UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 24, 2000

Mr. Donald R. Metzler
U.S. Department of Energy
Grand Junction Office
2597 B 3/4 Road
Grand Junction, CO 81503

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION CONCURRENCE OF THE GROUND WATER COMPLIANCE ACTION PLAN AND APPLICATION FOR ALTERNATE CONCENTRATION LIMITS FOR THE CANONSBURG, PENNSYLVANIA, UMTRA SITE

Dear Mr. Metzler:

The U.S. Department of Energy (DOE) submitted a Groundwater Compliance Action Plan (GCAP) and Application for Alternate Concentration Limits (ACL) for the Canonsburg, Pennsylvania, UMTRA site in letters dated September 9, 1998, April 8, 1999, and September 27, 1999. A request for additional information was made from this office, and DOE satisfied our concerns in a submittal dated December 17, 1999. Our staff has reviewed this information and concurs with the Groundwater Compliance Action Plan and approves the application for alternate concentration levels.

The staff has determined that the GCAP for the Canonsburg, Pennsylvania site satisfies the requirements set forth in the Uranium Mill Tailings Radiation Control Act of 1978, as amended and the standards in 40 CFR 192, Subpart B for the cleanup of groundwater contamination resulting from the processing of ores for the extraction of uranium. The compliance strategy proposed in the GCAP will achieve compliance with Subpart B of 40 CFR 192.12 through no remediation in conjunction with the application of an ACL, including groundwater monitoring and institutional controls to ensure that the ACL will continue to be protective of human health and the environment.

The staff's Technical Evaluation Report has been enclosed for your information. DOE should revise the Long-Term Surveillance Plan to be consistent with the Groundwater Compliance Action Plan.

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Please feel free to contact the NRC Project Manager, Jill Caverly, at (301) 415-6699 should you have any questions regarding this matter.

Sincerely,

Original Signed By

Thomas H. Essig, Chief
Uranium Recovery and
Low-Level Waste Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: Technical Evaluation Report

cc: James G. Yusko, Pennsylvania
Department of Environmental
Protection

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Enclosure: Technical Evaluation Report

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ENCLOSURE

TECHNICAL EVALUATION REPORT
CANONSBURG GROUNDWATER COMPLIANCE ACTION PLAN AND
ALTERNATE CONCENTRATION LIMIT APPLICATION

DATE: December 30, 1999

FACILITY: Canonsburg, PA

PROJECT MANAGER: Jill Caverly

TECHNICAL REVIEWER: William von Till

SUMMARY AND CONCLUSIONS:

The U.S. Department of Energy (DOE) submitted a Groundwater Compliance Action Plan (GCAP) and Application for Alternate Concentration Limits (ACLs) for the Canonsburg, Pennsylvania, UMTRA Project Site by cover letter dated September 9, 1998. U.S. Nuclear Regulatory Commission (NRC) staff reviewed the GCAP and provided preliminary comments to DOE in a conference call on August 17, 1999. DOE, by letter dated September 27, 1999, responded to the comments. NRC reviewed all relevant material and by letter dated October 13, 1999, requested additional information. DOE, by letter dated December 17, 1999, provided a response and revised Section 3.0 of the GCAP.

After review of the documents, the staff concurs with the proposed action. The compliance strategy proposed in the GCAP will achieve compliance with Subpart B of 40 CFR 192.12 through no remediation in conjunction with the application of an ACL, including groundwater monitoring and institutional controls to ensure that the ACL will continue to be protective of human health and the environment. Staff has determined that the GCAP for the Canonsburg, Pennsylvania, site satisfies the requirements set forth in the Uranium Mill Tailings Radiation Control Act of 1978, as amended (UMTRCA), and the standards in 40 CFR 192, Subpart B for the cleanup of groundwater contamination resulting from the processing of ores for the extraction of uranium.

The option of no remediation in conjunction with the application of ACLs for the uppermost aquifer is acceptable based on the following:

1) Constituents will not pose a risk to human health and the environment due to the use of institutional controls to prohibit groundwater use on the site during the ACL application period. Groundwater contamination discharging into the stream adjacent to DOE-controlled land will be diluted to well below harmful concentrations, and DOE and the State of Pennsylvania has control over the land from the tailings to the stream.

2) Alternatives would not produce an incremental benefit over the associated costs.

3) Compliance monitoring will be used to verify the decrease in contaminant concentrations, as predicted by modeling, for a minimum of five years and up to 30 years with re-evaluation after five years. To assure that groundwater constituents do not

flow under Chartiers Creek and migrate towards water supply wells, DOE will include monitoring well 406 in the monitoring program.

BACKGROUND:

The NRC concurred on the Remedial Action Plan (RAP) on May 18, 1984, and concurred on two modifications on January 24 and 28, 1986. The staff also concurred on the Remedial Action Inspection Plan on December, 1985. This concurrence was the staff's agreement that the Quality Control Program was acceptable.

DOE submitted a final Completion Report for surface remediation by letter dated April 7, 1994. The staff concurred on the action by letter dated August 14, 1995. The staff accepted DOE's Long-Term Surveillance Plan (LTSP), dated October 1995, by letter dated January 16, 1995.

This supplemental TER documents the staff's review of DOE's GCAP dated September 9, 1998. Canonsburg is one of three sites that were completed early in the program, and in accordance with the Memorandum of Understanding between the DOE and the NRC, dated November 6, 1990. The groundwater restoration phase of the Uranium Mill Tailings Remedial Action (UMTRA) project was initiated by DOE's final Programmatic Environmental Impact Statement (PEIS) for the UMTRA Ground Water Project. The final PEIS was approved for distribution on September 19, 1996, and the Record of Decision was approved and published on April 28, 1997.

Regulatory Framework:

The UMTRA Project regulations provide several ways to comply with the groundwater protection standards for Subpart B of 40 CFR Part 192.12(c). These include meeting the provisions of 40 CFR 192.02(c)(3) or a supplemental standard established under 40 CFR 192.21. Within 40 CFR 192.02(c)(3)(ii), the option for ACLs is established. ACLs are established on a site-specific basis, provided it is demonstrated that the constituents will not pose a substantial present or potential hazard to human health or the environment, as long as the ACLs are not exceeded.

The hazard assessments for ACLs will be acceptable if they meet the following criteria:

1) The point of exposure (POE) is identified.

2) The hazardous constituent source term and the extent of groundwater contamination are characterized.

3) The hazardous constituent transport in groundwater, and hydraulically connected surface water, and the adverse effects on water quality, including the present and potential health and environmental hazards, are assessed.

4) An assessment of human or environment exposures to hazardous constituents, including the cancer risk and other health and environmental hazards, is provided.

5) An evaluation of potential alternatives is provided.

Factors used in evaluating the ACL application can be found in Appendix 1 of this report as outlined in 40 CFR Part 192.02(c)(3)(ii)(B)(1 and 2).

Site Description:

The DOE Canonsburg facility is located in the Borough of Canonsburg, in northern Washington County, Pennsylvania, approximately 20 miles (mi)(32 kilometers [km]) southwest of Pittsburgh, Pennsylvania (Figure 1). The site encompasses approximately 18.5 acres (7.4 hectares) and is adjacent to Chartiers Creek (Figure 2). The facility has been used to process or contain radioactive materials since 1911. Between 1984 and 1986, DOE conducted surface remediation by removing the buildings, contaminated soils, and materials from the site and stabilizing them in a permanent disposal cell. The disposal cell covers 6 acres (2.4 hectares) and contains about 172,000 cubic yards (132,000 cubic meters) of contaminated materials. The site is currently being monitored in accordance with the Long-Term Surveillance Plan (LTSP) for the Canonsburg, Pennsylvania Disposal Site (DOE, 1995).

Groundwater is present in the unconsolidated materials and in the shallow bedrock of the Casselman Formation. The unconsolidated materials are composed of sandy loam to silty clay, clay, alluvium, and fill material up to 30 feet (ft) (9 meters [m]) thick. The lithology of the bedrock to a depth of 90 ft (29 m) consists predominantly of gray siltstone and shale, some inter-bedded limestone, and sparse coal seams. The two units are hydraulically connected with a vertical flow component from the unconsolidated materials to the bedrock. Groundwater depth in the unconsolidated material ranges from 3 to 14 ft (0.9 to 4.3 m) below ground surface. Groundwater occurs in the shallow bedrock under semi-confined conditions mainly in zones of secondary porosity (fractures). The groundwater velocity from the disposal cell toward Chartiers Creek is estimated at approximately 4 ft per day (1.4×10^{-3} cm per second). Groundwater from the unconsolidated material discharges into Chartiers Creek that is directly down-gradient from the disposal cell. Chartiers Creek has an average flow of 90 to 130 ft^3 per second (2.5 to 3.7 m^3 per second) and flows into the Ohio River 15 mi (24 km) downstream from the site. Local residents use the creek for fishing, swimming, and wading. The types of fish found in the creek include carp, catfish, and bluegill. The creek has elevated levels of iron and manganese as a result of acid mine drainage in the area.

Most of the residents in the area are connected to a municipal water supply system supplied by the Monongahela River. A water use survey identified 16 wells within a 1mi (1.6 km) radius of the site. Of these wells, one was in use, eleven were not in use, and four were abandoned. Seven of these wells are up-gradient of the site and would not be affected. The remaining five wells are located on the opposite side of Chartiers Creek, one of which is in use located approximately 400 ft (120 m) north of the site. This well is used only for washing cars, mixing cement, and watering the garden.

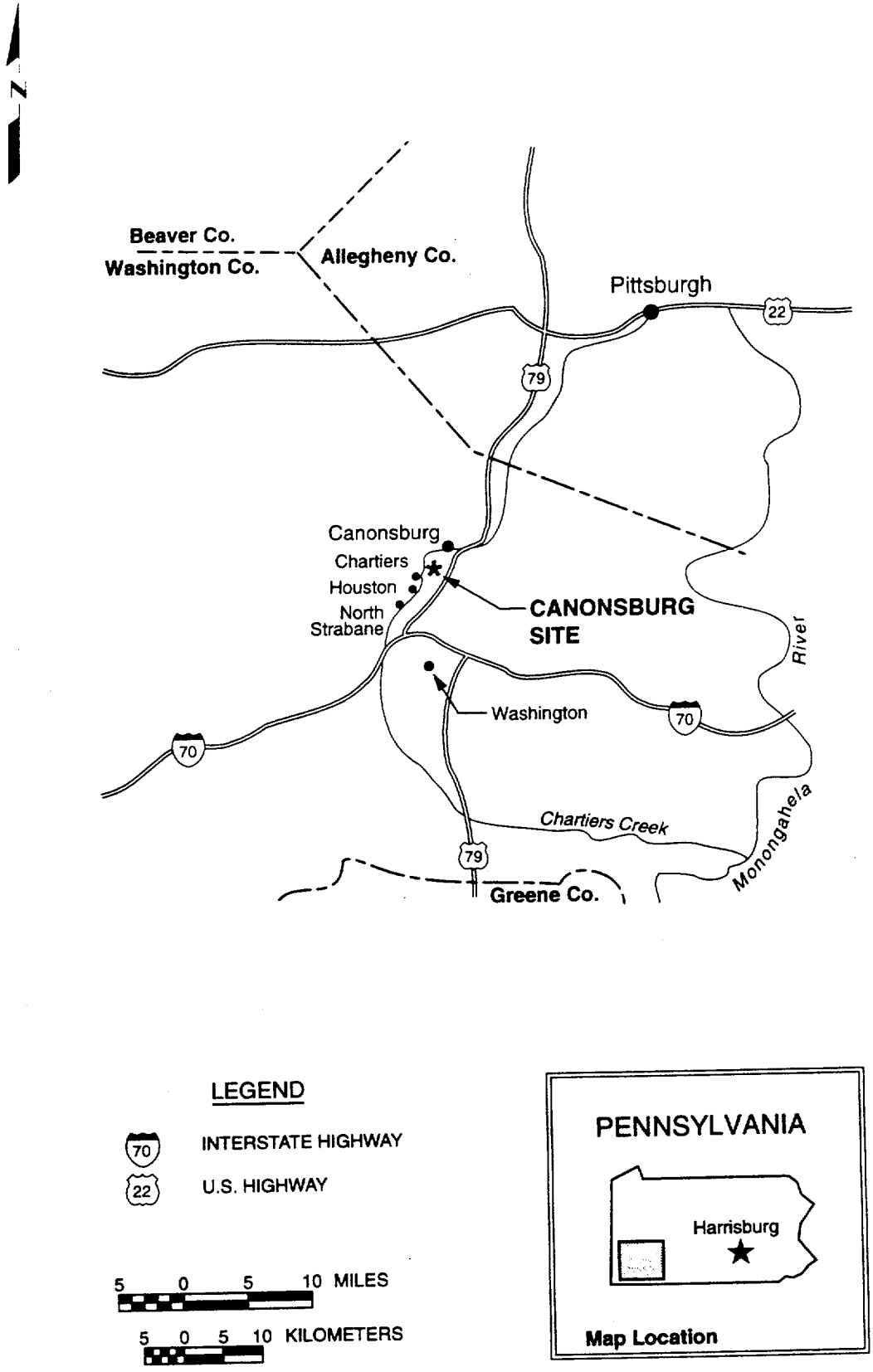
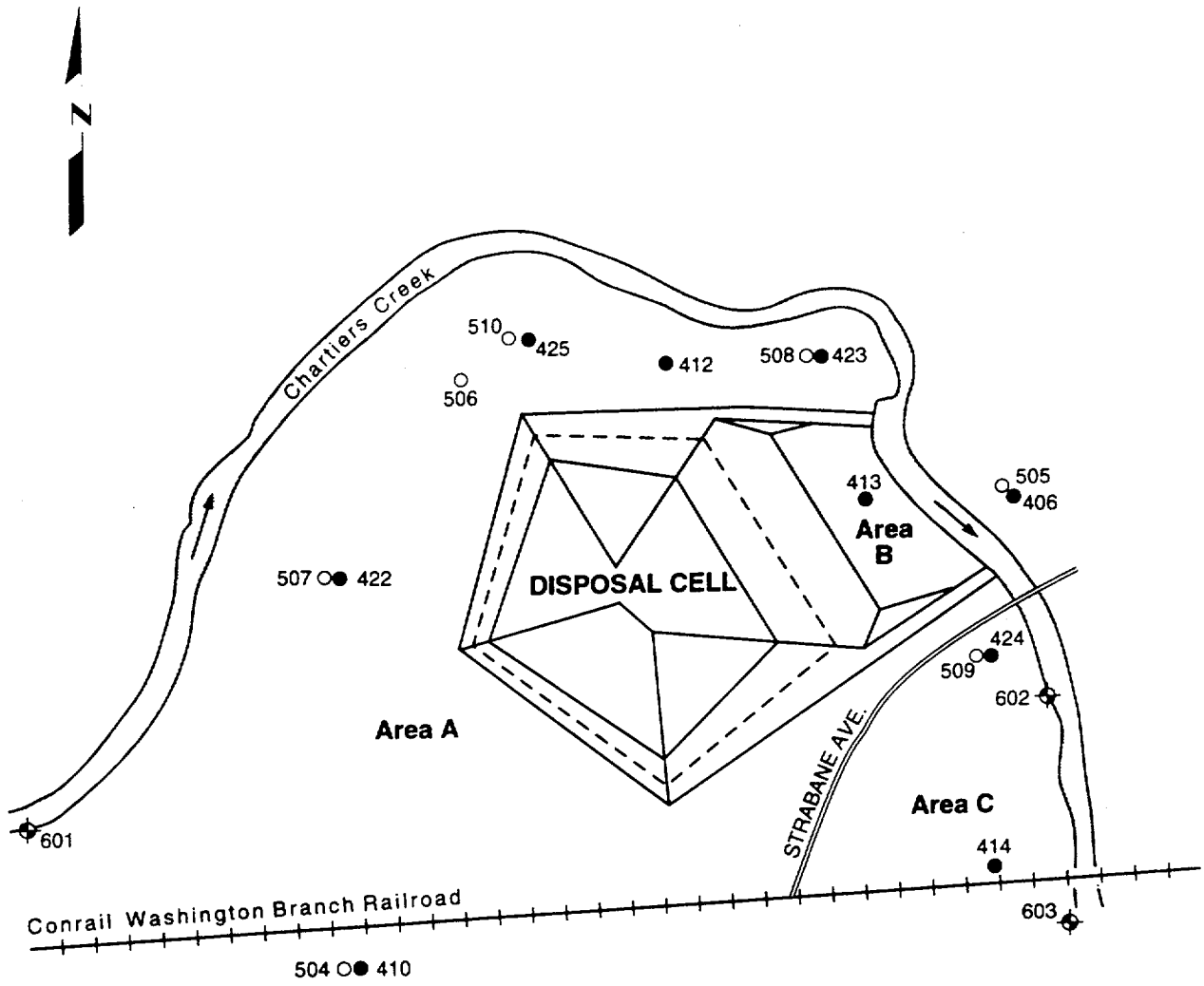


FIGURE 1
CANONSBURG, PENNSYLVANIA, SITE LOCATION MAP

.MAC: SITE/CAN/S&M/SITELOC



LEGEND

410 ● MONITOR WELL IN UNCONSOLIDATED MATERIAL

504 ○ MONITOR WELL IN SHALLOW BEDROCK

603 ⊕ SURFACE WATER SAMPLING LOCATION

← DIRECTION OF STREAM FLOW

200 0 200 400 FEET

50 0 50 100 METERS

FIGURE 2
LOCATIONS OF MONITOR WELLS AND SURFACE WATER SAMPLING
CANONSBURG, PENNSYLVANIA, DISPOSAL SITE

TECHNICAL EVALUATION:

DOE has proposed, based on the framework under the Programmatic Environmental Impact Statement for Uranium Mill Tailings Remedial Action Groundwater Project (PEIS)(DOE, 1996), no remediation in conjunction with the application of ACLs to groundwater contamination at the site. This will include incorporation of groundwater monitoring and institutional controls to ensure that the application of ACLs will continue to be protective of human health and the environment. The ACL will be established at a point of compliance (POC), which will consist of monitoring wells 412 and 413, down-gradient from the disposal cell, and monitoring well 414 in Area C. Monitoring well 406 will also be monitored to assure that migration of hazardous constituents under Chartiers Creek is limited. The point of exposure (POE) will be the surface water in Chartiers Creek adjacent to the site and monitoring well 602. DOE owns property from the POC wells to the Creek where groundwater discharges. Ground water constituents are currently flushing into the stream at levels that are below detection with the dilution of the stream.

Manganese, molybdenum, and uranium are the constituents of concern (COC) that have been present in concentrations that exceed MCLs or background in groundwater down-gradient from the disposal cell and in Area C. The proposed ACL for uranium is 1.0 mg/L. An ACL is not required for manganese because it does not have an MCL in Table 1 to Subpart A of 40 CFR 192, does not pose a threat to human health and the environment, and ambient manganese contamination in Chartiers Creek is present at the site. Institutional controls will ensure that the risks from groundwater ingestion of manganese are eliminated. Molybdenum concentrations have been exceeded historically at the site, but recent data indicates that concentrations are below the standard of 0.1 mg/l. The NRC requested that DOE monitor manganese and molybdenum, along with uranium, as part of the groundwater monitoring to make sure concentrations remain protective. DOE agreed to this in their September 27, 1999, correspondence.

Based on the Baseline Risk Assessment (BLRA) (DOE, 1995) no human health risks are currently associated with contaminated groundwater at the site other than potential ingestion of drinking water. Institutional controls will be in place to prevent any use of contaminated groundwater near the processing site and in Area C.

Numerical modeling estimates that there will be no future risk to human health and the environment and that the contaminants will be flushed in less than 30 years. Compliance monitoring will consist of annual monitoring for a period no less than 5 years and up to 30 years. Re-evaluating 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 modified as necessary. When uranium concentrations are consistency below the MCL, monitoring will be discontinued and the institutional controls lifted, subject to regulatory approval.

The hazardous constituent source term and extent of groundwater contamination have been characterized in the Remedial Action Plan (DOE, 1983), the Processing Site Characterization (DOE, 1984), the Baseline Risk Assessment (DOE, 1995), and the Groundwater Compliance Action Plan and Application for ACLs (DOE, 1998). The Canonsburg site has had some form of

radionuclide processing or containment within its boundaries since 1911. In the early 1960s, some surface soil remediation was performed in Area A; the resulting contaminated soils and material were placed in Area C and covered with a relatively impermeable cover material. DOE remediated the surface contamination from 1984 to 1986 that will isolate the source and greatly reduce further infiltration of water through the tailings.

To evaluate the concentrations of fate and transport of uranium between the POC and the POE (Chartiers Creek), DOE used the GANDT code followed by a stream-aquifer model called the riverine model (NRC, 1982). The GANDT model uses both analytical and numerical models of subsurface flow and transport (Knowlton, et al., in press). Sandia National Laboratories (SNL) has been developing the Groundwater Analysis and Network Design Tool, or GANDT, to provide DOE environmental restoration programs with a comprehensive system for analyzing groundwater flow and associated contaminant transport, while directly accounting for transport uncertainty and providing decision analysis capabilities for monitoring well network design.

The objective of the model was to evaluate the likelihood of success of applying ACLs at the site. A probabilistic approach was applied, using Monte Carlo methods to quantify uncertainties. The model estimated the transport of constituents within and from a contaminated source zone, using a pulsed leaching algorithm; through the vadose zone, into the groundwater in the uppermost aquifer, migration and attenuation through groundwater, discharge into the stream, and dilution with the stream. The model's assumptions include the following:

- The surficial aquifer is assumed to be connected to Chartiers Creek. The stream is assumed to be gaining, that is all groundwater discharging into the stream. The stream is assumed to be a sink for all groundwater flowing toward it in the model. Monitoring well 406 was added to verify that this assumption is correct as requested by the NRC.

- A steady-state flow system is assumed.

- The unconfined aquifer is assumed to be homogeneous.

- Sources are assumed to be a single source.

Results of the model predict that concentrations would be one or two orders of magnitude below detection limits. Based on NRC comments, DOE calculated a worse case scenario that uranium concentrations entering the stream at levels in excess of 100 mg/L would still be protective due to dilution. Uranium concentrations are not predicted to be near the levels of 100 mg/L, but NRC wanted to determine the magnitude of variability and uncertainty that could be factored into the program without causing risk. To take into account uncertainties, DOE proposed the ACL for uranium at the POC at 1.0 mg/l. This value is considered to be conservative since DOE calculated that concentrations more than 100 mg/L could discharge into the stream before levels in the stream would be a risk. From a transient perspective of the contamination migration process, it is predicted that a buildup of contaminant concentrations in the aquifer will occur as the initial leaching process proceeds, followed by a decrease in contaminant concentrations after the source term is removed. Once the source term is removed, the processes of desorption, dispersion, and flushing will dominate the characteristics of the migration process, thereby, attenuating the contaminants.

The Baseline Risk Assessment estimated the risk to humans and the environment and concluded that there are no current human health risks associated with the site contaminated groundwater and that there could be potential risk if people were to drink the contaminated groundwater or if contaminated groundwater were used in irrigation. Based on these findings, the conclusion was made that groundwater beneath the site that is contaminated should not be used, at least until levels are below the MCL. The risk of contaminated groundwater discharging into Chartiers Creek was assessed and the report concluded that due to dilution no risk was found or anticipated. The scenarios evaluated for the creek included incidental ingestion of surface water through recreational use, dermal contact with surface water through recreational use, incidental ingestion of sediments through recreational use, and ingestion of contaminated fish.

DOE evaluated a groundwater pump and treat alternative and concluded that it would cost approximately $1,112,000. Two hypothetical wells were modeled at a pumping rate of ten gallons per minute for a period of ten years. The model estimated that the concentrations would still be above the standard and would need an additional 5 to 10 years for natural attenuation to bring the contaminant levels to below the MCL. Therefore, the pump and treat option is marginally quicker than the preferred alternative and would be orders of magnitude more costly and would not be incrementally beneficial.

As a result of comments from the NRC, DOE evaluated the use of a permeable reactive treatment (PeRT) wall. DOE is using this innovative technology in Monticello, Utah, where uranium has been reduced to non-detectable levels. The wall would be placed between wells 412 and 414, down-gradient of the plume. Zero valent iron (ZVI) would be used to precipitate heavy metals from the ground water as it migrates through the wall. COCs uranium and molybdenum could be effectively reduced using this technology, however, manganese may increase because it is a trace element of ZVI. Uranium would precipitate as the mineral uraninite if the oxidation state of the aqueous solution is lowered sufficiently, as occurs with ZVI. The cost for this technology was estimated to be $1,700,000 and would, therefore, not be cost effective. The high cost of this technology is mainly due to costly materials (ZVI).

REFERENCES:

U.S. Department of Energy (DOE), 1998, Groundwater Compliance Action Plan (GCAP) and Application for Alternate Concentration Limits for the Canonsburg, Pennsylvania, UMTRA Project Site.

DOE, 1995, Baseline Risk Assessment of Ground Water Contamination at the Uranium Mill Tailings Site Near Canonsburg, Pennsylvania, DOE/AL/62350-149, Rev. 1.

DOE, 1996, Final Programmatic Environmental Impact Statement for the Uranium Mill Tailings Remedial Action Ground Water Project, DOE/EIS-0198.

DOE, 1995, Long-Term Surveillance Plan for the Canonsburg, Pennsylvania, Disposal Site, DOE/AL62350-203, Rev. 0.

DOE, 1993, Remedial Action Plan for Stabilization of the Inactive Uranium Mill Tailings Site at Canonsburg, Pennsylvania, UMTRA-DOE/AL-140.

DOE, 1984, Processing Site Characterization Report, Canonsburg, Pennsylvania, UMTRA-DOE/AL-0041.

Knowlton, R.G., D.M. Peterson, D. Walker, H.Zhang, J. White, in press. Reference Manual for Groundwater Analysis and Network Design Tool, or GANDT, Sandia National Laboratory, Albuquerque, New Mexico.

U.S. Nuclear Regulatory Commission (NRC), 1982, A collection of Mathematical Models for Dispersion in Surface Water and Groundwater, NUREG-0868, written by R.B. Codell, K.T. Key, and G. Whelan.

APPENDIX 1
FACTORS TO CONSIDER FOR ACLS 40 CFR PART 192.02(C)(ii)(B)

1) Potential adverse effects on groundwater quality

   i) The physical and chemical characteristics of constituents in the residual radioactive material at the site, including their potential for migration.

   ii) The hydrogeological characteristics of the site and surrounding land.

   iii) The quantity of groundwater and the direction of groundwater flow.

   iv) The proximity and withdrawal rates of groundwater users.

   v) The current and future uses of groundwater in the region surrounding the site.

   vi) The existing quality of groundwater, including other sources of contamination and their cumulative impacts on the groundwater quality.

   vii) The potential for health risks caused by human exposure to constituents.

   viii) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to constituents.

   ix) The persistence and permanence of the potential adverse effects.

   x) The presence of underground sources of drinking water and exempted aquifers identified under 144.7.

2) Potential adverse effects on hydraulically-connected surface water quality considering:

   i) The volume and physical and chemical characteristics of the residual radioactive material at the site.

   ii) The hydrogeological characteristics of the site and the surrounding land.

   iii) The quantity of groundwater and the direction of groundwater flow.

   iv) The patterns of rainfall in the region.

   v) The proximity to the site to surface waters

   vi) The current and future uses of surface waters in the region surrounding the site and any water quality standards established for those surface waters.

   vii) The existing quality of surface water, including other sources of contamination and their cumulative effect on surface water quality

   viii) The potential for health risks caused by human exposure to constituents.

   ix) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to constituents.

   x) The persistence and permanence of the potential adverse effects.