PATHFINDER

January 30, 2004

Mr. Gary Janosko, Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, Maryland 20852

Ref: Docket No. 40-6622, Source Material License No. SUA-442
September 15, 2003 Request for Additional Information – ACL Application

Dear Mr. Janosko:

In November of 2003, Pathfinder submitted a letter to the NRC containing responses to specific items in the referenced correspondence. In that letter, it was noted that the analysis of data pertaining to Item 1 was not yet complete and that a response to this particular item would be forthcoming. The following response is submitted regarding Item 1 of the referenced correspondence:

ITEM 1. ASSESSMENT OF SPRING CREEK IMPACTS AND EVALUATION OF ALLUVIUM

A qualitative biotic survey of Spring Creek and associated surface waters was conducted by Intermountain Resources, and the final report of this survey is included as attachment A. The reach of Spring Creek included in the survey extended from upgradient of the mine site to the confluence with the Little Medicine Bow River. Also included in the survey was a reach of the Little Medicine Bow River extending from upstream of the confluence with Spring Creek to downstream of the confluence. A reach of Fox Creek was also included in the survey which resulted in a total of three surface water reaches that are unquestionably upgradient of potential impacts from tailings seepage. Samples were taken at several locations along the impacted reach of Spring Creek and from Mine Creek. The surface water discharge from Mine Creek is largely supported by fresh-water injection as part of the ongoing Corrective Action Program (CAP) and Mine Creek will likely revert to a highly ephemeral channel after reclamation.

The biotic survey found no significant differences in presence and diversity of species that can be attributed to tailings seepage impacts on the stream. As an example, the number of macroinvertebrate species found in individual samples ranged from 15 to 20.

PATHFINDER Mines Corporation
935 Pendell Blvd., P.O. Box 730, Mills, WY 82644 - Tel. : (307) 234-5019 - Fax : (307) 473-7306

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This range is within the expected natural variation and there was no correlation of the number of macroinvertebrate species with areas of potential seepage impacts. Minor differences in the number of non-game fish at various locations were attributed to local habitat conditions such as escape cover and forage. Differences in type and density of vegetation resulted primarily from livestock grazing pressure. Ultimately, the biotic survey indicated that there were no significant differences in the occurrence and type of aquatic life and vegetation that were attributable to seepage from the tailings.

In conjunction with the biotic survey, a series of sediment samples were taken and analyzed for the presence of radionuclides. These samples were taken at locations that corresponded with those used for the biotic survey. The results of the sediment sampling are presented in the following table:

Radionuclides in Sediment Samples

Sample Location	Uranium (mg/kg-dry)	Selenium (mg/kg-dry)	Ra-226 (pCi/g-dry)	Ra-226 precision (pCi/g-dry)	Ra-228 (pCi/g-dry)	Ra-228 precision (pCi/g-dry)	Th-230 (pCi/g-dry)	Th-230 precision (pCi/g-dry)
SP-1*	6.28	0.79	1.2	0.08	1.2	0.2	0.8	0.1
SP-2	10.8	0.26	3	0.2	3.4	0.2	2.2	0.2
SP-3	3.4	ND	1.3	0.08	0.8	0.2	1.3	0.1
SP-4	3.83	ND	1.1	0.07	0.7	0.2	1	0.1
SP-5	3.03	ND	0.9	0.06	0.6	0.2	1.2	0.1
FC-1*	3.1	ND	1	0.1	2.4	1	1.7	0.2
MC-1	27.1	0.53	11	0.4	1.1	0.2	7.4	0.3
MB-1*	16.9	0.49	1.3	0.08	0.6	0.2	1.2	0.2
MB-2	2.27	0.12	1.1	0.07	1.8	0.2	0.8	0.1

Notes: * - Indicates sample that was taken at known upgradient location.
ND - Indicates non-detect.

The uranium concentration in sediment samples varies over roughly an order of magnitude with the largest concentration measured at Mine Creek. This location is expected to be the most severely impacted, but the 2^{nd} and 4^{th} largest uranium concentrations occurred at upgradient sites. The magnitude of the uranium concentration in the upgradient Little Medicine Bow River site MB-1 indicates that natural concentrations could approach those of areas where impacts from tailings seepage are likely. The largest selenium concentration in sediment was measured at the upgradient Spring Creek site and there is little or no correlation of the Ra-226, Ra-228 and Th-230 activities in sediment samples with the locations that are expected to exhibit the most severe impacts.

Although the Mine Creek sediment sample appears to be the most severely impacted based on uranium concentration and Th-230 activity, the levels of radionuclides in other sediment samples contradicts the hypothesis that the tailings impoundment is the primary or sole source of the radionuclides. Elevated concentrations or activities of radionuclides were detected in samples of native soil near Spring Creek during the windblown tailings

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cleanup. There may be some natural contribution to the presence of radionuclides in the sediments of Spring Creek. Further complicating the analysis is the fact that the nature of the sediment may also affect the adsorption of radionuclides. Clays with a platy particle structure are expected to more readily adsorb and retain radionuclides than clean sands. Thus, the concentration within a particular sample may be greatly influenced by local scour/aggradation processes and the nature of the sediments at the sample site. The mineralogy of the sediments may also play a part in the retention of radionuclides.

The results of the sediment sampling program do not indicate any clear accumulation of radionuclides in sediment that can be attributed to the tailings impoundment, and the confounding factors such as selective adsorption to sediment and the natural presence of radionuclides overshadow any tailings related impacts. The radionuclide adsorption/desorption processes may vary dramatically within a very short distance, and this is likely a dominant factor in the observed variability in radionuclide concentrations in sediment.

The evaluation of 'alluvium' adjacent to Spring Creek downstream of the tailings area included a search of historical drilling data and installation of three additional wells to define the lithology of the near-surface materials in the Spring Creek diversion. A summary report of this analysis is included as attachment B. The area of concern is referred to as the Spring Creek diversion because the original Spring Creek channel was permanently diverted to the north and east around the Area 3 mining. The upstream end of the diversion is located just upstream of the existing haul road crossing and thus the POE is located within the diversion. The base of the diversion was cut within native materials and this essentially eliminated any continuity with the limited alluvium in the upstream reaches of Spring Creek. The natural materials extending below the base of the diversion cut are predominantly clay and silt (see lithologic logs and cross sections in Attachment B) and have very limited permeability.

Aquifer properties testing of two of the newly installed wells reveals that transmitting capacity of the material at the base of the diversion is very small. The potential production from well SCDIV-2 is a fraction of a gallon per minute (see Attachment B), while there is virtually no production potential from well SCDIV-3. This well was pumped for 20 minutes at a rate of approximately 1/10 gpm before the water level reached the pump intake. The recovery of the well was very slow and there was still significant residual drawdown more than 36 minutes after the pumping was stopped. Hence, the yield of water to the well by the fine-grained materials is so small that virtually all of the water produced by the pump test came from storage in the casing. The third well, SCDIV-1, has approximately one foot of water in the bottom of the well and was dry at the time of drilling and for roughly two weeks after the well was drilled.

Based upon surveyed surface elevations at the well locations and the measured water levels, it appears that Spring Creek transitions to a losing stream through the diversion reach although the magnitude of the water loss is expected to be very small. This is not unexpected because the recharge area to the south of the diversion channel is limited to a

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narrow strip, and the predominance of clays in the near-surface materials likely limits recharge north of the channel. With the very slow yield of water to the wells and in particular the downgradient wells SCDIV-1 and SCDIV-3, it can be concluded that there is very little or no conveyance of ground water parallel to the stream channel through the diversion. There is no true alluvium in the diversion reach because the channel was relocated in this area. Development of alluvium may take centuries or millennia and sufficient time has not elapsed since the diversion was constructed for a viable alluvial aquifer to develop.

Sincerely,

Tom Hardgrove

T. W. Hardgrove
Manager, Reclamation Operations

Cc: C. Cain, U.S. NRC, Region IV
D. L. Wichers

ATTACHMENT A

SPRING CREEK AQUATIC SURVEY

2003 SPRING CREEK AQUATIC STUDY

SHIRLEY BASIN MINE AREA

Prepared For

Pathfinder Mines Corporation

Shirley Basin Mine

Prepared By,

Intermountain Resources
PO Box 1589
Laramie, WY 82073

307-745-3803

December, 2003

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1.0 INTRODUCTION

Intermountain Resources, located in Laramie Wyoming, completed qualitative evaluations of aquatic systems associated with Spring Creek on and adjacent to Pathfinder Mines Corporation, Shirley Basin Uranium Mine. These studies were completed to determine the presence of biotic organisms, primarily macroinvertebrates, fish, and reptiles or amphibians, at selected sample sites, as described in this report. Notes on major plant species present at the sample sites were also made.

2.0 DESCRIPTION OF THE STUDY AREA

The area sampled is located in the Shirley Basin area of Carbon County Wyoming, approximately 45 miles south of Casper. Nine sites were sampled on four drainages as listed below:

SP-1 Spring Creek above the area of impact by the mine at water quality sample site location SW-1A.

SP-2 Spring Creek immediately below the confluence with Mine Creek.

SP-3 Spring Creek in the diversion channel.

SP-4 Spring Creek below the diversion channel.

SP-5 Spring Creek above the confluence with the Little Medicine Bow River.

FC-1 Fox Creek above the confluence with Spring Creek.

MC-1 Mine Creek above the confluence with Spring Creek.

MB-1 Little Medicine Bow River above the confluence with Spring Creek.

MB-2 Little Medicine Bow River below the confluence with Spring Creek.

Sample sites SP-1, FC-1 and MB-1 are located above any water contributions from the Shirley Basin Mine and it will be assumed that these sample sites represent the natural conditions (unaffected by the Shirley Basin Mine mining activities) of the drainages in the immediate area. Sample site MC-1 is assumed to have the most water quality impacts from the mine site. Sample sites SP-2, SP-3, SP-4, SP-5 and MB-2 are assumed to have gradually lesser degrees of impact in the order listed.

3.0 METHODS

This study was designed to provide only qualitative information for the sites sampled. This study was not designed to provide any quantitative data on the abundance of individual species present.

Macroinvertebrates

Sampling for aquatic macroinvertebrates was conducted using two sampling techniques. The dip net technique was used for species which can be found living off the bottom or free-floating and bottom samples were collected for benthos (species generally found living closely associated with the bottom). Sample sites were chosen based on the site location that needed to be sampled and drainage bottom substrate. Riffles were sampled at all sites, however the riffles sometimes varied because of bottom substrates available in the reach of stream that needed to be sampled. Samples were collected from sites SP-1, SP-2, SP-3, SP-4, SP-5, MC-1, MB-1 and MB-2 on September 25 of 2003. Sample site FC-1 was later requested by the WDEQ and was sampled on November 8, 2003.

The dip net technique consisted of sweeping the channel pools, riffles and vegetation. The same amount of time (eight minutes) was spent using the dip net sweep technique at each sample site. The same approximate number of sweeps was also completed at each sample site.

The bottom samples were collected in undisturbed riffles at each sample site. This was accomplished by scooping out approximately a one quart sample from the bottom with a shovel and immediately placing that sample in a container.

The samples collected were preserved in the field in 70% isopropyl alcohol and taken back to the laboratory for analyses. Organisms were separated and identified using an illuminated magnifier and stereozoom-dissecting microscope. Macroinvertebrates were generally identified to family or genus.

Fish

Fish were sampled using dip nets since that was the only technique specified in the scientific sampling permit obtained from the Wyoming Game and Fish Department. Representatives from each fish species captured at each sample site were collected and taken back to the laboratory for identification.

Reptiles and Amphibians

Reptiles and amphibians were sampled at each site using dip nets and searching the vegetation and habitats in and adjacent to the stream channel. These species were identified in the field and then released.

Vegetation

Dominant vegetation was identified at each site based on visual observations. This evaluation was primarily for wetland species found in or immediately adjacent to the channel sampled. Upland species found in this zone were also recorded. Plant identification was difficult due primarily to heavy livestock grazing at some sample sites.

4.0 RESULTS

This section presents the results of the aquatic sampling completed in 2003 at the nine sites evaluated for the Pathfinder Mines Corporation Shirley Basin Mine.

Macroinvertebrates

Table 1 presents the results of the macroinvertebrate sampling completed in 2003 for the Shirley Basin Mine. A total of 33 different aquatic macroinvertebrate species were identified in the study area. The average number of species per sample was 17 with the most being found at MB-2 (20) and the least being found at SP-1 (15) and MC-1 (15).

The gastropod *Physa* sp. and the bivalve *Sphearium* sp. were found at all locations. A variety of aquatic insects were found throughout all sampling locations. There were two species of *Tricoptera* (*Helicopsychidae* sp., *Hydropsychidae* sp.) and the *Diptera, Chironomidae* sp., present at all sampling locations.

The Spring Creek (SP) macroinvertebrate species composition appears to be fairly constant throughout the five sampling locations along this drainage. *Tricoptera* dominated the Fox Creek (FC-1) insect species but this dominance does not appear to affect the downstream Spring Creek locations. Mine Creek (MC-1) had a very low flow and was partially impounded. These stream characteristics at MC-1 were different from

Table 1. Macroinvertebrates found in aquatic samples collected for the Shirley Basin Mine, 2003.

LOCATION	SP-1		SP-2		SP-3		SP-4		SP-5	
	dip net	benthos	dip net	benthos	dip net	benthos	dip net	benthos	dip net	benthos
TAXA										
NEMATODA								X		
MOLLUSCA										
Gastropoda										
Lymnaeiidae										
Lymnae sp.										
Physidae										
Physa sp.	X	X	X		X		X	X	X	
Planorbidae										
Gyraulus sp.				X	X	X	X		X	
Bivalva										
Sphaeriidae										
Sphearium sp.	X	X	X	X	X	X	X	X	X	X
ANNELIDA										
Oligochaeta		X		X	X	X	X	X	X	X
Euhirudinoidae										
Glossiphoniidae										
Glossiphonea sp.										
Placobdella sp.										
Helobdella sp.		X								
ARTHOPODA										
Insecta										
Plecoptera										
Perlidae sp.			X						X	
Ephemeroptera										
Caenidae sp.	X					X		X		
Potamanthidae			X				X		X	
Odonata										
Coenagrionidae sp.	X		X		X		X		X	
Gomphidae sp.			X		X		X		X	X
Coleoptera										
Elmidae sp.		X		X		X		X		X
Dytiscidae SP.										
Hemiptera										
Corixidae sp.			X		X		X		X	
Gerridae			X							
Tricoptera										
Hydropsychidae sp.	X	X	X		X	X	X		X	
Hydroptilidae sp.							X	X		
Helicopsychidae sp.	X	X	X	X	X	X		X	X	
Brachycentridae sp.							X		X	X
Limnephilidae sp.					X					
Leptoceridae sp.						X			X	
Ploycentropodidae sp.		X								X
Megaloptera										
Sailidae sp.		X								

Table 1. Macroinvertebrates (Continued).

LOCATION	SP-1		SP-2		SP-3		SP-4		SP-5	
	dip net	benthos	dip net	benthos	dip net	benthos	dip net	benthos	dip net	benthos
TAXA										
ARTHOPODA (Cont.)										
Insecta										
Diptera										
Chironomidae sp.	X		X	X	X		X	X	X	
Simuliidae sp.	X		X		X					
Ceratopogonidae sp.		X	X	X		X		X	X	X
Tipulidae sp.			X	X			X	X	X	
Tanyderidae			X							
Tanbanidae										
Crustacea										
Amphidoda										
Hyallela sp.	X		X	X	X	X			X	

LOCATION	FC-1		MC-1		MB-1		MB-2	
	dip net	benthos	dip net	benthos	dip net	benthos	dip net	benthos
TAXA								
NEMATODA								
MOLLUSCA								
Gastropoda								
Lymnaeiidae								
Lymnae sp.				X			X	
Physidae		X						
Planorbidae								
Gyraulus sp.	X		X	X			X	
Physa sp.	X		X		X	X	X	
Bivalva								
Sphaeriidae								
Sphearium sp.	X	X	X	X	X	X	X	X
ANNELIDA								
Oligochaeta	X	X				X	X	
Euhirudinoidae		X			X			
Glossiphoniidae								
Glossiphonea sp.	X				X	X	X	X
Placobdella sp.				X				
Helobdella sp.		X		X				X
ARTHOPODA								
Insecta								
Plecoptera								
Perlidae sp.						X	X	X
Ephemeroptera								
Caenidae sp.					X	X	X	X
Potamanthidae								
Odonata								
Coenagrionidae sp.			X		X	X	X	
Gomphidae sp.					X			

Table 1. Macroinvertebrates (Continued).

LOCATION	FC-1		MC-1		MB-1		MB-2	
	dip net	benthos	dip net	benthos	dip net	benthos	dip net	benthos
TAXA								
ARTHOPODA (Cont.)								
Insecta (Cont.)								
Coleoptera								
Elmidae sp.	X	X				X	X	X
Dytiscidae SP.			X					
Hemiptera								
Corixidae sp.			X		X		X	
Gerridae								
Tricoptera								
Hydropsychidae sp.	X	X	X		X	X		X
Hydroptilidae sp.	X		X			X		X
Helicopsychidae sp.	X	X			X	X	X	X
Brachycentridae sp.	X						X	
Limnephilidae sp.	X				X			
Leptoceridae sp.								
Ploycentropodidae sp.					X	X	X	X
Megaloptera								
Sailidae sp.		X						
Diptera								
Chironomidae sp.	X	X	X	X	X	X	X	X
Simuliidae sp.	X		X					
Ceratopogonidae sp.		X		X				
Tipulidae sp.	X				X		X	
Tanyderidae								
Tanbanidae					X			
Crustacea								
Amphidoda								
Hyallela sp.	X	X	X	X	X	X	X	X

the other streams sampled and resulted in fewer riffle area species. Mine Creek did not appear to affect the downstream Spring Creek locations. There appeared to be no differences observed in the Little Medicine Bow River between the above Spring Creek (MB-1) and below Spring Creek (MB-2) sampling locations.

Overall the results do not appear to show any trends in the presence or absence of groups of macroinvertebrates. The lowest diversity was found in a sample (SP-1) collected above mine impacts, as well as a sample (MC-1) collected within the mine impact area. The highest diversity was found at sample site MB-2 that is along the Little Medicine Bow River below the confluence with Spring Creek and would indicate little if any impact from the mine.

Fish

Two species of fish were found at all locations in the study area as shown in Table 2. They were shiner (*Notropis stramineus*) and the brook stickleback (*Culaea inconstans*). A single suckermouth minnow (*Phenacobius* sp.) was also found in Spring Creek. The shiner and suckermouth minnow are common to the Little Medicine Bow River drainage area. The brook stickleback is an undesireable species introduced to Wyoming and has been reported in other parts of the North Platte River drainage system. This may be the first collection of a brook stickleback this far up the Little Medicine Bow River drainage. Based on visual observations fish were most abundant at the sample site on Mine Creek (MC-1) and sample site SP-2, which is on Spring Creek just below where Mine Creek enters Spring Creek. Fish were also common at sample sites SP-3 and SP-5. Fish appeared to be less abundant at the other sample sites. The abundance of fish appeared to be related more to available habitat (forage, escape cover, etc.) rather than

Table 2. Fish, reptile, amphibian and plant species recorded at aquatic sample sites evaluated for the Shirley Basin Mine, 2003.

LOCATION	SP-1	SP-2	SP-3	SP-4	SP-5	FC-1*	MC-1	MB-1	MB-2
Life Forms									
Fish Species									
Culaea inconstans	X	X	X	X	X	X	X	X	X
Notropis stramineus	X	X	X	X	X	X	X	X	X
Phenacobius sp.		X							
Reptiles and Amphibians									
Rana pipiens		X	X		X	*	X		
Thamnophis elegans				X		*			
Plant Species									
Grasses									
Agropyron smithii	X					*			
Agrostis exarata						*	X		
Agrostis stolonifera	X	X	X		X	*	X	X	
Deschampsia cespitosa	X	X	X	X	X	*	X	X	X
Hordeum jubatum		X		X		*	X	X	X
Poa pratensis	X	X	X	X	X	*	X	X	X
Phalaris arundinaceae			X	X		*			
Phleum pratense	X				X	*			X
Grasslike									
Carex nebrascensis	X	X	X	X	X	*	X	X	X
Eleocharis macrostachya		X	X	X		*	X	X	X
Equisetum laevigatum					X	*			
Juncus balticus	X	X	X	X	X	*	X	X	X
Juncus tenuis			X			*			
Scirpus acutus		X				*			
Typha latifolia			X			*	X		
Forbs									
Achillea millefolium	X	X	X		X	*		X	
Antennaria rosea	X					*			
Aster falcatus	X				X	*	X	X	X
Cirsium arvense	X	X	X	X		*	X		
Melilotus officinalis				X		*			
Medicago lupulina						*			X
Potentilla anserina				X		*		X	X
Ranunculus spp.	X	X	X	X	X	*	X	X	X
Rorippa sinuata						*		X	
Taraxacum officinale		X	X			*	X		X
Thermopsis rhombifolia	X	X		X	X	*		X	X

* Site FC-1 was sampled on November 8, 2003 following a specific request by LQD. At that time the ground was snow covered so assessments could not be made for reptile, amphibian or plant species.

impacts from the mine. This conclusion is made since fish were most abundant at the sample site along Mine Creek where mine impacts would be expected to be highest.

Reptiles and Amphibians

The leopard frog (*Rana pipiens*) was the only amphibian species recorded at any of the sample sites as shown in Table 2. This species was found at sample sites SP-2, SP-3, SP-5 and MC-1. Sample sites SP-2, SP-3 and MC-1 were within the immediate mine impact area. The wandering garter snake (*Thamnophis elegans*) was the only reptile species observed at any of the sample sites. This snake was recorded at sample site SP-4 which is below the Spring Creek diversion constructed by the mine.

In general, reptile and amphibian species were observed at sites where vegetative cover was present. These species were not observed in areas where most of the vegetative cover had been removed by heavy livestock grazing. Mine impacts did not appear to have an influence on which sample sites these species were present at, but protection from grazing did appear to influence their presence.

Vegetation

Table 2 provides a brief list of the most common plant species observed at the sample sites. In general, similar species and life forms were recorded at all sample sites. The major difference between sample sites was attributed to heavy grazing on areas that were not protected from livestock by fencing.

5.0 CONCLUSIONS

Qualitative aquatic sampling was completed on Spring Creek, Mine Creek, Fox Creek and the Little Medicine Bow River within, or adjacent to, Pathfinder Mines Corporation Shirley Basin Mine in the fall of 2003. Data from this sampling did not indicate any major differences in species present that could be attributed to impacts from the mine operation or cessation of operations. All differences appeared to be minor and could be attributed to variations in habitats within each channel due to water flow rates, width, depth, bottom substrate, and presence or absence of vegetation due to the level of livestock utilization.

6.0 REFERENCES

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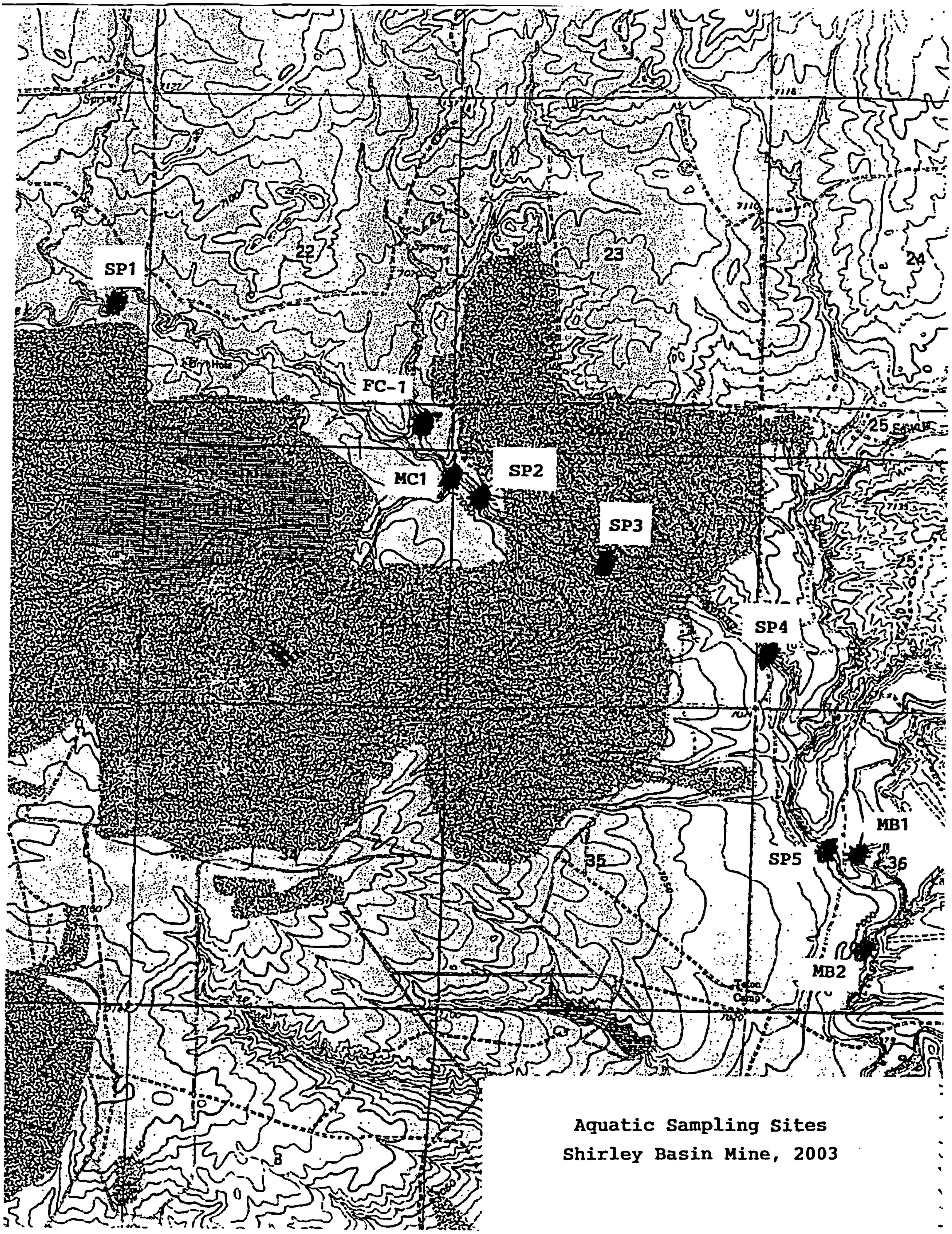

Aquatic Sampling Sites
Shirley Basin Mine, 2003

ATTACHMENT B

EVALUATION OF SPRING CREEK DIVERSION GROUND-WATER CONVEYANCE

Professional Engineer (Civil)
Thomas G. Michel
8335
Date

THOMAS G. MICHEL, Ph. D.
HYDROLOGIST

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FIGURES

B.1 INTRODUCTION

The evaluation of the potential for conveyance of ground water parallel to the stream channel along the Spring Creek diversion included review of lithology from historic drilling records and the drilling of three additional wells to evaluate lithology and hydraulic properties of the materials in the diversion. Only one of the wells (SCDIV-2) had a measurable water level immediately after installation, but after several weeks, there was a sufficient depth of water in well SCDIV-3 to attempt a pump test.

B.2 LITHOLOGY IN THE SPRING CREEK DIVERSION

The lithologic logs for wells SCDIV-1, SCDIV-2 and SCDIV-3 are presented in Figures B.2-1, B.2-2 and B.2-3, respectively. The wells were drilled with an auger rig and completed with 2-inch PVC casing. During the drilling of SCDIV-1, penetration was essentially stopped by a dense layer at a depth of 34 feet from land surface. Saturated cuttings were only detected in well SCDIV-2 during the drilling process. The approximate location of the wells is presented on Figure B.2-4 in addition to the location of bore holes for which the lithology is available. These additional bore holes include SER 1-1 and SER 4 which are shown on the cross sections in Figure B.2-4 at the pre-diversion land surface elevation.

The typical material encountered at a level corresponding with an alluvial aquifer was a brown clay. There was no indication of layers of sufficient permeability and thickness to function as an aquifer system. A simplified lithology is posted adjacent to the well locations on the cross sections in Figure B.2-4. The locations and land surface elevations for the recently installed wells were estimated.

HYDRO
HYDRO-ENGINEERING LLC
4685 S. MAGNOLIA
CASPER, WY. 82604
(307) 266-6597

WELL ID: SCDIV-1 DATE: 11/12/03 ENG: TGM

DRILLER/ COMPANY INBERG-MILLER

DRILL TIME LOG

11/12/03

10:25	On site
10:36	Drilling
10:59	@ 25'
11:45	@ 34'
11:53	Stopped drilling
12:15	Moving off

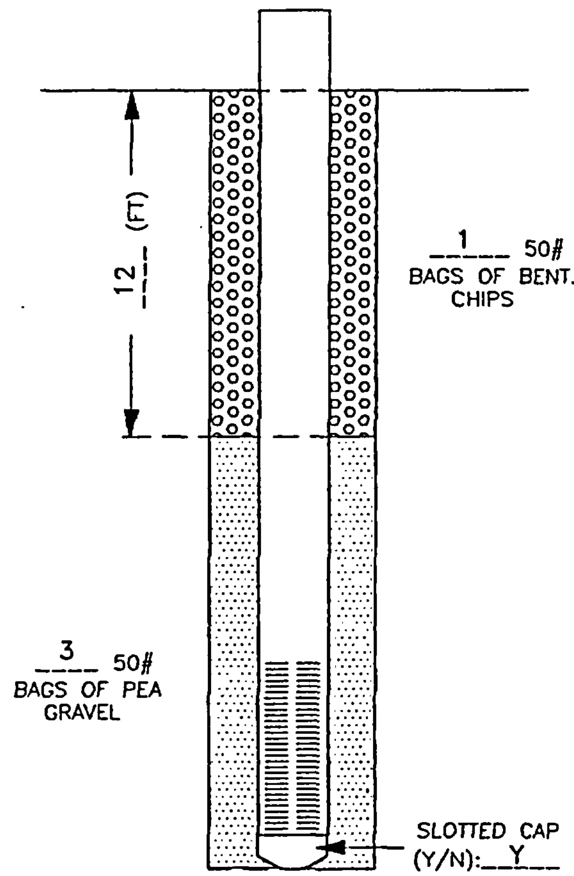
LITHOLOGIC LOG

0-4'	Fine sand - tan
4-9'	a/a with shale chips @ 8'
9-11'	a/a
11-14'	Green/brown clay
14-17'	Brown clay - moist
17-18'	Brown clay/silt with fine sand
18-19	Gray sandy clay
19-24'	Gray/white coating on brown clay - some vf sand
24-29'	No return - see withdrawal notes
29-31'	Tan to white silt/clay with some sand
31-34'	Tan to brown clay - coated white
34'	Hard layer - penetration stopped

Cuttings on auger during withdrawal

0-4'	Brown clay
4-9'	a/a
9-14'	brown/tan sandy clay with white coating
14-19'	a/a
19-24'	a/a
24-29'	a/a
29-34'	Brown clay - moist at bottom

WELL SCHEMATIC



CASING (IN.): 2"
BLANK (FT): 25.2
PERF (FT): 10
SLOT SIZE: 0.10"
SAND SIZE: Pea Gravel
STICK UP: 1.4'
TOTAL DEPTH: 35.2'
EST. GPM: No Production
PILOT BIT (IN./TYPE): 4" Auger
REAMING BIT (IN./TYPE): ____________

FIGURE B.2-1. COMPLETION AND LITHOLOGIC LOG FOR WELL SCDIV-1

HYDRO

HYDRO-ENGINEERING LLC
4685 S. MAGNOLIA
CASPER, WY. 82604
(307) 266-6597

WELL ID: SCDIV-2 DATE: 11/12/03 ENG: TGM

DRILLER/ COMPANY INBERG-MILLER

DRILL TIME LOG

11/12/03

12:56	Starting to drill
13:35	@ 39'
15:40	Depth to water – 20.8'

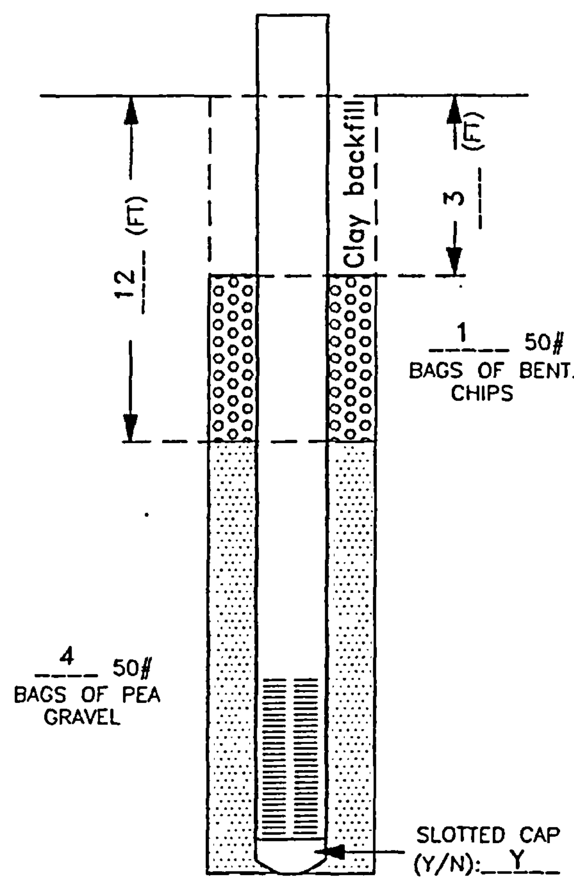
LITHOLOGIC LOG

0-4'	Brown sandy clay
4-9'	Brown clay – moist
9-14'	Brown clay – moist
14-18'	Brown clay – slightly moist
18-19'	Brown/green silty clay with some vf sand
19-24'	Brown clay with white coating
24-28'	Brown clay – getting wetter
28-29'	Saturated tan/brown clay – ribboning
29-34'	No return other than ribbons of saturated clay
33'	Hard lense
34-39'	No return

Cuttings on auger during withdrawal

14-19'	Green clay
19-24'	Green clay
24-29'	Brown clay
29-34'	Brown clay
34-39'	Brown clay

WELL SCHEMATIC



CASING (IN.): 2"
BLANK (FT): 31.25
PERF (FT): 10
SLOT SIZE: 0.10"
SAND SIZE: Pea Gravel
STICK UP: 2.1'
TOTAL DEPTH: 41.25'
EST. GPM: No Production
PILOT BIT (IN./TYPE): 4" Auger
REAMING BIT (IN./TYPE): ____________

FIGURE B.2-2. COMPLETION AND LITHOLOGIC LOG FOR WELL SCDIV-2

HYDRO-ENGINEERING LLC
4685 S. MAGNOLIA
CASPER, WY. 82604
(307) 266-6597

WELL ID: SCDIV-3 DATE: 11/12/03 ENG: TGM

DRILLER/ COMPANY INBERG-MILLER

DRILL TIME LOG

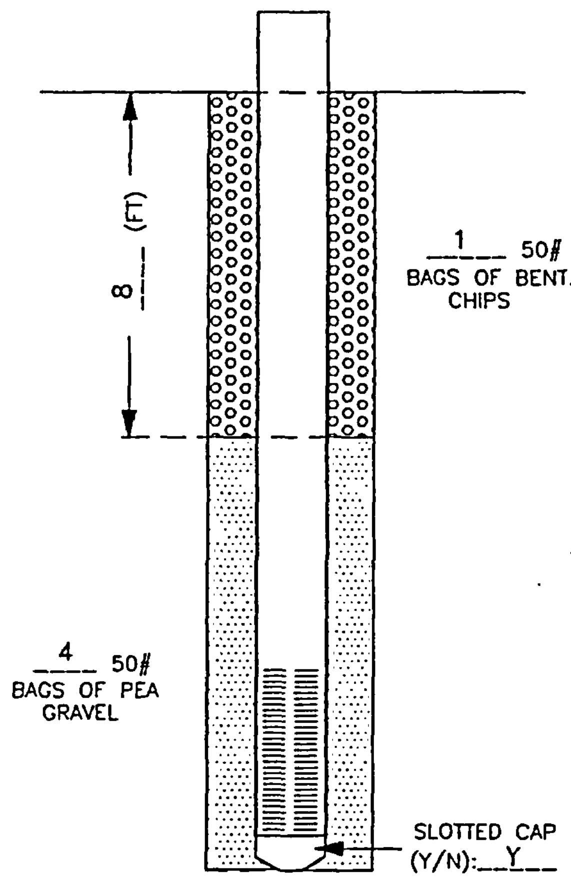
11/12/03

14:23	Starting
15:05	@ 39'

LITHOLOGIC LOG

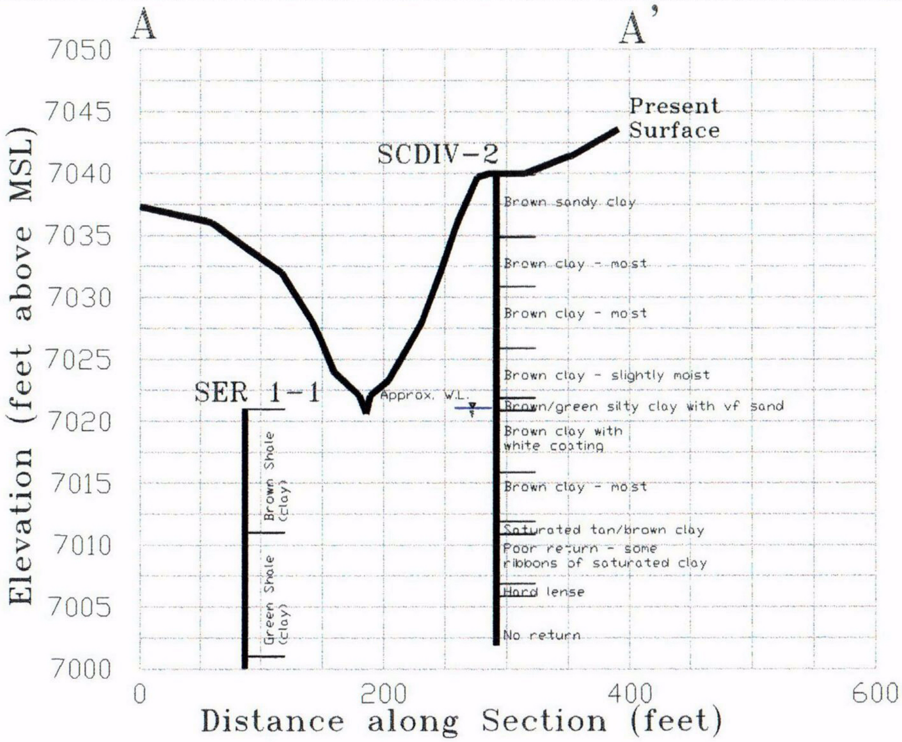
0-4'	Very fine sand - dry
4-8'	Very fine sand - dry
8-9'	Brown clay - slightly moist
9-14'	Brown clay
14-19'	Brown clay - getting wetter
19-24'	Brown clay - slightly moist
24-29'	Brown clay - slightly moist
29-34'	Brown clay - very moist @ 33'
34-39'	Brown clay - wetter

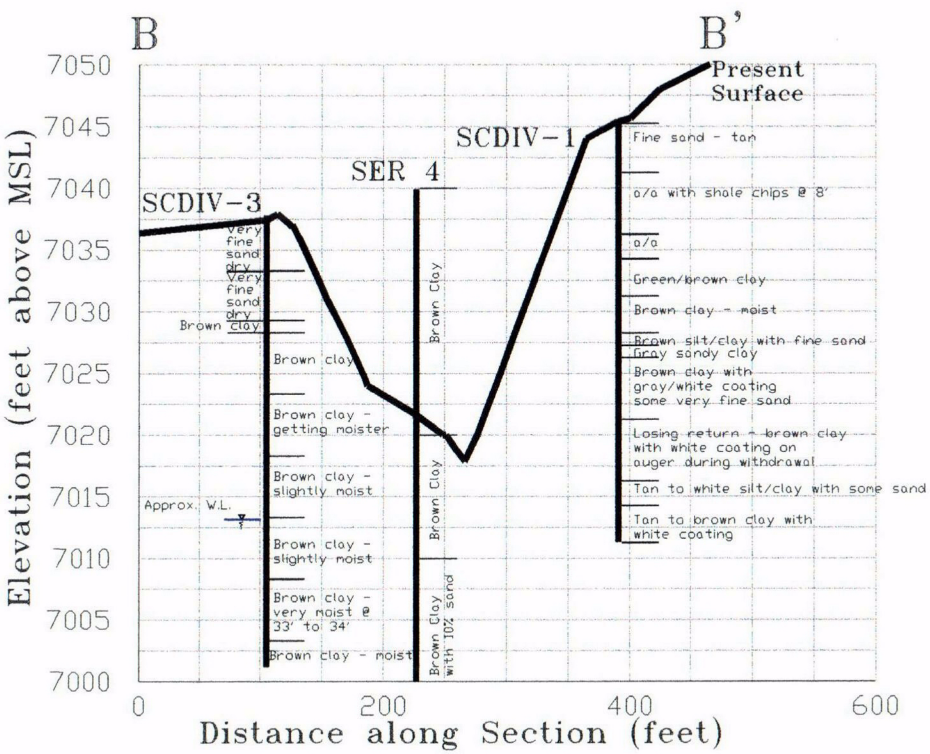
WELL SCHEMATIC

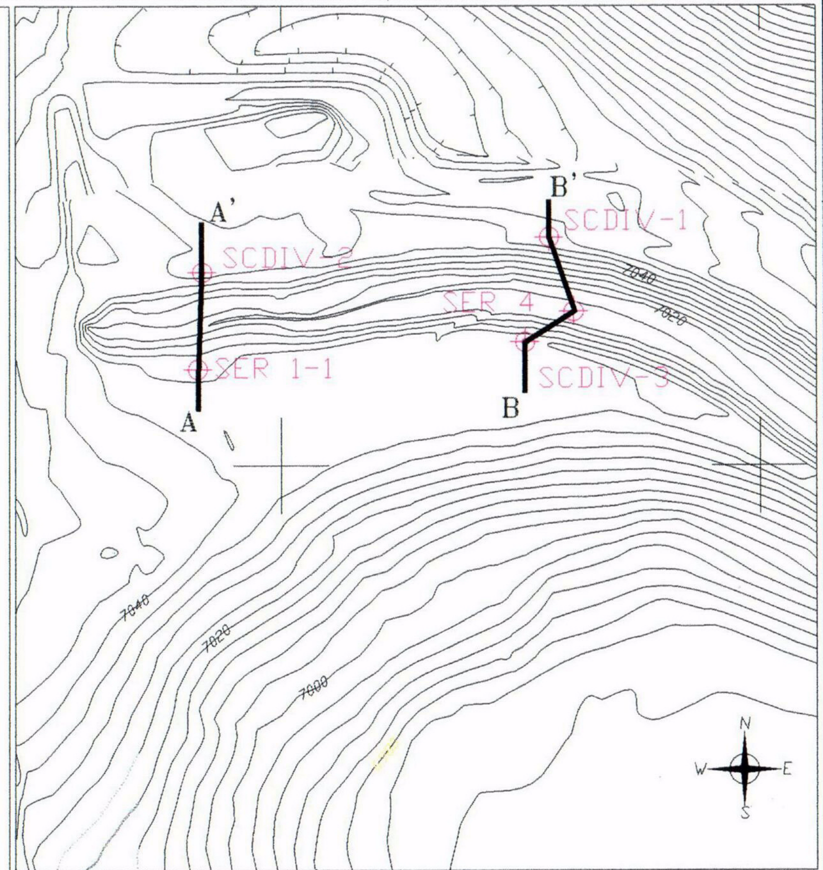


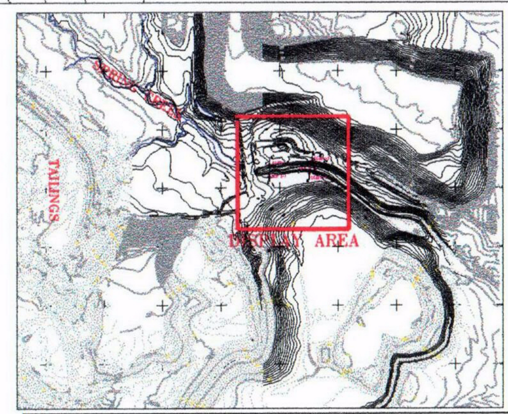
CASING (IN.): 2"
BLANK (FT): 27.6
PERF (FT): 10
SLOT SIZE: 0.10"
SAND SIZE: Pea Gravel
STICK UP: 1.2'
TOTAL DEPTH: 37.6'
EST. GPM: No Production
PILOT BIT (IN./TYPE): 4" Auger
REAMING BIT (IN./TYPE): ____________

FIGURE B.2-3. COMPLETION AND LITHOLOGIC LOG FOR WELL SCDIV-3









PATHFINDER

PATHFINDER MINES CORPORATION
SHIRLEY BASIN, WYOMING

T28N, R78W

FIGURE B.2-4. CROSS SECTIONS THROUGH SPRING CREEK DIVERSION

DRAWN BY: TGM	DATE: 1-2004	SCALE: VARIES
		SCQALFIG.DWG
REVIS. NO.:	HYDRO-ENGINEERING L.L.C.	

C01

B.3 AQUIFER PROPERTIES TESTING

Several weeks after installation, two of the recently installed wells (SCDIV-2 and SCDIV-3) had sufficient water to attempt pump testing. The results of the pumping test of well SCDIV-2 are included in Table B.3-1 and Figure B.3-1. The calculated transmissivity of 62 gal/day/ft is relatively low and the drawdown response reflects significant well storage effects. The potential production from the well is a fraction of a gallon per minute.

The results of the pump testing of well SCDIV-3 are presented in Table B.3-3 and Figure B.3-2. The yield during testing was very small and the drawdown was occurring so quickly that the variable frequency/rate pump had to be constantly adjusted to maintain a small discharge to the surface. The total volume of water produced during the test was approximately two gallons before the pumping level reached the pump intake. The bulk of the water produced during the test likely came from storage within the well bore, and the lagging recovery after pumping was stopped supports this. The calculated transmissivity of 1.9 gal/day/ft is very small.

TABLE B.3-1. AQUIFER-TEST DATA FOR PUMPING WELL SCDIV-2.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
01/13/04	8:16:00	-67	–	–	20.54	0.00	–	–	–	–
	8:51:00	Pump in - pump raised up approx. 2 feet								
	8:55:00	-28	–	–	20.46	-0.08	–	–	–	–
	8:59:00	-24	–	–	20.53	-0.01	–	–	–	–
	9:00:00	Controller not working - switching boxes								
	9:06:00	Pump on 48 hz								
	9:07:00	-16	–	–	20.58	0.04	–	–	–	–
	9:07:00	No water								
	9:08:00	Freq. = 105 hz								
	9:09:00	-14	–	–	20.62	0.08	–	–	–	–
	9:09:00	Still no water								
	9:10:00	Freq. = 180 hz								
	9:11:00	Freq. = 250 hz								
	9:12:00	-11	–	–	20.63	0.09	–	–	–	–
	9:12:00	Shutting pump off								
	9:17:00	Pulled pump - very dirty - reset to approx. 30 ft. & tested successfully								
	9:22:00	-1	–	–	20.78	0.24	–	–	–	–
	9:23:00	Pump on - freq. = 130 hz								
	9:24:00	1	–	–	23.43	2.89	–	–	–	–
	9:24:00	Turned down to 90 hz								
	9:25:00	Turned up to 106 hz - flow had stopped								
	9:26:00	3	–	–	22.67	2.13	–	–	–	–
	9:27:00	4	–	–	–	–	0.45	–	–	–
	9:29:00	6	–	–	22.81	2.27	–	–	–	–
	9:29:00	Very dirty								
	9:30:00	7	–	–	–	–	–	–	–	–
	9:32:00	9	–	–	22.94	2.40	–	–	–	–
	9:33:00	10	–	–	–	–	–	9	595	6.25
	9:36:00	13	–	–	23.06	2.52	–	–	–	–
	9:38:00	15	–	–	–	–	0.44	8.3	593	6.64
	9:40:00	17	–	–	23.13	2.59	–	–	–	–
	9:43:00	20	–	–	23.09	2.55	–	–	–	–
	9:43:00	Slight development effect?								
	9:44:00	21	–	–	–	–	0.45	–	–	–
	9:46:00	23	–	–	23.20	2.66	–	–	–	–
	9:52:00	29	–	–	23.33	2.79	–	–	–	–
	9:53:00	30	–	–	–	–	0.44	8.9	574	7.27
	9:57:00	34	–	–	23.33	2.79	–	–	–	–
	10:00:00	37	–	–	23.35	2.81	–	–	–	–
	10:02:00	39	–	–	–	–	0.42	–	–	–
	10:02:00	Turning freq. up to 108 hz								
	10:04:00	41	–	–	–	–	0.51	–	–	–
	10:04:00	Water starting to clear								
	10:06:00	43	–	–	23.75	3.21	–	–	–	–
	10:07:00	44	–	–	–	–	0.51	9.1	587	7.63

TABLE B.3-1. AQUIFER-TEST DATA FOR PUMPING WELL SCDIV-2, (CONTINUED).

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
01/13/04	10:10:00	47	–	–	23.86	3.32	–	–	–	–
	10:12:00	49	–	–	–	–	0.51	9.4	594	7.68
	10:14:00	51	–	–	23.99	3.45	–	–	–	–
	10:15:00	52	–	–	24.07	3.53	–	–	–	–
	10:17:00	54	–	–	–	–	0.56	–	–	–
	10:19:00	56	–	–	–	–	0.54	–	–	–
	10:20:00	57	–	–	24.10	3.56	–	–	–	–
	10:24:00	61	–	–	–	–	–	9.6	594	7.63
	10:24:00	Collect sample								
	10:27:00	64	–	–	24.20	3.66	–	–	–	–
	10:31:00	68	–	–	24.30	3.76	–	–	–	–
	10:35:00	72	–	–	24.32	3.78	0.54	–	–	–
	10:36:00	Pump off								
	10:37:00	74	1	74.000	22.80	2.26	–	–	–	–
	10:39:30	76	4	21.857	22.27	1.73	–	–	–	–
	10:40:00	77	4	19.250	22.18	1.64	–	–	–	–
	10:41:00	78	5	15.600	22.02	1.48	–	–	–	–
	10:43:00	Pulling Pump								
	10:47:00	84	11	7.636	21.65	1.11	–	–	–	–
	11:58:00	155	82	1.890	20.81	0.27	–	–	–	–
	12:10:00	167	94	1.777	20.75	0.21	–	–	–	–

TABLE B.3-2. AQUIFER-TEST DATA FOR PUMPING WELL SCDIV-3.

DATE	TIME	TIME SINCE PUMPING STARTED (t, min)	TIME SINCE PUMPING STOPPED (t', min)	t/t'	WATER LEVEL (ft below MP)	DRAWDOWN (ft)	DISCHARGE (gpm)	WATER TEMP. (deg C)	CONDUCTIVITY (umhos/cm @ 25 deg C)	pH (units)
01/13/04	10:54:00	-14	--	--	25.81	0.00	--	--	--	--
	10:58:00	Pump in - pump raised up approx. 3 feet								
	11:01:00	-7	--	--	25.33	-0.48	--	--	--	--
	11:07:00	-1	--	--	25.39	-0.42	--	--	--	--
	11:08:00	Pump on - 109 hz								
	11:09:00	1	--	--	26.50	0.69	--	--	--	--
	11:09:00	No water								
	11:10:00	Adjust freq. to 115 hz - producing water								
	11:11:00	3	--	--	28.50	2.69	--	--	--	--
	11:13:00	5	--	--	29.04	3.23	--	--	--	--
	11:13:00	Barely a trickle								
	11:14:00	Turn freq. up to 117 hz to restore flow								
	11:15:00	7	--	--	29.75	3.94	--	--	--	--
	11:15:00	Est. 1/8 gpm								
	11:16:00	8	--	--	30.04	4.23	--	--	--	--
	11:17:00	Freq. = 122 hz								
	11:18:00	10	--	--	29.70	3.89	--	--	--	--
	11:18:00	Flow had stopped								
	11:19:00	Freq. = 124 hz								
	11:20:00	12	--	--	30.14	4.33	--	--	--	--
	11:20:00	Less than 1/4 gpm								
	11:21:00	Freq. = 126 hz								
	11:22:00	14	--	--	31.04	5.23	--	--	--	--
	11:23:00	15	--	--	31.51	5.70	--	--	--	--
	11:23:00	Freq. = 128 hz								
	11:24:00	16	--	--	31.88	6.07	--	--	--	--
	11:24:00	Freq. = 130 hz								
	11:25:00	Freq. = 135 hz, Est. 1/10 gpm								
	11:26:00	18	--	--	32.02	6.21	--	--	--	--
	11:26:00	Freq. = 136 hz								
	11:27:00	Flow increased - reduce freq. to 120 hz								
	11:28:00	20	--	--	32.90	7.09	--	--	--	--
	11:28:00	Pump off - Flow started fluctuating								
	11:32:00	24	4	6.000	32.27	6.46	--	--	--	--
	11:32:00	Did not get enough water to sample								
	11:33:00	25	5	5.000	31.91	6.10	--	--	--	--
	11:35:00	27	7	3.857	31.69	5.88	--	--	--	--
	11:41:00	33	13	2.538	31.07	5.26	--	--	--	--
	11:43:00	35	15	2.333	30.86	5.05	--	--	--	--
	11:46:00	38	18	2.111	30.61	4.80	--	--	--	--
	11:48:00	Pulling Pump								
	11:51:00	43	23	1.870	30.67	4.86	--	--	--	--
	11:53:00	45	25	1.800	30.50	4.69	--	--	--	--
	12:04:00	56	36	1.556	29.67	3.86	--	--	--	--

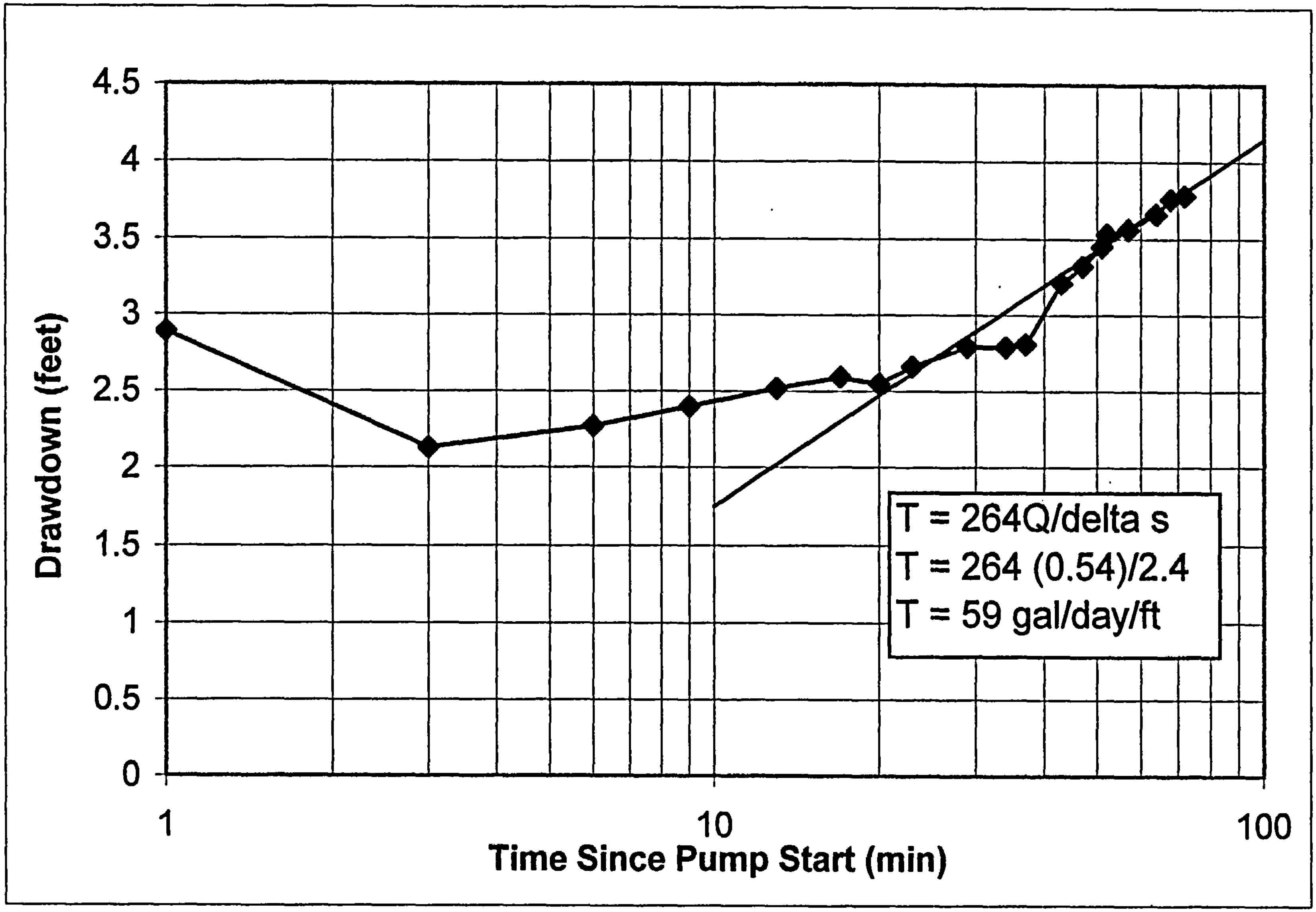


Figure B.3-1. Drawdown Response in Well SCDIV-2

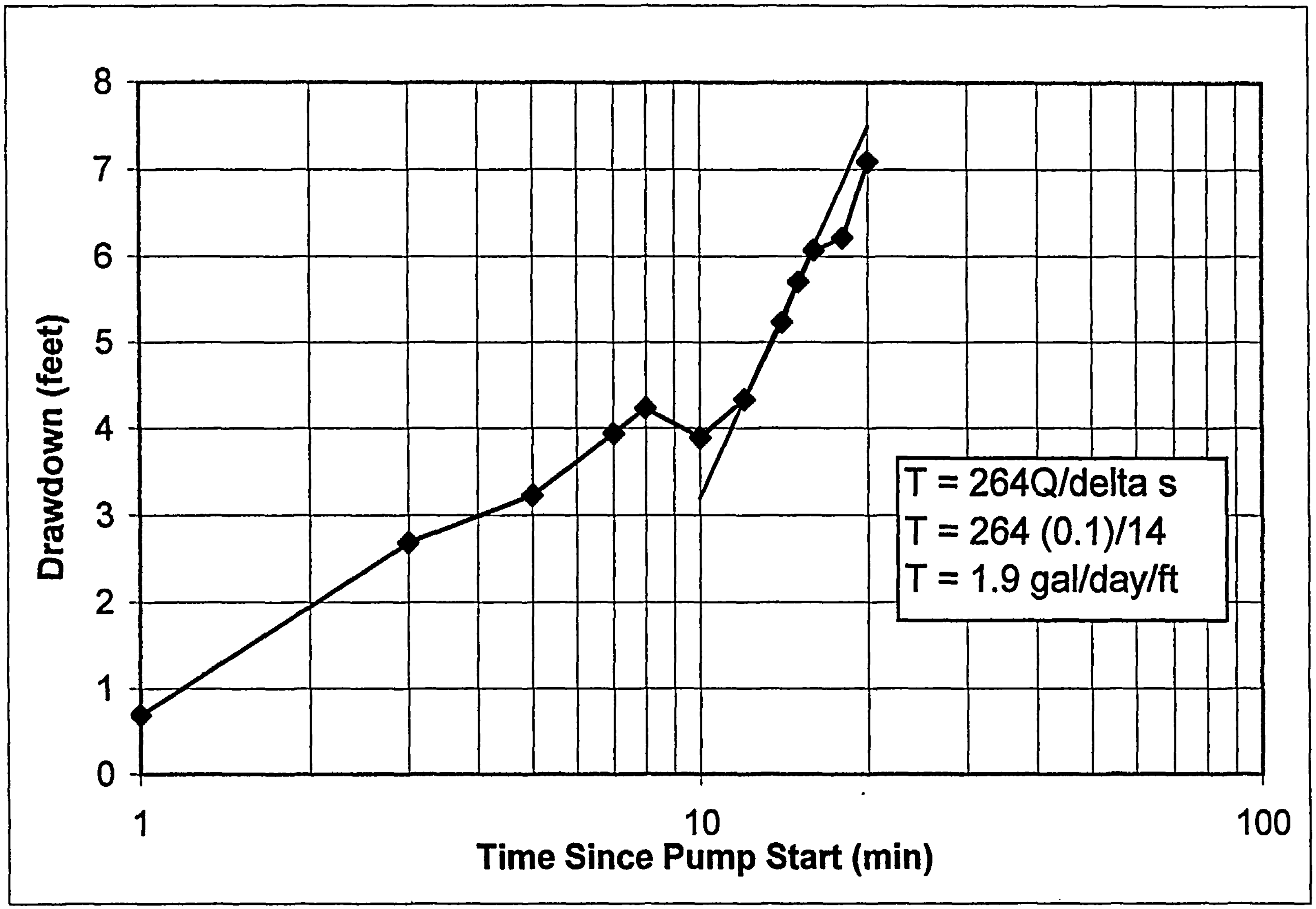


Figure B.3-2. Drawdown Response in Well SCDIV-3

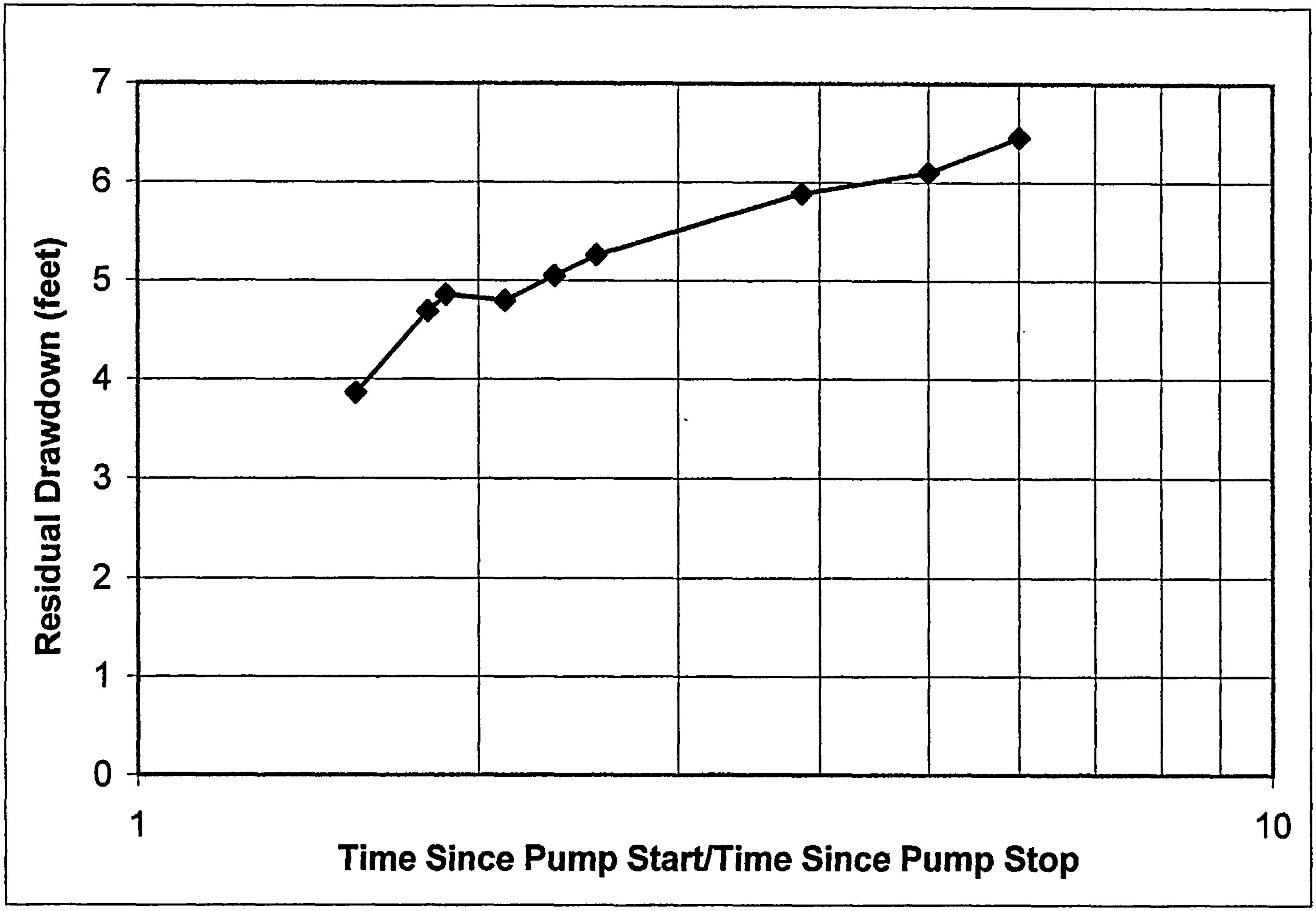


Figure B.3-3. Recovery Response in Well SCDIV-3

HYDRO - ENGINEERING, LLC

PATHFINDER

January 30, 2004

Mr. Gary Janosko, Branch Chief
Fuel Cycle Facilities Branch
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards
U. S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, Maryland 20852

Ref: Docket No. 40-2259, Source Material License No. SUA-672

Dear Mr. Janosko:

Enclosed please find two copies of the semi-annual ground water monitoring report as required by condition 60B of the referenced license. Please let us know if there are any questions regarding the report.

Sincerely,

Tom Hardgrove

T. W. Hardgrove
Manager, Reclamation Operations

Enclosure

Cc: C. Cain, USNRC Region IV
D. L. Wichers
Hydro-Engineering, LLC, w/o encl.

PATHFINDER Mines Corporation
935 Pendell Blvd., P.O. Box 730, Mills, WY 82644 • Tel. : (307) 234-5019 • Fax : (307) 473-7306

SEMI-ANNUAL
GROUND-WATER MONITORING
FOR LUCKY Mc MINE

PREPARED FOR:

PATHFINDER MINES CORPORATION
LUCKY Mc MINE

BY:

HYDRO-ENGINEERING, L.L.C.

JANUARY, 2004

George L. Hoffman

GEORGE L. HOFFMAN, P.E.
HYDROLOGIST

1/29/04

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(continued)

FIGURES

Page Number

TABLES

Page Number

1.0 Introduction and Summary of Results

This semi-annual report presents the results of ground-water monitoring for the second half of 2003 for the Lucky Mc tailings area. This report covers the requirement of NRC License SUA-672, License Condition 60B.

The following table lists the site standards that are in effect at Lucky Mc POC well T1-12. The tabulation also lists the measured December 2003 concentrations for POC well T1-12. All of the present concentrations in POC well T1-12 are significantly below the site standards. Plots of the key constituent concentrations for POC well T1-12 show that the concentrations at this well are steady or gradually declining. Comparison of the present concentrations at the POC and POE wells to the ACL model predictions indicates that the model results were conservative (higher than observed).

GROUND-WATER PROTECTION STANDARDS FOR POINT-OF COMPLIANCE WELL T1-12 AND DECEMBER 2003 POC CONCENTRATION

POC STANDARD & CONCENTRATION	CONSTITUENT								
	Arsenic	Beryllium	Cadmium	Chromium	Nickel	RA-226 + RA-228	Selenium	Thorium-230	Uranium
SITE STANDARD	0.05	0.07	0.02	0.05	0.85	7.5	1.10	13.2	1.70
T1-12, DECEMBER 2003	<0.002	<0.001	<0.001	<0.002	0.27	<2.8	0.55	<0.2	0.36

NOTE: All concentrations in mg/l except for Radium-226 plus Radium-228 and Thorium-230 which are in pCi/L

2.0 Piezometric Data

The water-level data collected during the second six months of 2003 is presented in Table 1 along with the first half of 2003 and 2002 water-level data. Figure 1 presents the piezometric surface of the Lucky Mc aquifer from the POC well through the Fraser Draw alluvium, while Figure 2 presents plots of the water-level elevations versus time for wells AL-6, T1-6, T1-12, AL-1, AL-7, AL-8 and AL-9. The corresponding water-level elevation or constituent concentration is posted adjacent to the well location on the plan view figures of the area (such as Figure 1). Water-level elevations in 2003 have been steady in these wells except for some water level change in well T1-6, which was used as a supply well for the Lucky Mc office during late 2002 and the first portion of 2003.

3.0 Water-Quality Data

License Condition 60B requires monitoring of water from the POC and POE wells and other selected wells for the constituents presented in Table 1. An analysis of the selenium, uranium, combined radium-226 plus radium-228, sulfate, chloride and TDS concentrations is required.

Figure 3 presents the December 2003 chloride concentrations for the Lucky Mc aquifer. The chloride concentrations are highest in the Wind River Channel at POC well T1-12 and decrease significantly beyond POE well AL-6. Figure 4 presents the plots of chloride concentrations versus time for the seven monitored wells. Overall, chloride concentrations are gradually declining in POC well T1-12. The chloride concentrations in well AL-1 declined to near the level in AL-7 in the second half of 2003.

Figure 5 presents the TDS concentrations for December 2003 water samples from the Lucky Mc aquifer. The TDS concentrations are greater than 5000 mg/l at POC well T1-12 and are between 2000 and 4000 mg/l in the Fraser Draw alluvial wells. Figure 6 presents the plots of TDS concentrations versus time and illustrates that the 2003 TDS concentrations are generally less than the average value for the previous few years. The largest decline in TDS was observed in well AL-1.

The measured sulfate concentrations for the Lucky Mc aquifer during 2003 are presented in Figure 7 and show that the sulfate concentrations in the western portion of the Fraser Draw alluvium are greater than 2000 mg/l while concentrations are less than 2000 mg/l in the eastern half. The sulfate concentrations versus time plots in Figure 8 show that sulfate concentrations have been steady in 2003 in POC well T1-12; however, they are slightly above the average of the previous two years.

Uranium concentrations for the Lucky Mc aquifer during 2003 are presented in Figure 9 and show the highest observed uranium concentration at POE well AL-6. Figure 10 shows that the uranium concentration in the POE well has been steady in 2003 compared to 2002 data. The uranium concentrations have been very steady in POC well T1-12 but have declined in the second half of 2003 in well AL-1.

Figure 11 presents the selenium concentrations for December 2003 for the Lucky Mc aquifer. Selenium concentrations are the greatest at POC well T1-12. Selenium concentrations in POC well T1-12 have been on an overall decline for several years but were steady in 2003 (see Figure 12). Selenium concentrations declined in AL-1 in 2003.

Figure 13 presents the radium-226 plus radium-228 activity for December 2003 at the Lucky Mc aquifer in pCi/l. All of these concentrations are below significant levels and therefore no contours are shown on this figure. Figure 14 shows plots of the radium-226 plus radium-228 activity versus time for the monitored wells. These plots show significant variability in these values, which is thought to be due to variability in the laboratory analysis. The value in the first quarter of 2003 was larger due to a large radium-228 activity. The previous measurement and the remainder of the 2003 activity values are significantly smaller and therefore the larger value is thought to be due to analytical variations.

Concentrations of the remainder of the constituents at the site are gradually decreasing or are not significant at POC well T1-12.

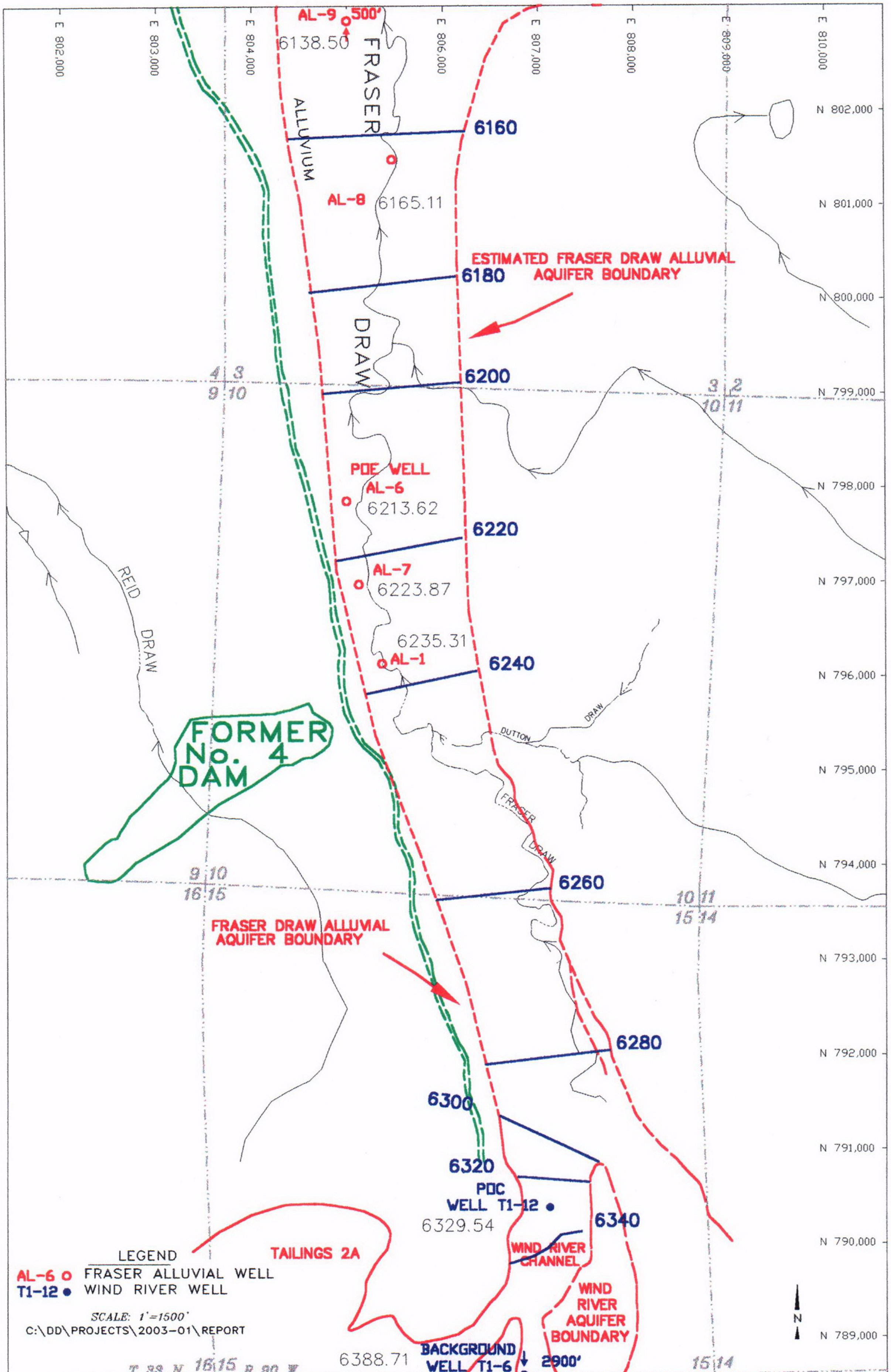
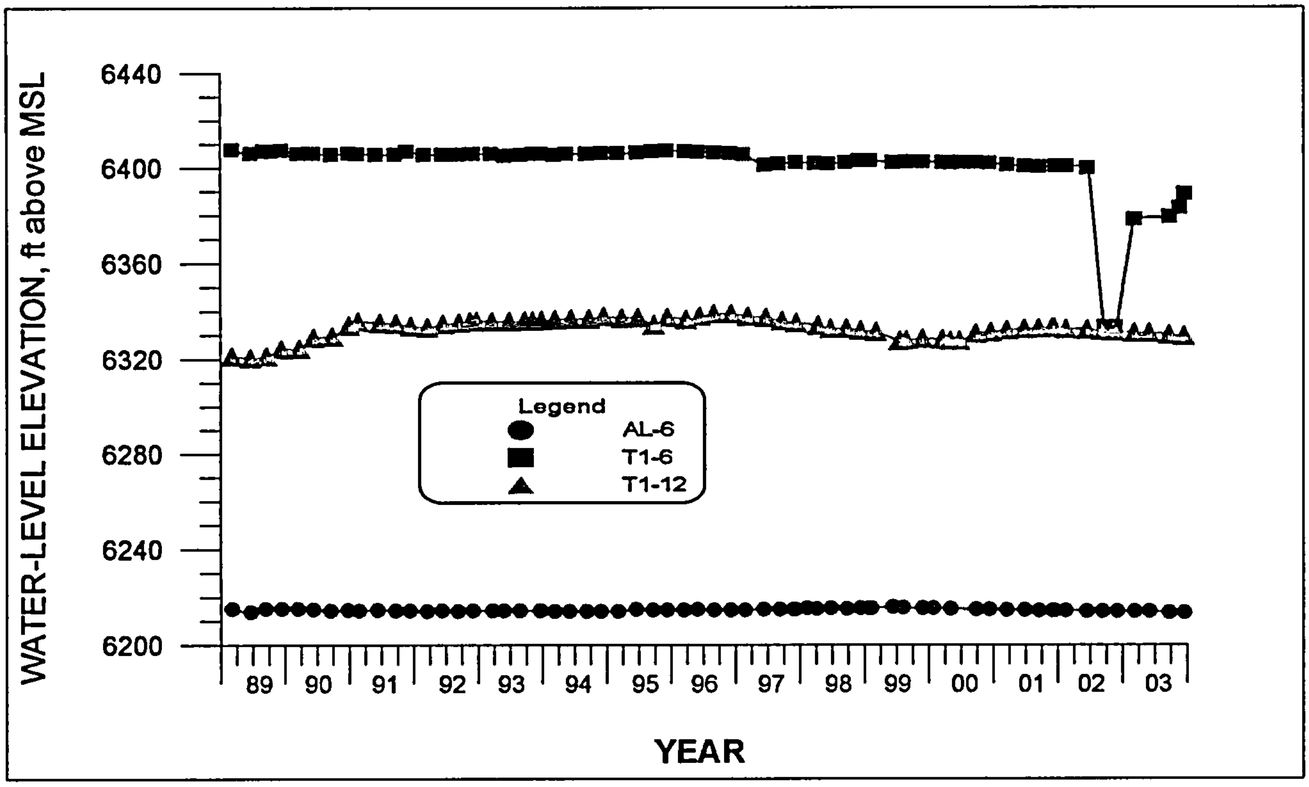


FIGURE 1. LOCATIONS OF MONITORING WELLS AND PIEZOMETRIC CONTOURS AT LUCKY MC IN DECEMBER 2003, FT-MSL.

C02



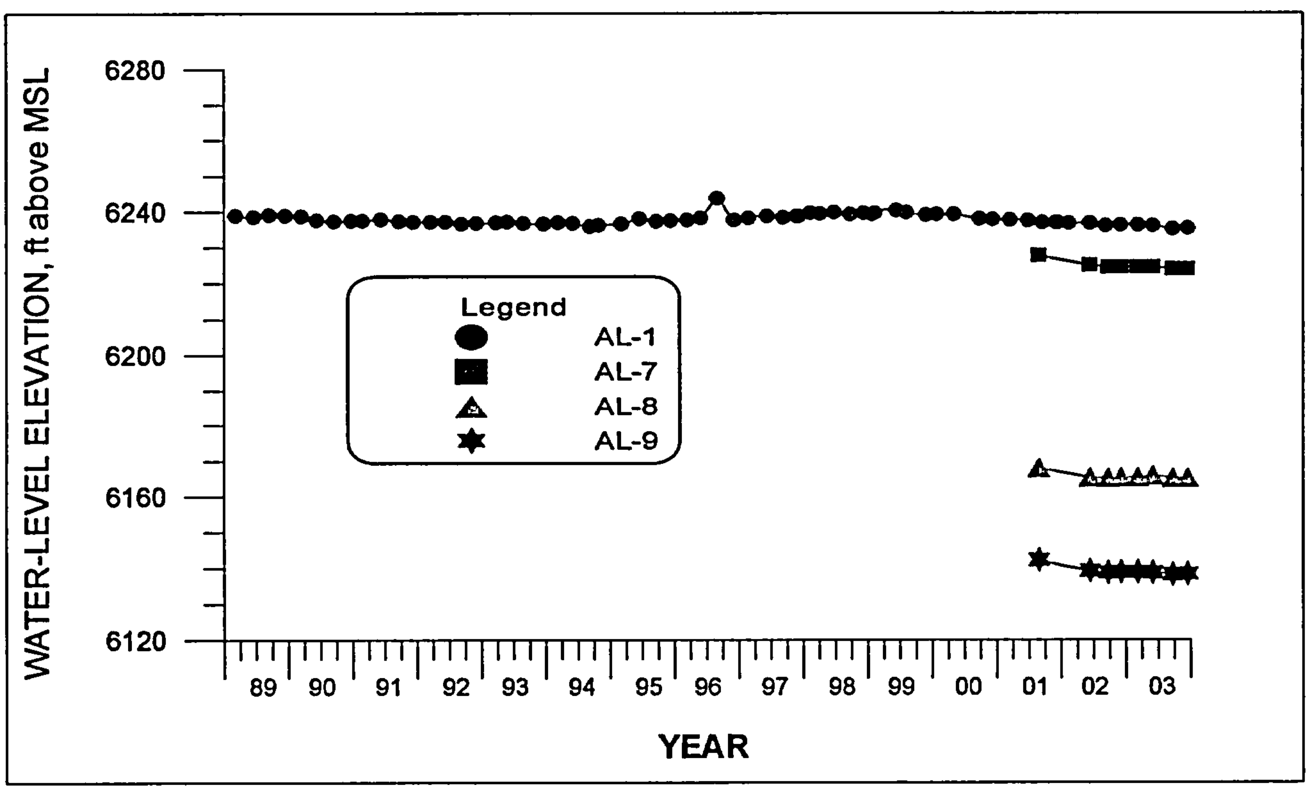


FIGURE 2. WATER-LEVEL ELEVATION VERSUS TIME FOR WELLS T1-6, T1-12, AL-1, AL-6, AL-7, AL-8 AND AL-9.

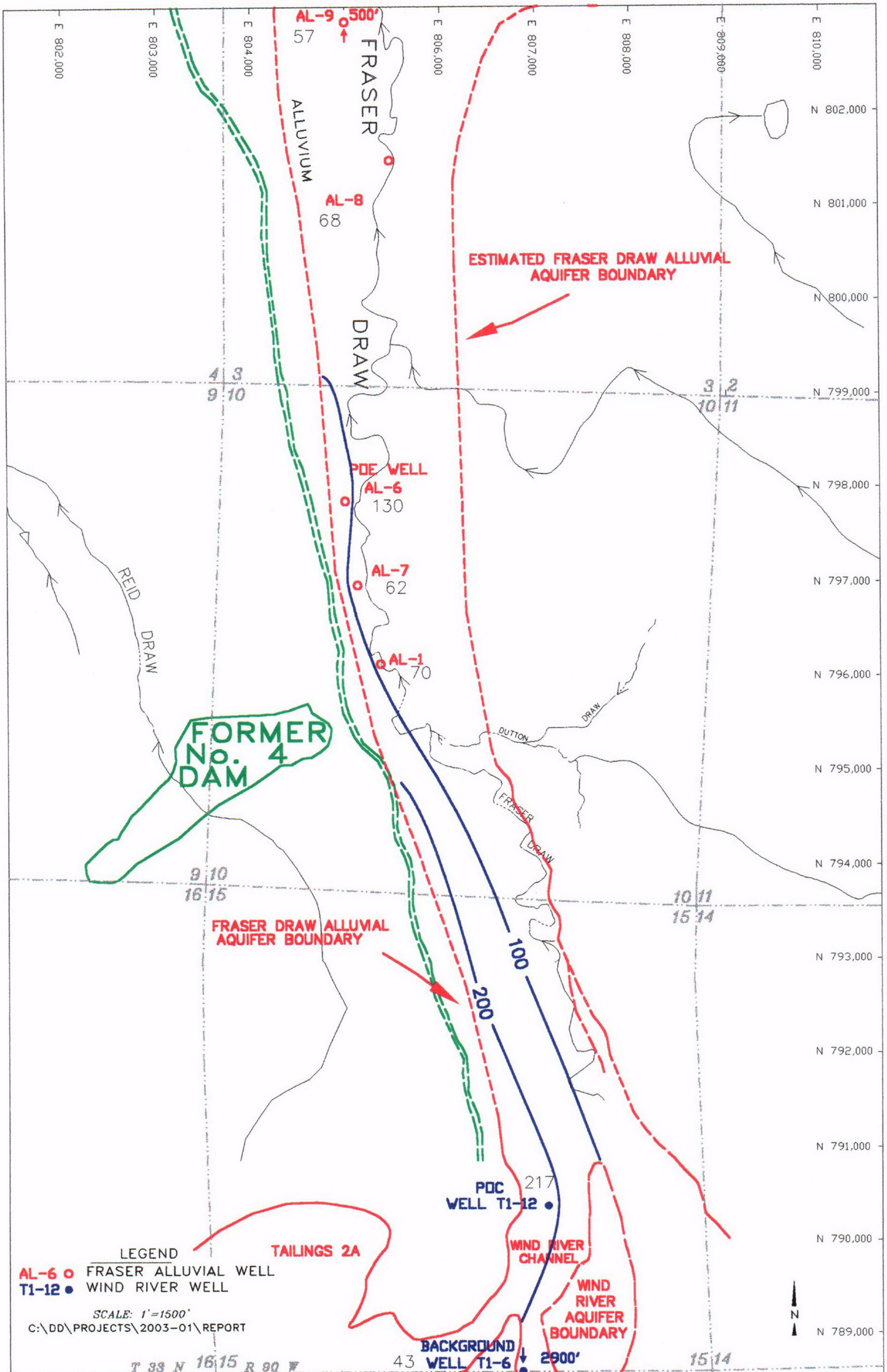
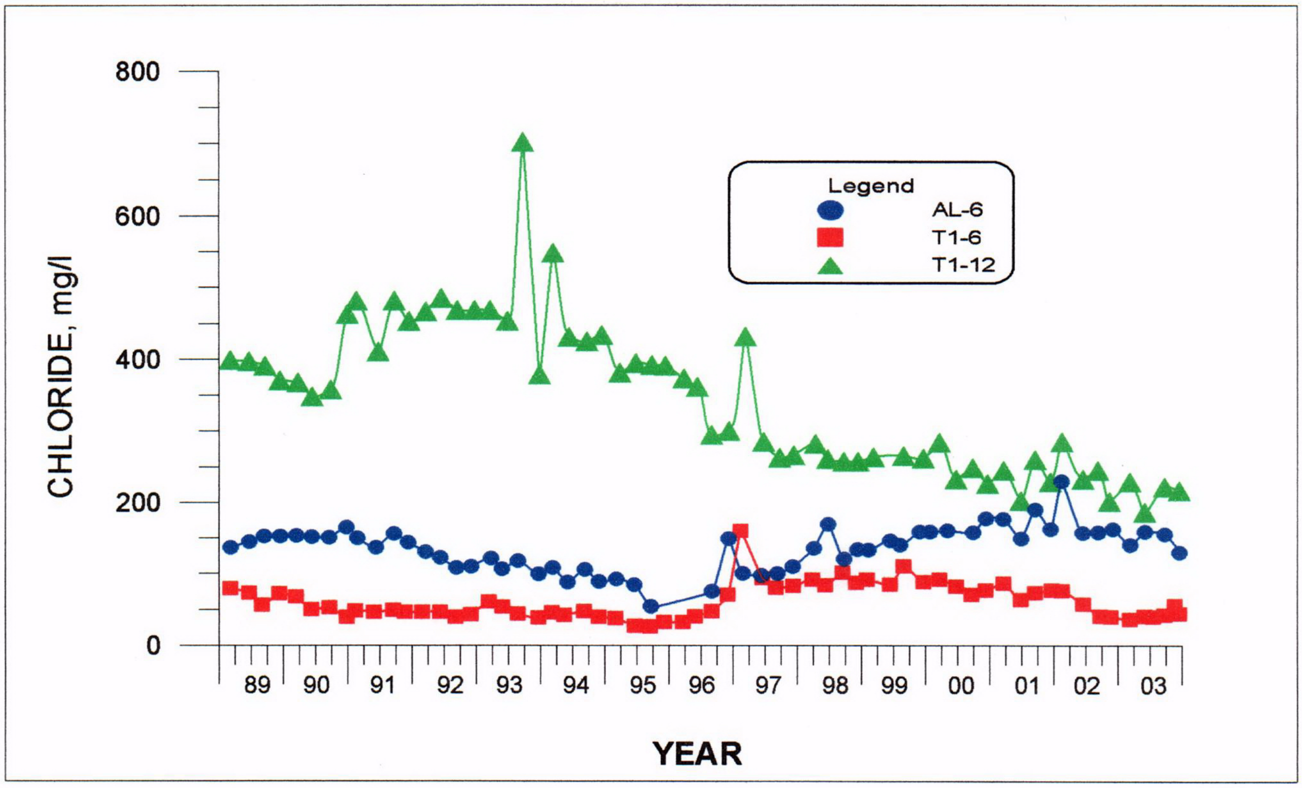


FIGURE 3. CHLORIDE CONCENTRATIONS IN DECEMBER 2003 AT LUCKY MC, IN mg/l

C03



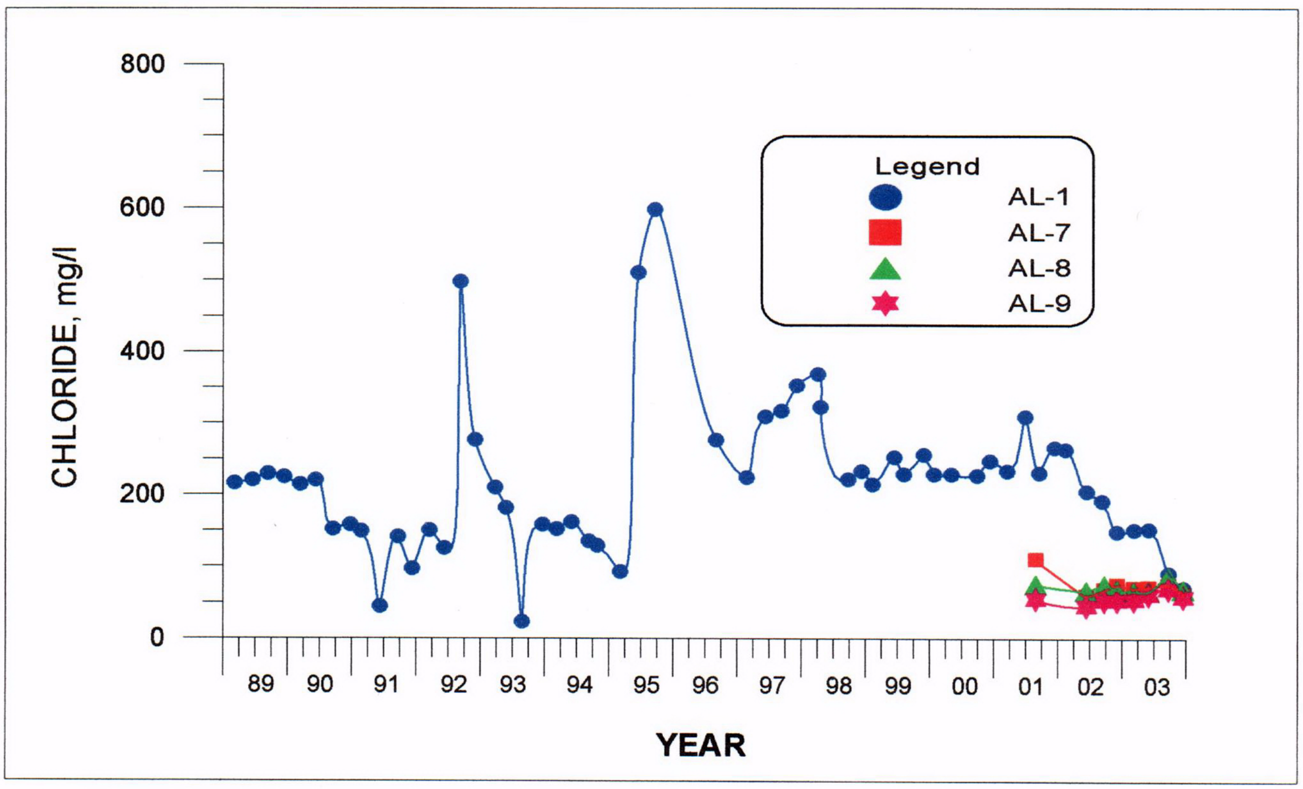


FIGURE 4. CHLORIDE CONCENTRATIONS VERSUS TIME FOR WELLS T1-6, T1-12, AL-1, AL-6, AL-7, AL-8 AND AL-9.

C04

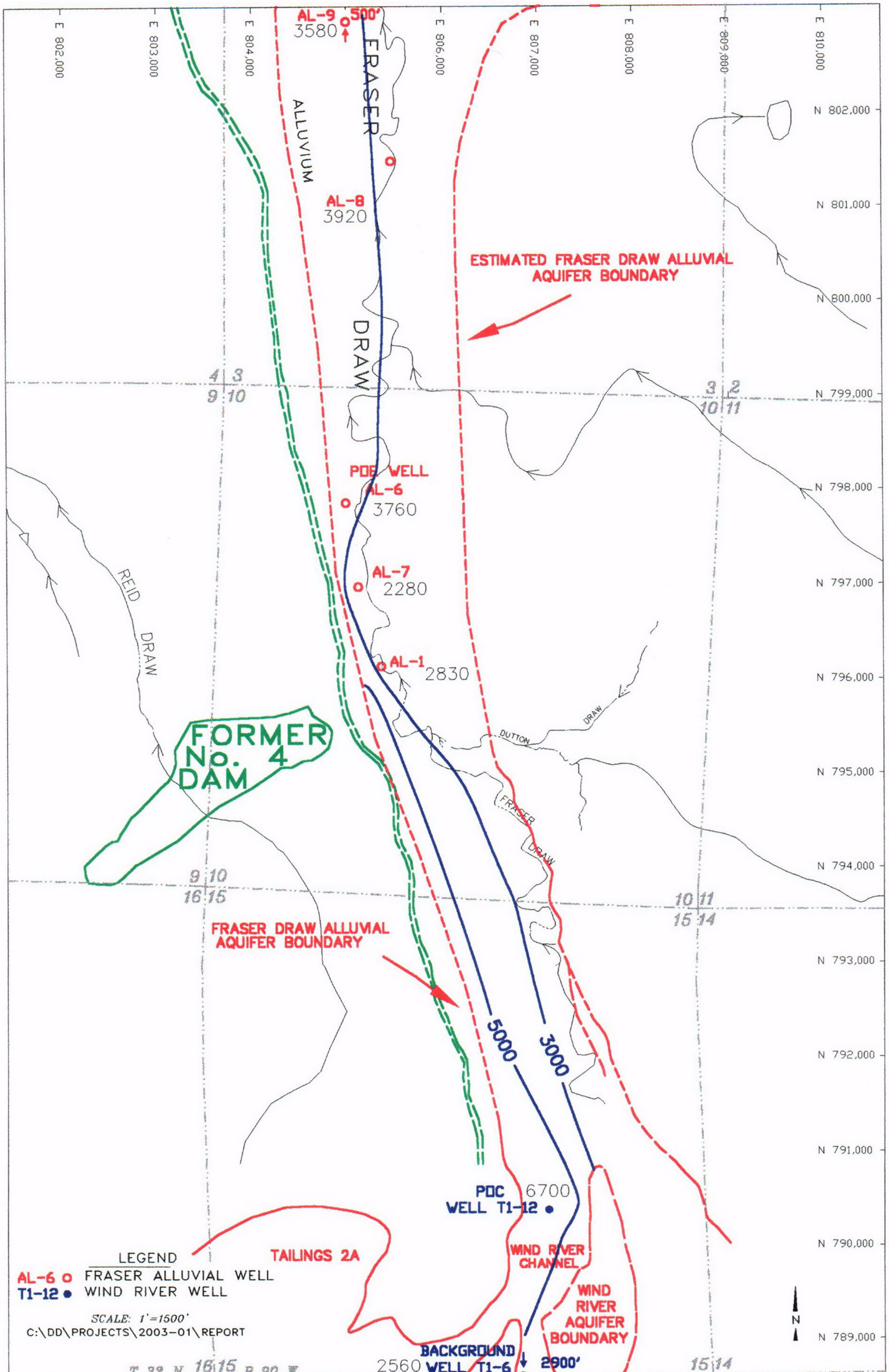
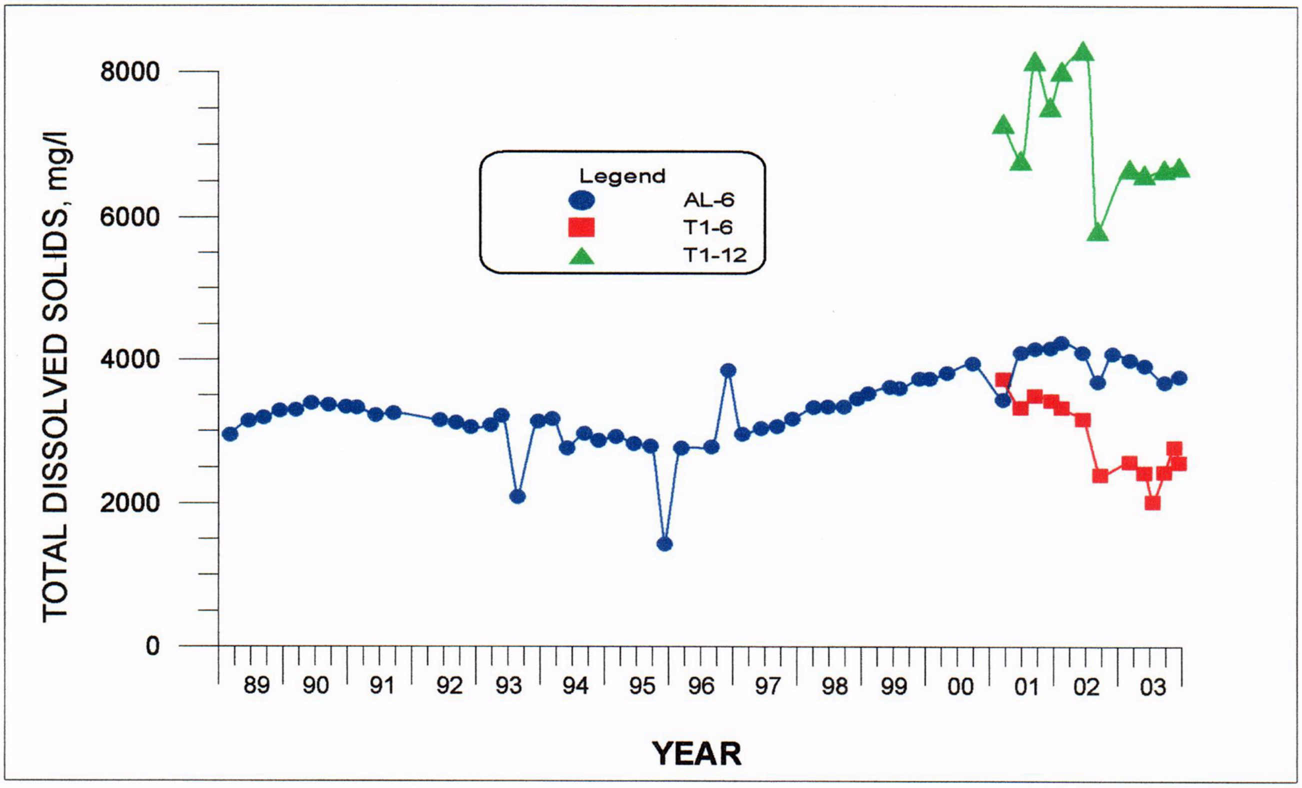


FIGURE 5. TDS CONCENTRATIONS IN DECEMBER 2003 AT LUCKY MC, IN mg/l

C05



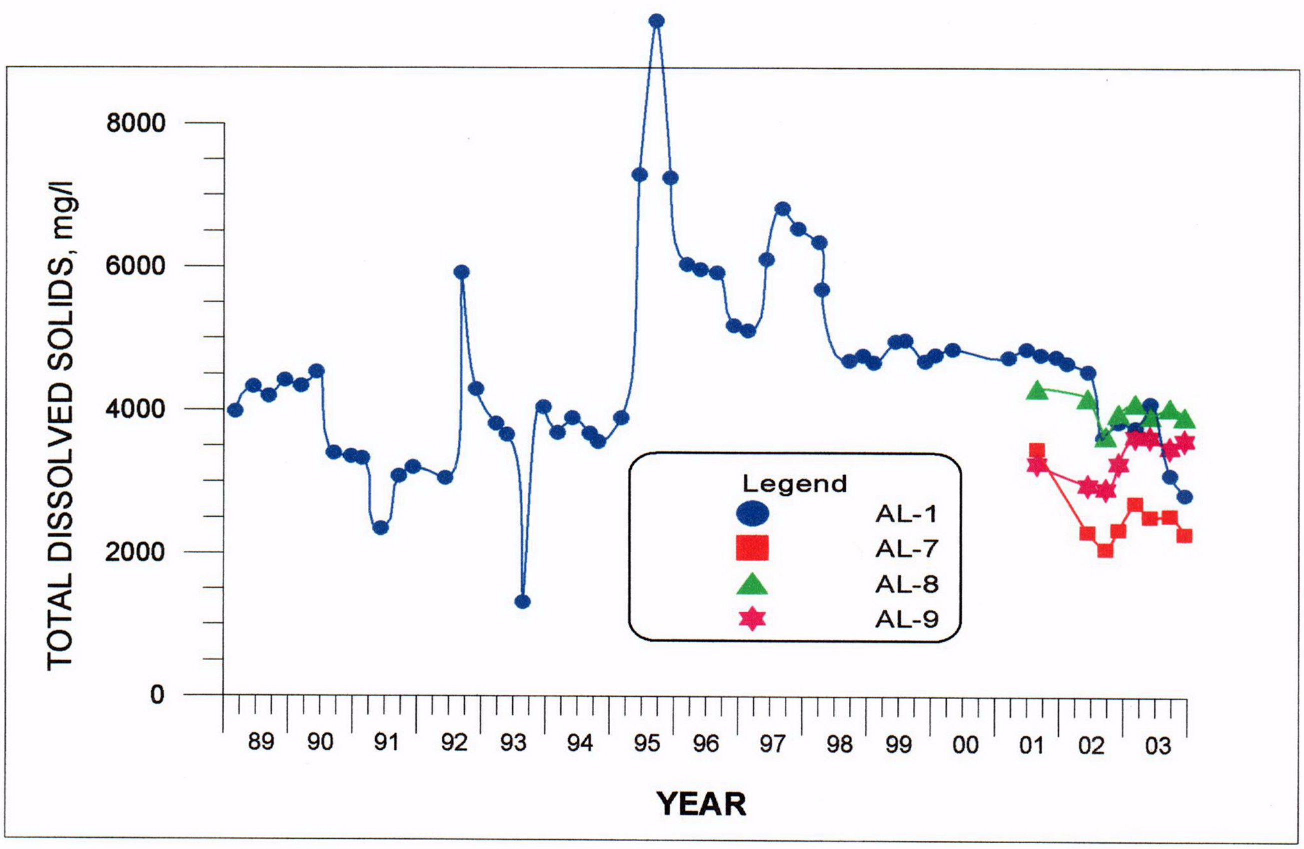


FIGURE 6. TDS CONCENTRATIONS VERSUS TIME FOR WELLS T1-6, T1-12, AL-1, AL-6, AL-7, AL-8 AND AL-9.

C06

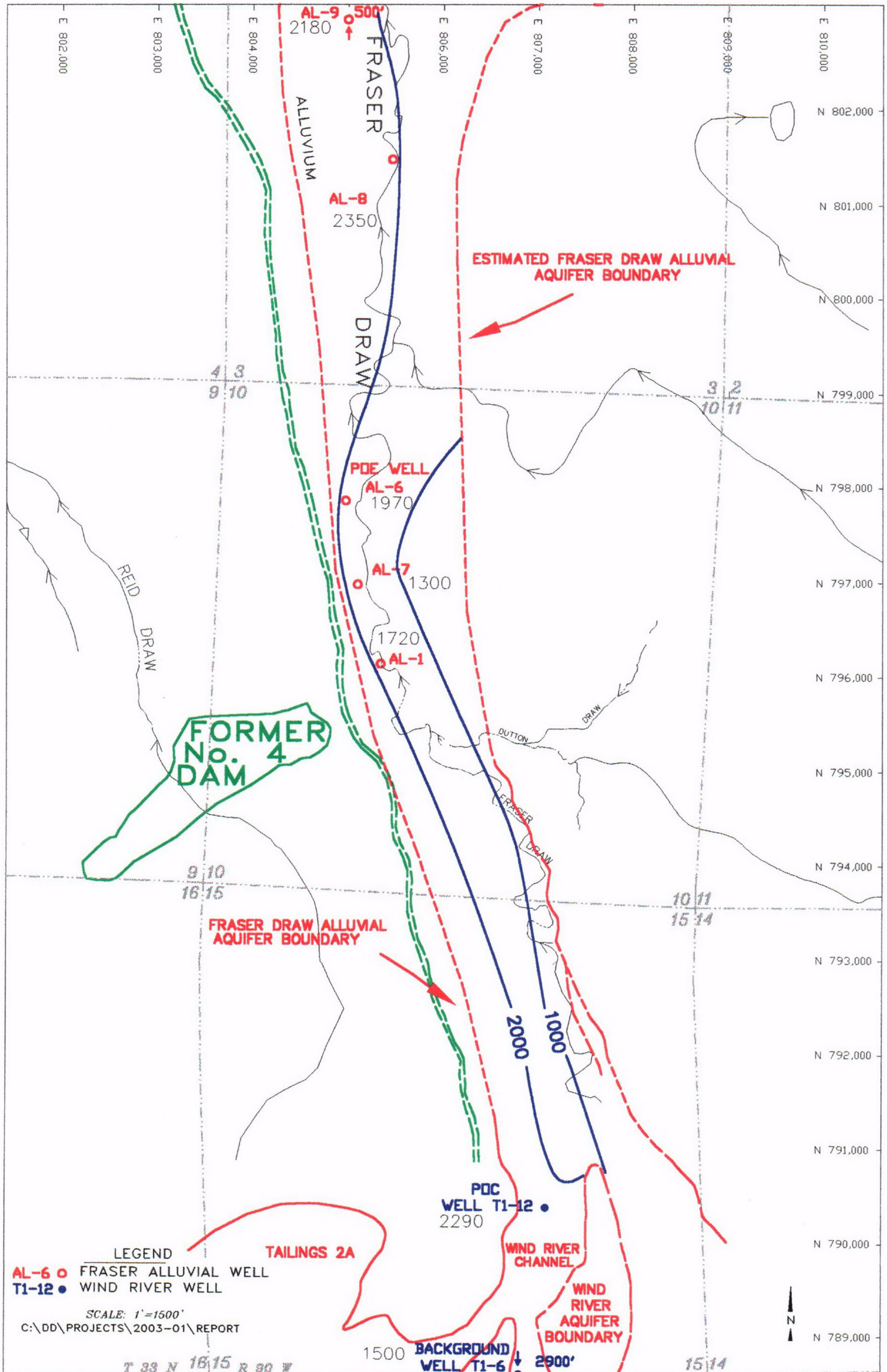
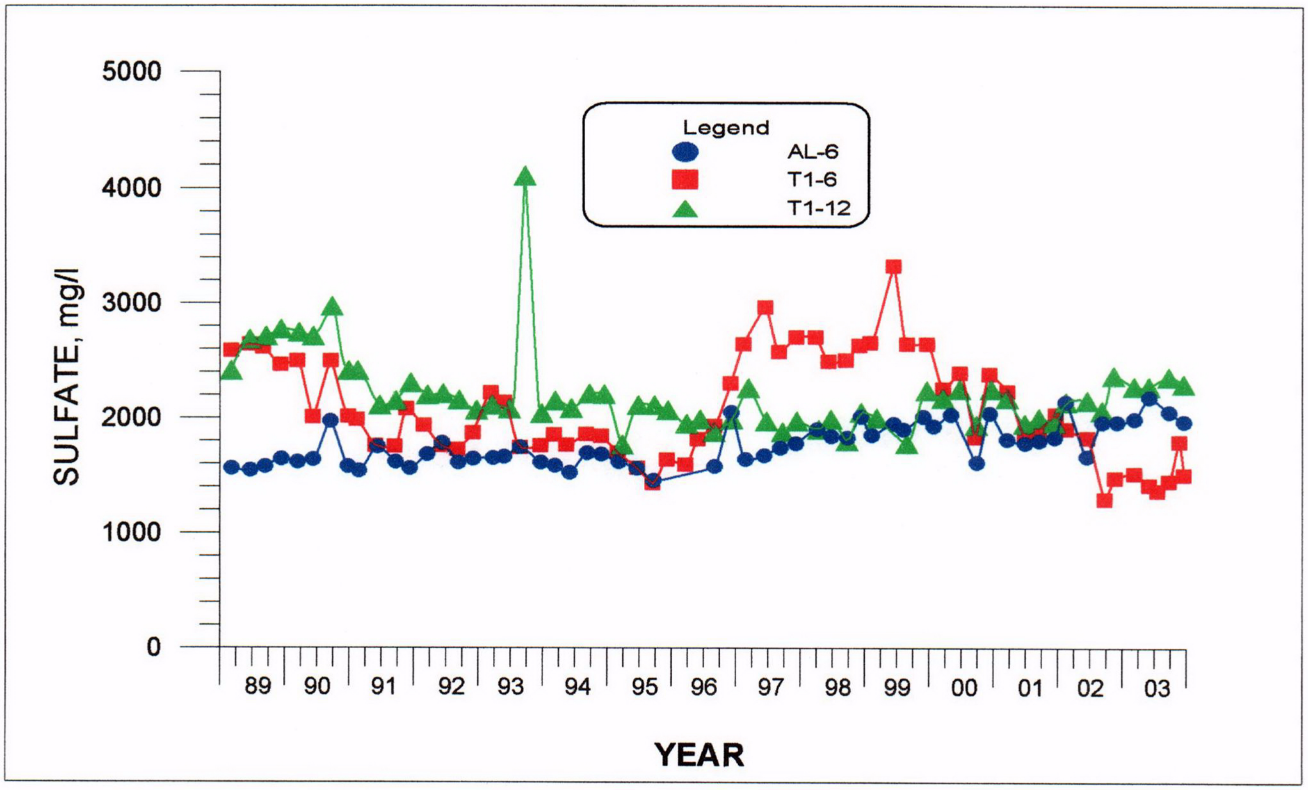


FIGURE 7. SULFATE CONCENTRATIONS IN DECEMBER 2003 AT LUCKY MC, IN mg/l

C07



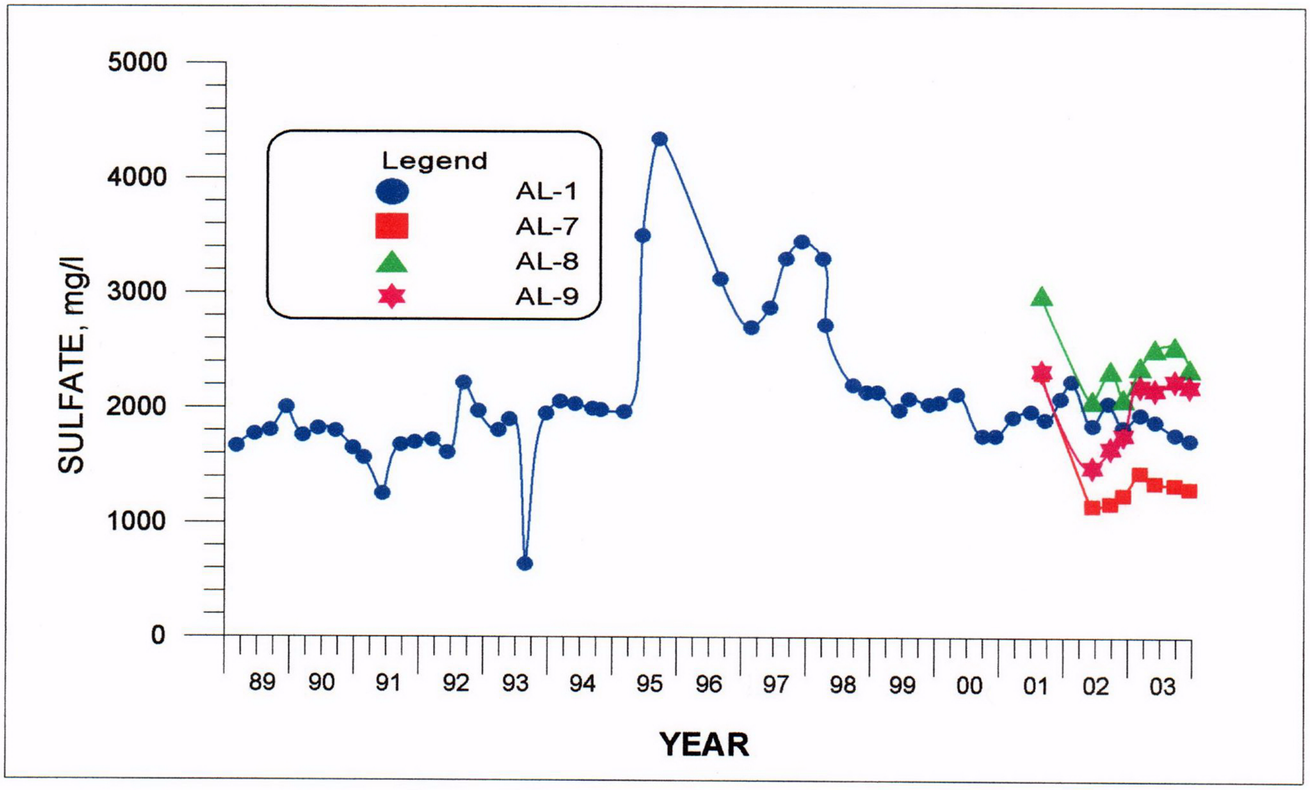


FIGURE 8. SULFATE CONCENTRATIONS VERSUS TIME FOR WELLS T1-6, T1-12, AL-1, AL-6, AL-7, AL-8 AND AL-9.

C08

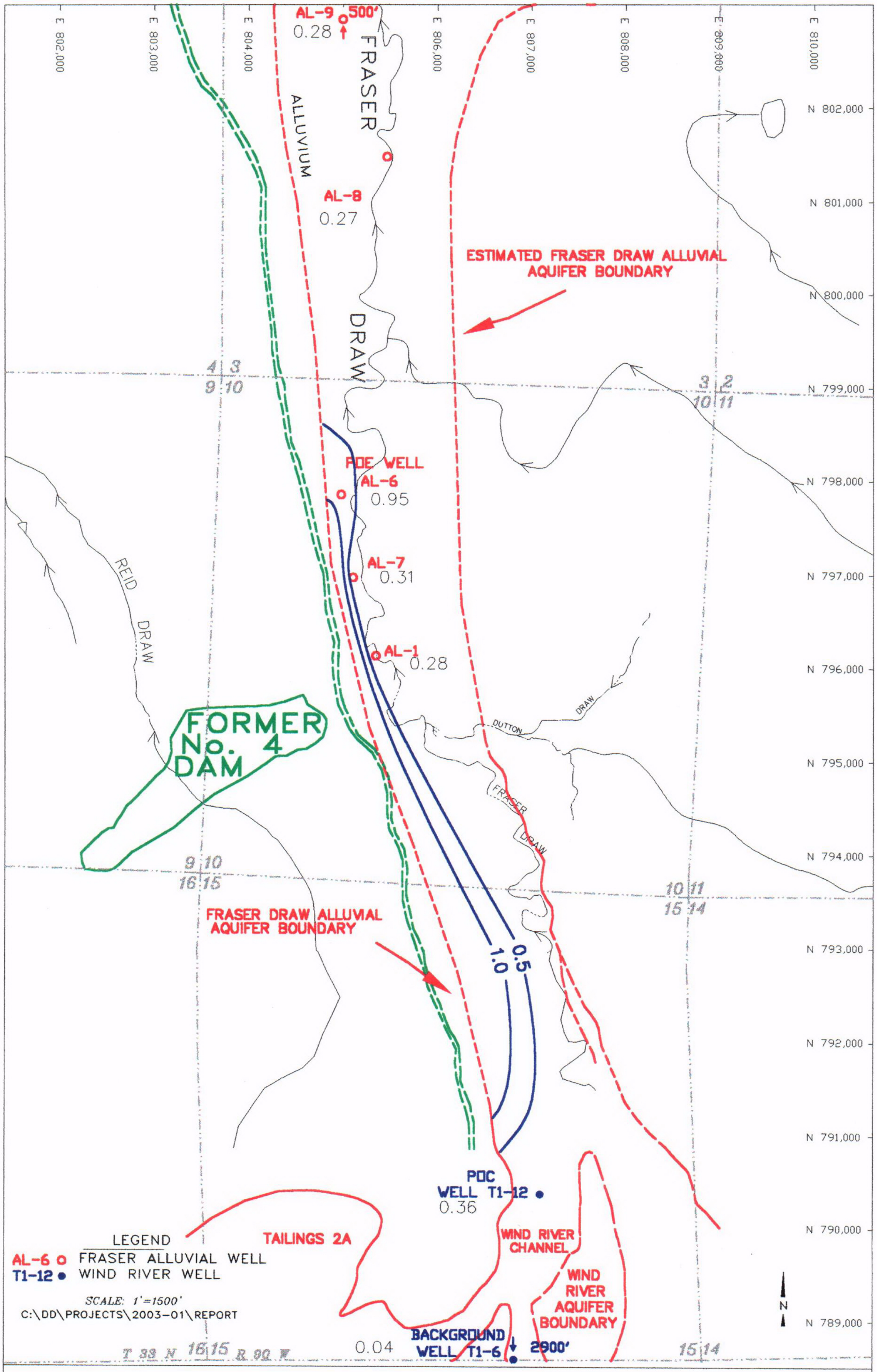
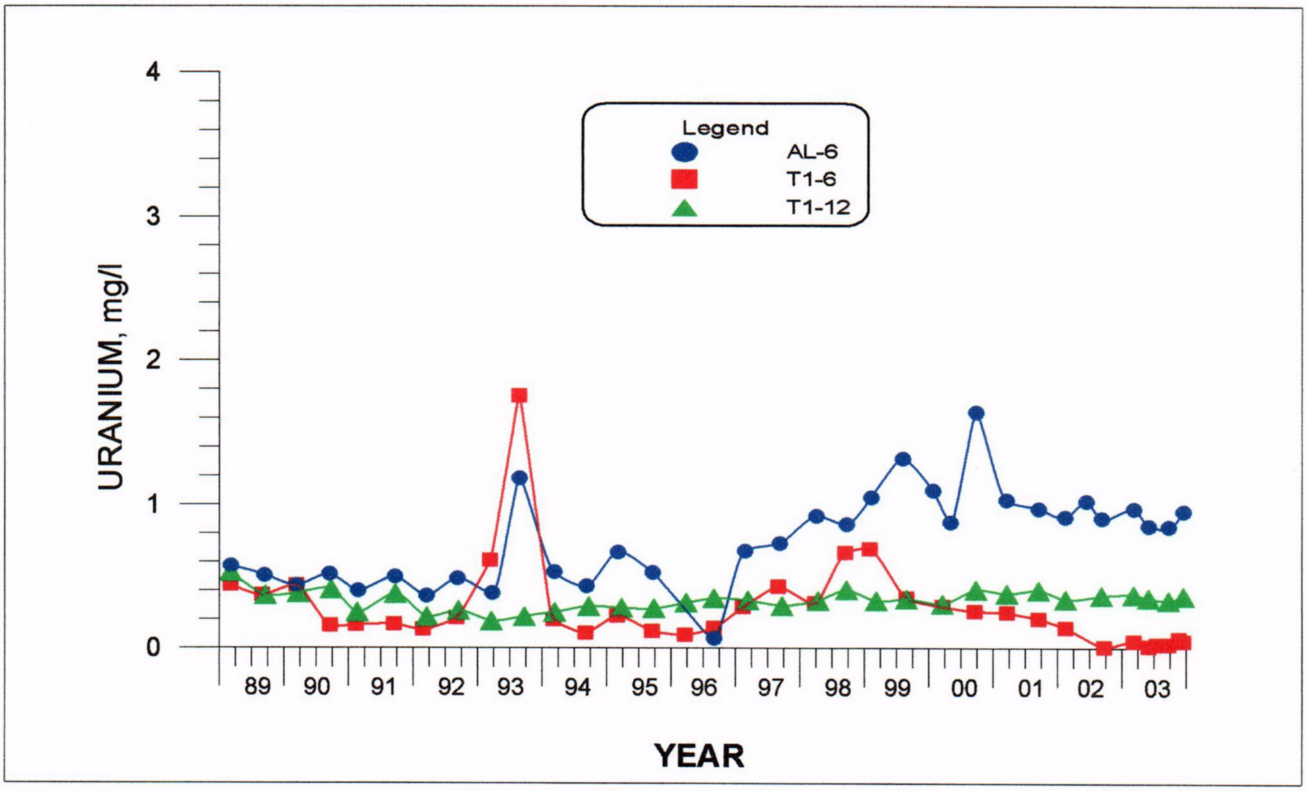


FIGURE 9. URANIUM CONCENTRATIONS IN DECEMBER 2003 AT LUCKY MC, IN mg/l

C09



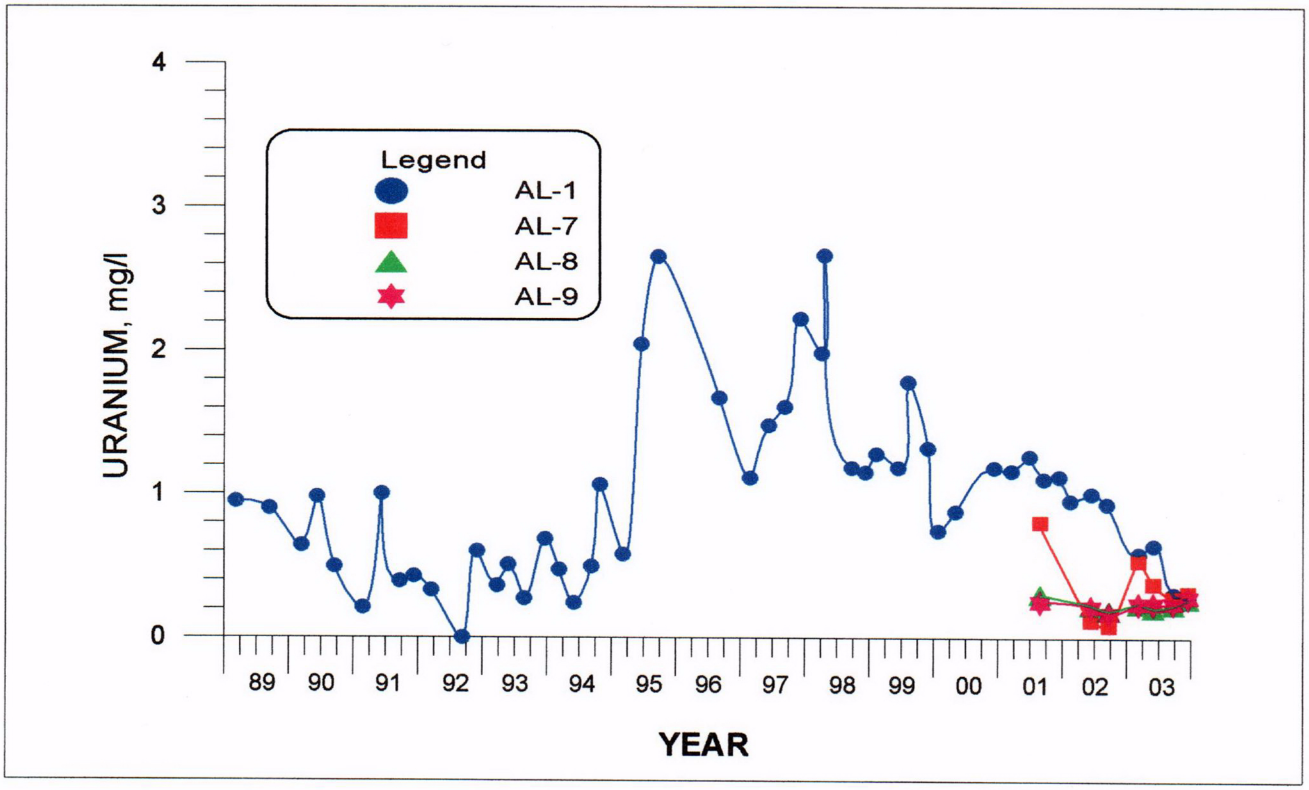


FIGURE 10. URANIUM CONCENTRATIONS VERSUS TIME FOR WELLS T1-6, T1-12, AL-1, AL-6, AL-7, AL-8 AND AL-9.

C10

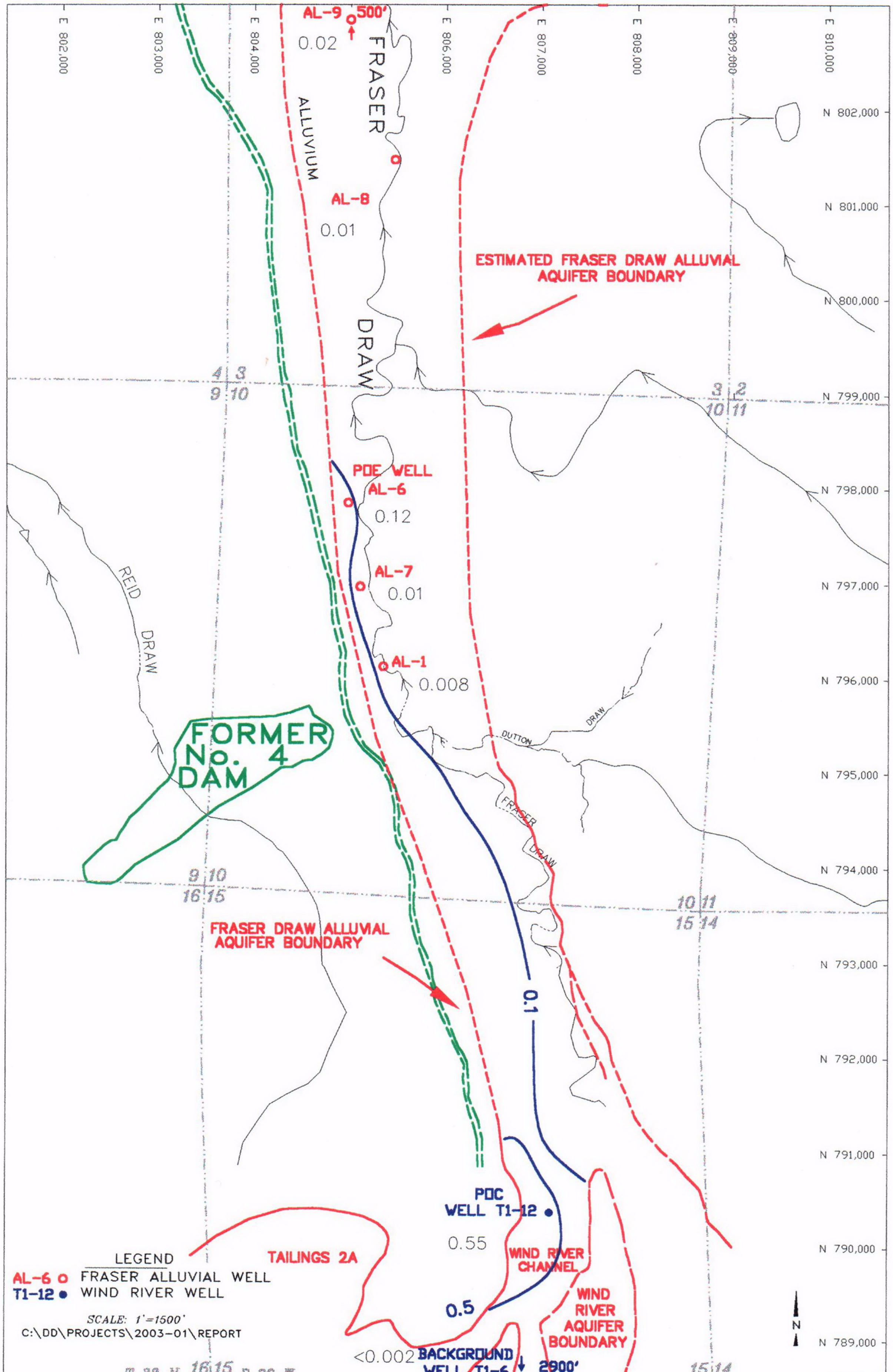
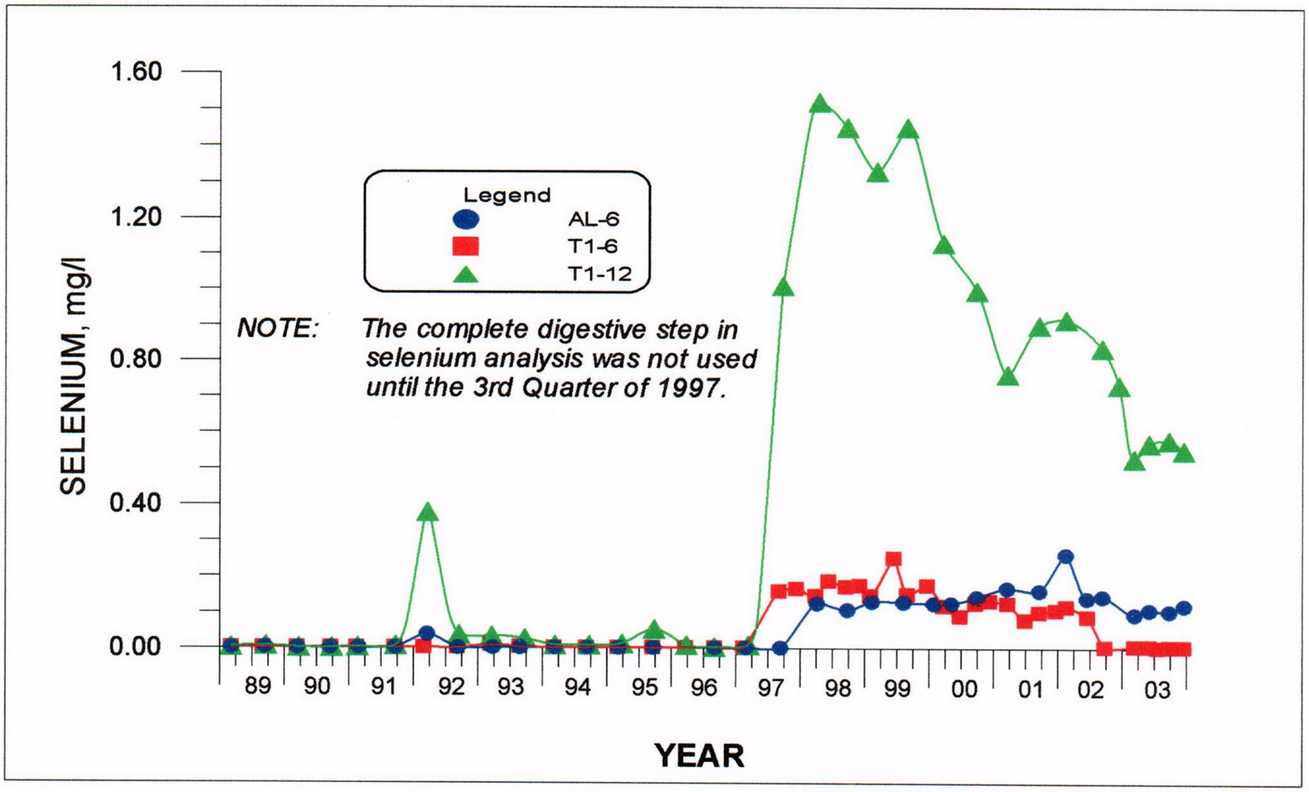


FIGURE 11. SELENIUM CONCENTRATIONS IN DECEMBER 2003 AT LUCKY MC, IN mg/l

C11



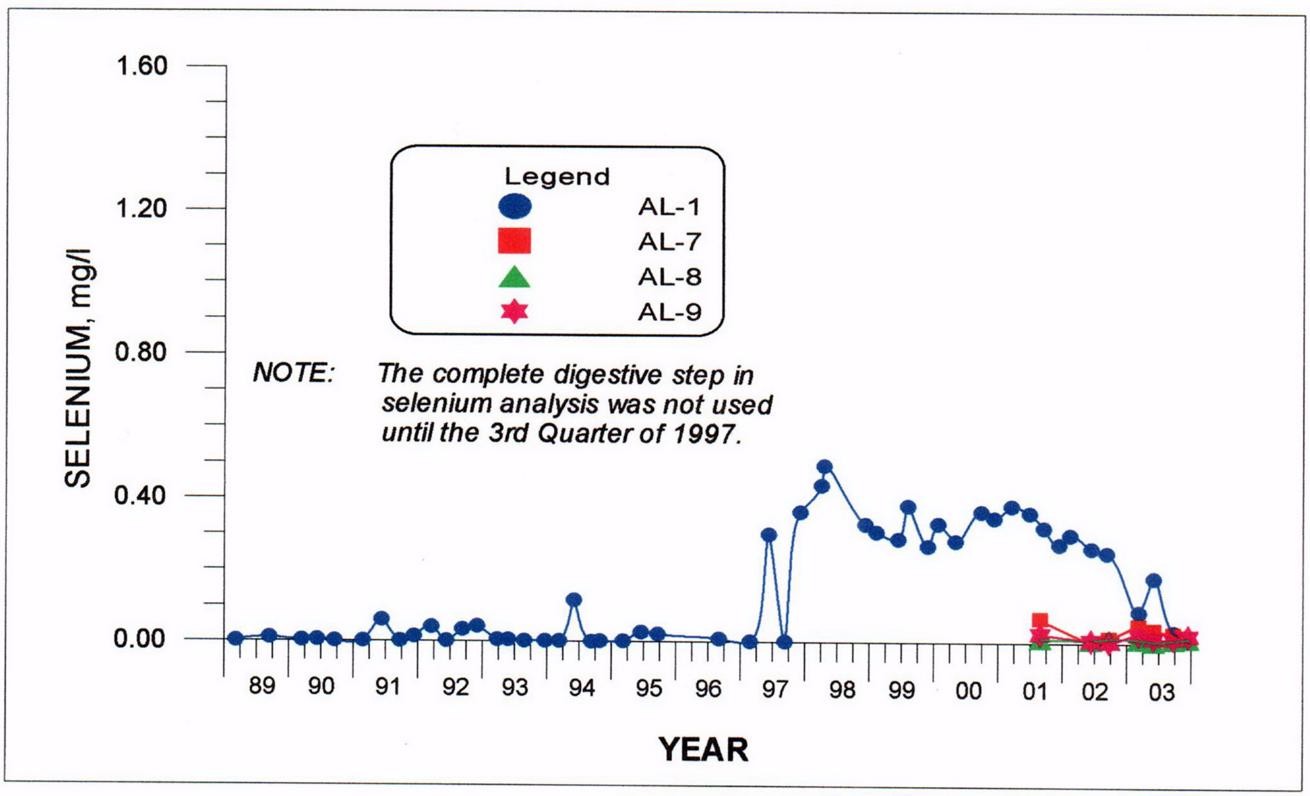


FIGURE 12. SELENIUM CONCENTRATIONS VERSUS TIME FOR WELLS T1-6, T1-12, AL-1, AL-6, AL-7, AL-8 AND AL-9.

C12

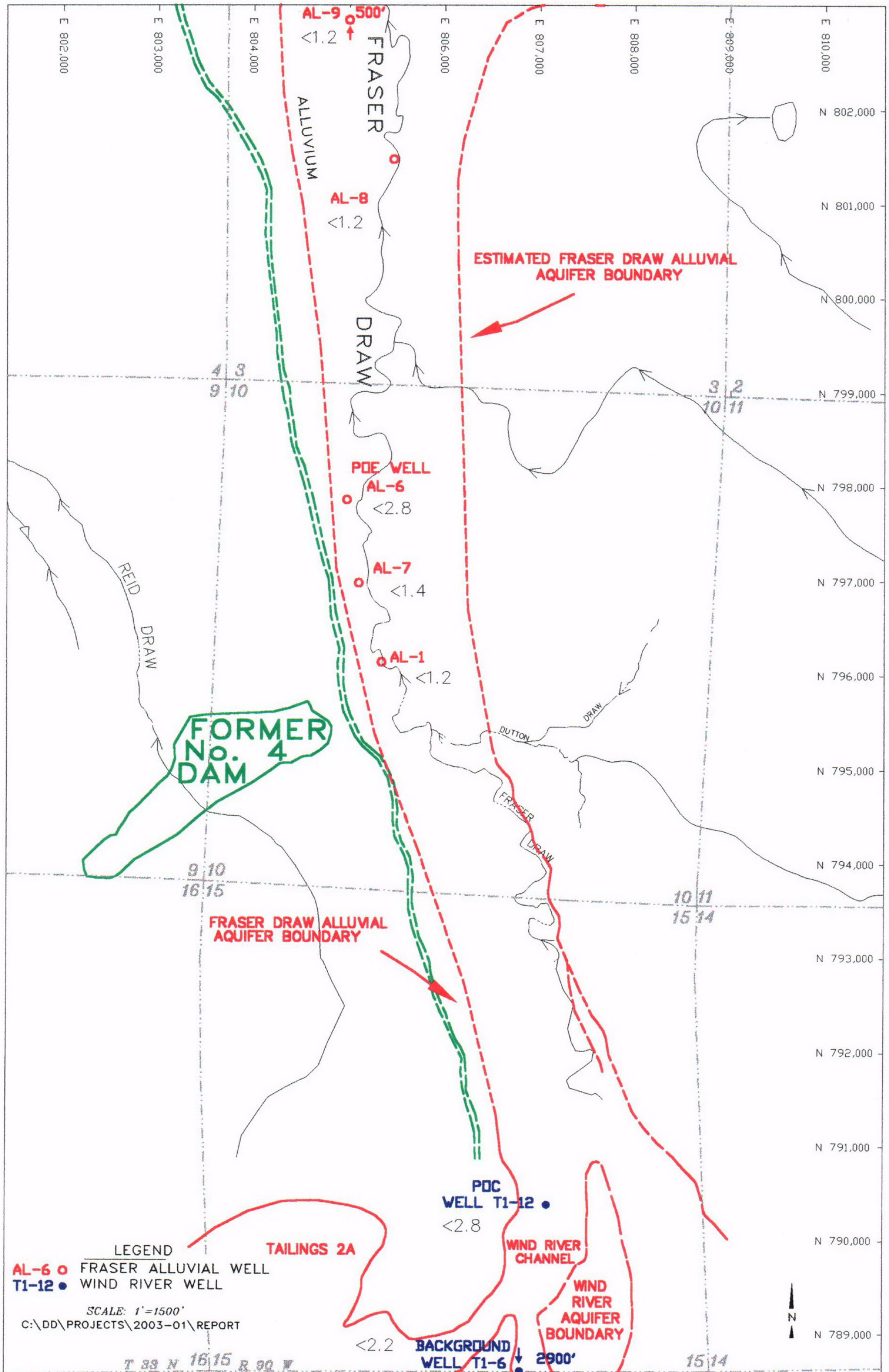
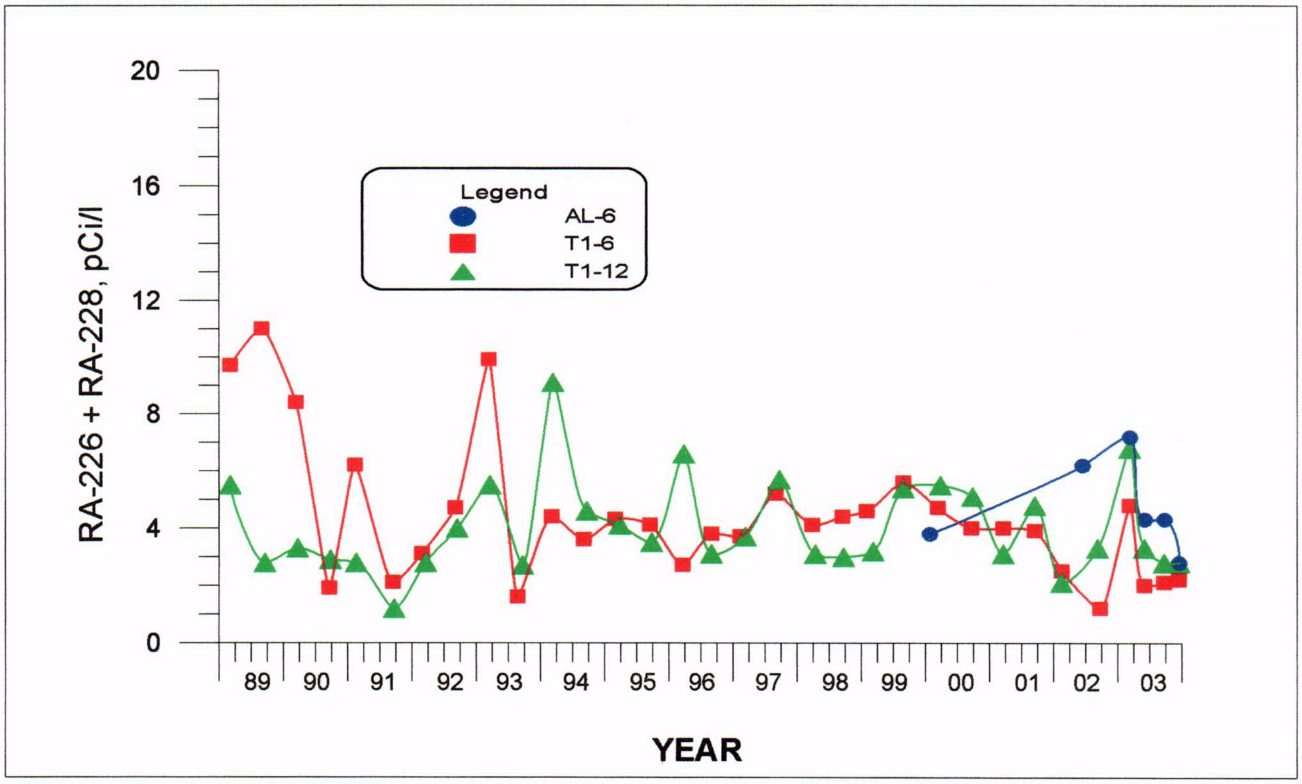


FIGURE 13. RADIUM-226 + RADIUM-228 ACTIVITY IN DEC. 2003 AT LUCKY MC, IN pCi/l

C13



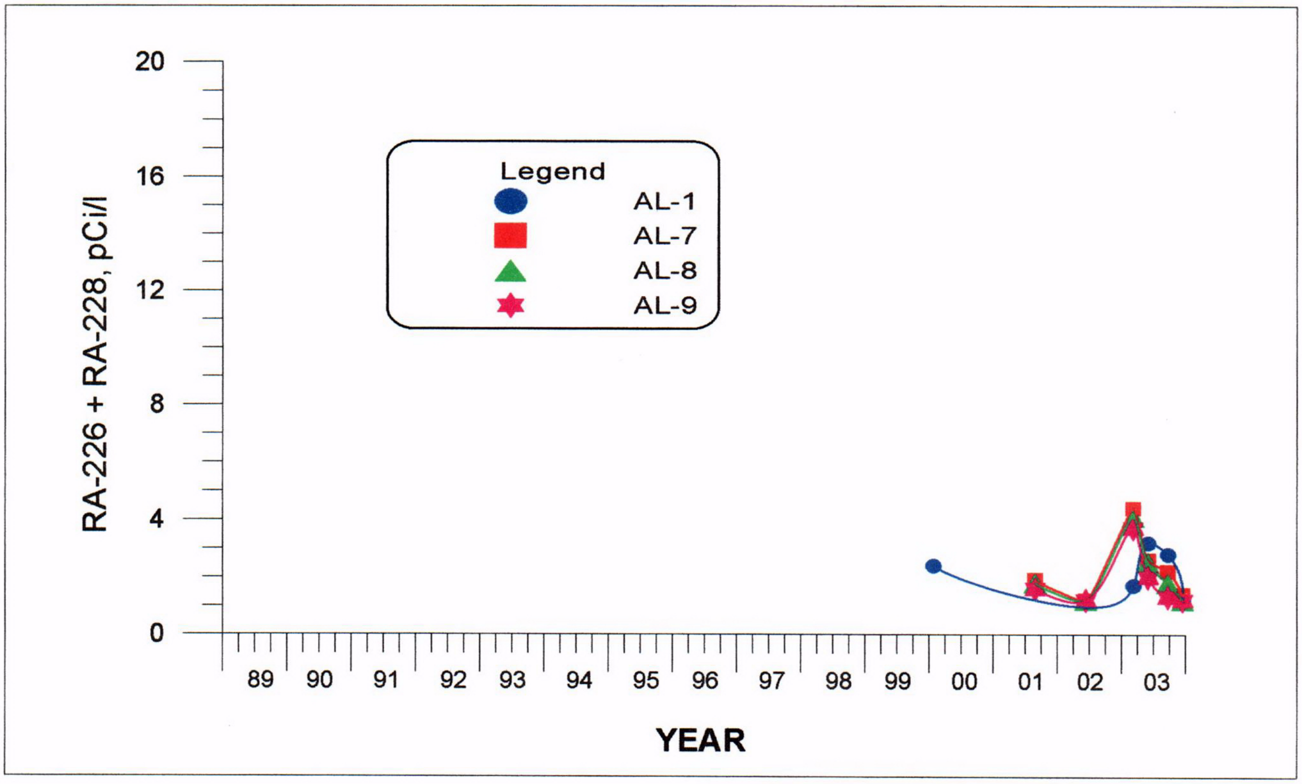


FIGURE 14. RADIUM-226 + RADIUM-228 ACTIVITY VERSUS TIME FOR WELLS T1-6, T1-12, AL-1, AL-6, AL-7, AL-8 AND AL-9.

C14

TABLE 1. WATER-LEVEL AND WATER-QUALITY DATA.

Lucky MC Mine - Pathfinder Mines Corp.

Sample Point Name	Date	WL (feet)	WL_ELEV (ft-msl)	pH(f) (std. units)	Cond(f) (µmhos)	TDS (mg/l)	SO4 (mg/l)	Cl (mg/l)	NO3+NO2 (mg/l)	Unat (mg/l)
AL-1	2/14/2002	27.75	6236.85	6.92	4473	4660	2230	263.0	124.0	0.949
	6/14/2002	27.84	6236.76	7.71	3763	4540	1850	204.0	109.0	0.998
	9/11/2002	28.51	6236.09	6.62	1249	3622	2044	191.2	106.0	0.928
	12/4/2002	28.31	6236.29	7.65	1860	3836	1833	148.6	50.8	—
	3/11/2003	28.27	6236.33	7.24	3840	3761	1944	150.6	42.6	0.582
	6/2/2003	28.49	6236.11	7.05	4370	4097	1884	151.4	78.8	0.642
	9/24/2003	29.47	6235.13	6.41	4210	3103	1774	90.8	6.5	0.304
	12/18/2003	29.29	6235.31	6.57	4280	2828	1722	70.1	9.9	0.278
AL-6	2/14/2002	22.46	6214.34	7.50	4015	4240	2140	230.0	77.7	0.909
	6/14/2002	22.55	6214.25	7.94	3479	4100	1660	157.0	72.9	1.020
	9/11/2002	22.77	6214.03	7.97	1919	3688	1961	158.5	67.1	0.900
	12/4/2002	22.79	6214.01	7.59	2143	4081	1963	162.4	64.0	—
	3/11/2003	22.83	6213.97	7.25	4160	3995	1986	139.9	59.6	0.969
	6/4/2003	22.82	6213.98	6.85	4210	3914	2175	159.1	59.4	0.850
	9/24/2003	23.11	6213.69	6.35	4360	3681	2050	155.4	47.8	0.843
	12/18/2003	23.18	6213.62	6.42	4040	3757	1968	130.2	58.1	0.952
AL-7	6/14/2002	26.98	6225.02	8.10	2333	2300	1150	59.4	0.3	0.122
	9/25/2002	27.42	6224.58	8.08	1476	2062	1174	67.9	0.7	0.082
	12/5/2002	27.55	6224.45	7.67	2316	2340	1242	74.1	4.8	—
	3/11/2003	27.59	6224.41	7.33	3070	2710	1436	70.0	18.8	0.531
	6/4/2003	27.48	6224.52	6.70	2910	2515	1352	71.3	12.5	0.371
	9/24/2003	27.96	6224.04	6.48	3510	2535	1335	75.0	9.3	0.278
	12/18/2003	28.13	6223.87	6.32	3120	2278	1296	62.5	3.4	0.309
AL-8	6/14/2002	29.65	6165.35	8.13	3752	4180	2070	66.7	0.2	0.228
	9/25/2002	29.92	6165.08	8.52	2157	3652	2335	74.2	< 0.1	0.192
	12/5/2002	29.70	6165.30	7.52	2340	3961	2086	68.2	< 0.1	—
	3/11/2003	29.67	6165.33	7.33	4630	4100	2365	65.7	< 0.1	0.237
	6/4/2003	29.17	6165.83	6.85	4580	3935	2520	65.8	0.2	0.210
	9/24/2003	29.90	6165.10	6.61	5390	4039	2545	86.2	< 0.1	0.230
	12/18/2003	29.89	6165.11	6.47	4860	3923	2346	68.1	0.2	0.271
AL-9	6/14/2002	34.67	6139.33	8.12	2912	2960	1480	45.6	< 0.1	0.214
	9/25/2002	35.11	6138.89	7.44	2146	2903	1646	53.1	< 0.1	0.169
	12/5/2002	34.95	6139.05	7.65	2131	3260	1769	52.7	< 0.1	—
	3/11/2003	34.98	6139.02	7.34	4110	3638	2189	53.8	0.1	0.233
	6/4/2003	35.18	6138.82	6.95	4290	3628	2156	61.2	< 0.1	0.236
	9/24/2003	35.63	6138.37	6.58	4700	3474	2232	69.7	< 0.1	0.239
	12/18/2003	35.50	6138.50	6.41	4420	3578	2181	57.3	< 0.1	0.279
T1-6	2/19/2002	27.66	6400.56	7.45	3491	3320	1900	75.6	4.8	0.137
	6/18/2002	28.39	6399.83	6.90	3183	3160	1820	57.1	3.6	—
	9/26/2002	94.97	6333.25	8.44	2634	2392	1288	39.8	1.1	0.006
	11/21/2002	95.03	6333.19	7.95	2191	—	1472	39.2	1.1	—
	3/12/2003	49.98	6378.24	7.32	3220	2570	1510	35.7	0.3	0.044

TABLE 1. WATER-LEVEL AND WATER-QUALITY DATA. (cont.)

Lucky MC Mine - Pathfinder Mines Corp.

Sample Point Name	Date	WL (feet)	WL_ELEV (ft-msl)	pH(f) (std. units)	Cond(f) (µmhos)	TDS (mg/l)	SO4 (mg/l)	Cl (mg/l)	NO3+NO2 (mg/l)	Unat (mg/l)
T1-6	6/4/2003	—	—	6.80	3070	2412	1411	40.1	0.9	0.007
	7/22/2003	—	—	7.43	3060	2020	1360	38.8	0.6	0.021
	9/24/2003	49.03	6379.19	6.68	3680	2428	1447	41.8	0.6	0.021
	11/20/2003	45.19	6383.03	7.10	3460	2772	1786	55.5	< 0.1	0.061
	12/18/2003	39.51	6388.71	6.47	3640	2562	1499	43.3	< 0.1	0.042
T1-12	2/19/2002	8.27	6332.53	7.06	6950	8020	2140	285.0	547.0	0.336
	6/17/2002	8.44	6332.36	6.96	6761	8300	2150	233.0	583.0	—
	9/10/2002	9.03	6331.77	8.17	5712	5813	2063	245.0	542.0	0.362
	11/14/2002	9.41	6331.39	7.08	4005	—	2366	202.2	337.0	—
	3/12/2003	9.77	6331.03	6.94	6510	6671	2270	229.6	305.0	0.369
	6/4/2003	9.88	6330.92	7.00	6900	6592	2272	186.5	342.0	0.345
	9/24/2003	10.62	6330.18	6.26	7770	6665	2357	222.5	327.0	0.330
	12/18/2003	11.26	6329.54	6.25	7230	6705	2294	216.7	354.0	0.360

TABLE 1. WATER-LEVEL AND WATER-QUALITY DATA. (cont.)

Lucky MC Mine - Pathfinder Mines Corp.

Sample Point Name	Date	Th230 (pCi/l)	Th230(e) (pCi/l)	Ra226 (pCi/l)	Ra226(e) (pCi/l)	Ra228 (pCi/l)	Ra228(e) (pCi/l)	Ra226+Ra228 (pCi/l)
AL-1	6/14/2002	—	—	4.0	± 0.4	—	—	—
	3/11/2003	< 0.2	—	0.7	± 0.2	< 1.0	—	< 1.7
	6/2/2003	1.1	± 0.5	2.2	± 0.2	< 1.0	—	< 3.2
	9/24/2003	1.4	0.5	1.8	0.2	< 1.0	—	< 2.8
	12/18/2003	0.2	—	< 0.2	—	< 1.0	—	< 1.2
AL-6	6/14/2002	—	—	5.2	± 0.8	< 1.0	—	< 6.2
	3/11/2003	< 0.2	—	4.4	± 0.3	2.8	± 1.2	7.2
	6/4/2003	0.3	± 0.3	3.3	± 0.2	< 1.0	—	< 4.3
	9/24/2003	0.7	0.4	3.3	0.2	< 1.0	—	< 4.3
	12/18/2003	0.2	—	1.8	± 0.5	< 1.0	—	< 2.8
AL-7	6/14/2002	—	—	< 0.2	—	< 1.0	—	< 1.2
	3/11/2003	< 0.2	—	1.6	± 0.2	2.8	± 1.2	4.4
	6/4/2003	0.3	± 0.3	1.6	± 0.2	< 1.0	—	< 2.6
	9/24/2003	< 0.2	—	1.2	0.2	< 1.0	—	< 2.2
	12/18/2003	0.2	—	0.4	± 0.3	< 1.0	—	< 1.4
AL-8	6/14/2002	—	—	< 0.2	—	< 1.0	—	< 1.2
	3/11/2003	< 0.2	—	1.3	± 0.2	2.8	± 1.2	4.1
	6/4/2003	0.4	± 0.4	1.5	± 0.2	< 1.0	—	< 2.5
	9/24/2003	< 0.2	—	0.8	0.2	< 1.0	—	< 1.8
	12/18/2003	0.2	—	< 0.2	—	< 1.0	—	< 1.2
AL-9	6/14/2002	—	—	< 0.2	—	< 1.0	—	< 1.2
	3/11/2003	0.3	± 0.2	0.9	± 0.2	2.8	± 1.2	3.7
	6/4/2003	0.3	± 0.3	1.0	± 0.2	< 1.0	—	< 2.0
	9/24/2003	< 0.2	—	0.3	0.2	< 1.0	—	< 1.3
	12/18/2003	0.2	—	< 0.2	—	< 1.0	—	< 1.2
T1-6	2/19/2002	< 0.2	—	1.5	± 0.2	< 1.0	—	< 2.5
	9/26/2002	< 0.2	—	< 0.2	—	< 1.0	—	< 1.2
	3/12/2003	0.3	± 0.2	2.0	± 0.2	2.8	± 1.2	4.8
	6/4/2003	0.3	± 0.3	1.0	± 0.2	< 1.0	—	< 2.0
	7/22/2003	—	—	1.7	0.5	—	—	—
	9/24/2003	< 0.2	—	1.1	0.2	< 1.0	—	< 2.1
	11/20/2003	—	—	2.9	0.5	—	—	—
	12/18/2003	0.2	—	1.2	± 0.4	< 1.0	—	< 2.2
T1-12	2/19/2002	< 0.2	—	1.1	± 0.3	< 1.0	—	< 2.1
	9/10/2002	< 0.2	—	2.3	± 0.4	< 1.0	—	< 3.3
	3/12/2003	0.4	± 0.4	2.1	± 0.3	4.7	± 2.0	6.8
	6/4/2003	0.3	± 0.3	2.3	± 0.2	< 1.0	—	< 3.3
	9/24/2003	< 0.2	—	1.8	0.2	< 1.0	—	< 2.8
	12/18/2003	< 0.2	—	1.8	± 0.5	< 1.0	—	< 2.8

TABLE 1. WATER-LEVEL AND WATER-QUALITY DATA. (cont.)

Lucky MC Mine - Pathfinder Mines Corp.

Sample Point Name	Date	As (mg/l)	Be (mg/l)	Cd (mg/l)	Cr (mg/l)	Ni (mg/l)	Se (mg/l)
AL-1	2/14/2002	< 0.001	—	—	—	—	0.301
	6/14/2002	0.003	—	< 0.010	< 0.050	0.05	0.263
	9/11/2002	0.011	—	—	—	—	0.251
	3/11/2003	< 0.002	< 0.010	< 0.010	< 0.050	< 0.05	0.087
	6/2/2003	0.032	< 0.001	0.002	< 0.002	0.07	0.181
	9/24/2003	0.007	< 0.001	< 0.001	< 0.001	0.06	0.032
	12/18/2003	< 0.001	< 0.001	< 0.001	< 0.001	0.05	0.008
AL-6	2/14/2002	< 0.001	—	—	—	—	0.261
	6/14/2002	0.007	—	< 0.010	< 0.050	< 0.05	0.139
	9/11/2002	0.007	—	—	—	—	0.144
	3/11/2003	0.007	< 0.010	< 0.010	< 0.050	< 0.05	0.094
	6/4/2003	0.003	< 0.001	< 0.001	< 0.002	0.01	0.107
	9/24/2003	0.007	< 0.001	< 0.001	< 0.001	0.01	0.103
	12/18/2003	0.008	< 0.001	< 0.001	< 0.001	0.01	0.120
AL-7	6/14/2002	0.004	—	< 0.010	< 0.050	< 0.05	0.003
	9/25/2002	0.003	—	—	—	—	0.014
	3/11/2003	0.002	< 0.010	< 0.010	< 0.050	< 0.05	0.050
	6/4/2003	0.005	< 0.001	< 0.001	< 0.002	0.01	0.038
	9/24/2003	0.003	< 0.001	< 0.001	0.007	0.02	0.026
	12/18/2003	< 0.001	< 0.001	< 0.001	< 0.001	0.01	0.010
AL-8	6/14/2002	0.002	—	< 0.010	< 0.050	< 0.05	0.009
	9/25/2002	0.005	—	—	—	—	0.013
	3/11/2003	0.007	< 0.010	< 0.010	< 0.050	< 0.05	0.011
	6/4/2003	0.003	< 0.001	< 0.001	< 0.002	0.05	< 0.005
	9/24/2003	0.003	< 0.001	< 0.001	< 0.001	0.02	0.009
	12/18/2003	0.006	< 0.001	< 0.001	0.001	0.01	0.014
AL-9	6/14/2002	0.003	—	< 0.010	< 0.050	< 0.05	0.007
	9/25/2002	0.004	—	—	—	—	0.003
	3/11/2003	0.003	< 0.010	< 0.010	< 0.050	< 0.05	0.024
	6/4/2003	< 0.002	< 0.001	< 0.001	< 0.002	0.01	0.015
	9/24/2003	0.003	< 0.001	< 0.001	< 0.001	0.02	0.014
	12/18/2003	0.003	< 0.001	< 0.001	< 0.001	0.01	0.021
T1-6	2/19/2002	0.011	< 0.010	< 0.010	< 0.050	0.06	0.116
	6/18/2002	< 0.001	—	—	—	—	0.087
	9/26/2002	0.002	< 0.010	< 0.010	< 0.050	< 0.05	0.003
	3/12/2003	< 0.002	< 0.010	< 0.010	< 0.050	< 0.05	< 0.005
	6/4/2003	< 0.002	< 0.001	< 0.001	< 0.002	0.02	< 0.005
	7/22/2003	< 0.001	—	< 0.005	< 0.050	< 0.05	< 0.002
	9/24/2003	0.001	0.001	< 0.001	< 0.001	0.02	< 0.003
	11/20/2003	0.001	—	< 0.001	< 0.001	—	0.003
	12/18/2003	< 0.001	< 0.001	< 0.001	< 0.001	0.02	< 0.003
T1-12	2/19/2002	< 0.001	< 0.010	< 0.010	< 0.050	0.29	0.915
	9/10/2002	0.010	< 0.010	< 0.010	< 0.050	0.27	0.835
	12/13/2002	—	—	—	—	—	0.733
	3/12/2003	< 0.002	< 0.010	< 0.010	< 0.050	0.29	0.528

TABLE 1. WATER-LEVEL AND WATER-QUALITY DATA. (cont.)

Lucky MC Mine - Pathfinder Mines Corp.

Sample Point Name	Date	As (mg/l)	Be (mg/l)	Cd (mg/l)	Cr (mg/l)	Ni (mg/l)	Se (mg/l)
T1-12	6/4/2003	0.005	< 0.001	< 0.001	< 0.002	0.28	0.570
	9/24/2003	< 0.002	< 0.001	< 0.001	0.006	0.37	0.579
	12/18/2003	< 0.002	< 0.001	< 0.001	< 0.002	0.27	0.551