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YOUR REFERENCE 1626C
OUR REFERENCE EVALUAT3

November 23, 1998

Anthony J. Thompson
Shaw, Pittman, Potts, & Trowbridge
2300 N Street, N.W.
Washington, D.C. 20037-128

Re: Evaluation of Potential for Tailings Cell Discharge - White Mesa Mill

Dear Mr. Thompson:

In response to your request, we have conducted an evaluation of tailings cell performance at the White Mesa Mill of your client, International Uranium (USA) Corporation (IUC). This independent review was commissioned to analyze the potential for discharge of tailings water from this facility. Our evaluation has included the following:

1. Review of tailings cell construction,
2. Review of liner leakage monitoring,
3. Modeling of hypothetical discharge of tailings water from Cell 3, and
4. Extrapolation of Cell 3 modeling to Cells 1 and 2.

This evaluation indicates that no discharge of tailings water to the underlying perched water zone in the Burro Canyon Sandstone is likely to occur during the operational life of the cell. Reclamation of tailings would eliminate the potential for future discharge. Should the cells be reclaimed with retained water, our modeling indicates that discharge to the perched water zone is not possible for approximately 1,300 years after closure. Even then, discharge of chemical constituents is not likely due to microfiltration by the low permeability liner and attenuation in the vadose zone.

We hope that this review proves beneficial in evaluating your client's standing with regard to the potential for discharge of tailings water. Please call if we can be of further assistance.

Sincerely,

KNIGHT PIÉSOLD LLC

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Project Engineer

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Tailings Cell Construction

Facility Summary

The White Mesa Mill has constructed four below-grade tailing disposal cells. These cells are summarized by the following:

1. Cell 1 is constructed with a 30-mil PVC liner covered with earthen material. This cell was completed in 1981 and is used for the evaporation and storage of process solution.
2. Cell 2 is constructed with a 30-mil PVC liner covered with earthen material. This cell was completed in 1980 and is used for the storage of barren tailing sands. This cell has received an interim cover and presently receives no liquid effluent from the mill.
3. Cell 3 is constructed with a 30-mil PVC liner covered with earthen material. This cell was completed in 1982 and is used for the storage of barren tailing sands and associated solution.
4. Cell 4 is constructed with a 40-mil HDPE liner. This cell was constructed in 1990 and presently receives no tailings from the mill. Tailing solution was initially stored in this cell but was later removed. A detailed analysis of liner performance will be conducted prior to any process use of this cell.

Foundation Conditions and Excavation

The cells have similar foundation conditions, namely, variable thickness of cohesive clay (ML to CL) overlying sandstone and claystone bedrock. Cells were excavated into the bedrock, but cell dikes incorporated in-situ soils unless they were found to be calcareous. Some calcareous soils in the vicinity of Cells 1 and 2 were excavated for this reason and replaced with non-calcareous soil. The soil excavated to form the cell bases was generally used in dike construction.

In general, bedrock was excavated by ripping and dozing to design grade, although some hard zones were encountered in all cells. The rock was excavated to a final surface that slopes toward the midpoint of the downslope (south) dike in each cell. After the last bedrock lift was excavated, large rock fragments and claystone were removed from the underlying surface; other fragments down to coarse sand were left in place for construction of the liner bedding layer.

Dike Construction

Dikes were constructed of cohesive (ML, CL) soils. D'Appolonia (1982a) reports that the soil was placed and compacted in lifts to at least 90% Modified Proctor dry density, or at least 115 pcf. Cohesive soils compacted to this dry density have substantial strength, low permeability, and essentially no liquefaction or settlement potential. Test results in D'Appolonia (1982a) show 1.9% maximum volume change in consolidation tests with acid pore liquid, demonstrating that these soils are not susceptible to weakening and collapse in the event of liner leakage. Harrison and Abt (1980) state that QC field density testing was performed frequently, averaging once per 1,000 cubic yards (cy). This frequency exceeds NRC requirements as stated in the construction specifications. Fill that failed testing was reworked and retested until it passed. This observation is confirmed by

D'Appolonia (1982a, Appendix B) for dikes for cells 1, 2, and 3. All inspections by Abt (1980)reported no deficiencies in construction or QC practices or results. The records provide high confidence that these dikes were well constructed and should remain intact under any failure or leakage scenario likely to be encountered at the White Mesa Mill site.

Base Preparation and Bedding

The cell bottoms were prepared for liner installation by crushing, then compacting, the last lift of ripped rock, less claystone and large sandstone blocks. The final excavated rock surface, on both the cell bottom and the slopes excavated in rock, was picked free of loose +6-inch rock fragments so that no rock protruded more than four inches above the general level of excavation. The small broken rock was ripped, then crushed to a consistency of sand using compactors. This material was placed on top of the remaining rock and rolled by a smooth-drum compactor until the surface was free of fragments protruding above the rolled surface, as documented by visual inspections by all parties (D'Appolonia, Energy Fuels Nuclear, and Goodrich or Watersaver) and photographs recorded in D'Appolonia (1982a) and Energy Fuels Nuclear (1983). The finished bedding, which covers rock surfaces on both the cell bottoms and side slopes, has a maximum size of 1.0 inch, less than 20 % clay, and gradations (D'Appolonia, 1982a; Fig. 13) consistent with a well graded medium to coarse sand. The bedding material conforms to the specifications for this material in the design (D'Appolonia, 1981). Cell 4, constructed of HPDE in 1990, was furnished with a 1-foot layer of clay underlying the HDPE.

Underdrain System

The underdrain system consists of a 12-inch sand drain on the inslope of the south dike of each cell, with a 3-inch diameter slotted PVC pipe buried in the downslope end of the sand drain connected to a Driscopipe riser that connects to the top of the inslope. During construction some modifications were made in the pipe connections to facilitate construction. The underdrain system was designed to intercept and bleed off any moisture that might penetrate the liner on the downstream (south) dike of each cell.

Although this system was originally intended to ensure that the dikes would not become saturated with acidic solution that would compromise their structural integrity, the underdrain is also hydraulically connected to the liner bedding, which is in direct contact with (directly underlies) the 12-inch thick sand drain of the underdrain system along the south inslope of each cell. Therefore, there is also direct hydraulic connection between the liner bedding layer and the 3-inch PVC pipe in the underdrain system, making the underdrain system also a leak detection system for the entire liner. A more extensive underdrain was incorporated into Cell 4 construction. However, Cell 4 is not in use and will not be modeled in this review.

Liner

The liner for cells 1, 2 and 3 is 30 mil PVC supplied and installed by B.F. Goodrich for cells 1 and 2 and Watersaver Company for cell 3. D'Appolonia (1982a) and Energy Fuels Nuclear (1983) have documented that liner materials supplied by these companies met or exceeded specifications. These reports also contain descriptions of ground preparation and daily inspections of the bedding surfaces prior to installation, pointing out that the liner installation contractor had to be satisfied with the surface before liner was installed.

D'Appolonia (1982a, Appendices C and D) and Energy Fuels Nuclear (1983, Appendices B and C) document the seaming procedures used to join liner panels as well as the results of field and laboratory tests performed on the liner seams. Additional documentation on liner installation and test results is contained in Harrison and Abt (1980), Goodrich General Products Division (1980), and D'Appolonia, (1980). The records contained in these documents demonstrate that QC protocols for assurance of liner material quality and installation were followed rigorously. This record establishes the basis for high confidence that the liner was installed correctly and would, therefore, be expected to function as designed.

Liner Cover and Slimes Pool Drain System

The liner was covered with 12 to 18 inches of qualifying (non-calcareous) soil in which a slimes pool drain system was installed in cells 2 and 3. The original design called for the liner cover to consist of coarse tailings; however, insufficient volume of coarse tailing was available early enough to construct the liner cover entirely of this material, so other qualifying soil was used in liner cover locations where no slimes pool drain pipes were installed. A graded sand was used to fill over and around the slimes pool drain pipes in Cell 2. Coarse tailings were used as pipe bedding material for all other cells. This drain system, intended to facilitate dewatering of fine tailings (slimes), consisted of a rectangular grid of slotted PVC pipe wrapped in Mirafi 140 filter cloth and connected to a Driscopipe riser at the middle of the south dike of each tailing cell, the low point in the cell bottom. The design is documented in D'Appolonia (1981). The actual grid pattern of pipes installed in Cell 3 (Energy Fuels Nuclear, 1983, Figure 4) differed from the design (D'Appolonia, 1981, Sheet 3) to better ensure gravity flow to the riser location.

Monitoring Plan

The monitoring plan (D'Appolonia, 1982b) covers inspection of operations, training of personnel, supervision, lines of communication and responsibility, and documentation relating to design, construction and operations of the tailings cells. It was prepared in recognition of the fact that diligence should not end at the end of construction but continue during operations. It calls for inspections to be performed at regular intervals, ranging from daily to yearly.

Daily Inspections are to be made of each active tailing disposal area, the slurry pipeline (including slurry flow and line pressure) and slurry discharge location, the evaporation pond (Cell 1), and the sump and drain systems. Three levels of response are defined, classified according to the urgency of the required response.

Weekly inspections include pond surface elevations, flow in sump and drain lines, and liquid levels in underdrain risers.

Monthly inspections are conducted of the surface water diversion and retention structures, and the pipeline is surveyed for wear (erosion of wall thickness) using ultrasonic methods.

Quarterly inspections are made of emergency spillways and post-construction changes outside the disposal area. A review of operating and maintenance procedures is also conducted.

Yearly inspections include surveys of the dike crests and slopes, technical evaluation of inspection reports, and a summary of inspection observations.

This monitoring plan provides regular, timely examination of the key indicators of cell and liner function assuring that leaks substantial enough to saturate the bedding layer will be detected under this program during the daily or weekly inspections.

Leak Detection System Monitoring

History

The uranium tailings cells (numbers 1, 2 and 3) were built in the early 1980's. Since the inception of their operation, there has been no indication that cells were or are discharging tailings liquid to the leak detection system or underlying aquifer. Also site records indicate that operators of the White Mesa Mill have followed inspection protocols requiring inspections of all tailings cell leak detection risers. Data reviewed by Knight Piésold indicate that there has been no detection of water in either of the LDS sumps from Cells 1 or 3. However, water was encountered during the construction of the Cell 2 LDS sump. Additional water was later detected in a previously dry Well 7-2, in June of 1980. This well was located between the Cell 2 Dike and the Cell 3 Safety Dike in an area which would later become the floor of Cell 3.

An October 1980 monthly report indicated that the water quality of Well 7-2 was similar to that of the Fly Ash Pond. In December 1981 water was detected in the Cell 2 LDS sump. After laboratory analysis this water was once again determined to be unrelated to tailings liquids. Subsequent analyses throughout the 1980s continued to corroborate that the LDS for Cell 2 was intercepting ponded waters in the Fly Ash Pond. Therefore, although some waters are being collected by the Cell 2 LDS, several years of analyses and evaluations support the conclusion that no tailings cell leakage has been detected in any of the LDS sumps for Cells 1, 2, or 3.

In August 1989, Umetco proposed a Detection Monitoring Program which was incorporated into the pre-1997 license conditions. These conditions originated from the desire to detect any statistically significant trends which would indicate that tailings liquids are present in the Cell 2 LDS sump. Although this procedure is applicable to all cells, at no time has water been detected in the LDS sump of either Cell 1 or 3. This program is summarized as the following:

1. Leak Detection Systems are to be checked weekly for presence of liquids. Any liquids found are to be removed.
2. Determination of "significant leakage" will trigger increased sampling frequency from selected compliance monitoring wells. Significant leakage was defined as flow greater than one gallon per minute. Should flows exceed one gallon per minute, an automatic pumping system would be installed.
3. Leakage would be analyzed and evaluated for statistically significant trends. Should this evaluation indicate that water removed from the LDS was originating from the lined facility, Umetco would characterize the extent and degree of contamination and report to the NRC. However, should water removed from the LDS originate from other sources (i.e., Mill Area Sedimentation Pond) no additional work would be required.

Present Condition

The 1997 license renewal modified the detection monitoring program to evaluate the chemical characteristics of any water found in the LDS, thus focusing the program on chemical analytes. International Uranium Corporation requested (January 9 and February 26, 1998) that the program be restored to the pre-1997 permit conditions which included an evaluation of flow rate as well as analytes. Such a program is more likely to detect leakage through a damaged liner than consideration of chemical analysis alone. The NRC concurred (1998) and issued an amended materials license in 1998 restoring the intent of the pre-1997 conditions. Although the amended materials license varies slightly from conditions proposed by Umetco in 1989, these variations are minor and do not change the overall monitoring program as outlined in the previous section.

Modeling of Potential Volumetric Flux

Purpose

This section assesses the hypothetical volumetric flux from tailings Cell 3 at White Mesa Mill. Modeling of Cell 3 was determined to be the most conservative case to model as its saturated depth and area are much greater than those of Cells 1 or 2, hence, the liner in the Cell 3 is under greater stress than in the remaining cells. This modeling assesses the quantity of potential volumetric flux through the liner of Cell 3 as well as the effect such flux might cause upon underlying strata. Results of these analyses for Cell 3 were extrapolated to Cells 1 and 2.

Background and Scope

Tailings Cell 3 was constructed in 1982 in accordance with the standards and requirements of the U.S. Nuclear Regulatory Commission (NRC), which approved both the design and construction. As-built records of the Cell 3 facility indicate that it is lined with 30-mil-thick polyvinyl chloride (PVC) plastic underlain by a 6-inch (in) compacted soil layer, except along the south embankment where the PVC liner is underlain by a 12-in layer of sand drain material containing a 3-in diameter perforated plastic pipe. A generalized schematic of Cell 3 is shown on Figure 1. Monitoring of the drain material since construction of Cell 3 has indicated no detectable water in this embankment underdrain system. Cell 3 will be used for an additional two to three years and then will be reclaimed.

In the absence of any evidence of leakage occurring from Cell 3, hypothetical modeling to evaluate potential environmental effects if the leakage were to occur from this cell was performed. This section presents results of the following:

1. modeling of volumetric flux through the PVC liner of Cell 3 based on historical measured water levels in the cell provided by IUC;

2. modeling of water retention within the unsaturated zone between Cell 3 and a perched water zone approximately 110 feet beneath the cell; and

3. modeling of the rate of water movement in the unsaturated zone beneath Cell 3 and the time it would take for water to reach the perched water table under assumed future operating and closure conditions in Cell 3.

Volumetric Flux through Cell 3 PVC Liner Under Historical Operation

Unlike water flow through a porous soil, water transmission through a PVC liner can only occur because of vapor diffusion and density discontinuities (EPA 1988). The discontinuities may be present as pinholes and installation defects. Vapor diffusion involves the transmission of water vapor through the liner on a molecular scale and is controlled by the permeability of the liner, its thickness, and the pressure head on the fluid. Pinholes and installation defects could serve as passageways for liquids. The combined flow through the discontinuities and vapor diffusion is henceforth termed volumetric flux.

The passage of water through a liner also is dependent upon the thickness and hydraulic conductivity of the materials immediately above and below the liner. Giroud and Bonaparte (1989) provide procedures for calculating flux rates through liners, taking into account the characteristics of the materials above and below the liner, potential installation defects, as well as the available hydraulic head on the liner. The total volumetric flux across the liner calculated in this review includes potential flux from vapor diffusion across the intact liner, flux through pinholes, and flux through the installation defects. Giroud and Bonaparte (1989) indicate that typical geomembrane liners have about 0.5 to 1.0 pinholes per acre from manufacturing defects. Additionally, good to excellent liner installation results in less than 1 defect per acre. To be conservative, the flux rate analyses in this review assume 1 pinhole and 2 defects per acre. Review of model results indicates that pinhole and defect flux rates are a minor factor in the calculation of total volumetric flux through the liner.

Volumetric flux through the Cell 3 liner was calculated in three parts due to the geometry and the underlying compacted soil/drainage layers; 1) flux through the south dike liner, 2) flux through the three remaining dike liners, and 3) flux through the cell bottom liner. The flux rates for these three were multiplied by their respective liner areas to give a total volumetric flux through the Cell 3 liner. The Cell 3 PVC liner equivalent hydraulic conductivity was taken from liner data published by the U.S. Environmental Protection Agency (EPA, 1988).

The total flux rate and the associated volumetric flux, based upon effective liner areas, were used to calculate the volume of water which would enter and be retained by the underlying unsaturated zone, as well as the time for the unsaturated zone to reach a water content which would begin to initiate unsaturated flow downward toward the perched water table. Figure 2 presents a time series of the historic Cell 3 water-surface elevations and also shows the calculated volumetric flux rates through the liner for those water-surface elevations.

Average Cell 3 water-surface elevation during the 190-month periods of record was 5,595.57 ft above mean sea level (famsl), with a minimum and maximum elevation, respectively of 5,580.23 and 5,605.41 famsl. These water surface elevations were used to calculated the hydraulic heads acting on the liner.

Based upon the calculated flux rates shown on Figure 2 and the liner areas over which they apply, the total volumetric flux across the Cell 3 liner is estimated to have averaged 50 ft^3/d over the 190-months. Figure 3 shows the cumulative volumetric flux of water that could have passed across the Cell 3 liner since January 1983. This volume is approximately 290,000 ft^3. Of this volume, approximately 79 percent is from vapor diffusion across intact liner surfaces, less than 1 percent is from hypothetical pinholes, and approximately 20 percent is from potential installation defects. Clearly, a majority of the seepage across the Cell 3 liner is from vapor diffusion across the intact liner surfaces.

This hypothetical flux is very low and equates to less than 5 gallons per acre of liner per day (gpad). Acknowledging that vapor diffusion through PVC liners occurs, the Environmental Protection Agency (EPA) recommends that liner seepage be limited to *de minimis* quantities. This term refers to the insignificant quantity of water vapor that may permeate a PVC liner. Although this rate is calculated for site-specific conditions, EPA has proposed that 5 to 20 gpad is representative of a liner installed with a high level of quality assurance (EPA, 1988). Our estimated flux rate, including potential installation defects, is less than 5 gpad and is indicative of a well-constructed, functional PVC liner.

Water Retention in the Unsaturated Zone Beneath Cell 3 Under Historical Operation

In unsaturated materials the pores are only partially filled with water, with the remaining pore space usually occupied by air. Additionally, unsaturated flow can occur only if enough of the pore volume has water in excess of moisture retained in storage by the forces of attraction. This threshold volumetric water content is called "specific retention" and is the water content at which essentially no water moves downward under gravity flow.

In the Dakota Sandstone and Burro Canyon formations underlying Cell 3, the rocks are unsaturated for a depth of 110 ft, until a perched water-bearing zone in the Burro Canyon Formation is encountered. Data published by Titan Environmental (1994) indicate that within this 110-ft unsaturated zone the average water content of the rocks is less than the moisture retention. This means that some volume of water can be stored in the unsaturated zone before initiation of unsaturated flow by gravity. This ability to permanently store additional water and the configuration of the strata underlying Cell 3 are shown on Figure 4.

The documented volumetric water content of the 110-ft unsaturated zone in the Dakota and Burro Canyon formations is 3.4 percent. Because the specific retention for this same thickness is 5.5 percent, 2.1 percent by volume is available for water storage prior to downward unsaturated water movement (Titan Environmental, 1994). Applying this potential storage volume to the footprint of Cell 3 (an area of 3,375,913 ft^2, approximately 77.5 acres) results in a residual storage volume of about 7.8 million cubic feet for the 110-ft thick unsaturated zone.

Assuming that 2.1 percent residual water storage volume was available in January 1983, and the seepage from Cell 3 between January 1983 and present was approximately 290,000 ft^3, indicates that approximately 4 percent of the residual pore volume in the unsaturated zone could have been filled since Cell 3 began operation in January 1983. This means that an additional 7.5 million cubic feet of water would have to discharge from Cell 3 just to bring the average water content of the underlying Dakota and Burro Canyon formations to moisture levels adequate to initiate unsaturated downward flow.

Cell 3 will be used for an additional 2 to 3 years, at which time it will be capped and reclaimed. We have estimated the volumetric flux for the remaining years of operation by conservatively assuming that the water-surface elevation in Cell 3 would be at a constant maximum level of 5,603 famsl. At this elevation the volumetric flux rate from the entire Cell 3 would be approximately 80 ft^3/d or 0.4 gallons per minute (gpm). After that time, Cell 3 would be capped and reclaimed. Hence, volumetric flux of tailings water from Cell 3 would have resulted in no discharge of tailings solution to the underlying perched water zone during its operation life.

The time to bring the Dakota and Burro Canyon sandstones to a volumetric moisture content of 5.5 percent would occur far into the future after Cell 3 closure and reclamation if drainable liquids remained in the cell. Model results indicate that an additional 7.5 million ft^3 of residual storage would still be available to store future fluxes across the Cell 3 liner after closure and reclamation. Conservatively assuming that water remains in the cell and an effective cell cap eliminates the addition of water to the cell, the amount of liquids available for seepage would be limited to that which was in the Cell 3 tailings at the time of closure. We estimate that the tailings within the cell have a specific retention of 75% (Hoffman and Cellan, 1998 and Vick, 1990). Using this relationship we have modeled a decreasing saturated level within the tails after capping. Projections of future water surface levels and liner flux rates are shown on Figures 5 and 6. These data indicate that the residual storage in the underlying Dakota and Burro Canyon formation would be filled to a volumetric moisture content of 5.5 percent in approximately 400 years after Cell 3 closure and reclamation. After that time, additional volumetric flux from Cell 3 could begin to move downward toward the perched water table at a very slow rate determined by the unsaturated hydraulic conductivity of the underlying formation. At the inception of unsaturated flow, volumetric flux from the cell would be 34 ft^3/d (Figure 6), and would require approximately 900 additional years to reach the perched water table 110 ft beneath Cell 3. In summary, a total of 1,300 years would be needed for volumetric flux from Cell 3 to reach the perched water table after closure of the cell.

Water-Quality Implications of Liner Seepage

A majority of the potential flux from the cell would result from vapor diffusion through the intact liner. PVC liners do not appear to be permeable by ions with the possible exception of hydrogen (EPA 1988). Because of this, a majority of the seepage would have a water chemistry much lower in dissolved solids (virtually absent) than the water seeping through the liner via pinholes and installation defects.

Transmission of water through soil or rock does not necessarily include the transmission of potential pollutants contained within the fluid. Several physical and chemical processes result in the attenuation of many chemical constituents. These processes include mechanical dispersion, adsorption to soil particles, cation exchange, and oxidation-reduction reactions. As a result of these processes, not only would it take approximately 1,300 years for volumetric flux to potentially reach the perched water zone, but such volumetric flux could be expected to be relatively free of most contaminants.

Extrapolation of Cell 3 Modeling to Cells 1 and 2

Modeling of Cell 3 was determined to be the most conservative case to model as its saturated depth and area are much greater that those of Cells 1 or 2. All three cells were lined with the same materials in the same fashion. Our review of construction reports indicates that all cells were constructed to the same general level of quality control - excellent. As flux through the liner is directly proportional to the head above the liner, estimated flux rates from Cells 1 and 2 will be consistently lower than for Cell 3. Therefore, modeling of Cell 3 results in the most conservative estimates of potential impacts to the perched water zone.

Summary of Conclusions

From the above review of cell construction and analyses of Cell 3 liner seepage during and after operation, we offer the following conclusions:

1. Since the cells were constructed in the early 1980's there have been no indications that tailing cells were or are discharging tailings liquid to either the leak detection systems or the underlying formation;

2. Water observed in the Cell 2 LDS sump has been thoroughly analyzed and determined not to be a component of the tailings water;

3. Recent modifications to the operating permit are based on sound engineering principles and are more likely to detect leakage through a damaged liner than consideration of chemical analysis alone;

4. Modeling of potentially occurring volumetric flux through the Cell 3 PVC liner during the period between January 1983 and October 1998 may have reached an average rate of 50 ft^3/d (0.25 gpm). This rate is considered "*de minimis*" and inherent for PVC liners by the EPA. Based on our modeling, the total volumetric flux since beginning of cell use would represent only 4 percent of the specific retention (i.e., permanent pore storage) in the underlying sandstone. Hence, 96 percent of the permanent pore storage would be available for future moisture if any were to migrate below the cell's liner;

5. Cessation of the discharge of any liquids upon termination of cell operating life and reclamation of tailings will result in the gradually diminishing rate of volumetric flux during the post-operation period;

6. If the status quo were to continue, the volumetric flux through the Cell 3 liner, based on our modeling would require at least 400 years after closure to fill remaining sandstone pores such that unsaturated flow downward toward the perched water zone could commence;

7. Unsaturated flow, if it were to exist, based on our modeling, would require an additional 900 years to travel the 110 vertical feet to the perched water-bearing zone after sandstone moisture is raised to a degree facilitating downward movement of moisture. In other words, a total of 1,300 years would be required before any potential volumetric flux from a reclaimed cell could reach the perched water zone below the site;

8. Dissolved metals in tailings water are unlikely to be transported through the 110-ft vadose zone due to significant attenuation from a number of potential processes documented to exist when moisture moves at a very slow rate through a very low permeability media. These processes include a combination of microfiltration through the PVC liner, adsorption to soil

particles, cation exchange, horizontal and vertical dispersion due to heterogeneities of rock, and oxidation-reduction processes.

9. Since Cell 1 and 2 are smaller and the hydraulic heads of liquids present in those cells are also lower, estimated flux rates from Cells 1 and 2 will be correspondingly lower than those which may occur for Cell 3.

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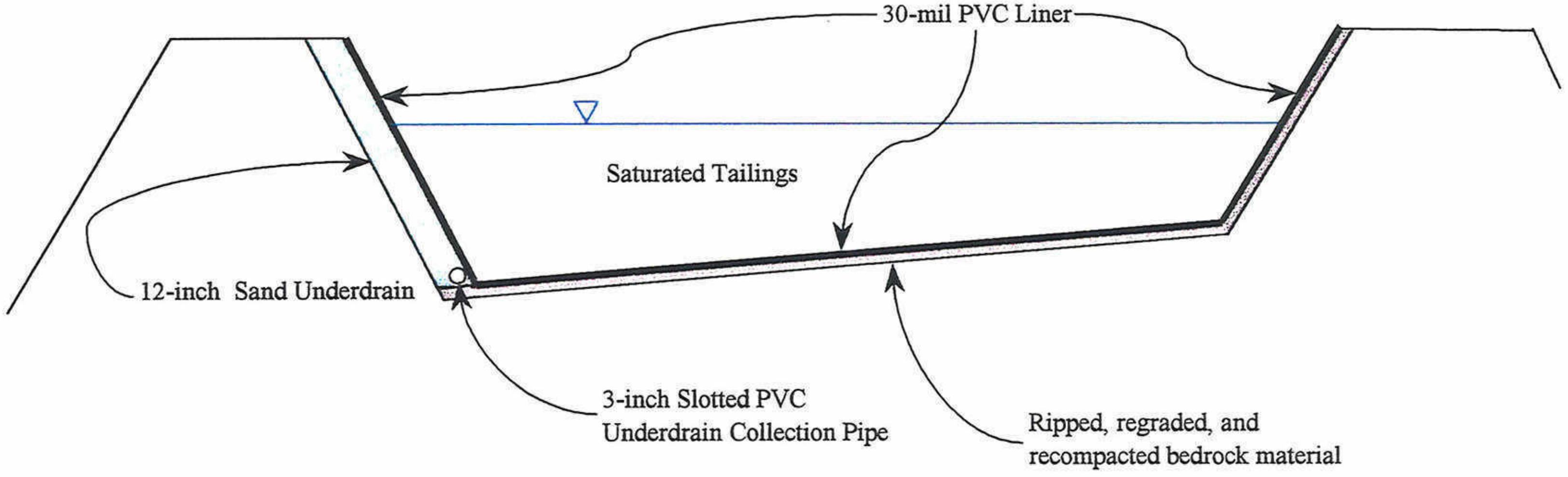
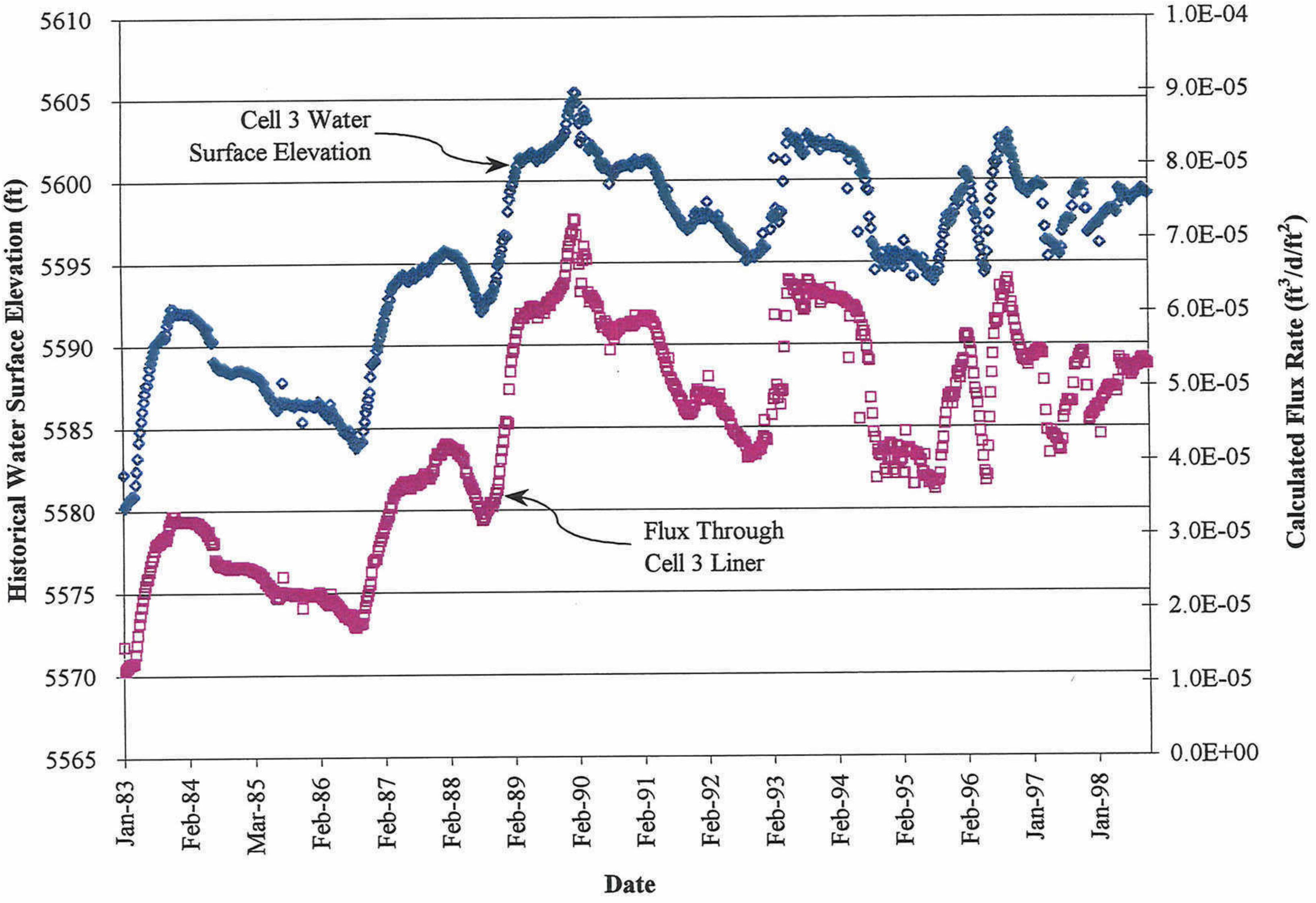


Client	Project	Title	
International Uranium (USA) Corp. **Knight Piésold LLC** CONSULTING ENGINEERS AND ENVIRONMENTAL SCIENTISTS	White Mesa Mill	Tailings Cell Schematic	
	Project No 1626c	Date 11/5/98	Figure 1



Client	Project	Title
International Uranium (USA) Corp.	White Mesa Mill	Cell 3 Historical Water Surface Elevation and Calculate Flux Rate
Knight Piésold LLC CONSULTING ENGINEERS AND ENVIRONMENTAL SCIENTISTS	Project No 1626c	Date 11/5/98 Figure 2

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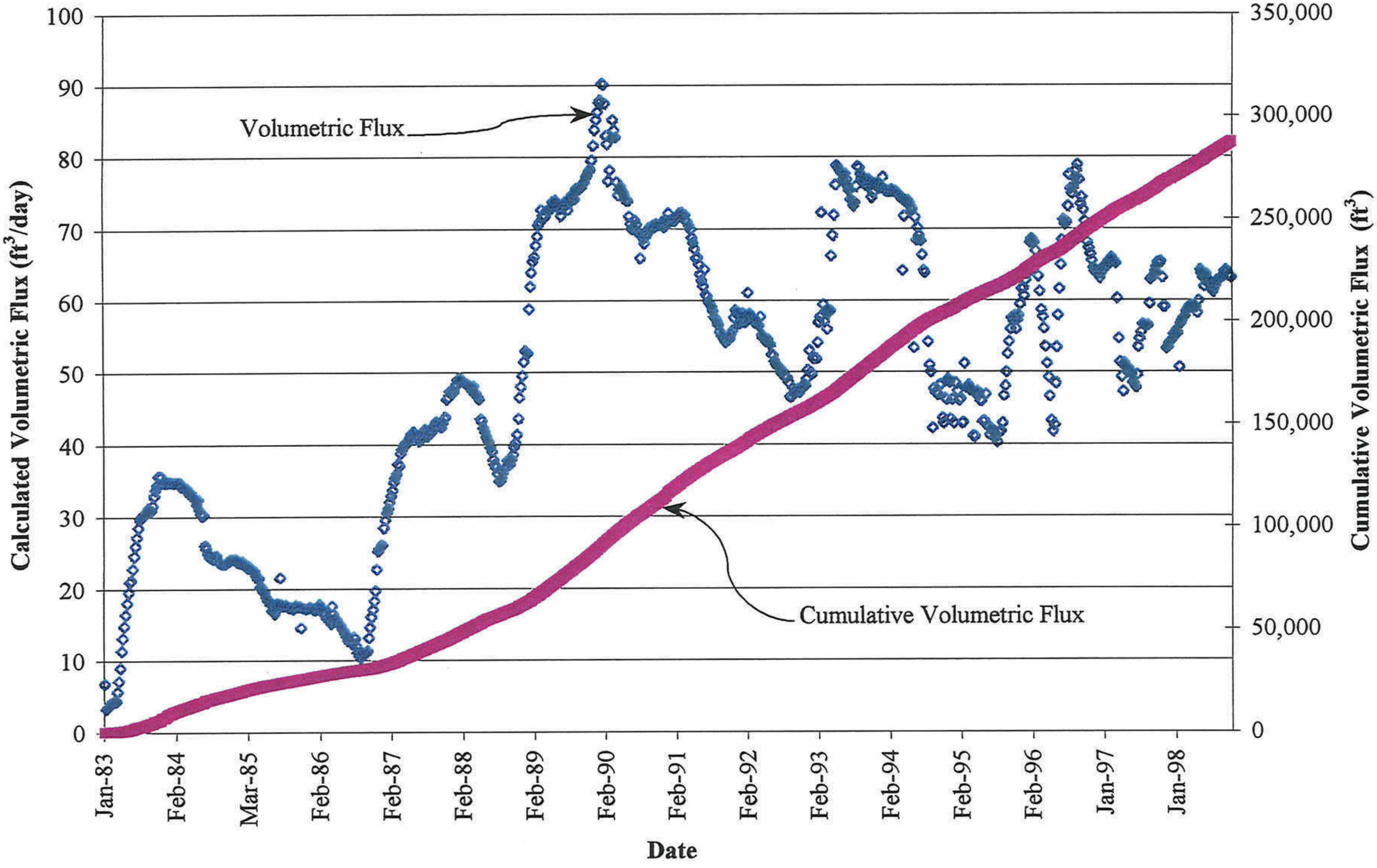

Client International Uranium (USA) Corp.	Project White Mesa Mill	Title Cell 3 Volumetric Flux Through Liner versus Time	
Knight Piésold LLC CONSULTING ENGINEERS AND ENVIRONMENTAL SCIENTISTS	Project No 1626c	Date 11/5/98	Figure 3

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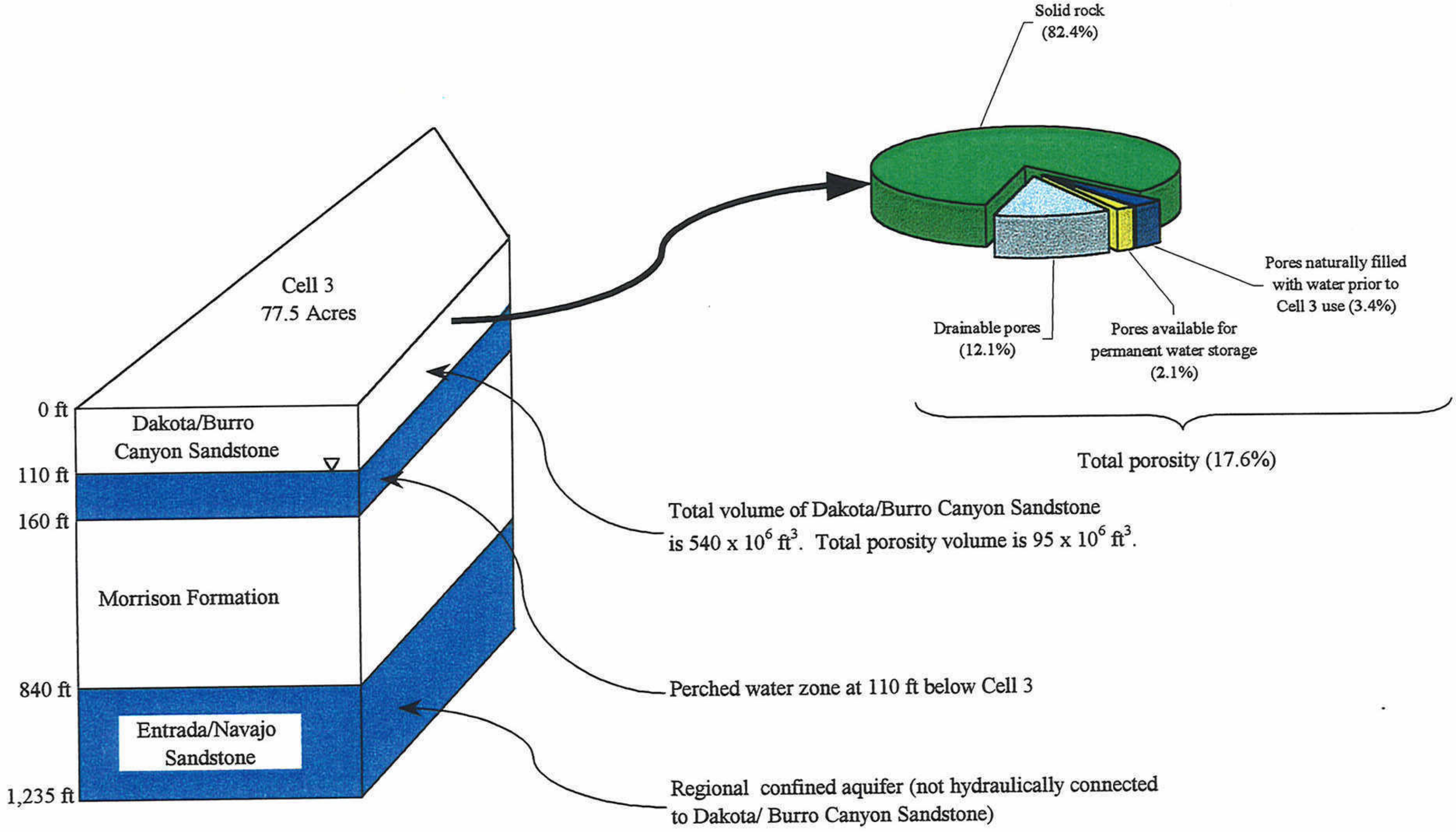

Total volume of Dakota/Burro Canyon Sandstone is 540 x 10^6 ft^3. Total porosity volume is 95 x 10^6 ft^3.

Perched water zone at 110 ft below Cell 3

Regional confined aquifer (not hydraulically connected to Dakota/ Burro Canyon Sandstone)

Client International Uranium (USA) Corp.	Project White Mesa Mill	Title Porosity Distribution in Dakota/Burro Canyon Sandstone	
Knight Piésold LLC CONSULTING ENGINEERS AND ENVIRONMENTAL SCIENTISTS	Project No 1626c	Date 11/5/98	Figure 4

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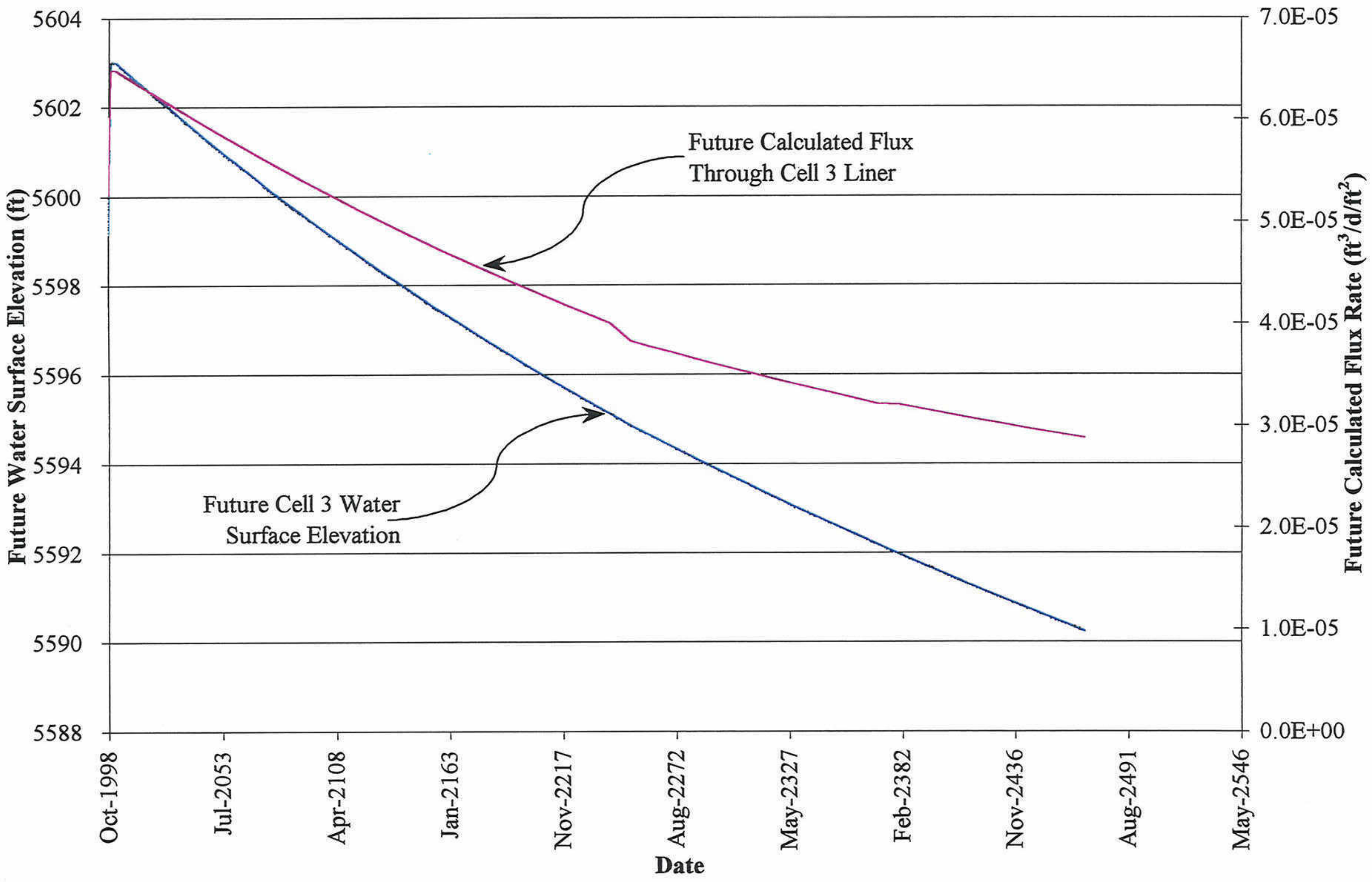

Client	Project	Title	
International Uranium (USA) Corp.	White Mesa Mill	Cell 3 Future Water Surface Elevation and Calculated Flux Rate versus Time	
Knight Piésold LLC CONSULTING ENGINEERS AND ENVIRONMENTAL SCIENTISTS	Project No 1626c	Date 11/5/98	Figure 5

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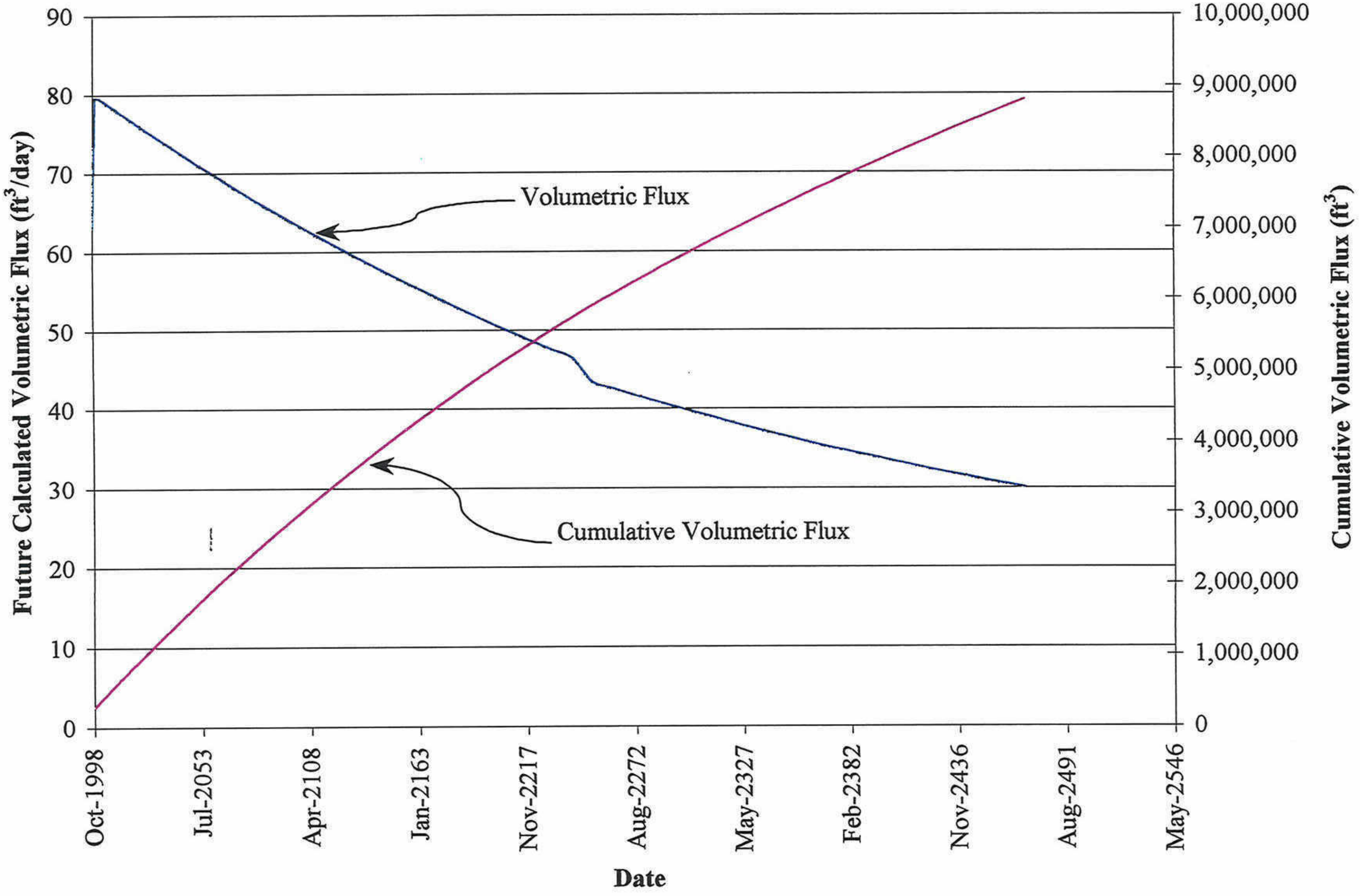

Client International Uranium (USA) Corp.	Project White Mesa Mill	Title Cell 3 Future Volumetric Flux Through Liner versus Time	
Knight Piésold LLC CONSULTING ENGINEERS AND ENVIRONMENTAL SCIENTISTS	Project No 1626c	Date 11/5/98	Figure 6

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