U.S. Department of Energy
Grand Junction Office
2597 B¾ Road
Grand Junction, CO 81503

DEC 17 1999

Thomas H. Essig, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety and Safeguards
Mail Stop T7J9
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Response to Nuclear Regulatory Commission Request of October 13, 1999, for Additional Information on Ground Water Compliance Action Plan and Alternate Concentration Limit Application for the Canonsburg, Pennsylvania, Title I Uranium Mill Tailings Site

Dear Mr. Essig:

The following information is provided in response to the U.S. Nuclear Regulatory Commission letter of October 13, 1999, requesting additional information on the Canonsburg, Pennsylvania, Ground Water Compliance Action Plan (GCAP) and Alternate Concentration Limit (ACL) Application. Responses are included for the three comments, along with changes and additions that will become part of the GCAP and ACL Application. When NRC concurs on these changes, the GCAP and ACL Application will be finalized, and page changes will be distributed.

The enclosed responses focus on changes to the monitoring program and revision of Section 3.0, considering remedial alternatives in more detail. All of these changes will be consistently reflected in other sections and summaries throughout the documents when the final revision is completed.

If you have any questions, please contact me at (970) 248-7612.

Sincerely,

Donald R. Metzler
Technical/Project Manager

Enclosures

DF03

cc w/o enclosure:
C. Abrams, NRC
M. Layton, NRC
R. Heydenburg, MACTEC-ERS
Project File GWCAN1.9 (P. Taylor)

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Canonsburg GCAP/ACL
NRC Request for Additional Information (RAI)

The following information is provided in response to the U.S. Nuclear Regulatory Commission (NRC) letter of 13 October 1999 requesting additional information on the Canonsburg, Pennsylvania Ground Water Compliance Action Plan (GCAP) and Alternate Concentration Limit (ACL) Application. Responses are included for the three comments, along with changes and additions that will become part of the GCAP and ACL Application. When NRC concurs on these changes the GCAP and ACL Application will be finalized and page changes will be distributed. The responses focus on changes to the monitoring program and revision of Section 3.0 considering remedial alternatives in more detail. All of these changes will be consistently reflected in other sections and summaries throughout the documents when the final revision is completed.

The NRC comments are paraphrased below *(in italics)* and DOE responses are provided. Any changes and additions to the text in the respective documents are shown in " . . . ".

- ***Comment 1:*** *Monitoring of ground water and surface water at the Canonsburg site.*

  The statement suggested by NRC in the RAI regarding monitoring will be inserted in the GCAP (last paragraph of Section 2.3) and in the ACL Application (Sections 4.2 and 5.0). The paragraph will read as follows:

  "To demonstrate compliance with the standards, DOE will monitor ground water in the POC wells (412, 413, and 414), monitor well 406, and at the POE (602), to ensure that the ACL for uranium of 1.0 mg/L at the POC and 0.010 mg/L at the POE are not exceeded and that uranium concentrations are decreasing with time. Ground water samples will be collected and analyzed for uranium, molybdenum, and manganese annually for a period no less than 5 years and up to 30 years. Re-evaluation of site conditions will be conducted after the 5 year period. If the compliance strategy is not proceeding as predicted, the site will be re-evaluated and the strategy will be modified as necessary. Termination of ground water monitoring or modification of the ground water compliance action plan strategy will not be made prior to NRC approval."

- ***Comment 2:*** *The remedial alternatives should be expanded.*

  Section 3.0 of the ACL Application will be revised to follow more closely the 1996 NRC ACL guidance and the framework discussed in the RAI. The revision of Section 3.0 is attached.

- ***Comment 3:*** *Establishment of ACL based on concentration levels which represent an extreme lifetime risk, at a point of exposure, to an average individual no greater than between 10^{-4} and 10^{-6} without ALARA assessment.*

  Changes to sections 3.4 and 3.5 are incorporated in the revision of Section 3.0, which is attached.

Revision of the Canonsburg ACL Application (Document Number U00358AA – September 1998) – this will replace Section 3.0 starting on page 43. This revision addresses Comment 2 in the NRC RAI of 13 October 1999. (Note – original color Figures 3-1 through 3-4 will be placed in the final version of the document).

3.0 Corrective Action Assessment

3.1 Results of Corrective Action Program

Two phases of remedial action have been performed to mitigate exposure to contaminated soils at the Canonsburg site. In the early 1960s contaminated surface soils were removed from the processing site in Area A and stockpiled in Area C. The contaminated soils were covered with a relatively impermeable cap in 1964. Between 1984 and 1986 contaminated soils and materials were stabilized in an on-site engineered disposal cell by DOE (DOE 1983 and 1995b). The disposal cell was designed to prevent any further migration of contaminated materials and is basically encapsulating the waste in perpetuity. DOE controls access to the site and has no plans for future development of the disposal cell site.

Since completion of remedial action at the Canonsburg site in the mid-1980s, concentrations of uranium in ground water downgradient from the disposal cell have increased through the mid-1990s, and are now generally on a downward trend (with minor anticipated fluctuations) (Figure 3-a). This is consistent with modeling predictions that concentrations will decrease over time. Although concentrations of uranium are still elevated above the MCL in ground water at two of the three POC wells, there is no potential impact to human health and the environment, and the concentrations are significantly below the proposed ACL (Section 4.1). Also, no uranium has ever been detected at the POE in surface water in Chartiers Creek.

3.2 Identification of Alternatives

Even though there is currently no potential impact to human health and the environment because of site-related contamination in ground water downgradient from the Canonsburg site, alternative corrective action measures will be considered and evaluated as part of the ACL application. Practicable corrective actions for controlling, reducing, mitigating, or eliminating ground water contamination include conventional pump-and-treat technology or the construction of a permeable reactive treatment (PeRT) wall. The third alternative considered is no remediation in conjunction with ACLs.

3.2.1 Pump-and-Treat

A common approach to mitigating ground water contamination is an active ground water withdrawal and ex situ treatment process (commonly referred to as the pump-and-treat method). One or more pumping wells are typically installed to hydraulically capture the contaminant plume, and then the water is pumped through some form of treatment

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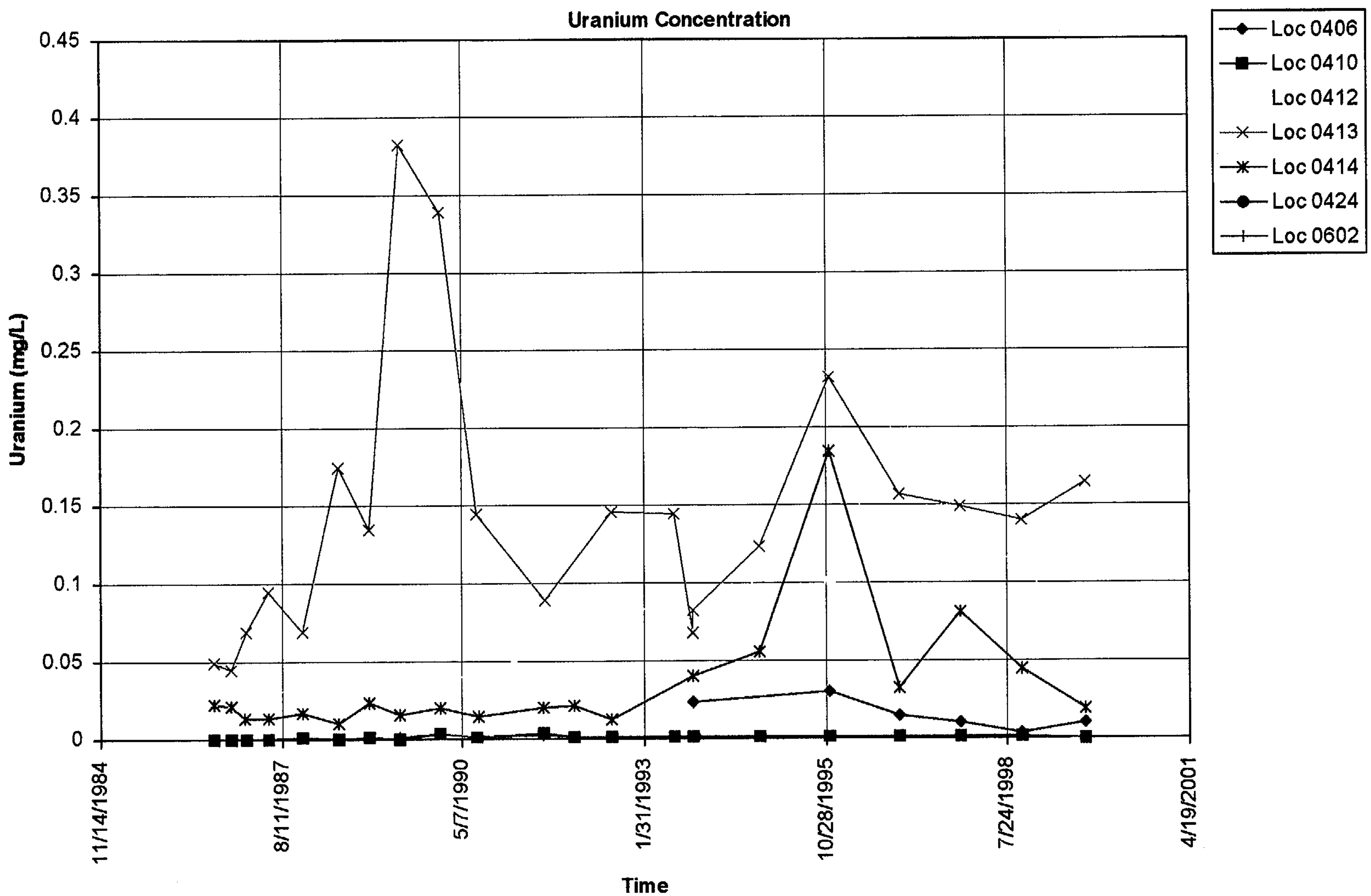

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system. Pump-and-treat methods are typically time consuming and costly because of the complex nature of contaminant transport processes in heterogeneous media. Depending on the cleanup criteria, some pump-and-treat operations have not been able to meet their technical objectives because of heterogeneities and sorption characteristics of the aquifer matrix. Despite the potential shortcomings, it is still considered the baseline technology for a comparison of alternatives.

3.2.2 PeRT Wall

Another option that was evaluated for use at the Canonsburg site is the construction of a PeRT wall. A PeRT wall is a zone of reactive material that is placed in a contaminated aquifer such that the ground water is remediated as it passes through the wall. To date, over 50 PeRT walls have been used to treat a wide range of contaminants. Most of these walls have been used to treat chlorinated solvents; however, several walls have been used to effectively treat heavy metals or low level radionuclides. These walls have only been in place for the last several years.

3.2.3 No Remediation

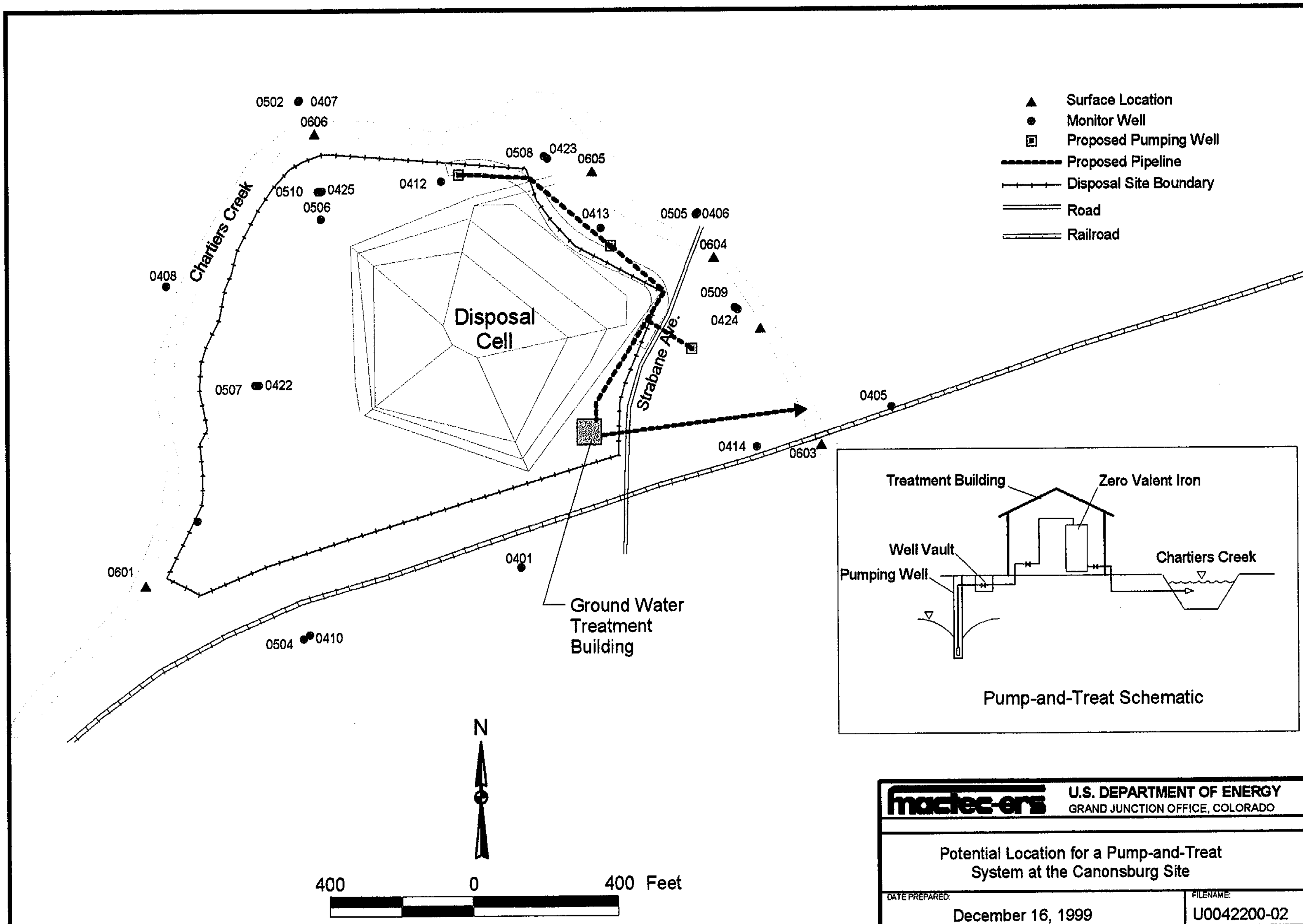
The third alternative is no remediation in conjunction with an ACL for uranium. Since there is no current or projected risk to human health and the environment because of site-related contamination in ground water or surface water at the Canonsburg site, this alternative would comply with the ground water protection standards. Also, ground water in the uppermost aquifer is not a current or potential source of drinking water, and access to ground water is (and will continue to be) prohibited by institutional controls.

3.3 Technical Feasibility

3.3.1 Pump and Treat

To evaluate a pump-and-treat option for the Canonsburg site, the GANDT model was employed to simulate the flow and transport potential, including withdrawal wells intended to hasten the cleanup of the aquifer. Any number of configurations could be used to effectively clean up the aquifer in terms of numbers of pumping wells, withdrawal rates, and duration of pumping. Several options were considered for this analysis. The following scenario was used for the feasibility analysis:

- Two pumping wells located downgradient from the disposal cell (the location of the disposal cell next to the creek is an obstacle to effective placement of the wells) (Figure 3-b).
- Pumping rates set at 10 gallons per minute in each well (it is unlikely that the wells could sustain this yield for extended periods of time).
- Duration of the pumping period set to 10 years.



U.S. DEPARTMENT OF ENERGY
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Potential Location for a Pump-and-Treat System at the Canonsburg Site

DATE PREPARED: December 16, 1999

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The modeling results suggest that a pump-and-treat scenario will do little to enhance the cleanup of the aquifer in a timely and cost-efficient manner. Figures 3–1 and 3–2 show the average concentration distributions of uranium at the site through time for the pumping scenario discussed above. Figures 3–3 and 3–4 show the probability distributions for the likelihood of concentrations being less than the MCL. Additional time frames are shown in Appendix C for both average concentration distributions and probability distributions in order to visualize the transient effects of a pump-and-treat scenario. From these simulation results it is likely that the pump-and-treat scenario will help clean up the site within 15 to 20 years.

For the purpose of this evaluation of alternatives, the pump-and-treat process would involve three wells, each pumping at 7 gallons per minute, to capture the plume downstream of the disposal cell. It is worth noting that the predicted drawdown at the three pumping wells is on the order of 5 to 6 ft (1.5 to 1.8 m). In the area between the disposal cell and Chartiers Creek, the unconsolidated materials (uppermost aquifer) are approximately 15 ft (4.6 m) thick with a saturated thickness of 10 ft (3 m). In addition, the pumping wells are located close enough to Chartiers Creek to likely induce recharge to the aquifer from the river. Lower pumping rates would cause less water to emanate from the river; however, it would have a pronounced effect on the hydraulic control of the plume. The position of the disposal cell next to the creek limits the optimal placement of pumping wells; therefore, the efficiency of a pump-and-treat system is questionable.

Assuming that an adequate stream of contaminated ground water could be extracted from the aquifer, it would be pumped through a collection pipe to the treatment facility. Because of the cold climate the treatment unit would need to be housed instead of being in the open. The most feasible treatment technology would utilize zero valent iron (ZVI) to reduce the uranium concentration in the ground water. The treatment unit would be comprised of ZVI filings inside of a steel tank. The ZVI would remove the uranium in a reaction similar to how the PeRT wall would work. Uranium is removed through reductive precipitation as the contaminated water contacts the ZVI. Because carbonates will precipitate onto the ZVI lowering the iron's hydraulic conductivity, the ZVI filing media will need to be replaced every four months. Conceptually it appears that no other treatment process or chemical additives are required. Although iron and manganese will leach out initially, the levels should drop off to concentrations that are acceptable and not require further treatment. From the tank the treated water would flow by gravity to a discharge point in Chartiers Creek. Figure 3.b depicts the conceptual treatment train.

Treated water will meet UMTRA Project ground water standards for heavy metals. Although it may not meet all drinking water standards, it should be clean enough to discharge directly into Chartiers Creek. A National Pollution Discharge Elimination System Permit required for this discharge would stipulate periodic monitoring. If there was a regulatory issue with discharging into the creek, the city sewer-line passing through the site presents another option. Since the discharge would eventually be treated at a Publicly Owned Treatment Works, the pretreatment standards for accepting wastes into the sewer-line are typically not as strict as a direct discharge would be into the creek.

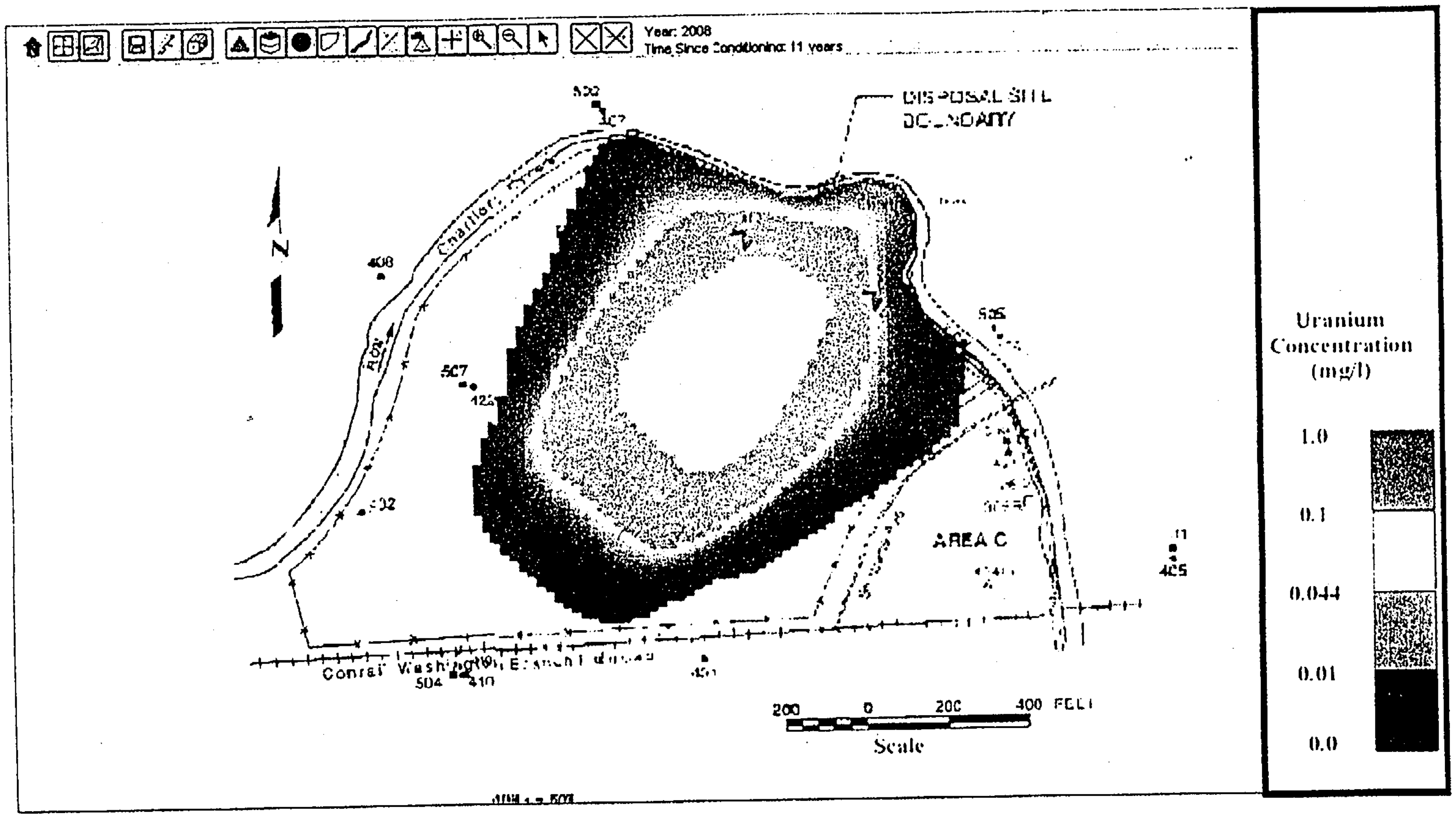


Figure 3–1. Mean Concentration Distribution for Uranium 10 Years After Start of Pump-and-Treat Scenario (y008)

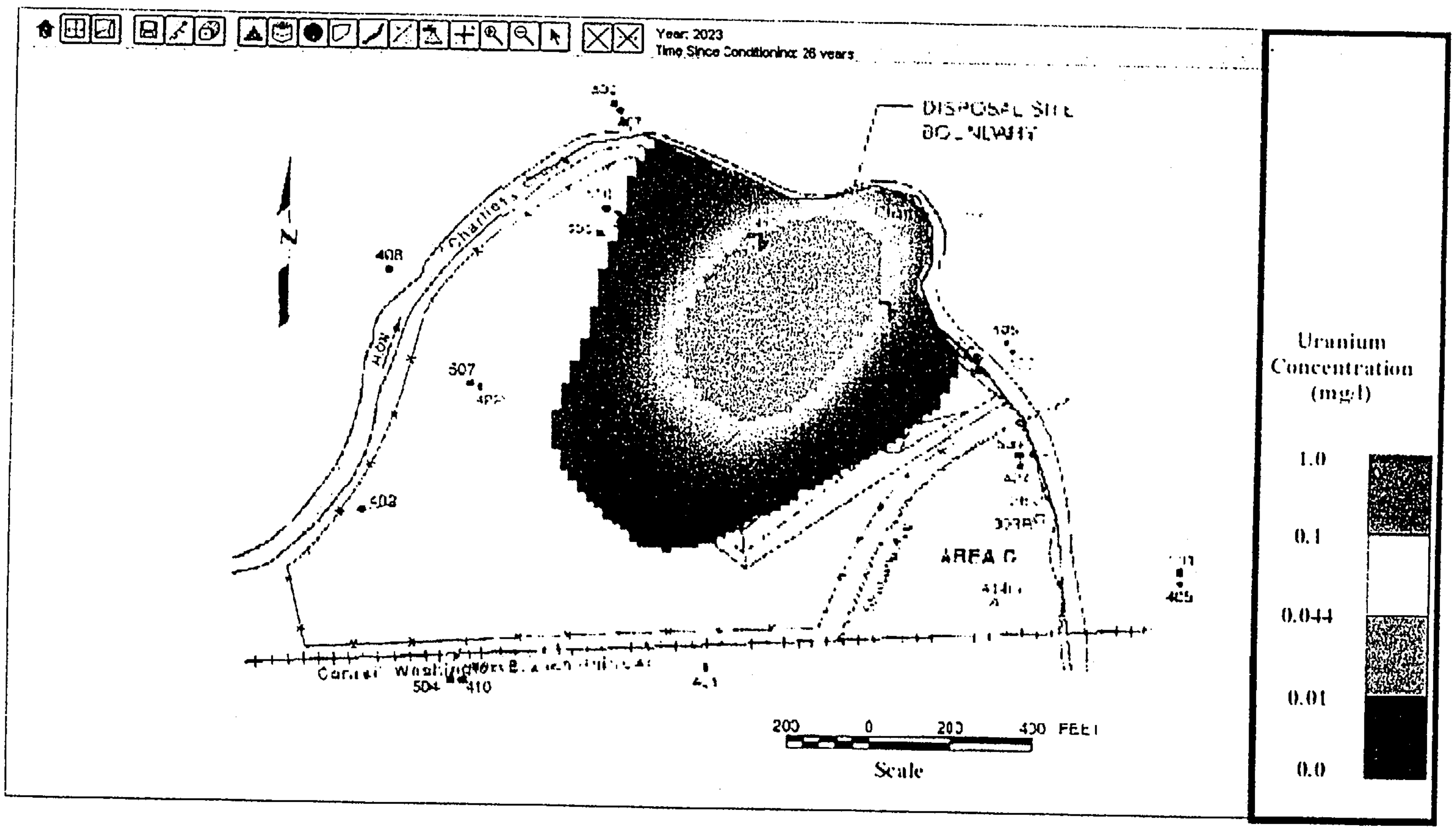


Figure 3–2. Mean Concentration Distribution for Uranium 15 Years After 10-Year Pump-and-Treat Scenario (2023)

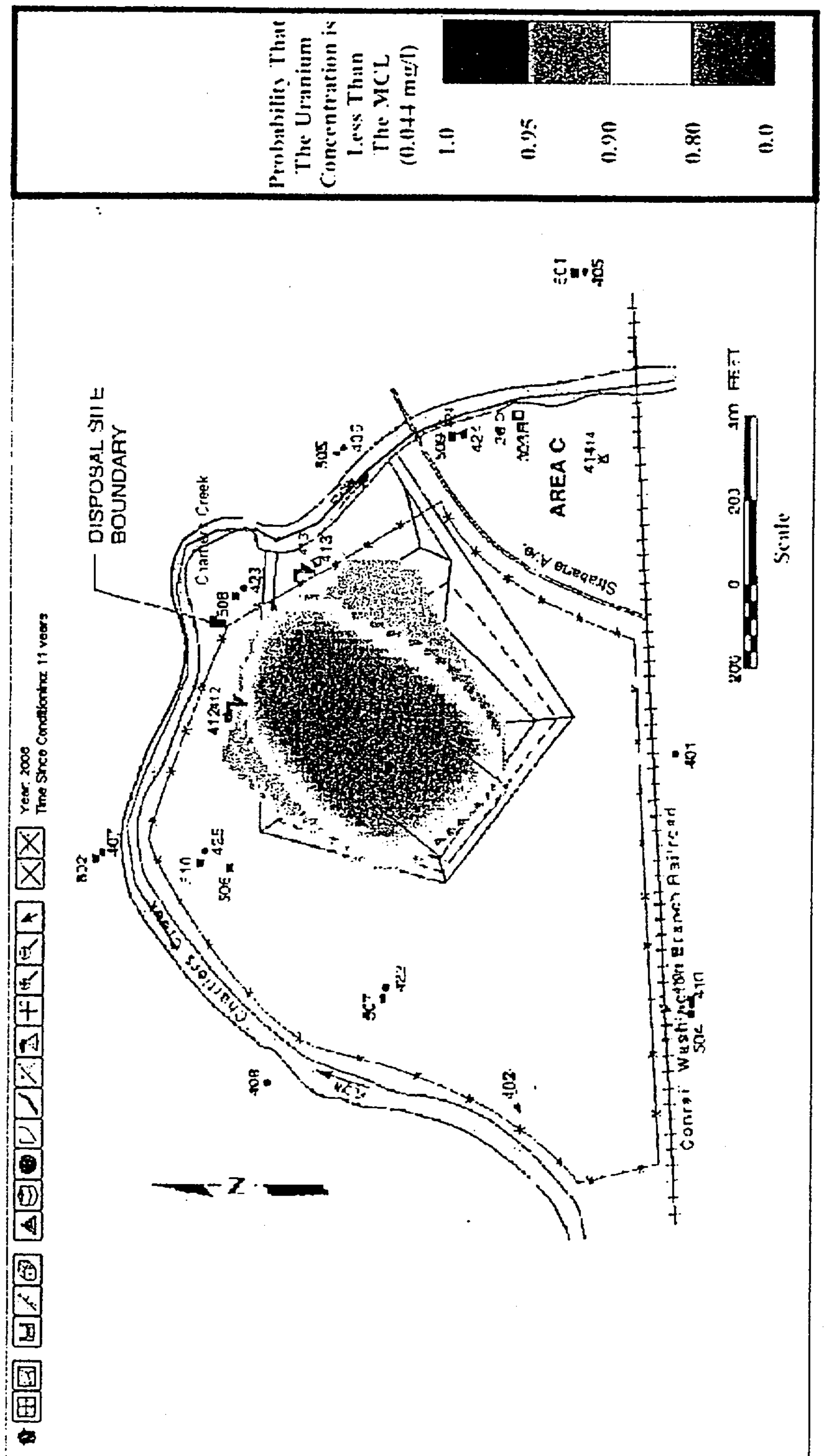


Figure 3–3. Probability of Concentration Being Less Than the MCL for Uranium 10 Years After Start of Pump-and-Treat Scenario (2008)

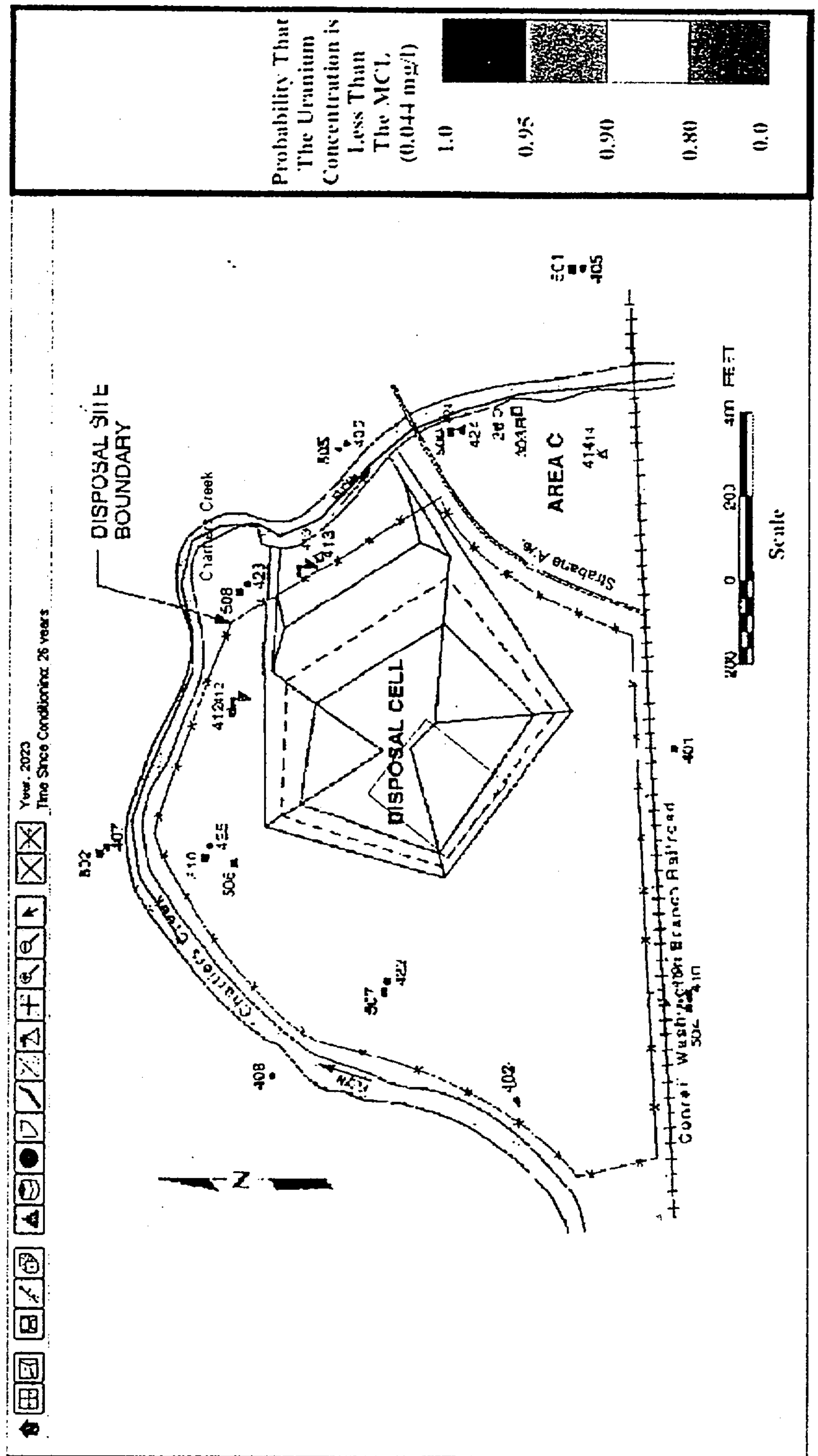


Figure 3–4. Probability of Concentration Being Less Than the MCL for Uranium 15 Years After 10-Year Pump-and-Treat Scenario (2023)

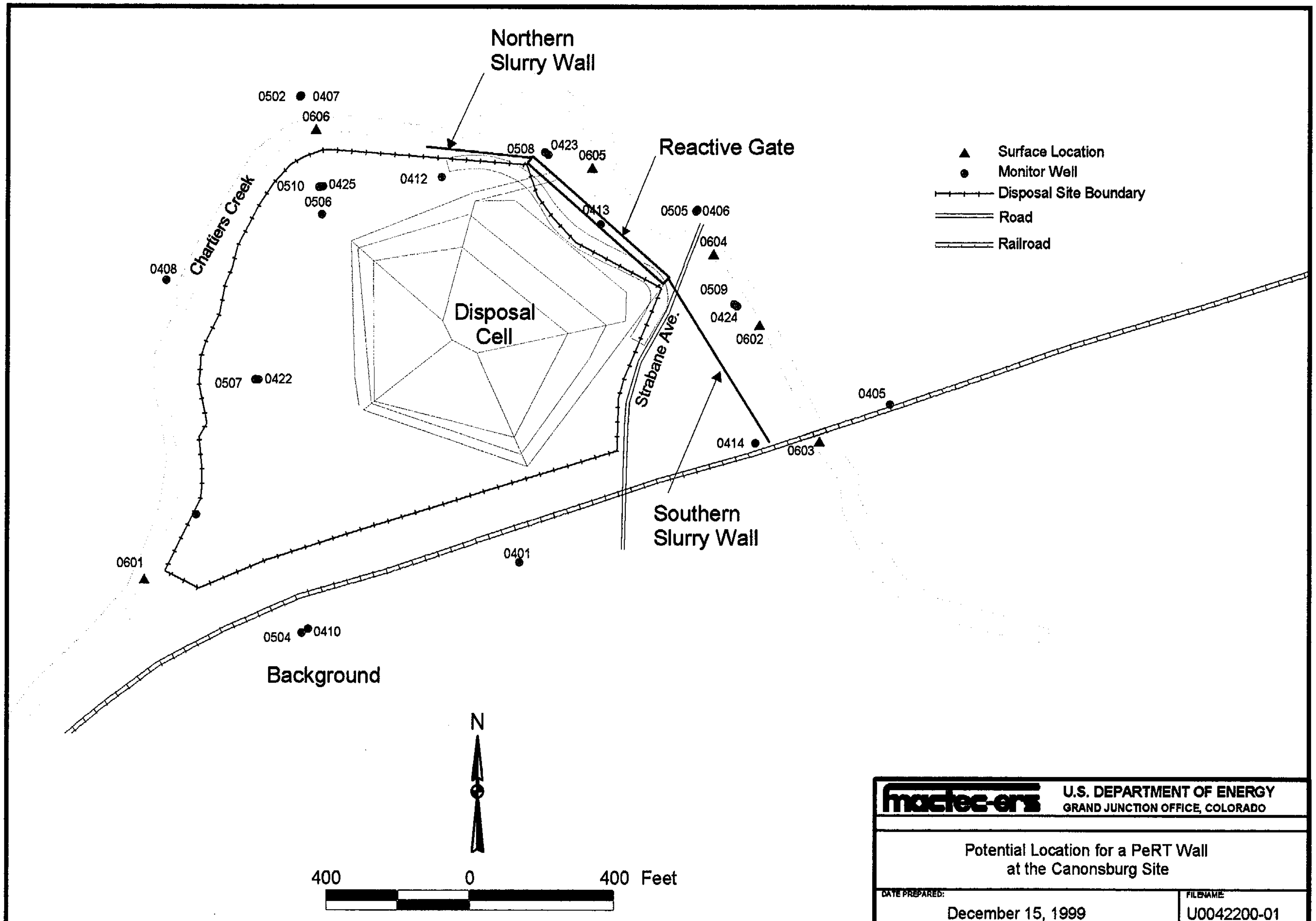
Other treatment technologies such as reverse osmosis and distillation were considered, however, they were considered impractical because they would each create large waste streams that would have to be disposed of. The NRC has verbally stated that the waste byproduct (solids of some form containing uranium) of treating the ground water would be residual radioactive material (RRM) as defined in Public Law 95-604, Uranium Mill Tailings Radiation Control Act. Consequently RRM would have to be disposed of in a licensed disposal cell increasing the costs to the point where these other options appear not feasible.

3.3.2 Permeable Reactive Treatment Wall

If a PeRT wall was constructed at Canonsburg, it would be emplaced between the disposal cell and Chartiers Creek (Figure 3-c). Because ground water flow is relatively low, a funnel and gate PeRT wall would be the most feasible. In this configuration, the gate is the reactive medium and the funnel is an impermeable material such as a bentonite/soil slurry wall. Contaminated water that contacts the impermeable portion is funneled to the reactive gate for passive treatment. Because of the low ground water flows at Canonsburg, only limited mounding is expected directly upgradient of the wall.

Numerous materials have been used in PeRT walls to remove contaminants from ground water. The most commonly used material is ZVI, which creates a strongly reducing environment in ground water. Heavy metals are removed from ground water as it passes through a ZVI barrier from reductive precipitation reactions. The major contaminant of concern, uranium, will precipitate as the mineral uraninite (or an amorphous precursor of this mineral) if the oxidation state of an aqueous solution is lowered sufficiently, as occurs with ZVI. Based on analytical results from the PeRT wall constructed in Monticello, Utah, ZVI was found to reduce uranium concentrations in ground water to nondetectable levels. ZVI was also found to be effective in reducing concentrations of molybdenum. However, for the other contaminant of concern at Canonsburg, manganese, ZVI may actually increase the concentrations in ground water. This occurs because manganese is a trace contaminant in ZVI. Typical contamination levels of manganese are approximately 0.5 percent. This may limit the practicality of using a PeRT wall at this site.

Based on the monitoring data, the most effective area for the PeRT wall would be between monitor wells 412 and 414 southwest of Chartiers Creek (Figure 3-c). The reactive portion of the wall would be directly downgradient of the encapsulation area. The southern impermeable wall would extend from just north of Strabane Avenue to monitor well 414. The northern impermeable wall would be from north of monitor well 412 to just west of monitor well 423. The bottom portion of this wall would be keyed into the bedrock. Based on a depth to ground water of approximately 5 feet below ground surface (bgs) and a depth to competent bedrock of approximately 25 feet bgs (including up to 10 feet of the weathered/fractured zone at the top of the bedrock) the vertical extent of the wall would be 20 feet.



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Potential Location for a PeRT Wall
at the Canonsburg Site

DATE PREPARED: December 15, 1999

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There do not appear to be any engineering constraints for constructing a PeRT wall at this location. The area north and east of the disposal cell is relatively flat with easy access for construction equipment. The estimated construction time is approximately 60 days with 6 to 9 months needed to develop a formal design, procure materials, and arrange for construction equipment, etc. Since this is a passive system, treatment would begin immediately after the wall is installed and continue as long as contaminated ground water passes through the ZVI. Precipitation reactions would eventually reduce the hydraulic conductivity of the ZVI, which would limit its effectiveness. Because this is a relatively new technology and the first PeRT wall has been in operation less than 10 years, the timeframe for when this may occur is unknown. Geochemical modeling on other systems indicates that failure could occur as soon as 10 years to as long as 100 or more years.

3.3.3 No Remediation

This alternative would require no additional activities at the site.

3.4 Estimated Costs and Benefits

The costs of implementing alternate corrective actions and their benefits must be compared to evaluate the feasibility of an ACL application. Direct and indirect benefits that may be considered include an estimate of the value of pre-contaminated water resources based on water rights, availability of alternative water supplies, water-use demands, and water rates to consumers. Benefits may also include those that result from cleaning up the aquifer and thereby reducing adverse effects to human health from exposure to contaminated ground water. Another consideration may involve the benefits associated with land-value depreciation. This last factor is left out of the evaluation because DOE will retain ownership of the property in perpetuity.

3.4.1 Pump and Treat

The costs to operate the pump-and-treat system will primarily involve power and labor. Since chemicals are not required to operate the system, only occasional checks on the pumps and meters will be required. The operator will have to change the media 3 times a year and store it until disposal. Sampling of the treated effluent and ground water will be required on a regular basis. Additionally, the hydrology of the system and effectiveness of the treatment system to reduce contaminants in the plume will have to be assessed on a regular basis. The iron filing treatment media, as discussed previously, will need to be managed as RRM. Since the Cheney disposal cell operated by DOE in Grand Junction, Colorado has no disposal fee and can accept RRM, the estimate assumes that the material would be transported to there from Pennsylvania.

The cost estimate for this analysis includes:

- Remedial design/permitting/construction management – includes preparing permits for discharge to creek and installation of wells, developing a hydrologic model of the plume, and construction oversight of subcontractors hired to install the system.

- Well installation and piping – includes well development, vaults, electrical service to each well, and discharge piping from the wells to the treatment facility.

- Treatment facility – includes garage style building, electrical controls, steel tank containing zero valent iron filings, one year supply of iron filings, piping and valves.

- Operation and maintenance costs – utilities for the building, electricity for well pumps, purchase and disposal of zero valent iron filing media, part-time labor to operate system, professional labor to assess plume.

- Monitoring and sampling costs – labor to sample wells and discharge effluent and analytical laboratory costs.

Table 3-1 shows a summary breakdown of the cost estimate for the pump-and-treat option. Operating and monitoring costs are shown as the present worth value of operating the system for ten years. The total cost of the pump-and-treat option is $1,112,000.

Table 3–1 Cost Estimate for Pump-and-Treat Operation

Item	Cost
Remedial Design/Permitting/Construction Management	$100,000
Well Installation/Piping	$108,000
Treatment Facility	$73,000
Operation and Maintenance	$435,000
Monitoring/Sampling Costs	$140,000
Subtotal	$856,000
Contingency @ 30%	$256,000
Total Cost	**$1,112,000**

No households in the area use ground water from the shallow unconfined aquifer as a drinking water source. Residents of the area have a public water distribution system supplied mostly by surface water from some distance away from the site. Therefore, direct impacts or benefits to the surrounding population relative to a degraded water supply are not directly applicable. However, for the sake of justifying a cost-benefit analysis, an estimate of the economic worth of the degraded resource is provided. The GANDT code is capable of estimating the volume of the aquifer contaminated within a specified concentration threshold. From the GANDT model runs, the average volume of contaminated ground water (i.e., water with a concentration greater than or equal to the MCL) is estimated at 42.3 million gallons. A typical rate for water use is 0.0094 cents per gallon. Therefore, the economic worth of the contaminated ground water based on consumptive use rates is approximately $40,000.

From a cost-benefit analysis perspective, the economic and risk-reduction benefits of performing an action should outweigh the cost of implementation. In this particular case, if the pump-and-treat option were invoked it would arguably produce economic benefits on the order of $40,000 (assuming the water resource benefit is $40,000). The estimated cost of implementing the pump-and-treat scenario over a 10-year period (which does not bring concentrations completely down to the MCL but still requires 10 or more years of natural attenuation to achieve the cleanup goal) is approximately $1 million. Concentrations of uranium at the point of exposure are at the low end of EPA's 10^{-4} to 10^{-6} risk range for carcinogens and are not expected to undergo any significant increase. As such, pump-and-treat would provide no practical risk reduction. Therefore, the cost of implementation far outweighs the economic and risk-reduction benefits, and the pump-and-treat system is not considered an efficient or effective alternative.

3.4.2 Permeable Reactive Treatment Wall

PeRT walls do have high capital costs, in part, because of the high costs of materials. Table 3-2 shows a summary cost estimate for a PeRT wall at the Canonsburg site, based on PeRT wall construction information from the Monticello, Utah project. The capital costs for a PeRT wall are approximately $1,700,000. Since PeRT walls are passive systems, there are no annual operating costs. However, site-monitoring costs will increase because of the additional monitor wells that are needed to evaluate performance.

The cost-benefit analysis and risk-reduction benefits for the PeRT wall follows the same rationale described above for the pump-and-treat system. Since the PeRT wall has a higher cost then the pump-and-treat alternative, it is also not considered an efficient or effective alternative.

3.4.3 No Remediation

The only costs associated with the no remediation alternative would be the ongoing monitoring of ground water at the three POC wells and surface water at the POE in Chartiers Creek.

3.5 Selection of Preferred Alternative

The three corrective action alternatives under consideration for the Canonsburg site are (1) a conventional pump-and-treat scenario for active cleanup of the aquifer, (2) a PeRT wall to remove uranium from ground water, and (3) no remediation in conjunction with an ACL. If the cost of implementing a corrective action is greater than the benefits of the outcome, then the alternative may be inappropriate or inefficient. The cost for implementing a pump-and-treat system is approximately $1.1 million and the cost for a PeRT wall is approximately $1.7 million. Neither alternative provides any practical risk reduction. Therefore, neither the pump-and-treat or the PeRT wall options would be an appropriate or efficient corrective action alternative.

Table 3-2

Canonsburg Permeable Reactive Treatment (PeRT) Wall
Cost Estimate -- Capital Cost

Item	Quantity	Units	Cost/Unit	Total Cost	Notes
ZVI Cost	20000	Cubic Ft	$33.21	$664,200	Based on prior quotes for -8/+50 mesh ZVI. This includes shipping.
Slurry Wall Installation	16000	Square Ft	$15.60	$249,600	Unit price based on slurry wall quote for the Monticello PeRT wall.
Mob/demob	1	Event	$90,000.00	$90,000	Based on Monticello
Install Sheet Piling	1004	Square Ft	$89.00	$89,356	Installed for the reactive gate portion. Monticello Quote.
Remove Sheet piling	1000	Square Ft	$3.80	$3,800	Pilings perpendicular to ground water flow are removed after placement of ZVI
Excavate Reactive Wall	741	Cubic Yd	$72.00	$53,352	Removal of native materials before ZVI is placed. Based on Monticello Estimate
Place ZVI in the trench	1	Activity	40,000.00	$40,000	Placed from Supper Sacks. Rough estimate based on one week of labor and equipment use
Temporary Facilities	2	Number	$17,000.00	$34,000	Unit cost based on Monticello
Site prep/Cleanup	1	Activity	$25,000.00	$25,000	Limited site prep/cleanup is expected. Rough Estimate.
Monitoring Well Install.	30	Wells	$1,000.00	$30,000	Unit Cost based on Monticello costs. Number of wells needed to fully evaluate performance
Subtotal				$1,279,308	
Construction Oversight	30	% of subtotal		$383,792	
Total Cost				**$1,663,100**	

PeRT Wall Assumptions:

Funnel and gate construction
Impermeable portion is a slurry wall
Ground water capture is needed from Well 414 to Well 412
Measured linear feet based on drawing CAN-LTSP-001: 500 feet Southern Slurry, 500 feet reactive gate, 300 feet Northern Slurry
Assumes Reactive gate is directly downgadient of the repository and ground water flow is low enough to minimize mounding
Depth to ground water is approximately 5 feet
Depth to bedrock is 25 feet
Therefore, vertical depth of slurry wall and reactive gate is 20 feet
The reactive material in the gate is Zero valent Iron (ZVI). ZVI is very effective in taking uranium concentrations to nondetect
The thickness of the reactive gate is 2 feet
Assume that gravel packs are not used on the reactive gate
Ten rows (with 3 wells in each row-1 upgradient, 1 in the ZVI, and 1 downgradient) of performance monitoring wells will be installed in the gate

Slurry Wall Size 800 x 20 =16,000 ft2
Reactive Gate Size 500 x 20 x 2=20,000 ft3

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The Canonsburg site is already in compliance with the proposed ACL, as concentrations of uranium in ground water at the POC wells are already below the ACL, and uranium has never been detected in surface water at the POE in Chartiers Creek. Thus, there is no practicable reason to consider implementing any expensive and intensive corrective action alternative. Also, ground water in the vicinity is not a current or potential source of drinking water, alternative water supplies are readily available and in use in the area, and there is no problem with potential exposure of contaminated ground water.

Therefore, based on current and predicted conditions at the site and evaluation of the identified alternatives, no remediation in conjunction with an ACL for uranium is the preferred alternative for the compliance strategy to meet ground water protection standards at the Canonsburg site. This alternative is the most cost effective, providing maximum benefit and protection of human health and the environment.