DE-FC21-94MC29244--13

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Disposal of Fluidized Bed Combustion Ash in an Underground Mine to Control Acid Mine Drainage and Subsidence

Quarterly Report
December 1, 1996 - February 28, 1997

Work Performed Under Contract No.: DE-FC21-94MC29244

For
U.S. Department of Energy
Office of Fossil Energy
Federal Energy Technology Center
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Project - ETD05 "Disposal of Fluidized Bed Combustion Ash in an Underground Mine to Control Acid Mine Drainage and Subsidence"

EXECUTIVE SUMMARY

This project will evaluate the technical, economic and environmental feasibility of filling abandoned underground mine voids with alkaline, advanced coal combustion wastes (Fluidized Bed Combustion -FBC ash). Success will be measured in terms of technical feasibility of the approach (i.e. % void filling), cost, environmental benefits (acid mine drainage and subsidence control) and environmental impacts (noxious ion release).

Phase I of the project was completed in September 1995 and was concerned with the development of the grout and a series of predictive models. These models were verified through the Phase II field phase and will be further verified in the large scale field demonstration of Phase III. The verification will allow the results to be packaged in such a way that the technology can be easily adapted to different site conditions. Phase II was successfully completed with 1000 cubic yards of grout being injuected into Anker Energy's Fairfax mine. The grout flowed over 600 feet from a single injection borehole. The grout achieved a compressive strength of over 1000 psi (twice the level that is needed to guarantee subsidence control). Phase III is to take 26 months and will be a full scale test at Anker's eleven acre Longridge mine site.

It is expected that the FBC ash will replace what is now an acid mine pool with alkaline solid so that the groundwater will tend to flow around and through the pillars rather than through the previously mined areas. The project has demonstrated that FBC ash can be successfully disposed in underground mines. Additionally, the project is directed towards showing that such disposal can lead to reduction or elimination of environmental problems associated with underground mining such as acid mine drainage and subsidence.

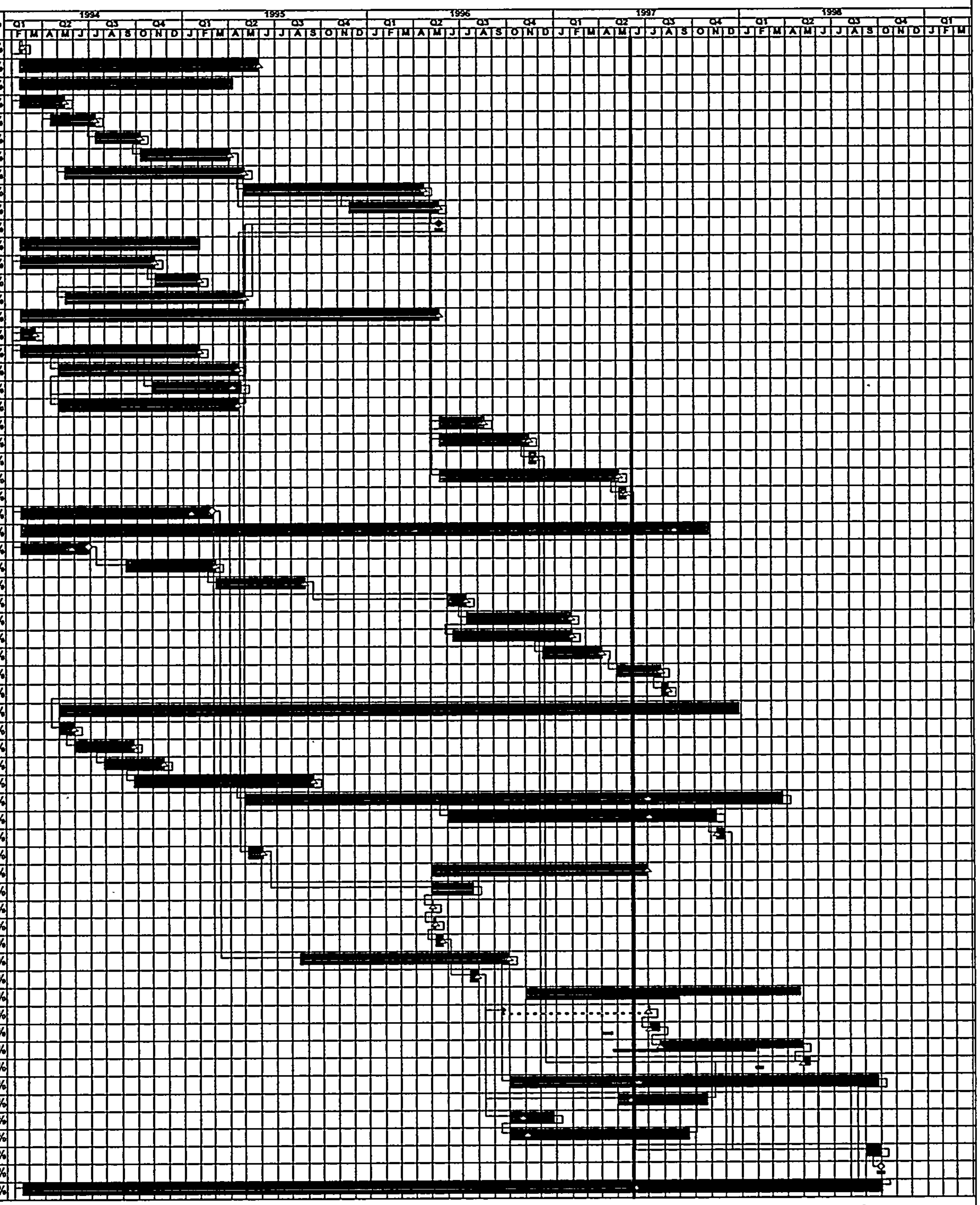
During Phase III the majority of the activity involves completing two full scale demonstration projects. The eleven acre Longridge mine in Preston County will be filled with 53,000 cubic yards of grout during the summer of 1997 and monitored for following year. The second demonstration involves stowing 2000 tons of ash into an abandoned mine to demonstrate the newly redesigned Burnett Ejector. This

demonstration is anticipated to take place during Summer 1997, as well.

This document will report on progress made during Phase III. The report will be divided into four major sections. The first will the Hydraulic Injection component. This section of the report will report on progress and milestones associated with the grouting activities of the project. The Phase III tasks of Economic Analysis and Regulatory Analysis will be covered under this section. The second component is Pneumatic Injection. This section reports on progress made towards completing the demonstration project. The Water Quality component involves background monitoring of water quality and precipitation at the Phase III (Longridge) mine site. The last component involves evaluating the migration of contaminants through the grouted mine. A computer model has been developed in earlier phases and will model the flow of water in and around the grouted Longridge mine. The Gantt Chart on the following page details progress by task.

Gantt Chart

WBS C	Task Name	Dura	%Comp
8.0	NEPA DOCUMENTATI	.19M	0.00%
1.0	GROUT DEVELOPME	16M	0.00%
1.1	GROUT FORMULATIO	.24M	0.00%
1.1.1	WATER CONTENT/AG	3M	0.00%
1.1.2	SCREEN AND CHOOS	3M	0.00%
1.1.3	WATER TYPE TESTS	3M	0.00%
1.1.4	ADMIXTURE TESTS	6M	0.00%
1.1.5	GROUT CONSISTENC	12M	0.00%
1.2	LONG TERM PERFOR	12M	0.00%
1.3	GROUT COHESION	6M	0.00%
1.3.1	COMPLETE CONSIST	0M	0.00%
1.4	HYDRAULIC PROPER	12M	0.00%
1.4.1	PERMEABILITY TESTI	9M	0.00%
1.4.2	DETERMINE LEACHA	3M	0.00%
1.5	GROUT DURABILITY	12M	0.00%
2.1	GROUT FLOWABILITY	28M	0.00%
2.1.1	LITERATURE SEARC	1M	0.00%
2.1.2	CHARACTERIZE GRO	12M	0.00%
2.1.3	ANALYTICAL MODEL	12M	0.00%
2.1.4	NUMERICAL MODEL	6M	0.00%
3.0	BENCH SCALE TEST	12M	0.00%
9.1	FIELD STRENGTH PE	3M	0.00%
9.2	FIELD DATA ANALYSI	6M	0.00%
7.1	GROUT DEVELOPME	10d	0.00%
9.3	FIELD FLOWABILITY	12M	0.00%
7.2	FINAL REPORT FLOW	10d	0.00%
4.0	WATER SAMPLING A	7.03h	0.00%
5.0	SUBSIDENCE CONTR	46M	5.00%
5.1	GROUT STRENGTH R	756h	0.00%
5.2	BACKFILL REQUIREM	6M	0.00%
5.3	GEOLOGIC VARIABL	6M	0.00%
5.4.1	INVESTIGATE FIELD S	1.3M	0.00%
5.4.2	UNDERGROUND OBS	7M	0.00%
5.5	DEVELOP BACKFILL	8M	0.00%
5.6.1	ANALYSIS OF DATA	4M	0.00%
5.6.2	ANALYSIS OF RESUL	3M	0.00%
7.3	FINAL REPORT SUBSI	10d	0.00%
6.0	CONTAMINANT TRAN	5.5M	4.00%
6.1	LITERATURE REVIEW	1M	0.00%
6.2	ID KEY FACTORS	4M	0.00%
6.3	CHARACTERIZE CON	4M	0.00%
6.4	PARAMETRIC STUDY	12M	0.00%
6.5	ANALYSIS OF MINE SI	36M	5.00%
6.6	ANALYSIS OF RESUL	18M	5.00%
7.4	FINAL REPORT CONT	10d	0.00%
8.1	ENVIRONMENTAL INF	1M	0.00%
9.0.0	FIELD APPLICATION	.42M	0.00%
9.1	SMALL SCALE-FAIRF	.76M	0.00%
9.2	FAIRFAX SITE PREP	.05M	0.00%
9.3	FAIRFAX DRILLING	.19M	0.00%
9.4	FAIRFAX GROUTING	.48M	0.00%
9.5	WATER SAMPLING A	14M	0.00%
10.0	TOPICAL REPORT	0.5M	0.00%
11.0	LARGE SCALE-LONG	.33M	5.00%
11.1	LONGRIDGE SITE PR	2d	0.00%
11.2	LONGRIDGE DRILLIN	14d	0.00%
11.3	LONGRIDGE GROUTI	200d	0.00%
11.4	FINAL REPORT FIELD	10d	0.00%
11.5	WATER SAMPLING A	152h	5.00%
11.6	COST ANALYSIS	6M	5.00%
11.7	REGULATORY ANALY	3M	0.00%
13.0	WATER QUALITY MO	12M	0.00%
7.6.1	DRAFT FINAL PROJE	1M	0.00%
7.6.2	FINAL PROJECT REP	0M	0.00%
15.0	PROGRAM ADMINIST	7.5M	1.50%



Gantt Chart

Gantt Chart Legend

	Critical		Critical Milestone
	Noncritical		Noncritical Milestone
	Complete		Complete Milestone
	Summary		Summary Milestone
	External		External Milestone
	Total Float (+)		Effort %Complete
	Total Float (-)		Delay
	Free Float		Non-Resource
	Baseline		

A. Hydraulic Injection

1.0 Task Description:

Task 11 - Hydraulic Injection: The purpose of this task is to grout the eleven acre Longridge mine with a grout consisting of coal combustion byproducts.

Task 12 - Economic Analysis: Burnett Engineering, Inc. shall develop economic analyses to compare the cost associated with disposal of coal ash in landfills with disposal of coal ash in underground mines to control subsidence and acid mine drainage.

Landfill disposal of MEA AFBC Power Plant ash. Burnett Engineering, Inc. shall develop an economic analysis for disposing of MEA AFBC ash in a landfill located near the Fairfax and Longridge mines. Costs to be included in the economic analysis include, but are not limited to, loading of ash at the power plant, transportation to the disposal site, landfill construction, landfill operation, landfill maintenance, and regulatory compliance. In addition, long-term cost impact on property values shall be estimated.

Landfill disposal practices of Northeast utilities. Burnett Engineering, Inc. shall use published data from the Electric Power Research Institute, and data from Monongahela Power Company and Allegheny Power Company to generate a range of cost estimates for disposing power plant ash in landfills. Burnett Engineering, Inc. shall describe the similarities and differences in ash disposal practices and costs for three utilities. Description of the similarities and differences shall include, but is not limited to, regulatory environment, environmental protection features in landfill design (e.g., liners), monitoring requirements, transportation, and ash handling.

Underground coal mine disposal of MEA AFBC Power Plant ash. Burnett Engineering, Inc. shall develop an economic analysis for disposing of MEA AFBC ash in the Longridge coal mine. Costs to be included in the economic analysis include, but are not limited to, loading of ash at the power plant, transportation to the disposal site, production of grout, injection of grout, mine maintenance, and regulatory compliance.

Burnett Engineering, Inc. shall analyze the costs associated with the benefits of underground mine disposal of the MEA AFBC Power Plant ash. These benefits include, but are not limited to, lower quantities of waste to be placed in the landfill, reduction in land subsidence, and improvements in water quality.

Task 13 - Water Quality Model: WVU shall use existing water quality model(s) or modifications of existing water quality model(s) to estimate the impact of ash disposal in underground mines on the concentrations of contaminants in nearby surface and ground water. Data from a geographical information system (GIS) shall be coupled with the water quality model results to estimate the impact of disposal of MEA AFBC ash in the Longridge mine on concentrations of contaminants in nearby surface and ground water.

Task 14 - Regulatory Analysis: WVU shall review existing Federal, State of West Virginia, and local regulations and policies which could impact the disposal of ash from advanced coal combustion technologies in underground mines. The contractor shall identify any regulatory barriers to the widespread adoption of this disposal practice in West Virginia.

2.0 Summary of Accomplishments

2.1 Work commenced on development of alternative grout mixture.

2.2 Regulatory Analysis task is underway with no results to report to date.

3.0 To-Date Accomplishments

Successfully completed Phase II grout injection.

4.0 Technical Progress Report

An alternative grout mixture is being considered givent he recent short-fall of FBC ash. All FBC ash being produced from the Morgantown Energy Associates Plant is currently being used by the coal industry in nothern West Virginia to line the pits of surface mines, blend with acidic overburden and as soil amendments. The supply is depleted to the point that scheduling enough tonnage for the Phase III demonstration was problematic. Given the constraints on the supply, an alternative grout mixture was sought. Initially a mixture that would lessen the amount of FBC was desirable. The Phase II mix was used as a base with some of the FBC ash being replaced with locally available Class F ash. While strength properties were good the mixture did not have sufficient flow. Again the goal of the project is to completely fill an abandoned mine with grout. The project hopes to do this in an economical so that the abandoned mine land program and the coal industry can adopt this reclaimation technique.

Several grout mixtures are being considered. The base of which is a high loss on ignition (LOI) ash that Anker Energy brings into Albright , WV. This material is available for the cost of trucking to the mine site (less than three dollars a ton). Bentonite is being considered at a much lower application rate (less than 1%) to aid in the flowability and stability of the grout. More information of the candidate grout mixes will be discussed in next quarter's report.

5.0 Plans for Next Quarter

5.1 Finalize NEPA documentation with U.S. DOE.

5.2 Coordinate Phase III injection with coal company personnel.

5.3 Continue with numeric modeling of grouting operations.

5.4 Continue work on alternative grout mix to check flowability and economic vialbility as compared to Phase II recipe.

B. Pneumatic Injection

1.0 Task Description

The purpose of this task is to inject coal combustion byproducts into an underground mine via the Burnett Ejector. A complete economic analysis will be completed on the feasibility of this method of injection. Two thousand tons of ash are scheduled to be injected.

2.0 Summary of Accomplishments & Significant Events

A camera was purchased and will be mounted to aid in the aiming of the camera in the mine void.

3.0 To Date Accomplishments

Redesigned and manufactured pneumatic ejector.

4.0 Technical Progress Report

All work this quarter was devoted to selecting an injection site. Several candidate mines have been indentified. A site will be chosen based on several factors. The first being surface access. A mine site that has an open field above it would be ideal for moving of equipment and ease of drilling boreholes into the mine void. The second factor is the length and slope of the mine void. A mine with long, straight and relatively flat mine void is most desirable. The third factor to consider is water. The injection needs to take place in a mine that is dry. The ejector will not work under water. Given these considerations a mine will chosen and access gained through an agreement with the owner. Currently two mine sites are candidates. Both are owned by Anker Energy and are located near the Phase III Longridge site. The candidate sites are Decondor Mine and Squires Creek.

A mine site will be selcted and the demonstration project scheduled by the end of July 1997. All scheduling and preparations for the demo are on schedule. Jboth mines being considered are currently still active so injection activities will have to work around the mining schedule.

5.0 Plans for next Quarter

5.1 Select mine site and gain access through an agreement with owner.

5.2 Conduct a large scale demonstration to prove the effectiveness and economic viability of pnuematic injection.

C. Water Quality Monitoring

1.0 Task Description

Baseline Water Quality Monitoring

The purpose of this task is to monitor the baseline water quality of the acid mine drainage (AMD) from the Longridge and Fairfax Mines prior to and during grouting. A flow monitoring and sampling station has been set up at the Longridge mine and a precipitation gauge has been established between the two mines.

2.0 Summary of Period's Accomplishments & Significant Events

Water quality monitoring and sampling continued as planned. Data is presented and discussed in some detail below for the reporting period of approximately three months. Flow from the Longridge Mine averaged around 91 gallons per minute. Acidity concentrations ranged from 528 mg/l to 646 mg/l.

Sampling from the well located below the Fairfax Mine coal seam was conducted. Data is presented below.

3.0 Accomplishments to Date

Accomplishments to date include choice of parameters to sample, design of the sampling station, procurement of equipment, site preparation, installation and shake down of equipment, initiation of sampling and data analysis.

4.0 Technical Progress Report

Table 5 displays the water quality data collected from the Longridge mine. Metal concentrations were consistent for the period. Average daily flows ranged from 48 to 165 gallons per minute with an average of 90.8 gpm. Acidity concentrations were constistent as well ranging from 528 to 646 mg/l and averaging 595 mg/l. The consitency of the concetrations can also be verified by noting the Conductivity and Sulfate levels.

Table 6 displays data from the Fairfax Groundwater Monitoring well. This well was established to check for contaminants leaching from the Phase II demonstration area. No water has been collected from the mine so the likelihood of leaching is very low. However, the well is a security mesure and will continue to be monitored. Similar wells will be established at the Phase III Longridge Mine site. Upon review of the data, it can be concluded that no contaminants are leaching into the well. The water is alkaline and metal concentrations are below action limits.

All analyses were conducted by the National Research Center for Coal and Energy's Analytical Laboratory. The NRCCE Lab is certified by the State of West Virginia for all analytes reported.

5.0 Plans for next Quarter

5.1 Continue monitoring the Longridge mine for water quality and flow.

5.2 Continue to monitor Fairfax borehole for possible contamination from grout.

D. Contaminant Transport

1.0 Task Description

Task 6.0 Contaminant Transport

Determine how contaminants will migrate from the grout (if any) and determine how the water that was filling the void will interact with the impermeable plug filling the void after injection.

2.0 Summary of Quarters Accomplishments and Significant Events

2.1 Calculations of the floor areas, roof areas and pillar surface areas of the idealized Longridge mine were performed to provide input on acid concentration in the contamainant transport computer modeling tasks.

2.2 Different hypothetical scenarios of grouting of the mine were considered in the groundwater and contamainat transport modeling work.

2.3 The contamiant transport patterns corresponding to different grouting scenarios were compared by computing contaminat concentrations at a number of pre-determined points in the idelaized mine map.

3.0 To Date Accomplishments

3.1 The Longridge Mine was idealized for the task on modeling the contaminant transport.

3.2 A finite element difference grid for the idealized Longridge mine was constructed and some example groundwater flow problems were solved using the existing computer software.

4.0 Technical Progress Report

The exposed floor, roof and pillar surface areas in the Longridge Mine were calculated based on the idealized Longridge Mine map (see Figure 1). These areas are the source of mineral pyrites, which form the basis of AMD. The calculations of areas shown in Table 1 were performed to provide input on acid concentrations used in the computer model.

In order to study how contaminat transport in the mine would be affected by grouting, several hypothetical scenarios of grouting were considered in computer models. The calculations illustrating the impact of different scenarios of grouting on the exposed surface area are shown in Tables 2, 3 and 4.

Table 2 shows the total exposed areas in the mine as a function of different grout heights in the hallways. The hydraulic conductivities were reduced in inverseproportion to the increasing grout height. This was based on the assumption that increasing the amount of grout would result in a reduction of groundwater flow in the mine hallways. Figure 2 shows the variation of exposed surface area with the grout height. Table 3 and 4 show exposed surface areas corresponing to 6 inches and 12 inches of grout height in the hallways, respectively.

Groundwater and contaminant transport models were run based on the information shown in Table 2. The three dimensional grid used in these simulations is shown in Figure 3. The mine layer discretization is shown in Figure 4. Six cases of groundwater flow and contamiant transport models were completed. Typical results of these simulations are shown in Figures 5 and 6.

Some observation points were chosen in the mine layer grid (see Figure 7) to compare contaminant transport patterns of different cases. Figures 8, 9 and 10 show the comparisons at the seven observation points for the six cases. These preliminary results suggest that thé height of the grout in the hallways affects the contaminant propagation in the mine.

5.0 Plans for Next Quarter

To continue the analysis of fluid flow and contaminant transport problems at the Longridge Mine. Groundwater flow and contaminant transport calculations will be performed for the scenarios in Table 3 and 4. The effect of cracks and fissures (fracture zones) around the mine area will be studied.

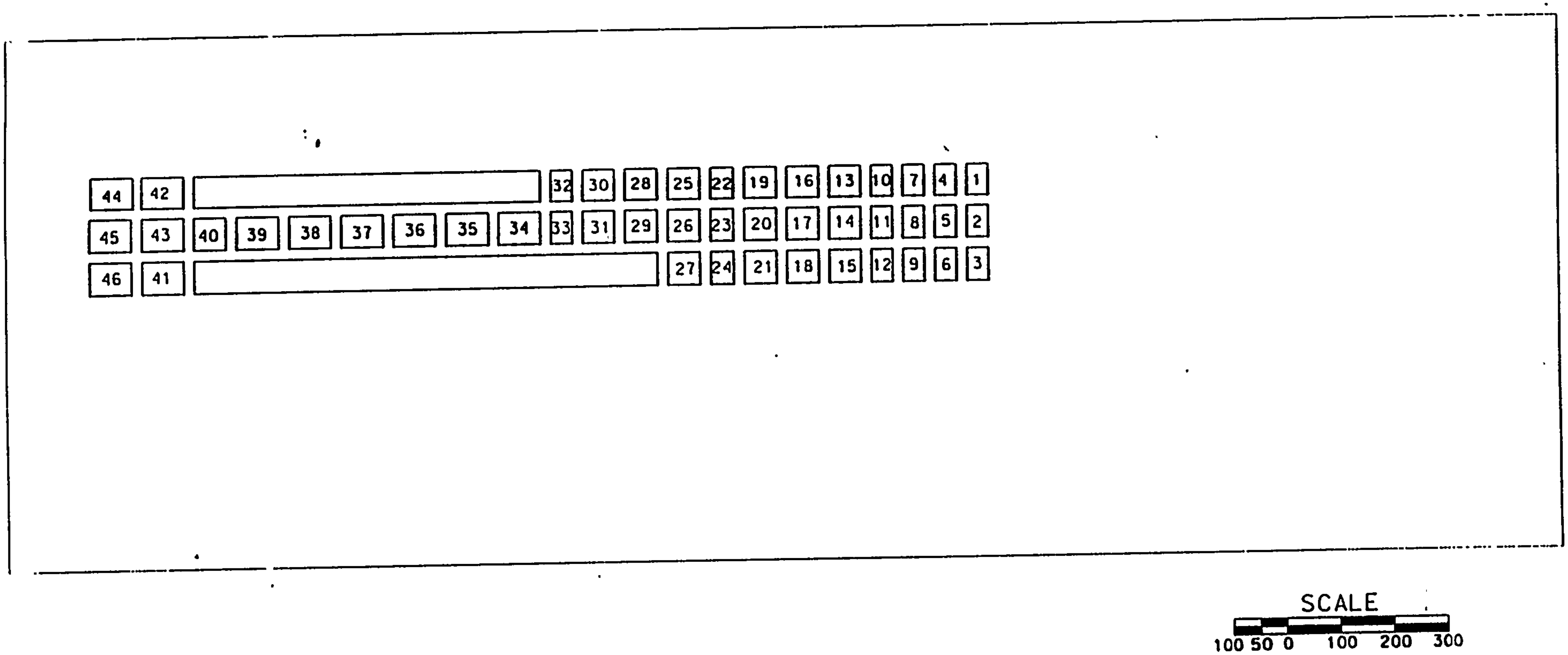


Figure-1: Idealized Longridge Mine With the Catchment Area

Table-1: Pillar Dimensions of the Idealized Longridge Mine

updated April 30, '97

pillar ht. 5 feet

Pillar No	L (in.)	B (in.)	A (sq.in)	L (ft)	B (ft)	A (sq.ft)	srfA (sqft)
1	0.3	0.2	0.06	60	40	2400	1000
2	0.3	0.2	0.06	60	40	2400	1000
3	0.3	0.2	0.06	60	40	2400	1000
4	0.3	0.2	0.06	60	40	2400	1000
5	0.3	0.2	0.06	60	40	2400	1000
6	0.3	0.2	0.06	60	40	2400	1000
7	0.3	0.2	0.06	60	40	2400	1000
8	0.3	0.2	0.06	60	40	2400	1000
9	0.3	0.2	0.06	60	40	2400	1000
10	0.3	0.2	0.06	60	40	2400	1000
11	0.3	0.2	0.06	60	40	2400	1000
12	0.3	0.2	0.06	60	40	2400	1000
13	0.3	0.3	0.09	60	60	3600	1200
14	0.3	0.3	0.09	60	60	3600	1200
15	0.3	0.3	0.09	60	60	3600	1200
16	0.3	0.3	0.09	60	60	3600	1200
17	0.3	0.3	0.09	60	60	3600	1200
18	0.3	0.3	0.09	60	60	3600	1200
19	0.3	0.3	0.09	60	60	3600	1200
20	0.3	0.3	0.09	60	60	3600	1200
21	0.3	0.3	0.09	60	60	3600	1200
22	0.3	0.2	0.06	60	40	2400	1000
23	0.3	0.2	0.06	60	40	2400	1000
24	0.3	0.2	0.06	60	40	2400	1000
25	0.3	0.3	0.09	60	60	3600	1200
26	0.3	0.3	0.09	60	60	3600	1200
27	0.3	0.3	0.09	60	60	3600	1200
28	0.3	0.3	0.09	60	60	3600	1200
29	0.3	0.3	0.09	60	60	3600	1200
30	0.3	0.3	0.09	60	60	3600	1200
31	0.3	0.3	0.09	60	60	3600	1200
32	0.3	0.2	0.06	60	40	2400	1000
33	0.3	0.2	0.06	60	40	2400	1000
34	0.3	0.4	0.12	60	80	4800	1400
35	0.3	0.4	0.12	60	80	4800	1400
36	0.3	0.4	0.12	60	80	4800	1400
37	0.3	0.4	0.12	60	80	4800	1400
38	0.3	0.4	0.12	60	80	4800	1400
39	0.3	0.4	0.12	60	80	4800	1400
40	0.3	0.3	0.09	60	60	3600	1200
41	0.3	0.4	0.12	60	80	4800	1400
42	0.3	0.4	0.12	60	80	4800	1400
43	0.3	0.4	0.12	60	80	4800	1400
44	0.3	0.4	0.12	60	80	4800	1400
45	0.3	0.4	0.12	60	80	4800	1400
46	0.3	0.4	0.12	60	80	4800	1400
47	0.3	3.3	0.99	60	660	39600	7200
48	0.3	4.4	1.32	60	880	52800	9400
					Total =	252000	70800

Total Area of the Mine	452,400	sq. ft
Area of Exposed Roof	200,400	sq. ft
Area of Exposed Floor	200,400	sq. ft
Total Exposed Area	471,600	sq. ft

Table-2 : Exposed Area in the Mine as a Function of the Grout Height

Grout Height (feet)	Exposed Pillar Area (sq. ft.)	Exposed Roof Area (sq. ft.)	Exposed Floor Area (sq. ft.)	Total Exposed Area (sq. ft.)	Hydraulic Conductivity (ft./day)	% of Exposed Area (as a % of maximum exposed area)
0	70,800	200,400	200,400	471,600	64,000	100.00
1	56,640	200,400	0	257,040	51,200	54.50
2	42,480	200,400	0	242,880	38,400	51.50
3	28,320	200,400	0	228,720	25,600	48.50
4	14,160	200,400	0	214,560	12,800	45.50
5	0	0	0	0	8	0

Table-3 : Exposed Area in the Mine as a Function of Grout Covered Floor Area*

% of Floor Area Covered by Grout	Exposed Pillar Area (sq. ft.)	Exposed Roof Area (sq. ft.)	Exposed Floor Area (sq. ft.)	Total Exposed Area (sq. ft.)	% of Exposed Area (as a % of maximum exposed area)
0	70,800	200,400	200,400	471,600	100.00
25	69,030	200,400	150,300	419,730	89.00
50	67,260	200,400	100,200	367,860	78.00
75	65,490	200,400	50,100	315,990	67.00
100	63,720	200,400	0	264,120	56.00

*For a Grout Height of 6-inches

Table-4 : Exposed Area in the Mine as a Function of Grout Covered Floor Area*

% of Floor Area Covered by Grout	Exposed Pillar Area (sq. ft.)	Exposed Roof Area (sq. ft.)	Exposed Floor Area (sq. ft.)	Total Exposed Area (sq. ft.)	% of Exposed Area (as a % of maximum exposed area)
0	70,800	200,400	200,400	471,600	100.00
25	67,260	200,400	150,300	417,960	88.62
50	63,720	200,400	100,200	364,320	77.25
75	60,180	200,400	50,100	310,680	65.88
100	56,640	200,400	0	257,040	54.50

*For a Grout Height of 12-inches

Figure-2 : Height of Grout Vs Percentage of Exposed Area

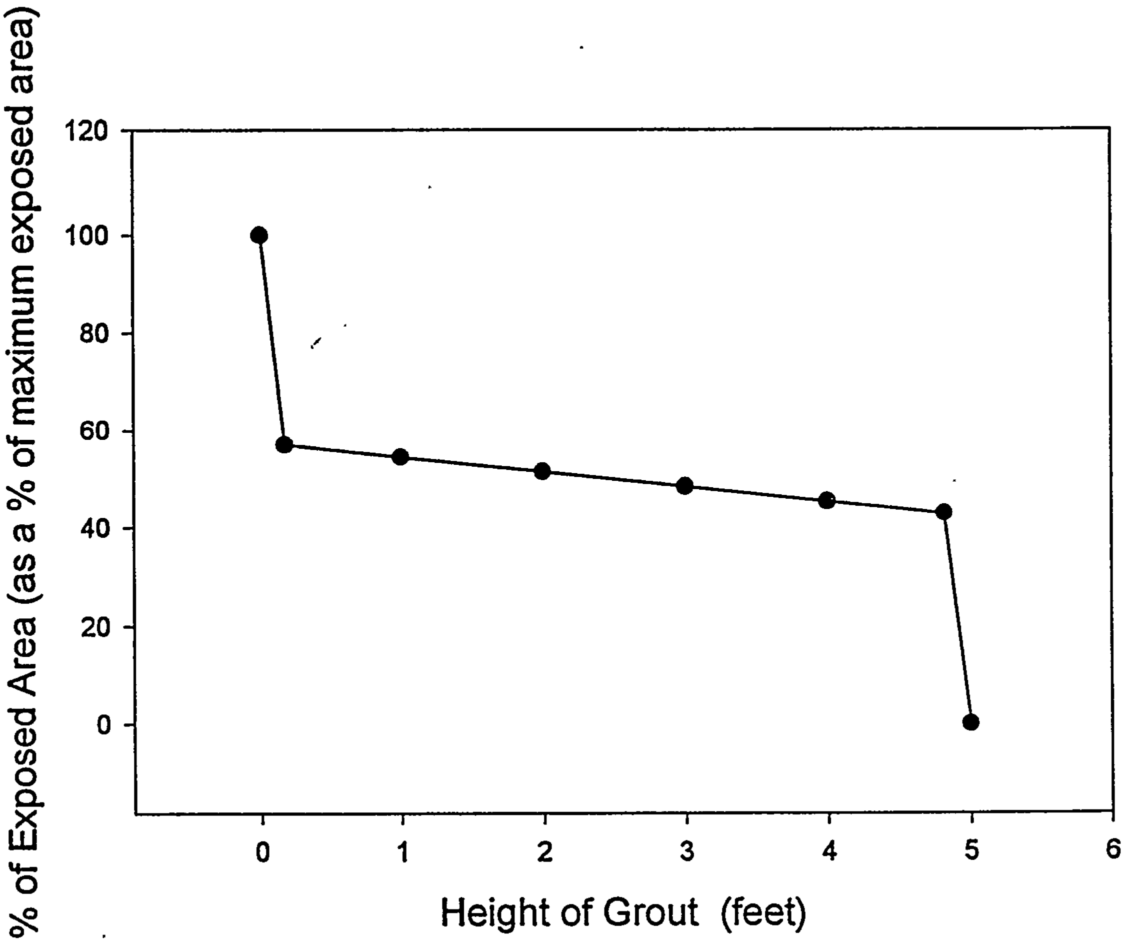


Figure-3 : 3-D Grid Used in the Simulations

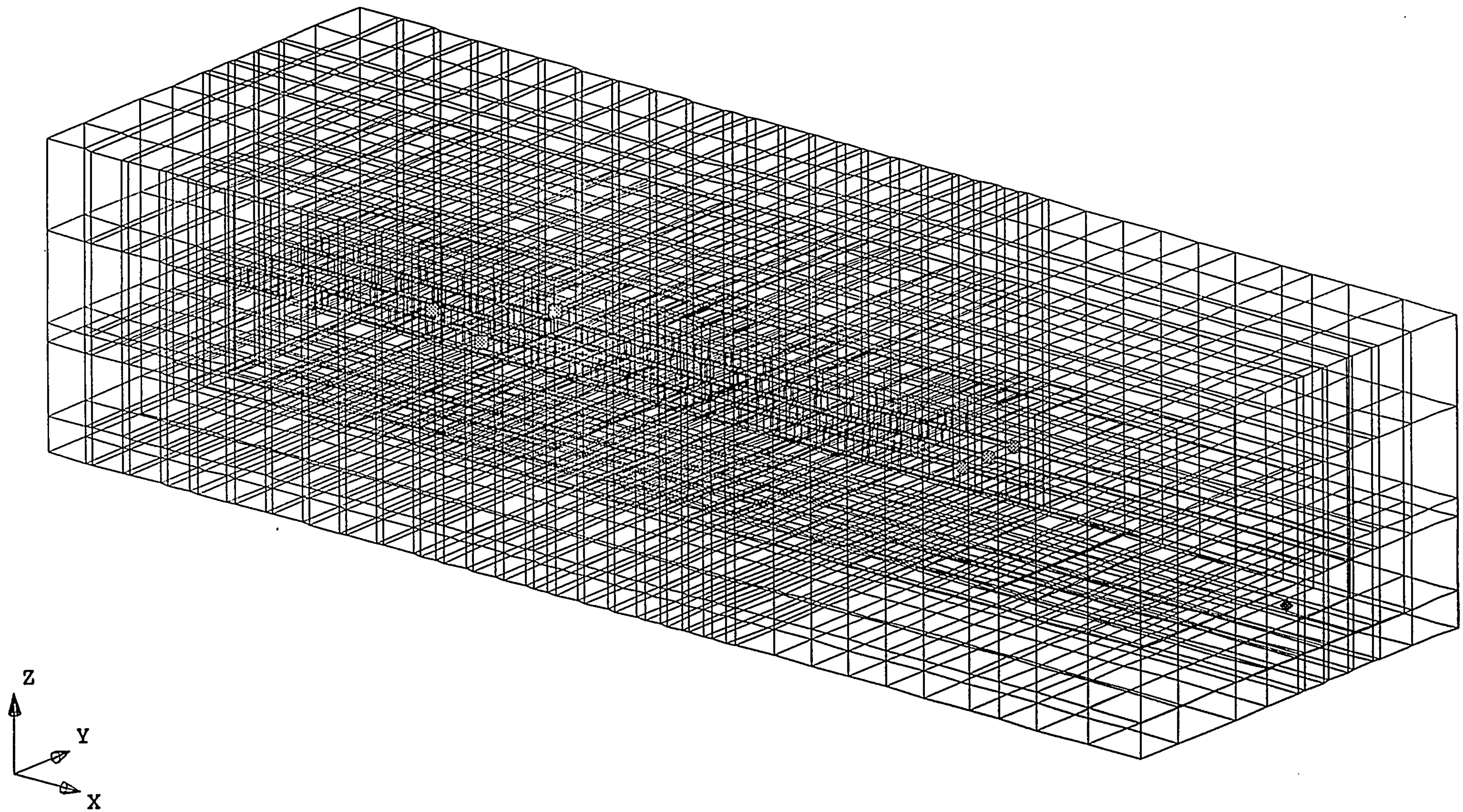


Figure-4 : The Mine Layer of the 3-D Grid

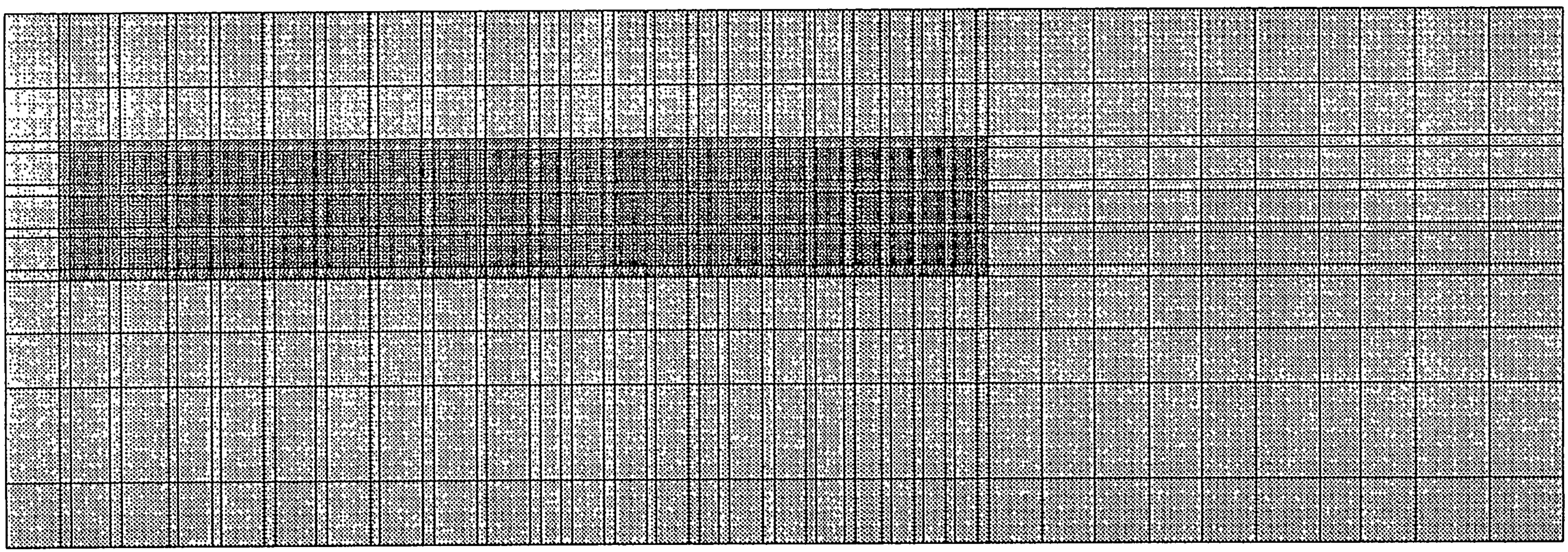


Figure-5: Typical Flow Modeling Results in the Mine Layer

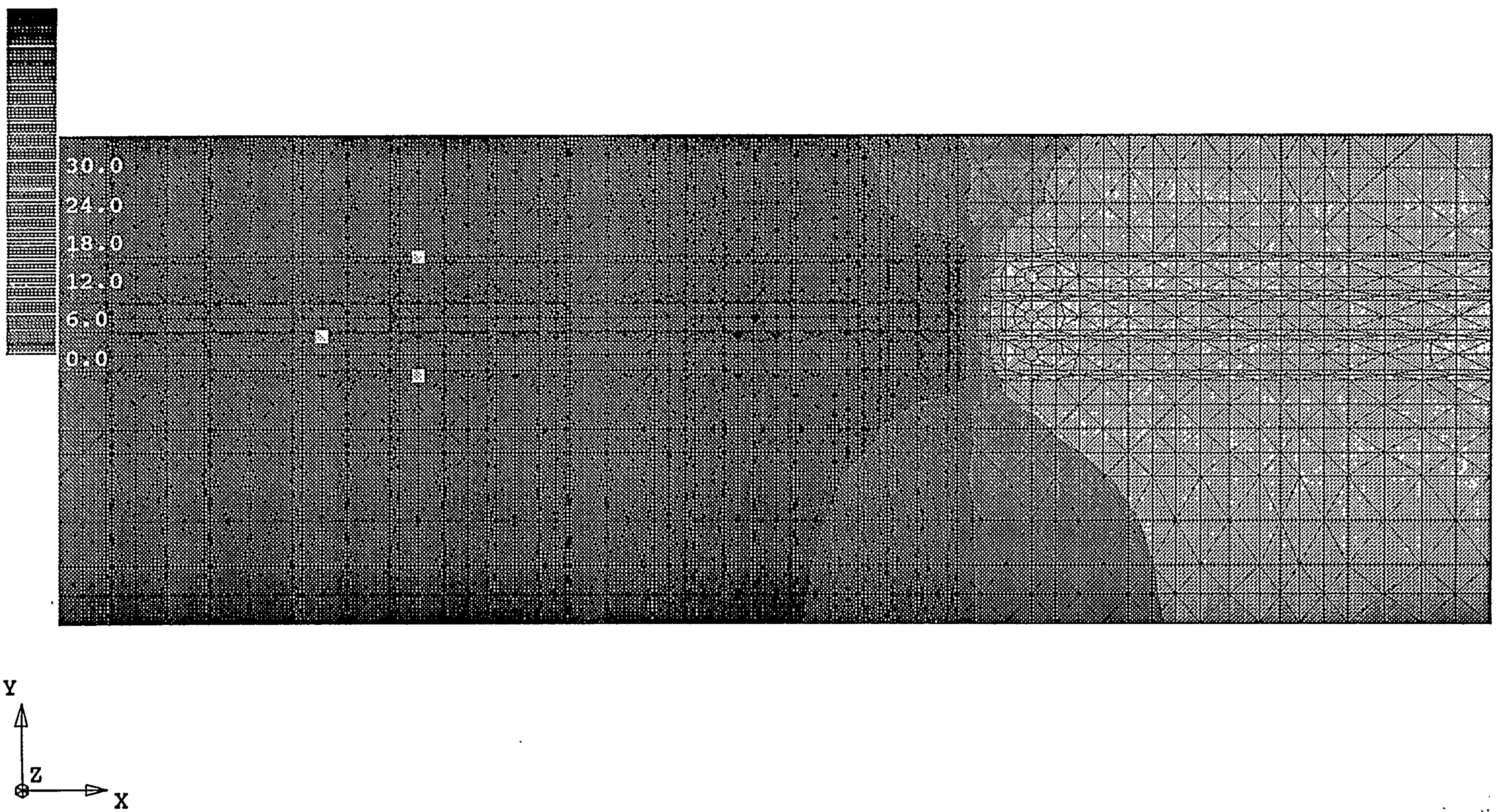


Figure-6: Typical Contaminant Transport Modeling Results in the Mine Layer

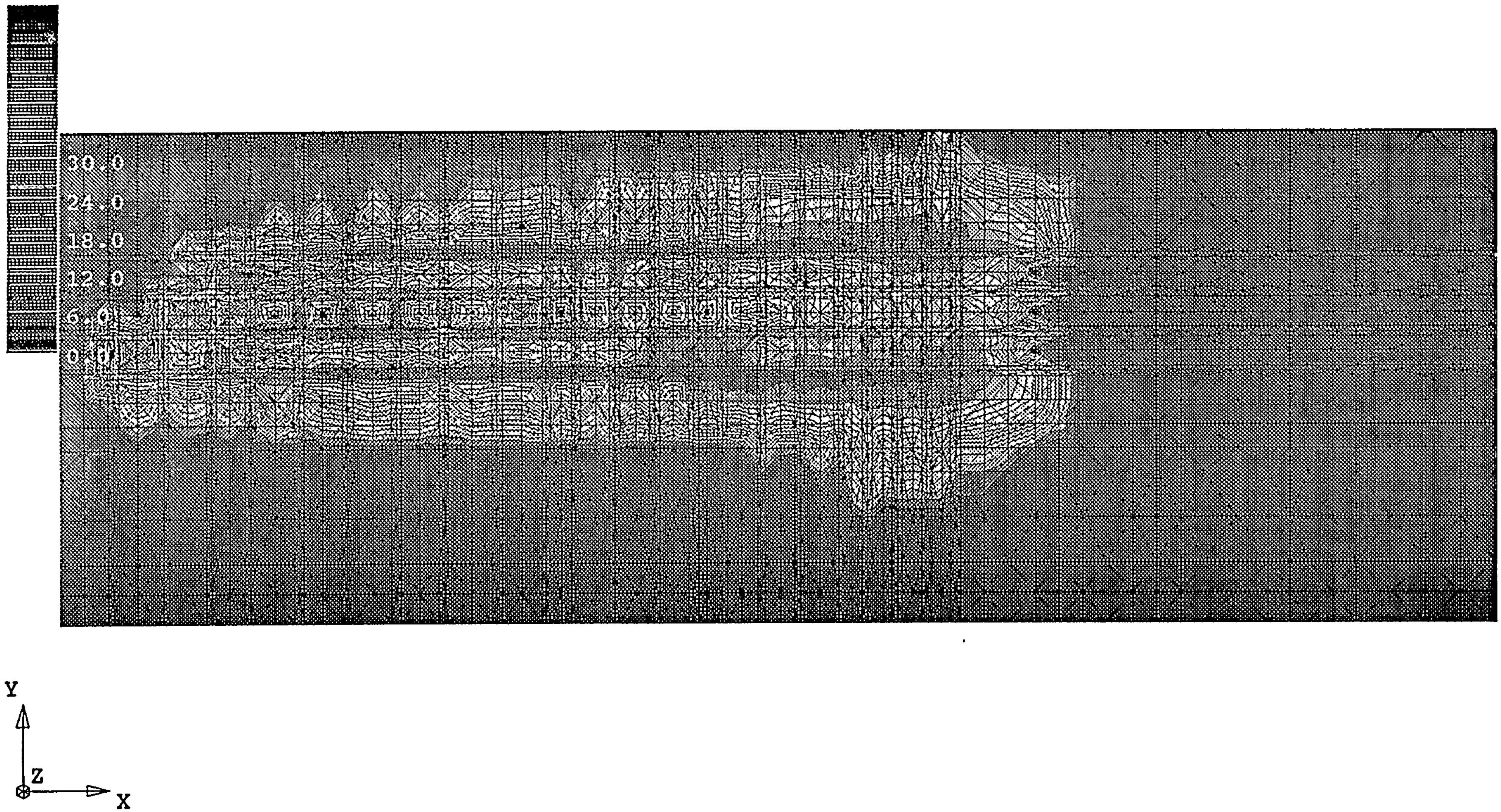
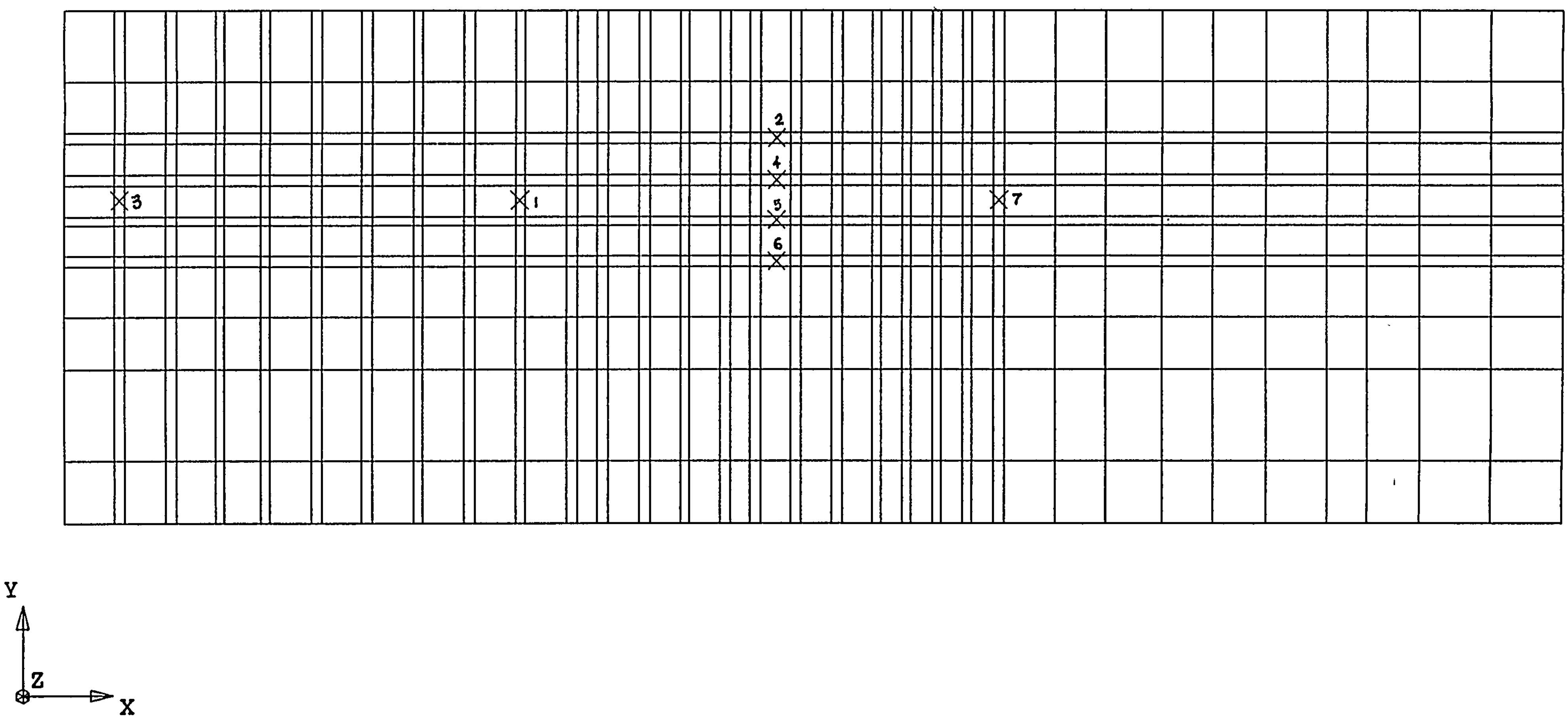
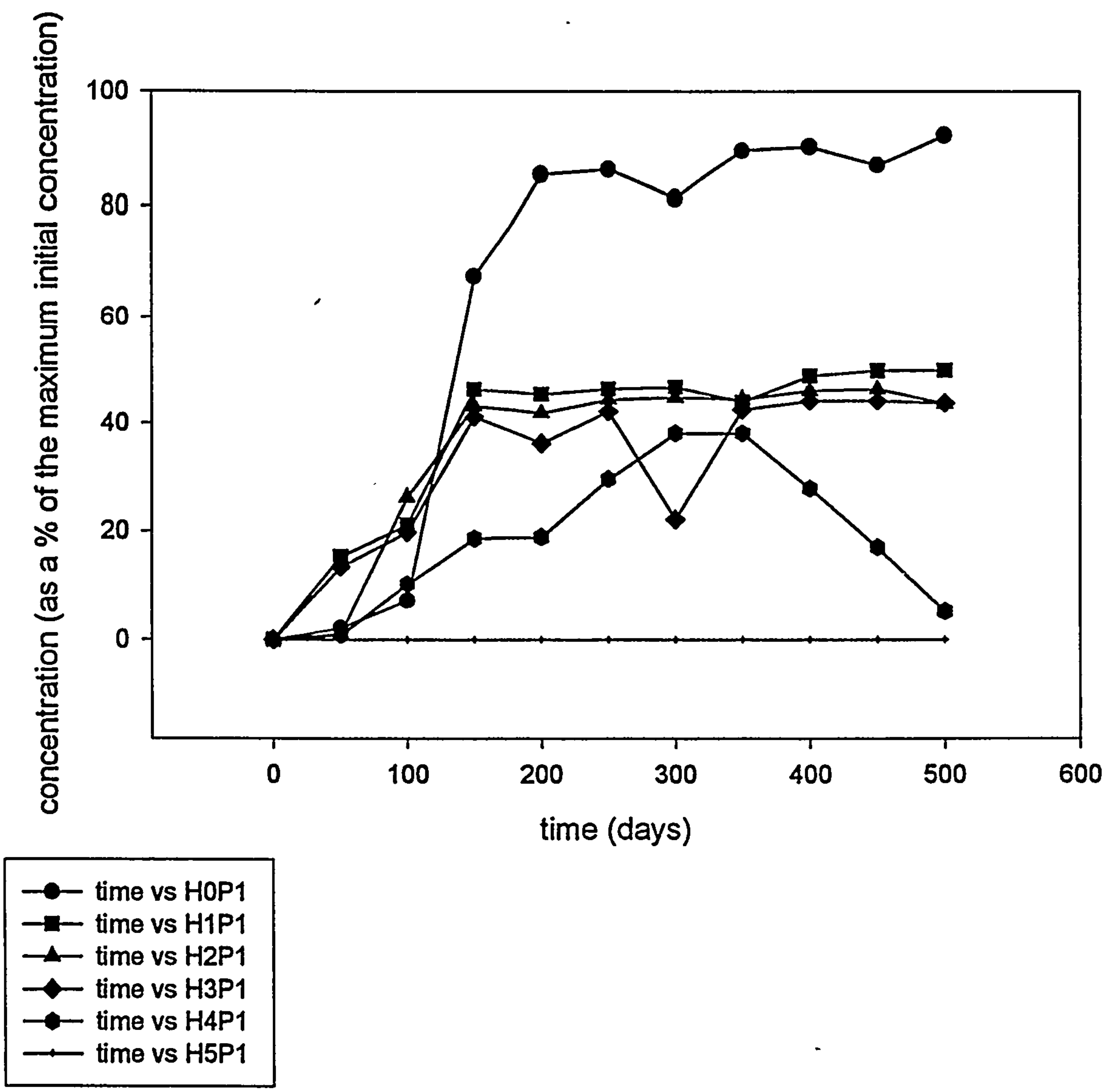


Figure-7: Computer Modeling Observation Points in the Mine Layer



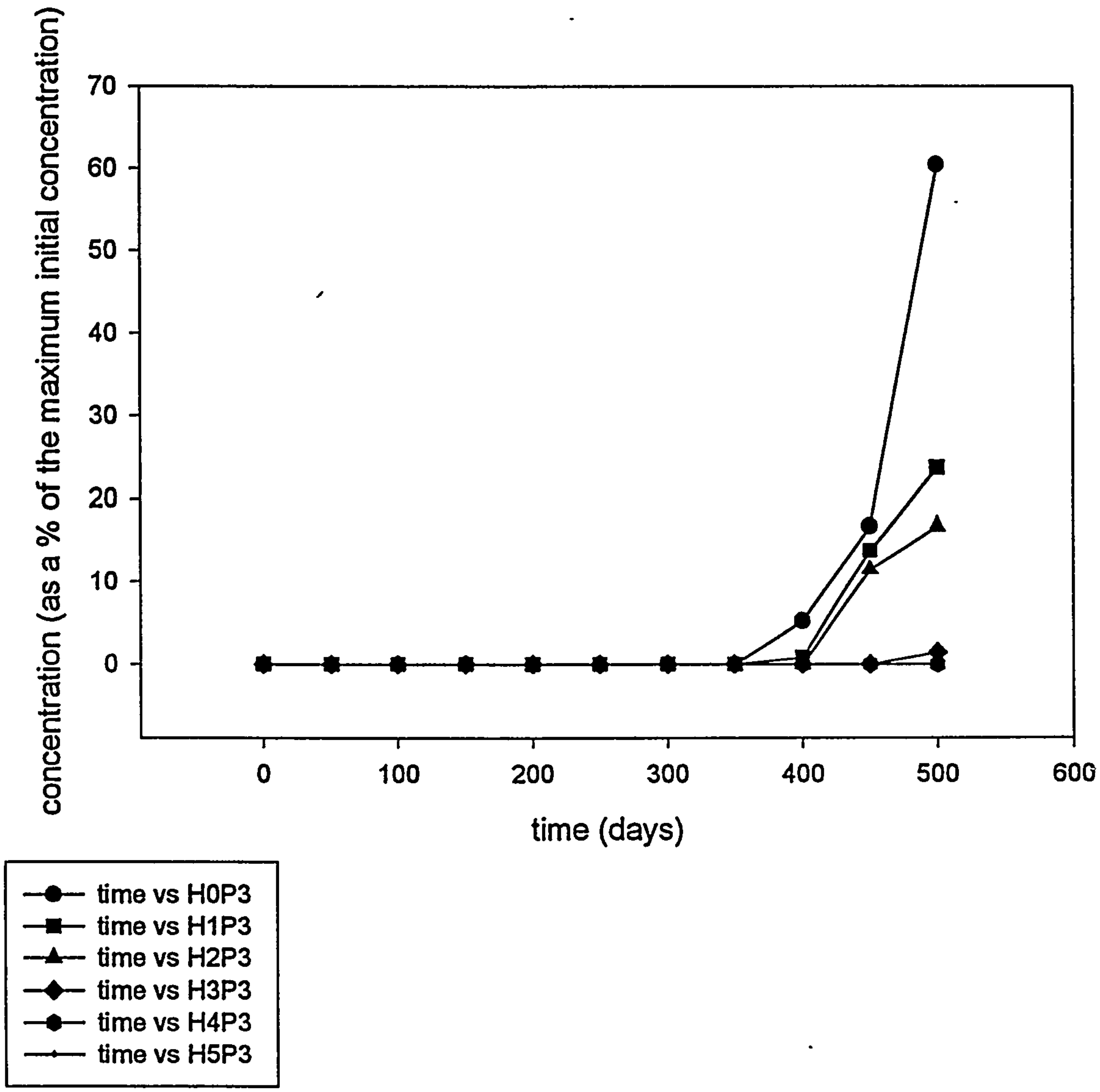
<u>Time Vs. Concentration Plot at an Observation Point for Cases With Different Hydraulic Conductivities</u>

Figure-8: Observation Point - 1



Time Vs. Concentration Plot at an Observation Point for Cases With Different Hydraulic Conductivities

Figure-9: Observation Point - 3



Time Vs. Concentration Plot at an Observation Point for Cases With Different Hydraulic Conductivities

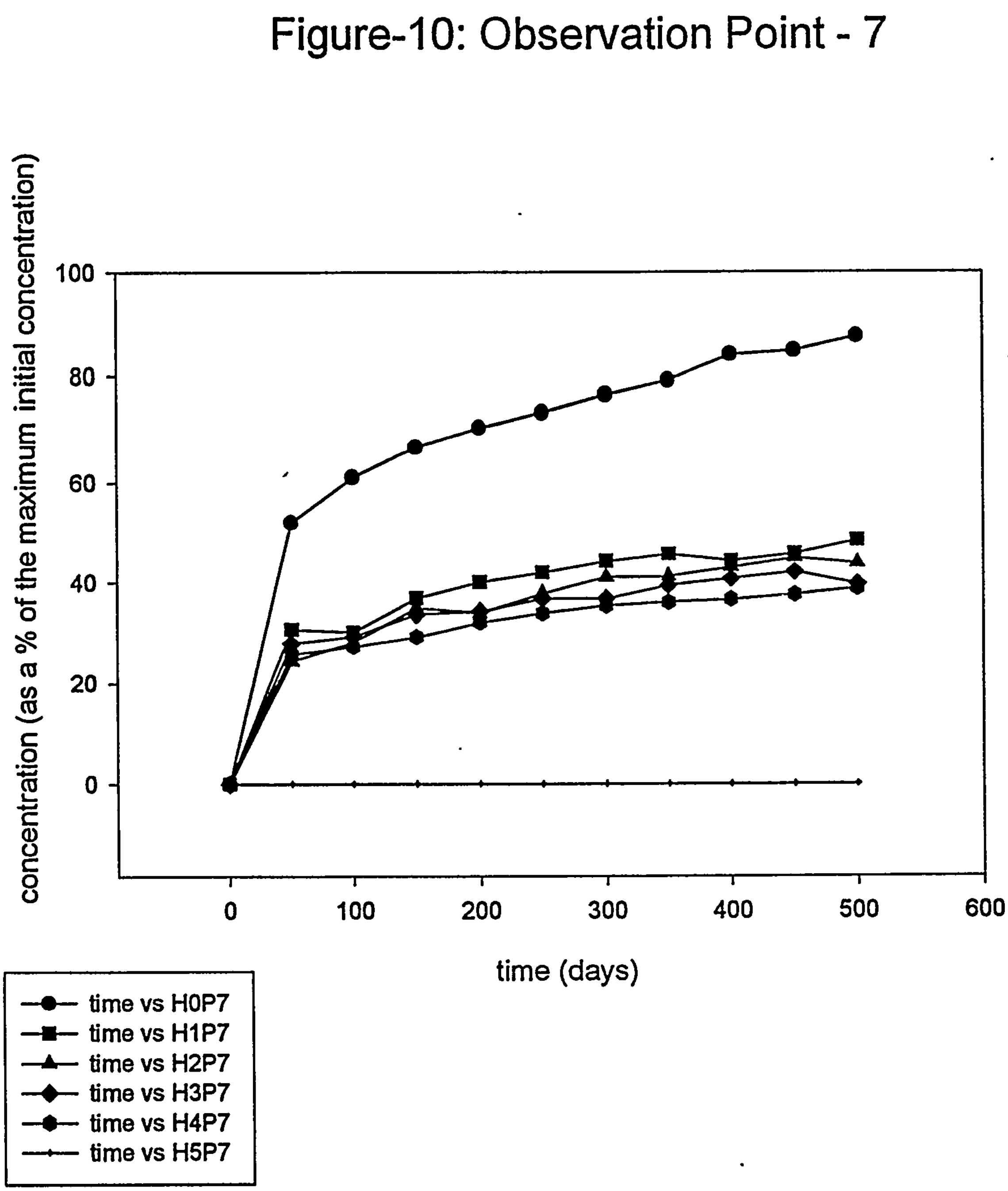


TABLE 5

Patriot Mining
Longridge mine discharge

Date	Set	pH	Cond.	Alkalinity mg/l	Acidity mg/l	Al mg/l	As mg/l	B mg/l	Ba mg/l	Ca mg/l	Cd mg/l	Fe mg/l	Mg mg/l	Mn mg/l	Pb mg/l	Se mg/l	SO4 mg/l	Total Flow gallons	Min. Flow gpm	Max. Flow gpm	Ave. Flow gpm
12-6-96	100	2.72	2020	0	597	43	0.38	0.07	<0.001	76	<0.001	84	47	14	<0.040	0.33	970	2501192	7.78	514.86	148.76
12-13-96	101	3.13	1970	0	644	50	0.46	<0.030	<0.001	92	<0.001	93	55	16	<0.040	0.31	1100	2287667	38.86	514.86	137.46
12-27-96	103	2.90	2070	0	622	49	0.49	0.08	0.008	96	<0.001	92	54	15	0.15	0.36	1200	1107530	7.69	124.41	66.55
1-4-97	104	2.90	1960	0	537	42	0.39	0.06	0.011	83	<0.001	80	48	14	0.11	0.42	1000	713899	72.21	137.76	101.18
1-11-97	105	2.98	2050	0	585	47	0.5	0.078	0.012	93	<0.001	90	52	14	0.11	0.44	1100	274128	31.42	162.69	53.57
1-21-97	106	2.67	2300	0	646	46	0.57	0.1	0.003	110	<0.001	110	59	17	0.2	0.5	1100	805819	10.32	162.69	48.42
2-12-97	108	2.65	2000	0	644	41	0.5	0.092	<0.001	120	<0.001	110	78	18	0.15	0.46	1100	1335655	29.93	140.82	66.24
3-18-97	109					58	<0.175	0.21	0.045	109	0.012	102	59	19	<0.040	<0.139		3969049	47.04	482.14	165.42
4-29-97	110	2.49	1940	0	528	37	0.42	0.11	<0.001	80	<0.001	67	49	14	0.042	0.24	1100	2850658	21.04	141.48	59.68
5-29-97	111	2.76	1800	0	548	36	0.51	0.18	0.013	85	0.0072	74	46	13	0.15	0.38	920	2131404	21.04	178.98	60.37

TABLE 6 Patriot Mining
Fairfax groundwater monitoring well

Date	Set	pH	Cond.	Alkalinity mg/l	Acidity mg/l	Al mg/l	As mg/l	B mg/l	Ba mg/l	Ca mg/l	Cd mg/l	Fe mg/l	Mg mg/l	Mn mg/l	Pb mg/l	Se mg/l	SO4 mg/l
1-11-97	105F	7.51	540	140	0	1.6	<0.175	<0.030	0.15	44	<0.001	0.33	10	0.086	<0.040	<0.139	120
2-12-97	108F	7.37	430	139	0	1.2	<0.175	<0.030	0.10	40	<0.001	0.42	8.4	0.084	<0.040	<0.139	96
3-18-97	109F					0.176	<0.175	<0.030	0.27	40	0.001	0.11	8.9	0.045	<0.040	<0.139	
4-30-97	110F	7.35	403	141	0	0.94	<0.175	0.11	0.13	31	<0.001	0.37	7.8	0.048	<0.040	<0.139	96
5-29-97	111F	7.37	335	190	0	0.86	<0.175	0.11	0.14	27	<0.001	0.18	6.1	0.021	<0.040	<0.139	76