# MODELLING, DESIGN AND SPECIFICATIONS OF THE COLLECTION AND INJECTION SYSTEMS AT UNITED NUCLEAR-HOMESTAKE PARTNERS' MILL NEAR MILAN, NEW MEXICO

FOR

UNITED NUCLEAR-HOMESTAKE PARTNERSHIP

BY

SCIENCE AND ENGINEERING RESOURCES, INC.

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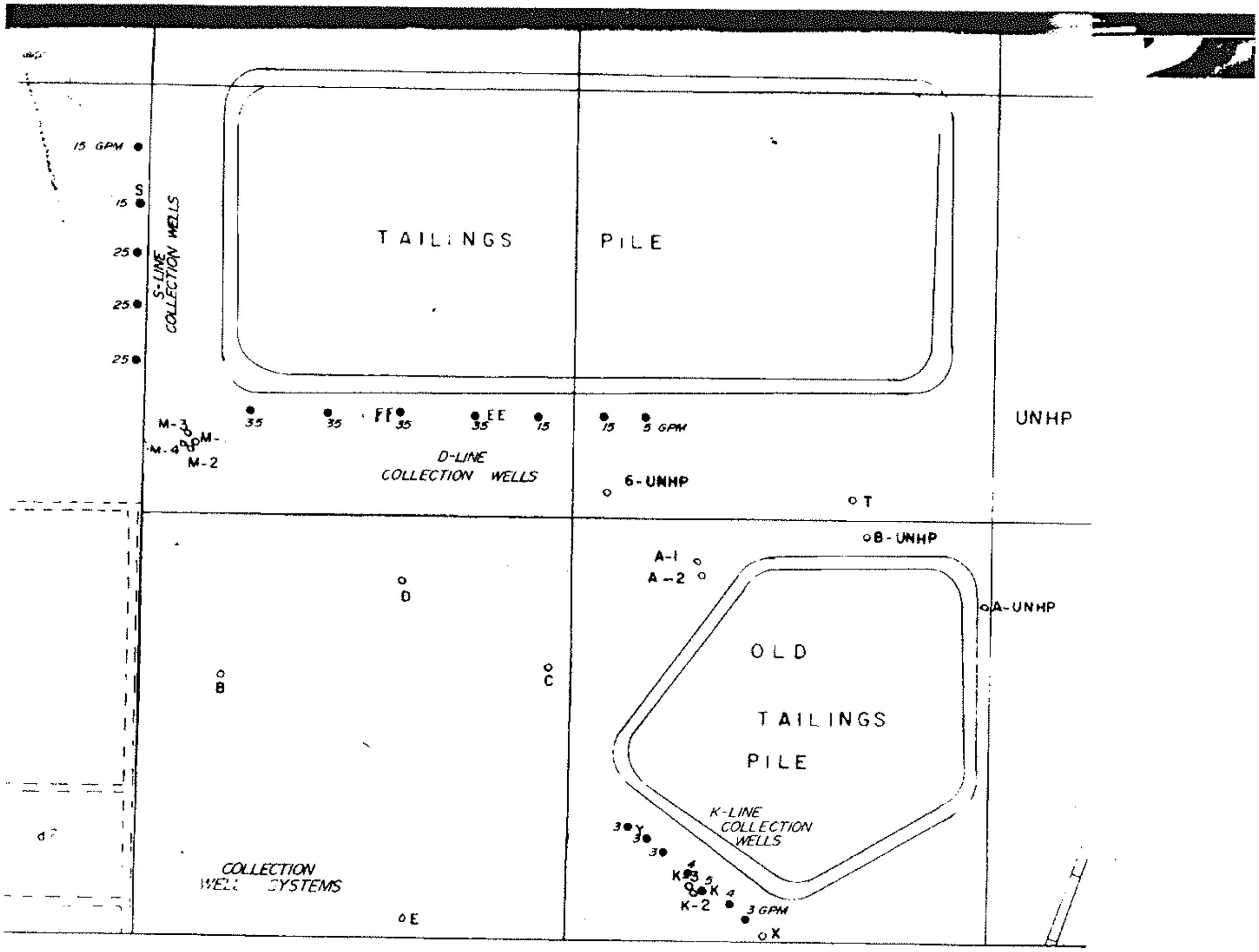


# MODELING, DESIGN AND SPECIFICATIONS OF THE COLLECTION AND INJECTION SYSTEMS

AT

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NEAR

# MILAN, NEW MEXICO

## INTRODUCTION

This report was prepared for United Nuclear Homestake Partners (UNHP) to meet certain requirements in the Groundwater Protection Plan agreement with the Environmental Improvement Agency (EIA). Items 11, part (a), numbers 3, 4, 5 and 6 of the agreement are covered by this report while items 11, part (a), numbers 1 and 2 were presented in the groundwater hydrology report which has been given to the EIA previously.

This report covers the modelling and design for the injection and collection well systems for the groundwater protection plan. The hydrologic impact from the injection and collection systems is also discussed. The needed management of the collection and injection systems to insure that the systems are properly working is also included in the report.

## MODELLING RECHARGE LINE G

A digital model which was developed by Pinder (1970), was used to predict the water level changes for different proposed sets of recharge wells. This model simulates the groundwater system with numerous discrete grids. A finite difference scheme is used to solve the equations which describe the flow of water from each grid. The model predicts the average drawdown for each grid for several different pumping periods. Aquifer properties of water level elevation, transmissivity and specific yield were inputs to the model

(see report on Groundwater Hydrology of the Alluvium at United Nuclear-Homestake Partners' Mill near Milan, New Mexico). Several different well spacings and discharges were modelled in an effort to obtain the desired groundwater movement in the alluvial aquifer in Broadview Acres. Rise in water level and water level elevation were the output of the model and were used to judge the acceptability of a particular set of recharge wells.

Well spacing of 150 and 200 feet were tried while injection rates of 50 and 100 gpm were used. The injection rate of 50 gpm was chosen because this injection rate yields similar flushing results to the 100 gpm rate except that it takes longer. The smaller injection rate also reduces the size of the pipeline which will convey the water to the wells. The 200 foot well spacing was selected because the 150 foot spacing was not necessary to maintain the desired water levels between the injection wells and such spacing reduces cost.

It is very difficult to determine at what water level rise the present aquifer water will be sufficiently diluted. It is probably less than five feet of water level rise as the aquifer water will have been diluted by at least 25 percent due to the small aquifer thickness. The actual dilution due to a five foot rise near the injection well would be greater than 25 percent because the injected water would have also pushed some of the present aquifer water downstream.

A one foot rise in water level could yield sufficient dilution of the water. Plate 2 gives the rise in water level from injecting 50 gpm at six proposed wells for 36 days. If the one foot in water level rise is satisfactory to dilute the comtaminated water then 36 days of injecting is probably sufficient. If a larger rise in water level is needed the injection will have to be conducted a longer period of time. The predicted water level elevation after 36 days of injecting with 50 gpm each is given on Plate 3. The dash-dot line shows the new water level elevation while the water level elevation before injection is given by the solid and dashed line. Plate 3 shows that if the injection wells are operated for approximately one month, the water level elevations will not be affected at a large distance from the injection wells.

The predicted water level elevations for 185 days (approximately six months) of injection is given on Plate 4. The mound of injected water after injecting for 185 days is significantly larger than the mound given on Plate 2 for 36 days of injection. Water levels near the tailings piles should not be affected from the injection of the G line of wells.

An injection rate of 50 gpm for six wells which are spaced at 200 foot intervals, was determined to be the most desirable injection plan. Modelling indicated that at least a month of injection will be required to dilute the groundwater. Two months will probably be needed to dilute the groundwater sufficiently. The results of the modelling were used in the design and specifications of the injection system which will be presented next.

## DESIGN AND SPECIFICATIONS OF RECHARGE SYSTEM

The design of the injection system for line G will be presented in two parts. Design of the injection wells will be presented first followed by the injection well piping.

### INJECTION WELL

A schematic of the well completion details for the injection wells is given in Appendix A. Appendix A also includes the specifications and materials list for the injection wells. Monitoring wells G and GG are proposed to be two of the injection wells and the other four proposed wells will be labeled GA, GB, GC and GD. Well completion details are given in the schematic of wells GA, GB, GC and GD. Ten inch diameter hole is to be drilled for each of the proposed injection wells to a depth of approximately 75 feet. Four inch plastic casing with a twenty foot section of slotted PVC casing is proposed for the perforation of the injection wells. One centering guide is proposed to aid in centering the casing in the drill hole. Coarse sand is proposed to extend from 40 feet below land surface to the bottom of the well as a gravel pack. Clay or fine sand is to be put in the annulus above the gravel pack to the land surface to retard the flow of water up the annulus into shallow sands.

A materials list is given in Appendix A for the four additional recharge wells, GA, GB, GC and GD. The quantity, unit cost and total cost for each item is given in the materials list. A total estimated cost for materials is also given for this portion of the project.

INJECTION WELL PIPING

The design of the injection well piping will be presented next. The source of injection water in UNHP's well number two which is completed in the San Andres Limestone. The following concentrations were obtained from a sample from well number two in October, 1976.

IN mg/l

TDS = 1928; CL = 156; F = 0.52; $SO_4$ = 569; ph = 7.1; Total Hg <0.0004; Phenols <0.001; Nitrogen Nitrate = 0.6; TOC = 23.7; As <0.01; Ba <0.1; Cd <0.001; Cr = 0.006; Pb <0.001; Se = 0.09; Ag <0.001; Cu <0.001; Fe = 0.155; Mn = 0.009; Zn <0.001; Al = 0.01; CO <0.01; V <0.01; B = 0.4; Mo <0.001; Ni <0.01; U = 0.0162

IN pCi/l

Radium 226 = 2.80*

*Large counting error due to insufficient sample volume, average of four samples.

The radium concentrations are much higher than the expected value for the San Andres and therefore the high concentrations are probably due to inadequate sample volume.

Well number two is shown on the schematic of the piping layout for the injection wells which is given in Appendix B. The schematic of the piping layout also gives details of the main pipe line which will convey water to the G line and the lateral line which will distribute the water to each well.

An existing tee on the existing water line near well #2 will be used to connect the proposed pipe line to well #2. A six inch gate valve will be installed in the six inch pipe before the adapter which connects the aluminum and PVC pipe. Six inch rented irrigation pipe will be used to convey the water from the well to the injection lateral. The aluminum pipe will be connected to the six inch PVC pipe at the lateral, as it was next to well #2. The lateral starts with a six inch PVC tee with reducers to the main four inch PVC lateral pipe. The lateral pipe is to be buried twelve inches deep and sloped toward each end so the line will drain.

A schematic of the connection to the injection well is given in Appendix B with details on the lateral connection to the injection wells. A plan view of the lateral line and an injection well show that a 1½ inch meter and valve will be installed between the lateral and well. The side and top views give details of line installation in the injection well. Locked metal covers will be installed on each injection well (see Broadview Acres Monitoring Well schematic for details). A small slope is proposed for the 1½ inch line so it will drain. A 3/4 inch PVC pipe is to be installed in the well to enable water level measurements to be obtained.

DESIGN AND SPECIFICATIONS OF THE BROADVIEW ACRES MONITORING WELLS

Two monitoring wells are proposed to be located south of Broadview Acres. The approximate location of these wells is shown on Plate 1. The EIA will select the exact location of the monitoring wells and will operate them. UNHP will install these wells and assist in sampling.

The monitoring wells are designed essentially as were the collection wells. Appendix C gives the well completion details for the Broadview Acres monitoring wells. Fully penetrating wells are proposed for the monitoring wells which will consist of slotted well casing from the static water level to the top of the Chinle. The slotted well casing is factory slotted PVC casing with approximately ten percent of its area as openings for an efficient well. The well will be gravel packed with coarse sand to approximately ten feet above the expected water level. The upper few feet of the well annulus will be cemented with a metal cover set in cement to prevent surface contamination of the groundwater and vandalism. A materials list is included with the design specifications in Appendix C for the two monitoring wells.

MODELLING OF COLLECTION WELLS

The modelling of the collection line near the old tailings pile and the collection lines near the operational tailings pile will be conducted separately to enable each of the collection lines to be simulated in more detail. The drawdowns of the two collection systems will overlap for the long-term simulation. The long-term drawdowns of both systems will be summed to approximate their combination effect.

Modelling results for the collection line near the old tailings pile will be presented first, which will be followed by the modelling results of the simulation of the collection lines near the operational tailings pile. The collection lines near the operational tailings pile are called D, south of the pile, and S, west of the pile. The collection line proposed for the southwest side of the old tailings pile will be labeled K.

COLLECTION LINE-K

The major criterion used to judge the acceptability of the line of collection wells is reversal of the hydraulic gradient between each of the collection wells. If reversal occurs between two collection wells then it certainly occurs near each of the collection wells. Plate 1 shows the location of collection wells and the rates for the proposed collection lines. The discharges given for the K collection wells were estimated from the transmissivity and saturated thickness maps from the hydrology report. These rates should be maintainable for a long period of pumping. Simulation of pumping these wells was conducted with a digital model to evaluate the acceptability of particular well spacings. Seven wells with the discharge which are given on Plate 1 and well spacings of 100, 150, 150, 100, 100 and 100 feet ending at well Y were selected as the collection wells for the K-line. The time to a reversal of the hydraulic gradient between collection wells was selected to be relatively short for the K-line of wells due to a possible inability of long-term continuous pumping from the shallow aquifer at the K wells. Therefore, a reversal between collection wells was desired within two weeks.

Plate 5 gives the water level elevations for the grid close to the collection wells after seven days of pumping. A slight reversal has occurred between the first two wells while the gradient between the remainder of the wells has not reversed. The water level elevation after 16 days of pumping is given on Plate 6. A reversal has occurred between all of the wells for 16 days of continuous pumping. All of the water flowing between the collection wells should flow toward the collection wells. Plate 7 shows the water level elevation after pumping the K-line 36 days.

The selection of well spacings so a quick reversal will occur is due to the large potential of variation of aquifer properties. Well spacings have been selected so that if major differences in the aquifer properties occur, reversals will still be possible by variation in pumping rate or pumping intervals. The proposed well spacings and discharges will require a modification of the continuous pumping to noncontinuous pumping of at least some wells.

COLLECTION LINES S AND D

Both collection lines, S and D (see Plate 1 for location), near the operational tailings pile were modelled together due to the small distance (see Plate 1 for location) between them. These two collection lines are not continuous between each other because water from well M has concentration below background. The proposed collection wells for lines S and D are given on Plate 1 with their individual discharges. These discharges and well spacings were selected to obtain a reversal in the hydraulic gradient between wells after approximately a month of pumping. A longer period of time to obtain reversal was selected for the S and D lines than for the K-line because longer continuous discharges from wells in the S and D lines is possible.

Plate 8 gives the water level elevation after pumping the S and D lines for 16 days. Reversal of the hydraulic gradient between the pumping wells has not occurred after 16 days of pumping. Plate 1 should be consulted to reference the collection wells to the tailings pile.

The water level elevation for 36 days of pumping is given in Plate 9. A reversal in the hydraulic gradient has been developed between each of the collection wells. All water flowing between each of the collection wells should eventually be collected by the system after 36 days of pumping. Well spacing and discharge is given in the legend of each plate.

## DESIGN AND SPECIFICATIONS OF COLLECTION SYSTEM

The design of the collection wells will be presented first. The pumps and piping systems needed to withdraw and convey the water from the wells will follow the well design.

## COLLECTION WELLS

The collection wells for lines K, S and D are shown on Plate 1. Water level management wells are also shown on Plate 1 for each of the collection lines. These wells will be used to judge whether the collection systems are operating as predicted. The water level management wells on the end of each of the collection lines might be needed as collection wells and therefore, should be completed as a collection well.

Seven collection wells are proposed for the K-line while four water level management wells are suggested. One of each of the collection and water level management wells is an existing well. Therefore, six collection and three water level management wells are needed to be drilled for the K-line. A typical well completion for the K collection well is given in Appendix D. The depth of the well will vary depending on the depth to the top of the Chinle. The engineer on site will define the depth at which each well is to be completed. The diameter of each of the collection well's casing was selected to be five inches because a four inch diameter casing could result in pump installation problems. Water level management wells not on the end of the collection lines will be four inches in diameter and a typical well completion is given in Appendix D also. All of the K wells well be gravel packed with coarse sand adjacent to the aquifer while pea gravel will be used to fill the remainder of the annulus. The slotted well casing in the collection wells in No. 40 slot size with approximately 10 percent opening areas. The water level management wells have slotted well casing with No. 30 slot size and approximately two percent opening area. A materials list and cost estimate is given in Appendix D for each of the collection lines.

The collection line on the west side of the tailings pile, line S, has five proposed collection wells and four water level management wells. The well completion schematic which, is given in Appendix D, is based on the expectation of the average depth of wells. The site engineer will have to determine the desired well depth in the field because these two lines of collection wells will probably vary in well depth from 60 to 120 feet. The remainder of the completion details will be the same as the K collection wells. The materials list in Appendix D includes an estimated sub-total cost for each collection line and the total cost for the collection wells.

COLLECTION WELL PIPING

The design of the main pipe lines were based on twice the total expected discharge from the line of collection wells. This was done to enable an extension of the collection lines if needed to complete the reclamation project. The pipe line from the K collection wells to the sump was therefore based on 50 gpm. Appendix E gives the details for the collection well piping. A schematic of the piping layout is first presented in Appendix E. This layout shows the size and footage of each of the pipe lines. The pipe line for the S collection line was selected to be four inches while the D line was designed to be six inches because it must convey the water from S and D lines to the sump. The K-line pipe line required only a 2½ inch PVC pipe.

Pump size are given on the piping layout sheet in Appendix E for each of the wells. These pumps were based on a desired discharge range and the total hea which each well would have to pump against. The initial desired discharges are given for each well on Plate 1. Eight ½ hp, seven 1½ hp and four 2 hp pumps have been selected for the collection systems.

The details of the piping which connects the main pipe lines to the wells is given in the piping and equipment schematic in Appendix E. The connecting piping varies with respect to the different pump sizes and is given in the notes on this schematic. A polyproplene rope is proposed to be attached to an eye bolt to secure the pump. A 3/4 inch drawdown tube will be installed in each well to enable the determination of the drawdown in each pumping well. The pump discharge pipe also varies according to the pump size. The valve and meter will be located above the ground for easy access while the check valve is located below the ground surface. The check valve is needed to enable some wells to be pumped while the remainder are not. A stop and waste valve is proposed so water in the piping above the ground will drain when the pump is shut-off. A materials list is given in Appendix E for the collection well piping with a cost estimate for these materials.

PROJECT MATERIALS LIST

A total project materials list is given in Appendix F.

This list includes all of the materials list previously presented in this report and gives an estimated cost for all materials for this project. This materials list should be used for ordering materials.

HYDROLOGIC IMPACT FROM THE COLLECTION AND INJECTION SYSTEMS

This portion of the report is included to meet specific requirements of the agreement between the EIA and UNHP. The design and specifications give the information to meet the requirements of item 11, part (a), number 3. Plate 1 gives the initial proposed rates for the collection and injection wells while Table 1 gives the estimated schedule of pumping rates for each collection well. Table 2 gives pumpage information relative to each of the collection lines. These items meet the requirements for item 11, part (a), number 4. The remainder of this section of the report will include the information which is needed to comply with item 11, part (a), numbers 5 and 6 - a,b and c. Part d of number 6 will be included in the Management of Injection and Collection Systems section. Water level change and water level elevation after six months, one year and twelve years of operating the collection systems will first be presented to meet these requirements. A discussion of the impacts on water levels in the subdivisions, on pumping the San Andres for injection and on local surface water bodies will follow the discussion of the predicted water levels.

TABLE 1. ESTIMATED SCHEDULE OF PUMPING RATES FOR EACH COLLECTION WELL

| TIME SINCE PUMPING STARTED | COLLECTION WELL PUMPING RATES IN GPM | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | K-LINE | | | | | | | S-LINE | | | | | D-LINE | | | | | | |
| DAYS | KA | KB | KC | KD | KE | KF | Y | SA | S | SB | SC | SD | DE | DF | EE | DG | DH | DI | DJ |
| 39.8 | 3 | 4 | 5 | 4 | 3 | 3 | 3 | 15 | 15 | 25 | 25 | 25 | 5 | 15 | 15 | 35 | 35 | 35 | 35 |
| 64.6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 15 | 15 | 25 | 25 | 25 | 5 | 15 | 15 | 35 | 35 | 35 | 35 |
| 102 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 15 | 15 | 25 | 25 | 25 | 5 | 15 | 15 | 35 | 35 | 35 | 35 |
| 158 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 15 | 15 | 25 | 25 | 25 | 5 | 15 | 15 | 35 | 35 | 35 | 35 |
| 241 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 15 | 0 | 25 | 0 | 0 | 15 | 0 | 35 | 0 | 35 | 0 |
| 367 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 15 | 0 | 25 | 0 | 0 | 15 | 0 | 35 | 0 | 35 | 0 |
| 555 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 15 | 0 | 15 | 0 | 0 | 15 | 0 | 20 | 0 | 35 |
| 838 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 10 | 0 | 15 | 0 | 0 | 15 | 0 | 20 | 0 | 35 | 0 |
| 1260 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 15 | 0 | 15 | 0 | 0 | 15 | 0 | 20 | 0 | 35 |
| 1900 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 10 | 0 | 15 | 0 | 0 | 15 | 0 | 20 | 0 | 35 | 0 |
| 2850 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 10 | 0 | 10 | 0 | 0 | 15 | 0 | 15 | 0 | 30 |
| 4280 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 0 | 10 | 0 | 15 | 0 | 0 | 15 | 0 | 15 | 0 | 30 | 0 |

TABLE 2 . QUANTITY OF WATER PUMPED AND PUMPING RATE FOR THE COLLECTION LINES.

| TIME SINCE PUMPING STARTED | | CUMULATIVE QUANTITY PUMPED | | | PUMPING RATE FOR LAST TIME PERIOD | |
|---|---|---|---|---|---|---|
| DAYS | YEARS | K-LINE | S-D-LINES | TOTAL | K-LINE | S-D-LINES |
| | | THOUSANDS OF CUBIC FEET | | | GPM | |
| 39.8 | 0.1 | 199 | 2,146 | 2,345 | 25 | 280 |
| 64.6 | 0.2 | 299 | 3,483 | 3,782 | 21 | 280 |
| 102 | 0.3 | 450 | 5,488 | 5,938 | 21 | 280 |
| 158 | 0.4 | 675 | 8,497 | 9,172 | 21 | 280 |
| 241 | 0.7 | 901 | 10,510 | 11,411 | 14 | 125 |
| 367 | 1.0 | 1,240 | 13,530 | 14,770 | 14 | 125 |
| 555 | 1.5 | 1,240 | 17,520 | 18,760 | 0 | 110 |
| 838 | 2.3 | 2,000 | 22,690 | 24,690 | 14 | 95 |
| 1260 | 3.5 | 2,000 | 31,660 | 33,660 | 0 | 110 |
| 1900 | 5.2 | 3,717 | 43,290 | 47,007 | 14 | 95 |
| 2850 | 7.8 | 3,717 | 59,810 | 63,527 | 0 | 90 |
| 4280 | 12.0 | 7,575 | 83,220 | 90,795 | 14 | 85 |

ESTIMATED TOTAL PUMPAGE
AT END OF 12 YEARS = 90,795,000 $FT^3$

PREDICTED WATER LEVEL CHANGES AND WATER LEVEL ELEVATIONS

The numerical models which were used to select well spacings and discharges for the collection lines were used to predict the water level elevations and water level changes for long term operation of these collection wells. The simulation was done for a maximum period of 12 years. Longer periods would require redigitization of data. We suggest that this be done after the entire system is monitored and tested for some period of time. The K collection system was therefore modelled separately from the S and D lines because the models were chosen to give the needed detail around the wells for design purposes. A reconstruction of these models into a single model would have been more appropriate for long-term prediction but was not deemed necessary considering the time constraints on project imitation. The results of these two models was summed together to indicate the effects of modelling the systems as one. Table 1 gives the pumping schedule for each individual well, while Table 2 presents the cumulative quantity of water pumped and the pumping rate for each line of wells. These pumping rates were selected so reversal in hydraulic gradient between collection wells is maintained. Water levels were kept significantly below the minimum required to maintain the reversal in hydraulic gradient. Therefore, the estimated quantities to be pumped should be conservative, that is, they should be large (worst case impact).

Plate 10 gives the predicted water level elevations after operating the collection wells for six months. Tables 1 and 2 should be consulted for pumping rates. Wells Y, S and EE should be used to associate individual well numbers from Table 1 to the collection wells on the plates. The dash-dot line (on Plate 10) is the estimated water level elevation after six months of pumping. Plate 11 gives the water level change for six months of pumping. This map shows the affected area with respect to water level decline for six months of pumping. Very little loss in maximum well yield would occur in wells outside the one foot drawdown. Significant losses in maximum well discharge would probably be noticed in wells inside the five foot contour. Drawdowns are normally larger up-gradient due to the higher heads up-gradient which make it easier for the wells to pull water from up-gradient than from downgradient.

The water level elevation and drawdown of the alluvium near the mill is given in Plates 12 and 13 respectively for one year of pumping the collection wells. The minimum drawdown contour that is shown on Plate 13 is five feet because the model's accuracy does not sufficiently define the one foot drawdown contour. The drawdown cone has not increased greatly between the six month and one year pumping periods. In fact, the 15 foot contour is smaller after one year of pumping than after six months. This is due to the decrease in pumping rates between the six months and one year of pumping.

Plate 14 presents the water level elevation after 12 years of pumping the collection wells according to the schedule which is given in Table 1. Major changes in the water level elevations are predicted after 12 years of operation of the collection systems. These water level changes are still limited to within a few thousands of feet from the collection wells. The influence from pumping for 12 years is given on Plate 15. The extent of the five foot contour has increased substantially beyond the one year pumping period.

Item 11, part (a), number 5 of the agreement with the EIA and UNHP request predictions of water level elevations until equilibrium is reached. The aquifer system will not reach equilibrium until the cone of influence reaches a recharge source. The system was modelled without consideration of the quantity of water which might be leaking from the tailings pile because the rate of leakage is unknown. If this leakage is present equilibrium is possible and would tend to limit the cone of drawdown. Modelling without leakage is therefore the conservative approach on estimating the extent of the drawdown.

EFFECT ON WATER LEVELS IN SUBDIVISIONS

The effect on the water levels in the subdivisions from injection and pumping will be discussed separately due to their independence. The injection along line G will affect the water levels in Broadview Acres while injection will not greatly influence the water levels in Murray Acres. The rise in water levels in Broadview Acres is given on Plate 2 for 36 days of injection. If injection lasted two months, the rise in water level would be similar to that of one month except the areal extent of rise will be larger.

The effect on the water levels in the subdivisions from pumping the collection wells can be evaluated from the drawdown maps. Plates 11, 13, and 15 give the drawdown after six months, one year and 12 years of pumping respectively. Essentially no effect on the water levels in the subdivision should occur during the first year of pumping. Some effect should occur between the first year and twelve years of pumping. Drawdowns are not shown in the subdivisions on Plate 15 because the accuracy of the model did not warrant contouring below five feet of drawdown. The average drawdown in the subdivisions will probably be approximately one foot after 12 years of pumping. A decrease of one foot in the aquifer thickness should not decrease the maximum discharge of wells greater than ten percent. Therefore, the impact of the collection systems on the water levels in the subdivisions does not seem to be very large.

EFFECT ON PUMPING SAN ANDRES FOR INJECTION WATER

UNHP will pump from their San Andres wells for the injection water. Injection at the rate of 300 gpm is proposed for line G until sufficient dilution has occurred in Broadview Acres. If injection lasts two months, 80 ac-ft of water will have been pumped from the San Andres for injection. Pumpage from the San Andres for mill water will be cut back by the quantity of water produced by the collection wells. Therefore after the collection wells are in operation, pumpage from the San Andres will decrease. If injection lasts beyond two months, the cut back in pumping the San Andres due to pumping the collection wells will off-set the injection pumpage.

The major effect on pumping the San Andres for the injection water is the increase in drawdown in the San Andres aquifer around the pumping well. Multiplication of the specific capacity of the pumping well times the additional pumping rate for the injection will yield a good estimate of the additional drawdown in the pumping well. The specific capacity of the pumping well is 158 gallons per minute per foot of drawdown according to a State Engineer's report (see Gordon, Ellis 1961, page 105, Table 9, well 12N. 10W. 26. 322a). An additional drawdown of two feet would result from pumping this well an additional 300 gpm. This drawdown would increase with pumping time but should still be only a few feet at the end of two continuous months of pumping. The effect on drawdowns in the San Andres from the additional pumping for injection should be small and localized.

EFFECT ON LOCAL SURFACE WATER BODIES

The Rio San Jose which is approximately 9000 feet to the southwest of the collection wells is the nearest surface water body. Effects on the Rio San Jose is possible if the alluvium near the Rio San Jose has drawdown. Modelling results indicated that the one foot drawdown after 12 years of pumping would be near the two subdivisions. The southwest edges of the subdivisions are approximately one-half the distance from the collection wells to the Rio San Jose. This indicates that the Rio San Jose would not be affected within the first twelve years of pumping. If injection into the alluvium on mill property were to be conducted to prevent affecting the Rio San Jose, injection would have to start before drawdown reaches the Rio San Jose. Injection on mill property could probably start after drawdowns are one-half the way to the Rio San Jose and still prevent any effect. Impact on the Rio San Jose from the collection wells should not be present for the first twelve years of operation but injection into the alluvium should probably start around this time to prevent future impact beyond 12 years. If leakage from the tailings pile and pumpage reach an equilibrium, impact on the Rio San Jose without injection should be negligible.

## MANAGEMENT OF INJECTION AND COLLECTION SYSTEMS

This section of the report will discuss the estimated length of injection and management of the injection system to determine when sufficient dilution has occurred. It will also contain a discussion on the management of the collection systems which includes the possible need to reactivate injection periodically to maintain the water levels at acceptable levels in the subdivisions.

## INJECTION SYSTEM

Injection will probably have to occur for one to six months for sufficient dilution. Modelling indicates that two months is probably the best estimate of injection time. Water level and water quality measurements will be conducted to evaluate when sufficient dilution has occurred. The two monitoring wells which are shown on Plate 1 and additional wells in Broadview Acres will be used to judge whether adequate clean-up has occurred. Four to six existing wells in Broadview Acres should be used as management wells for the injection system. Periodic water level and water quality measurements of these wells and the two monitoring wells should produce the information to manage the injection system properly. Water levels will also be observed to prevent the depth to water from becoming small enough to damage septic tanks or basements.

## COLLECTION SYSTEM

Several new wells and some existing wells are proposed as water level management wells for the collection systems (see Plate 1). These wells are located to determine whether a reversal had occurred. The water levels in the wells will be measured periodically to determine if the collection system is working and whether adjustment in the pumping schedule of the discharge wells is required. If the collection systems are not performing as expected, re-simulation might be required to predict future water levels and needed changes in the groundwater protection plan.

A discussion of the effect from injection and collection on water levels in the subdivisions has been presented in this report. Model results did not indicate a major impact on well yields in the subdivisions from the operations of the collection systems for the first twelve years. Modelling accuracy in the subdivision area was not sufficient to predict accurate drawdowns in these areas. Average drawdowns in the subdivisions will probably be on the order of one foot after twelve years of collection. This drawdown should not reduce well yields significantly and therefore injection to maintain well yields will probably not be necessary for the first twelve years. The State Engineer's Office might require injection to offset the quantity of water removed from the alluvium.

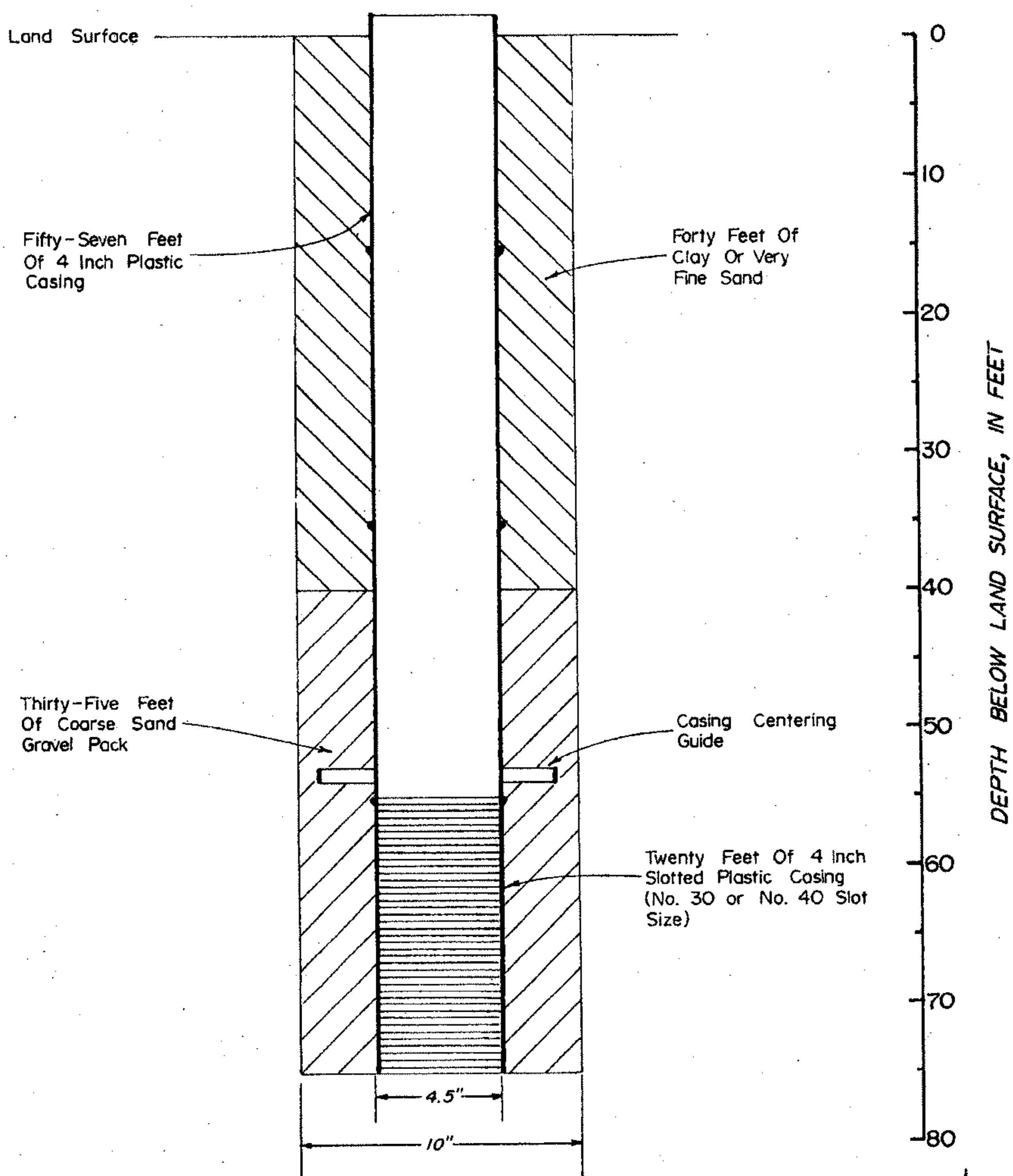
## REFERENCES


Gordon, Ellis, 1961. Geology and Ground-Water Resources of the Grants-Bluewater Area, Valencia County, New Mexico. New Mexico State Engineer, Technical Report 20.

Pinder, George, 1970. A Digital Model for Aquifer Evaluation. U. S. Geological Survey, Techniques of Water Resources Investigations, Book 7, Chapter C1.

# APPENDIX A

## WELL COMPLETION DETAILS FOR THE INJECTION WELLS




WELLS GA, GB, GC and GD

# SPECIFICATIONS FOR WELLS GA, GB, GC AND GD

Estimated well depth of 75 feet.

Well diameter of four inches.

Drill hole diameter of ten inches.

Well location is: GA 200 feet east of GG.
GB 200 feet east of GA.
GC 200 feet east of GB.
GD 200 feet east of GC.

Sixty feet of four inch bell plastic casing (SDR 26).

Twenty feet of slotted four inch plastic casing (Well Casing 100, No. 30 or No. 40 slot size). Cost approximately $2.00/ft.

One four inch well casing coupling (collar to connect two female ends).

Casing cement weld and cleaner.

One 4 inch casing cap.

One casing centering guide.

Gravel pack
- Median grain size of approximately two mm.
- Uniformity coefficient not greater than three.
- Quantity of 0.6 cubic yards.

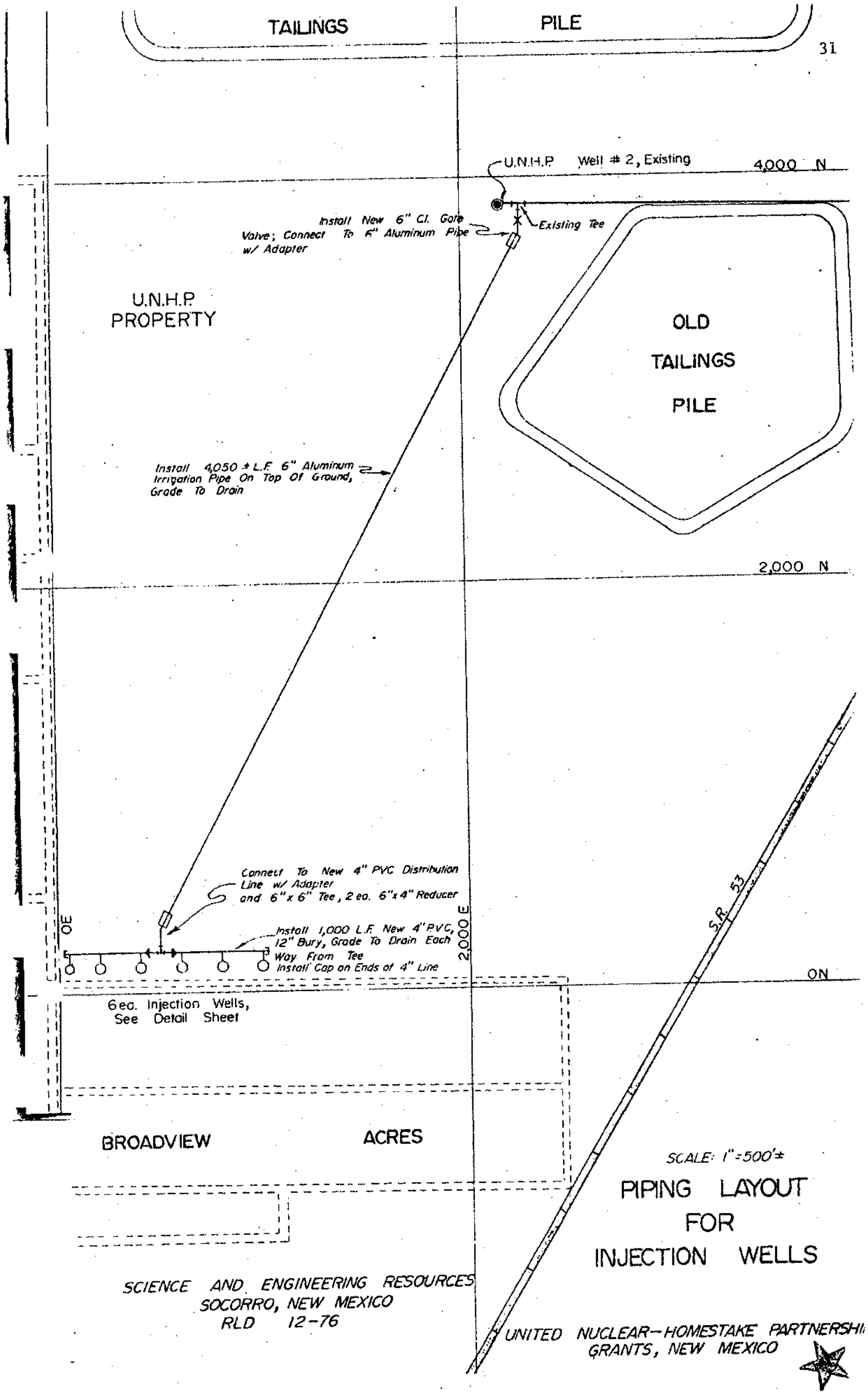
Well should be developed for at least one hour after drilling.

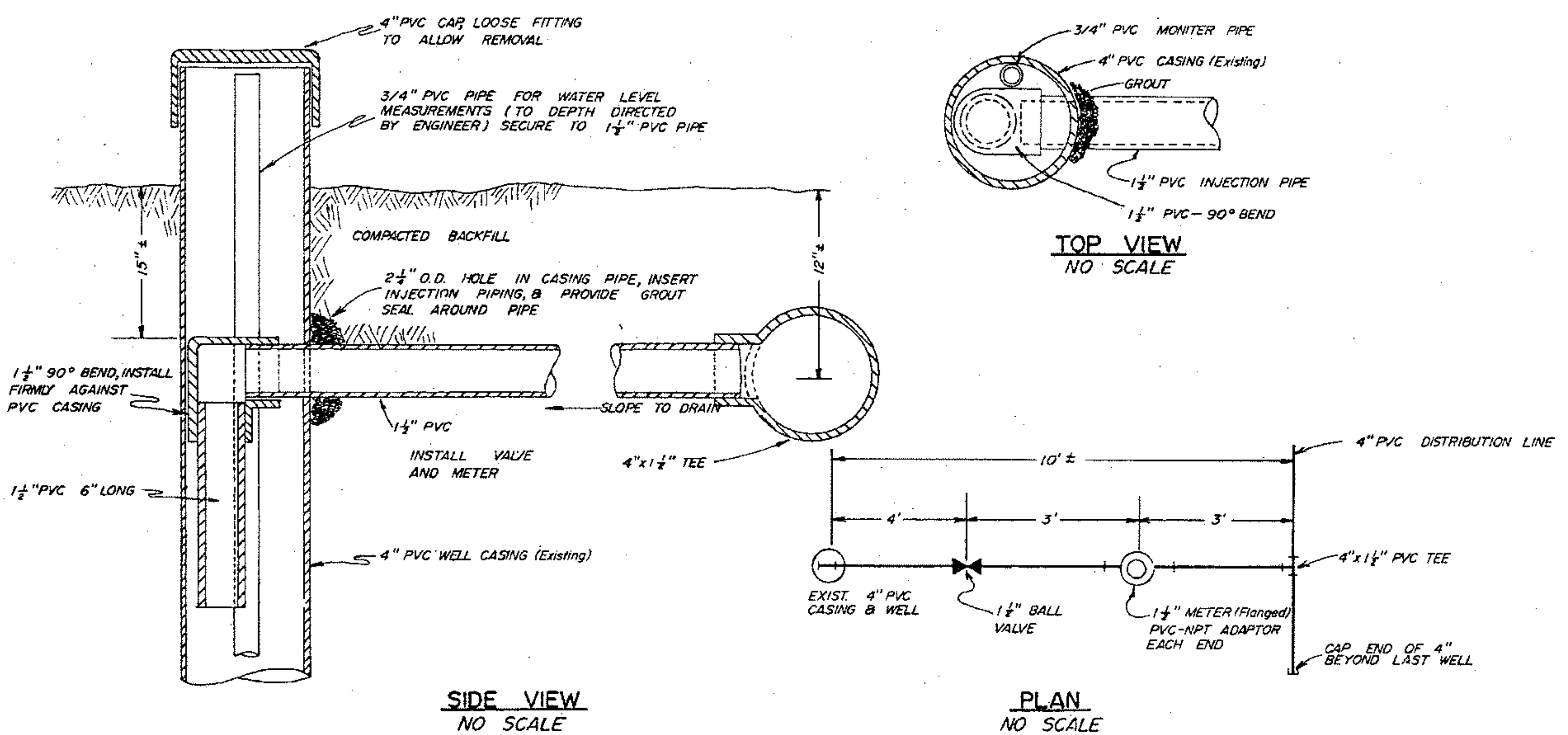
MATERIALS LIST FOR INJECTION WELLS
UNITED NUCLEAR HOMESTAKE PARTNERS
GRANTS, NEW MEXICO

| ITEM | DESCRIPTION | UNIT | QUANTITY | UNIT COST | EXTENDED AMOUNT |
|---|---|---|---|---|---|
| 1 | 4" Bell SDR 26 PVC Pipe | FT | 320 | 0.69 | 220.80 |
| 2 | 4" Slotted PVC Casing With No. 30 Slots | FT | 80 | 2.00 | 160.00 |
| 3 | 4" Casing Caps | EA | 4 | 2.59 | 10.36 |
| 4 | Centering Guides | EA | 4 | 10.00 | 40.00 |
| 5 | Gravel Pack 50 lb. Bags Coarse Blasting Sand | EA | 83 | 1.20 | 99.60 |
| | | | | Total | 530.76 |

# APPENDIX B

## INJECTION WELL PIPING


TAILINGS PILE
U.N.H.P. Well # 2, Existing
4,000 N
Install New 6" C.I. Gate Valve; Connect To 6" Aluminum Pipe w/ Adapter
Existing Tee
U.N.H.P. PROPERTY
OLD TAILINGS PILE
Install 4,050 ± L.F. 6" Aluminum Irrigation Pipe On Top Of Ground, Grade To Drain
2,000 N
Connect To New 4" PVC Distribution Line w/ Adapter and 6" x 6" Tee, 2 ea. 6" x 4" Reducer
0E
2,000 E
Install 1,000 L.F. New 4" PVC, 12" Bury, Grade To Drain Each Way From Tee
Install Cap on Ends of 4" Line
0N
6 ea. Injection Wells, See Detail Sheet
S.R. 53
BROADVIEW ACRES
SCALE: 1"=500'±
PIPING LAYOUT FOR INJECTION WELLS
SCIENCE AND ENGINEERING RESOURCES
SOCORRO, NEW MEXICO
RLD 12-76
UNITED NUCLEAR-HOMESTAKE PARTNERSHIP
GRANTS, NEW MEXICO




SCIENCE AND ENGINEERING RESOURCES
SOCORRO, NEW MEXICO
RLD 12-76

# INJECTION WELL DETAIL

UNITED NUCLEAR — HOMESTAKE PARTNERSHIP
GRANTS, NEW MEXICO

MATERIALS LIST FOR INJECTION WELL PIPING
UNITED NUCLEAR HOMESTAKE PARTNERSHIP
GRANTS, NEW MEXICO

| ITEM | DESCRIPTION | UNIT | QUANTITY | UNIT COST | EXTENDED AMOUNT | REMARKS |
|---|---|---|---|---|---|---|
| 1 | 8" x 6" PVC TEE | EA | 1 | 33.62 | 33.62 | |
| 2 | 8" COMPRESSION COUPLINGS | EA | 2 | 18.43 | 36.86 | |
| 3 | 6" CLASS 160 PVC PIPE | FT | 20 | 1.45 | 29.00 | |
| 4 | 6" GATE VALVE (M.J.) | EA | 1 | 125.00 | 125.00 | |
| 5 | 6" PVC-ALUM ADAPTOR | EA | 2 | 26.98 | 73.96 | RAIN-FOR-RENT (345-2468) |
| 6 | 6" PVC TEE | EA | 1 | 11.70 | 11.70 | |
| 7 | 6" x 4" PVC REDUCER | EA | 2 | 3.51 | 7.02 | |
| 8 | 4" CLASS 160 PVC PIPE (SLIP JOINT) | FT | 1040 | .68 | 707.20 | |
| 9 | 4" x 1½" PVC TEE (SOLVENT WELD) | EA | 6 | 3.41 | 20.46 | |
| 10 | 1½" PVC-NPT ADAPTOR | EA | 24 | .47 | 11.28 | |
| 11 | 1½" CLASS 160 PVC PIPE | FT | 60 | .19 | 11.40 | |
| 12 | 1½" BALL VALVE | EA | 6 | 16.75 | 100.50 | |
| 13 | 1½" WATER METER | EA | 6 | 171.57 | 1029.42 | |
| 14 | 1½" PVC 90° BEND | EA | 6 | .65 | 3.90 | |
| 15 | 3/4" SCHEDULE 40 PVC PIPE | FT | 360 | .14 | 50.40 | |
| 16 | 6" PVC COUPLING | EA | 2 | 2.44 | 4.88 | |

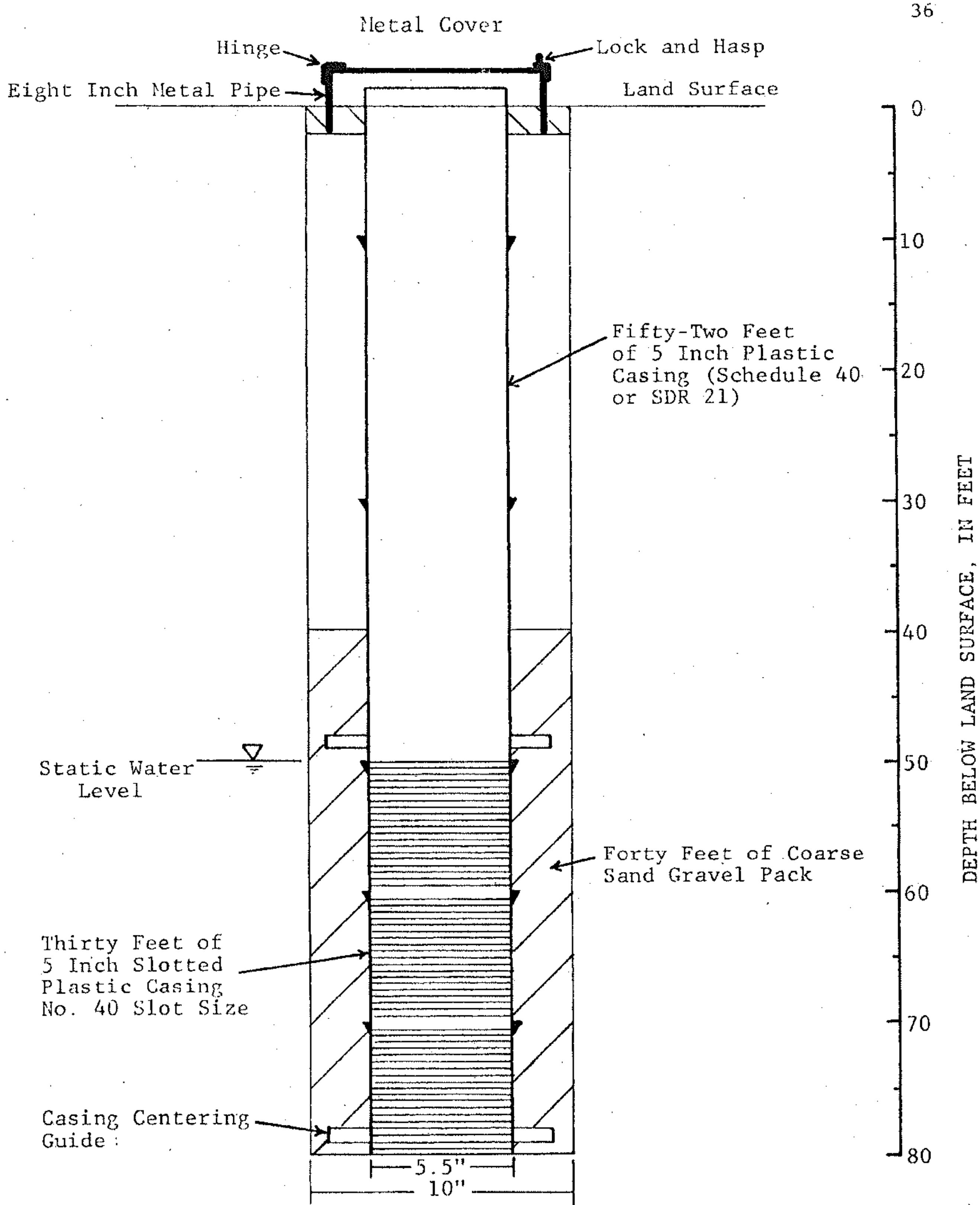
MATERIALS LIST FOR INJECTION WELL PIPING
UNITED NUCLEAR HOMESTAKE PARTNERSHIP
GRANTS, NEW MEXICO
(CONT'D)

| ITEM | DESCRIPTION | UNIT | QUANTITY | UNIT COST | EXTENDED AMOUNT | REMARKS |
|---|---|---|---|---|---|---|
| 17 | 6" x 3/4" SERVICE SADDLE | EA | 1 | 7.95 | 7.95 | |
| 18 | 3/4" STOP & WASTE VALVE | EA | 1 | 6.92 | 6.92 | |
| 19 | 4" PVC CAP (SOLVENT WELD) | EA | 2 | 2.59 | 5.18 | |
| | | | TOTAL EXTENDED AMOUNTS | = | $2,276.65 | |

RENTAL COST OF 6" ALUM. PIPE $0.24 PER FT. FIRST MONTH AND $0.13 PER FT. EACH ADDITIONAL MONTH. 4,100' @ $0.24 = $984.00
4,100' @ $0.13 = $533.00
PRICES F.O.B. ALBUQUERQUE PER A-1 INDUSTRIES (877-8185)

# APPENDIX C

## WELL COMPLETION DETAILS FOR THE BROADVEIW ACRES MONITORING WELLS




BROADVIEW ACRES MONITORING WELLS

SPECIFICATIONS FOR THE BROADVIEW ACRES MONITORING WELLS

Estimated well depth of 80 feet (to top of the Chinle).

Well diameter of five inches.

Drill hole diameter of ten inches.

Well location (see Plate 1)

Fifty feet of five inch bell plastic casing
(Schedule 40 or SDR 21)

Thirty feet of slotted PVC well casing (No. 40 Slot Size
with approximately 10 percent openings)

Three five inch well casing coupling

Two casing centering guides

Gravel Pack
Median grain size of approximately two millimeters.
Uniformity coefficient not greater than three.
Quantity of 50 x 50 # Bags.

Metal Cover with lock

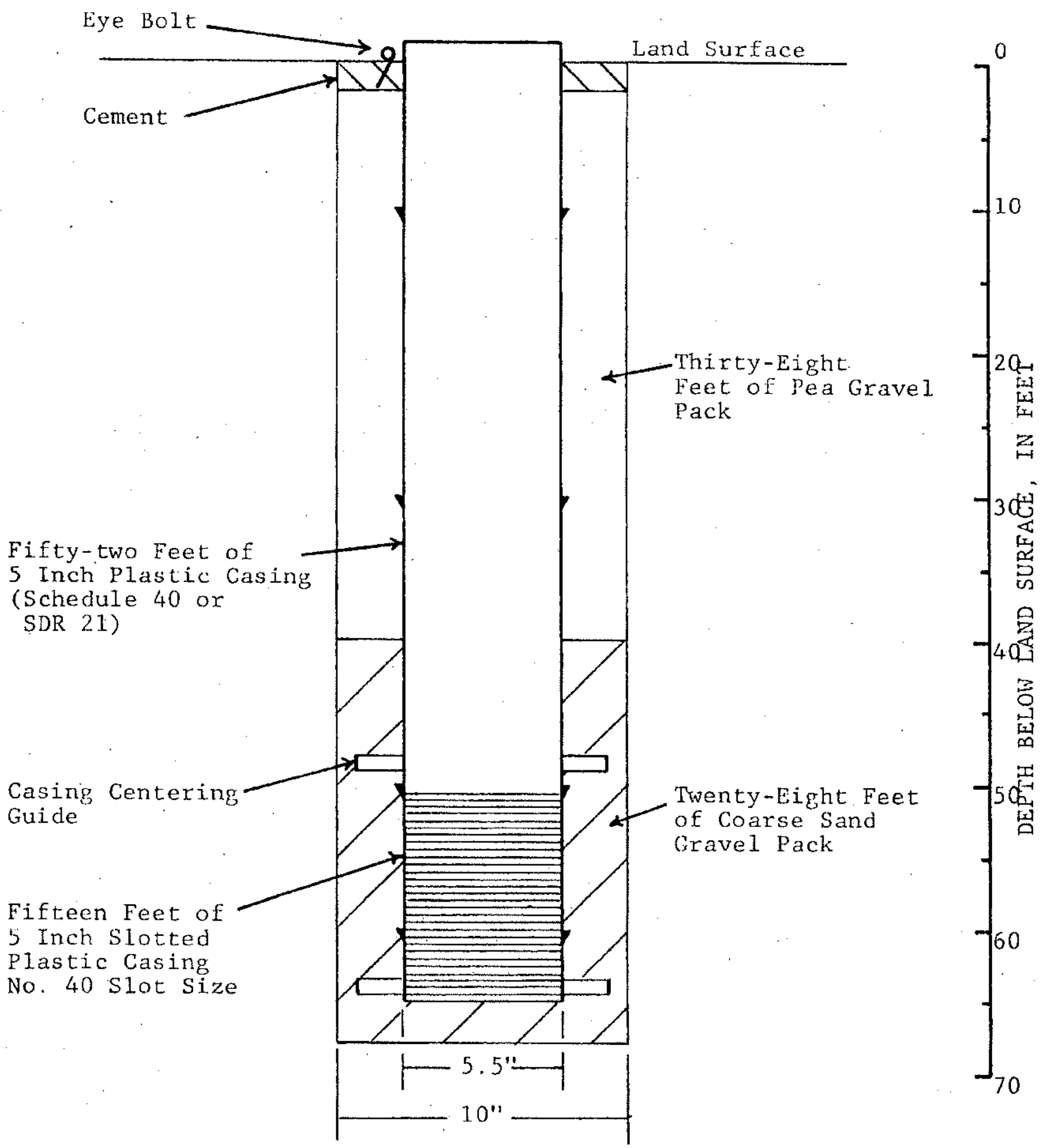
Well should be developed for at least one hour after drilling.

MATERIALS LIST FOR BROADVIEW
ACRES MONITORING WELLS

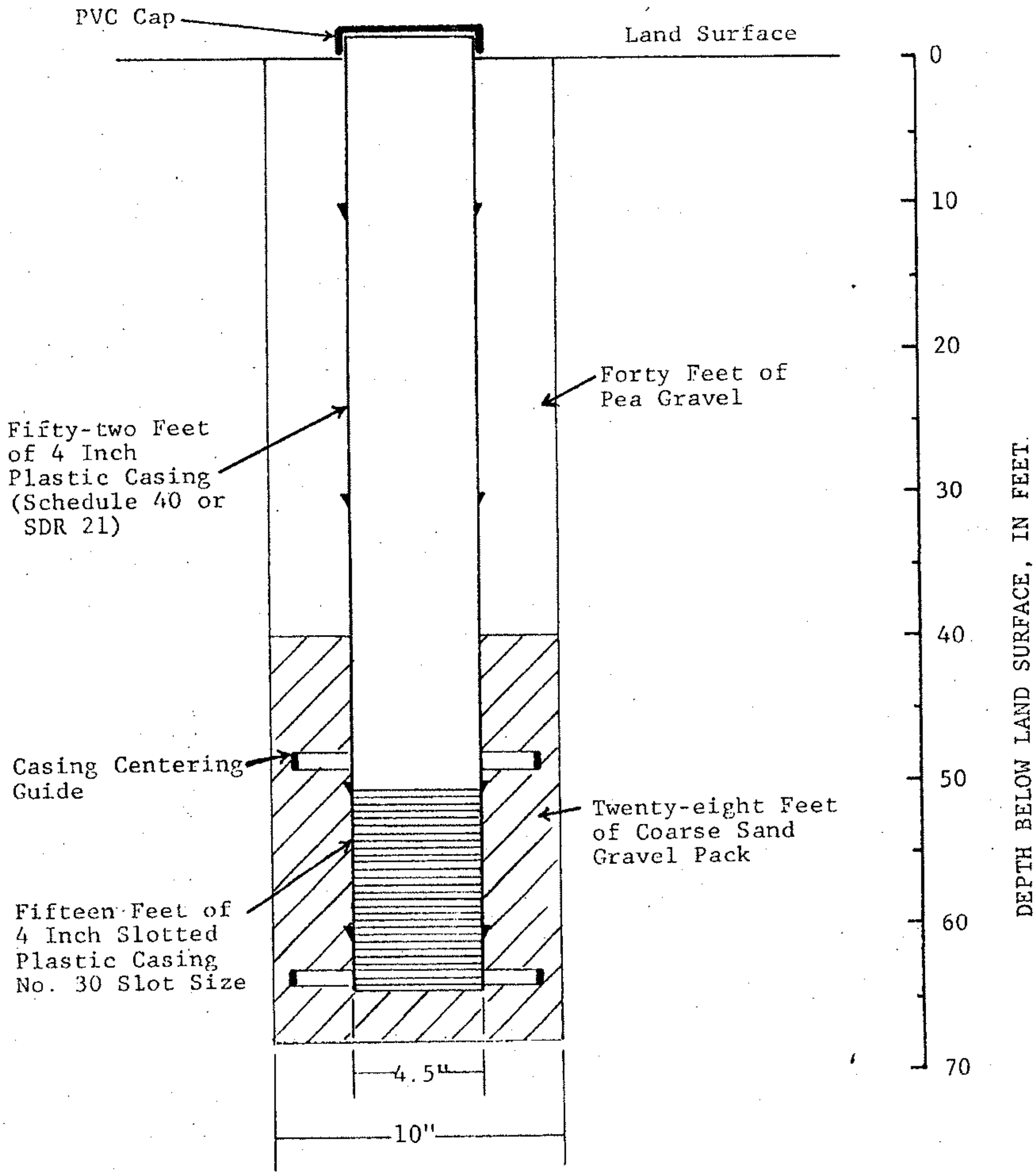
| ITEM | DESCRIPTION | UNIT | QUANTITY | UNIT COST | EXTENDED AMOUNT |
|---|---|---|---|---|---|
| 1 | 5" Schedule 40 or SDR 21 PVC Pipe, Bell End | FT | 100 | 2.10 | 210.00 |
| 2 | 5" Slotted PVC Well Casing Plain Ends, 10' Lenghts | EA | 6 | 56.43 | 338.58 |
| 3 | Centering Guides | EA | 4 | 10.00 | 40.00 |
| 4 | Gravel Pack 50 lb. Bags Coarse Blasting Sand | EA | 100 | 1.20 | 120.00 |
| 5 | 5" PVC Couplings | EA | 6 | 4.00 | 24.00 |
| 6 | Metal Cover with Lock | EA | 2 | 20.00 | 40.00 |
| | | | TOTAL | | 772.58 |

# APPENDIX D

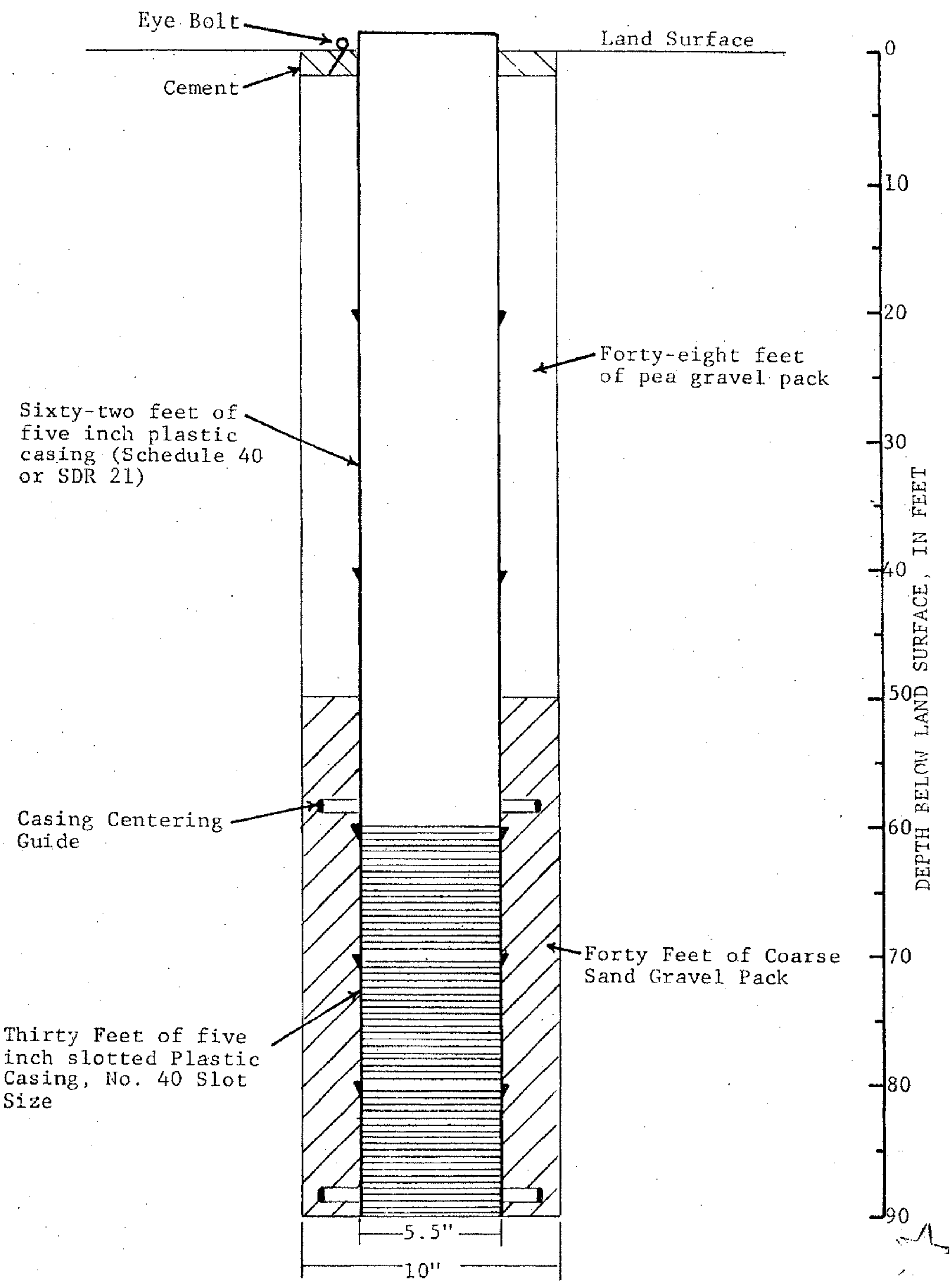
## WELL COMPLETION DETAILS FOR THE COLLECTION WELLS



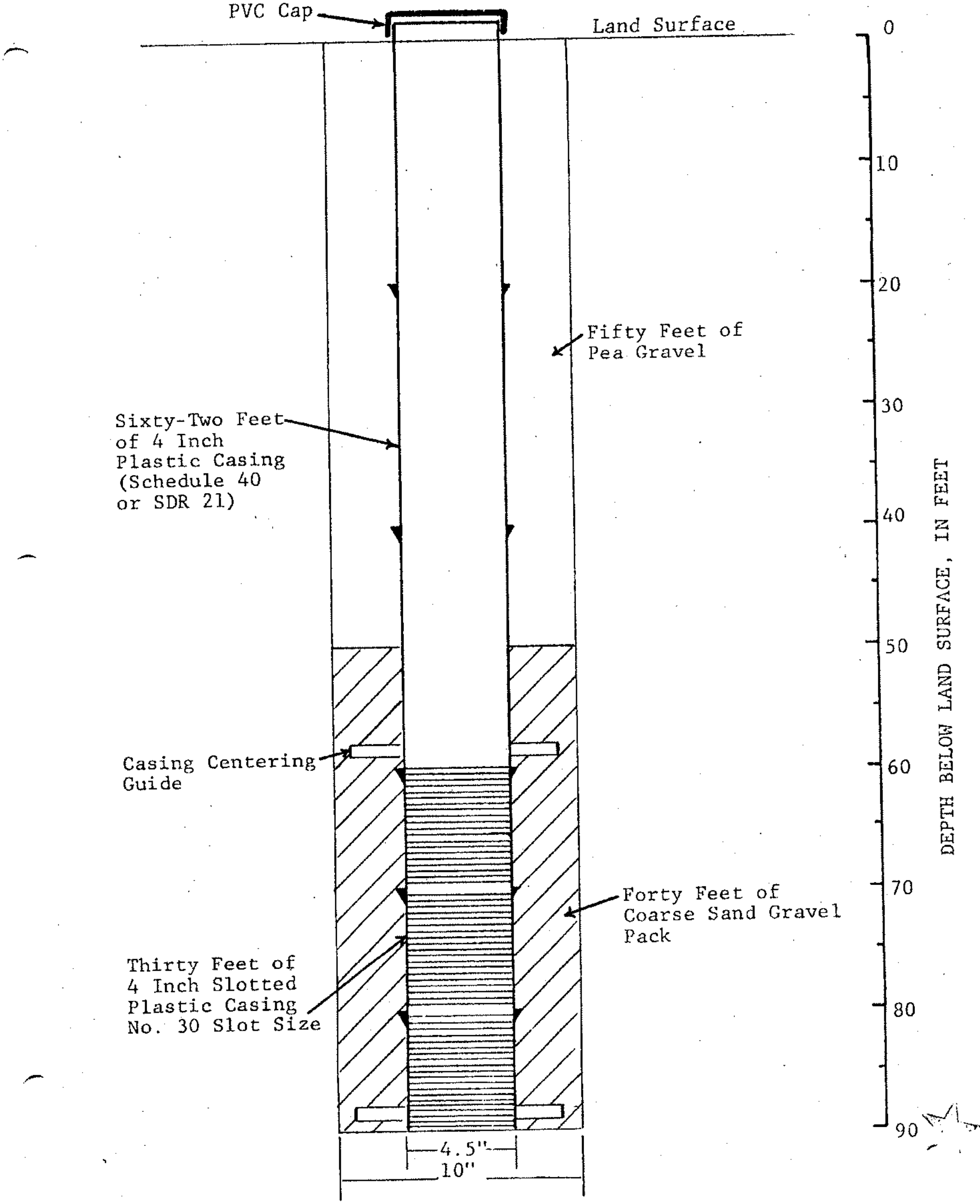

K-LINE COLLECTION WELLS




WATER LEVEL MANAGEMENT WELLS NEAR K-LINE




S AND D - LINE COLLECTION LINES




WATER LEVEL MONITORING WELLS NEAR S AND D LINES

MATERIALS LIST
FOR COLLECTION WELLS

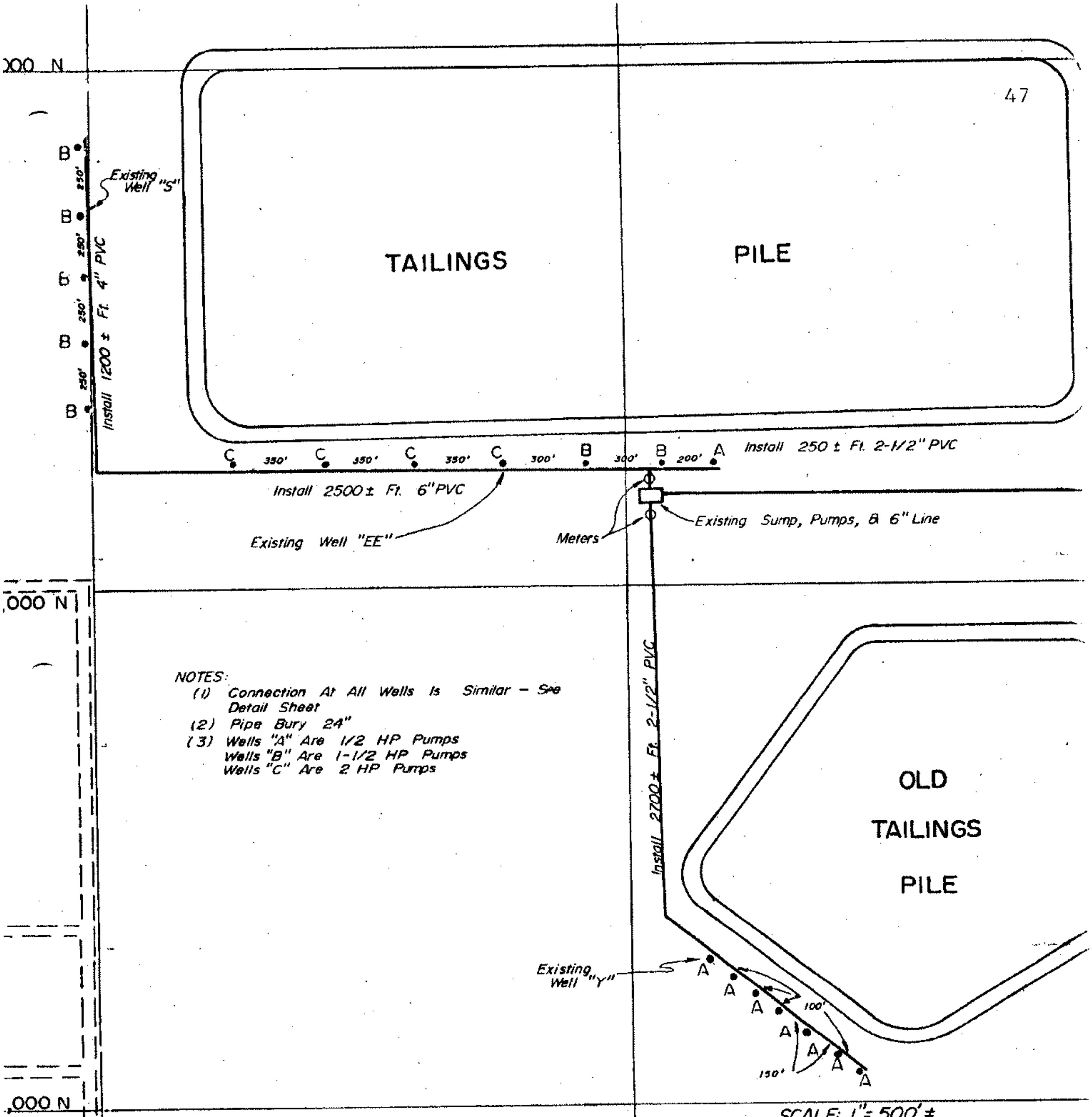
| ITEM | DESCRIPTION | UNIT | QUANTITY | UNIT COST | EXTENDED AMOUNG |
|---|---|---|---|---|---|
| | K-LINE | | | | |
| 1 | 5" Schedule 40 or SDR 21 PVC Pipe, Bell End | FT | 400 | 2.10 | 840.00 |
| 2 | 5" Slotted PVC Well Casing Plain Ends, 10' Lengths | EA | 11 | 56.43 | 620.73 |
| 3 | 5" PVC Couplings | EA | 18 | 4.00 | 72.00 |
| 4 | 4" Schedule 40 or SDR 21 PVC Pipe, Bell End | FT | 120 | 1.80 | 216.00 |
| 5 | 4" Slotted PVC Well Casing | FT | 20 | 2.00 | 40.00 |
| 6 | 4" PVC Coupling | EA | 2 | 4.00 | 8.00 |
| 7 | Centering Guides | EA | 18 | 10.00 | 180.00 |
| 8 | GRAVEL PACK | | | | |
| | Coarse Sand 50# Bags | EA | 350 | 1.20 | 420.00 |
| | Pea Gravel | $YD^3$ | 10 | 50.00 | 500.00 |
| | | | Sub Total | = | $2,896.73 |
| | S-LINE | | | | |
| 1 | 5" Schedule 40 or SDR 21 PVC Pipe, Bell End | FT | 420 | 2.10 | 882.00 |
| 2 | 5" Slotted PVC Well Casing Plain Ends, 10' Lengths | EA | 21 | 56.43 | 1185.03 |
| 3 | 5" PVC Couplings | EA | 21 | 4.00 | 84.00 |
| 4 | 4" Schedule 40 or SDR 21 PVC Pipe, Bell End | FT | 140 | 1.80 | 252.00 |
| 5 | 4" Slotted PVC Well Casing | FT | 30 | 2.00 | 60.00 |
| 6 | 4" PVC Coupling | EA | 4 | 4.00 | 16.00 |
| 7 | Centering Guides | EA | 18 | 10.00 | 180.00 |

MATERIALS LIST
FOR COLLECTION WELLS
(CONT'D)

| ITEM | DESCRIPTION | UNIT | QUANTITY | UNIT COST | EXTENDED AMOUNT |
|---|---|---|---|---|---|
| 8 | Gravel Pack | | | | |
| | Coarse Sand 50# Bags | EA | 500 | 1.20 | 600.00 |
| | Pea Gravel | $YD^3$ | 11 | 50.00 | 550.00 |
| | | | Sub Total | = | $3,809.03 |
| | D-LINE | | | | |
| 1 | 5" Schedule 40 or SDR 21 PVC Pipe, Bell End | FT | 360 | 2.10 | 756.00 |
| 2 | 5" Slotted PVC Well Casing Plain Ends, 10' Lengths | EA | 18 | 56.43 | 1015.74 |
| 3 | 5" PVC Couplings | EA | 20 | 4.00 | 80.00 |
| 4 | 4" Schedule 40 or SDR 21 PVC Pipe, Bell End | FT | 140 | 1.80 | 252.00 |
| 5 | 4" Slotted PVC Well Casing | FT | 30 | 2.00 | 60.00 |
| 6 | 4" PVC Couplings | EA | 4 | 4.00 | 16.00 |
| 7 | Centering Guides | EA | 16 | 10.00 | 160.00 |
| 8 | Gravel Pack | | | | |
| | Coarse Sand 50# Bags | EA | 450 | 1.20 | 540.00 |
| | Pea Gravel | $YD^3$ | 11 | 50.00 | 550.00 |
| | | | Sub Total | = | $3,429.74 |
| | | | TOTAL | | 10,135.50 |

# APPENDIX E

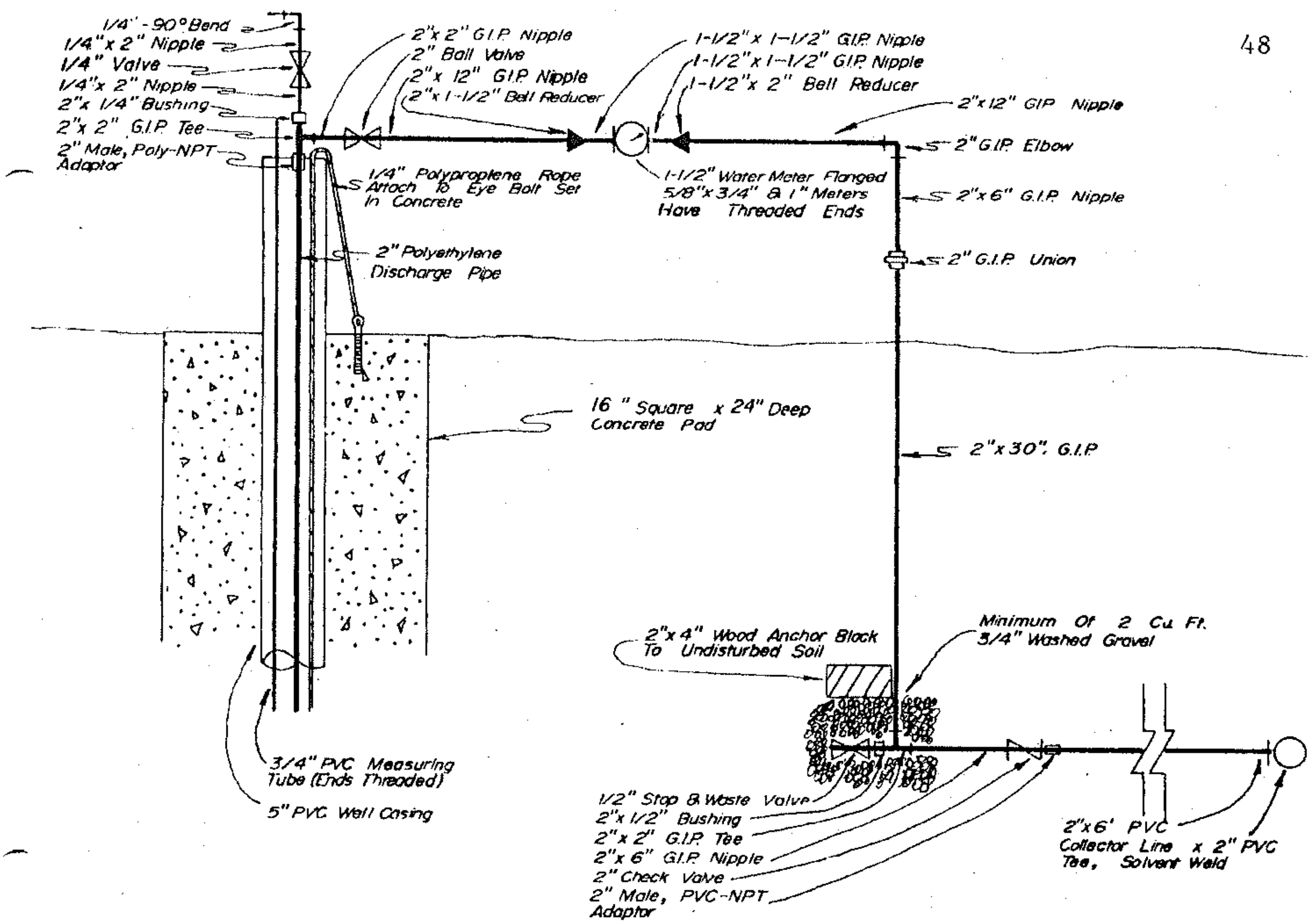
# COLLECTION WELL PIPING




# PIPING LAYOUT FOR GROUNDWATER PROTECTION PLAN

SCIENCE AND ENGINEERING RESOURCES
SOCORRO, NEW MEXICO

UNITED NUCLEAR–HOMESTAKE PARTNERSHIP
GRANTS, NEW MEXICO




NOTES:

(1) $\frac{1}{2}$ HP PUMPS HAVE 1" DISCHARGE & $\frac{5}{8}$" x $\frac{3}{4}$" WATER METER
$1\frac{1}{2}$ HP PUMPS HAVE $1\frac{1}{4}$" DISCHARGE & 1" WATER METER
2 HP PUMPS HAVE 2" DISCHARGE & $1\frac{1}{2}$" WATER METER

(2) LAYOUT FOR ALL WELLS IS SIMILAR HOWEVER PIPING SIZE VARIES TO CONFORM TO DISCHARGE

# PIPING & EQUIPMENT DETAILS FOR COLLECTION WELLS GROUNDWATER PROTECTION PLAN

SCIENCE AND ENGINEERING RESOURCES
SOCORRO, NEW MEXICO

UNITED NUCLEAR—HOMESTAKE PARTNERSHIP
GRANTS, NEW MEXICO

## COLLECTION WELL PIPING

| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 1 | 4" SDR 26 PVC Pipe, Bell End | Ft | 1200 | 0.69 | 828.00 | |
| 2 | 4" Casing Caps | Ea | 1 | 2.59 | 2.59 | |
| 3 | 3/4" Schedule 40 or SDR 21 PVC Pipe w/threaded Adapters | Ft | 1860 | 0.19 | 353.40 | |
| 4 | 6" Class 160 PVC Pipe | Ft | 2520 | 1.45 | 3654.00 | |
| 5 | 6" X 6" PVC Tee | Ea | 2 | 11.70 | 23.40 | |
| 6 | 6" X 4" PVC Reducer | Ea | 1 | 3.51 | 3.51 | |
| 7 | 1½" Water Meter | Ea | 4 | 171.57 | 686.28 | |
| 8 | 2½" Class 160 PVC Pipe | Ft | 3000 | 0.30 | 900.00 | |
| 9 | 2" Class 160 PVC Pipe | Ft | 40 | 0.16 | 6.40 | |
| 10 | 1¼" Class 160 PVC Pipe | Ft | 20 | 0.15 | 3.00 | |
| 11 | 1" Class 160 PVC Pipe | Ft | 40 | 0.10 | 4.00 | |
| 12 | 1" Polyethylene Pipe 80 psi | Ft | 640 | 0.11 | 70.40 | |
| 13 | 1¼" Polyethylene Pipe 80 psi | Ft | 560 | 0.16 | 89.60 | |
| 14 | 2" Polyethylene Pipe 80 psi | Ft | 360 | 0.57 | 205.20 | |
| 15 | 6" X 2½" PVC Reducer | Ea | 1 | 17.11 | 17.11 | |
| 16 | 6" PVC Cap | Ea | 1 | 4.98 | 4.98 | |
| 17 | 2½" PVC Cap | Ea | 1 | 1.97 | 1.97 | |

COLLECTION WELL PIPING (CONT'D)

| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 18 | 12D5P051 Submersible Pump w/control | Ea | 9 | 243.25 | 2189.25 | 1" Disch-1/2 HP |
| 19 | 14D18P151 Submersible Pump w/control | Ea | 8 | 479.80 | 3838.40 | 1¼" Disch-1½ HP |
| 20 | 8D35P201 Submersible Pump w/control | Ea | 5 | 555.40 | 2777.00 | 2" Disch-2 HP |
| 21 | #12-3 Conductor Elec. Cable | Ft | 1800 | 0.31 | 558.00 | |
| 22 | 5/16" Polypropolene Rope | Ft | 1500 | 0.05 | 75.00 | |
| 23 | Lightening Arrestor | Ea | 19 | 15.45 | 293.55 | |
| 24 | Fluid Level Control w/wire | Ea | 19 | 59.50 | 1130.50 | |
| 25 | Torque Resistor | Ea | 19 | 7.80 | 148.20 | |
| 26 | 2" Poly-GIP Adaptor (Male w/clamps) | Ea | 4 | 2.80 | 11.20 | |
| 27 | 2" GIP Tee | Ea | 8 | 2.75 | 22.00 | |
| 28 | 2" X ¼" Bushing | Ea | 8 | 1.35 | 10.80 | |
| 29 | 2" X 6" GIP Nipple | Ea | 12 | 3.09 | 37.08 | |
| 30 | 2" X 12" GIP Nipple | Ea | 4 | 3.75 | 15.00 | |
| 31 | 2" X 30" GIP Nipple | Ea | 4 | 4.15 | 16.60 | |
| 32 | 2" GIP Union | Ea | 4 | 5.12 | 20.84 | |
| 33 | 2" X 1½" GIP Reducer | Ea | 8 | 2.50 | 20.00 | |
| 34 | 1½" X 2" GIP Nipple | Ea | 8 | 2.00 | 16.00 | |
| 35 | 2" PVC-GIP Adaptor (Male) | Ea | 4 | 1.50 | 6.00 | |

## COLLECTION WELL PIPING (CONT'D)

| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 36 | 2" Ball Valve | Ea | 4 | 31.60 | 126.40 | |
| 37 | 2" Check Valve | Ea | 4 | 24.90 | 99.60 | |
| 38 | 1¼" Poly-GIP Adaptor (Male w/clamps) | Ea | 7 | 2.40 | 16.80 | |
| 39 | 1¼" GIP Tee | Ea | 14 | 2.25 | 31.50 | |
| 40 | 1¼" X ¼" Bushing | Ea | 14 | 1.00 | 14.00 | |
| 41 | 1¼" X 6" GIP Nipple | Ea | 21 | 2.25 | 47.25 | |
| 42 | 1¼" X 6" GIP Nipple | Ea | 7 | 3.00 | 21.00 | |
| 43 | 1¼" X 30" GIP Nipple | Ea | 7 | 3.25 | 22.75 | |
| 44 | 1¼" GIP Union | Ea | 7 | 4.00 | 28.00 | |
| 45 | 1¼" PVC-GIP Adaptor (Male) | Ea | 7 | 0.75 | 5.25 | |
| 46 | 1" Water Meter | Ea | 7 | 45.00 | 315.00 | |
| 47 | 1" Meter Setter | Ea | 7 | 25.00 | 175.00 | |
| 48 | 1¼" Ball Valve | Ea | 7 | 27.00 | 189.00 | |
| 49 | 1¼" Check Valve | Ea | 7 | 12.50 | 87.50 | |
| 50 | 1" Poly-GIP Adaptor w/clamps (M) | Ea | 8 | 1.92 | 15.36 | |
| 51 | 1" GIP Tee | Ea | 16 | 1.75 | 28.00 | |
| 52 | 1" X ¼" Bushing | Ea | 16 | 0.65 | 10.40 | |
| 53 | 1" X 6" GIP Nipple | Ea | 24 | 1.75 | 42.00 | |
| 54 | 1" X 12" GIP Nipple | Ea | 16 | 2.50 | 40.00 | |
| 55 | 1" X 30" GIP Nipple | Ea | 8 | 2.50 | 20.00 | |

COLLECTION WELL PIPING (CONT'D)

| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 56 | 1" GIP Union | Ea | 8 | 2.75 | 22.00 | |
| 57 | 1" PVC - GIP Adaptor (Male) | Ea | 8 | 0.40 | 3.20 | |
| 58 | 5/8" X 3/4" Water Meter | Ea | 8 | 27.50 | 220.00 | |
| 59 | 3/4" Meter Setter | Ea | 8 | 14.75 | 118.00 | |
| 60 | 1" Ball Valve | Ea | 8 | 21.55 | 172.40 | |
| 61 | 1" Check Valve | Ea | 8 | 7.35 | 58.80 | |
| 62 | ½" Stop and Waste Valve | Ea | 19 | 3.97 | 75.43 | |
| 63 | ¼" 90° Elbow | Ea | 19 | 0.50 | 9.50 | |
| 64 | ¼" X 2" GIP Nipple | Ea | 38 | 0.25 | 9.50 | |
| 65 | ¼" Valve | Ea | 19 | 1.25 | 23.75 | |
| 66 | 3/4" PVC Cap | Ea | 19 | 0.30 | 5.70 | |
| 67 | 4" Water Meter | Ea | 1 | 495.00 | 495.00 | |
| 68 | 1¼" Water Meter | Ea | 1 | 100.00 | 100.00 | |
| 69 | 2½" Gate Valve w/box | Ea | 1 | 24.00 | 24.00 | |
| 70 | 6" Gate Valve w/box | Ea | 1 | 125.00 | 125.00 | |
| 71 | 2½" X 1¼" Tee PVC | Ea | 1 | 4.00 | 4.00 | |
| 72 | 2½" X 1" Tee PVC | Ea | 9 | 4.00 | 36.00 | |
| 73 | 6" X 2" Tee PVC | Ea | 4 | 26.80 | 107.20 | |
| 74 | 6" X 1½" Tee PVC | Ea | 1 | 26.80 | 26.80 | |
| 75 | 4" X 1¼" Tee PVC | Ea | 5 | 15.00 | 75.00 | |

COLLECTION WELL PIPING (CONT'D)

| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 76 | ½" Dia. Steel Eye Bolt, 2' long | Ea | 25 | 1.00 | 25.00 | |
| 77 | 4" PVC Couplings | Ea | 16 | 10.00 | 160.00 | |
| 78 | 2" X ½" Bushing | Ea | 4 | 1.35 | 5.40 | |
| 79 | 1" X ½" Bushing | Ea | 8 | 0.65 | 5.20 | |
| 80 | 1¼" X ½" Bushing | Ea | 7 | 1.00 | 7.00 | |
| | | TOTAL | | | $ 21,099.35 | |

HMC0173561

# APPENDIX F

## PROJECT MATERIALS LIST

# INJECTION AND COLLECTION WELL MATERIAL LIST

| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 1 | 5" Schedule 40 or SDR 21 PVC Pipe, Bell End | Ft | 1300 | 2.10 | 2730.00 | |
| 2 | 5" Slotted PVC Well Casing Plain Ends, 10' Lengths (No. 40 Slot) Approx. 10% openings | Ea | 54 | 56.43 | 3047.22 | Source: Cook Well Straine Corp., 6330 Glenway Ave. 513-481-8800, P. O. Box 11002, Cincinnati, Ohio 45211 |
| 3 | 5" PVC Couplings (Collars to connect to female ends) | Ea | 63 | 4.00 | 252.00 | |
| 4 | 4" Schedule 40 or SDR 21 PVC Pipe, Bell End | Ft | 400 | 1.80 | 720.00 | |
| 5 | 4" Slotted PVC Well Casing | Ft | 80 | 2.00 | 160.00 | |
| 6 | Centering Guides (1' Section of PVC Pipe with PVC Dowel) | Ea | 56 | 10.00 | 560.00 | |
| 7 | Gravel Pack | | | | | |
| | Coarse Blasting Sand (50 lb. bags) | Ea | 1400 | 1.20 | 1680.00 | |
| | Pea Gravel | $Yd^3$ | 32 | 50.00 | 1600.00 | |
| 8 | 4" SDR 26 PVC Pipe, Bell End | Ft | 1520 | .69 | 1048.80 | 320 ft. already purchased |
| 9 | Casing Cement Weld and Cleaner Cans | Ea | 5 | 5.00 | 25.00 | |
| 10 | 4" Casing Caps | Ea | 13 | 2.59 | 33.67 | |
| 11 | 5" Casing Caps | Ea | 2 | 3.75 | 7.50 | |
| 12 | 3/4" Schedule 40 or SDR 21 PVC Pipe w/threaded Adapters | Ft | 1860 | .19 | 353.40 | |

INJECTION AND COLLECTION WELL MATERIAL LIST (CONT'D)

| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 13 | 8" X 6" PVC Tee | Ea | 1 | 33.62 | 33.62 | |
| 14 | 8" Compression Couplings | Ea | 2 | 18.43 | 36.86 | |
| 15 | 6" Class 160 PVC Pipe | Ft | 2520 | 1.45 | 3654.00 | |
| 16 | 6" Gate Valve (M.J.) | Ea | 1 | 125.00 | 125.00 | |
| 17 | 6" PVC-Alum. Adaptor | Ea | 2 | 36.98 | 73.96 | Rain-for-Rent (345-2468) |
| 18 | 6" X 6" PVC Tee | Ea | 3 | 11.70 | 35.10 | |
| 19 | 6" X 4" PVC Reducer | Ea | 3 | 3.51 | 10.53 | |
| 20 | 4" Class 160 PVC Pipe (Slip Joint) | Ft | 1040 | 0.68 | 707.20 | |
| 21 | 4" X 1½" PVC Tee (Solvent Weld) | Ea | 6 | 3.41 | 20.46 | |
| 22 | 1½" PVC-NPT Adaptor | Ea | 24 | 0.47 | 11.28 | |
| 23 | 1½" Class 160 PVC Pipe | Ft | 60 | 0.19 | 11.40 | |
| 24 | 1½" Ball Valve | Ea | 6 | 16.75 | 100.50 | |
| 25 | 1½" Water Meter | Ea | 10 | 171.57 | 1715.70 | |
| 26 | 1½" PVC 90° Bend | Ea | 6 | 0.65 | 3.90 | |
| 27 | 6" PVC Coupling | Ea | 2 | 2.44 | 4.88 | |
| 28 | 6" X 3/4" Service Saddle | Ea | 1 | 7.95 | 7.95 | |
| 29 | 3/4" Stop & Waste Valve | Ea | 1 | 6.92 | 6.92 | |
| 30 | 2½" Class 160 PVC Pipe | Ft | 3000 | 0.30 | 900.00 | |
| 31 | 2" Class 160 PVC Pipe | Ft | 40 | 0.16 | 6.40 | |
| 32 | 1¼" Class 160 PVC Pipe | Ft | 20 | 0.15 | 3.00 | |

INJECTION AND COLLECTION WELL MATERIAL LIST (CONT'D)

| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 33 | 1" Class 160 PVC Pipe | Ft | 40 | 0.10 | 4.00 | |
| 34 | 1" Polyethylene Pipe 80 psi | Ft | 640 | 0.11 | 70.40 | |
| 35 | 1¼" Polyethylene Pipe 80 psi | Ft | 560 | 0.16 | 89.60 | |
| 36 | 2" Polyethylene Pipe 80 psi | Ft | 360 | 0.57 | 205.20 | |
| 37 | 6" X 2½" PVC Reducer | Ea | 1 | 17.11 | 17.11 | |
| 38 | 6" PVC Cap | Ea | 1 | 4.98 | 4.98 | |
| 39 | 2½" PVC Cap | Ea | 1 | 1.97 | 1.97 | |
| 40 | 12D5P051 Submersible Pump w/control | Ea | 9 | 243.25 | 2189.25 | 1" Disch-1/2 HP |
| 41 | 14D18P151 Submersible Pump w/control | Ea | 8 | 479.80 | 3838.40 | 1¼" Disch-1½ HP |
| 42 | 8D35P201 Submersible Pump w/control | Ea | 5 | 555.40 | 2777.00 | 2" Disch-2 HP |
| 43 | #12-3 Conductor Elec. Cable | Ft | 1800 | 0.31 | 558.00 | |
| 44 | 5/16" Polypropolene Rope | Ft | 1500 | 0.05 | 75.00 | |
| 45 | Lightening Arrestor | Ea | 19 | 15.45 | 293.55 | |
| 46 | Fluid Level Control w/wire | Ea | 19 | 59.50 | 1130.50 | |
| 47 | Torque Resistor | Ea | 19 | 7.80 | 148.20 | |
| 48 | 2" Poly-GIP Adaptor (Male w/clamps) | Ea | 4 | 2.80 | 11.20 | |
| 49 | 2" GIP Tee | Ea | 8 | 2.75 | 22.00 | |
| 50 | 2" X ¾" Bushing | Ea | 8 | 1.35 | 10.80 | |

## INJECTION AND COLLECTION WELL MATERIAL LIST (CONT'D)

| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 51 | 2" X 6" GIP Nipple | Ea | 12 | 3.09 | 37.08 | |
| 52 | 2" X 12" GIP Nipple | Ea | 4 | 3.75 | 15.00 | |
| 53 | 2" X 30" GIP Nipple | Ea | 4 | 4.15 | 16.60 | |
| 54 | 2" GIP Union | Ea | 4 | 5.12 | 20.84 | |
| 55 | 2" X 1½" GIP Reducer | Ea | 8 | 2.50 | 20.00 | |
| 56 | 1½" X 2" GIP Nipple | Ea | 8 | 2.00 | 16.00 | |
| 57 | 2" PVC-GIP Adaptor (Male) | Ea | 4 | 1.50 | 6.00 | |
| 58 | 2" Ball Valve | Ea | 4 | 31.60 | 126.40 | |
| 59 | 2" Check Valve | Ea | 4 | 24.90 | 99.60 | |
| 60 | 1¼" Poly-GIP Adaptor (Male w/clamps) | Ea | 7 | 2.40 | 16.80 | |
| 61 | 1¼" GIP Tee | Ea | 14 | 2.25 | 31.50 | |
| 62 | 1¼" X ¾" Bushing | Ea | 14 | 1.00 | 14.00 | |
| 63 | 1¼" X 6" GIP Nipple | Ea | 21 | 2.25 | 47.25 | |
| 64 | 1¼" X 6" GIP Nipple | Ea | 7 | 3.00 | 21.00 | |
| 65 | 1¼" X 30" GIP Nipple | Ea | 7 | 3.25 | 22.75 | |
| 66 | 1¼" GIP Union | Ea | 7 | 4.00 | 28.00 | |
| 67 | 1¼" PVC-GIP Adaptor (Male) | Ea | 7 | 0.75 | 5.25 | |
| 68 | 1" Water Meter | Ea | 7 | 45.00 | 315.00 | |
| 69 | 1" Meter Setter | Ea | 7 | 25.00 | 175.00 | |
| 70 | 1¼" Ball Valve | Ea | 7 | 27.00 | 189.00 | |

## INJECTION AND COLLECTION WELL MATERIAL LIST (CONT'D)

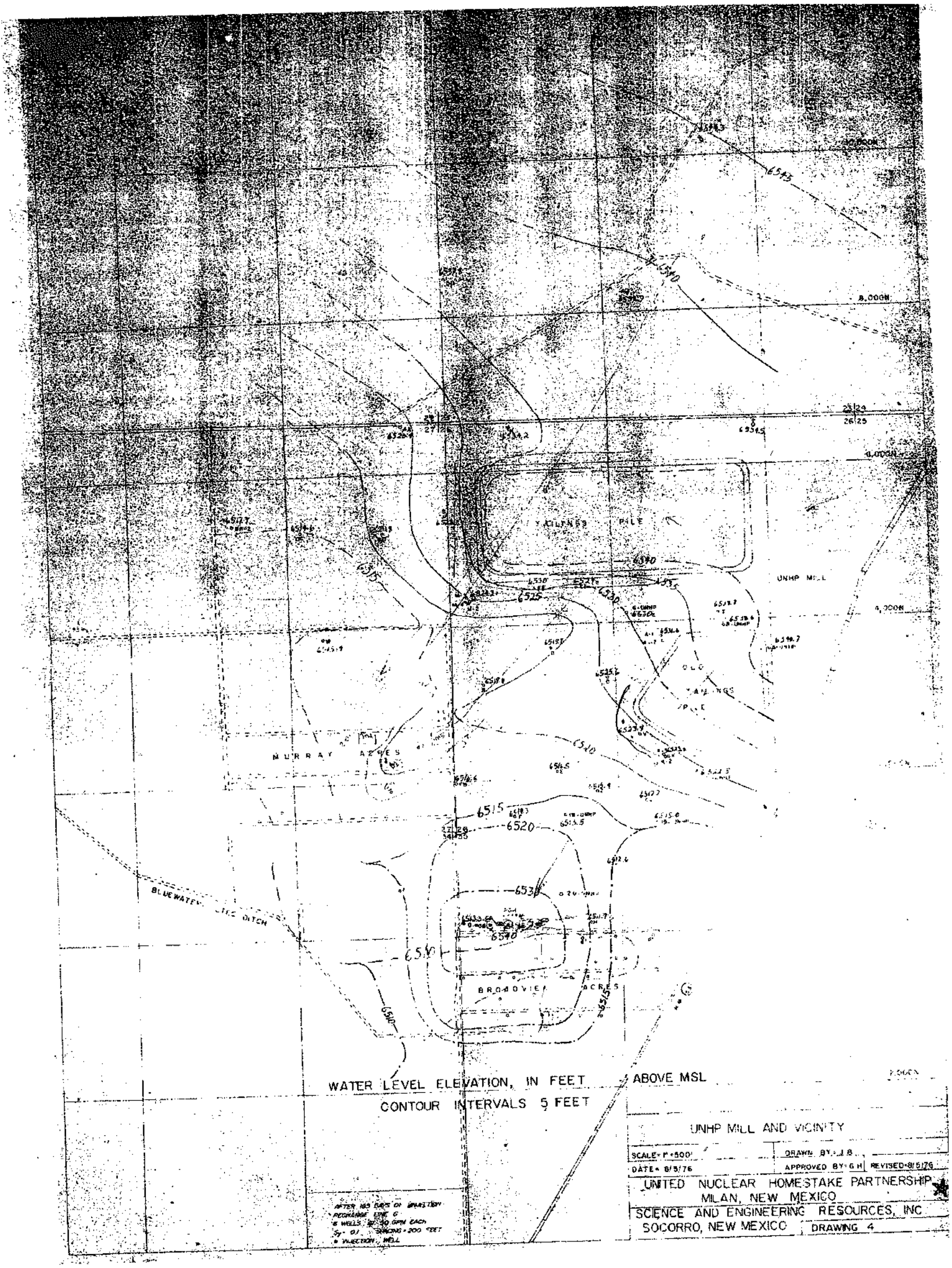
| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 71 | 1¼" Check Valve | Ea | 7 | 12.50 | 87.50 | |
| 72 | 1" Poly-GIP Adaptor w/clamps (M) | Ea | 8 | 1.92 | 15.36 | |
| 73 | 1" GIP Tee | Ea | 16 | 1.75 | 28.00 | |
| 74 | 1" X ¼" Bushing | Ea | 16 | 0.65 | 10.40 | |
| 75 | 1" X6" GIP Nipple | Ea | 24 | 1.75 | 42.00 | |
| 76 | 1" X 12" GIP Nipple | Ea | 16 | 2.50 | 40.00 | |
| 77 | 1" X 30" GIP Nipple | Ea | 8 | 2.50 | 20.00 | |
| 78 | 1" GIP Union | Ea | 8 | 2.75 | 22.00 | |
| 79 | 1" PVC - GIP Adaptor (Male) | Ea | 8 | 0.40 | 3.20 | |
| 80 | 5/8" X 3/4" Water Meter | Ea | 8 | 27.50 | 220.00 | |
| 81 | 3/4" Meter Setter | Ea | 8 | 14.75 | 118.00 | |
| 82 | 1" Ball Valve | Ea | 8 | 21.55 | 172.40 | |
| 83 | 1" Check Valve | Ea | 8 | 7.35 | 58.80 | |
| 84 | ½" Stop and Waste Valve | Ea | 19 | 3.97 | 75.43 | |
| 85 | ¼" 90° Elbow | Ea | 19 | 0.50 | 9.50 | |
| 86 | ¼" X 2" GIP Nipple | Ea | 38 | 0.25 | 9.50 | |
| 87 | ¼" Valve | Ea | 19 | 1.25 | 23.75 | |
| 88 | 3/4" PVC Cap | Ea | 19 | 0.30 | 5.70 | |
| 89 | 4" Water Meter | Ea | 1 | 495.00 | 495.00 | |
| 90 | 1¼" Water Meter | Ea | 1 | 100.00 | 100.00 | |

INJECTION AND COLLECTION WELL MATERIAL LIST (CONT'D)

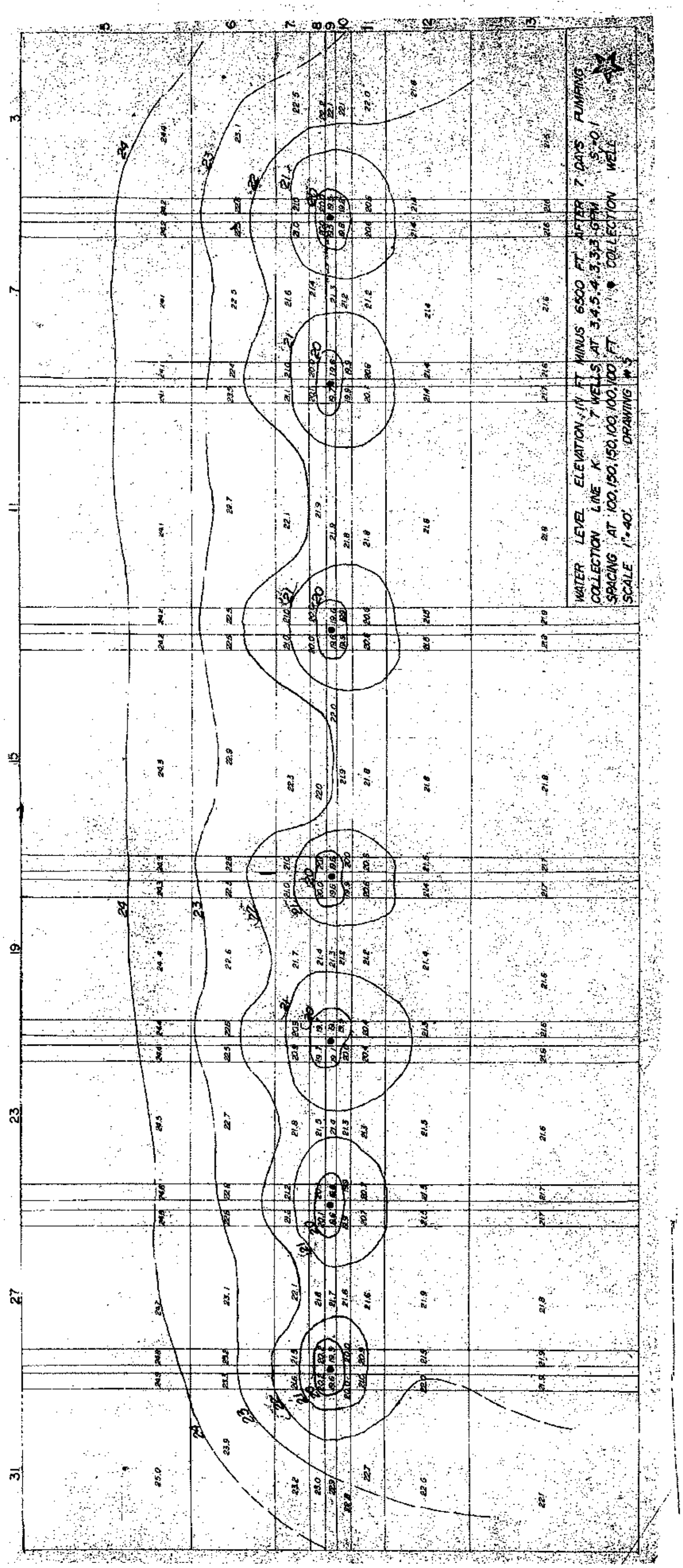
| Item | Description | Unit | Quantity | Unit Cost | Extended Amount | Remarks |
|---|---|---|---|---|---|---|
| 91 | 2½" Gate Valve w/box | Ea | 1 | 24.00 | 24.00 | |
| 92 | 6" Gate Valve w/box | Ea | 1 | 125.00 | 125.00 | |
| 93 | 2½" X 1¼" Tee PVC | Ea | 1 | 4.00 | 4.00 | |
| 94 | 2½" X 1" Tee PVC | Ea | 9 | 4.00 | 36.00 | |
| 95 | 6" X 2" Tee PVC | Ea | 4 | 26.80 | 107.20 | |
| 96 | 6" X 1½" Tee PVC | Ea | 1 | 26.80 | 26.80 | |
| 97 | 4" X 1¼" Tee PVC | Ea | 5 | 15.00 | 75.00 | |
| 98 | ½" Dia. Steel Eye Bolt, 2' long | Ea | 25 | 1.00 | 25.00 | |
| 99 | 4" PVC Couplings | Ea | 16 | 10.00 | 160.00 | |
| 100 | 2" X ½" Bushing | Ea | 4 | 1.35 | 5.40 | |
| 101 | 1" X ½" Bushing | Ea | 8 | 0.65 | 5.20 | |
| 102 | 1¼" X ½" Bushing | Ea | 7 | 1.00 | 7.00 | |
| | | | | | $34,513.62 | |

Rental cost of 6" Alum. Pipe is $0.24/ft. first month

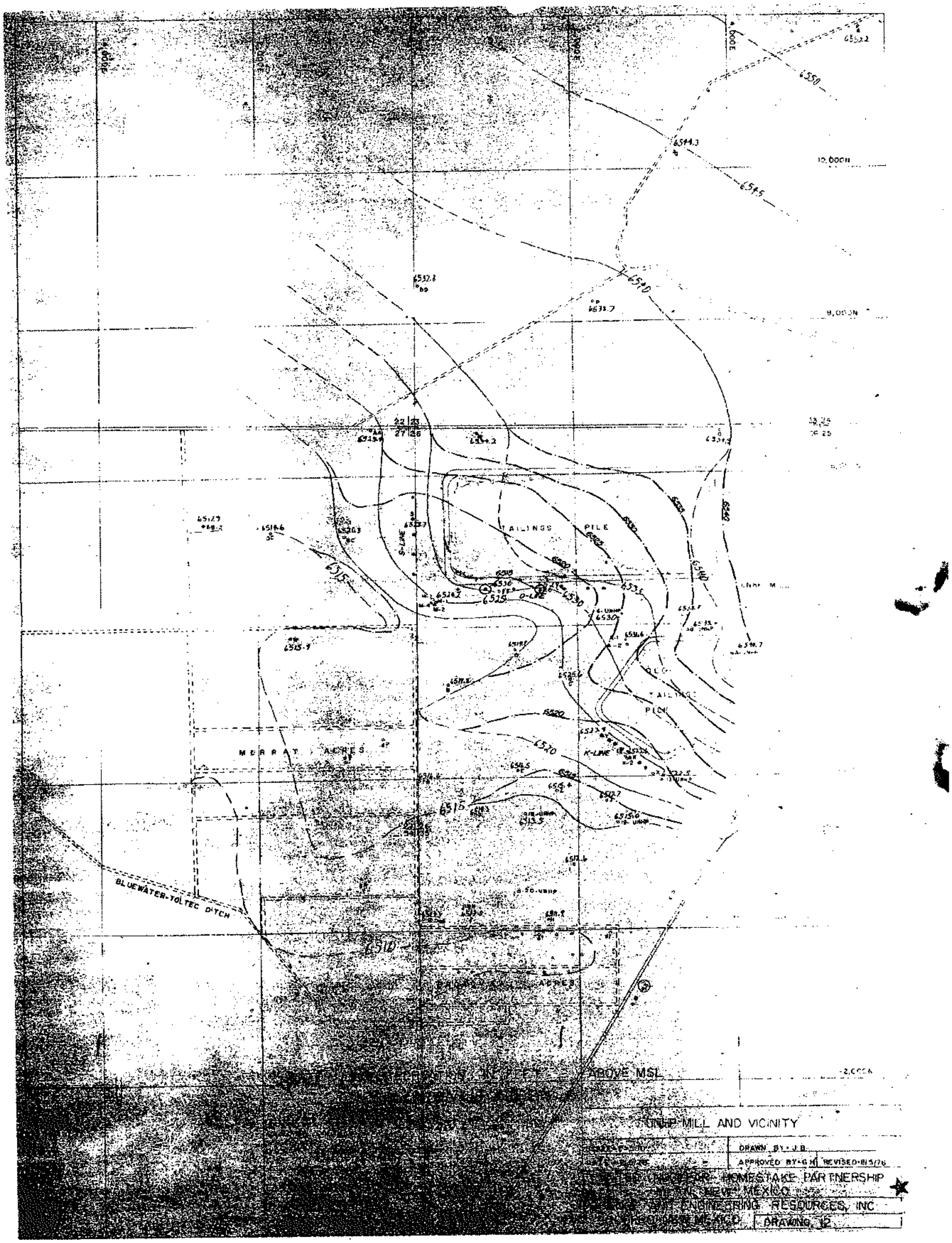
$0.13/ft. Each additional month. 4100' @ $0.24 = 984.00
4100' A 0.13 = 533.00
$1517.00 for two months of injecting



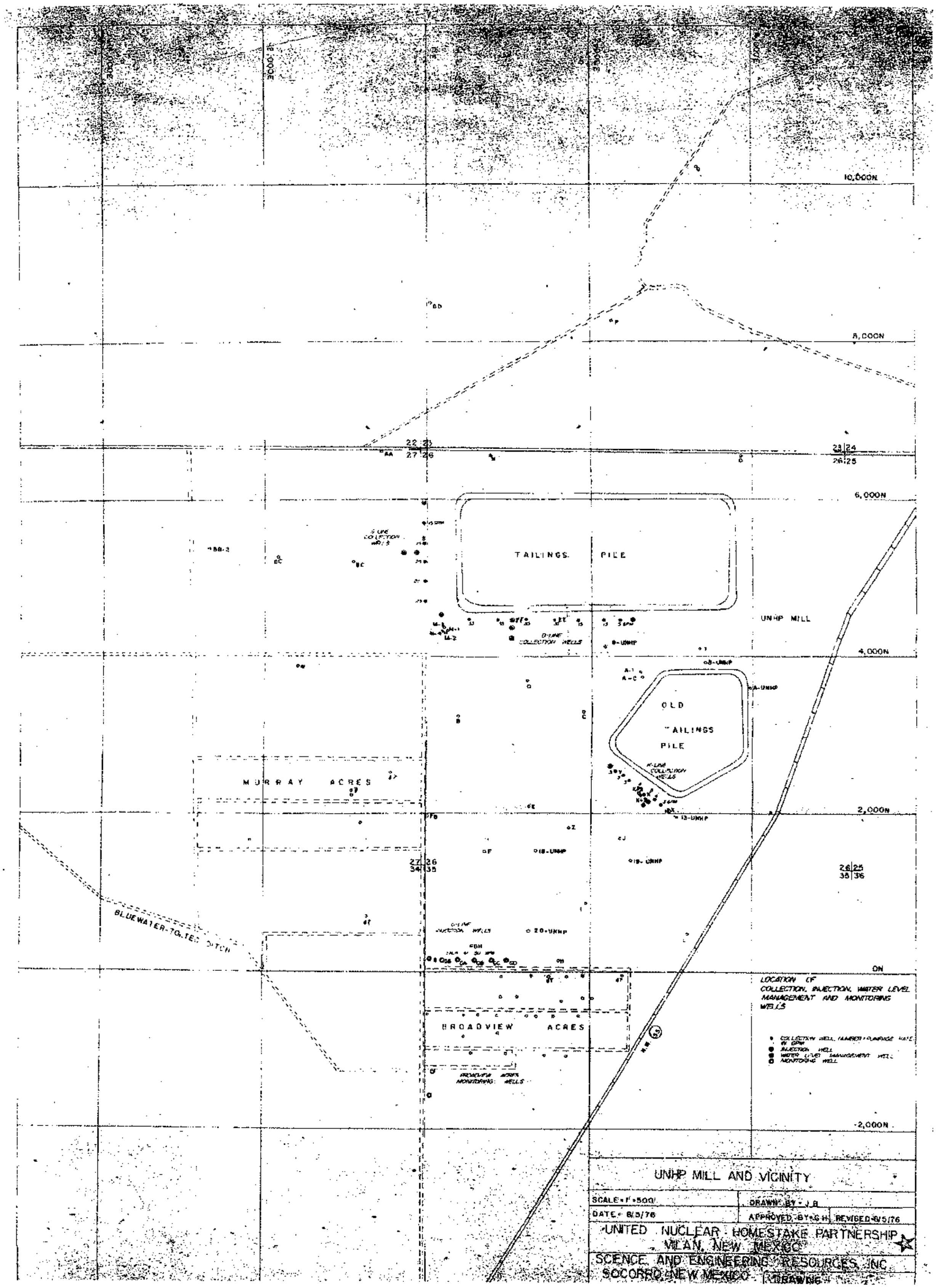
TAILINGS PILE
UNHP MILL
MURRAY ACRES
6545
6540
6530
6525
6520
6515
6510
WATER LEVEL ELEVATION, IN FEET ABOVE MSL
CONTOUR INTERVALS 5 FEET
UNHP MILL AND VICINITY
DATE: 8/5/76
UNITED NUCLEAR HOMESTAKE PARTNERSHIP
MILAN, NEW MEXICO
SCIENCE AND ENGINEERING RESOURCES, INC
SOCORRO, NEW MEXICO
DRAWING 4

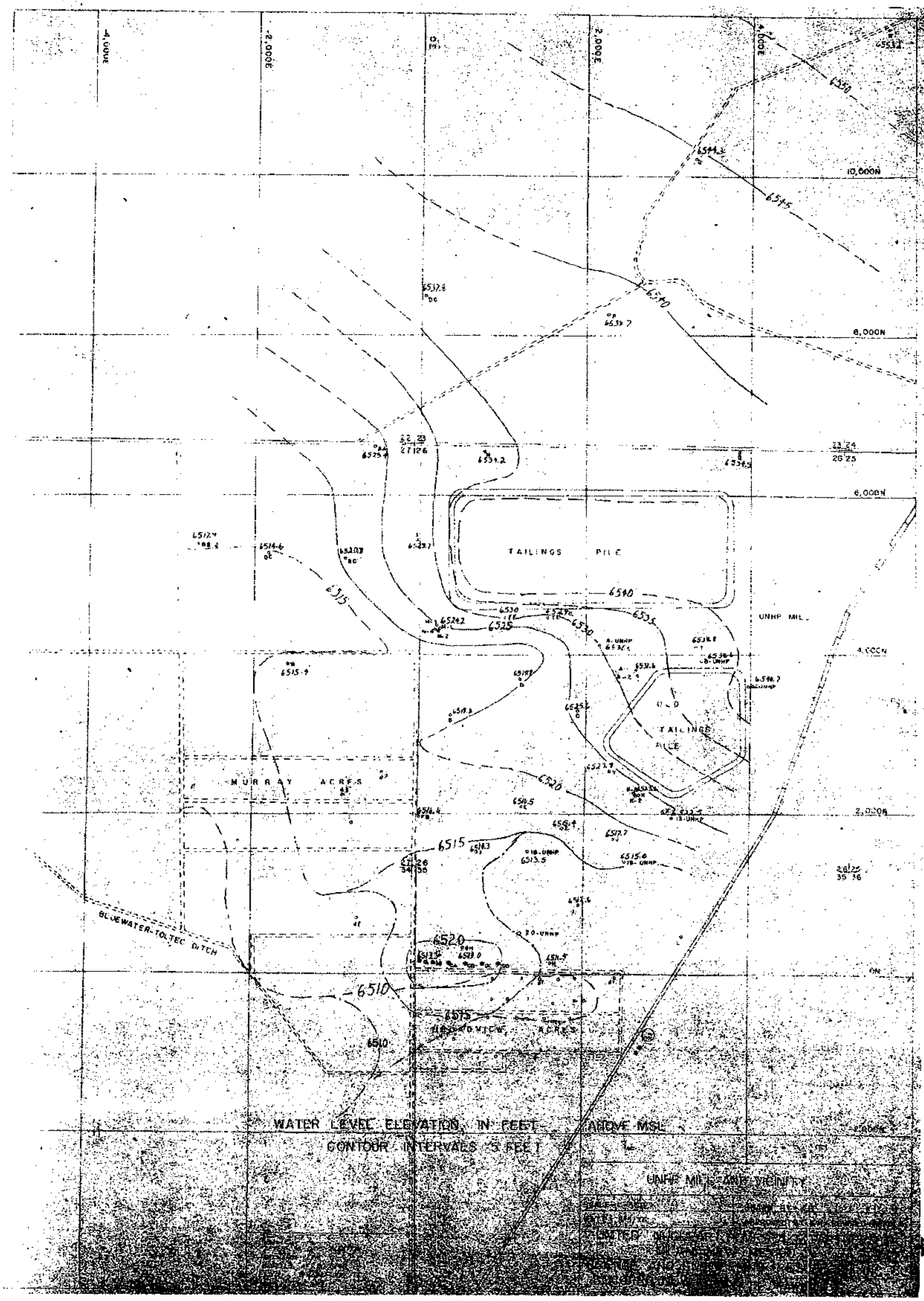


WATER LEVEL ELEVATION - IN FT. MINUS 6500 FT. AFTER 7 DAYS PUMPING
COLLECTION LINE K 7 WELLS AT 3,4,5,4,3,3,3 GPM S=0.1
SPACING AT 100,150,150,100,100,100 FT ● COLLECTION WELL
SCALE 1"=40' DRAWING #5


6550
6545
6544.3
10,000N
9,000N
6540
6535
6530
6525
6520
6515
6510
TAILINGS PILE
OLD TAILINGS PILE
S-LINE
K-LINE
MURRAY ACRES
BLUEWATER-TOLTEC DITCH
ABOVE MSL
-2,000N
MILL AND VICINITY
DRAWN BY: J.B.
APPROVED BY: G.H.
REVISED: 8/5/76
HOMESTAKE PARTNERSHIP
NEW MEXICO
ENGINEERING RESOURCES, INC
DRAWING 12

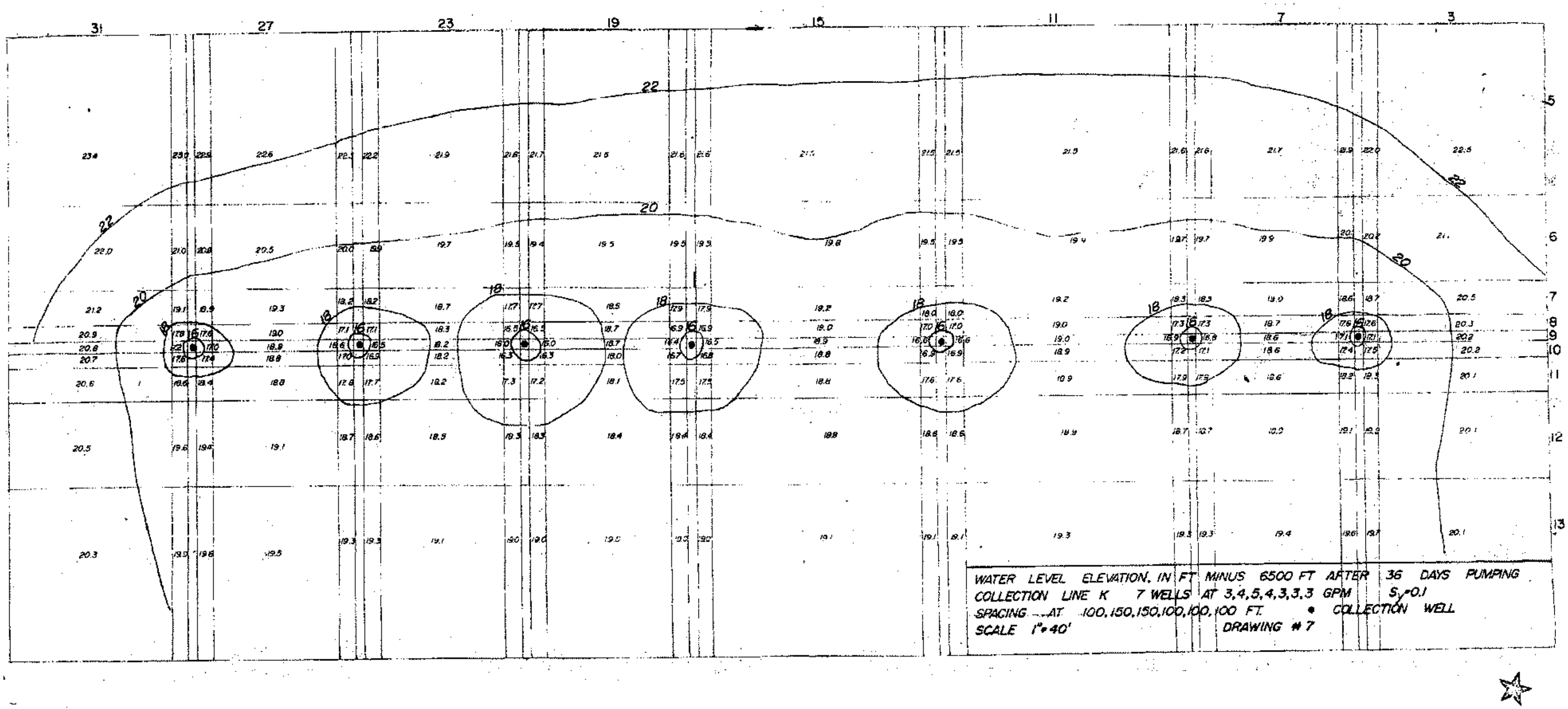
HMC0173571

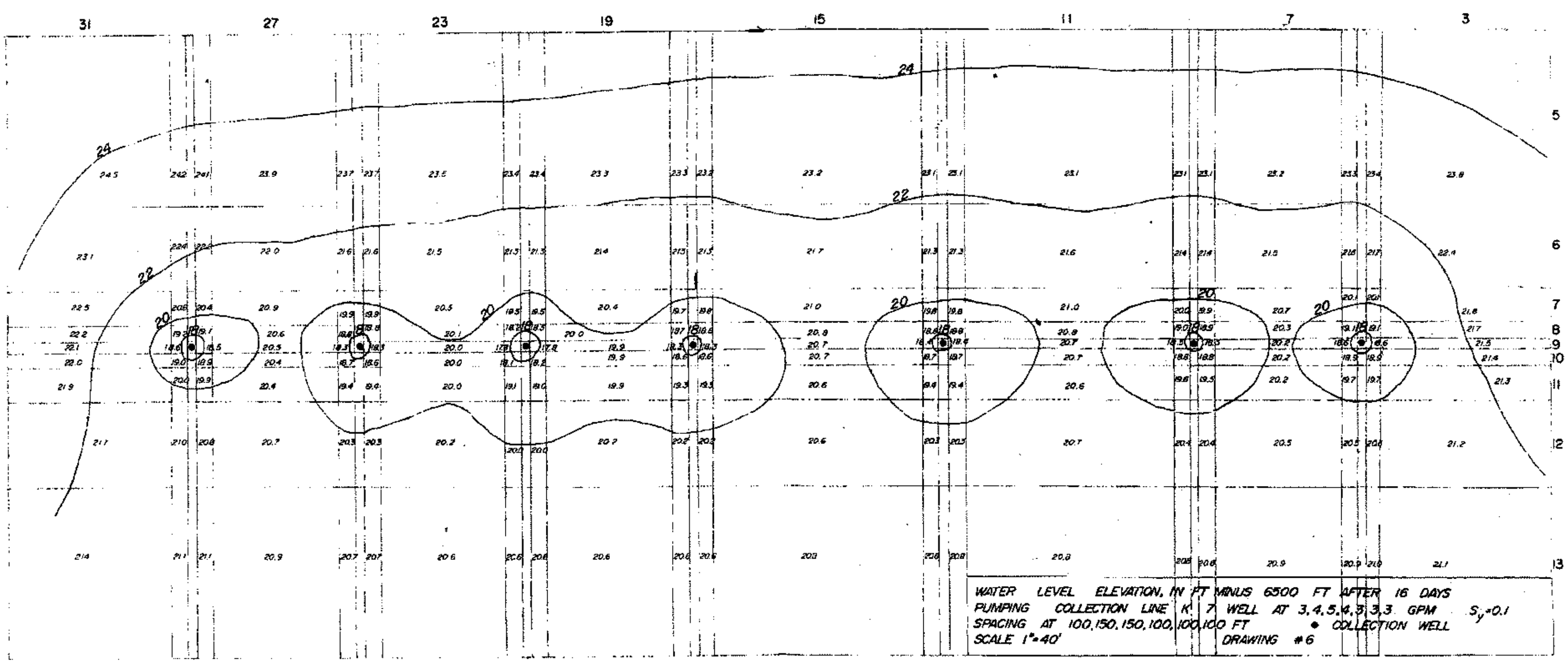

10,000N
8,000N
6,000N
4,000N
2,000N
ON
-2,000N
22 23
27 26
23 24
26 25
27 26
34 35
26 25
35 36
TAILINGS PILE
UNHP MILL
OLD TAILINGS PILE
MURRAY ACRES
BROADVIEW ACRES
BLUEWATER-TOLTEC DITCH
D-LINE COLLECTION WELLS
K-LINE COLLECTION WELLS
LOCATION OF COLLECTION, INJECTION, WATER LEVEL MANAGEMENT AND MONITORING WELLS
UNHP MILL AND VICINITY
SCALE: 1" = 500'
DRAWN BY: J.B.
DATE: 8/5/76
APPROVED BY: G.H.
REVISED 8/5/76
UNITED NUCLEAR - HOMESTAKE PARTNERSHIP
MILAN, NEW MEXICO
SCIENCE AND ENGINEERING RESOURCES, INC
SOCORRO, NEW MEXICO
DRAWING

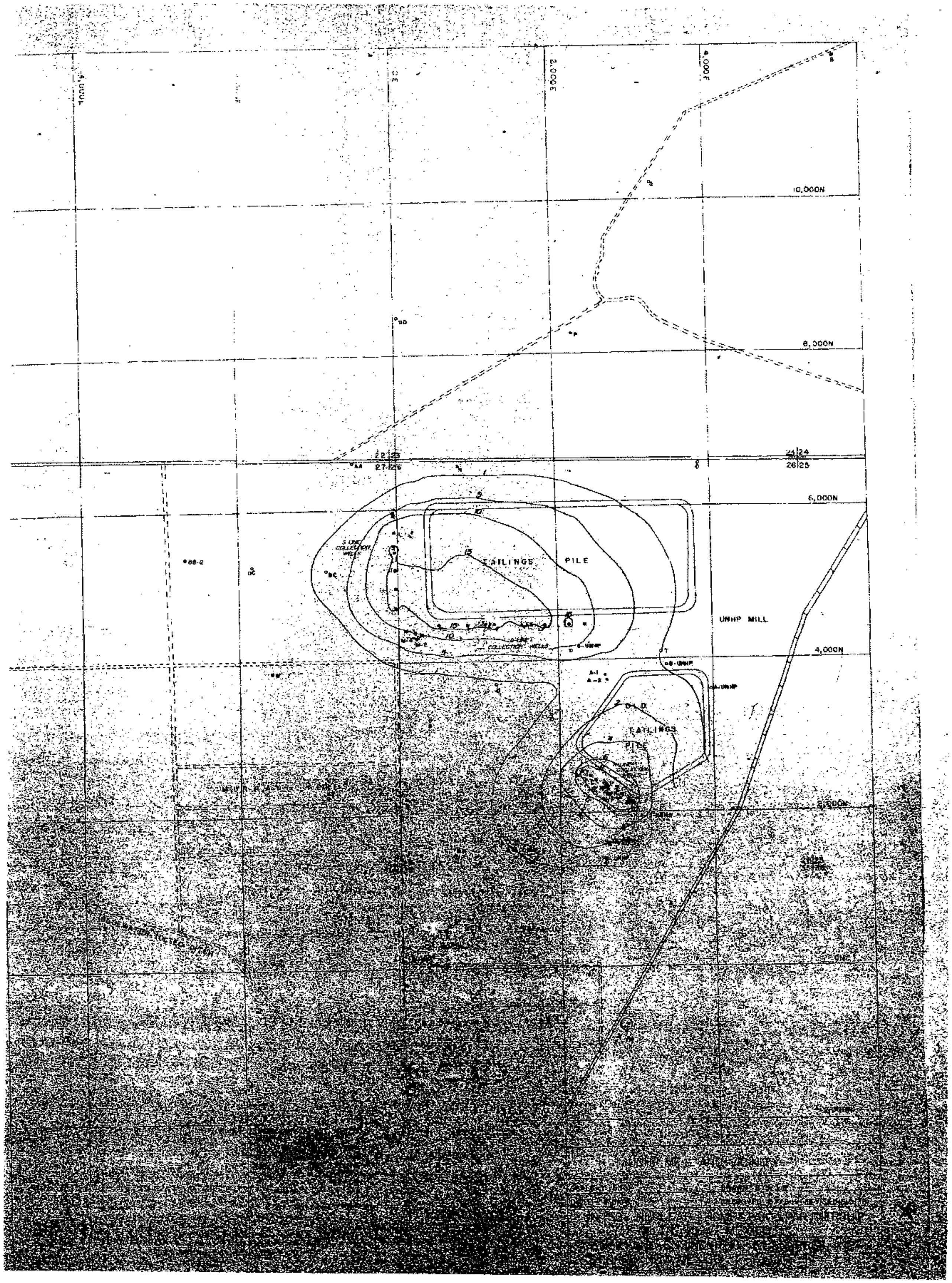


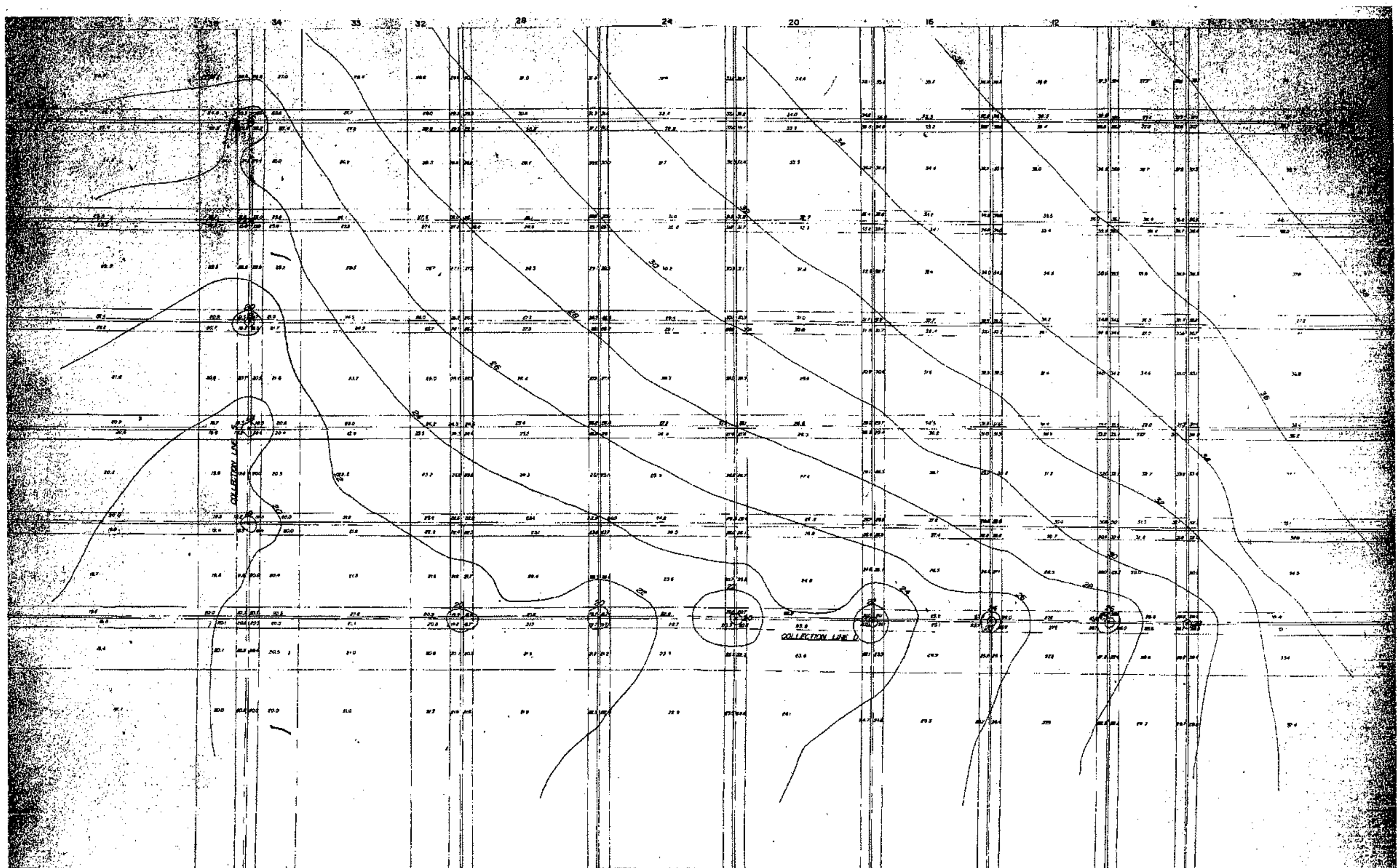
TAILINGS PILE
OLD TAILINGS PILE
UNHP MILL
MURRAY ACRES
BLUEWATER-TOLTEC DITCH
WATER LEVEL ELEVATION, IN FEET ABOVE MSL
CONTOUR INTERVALS 5 FEET
UNHP MILL AND VICINITY


HMC0173573

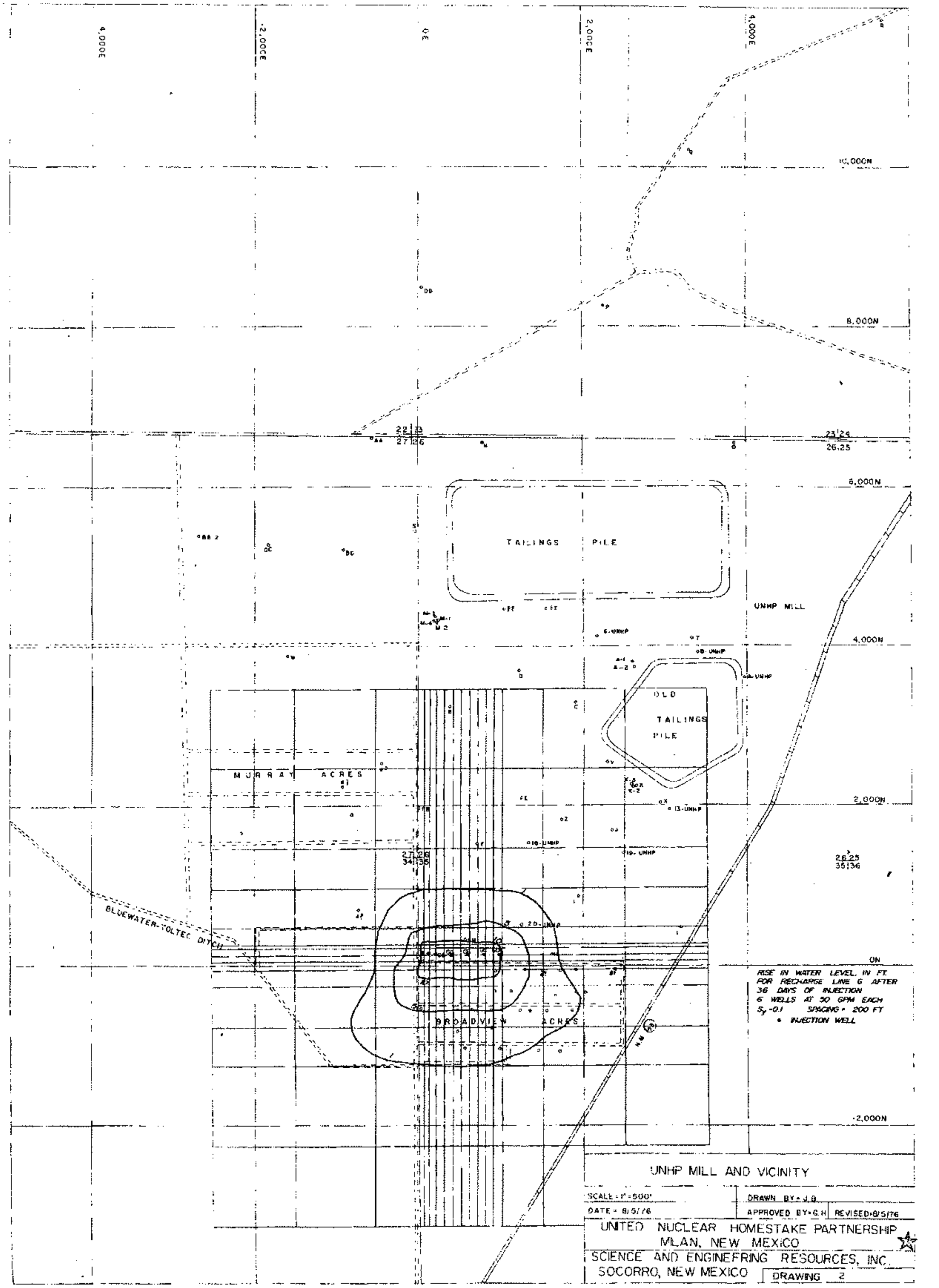

WATER LEVEL ELEVATION, IN FT MINUS 6500 FT AFTER 36 DAYS PUMPING
COLLECTION LINE K 7 WELLS AT 3,4,5,4,3,3,3 GPM $S_y$=0.1
SPACING AT 100,150,150,100,100,100 FT. • COLLECTION WELL
SCALE 1"=40'
DRAWING # 7


WATER LEVEL ELEVATION, IN FT MINUS 6500 FT AFTER 16 DAYS
PUMPING COLLECTION LINE K 7 WELL AT 3,4,5,4,3,3,3 GPM $S_y$=0.1
SPACING AT 100,150,150,100,100,100 FT ● COLLECTION WELL
SCALE 1"=40' DRAWING #6


2,000E
4,000E
10,000N
8,000N
6,000N
4,000N
TAILINGS PILE
UNHP MILL
OLD TAILINGS PILE

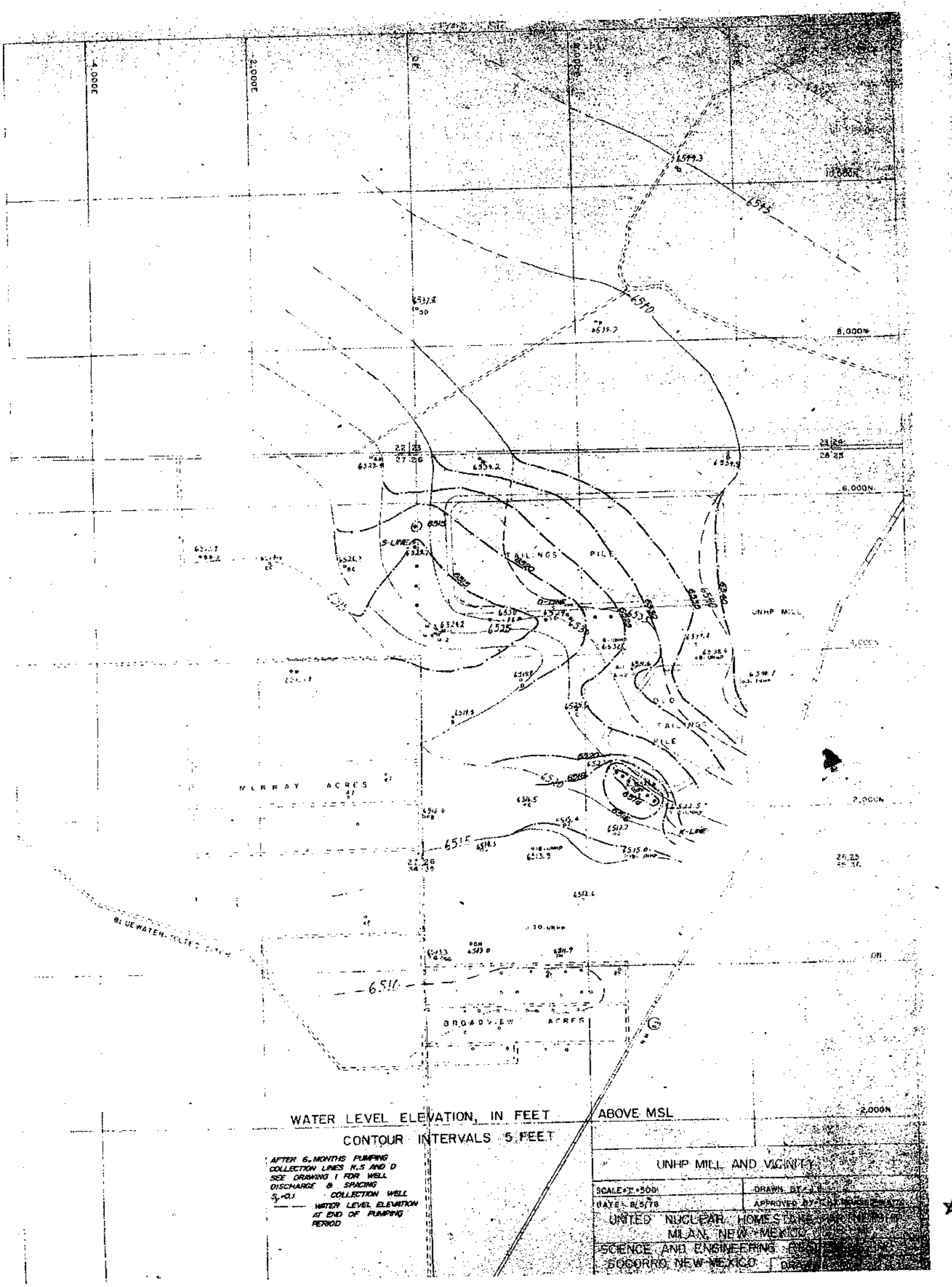



WATER LEVEL ELEVATION, IN FT MINUS 6500 FT COLLECTION LINES S AND D
AFTER 36 DAYS OF PUMPING D-LINE AT 5,15, 0,35,35,35,35 GPM
SPACING AT 200, 300, 300, 350, 350, 350 FT S-LINE AT 15,15,25, 25,25 GPM
SPACING AT 250, 250, 250, 250 FT $S_y$ =0.1 • COLLECTION WELL
DRAWING # 9 SCALE 1" = 100'



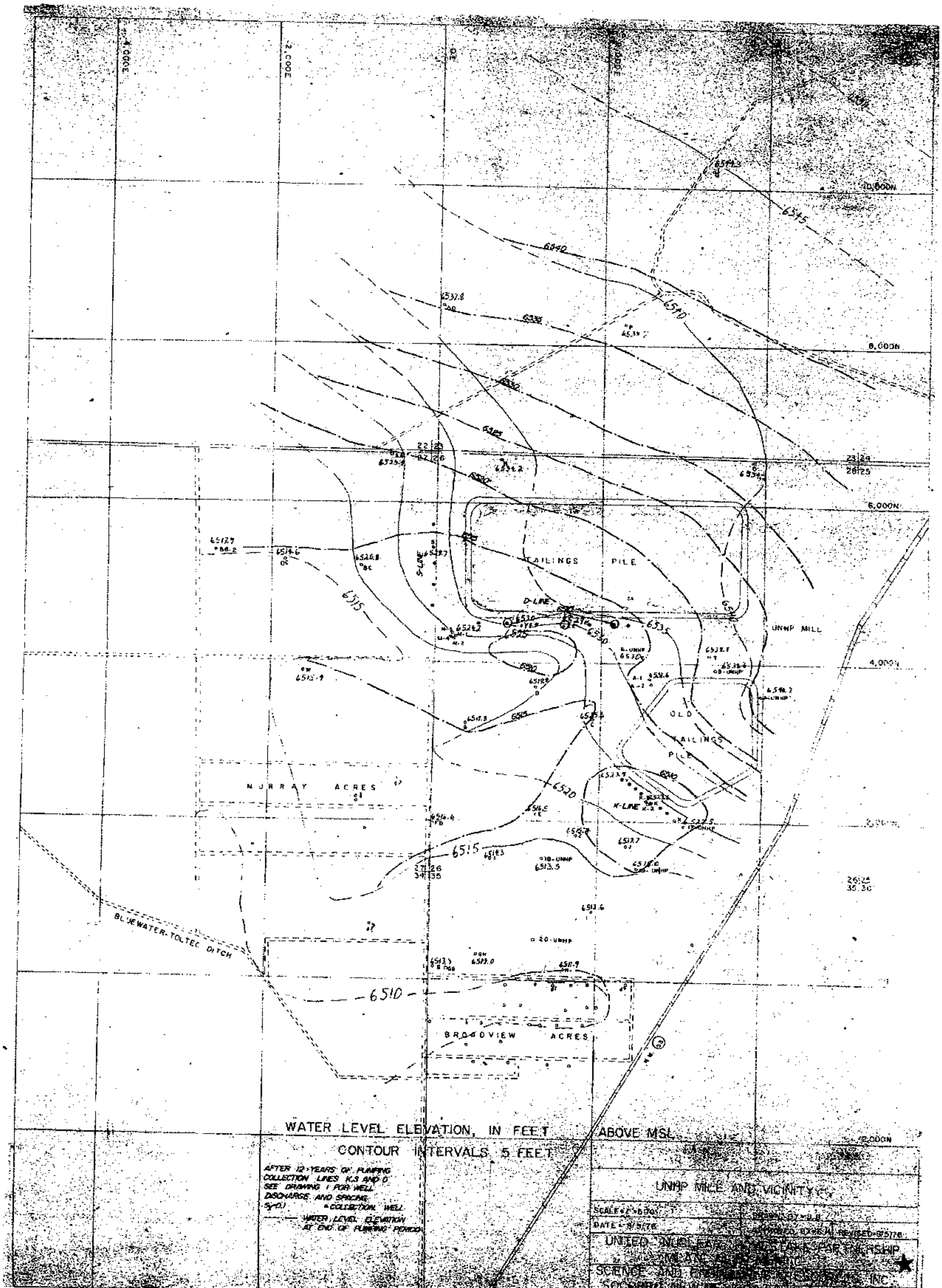
4,000E
-2,000E
0E
2,000E
4,000E
10,000N
8,000N
6,000N
4,000N
2,000N
0N
-2,000N
TAILINGS PILE
UNHP MILL
OLD TAILINGS PILE
MURRAY ACRES
BROADVIEW ACRES
BLUEWATER-TOLTEC DITCH
RISE IN WATER LEVEL, IN FT.
FOR RECHARGE LINE G AFTER
36 DAYS OF INJECTION
6 WELLS AT 50 GPM EACH
$S_y$ -0.1 SPACING = 200 FT
• INJECTION WELL
UNHP MILL AND VICINITY
SCALE = 1" = 500'
DATE = 8/5/76
DRAWN BY = J.B.
APPROVED BY = G.H
REVISED = 8/5/76
UNITED NUCLEAR HOMESTAKE PARTNERSHIP
MILAN, NEW MEXICO
SCIENCE AND ENGINEERING RESOURCES, INC.
SOCORRO, NEW MEXICO
DRAWING 2

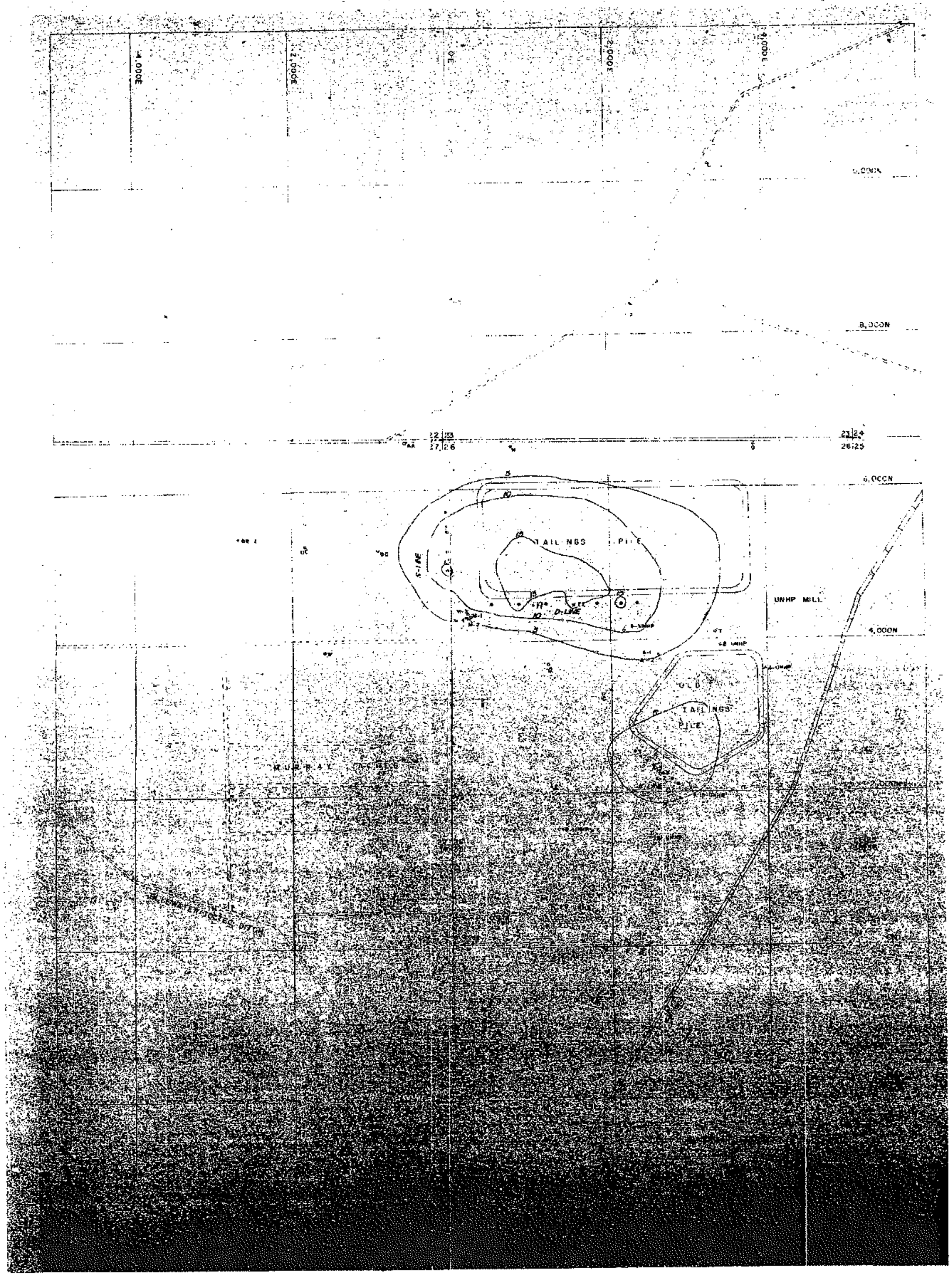

HMC0173578



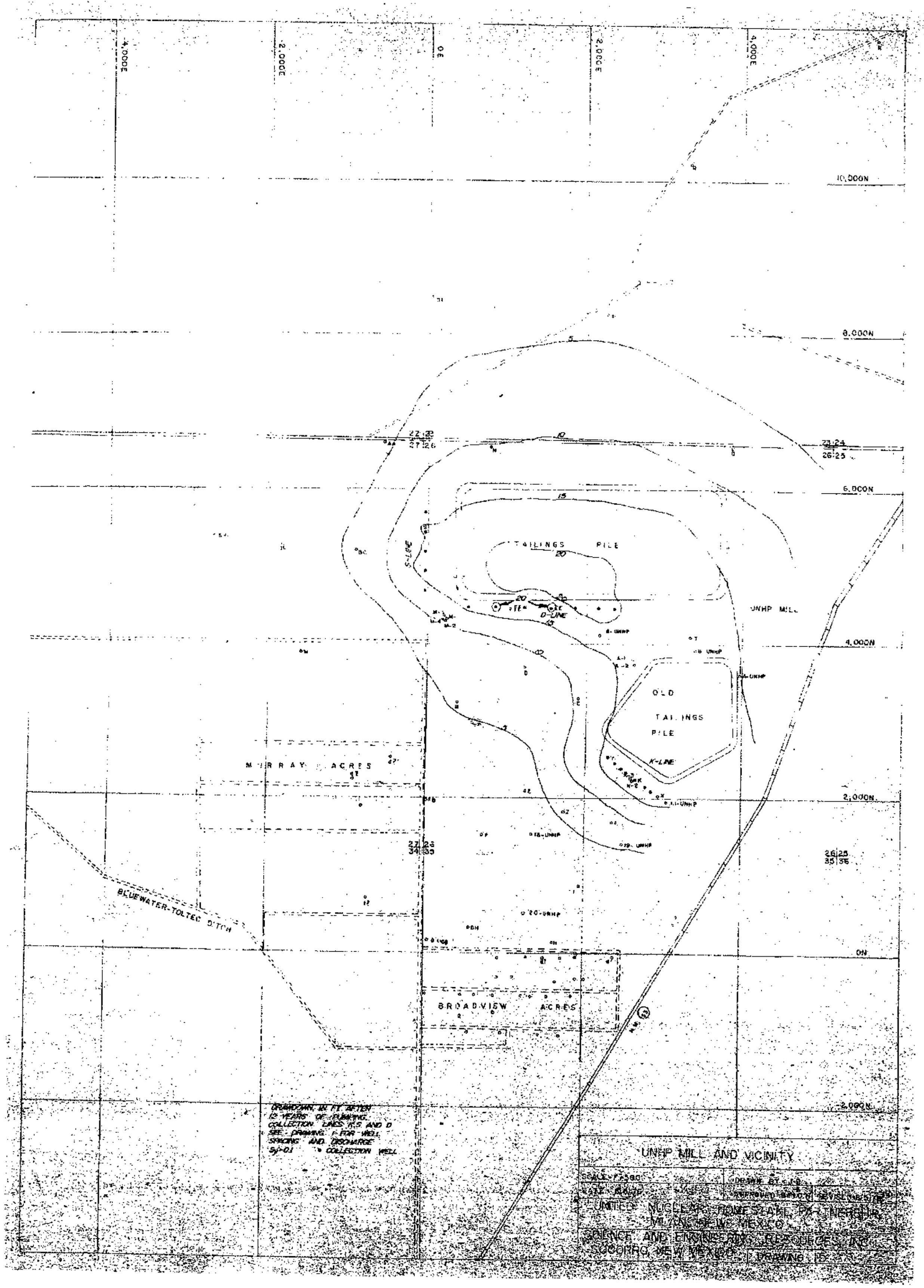
TAILINGS PILE
UNHP MILL
MURRAY ACRES
BROADVIEW ACRES
S-LINE
D-LINE
K-LINE
6515
6510
6525
6530
6535
6540
WATER LEVEL ELEVATION, IN FEET ABOVE MSL
CONTOUR INTERVALS 5 FEET
AFTER 6 MONTHS PUMPING
COLLECTION LINES K,S AND D
SEE DRAWING I FOR WELL
DISCHARGE & SPACING
Sy=0.1 · COLLECTION WELL
WATER LEVEL ELEVATION AT END OF PUMPING PERIOD
UNHP MILL AND VICINITY
SCALE 1"=500'
DATE 8/5/78
DRAWN BY
APPROVED BY
UNITED NUCLEAR HOMESTAKE PARTNERSHIP
MILAN, NEW MEXICO
SCIENCE AND ENGINEERING
SOCORRO, NEW MEXICO

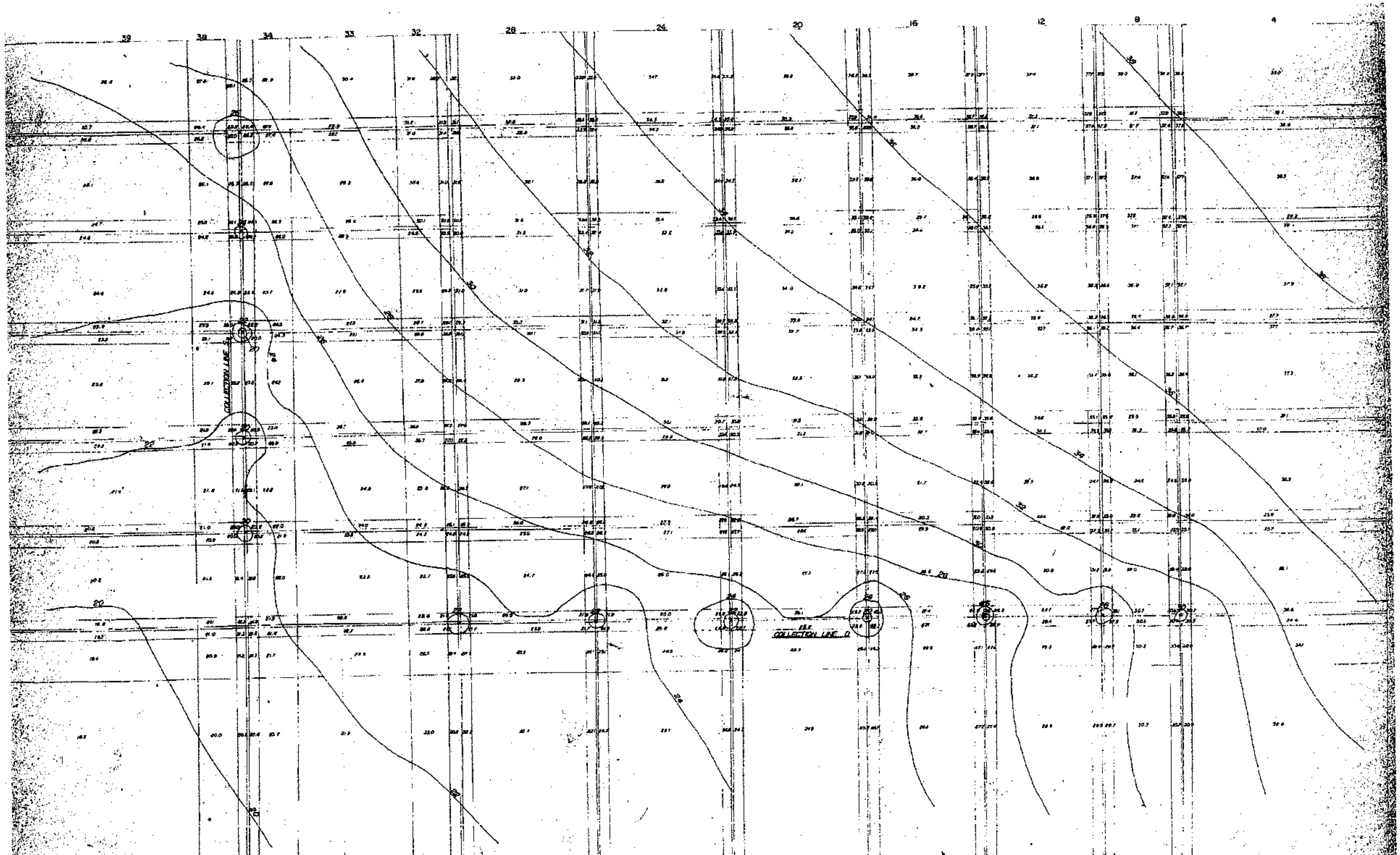

HMC0173579


TAILINGS PILE
OLD TAILINGS PILE
UNHP MILL
MURRAY ACRES
BROOKVIEW ACRES
BLUEWATER-TOLTEC DITCH
S-LINE
D-LINE
K-LINE
6545
6540
6535
6530
6525
6520
6515
6510
8,000N
6,000N
4,000N
2,000N
WATER LEVEL ELEVATION, IN FEET ABOVE MSL
CONTOUR INTERVALS 5 FEET
AFTER 12 YEARS OF PUMPING COLLECTION LINES K,S AND D
SEE DRAWING 1 FOR WELL DISCHARGE AND SPACING
• COLLECTION WELL
WATER LEVEL ELEVATION AT END OF PUMPING PERIOD
UNHP MILL AND VICINITY
UNITED NUCLEAR
SCIENCE AND
INC.


4,000E
2,000E
0E
2,000E
4,000E
8,000N
6,000N
4,000N
TAILINGS PILE
D-LINE
S-LINE
UNHP MILL
OLD TAILINGS PILE
MURRAY

HMC0173581


4,000E
2,000E
0E
2,000E
4,000E
10,000N
8,000N
6,000N
4,000N
2,000N
0N
2,000N
22|23
27|26
23|24
26|25
27|26
34|35
26|25
35|36
TAILINGS PILE
S-LINE
D-LINE
K-LINE
UNHP MILL
OLD TAILINGS PILE
MURRAY ACRES
BLUEWATER-TOLTEC DITCH
BROADVIEW ACRES
DRAWDOWN, IN FT, AFTER
12 YEARS OF PUMPING
COLLECTION LINES K,S AND D
SEE DRAWING 1 FOR WELL
SPACING AND DISCHARGE
• COLLECTION WELL
UNHP MILL AND VICINITY
UNITED NUCLEAR - HOMESTAKE PARTNERSHIP
MILAN, NEW MEXICO
SCIENCE AND ENGINEERING RESOURCES, INC.
SOCORRO, NEW MEXICO
DRAWING 15




WATER LEVEL ELEVATION IN FT MINUS 6300 FT
AFTER 18 DAYS OF PUMPING
SPACING AT 200, 300, 300, 350, 350, 350 FT
SPACING AT 250, 250, 250, 250 FT
DRAWING # 8

COLLECTION LINES S AND D
D-LINE AT 5, 15, 15, 35, 35, 35, 35 GPM
S-LINE AT 5, 15, 25, 25, 25 GPM
5:1.01 • COLLECTION WELL
SCALE 1"=100'