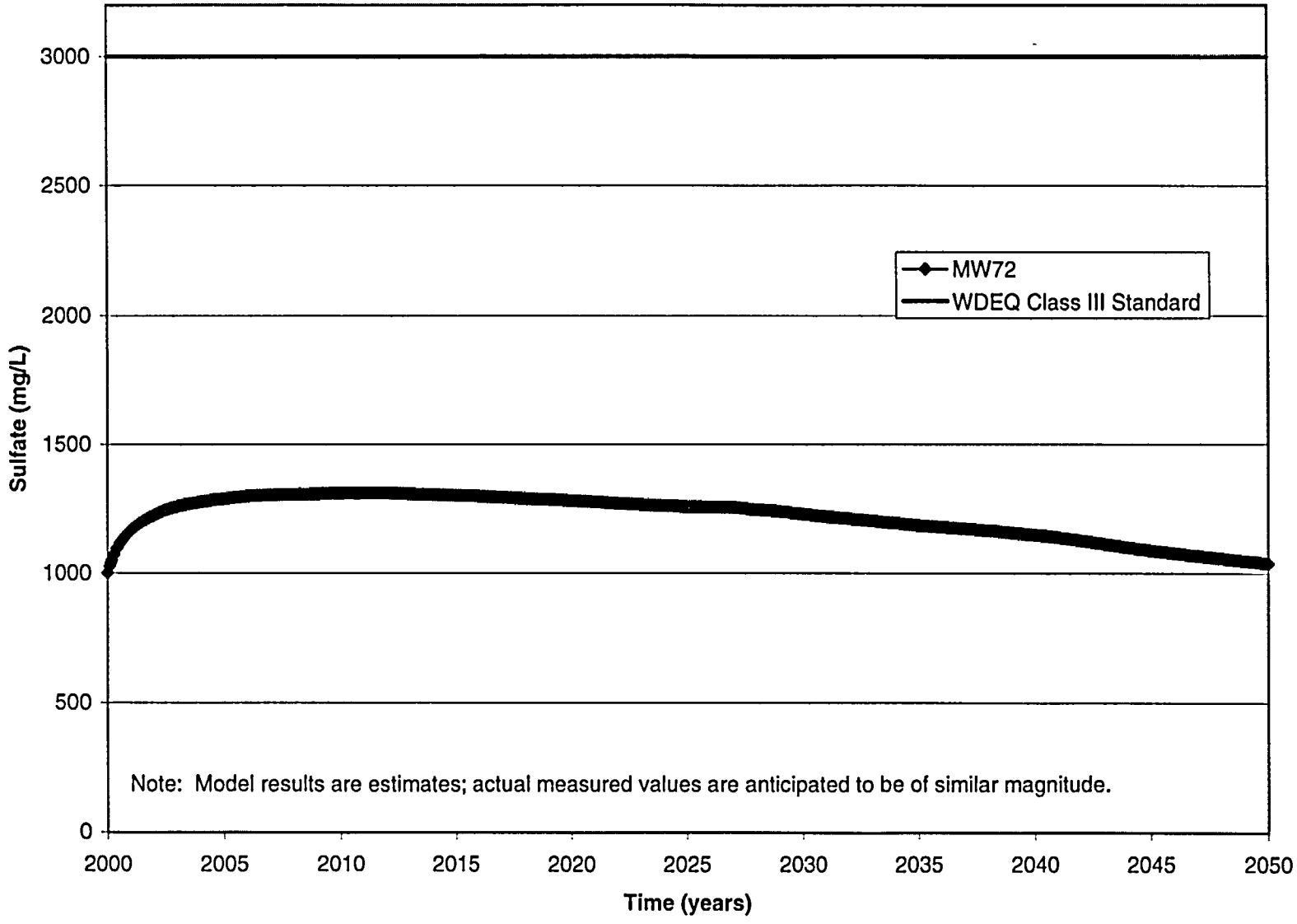



Figure 8b. Simulated Sulfate Trends at MW72 (50 Years)-Southwestern Flow Regime
Gas Hills Wyoming, Umetco Minerals Corporation