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Revision 1

The Second CERCLA Five-Year Review Report for the Hanford Site

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

Printed in the United States of America

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Approved by: ______________________ Date: Nov. 10, 2006
Keith Klein, Manager
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Richland Operations Office

Executive Summary

The *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and Executive Order (EO) 12580 mandate that the U.S. Department of Energy (DOE), as the federal lead agency, conduct response actions (removal and remedial) at the Hanford Site. CERCLA requires that a review of the status of response actions for waste sites where contamination remains which prohibits unrestricted use is required to be conducted no less frequently than once every five years to determine whether the selected remedy(ies) at a site remain protective of human health and the environment.

The Hanford cleanup is guided by the Tri-Party Agreement (TPA). The TPA is a legally binding agreement between DOE, the U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) that establishes the regulatory guidelines and framework for achieving the cleanup. Records of decision are the decision documents from these processes that identify the selected remedies to address the identified risks. The five-year review process validates the remedies selected in action memoranda and records of decision (RODs) are, or will be, protective when completed, unless the conditions and assumptions on which the decisions were based have changed significantly. The purpose of the five-year report is to present the results of the review, identify whether or not the actions are protective, and recommend appropriate corrective actions when the remedy is not achieving the established goals.

The DOE Hanford Site was established in 1943 to produce nuclear materials for national defense. During the period the site produced nuclear material to be used in the national defense, many activities resulted in the disposal of wastes containing hazardous constituents and/or radioactive materials. Adverse impacts on the environment from those activities are being remediated.

The Hanford Site was divided into four sites when it was placed on the National Priorities List (NPL) on November 3, 1989. The four NPL sites listed were: the DOE Hanford 100 Area, 200 Area, 300 Area, and 1100 Area. Since the Hanford Site was placed on the NPL, DOE has made considerable progress in cleaning up the site. Some of the progress demonstrated includes deletion of portions of the 100 Area, including the Wahluke Slope north of the Columbia River, and the entire 1100 Area from the NPL.

The five-year review conducted by the EPA in 2000, covered all portions of the site with a CERCLA decision document and covered areas that contain hazardous substances, pollutants, or contaminants, which are to be remediated under CERCLA. DOE considered the *USDOE Hanford Site First Five-Year Review Report* issued by EPA in April 2001 as the starting point for this second five-year review. In this second review, DOE has reviewed CERCLA decisions made and activities initiated, terminated, or completed in the intervening five-year period between CERCLA five-year reviews.

The five-year review in 2000 evaluated the performance of the remedies selected in interim records of decision, including existing institutional controls in place to prevent exposure to the public and the environment. EPA concluded that the selected remedies were protective, or would be protective when the remedial action was completed. EPA identified some deficiencies and corrective actions to address the deficiencies. In conducting the 2005/2006 five-year review, DOE applied the same approach that EPA used and followed the revised EPA and DOE guidance on how to conduct five-year reviews.

The following summarizes the results of the review conducted by DOE.

100 Areas NPL Site. For the 100 Areas, eight RODs for interim actions have been issued. Based on additional characterization, RODs were amended to address contaminants not previously included or contaminated areas not originally covered by the ROD. Explanations of significant difference have been issued to modify a ROD when DOE determined that the changes were not significant enough to require a formal amendment to the ROD. Five of the RODs in the 100 Areas address soil contamination, one addresses K-Basins spent fuel removal, and the other two address contaminated groundwater. Seventeen additional CERCLA decision documents address the demolition of buildings and structures, soil removal, groundwater treatment, landfill cleanup in the 100 Areas, including ten action memoranda and seven expedited response action approvals. Final RODs have not been issued for operable units included in the DOE Hanford 100 Area NPL site.

In the 100 Areas, interim actions are meeting the removal action and interim remedial action objectives. Removal actions primarily consisting of building demolition and placing old reactors in "interim safe storage" condition have met the removal action goals as outlined in the action memoranda. One hundred twenty (120) of the waste sites in the 100 Area NPL site have been remediated to meet the cleanup levels established in the interim RODs or action memoranda since the last five-year review. The review determined that most of the groundwater interim actions are also meeting the remedial action objectives established in the interim records of decision. The strontium-90 groundwater plume at the 100-N Area is an exception, and an alternative technology approach is being tested. The groundwater contaminant plumes in some areas have not yet been addressed and will be addressed in future RODs.

The source removal actions to remediate contaminated soil waste sites in the 100 Areas through the remove, treat, and dispose remedy were, and are, designed to be consistent with final cleanup actions, including applicable or relevant and appropriate requirements (ARARs). It is also anticipated that the residual human health and environmental risks from these waste sites will achieve the required risk levels when the remediation is completed. For these areas, DOE believes it is appropriate to state that the selected interim remedy is protective or will be when completed. If, upon completion of the River Corridor Baseline Risk Assessment, it is clear that the residual risk from these areas is not acceptable, the need for additional remediation will be addressed in the final RODs and evaluated and addressed in future five-year reviews.

The groundwater interim actions in the 100 Areas are not designed to be remedial actions. They are designed as interim measures to keep selected principle threat contaminants from reaching the Columbia River. Consequently, the protectiveness of the selected remedies for groundwater remediation cannot be assessed through the same logic. There may be contaminants other than the selected principle threat contaminants addressed in the interim actions that may need to be addressed in the final RODs.

For the 100-NR-2 Groundwater Operable Unit, the remedial action objectives for the strontium-90 contaminant in the groundwater established in the ROD are not being met. Data demonstrates that the strontium-90 concentrations at the river's edge have not been impacted by the pump-and-treat system. Institutional controls are in place to prevent use of the groundwater. For this operable unit, the institutional controls are effective in protecting human health; however, a determination of protectiveness is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process. Alternative remedies including a permeable reactive barrier with a potential additional "polishing" phytoremediation technology are being tested. However, because the test has not been completed, the benefit cannot be demonstrated in this review, therefore the determination of long-term protectiveness statement is deferred.

With the (a) completion of the River Corridor Baseline Risk Assessment, (b) expansion of the pump-and-treat technology with potential application of supporting technologies to cover the plumes more thoroughly, and (c) development of improved data on performance of the pump-and-treat and apatite sequestration technologies, the remedies selected in the final RODs for the 100 Areas operable units will more completely address the human health and environmental risks. The protectiveness of those remedies will be evaluated in future five-year reviews.

200 Areas NPL Site. For the Hanford 200 Area NPL site, four RODs are in place: two RODs for interim action address groundwater contaminants, and two final RODs address the Environmental Restoration Disposal Facility (ERDF) and contaminated soil removal at the 221-U Facility (Canyon Disposition Initiative). Nine action memoranda have been issued for removal actions. The ERDF operations have been exemplary and the facility is operating as required to meet the objectives outlined in the ROD of disposing of waste from all Hanford CERCLA activities. Because the remedial actions covered by the 221-U ROD, signed in September 2005, are just being initiated, it was not evaluated in this five-year review. Completed removal actions performed under the nine action memoranda, such as removal of the 232-Z facility, have met the remedial objectives.

For the 200 Area Source (soil) Operable Units, remedial investigations and feasibility studies are being conducted. Because final remedies have not yet been selected or implemented, protectiveness determinations cannot be made. However, some removal actions have been initiated or completed. It is anticipated that the results of the removal actions will be consistent with the final remedies selected through the remedial investigation/feasibility study and ROD processes.

Two pump-and-treatment systems and a vapor extraction system have been installed as interim actions to treat groundwater contamination in the 200 Areas. The 200-ZP-1 Groundwater Operable Unit has a pump-and-treatment system to remove carbon tetrachloride from the groundwater. This system was designed to address only the most concentrated portion of the shallow portion of the plume and will be expanded through the CERCLA remedial investigation/feasibility study process to address the deeper portion of the plume. A protectiveness determination for the pump-and-treat interim remedy is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

The 200-PW-1 (formerly 200-ZP-2) Soil Operable Unit has a vapor extraction system to remove carbon tetrachloride from the soil. This system has proven to be effective and will continue operation, with improvements. The 200-UP-1 Groundwater Operable Unit has a pump-and-treatment system to remove uranium and technetium-99 from the groundwater. This system has met the remedial action objectives identified in the ROD for interim action and is currently undergoing a rebound test. The need for additional work will be assessed through the CERCLA remedial investigation/feasibility study process. A protectiveness determination for the vapor extraction system interim remedy is being deferred until a more complete remedy is selected through the CERCLA remedial investigation/feasibility study process.

300 Area NPL Site. The CERCLA decision documents for the 300 Area include a final ROD for contaminated soil remediation, one ROD for interim actions for contaminated soil remediation, one ROD for interim actions for groundwater remediation, one expedited response action approval, and three action memoranda. The contaminated soil remedial action under the final ROD met all of the remedial action objectives. Work under the ROD for interim action for contaminated soil remediation is still in progress.

The source removal actions in the 300 Area to remediate contaminated soil waste sites through the remove, treat, and dispose remedy were, and are, designed to be consistent with final cleanup actions, including ARARs. It is also anticipated that the residual human health and environmental risks from these waste sites will achieve the required risk levels when the removal action is completed. For these areas, additional final remedial actions are not anticipated; therefore, DOE believes it is appropriate to state that the selected interim remedy is protective or will be when completed. If, upon completion of the River Corridor Baseline Risk Assessment, it is clear that the residual risk from these areas is not acceptable, the need for additional remediation will be addressed in the final RODs and evaluated and addressed in future five-year reviews.

Remediation of the uranium plume in the 300 Area groundwater through natural attenuation with monitoring has not achieved the remedial action objectives in the ten-year time frame envisioned when the ROD for interim action for groundwater was established. Under the existing ROD, institutional controls to prevent use of the groundwater is the primary means of protecting human health until remedial measures bring the uranium concentrations to below drinking water standards are completed. For this operable unit, the institutional controls are effective in protecting human health; however, a determination of protectiveness is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process. DOE is currently performing additional characterization activities and has initiated treatability studies supporting more aggressive treatment options. Selection of more effective remedies is anticipated in the near future. Protectiveness of the selected long-term remedies will be evaluated in future five-year reviews.

1100 Area NPL Site. The remedies selected in the 1100 Area Operable Unit ROD met the remedial action objectives. The remedial actions selected for the 1100 Area Operable Units have been completed, the remedy remains protective, and the 1100 Area NPL site has been deleted from the list. During the last five years, some residual dichlorodiphenyl trichloroethane (DDT) contamination at the Horseshoe Landfill was detected and removed. Groundwater contaminants in the vicinity of the Horn Rapids Landfill have been reduced below the applicable drinking water standard. Asbestos waste disposed in the Horn Rapids Landfill is still in place and remains secure. DOE will continue to maintain the integrity of the cap and fencing at the Horn Rapids Landfill per the Superfund Site Closeout Report requirements. Because contamination was left in place, the 1100 Area will continue to be included in future five-year reviews.

During the course of conducting this review, some issues were noted and corrective actions identified. A summary of the issues and follow up actions is provided in Table ES.1.

Table ES.1 combines two of the tables recommended in the EPA Comprehensive CERCLA Five-Year Review Guidance; the "Table for Listing Issues," and the "Table for Listing Recommendations and Follow-up Actions." The Table for Listing Issues includes columns for addressing whether the issue(s) affects current or future protectiveness. The Table for Listing Recommendations and Follow-up Actions also has columns for addressing whether the recommendations or actions affect current or future protectiveness. The combined table includes those same columns. In addressing whether the issues and recommendations or actions affect protectiveness, DOE asked these two questions: 1) Does this issue/action currently affect the protectiveness of the remedy? 2) Will this issue/action affect the protectiveness of the remedy in the future? If the answer was yes, it is so noted. If the answer was no, it was also noted and a footnote has been added to provide additional explanation. DOE Richland Operations Office (RL) will follow the CERCLA process to correct any deficiencies or to address any protectiveness concerns.

Table ES.1. CERCLA Five-Year Review Issues and Actions

Issues and Actions	Affects Current Protectiveness[1]	May Affect Future Protectiveness[2]	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
	(Yes / No)	(Yes / No)			
100/300 Crosscutting					
Issue 1. Additional risk assessment information is needed to evaluate the interim actions prescribed within the records of decisions and to develop final cleanup decisions.	No[3]	Yes			
Action 1-1. Submit Draft A of the River Corridor Baseline Risk Assessment Report.	No[3]	Yes	RCP	EPA/WDOE	06/2007
Action 1-2. Submit draft sampling and analysis plan for Inter-Areas Shoreline Assessment.	No[3]	Yes	RCP	EPA/WDOE	08/2006
Issue 2. A strategy to obtain the final records of decisions and integrate the waste sites, deep vadose zone and groundwater has not been developed and agreed upon with the regulator agencies.	No[3]	No			
Action 2-1. Submit Draft A of the River Corridor Strategy for Achieving Final Cleanup Decision in the River Corridor. Document will identify issues for integration and provide alternatives for future discussions between the Tri-Parties on milestones for final records of decision in the River Corridor.	No[3]	No	RCP	EPA/WDOE	11/2006
100-B/C Area					
No issues or actions specific to the 100-B/C Area were identified.					
100-K Area					
Issue 3. The southeastern (inland) extent of the chromium groundwater plume from the 116-K-2 trench, northeast of the current injection wells, has not been delineated.	No[3]	Yes			
Action 3-1. Install three additional wells to further delineate the southeastern (inland) extent of the chromium groundwater plume from the 116-K-2 trench, northeast of the current injection wells. Wells installed as part of the pump-and-treat system expansion or injection well relocation may count towards this effort if appropriately located.	No[3]	Yes	GRP	EPA	08/2008

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
Issue 4. The small chromium plume at KW Reactor site has reached the river, as evidenced by near-shore aquifer tubes. There is currently no active remediation system in place for the small chromium plume at the KE-KW Reactor site. Therefore, construction of a new pump-and-treat system has been initiated in response to this condition.	Yes	Yes			
Action 4-1. Construct a new pump-and-treat facility to the address the chromium groundwater plume in the KW Reactor area.	Yes	Yes	GRP	EPA	08/2008
Issue 5. Groundwater monitoring indicates that the expansion of the 100-K Area pump-and-treat extraction system has not yet achieved the remedial action objective.	Yes	Yes			
Action 5-1. Expand the 100-K Area pump-and-treat system by 378.5 liters (100 gallons) per minute to enhance remediation of the chromium plume between the 116-K-2 and the N Reactor perimeter fence.	Yes	Yes	GRP	EPA	08/2008
Action 5-2. Add additional wells between the 166-K-2 trench and the N Reactor perimeter fence for groundwater extraction, and connect the additional wells to the pump-and-treat system.	Yes	Yes	GRP	EPA	03/2007
100-N Area					
Issue 6. The pump-and-treat system is ineffective and inefficient in reducing the flux of strontium-90 to the Columbia River, providing only a fraction (1:10) of the protection provided by natural radioactive decay. The degree of protection provided by hydraulic control from the pump-and-treat is unproven.	Yes	Yes			
Action 6-1. Implement the treatability test plan for permeable reactive barrier utilizing apatite sequestration as described in the *Strontium-90 Treatability Test Plan for 100-NR-02 Groundwater Operable Unit* (DOE 2005c). Issue Treatability Test Report.	Yes	Yes	GRP	WDOE	09/2008
Issue 7. Additional ecological data is needed to assess the interim actions prescribed within the record of decisions and to develop final cleanup standard. The extent of shoreline water quality impacts related to the diesel spill that occurred circa 1963 are not well known.	No[3]	Yes			
Action 7-1. Perform additional data collection to support risk assessment, provide to Ecology previously collected data, and coordinate with River Corridor sampling efforts to collect additional pore water data from new and existing aquifer tubes along the 100-NR-2 shoreline in order to assess water quality impacts.	No[3]	Yes	GRP	WDOE	09/2008

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
100-D Area					
Issue 8. Groundwater monitoring data indicates there is an unidentified chromium vadose source in the 100-D Area near the demolished 190-DR clear wells.	No[3]	Yes			
Action 8-1. Complete a field investigation to investigate additional sources of chromium groundwater contamination within the 100-D Area. Additional geologic and geochemical investigations of the vadose zone in the 100-D Area.	No[3]	Yes	GRP	WDOE	03/2009
Issue 9. There is less than adequate data to characterize potential chromium groundwater contamination between the 100-D and 100-H Area, in the area known as the "horn."	No[3]	Yes			
Action 9-1. Perform additional characterization of the aquifer for chromium contamination between the 100-D and 100-H Area, in the area known as the "horn," and evaluate the need to perform remedial action to meet the remedial action objectives of the 100-D record of decision for interim action. This issue will also be addressed in the final record of decision.	No[3]	Yes	GRP	WDOE	09/2009
Action 9-2. Incorporate the "horn" area into the 100-HR-3 interim ROD treatment zone if Action 9-1 indicates "horn" contains a groundwater chromium plume that needs immediate remediation.	Yes	Yes	GRP	WDOE	09/2009
Issue 10. Some of the groundwater wells near the 182-D reservoir show conductivity values similar to values expected for raw water indicating some leakage from the reservoir.	Yes	Yes			
Action 10-1. Issue direction to the operating contractor to change operations to further minimize leakage from the 182-D reservoir.	Yes	Yes	GRP	WDOE	Completed
Issue 11. A few wells within the in situ redox manipulation barrier have shown break through much sooner than expected.	Yes	Yes			
Action 11-1. Initiate limited iron amendments to the in situ redox manipulation barrier to evaluate whether this enhances the performance.	Yes	Yes	GRP	WDOE	09/2007

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
100-H Area					
Issue 12. Groundwater samples from one deep well extending below the aquitard exceed the drinking water standard (100 µg/L) for chromium. The extent of chromium contamination in this zone is not well understood.	No[3]	Yes			
Action 12-1. Perform additional characterization of the aquifer below the initial aquitard.	No[3]	Yes	GRP	WDOE	09/2009
100-F Area					
No issues or actions specific to the 100-F Area were identified.					
200 Areas					
Issue 13. There is less than adequate deep groundwater monitoring data downgradient of T Tank Farm to define the nature and extent of technetium-99 contamination. Further characterize the technetium-99 groundwater plume near T Tank Farm.	No[3]	Yes			
Action 13-1. Complete a data quality objective process and sampling plan to further characterize the technetium-99 groundwater plume near T Tank Farm.	No[3]	Yes	GRP	EPA	03/2007
Issue 14. The recent expansion of the 200-ZP-1 extraction well network near the TX-TY Tank Farm may result in technetium-99 contamination being pulled into the 200-ZP-1 treatment system. Treatment options for groundwater contaminated with technetium-99 need to be assessed.	No[3]	Yes			
Action 14-1. Assess treatment options to address technetium-99 near T Tank Farm.	No[3]	Yes	GRP	EPA	09/2007
Issue 15. Soil resistivity measurements have detected large regions of anomalous high soil conductivity in the area south of PUREX around the 216-A-4 crib and near the B/C cribs and trenches. Further characterization of the B/C cribs and trenches is needed.	No[3]	Yes			
Action 15-1. Complete data quality objective process and sampling plan to further characterize the high soil conductivity measurements detected at B/C cribs and trenches.	No[3]	Yes	GRP	EPA	12/2007
Issue 16. Efficiency and effectiveness of the 200-ZP-1 pump-and-treat system could be increased by increasing the pumping rate to fully utilize the treatment capacity.	No[4]	Yes			
Action 16-1. Increase the pump size in 200-ZP-1 extraction wells 299-W15-45 and 299-W15-47.	No[4]	Yes	GRP	EPA	03/2007

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
Issue 17. Efficiency of the carbon tetrachloride remediation could be increased by increasing the use of the 200-ZP-2 vapor extraction system. The soil-vapor extraction system is in limited operation. Expanding the soil-vapor extraction operations should be evaluated.	No[5]	Yes			
Action 17-1. Evaluate expanding the soil-vapor extraction operations. Also, specifically review converting former groundwater extraction well 299-W15-32 to a soil-vapor extraction well.	No[5]	Yes	GRP	WDOE	03/2007
Issue 18. The remedial action objective for uranium was based upon the Washington State *Model Toxics Control Act* (MTCA) cleanup standard of 48 ppb when the 200-UP-1 interim ROD was issued. Since this time, EPA has established a drinking water standard for uranium of 30 ppb. There are also some other issues to be addressed within the ROD if an explanation of significant difference is prepared. These include the limited quarterly pumping requirement at well 299-W23-19, adjusting the pumping requirement for 200-UP-1 due to limited flow within the extraction well network, and technetium-99 groundwater contamination at other locations within the operable unit.	No[6]	Yes			
Action 18-1. Prepare an explanation of significant difference for 200-UP-1 interim ROD.	No[6]	Yes	GRP	WDOE	6/2008
300 Area					
Issue 19. Predicted attenuation of uranium contaminant concentrations in the groundwater under the 300 Area has not occurred. DOE is currently performing additional characterization and treatability testing in the evaluation of more aggressive remedial alternatives.	Yes	Yes			
Action 19-1. Complete focused feasibility study for 300-FF-5 Operable Unit to provide better characterization of the uranium contamination, develop a conceptual model, validate ecological consequences and evaluate treatment alternatives. Concurrently test injection of polyphosphate into the aquifer to immobilize the uranium and reduce the concentration of dissolved uranium. These activities support a CERCLA proposed plan.	No[7]	Yes	GRP	EPA	09/2008

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
1100 Area					
Issue 20. Groundwater monitoring for the 1100-EM-1 Operable Unit is no longer necessary but continues following an extended period of monitoring that shows contaminant levels are below the maximum contaminant level and continue to show a downward trend.	No[8]	No[8]			
Action 20-1. Submit a change request to modify groundwater monitoring for the 1100-EM-1 Operable Unit.	No[8]	No[8]	GRP	EPA	6/2007

1 Does this issue/action currently affect the protectiveness of the remedy?
2 Will this issue/action affect the protectiveness of the remedy in the future?
3 Identifying the need for, and acquiring new data in the future, does not affect the current status of protectiveness.
4 Identifying the need for, and expanding the capacity of the pumps in the future, does not affect the current status of protectiveness.
5 Identifying the need for, and increasing the use of the vapor extraction system in the future, does not affect the current status of protectiveness.
6 Changing the remedial action objective or other requirements of the ROD through an ESD does not affect the current status of protectiveness.
7 Completion of the focused feasibility study in the future does not affect the current status of protectiveness
8 Modifying the groundwater monitoring requirements for the 1100-EM-1 Operable Unit does not affect the current status of protectiveness.

RCP – River Corridor Remediation Project
GRP – Groundwater Remediation Project
EPA – Environmental Protection Agency
WDOE – Washington State Department of Ecology

Protectiveness Statements

In response to the public comments and dialogue on the protectiveness statements, DOE has reviewed the protectiveness statements and agrees that in some cases the statements made in the Public Review Draft overstated the level of protectiveness that can be determined based on the information available at this time. DOE concluded a more conservative determination would more accurately reflect the situation. Revisions to some of the protectiveness statements were made to reflect the level of knowledge on which the statements are based.

The revised protectiveness statements are provided below. For perspective, protectiveness statements from the first five-year review conducted by EPA are also provided.

2001 Five-Year Review Report Protectiveness Statement – 100 Areas NPL Site

"I certify that remediation of the soil sites, D&D of buildings, in-situ treatment of chromium, and K Basins remedial actions in the 100 Area are protective of human health and the environment. The 100 Area pump-and-treat actions for chromium are not achieving the criteria for protection of the environment. While the N Area pump-and-treat system is currently containing much of the plume and removing mass, high concentrations of Strontium-90 in the groundwater adjacent to the river continue to pose a risk to human health and the environment. Existing ICs, along with the ICs resulting from the implementation of the recommendations in this five-year review, will be protective of human health and the environment. I also certify that those remedial activities that are not completed, or are still in the design or investigation stage, do not require immediate response actions to protect human health and the environment."

2006 Five-Year Review Report Protectiveness Statement for 100 Area NPL Site Source Operable Units

For the 100 Area Source (soil) Operable Units, cleanup has occurred, or is ongoing, under RODs for interim actions. All of the contaminants of potential concern are addressed. ARARs were established for the contaminants of concern. Remedial action objectives consistent with the ARARs were established in the RODs. The cleanup that is occurring under these RODs for interim actions has not at this time been completed for all of the waste sites within the operable unit. In addition, broader areas, such as the river shoreline, that are currently being evaluated in the River Corridor risk assessments have not been included in the RODs for interim actions.

For the source (soil) sites included in Operable Units 100-BC-1, 100-BC-2, 100-KR-1, 100-KR-2, 100-NR-1, 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, 100-FR-1, and 100-FR-2, based on this review and taking the protectiveness determination questions into account, DOE has concluded that the remedies selected for the 100 Area operable units are protective in the short-term of human health and the environment because the cleanup standards are being met and are within the acceptable risk range. There is no outward evidence of ecological harm; however, DOE is conducting an ecological risk assessment to determine if there are any residual risks that have not been adequately addressed. The determination for long-term protectiveness for human health and the environment for these operable units is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

2006 Five-Year Review Report Protectiveness Statement for 100 Area NPL Site Groundwater Operable Units

RODs for interim action have been written for 100-HR-3 (including 100-D Area) and 100-KR-4 Groundwater Operable Units where chromium contaminated groundwater has the potential to exceed ambient water quality standards in areas where aquatic biota are exposed to a mixture of groundwater and river water. The remedial action objectives are to reduce hexavalent chromium concentrations at near river wells to less than two times the ambient water quality standard for hexavalent chromium, recognizing the dilution of groundwater as it enters the gravels of the river bottom. These RODs were not intended to address secondary contaminants of potential concern or to restore the aquifer but to assure protectiveness of aquatic resources. Final RODs will address secondary contaminants and aquifer restoration to the extent practicable.

DOE believes that the selected remedies of source control, pump-and-treat, and chemical reduction will be protective when fully implemented. It is recognized that improvements are necessary to the existing system design to expand the scope of coverage. Furthermore, all of the sources of the chromium have not been identified and remediated. Therefore, improvements are planned for the selected remedies. DOE is evaluating new technologies and expanded pump-and-treat systems for the final RODs. Institutional controls currently assure protection of human health. The final RODs will address all the contaminants of potential concern and the full extent of contamination to assure protection of human health and the environment. The determination for long-term protectiveness for human health and the environment for the 100-HR-3 and 100-KR-4 Operable Units is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

For the 100-NR-2 Groundwater Operable Unit, the remedial action objectives for the strontium-90 contaminant in the groundwater established in the ROD are not being met. Data show that strontium-90 concentrations at the shoreline have not been reduced by the pump-and-treat system. Alternative remedies are being investigated and work has been initiated on a field treatability test during 2006. Institutional controls are in place to prevent use of the groundwater. Therefore, for this operable unit, the remedy (pump-and-treat) is not considered to be protective in the short-term. Follow-up actions, including evaluation of the effectiveness of the alternative permeable reactive barrier technology currently being tested, are necessary to determine effectiveness of the technology. The determination for long-term protectiveness for human health and the environment for the 100-NR-2 Groundwater Operable Unit is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

2001 Five-Year Review Report Protectiveness Statement for 200 Areas NPL Site

"The 200 Area NPL site is in the early stages of the CERCLA process. Given the status of investigations and remedial actions, I certify that no soil waste sites or buildings undergoing decontamination and decommissioning in the 200 NPL site require immediate response actions to protect human health and the environment. I certify that the 200-BP-5 and 200-PO-1 Operable Units do not require immediate response actions to protect human health and the environment. I certify that, for the 200-ZP-1 Operable Unit and the 200-UP-1 Operable Unit, additional actions are required to ensure protection of human health and the environment."

2006 Five-Year Review Report Protectiveness Statement for 200 Area NPL Site Source Operable Units

For the 200 Area Source (soil) Operable Units, final remedies have not yet been selected or implemented and protectiveness determinations cannot be made. For removal actions that have been initiated or completed, it is anticipated that the results will be consistent with the final remedies selected through the remedial investigation/feasibility study and ROD processes. Protectiveness of those remedies will be evaluated in future five-year reviews.

2006 Five-Year Review Report Protectiveness Statement for 200 Area NPL Site Groundwater Operable Units

For the two RODs for interim action that address groundwater contaminants, two pump-and-treatment systems and a vapor extraction system have been installed as interim actions to treat groundwater contamination in the 200 Areas. The 200-ZP-1 Groundwater Operable Unit has a pump-and-treatment system to remove carbon tetrachloride from the groundwater. This system was designed to address only the most concentrated portion of the shallow portion of the plume and the will be expanded through the CERCLA remedial investigation/feasibility study process to address the deeper portion of the plume. A protectiveness determination for the 200-ZP-1 pump-and treat interim remedy is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

The 200-UP-1 Groundwater Operable Unit has a pump-and-treatment system to remove uranium and technetium-99 from the groundwater. This system has met the remedial action objectives identified in the ROD for interim action and is currently undergoing a rebound test. A protectiveness determination for the 200-UP-1 pump-and treat interim remedy is being deferred until a review of the rebound study results is completed and a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

The 200-PW-1 (formerly 200-ZP-2) Soil Operable Unit has a vapor extraction system to remove carbon tetrachloride from the soil. This system has proven to be effective and will continue operation, with improvements. The need for additional work will be assessed through the CERCLA remedial investigation/feasibility study process. A protectiveness determination for the vapor extraction system interim remedy is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

2001 Five-Year Review Report Protectiveness Statement for 300 Area NPL Site

"I certify that remediation of the soil sites and groundwater in the 300 Area NPL site are protective of human health and the environment. Existing institutional controls, plus those resulting from implementing the action items in this five-year review, will ensure protection of human health in the future. I also certify that those remedial activities that are not completed, or are still in the design or investigation stage, do not require immediate response actions to protect human health and the environment."

2006 Five-Year Review Report Protectiveness Statement for 300 Area NPL Site Source Operable Units

For the 300 Area source (soil) sites in the 300-FF-2 Operable Unit, cleanup has occurred, or is ongoing, under an ROD for interim actions. For the source (soil) sites in the 300-FF-1 Operable Unit, cleanup has been completed under a final ROD. For both RODs, all of the contaminants of potential concern are addressed. ARARs were established for the contaminants of concern. Remedial action objectives consistent with the ARARs were established in the RODs.

For the source (soil) sites included in the 300-FF-1 and 300-FF-2 Operable Units, based on this review and taking the protectiveness determination questions into account, DOE has concluded that the remedies selected are protective in the short term of human health and the environment because the cleanup standards are being met and are within the acceptable risk range. There is also no outward evidence of ecological harm associated with the 300-FF-1 or 300-FF-2 Operable Units. The determination for long-term protectiveness for human health and the environment for the 300-FF-2 Operable Unit is being deferred until the risk assessment is completed and a final remedy is selected. The remedy selected for the 300-FF-1 Operable Unit is protective in the long term for the above reasons and the fact the remedy was selected under a final ROD. DOE recognizes, however, that the risk assessment will evaluate this area again, and final decisions will be made for source sites adjacent to the 300-FF-1 Operable Unit. Protectiveness for the 300-FF-1 Operable Unit will be re-evaluated upon completion of the risk assessment and final remedy selection for the 300-FF-2 Operable Unit. Protectiveness of those remedies will be evaluated in future five-year reviews.

2006 Five-year Review Report Protectiveness Statement for 300 Area NPL Site Groundwater Operable Units

For 300-FF-5 Groundwater Operable Unit, the selected remedy of monitored attenuation for the uranium contaminant in the groundwater is not achieving the remedial action objectives established in the ROD. However, institutional controls are in place to prevent human consumption of the groundwater. For this operable unit the remedy is not considered protective. Follow up actions are necessary to determine long-term protectiveness because remedial action objectives are not expected to be met. The remedial actions and remedial action objectives are being re-evaluated.

2001 Five-year Review Report Protectiveness Statement for 1100 Area NPL Site

"The protection of human health and the environment by the remedial actions at 1100-EM-1, 1100-EM-2, 1100-EM-3, and 1100-IU-1 are discussed below. Because the remedial actions at the operable units are protective of human health and the environment, the remedy for the site is expected to be protective of human health and the environment."

1100-EM-1

The remedy at 1100-EM-1 is protective of human health and the environment. The cap is effective at containing the asbestos fibers. The vegetation has taken hold and is preventing wind erosion of the cap. The groundwater contamination continues to attenuate throughout the plume and the current trend in TCE concentrations indicate that TCE should meet cleanup values (the MCL of 5 μg/L) in 5 to 7 years.

1100-EM-2

The remedy at 1100-EM-2 is protective of human health and the environment. The remedial actions allow for unrestricted use and unlimited exposure.

1100-EM-3

The remedy at 1100-EM-3 is protective of human health and the environment. The remedial actions allow for unrestricted use and unlimited exposure.

1100-IU-1

The remedy at 1100-IU-1 is protective of human health and the environment. The remedial actions allow for unrestricted use and unlimited exposure."

2006 Five-Year Review Report Protectiveness Statement for 1100 Area Operable Units

The remedies selected for the operable units included in the 1100 Area NPL site have been completed and the remedial action objectives established in the final ROD have been achieved. These remedies are protective of human health and the environment. The 1100 Area site has been deleted from the NPL.

Acronyms

AEA	*Atomic Energy Act*
ALE	Fitzner-Eberhardt Arid Lands Ecology (Reserve)
ARAR	applicable or relevant and appropriate requirements
BEHP	bis(2-ethylhexyl)phthalate
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFR	Code of Federal Regulations
CWC	Central Waste Complex
D&D	decontamination and decommissioning
DDT	dichlorodiphenyl trichloroethane
DNAPL	dense nonaqueous phase liquid
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
Ecology	Washington State Department of Ecology
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FY	fiscal year
NCP	National Oil and Hazardous Substances Contingency Plan
NEPA	*National Environmental Policy Act*
NPL	National Priorities List
PCB	polychlorinated biphenyls
PFP	Plutonium Finishing Plant
PUREX	plutonium/uranium extraction (Plant)
RCRA	*Resource Conservation and Recovery Act*
REDOX	reduction/oxidation (Plant)
ROD	record of decision
TPA	*Hanford Federal Facility Agreement and Consent Order,* aka Tri-Party Agreement
WAC	Washington Administrative Code

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Introduction

Five-Year Review Requirement

The *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) places responsibilities for conducting response actions on federal facilities with the President of the United States. CERCLA Section 9615 authorizes the President to delegate his CERCLA responsibilities to responsible federal agencies.

Through Executive Order 12580 (EO 12580), the President delegated many of those responsibilities to Executive Branch agencies, including the U.S. Department of Energy (DOE). Under EO 12580, DOE is designated as the lead agency responsible for conducting response actions (removal and remedial) at facilities under its control, including the Hanford Site. One of the delegated responsibilities of a lead agency is to conduct reviews of the status of the response actions no less frequently than once every five years.

The purpose of a five-year review is to determine whether the remedies at a site are protective of human health and the environment. The methods, findings, and conclusions of those five-year reviews are documented in a five-year review report. The five-year review report also identifies issues found during the review, if any, and identifies actions to address them.

DOE is required to implement five-year reviews in a manner consistent with the CERCLA and the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP) (40 CFR 300). CERCLA §121(c), as amended, states:

> "If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented."

The NCP Part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

> "If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action."

Purpose of the Five-Year Review

The purpose of this five-year review is to:

1. Evaluate the performance of the selected remedies for CERCLA source and groundwater operable units that required either active remediation or no action(s) at that time in the 100, 200, 300, 1100 Areas and other areas on the Hanford Site to determine whether they are protective of human health and the environment.

2. Verify that immediate threats have been addressed where the operable unit has a remedial action that is still in the Remedial Action Construction phase or Remedial Action Operation phase or where a removal action is in progress and that the selected remedy(ies) will be protective when complete.

3. Verify that the selected remedy remains protective where a removal or remedial action site is in the long-term operation and maintenance phase.

4. Recommend actions to improve performance when the five-year review indicates that a remedy is not performing as designed.

The five-year review is required by CERCLA 121(c) and NCP (40 CFR 300) because hazardous substances, pollutants, or contaminants remain and will remain on property above levels that would otherwise allow for unrestricted use and unrestricted exposure. The statute and regulation triggers the 2005/2006 five-year review, which considers recommendations and findings of the first five-year review, conducted in 2000 and completed in 2001 (EPA 2001b).

Scope and Objectives of the Five-Year Review

The first five-year review (EPA 2001b) included all portions of the site that have a CERCLA decision document, e.g., a record of decision (ROD) or in some instances an action memorandum, and where hazardous substances, pollutants, or contaminants remain. Interim remedial actions were reviewed the same as other remedial actions for the purposes of the five-year review. The second five-year review has generally followed the approach taken in the first five-year review and will address those past decisions made and activities initiated, terminated, or completed in the intervening period.. DOE established September 30, 2005, as the ending period for the inclusion of newly issued decision documents.

This second five-year review focused on the following general areas consistent with *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Five-Year Review Guide* (DOE 2002a) and U.S. Environmental Protection Agency (EPA) *Comprehensive Five-Year Review Guidance* (EPA 2001a):

1. Evaluate whether the remedy is operational and functional by evaluating those parameters that the Tri-Party agencies established as appropriate indicators of performance via records of decision and action memoranda, i.e., performance assessment of the remedy for completed actions, ongoing long-term remedial actions, and interim remedial actions.

2. Evaluate those assumptions critical to the effectiveness of remedial measures or the protection of human health and the environment for the remedial decisions to determine, given the current information, whether these assumptions are still valid. Three critical assumptions include the following: a) assumptions regarding the future land use and associated exposure pathways; b) assumptions regarding site conditions such as degree to which remedy performance is based on the original assumption(s); and c) assumptions regarding contaminant toxicity.

3. Evaluate whether corrective measures are required to address any identified deficiencies.

4. Evaluate whether there are opportunities to optimize the long-term performance of the remedy or reduce life-cycle costs such as expediting attainment of remedial objectives, transitioning response phases, and scaling back monitoring.

In determining the protectiveness of the remedies, DOE Richland Operations Office (RL) considered the following three questions:

1. Is the remedy functioning as intended by the decision document?

2. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

3. Has any other information come to light that could call into question the protectiveness of the remedy?

Five-Year Review Process

The review process for source and groundwater remediation operable units included the following activities:

Data Gathering and Review. The first step in the review process for producing the second CERCLA five-year review was to gather the documentation needed to perform the review. For operable units with active removal or remedial actions, these documents included the action memorandum, ROD, any subsequent ROD amendments or explanations of significant difference, and remedial design or remedial action work plans. These documents provide the performance and operational requirements on which removal or remedial action performance is judged. In addition to the performance related documentation, a second set of compliance documentation is also gathered and reviewed. These documents include waste management plans, sampling and analysis plans, and other related monitoring information needed to assess compliance of the ongoing removal or remedial action. Finally, findings, recommendations, and action items from the first CERCLA five-year review (EPA 2001b) were also gathered as part of the initial review since these issues may constitute additional requirements above and beyond those in the performance and compliance documents.

Once the requirement-related documents were gathered and reviewed, the next step was to compile and review the performance and compliance documentation. Together, these documents and reports provided the technical basis for performing the review.

Site Visits and Field Evaluation. Representatives from DOE, EPA and/or Washington State Department of Ecology (Ecology), and DOE contractor staff performed field evaluations as necessary. Because DOE project and regulatory agency personnel are actively involved in oversight of the cleanup activities, they are frequently in the field inspecting the DOE contractors' work. As a result of this ongoing activity, additional special site visits and field evaluations were not conducted. When necessary, field evaluations were initiated with the DOE contractor performing the work under consideration to discuss potential issues identified during the data gathering and review portion. If necessary, a site visit was conducted to assess the performance and compliance status of the project and develop a preliminary set of issues for consideration in the second CERCLA five-year review.

Development of Draft Technical Assessment and Recommendations. When necessary, an initial assessment and recommendations to address issues were prepared for review. After review and discussions within DOE, these draft technical assessments and recommendations were provided to Ecology and EPA for their review and comment.

Support for Action Item Discussions. Discussions to address outstanding recommendations or performance issues were initiated between DOE and the lead regulatory agency. Action items resulting from these discussions were developed for inclusion into the second CERCLA five-year review report.

Development of the Protectiveness Statements. A review of the operable units included in each National Priorities List (NPL) site was completed. Using the three questions listed above, the reviews evaluated the success in implementation of the selected remedies against the remedial action objectives and clean up criteria established in the records of decision. Once the review of all operable units for each NPL site was completed, DOE, following EPA guidance and with input from Ecology and EPA, prepared statements on the protectiveness of the completed and ongoing remedial actions for each of the four Hanford NPL sites (100, 200, 300, and 1100 Areas). If EPA and DOE are unable to agree on a protectiveness statement for each NPL site, EPA has the option of preparing its own statement.

Next Review

The Hanford NPL sites are statutory sites that require ongoing five-year reviews. The next review will be conducted five years after the completion of this five-year review report.

Five-Year Review Background

The Tri-Party Agreement (TPA) (Ecology et al. 1989) allows EPA and Ecology an option to independently conduct five-year reviews as well. During 2000, EPA exercised this option and conducted the first CERCLA five-year review of response actions for the Hanford Site. In April 2001, EPA released the *USDOE Hanford Site First Five-Year Review Report* (EPA 2001b), which provides the results of its review.

To meet the requirements of CERCLA and EO 12580, the second five-year review was conducted by DOE. In the first five-year review conducted by EPA in 2000, the performance of the remedies selected in interim RODs was evaluated, including existing institutional controls in place to prevent exposure to the public and the environment, and it was concluded that the selected remedies were protective, or would be protective when the remedial action was completed. For information purposes, the protectiveness determinations reached by EPA are included in this document. EPA identified some deficiencies and corrective actions to address the deficiencies. In conducting the 2005/2006 second five-year review, DOE applied the same approach that EPA used and followed the EPA *Comprehensive Five-Year Review Guidance* (EPA 2001a), OSWER Directive 9355.7-03B-P, dated June 2001 and the *Department of Energy Office of Environmental Management Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Five-Year Review Guide*, dated March 2002 (DOE 2002a).

Hanford Site NPL Listing Background

The DOE Hanford Site was established in 1943 to produce nuclear materials for national defense. The Hanford Site covers approximately 1,518 square kilometers (586 square miles) adjacent to the city of Richland in Benton, Franklin, and Grant Counties of Washington State. During the period the site produced nuclear material to be used in the national defense, many activities resulted in the disposal of wastes containing hazardous constituents and/or radioactive materials. Consequently, there have been adverse impacts on the environment that must be addressed and response actions conducted to remediate the environmental impacts to the extent possible.

When the Hanford cleanup project was initiated in 1989 with the signing or the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), known as the Tri-Party Agreement (TPA), efforts were initiated to fully characterize known and suspected contamination. Early remedial investigation/ feasibility study and *Resource, Conservation and Recovery Act* (RCRA) facility investigation/corrective measures study (RFI/CMS) work plans indicated it would require seven to ten years of characterization before cleanup decisions could be evaluated and determined.

Based on past Hanford Site waste disposal practices and knowledge of spills and releases to the environment, it was known that there were adverse environmental impacts that might cause the Hanford Site to qualify to be listed on the CERCLA NPL. This initiated a preliminary assessment/site investigation process, conducted by DOE. The preliminary assessment/site investigation included a comprehensive review of historical records including facility operating records, data from groundwater, surface water, soil and air monitoring and sampling; aerial photographs; interviews with workers; and walking the site to identify potentially disturbed areas. Using the information gathered, it was determined that the Hanford Site qualified for inclusion on the NPL and four areas of the site (the 100, 200, 300 and 1100 Areas) were listed.

The preliminary assessment/site investigation identified that some contaminants posed a potential immediate threat to human health and the environment. As a result, DOE established a "bias for action" approach to the cleanup. The "bias for action" allowed DOE (with regulatory agency approval) to conduct removal actions in areas that posed a potential immediate threat to human health and the environment. The "bias for action" resulted in interim removal actions prior to full characterization of the type, level, and extent or degree of contamination and prior to development of final CERCLA remedy selection decision documents (final RODs).

Basis for Interim Actions

Because sufficient information on the severity and extent of contamination was not available to support final decisions, "interim action" decision documents were developed (RODs for interim actions, expedited response action approvals, and action memorandums). During interim cleanup actions, samples are collected and analyzed to evaluate the progress of the action and to enable a more complete understanding of the types, levels, and extent of the contamination and more complete remedial actions.

The remedial actions selected addressed the contaminants of greatest concern in the areas where the environmental threat was known to be highest. As a result cleanup focused for several years in areas that posed the highest risk to the Columbia River (the "River Corridor"). In particular, the focus has been on activities intended to protect the Columbia River through contaminant source removal actions and groundwater pump-and-treat systems designed to remove source contaminants in the soil and groundwater from reaching the river.

Approximately 1,200 waste management units have been identified within the boundaries of the Hanford Site. This includes approximately 1,000 past-practice units. Most past-practice units are located in two general geographic areas as identified by DOE (the 100 and 200 Areas). Other past-practice units are located in the 300, 1100, and other areas of the Hanford Site.

The 100, 200, 300, and 1100 Areas were identified as aggregate areas for inclusion of the Hanford Site on the CERCLA NPL. Each of these areas has a unique environmental setting and waste disposal history.

Units from other areas were assigned to one of the four aggregate areas for the purpose of investigation and subsequent action. Any future units that may be identified will also be assigned to an aggregate area.

When the Hanford Site was placed on the NPL in 1989, it was divided into four NPL sites: the 100 Area, 200 Area, 300 Area, and 1100 Area. The four areas were proposed for inclusion in the NPL on June 24, 1988, and were placed on the NPL on November 3, 1989. The areas are shown on Figure 1. Each NPL site was further divided into operable units to simplify the response actions. An operable unit is a grouping of individual sites based primarily on geographic area or common waste sources; soil and groundwater contamination are usually addressed in separate operable units (Figures 2 and 3).

The two other areas of the Site that are identified as numbered areas are the 400 Area, where the Fast Flux Test Facility (FFTF) is located; and the 600 Area, which includes all the portions of the Site that are not included in the 100, 200, 300, 400, or 1100 Areas. Because no waste sites resulting from release of CERCLA hazardous were identified in the 400 Area, the 400 Area was not listed on the NPL. Some waste sites that might have been in the 600 Area were included in the 100, 200, 300, and 1100 Areas because they were in close proximity to and/or were similar to wastes sites in those areas. Therefore, the 600 Area was not placed on the NPL.

Even though the 400 Area is not an NPL site, the decontamination and demolition of the FFTF is planned to be conducted as a CERCLA removal action under a joint DOE and EPA 1995 *Policy on Decommissioning Department of Energy Facilities under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*, dated May 22, 1995 (DOE 1995a).

Other areas of the Site, such as the Energy Northwest Columbia Generating Station, the US Ecology commercial low-level radioactive disposal site, and the National Science Foundation Laser Interferometer Gravitational-Wave Observatory (LIGO), operated by the California Institute of Technology and the Massachusetts Institute of Technology are leased to other government organizations by the U.S. Department of Energy and are not included in the Hanford CERCLA activities.

In anticipation of the NPL listing, DOE entered into the TPA (Ecology et al. 1989). The TPA establishes the regulatory guidelines and framework for achieving the cleanup and is a legally binding agreement among the DOE, EPA, and Ecology. For each operable unit, the TPA designates either EPA or Ecology as the lead regulatory agency. The DOE is the lead agency for purposes of implementing the requirements of the TPA.

The scope of the TPA is broader than this five-year review. The TPA addresses regulated RCRA units, as well as the clean up of past-practice units required under RCRA and/or CERCLA. However, only operable units listed as past-practice units in the TPA are covered in this five-year review report. Removal of radiologically contaminated structures, if conducted pursuant to the joint DOE and EPA 1995 *Policy on Decommissioning Department of Energy Facilities under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (DOE 1995a), is also included. CERCLA remedial actions on the canyons are also covered by this report.

Active RCRA treatment, storage, or disposal units, such as the Hanford tank farms, are not part of this review. Although this five-year review does not include RCRA treatment, storage, and disposal activities, the Tri-Parties are integrating the closure of inactive treatment storage, and disposal facilities with

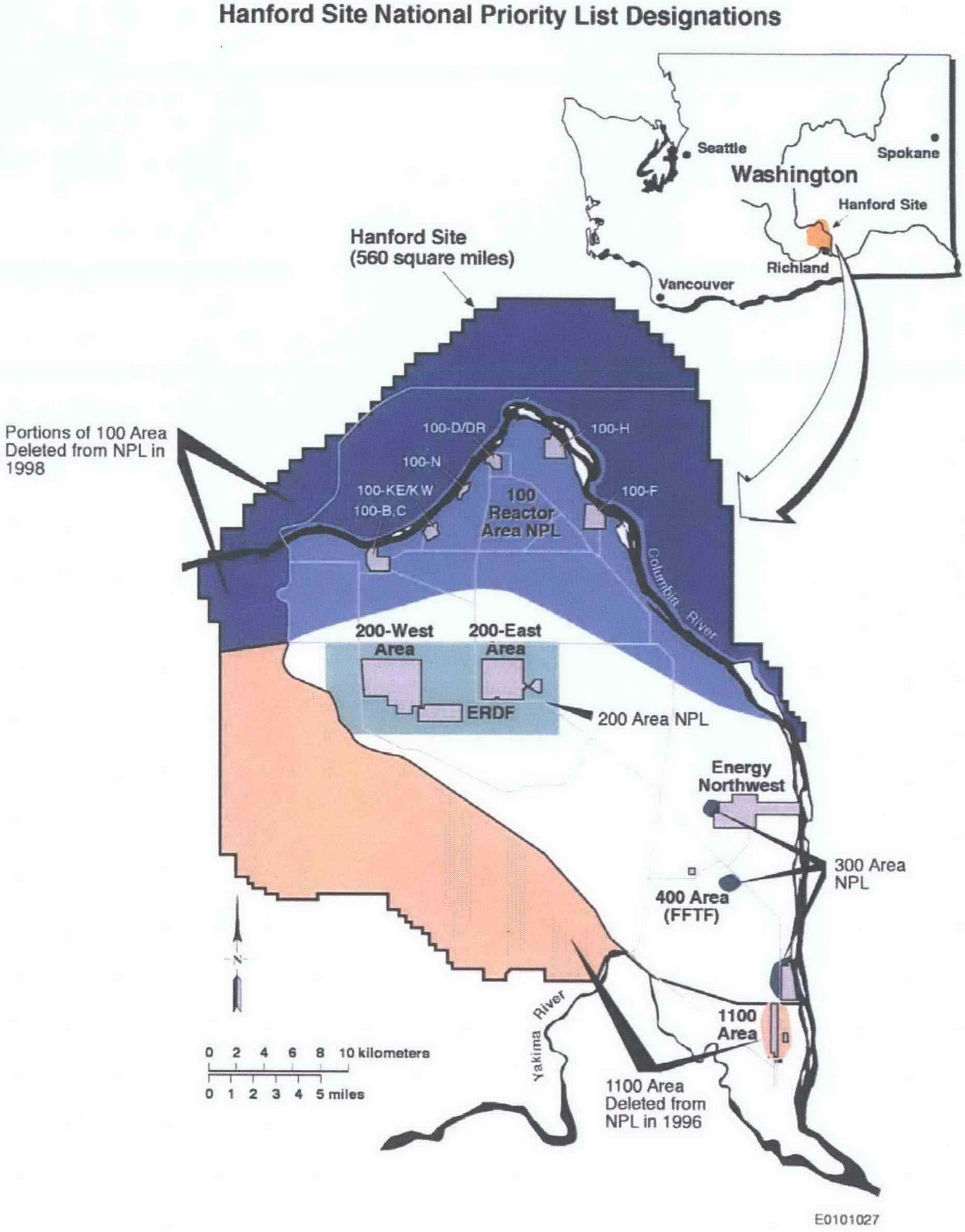

Figure 1. National Priorities List Sites

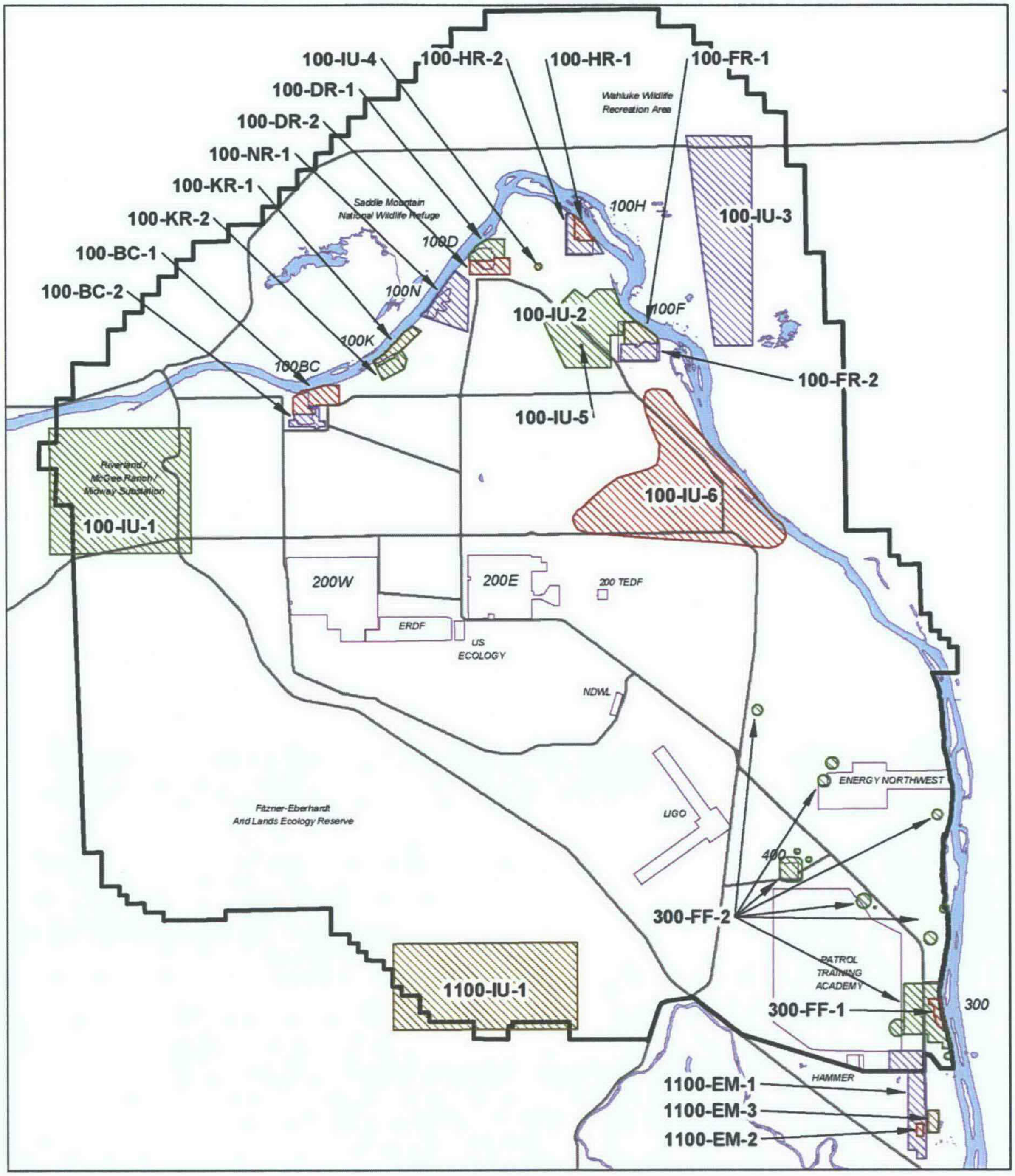

Figure 2. Source Operable Units on the Hanford Site

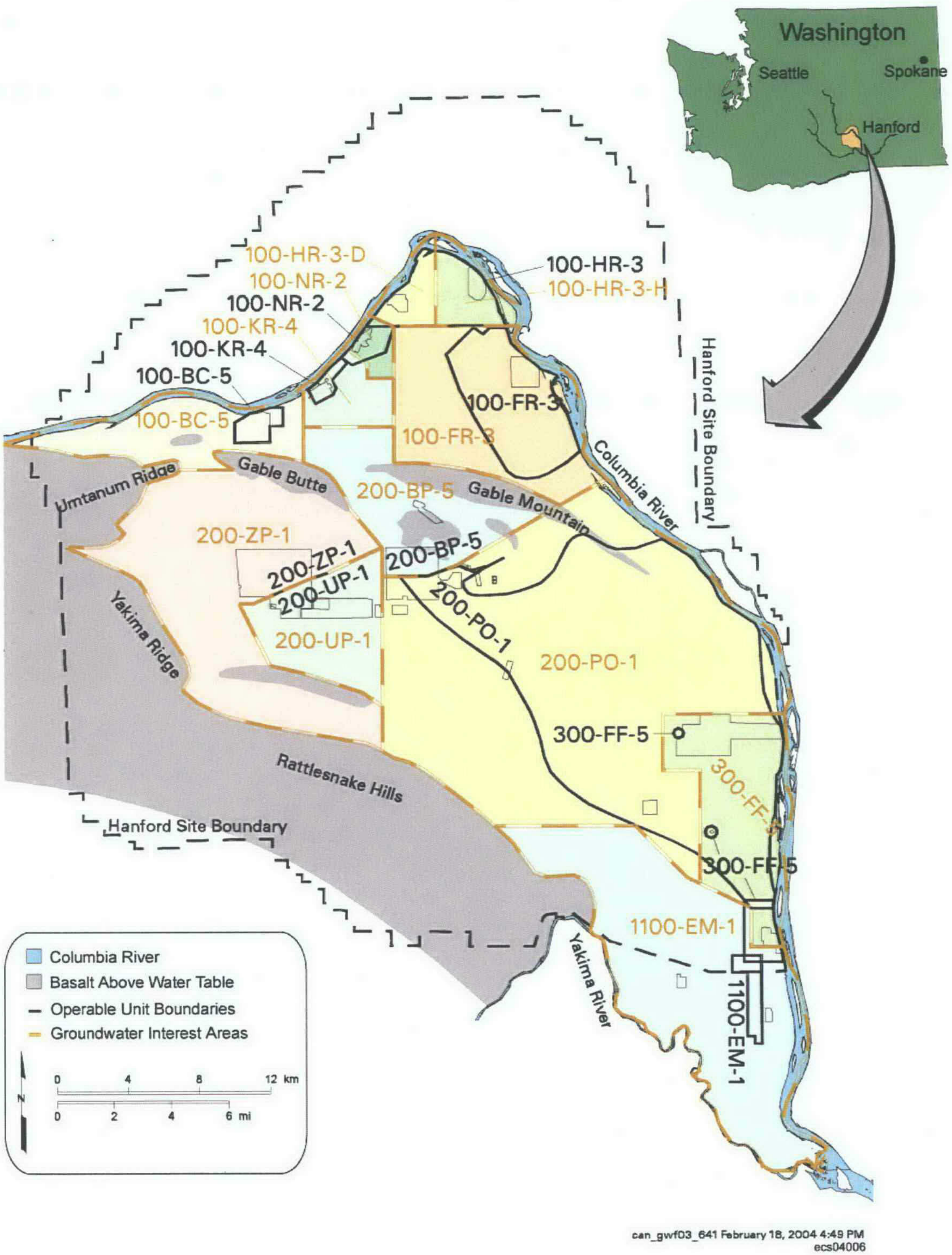

Figure 3. Groundwater Operable Units and Groundwater Interest Areas on the Hanford Site

CERCLA waste site cleanup as intended by the TPA. The Tri-Parties are also applying a strategy for groundwater cleanup that integrates the authorities and requirements of the AEA, CERCLA and RCRA (DOE 2003e).

The RCRA/CERCLA interface is described explicitly in the TPA. The closure and corrective actions at some closed or closing RCRA treatment, storage, and disposal units were integrated with the remedial actions evaluated in this five-year review. The affected operable units (and specific treatment, storage, and disposal units) include the 100-DR-1 (100-D Ponds unit), 100-HR-1 (183-H solar evaporation basin unit), 100-NR-1 (1301, 1325, 1324 and 1324-NA units), and the 300-FF-1 (300 Area process trenches treatment, storage, and disposal unit).

RODs are the decision documents from these processes that identify the selected remedies to address the identified risks. The five-year review process is meant to validate that the remedies selected in action memoranda and RODs are expected to be protective when completed, unless the conditions and assumptions on which the decisions were based have changed significantly.

Table 1 presents a list of RODs, action memoranda, and other CERCLA decision documents that are the subjects of this second Hanford Site CERCLA five-year review. These are all approved decision documents that are available in the TPA Administrative Record [http://www2.hanford.gov/arpir]. Consistent with the EPA and DOE guidance, this five-year review included interim remedial actions.

NPL Sites

This report documents the results of the second five-year review that was conducted from June through November 2005. The four NPL sites on the Hanford Site are shown on the map in Figure 1; the NPL sites are summarized in the following paragraphs and discussed in greater detail in separate sections of this report.

100 Areas. The 100 Areas consists of six nuclear reactor areas principally contaminated with radionuclides, metals, and other hazardous substances. There are 22 operable units in the 100 Areas, 17 source operable units and 5 groundwater operable units. In addition to the immediate reactor areas, there are outlying waste sites whose contaminants are similar. The primary cleanup actions in progress, or that are planned, are to remove, treat if necessary, and dispose of contaminated soil, debris, piping, burial grounds, engineered structures; decontaminate and/or demolish buildings; capture and/or treatment of contaminated groundwater; and remove spent nuclear fuel and associated waste from water-filled basins that have a history of leaks. Furthermore, institutional controls are an additional element in many of the selected remedies.

For the 100 Areas, eight interim RODs have been issued. Based on additional characterization, some of these RODs have been amended to address other contaminants or areas not originally included. Explanations of significant difference have been issued for others to explain less significant changes. Five of the records of decision address soil contamination, one addresses the removal of spent fuel at K Basins, and the other two address groundwater contamination. Seventeen additional CERCLA decision documents address demolition of buildings and structures, soil removal, groundwater treatment, landfill cleanup in the 100 Areas, including ten action memoranda and seven expedited response action approvals. There have been no final RODs issued for operable units included in the DOE Hanford 100 Area NPL site.

Table 1. CERCLA Records of Decision for the Hanford Site

Record of Decision - Location	Date
100 Area	
ROD for 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units – Soil Remediation (EPA 1995a)	September 1995
ROD for 100-IU-1, 100-IU-3, 100-IU-4, and 100-IU-5 Operable Unit Remedial Action (EPA 1996b)	February 1996
ROD for the 100-HR-3 and 100-KR-4 Operable Unit Interim Remedial Actions – hexavalent chromium pump-and-treat system (EPA 1996c)	April 1996
Amendment to the ROD for 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units Interim Remedial Actions (EPA 1997a)	May 1997
Interim Action ROD for the 100 Area Remaining Sites: 100-BC-1, 100-BC-100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-1, 100-IU-6, and 200-CW-3 (EPA 1999d)	July 1999
ROD for the 100-KR-2 Operable Unit K Basins Interim Remedial Action (Also CCN 103091) (EPA 1999c)	September 1999
Amended ROD for the 100-HR-3 Operable Unit Interim Remedial Action – In situ redox manipulation (EPA 1999a)	September 1999
Interim Action ROD for the 100-NR-1 and 100-NR-2 Operable Units (EPA 1999e)	October 1999
Replacement of Table 3 in the Interim ROD for 100-NR-1 and 100-NR-2 (Bond 1999a)	October 1999
Replacement of Appendix B in the Interim ROD for 100-NR-1 and 100-NR-2 (Bond 1999b)	November 1999
ROD for the 100-NR-1 Operable Unit Interim Remedial Actions (EPA 2000e)	January 2000
Explanation of Significance Difference to the Interim Action ROD for the Remaining Sites, 100-IU-6 Operable Unit – Addition of the 600-23 and JA Jones #1 waste site (EPA 2000a)	June 2000
ROD for 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units (100 Area Burial Grounds) (EPA 2000d)	September 2000
Explanation of Significant Difference for the 100-HR-3 Operable Unit ROD (EPA 2003a)	April 2003
Explanation of Significant Difference for 100-NR-1 Operable Unit Treatment, Storage, and Disposal Interim Action ROD and 100-NR-1/100-NR-2 Operable Unit Interim Action ROD (EPA 2003b)	May 2003
Explanation of Significant Difference to Remaining Sites – adds waste sites, ARARs, and institutional controls (EPA 2004b)	February 2004
Amendment to the Interim Record of Decision for the 100-KR-2 Operable Unit (EPA 2005)	July 2005
200 Area	
Interim ROD for 200-ZP-1 Operable Unit – Pump-and-treat for carbon tetrachloride (EPA 1995c)	June 1995
Interim ROD for 200-UP-1 Operable Unit– Pump-and-treat for uranium and technetium-99 (EPA 1997d)	February 1997
Final Record of Decision for the 221-U Facility (Canyon Disposition Initiative) and Responsiveness Summary (DOE et al. 2005)	September 2005
300 Area	
Final ROD for the 300-FF-1 and Interim ROD for 300-FF-5 – Removal, treatment, monitoring (EPA 1996d)	July 1996
Explanation of Significant Difference to the ROD for 300-FF-1 Operable Unit – Site-specific variance from Land Disposal Restrictions treatment standard for lead (EPA 2000c)	January 2000
Explanation of Significant Difference for the 300-FF-5 Operable Unit ROD – Expansion of 300-FF-5 scope, increased monitoring and new operation and maintenance plan (EPA 2000b)	June 2000
ROD for 300-FF-2 Operable Unit Interim Remedial Actions – Removal, treatment, monitoring (EPA 2001c)	April 2001
Explanation of Significant Difference to 300-FF-2 Operable Unit ROD – soil cleanup level (EPA 2004a)	May 2004

Table 1. (contd)

1100 Area	
ROD for 1100 Area Final Remedial Action – 1100-EM-1, 2, 3, and 1100-IU-1 Operable Units (EPA 1993)	September 1993
ERDF	
ROD for ERDF Remedial Action – Authorizes construction of ERDF (Also CCN 009606) (EPA 1995b)	January 1995
Explanation of Significant Difference for ERDF Remedial Action – Allows disposal of investigation-derived waste at ERDF and use of the ERDF leachate as dust suppression (Also CCN 103092) (EPA 1996a)	August 1996
Memo from EPA – Clarification to August 1996 explanation of significant difference (Innis 1997)	December 1997
Amendment to the ROD for ERDF– ERDF expansion; and treatment (stabilization) in containers at ERDF (EPA 1997b)	October 1997
Amendment to the ROD for ERDF – Delisting of ERDF leachate (EPA 1999b)	March 1999
Amendment to the ROD for ERDF – ERDF expansion; and establishes use of staging areas at ERDF for waste requiring treatment (EPA 2002)	January 2002
Action Memoranda - Location	
100 Area	
Sodium Dichromate Barrel Landfill (Ecology and EPA 1993)	March 1993
Sodium Dichromate ERA Removal of Landfill Waste per Action Memo dated March 1993 (Freeberg 1993)	April 1993
Riverland Site ERA (EPA and Ecology 1993)	June 1993
North Slope ERA Cleanup Plan (Ecology and EPA 1994a)	March 1994
N Springs ERA Cleanup Plan (Ecology and EPA 1994b)	September 1994
DOE Request to Change N Springs Action Memo (Wisness 1995)	February 1995
(Regulator Approval) DOE Request to Change N Springs Action Memo (Stanley and Sherwood 1995)	March 1995
ERA Proposal 100-BC-1 Demonstration Project (EPA and Ecology 1995)	June 1995
183-H Solar Evaporation Basin Waste ERA Cleanup Plan (DOE 1996a)	November 1996
N Area Waste ERA Cleanup Plan (DOE 1996b)	November 1996
100 NPL Agreement Form, Control Number 110, Action Memo: N Springs ERA Action Cleanup Plan (Olson 1996)	December 1996
100 B/C Area Ancillary Facilities and the 108-F Building Removal Action (EPA 1997c)	January 1997
Notice of Change to the Waste Volume Estimates in the N Area Waste ERA Action Memo (Wagoner 1997)	March 1997
Clarification to N Springs ERA Plan for the Pump and Treat (Olson 1997)	March 1997
100-IU-3 Operable Unit – Wahluke Slope (2,4-D Site) (Ecology and DOE 1997)	August 1997
Action Memorandum for 105-F and 105-DR Reactor Buildings and Ancillary Facilities (Ecology et al. 1998)	July 1998
Inclusion of 105-N Roof Waste in the Future Action Memo for the 100-N Area Ancillary Facilities (Wanek 1998)	September 1998
Final Waste Volumes for N Area Project and Clarification to the N Area Waste ERA Action Memo (Bauer 1998)	December 1998
100-N Ancillary Facilities (DOE et al. 1998)	January 1999
105-D and 105-H Reactor Facilities and Ancillary Facilities (DOE and Ecology 2000)	December 2000
100 Area NPL 105-B Reactor Facility (DOE and EPA 2001)	December 2001
183-H Action Memo to move waste from Central Waste Complex (DOE et al. 2003)	June 2003
105-N Reactor Building and 100-N Heat Exchange Building Action Memorandum (Ecology 2005)	February 2005
Action Memorandum for the Non-Time-Critical Removal Action for the 100-K Ancillary Facilities (DOE and EPA 2005b)	June 2005

Table 1. (contd)

200 Area	
200 West Area carbon tetrachloride plume (EPA and Ecology 1992)	January 1992
Removal Action at 233-S Plutonium Concentration Facility (DOE and EPA 1997)	March 1997
224-B Plutonium Concentration Facility (DOE 2004c)	June 2004
218-W-4C Waste Retrieval (DOE et al. 2004)	May 2004
232-Z Waste Recovery (DOE and EPA 2004)	November 2004
Action Memorandum for the Non-Time-Critical Removal Action for the U Plant Ancillary Facilities (DOE 2004d)	November 2004
Action Memorandum for PFP 232-Z facility decontamination and dismantlement to slab-on-grade. (DOE and EPA 2004)	November 2004
CERCLA Non-Time-Critical Removal Action Memorandum for Plutonium Finishing Plant, Above-Grade Structures (DOE 2005c)	May 2005
Action Memorandum for the Non-Time-Critical Removal Action for the 224-T Plutonium Concentration Facility	June 2005
300 Area	
Expedited Response Action for the 618-9 Burial Ground (Remove and dispose of drums containing uranium-contaminated hexone.)	1991
316-5 Process Trenches (EPA and Ecology 1991)	July 1991
331-A Virology Laboratory Building (DOE and EPA 2000)	February 2000
300 Area #1 Action Memo (DOE and EPA 2005a)	January 2005

DOE = U.S. Department of Energy.
ERA = Expedited response action.
ERDF = Environmental Restoration Disposal Facility.
LDR = Land disposal restrictions.

For the most part, interim actions have been successful in meeting the removal action and interim remedial action objectives. One hundred twenty (120) of the contaminated soil sites in the 100 Area NPL site have been remediated to meet the cleanup levels established in the interim RODs. Several removal actions, primarily building demolition and placing the old reactors in an "interim safe storage" condition also have been completed in the 100 Areas since the last five-year review. Some of the groundwater interim actions are also meeting the remedial action objectives established in the interim RODs. Noted exceptions are the strontium-90 plume at 100-N Area, and the chromium plume at 100-D and 100-H Areas. There are also other groundwater contaminant plumes that have not yet been addressed but will be addressed by the final remedy selected through the remedial investigation/feasibility study process documented in future RODs.

The source removal actions to remediate areas of contaminated soil through the remove, treat, and dispose remedy have been designed to be consistent with final cleanup actions, including ARARs. It is also anticipated that the residual human health and environmental risks for these areas will achieve the required risk levels when the remediation is completed. For these areas, DOE believes it is appropriate to state that the selected interim remedy is protective or will be when completed. However, if upon completion of the River Corridor Baseline Risk Assessment it is clear that the residual risk from these areas is not acceptable, the need for additional remediation will be addressed in the final RODs and evaluated and addressed in future five-year reviews.

The groundwater interim remediation actions in the 100 Areas are not designed to be removal actions. They are designed as interim measures to keep selected principle threat contaminants from reaching the river. The existing pump-and-treat systems for chromium will likely be a part of an expanded remedial action designed to restore the aquifer and meet ambient water quality standards where aquatic life is exposed. Consequently, the protectiveness of the selected remedies for groundwater remediation cannot be assessed through the same logic. While the selected pump-and-treat remedy at 100-H Area may be achieving the interim remedial action objectives, it is not necessarily protective in the broader context because the system does not cover the entire breadth of the contaminant plumes in 100-D and 100-H Areas. There are also other contaminants that may contribute to human health and environmental risk that are not being addressed by the existing systems and will be addressed by the final remedy selected through the remedial investigation/feasibility study process.

The pump-and-treat system for strontium-90 at 100-N Area was ineffective at reducing the flux of strontium-90 to the Columbia River and is determined to not be protective. DOE has initiated application of an apatite sequestration test that is expected to have a more immediate and greater impact on the flux of strontium-90. However, because the test barrier has not yet been constructed, the benefit cannot be demonstrated in this review; therefore, the protectiveness statement is deferred.

With the (a) completion of the River Corridor Baseline Risk Assessment, (b) expansion of the pump-and-treat technology with potential application of supporting technologies to cover the plumes more thoroughly, and (c) development of better data on performance of the pump-and-treat and apatite sequestration technologies, the remedies selected in the final RODs for the 100 Areas operable units will more completely address the human health and environmental risks. The protectiveness of those remedies will be evaluated in future five-year reviews.

200 Areas. The 200 Areas of the Hanford Site were used for chemical processing and for waste management. These activities generated radioactive, hazardous, and mixed waste that was disposed of into the soil column and resulted in large amounts of contaminated soil and groundwater in the 200 Areas. This five-year review focuses on the inactive soil disposal area, inactive facilities, contaminated groundwater, and the Environmental Restoration Disposal Facility (ERDF). Ongoing waste management activities, active treatment, storage, or disposal facilities, and tank farm operations are not included in this review.

The 200 Areas are divided into 24 Soil (Source) Operable Units. These units contain approximately 900 soil waste sites and associated structures, as well as numerous facilities requiring decontamination and decommissioning. In addition to the 24 soil (source) operable unit groupings, the 200 Area NPL site contains four groundwater operable units, two of which (200-ZP-1 and 200-UP-1) are in 200 West Area and two of which (200-BP-5 and 200-PO-1) are in 200 East Area.

The 24 soil (source) operable units are in various ongoing stages of the remedial investigation/feasibility study process. To date, only one of the soil (source) operable units in the 200 NPL site has an associated formal CERCLA interim action ROD where a remedy has been selected: the 200-CW-3, 200 North Area Operable Unit that was included in the 1999 100 Area Remaining Sites Interim Action (EPA 1999d). In addition, two action memos have been issued for nine facilities and waste sites in the 200 Areas as listed in Table 1. Action memos are the decision documents used for CERCLA removal actions as specified in 40 CFR 300.415.

For operable units in the DOE Hanford 200 Area NPL site, there are four RODs: two RODs for interim action address groundwater contaminants and two final RODs, the ERDF and contaminated soil removal at the 221-U facility have been issued. Nine action memoranda have been issued for removal actions.

The ERDF operations have been exemplary, and the facility is being successfully utilized to dispose of waste from all Hanford CERCLA activities. Canyon Disposition Initiative remedial actions under the 221-U ROD (DOE et al. 2005) are just beginning and are not covered in this five-year review. The removal actions that have been done to date under action memoranda, such as removal of the 232-Z facility, have been very successful.

Review of the 200-ZP-1 Groundwater Operable Unit and the 200-PW-1 Plutonium/Organic-Rich Process Condensate/Process Waste Group (originally designated as "200-ZP-2") Source Operable Unit, both of which represent the major carbon tetrachloride contamination problem on Hanford's Central Plateau, revealed several areas of concern that are being addressed through the ongoing remedial investigation/ feasibility study process that will result in the identification of remedies necessary to ensure protection of human health and the environment. Soil-vapor extraction has been used to remove carbon tetrachloride from the soil for the past thirteen years. Vapor extraction has been a highly successful remedial action, removing more than 77,000 kilograms (169,000 pounds) of carbon tetrachloride. However, during the past three years, removal efficiency has dropped significantly and less carbon tetrachloride has been removed during this period.

300 Area. The 300 Area consists of three operable units: 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units. The 300-FF-1 and 300-FF-2 Operable Units contain contaminated soil, debris, and burial grounds associated with 300 Area operations. The CERCLA decision documents for the 300 Area include a final ROD for contaminated soil remediation in 300-FF-1 operable unit; a ROD for interim action for contaminated soil remediation in 300-FF-2 Operable Unit; a ROD for interim action for groundwater remediation in the 300-FF-05 Operable Unit; an expedited response action approval; and three action memoranda. The primary cleanup actions in progress, or that are planned to be performed, are to remove, treat if necessary, and dispose of contaminated soil, debris, piping, burial grounds, engineered structures; and decontamination and/or demolition of buildings. The contaminated soil remedial action under the final ROD met all of the remedial action objectives. Work under the ROD for interim action is still in progress. The 300-FF-5 Operable Unit includes groundwater in the entire 300 Area. The selected remedial action for the groundwater is natural attenuation and continued monitoring. However, this action has not achieved the cleanup goal. Additional evaluations of future actions are in progress and are discussed in succeeding sections of this document.

1100 Area. The 1100 Area contains four operable units: 1100-EM-1, 1100-EM-2, 1100-EM-3, and 1100-IU-1. The 1100 Area was deleted from NPL in 1996. The Horn Rapids Landfill (1100-EM-1) was used for asbestos disposal and was closed in accordance with the asbestos regulations; institutional controls are in place to maintain a fence at the landfill, maintain the existing cap, and prevent the use of contaminated groundwater under the landfill. The groundwater is contaminated with trichloroethene, and natural attenuation was the remedy.

Additional sampling performed at the Horseshoe Landfill (1100-IU-1) between 1998 and 2003 detected residual dichlorodiphenyl trichloroethane (DDT) in the soil in portions of the landfill above the cleanup level for DDT (1 ppm) after performance of the initial remedial action. EPA issued a memo-to-file in May 2005 to document non-significant changes to the 1100 Area ROD (EPA 1993) to allow removal of the DDT contaminated soil. Based on ecological protection, a DDT cleanup level of 0.75 ppm was selected to be protective. Additional cleanup actions have taken place to achieve the cleanup goals and standards.

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1.0 100 Area

1.1 Introduction

The 100 Area is the north portion of the Hanford Site. The portion north and east of the river is the North (or Wahluke) Slope, which contained contaminants remaining from anti-aircraft missile bases. This portion of the 100 Area was deleted from the National Priorities List (NPL) in 1998. The portion south and west of the river is the site of six reactor areas (100-B/C, 100-D/DR, 100-F, 100-H, 100-K East/ K-West, and 100-N Areas) and numerous other waste sites primarily associated with Hanford Site construction. It encompasses approximately 67.4 square kilometers (26 square miles) and directly adjacent to the Columbia River. The locations of the 100 Areas along the Columbia River are shown in Figure 1.1.

Nine nuclear reactors were constructed in the six reactor areas (two each at 100-B/C, 100-D/DR, and 100-K East/K-West). The first eight reactors were constructed between 1944 and 1955 and used Columbia River water in a single-pass process for cooling. Water was then discharged back to the river or to onshore liquid waste disposal sites. The discharged cooling water contained radioactive materials and hazardous waste constituents. Onshore discharge of this liquid waste created contaminated soil (source) sites and groundwater.

The 100-N Reactor differed from the other eight reactors, in that it had the dual purpose of producing electricity and special nuclear material. The process of using the heat for electricity generation eliminated the need for large volumes of cooling water to be discharged to the Columbia River. Water was recirculated through the reactor to produce superheated steam in a primary closed loop system. A secondary system produced steam that was recirculated through the turbine generator. Cooling water from the Columbia River was circulated through a tertiary system and did not come into contact with radioactive materials. The primary and secondary loop systems were fed via a feed-and-bleed process. This process caused the recirculation water to accumulate much higher concentrations of radionuclides than the other 100 Area reactors, so the soil that received the discharges from the feed-and-bleed system had higher concentrations of contaminants than the liquid waste soil sites in the other 100 Areas. The 100-NR-1 Operable Unit is also different from the other operable units because it has soil sites that are contaminated with petroleum and sites contaminated with both petroleum and hazardous substances.

Other contamination and cleanup needs in the 100 Area include contaminated structures such as buildings, buried pipelines, buried and exposed disposal cribs, and trenches. Spent nuclear fuel from the reactors in the 100 Areas was previously stored in two water-filled basins in the 100-K Area. Most of the spent fuel has been removed and remedial actions are ongoing to complete the cleanout of the basins and ultimate demolition of the basins.

The contaminated groundwater in the 100 Areas reactor sites has been grouped into five operable units, specifically 100-HR-3 (100-D/DR and 100-H reactor sites), 100-KR-4, 100-NR-2 100-BC-5 (includes 100-B and 100-C reactor sites), and 100-FR-3. The 200-BP-5 Operable Unit extends into the southern portion of the 100 Area, but is discussed in the 200 Area section of this five-year review. The annual Hanford Site groundwater monitoring report (e.g., Hartman et al. 2005) provides detailed information for all groundwater monitoring.

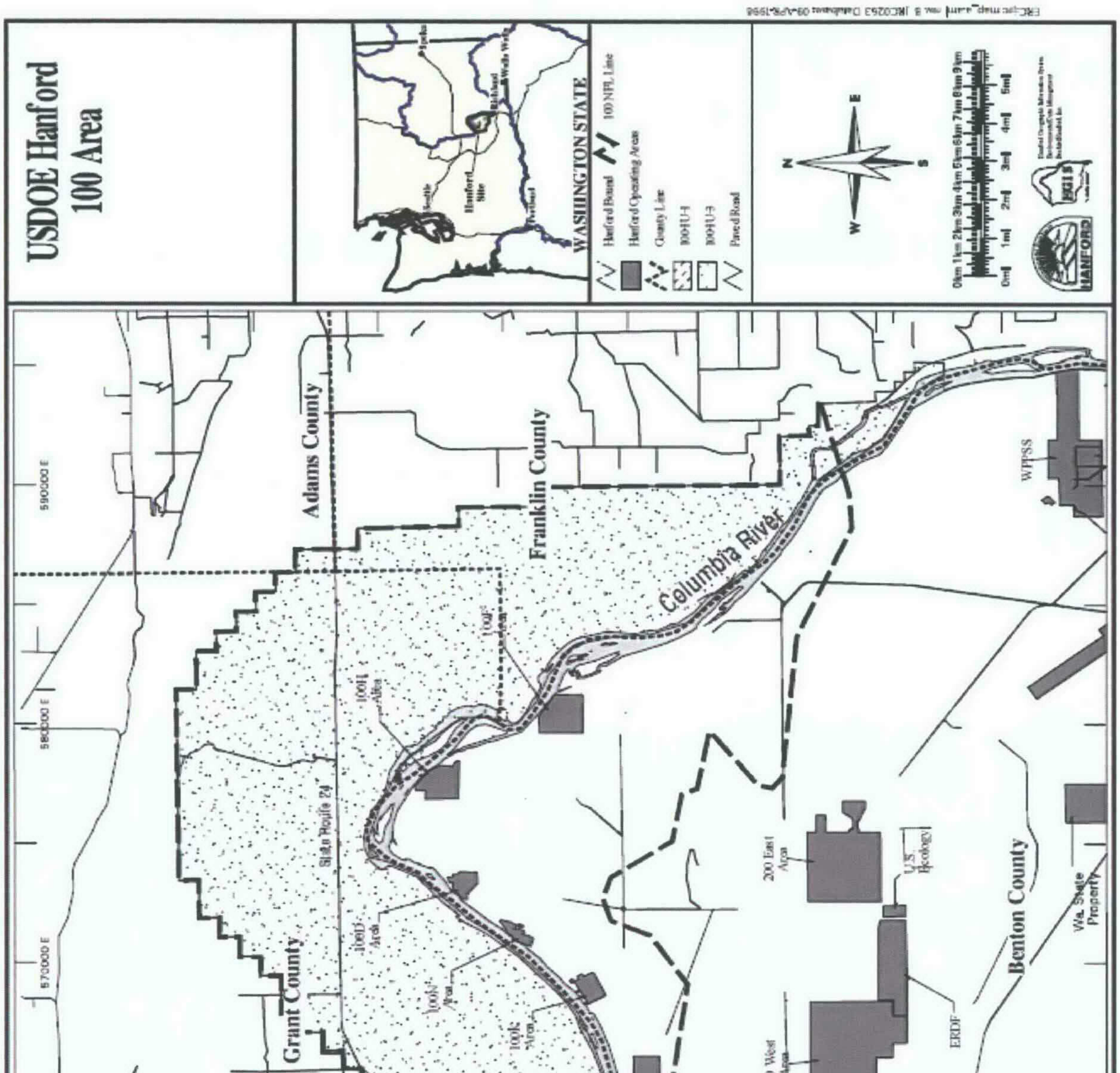

Figure 1.1. 100 Areas

Contaminated waste sites and buildings are grouped geographically into 17 soil (source) operable units: 100-BC-1, 100-BC-2, 100-KR-1, 100-KR-2, 100-NR-1, 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, 100-FR-1, 100-FR-2, 100-IU-1, 100-IU-2, 100-IU-3, 100-IU-4, 100-IU-5, and 100-IU-6. These source operable units contain about 400 waste sites, each of which can be categorized as containing one of four different types of contamination: contaminated soil, structures, debris, or burial grounds.

The waste sites are undergoing similar remedial actions with similar remedial action objectives and cleanup standards. Currently, the 100 and 300 Areas deep vadose contamination is considered to be part of the soil operable units. The 100 and 300 Area operable unit soil records of decision include a remedial action objective to protect the underlying groundwater from further seepage of percolating water through contaminants below the depth of excavation in the soil column that would result in exceeding groundwater drinking water standards. The 100-N Area ROD was modified through an explanation of significant difference to reflect this unique situation. It is also currently understood that deep vadose zone uranium sources that are periodically rewetted by rising groundwater levels in response to river stage is impacting the 300 Area groundwater. The limited field investigation and treatability test are designed to address this situation. It is also recognized that deep sources of chromium exist in the 100 Areas that appear to be a continuing source of groundwater contamination during high river stage.

This five-year review discusses cleanup progress based on the types of remedial actions required. In this review, the 22 operable units in the 100 Areas are identified and described (Table 1.1), the decision documents (Tables 1.2 and 1.3) are discussed, and the decision documents relevant to each type of remedial action are identified in the discussion of each type of remedial action. With the exception of operable units that are designated isolated units, the 100 Area operable units are associated with the reactor areas. The following sections discuss the remedial decisions, progress, technical assessments, and recommendations by area and by groundwater operable unit in this second five-year review.

Table 1.1. 100 Area Operable Units

Operable Unit	Brief Description
100-BC-1	Soil, Buildings, and Burial Grounds in the 100-BC Reactor Area
100-BC-2	Soil, Buildings, and Burial Grounds in the 100-BC Reactor Area
100-BC-5	Groundwater under the 100-BC Area
100-KR-1	Principally Soil Sites Contaminated by Liquid Discharges
100-KR-2	Soil, Buildings, and Burial Grounds in the 100-K Reactor Area
100-KR-4	Groundwater under the 100-K Area
100-NR-1	Soil, Buildings, and Burial Grounds in the 100-N Reactor Area
100-NR-2	Groundwater under the 100-N Area and the Shoreline Site
100-DR-1	Soil, Buildings, and Burial Grounds in the 100-D Reactor Area
100-DR-2	Soil, Buildings, and Burial Grounds in the 100-D Reactor Area
100-HR-1	Soil, Buildings, and Burial Grounds in the 100-H Reactor Area
100-HR-2	Soil, Buildings, and Burial Grounds in the 100-H Reactor Area
100-HR-3	Groundwater under and between the 100-D/DR and 100-H Reactor Areas
100-FR-1	Principally Soil Sites Contaminated by Liquid Discharges
100-FR-2	Soil, Buildings, and Burial Grounds in the 100-F Reactor Area
100-FR-3	Groundwater under the 100-F Reactor Area
100-IU-1	Riverland Railroad Wash Station
100-IU-2	White Bluffs Town Site Area
100-IU-3	North Slope (also known as Wahluke Slope)
100-IU-4	Buried Sodium Dichromate Drums
100-IU-5	Pickling Acid Cribs
100-IU-6	Hanford Town Site Area

Table 1.2. 100 Area Records of Decision Document Chronology

100 Areas Record of Decision – Location	Date
ROD for 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units – Soil Remediation (EPA 1995a)	September 1995
ROD for 100-IU-1, 100-IU-3, 100-IU-4, and 100-IU-5 Operable Units (EPA 1996b)	February 1996
Interim ROD for the 100-HR-3 and 100-KR-4 – Hexavalent chromium pump-and-treat[a] (EPA 1996c)	April 1996
Amended ROD for 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units (EPA 1997a)	May 1997
Interim ROD for the 100 Area remaining sites: 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-1, 100-IU-6, and 200-CW-3 (EPA 1999d)	July 1999
Interim ROD for the 100-KR-2 Operable Unit – K Basins (Also CCN 103091) ((EPA 1999c)	September 1999
Amended ROD for the 100-HR-3 Operable Unit – In situ redox manipulation[a] (EPA 1999a)	September 1999
Interim ROD for the 100-NR-1 and 100-NR-2 Operable Units[a] (EPA 1999e)	October 1999
Replacement of Table 3 in the Interim ROD for 100-NR-1 and 100-NR-2 (Bond 1999a)	October 1999
Replacement of Appendix B in the Interim ROD for 100-NR-1 and 100-NR-2 (Bond 1999b)	November 1999
Interim ROD for the 100-NR-1 Operable Unit (EPA 2000e)	January 2000
Explanation of significant difference to the remaining sites ROD for the 100-IU-6 Operable Unit – Addition of the 600-23 and JA Jones #1 waste site. (EPA 2000a)	June 2000
ROD for 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-HR-2, 100-FR-2, and 100-KR-2 100 Area burial grounds (EPA 2000d)	September 2000
Explanation of significant difference for the 100-HR-3 Operable Unit ROD April 2004[a] (EPA 2003a)	April 2003
Explanation of significant difference for 100-NR-1 Operable Unit treatment, storage, and disposal interim action ROD and 100-NR-1/ 100-NR-2 Operable Unit interim action ROD (EPA 2003b)	May 2003
Explanation of significant difference to remaining sites – adds waste sites, ARARs, and institutional controls (EPA 2004b)	February 2004
Amendment to the Interim Record of Decision for the 100-KR-2 Operable Unit (EPA 2005)	July 2005

(a) Indicates groundwater operable unit-related decisions reviewed within this report.
ARAR = Applicable or relevant and appropriate requirement.
ROD = Record of decision.

Table 1.3. 100 Area Action Memoranda Document Chronology

100 Areas Action Memoranda – Location	Date
Sodium Dichromate Barrel Landfill (Ecology and EPA 1993)	March 1993
Sodium Dichromate ERA Removal of Landfill Waste per Action Memo dated March 1993 (Freeberg 1993)	April 1993
Riverland Site ERA (EPA and Ecology 1993)	June 1993
North Slope ERA Cleanup Plan (Ecology and EPA 1994a)	March 1994
N Springs ERA Cleanup Plan (Ecology and EPA 1994b)	September 1994
DOE Request to Change N Springs Action Memo (Wisness 1995)	February 1995
(Regulator Approval) DOE Request to Change N Springs Action Memo (Stanley and Sherwood 1995)	March 1995
ERA Proposal 100-BC-1 Demonstration Project (EPA and Ecology 1995)	June 1995
183-H Solar Evaporation Basin Waste ERA Cleanup Plan (DOE 1996a)	November 1996
N Area Waste ERA Cleanup Plan (DOE 1996b)	November 1996
100 NPL Agreement Form, Control Number 110, Action Memo: N Springs ERA Action Cleanup Plan (Olson 1996)	December 1996
100 B/C Area Ancillary Facilities and the 108-F Building Removal Action (EPA 1997c)	January 1997
Notice of Change to the Waste Volume Estimates in the N Area Waste ERA Action Memo Wagoner 1997)	March 1997
Clarification to N Springs ERA Plan for the Pump-and-Treat (Olson 1997)	March 1997
100-IU-3 Operable Unit – Wahluke Slope (2,4-D Site) (Ecology and DOE 1997)	August 1997
Action Memorandum for 105-F and 105-DR Reactor Buildings and Ancillary Facilities (Ecology et al. 1998)	July 1998
Inclusion of 105-N Roof Waste in the Future Action Memo for the 100-N Area Ancillary Facilities (Wanek 1998)	September 1998
Final Waste Volumes for N Area Project and Clarification to the N Area Waste ERA Action Memo (Bauer 1998)	December 1998
100-N Ancillary Facilities (DOE et al. 1998)	January 1999
105-D and 105-H Reactor Facilities and Ancillary Facilities (DOE and Ecology 2000)	December 2000
100 Area NPL 105-B Reactor Facility (DOE and EPA 2001)	December 2001
183-H Action Memo to move waste from Central Waste Complex (DOE et al. 2003)	June 2003
105-N Reactor Building and 100-N Heat Exchange Building Action Memorandum (Ecology 2005)	February 2005
Action Memorandum for the Non-Time-Critical Removal Action for the 100-K Ancillary Facilities (DOE and EPA 2005b)	June 2005
ERA = Expedited response action. NPL = National Priorities List.	

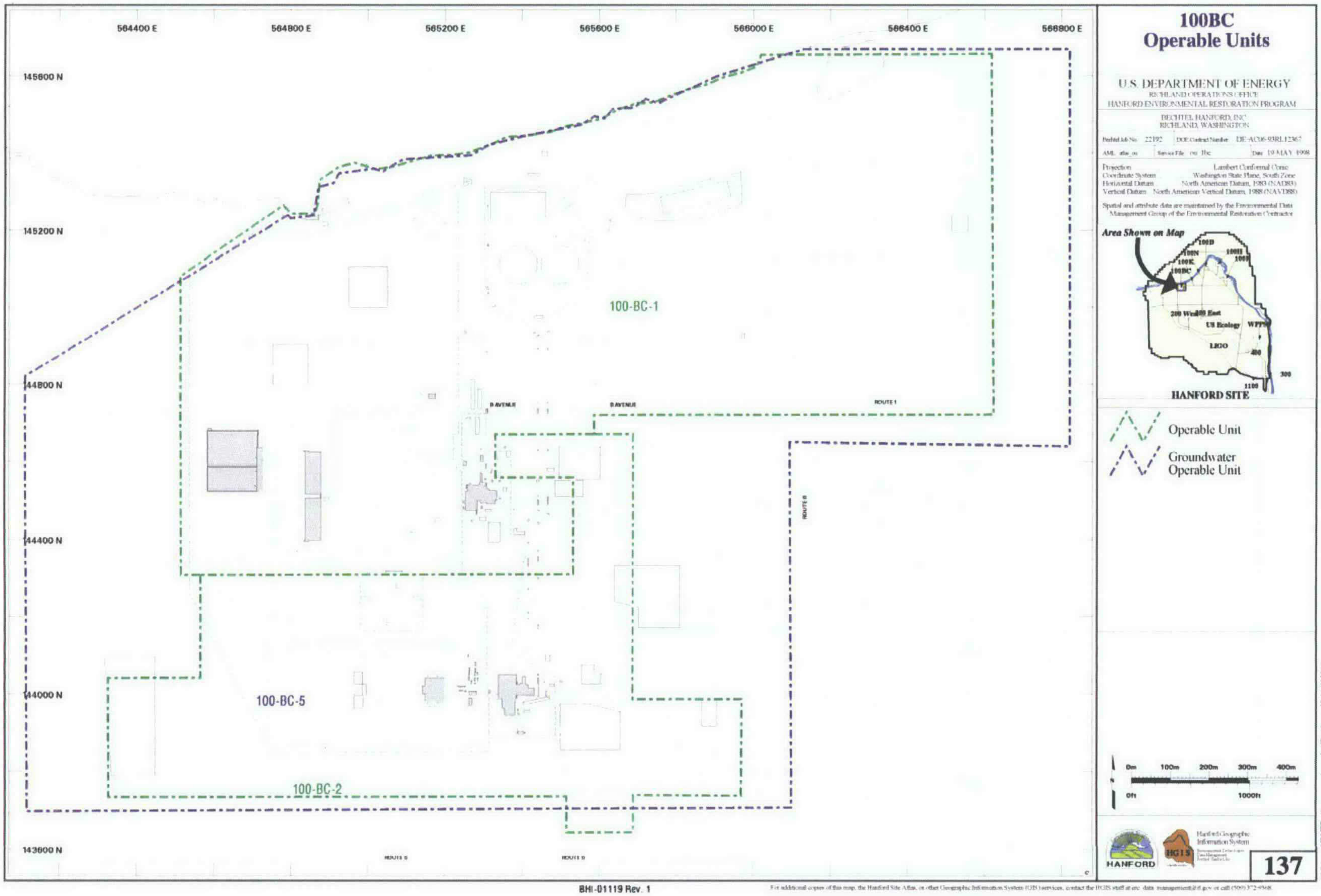

Figure 1.2. 100-B/C Area Showing Operable Unit Boundaries

1.2 Chronology

A list of the CERCLA decision documents for the 100 Areas is included in Tables 1.2 and 1.3. The documents included in this five-year review are noted in these tables.

1.3 Background

100-BC Area. The B Reactor was constructed in 1943 and operated from 1944 through 1968. The B Reactor building is presently being considered for being transitioned into a museum by the National Park Service. The C Reactor was constructed in 1951 and operated from 1952 until 1969. Currently, the only active facilities in the 100-BC-1 and 100-BC-2 Operable Units are those used as part of the ongoing remedial actions, such as field office trailers, and the facilities that extract and treat water from the Columbia River and transport that water to other 100 Area and 200 Area facilities. The 100-BC-1 and 100-BC-2 Operable Units, which are located in the 100-B/C Area, include contaminant sources, while the 100-BC-5 Operable Unit located in that area includes contamination present in the underlying groundwater. Figure 1.2 shows a map of the 100-B/C Area and the associated operable units.

100-K Area. The KW Reactor operated from 1955 to 1970, and the KE Reactor operated from 1955 to 1971. The 100-KR-1 and 100-KR-2 Source Operable Units, which are located in the 100-K Area, include contaminant sources, while the 100-KR-4 Groundwater Operable Unit located in that area includes contamination in the underlying groundwater. Currently, there are several active facilities within the 100-K Area, including the 105-KE and 105-KW fuel storage basins. Figure 1.3 shows a map of the 100-K Areas and the associated operable units.

100-N Area. The N Reactor operated from 1963 until 1987. In 1991, the final decision to retire the N Reactor from service was issued. The 100-NR-1 Operable Unit, which is located in the 100-N Area, includes contaminant sources, while the 100-NR-2 Operable Unit located in that area includes contamination present in the underlying groundwater. Figure 1.4 shows a map of the 100 N Area and the associated operable units.

100-D/DR Area. The 100-D/DR Area contains two reactors: the D Reactor associated with the 100-DR-1 Operable Unit, and the DR Reactor associated with the 100-DR-2 Operable Unit. The D Reactor operated from 1944 to 1967. The DR Reactor operated from 1950 to 1964. 100-DR-1 and 100-DR-2 are source operable units in the 100-D Area; 100-HR-3 is the groundwater operable unit for the 100-D/DR and 100-H Areas. Figure 1.5 shows a map of the 100-D/DR Area and the associated operable units.

100-H Area. The H Reactor complex was constructed after World War II. The H Reactor operated from 1949 to 1965. Currently, there are no active facilities, operations, or liquid discharges within the 100-H Area. The 100-HR-1 and 100-HR-2 Source Operable Units, which are located in the 100-H Area, include contaminant sources, while the 100-HR-3 Groundwater Operable Unit located in that area includes the contamination present in the underlying groundwater. Figure 1.6 shows a map of the 100-H Area and the associated operable units.

100-F Area. The F Reactor was constructed from 1943 to 1945 and operated from 1945 to 1965. Most of the facilities associated with F Reactor, other than the biological research facilities, were also retired in

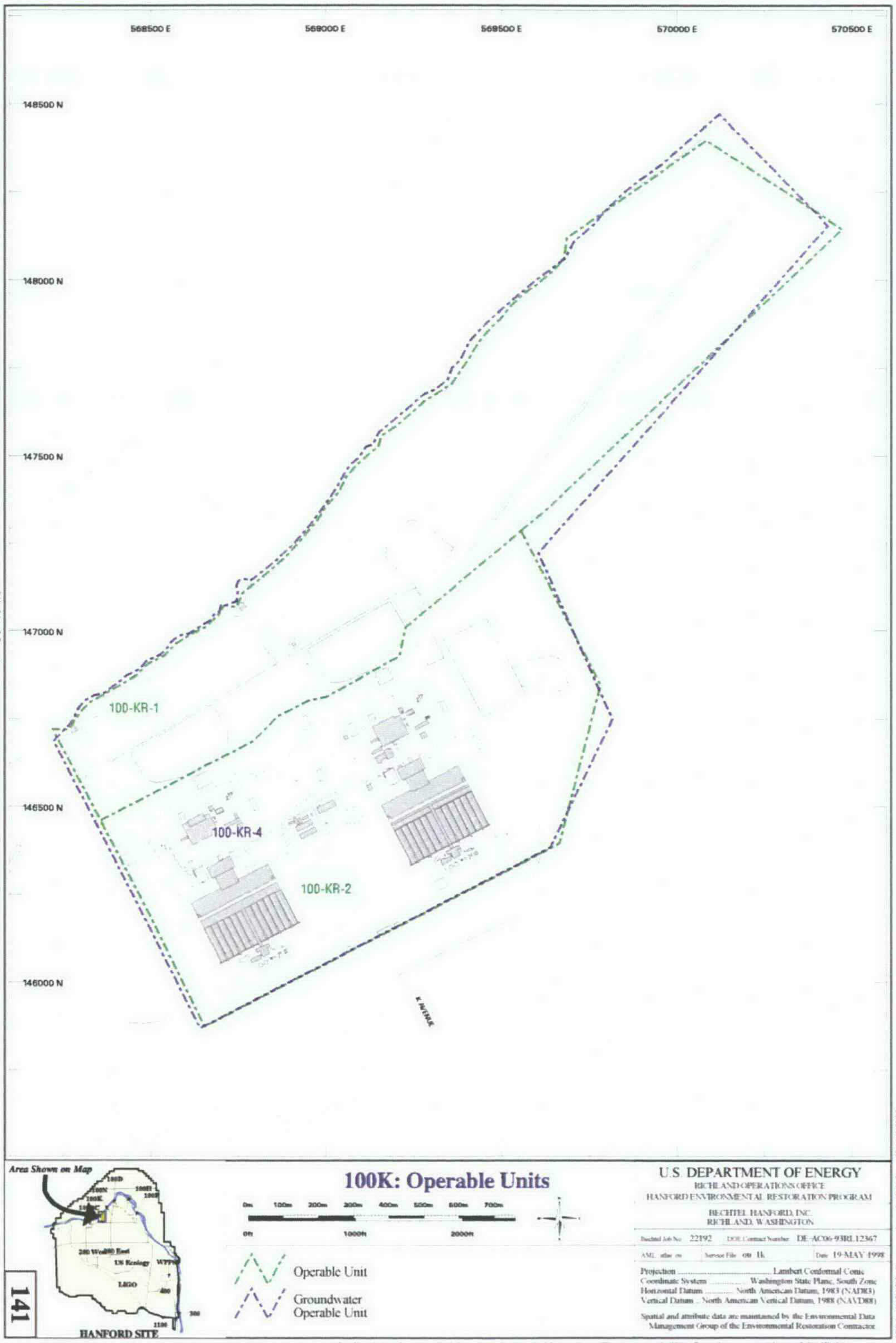

Figure 1.3. 100-K Operable Units

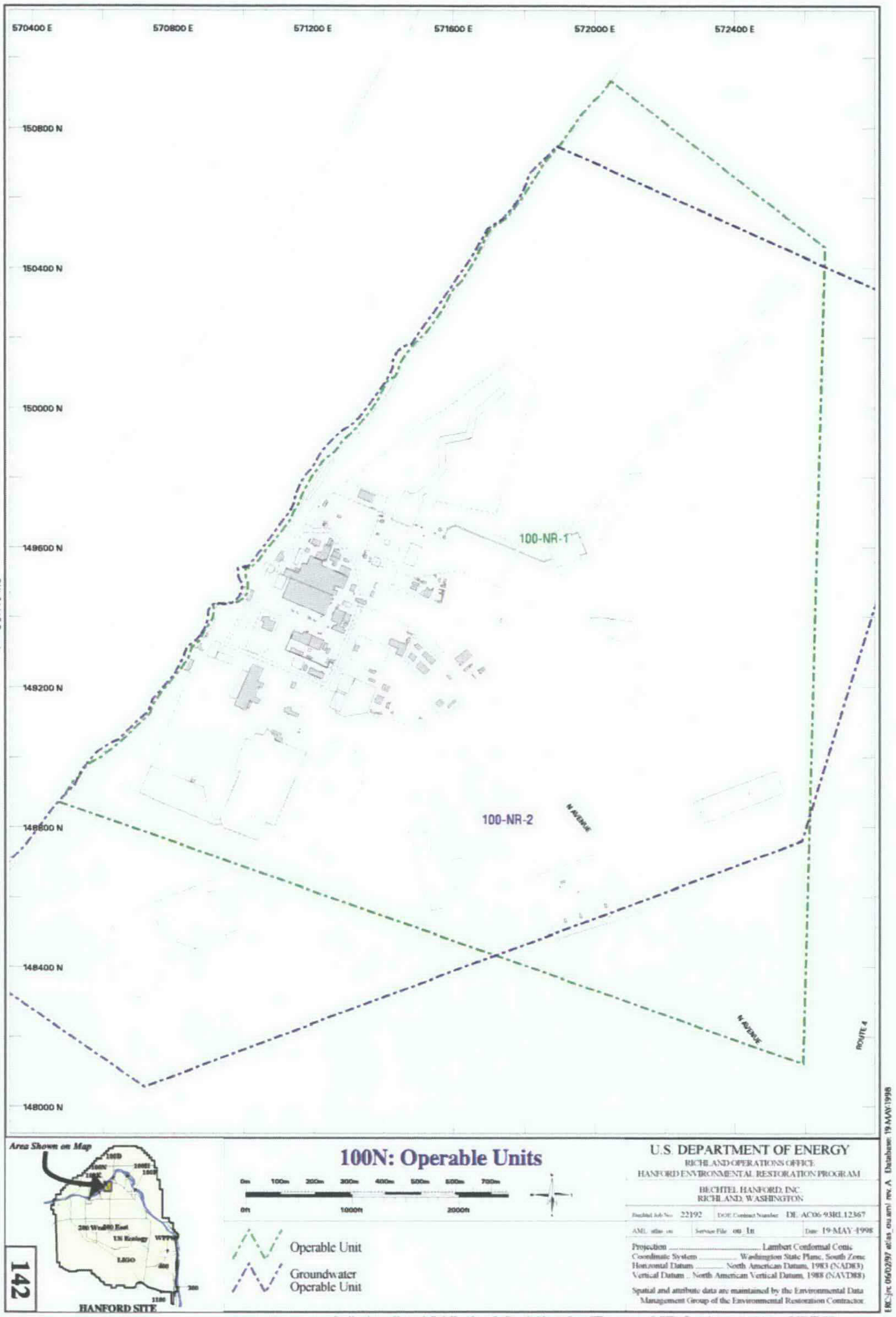

Figure 1.4. 100-N Area Operable Units

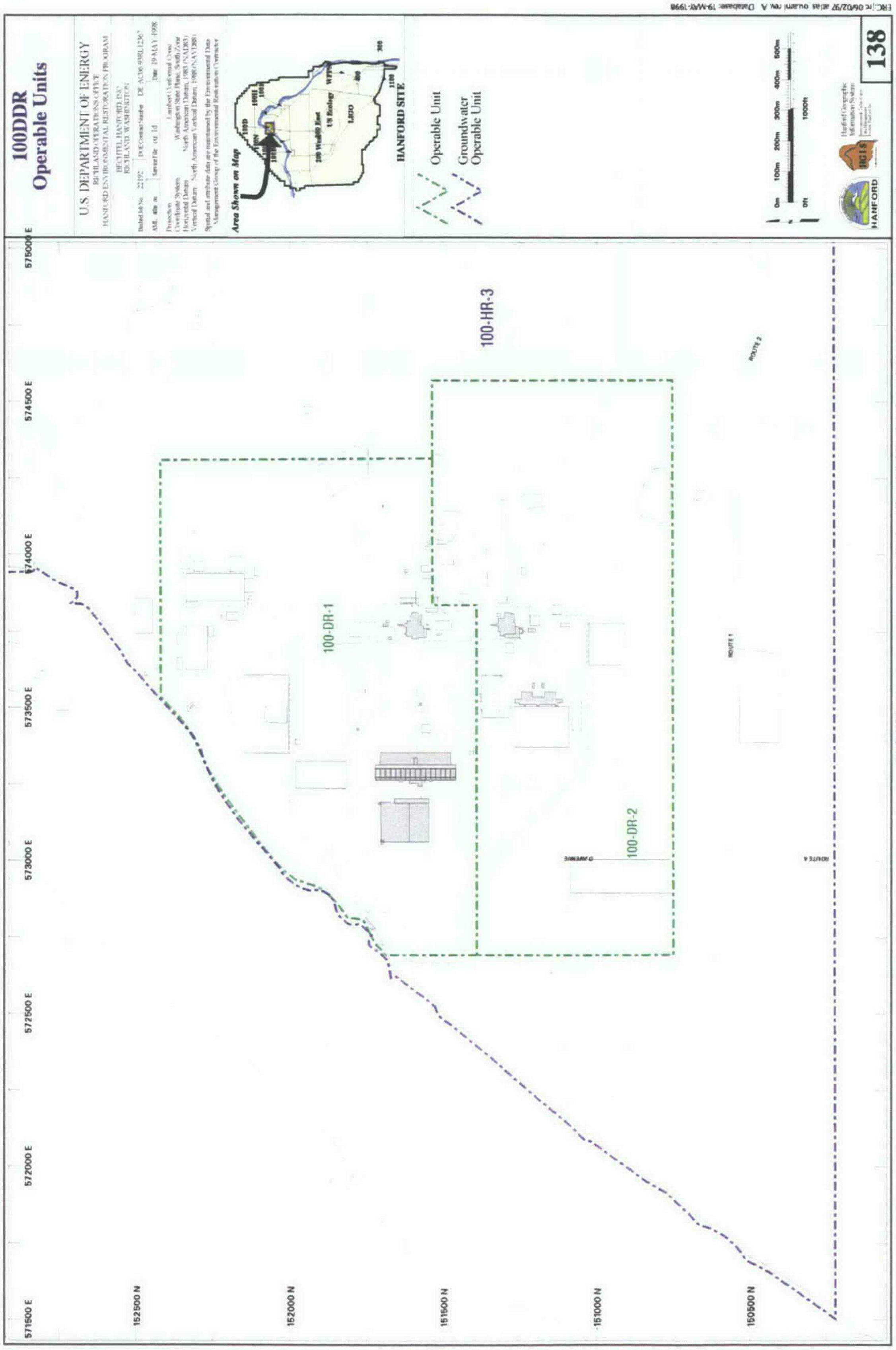

Figure 1.5. 100-D/DR Area Operable Unit

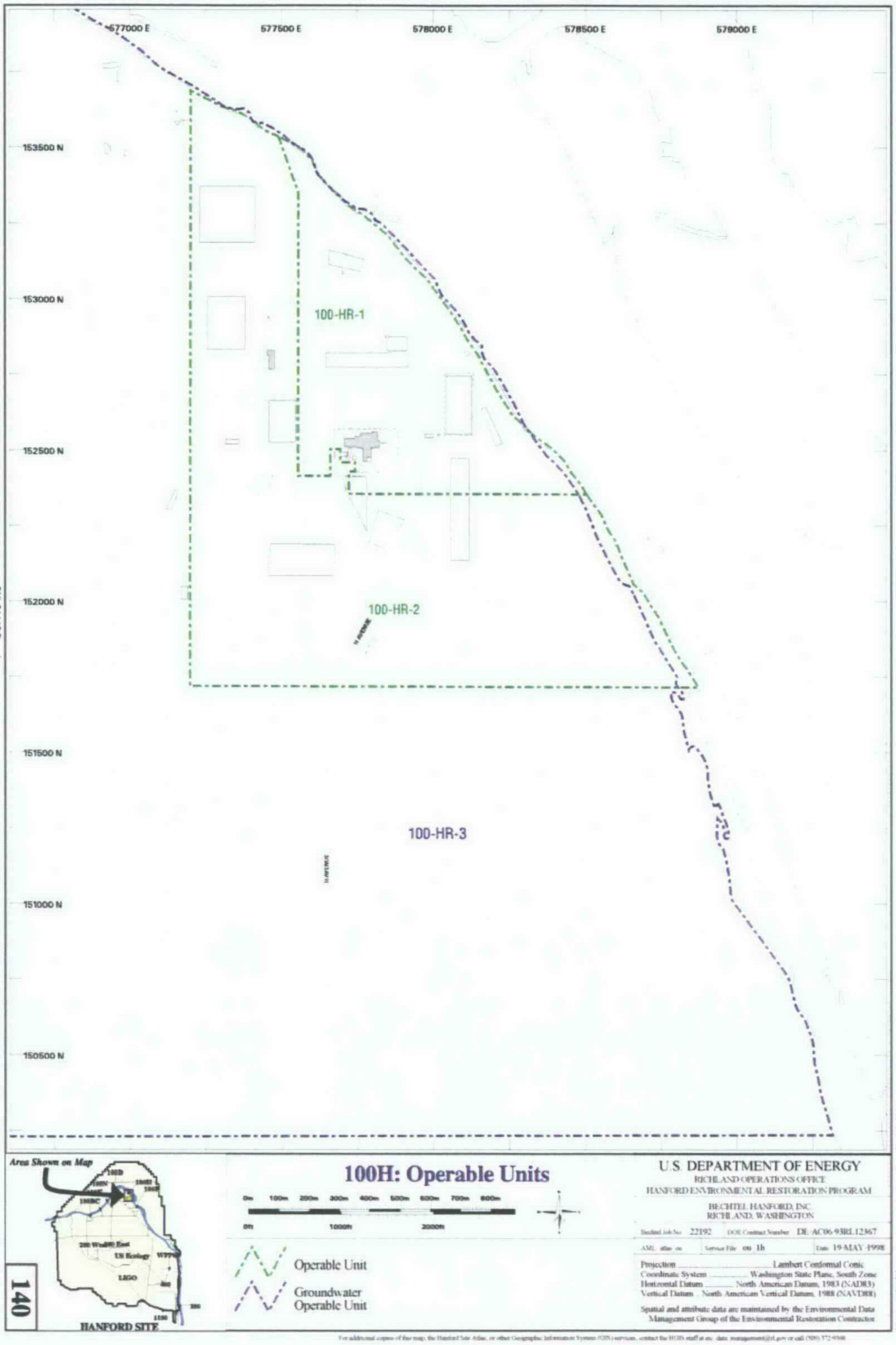

Figure 1.6. 100-H Area Operable Units

1965. The 100-FR-1 and 100-FR-2 Source Operable Units, which are located in the 100-F Area, include contaminant sources, while the 100-FR-3 Groundwater Operable Unit located in that area includes the contamination in the underlying groundwater. Figure 1.7 shows a map of the 100-F Area and the associated operable units.

1.4 Remedial Actions

The following paragraphs summarize the RODs and other CERCLA decision documents for the removal and/or remedial actions that have been or are being completed in the 100 Areas. Following these sections, the remedies that have been, or will be, implemented are discussed. Any remedy implementation issues are included along with actions to address the identified issues. An evaluation of whether the selected remedy is, or will be, protective when the remedy is completed is included. All 100 Area RODs listed below are for interim actions.

1.4.1 Hanford 100 Area Decision Documents

Table 1.4 lists the remedial action objectives for the 100 Area Source Operable Units.

Table 1.4. Source Operable Unit Remedial Action Objectives

Item	Description
Remedial Action Objective 1	Protect human and ecological receptors from exposure to contaminants in soil, structures, and debris by dermal exposure, inhalation, or ingestion of radionuclides, inorganics, or organics. Protection will be achieved by reducing concentration of, or limiting exposure pathways to, contaminants in the upper 4.6 m (15 ft) of the soil exposure scenario. The levels of reduction will be such that the total dose for radionuclides does not exceed 15 mrem/yr above Hanford Site background for 1,000 years following remediation and Washington State *Model Toxics Control Act* Method B levels for inorganics and organics.
Remedial Action Objective 2	Control the sources of groundwater contamination to minimize the impacts to groundwater resources, protect the Columbia River from further adverse impacts, and reduce the degree of groundwater clean up that may be required under future actions. Protection will be such that contaminants remaining in the soil after remediation do not result in an adverse impact to groundwater that could exceed maximum contaminant levels and non-zero maximum contaminant level goals under the *Safe Drinking Water Act*. The *Safe Drinking Water Act* maximum contaminant level for radionuclides will be attained at a designated point of compliance beneath or adjacent to the waste site in groundwater. The location and measurement of the point of compliance will be defined by EPA and Ecology. Monitoring for compliance will be performed at the defined point. Protection of the Columbia River from adverse impacts so contaminants remaining in the soil after remediation do not result in an impact to groundwater and, therefore, the Columbia River, that could exceed the ambient water quality criteria under the *Clean Water Act* for protection of fish. Since there are no ambient water quality criteria for radionuclides, maximum contaminant levels will be used. The protection of receptors (aquatic species, with emphasis on salmon) in surface waters will be achieved by reducing or eliminating further contaminant loadings to groundwater so receptors at the point of groundwater discharge in the Columbia River are not subject to additional adverse risks. Measurement of compliance will be at a near-shore well, in the downgradient plume. The location and measurement will be defined by EPA and Ecology.

The implementation of the selected remedy to meet the remedial action objectives listed in Table 1.4 generally includes the following steps:

1. Remove contaminated soil, structures, and debris from 100 Area source waste sites using the "observational approach." The observational approach uses analytical screening during remediation to guide the extent of excavation. Remediation proceeds until it can be demonstrated through a combination of field screening and verification sampling that cleanup goals have been achieved.

2. Treat the waste as required to meet applicable waste disposal criteria.

3. Dispose of contaminated materials at the Environmental Restoration Disposal Facility (ERDF).

4. Backfill excavated areas and re-vegetate.

1995 ROD. There are 37 waste sites in operable units 100-BC-1, 100-DR-1, and 100-HR-1 covered by this ROD. Cleanup levels are consistent with remedial action objective listed in Table 1.4.

1995 ROD as Amended in 1997. There are 71 sites covered by this amended ROD. Cleanup levels are consistent with the remedial action objectives listed in Table 1.4.

1996 ROD for Groundwater at 100-HR-3 and 100-KR-4. The remedy involves plume capture and removing hexavalent chromium from groundwater via a pump-and-treat system. Groundwater is extracted via wells near the river, the chromium is removed, and the treated water is discharged to the upgradient aquifer. This remedial action is currently in progress only in selected portions of the entire chromium plume in the D, K and H Reactor areas only. The location of the remedial action is based on the highest concentration. The Tri-Parties have agreed that there needs to be a better understanding of the nature and extent of the chromium plume in the area. No action is taken in the remaining portion of the areas where the contamination is above the current remedial action objectives, pending the evaluation on the success of these selected activities.

The principal threat being addressed is the ecological risk to aquatic organisms living in the river gravels where contaminated groundwater upwells into the Columbia River. The cleanup standard of 11 μg/L of hexavalent chromium was the Washington State ambient water quality standard for chronic exposure that is more stringent than the 100-μg/L drinking water standard needed for protection of human health. Contaminant levels in the groundwater nearby the Columbia River, which discharges into the river, have been measured at over 2,000 μg/L hexavalent chromium.

1997 Action Memo for 100-C Reactor Waste Disposal, Ancillary Facilities, and 108-F Laboratory. The remedy involves the decontamination and demolition of structures and the disposal of the resulting waste. Where hazardous substances are present, cleanup progresses with the same depth criteria as for the soil sites. This project, initiated under the *National Environmental Policy Act* (NEPA), resulted in an interim safe storage enclosure over the reactor block to ensure containment of the hazardous substances. Subsequent interim safe storage projects were initiated under CERCLA.

1998 Action Memo for 100-DR and 100-F Reactor Interim Safe Storage. The remedy in this action memo is to decontaminate and demolish the contaminated reactor buildings (except for the reactor blocks) and the ancillary facilities, and disposal of the waste. The action memo required a safe storage enclosure over the reactor blocks to ensure containment of the hazardous substances.

Figure 1.7. 100-F Area Operable Units

1999 ROD for Remaining Sites (includes 2000 Explanation of Significant Difference for 100-IU-6). The remedy was designed to be inclusive of all other past-practice waste sites in the 100 Areas not already covered by an existing CERCLA decision document, with the exception of the 100 Area solid waste burial grounds. Cleanup levels are consistent with the remedial action objectives listed in Table 1.4. The 1999 ROD identified 46 sites for the remove-treat-dispose remedy. The 2000 explanation of significant difference has increased this to 48 sites. In addition to the observational approach to characterization during remove, treat, and dispose remediation, this ROD uses a "plug-in approach." The plug-in approach applies to more than 160 additional waste sites (and future discovery waste sites) with little or no characterization data. These sites are candidates for remove, treat, and dispose remediation; however, further sampling is required to determine if there is a need for remedial action. If remediation is needed, they will be plugged into the remove, treat, and dispose remedy.

1999 ROD for the K Basins. The remedy requires the removal of the spent nuclear fuel, sludge, water, and debris, as well as the deactivation of the two water-filled spent nuclear fuel storage basins in the 100-K Area. Fuel will be packaged, removed from the basins, dried, and placed in storage in the 200 Area. Sludge will be packaged, removed, and placed in storage in the 200 Area. Debris will be removed, treated, and disposed at ERDF. Water contaminated with radionuclides will be removed, treated, and disposed of. Deactivation waste will be disposed of at ERDF. This ROD does not contain specific cleanup levels. The emptied and deactivated basins resulting from this remedial action will then be remediated under the 1999 ROD for remaining sites.

1999 ROD for 100-NR-1 and 100-NR-2. There are 81 waste sites in the 100-NR-1 Operable Unit identified as requiring interim remedial actions under this ROD (see Table 1 in the ROD, EPA 1999e). For 58 of the sites, the remove, treat, and dispose remedy was selected (37 radioactive sites, 6 inorganic waste sites, 6 burn pits, and 9 surface solid waste and miscellaneous source waste sites). Other actions for 22 petroleum sites include excavate and treat soil using ex situ bioremediation and dispose of the treated soil for 20 near-surface petroleum sites, and in situ bioremediation for two deep petroleum sites. The final site is the shoreline where institutional controls were the selected remedy. The remedy for 100-NR-2 is the continuation of a pump-and-treat system for strontium-90, which was begun as a removal action in 1995, and the capture of free-floating petroleum within any monitoring wells. Remediation of the unplanned release sites is scheduled to begin following remediation of the 100-NR-1 treatment, storage, and disposal units (see following paragraph, 2000 ROD for 100-NR-1).

1999 ROD Amendment to 100-HR-3. The remedy in this ROD amendment is in situ treatment of a chromium plume in the 100-D Area. This remedial action will install a permeable reactive barrier upgradient to groundwater discharge to the Columbia River.

2000 ROD for 100-NR-1. Approximately 600 feet of piping that is associated with the 1301-N (or 116-N-1) waste site and the 116-N-2 facility and support facilities (1322-NA, NB, NC) will be deferred until decontamination and decommissioning (D&D) of these facilities. This deferral is due to safety concerns with remediating the piping and the radiological dose exposure to remedial action workers. Remediation will require excavation of the earthen berm at the 116-N-2 facility, which provides radiological shielding. This work is scheduled to begin in 2009.

Additionally, approximately 5,600 feet of piping that is associated with 116-N-1, 105-N and 109-N facilities (part of the N Reactor facility complex) will be deferred until D&D activities of the N Reactor facility complex. This deferral is also due to safety concerns with remediating the piping. Remediation will require excavation up to foundation walls of these facilities, thus, jeopardizing the integrity of the facilities. The pipelines intersect and/or follow active underground power lines and potable water lines. Finally, remediation will block the access routes to the ongoing pump-and-treat operations at the 100-N springs and other active facilities in the 100-N Area. This work is scheduled to begin in 2011.

The deferred piping associated with the 105-N and 109-N facilities will be remediated as part of D&D of the N Reactor facility complex in accordance with TPA Milestone M-093-20.

2000 Explanation of Significant Difference for Remaining Sites ROD (specifically to 100-IU-6). The explanation of significant difference to the remaining sites added two waste sites, which were formerly part of the 300 Area, to the 100-IU-6 Operable Unit. These sites were remediated by the remove, treat, and dispose remedy for soil sites.

2000 ROD for 100 Area Burial Grounds. This ROD was issued for 45 burial grounds located in the 100 Area, and the selected remedy is to remove, treat if necessary, and dispose of contaminated soil, structures, and associated debris to the ERDF to meet the remedial action objectives in Table 1.4. Also included in the remedy is backfilling, revegetation, and institutional controls.

2003 Explanation of Significant Difference for 100-NR-1 Treatment, Storage, and Disposal Units. This explanation of significant difference was issued to consider the use of balancing factors to determine the extent of additional excavation where residual contamination exists below the engineered structure and at a depth greater than 4.6 meters (15 feet). The explanation of significant difference also revised the annual institutional control requirements in the remedy to be consistent with the reporting requirement contained in the *Site Wide Institutional Controls Plan for Hanford CERCLA Response Actions* (DOE 2002b). Based on the balancing factors analysis, additional excavation at a depth greater than 4.6 meters (15 feet) was not necessary provided irrigation was not applied. Modeling the contaminants remaining still demonstrated protectiveness of the groundwater.

2003 Explanation of Significant Difference for 100-NR-1/100-NR-2 ROD. This explanation of significant difference revised the annual institutional control requirements in the selected remedy to be consistent with the reporting requirement contained in the *Site Wide Institutional Controls Plan for Hanford CERCLA Response Actions* (DOE 2002b).

2004 Explanation of Significant Difference for Remaining Sites ROD. This explanation of significant difference was issued to add 28 waste sites, add new applicable or relevant and appropriate requirements (ARARs), and revise the annual institutional control requirements in the selected remedy to be consistent with the reporting requirement contained in the *Site Wide Institutional Controls Plan for Hanford CERCLA Response Actions* (DOE 2002b).

2005 ROD Amendment for the K Basins. The 2005 ROD Amendment for the K Basins changes the sludge disposition and how underwater debris is retrieved, treated, and disposed from both the 105-K East and 105-K West Spent Nuclear Fuel Basins. The ROD amendment requires the sludge be treated and packaged for disposal, and shipped off-Hanford to a national repository. The ROD amendment also amends the remedy for some of the debris which will remain in the basins while they are partially filled with a cement-based grout. The debris grouted in place will be removed in conjunction with removal of the basins. These changes will result in increased protection to human health and the environment.

1.4.2 Remedy Implementation

Several of the decision documents listed in Tables 1.2 and 1.3 are specific to waste sites or groundwater plumes. Most of the 100 Area decision documents, however, address types of waste sites. Remedy implementation for the source operable units are reviewed by waste site type rather than individual waste sites. Groundwater operable units are evaluated individually.

The various cleanup decision documents in the 100 Areas can be grouped into four types of cleanup actions and groundwater remediation. These include the following:

- **K Basins Spent Fuel Removal and Cleanup**. This cleanup action consists of the removal of the contents and deactivation, demolition, removal, and disposal of the K Basins structures.

- **Decontamination and Decommissioning (D&D) of Buildings**. This cleanup action consists of the D&D of buildings, and may include demolition of structures, and removal of associated debris, including any unanticipated material that was part of the engineered structure or otherwise deposited at the site; followed by treatment as necessary, and disposal to ERDF.

- **Soil Sites and Burial Ground Sites - Remove, Treat, and Dispose**. This cleanup action consists of the excavation and removal of contaminated soil, the pipelines that transported the liquid waste, structures, and associated debris, including any unanticipated material that was part of the engineered structure or otherwise deposited at the site; followed by treatment as necessary, and disposal to ERDF. Generally, this cleanup action includes institutional controls and use limitations to ensure protection of human health and the environment during and after execution of the remedy.

- **Groundwater Remediation**. This action consists of groundwater remediation which may consist of in situ bioremediation, in situ chemical treatment, pump and treat, and/or natural attenuation.

1.4.2.1 K Basins Spent Fuel Removal and Cleanup

The K Basins Closure Project is removing the spent fuel that has been stored in the fuel storage basins in the 100-K Areas for over 20 years. The project includes removal of all of the fuel and the baskets and racks in which the fuel was stored, removal of the sludge that has accumulated in the basins, removal of the water from the basins, and demolition and disposal of the basin structures. The other CERCLA actions in the 100-KE and 100-KW Areas that are being conducted under the River Corridor Project include the D&D of the ancillary buildings, placing the reactors in interim safe storage, remediating soil waste sites, and remediating the groundwater.

There are three decision documents that deal with the K Basins Closure Project:

- 1999 100-KR-2 ROD for the removal of the contents of the K Basins (EPA 1999c)

- 1999 ROD for the 100 Area Remaining Sites that directs remediation of the basins and underlying contaminated soil (EPA 1999d)

- 100-K Area ROD Amendment signed in July 2005 (EPA 2005)

The following is a status of the selected remedies for the K Basins Closure Project, listed by waste stream:

Spent nuclear fuel: Currently, most spent nuclear fuel has been removed from the basins, therefore, satisfying one of the remedial action objectives identified in the 100-KR-2 ROD. The 100-K Area ROD Amendment does not amend the remedy for this waste stream.

Radioactive sludge: The 100-KR-2 ROD directed that sludge be removed from the basins and placed in storage pending future treatment. The treatment of sludge was not included within the scope of the 100-KR-2 ROD. The 100-K Area ROD Amendment expanded the scope of the 100-KR-2 ROD by eliminating the need for extended storage of the untreated sludge and requiring that 1) the sludge be treated for disposal and 2) the treated sludge be delivered to a national repository for disposal. Implementation of these provisions in the 100-K Area ROD Amendment is currently in progress.

Water: Treatment and removal of water from the K East Basin was initiated in 2004. Removal of K West Basin water is planned following sludge removal.

Debris: The 100-KR-2 ROD directed that debris be removed, treated as required, and disposed on-site to ERDF as appropriate. The 100-KR-2 ROD did not specify the details of debris retrieval; however, the anticipated process was to be an item-by-item removal with any treatment to be done outside the basin. The 100-K Area ROD Amendment expanded the scope of the 100-KR-2 ROD by allowing some of the debris to 1) remain in the basins and be encased in grout and 2) be removed as part of the demolition and removal of the basin structure.

Deactivation: Deactivation of the basin has not yet been initiated.

Institutional controls are in place to restrict access and prevent public access until the final remedial action is completed.

There have been new ARARs introduced as appropriate for the increased scope of the 100-K Area ROD Amendment. Otherwise, there have been no changes in standards that were identified as ARARs for this remedial action. There are no deficiencies noted for the K Basins remedial action as of this review. It is recommended to continue to implement the K Basins remedial action as directed in the 100-KR-2 ROD and 100-K Area ROD Amendment.

1.4.2.2 Decontamination & Decommissioning of Buildings

The following decision documents address D&D of buildings:

- 1997 Action Memo for 100-B/C Area Ancillary Facilities and 108-F Building (EPA 1997c)
- 1998 Action Memo for 105-F and 105-DR Reactor Buildings and Ancillary Facilities (Ecology et al. 1998)
- 1998 Action Memo for 100-N Ancillary Facilities DOE et al. 1998)
- 2000 Action Memo for 105-D and 105-H Reactor Buildings and Ancillary Facilities (DOE and Ecology 2000)
- 2001 Action Memo for Hazard Mitigation at 105-B Reactor Facility (DOE and EPA 2001)

- 2005 Action Memo for 105-N Reactor Building and 109-N heat Exchanger Building
- 2005 Action Memo for 100-K Ancillary Facilities

Removal action alternatives for B Reactor were constrained to exclude any activities that could impact historical significance. The scope of the removal action required protection to be ensured for a period of up to 10 years because a DOE decision on its final configuration, which may include historical preservation of some or all of the facility structure and contents, is pending. The resulting Action Memorandum called for hazard mitigation actions to protect human health and the environment and to support public access to the 105-B Reactor facility for a 10-year period. Since issuance of the Action Memorandum, potential hazards associated with electrical and lighting systems, fresh air supply, wooden surfaces, pipes and conduits, stairways, and intrusion openings for birds and animals have been mitigated. Options for roof replacement or repair are being evaluated and will be implemented as resources become available.

Since the last five-year review, a total of 10 ancillary facilities at 100-N and 100-K have been demolished and four additional reactors and their associated ancillary facilities have undergone removal actions to put them in condition for interim safe storage. The interim safe storage completions include the reactor complexes in 100-D/DR, 100-H, and 100-F Areas.

Interim safe storage involves demolishing the reactor building down to the concrete shield walls surrounding the reactor core. All openings in the remaining structure are sealed, a new roof is constructed, and temperature and moisture sensors are installed for remotely monitoring conditions inside the sealed reactor building. Workers will enter the structure once every five years to conduct inspections and make any needed repairs.

In fiscal year (FY) 1998, the 105-C Reactor Building completed interim safe storage activities to ensure the reactor would be maintained in a safe, environmentally secure and cost effective manner until final closure could be accomplished through decommissioning (up to 75 years duration). Since completion of activities to put the reactor into condition for interim safe storage in 1998, ongoing surveillance and maintenance activities (external areas – every year and internal areas – every five years) are conducted that meet the following requirements:

- To ensure adequate confinement of hazardous substances were maintained within the Safe Storage Enclosure

- To provide physical safety and security controls for the Safe Storage Enclosure

- To verify the structural integrity of the facility

- To maintain the facilities in a manner that will minimize potential hazards to the public and workers

- To assure adequate frequency of future inspections and identify potential hazards for the 105-C Safe Storage Enclosure to maintain the operability of installed equipment and facilitate periodic surveillance and required maintenance of the enclosure

- To provide continuous remote monitoring of key functions within the facility

The general overall condition of the internal portion of the 105-C Safe Storage Enclosure in FY 2002 was found to be very similar to the original condition of the post enclosure building in FY 1998. There were two discoveries of small amounts of oil that had leaked from an overhead hoist and a valve assembly in the far-side experimental rooms. The oil leaks were cleaned up and absorbent pads placed in these areas.

It is concluded that the 105-C Safe Storage Enclosure configuration is working successfully with continuous monitoring, annual external inspections, and five-year internal inspections.

1.4.2.3 Soil Sites and Burial Ground Remediation

The following decision documents deal with remediation of contaminated soil and hazardous waste burial grounds sites in the 100 Areas:

- 1995 ROD as amended in 1997 (EPA 1995a, 1997a)
- 1999 ROD for 100-NR-1 and 100-NR-2 (EPA 1999e)
- 1999 ROD for remaining sites (EPA 1999d)
- 2000 ROD for 100-NR-1 (EPA 2000e)
- 2000 Explanation of Significant Difference for 100-IU-6 (EPA 2000a)
- 2003 Explanation of Significant Difference for 100-NR-1/100-NR-2 ROD and 100-NR-1 ROD (treatment, storage and disposal ROD) (EPA 2003b)
- 2004 Explanation of Significant Difference for remaining sites ROD (EPA 2004b)

Progress Since Last Review – 100 Areas General Soil Site Remediation. Since the last five-year review, there have been 120 waste sites remediated or closed within the 100 Areas with completion of the action approved by the lead regulatory agency. Approval is documented through approval of the waste site reclassification forms included in the waste site cleanup verification package or remaining sites verification package. The waste sites that have been remediated since the last review through September 2005 are listed in Table 1.5. Approximately 4.7 million metric tons (5.2 million tons) of soil and debris has been removed from waste sites in the 100 Area since the inception of CERCLA remediation. Waste sites in the shadow of the reactor buildings are being left in place until final disposition of the reactor building.

The observational approach that uses data collected during the remedial action to guide the extent of the excavation has been used very successfully at these waste sites. This method compares sampling data against cleanup standards to determine the physical extent of excavation required to meet the remedial action goals.

Table 1.5. Approved Waste Site Cleanup Verification Packages for the 100 Area Since the Last Five-Year Review

100-B Area	**100-D Area** (contd)	**100-H Area** (contd)
1607-B7 Sanitary Sewer System	100-F-25 Drywells	1607-H2 Septic System
1607-B8 Sanitary Sewer System	122-DR-1 Sodium Fire Facility	1607-H4 Septic System
100-B-5 Disposal Trench	132-DR-2 Reactor Exhaust Stack	116-H-7 Retention Basin
118-B-4 Burial Ground	**100-F Area**	100-H-21 Underground Pipelines
100-B-8 Underground Pipelines	100-F-29 Process Sewer Pipelines	116-H-2 Liquid Waste Disposal Trench
132-B-6 Outfall Structure	116-F-11 French Drain	100-H-1 Rod Cave
118-B-5 Burial Ground	116-F-5 Crib	100-H-22 Contaminated Soil Site
118-B-10 Ball Storage Vault	116-F-10 French Drain	100-H-30 Sanitary Sewer Trench
118-B-2 Construction Burial Ground	100-F-35 Soil Contamination Area	100-H-2 Buried Thimble Site
118-B-3 Construction Burial Ground	1607-F2 Sanitary Sewer System	100-H-17 Trench Overflow
116-B-7 Outfall Structure	116-F-2 Liquid Waste Disposal Trench	100-H-24 Substation
100-B-16 Debris Piles	116-F-1 Trench	**100-K Area**
132-C-2 Outfall	116-F-6 Liquid Waste Disposal Trench	116-KW-3 Retention Basin
100-BC-2 Operable Unit	118-F-8 Below Grade Structures and Soil	116-K-1 Crib
600-232 Electrical Laydown Area	100-F-10 French Drain	116-KE-4 Retention Basins
100-C Area	116-F-4 Crib	100-K-30 Sulfuric Acid Tank Bases
1607-B9 Sanitary Sewer System	1607-F6 Sanitary Sewer System	100-K-33 Sulfuric Acid Tank Bases
1607-B10 Septic Tank System	UPR-100-F-2 Basin Leak Ditch	128-K-1 Burning Pit
1607-B11 Septic Tank System	116-F-14 Retention Basin	100-K-31 Sulfuric Acid Tank Bases
100-C-3 French Drain	100-F-11 French Drain	100-K-32 Sulfuric Acid Tank Bases
118-C-4 Rod Storage Cave	100-F-15 French Drain	100-K-29 Sandblasting Site
100-C-6 Underground Pipelines	100-F-4 French Drain	**100-N Area**
118-C-2 Ball Storage Tank	100-F-16 French Drain	116-N-3 Crib and Trench
116-C-6 Percolation Pit	100-F-2 Strontium Garden	100-N-58 South Settling Pond
100-D Area	116-F-3 Storage Basin Trench	**100-IU-2 Operable Unit**
116-D-6 French Drain	116-F-12 French Drain	600-131 Shop and Warehouse
100-D-52 Dry Well	100-F-34 French Drain	600-139 Automotive Repair Shop
116-D-4 Crib	100-F-37 French Drain	600-201 Waste Disposal Site
116-DR-6 Liquid Waste Disposal Trench	100-F-19 Underground Pipelines	600-181 Oil Dump Site
116-DR-4 Crib	116-F-9 Leaching Trench	600-128 Oil and Oil Filter Dump Site
100-D-12 Liquid Waste Site	100-F-9 French Drain	600-132 Construction Shop Landfill
116-D-2 Crib	100-F-7 Underground Fuel Tank	600-191 Dump Site
100-D-5 Solid Waste Site	100-F-18 Drain Field	600-129 Dump Site
100-D-6 Burial Ground	100-F-14 Vent Pipe	600-98 Landfill
116-D-9 Crib	116-F-7 Crib and Pipeline	**100-IU-6 Operable Unit**
100-D-46 Burial Ground	118-F-4 Crib	600-23 Dumping Area
100-D-19 Sludge Trench	UPR-100-F-1 Sewer Line Leak	JA Jones 1 Construction Pit
UPR-100-D-4 Basin Leak Site	100-F-24 Drywell	600-110 Landfill
100-D-23 Sample Building Drywell	100-F-23 Drywell	600-204 Burn and Burial Trench
100-D-64 Stack Sampling Building	**100-H Area**	600-208 Construction Camp Ponds
118-DR-2 Below Grade Structures and Soil	100-H-5 Sludge Burial Site	**600 Area Misc**
116-D-1A & -1B Storage Basin Trenches	116-H-5 Outfall Structure	600-235 Lead Sheathed Telephone Cables
100-D-53 HEPA Filter Building	116-H-1 Liquid Waste Disposal Trench	
100-D-54 Drywell	116-H-3 French Drain	

1.4.2.4 Groundwater Remediation

The following decision documents address remediation of groundwater operable units in the 100 Areas:

- 1996 Interim ROD for the 100-HR-3 and 100-KR-4 – Hexavalent Chromium Pump-and-Treat (EPA 1996c)
- 1999 Interim ROD for the 100-KR-2 Operable Unit – Basins (Also CCN 103091) (EPA 1999c)
- 1999 Interim ROD for the 100-NR-1 and 100-NR-2 Operable Units (EPA 1999e)
- 1999 Amended ROD for the 100-HR-3 Operable Unit – In Situ Redox Manipulation (EPA 1999a)
- 2003 Explanation of Significant Difference for the 100-HR-3 Operable Unit ROD (EPA 2003a)

Progress Since Last Review – 100 Areas General Groundwater Remediation. Chromium has migrated to the groundwater from soil site sources, resulting in soil and groundwater contamination. Since shut-down of the reactors, the once-large groundwater chromium plumes have shrunk to become discrete plumes downgradient of the soil discharge sites. Test pits, boreholes, and aquifer response to rising water table associated with high river stage in the 100 Area have documented that chromium is present in the deep vadose zone. In 100-D Area, all of the sources of contamination in the vadose zone are yet to be identified and delineated. It is typical in the 100/300 Areas to observe increased contamination levels in the groundwater following sustained high Columbia River water levels. The high river water levels raise the groundwater table and wet portions of the deep vadose zone. These temporary wettings of the contamination in the deep vadose zone then result in pulses of contamination in the groundwater. This suggests that these deep vadose zone chromium residues continue to act as a reserve for future contamination of the groundwater.

DOE has initiated a series of technology improvements designed to better identify, understand and remediate the sources of chromium in the 100 Area soils that may be impacting groundwater. There are also projects to evaluate groundwater remediation technologies. These projects can be found at http://www.hanford.gov/cp/gpp/science/em21.cfm.

1.4.2.5 River Corridor Baseline Risk Assessment

Since the last review, a human health and ecological risk assessment was initiated to evaluate post-remediation conditions of source waste sites and current conditions in groundwater, the riparian zone, and the near shore of the Columbia River. DOE prepared and received regulatory approval of a *Risk Assessment Work Plan for the 100 Area and 300 Area Component of the RCBRA* (DOE 2005g). DOE, with technical assistance from Hanford Natural Resource Trustee representatives, went through a data quality objective process and produced and received regulatory approval of *100 Area and 300 Area Component of the RCBRA Sampling and Analysis Plan* (DOE 2006a). Using existing data gathered at the completion of waste site remediation prior to backfill and supplemental data to be gathered under the sampling and analysis plan, a risk assessment report will be produced. A TPA milestone was established during the approval process of the work plan (DOE 2005g) to submit the risk assessment report to the EPA and Ecology for review by June 30, 2007.

1.4.3 100-B/C Area

1.4.3.1 100-B/C Area Soil Site Remediation

Ground surface remedial action activities began in the 100-B/C Area in 1996. All of the high-priority 100-B/C Area liquid waste sites, including cribs, ditches, trenches, and retention basins, have been remediated and backfilled with clean soil. Remediation of the 100-B/C solid waste burial grounds was initiated during the review period and significant progress has been made, with eight of the ten burial grounds completed by the end of FY 2005. Burial grounds 118-B-1 and 118-C-1 are scheduled to be completed in 2006. Spent nuclear fuel and other unanticipated waste materials have been discovered in these two sites, initially halting 100-B/C remediation activities and subsequently slowing progress on phases of the work. Safe and appropriate handling, treatment, and disposal solutions for the unanticipated waste have been developed and are being openly reviewed and discussed with the regulatory authorities. There is the potential that schedule delays associated with the discovery of this unanticipated waste could adversely impact achievement of the current TPA milestone completion date.

The 100-B/C Pilot Project Risk Assessment was initiated in April 2002 to develop a process to evaluate the protectiveness of remedial actions performed for the 100-B/C Area operable units with the intent that lessons learned would be applied to subsequent risk assessments performed within the River Corridor. The pilot completed characterization but is not being pursued to completion as a stand alone assessment. Rather, it is being integrated into the River Corridor Baseline Risk Assessment described above.

During excavation of the 100-C-7 waste site in the south-central 100-B/C Area, chromium contamination remained at the bottom of the excavation. A characterization borehole was drilled in August 2005 to determine the depth of contamination. A grab sample of groundwater showed low but detectable concentrations of chromium. Details and additional evaluation of results are pending. Discussions with regulatory authorities may be required, and TPA Milestone M-16-45 could be affected. Draft results from the B/C Pilot will be carried forth and finalized in the 100 and 300 Areas risk assessment due in 2007.

1.4.3.2 100-B/C Area Groundwater Remediation

Based on the outcome of the limited field investigation, it was determined that interim remedial measures for contaminants of concern in this operable unit were not warranted. The recommended course of action was to continue monitoring groundwater until source remedial actions are complete, then re-evaluate the risk associated with groundwater.

A conceptual site model for the 100-B/C Area was completed in 1996, identifying contaminants of potential concern. This model was updated and constituents of concern for groundwater monitoring were identified in a data quality objectives process in 2003. The results fed into the 2004 revision of the sampling and analysis plan.

The following progress has been made in the 100 B/C Area within the 100-BC-5 Operable Unit, since the last review:

- The drinking water standard for chromium is 100 μg/L and the aquatic standard for hexavalent chromium in surface waters is currently 10 μg/L. Initial hexavalent chromium concentrations in 100-B/C Area groundwater were very close to or exceeded the drinking water standard. During the past five years, hexavalent chromium contaminant concentrations have been steady or declining. Recent measured concentrations have ranged from below detection to approximately 20 to 30 μg/L Chromium concentrations exceeded 20 μg/L in several wells in the north 100-B/C Area. However, the limited extent of chromium-contaminated groundwater and declining concentrations support the decision to take no additional interim remedial measures.

- Figure 1.8 shows the distribution of dissolved chromium at the top of the aquifer in year 2005. Concentrations are below the 100-μg/L drinking water standard, but exceeded 20 μg/L in several wells in the north 100-B Area.

- Chromium concentrations in aquifer tube sites located along the 100-B/C Area shoreline have had a maximum concentration of 115 μg/L detected in 1999. Results in November 2004 were between 22 and 33 μg/L; these values were improved but were still above the 10 μg/L aquatic standard.

- Strontium-90 concentrations in the 100-B/C Area have ranged from 39 to 170 pCi/L between year 2005 in a well down gradient from the 116-C-1 trench. Figure 1.9 show strontium-90 distribution in year 2005. Strontium-90 is limited to the top of aquifer. It has been consistently detected in shallow and mid-level aquifer tubes where concentrations have declined to 11 pCi/L in November 2004. However, none has been detected in deeper wells or in deep aquifer tubes.

- The strontium-90 plume in groundwater is wedge-shaped, with an apex in the central 100-B/C Area, extending and spreading north toward the Columbia River. The concentration of strontium-90 has exceeded the drinking water standard of 8 μg/L. It has not changed significantly in the past 10 years. Strontium-90 concentrations are neither increasing nor decreasing in monitoring wells.

- The uppermost aquifer beneath the 100-B/C Area is contaminated with tritium, which has exceeded the 20,000-pCi/L drinking water standard in several wells and aquifer tubes. Data from 2005 show increased concentrations in monitoring wells and aquifer tubes. The 2005 data shows a portion of the plume exceeding the drinking water standard near the 118-B-1 burial ground.

- Several wells in the 100-B/C Area showed sharp spikes in tritium concentration in the late 1990s, with subsequently declining levels. This pattern was observed in wells throughout the 100-B/C Area. Tritium increased sharply to 161,000 pCi/L during 2005 in a well located between the reactor buildings and the 116-C-5 retention basins. This is significantly lower than the peak in the late 1990s; the cause of either peak is unknown.

- Tritium concentrations have declined in aquifer tubes located just east of the 100-B/C Area. Concentrations were near or at the drinking water standard. Tritium east of the 100-B/C Area is believed to represent a plume from the 200 Areas that migrated northward.

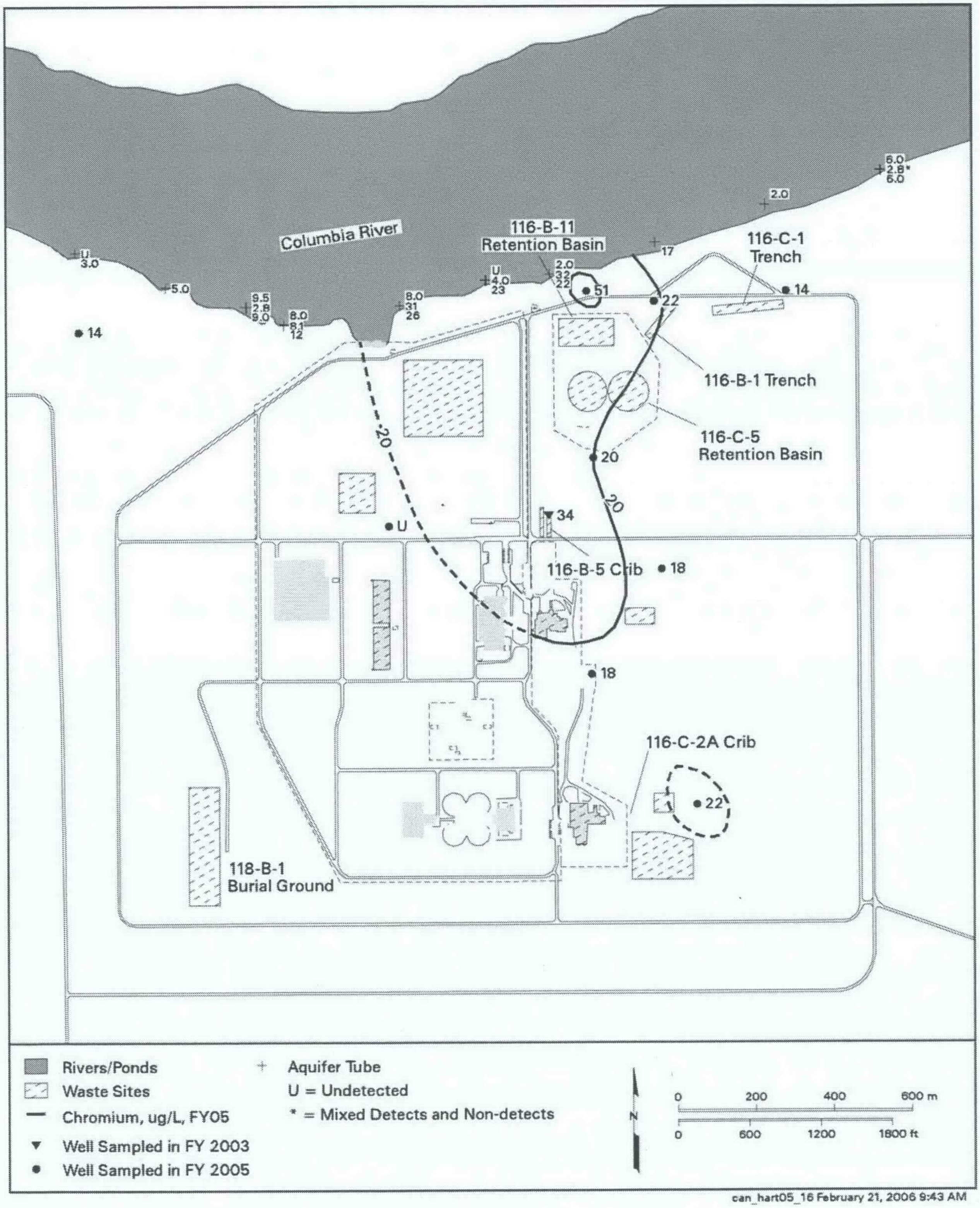

Figure 1.8. Average Dissolved Chromium Concentrations in 100-B/C Area – 2005

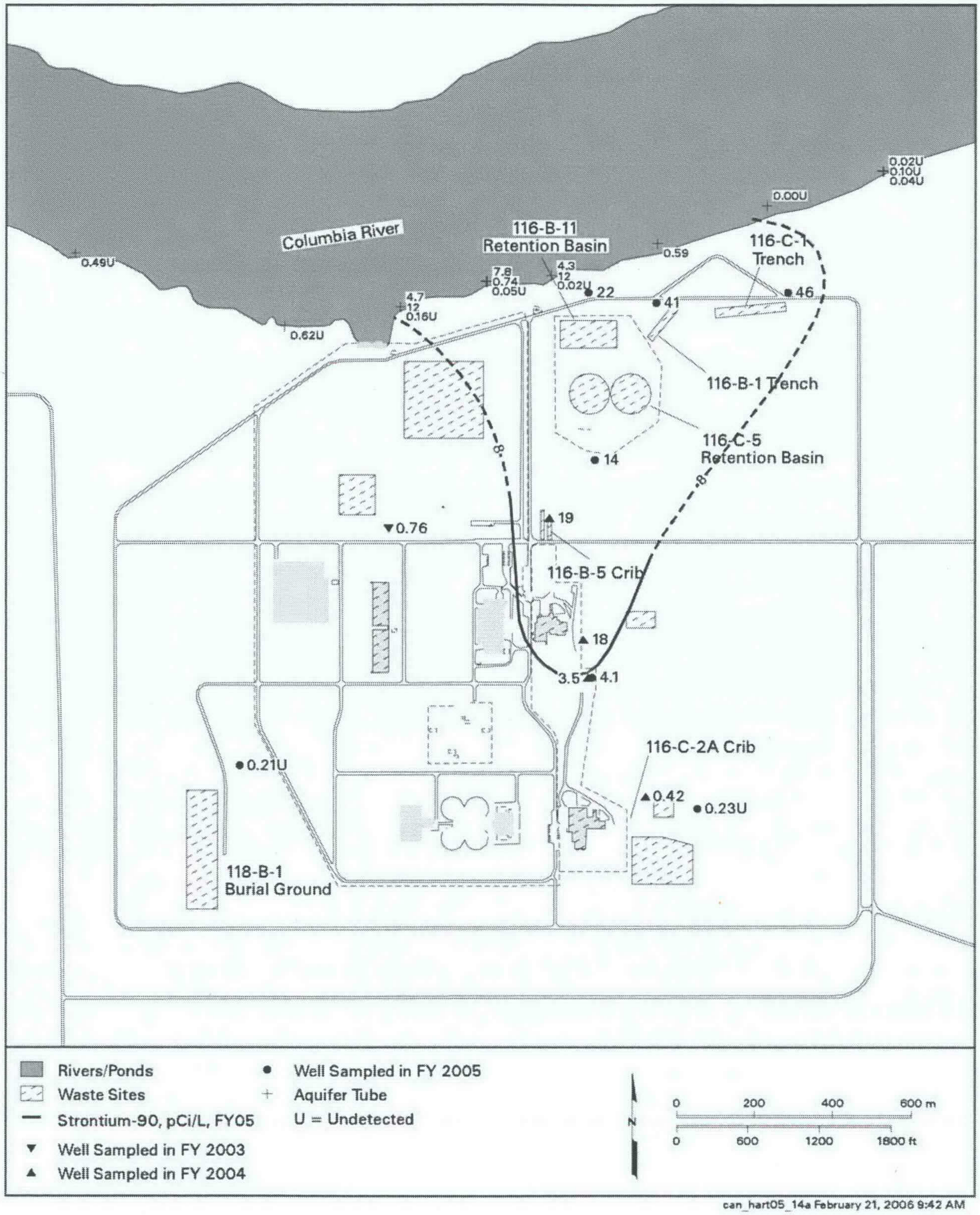

Figure 1.9. Strontium-90 Plume Concentrations in 100-B/C Area – 2005

1.4.3.3 100-B/C Area Technical Assessments

A ROD for groundwater remediation has not been established for this area. Previous assessments have not identified groundwater conditions that warrant interim remedial measures, assuming that the source control measures will meet established remedial action objectives designed to reduce contaminant recharge to the aquifer.

Increasing tritium concentrations have been observed in well 199-B5-2. The amount of time this has been observed and the levels of contamination have not yet justified an immediate action. Monitoring and assessment of this plume will continue.

1.4.3.4 100-B/C Area Issues and Actions

No issues or actions specific to the 100-B/C Area were identified during the review.

1.4.4 100-K Area

1.4.4.1 100-K Area Soil Site Remediation

Two separate types of CERCLA actions are ongoing in the 100-KE and 100-KW Areas. The K Basins Closure Project is removing the spent fuel that has been stored in the fuel storage basins in the 100-K Areas for over 20 years. The project includes removal of all the fuel and the baskets and racks in which the fuel was stored, removal of the sludge that has accumulated in the basins, removal of the water from the basins, and demolition and disposal of the basin structures. The other CERCLA actions in the 100-KE and 100-KW Areas that are being conducted under the River Corridor Project include D&D of the ancillary buildings, placing the reactors in interim safe storage, remediating soil waste sites, and remediating the groundwater.

All but one of the high-priority 100-K Area liquid waste sites including cribs, ditches, trenches, and retention basins have been remediated and backfilled with clean soil. Backfill of the 116-K-2 waste site will be completed in 2006. The 116-KE-1 and 116-KW-1 condensate cribs were partially remediated in an effort to reduce elevated tritium levels in the groundwater. Remediation of the solid waste burial grounds will be initiated in 2006.

1.4.4.2 100-K Area Groundwater Remediation

The following progress has been made in 100-K Area within the 100-KR-4 Groundwater Operable Unit since the last review and includes system operations and operation and maintenance information as applicable.

- Some chromium concentrations in the groundwater north and east of the 100-K Area continue to decline as a result of pump-and-treat operations.

- Continued expansion of the extraction and monitoring network has been required to enhance plume capture and verify performance.

The extent of the chromium contamination in the groundwater within the 100-K Area is shown in Figure 1.10.

1.4.4.3 100-K Area Technical Assessment

The 100-K Area pump-and-treat system was intended to contain the groundwater chromium plume while the waste sites were remediated. The primary remedial action objective is to prevent the discharge of hexavalent chromium to the Columbia River substrate at concentrations exceeding those that are considered protective of aquatic life in the river and river bed sediments. The following assessment was made with respect to the groundwater in the 100-K Area:

- The chromium concentrations at well 199-K-18 have steadily increased, even though this well is located at the west end of the capture zone of the pump-and-treat system.
- Both strontium-90 and carbon-14 contaminants appear to be highly concentrated in the groundwater near liquid waste disposal sites adjacent to the 100-K East and 100-K West Reactors.
- Portions of the 100-K Area groundwater contaminated with strontium-90 and carbon-14 are likely to require future use restrictions.
- Tritium concentrations are likely to remain well above the maximum contaminant level in the groundwater adjacent to 100-K East Basin and the 118-K-1 burial ground until well after the sources are removed.
- The northeast end of the plume resulting from disposal of hexavalent chromium into the mile-long trench is not being captured sufficiently to meet the primary remedial action objective. This poses a potential for current local ecological risk.
- The existing 300 gpm pump-and-treat system is insufficient.
- There is a plume of hexavalent chromium downgradient of the 100-KW Reactor that has reached the river and poses a current local ecological risk resulting in the initiation of the construction of a new pump-and-treat system.

Further information regarding the performance of the groundwater pump-and-treatment systems can found in the annual summary report (DOE 2005e).

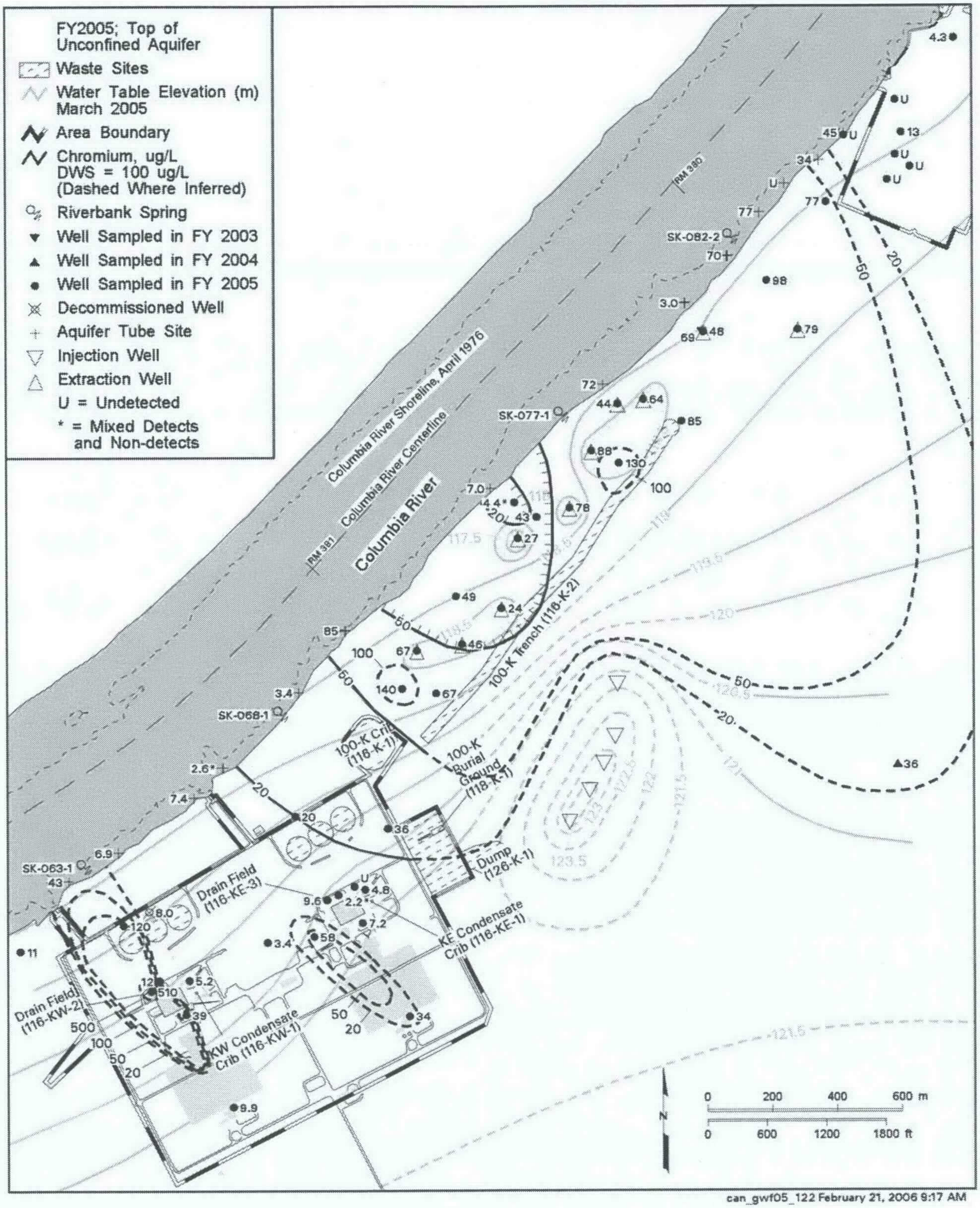

Figure 1.10. Chromium Groundwater Plume in 100-K Area – 2005

1.4.4.4 100-K Area Issues and Actions

- **Issue 3**. The southeastern (inland) extent of the chromium groundwater plume from the 116-K-2 trench, northeast of the current injection wells, has not been delineated.

  - **Action 3-1**. Install three additional wells to further delineate the southeastern (inland) extent of the chromium groundwater plume from the 116-K-2 trench, northeast of the current injection wells. Wells installed as part of the pump-and-treat system expansion or injection well relocation may count towards this effort if appropriately located.

- **Issue 4**. The small chromium plume at 100-KW Reactor site has reached the river, as evidenced by near-shore aquifer tubes. There is currently no active remediation system in place for the small chromium plume at the 100-KW Reactor site. Therefore, construction of a new pump-and-treat system has been initiated in response to this condition.

  - **Action 4-1**. Construct a new pump-and-treat facility to the address the chromium groundwater plume in the KW Reactor area.

- **Issue 5**. Groundwater monitoring indicates that the expansion of the 100-K East pump-and-treat extraction system has not yet achieved the remedial action objective.

  - **Action 5-1**. Expand the 100-K East pump-and-treat system by 378.5 liters (100 gallons) per minute to enhance remediation of the chromium plume between the 116-K-2 and the N Reactor perimeter fence.

  - **Action 5-2**. Connect additional wells for extraction between the 116-K-2 trench and the N Reactor perimeter fence to the pump-and-treatment system.

1.4.5 100-N Area

1.4.5.1 100-N Area Soil Site Remediation

Remediation activities for the 120-N-1 and 120-N-2 as specified in the closure sections of the RCRA permit have been completed. Closure activities consisted of excavation and disposal followed by verification sampling of remaining soils. Verification sample results confirm residential cleanup levels were achieved for these sites. Groundwater contamination attributed to these facilities remains above the secondary drinking water standard for sulfates. Continued groundwater monitoring is required by the RCRA permit.

Modeling of deep zone contamination beneath the 116-N-1 site indicated potential impacts to groundwater if the rural residential exposure scenario with 76 centimeters (30 inches) of annual irrigation was used. After public meetings, an explanation of significant differences was issued by the Tri-Parties to evaluate risk assuming no irrigation at this site and require an additional institutional control restricting irrigation.

1.4.5.2 100-N Area Groundwater Remediation

Significant progress has been made in evaluating alternative remedial technologies and evaluating the ecological conditions at 100-N. The extent of the strontium-90 groundwater contamination within the 100-N Area is shown in Figure 1.11.

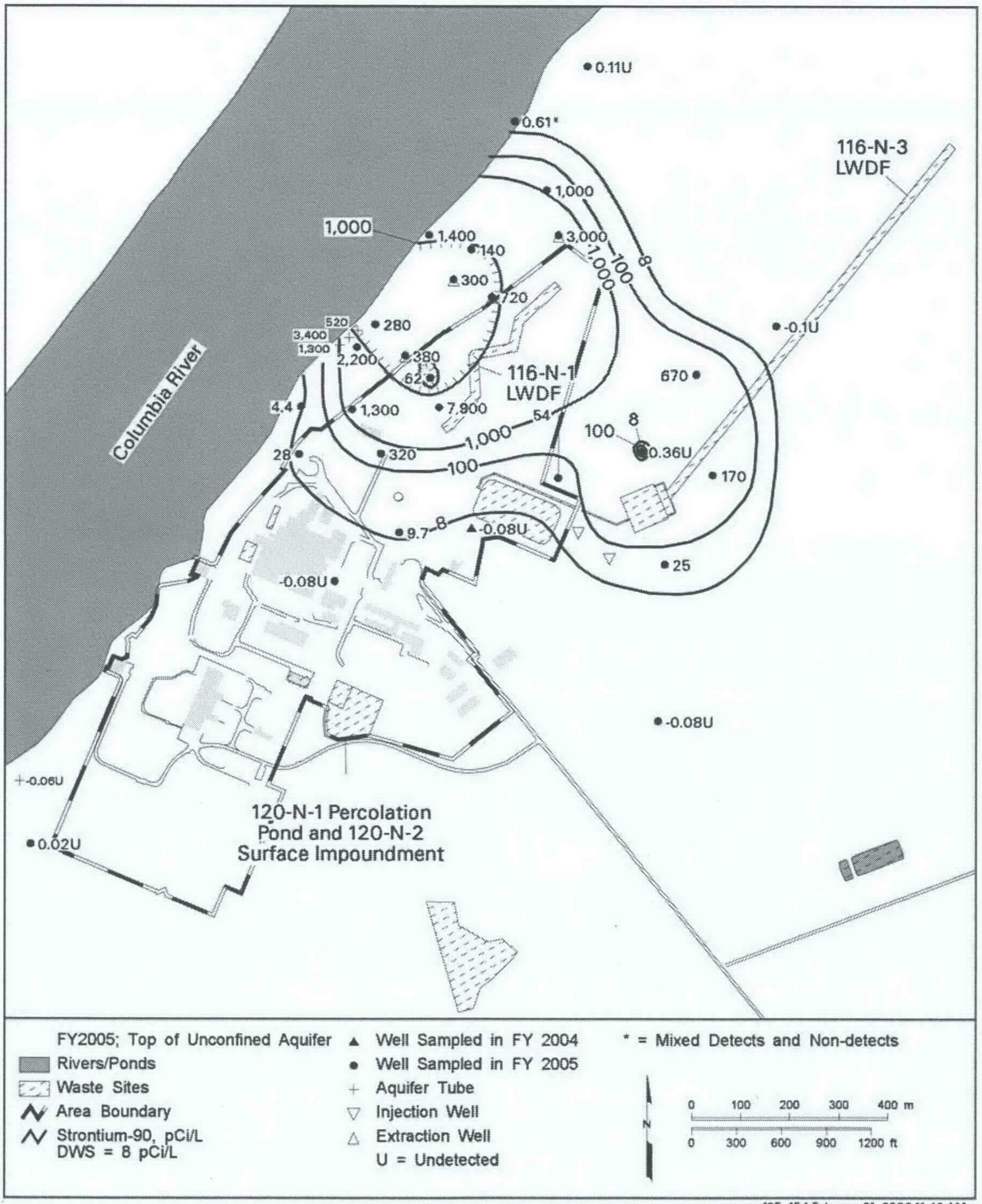

Figure 1.11. Strontium-90 Groundwater Plume in 100-N Area – 2005

1.4.5.3 100-N Area Technical Assessments

The 100-N Area pump-and-treat system was intended as an interim action, to provide some environmental protection while more efficient remedial technologies were identified and deployed. At a pumping rate of 227 liters (60 gallons) per minute, the pump-and-treat system extracts approximately 0.2 Ci/year, which is about ten times less than the amount removed by radioactive decay of the strontium-90 stored in the aquifer (DOE 2003b). In addition to this relatively inefficient (1:10) effect of the pump-and-treat system, it has been difficult to demonstrate if the hydraulic control provided by the pump-and-treat system also reduces the flux of strontium-90 to the Columbia River. A reduction in the flux is one of the ROD objectives. It has also been difficult to evaluate the degree of protection that the pump-and-treat system provides to the aquatic and riparian eco-system. An ecological impact assessment report has been submitted. Data indicate that strontium-90 concentrations at the river's edge have not been impacted by the pump-and-treat system.

A 2001 evaluation of potential technologies has resulted in a DOE proposal to test a chemical injection barrier in the near-shore aquifer. The barrier could reduce the flux of strontium-90 to the Columbia River environment by sequestering (chemically binding) the radioactive strontium-90. If the barrier technological proves successful, it could replace the interim action pump-and-treat system. Phytoremediation, as a "polishing" step to the barrier, is also being tested. As the barrier is designed to operate as a natural gradient passive reactive barrier, the pump-and-treat system has been placed in a cold stand-by configuration. Extraction, injection, and monitoring wells associated with the pump-and-treat system are also being maintained in cold standby status.

Further information regarding the performance of the groundwater pump-and-treatment systems can found in the annual summary report (DOE 2005e).

DOE has obtained some new ecological data; studies are ongoing and scheduled to be completed in 2008. The 100-N ecological data published in *Aquatic and Riparian Receptor Impact Information for the 100-NR-02 Groundwater Operable Unit* (DOE 2006b) is consistent with previously identified data and analyses that the pump-and-treat system, operating in that location for the last ten years, has not appreciably reduced the strontium-90 concentrations in groundwater that upwells into the Columbia River. The permeable reactive barrier currently being tested at 100-N Area is being designed to meet a goal of ninety percent reduction of strontium-90 concentrations at the river's edge. Further discussion with regulators, tribes, and stakeholders is necessary before DOE can articulate what further work will be done and the schedule for performing such work. Any further ecological work at 100-N Area will be integrated into the overall 100/300 Areas ecological risk studies that are currently being planned.

1.4.5.4 100-N Area Issues and Actions

- **Issue 6**. The pump-and-treat system is ineffective and inefficient in reducing the flux of strontium-90 to the Columbia River, providing only a fraction (1:10) of the protection provided by natural radioactive decay. The degree of protection provided by hydraulic control from the pump-and-treat is unproven.

  - **Action 6-1**. Implement the treatability test plan for permeable reactive barrier utilizing apatite sequestration as described in the *Strontium-90 Treatability Test Plan for 100-NR-02 Groundwater Operable Unit* (DOE 2005c). Issue Treatability Test Report.

- **Issue 7**. Additional ecological data is needed to assess the interim actions prescribed within the record of decisions and to develop final cleanup standards. The extent of shoreline water quality impacts related to the diesel spill that occurred circa 1963 are not well known.

  - **Action 7-1**. Perform additional data collection to support risk assessment, provide to Ecology previously collected data, and coordinate with River Corridor sampling efforts to collect additional pore water data from new and existing aquifer tubes along the 100-NR-2 shoreline in order to assess water quality impacts.

1.4.6 100-D Area

1.4.6.1 100-D Area Soil Site Remediation

During the past five years, DOE attempted, without success, to find a chromium source in 100-D Area. Due to the groundwater contamination in the 100-HR-3 Operable Unit, Ecology requested DOE to perform additional 100-D Area source characterization in soil at the rail line that runs east from the sodium dichromate station. The investigation included 12 test pits and nearly 116 soil samples. The sampling did not identify a vadose zone source of hexavalent chromium. An extensive effort was recently made to conduct historical research review of documents, photographs, and construction drawings to investigate sodium dichromate use in the 100-D/DR Reactor Area. This investigation identified at least 31 potential point source locations for sodium dichromate contamination, including ten primary potential sources. Additional characterization activities are planned in calendar year 2007 to find chromium sources.

Remediation at high-priority 100-D Area liquid waste sites was completed before the term of this five-year review; previously excavated sites were backfilled and re-vegetated during the period ending September 30, 2005. Remediation activities for all remaining soil sites and burial grounds are scheduled to be initiated in the summer of 2006.

1.4.6.2 100-D Area Groundwater Remediation

The following progress has been made in the 100-D Area within the 100-HR-3 Operable Unit, since the last review. The extent of the chromium groundwater plume is shown in Figure 1.12.

Pump-and-Treat Operations

- Since 1997, pump-and-treat operation is carried out only in selected portions of the entire chromium plume in the 100-D Area. The location of the remedial action is based on the highest concentration and the Tri-Parties agree that they need a better understanding of the nature and extent of the chromium plume in the area. Since startup of the 100-HR-3 treatment system, the total mass of hexavalent chromium removed from the 100-D Area through June 2005 was 215 kilograms (474 pounds). The system had processed approximately 1,239 million liters (327 million gallons) of groundwater. The 100-HR-3 pump-and treat-system was operational over 95% of the time removing chromium at an acceptable level. In addition, the 100-DR-5 system has treated about 46.2 million liters (12.2 million gallons) of groundwater through the end of FY 2005 and removed about 45 kilograms (99 pounds) of dissolved chromium.

- Since 2001, three compliance wells show a general decline from a maximum of approximately 400 µg/L 200 µg/L, 150 µg/L, respectively, to about 100 µg/L.

- Maximum concentrations in the area of the original 100-D Area pump-and-treat plume have been reduced to between 250 µg/L and 500 µg/L.

- Approximately 80% of the pressurized water lines in the 100-D Area have been cut and capped, greatly reducing potential water line leakage as a contaminant driving force.

In Situ Redox Manipulation Barrier

The pilot scale test for the in situ redox manipulation barrier proved the feasibility of the concept, and the treatment zone was constructed between 1999 and 2003 to a length of 680 meters (2,231 feet). However, some sections of the barrier test have required multiple injections of sodium dithionite to maintain a reducing environment. The barrier has experienced breakthrough in some of the wells. Technologies are planned to be tested that are designed to augment the barrier performance.

1.4.6.3 100-D Area Technical Assessment

The 100-D Area pump-and-treat system was intended to contain the groundwater chromium plume while the waste sites were remediated. The following assessment was made with respect to the groundwater in the 100-D Area:

- Leakage of raw water from the 182-D reservoir has perturbed groundwater flow and may have impacted remediation efforts. Administrative controls on reservoir operation (instituted in 2004) have significantly reduced the leak rate.

Further information regarding the performance of the groundwater pump-and-treatment systems can found in the annual summary report (DOE 2005e).

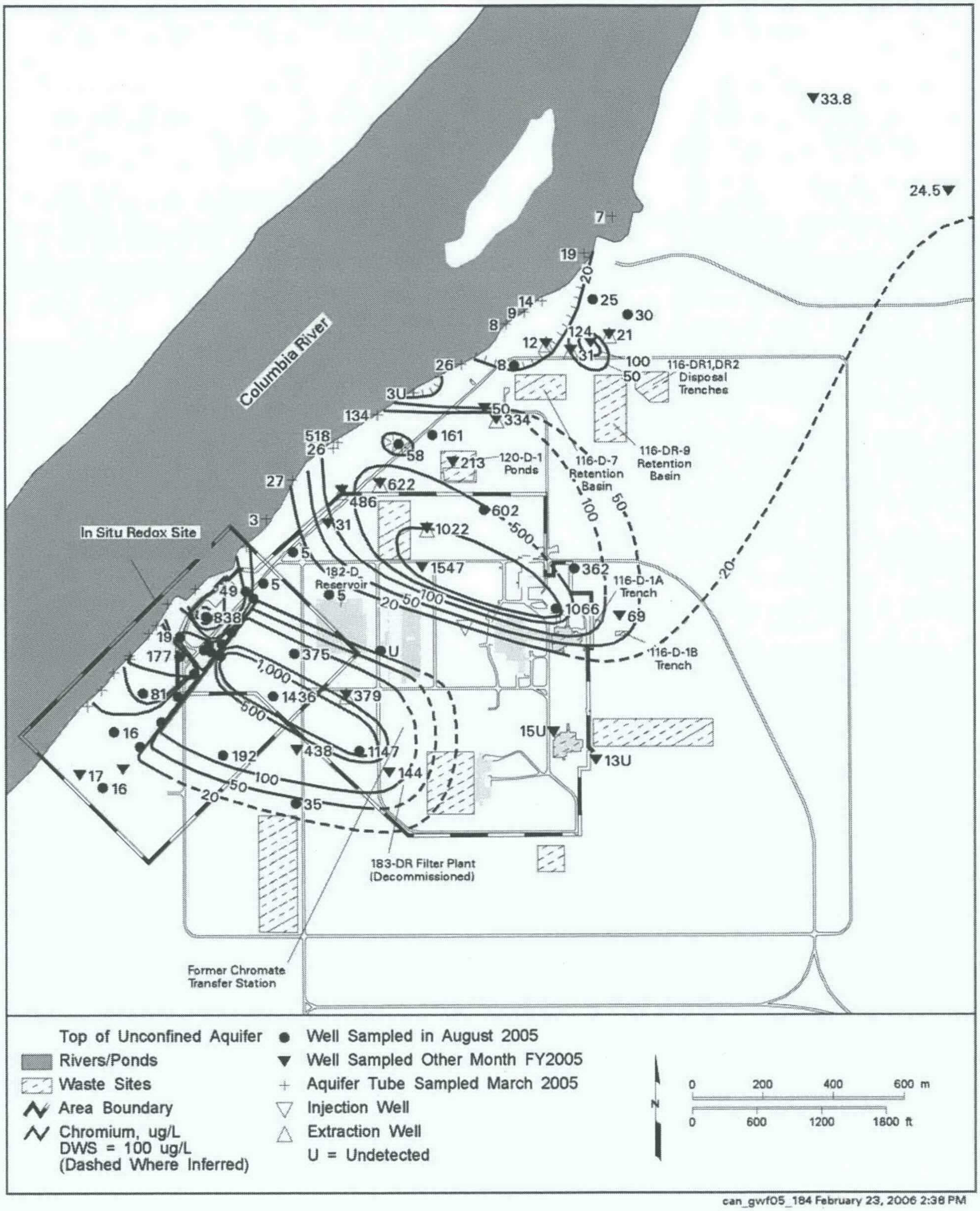

Figure 1.12. Chromium Groundwater Plume in 100-D Area – 2005

1.4.6.4 100-D Area Issues and Actions

- **Issue 8**. Groundwater monitoring data indicates there is an unidentified chromium vadose source in the 100-D Area near the demolished 190-DR clear wells.
  - **Action 8-1**. Complete a field investigation to investigate additional sources of chromium groundwater contamination within the 100-D Area. Additional geologic and geochemical investigations of the vadose zone in the 100-D Area.

- **Issue 9**. There is less than adequate data to characterize potential chromium groundwater contamination between the 100-D and 100-H Areas (Figure 1.13), in the area known as the "horn."
  - **Action 9-1**. Perform additional characterization of the aquifer for chromium contamination between the 100-D and 100-H Areas, in the area known as the "horn," and evaluate the need to perform remedial action to meet the remedial action objectives of the 100-D record of decision for interim action. This issue will also be addressed in the final record of decision.
  - **Action 9-2**. Incorporate the "horn" area into the 100-HR-3 Interim ROD treatment zone if Action 9-1 indicates "horn" contains a groundwater chromium plume that needs immediate remediation.

- **Issue 10**. Some of the groundwater wells near the 182-D reservoir show conductivity values similar to values expected for raw water indicating some leakage from the reservoir.
  - **Action 10-1**. Issue direction to the operating contractor to change operations to further minimize leakage from the 182-D reservoir.

- **Issue 11**. Groundwater monitoring indicates that the 100-D Area treatments systems have not yet achieved the remedial action objective. A few wells within the in situ redox manipulation barrier have shown break through much sooner than expected. Monitoring also indicates that the pump-and-treat system is not fully capturing the chromium plume.
  - **Action 11-1**. Initiate limited iron amendments to the in situ redox manipulation barrier to evaluate whether this enhances the performance.
  - **Action 11-2**. Expand groundwater pump-and-treat extraction within the 100-D Area by 378.5 liters (100 gallons) per minute to enhance remediation of the chromium plume.

1.4.7 100-H Area

1.4.7.1 100-H Area Soil Site Remediation

Remediation of all the high-priority 100-H Area liquid waste sites, including cribs, ditches, trenches, and retention basins has been initiated. While the all the high-priority units have been backfilled, contamination remains (i.e., vadose zone and groundwater) associated with the 183-H Solar Evaporation Basins and post-closure maintenance of the unit is required. Due to groundwater contamination in the 100-HR-3 Operable Unit, DOE performed additional 100-D Area source characterization in soil at the rail line that runs west from the sodium dichromate station. The investigation included 12 test pits and approximately 116 soil samples. The sampling did not identify a shallow vadose source of hexavalent chromium in this area. The samples collected for this study were taken from the shallow zone to a depth of 3.7 meters (12 feet). Hexavalent chromium was found at greater depth during sampling at railway tracks in the 100-B/C Area.

1.4.7.2 100-H Area Groundwater Remediation

The pump-and-treat operation is carried out only in selected portions of the entire chromium plume in the 100-D Area. The location of the remedial action is based on the highest concentration. The Tri-Parties agree that they need a better understanding of the nature and extent of the chromium plume in the area. The following progress has been made in 100-H Area within the 100-HR-3 Groundwater Operable Unit since the last review and includes system operations and operation and maintenance information as applicable.

- Chromium concentrations in the upper most aquifer throughout the 100-H Area groundwater plume continue to decline and are below the drinking water standards. These reductions in both concentration and aerial extent are a result of nearly ten years of pump-and-treat operations. Chromium concentrations in three of four near-river compliance wells continue to decline but are still above the aquatic protection criteria. Several of the aquifer tubes have achieved the aquatic protection criteria while other continue to decline and are approaching the criteria.

- Secondary contaminants uranium, technetium-99, and nitrate have also declined, with only a few wells now exceeding the maximum contaminant limits. Strontium-90 also exceeds the maximum contaminant levels in isolated wells adjacent to 107-H basins. Concentrations of all these contaminants are expected to decline to acceptable levels through natural processes.

The extent of the chromium contamination in the groundwater within the 100-H Area is shown in Figure 1.14.

1.4.7.3 100-H Area Technical Assessment

Further information regarding the performance of the groundwater pump-and-treatment systems can found in the annual summary report (DOE 2005e).

- All major chromium soil waste sites within 100-H Area have been remediated. These actions in conjunction with the pump-and-treat operations have restored much of the groundwater beneath 100-H Area to potential beneficial use status.

- The current remediation does not include a portion of the chromium plume (e.g., northern portion toward the Columbia River shoreline "horn" and northwest; see Figure 1.13). This area needs to be addressed through proper characterization, delineation/evaluation, and appropriate remediation.

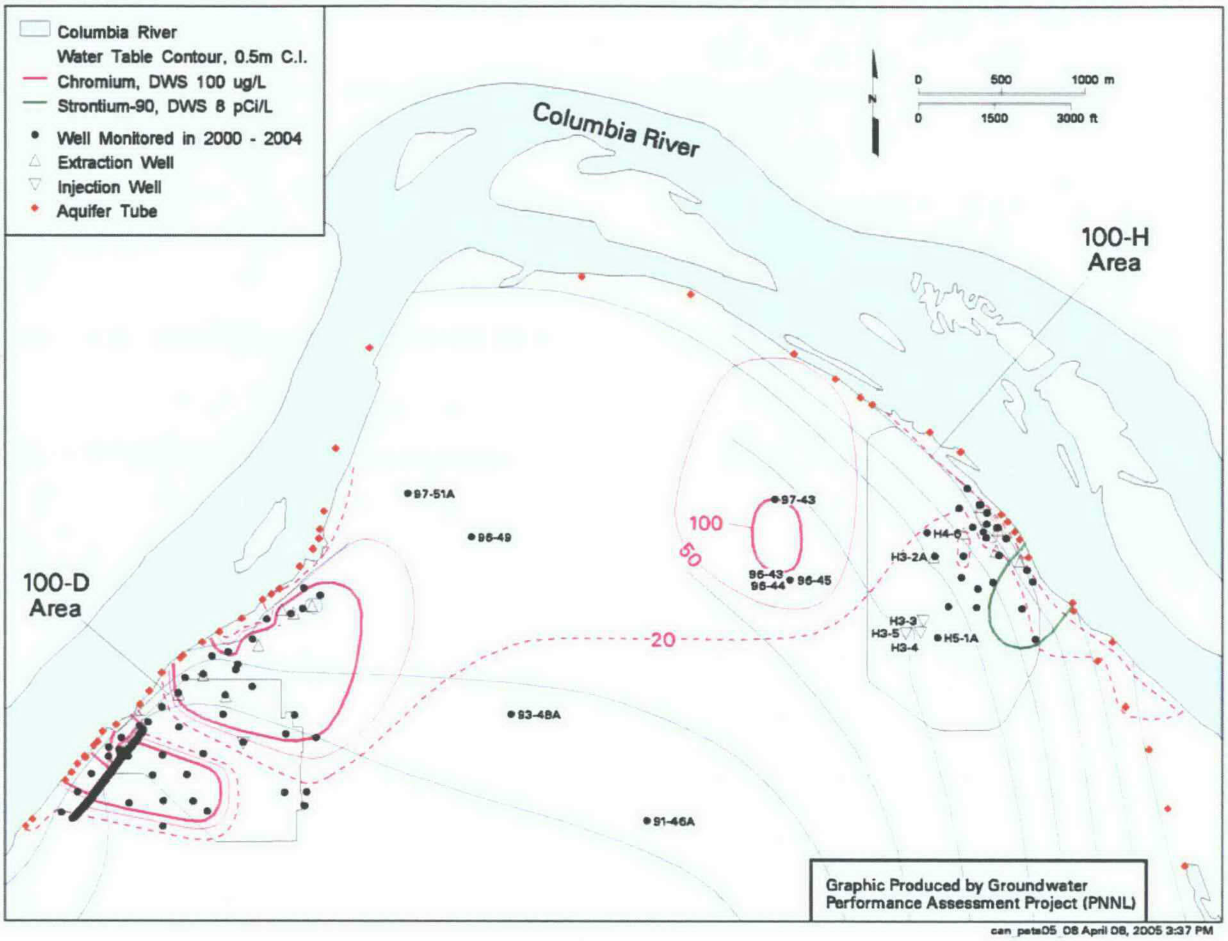

Figure 1.13. Area between 100-D and 100-H Areas known as the "Horn"

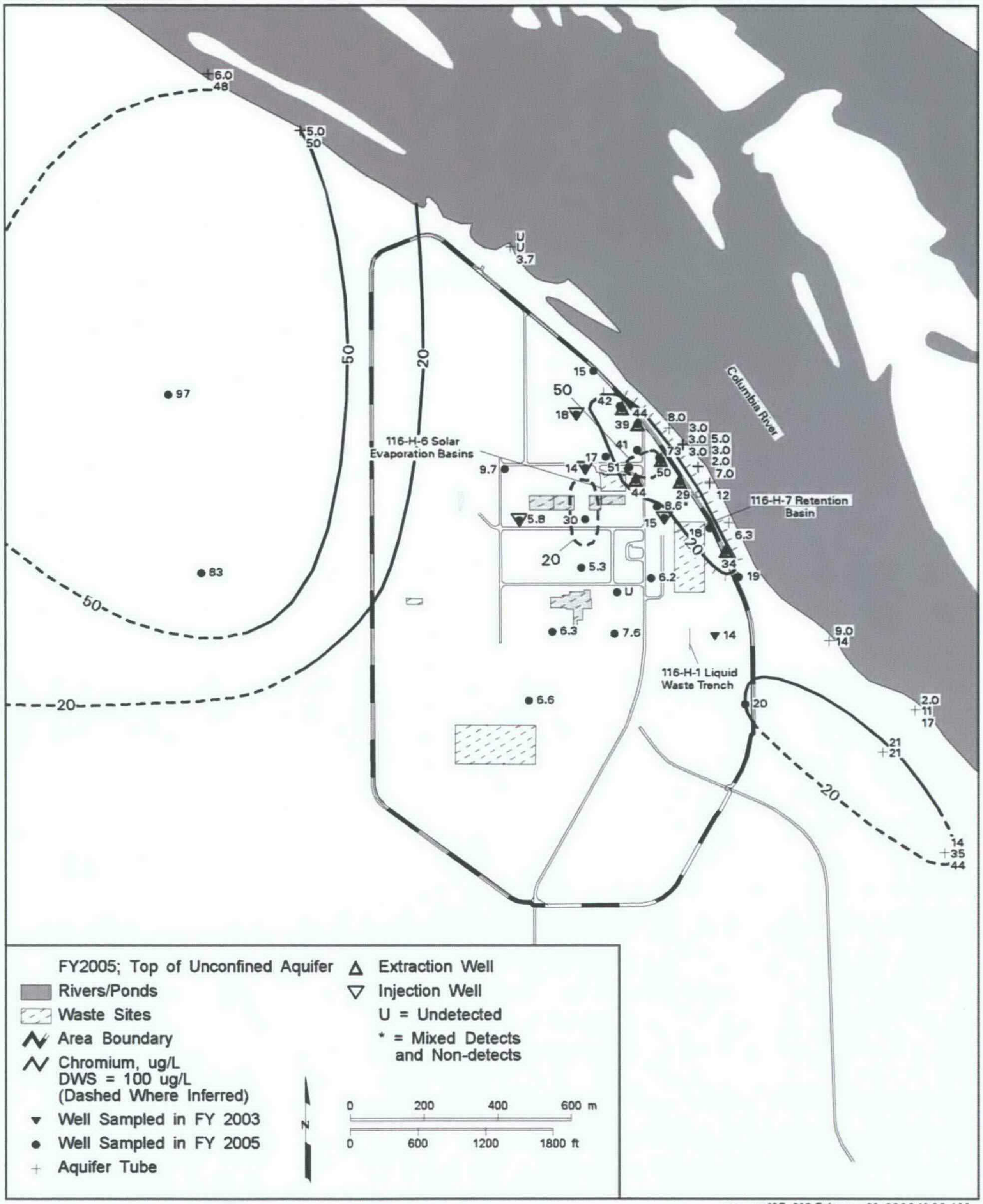

Figure 1.14. Chromium Groundwater Plume in 100-H Area – 2005

1.4.7.4 100-H Area Issues and Actions

- **Issue 9**. There is less than adequate data to characterize potential chromium groundwater contamination between the 100-D and 100-H Areas (Figure 1.13), in the area known as the "horn."
  - **Action 9-1**. Perform additional characterization of the upper confined aquifer for chromium contamination between the 100-D and 100-H Areas, in the area known as the "horn," and evaluate the need to perform remedial action to meet the remedial action objectives of the 100-D record of decision for interim action. This issue will also be addressed in the final record of decision.
  - **Action 9-2**. Incorporate the "horn" area into the 100-HR-3 Interim ROD treatment zone if Action 9-1 indicates "horn" contains a groundwater chromium plume that needs immediate remediation.
- **Issue 12**. Groundwater samples from one deep well extending below the aquitard exceed the drinking water standard (100 μg/L) for chromium. The extent of chromium contamination in this zone is not well understood.
  - **Action 12-1**. Perform additional characterization of the aquifer below the initial aquitard.

1.4.8 100-F Area

1.4.8.1 100-F Area Soil Site Remediation

All of the high-priority 100-F Area surface cleanup action liquid waste sites, including cribs, ditches, trenches, and retention basins, have been remediated and backfilled with clean soil. Fourteen waste sites were completed in FY 2005. Site preparation and remediation of 100-F Area solid waste burial grounds will be initiated FY 2006, beginning with 100-F-20, 118-F-1, 118-F-5, and 118-F-6.

The initial limited field investigation (DOE 1996c) also recommended a supplemental investigation to determine the extent and potential source of trichloroethene in southwest 100-F Area. That investigation concluded the trichloroethene posed a low risk.

A conceptual site model was completed in 1996, identifying contaminants of potential concern. This model was updated and constituents of concern for groundwater monitoring were identified in a data quality objectives process in 2003.

1.4.8.2 100-F Area Groundwater Remediation

There has been no active groundwater remediation in this area since the last five-year review. This section summarizes the groundwater monitoring that has taken place in the 100-FR-3 Operable Unit since 1996 because this operable unit was not reviewed in the last five-year review. The contaminants of concern for groundwater in the 100-FR-3 Operable Unit are hexavalent chromium, nitrate, strontium-90, trichloroethene, tritium, and uranium.

Figure 1.15 shows the distribution of dissolved chromium at the top of the aquifer in year 2005. In 1996, the maximum concentration exceeded 150 µg/L. In 2005, the maximum concentration no longer exceeds the 100-µg/L drinking water standard, but the overall extent of the plume has changed little since 1996.

Four 100-F Area wells typically have the highest concentrations of chromium. Three of the four wells show trends that are increasing overall. In 2005, the maximum concentration of chromium was 61 µg/L in one of the wells. A value of 98 µg/L, just below the drinking water standard of 100 µg/L, was measured in another well in 2004, but the level declined to 54 µg/L in 2005. A third well shows an overall decreasing trend, although it is located between wells with increasing trends.

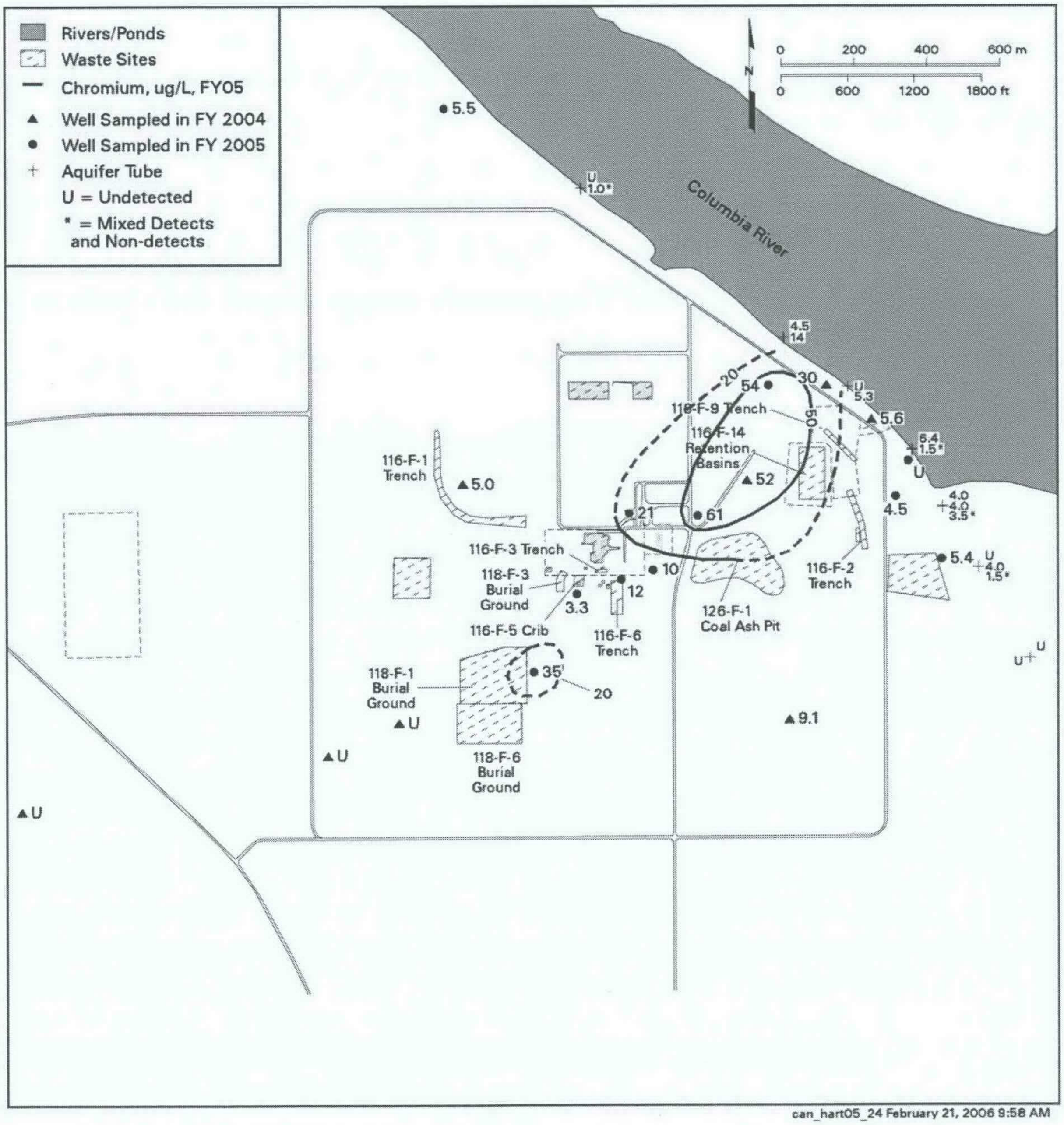

Figure 1.15. Average Dissolved Chromium Concentrations in 100-F Area – 2005

A large nitrate plume extends from the 100-F Area southward. The portion of the plume with concentrations above 100 mg/L appears to have grown since 1996, spreading southward into the 600 Area. However, data in this region were sparse in 1996. Nitrate concentrations also increased north of the 100-F Area, exceeding 20 mg/L. Nitrate concentrations increased throughout the 100 Areas in the 1990s but the cause of the increase is not known.

Wells in the main 100-F Area continued to show levels of nitrate that exceeded the drinking water standard and concentrations are increasing in some wells. The highest, recent nitrate concentration was 166 mg/L in well 199-F7-3 in February 2004 (well is sampled biennially). Concentrations had been increasing in this well from the late 1990s until 2002. Concentrations are lower and declining in well 199-F8-4. South of the 100-F Area, nitrate concentrations are near 100 mg/L in wells 699-62-31 and 699-71-30. Concentrations increased in these wells since the early 1990s, but decreased in the most recent samples (October 2004 and January 2005, respectively). Aquifer tubes south of the main 100-F Area also have elevated nitrate concentrations. Tubes at site 75 typically exceed the 45-mg/L drinking water standard. There is no aquatic standard for nitrate.

Strontium-90 concentrations exceed the 8-pCi/L drinking water standard beneath a portion of the 100-F Area around the 116-F-14 retention basin and nearby disposal trenches. The extent of the plume has not changed significantly in over 10 years.

Well 199-F5-1 currently has the highest strontium-90 concentrations (22.6 pCi/L in year 2004; the well is sampled biennially). Peak concentrations in the mid- to late-1990s was caused by higher-than-average water levels, which mobilized strontium-90 in the lower vadose zone and increased concentrations in groundwater. Strontium-90 also exceeds the drinking water standard in wells 199-F5-44 and 199-F5-46. The trends are neither increasing nor decreasing overall.

Strontium-90 is limited to the shallow portion of the aquifer. Strontium-90 concentrations in aquifer tubes are below the drinking water standard. The maximum concentration detected to date was 2.25 pCi/L.

Trichloroethene concentrations in the southwest 100-F Area exceed the 5-µg/L drinking water standard. The plume appears to be centered west of the 100-F Area. Concentrations near the drinking water standard also are detected in wells in the central 100-F Area. The plume appears to have moved slightly eastward since 1996.

Tritium concentrations are somewhat elevated beneath the south 100-F Area, but no longer exceed the 20,000-pCi/L drinking water standard. The plume extends to the southeast into the 600 Area at concentrations above 2,000 pCi/L. The only well where tritium historically exceeded the drinking water standard is a well at the 199-F8-3 burial ground. Concentrations have declined to 12,600 in October 2004.

For most of the period of operable unit groundwater monitoring, gross alpha has been monitored to screen for uranium. There are uranium data from years 1996 to 2000 and 2005.

Uranium concentrations have remained below the 30-µg/L drinking water standard in all of the available data. Gross alpha concentrations in this well show no overall trend; the level was above the 15-pCi/L drinking water standard occasionally in the early 1990s but are now below the standard (13 pCi/L in year 2005).

1.4.8.3 100-F Area Technical Assessment

A ROD for groundwater remediation has not been established for this area. Previous assessments have not identified groundwater conditions that warrant interim remedial measures, assuming that the source control measures will meet established remedial action objectives designed to reduce contaminant recharge to the aquifer.

1.4.8.4 100-F Area Issues and Actions

No issues or actions specific to the 100-F Area were identified.

1.5 Technical Assessment Summary

The purpose of the five-year review is to determine whether the remedy at a site is, or upon completion will be, protective of human health and the environment. The technical assessment of the remedy reviews three questions:

- Is the remedy functioning as intended by the decision document?
- Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?
- Has any other information come to light that could call into question the protectiveness of the remedy?

These questions are provided by federal regulations and establish a framework for organizing and evaluating data and ensuring that all relevant issues are considered when determining the protectiveness of the remedy. DOE has reviewed the status of the entire CERCLA cleanup at Hanford in this report; however a technical assessment of a remedy requires that a decision document has been completed for the specific operable unit. A decision document has not been completed for many of the operable units.

The protectiveness determination criteria are summarized below. Some RODs only cover specific portions of an operable unit; therefore, some operable units are covered by both an interim ROD and a ROD.

- Is the remedy functioning as intended by the decision documents?

  The remedy is functioning as intended by the decision documents to the extent the actions are completed for the following operable units:

100-IU-1	100-BC-1	100-KR-1	100-HR-1	100-DR-1	100-FR-1
100-IU-3	100-BC-2	100-KR-2	100-HR-2	100-DR-2	100-FR-2
100-IU-4		100-KR-4	100-HR-3		
100-IU-5					
100-IU-6	100-NR-1				

The remedy is not functioning as intended by the decision document for the 100-NR-2 Operable Unit. The remedial action objective to reduce strontium-90 at the river as identified in the 1999 ROD is not being met.

A decision document has not been completed for two of the 100 Area operable units; CERCLA decision documents have not been completed regarding the 100-FR-3 and 100-BC-5 Operable Units.

When considering whether a remedy is functioning as intended, the review focused on the technical performance of the remedy, whether the remedy is related to a single operable unit or group of operable units. Data on monitoring, system performance, and operation and maintenance of the remedy were important aspects in the determination, as was confirmation that access and institutional controls are in place and successfully prevent exposure. Status of the remedy is also considered. If the remedy is under construction, the review focused on whether the remedy is being constructed in accordance with the requirements of the decision documents, and if the remedy is expected to be protective when completed. If the remedy is operating or completed, additional aspects of remedy implementation were considered, such as remedial action performance, costs of system operations, monitoring activities and opportunities for optimization.

- Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

  The exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for all operable units.

When considering whether the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives are still valid, the review focused on all of the risk parameters on which the original remedy decision was based. Changes to target populations, exposure pathways, site characteristics, land use and applicable or relevant and appropriate requirements were reviewed.

- Has any other information come to light that could call into question the protectiveness of the remedy?

  No new information has come to light that could call into question the protectiveness of the remedy for all operable units except for 100-NR-2. New information indicates the pump-and-treat system does not impact the strontium-90 concentrations at the groundwater/river interface where biologic receptors are exposed.

  DOE has initiated the River Corridor Baseline Risk Assessment for the purpose of evaluating post-remediation conditions. The first review draft of the risk assessment report is scheduled to be completed in June 2007 and, therefore, is not available for this review.

When considering whether any other information came to light that could call into question the protectiveness of the remedy, the review focused on whether ecological risks had been adequately evaluated and addressed, or whether new ecological risk information had become available.

1.6 Issues and Actions

Table 1.6 shows the issues and actions for the 100 Area Operable Units.

1.7 Protectiveness Statement

This is the second five-year review for the Hanford Site. For perspective, previous reviews are also provided in this section.

2001 Five-Year Review Report Protectiveness Statement – 100 Areas NPL Site

"I certify that remediation of the soil sites, D&D of buildings, in-situ treatment of chromium, and K Basins remedial actions in the 100 Area are protective of human health and the environment. The 100 Area pump-and-treat actions for chromium are not achieving the criteria for protection of the environment. While the N Area pump-and-treat system is currently containing much of the plume and removing mass, high concentrations of strontium-90 in the groundwater adjacent to the river continue to pose a risk to human health and the environment. Existing ICs, along with the ICs resulting from the implementation of the recommendations in this five-year review, will be protective of human health and the environment. I also certify that those remedial activities that are not completed, or are still in the design or investigation stage, do not require immediate response actions to protect human health and the environment."

2006 Five-Year Review Report Protectiveness Statement for 100 Area NPL Site Source Operable Units

For the 100 Area Source (soil) Operable Units, cleanup has occurred, or is ongoing, under RODs for interim actions. All of the contaminants of potential concern are addressed. ARARs were established for the contaminants of concern. Remedial action objectives consistent with the ARARs were established in the RODs. The cleanup that is occurring under these RODs for interim actions has not at this time been completed for all of the waste sites within the operable unit. In addition, broader areas, such as the river shoreline, that are currently being evaluated in the River Corridor risk assessments have not been included in the RODs for interim actions.

For the source (soil) sites included in Operable Units 100-BC-1, 100-BC-2, 100-KR-1, 100-KR-2, 100-NR-1, 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, 100-FR-1, and 100-FR-2, based on this review and taking the protectiveness determination questions into account, DOE has concluded that the remedies selected for the 100 Area operable units are protective in the short-term of human health and the environment because the cleanup standards are being met and are within the acceptable risk range. There is no outward evidence of ecological harm; however, DOE is conducting an ecological risk assessment to determine if there are any residual risks that have not been adequately addressed. The determination for long term protectiveness for human health and the environment for these operable units is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

2006 Five-Year Review Report Protectiveness Statement for 100 Area NPL Site Groundwater Operable Units

RODs for interim action have been written for 100-HR-3 (including 100-D Area) and 100-KR-4 Groundwater Operable Units where chromium contaminated groundwater has the potential to exceed ambient

Table 1.6. Issues and Actions for the 100 Area Operable Units

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
100/300 Crosscutting					
Issue 1. Additional risk assessment information is needed to evaluate the interim actions prescribed within the records of decisions and to develop final cleanup decisions.	No[3]	Yes			
Action 1-1. Submit Draft A of the River Corridor Baseline Risk Assessment Report.	No[3]	Yes	RCP	EPA/WDOE	06/2007
Action 1-2. Submit draft sampling and analysis plan for Inter-Areas Shoreline Assessment.	No[3]	Yes	RCP	EPA/WDOE	08/2006
Issue 2. A strategy to obtain the final records of decisions and integrate the waste sites, deep vadose zone and groundwater has not been developed and agreed upon with the regulator agencies.	No[3]	No			
Action 2-1. Submit Draft A of the River Corridor Strategy for Achieving Final Cleanup Decision in the River Corridor. Document will identify issues for integration and provide alternatives for future discussions between the Tri-Parties on milestones for final records of decision in the River Corridor.	No[3]	No	RCP	EPA/WDOE	11/2006
100-B/C Area					
No issues or actions specific to the 100-B/C Area were identified.					
100-K Area					
Issue 3. The southeastern (inland) extent of the chromium groundwater plume from the 116-K-2 trench, northeast of the current injection wells, has not been delineated.	No[3]	Yes			
Action 3-1. Install three additional wells to further delineate the southeastern (inland) extent of the chromium groundwater plume from the 116-K-2 trench, northeast of the current injection wells. Wells installed as part of the pump-and-treat system expansion or injection well relocation may count towards this effort if appropriately located.	No[3]	Yes	GRP	EPA	08/2008

Table 1.6. (contd)

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
Issue 4. The small chromium plume at KW Reactor site has reached the river, as evidenced by near-shore aquifer tubes. There is currently no active remediation system in place for the small chromium plume at the KE-KW Reactor site. Therefore, construction of a new pump-and-treat system has been initiated in response to this condition.	Yes	Yes			
Action 4-1. Construct a new pump-and-treat facility to the address the chromium groundwater plume in the KW Reactor area.	Yes	Yes	GRP	EPA	08/2008
Issue 5. Groundwater monitoring indicates that the expansion of the 100-K Area pump-and-treat extraction system has not yet achieved the remedial action objective.	Yes	Yes			
Action 5-1. Expand the 100-K Area pump-and-treat system by 378.5 liters (100 gallons) per minute to enhance remediation of the chromium plume between the 116-K-2 and the N Reactor perimeter fence.	Yes	Yes	GRP	EPA	08/2008
Action 5-2. Add additional wells between the 166-K-2 trench and the N Reactor perimeter fence for groundwater extraction, and connect the additional wells to the pump-and-treat system.	Yes	Yes	GRP	EPA	03/2007
100-N Area					
Issue 6. The pump-and-treat system is ineffective and inefficient in reducing the flux of strontium-90 to the Columbia River, providing only a fraction (1:10) of the protection provided by natural radioactive decay. The degree of protection provided by hydraulic control from the pump-and-treat is unproven.	Yes	Yes			
Action 6-1. Implement the treatability test plan for permeable reactive barrier utilizing apatite sequestration as described in the *Strontium-90 Treatability Test Plan for 100-NR-02 Groundwater Operable Unit* (DOE 2005c). Issue Treatability Test Report.	Yes	Yes	GRP	WDOE	09/2008

Table 1.6. (contd)

Issues and Actions		Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
Issue 7. Additional ecological data is needed to assess the interim actions prescribed within the record of decisions and to develop final cleanup standard. The extent of shoreline water quality impacts related to the diesel spill that occurred circa 1963 are not well known.		No[3]	Yes			
	Action 7-1. Perform additional data collection to support risk assessment, provide to Ecology previously collected data, and coordinate with River Corridor sampling efforts to collect additional pore water data from new and existing aquifer tubes along the 100-NR-2 shoreline in order to assess water quality impacts.	No[3]	Yes	GRP	WDOE	09/2008
	100-D Area					
Issue 8. Groundwater monitoring data indicates there is an unidentified chromium vadose source in the 100-D Area near the demolished 190-DR clear wells.		No[3]	Yes			
	Action 8-1. Complete a field investigation to investigate additional sources of chromium groundwater contamination within the 100-D Area. Additional geologic and geochemical investigations of the vadose zone in the 100-D Area.	No[3]	Yes	GRP	WDOE	03/2009
Issue 9. There is less than adequate data to characterize potential chromium groundwater contamination between the 100-D and 100-H Area, in the area known as the "horn."		No[3]	Yes			
	Action 9-1. Perform additional characterization of the aquifer for chromium contamination between the 100-D and 100-H Area, in the area known as the "horn," and evaluate the need to perform remedial action to meet the remedial action objectives of the 100-D record of decision for interim action. This issue will also be addressed in the final record of decision.	No[3]	Yes	GRP	WDOE	09/2009
	Action 9-2. Incorporate the "horn" area into the 100-HR-3 Interim ROD treatment zone if Action 9-1 indicates "horn" contains a groundwater chromium plume that needs immediate remediation.	Yes	Yes	GRP	WDOE	09/2009

Table 1.6. (contd)

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
Issue 10. Some of the groundwater wells near the 182-D reservoir show conductivity values similar to values expected for raw water indicating some leakage from the reservoir.	Yes	Yes			
Action 10-1. Issue direction to the operating contractor to change operations to further minimize leakage from the 182-D reservoir.	Yes	Yes	GRP	WDOE	Complete d
Issue 11. A few wells within the in situ redox manipulation barrier have shown break through much sooner than expected.	Yes	Yes			
Action 11-1. Initiate limited iron amendments to the in situ redox manipulation barrier to evaluate whether this enhances the performance.	Yes	Yes	GRP	WDOE	09/2007
100-H Area					
Issue 12. Groundwater samples from one deep well extending below the aquitard exceed the drinking water standard (100 μg/L) for chromium. The extent of chromium contamination in this zone is not well understood.	No[3]	Yes			
Action 12-1. Perform additional characterization of the aquifer below the initial aquitard.	No[3]	Yes	GRP	WDOE	09/2009
100-F Area					
No issues or actions specific to the 100-F Area were identified.					

1 Does this issue/action currently affect the protectiveness of the remedy?
2 Will this issue/action affect the protectiveness of the remedy in the future?
3 Identifying the need for, and acquiring new data in the future, does not affect the current status of protectiveness.
RCP – River Corridor Remediation Project
GRP – Groundwater Remediation Project
EPA – Environmental Protection Agency
WDOE – Washington State Department of Ecology

water quality standards in areas where aquatic biota are exposed to a mixture of groundwater and river water. The remedial action objectives are to reduce hexavalent chromium concentrations at near river wells to less than two times the ambient water quality standard for hexavalent chromium, recognizing the dilution of groundwater as it enters the gravels of the river bottom. These RODs were not intended to address secondary contaminants of potential concern or to restore the aquifer but to assure protectiveness of aquatic resources. Final RODs will address secondary contaminants and aquifer restoration to the extent practicable.

DOE believes that the selected remedies of source control, pump-and-treat, and chemical reduction will be protective when fully implemented. It is recognized that improvements are necessary to the existing system design to expand the scope of coverage. Furthermore, all of the sources of the chromium have not been identified and remediated. Therefore, improvements are planned for the selected remedies. DOE is evaluating new technologies and expanded pump-and-treat systems for the final RODs. Institutional controls currently assure protection of human health. The final RODs will address all the contaminants of potential concern and the full extent of contamination to assure protection of human health and the environment. The determination for long-term protectiveness for human health and the environment for the 100-HR-3 and 100-KR-4 Operable Units is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

For the 100-NR-2 Groundwater Operable Unit, the remedial action objectives for the strontium-90 contaminant in the groundwater established in the ROD are not being met. Data show that strontium-90 concentrations at the shoreline have not been reduced by the pump-and-treat system. Alternative remedies are being investigated and work has been initiated on a field treatability test during 2006. Institutional controls are in place to prevent use of the groundwater. Therefore, for this operable unit, the remedy (pump-and-treat) is not considered to be protective in the short-term. Follow-up actions, including evaluation of the effectiveness of the alternative permeable reactive barrier technology currently being tested, are necessary to determine effectiveness of the technology. The determination for long-term protectiveness for human health and the environment for the 100-NR-2 Groundwater Operable Unit is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

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2.0 200 Area

2.1 Introduction

The Hanford 200 Area NPL site consists of the 200 East and West Areas, along with a smaller North Area, all located in the Central Plateau portion of the Hanford Site. The Hanford 200 Areas NPL sites cover approximately 194 square kilometers (75 square miles). The 200 East Area is located 27 kilometers (17 miles) north-northwest of the city of Richland. The 200 West Area is located 9.6 kilometers (6 miles) further west.

Hanford's 200 East and 200 West Areas are divided into 24 source operable units (Figures 2.1 and 2.2). These units contain almost 900 soil waste sites and associated structures, as well as almost 1,000 facilities requiring decontamination and decommissioning. In June 2002, 23 operable units were consolidated from the original 32 geographically based source operable units. The operable units are organized by discharge types and waste site types. Examples of discharge types include solid waste, cooling water, process water, and uranium-rich waste. Examples of waste site types include pond, crib, ditch, and burial ground. In April 2004, as part of a modification to Appendix C of the TPA (Ecology et al. 1989), an additional consolidation of waste sites from various operable units that contained waste sites in the footprint of the U Plant area was approved to support the demonstration of a coordinated approach to remediation of the waste sites. This action established the twenty-fourth operable unit referred to as the 200-UW-1 Operable Unit, shown on Figure 2.1.

The 200 Area NPL site also contains four groundwater operable units. Two (200-ZP-1 and 200-UP-1) are in 200 West Area and two (200-BP-5 and 200-PO-1) are in 200 East Area. Figure 2.3 shows the groundwater operable units in the 200 Areas.

This five-year review is focused on the inactive soil disposal areas, inactive facilities, contaminated groundwater, and ERDF. Ongoing waste management activities, active treatment, storage, or disposal facilities, and tank farm operations are not included in this review. This report provides a high-level summary of the conditions that exist within each operable unit as appropriate to facilitate the five-year review discussion. Operable-unit-specific documentation provides detailed information regarding the operable units. The annual Hanford Site groundwater monitoring report (e.g., Hartman et al. 2005) provides detailed information for all groundwater monitoring.

The action that triggered the first statutory review was the start of remedial action for ERDF, which occurred on May 5, 1995. Because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unrestricted use and unlimited exposure for the foreseeable future, this five-year review and additional five-year reviews are required.

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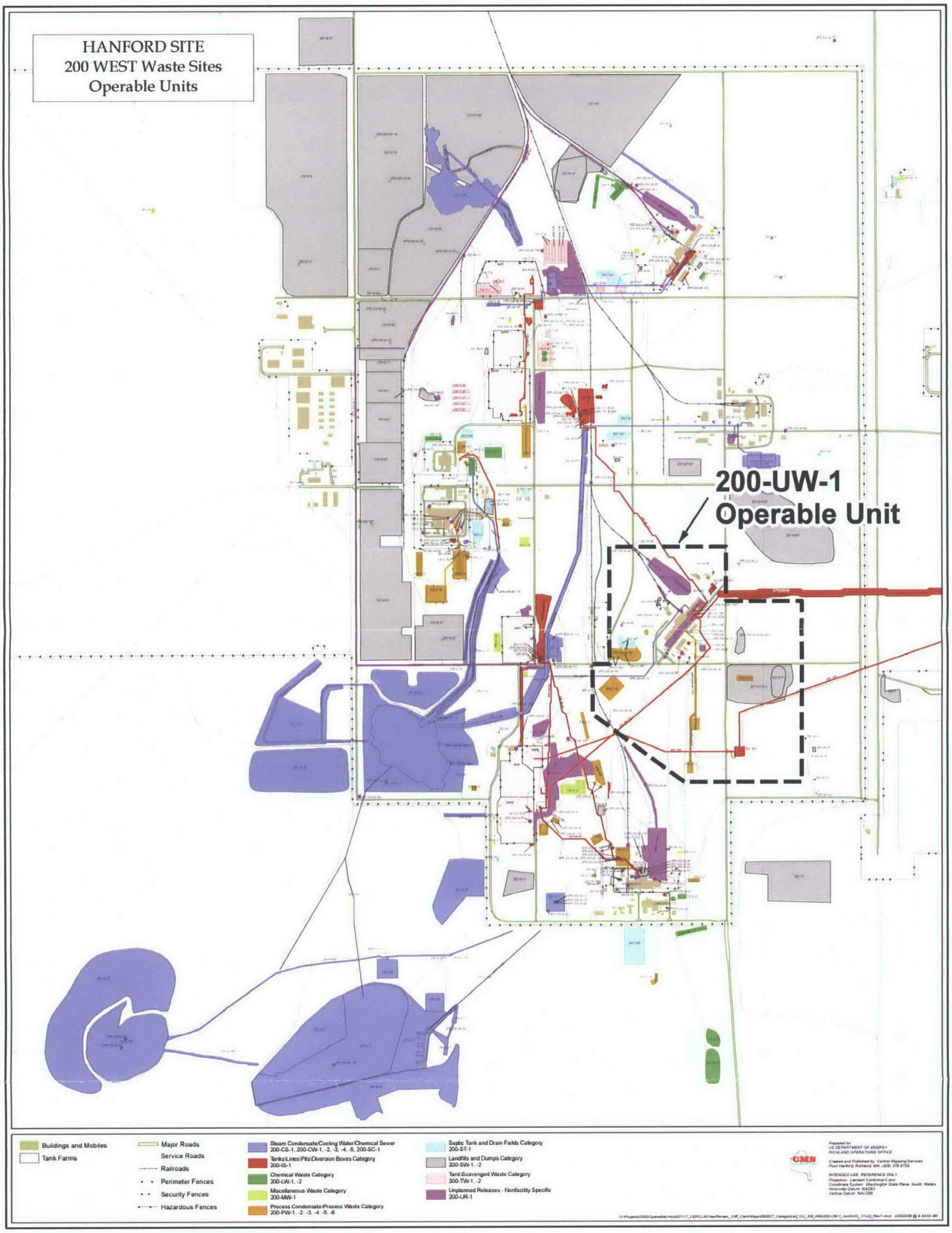

Figure 2.1. 200 West Area Operable Units

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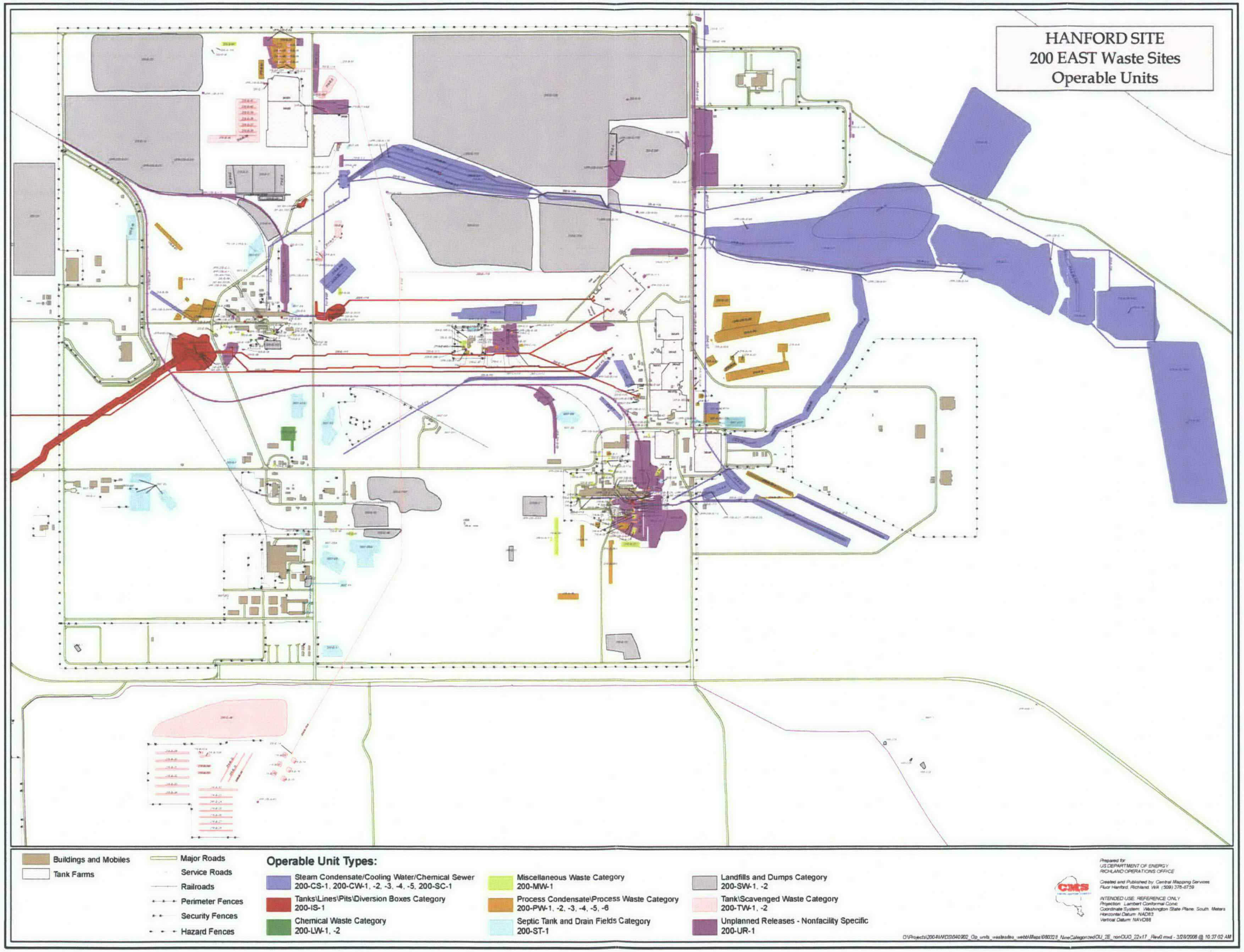

Figure 2.2. 200 East Area Operable Units

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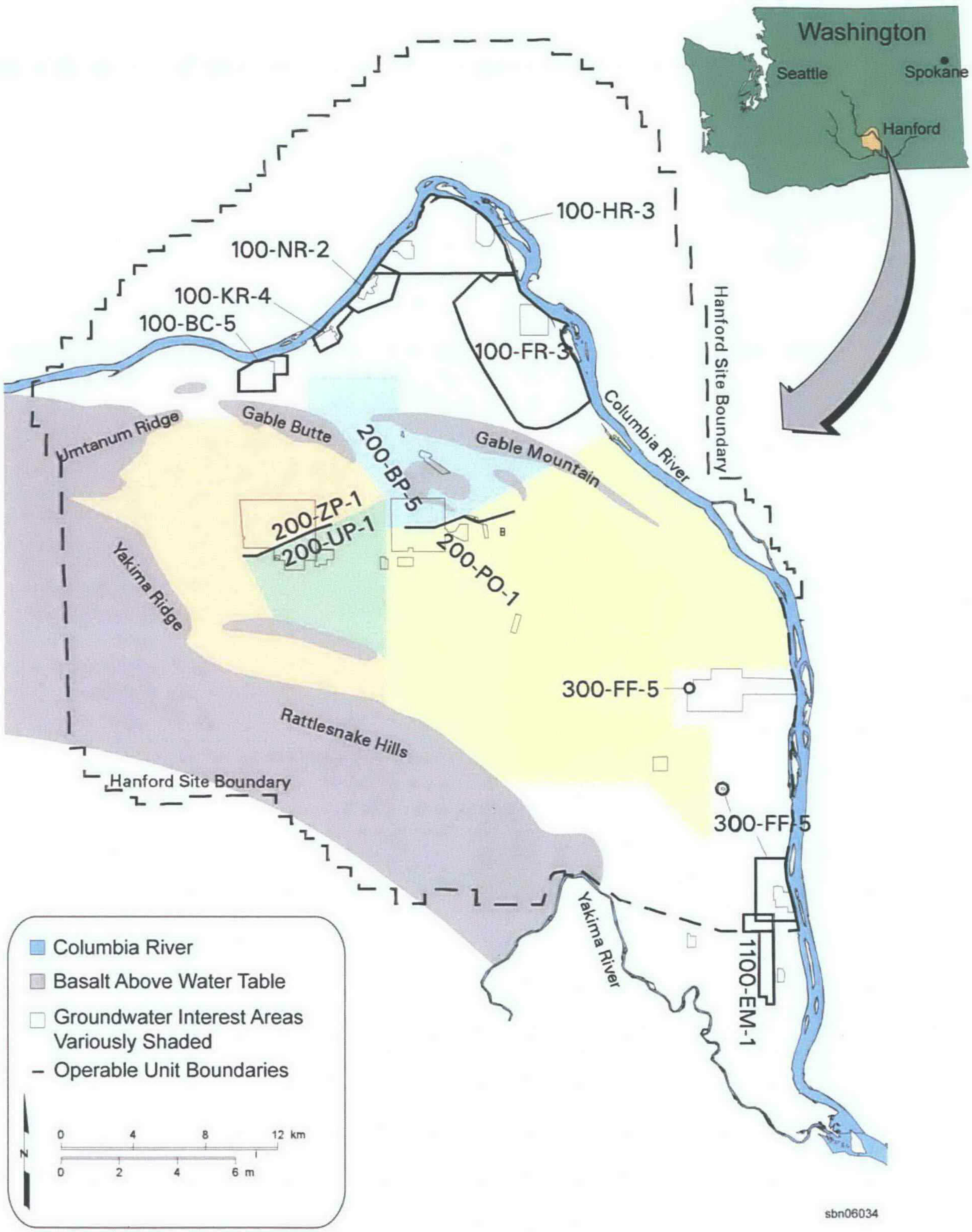

Figure 2.3. 200 Area Groundwater Operable Units

2.2 Chronology

A list of the CERCLA decision documents for the 200 Area Source and Groundwater Operable Units, as well as those associated with decontamination and decommissioning of facilities, is provided in Table 2.1. The 200 Area was listed on the NPL on October 4, 1989. Remedial investigations began in the 200 Areas in 1992. These initial investigations pointed to the need for remedial action for a carbon tetrachloride plume located in the 200-ZP-1 Groundwater and 200-PW-1 Source Operable Units, as well as an action for uranium and technetium contamination in the 200-UP-1 Groundwater Operable Unit.

2.3 Background

The Central Plateau of the Hanford Site consists mainly of the 200 East and West Areas, which were primarily used for reprocessing spent nuclear fuel to recover special nuclear materials for use in the national defense and for waste management activities. Approximately 1,000 facilities, structures, and buildings, including the Plutonium Finishing Plant complex and five large chemical processing facilities or "canyon" facilities: T plant, B Plant, U Plant, S Plant (the Reduction-Oxidation Plant [REDOX]), and the Plutonium-Uranium Extraction [PUREX] Plant), were built to support processing of irradiated fuel from the plutonium production reactors and for treatment, storage, and disposal of waste. These processing activities generated large volumes of radioactive, hazardous, and mixed waste that were disposed to the soil column as liquid effluent, or went into the soil column as spills and leaks. The processing activities also generated solid waste that was disposed in burial grounds. The intentional and inadvertent disposal of this waste created approximately 900 waste sites in the Hanford 200 Area.

Chemical processing of nuclear materials was terminated in the early 1990s, but waste management activities continue and are anticipated to continue into the foreseeable future. In particular, radioactive and mixed waste treatment and disposal are anticipated to continue for many years, at least until 2035 or beyond. The underground storage tank farms, buried solid waste, and the contaminated inactive soil areas and groundwater are the legacy of the old production mission and the primary focus of today's cleanup mission. Another key component of the 200 Areas is the ERDF, which was built to provide safe disposal of waste generated as a result of ongoing cleanup activities across the Hanford Site.

Land use in the Central Plateau is designated as industrial exclusive. The industrial exclusive designation means, "An area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and non-radioactive wastes. Includes related activities consistent with Industrial-Exclusive uses" (DOE 1999). As with other areas of the Hanford Site, land and water uses in the Central Plateau are controlled by DOE.

2.3.1 Canyons

The Central Plateau contains five large defense production facilities, referred to as canyons, that originally were designed for fuel reprocessing operations: T Plant, B Plant, U Plant, REDOX Plant, and PUREX Plant. The canyon buildings range from approximately 244 meters (800 feet) long to over 305 meters (1,000 feet) long and are constructed of thick reinforced concrete. Approximately half of the structure was constructed below grade level for shielding purposes. The below-grade portion of the structure is divided into cells that contain a variety of equipment and piping used for reprocessing operations. Thick concrete cover blocks over the cells form the surface of the canyon deck. These

Table 2.1. 200 Area CERCLA Decision Documents

200 Areas Records of Decision - Location	Date
Interim ROD for 200-ZP-1 pump-and-treat for carbon tetrachloride[(a)] (EPA 1995c)	June 1995
Interim ROD for 200-UP-1 pump-and-treat for uranium and technetium-99[(a)] (EPA 1997d)	February 1997
Final Record of Decision for the 221-U Facility (Canyon Disposition Initiative) and Responsiveness Summary (DOE et al. 2005)	September 2005
200 Areas Action Memoranda – Location	
200 West Area carbon tetrachloride plume (EPA and Ecology 1992)	January 1992
Removal Action at 233-S Plutonium Concentration Facility (DOE and EPA 1997)	March 1997
224-B Plutonium Concentration Facility (DOE 2004c)	June 2004
218-W-4C Waste Retrieval (DOE et al. 2004)	May 2004
232-Z Waste Recovery (DOE and EPA 2004)	November 2004
Action Memorandum for the Non-Time Critical Removal Action for the U Plant Ancillary Facilities (DOE 2004d)	November 2004
Action Memorandum for PFP 232-Z facility decontamination and dismantlement to slab-on-grade. (DOE and EPA 2004)	November 2004
CERCLA Non-Time-Critical Removal Action Memorandum for Plutonium Finishing Plant, Above-Grade Structures (DOE 2005c)	May 2005
Action Memorandum for the Non-Time-Critical Removal Action for the 224-T Plutonium Concentration Facility	June 2005
ERDF Records of Decision - Location	
ROD for ERDF Remedial Action – Authorizes construction of ERDF (Also CCN 009606) (EPA 1995b)	January 1995
Explanation of Significant Difference for ERDF Remedial Action – Allows disposal of investigation-derived waste at ERDF and use of the ERDF leachate as dust suppression (Also CCN 103092) (EPA 1996a)	August 1996
Memo from EPA – Clarification to August 1996 explanation of significant difference (Innis 1997)	December 1997
Amendment to the ROD for ERDF– ERDF expansion; and treatment (stabilization) in containers at ERDF (EPA 1997b)	October 1997
Amendment to the ROD for ERDF – Delisting of ERDF leachate (EPA 1999b)	March 1999
Amendment to the ROD for ERDF – ERDF expansion; and establishes use of staging areas at ERDF for waste requiring treatment (EPA 2002)	January 2002

(a) Groundwater related decisions.
PFP = Plutonium Finishing Plant.
ROD = Record of Decision.

facilities will be decontaminated and demolished under remedial actions in accordance with the joint DOE and EPA 1995 *Policy on Decommissioning of Department of Energy Facilities Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* (DOE 1995a).

Primary waste streams from canyon facilities included process waste, decontamination wastewater, and aqueous process waste that were discharged to tanks, cribs, and trenches. The non-radioactive, low-volume chemical sewer waste was generally sent to ponds and ditches. Very low-volume radioactive waste streams were sent to the French drains.

T Plant. The T Plant complex (including 221-T Canyon Building and 224-T Building) was built in 1944 and operated as one of the first nuclear material separation facilities at the Hanford Site until 1956. This facility used a bismuth phosphate separation process.

The 221-T Building was used for a series of testing programs from 1964 to 1990. Current operations in the 221-T Building include services in radioactive decontamination and reclamation, as well as decommissioning of process equipment. T Plant will receive sludge from the cleanout of the K Basins for storage.

Plutonium scrap in liquid and solid forms was stored in the 224-T Building beginning in the early 1970s. The scrap was removed from the 224-T Building in 1985 when it was designated as the Transuranic Waste Storage and Assay Facility. The Transuranic Waste Storage and Assay Facility was used for nondestructive assay and nondestructive examination of newly generated, contact-handled transuranic solid waste packages destined to be shipped the Waste Isolation Pilot Plant. Use of the 224-T Building for this activity ceased in 1997.

B Plant. The B Plant, one of the original fuels-separation facilities, was constructed between August 1943 and February 1945; it was operated until 1952. The plant used the bismuth phosphate process to separate plutonium from irradiated fuel. In 1968, the B Plant was converted to a waste-fractionization plant as part of a program to solidify high-level waste. B Plant also played a role in removing strontium-90 and cesium-137 from PUREX Plant acid waste and high-level supernatant liquids, as well as sludges from self-boiling liquid waste to manufacture sealed source capsules containing cesium-137 and strontium-90. The capsules are currently stored underwater in the Waste Encapsulation and Storage Facility adjacent to B Plant.

U Plant. The U Plant facility was built in 1944 to 1945 and consisted of the 221-U Canyon Building, 222-U Laboratory, and 224-U Concentration Building, as well as various support structures and storage tanks. These buildings were initially designed to support the bismuth-phosphate batch process for plutonium separations and recovery but were never operated in this mode. Instead, the complex was used between 1952 and 1957 to recover uranium from the bismuth-phosphate process waste stored in the 200 East and 200 West Areas single-shell tank farms. The process used a continuous tributyl phosphate-based solvent extraction chemistry to separate uranium from solutions with large quantities of fission products. After this process ended, the canyon building and most facilities were shut down, although the 224-U Building continued to operate into the early 1990s as a calcining unit, converting uranyl nitrate hexahydrate solutions from the PUREX Plant into a uranium-trioxide form.

REDOX Plant. The REDOX Plant (also known as S Plant) in the 200 West Area was built in the late 1940s and operated between 1952 and 1967. In the REDOX process, hexone was used as a diluent to extract plutonium and uranium from acidic, fission-product-rich solutions in which the fuel rods had been dissolved. The complex consisted of the main 202-S REDOX Canyon Building, the 222-S Laboratory, 233-S Concentration Facility, and a series of support buildings and waste handling and storage facilities. The 222-S Laboratory continues to support the 200 Areas for process control and environmental sample analysis.

The 233-S Concentration Facility was a plutonium processing facility that was demolished to slab-on-grade. The materials were shipped to ERDF with the exception of the transuranic materials, which have been packaged and are awaiting shipment to the Waste Isolation Pilot Plant. The below grade structure portion of 233-S will be addressed through remedial action for the REDOX canyon.

***PUREX Plant*.** The PUREX Plant was constructed between April 1953 and October 1955 and took over fuel-processing operations from the REDOX Plant. The PUREX Plant was operated from 1956 to 1972; in 1972, it was placed in operational standby mode. Plant operations resumed in 1983 and ended in 1990. At this facility, uranium, plutonium, and neptunium were separated from fission products found in the production reactors' irradiated uranium fuel. The process steps involve fuel-element decladding, uranium metal dissolution, solvent extraction, ion exchange, and production load out.

2.3.2 Z Plant

From 1945 to 1949, the Z Plant operated as the Plutonium Isolation Facility, which concentrated Plutonium nitrate solution produced by either of the separation facilities (T Plant or B Plant) and converted the concentrate to a plutonium nitrate paste for shipment to Los Alamos, New Mexico, for further refinement. Primary waste streams from the Plutonium Isolation Facility included process waste and wastewater that were discharged to a ditch, several cribs, and a reverse well.

In 1949, the 234-5 Building was constructed to house production of plutonium metal. The 234-5, or Z Plant Complex (also referred to as the Plutonium Finishing Plant [PFP]), operated continuously from 1949 to 1973, and intermittently from 1985 to 1988. This plant processed plutonium to a plutonium metal and/or plutonium oxide.

Plutonium recovery facilities also operated in the Z Plant process area. These included the Recovery of Uranium and Plutonium by Extraction Facility (234-5Z Building), which operated from 1955 to 1962, and the Plutonium Reclamation Facility (236-Z Building), which operated from 1964 to 1979 and from 1984 to 1987. These facilities recovered plutonium from the PFP liquid waste stream.

A process line to recover americium from the PFP waste stream operated in the 242-Z Building from 1949 to 1959, and again from 1964 to 1976. The primary waste stream from the americium recovery was spent ion-exchange resin that was discharged to ditches and a pond. The americium recovery process also generated an organic waste stream (carbon tetrachloride and dibutyl butyl phosphonate). This waste resulted in a large underground plume of organic materials. An analytical laboratory has operated at Z Plant from 1955 to the present.

2.3.3 Tank Farms

High radioactivity level liquid effluents from the canyons were sent to the single and double shell underground tanks in the tank farms. Underground tanks in the Central Plateau include the 177 single-shell and double-shell tanks used to store high-activity waste generated during reprocessing operations. The tanks range in size from 208,198 liters (55,000 gallons) to approximately 3.8 million liters (1 million gallons). These tanks received liquid waste from all of the processing facilities. Double-shell tanks are active RCRA-permitted units, while single-shell tanks are in RCRA units in varying stages of waste retrieval and closure planning and operations. In some cases, there have been leaks from single-shell tanks that are either known or suspected to commingle with soil contamination from liquid effluent disposal sites (e.g., cribs). The Tri-Party agencies are beginning to characterize that commingled contamination in an integrated manner (e.g., at the B-BX-BY Tank Farms and adjacent waste disposal sites). Closure and long-term disposition of these tanks is not discussed in this CERCLA five-year review.

2.4 Response Actions

This review of remedial and removal actions focuses on four types of sites/media, including soil waste sites, buildings undergoing D&D, contaminated groundwater, and ERDF.

2.4.1 Source Operable Units

Table 2.2 contains a list of each of the 24 source operable units and a brief description of each. The Central Plateau waste site operable units are shown on Figure 2.4.

Only one source operable unit, 200-CW-3, has had a ROD issued. Because the waste sites located in 200-CW-3 Operable Unit contained similar contaminants and were constructed in the same manner as the 100 Area sites, they were included in the interim action ROD for the 100 Area remaining sites (EPA 1999d). As of 2005, EPA has not agreed to move the CW-3 waste sites from the approved 100 Area ROD to the proposed plan for the 200 Area Central Waste sites. With the establishment of the River Corridor Cleanup Project, the waste sites in 200-CW-3 Operable Unit were included in the March 2003 Draft A of a Feasibility Study and Proposed Plan for the 200-CW-1 & 200-CW-3 Operable Unit and 200 North Area Waste Sites.

All 24 source operable units are in various stages of progression toward completing the remedial investigation/feasibility study process. Significant progress has been made toward the completion of those processes over the past five years. During the past two years some of the Central Plateau waste site remedial action decision-making documents have undergone or are nearing the public comment stage based on initial remedial alternative feasibility studies. The Tri-Party agencies recognized that some of the standard remedial alternatives being considered might need to be modified and that additional characterization data may be needed to make remedy selection decisions; the agencies are developing conceptual-level data needs, but had not developed specific details through the end of December 2005.

It is anticipated that the path forward will identify decision models for waste sites, characterization needs based on the decision models, gaps within current data, and recommend appropriate milestones. Upon completion of the remedial investigation/feasibility study processes remedy selections for the 200 Areas will be documented in RODs.

2.4.1.1 U Plant Area Remediation Prototype Effort

The U Plant Area is located in the 200 Areas (Central Plateau) of the Hanford Site. It is approximately 1.3 kilometer (0.5 mile) square and consists of the U Plant Canyon Building (221-U Facility), ancillary facilities that supported the canyon, soil waste sites, underground pipelines, and the groundwater underneath the area. The sand filter and thorium vault were not part of the prototype effort and will be addressed in a future decision.

In FY 2000, the Richland Operations Office initiated the U Plant Area closure project to demonstrate a prototype for conducting zone-oriented remediation. The CERCLA decisions occurring during the five-year review period are: the ROD for the canyon, the action memorandum for the ancillary facilities, and the time critical removal action for the pipeline (200-W-42) discharging to the 200-U-8 and 12 waste sites.

Table 2.2. 200 Area Source Operable Units

Process Condensate/Process Waste Category	
200-PW-1	Plutonium/Organic-Rich Waste
200-PW-2	Uranium-Rich Process Waste
200-PW-3	Organic-Rich Process Waste
200-PW-4	General Process Waste
200-PW-5	Fission Product-Rich Process Waste
200-PW-6	Plutonium Process Waste
Steam Condensate/Cooling Water/Chemical Sewer Category	
200-CW-1	Gable Mountain/B-Ponds and Ditches Cooling Water
200-CW-2	S Pond And Ditches Cooling Water
200-CW-3	200 North Cooling Water
200-CW-4	T Pond And Ditches Cooling Water
200-CW-5	U Pond/Z Ditches Cooling Water
200-SC-1	Steam Condensate
200-CS-1	Chemical Sewer
Chemical Waste Category	
200-LW-1	300 Areas Chemical Laboratory Waste
200-LW-2	200 Areas Chemical Laboratory Waste
Miscellaneous Waste Category	
200-MW-1	Miscellaneous Waste
Tank/Scavenged Waste Category	
200-TW-1	Scavenged Waste
200-TW-2	Tank Waste
Tanks/Lines/Pits/Diversion Boxes Category	
200-IS-1	Tanks/Lines/Pits/Boxes
Unplanned Releases Category	
200-UR-1	Unplanned Releases
Septic Tank and Drain Fields Category	
200-ST-1	Septic Tank and Drain Fields
Landfills and Dumps Category	
200-SW-1	Non-Radioactive Landfills and Dumps
200-SW-2	Radioactive Landfills and Dumps
U Plant Area Category	
200-UW-1	U Plant Area Waste Sites

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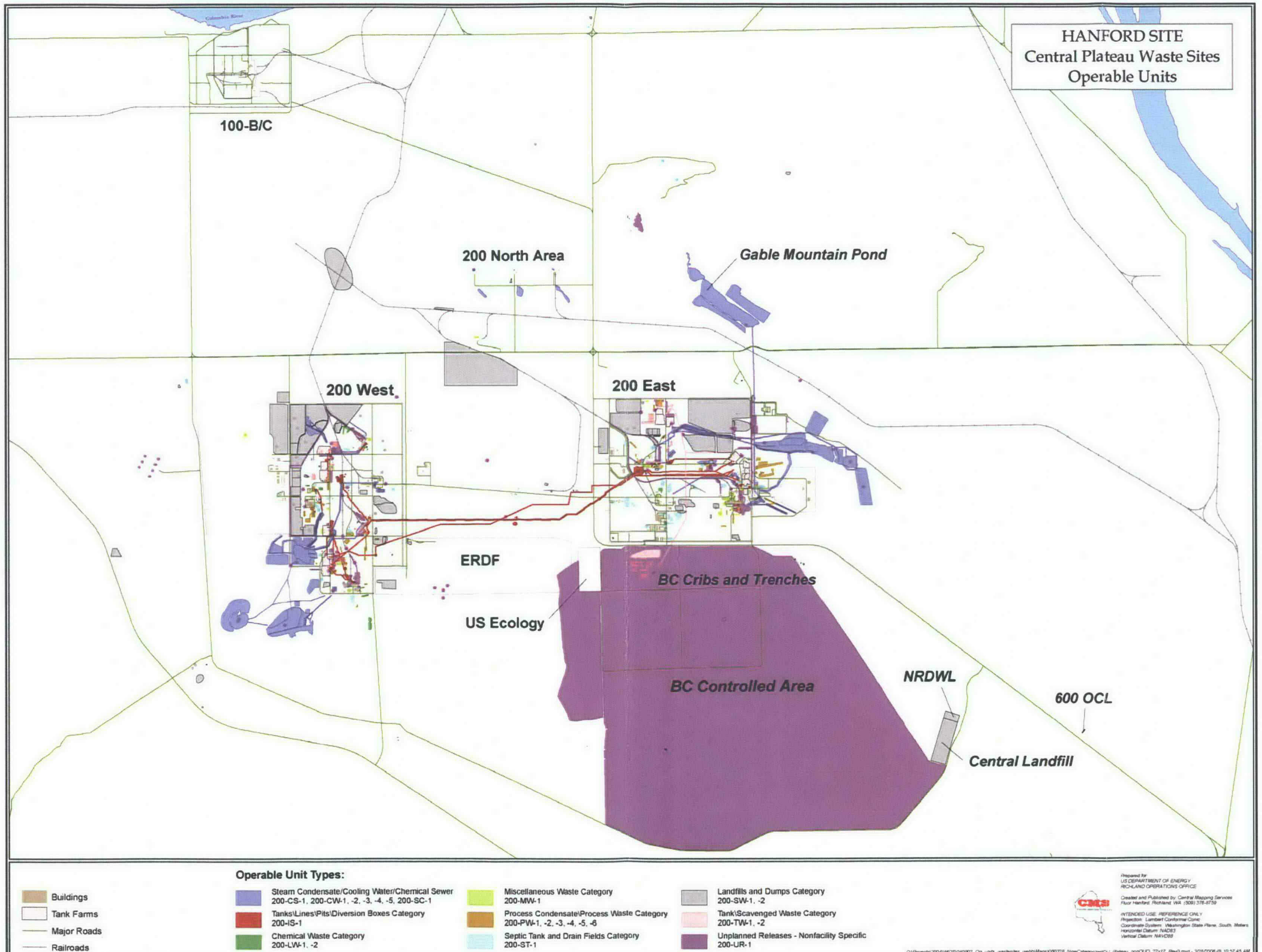

Figure 2.4. Central Plateau Waste Site Operable Units

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2.4.1.2 Canyon Disposition Initiative for the 221-U Facility

The Canyon Disposal Initiative is a program being implemented by DOE to carry out the decontamination and demolition of the large chemical separations plants on the Hanford Site. The Canyon Disposal Initiative resulted from a 1996 Agreement in Principle among the Tri-Party agencies to determine the final disposition for Hanford's five canyon buildings. The purpose of the Canyon Disposition Initiative is to evaluate disposition paths for the canyon buildings using CERCLA processes and to explore the potential for using the canyon buildings as disposal sites for Hanford cleanup waste, instead of demolishing structures and sending the resulting waste/debris to another disposal facility.

The 221-U Facility is the first canyon building to be dealt with under the Canyon Disposal Initiative. The process to disposition this facility is viewed as a pilot project to assist in the disposition of the remaining four canyon buildings as well as providing lessons learned for similar facilities at the Idaho National Laboratory and Savannah River. A CERCLA ROD was signed in September 2005 establishing the selected remedial action as partial demolition of the building followed by installation of an earthen cap. The remedial design report and remedial action work plan are currently being developed, supporting a ROD requirement to submit a draft by December 31, 2006.

2.4.1.3 U Plant Ancillary Facilities

The U Plant Ancillary Facilities consist of processing, support and administrative buildings located within the U Plant complex. A removal action to minimize the potential for a release of hazardous substances from the U Plant Ancillary Facilities that could adversely impact human health and the environment, protect site personnel and the environment, and contribute to the efficient performance of any anticipated long-term remedial actions, including any future subsurface soil remediation was proposed in a CERCLA Engineering Evaluation/Cost Assessment. The assessment was prepared to evaluate removal action alternatives for the U Plant Ancillary Facilities and was submitted for public comment on August 23, 2004. Following a 30-day comment period, revisions to the preferred alternative to strengthen post-removal sampling and verification activities were incorporated into an Action Memorandum. The *U Plant Action Memorandum for the Non-Time-Critical Removal Action for the U Plant Ancillary Facilities*, DOE/RL-2004-67, Revision 0, was approved in November 2004 (DOE 2004d).

2.4.1.4 U Plant Area Waste Sites

The proposed plan for U Plant area waste sites is under review. The time critical removal action for the 200-W-42 pipeline was signed in December 2004 and field work has been initiated.

2.4.1.5 200 B/C Cribs and Trenches

In 1999, the 200-TW-1 Scavenged Waste Group, the 200-TW-2 Tank Waste Group, and the 200-PW-5 Fission Product-Rich Waste Group Operable Units were identified as high priority for initiation of the remedial investigation/feasibility study process because of the number of waste sites within the operable units that represented high risk of contaminating groundwater. In March 2004, DOE-RL completed the remedial investigation work and submitted an initial draft of a feasibility study and proposed plan to both EPA and Ecology. The Tri-Party agencies agreed to focus the path forward for this operable unit group on a subset of potential high risk waste sites known as the 200 B/C cribs and trenches. This proposal was made ahead of other operable units because of the high risk that these sites could contaminate groundwater. As of December 2005, the ROD had not been prepared.

The Draft A version of the focused feasibility study and proposed plan for the BC cribs and trenches area was submitted by DOE-RL to EPA for their review on June 17, 2005. On August 4, 2005, EPA provided comments on the study and plan to DOE-RL stating its disagreement with the DOE-RL recommendation for capping, instead preferring "near-surface excavation and capping." On September 8, 2005, DOE-RL provided a formal response to EPA's comments that reaffirmed DOE-RL's recommendation for capping rather than partial excavation and capping. Follow-on meetings between DOE-RL and EPA resulted in a December 8, 2005, agreement by DOE-RL to "excavate where such removal of shallow contamination might eliminate the need for a barrier or where it simplifies the design of a barrier and its associated institutional controls." DOE-RL also proposed working collaboratively with EPA to develop criteria for excavation through the CERCLA ROD and subsequent remedial design process.

Issues and Actions.

- **Issue 15**. Soil resistivity measurements have detected large regions of anomalous high soil conductivity in the area south of PUREX around the 216-A-4 crib and near the B/C cribs and trenches. Further characterization of the B/C cribs and trenches is needed.
  - **Action 15-1**. Complete data quality objective process and sampling plan to further characterize the high soil conductivity measurements detected at B/C cribs and trenches.

2.4.1.6 Central Plateau Ecological Risk Assessment

Establishing the contaminants of concern present in the soil in the top 4.6 meters (15 feet) and identifying the terrestrial plants and animals that could be affected by these contaminants will allow an assessment of exposure pathways and potential ecological risks. The ecological evaluation results, combined with human health exposure/risk assessment information, will help make certain the remedial measures implemented in the 200 Areas are effective in protecting human health and the environment.

Initially, DOE prepared a screening-level evaluation of ecological risk in the 200 Areas. In addition, a phased approach for completing a Central Plateau-wide ecological risk assessment to support remedial investigation/feasibility study processes was initiated for the majority of soil waste site operable units in the 200 Areas. An ecological evaluation of the 200 Areas, with emphasis on the current status of waste site habitats, was initiated to identify potential ecological risks that might need to be considered in the evaluation of site remediation alternatives.

The Central Plateau ecological risk assessment is being performed in three phases. Phase I, which focused on CERCLA waste sites in the 200 East and 200 West Areas, and Phase II, which evaluated the need for ecological sampling in the US Ecology site, tank farms, the B/C Controlled Area, and West Lake, were completed in FY 2005. Phase III, to be conducted in FY 2006, is planned to evaluate the need for ecological sampling in habitat (non-operational) areas across the 200 East and 200 West Areas and to provide follow-up sampling at Phase I and II sites if analysis of the data from those phases identifies additional data needs and to provide follow-up sampling at Phase I and II sites if analysis of the data from those phases identifies additional data needs. The culmination of the phased data quality objectives, sampling and analysis plans, and field characterization activities will be the development of a Central Plateau-wide ecological risk assessment, planned for FY 2007, which will be integrated with the remedial investigation/feasibility study process for source operable units. Ultimately, the information developed through the ecological risk assessment will be used in support of final remedy selection in RODs for the 200 Area Operable Units.

2.4.1.7 200-PW-1, 200 PW-3, and 200-PW-6 Operable Units

The 200-PW-1(formerly named 200-ZP-2), 200-PW-3, and 200-PW-6 Operable Units, grouped together as the Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Units, remain a high priority for completion of the remedial investigation/feasibility study process because of the large scale carbon tetrachloride contamination problem primarily associated with the 200-PW-1 Operable Unit on the Central Plateau. The following sections focus on the 200-PW-1 Operable Unit, which includes those waste sites that received the largest amounts of liquid waste effluent contaminated with carbon tetrachloride.

The vadose zone underlying the carbon tetrachloride area consists of approximately 66 meters (216.5 feet) of relatively permeable sand and gravel. This region is interrupted from 38 to 45 meters (125 to 148 feet) by a less permeable interval composed of 7 meters (23 feet) of silt and sand. Because it constitutes a relatively low-flow zone, this less permeable interval effectively divides the vadose zone into two distinct zones: an upper zone from the ground surface to the top of the less permeable layer and a lower zone from the bottom of the less permeable layer to the water table.

History of Contamination. Carbon tetrachloride contained in aqueous and organic liquid waste generated during plutonium-processing operations at PFP (formerly called Z Plant) was discharged primarily to three subsurface infiltration facilities. The recovery of uranium and plutonium by extraction plutonium-processing operation was discontinued in April 1962 and was replaced in May 1964 by the Plutonium Reclamation Facility. A total of 570,000 to 920,000 kilograms (1,256,633 to 2,028,250 pounds) or 360,000 to 580,000 liters (95,102 to 153,220 gallons) of carbon tetrachloride is estimated to have been discharged to the soil column between 1955 and 1973.

Remedial Action Chronology. Carbon tetrachloride was found in the unconfined aquifer beneath the 200 West Area at the Hanford Site in the mid-1980s. Groundwater monitoring indicated that the carbon tetrachloride plume was widespread and that concentrations were increasing. In 1990, DOE-RL began detailed planning, including non-intrusive field work, to implement an expedited response action for removing carbon tetrachloride contamination from the unsaturated soil in the 200 West Area. The purpose of the expedited response action was to minimize carbon tetrachloride migration within the vadose zone and away from the carbon tetrachloride disposal sites in the 200 West Area and to mitigate the threat to site workers, public health, and the environment caused by the migration of carbon tetrachloride vapors through the soil column and into the groundwater. The expedited response action is an interim action taken to reduce the mass of carbon tetrachloride in the soil column beneath the 200 West Area pending final cleanup activities.

The action memorandum for the expedited response action established the removal action objectives described in Table 2.3.

Based on the initial investigations and an engineering evaluation/cost analysis, the preferred alternative for removal of the carbon tetrachloride from the vadose zone was soil-vapor extraction followed by aboveground vapor treatment using granular activated carbon. The expedited response action for removal of carbon tetrachloride from the vadose zone was implemented to remove the source of carbon tetrachloride to prevent further degradation of the groundwater. Figure 2.5 shows a comparison of the shallow carbon tetrachloride plume between 1990 and 2005.

Table 2.3. Removal Action Objectives for the Expedited Response Action to Remediate Carbon Tetrachloride Concentrations in the 200-ZP-1 and 200-ZP-2 Operable Units

Removal Action Objective	Explanation
Mitigate the threat to site workers	In the area remediated using soil-vapor extraction, concentrations of carbon tetrachloride vapor in the vadose zone have been significantly reduced, as measured at the soil-vapor extraction system inlet and at individual extraction wells and monitoring probes. However, carbon tetrachloride is still present in the vadose zone. Because the potential for worker exposure still is present, only limited progress has been achieved toward mitigating risk to site workers. Site workers have been protected before and during the ERA and will also be protected after the ERA through proper conduct of operations, monitoring, and the use of engineering controls and personal protective equipment.
Mitigate the threat to public health	Protection of public health has occurred by the institution of controls preventing public access to contaminated areas and continued monitoring of those areas. The action memorandum also identified a concern that carbon tetrachloride vapors could migrate offsite in an independent direction from groundwater flow. None of the groundwater samples collected from wells located west of the extended 200 West Area indicate that carbon tetrachloride vapor is migrating westward offsite. All analyses to date have yielded non-detect results. At this time, based on groundwater data, there is no indication that carbon tetrachloride vapor is posing a threat to the public. This remedial action objective will continue until both the vadose zone and the groundwater have been remediated.
Mitigate the threat to the environment caused by migration of contaminants from the soil into groundwater	Initiation of the ERA was based on the assumption that contamination in the vadose zone posed a continuing threat to groundwater and that if no expedited action were taken, the groundwater quality would continue to degrade. This remedial action objective is considered to be met when the carbon tetrachloride concentration gradient between the vadose zone and groundwater indicates that the vadose zone contamination is no longer degrading groundwater quality. The potential for transport of carbon tetrachloride between the soil vapor and the groundwater was evaluated using Henry's Law as a guideline. Henry's Law describes the equilibrium partitioning of a compound between the aqueous and vapor phases.
Reduce the mass of carbon tetrachloride in the soil	Two distinct phases are commonly observed during in situ remediation projects. The first phase is generally characterized by higher rates of mass removal while the readily available volatile contaminant is being swept out of the higher permeability zones. With continued extraction, concentrations decrease more slowly as the supply of volatile contaminant becomes limited by desorption and diffusion of the contaminant from micropores and/or lower permeability soil. In this second phase, diffusion controls contaminant migration. The history of mass recovery using soil-vapor extraction at the carbon tetrachloride source cribs reflects these two phases typical to soil-vapor extraction operations. Although additional carbon tetrachloride can be recovered using soil-vapor extraction, the rate of removal has been decreasing. The decline in the rate of removal can be attributed primarily to diffusion-dominated extraction, but it has also been affected by the reduction in soil-vapor extraction system capacity, the reduction in the yearly duration of extraction operations, and potentially the continued use of the same airflow pathways established by using the same set of extraction wells. Because of the reduction of carbon tetrachloride mass in the soil, it is reasonable to conclude that the much higher percentage of extracted mass has been removed from the larger pore spaces, contributing to achieving the remedial action objective.
ERA = Expedited response action.	

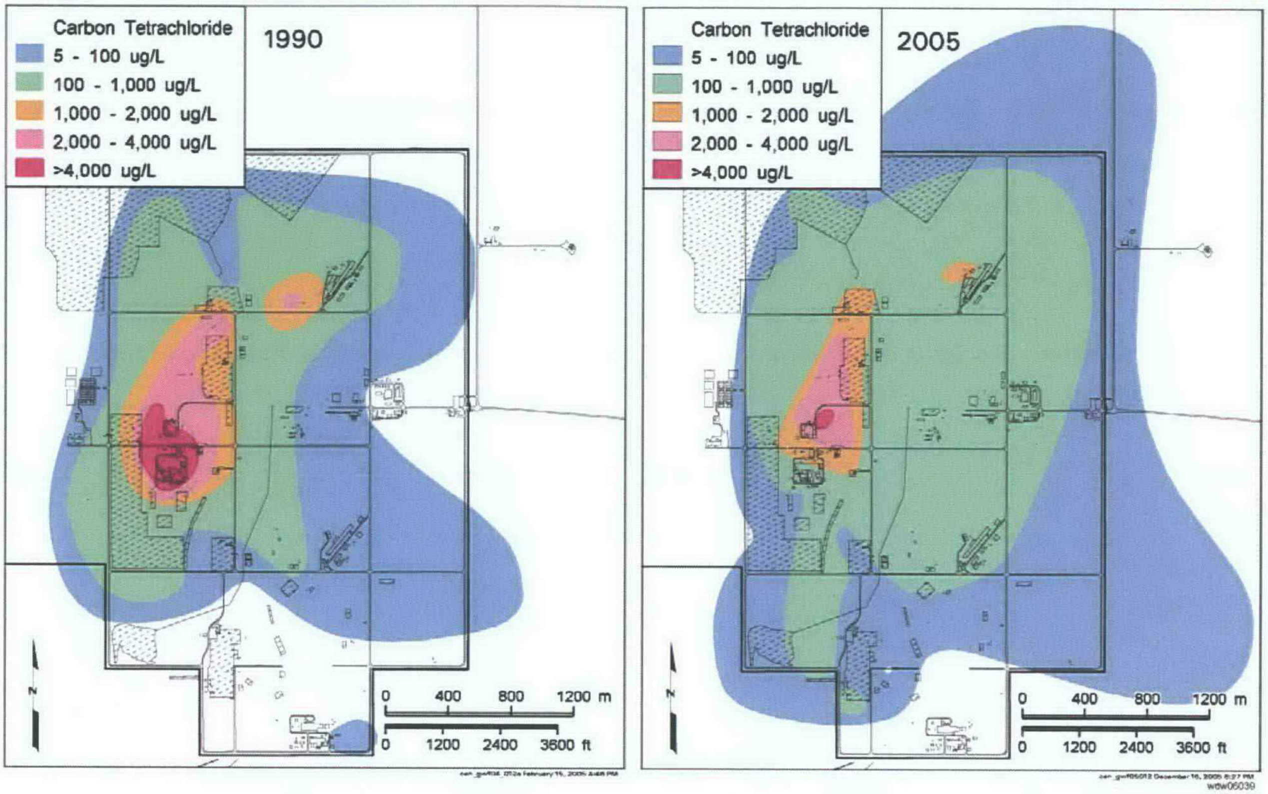

Figure 2.5. Comparison of the Shallow Carbon Tetrachloride Plume Beneath 200 West Area, Top of the Unconfined Aquifer

Initial Response. A pilot soil-vapor extraction system was tested at the 216-Z-1A tile field in April 1991. Based on the results of this testing, a full-scale soil-vapor extraction system was installed and began operating at the tile field in February 1992. This system originally had a design capacity of 14.2 cubic meters (502 cubic feet) per minute but was upgraded to 28.3 cubic meters (999 cubic feet) per minute in March 1993. Two additional systems, one with 42.5-cubic-meter (1,501-cubic-foot) per minute capacity and the other with 14.2-cubic-meter (502-cubic-foot) per minute capacity, began operating in March 1993 at the 216-Z-9 trench. The carbon tetrachloride was captured on granulated activated carbon and sent off site for regeneration.

There are currently 46 drilled wells available for soil-vapor extraction. Thirteen of these wells were completed as vapor extraction wells with stainless steel casings and screens; one well at the north end of trench 216-Z-9 was drilled at a 45-degree incline. Existing wells were adapted for vapor extraction by perforating the well casings. Two of these wells were deepened in 2001 and completed with stainless steel screens and casing that extend below the perforated intervals. The soil-vapor extraction system extracts simultaneously from multiple wells that are open either above and/or below the less permeable layer.

A rebound study was conducted throughout the carbon tetrachloride soil-vapor extraction sites in FY 1997. The purpose of the study was to determine the increase in carbon tetrachloride vapor concentrations following temporary cessation of operations. Operation of all three soil-vapor extraction systems was temporarily suspended in November 1996 and restarted in July 1997. All three systems continued to operate through September 1997.

Based on the results of the FY 1997 rebound study and the declining rate of carbon tetrachloride removal during continuous extraction operations, the operating strategy was modified in FY 1998. Rather than operating all three soil-vapor extraction systems continuously, only the 14.2-cubic-meter (502-cubic-foot) per minute system was used for carbon tetrachloride removal during FY 1998, FY 1999, FY 2001, FY 2002, FY 2003, FY 2004, and FY 2005. During each of these fiscal years, the system typically operated from April through September alternately between the 216-Z-9 and the 216-Z-1A/Z-18 sites (for approximately 3 months at each site) and was maintained in standby mode from October through March to allow time for carbon tetrachloride vapor concentrations to rebound. The system was not operated in the year 2000 while EPA and DOE investigated enhancements to the system. Beginning in FY 2003, the 28.3-cubic-meters (999-cubic-feet) per minute and 42.5-cubic-meter (1,501-cubic-foot) per minute soil-vapor extraction systems were no longer maintained in standby mode and are being evaluated for the potential to excess.

Progress Since Last Review. Since the last review significant progress has been made in the 200-PW-1 Operable Unit as described in the following paragraphs:

- Between 2000 and 2005, an additional 2,250 kilograms (4,961 pounds) of carbon tetrachloride was removed from the vadose zone using the 14.2- cubic-meter (502-cubic-foot) per minute soil-vapor extraction system. During this time, the passive systems have removed approximately 70 kilograms (154 pounds) of carbon tetrachloride from the vadose zone near the groundwater. The total mass of carbon tetrachloride removed (79,000 kilograms [174,165 pounds]) since 1991 (pilot test) represents an estimated 9% to 14% of the original carbon tetrachloride inventory (570,000 to 920,000 kilograms [1,256,633 to 2,028,250 pounds]) discharged to the soil column.

- During 2001, two existing wells (299-W15-84 and 299-W15-95) at the 216-Z-9 trench were deepened and completed for use as vapor extraction wells. During 2005, two additional existing wells (299-W15-8 and 299-W15-32) at the 216-Z-9 trench were configured for use with the soil-vapor extraction system.

- During 2004, an additional soil-vapor extraction system was operated at the 218-W-4C burial ground due to elevated concentrations of carbon tetrachloride detected at the east end of trench T-04 in this burial ground during the remedial investigation for the 200-PW-1 Operable Unit. Operation of the soil-vapor extraction system removed approximately 11 kilograms (24.25 pounds) of carbon tetrachloride from the burial ground trench.

- During FY 2004 and FY 2005, a deep borehole was drilled south of the floor of the 216-Z-9 trench to investigate the presence of dense, nonaqueous-phase liquid (DNAPL) carbon tetrachloride and to collect other data needed to support the CERCLA remedial investigation/feasibility study process for the 200-PW-1 and 200-ZP-1 Operable Units. Carbon tetrachloride was detected in the groundwater at as high as 3,800 ppb. During drilling, relatively high concentrations (380,000 ppb) of carbon tetrachloride were detected in a silt layer approximately 20 meters (65 feet) below ground surface. Based on the concentration of carbon tetrachloride and the results of field screening tests for the presence of DNAPL, the carbon tetrachloride may be present in a nonaqueous phase liquid.

In FY 2004, DOE awarded a contract to perform DNAPL carbon tetrachloride investigations within the 200-PW-1 and 200-ZP-1 Operable Units. Field investigations to date have included passive and active soil gas surveys, depth-discrete groundwater sampling, FLUTe™ DNAPL ribbon sampling, vadose zone soil sampling using a cone penetrometer, push-pull soil vapor tests, and cross-well geophysical surveys. The extent of the silt layer encountered at 20-meter (65-foot) depth is also being investigated.

- In April 2004, the remedial investigation/feasibility study work plan for the 200-PW-1 Operable Unit was approved. The work plan includes the carbon tetrachloride remediation strategy. Between 2002 and 2005, much of the remedial investigation was completed.

- Carbon tetrachloride concentrations in the extracted soil vapor have decreased significantly at both the 216-Z-1A/Z-18/Z-12 and 216-Z-9 well fields during operation of soil-vapor extraction.

- Between April 1991 (pilot test) and October 2004, 95.7 million cubic meters (125.2 million cubic yards) of soil vapor were extracted and processed using the three systems. This volume was extracted from two well fields, with 41.8 million cubic meters (54.7 million cubic yards) extracted from the 216-Z-9 well field and 53.9 million cubic meters (70.5 million cubic yards) extracted from the 216-Z-1A/Z-18/Z-12 well field.

- The 200-ZP-1 remedial investigation draft report to the regulators is expected by May 31, 2006, per the TPA milestone, and it will have the DNAPL work incorporated into it.

Issues and Actions.

- **Issue 17**. Efficiency of the carbon tetrachloride remediation could be increased by increasing the use of the 200-ZP-2 vapor extraction system. The soil-vapor extraction system is in limited operation. Expanding the soil-vapor extraction operations should be evaluated.

  - **Action 17-1**. Evaluate expanding the soil-vapor extraction operations. Also, specifically review converting former groundwater extraction well 299-W15-32 to a soil-vapor extraction well.

2.4.1.8 200 Area Surveillance and Maintenance Program

DOE has established a waste site surveillance and maintenance program and an environmental monitoring program that support DOE's ability to maintain protectiveness from current conditions through the remedial investigation phases and the completion of remedial actions. The 200 Area surveillance and maintenance operations include surveillances on the waste sites that are inspected as often as three times a year. The frequency depends on the specific waste site conditions related to erosion potential, vegetation uptake potential, and biotic intrusion potential.

The surveillance and maintenance program makes certain a consistent process is in place to provide appropriate physical controls to prevent intrusion into hazardous areas and maintain waste sites in a stabilized condition that minimizes exposure to contamination. Physical controls such as postings, markers, and barriers/fencing are maintained via the surveillance and maintenance program to prevent potential exposure to contamination.

2.4.2 Environmental Restoration Disposal Facility (ERDF)

ERDF is a large, multi-cell CERCLA waste disposal facility located just southeast of the 200 West Area on the Central Plateau. ERDF was constructed using a double liner and a leachate collection system that meet RCRA Subtitle C technical requirements. ERDF is used to dispose of hazardous/dangerous waste and low-level radioactive waste, as well as mixed waste that meet, or have been treated to meet, land disposal restrictions and ERDF waste acceptance criteria. CERCLA decision documents for the ERDF are listed in Table 2.4.

Table 2.4. Decision Documents for Environmental Restoration Disposal Facility

Decision Document	Date
ROD Signature	1/20/95
Expansion ROD Amendment	9/30/97
Delisting ROD Amendment	3/23/99
Second Expansion ROD Amendment	1/31/02

In January 1995, the Tri-Parties signed a CERCLA ROD (EPA 1995b) authorizing the construction of ERDF to provide waste disposal capacity for cleanup of contaminated areas on the Hanford Site. The ERDF ROD provides the overall plan for construction of the facility and disposal of remediation waste from the Hanford Site.

A subsequent explanation of significant difference to the ERDF ROD was issued in July 1996 (EPA 1996a). The explanation of significant difference allows for the disposal of investigation-derived waste; D&D waste; waste from RCRA past-practice operable units and closures; and non-RCRA waste from inactive treatment, storage, and disposal facilities. The explanation of significant difference also authorized the conditional use of ERDF leachate for dust suppression and waste compaction.

Three ROD amendments have been issued for ERDF. The first amendment was issued in October 1997 (EPA 1997b) to authorize expansion of the facility by constructing two new disposal cells and to allow for limited waste treatment at the ERDF. The second amendment (EPA 1999b) was issued in March 1999 authorizing the delisting of ERDF leachate. Delisting the ERDF leachate was done to allow for implementation of more cost-effective and appropriate leachate handling techniques. The basis for the delisting was leachate analytical results that showed no significant level of contaminants to be present. The third amendment (EPA 2002), signed on January 31, 2002, authorized the second ERDF expansion to disposal cells 5 through 8, and allowed the staging of remediation waste at the ERDF while awaiting treatment.

Since beginning operation on July 1, 1996, more than 5.4 million metric tons (6 million tons) of remediation waste has been disposed at ERDF. Approximately 31.4 million liters (6.9 million gallons) of ERDF leachate have been treated or recycled, and approximately 27,124.8 metric tons (29,900 tons) of waste has been treated at ERDF prior to disposal. The two initial disposal cells reached their operational capacity in August 2000 and an interim cover has been installed. Four additional disposal cells have been constructed, all of which have been placed into operation.

2.4.3 Groundwater Operable Units

The 200 Area Groundwater Operable Units are depicted in Figure 2.3. Numerous sources of liquid waste discharges have existed in the 200 Areas since the inception of activities on the Hanford Site in 1945. Low-level waste was disposed to open trenches and ponds and later flushed with fresh water.

2.4.3.1 200-ZP-1 Operable Unit

The contamination in the 200-ZP-1 Groundwater Operable Units lies in a thick sequence of gravels, sands, and silts that overlays the basalt bedrock and sedimentary interbeds. Figure 2.6 illustrates the conceptual geologic and hydrogeologic columns of the major stratigraphic units.

Depth to the water table below the 200 Areas ranges from approximately 50 meters (165 feet) near the southwest corner of the REDOX (S) Plant source area to more than 80 meters (262 feet) near the southeast corner of the T Plant source area.

The groundwater monitoring plumes of greatest concern in the 200-ZP-1 Operable Unit are carbon tetrachloride and technetium-99. Other contaminants that are known to be present in concentrations exceeding drinking water standards include trichloroethene, iodine-129, hexavalent chromium, tritium, and nitrate.

History of Contamination. The primary potential sources of groundwater contamination in the 200-ZP-1 Operable Unit include T Plant, PFP (Z Plant), and support facilities associated with these plants such as cribs and trenches; T, TX, and TY Tank Farms; and the Z-1A tile field. The following section provides a summary of the history of waste discharges associated with each of these sources, along with details on the installation of a pump-and-treat system to serve as an interim remedial action. Table 2.5 lists the major potential sources of groundwater contamination at the 200-ZP-1 Operable Unit.

Basis of Action. The basis for this interim action within the 200-ZP-1 Groundwater Operable Unit is that carbon tetrachloride and several other contaminants of concern are present in concentrations exceeding corresponding drinking water standards and interim remedial action objectives specified in the interim ROD.

Remedial Action Chronology. The 200-ZP-1 Operable Unit includes groundwater contamination from sources in the north portion of the 200 West Area. The pump-and-treat system for this operable unit, located north of PFP, was implemented as an interim action to prevent further movement of carbon tetrachloride groundwater contamination from the high-concentration portion of the carbon tetrachloride plume and to reduce contaminant mass. The other contaminants of concern in the ROD (EPA 1995c) are chloroform and trich1oroethene.

Remedial investigation/feasibility study complete	May 24, 1995
Interim action ROD signature	April 24, 1995
Remedial design start	June 7, 1995
Remedial design complete	July 23, 1996
Actual remedial action start	August 26, 1996
Remedial Investigation/Feasibility Study Work Plan	October 4, 2004

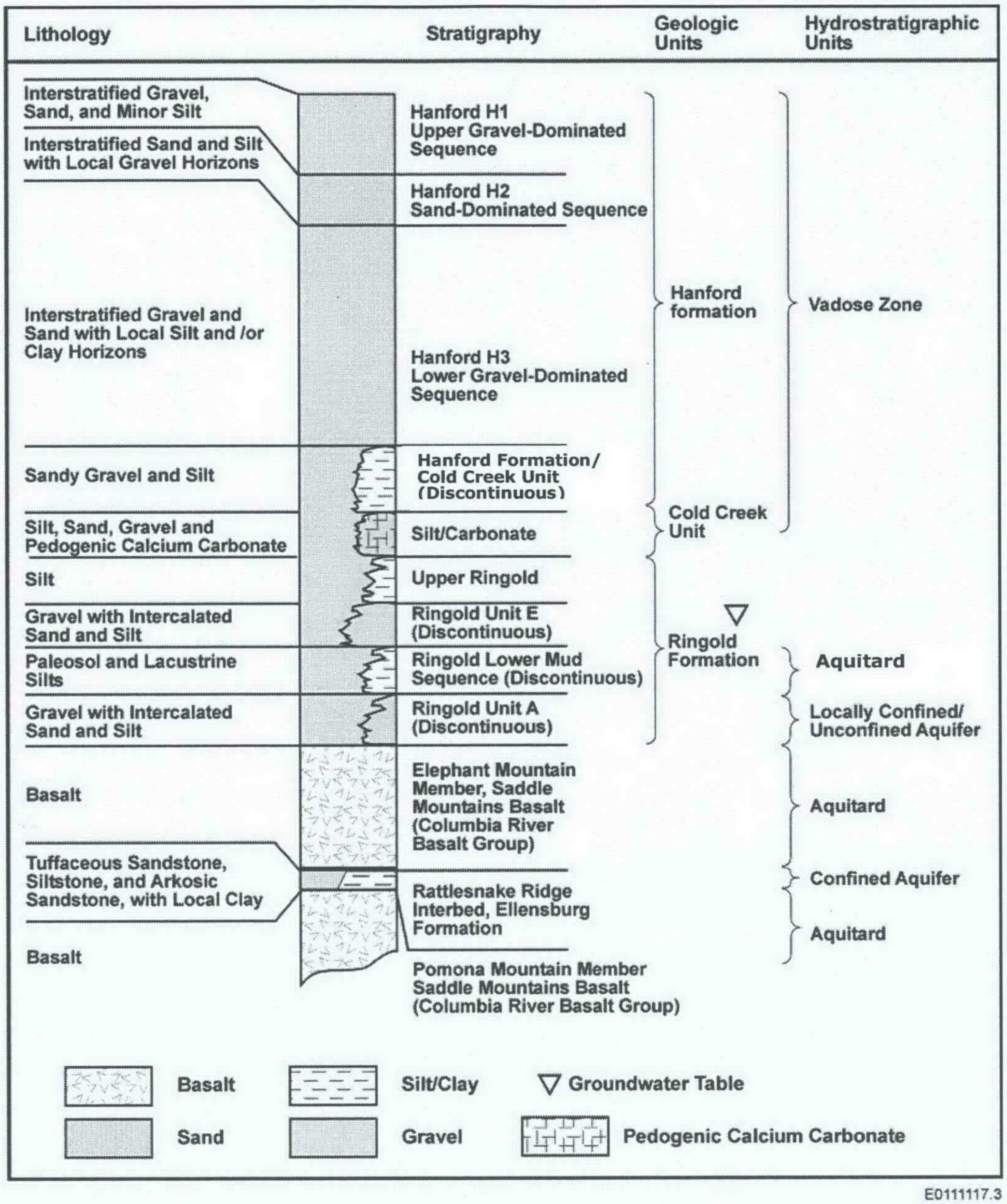

Figure 2.6. Generalized Geologic and Hydrogeologic Column for 200-ZP-1 Groundwater Operable Unit

Remedial action objectives for this project are as follows:

- Prevent further movement of contaminants from the highest concentration area of the plume (2,000 to 3,000 ppb carbon tetrachloride contour interval).
- Reduce contamination in the area of highest concentration of carbon tetrachloride.
- Provide information that will lead to the development of a final remedy that will be protective of human health and the environment.

Table 2.5. Potential Sources of Groundwater Contamination at the 200-ZP-1 Operable Unit

Potential Source of Contamination	Potential Contaminants from Source Area
216-S-25 Crib	Uranium
216-T-7 Crib	Chromium (total), technetium-99
216-T-25 Trench	Technetium-99
216-T-26 Crib	Iodine-129, nitrate, technetium-99
216-T-28 Crib	Iodine-129, nitrate, technetium-99
216-T-32 Crib	Chromium (total), technetium-99
216-Z-1A tile field	Carbon tetrachloride, chloroform, trichloroethene, nitrate
216-Z-9 Trench	Carbon tetrachloride, chloroform, trichloroethene, nitrate
216-Z-18 Crib	Carbon tetrachloride, chloroform, trichloroethene, nitrate
218-W-4C Site	Cadmium
Agricultural activities upgradient from Hanford Site	Nitrate
T, TX, TY Tank Farms	Chloroform, trichloroethene, technetium-99, tritium, fluoride
T Plant	Uranium, tritium
T Evaporator	Tritium
T Plant disposal facilities (miscellaneous)	Tritium
Z Plant BP WIDS Site	Cadmium

In addition to the remedial action objectives listed previously, the interim ROD also required DOE to investigate the potential for carbon tetrachloride as DNAPL and, if confirmed, take appropriate remedial actions.

The pump-and-treat system and operations were implemented in a three-phased approach. In FY 2004, DOE awarded a separate contract to perform DNAPL investigations within the 200-PW-1 and 200-ZP-1 Operable Units. Field investigations performed to date have included passive and active soil gas surveying, depth-discrete groundwater sampling, FLUTe™ DNAPL ribbon sampling, cone penetrometer work, push-pull tests, thermal measurements, collecting sediment samples from the Cold Creek Unit, and surface and cross-well geophysical surveys.

Initial Response. The 200-ZP-1 pump-and-treat was implemented in a three-phased approach. The following paragraphs describe the three-phased response that was taken to respond to the 200-ZP-1 groundwater contamination.

Phase I operations consisted of the pilot-scale treatability test between August 29, 1994, and July 19, 1996, around the 216-Z-12 crib. During this phase, contaminated groundwater was removed through a single extraction well at a rate of approximately 151 liters (40 gallons) per minute, treated using granulated activated carbon and then returned to the aquifer through an injection well. Concurrent with Phase I operations, the *Declaration of the Interim Record of Decision for the 200-ZP-1 Operable Unit* was issued in June 1995. The selected remedy was to use groundwater pump-and-treat technology to minimize further migration of carbon tetrachloride, chloroform, and trichloroethene in the groundwater and remove mass.

Phase II operations commenced August 5, 1996, in accordance with the interim action ROD. The well field configuration during Phase II operations consisted of three extraction wells pumping at a combined rate of approximately 567.8 liters (150 gallons) per minute and a single injection well. Groundwater was treated using an air stripper to release carbon tetrachloride into a vapor phase, and granulated activated carbon was used to collect the vapor. Phase II operations were terminated on August 8, 1997, to transition to Phase III operations.

Phase III operations began on August 29, 1997. The well field for Phase III operations was expanded to include six extraction wells and five injection wells. The total pumping rate was increased to more than 800 liters (+200 gallons) per minute, versus a total treatment system capacity of 1,893 liters (500 gallons) per minute. The treatment process for the Phase III system uses the same air-stripping and granulated activated carbon systems used in Phase II. Extraction wells were installed to contain the high-concentration portion of the carbon tetrachloride plume located near PFP, as required by the interim action ROD. The southernmost extraction well was converted to a monitoring well in January 2001 because of its limited impact on hydraulic capture of the high-concentration portion of the plume. In 2004, two additional extraction wells were brought online to replace extraction wells that were no longer producing adequate flow. In July 2005, four additional extraction wells were brought online to capture the north lobe of the 2,000 µg/L carbon tetrachloride contour.

Progress Since Last Review. The following progress has been made in the 200-ZP-1 Groundwater Operable Unit since the last review.

1. Within the 200-ZP-1 Operable Unit, the carbon tetrachloride plume has been significantly influenced by pump-and-treat operations. Since June 1996, the 4,000-µg/L contour of the carbon tetrachloride plume has been reduced to less than half of its original size and has been pulled 305 meters (1,000 feet) to the north where it now effectively remains within the capture zone of a single extraction well (299-W15-34). The carbon tetrachloride concentrations in this high concentration portion of the plume continue to decline as a result of soil-vapor extraction and groundwater pump-and-treat.

2. In response to First Five-Year Review Action Item 200-2, DOE continued to investigate DNAPL detection technologies. Some of the more innovative technologies that were investigated include FLUTeTM DNAPL ribbon sampling, cone penetrometer sampling methods, push-pull tests, thermal measurements, and surface and cross-well geophysical surveys.

3. In response to First Five-Year Review Action Item 200-3, groundwater monitoring well 299-W15-42 was installed within the high-concentration area of the carbon tetrachloride plume near the PFP. The information gathered during the drilling of this well was used to support the CERCLA remedial investigation/feasibility study process and DNAPL investigations.

4. In response to First Five-Year Review Action Item 200-4, in FY 2002 and FY 2003 the EPA's data quality objectives process was used to establish a comprehensive groundwater monitoring network for the entire 200 West Area including the 200-ZP-1 Operable Unit. This network integrated the monitoring requirements of RCRA, CERCLA, and the *Atomic Energy Act* (AEA). This integrated

monitoring network was more recently incorporated into a sampling and analysis plan that is attached to the 200-ZP-1 remedial investigation/feasibility study work plan (DOE 2003d).

5. Following the integration of the RCRA/CERCLA/AEA groundwater monitoring requirement, the data quality objectives process was used to identify missing data needed to support the 200-ZP-1 CERCLA remedial investigation/feasibility study process. The results from this process were then used to support the preparation of a remedial investigation/feasibility study work plan for the 200-ZP-1 Operable Unit (DOE 2003d).

6. DNAPL investigation work performed to date have included passive and active soil gas surveying, depth-discrete groundwater sampling, FLUTe™ DNAPL ribbon sampling, cone penetrometer work, push-pull tests, thermal measurements, collecting sediment samples from the Cold Creek Unit, and surface and cross-well geophysical surveys.

7. To assist the DNAPL investigation and to collect other data needed to support the CERCLA remedial investigation/feasibility study process, one deep borehole just south of the Z-9 trench was drilled and sampled. This borehole was drilled to a depth of 160 meters (525 feet) below ground surface where basalt was encountered. While this well was originally planned to be completed as a vapor extraction well, the relatively high concentrations of carbon tetrachloride detected in the groundwater justified completing it as a groundwater monitoring well. A nearby well was converted to a vapor extraction well.

8. Since the performance of two of five groundwater extraction wells began to drop off significantly over time, these wells were replaced in FY 2004 by new extraction wells. This replacement boosted groundwater pumping rates from approximately 568 liters (125 gallons) per minute to close to 909 liters (200 gallons) per minute. In July 2005, four additional groundwater wells were converted to extraction wells after it was determined from new characterization data that the 2,000 µg/L carbon tetrachloride plume extends farther to the north than originally understood. These four additional extraction wells are expected to provide the capacity needed to contain this part of the plume, and have increased the 200-ZP-1 groundwater pumping rates to approximately 1,591 liters (350 gallons) per minute.

9. Table 2.6 presents a list of all of the groundwater monitoring wells that have been installed in the 200-ZP-1 Operable Unit since the last five-year review. The majority of these wells were drilled and installed to fulfill both CERCLA characterization and RCRA monitoring needs. However, two of these wells were replacement extraction wells. Figure 2.4 shows the carbon tetrachloride plume beneath 200 West Area.

Technical Assessment Summary

1. Peak carbon tetrachloride concentrations (>4,000 ppb) in the heart of the shallow portion of the plume continue to decline as the soil-vapor extraction and groundwater pump-and-treat systems continue to remove contamination.

2. The size of the carbon tetrachloride groundwater plume within the 2,000-ppb contour continues to expand to the north outside of the influence of the existing pump-and-treat extraction system. The ongoing expansion of the extraction well network should provide the capacity needed to contain this part of the plume.

Table 2.6. 200-ZP-1 Wells Installed Between FY 2001 and FY 2005

Well Number	Well ID	Monitoring Area
299-W15-46	C3426	200-ZP-1 Remedial Investigation
299-W15-49	C4301	200-ZP-1 Remedial Investigation
299-W15-50	C4302	200-ZP-1 Remedial Investigation
299-W18-16	C4303	200-ZP-1 Remedial Investigation
299-W11-46	C4950	T Farm
299-W14-11	C4668	TX-TY Tank Farms
299-W13-1	C4238	200-ZP-1 Remedial Investigation
299-W17-1	C4237	200-ZP-1 Remedial Investigation
299-W15-47	C4184	200-ZP-1 Replacement Extraction Well #4
299-W15-49	C4301	200-ZP-1 Remedial Investigation
299-W15-50	C4302	200-ZP-1 Remedial Investigation
299-W15-45	C4119	200-ZP-1 Replacement Extraction Well #1
299-W14-11	C4668	TX Tank Farm
299-W15-43	C3955	200-ZP-1 Remedial Investigation
299-W14-19	C3957	TX-TY Tank Farm
299-W15-44	C3956	TX-TY Tank Farm
299-W11-39	C3117	T Tank Farm
299-W11-40	C3118	T Tank Farm
299-W10-28	C3400	T Tank Farm
299-W14-16	C3120	TX-TY Tank Farm
299-W14-17	C3121	TX-TY Tank Farm
299-W14-18	C3396	TX-TY Tank Farm
299-W15-763	C3339	TX-TY Tank Farm
299-W15-765	C3397	TX-TY Tank Farm
299-W10-27	C3125	TX-TY Tank Farm

3. Recent discoveries of elevated technetium-99 and carbon tetrachloride at depth within the 200 West Area suggest that dramatic changes in the water-table elevation over the last sixty years of operations have caused these contaminants to be spread vertically within the unconfined aquifer at greater distance from the source area than previously anticipated.

4. A greater percentage of the carbon tetrachloride inventory is likely to be present in the unconfined aquifer due to the much greater depth of contamination and the potentially much larger volume of contaminated groundwater. Additional characterization activities continues and a revised carbon tetrachloride inventory will be discussed in the remedial investigation report.

5. Soil-vapor extraction represents a more cost effective method of mass reduction for carbon tetrachloride compared to the subsurface than the pump-and-treat system. Consideration should be given to operate soil-vapor extraction for a longer duration each year or returning the system to continuous operation.

Further information regarding the performance of the groundwater pump-and-treatment systems can found in the annual summary report (DOE 2005f).

Issues and Actions.

- **Issue 13**. There is less than adequate deep groundwater monitoring data downgradient of T Tank Farm to define the nature and extent of technetium-99 contamination. Further characterize the technetium-99 groundwater plume near T Tank Farm.
  - **Action 13-1**. Complete a data quality objective process and sampling plan to further characterize the technetium-99 groundwater plume near T Tank Farm.
- **Issue 14**. The recent expansion of the 200-ZP-1 extraction well network near the TX-TY Tank Farm may result in technetium-99 contamination being pulled into the 200-ZP-1 treatment system. Treatment options for groundwater contaminated with technetium-99 need to be assessed.
  - **Action 14-1**. Assess treatment options to address technetium-99 near T Tank Farm.
- **Issue 16**. Efficiency and effectiveness of the 200-ZP-1 pump-and-treat system could be increased by increasing the pumping rate to fully utilize the treatment capacity.
  - **Action 16-1**. Increase the pump size in 200-ZP-1 extractions wells 299-W15-45 and 299-W15-47 if well configuration will support a higher flow rate.
  - **Action 16**-2. Initiate the expanded 200-ZP-1 pump-and-treat system to accelerate meeting the remedial action objectives.

2.4.3.2 200-UP-1 Operable Unit

The contamination in the 200-UP-1 Groundwater Operable Units lies in a thick sequence of gravels, sands, and silts that overlays the basalt bedrock and sedimentary interbeds. The geology of the 200-UP-1 Operable Unit is described in detail in the 200 West groundwater aggregate area management study report. Figure 2.5 illustrates the conceptual geologic and hydrogeologic columns of the major stratigraphic units.

History of Contamination. Numerous sources of liquid waste discharges have existed in the 200 Areas since the inception of activities on the Hanford Site in 1945. Low-level waste was disposed to open trenches and ponds and later flushed with fresh water.

The basis for taking action within the 200-UP-1 Groundwater Operable Unit is that multiple contaminants (e.g., technetium-99, uranium, carbon tetrachloride) are present in concentrations exceeding corresponding drinking water standards. Also until recently, concentrations of technetium-99 and uranium in the vicinity of U Plant exceeded interim remedial action objectives specified in the interim ROD (EPA 1997d). The 200-UP-1 Operable Unit contamination resulted from discharges to five primary liquid waste disposal sites. The principal contaminants of concern in the waste streams were uranium and technetium-99. Secondary contaminants were carbon tetrachloride, nitrate, chromium, trichloroethylene, tritium, and iodine-129. These contaminants were discharged within high volumes of water and resulted in large plumes of contamination. The groundwater monitoring plumes of greatest concern in the 200-UP-1 Operable Unit is that of technetium-99, uranium, and carbon tetrachloride. Other contaminants that are known to be present in concentrations exceeding drinking water standards include trichloroethene, iodine-129, hexavalent chromium, tritium, and nitrate.

Remedial Action Chronology. The interim action in the 1997 ROD (DOE 1997) involved removing the primary contaminants of uranium and technetium-99 and secondary contaminants of nitrate and carbon tetrachloride. The process involves pumping the groundwater from the operable unit, piping the groundwater to the 200 Area Effluent Treatment Facility located in the 200 East Area for treatment, and then discharging the treated groundwater to the State-Approved Land Disposal Site north of the 200 West Area.

Interim remedial investigation/feasibility study complete	February 24, 1997
ROD signature	February 24, 1997
Remedial design start	February 24, 1997
Remedial design complete	November 19, 1997

The remedial action objectives include the following

- Reduce contamination in the areas of highest concentration of uranium and technetium-99 to below 10 times the cleanup level (i.e., below 480 µg/L) for uranium, and to below 10 times the maximum contaminant level (i.e., below 9,000 pCi/L) for technetium-99.

- Reduce potential adverse human health risks through reduction of contaminant mass.

- Prevent further movement of these contaminants from the highest concentration area.

- Provide information that will lead to the development and implementation of a final remedy that will be protective of human health and the environment.

Initial Response. Following completion of a pilot test, pump-and-treat operations commenced September 25, 1995, and continued until February 7, 1997, using the onsite plant and single new extraction and injection wells. Groundwater was extracted at a rate of 189.3 liters (50 gallons) per minute.

On February 25, 1997, the *Record of Decision for the 200-UP-1 Interim Remedial Measure* (EPA 1997d) was issued for 200-UP-1 Operable Unit pump-and-treat operations. The selected remedy consisted of pumping from the highest concentration zone of the uranium and technetium-99 groundwater plumes and routing the groundwater to the Effluent Treatment Facility in the 200 East Area for treatment.

The selected remedy section of the 200-UP-1 interim action ROD established the high-concentration zone for technetium-99 as the area contained within the 9,000-pCi/L contour, equal to 10 times the 900-pCi/L maximum contaminant level. For uranium, the selected remedy's high concentration zone was a contour set at 480 µg/L, which was 10 times the then-cleanup level of 48 µg/L. In FY 2004, the standard was lowered to 30 µg/L; however, the interim action ROD was not modified to reflect the lower maximum contaminant level. It should be noted that these "10 times maximum contaminant level" remediation action objectives were not risk-based.

Beginning on March 31, 1997, contaminated groundwater has been transported 11.3 kilometers (7 miles) through a pipeline from the extraction wells in the 200 West Area to the Effluent Treatment Facility for treatment. After treatment, groundwater is discharged to the State-Approved Land Disposal Site, located north of the 200 West Area.

Over time, declines in water-table elevation at 200-UP-1 Operable Unit have reduced the volume of water produced by extraction wells. As a result, different wells have been used and pumping continued through January 25, 2005.

Progress Since Last Review. The following progress has been made in the 200-UP-1 Operable Unit since the last review.

The 200-UP-1 pump-and-treat system was expanded to allow the 189.3 liters (50 gallons) per minute pumping requirement specified in the interim ROD to be achieved. Also, 3,785.4 liters (1,000 gallons) of water is being pumped out of well 299-W23-19 on a quarterly basis for disposal due to its high technetium levels (exceeding 100,000 pCi/L). Ecology directed the 3,785.4 liter (1,000 gallon) pumping as an interim measure for contamination from the S-SX Tank Farm, and the pumping complements the 200-UP-1 pump-and-treat interim action.

A comprehensive groundwater monitoring network was established for the entire 200 West Area. This network integrated the monitoring requirements of RCRA, CERCLA, and AEA (DOE 2004e).

Technical Assessment Summary. Missing data needs to support the 200-UP-1 CERCLA remedial investigation/feasibility study processes have been identified.

In September 2004, a report was published that presents a geochemical model for uranium transport in the unsaturated and saturated sediments in the 200 West Area. The results from this study will be used to help support the screening of remedial alternatives in the feasibility study.

After the interim remedial action objectives for technetium-99 and uranium had been achieved along with a one-year average pumping rate of 189.3 liters (50 gallons) per minute, the extraction wells were turned off January 26, 2005, to begin a one-year rebound study. This study is currently ongoing.

Table 2.7 presents a list of all of the groundwater monitoring wells that have been installed in the 200-UP-1 Operable Unit since the last five-year review. These wells were drilled and installed to fulfill both CERCLA characterization and RCRA monitoring needs.

Pump-and-treat technology has been effective in reducing the concentrations of uranium and technetium-99 in the plume south of U Plant to less than ten times the maximum contaminant level as established when the ROD was written, although the uranium took much longer to meet the objective than previously predicted. The periodic evaluation of the rebound study showed gradual increase of uranium in certain wells and is currently less than ten times above the remedial action objective of 480 μg/L. It is noted that the maximum contaminant level of uranium was lowered from 48 μg/L to 30 μg/L after the ROD for interim action was issued and current uranium concentration exceeds ten times this standard. The final cleanup standard for technetium-99 and uranium will be established through the CERCLA process.

In the absence of source control remedies, contaminants are expected to migrate from the vadose zone into the groundwater. Source controls are needed to ensure concentrations of technetium-99, uranium, and other contaminants continue to decline.

Carbon tetrachloride concentrations migrating into certain portions of 200-UP-1 Operable Unit continue to rise and now represent an increasing risk to groundwater in addition to the primary contaminants of concern. Remediation of the carbon tetrachloride is planned to be performed as part of the 200-ZP-1 Operable Unit.

Table 2.7. 200-UP-1 Wells Installed Between FY 2001 and FY 2005

Well Number	Well ID	Project
FY 2005		
299-W19-48	C4300	200-UP-1 Remedial Investigation
299-W21-2	C4639	200-UP-1 Remedial Investigation
699-30-66	C4298	200-UP-1 Remedial Investigation
699-36-70B	C4299	200-UP-1 Remedial Investigation
299-W22-47	C4667	S-SX Tank Farms
FY 2004		
699-38-70B	C4236	200-UP-1 Remedial Investigation
699-38-70C	C4256	200-UP-1 Remedial Investigation
699-40-65	C4235	200-UP-1 Remedial Investigation
299-W19-47	C4258	U Tank Farm
FY 2003		
299-W26-14	B8828	216-S-10 Ditch
FY 2002		
299-W19-46	C3958	200-UP-1 Remedial Investigation
FY 2001		
299-W19-43	C3381	200-UP-1 Remedial Investigation
299-W22-84	C3398	S Tank Farm
299-W22-81	C3123	SX Tank Farm
299-W22-82	C3124	SX Tank Farm
299-W22-83	C3126	SX Tank Farm
299-W22-85	C3399	SX Tank Farm
299-W23-21	C3113	SX Tank Farm
699-13-0A	C3256	Tritium Investigation
699-13-1E	C3798	Tritium Investigation
699-13-2D	C3254	Tritium Investigation
699-12-2C	C3253	Tritium Investigation
299-W18-40	C3395	U Tank Farm
299-W19-44	C3393	U Tank Farm
299-W19-45	C3394	U Tank Farm

Further information regarding the performance of the groundwater pump-and-treatment systems can found in the annual summary report (DOE 2005f).

Issues and Actions.

- **Issue 18**. The remedial action objective for uranium was based upon the *Washington State Model Toxics Control Act* (MTCA) cleanup standard of 48 ppb when the 200-UP-1 Interim ROD was issued.

Since this time, EPA has established a drinking water standard for uranium of 30 ppb. There are also some other issues to be addressed within the ROD if an explanation of significant difference is prepared. These include the limited quarterly pumping requirement at well 299-W23-19, adjusting the pumping requirement for 200-UP-1 due to limited flow within the extraction well network, and technetium-99 groundwater contamination at other locations within the operable unit.

- **Action 18-1**. Work with Ecology to prepare an explanation of significant difference for the 200-UP-1 ROD for interim action.

2.4.3.3 200-PO-1 Operable Unit

History of Contamination. The 200-PO-1 Operable Unit was investigated in 1992 as part of study of the entire 200 East Area groundwater system. Contaminants present in the 200-PO-1 Groundwater Operable Unit in the 200 East Area of the Hanford Site originated from historical liquid waste disposal during operations of the PUREX Plant and B-Plant in the 200 East Area. The liquid discharges are the product of chemical processing activities, which resulted in disposal of radionuclides, heavy metals, and organic solvents directly to the soil column via cribs, trenches, and ponds. Due to the high volume of discharge, some of the constituents have impacted the groundwater in the 200 East Area. The contaminants identified that exceed groundwater quality criteria include arsenic, chromium, iodine-129, manganese, strontium-90, tritium, vanadium, and nitrate. Tritium and iodine-129 are the principal contaminants of concern because of their high mobility and the large area of the aquifer that is above the maximum contaminant level.

The tritium plume covers approximately 190 square kilometers (73 square miles). The plume has reached the Columbia River, and the concentration at the riverbank is greater than the drinking water standard of 20,000 pCi/L. At a riverbank spring near the Hanford town site, the average tritium concentration is 142,000 pCi/L.

The iodine-129 plume is large, covering approximately 75 square kilometers (29 square miles), and diffuse, with areas of higher activity located near the original disposal sites. The highest groundwater concentration for the 200 East Area plume is 12.4 pCi/L. The drinking water standard is 1 pCi/L.

There has been a general decline of the iodine-129 concentration, due mainly to natural attenuation through plume movement. The iodine-129 will continue to move toward the river; however, dispersion and mixing will further reduce concentrations.

There is currently no decision document in place for this operable unit, and at this time there are no viable technologies to remediate the tritium or iodine-129 plumes. Monitoring data for this operable unit is currently presented in an annual groundwater report produced by the Pacific Northwest National Laboratory for DOE. The following conditions exist at the operable unit:

- The ability to describe groundwater flow directions in the southeastern portion of the 200 East Area is limited due to a low hydraulic gradient.

- Tritium, nitrate, and iodine-129 remain as major plumes.

- The areal extent of the large tritium plume is similar to what it was in 1996, but the most concentrated portions are shifting to the east toward the Columbia River.

- The large nitrate plume has dispersed in downgradient areas, but small, isolated areas remain where the concentration is above the 45-mg/L drinking water standard. Concentrations near the PUREX cribs (the most likely source for the large nitrate plume) are rising in some wells and decreasing in others.

- Iodine-129 contamination in groundwater moves very slowly. The large iodine-129 plume (>1 pCi/L, the drinking water standard) has changed very little since 1996.

- Technetium-99 groundwater contamination at Waste Management Area A-AX exceeds the drinking water standard (900 pCi/L) in one well, although its trend is decreasing in that well.

- Strontium-90 groundwater contamination remains above the drinking water standard (8 pCi/L) at one well at the 216-A-36B crib, and the trend is increasing slightly in that well.

Progress Since Last Review. Since the last five-year review, the following progress has been made:

- Conducted a data quality objectives process (dated September 2002 – PNNL-14049); then developed the *Groundwater Sampling and Analysis Plan for the 200-PO-1 Operable Unit* (DOE 2003).

- Revised the sampling and analysis plan.

- Installed 14 monitoring wells and 15 river aquifer tubes at 6 sites between 1996 and 2005.

Technical Assessment Summary. A 1996 report investigated the feasibility of remediation of iodine-129 at the Hanford Site. Review of the technical literature and contacts with groundwater equipment manufacturers produced no case study information on attempts to remediate groundwater contaminated with iodine-129. Groundwater extraction and treatment with ion exchange, activated carbon, reverse osmosis, or precipitation technologies have theoretical potential for the removal of iodine-129 contamination; however, the ability to treat groundwater to the low concentrations required to reintroduce the treated effluent to the aquifer has not been demonstrated. Remediation of contaminated groundwater in the 200-PO-1 Operable Unit has not been evaluated since the Corrective Measures Study was prepared in 1996. However, some activity has occurred, as described below:

- Because this operable unit is designated as a RCRA past-practice operable unit, a RCRA corrective measures study was prepared (and approved) in 1996.

- A draft permit modification was prepared by DOE in 1997 and submitted to Ecology, but was not incorporated in the Hanford Facility RCRA Permit.

- The recommended action in the draft permit modification was continued monitoring and institutional controls for iodine-129 and tritium.

- Since the draft permit modification was submitted there have been several technical and non-technical developments that potentially impact recommendations for the 200-PO-1 Operable Unit:

  - Both EPA and DOE have released guidance documents for developing monitored natural attenuation remedies.

- EPA has released guidance on institutional controls.
- DOE has prepared and submitted TPA-required reports on the available technologies to treat tritium (M-26) and iodine.
- Continued monitoring and characterization of the groundwater and vadose zone have contributed to a better conceptual site model of the sources and migration of contamination overlying and within the 200-PO-1 Operable Unit.

The groundwater "divide" under the B Pond, that originally distinguished between the 200-PO-1 and 200-BP-5 Operable Units, is being investigated as part of the 200-BP-5 and 200-PO-1 characterization effort.

The assessment of protectiveness is based on groundwater monitoring results since then. Monitoring data have indicated that the areal extent of the three major plumes greater than drinking water standards has not changed very much since 1996, but the portion of the tritium plume with the highest concentration has moved eastward greatly reducing the concentration in the central portion of the plume. Contamination has migrated to the Columbia River from earlier (before 1996) waste releases. The concentrations of the three major plumes near their sources at the PUREX cribs have not changed significantly since 1996. A newly installed well (2003) near the A-AX Single-Shell Tank Farms has shown increased levels of technetium-99, and the single well at the PUREX cribs with elevated levels of strontium-90 has shown a slightly increasing trend since 1996. No other recent increases in groundwater contamination have occurred.

The 1998 *Screening Assessment and Requirements for a Comprehensive Assessment* (DOE 1998) concluded that there is no current adverse impacts to human health or ecological receptors from either tritium or iodine-129.

The uncertainty in the extent and mobility of vadose zone contamination has the potential to influence cleanup decisions. Vadose zone contamination under Waste Management Area A-AX, PUREX cribs, and B/C cribs will continue to be characterized and evaluated to reduce uncertainty and make cleanup decisions as progress continues under the various remedial investigation/feasibility study activities for near-surface sources and the RFI/CMS activities for the tank farms.

Issues and Actions. No issues or actions specific to the 200-PO-1 Operable Unit were identified.

2.4.3.4 200-BP-5 Operable Unit

The 200-BP-5 Operable Unit includes the groundwater beneath the north part of the 200 East Area as shown in Figure 2.3. Technetium-99 is the contaminant of greatest concern due to its broad areal distribution and its mobility. The 200-BP-5 Operable Unit includes several CERCLA units (the 216-B-5 reverse well, BY cribs, and Gable Mountain pond). There are also five facilities with the operable unit that have groundwater monitoring requirements under RCRA and AEA (Waste Management Area B-BX-BY, 216-B-63 trench, Low-Level Waste Management Areas 1 and 2, Liquid Effluent Retention Facility, Waste Management Area C). There is no active groundwater remediation in this operable unit, and no final remediation decision has been made regarding this operable unit.

This operable unit was included in the previous five-year review, but only in regard to an action to develop a monitoring well network. The locations of the 600 Area monitoring wells are shown in Figure 2.7. The locations of 200 Area monitoring wells, 200-BP-5 Operable Unit, and selected waste sites are shown in Figure 2.8.

History of Contamination. Contaminants of concern identified for the 200-BP-5 Operable Unit include technetium-99, cobalt-60, cyanide, uranium, nitrate, cesium-137, strontium-90, iodine-129, tritium, and plutonium-239/240. Tritium, iodine-129, and nitrate have multiple sources within 200 East Area, including large discharges from facilities associated with the PUREX Plant processes (located in the 200-PO-1 Operable Unit). During disposal of these large discharges, contamination from these facilities likely extended throughout the 200 East Area, including the 200-BP-5 Operable Unit. It is difficult to differentiate the initial sources and current distribution of earlier plumes of tritium, iodine-129, and nitrate in 200 East Area. The FY 2004 plume areas in the 200-BP-5 Operable Unit with contaminant concentrations above the drinking water standard are shown in Table 2.8.

The small differences in water-table elevation across the 200 East Area portion of the operable unit make it difficult to determine the direction of groundwater flow from water-table maps. Groundwater currently entering the 200 East Area from the west divides and flows to the Columbia River along two separate paths: one to the southeast and one to the northwest though Gable Gap. The water table has been generally declining following the decrease in liquid effluent discharges to the soil in the 200 East Area. The ability to describe current flow characteristics, however, is limited owing to the low hydraulic gradients present. The extent of the basalt units above the water table also continues to increase due to the declining water table.

The upper basalt-confined aquifer is also monitored in the 200-BP-5 Operable Unit because of the potential for migration of contaminants from the overlying unconfined aquifer. The basalt north of the 200 East Area was eroded by late Pleistocene flooding, which may facilitate aquifer intercommunication. Discharge to overlying or underlying aquifers in the vicinity of the Gable Butte/Gable Mountain structural area, for example, may occur through erosional windows in the basalt where removal of the Elephant Mountain basalt has left a region of intercommunication between the Rattlesnake Ridge interbed aquifer and the unconfined aquifer.

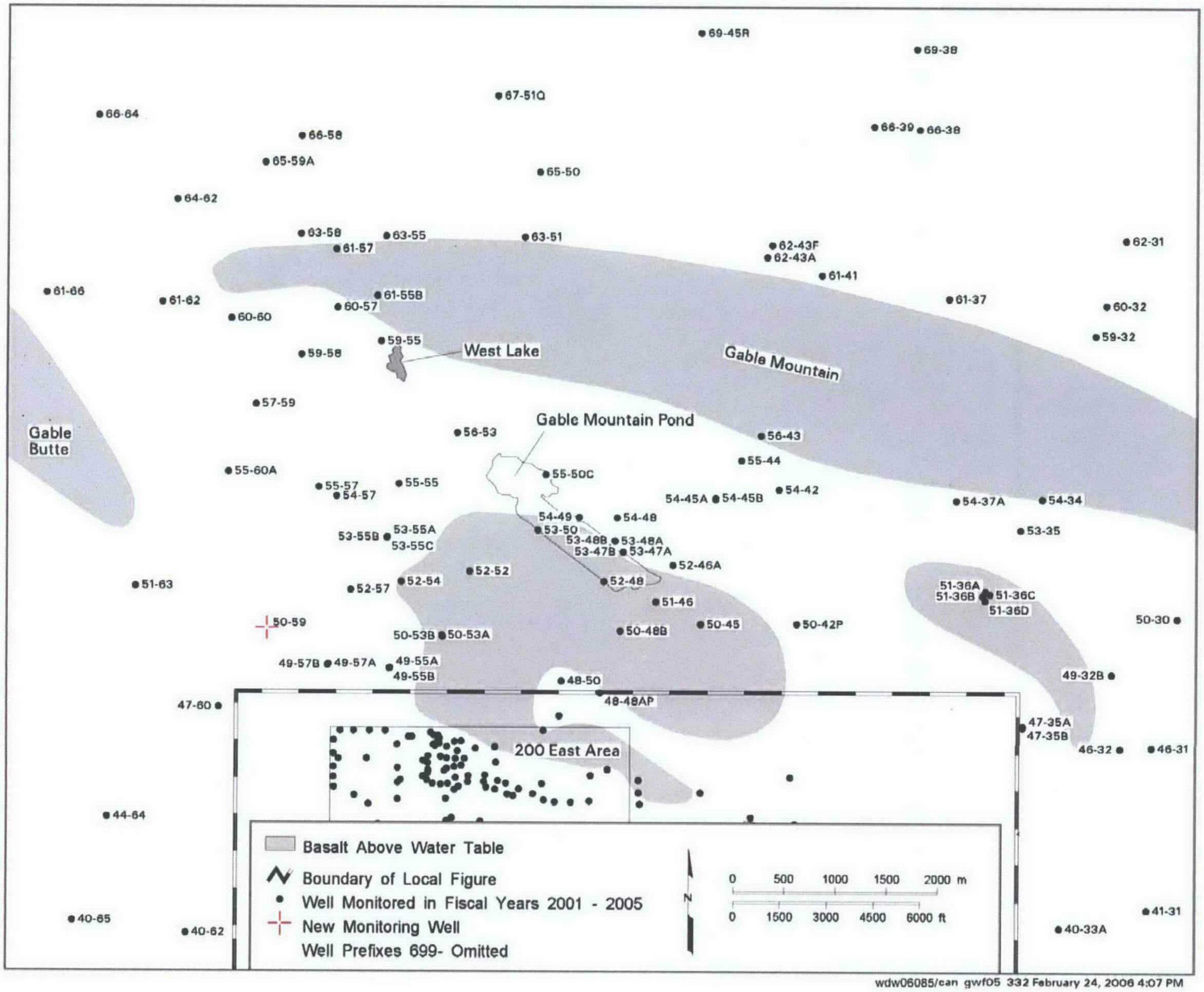

Figure 2.7. Location of 200-BP-5 Operable Unit Groundwater Monitoring Wells Located in the 200 Area

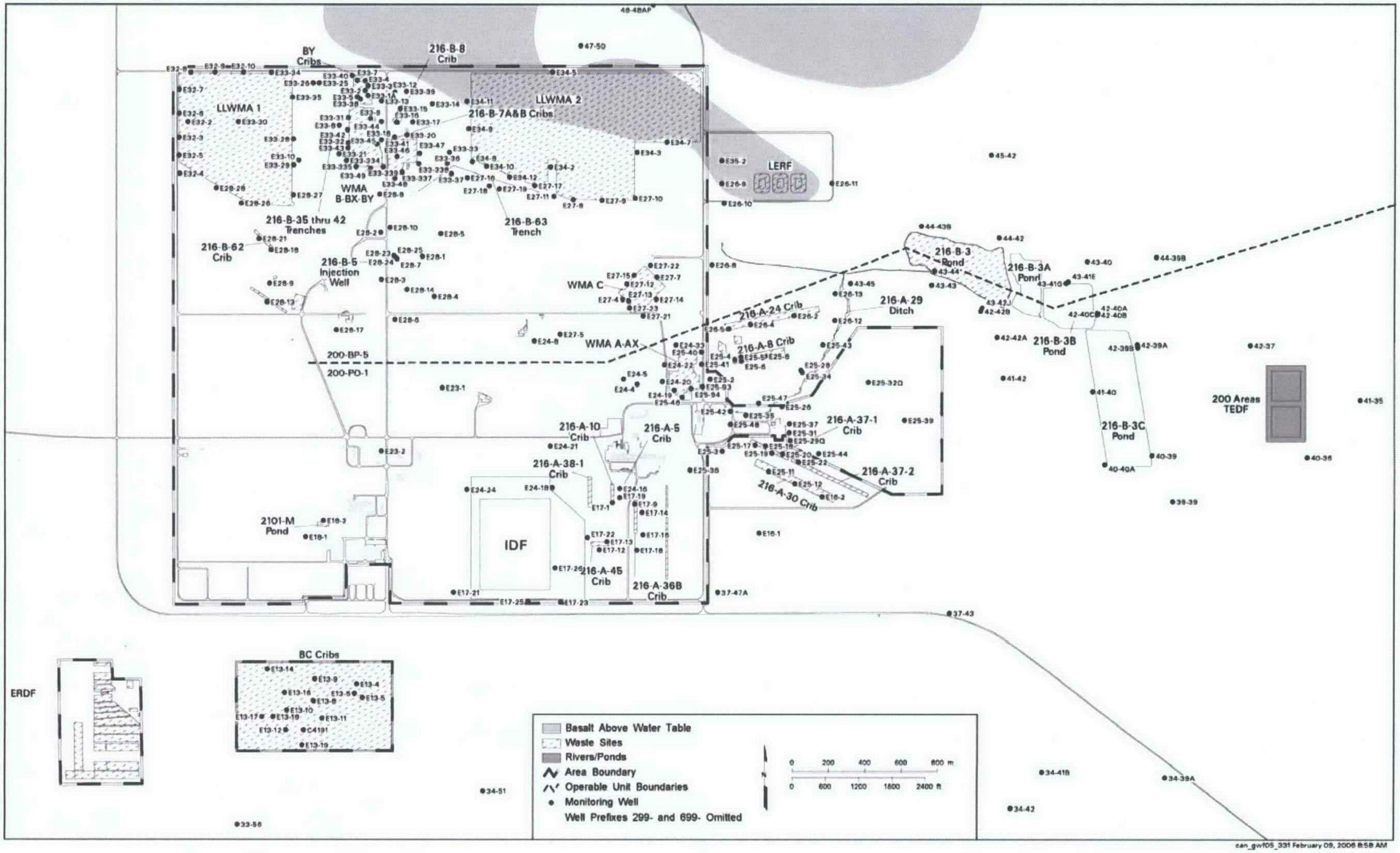

Figure 2.8. Location of 200-BP-5 Operable Unit Groundwater Monitoring Wells and Selected Waste Sites Within the 200 East Area

Table 2.8. FY 2004 Plume Areas for Major 200-BP-5 Operable Unit Contaminants

Contaminant	Plume Area Above Drinking Water Standards km^2 (mi^2)
Iodine-129	3.49 (1.35)
Nitrate	5.08 (1.96)
Strontium-90	0.72 (0.28)
Technetium-99	2.18 (0.84)
Tritium	3.44 (1.33)
Uranium	0.19 (0.07)

Remedial Action Chronology. Activities were undertaken in 1995 in the 200-BP-5 Operable Unit to evaluate the remediation of groundwater contamination. The 200-BP-5 Operable Unit Treatability Test Report summarized the performance of pilot-scale treatability tests conducted to assess the ability of an aboveground pump-and-treat system to extract and treat groundwater from the B-5 reverse well and BY cribs plumes. The aquifer conditions in the area impacted by the test did not allow meaningful removal of contaminants from the aquifer to justify continuation of treatability test operations. In 1995, 200-BP-5 Operable Unit was removed from the accelerated interim remedial measures pathway for groundwater cleanup, and monitoring has continued under an integrated site-wide monitoring organization.

Technetium-99. Technetium-99 contamination in groundwater within the 200-BP-5 Operable Unit has been increasing in the past few years. Figure 2.9 shows the distribution of technetium-99 in the aquifer in 2004. Technetium-99 extends from the area of the BY cribs and Waste Management Area B-BX-BY to the northwest. Technetium-99 is present north of the gap between Gable Mountain and Gable Butte. Three things are noted in comparing the maps between 1996 and 2004. First, the lateral distribution of technetium-99 is nearly identical; second, the concentration of technetium-99 has increased near the BY cribs and B-BX-BY Tank Farms; and third, the extent of basalt above the water table has increased toward the west owing to the declining water-level elevation.

Peaks in technetium-99 concentration occurred in 2000/2001 and again in 2004 indicating a source or sources of contamination near these facilities that is more recent than the plume addressed in 1995 during the treatability study. Technetium-99 has continued to increase since 1996 in most wells north of the 200 East Area. Technetium-99 is elevated north of the gap between Gable Mountain and Gable Butte, though not above drinking water standards (900 pCi/L).

The maximum technetium-99 concentrations measured in 200-BP-5 Operable Unit groundwater since 1996 were 23,100 pCi/L and 13,300 pCi/L in two wells located within the BY cribs. The source and pathway for the increasing technetium-99 is currently being investigated as part of the 200-BP-5 remedial investigation. These results indicate recent and continuing technetium-99 groundwater contamination in this vicinity. Wells near the single-shell tanks Waste Management Area C also reflect technetium-99 contamination in groundwater. The highest value (8,370 pCi/L) to date was measured in June 2004.

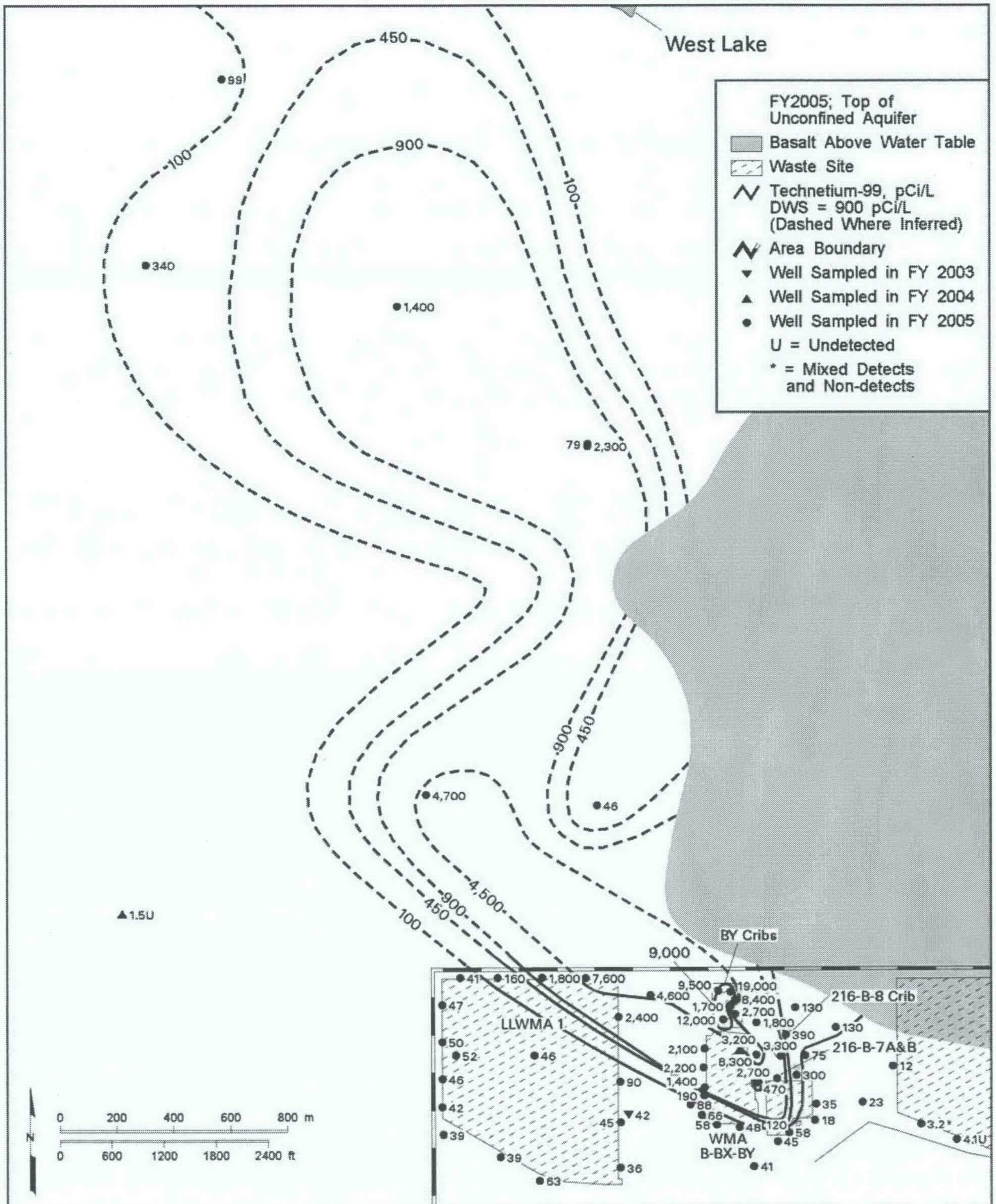

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Figure 2.9. Technetium-99 Distribution in Groundwater in 200-BP-5 Operable Unit – 2005

Uranium. Uranium contamination in groundwater within the 200-BP-5 Operable Unit has been increasing since prior to 1992. Figure 2.10 shows the distribution of uranium in the aquifer in 2004. Significant uranium contamination in the area of the single-shell tanks Waste Management Area B-BX-BY and the BY cribs was initially observed from 1998 to 1999 in two wells located under and east of the BY Tank Farm. Elevated values were also found to the southeast near the 216-B-7A and B cribs and to the north in the BY cribs. The lateral extent in 1997 was limited to a region beneath the BY cribs, the BY Tank Farm, and the 216-B-7A and B cribs. Over the years, uranium contamination has increased to the west and south. Currently, uranium contamination extends west from the BY cribs to low-level burial grounds Waste Management Area 1 and south of Waste Management Area B/BX/BY. There are lesser concentrations of uranium contamination also increasing north of the 200 East Area boundary.

The levels of contamination have also generally increased between 1997 and 2004. The highest uranium concentration observed in the 200-BP-5 Operable Unit since 1997 was a value of 805 μg/L in June 2006 at well 299-E33-9. The dropping water table appears to have a potential effect on groundwater flow as evidence of multiple conceptual models. Continued monitoring and the 200-BP-5 remedial investigation/ feasibility study will attempt to resolve the groundwater flow uncertainty in this area.

The uranium and technetium-99 plumes overlap to some extent, exhibiting some differences in spatial distribution but similar trend behavior. The patterns of contamination in this area indicate multiple sources and contaminant migration pathways in the vadose zone. Uranium is also present above the drinking water standards in isolated wells east of B Plant, and near the 216-B-62 crib.

Nitrate. Nitrate contamination has increased in the 200-BP-5 Operable Unit between 1996 and 2004. Nitrate contamination migrated north between 1996 and 2004. Figure 2.11 shows the location of the contamination in 2004. Wells between Gable Gap and the Columbia River had increased to more than 20 mg/L by 1997. Concentrations have increased substantially since 1996 in the vicinity of the BY cribs, as well. The highest nitrate concentration since 1996 was 1,890 mg/L measured on May 9, 2005. Nitrate increased significantly in several wells between 1997 and 2001 and continues to be elevated above 400 mg/L in several wells. The plume with levels exceeding the maximum contaminant level extends toward the west and northwest. The relationship between the recent increases in these wells and the increases in wells near the BY cribs is not fully understood.

Tritium. The distribution of tritium was largely unchanged between 1996 and 2004. Figure 2.12 illustrates the location of the plume in 2004. However, tritium exceeded the maximum contaminant level in November 2000 in a well to the northwest and the plume at concentrations below the maximum contaminant level extended to the Columbia River. Tritium has increased in wells near the BY cribs and the B-BX-BY Tank Farms and the level increased to a maximum of 118,000 pCi/L in one well on February 4, 2005. The most recent sample in this well was 68,300 pCi/L.

Iodine-129. Iodine-129 contamination is present throughout the west portion of the 200-BP-5 Operable Unit. Like the tritium plume, the iodine-129 plume extends to the northwest toward the gap between Gable Mountain and Gable Butte. The distribution of iodine-129 has not changed significantly between 1996 and 2004, but the levels of iodine-129 have decreased slightly in several wells. A band of elevated iodine-129 concentrations (~5 pCi/L) exists in Waste Management Area B-BX-BY. The highest reported value in this vicinity was 7.00 pCi/L reported in well 299-E33-16 on May 1, 2000.

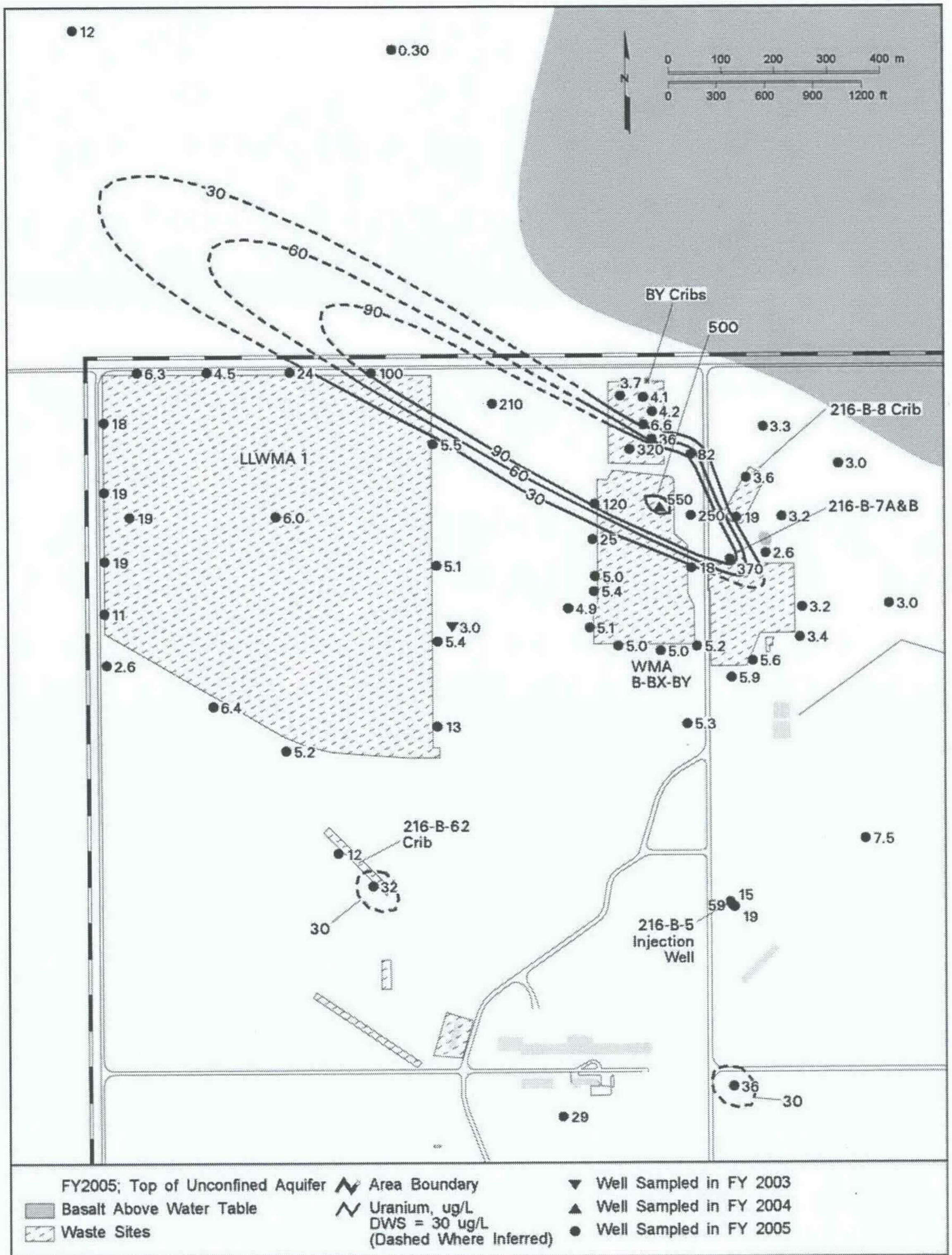

Figure 2.10. Uranium Distribution in Groundwater in 200-BP-5 Operable Unit – 2005

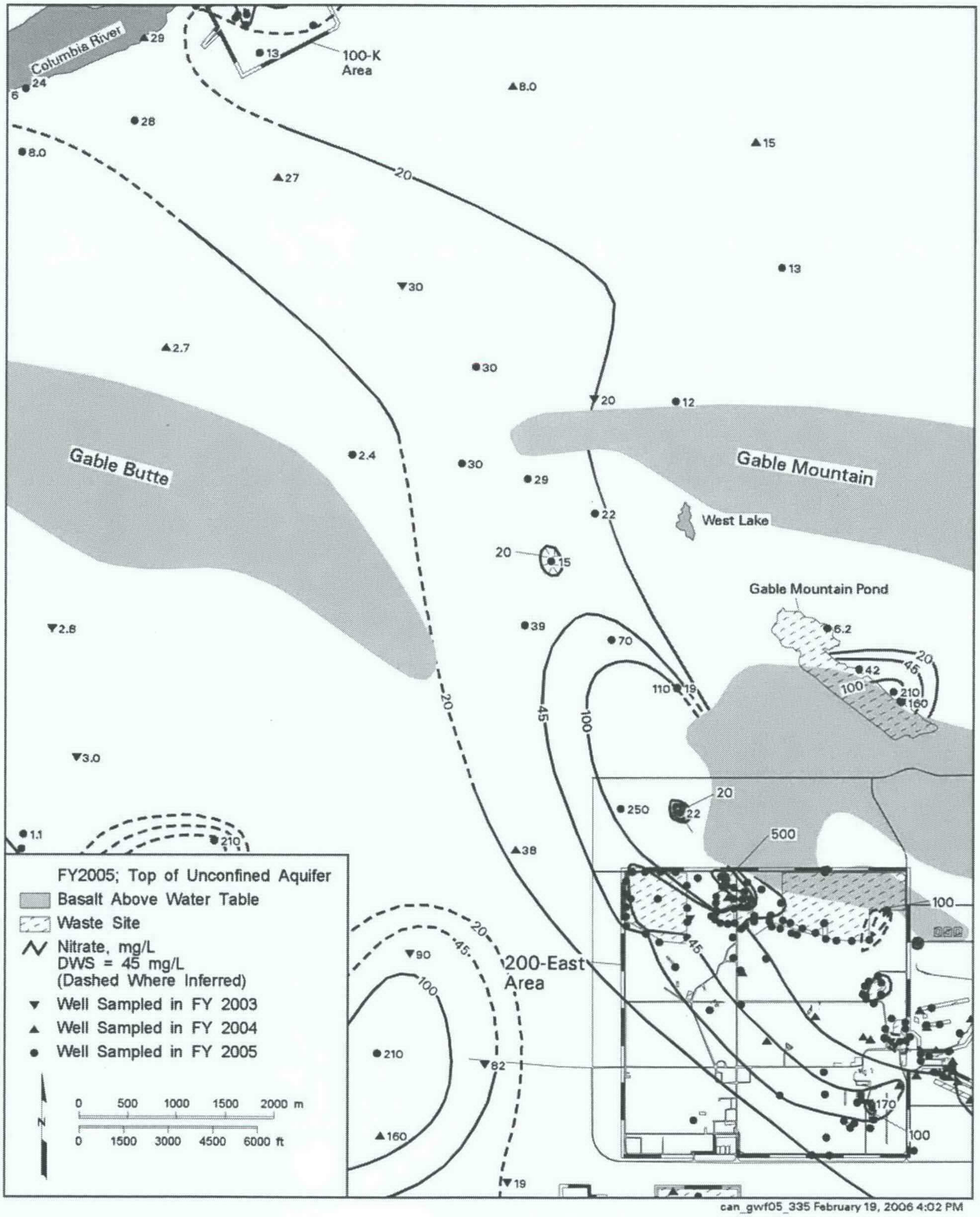

Figure 2.11. Nitrate Distribution in Groundwater in 200-BP-5 Operable Unit – 2005

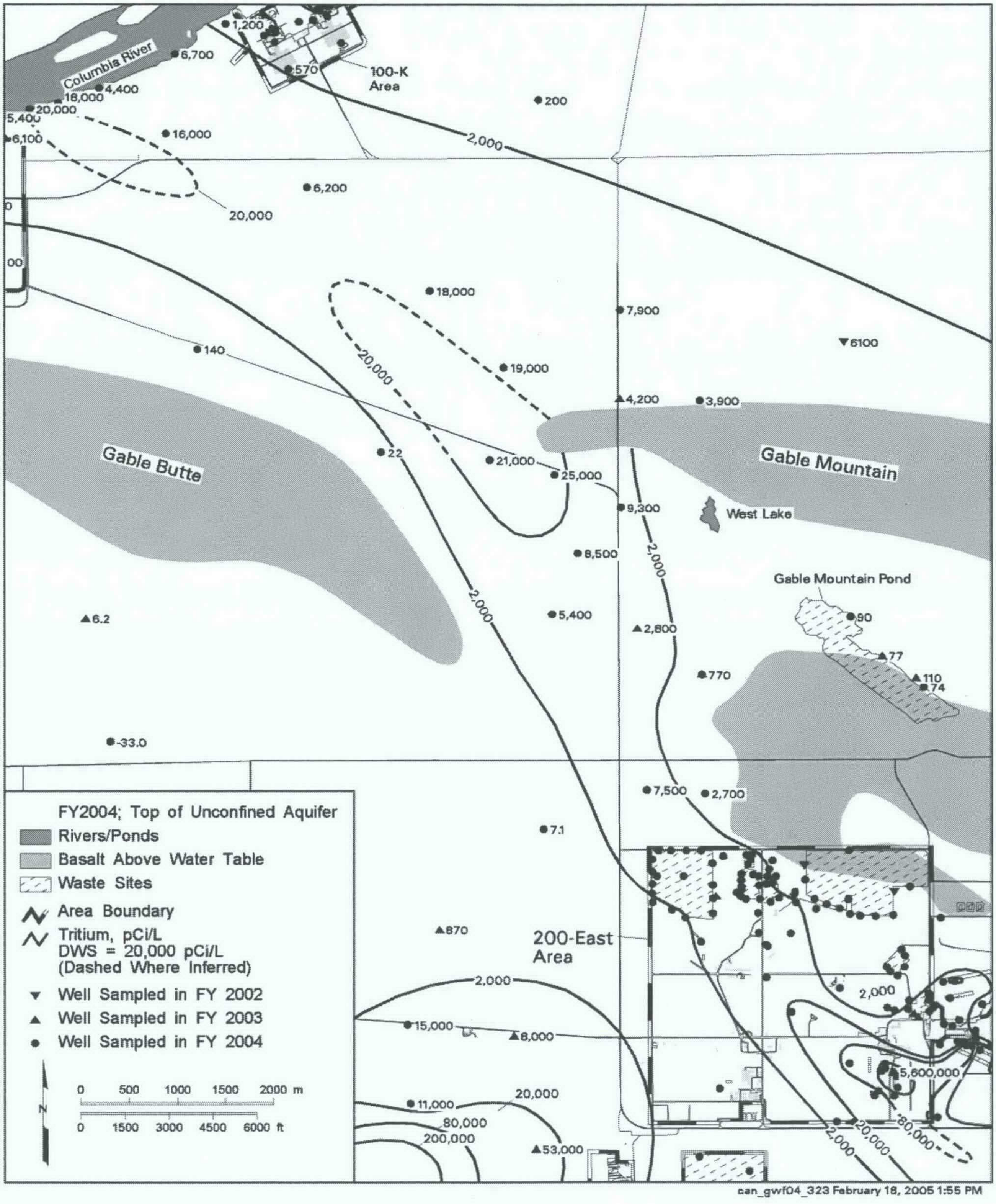

Figure 2.12. Tritium Distribution in Groundwater in 200-BP-5 Operable Unit – 2005

Cobalt-60 and Cyanide. Cyanide is found in more than one well at levels above the drinking water standard (200 μg/L), and cobalt-60 is found in one well at levels above the drinking water standard (100 pCi/L). The maximum cyanide concentration in this area since 1996, a value of 859 μg/L, was present in a well located in the northern part of the BY cribs. Cyanide contamination has increased in a few wells and may be related to past discharges of ferrocyanide waste to the BY cribs.

Elevated cobalt-60 values were detected in wells monitoring the BY cribs, which are believed to be the source of this contamination. The highest cobalt-60 concentration was 200 pCi/L observed in a well in the BY cribs area in November 2004. Other wells in the BY cribs vicinity have also had elevated cobalt-60. Based on observed elevated cobalt-60 concentrations it appears that cobalt-60 in groundwater extends some distance northwest of the BY cribs.

Cesium-137 and Strontium-90. Cesium-137 and strontium-90 have relatively low mobility and are generally found near their source. One well near the 216-B-5 injection well has consistently had concentrations of cesium-137 greater than the drinking water standard (200 pCi/L) but less than the DOE derived concentration guide (3,000 pCi/L).

Strontium-90 distribution near Gable Mountain Pond has not changed appreciably between 1996 and 2004; however, levels have been declining in recent years after highest levels were reached in 1996 and 1997. The highest value observed since the beginning of 1996 was 1,475 pCi/L from a sample taken in April 1996.

Several wells near the 216-B-5 injection well have had elevated concentrations of strontium-90. Four wells have had concentrations of strontium-90 above the drinking water standard (8.0 pCi/L) in FY 2004. Two of the wells have had concentrations greater than the DOE derived concentration guide (1,000 pCi/L) in past years and in FY 2004.

Plutonium-239 and -240. Plutonium-239 and plutonium-240 have been detected during past years in samples taken from several wells near the 216-B-5 injection well. Plutonium is relatively immobile and, therefore, is found only near the source, which was the injection well. The highest reported plutonium concentration since 1996 was 81.68 pCi/L for an unfiltered sample collected in June 1996. More recently, the highest plutonium concentrations have been a filtered value of 5.27 pCi/L and an unfiltered value of 66.2 pCi/L in a sample from June 2004. The lower concentration in the filtered versus unfiltered samples suggests that a portion of the plutonium is associated with particulates. The concentration of plutonium has not exhibited a change in trend in recent years. Wells sampled at the 216-B-5 injection well site have indicated plutonium levels were below the DOE derived concentration guide in recent years.

Progress Since Last Review. Since the first five-year review in 2001, sampling and analysis plans have been developed, new wells have been installed, and data collected from 1996 through FY 2004 and part of FY 2005. Plume maps have been developed based on the groundwater data collected. Because review of data for the 200-BP-5 Operable Unit was not included in the last five-year review, current plume maps are compared to 1996, after the date of the treatability test.

Sample collection was interrupted in 2000 in the 200-BP-5 Operable Unit, and throughout the Hanford Site, because of waste management issues. Waste management and regulatory requirements mandated that a sampling and analysis plan and a waste control plan be prepared and approved by EPA before sample collection could resume. The groundwater monitoring requirements for the 200-BP-5 Operable Unit were then documented and a draft sampling and analysis plan was written between September and December 2001. However, it was determined in April 2002 that a data quality objectives process was necessary to define the groundwater monitoring objectives and requirements, and a data quality objectives report was then completed. After the report was approved the *Waste Control Plan for the 200-BP-5 Operable Unit* was completed and approved. Revisions of the sampling and analysis plan and waste control plan have been completed and approved by EPA.

Fifteen new monitoring wells have been installed in the 200-BP-5 Operable Unit since 1996; the wells support groundwater monitoring for RCRA treatment, storage, and disposal sites, CERCLA, and AEA. The well names, the locations where they were installed, and the date of installation are provided in Table 2.9.

Technical Assessments Discussion. Based on the outcome of the treatability test report, it was determined that interim remedial measures for contaminants of concern were not warranted. Since a remedy has not been determined for groundwater contamination, assessment of protectiveness is based on groundwater monitoring results. No further evaluation of the risk associated with groundwater has been performed since the treatability test report; however, groundwater monitoring data have indicated recent increases in groundwater contamination.

Table 2.9. Groundwater Monitoring Wells in Operable Unit 200-BP-5

Well Name	Location	Date Completed
299-E33-44	Single-Shell Tanks B-BX-BY	CY 1998
299-E33-334	Single-Shell Tanks B-BX-BY	CY 2000
299-E33-335	Single-Shell Tanks B-BX-BY	CY 2000
699-43-44	216-B-3 Pond	CY 2000
299-E33-337	Single-Shell Tanks B-BX-BY	CY 2001
299-E33-338	Single-Shell Tanks B-BX-BY	CY 2001
299-E33-339	Single-Shell Tanks B-BX-BY	CY 2001
299-E27-22	Single-Shell Tank C	CY 2003
299-E27-4	Single-Shell Tank C	CY 2003
299-E27-21	Single-Shell Tank C	CY 2003
299-E27-23	Single-Shell Tank C	CY 2003
299-E33-47	Single-Shell Tanks B-BX-BY	CY 2004
299-E33-48	Single-Shell Tanks B-BX-BY	CY 2004
299-E33-49	Single-Shell Tanks B-BX-BY	CY 2004
699-50-59	North of 200 East Area	CY 2005

The following factors have the potential to influence cleanup decisions, but it is expected they will be resolved through the remedial investigation/feasibility study process:

- Source units that have not been remediated. Removal of contamination from waste sites is expected to have the long-term effect of reducing the amount of contamination that migrates to groundwater.

The remedial investigation/feasibility study activities for these source operable units will address remediation of these waste sites.

- The greatest increases in contaminant concentrations have occurred near waste source areas. In order to address the increasing contamination, a data quality objectives process is underway to support remedial investigation/feasibility study characterization activities for the 200-BP-5 Operable Unit.

- The number of monitoring wells in the 200-BP-5 Operable Unit is limited, especially near BY cribs and B-BX-BY Tank Farms. New monitoring wells are proposed as part of the data quality objectives process, and the remedial investigation/feasibility study work plan will identify the number, locations, and characterization requirements of new wells.

- Uncertainty in the extent and mobility of vadose zone contamination. Vadose zone contamination under the tank farms, cribs, and trenches will continue to be characterized and evaluated to reduce uncertainty and make cleanup decisions as progress continues under the remedial investigation/feasibility study process.

Issues and Actions. No issues or actions specific to the 200-BP-5 Operable Unit were identified.

2.4.4 Decontamination and Decommissioning of Facilities

2.4.4.1 CERCLA Facility Binning

A report has been prepared listing the facilities on the Central Plateau in groups (bins) with similar characteristics to facilitate identification of the necessary CERCLA documentation needed to complete deactivation and decommissioning. This binning effort resulted in the most highly contaminated facilities, which are listed in the TPA (Ecology et al. 1989), being assigned their own special bin (Bin A). These facilities will generally require individual RODs and their own associated TPA milestones. The moderately contaminated facilities (Bin B) may require a few engineering evaluations and cost analyses to cover all of these facilities. The slightly contaminated facilities (Bin C) will probably require only one engineering evaluation and cost analysis for all of the facilities. Bin D facilities (non-contaminated) will be disposed of in landfills. Bin R facilities are those which will be dispositioned under RCRA rather than CERCLA. Bin X facilities are those with their path forward already determined.

2.4.4.2 233-S Plutonium Concentration Facility

The 233-S Plutonium Concentration Facility was built in 1955 to expand production and further concentrate the plutonium nitrate product solution from the REDOX Plant. The 233-S Facility was decommissioned in 1967. The facility was contaminated from normal operations, a control air line contamination (1956), and a fire in the process hood (1963). The facility endured over 30 years of freeze-thaw cycles and had deteriorated significantly. In 1997, it was decided that surveillance and maintenance activities could no longer adequately protect against the threat of release of radiological and hazardous contaminants. An action memo (DOE and EPA 1997) signed by EPA and DOE on March 26, 1997, authorized the decontamination and dismantlement of the facility. This action was completed (except for shipping the transuranic waste to Waste Isolation Pilot Plant) in 2004 with the removal of all structures to grade level. Final remediation will be conducted in coordination with the REDOX Plant.

2.4.4.3 Plutonium Finishing Plant

PFP Above-Grade Structures Removal Action. The PFP structures and soil will be decontaminated and demolished or remediated in phases. The first phase will be decontamination and dismantlement of the above-grade structures to slab-on-grade. An engineering evaluation and cost analysis was prepared that resulted in an Action Memorandum, *Plutonium Finishing Plant Above-Grade Structures Non-Time Critical Removal Action*, signed by DOE and Ecology in May 2005. The Action Memorandum authorized the decontamination and dismantlement of the above-grade structures to slab-on-grade. The removal of below grade structures will be evaluated in FY 2008. Soil remediation activities will be coordinated with the 200-PW-1 Operable Unit.

The RCRA 241-Z facility is undergoing a clean closure in conjunction with the CERCLA action. Drain pipe and utility isolation continues with physical isolation of both the steam lines and electrical power to the tank cells being completed.

The PFP above-grade structures consist of processing, support and administrative buildings located within the PFP Facility on the Hanford Site. The PFP Facility was used to conduct plutonium processing, storage, and support operations for national defense, including the following:

- Special nuclear material handling and storage
- Plutonium recovery
- Plutonium conversion
- Laboratory support
- Waste handling
- Shutdown and operational facility surveillances

In October 1996, DOE issued a shutdown order that stated the operation of the PFP Facility as a production processing plant was no longer required. Deactivation was initiated in preparation for decommissioning and demolition.

PFP plutonium processing buildings contain plutonium chemical process equipment or process waste handling equipment contaminated with radiological and chemical substances used or generated during plutonium processing and process waste management operations. The 216-Z-9 facilities (216-Z-9A, 216-Z-9B, and 216-Z-9C) were internally contaminated during 'mining' of the 216-Z-9 crib (waste site) to remove plutonium-contaminated soil. Remaining buildings within the scope of this removal action are non-process support structures. Potential radiological and chemical substances in these buildings have been identified from characterization data, historical operating data, process knowledge, and knowledge of hazardous substances in construction materials (e.g., asbestos, polychlorinated biphenyls [PCBs]).

232-Z Contaminated Waste Recovery Facility Demolition Project. An action memo signed by DOE and Ecology in November 2004 (DOE and EPA 2004) authorized the decontamination and dismantlement of the PFP 232-Z facility to slab-on-grade.

The 232-Z Demolition Project is proceeding with removal of process equipment and preparing for demolition. All glove boxes and hoods have been removed from the facility and work to clean out the scrubber cell has been initiated. Contamination in the duct work from 232-Z to the stack plenum in 291-Z has been characterized and preparations to put the underground section in a safe mode have been made.

The schedule for completion of 232-Z decontamination and dismantlement activities requires that DOE complete the removal of the 232-Z Building no later than September 30, 2006.

The 232-Z Waste Incinerator Facility processed contaminated waste to recover residual plutonium through incineration and/or leaching of the scrap material. Since 1994, the 232-Z Facility has been in a safe and stable surveillance and maintenance mode.

Surveys of the 232-Z Facility have indicated radionuclide contamination in a significant percentage of the building. Since 1994, the 232-Z Facility has been in a safe and stable surveillance and maintenance mode. Work is currently underway to complete the 232-Z deactivation process (i.e., cleanout and equipment removal) in fiscal year 2005, to be followed immediately by dismantlement in FY 2006.

2.4.4.4 224-T Plutonium Concentration Facility

DOE signed an Action Memorandum for the Non-Time-Critical Removal Action for the 224-T Plutonium Concentration Facility in June 2005. Work on demolition of this facility has been postponed due to funding priorities.

2.4.4.5 224-B Plutonium Concentration Facility

An *Action Memorandum for the Non-Time-Critical Removal Action for the 224-B Plutonium Concentration Facility* was approved in June 2004 (DOE 2004c). Work has not begun on the 224-B facility itself and a removal action work plan and sampling and analysis plan will be prepared in the future. Twenty-two ancillary facilities and structures in the B Plant Laydown Yard were demolished under the 224-B removal action.

2.4.4.6 U Plant Ancillary Facilities

An *Action Memorandum for the Non-Time-Critical Removal of Action for the U Plant Ancillary Facilities* was signed in November 2004 (DOE 2004d). Work on 10 of the 17 U Plant Ancillary Facilities has been completed.

2.5 Technical Assessment Summary

The purpose of the five-year review is to determine whether the remedy at a site is, or upon completion will be, protective of human health and the environment. The technical assessment of the remedy reviews three questions:

- Is the remedy functioning as intended by the decision document?
- Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?
- Has any other information come to light that could call into question the protectiveness of the remedy?

These questions are provided by federal regulations and establish a framework for organizing and evaluating data and ensure that all relevant issues are considered when determining the protectiveness of the remedy. DOE has reviewed that status of the entire CERCLA cleanup at Hanford in this report; however, a technical assessment of a remedy requires that a decision document has been completed for the specific operable unit. A decision document has not been completed for many of the operable units.

The protectiveness determination criteria are summarized below.

- Is the remedy functioning as intended by the decision documents?

  The remedy is functioning as intended by the decision documents to the extent the actions are completed for the following operable units:

  200-ZP-1 200-PW-1 200-UP-1 ERDF U Plant Canyon

  No CERCLA decision documents have been completed regarding the remaining operable units.

When considering whether a remedy is functioning as intended, the review focuses on the technical performance of the remedy, whether the remedy is related to a single operable unit or group of operable units. Data on monitoring, system performance and operation and maintenance of the remedy were important aspects in the determination. In addition, confirmation that access and institutional controls are in place and successfully prevent exposure. Status of the remedy is also considered. If the remedy is under construction, the review focused on whether the remedy is being constructed in accordance with the requirements of the decision documents, and if the remedy is expected to be protective when completed. If the remedy is operating or completed, additional aspects of remedy implementation were considered, such as remedial action performance, costs of system operations, monitoring activities and opportunities for optimization.

- Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

  The exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection are still valid for the following operable units:

  200-ZP-1 200-PW-1 200-UP-1 ERDF U Plant Canyon

When considering whether the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives are still valid, the review focused on all of the risk parameters on which the original remedy decision was based. Changes to target populations, exposure pathways, site characteristics, land use and applicable or relevant and appropriate requirements were reviewed.

- Has any other information come to light that could call into question the protectiveness of the remedy?

  No new information has come to light that could call into question the protectiveness of the remedy for the following operable units:

  200-ZP-1 200-PW-1 200-UP-1 ERDF U Plant Canyon

When considering whether any other information came to light that could call into question the protectiveness of the remedy, the review focused whether ecological risks had been adequately evaluated and addressed or whether new ecological risk information had become available.

2.6 Issues and Actions

Table 2.10 shows the issues and actions for the 200 Area Operable Units.

2.7 Protectiveness Statement

This is the second five-year review for the Hanford Site. For perspective, previous reviews are also provided in this section.

2001 Five-Year Review Report Protectiveness Statement for 200 Areas NPL Site

"The 200 Area NPL site is in the early stages of the CERCLA process. Given the status of investigations and remedial actions, I certify that no soil waste sites or buildings undergoing decontamination and decommissioning in the 200 NPL site require immediate response actions to protect human health and the environment. I certify that the 200-BP-5 and 200-PO-1 Operable Units do not require immediate response actions to protect human health and the environment. I certify that, for the 200-ZP-1 Operable Unit and the 200-UP-1 Operable Unit, additional actions are required to ensure protection of human health and the environment."

2006 Five-Year Review Report Protectiveness Statement for 200 Area NPL Site Source Operable Units

For the 200 Area Source (soil) Operable Units, final remedies have not yet been selected or implemented; therefore, protectiveness determinations cannot be made. For removal actions that have been initiated or completed, it is anticipated that the results will be consistent with the final remedies selected through the remedial investigation/feasibility study and ROD processes. Protectiveness of those remedies will be evaluated in future five-year reviews.

2006 Five-Year Review Report Protectiveness Statement for 200 Area NPL Site Groundwater Operable Units

For the two RODs for interim action that address groundwater contaminants, two pump-and-treatment systems and a vapor extraction system have been installed as interim actions to treat groundwater contamination in the 200 Areas. The 200-ZP-1 Groundwater Operable Unit has a pump-and-treatment system to remove carbon tetrachloride from the groundwater. This system was designed to address only the most concentrated portion of the shallow portion of the plume and the will be expanded through the CERCLA remedial investigation/feasibility study process to address the deeper portion of the plume. A protectiveness determination for the 200-ZP-1 pump-and treat interim remedy is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

The 200-UP-1 Groundwater Operable Unit has a pump-and-treatment system to remove uranium and technetium-99 from the groundwater. This system has met the remedial action objectives identified in the ROD for interim action and is currently undergoing a rebound test. A protectiveness determination for the 200-UP-1 pump-and treat interim remedy is being deferred until a review of the rebound study results is completed and a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

The 200-PW-1 (formerly 200-ZP-2) Soil Operable Unit has a vapor extraction system to remove carbon tetrachloride from the soil. This system has proven to be effective and will continue operation, with improvements. The need for additional work will be assessed through the CERCLA remedial investigation/feasibility study process. A protectiveness determination for the vapor extraction system interim remedy is being deferred until a final remedy is selected through the CERCLA remedial investigation/feasibility study process.

Table 2.10. Issues and Actions for the 200 Area Operable Units

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
Issue 13. There is less than adequate deep groundwater monitoring data downgradient of T Tank Farm to define the nature and extent of technetium-99 contamination. Further characterize the technetium-99 groundwater plume near T Tank Farm.	No[3]	Yes			
Action 13-1. Complete a data quality objective process and sampling plan to further characterize the technetium-99 groundwater plume near T Tank Farm.	No[3]	Yes	GRP	EPA	03/2007
Issue 14. The recent expansion of the 200-ZP-1 extraction well network near the TX-TY Tank Farm may result in technetium-99 contamination being pulled into the 200-ZP-1 treatment system. Treatment options for groundwater contaminated with technetium-99 need to be assessed.	No[3]	Yes			
Action 14-1. Assess treatment options to address technetium-99 near T Tank Farm.	No[3]	Yes	GRP	EPA	09/2007
Issue 15. Soil resistivity measurements have detected large regions of anomalous high soil conductivity in the area south of PUREX around the 216-A-4 crib and near the B/C cribs and trenches. Further characterization of the B/C cribs and trenches is needed.	No[3]	Yes			
Action 15-1. Complete data quality objective process and sampling plan to further characterize the high soil conductivity measurements detected at B/C cribs and trenches.	No[3]	Yes	GRP	EPA	12/2007
Issue 16. Efficiency and effectiveness of the 200-ZP-1 pump-and-treat system could be increased by increasing the pumping rate to fully utilize the treatment capacity.	No[4]	Yes			
Action 16-1. Increase the pump size in 200-ZP-1 extraction wells 299-W15-45 and 299-W15-47.	No[4]	Yes	GRP	EPA	03/2007

Table 2.10. (contd)

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
Issue 17. Efficiency of the carbon tetrachloride remediation could be increased by increasing the use of the 200-ZP-2 vapor extraction system. The soil-vapor extraction system is in limited operation. Expanding the soil-vapor extraction operations should be evaluated.	No[5]	Yes			
Action 17-1. Evaluate expanding the soil-vapor extraction operations. Also, specifically review converting former groundwater extraction well 299-W15-32 to a soil-vapor extraction well.	No[5]	Yes	GRP	WDOE	03/2007
Issue 18. The remedial action objective for uranium was based upon the Washington State *Model Toxics Control Act* (MTCA) cleanup standard of 48 ppb when the 200-UP-1 Interim ROD was issued. Since this time, EPA has established a drinking water standard for uranium of 30 ppb. There are also some other issues to be addressed within the ROD if an explanation of significant difference is prepared. These include the limited quarterly pumping requirement at well 299-W23-19, adjusting the pumping requirement for 200-UP-1 due to limited flow within the extraction well network, and technetium-99 groundwater contamination at other locations within the operable unit.	No[6]	Yes			
Action 18-1. Prepare an explanation of significant difference for 200-UP-1 Interim ROD.	No[6]	Yes	GRP	WDOE	6/2008

1 Does this issue/action currently affect the protectiveness of the remedy?
2 Will this issue/action affect the protectiveness of the remedy in the future?
3 Identifying the need for, and acquiring new data in the future, does not affect the current status of protectiveness.
4 Identifying the need for, and expanding the capacity of the pumps in the future, does not affect the current status of protectiveness.
5 Identifying the need for, and increasing the use of the vapor extraction system in the future, does not affect the current status of protectiveness.
6 Changing the remedial action objective or other requirements of the ROD through an ESD does not affect the current status of protectiveness.

RCP – River Corridor Remediation Project
GRP – Groundwater Remediation Project
EPA – Environmental Protection Agency
WDOE – Washington State Department of Ecology

3.0 300 Area

3.1 Introduction

The 300 Area is located along the Columbia River north of the Richland, Washington, city limits in the southeast portion of the Hanford Site (see Figure 3.1). The 300 Area consists of three operable units. The 300-FF-1 and 300-FF-2 Operable Units address contaminated soil, debris, and burial grounds associated with 300 Area operations, and the 300-FF-5 Operable Unit covers the contaminated groundwater under the 300-FF-1 and 300-FF-2 Operable Units. The 300 Area consists of a 0.66-square-kilometer (0.25-square-mile) industrial complex area that was used for uranium fuel fabrication and research and development activities for the Hanford Site; unlined liquid disposal areas north of the industrial complex area; and burial grounds, landfills, and miscellaneous disposal sites associated with operations in the industrial complex.

3.2 Chronology

A list of the CERCLA decision documents for the 300 Area Operable Units is provided in Table 3.1.

Table 3.1. 300 Area CERCLA Decision Documents

Documents	Date
Expedited Response Action for the 618-9 Burial Ground (Remove and dispose of drums containing uranium-contaminated hexone.)	1991
Action Memorandum for the 316-5 Process Trenches (ERA to remove soil from the 300 Area Process Trenches) (EPA and Ecology 1991)	July 1991
Final ROD for the 300-FF-1 and Interim ROD for 300-FF-5 Operable Units (Remove, treat as appropriate, and dispose of contaminated soil and debris. Monitor natural attenuation for groundwater.) (EPA 1996d)	July 1996
Explanation of Significant Differences for 300-FF-1 (land disposal restriction treatability variance) (EPA 2000c)	January 2000
331-A Virology Laboratory Building Action Memorandum (demolition, removal, and disposal of building) (DOE and EPA 2000)	February 2000
Explanation of Significant Difference for the 300-FF-5 ROD (Additional groundwater monitoring required.) (EPA 2000b)	June 2000
Interim ROD for the 300-FF-2 Operable Unit (EPA 2001c)	April 2001
Explanation of Significant Difference for 300-FF-2 ROD (change cleanup levels from industrial to unrestricted for eight waste sites and modified soil cleanup levels for groundwater protection) (EPA 2004a)	May 2004
Action Memorandum #1 for the 300 Area Facilities (DOE and EPA 2005)	January 2005
Note: The 300-FF-1 Operable Unit has a final ROD and the RODs for the 300-FF-2 and 300-FF-5 Operable Units are interim.	

3.3 Background

Use of the 300 Area began in 1943. The 300 Area facilities were primarily associated with reactor fuel fabrication and research and development activities for the Hanford Site. During the period of operation

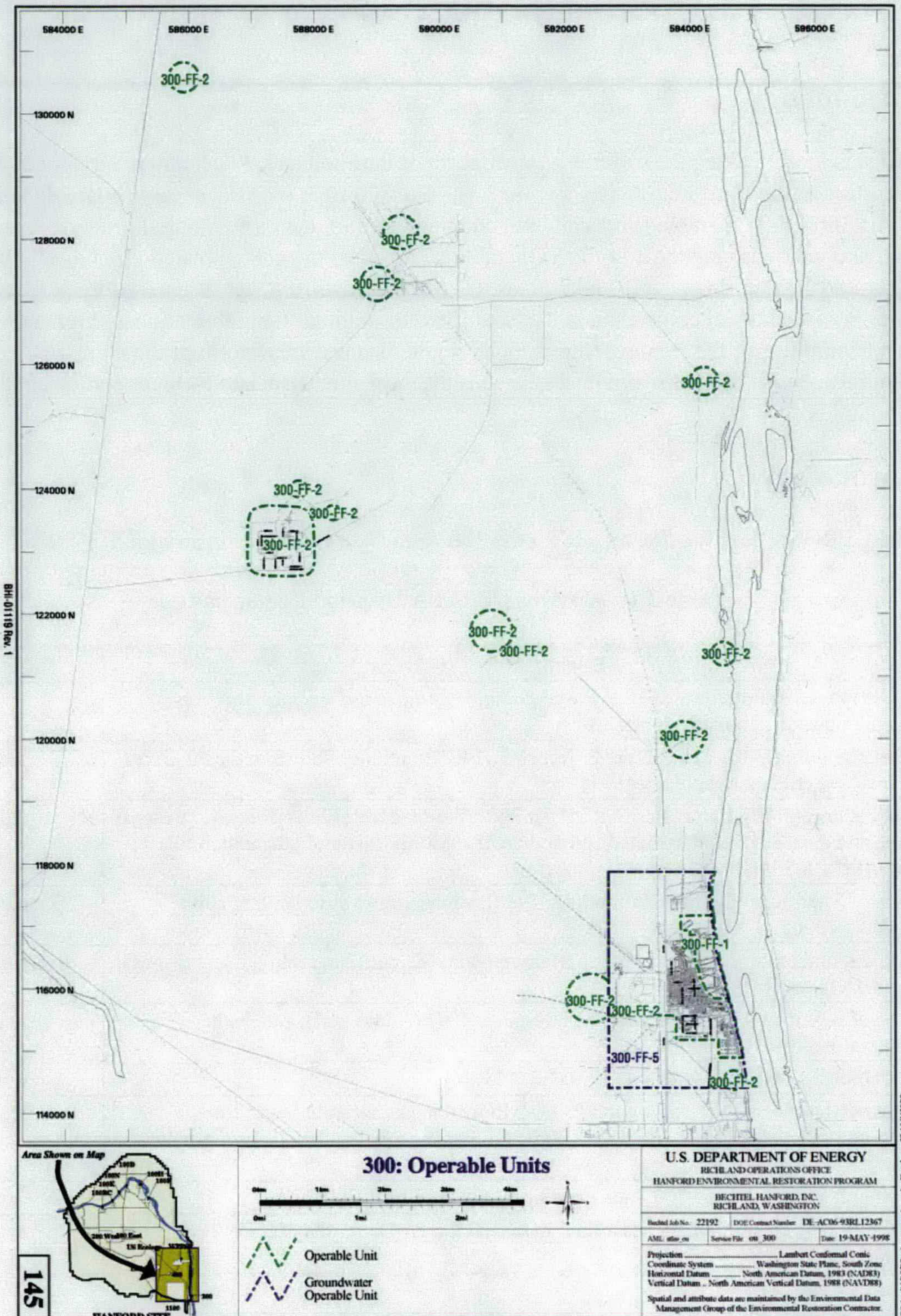

Figure 3.1. Map of the Hanford Site and the 300 Area Operable Units

(most operations ended before or during the 1990s), fuel fabrication and laboratory facilities disposal practices, spills, and other unplanned releases resulted in contamination of the facilities, surface, underlying soil column, and groundwater. Waste from 300 Area operations was also purposefully disposed in unlined landfills/burial grounds and discharged to unlined surface ponds/trenches. The 300 Area NPL site, which includes three operable units, was placed on EPA's NPL in 1989. Figure 3.2 depicts the boundaries of the 300 Area Operable Units. The 300-FF-1 and 300-FF-2 Operable Units deal with contaminated soil, debris, piping, and burial grounds associated with operations in the 300 Area. The 300-FF-5 Operable Unit includes groundwater contamination beneath the burial grounds and soil waste sites.

The primary contaminant in many of the waste sites is uranium from the fuel fabrication process. However, additional contaminants such as plutonium, beryllium, metals, and petroleum, are expected throughout the various burial grounds. Chlorinated organics have also been identified as contaminants.

The primary cleanup actions involve the removal of contaminated soil and debris; treating the material, as appropriate, to reduce the toxicity, mobility, or volume of waste; and disposing of the material in an appropriate long-term waste management facility. The majority of waste from cleanup of the 300 Area will be disposed of at ERDF in the 200 West Area of the Hanford Site.

The cleanup activities specifically declared in the 300-FF-1 ROD have been completed. A remedial action report was issued documenting the cleanup of the waste sites listed in the 300-FF-1 ROD. Cleanup activities are still in progress at various 300-FF-2 waste sites, as well as decontamination and decommissioning of buildings in the 300 Area.

The 300-FF-5 Operable Unit includes groundwater contamination beneath the soil waste sites and burial grounds. The current decision for contaminated groundwater in the 300 Area is to monitor the groundwater to ensure that contamination levels are attenuating through natural processes in a reasonable time frame.

An industrial exposure scenario and a qualitative ecological risk assessment are being used as the basis for establishing risk and cleanup levels, the exception being eight waste sites identified in the May 2004 explanation of significant difference to the 300-FF-2 ROD. These eight waste sites are required to meet cleanup levels based on an unrestricted use.

3.4 Remedial Actions

3.4.1 Source Operable Units

3.4.1.1 Action Memorandum for Expedited Response Action to Remove Hexone Drums from the 618-9 Burial Ground – 1991

In 1991, approximately 3,183 liters (700 gallons) of methyl isobutyl ketone (also known as hexone) and 4,092 liters (900 gallons) of kerosene solvent was removed from 120 drums that had been buried at the west end of the 618-9 burial ground. Additional materials (e.g., empty waste drums, construction debris, and soil) were also removed from the remainder of the burial ground. The cleanup actions at the 618-9 burial ground allow for unrestricted use and unlimited exposure of the site.

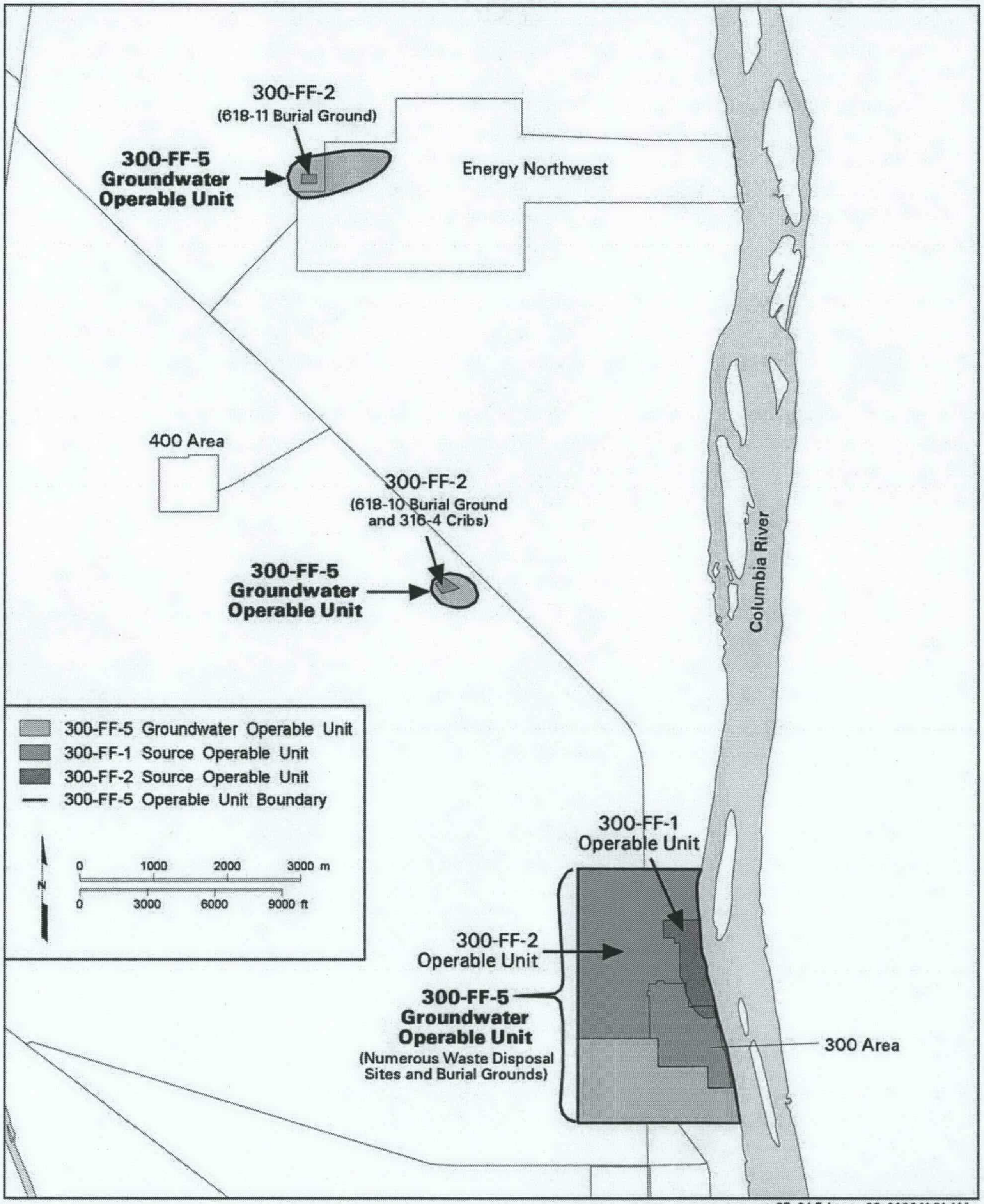

Figure 3.2. 300 Area Operable Unit Boundaries

3.4.1.2 Action Memorandum for Expedited Response Action at the 300 Area Process Trenches – July 1991

The 300 Area Process Trenches received wastewater from operations in the 300 Area. In 1991, an expedited response action was performed to reduce the migration of radioactive and inorganic (heavy metals) contaminants to groundwater. Excavation sample results taken after the expedited response action indicate that the response action successfully reduced contamination in all areas of the trenches except the spoils area. The spoils pile and the remainder of the process trenches were later cleaned up as part of the 300-FF-1 remedial action (see following paragraph).

3.4.1.3 300-FF-1 Operable Unit Record of Decision – July 1996

The 300-FF-1 Operable Unit includes the major 300 Area liquid/process waste disposal sites, the 618-4 burial ground, and three small landfills. The liquid/process waste disposal sites were unlined trenches and ponds that received discharges of millions of gallons of contaminated wastewater. These liquid/process waste disposal sites are suspected to be the primary source of uranium contamination in the groundwater beneath the 300 Area. The remedial action objectives from the ROD are provided in Table 3.2.

Table 3.2. 300-FF-1 and FF-5 Operable Unit Remedial Action Objectives

Item	Description
Remedial Action Objective 1	Protect human and ecological receptors from exposure to contaminants in soil and debris by exposure, inhalation, or ingestion of radionuclides, metals, or organics. This remedial action objective will be achieved through compliance with the *Model Toxics Control Act* cleanup values for organic and inorganic chemical constituents in soil to support industrial land use (WAC 173-340-745), and the draft EPA and the draft Nuclear Regulatory Commission proposed protection of human health standards of 15 mrem/year in soils above background for radionuclides.
Remedial Action Objective 2	Protect human and ecological receptors from exposure to contaminants in the groundwater and control the sources of groundwater contamination in 300-FF-1 to minimize future impacts to groundwater resources. This remedial action objective will be achieved by attaining maximum contaminant levels and non-zero maximum contaminant level goals promulgated under the *Safe Drinking Water Act* implementing regulations (40 CFR 141). The specific location and measurements of the compliance monitoring will be documented in an operations and maintenance plan for the 300-FF-5 Operable Unit, which will be approved by EPA. Also, the contaminants remaining in the soil after remediation will not result in further degradation of groundwater quality.
Remedial Action Objective 3	Protect the Columbia River such that contaminants in the groundwater or remaining in the soil after remediation do not result in an impact to the Columbia River that could exceed the Washington State Surface Water Quality Standards (WAC 173-201A). The protection of the river will be achieved by preventing further degradation of groundwater quality in the uranium plume such that receptors that may be affected at the groundwater discharge point to the Columbia River are not subject to any additional incremental adverse risks. The specific location and measurements of the compliance monitoring will be documented in an operations and maintenance plan for the 300-FF-5 Operable Unit, which will be approved by EPA.

A CERCLA ROD for 300-FF-1 Operable Unit was issued in July 1996 (EPA 1996d). The ROD directed removal of contaminated soil and debris, treatment as necessary, and disposal of the waste in ERDF. Institutional controls are required as part of the remedy because the cleanup will leave waste in place and not allow for unrestricted use.

In January 2000, EPA issued an explanation of significant difference to the ROD (EPA 2000c) for 300-FF-1 to grant a site-specific treatability variance for a small quantity of soil and debris (925 cubic meters [1,210 cubic yards]) in one 300-FF-1 waste site (Landfill 1D) so that it could be removed from the 300 Area and disposed of in ERDF. The explanation of significant difference resulted in a reduction in cleanup cost and complexity, while maintaining protection for human health and the environment.

Remedial actions at the 300-FF-1 Operable Unit were initiated in 1997 and were completed in 2004. The selected remedy and remedial action objectives established in the 300-FF-1 ROD have been met. Three 300-FF-2 waste sites were also remediated in conjunction with 300-FF-1, including 300-10, 300-45, and 618-5 burial ground. An evaluation of the *300-FF-1 Operable Unit Remedial Action Report* (DOE 2004b) was performed, which documents completion and outlines the submittal of cleanup verification packages submitted.

3.4.1.4 300-FF-2 Operable Unit Record of Decision – April 2001

The 300-FF-2 Operable Unit contains 56 waste sites. Forty waste sites are located beneath existing facilities and/or covered areas inside the 300 Area industrial complex fences; seven waste sites are outside the industrial complex fences, seven general content burial grounds are in the vicinity of the 300 Area (one is actually beneath a building in the complex area); and two burial grounds containing transuranic-contaminated material are north of the 300 Area fenced complex.

Cleanup activities for waste sites within the 300 Area complex are being conducted (in most cases) after the demolition of structures above and adjacent to the waste sites. Approximately 150 buildings and structures will have to be removed from the 300 Area before the cleanup of nearly 40 waste sites beneath them can be completed.

The 300-FF-2 ROD was issued in April 2001 (EPA 2001c). The selected remedy requires removal of contaminated soil, structures and associated debris; treatment if necessary to meet the waste acceptance criteria of the acceptable disposal facility; and disposal in ERDF, the Waste Isolation Pilot Plant, or other disposal facilities approved by EPA. Remedial action objectives for the 300-FF-2 Operable Unit ROD are provided in Table 3.3.

Remedial actions in the 300-FF-2 Operable Unit waste sites are ongoing. Eight remotely located waste sites are using cleanup standards for unrestricted use, and the remaining waste sites are being remediated to industrial use cleanup standards. Work in burial grounds at the 300-FF-2 Operable Unit has been progressing and presents additional challenges. Waste segregation and sorting operations are necessary to discover unknown waste and waste requiring treatment prior to disposal. Waste staging areas are located adjacent to the burial grounds to allow a sufficient area to further segregate and sort material. Additionally, the discovery of unknown materials requires additional characterization and/or may not be covered by the existing authorization basis approved by DOE. Treatment of waste may be necessary and the location of the treatment operations may be performed at the 300 Area, ERDF, or offsite.

Since waste piles require sorting and segregation, the potential for spreading contamination is high in the event of high winds. The existing air monitoring plan identifies the necessary controls to minimize fugitive dust. DOE has implemented additional controls for waste staging piles due to recent wind events that caused some material to move outside of the controlled area. Implementation of the additional control measures for waste staging piles, as well as the waste site, has been effective in controlling air emissions and movement of material outside of controlled areas.

Table 3.3. 300-FF-2 Operable Unit Remedial Action Objectives

Item	Description
Remedial Action Objective 1	Prevent or reduce risk to human health, ecological receptors, and natural resources associated with exposure to wastes or soil contaminated above applicable or relevant and appropriate requirements or risk-based criteria. For radionuclides, this remedial action objective means prevention or reduction of risks from exposure to waste or contaminated soil that exceed the CERCLA cumulative excess cancer risk range of 10^{-4} to 10^{-6}.[a] For chemicals, this item means prevention or reduction of risk from direct contact with waste or contaminated soil that exceed the *Model Toxic Control Act* (WAC 173-340-745) cumulative excess cancer risk goal of 10^{-5} and/or a hazard index of 1.[b]
Remedial Action Objective 2	Prevent migration of contaminants through the soil column to groundwater and the Columbia River such that concentrations reaching groundwater and the Columbia River do not exceed maximum contaminant levels/non-zero maximum contaminant level goals under the federal *Safe Drinking Water Act* implementing regulations (40 CFR 141) and/or Washington State drinking water standards (WAC 246-290), ambient water quality criteria for protection of freshwater aquatic organisms under the federal *Clean Water Act* implementing regulations (40 CFR 131) and/or Washington State surface water quality standards (WAC 173-201A), and the *Model Toxic Control Act* groundwater cleanup standards (WAC 173-340-720).
Remedial Action Objective 3	Prevent or reduce occupational health risks to workers performing remedial action.
Remedial Action Objective 4	Minimize the general disruption of cultural resources and wildlife habitat, and prevent adverse impacts to cultural resources and threatened or endangered species.
Remedial Action Objective 5	Ensure that appropriate institutional controls and monitoring requirements are in place to protect future users at a remediated site.

[a] The Tri-Parties have chosen 15 mrem/yr. above background over a period of 1,000 years after final remediation for a maximally exposed individual to address this remedial action objective. Meeting this objective will also be protective of ecological receptors based on criteria specifying that dose rates shall not exceed 0.1 rad/day for terrestrial organisms and 1.0 rad/day for aquatic organisms and terrestrial plants.
[b] Direct contact values may have to be adjusted further to be protective of terrestrial plants and animals depending on the location of the individual waste site and the nature of the surrounding habitat.
Note: For most radionuclides, maximum contaminant levels correspond to a cumulative dose of 4 mrem/yr.

The 618-7 burial ground is located northwest of the 300 Area complex. There is the potential for drummed waste to be pyrophoric. An investigation was performed in March 2005 in accordance with the *618-7 Burial Ground Field Investigation Plan*. The scope of the investigation was to locate drums, determine their condition, sample their contents and soils, and determine potential treatment options and costs. The investigation was not successful in locating the drums. The remediation schedule for the 618-7 burial ground will account for the necessary evaluation upon discovery of the drums, including revision or re-evaluation of the treatment plan.

Excavation of the 316-4 waste site began in 2004 with excavation continuing into early 2005. Uranium is the primary contaminant. The uranium concentrations increase with depth. Further excavation appears to be necessary. Excavating deeper will require benching and, based on the location of the 618-10 burial ground, benching and maintaining safe slopes will infringe on the 618-10 burial ground boundary. Further excavation at 316-4 has been postponed until remediation of the 618-10 burial ground. The site was backfilled in August 2005 for safety reasons.

Three waste sites in the 300-FF-2 Operable Unit were remediated as part of the 300-FF-1 cleanup actions. These sites were 300-10, 300-45, and 618-5 burial ground. Cleanup activities were completed by 2004. Cleanup actions on other 300-FF-2 waste sites have been ongoing since 2004.

3.4.1.5 Explanation of Significant Difference for 300-FF-2 ROD – May 2004

In May 2004, an explanation of significant difference (EPA 2004a) to the 300-FF-2 ROD was issued to revise the soil cleanup standard for uranium concentration in contaminated soil and to modify the soil cleanup levels for eight specific waste sites in the 300-FF-2 Operable Unit from industrial to unrestricted use. The original ROD (EPA 2001c) required an engineering study to more accurately define the leachability and mobility of uranium in 300 Area soil. As a result of the study, the soil cleanup level for uranium (industrial) changed from 350 pCi/g to 267 pCi/g.

3.4.2 Groundwater Operable Units

Contaminated groundwater discharges to the Columbia River shoreline and near-shore river bottom. Near-shore seeps and pore water are sampled at a number of locations and are scheduled for regular monitoring. Monitoring is condition dependent (i.e., aquifer tubes cannot be sampled during high river levels) and performed by DOE and Washington Department of Health. Both agencies report and evaluate their respective monitoring results in the annual monitoring reports prepared by the two agencies. Neither agency has identified any actual or potential acute or chronic effects from contaminant discharges to the Columbia River and its shoreline. A detailed ecological risk assessment of the Columbia River Corridor is in progress, and should reach conclusions about potential effects.

3.4.2.1 300-FF-5 Operable Unit (Record of Decision – July 1996)

The ROD for 300-FF-1 and 300-FF-5 was signed in July 1996 (EPA 1996d). At that time, the geographic area for the 300-FF-5 Operable Unit included the groundwater affected by releases from 300-FF-1 sources. The contaminants of concern identified in the ROD were uranium, trichloroethene, and 1,2-dichloroethene.

The remedial action objectives defined in the ROD are to protect human and ecological receptors from exposure to contaminants in the groundwater and protect the Columbia River such that contaminants in the groundwater do not result in an impact to the Columbia River that could exceed the Washington State Surface Water Quality Standards (WAC 173-201A). The remedial action objectives for groundwater remediation remain as "restoration of the aquifer." Groundwater cleanup decisions will be based on the effectiveness of current cleanup technologies and their ability to meet CERCLA groundwater cleanup objectives, including the restoration of the aquifer to beneficial uses wherever practicable within a reasonable time frame given the particular circumstances of the Hanford Site. If, through the CERCLA process, restoration is determined to not be practicable, it is expected that appropriate actions will be taken to prevent further migration of the plume, exposure to the contaminant, and evaluate further risk reduction. This approach is consistent with 40-CFR 300.430(a)(1)(iii)(F).

The remedy selected was monitored natural attenuation with institutional controls to prevent human exposure to groundwater. The ROD required continued groundwater monitoring to verify modeled predictions of contaminant attenuation and to evaluate the need for active remedial measures. Institutional controls were required to prevent groundwater use while contaminant plumes were still present above drinking water standards. The uranium plume has not attenuated at the rate expected when the ROD was issued. Therefore, DOE has initiated additional characterization activities and is evaluating more aggressive treatment alternatives to address the uranium plume. In the interim, the institutional controls on the use of groundwater prevent human consumption of groundwater. The original operations and maintenance plan was revised per an action item from the first five-year review (DOE 2001).

The decision to rely on natural attenuation with continued monitoring groundwater while source remedial actions progressed was partially predicated on the presumption that concentrations of the contaminants of potential concern in groundwater would continue to decrease at rates suggested by monitoring data and modeling results obtained during the initial remedial investigation (DOE 1995b). An additional presumption was that contaminated groundwater would not pose an unacceptable risk to human health and the environment under the land use expected to prevail during the foreseeable future, i.e., while source remedial actions were underway and the land remained under federal control.

An explanation of significant difference (EPA 2000b) to the 300-FF-5 ROD was developed in June 2000. The explanation expanded the scope of 300-FF-5 to include groundwater beneath 300-FF-2 waste sites and burial grounds. The explanation of significant difference also required that an update to the operation and maintenance plan for 300-FF-5 to ensure that adequate groundwater monitoring requirements and institutional controls are in place. The explanation of significant difference did not make any fundamental changes to the 1996 remedy selection.

Of the newly added outlying waste sites, those with the potential to impact groundwater were the 618-11 burial ground and the 316-4 cribs/618-10 burial ground. Additional contaminants of concern identified in the explanation of significant difference were tritium at the 618-11 burial ground waste site and uranium and tributyl phosphate at the 316-4 crib waste sites. The selected remedies and remedial action objectives for groundwater contained in the original ROD (EPA 1995c) were not changed with the addition of the two new sub-regions.

3.4.2.2 Explanation of Significant Difference: Additional Constituents of Concern – June 2000

In 2000, an explanation of significant difference (EPA 2000b) was issued to expand the scope of the 300-FF-5 ROD to include all groundwater that underlies the 300 Area waste sites and burial grounds. This includes the groundwater beneath the outlying 300-FF-2 source sites and burial grounds, including the following: 618-10 burial ground, 618-11 burial ground, 316-4 source waste site, 600-63 source waste site, and 600-259 source waste site. In addition, the groundwater beneath any newly discovered waste sites that are plugged into the 300-FF-2 ROD in the future will be included in the scope of the 300-FF-5 ROD. The explanation of significant difference also required an update to the operations and maintenance plan for the 300-FF-5 Operable Unit (DOE 1995b) to ensure that an adequate monitoring and institutional control plan is in place for groundwater beneath 300-FF-1 and 300-FF-2 waste sites.

3.4.3 Decontamination and Decommissioning of Facilities

3.4.3.1 Action Memorandum for Decontamination and Decommissioning of the 331-A Virology Laboratory – February 2000

A small, one-story concrete block building in the 300 Area was decontaminated and decommissioned in February/March 2000. The building, known as the 331-A Virology Laboratory, was part of the 331 Life Sciences Laboratory Complex operated by the Pacific Northwest National Laboratory. Because of radioactive contamination, the building could not be demolished and disposed in an off-site landfill. Therefore, an engineering evaluation/cost analysis was performed to evaluate options for performing the decontamination and decommissioning under CERCLA. DOE authorized, with EPA concurrence, the decontamination and decommissioning of the facility in an Action Memo dated February 15, 2000 (DOE and EPA 2000). The removal action removed the above-ground structure (i.e., walls and roof). The floor slab and any contaminated below-ground structures or soil associated with the building will be assessed and removed as part of the 300-FF-2 Operable Unit.

3.4.3.2 Action Memorandum Decontamination and Decommissioning of 300 Area Buildings and Structures – January 2005

Action Memorandum #1 for the 300 Area (DOE and EPA 2005) authorized the demolition of buildings, vaults, structures, and pipelines in the north quarter of the 300 Area. Work immediately began on the demolition of the 313 facility upon issuance of this action memorandum. Disposition activities in the 314 Building and other buildings on top of the 618-1 burial ground will continue.

3.4.4 Progress Since the Last Five-Year Review

Key developments since 2001 include the following:

- Remediation of the principal 300 Area liquid waste disposal sites that acted as source areas for groundwater contamination (i.e., North and South Process Ponds; 300 Area Process Trenches). Remediation consisted of excavating contaminated soils, backfilling, and restoring the ground surface.

- Laboratory investigations involving the geochemistry of uranium and implications for its persistence in the 300 Area.

- Computer simulation models are under development to provide better estimates for the flow of groundwater and transport of contaminants of concern beneath the 300 Area (uranium plume) and 618-11 burial ground (tritium plume).

- Installation of new groundwater monitoring facilities:
  - Two new wells installed in 2004 at the 618-10 burial ground to monitor impacts on groundwater from potential releases at that site.
  - Aquifer sampling tubes at eight new monitoring sites along the 300 Area shoreline during 2004 providing comprehensive coverage for monitoring groundwater as it passes across the groundwater/river water interface.

– One new monitoring well installed in 2005 at the northwest corner of the 300 Area to provide data for the groundwater flow model.

- An expanded groundwater report for FY 2004 was prepared to meet requirements described in the 300-FF-5 Operations and Maintenance Plan to support the second five-year review of the ROD. That report includes descriptions of:
  – Concentration trends for contaminants of potential concern.
  – Updated conceptual models for uranium contamination at the 300 Area and tritium contamination in the 618-11 sub-region.
  – Analysis of progress made during the period of interim remedial action.

- Remedial action/feasibility study activities were initiated during 2004 to better understand the persistence of the 300 Area uranium plume and to investigate technologies that may reduce in groundwater contaminant concentrations below the maximum contaminant level for drinking water supplies (the current standard is 30 µg/L).

- Since the last review, a human health and ecological risk assessment was initiated to evaluate post-remediation conditions of source waste sites and current conditions in groundwater, the riparian zone, and the near shore of the Columbia River. DOE prepared and received regulatory approval for a *Risk Assessment Work Plan for the 100 Area and 300 Area Component of the RCBRA* (DOE 2005g). DOE, with technical assistance from Hanford Natural Resource Trustee representatives, went through a data quality objective process and produced and received regulatory approval of *100 Area and 300 Area Component of the RCBRA Sampling and Analysis Plan* (DOE 2006a). Using existing data gathered at the completion of waste site remediation prior to backfill and supplemental data to be gathered under the sampling and analysis plan, a risk assessment report will be produced. A TPA milestone was established during the approval process of the work plan to submit the risk assessment report to the EPA and Ecology for review by June 30, 2007.

3.5 Technical Assessment Summary

The purpose of the five-year review is to determine whether the remedy at a site is, or upon completion will be, protective of human health and the environment. The technical assessment of the remedy reviews three questions:

- Is the remedy functioning as intended by the decision document?

- Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

- Has any other information come to light that could call into question the protectiveness of the remedy?

These questions are provided by federal regulations and establish a framework for organizing and evaluating data and ensure that all relevant issues are considered when determining the protectiveness of the remedy. DOE has reviewed that status of the entire CERCLA cleanup at Hanford in this report; however a technical assessment of a remedy requires that a decision document has been completed for the specific operable unit. A decision document has not been completed for many of the operable units.

Per DOE and EPA five-year review guidance, DOE has evaluated whether the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection are still valid. The 300 Area ROD and interim action ROD that are the basis for completed and ongoing remedial actions are based on exposure assumptions consistent with an industrial use exposure scenario. The industrial use scenario is consistent with the *U.S. Department of Energy Environment Impact Statement Record of Decision on the Hanford Comprehensive Land Use Plan.*

Since the first five-year review was issued in 2001 (DOE 2001), stakeholder concerns regarding the appropriateness of using the industrial land use scenario for developing cleanup standards for the 300 Area have been raised. In response to some of the questions, DOE and EPA funded a City of Richland study to look at potential redevelopment opportunities in the 300 Area. The report suggests that industry is not interested in reoccupying this land because large areas of uncontaminated property in other areas are being promoted for development by the City of Richland. Instead, the report recommends a multiple use for the 300 Area incorporating uses ranging from shopping malls to golf courses, including residences.

Separate from the need to review the established land use as part of the CERCLA five-year review, DOE Policy 455.1, *Use of Risk Based End State* required DOE to produce an end-state vision document. During this process, several public workshops were held to gather input from the public on end states for each of the major areas of Hanford, including the 300 Area. The 300 Area workshop was held on May 19, 2005. Subsequent to the workshop the Hanford End State Vision document (DOE 2005b) was finalized. Future land use possibilities identified by the public during the workshop included a number of industrial uses, recreational and other ideas. The recommendation that came out of the end state process for the 300 Area was to:

- Continue remediation of waste sites to industrial standards as required under the current interim action ROD.

- The River Corridor Baseline Risk Assessment will be completed to support final remedial decisions. The outcome of the River Corridor Baseline Risk Assessment, the final remedy for groundwater, the five-year review of land use decisions and the data gathered during the early stages of cleanup will be considered along with public input before final 300 Area site remedies are identified.

Based on the DOE review of the results of the 300 Area End States workshop and its own land use plan, DOE has concluded that the industrial exposure assumptions are still appropriate at this time. DOE's position on land use for the 300 Area has not changed in that DOE may have a future mission for the 300 Area. No decision has been made, nor are any decisions pending, to transfer this land out of federal control in the foreseeable future.

Lands under the control of the federal government are not subject to the Washington *Growth Management Act* (RCW 36.70A). Consequently, local and regional land use plans, such as the *City of Richland Land Use Plan* (Richland 2005), do not apply on federal lands. However, to ensure that local city and county governments understood the way DOE planned to use the federal lands in proximity to private lands, several years ago DOE prepared an environmental impact statement and issued a *National Environmental Policy Act* ROD on the *Hanford Comprehensive Land Use Plan* (DOE 1999). As long as the land remains under federal control, this document provides the legal basis and underlying logic for the land use for the Hanford Site, including the 300 Area. The *Hanford Comprehensive Land Use Plan* designates the land use for the 300 Area to be industrial with restricted surface use. As long as the lands in the 300 Area remain under federal control, the appropriate land use will be determined by the responsible federal agency.

3.5.1 Groundwater Uranium Contamination in the 300 Area Sub-Region

The exposure assumptions for contaminants of potential concern beneath the 300 Area remain essentially the same as at the time of the ROD in 1996, because land use has not changed and is not anticipated to change as long as the 300 Area remains under federal government control. The assumption that the primary exposure pathways for groundwater are groundwater withdrawal to support various human activities, and exposure of contaminated groundwater along the river shoreline, remains valid.

For uranium, the primary contaminant of concern at the 300 Area, the EPA maximum contaminant level for drinking water supplies remains 30 µg/L. Risk to human health is driven by chemical toxicity, not radiological dose (radiological dose comes in to play at concentrations higher than the standard for chemical toxicity). For ecological risk, there has been some new research conducted regarding toxicity to aquatic organisms but no new standards have evolved.

For the uranium plume at the 300 Area, a computer simulation made during the initial remedial investigation indicated that groundwater concentrations were likely to decrease to the proposed drinking water standard (20 µg/L) in 3 to 10 years from 1993. This decrease has not occurred. The reasons for concentration trends during this period are now better understood than at the time of the first five-year review in 2001.

The better understanding of uranium contamination in groundwater has not yet led to a revised remedial action. Therefore, institutional controls are required while DOE completes limited field investigations and proposes remedial actions. The DOE currently controls the 300 Area and use of the groundwater. The existing institutional controls on groundwater are expected to remain protective until the final remedy is identified and selected.

The prediction that uranium concentrations would decrease to a proposed drinking water standard of 20 µg/L in 3 to 10 years from 1993 was based on key assumptions that there would be no future increases in groundwater concentrations (because of source removal actions), and negligible re-supply of uranium to the groundwater plume. If there had been no re-supply since the early 1990s, concentrations should have fallen to less than the concentration standard because of uranium mass removal by discharge of contaminated groundwater into the river, and withdrawal of contaminated groundwater. The current conceptual model for the plume suggests that these assumptions are not completely valid, and that uranium is being re-supplied to groundwater by several mechanisms.

First, evidence suggests the slow release of uranium from the lower vadose zone beneath some past-practices disposal sites, i.e., at depths in the vadose zone greater than the remedial action excavation depths. This is revealed by higher groundwater concentrations at these sites. Because of the interaction between liquid waste containing uranium and vadose zone sediment, some uranium remains bound to the sediment and available for subsequent remobilization by infiltrating moisture and/or unusually high water table conditions.

Second, uranium has likely been widely distributed beneath the 300 Area by historical high water-table events. During the early operations period (1940s, 1950s, and 1960s), high river stage conditions (e.g., the 1948 flood was an extreme example) created a hydraulic gradient that caused groundwater plumes to move inland from their normal positions under more typical gradients and river stages. Also, the water table was elevated well above typical levels by these high river conditions, thus pushing contaminated groundwater upward into the lower vadose zone. Currently, uranium-bearing moisture and sediment in the lowermost portion of the vadose zone (i.e., throughout the range of the capillary fringe) continues to release uranium to groundwater during periodic high water table events.

Third, aquifer sediment beneath the 300 Area is heterogeneous in texture and its ability to transmit water. Lenses of low-transmissivity sediment may have been saturated with the relatively more contaminated groundwater that existed during the operations period, and those lenses are today slowly releasing that contamination to the relatively less contaminated groundwater in the surrounding highly transmissive sediment. Though no direct evidence is yet available to demonstrate this process, work planned for the limited field investigation will likely reveal new information on this potential source for re-supplying the plume.

Finally, excavations at liquid waste disposal sites during the 1990s removed some protective surface cover and shortened the distance between the exposed surface and the water table, thus somewhat enhancing conditions for vadose zone uranium to migrate downward, potentially reaching groundwater. Also, some application of water was necessary during the excavation operations for protecting workers from contaminated airborne dust. The increased infiltration of moisture beyond the amount from natural precipitation may have remobilized uranium and carried it down to the aquifer.

Use by the public of the 300 Area river shore continues, as during previous years, for water sports and hunting. While public use of the river for recreation purposes is expected to increase as cleanup of the Hanford Site is completed, no new information has evolved that would question the protectiveness under current land use.

Cleanup level for source operable units, which are intended to be protective of the underlying groundwater, was initially established at 350 pCi/g in soil at the bottom of the excavations. This value was subsequently reduced to 267 pCi/g. The remedial action objectives, as stated in the ROD for interim action, remain appropriate for the 300 Area sub-region.

3.5.2 Groundwater Tritium Contamination in the 618-11 Burial Ground Sub-Region

The high concentration tritium plume created by releases from materials in the 618-11 burial ground has not changed appreciably in areal extent since its discovery in 2000. The highest concentrations, which are in groundwater adjacent to the eastern side of the burial ground, have dropped significantly from peak values of ~8 million pCi/L observed in 2000, to their current level of ~ 1.8 million pCi/L (June 2005). Concentration trends at other wells that monitor the plume suggest a slow downgradient migration from the burial ground. Based on computer simulation of future plume behavior, the tritium plume is not expected to create an exposure risk at the Columbia River (Vermeul et al. 2005).

3.5.3 Groundwater Contamination in the 618-10 Burial Ground/316-4 Crib Sub-Region

Concentrations for contaminants of potential concern in groundwater beneath these two waste sites have remained consistent with expectations, as described in the limited field investigation report for the 300-FF-2 Operable Unit and re-iterated in the explanation of significant difference to the ROD.

Groundwater contamination associated with the 316-4 waste site has remained constant or has declined during the past five years. Although no direct evidence has surfaced indicating impacts on groundwater because of releases from the 618-10 burial ground, there is some suspicion that localized release of uranium may have occurred. The evidence is based on uranium isotope ratios, which suggest that some of the uranium in groundwater is from more recent wastes, e.g. those in the burial ground, than those disposed earlier to the 316-4 cribs.

There is currently no removal of groundwater from this sub-region, and no foreseeable need for near-future extraction of groundwater. Although a groundwater plume may have been created by releases to the 316-4 cribs during the 1950s, there are no data available to map the extent and current position. The most likely contaminants within a potential plume are uranium and possibly volatile organic compounds, such as tributyl phosphate, a solvent commonly used in the 300 Area.

The cleanup level that is protective of groundwater for uranium beneath the 316-4 cribs is 267 pCi/g. Analysis of uranium and other vadose zone contaminants is currently in progress (September 2005), following backfilling at the excavation site. The remedial action objectives, as stated in the ROD for interim action, remain appropriate for the 300 Area sub-region.

There is no current or anticipated use of groundwater in the vicinity of these waste sites, nor are there any known locations for potential exposure of humans and biota.

The protectiveness determination criteria are summarized from the above sections as follows:

- Is the remedy functioning as intended by the decision document?
  - 300-FF-1 ROD — Yes, remedy is functioning as planned
  - 300-FF-2 ROD — Yes, the remedy is functioning as intended by the decision document to the extent the actions are completed
  - 300-FF-5 ROD — No, monitored natural attenuation is not functioning as planned

When considering whether a remedy is functioning as intended, the review focused on the technical performance of the remedy and whether the remedy is related to a single operable unit or group of operable units. Data on monitoring, system performance and operation and maintenance of the remedy were important aspects in the determination, as well as confirmation that access and institutional controls are in place and successfully prevent exposure. Status of the remedy is also considered. If the remedy is under construction, the review focused on whether the remedy is being constructed in accordance with the requirements of the decision documents, and if the remedy is expected to be protective when completed. If the remedy is operating or completed, additional aspects of remedy implementation were considered, such as remedial action performance, costs of system operations, monitoring activities and opportunities for optimization.

- Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?
  - 300-FF-1 ROD — Yes, assumptions, data, cleanup levels and remedial action objectives are still valid
  - 300-FF-2 ROD — Yes, assumptions, data, cleanup levels and remedial action objectives are still valid

– 300-FF-5 ROD Yes, assumptions, data, cleanup levels and remedial action objectives are still valid

When considering whether the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives are still valid, the review focused on all of the risk parameters on which the original remedy decision was based. Changes to target populations, exposure pathways, site characteristics, land use and applicable or relevant and appropriate requirements were reviewed.

- Has any other information come to light that could call into question the protectiveness of the remedy?
  – 300-FF-1 ROD No, no new information has come to light that could call into question the protectiveness of the remedy.
  – 300-FF-2 ROD No, no new information has come to light that could call into question the protectiveness of the remedy.
  – 300-FF-5 ROD No, no new information has come to light that could call into question the protectiveness of the remedy.

When considering whether any other information came to light that could call into question the protectiveness of the remedy, the review focused whether ecological risks had been adequately evaluated and addressed or whether new ecological risk information had become available.

DOE has initiated a River Corridor Baseline Risk Assessment for the purpose of evaluating post-remediation conditions. The first review draft of the risk assessment report is scheduled to be completed in June 2007 and, therefore, is not available for this review.

3.6 Issues and Actions

Table 3.4 shows the issues and actions for the 300 Area Operable Units.

3.7 Protectiveness Statement

This is the second five-year review for the Hanford Site. For perspective, previous reviews are also provided in this section.

2001 Five-Year Review Report Protectiveness Statement for 300 Area NPL Site

"I certify that remediation of the soil sites and groundwater in the 300 Area NPL site are protective of human health and the environment. Existing institutional controls, plus those resulting from implementing the action items in this five-year review, will ensure protection of human health in the future. I also certify that those remedial activities that are not completed, or are still in the design or investigation stage, do not require immediate response actions to protect human health and the environment."

Table 3.4. Issues and Actions for the 300 Area

Issues and Actions		Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
	100/300 Crosscutting					
Issue 1. Additional risk assessment information is needed to evaluate the interim actions prescribed within the records of decisions and to develop final cleanup decisions.		No[3]	Yes			
	Action 1-1. Submit Draft A of the River Corridor Baseline Risk Assessment Report.	No[3]	Yes	RCP	EPA/WDOE	06/2007
	Action 1-2. Submit draft sampling and analysis plan for Inter-Areas Shoreline Assessment.	No[3]	Yes	RCP	EPA/WDOE	08/2006
Issue 2. A strategy to obtain the final records of decisions and integrate the waste sites, deep vadose zone and groundwater has not been developed and agreed upon with the regulator agencies.		No[3]	No			
	Action 2-1. Submit Draft A of the River Corridor Strategy for Achieving Final Cleanup Decision in the River Corridor. Document will identify issues for integration and provide alternatives for future discussions between the Tri-Parties on milestones for final records of decision in the River Corridor.	No[3]	No	RCP	EPA/WDOE	11/2006
	300 Area					
Issue 19. Predicted attenuation of uranium contaminant concentrations in the groundwater under the 300 Area has not occurred. DOE is currently performing additional characterization and treatability testing in the evaluation of more aggressive remedial alternatives.		Yes	Yes			
	Action 19-1. Complete focused feasibility study for 300-FF-5 Operable Unit to provide better characterization of the uranium contamination, develop a conceptual model, validate ecological consequences and evaluate treatment alternatives. Concurrently test injection of polyphosphate into the aquifer to immobilize the uranium and reduce the concentration of dissolved uranium. These activities support a CERCLA proposed plan.	No[4]	Yes	GRP	EPA	09/2008

1 Does this issue/action currently affect the protectiveness of the remedy?
2 Will this issue/action affect the protectiveness of the remedy in the future?
3 Identifying the need for, and acquiring new data in the future, does not affect the current status of protectiveness.
4 Completion of the focused feasibility study in the future does not affect the current status of protectiveness
RCP – River Corridor Remediation Project
GRP – Groundwater Remediation Project
EPA – Environmental Protection Agency
WDOE – Washington State Department of Ecology

2006 Five-Year Review Report Protectiveness Statement for 300 Area NPL Site Source Operable Units

For the 300 Area source (soil) sites in the 300-FF-2 Operable Unit, cleanup has occurred, or is ongoing, under an ROD for interim actions. For the source (soil) sites in the 300-FF-1 Operable Unit, cleanup has been completed under a final ROD. For both RODs, all of the contaminants of potential concern are addressed. ARARs were established for the contaminants of concern. Remedial action objectives consistent with the ARARs were established in the RODs.

For the source (soil) sites included in the 300-FF-1 and 300-FF-2 Operable Units, based on this review and taking the protectiveness determination questions into account, DOE has concluded that the remedies selected are protective in the short term of human health and the environment because the cleanup standards are being met and are within the acceptable risk range. There is also no outward evidence of ecological harm associated with the 300-FF-1 or 300-FF-2 Operable Units. The determination for long-term protectiveness for human health and the environment for the 300-FF-2 Operable Unit is being deferred until the risk assessment is completed and a final remedy is selected. The remedy selected for the 300-FF-1 Operable Unit is protective in the long term for the above reasons and the fact the remedy was selected under a final ROD. DOE recognizes, however, that the risk assessment will evaluate this area again, and final decisions will be made for source sites adjacent to the 300-FF-1 Operable Unit. Protectiveness for the 300-FF-1 Operable Unit will be re-evaluated upon completion of the risk assessment and final remedy selection for the 300-FF-2 Operable Unit. Protectiveness of those remedies will be evaluated in future five-year reviews.

2006 Five-year Review Report Protectiveness Statement for 300 Area NPL Site Groundwater Operable Units

For 300-FF-5 Groundwater Operable Unit, the selected remedy of monitored attenuation for the uranium contaminant in the groundwater is not achieving the remedial action objectives established in the ROD. However, institutional controls are in place to prevent human consumption of the groundwater. For this operable unit the remedy is not considered protective. Follow up actions are necessary to determine long-term protectiveness because remedial action objectives are not expected to be met. The remedial actions and remedial action objectives are being re-evaluated.

4.0 1100 Area

4.1 Introduction

The 1100 Area was divided into four operable units to simplify the remedial investigation and response. The remedies at three of the operable units (1100-EM-2, 1100-EM-3, and 100-IU-1) allow for unrestricted use and unlimited exposure. Hazardous substances remain in the 100-EM-1 Operable Unit at levels that do not allow for unlimited use and unrestricted exposure.

This is the second review for the DOE Hanford Site 1100 Area. The triggering action for this second review is a requirement that this five-year review include the portions of the 1100 Area (specifically the Horn Rapids Landfill and the nearby trichloroethene-contaminated groundwater plume), which have hazardous substances, pollutants, and/or contaminants that remain at the site above levels that allow for unrestricted use and unlimited exposure. Because there are contaminants (asbestos) that were disposed in the Horn Rapids Landfill that will remain at the site above levels that would allow for restricted use and unlimited exposure, the 1100 Area will continue to be included in future five-year reviews.

4.2 Chronology

Event	Date
Added to the National Priority List	October 4, 1989
Remedial Investigation/Feasibility Study Complete	September 24, 1993
ROD Signature	September 24, 1993
Remedial Design Start (EM-1, EM-2, EM-3)	June 13,1994
Remedial Design Complete (EM-1, EM-2, EM-3)	April 28, 1995
Remedial Design Start (IU-1)	June 13, 1994
Remedial Design Complete (IU-1)	August 15, 1994
Remedial Action Start (IU-1)	August 15, 1994
Remedial Action Start (EM-1, EM-2, EM-3)	January 15,1995
Construction Dates (IU-1)	August 15, 1994 to September 30, 1994
Construction Dates (EM-1, EM-2, EM-3)	January 3, 1995 to November 14, 1995
Construction Complete Date	December 12, 1995
Final Closeout Report	July 25, 1996
NPL Deletion	September 30, 1996
First Five-Year Review	April 25, 2001
Memo to File	May 12, 2005

4.3 Background

The Hanford Site, which is operated by DOE, was established in 1943 to produce nuclear material for national defense. The Hanford 1100 Area NPL site consists of two non-adjacent areas located in the south portion of the Hanford Site and covers less than 13 square kilometers (5 square miles). The majority of the NPL site is located adjacent to the city of Richland. The other portion is located on the Fitzner-Eberhardt Arid Lands Ecology (ALE) Reserve, approximately 24 kilometers (15 miles) northwest of Richland. The 1100 Area NPL site was divided into four operable units. Three of the operable units (1100-EM-1, 1100-EM-2, and 1100-EM-3) are located adjacent to the city of Richland, and one (1100-IU-1) is located on the ALE Reserve.

The area occupied by the 1100-EM-1, 1100-EM-2, and 1100-EM-3 Operable Units contained the central warehousing, vehicle maintenance, and transportation distribution center for the entire Hanford Site. The ALE Reserve was set aside as a natural resource research area in 1967. The facilities that comprise the 1100-IU-1 Operable Unit are a former NIKE missile base and control center. These buildings were formerly used as the ALE headquarters but are now scheduled for cleanup, demolition, and removal.

The 1100 Area was listed on the NPL in October 1989 based on two factors: the proximity of the 1100-EM-1, 1100-EM-2, and 1100-EM-3 Operable Units to groundwater wells used by the city of Richland to supply drinking water; and the disposal of up to 56,781 liters (15,000 gallons) of waste battery acid in a sand pit in the 1100-EM-1 Operable Unit. As a result of the listing, DOE conducted an remedial investigation/feasibility study to determine the nature and extent of contamination at the 1100 Area and to evaluate alternatives for cleanup of contaminated areas.

4.3.1 Memo-to-File for 1100 Area ROD

Additional sampling performed at the Horseshoe Landfill (1100-IU-1) between 1998 and 2003 detected residual dichlorodiphenyl trichloroethane (DDT) in the soil in portions of the landfill above the cleanup level for DDT (1 ppm) that still remained after performance of the initial remedial action. EPA issued a memo-to-file in May 2005 to document non-significant changes to the 1100 Area ROD to allow removal of the DDT contaminated soil. Based on ecological protection, a DDT cleanup level of 0.75 ppm was selected to be protective. Cleanup actions are completed, and the site is awaiting backfill and revegetation. The actions performed achieved the cleanup goals and standards outlined in the appropriate decisions documents, including other necessary requirements that may be outlined in the selected remedy or Memo-to-File.

4.3.2 1100-EM-1 Operable Unit

The 1100-EM-1 remedial investigation addressed potential soil contamination at ten different waste sites in the 1100 Area. The 1100-EM-1 remedial investigation also investigated groundwater beneath these waste sites. Of the seven areas, only the following three sites and the groundwater required remedial action:

- **Discolored Soil Site**. At this site, bis(2-ethylhexyl)phthalate (BEHP) was identified as the contaminant of concern. BEHP is considered to be carcinogenic. The source of the BEHP was an unrecorded spill. The highest level detected during the remedial investigation was 25,000 mg/kg.

- **Ephemeral Pool**. This is an elongated depression adjacent to a parking area where runoff water collects and evaporates. Polychlorinated biphenyls (PCBs) from an unknown release resulted in the Ephemeral Pool being contaminated up to 42 mg/kg.

- **Horn Rapids Landfill**. This landfill was used primarily for the disposal of office and construction waste, asbestos, sewage sludge, and fly ash. The contaminants of concern are the asbestos distributed throughout the landfill and a localized area of soil contaminated with PCBs. The highest PCB concentration identified was 100 mg/kg.

- **Groundwater**. Groundwater in the vicinity of the Horn Rapids Landfill was found to be contaminated with trichloroethene. Trichloroethene was found both upgradient and downgradient of the landfill. The maximum concentration of trichloroethene was 110 µg/L, although current concentrations are less than 10 µg/L.

The *Draft Remedial Investigation/Feasibility Study for the 1100-EM-1 Operable Unit, Hanford* concluded that the trichloroethene plume was attenuating and would be below the maximum contaminant level of 5 µg/L by 2017. The ROD required monitoring for trichloroethene as well as nitrate in the vicinity of the DOE inactive Horn Rapids Landfill. The ROD also required a point of compliance be established to determine if cleanup values (5 µg/L) were being attained or if further action was necessary. These actions were implemented via a sampling plan, which was revised in 1999 to reflect Pacific Northwest National laboratory's responsibilities for groundwater monitoring at the 1100-EM-1 Operable Unit.

Remediation of the soil contamination has been completed in the 1100 Area. The 1100 Area was deleted from the NPL on September 30, 1996. The Hanford Site first five-year review (EPA 2001b) concluded that the cleanup levels selected in the ROD were still protective, and stated, "The groundwater contamination continues to attenuate throughout the plume and the current trend in TCE concentrations indicate that TCE should meet cleanup values (the maximum contaminant level of 5 µg/L) in 5 to 7 years."

4.4 Remedial Actions

4.4.1 1100-EM-1 Operable Unit

Progress Since the Previous Five-Year Review. Wells near the Horn Rapids Landfill are sampled annually and analyzed for trichloroethene and nitrate. The locations of monitoring wells are shown in Figure 4.1. The results of monitoring have been published annually in the groundwater monitoring reports (e.g., Hartman et al. 2005). A summary of the results of sampling and analysis for trichloroethene, for which a cleanup value has been established at 5 µg/L, is provided below.

Trichloroethene Contaminant Plumes. All wells monitoring the Horn Rapids Landfill currently show trichloroethene concentrations below the 5-µg/L maximum contaminant level. This level was first met at the point of compliance in 1999 and has remained below this level every year through 2005. All of the 1100-EM-1 Operable Unit monitoring wells had trichloroethene concentrations below the maximum contaminant level in 2001 and continued to be below this level through 2005.

Trichloroethene concentrations throughout the plume have decreased to levels less than the cleanup value of 5 µg/L, have continued to decrease, and are consistently below 5 µg/L. Figure 4.1 demonstrates that the trichloroethene concentrations throughout the plume have decreased to levels less than the cleanup value of 5 µg/L. The trichloroethene trends plots presented in Figures 4.2 through 4.5 further support the conclusion that the levels have continued to decrease and are consistently below 5 µg/L.

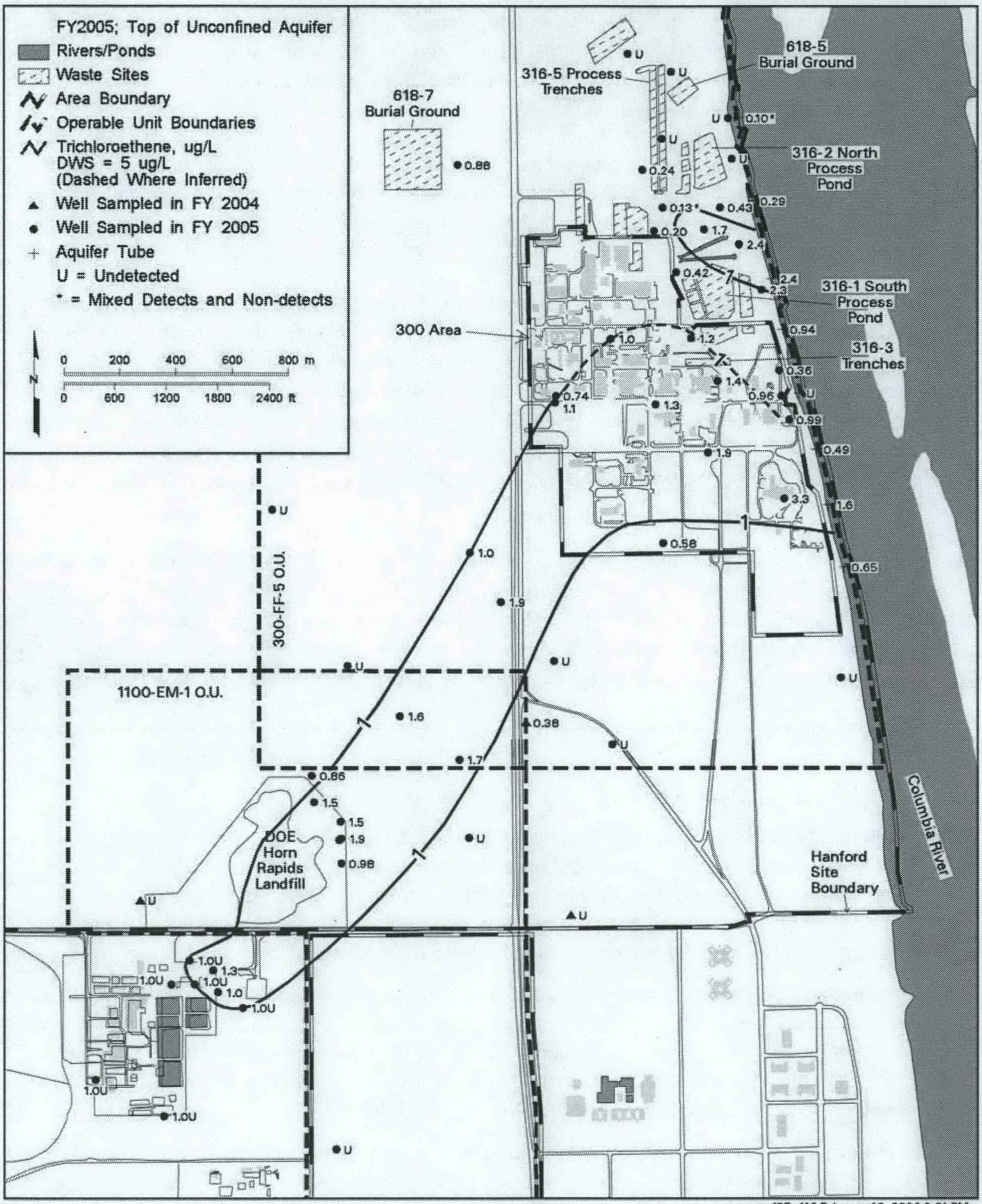

Figure 4.1. Horn Rapids Landfill Wells

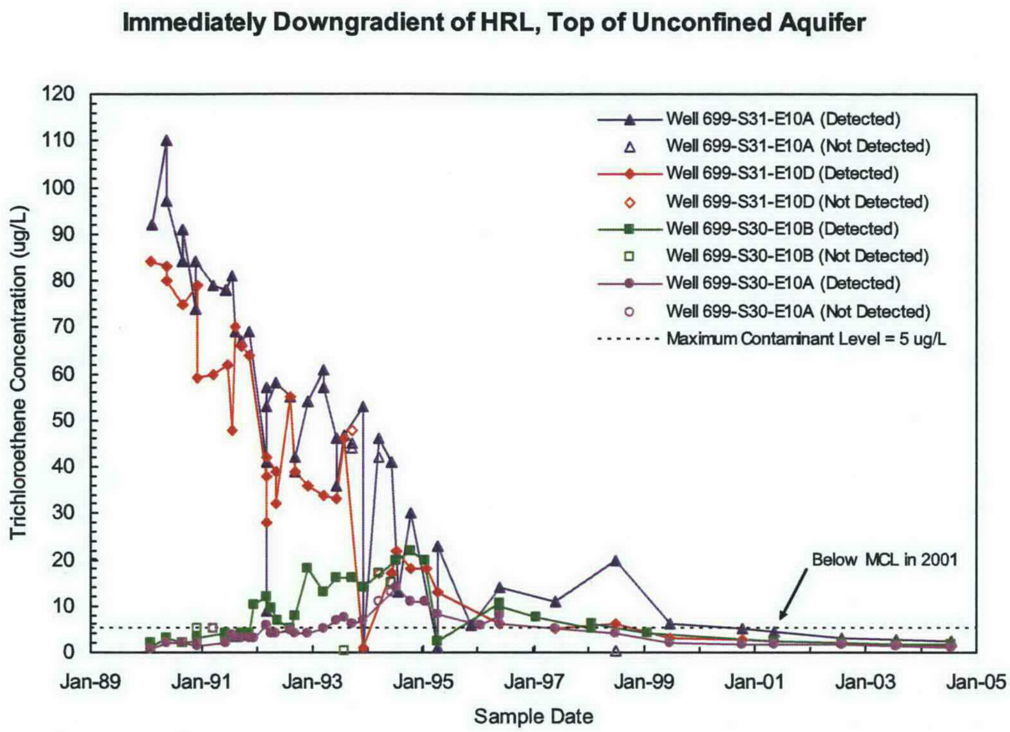

Figure 4.2. Trichloroethene Concentration Trends Adjacent to the DOE Horn Rapids Landfill on its Northeast and East Sides

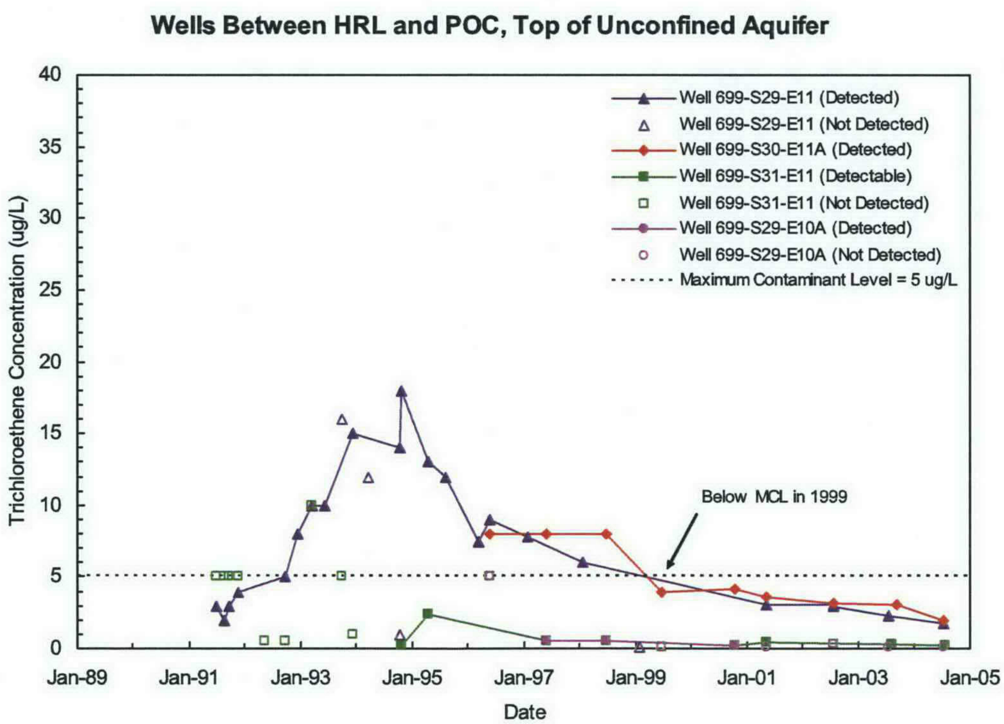

Figure 4.3. Trichloroethene Concentration Trends in Wells Between the DOE Horn Rapids Landfill and the Point of Compliance

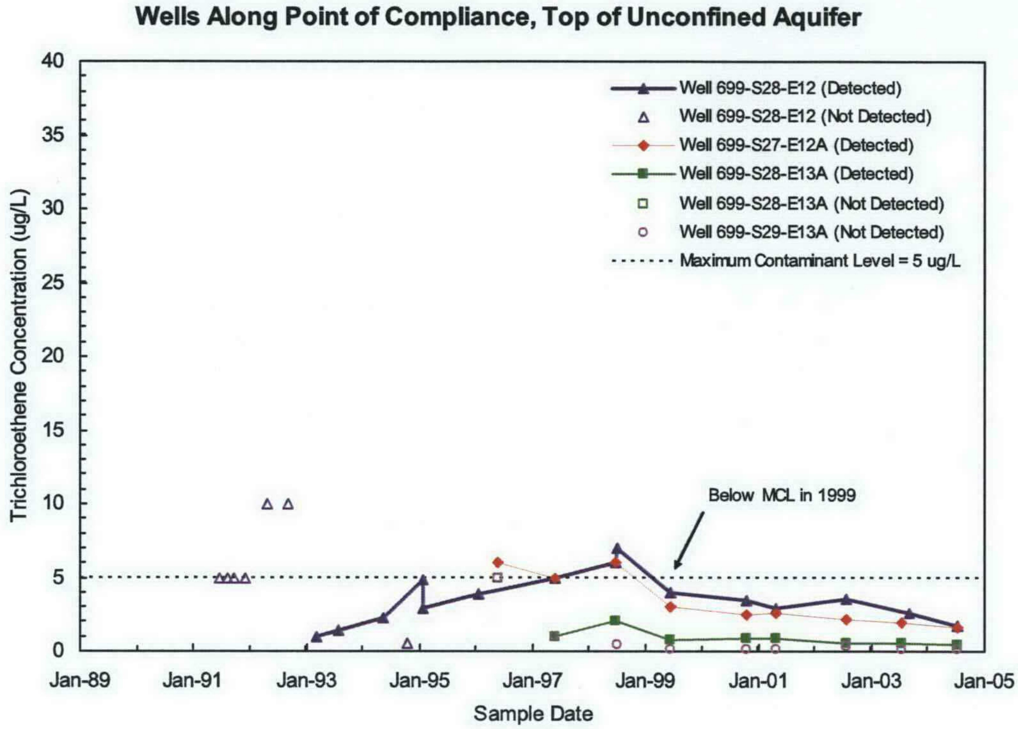

Figure 4.4. Trichloroethene Concentration Trends in Wells Along the Point of Compliance

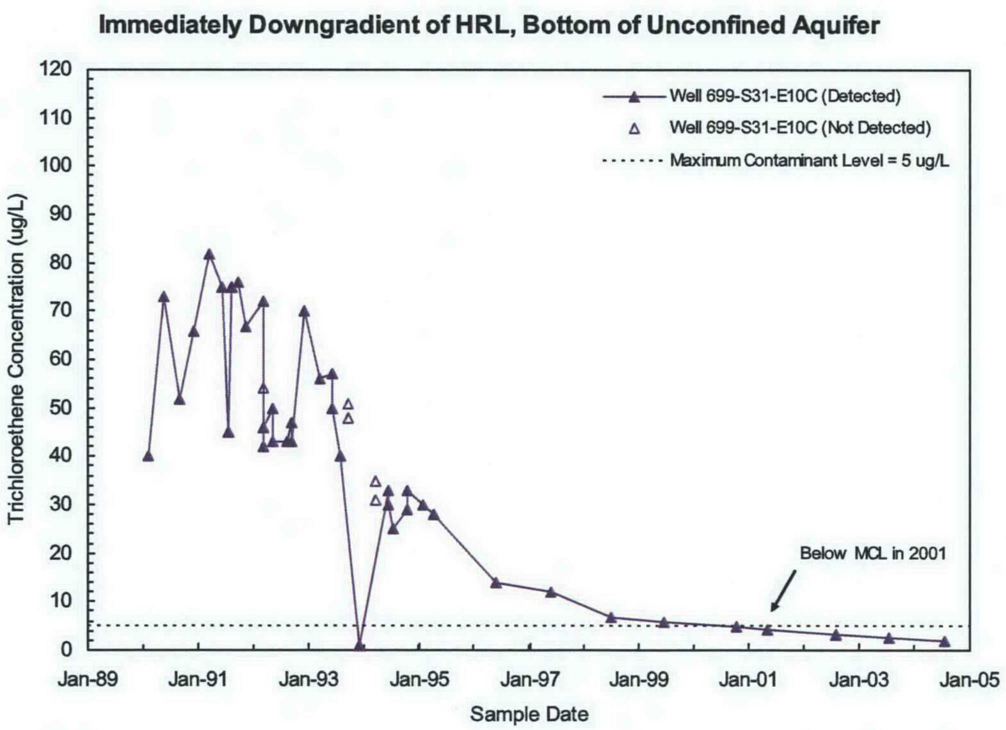

Figure 4.5. Trichloroethene Concentrations in the Bottom of the unconfined Aquifer Near the DOE Horn Rapids Landfill

Trichloroethene Contaminant Trends. Trichloroethene concentration trends in wells immediately east and northeast (downgradient) of the Horn Rapids Landfill had decreased below the maximum contaminant level by 2001, and remains less than that level. The highest value measured in 2005 was 1.5 µg/L.

Trichloroethene concentrations in wells between the Horn Rapids Landfill and the point of compliance decreased to below the maximum contaminant level in 1999. The highest value reported in 2005 was 1.6 µg/L.

Results from monitoring wells located at the point of compliance indicate that trichloroethene concentrations decreased to levels less than the maximum contaminant level by 1999. The highest value reported in 2005 was 1.9 µg/L.

Well 699-S31-E10C monitors the deep portion of the unconfined aquifer above the clayey silt aquitard, at a depth of ~5 to 8 meters (15 to 25 feet) below the water table. Trichloroethene concentrations in this well decreased to a level below the maximum contaminant level by 2001. The level reported in 2005 was 2.0 µg/L.

Analytical results indicate that potential breakdown products of trichloroethene have not been detected in any samples collected from the 1100-EM-1 Operable Unit or groundwater surveillance monitoring wells near the Horn Rapids Landfill.

The first five-year review identified two minor issues regarding the institutional control requiring signage and fencing to restrict access to the Horn Rapids Landfill area. During the first five-year review it was noted that a sign was missing and a single strand of the fence was down. An action item called for corrections of these two deficiencies. That action item was completed in 2001. A field review in 2006 determined that the institutional control for signage and fencing was being met.

4.5 Technical Assessment Summary

The purpose of the five-year review is to determine whether the remedy at a site is, or upon completion will be, protective of human health and the environment. The technical assessment of the remedy reviews three questions:

- Is the remedy functioning as intended by the decision document?
- Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?
- Has any other information come to light that could call into question the protectiveness of the remedy?

These questions are provided by federal regulations and establish a framework for organizing and evaluating data and ensure that all relevant issues are considered when determining the protectiveness of the remedy. DOE has reviewed that status of the entire CERCLA cleanup at Hanford in this report; however, a technical assessment of a remedy requires that a decision document has been completed for the specific operable unit. A decision document has not been completed for many of the operable units.

The surface barrier is effective at containing the asbestos fibers. The vegetation has taken hold and is preventing erosion of the cap.

The data presented demonstrate that the cleanup level of 5 μg/L for trichloroethene at the point of compliance has been met. This objective was first met at the point of compliance in 1999, and trichloroethene remained below the maximum contaminant level annually from 2000 through 2005, six years in a row. In addition, trichloroethene concentrations in all 1100-EM-1 Operable Unit compliance wells were at levels below the maximum contaminant level from 2001 through 2005, five years in a row. Based on monitoring trends, it is expected that concentrations in the trichloroethene plume will continue to decrease at levels below the maximum contaminant level near the DOE inactive Horn Rapids Landfill in the future.

The plume mass and concentration have been adequately reduced to be protective of human health and the environment.

The protectiveness determination criteria are summarized below:

- Is the remedy functioning as intended by the decision document?
  - 1100-EM-1 ROD   Yes, remedy is functioning as planned.

When considering whether a remedy is functioning as intended, the review focused on the technical performance of the remedy, whether the remedy is related to a single operable unit or group of operable units. Data on monitoring, system performance and operation and maintenance of the remedy were important aspects in the determination, as well as confirmation that access and institutional controls are in place and successfully prevent exposure. Status of the remedy is also considered. If the remedy is under construction, the review focused on whether the remedy is being constructed in accordance with the requirements of the decision documents, and if the remedy is expected to be protective when completed. If the remedy is operating or completed, additional aspects of remedy implementation were considered, such as remedial action performance, costs of system operations, monitoring activities and opportunities for optimization.

- Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?
  - 1100-EM-1 ROD   Yes, assumptions, data, cleanup levels and remedial action objectives are still valid.

When considering whether the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives are still valid, the review focused on all of the risk parameters on which the original remedy decision was based. Changes to target populations, exposure pathways, site characteristics, land use and applicable or relevant and appropriate requirements were reviewed.

- Has any other information come to light that could call into question the protectiveness of the remedy?
  - 1100-EM-1 ROD   No, no new information has come to light that could call into question the protectiveness of the remedy.

When considering whether any other information came to light that could call into question the protectiveness of the remedy, the review focused whether ecological risks had been adequately evaluated and addressed or whether new ecological risk information had become available.

4.6 Issues and Actions

Table 4.1 shows the issue and action for the 1100 Operable Unit.

4.7 Protectiveness Statement

This is the second five-year review for the Hanford Site. For perspective, previous reviews are also provided in this section.

2001 Five-year Review Report Protectiveness Statement for 1100 Area NPL Site

"The protection of human health and the environment by the remedial actions at 1100-EM-1, 1100-EM-2, 1100-EM-3, and 1100-IU-1 are discussed below. Because the remedial actions at the operable units are protective of human health and the environment, the remedy for the site is expected to be protective of human health and the environment.

1100-EM-1

The remedy at 1100-EM-1 is protective of human health and the environment. The cap is effective at containing the asbestos fibers. The vegetation has taken hold and is preventing wind erosion of the cap. The groundwater contamination continues to attenuate throughout the plume and the current trend in TCE concentrations indicate that TCE should meet cleanup values (the MCL of 5 µg/L) in 5 to 7 years.

1100-EM-2

The remedy at 1100-EM-2 is protective of human health and the environment. The remedial actions allow for unrestricted use and unlimited exposure.

1100-EM-3

The remedy at 1100-EM-3 is protective of human health and the environment. The remedial actions allow for unrestricted use and unlimited exposure.

1100-IU-1

The remedy at 1100-IU-1 is protective of human health and the environment. The remedial actions allow for unrestricted use and unlimited exposure."

2006 Five-Year Review Report Protectiveness Statement for 1100 Area Operable Units

The remedies selected for the operable units included in the 1100 Area NPL site have been completed and the remedial action objectives established in the final ROD have been achieved. These remedies are protective of human health and the environment. The 1100 Area site has been deleted from the NPL.

Table 4.1. Issues and Actions for the 1100 Area

Issues and Actions	Affects Current Protectiveness[1] (Yes / No)	May Affect Future Protectiveness[2] (Yes / No)	Responsible Organization within DOE	TPA Lead Regulator	Action Due Date
1100 Area					
Issue 20. Groundwater monitoring for the 1100-EM-1 Operable Unit is no longer necessary but continues following an extended period of monitoring that shows contaminant levels are below the maximum contaminant level and continue to show a downward trend.	No[3]	No[3]			
Action 20-1. Submit a change request to modify groundwater monitoring for the 1100-EM-1 Operable Unit.	No[3]	No[3]	GRP	EPA	6/2007

1 Does this issue/action currently affect the protectiveness of the remedy?
2 Will this issue/action affect the protectiveness of the remedy in the future?
3 Modifying the groundwater monitoring requirements for the 1100-EM-1 Operable Unit does not affect the current status of protectiveness.
RCP – River Corridor Remediation Project
GRP – Groundwater Remediation Project
EPA – Environmental Protection Agency
WDOE – Washington State Department of Ecology

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Appendix A

Institutional Controls

Appendix A

Institutional Controls

Institutional controls have been a critical element of Hanford Site operations since the site was created as part of the Manhattan Project. Due to the nature of the Manhattan Project and later nuclear materials production activities, public access to the site was prohibited and was very carefully controlled through the use of signs, fences, sophisticated monitoring technology, armed guards at all points of ingress, and armed patrols. DOE is successfully implementing effective institutional controls.

More recently, with the change in mission from nuclear materials production to environmental cleanup, the need for some of the more aggressive institutional controls has been reduced. However, to protect physical assets and to protect the public from inadvertent exposure to potential Hanford Site hazards, access to the Hanford Site is still carefully controlled through the use of institutional controls.

To ensure that all of the institutional controls required under CERCLA are effectively implemented the Department of Energy prepared a *Site Wide Institutional Controls Plan for Hanford CERCLA Response Actions* (DOE 2001) (Plan). This Plan lists the existing Hanford Site-wide institutional controls and controls required by interim and final RODs. Table A.1 summarizes the site-wide institutional controls currently in use at the Hanford Site.

Table A.1. Site-Wide Institutional Controls

Control	Mechanism	Objective	Who it Protects[a]
Warning Notices	Signs	• Provide visual identification and warning of hazardous or sensitive areas.	• DOE employees • DOE contractors • Hanford Site visitors • Inadvertent intruders
Entry Restrictions	Procedural Requirements for Access	• Control human access to hazardous or sensitive areas. • Ensure adequate training for those who enter hazardous or sensitive areas. • Avoid disturbance and exposure to hazardous waste. • Provide a basis for the enforcement of access restrictions.	• DOE employees • DOE contractors • Hanford Site visitors • Inadvertent intruders
	Fencing	• Prevent unauthorized human access to hazardous or sensitive areas. • Provide protective barriers to standard industrial hazards. • Provide visual warnings.	• DOE employees • DOE contractors • Hanford Site visitors • Inadvertent intruders

Table A.1. (contd)

Control	Mechanism	Objective	Who it Protects[a]
Land-Use Management	Land-Use and Real Property Controls	• Ensure that use of the land is compatible with any hazards that exist. • Ensure that any changes in use of the land are adequately assessed before being allowed. • Ensure that the record of the property documents restrictions that will apply beyond change in ownership or management of the property.	• DOE employees • DOE contractors • Hanford Site visitors • Non-DOE entities using DOE land • Environmental receptors
	Excavation Permits	• Avoid unplanned disturbance or infiltration. • Inform and protect workers regarding potential exposure to hazardous waste. • Avoid the creation of potential pathways for the migration of hazardous waste.	• DOE employees • DOE contractors • Non-DOE entities using DOE land
Groundwater Use Management	Groundwater Controls	• Ensure proper use of groundwater.	• DOE employees • DOE contractors • Hanford Site visitors Non-DOE entities using DOE land
Waste Site Information Management	Administrative	• Maintain and provide access to information on the location and nature of contamination.	• DOE employees • DOE contractors • Hanford Site visitors

[a]The institutional controls help to protect DOE employees, DOE contractors, and one or more of the following:
- Non-DOE entities using DOE land - individuals who are associated with an organization, other than DOE or its contractors, that is located on the Hanford Site or is conducting activities on the Hanford Site
- Hanford Site visitors - individuals who access the Hanford Site for a site-related purpose (e.g., public tour)
- Inadvertent intruders - individuals who inadvertently access the Site (e.g., inadvertent access to the Hanford Site along the Columbia River shoreline for recreational purposes)

Environmental Receptors – Fish, wildlife, and plant populations that inhabit the Hanford Site, as well as their habitats.

The Plan requires that DOE conduct annual reviews of the implementation of the institutional controls. To date, DOE has conducted three annual reviews of its institutional controls. Summaries of these reviews follow.

The *2003 Site Wide Institutional Controls Annual Assessment Report for Hanford CERCLA Response Actions* (DOE 2003) documented the review of 144 waste sites out of approximately 560 waste sites. The assessment did not result in any major findings. Generally, the institutional controls were found to be properly implemented and effective. The excavation permit process effectively identified waste sites at or near work location and evaluated excavation activities for potential impacts from the waste sites. Security of the groundwater wells was checked during routine and non-routine well maintenance inspections and by the sampling teams. All wells have caps and locks in place to avoid unauthorized access.

Two observations from the 2003 assessment were subsequently corrected as noted in Table A.2.

Table A.2. Institutional Control Observations Identified During 2003 Assessment

Observation	Corrective Action
A few warning signs were missing along the Hanford Site shoreline.	To maintain the voluntary 152-meter (500-foot) interval between signs, the missing signs were replaced.
A single strand of the wire fence at the Horn Rapids Landfill entrance needed repairing.	The fence was repaired.

The 2004 *Site Wide Institutional Controls Annual Assessment Report for Hanford CERCLA Response Actions* (DOE 2004) documented a focused evaluation of eight topical areas:

1. Physical assessment of the waste sites
2. Trespass incidents
3. Evaluation efforts of the surveillance and maintenance program
4. Assessment of Hanford Site groundwater use controls
5. Assessment of the Hanford Site excavation process
6. Assessment of real property controls for the Hanford Site
7. Assessment of audience and needs of post-cleanup site information
8. Assessment of deleted portions of NPL or transferred properties from DOE ownership

The results of the 2004 assessment indicated that the institutional controls are performing effectively, as designed. However, some observations were identified along with the suggested corrective actions. Five observations and recommended corrective actions are noted in Table A.3.

Table A.3. Institutional Control Observations Identified During 2004 Assessment

Observation	Corrective Action
Several newly installed haul roads in the 100 Area were found not to be adequately signed.	A strategy was developed for maintaining signage on newly installed haul roads.
Concerns regarding effectiveness of institutional controls in the 300 Area due to its proximity to the city of Richland.	The 2005 assessment evaluated the 300 Area surveillance and maintenance program to determine its adequacy.
Real property controls: procedures required deed information to be included in the waste information data system, but it was not done.	DOE evaluated the waste information data system and is currently working with EPA and the Washington Department of Ecology on changes to update the system.
Post-cleanup site information: The waste information data system database and the DOE Administrative Record were found to be adequate and effective in identifying institutional controls requirements for units in post-closure, when applicable. The regulatory agencies have expressed concern over the usability and accessibility of database to support the current and future cleanup decisions.	DOE evaluated the waste information data system and is currently working with EPA and the Washington Department of Ecology on changes to update the system.

The 2005 Institutional Controls Assessment focused on the effectiveness of the surveillance and maintenance program for 43 facilities in the 300 Area in lieu of formal CERCLA institutional controls. The results of this assessment were documented in, *An Evaluation of the 300 Area Surveillance and Maintenance Program* (DOE 2005). During this assessment, no systematic concerns or major physical problems such as broken fence or damaged signs, or significant facility deterioration that could result in a release of hazardous substances to the environment were observed with existing access control. The evaluation indicated that the existing 300 Area surveillance and maintenance program is sufficiently protective of human health and the environment such that formal institutional controls would be unnecessary.

Recommendation

The current requirement is for DOE to perform an annual review of the CERCLA institutional controls. Based on the first three reviews and the adequacy of the institutional controls, it is recommended that the reviews coincide with the CERCLA five-year review cycle. Subsequent five-year reviews will evaluate whether more frequent reviews for site-wide institutional controls are required. The site-wide institutional control plan should be modified to reflect this new review cycle.

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Appendix B

Response to Comments

Appendix B

Response to Comments

COMMENTER 1 Todd Martin, Hanford Advisory Board

Comment 1: The Hanford Advisory Board (Board) recognizes the time and effort U.S. Department of Energy (DOE) staff spent preparing the draft Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Five-Year Review Report for the Hanford Site. The Board believes DOE's review misses critical parts of the intent of a five-year review, including the failure to incorporate new information.

Response to Comment 1: The U.S. Department of Energy (DOE) appreciates the Board's interest and involvement in the second CERCLA five-year review process.

DOE disagrees and believes the review addressed the intent of the five-year review as outlined in CERCLA, Executive Order 12580, 40 CFR 300, and DOE and EPA guidance. EPA guidance states the purpose of a five-year review is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment when completed.

Additional details for conducting five-year review process are prescribed in both EPA and DOE guidance. These guidance documents provide some discretion in how the review is conducted. For example, DOE included all CERCLA actions, in addition to final records of decisions (ROD).

As required, DOE sought and considered information from various sources in the attempt to identify new information that might influence the protectiveness of selected remedies, including three public workshops. DOE received and reviewed significant amounts of new information, then analyzed and incorporated it where appropriate into this five-year review.

Comment 2: The five-year review misses part of the intent of a five-year review.
The five-year review does not provide the insights the Board hoped to see in such a review. While the five-year review requirement provides room for interpretation, the Board believes a Hanford five-year review would be more useful if it assessed the ongoing protectiveness of remedies *beyond the institutional control period.* This point is where the Board disagrees with the current five-year review, as it bases its protectiveness statements primarily on exposures being limited by institutional controls.

For example, the review states that groundwater remedies are effective because institutional controls prevent use of the groundwater. This statement ignores the spread of contamination and human/ecological exposures due to shoreline contamination, upwelling in the river and the loss of institutional controls.

Because of these omissions, the Board is unable to assess whether Hanford cleanup is on track to meet the Board's cleanup goals in the long-term. For example, the current review does not provide an analysis of whether cleanup is on track to meet the "unrestricted use" goal in the River Corridor. The review also asserts for the River Corridor that the current cleanup is protective of the environment. Until the risk assessments for the River Corridor are completed, there is not enough data to make that conclusion.

Response to Comment 2: As stated in the previous response, the five-year review process is meant to verify that the remedies selected in Action Memoranda and records of decision are working as predicted. These remedies are expected to be protective when completed, unless the conditions and assumptions on which the decisions were based have changed significantly.

DOE disagrees that the protectiveness statements are based primarily on exposures being limited by institutional controls. DOE strives to meet CERCLA groundwater cleanup goals, including meeting "applicable or relevant and appropriate" requirements (ARARs), guided by the nine CERCLA evaluation criteria for remedial actions. The Hanford cleanup will meet CERCLA groundwater cleanup objectives, including the restoration of the aquifer to beneficial uses wherever practicable within a time frame reasonable given the particular circumstances of the Hanford Site. If, through the CERCLA process, restoration is determined to not be practicable, DOE expects to take appropriate actions to prevent further migration of the plume, prevent exposure to the contaminant and evaluate further risk reduction.

Some remedies include cleanup alternatives (e.g., remove, treat and dispose or natural attenuation) and interim institutional controls (ICs). The five-year review must include an evaluation of those ICs for a given period of time in determining protectiveness. When they are no longer necessary, the protectiveness assessment of the remedy will not include them. In other cases, ICs are part of the final selected remedy to ensure that it is protective over a longer period of time. These ICs will always be considered when determining protectiveness. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. ICs will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required.

DOE disagrees that the River Corridor risk assessment must be completed to make protectiveness determinations on selected interim or final remedies. Protectiveness determinations are based on evaluation of the performance of selected remedies not risk assessments. Risk assessments are part of the remedial investigation/feasibility study (RI/FS) process. The remedy selected through the RI/FS process must address the risks identified in the RI/FS process and mitigate the identified risks to be protective of human health and the environment. The five-year review process verifies that the selected remedy is or will be protective when final.

DOE had numerous discussions with the public and received over 300 written comments on the draft document. In response to those comments, DOE revised the document. DOE agrees that in some cases the protectiveness statements in the Public Review Draft of the *CERCLA Five-Year Review Report for the Hanford Site* overstated the level of protectiveness that can be determined based on the information available at this time. DOE concluded that in some cases a more conservative determination would accurately reflect the situation. Therefore, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 3: The five-year review should incorporate new information. The draft five-year review states that it will answer the question, "Has any other information come to light that could call into question the protectiveness of the remedy?" The review appears to have overlooked several new pieces of information. If this new information impacts protectiveness, it may trigger a reconsideration of ROD requirements as well as discussion in the five-year review. Examples of new information that should be assessed include:

- The City of Richland's industrial re-use study, which addresses assumptions for potential land use in the 300 Area;

- Biological Effects of Ionizing Radiation Study Number VII (BEIR VII) Report of the National Academy of Science relative to new risk data;

- Protectiveness as defined by the Yakama Nation and the Nez Perce Nation (Seattle State of the Site meeting September 2005) to fulfill Natural Resource Trustee responsibility per 40 CFR 300.615;

- Recent studies and negotiations with Priest Rapids dam operators addressing river fluctuations and resultant effect on contaminant levels;

- New data on chromium risks based on the report "Chromium Toxicity Test for Fall Chinook Salmon Using Hanford Site Groundwater" (PNNL-13471). The U.S. Geological Survey (USGS) has additional findings/data that show genetic damage; DOE should be assessing the ramifications of this.

Response to Comment 3: New information pertaining to the Hanford Cleanup Project is assessed on an ongoing basis. As the information is received, it is evaluated for potential impacts on the cleanup. If the assessment of the new information indicated that it could trigger a reconsideration of requirements in a ROD, it was incorporated into the five-year review. The information provided from HAB advice was identified, including the City of Richland study, reviewed and assessed. None of the five examples provided by the HAB necessitated a change in a ROD requirement as explained below.

<u>City of Richland's industrial re-use study</u>. The 300 Area industrial re-use study conducted by the City of Richland was assessed to determine if it would affect any of the CERCLA remedial action decisions that have been established in RODs. DOE concluded that the recommendations from the study are factors that would be taken into consideration when the DOE evaluates its final land use decisions for the 300 Area. At this time the City of Richland study does not warrant a change to the current or reasonably anticipated future land uses for the 300 Area as established in the Hanford Comprehensive Land Use Plan. The DOE anticipates it may have future missions for the 300 Area and has not made a decision to transfer this parcel of land out of the DOE's administration in the foreseeable future.

<u>Biological Effects of Ionizing Radiation Study</u>. DOE-RL has evaluated the BEIR VII Report as it relates to the CERCLA five-year review. Based on this evaluation, the Nuclear Regulatory Commission's (NRC's) review and EPA Federal Guidance Report #13 discussed below, DOE-RL has concluded that the BEIR VII Report does not represent significant new information, and therefore does not affect remedial action decisions being evaluated in this review, or the protectiveness of those decisions. The cancer risk estimates reported in the BEIR VII Report are generally consistent with the risk estimates in the BEIR V Report, and the risk estimates currently reported and/or used by other national and international regulatory and scientific organizations.

The NRC in its review of the BEIR VII Report stated that the BEIR VII risk estimates "are numerically similar to risk estimates provided in BEIR V and in more recent UNSCEAR (United Nations Scientific Committee on the Effects of Atomic Radiation) and ICRP (International Commission of Non-Ionizing Radiation Protection) reports", and "therefore, the NRC's regulations continue to be adequately protective of public health and safety and the environment." In addition, the BEIR VII Report concluded that there is no direct evidence of increased risk of non-cancer diseases in humans at low doses. In summary, the BEIR VII Report states that the conclusions of the study "contributes to refining earlier risk estimates, but none leads to a major change in the overall evaluation of the relationship between exposure to ionizing radiation and human health effects."

DOE reviews to date indicate that it is generally consistent with the risk estimates in EPA's Federal Guidance Report #13. Federal Guidance Report #13 is the basis for EPA's cancer risk slope factors (Health Effects Assessment Summary Tables) used in DOE CERCLA risk assessments. When BEIR VII results are incorporated into applicable guidance such as EPA's Federal Guidance Report #13 and the cancer risk slope factors, then DOE will incorporate such guidance for Hanford CERCLA radiation risk assessments.

Protectiveness to fulfill Natural Resource Trustee responsibility per 40 CFR 300.615. DOE intends to meet its Natural Resource Trustee responsibilities per 40 CFR 300.615. We continue to believe that the important issues facing Hanford's natural resource trustees are best addressed through the Trustee Council, which operates on the basis of collaboration and consensus. DOE will continue to coordinate its actions with the Council and to work together with other trustees regarding the appropriate strategies to restore resources.

Recent studies and negotiations with Priest Rapids dam operators. Near-river groundwater levels are impacted by the stage (elevation) of the Columbia River. This condition may enhance or reduce groundwater contaminant concentrations and contaminant mass flux rates to the river. In general, high river stages, and corresponding high groundwater levels, were demonstrated to result in increased concentrations of uranium in the 300 Area groundwater and strontium-90 in groundwater at the 100-NR-02 Operable Unit. Deep vadose zone sources are rewetted as the groundwater levels cycle through high water periods. Influx of river water into bank storage at the 300 Area may geochemically retard the flow of uranium towards the river. Technologies are currently being tested in both the 300 Area and 100-NR-02 that will be designed to respond to the concerns raised by this comment. In the 100 Area chromium plumes, high river stages tend to push the chromium plumes away from the river. Concentrations of chromium in the pump-and-treat extraction wells near the river have been observed to decrease during periods of high river stage. Technological improvements are also being designed for the chromium plumes in the 100 Area. The dynamic nature of the 100 Area flow system will be considered in the design of these improved systems. This five-year review analyzes, discusses and incorporates new information about 100 Area chromium plumes.

New data on chromium risks based on the report *Chromium Toxicity Test for Fall Chinook Salmon Using Hanford Site Groundwater* (Patton et al. 2001[1]). The U.S. Geological Survey chromium study was a

[1] Patton GW, DD Dauble, MA Chamness, CS Abernethy, and CA McKinstry. 2001. *Chromium Toxicity Test for Fall Chinook Salmon (Oncorhynchus tshawytscha) Using Hanford Site Groundwater: Onsite Early Life-Stage Toxicity Evaluation.* PNNL-13471, Pacific Northwest National Laboratory, Richland, Washington.

laboratory salmon study designed to create exposure conditions that would cause adverse effects such as genetic damage. The results of the study indicated possible DNA damage at some, but not all of the chromium concentrations studied. The results of the study also indicated that the cleanup level specified in the 100-HR-3/KR-4 groundwater operable unit interim action ROD is protective of Chinook salmon. Initial findings appear to confirm the adequacy of the National Ambient Water Quality Standard for Chromium which DOE applies. The results of the study were incorporated into the design of the ecological portion of DOE's River Corridor Baseline Risk Assessment. In summary, the study supported the protectiveness levels established in interim RODs.

Comment 4:
ADVICE - The Board advises DOE that the draft CERCLA five-year review report should address the following items:

Expand the review of protectiveness of current remedial actions beyond reliance on current or near-term institutional controls that limit exposure. This extended analysis would help assess and determine whether or not the current cleanup remediation strategy will meet the long-term cleanup goals expressed by the Board.

Response to Comment 4: DOE agrees that the reviews of protectiveness should address the entire timeframe of selected remedial actions to ensure that the remedies meet CERCLA requirements for the Hanford Site and thus, it did so in this five-year review. That said, where RODs are not final, the success of their protectiveness will be analyzed and modified, if necessary, in the final ROD.

Most of the work completed recently, or in progress, is being done under Interim Records of Decision. Interim RODs are the appropriate tool to use in cases where waste sites may be added later or where additional data or analysis is needed to formulate the final cleanup decision. Interim RODs allows cleanup to proceed and facilitate actions necessary to move the Hanford cleanup mission closer to its final goals. DOE intends for the remedies selected in final RODS to be protective of human health and the environment upon completion. In some circumstances, additional work may be necessary and ROD amendments may be required.

Comment 5: Formally consider and respond to public input, and show how public values for use of resources are incorporated into evaluations of reasonable maximum exposure scenarios – for both the near- and long-term time periods.

Response to Comment 5: Public values on use of resources are considered in all DOE planning and actions, including evaluations of reasonable maximum exposure scenarios under CERCLA. The CERCLA five-year review has evaluated the performance of the interim and final remedies that have been selected through the appropriate CERCLA processes and documented in Action Memoranda or records of decision. As noted in the prior comment response, final RODs will be issued for much of the Hanford Site in the future. Before finalizing the decisions and respective documents DOE will again consider public input as part of the decision making processes. DOE has looked to HAB, the Tribes, and other stakeholders to provide insight into reasonable maximum exposure scenarios in the past and will continue to welcome specific examples of where stakeholders believe DOE should change its scenarios now and in the future.

Comment 6: Update the review using available new information.

Response to Comment 6: As previously stated in response to comment 3, new information was assessed and incorporated into this five-year review as appropriate.

Comment 7: Evaluate the breadth of the review to identify shortfalls that should trigger amendments to Interim and/or Final RODs.

Response to Comment 7: DOE agrees and has done so. The breadth of the review was defined by the scope of the CERCLA activities on the Hanford Site. Where selected remedies identified in RODs or Action Memoranda are not working in a manner that will assure attainment of remedial action objectives; actions to improve the efficiency of the remedy or recommended changes to the remedy are reflected in the final document.

Comment 8: Finally, the U.S. Environmental Protection Agency (EPA) should give serious consideration to Board advice in determining whether the cleanup remedies under review are, in fact, protective of human health and the environment.

Response to Comment 8: Pursuant to *Comprehensive Five-Year Review Guidance* (June 2001) OSWER 9355.7-03B-P, EPA 540-R-01-007 the CERCLA five-year review report for the Hanford Site was provided to EPA for its review and concurrence with the protectiveness determinations. If EPA does not concur with the DOE protectiveness statements it will inform DOE. EPA may issue a separate report that includes protectiveness statements reflecting that agency's opinions.

COMMENTER 2 (Columbia Riverkeeper)

Comment 1: I am writing on behalf of Columbia Riverkeeper (CRK) to comment on the DOE's Draft CERCLA Five-Year Review Report for the Hanford Site (Report). CRK appreciates the chance to comment on the Report, but has grave concerns as to its results. While we recognize that the cleanup of such a massive waste site is extremely complex and not easily accomplished, the potential environmental consequences dictate that the utmost care be exercised in its undertaking.

As a preliminary matter, CRK incorporates by reference the May 24, 2006 comments of Heart of America Northwest and the June 2, 2006 comments of the Hanford Advisory Board. We offer the following additional comments:

Response to Comment 1: The DOE appreciates Columbia Riverkeeper's interest in the Hanford cleanup and the time spent preparing these comments. We agree that the Hanford cleanup is massive, extremely complex, not easily accomplished, and has the potential environmental consequences dictating that the utmost care be exercised in completing the cleanup.

Comment 2: As the report's Executive Summary states, "The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Executive Order (EO) 12580 mandate that DOE, as the lead federal agency, must conduct response actions no less frequently than once every five year [sic] **to determine whether the selected remedy(ies) at a site is/are protective of human health and the environment."** (Emphasis added.)

CRK believes that the report fundamentally misses the purpose, scope, and depth of an adequate five-year review. The intent of the Presidential Executive Order was for the five-year review to not only assess current conditions, but to project whether the current cleanup and remediation strategy will ultimately meet the long-term goals of cleanup. In other words, this is an opportunity to take a hard look at the existing situation and ask "Where are we? Are we headed in the right direction? Will we meet our goals? Will the cleanup that we are performing give us the results that are required by law? In essence, will the cleanup 'protect human health and the environment'?" For example, in the River Corridor, where unrestricted use is the desired end-use level, will we achieve that level of protectiveness?

Response to Comment 2: DOE disagrees that this five-year review misses the purpose, scope and depth required. DOE conducted this review in accordance with CERCLA, Executive Order 12580, and the DOE and EPA guidance for conducting CERCLA five-year reviews.

The requirement to conduct five-year reviews applies to CERCLA remedial actions for which a remedy has been selected and a remedial action has been completed or is in progress and where waste has been or will be left in place. The five-year review ensures that completed remedies continue to be protective when it is possible that no one is present at a site frequently enough to provide on-going oversight of the remedy's performance. DOE agrees that the reviews of protectiveness should address the entire timeframe of selected remedial actions to ensure that the remedies meet CERCLA requirements for the Hanford Site. The assessments of protectiveness in this five-year review addressed protectiveness for present and anticipated future situations.

Both DOE and EPA guidance allow discretion to include all CERCLA actions in the review, not just those with a final ROD. DOE decided to exercise that discretion and include all of the CERCLA actions planned, in process, and completed on the Hanford Site

The five-year review process is designed to verify that the remedies selected in Action Memoranda and RODs are working as predicted. These remedies are expected to be protective when completed, unless the conditions and assumptions on which the decisions were based have changed significantly.

DOE's reasonably anticipated future land use for the next 50 years for the River Corridor, as described in the DOE Comprehensive Land Use Plan, is conservation and preservation in the 100 Areas and industrial use in the 300 Area. Current cleanup in the 100 Area allows for unrestricted surface use in the 100 Area and industrial uses in the 300 Area. In order to complete the cleanup of Hanford, DOE must follow a series of regulatory steps prescribed in the Tri-Party Agreement, a legally binding agreement among DOE, State of Washington and EPA and validated by the regulatory agencies to ensure the final cleanup meets the requirements of the Tri-Party Agreement and State and Federal laws. This five-year review discusses where specific interim actions have achieved their purposes and where they have not, where corrections are needed, and where they are not. This review generally did not attempt to guess whether "in-progress" actions were going to be protective or not, nor did it generally suggest changing course where final remedies had not yet been selected or implemented.

As the comment also notes, the draft document omitted an "s," which DOE has now corrected. The phrase now reads "once every five years."

Comment 3: Instead, DOE's approach was to limit the assessment of protectiveness to the current state of remedial actions. DOE bases its assertion that the current protectiveness goal is met largely on the existence of institutional controls (IC) presently in place that limit exposure in the here and now. This five-year review can trigger corrective actions, and it should trigger amendments to final decisions and future documents. But it will not do so if the focus is on the assessment of the current situation, ignoring the likely destination in view of the observed trajectory of the cleanup. Basically, DOE's attitude seems to be, "We have some problems now, but we think everything will turn out alright." Thus, the five-year review falls severely short of identifying shortcomings in the cleanup plan that will hinder or slow the ability to meet the plan's goals in a timely and cost effective manner. The review should directly address public, Tribal, agency, and other stakeholder views and concerns about the protectiveness of remedies and the possible failure of institutional controls. As a start, DOE should clearly define what the word 'protective' means.

The Summary goes on to list the three questions on which the review focused:

1. Is/are the remedy(ies) functioning as intended by the decision document?

2. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?

3. Has any other information come to light that could call into question the protectiveness of the remedy?

Response to Comment 3: A five-year review evaluates whether remedies selected in CERCLA decision documents have resulted in a final condition that is protective of human health and the environment or that the final condition will be protective when the remedy is completed. This DOE five-year review also includes discussion of those areas where CERCLA removal or remedial actions are expected to be conducted and provides a description and discussion of the status of those areas.

Institutional controls are an element of many removal and remedial actions and are used during removal actions to ensure protection of human health and the environment until such time that a final remedy is completed. Institutional controls are also a fundamental part of some permanent remedies when it is not feasible to treat or remove all contaminants and some are left in place.

DOE will implement institutional controls as necessary, along with other mitigating or preventive measures, to provide a reasonable expectation that if one control temporarily fails, other controls will be in place, or actions will be taken, to mitigate significant consequences of the failure. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required.

Protectiveness is generally defined in the National Contingency Plan (NCP) by the risk range and the hazard index (HI). In reviewing protectiveness of remedies in this review, DOE accepted the definition of "protective" of the EPA-Office of Inspector General. According to that office, "CERCLA protective is defined as 'protective of human health and the environment as defined generally by a 10^{-4} to 10^{-6} risk range and a hazard index of 1 or less.'" A risk range of 10^{-4} to 10^{-6} is consistent with risk management decisions made in other EPA regulatory programs and in federal regulatory agencies in general. Therefore, promulgated regulations include, incorporate, or account for this risk range. Applicable or relevant and appropriate requirements (ARARs) are selected from regulations and cleanup remedies must comply with ARARs. Hence, compliance with ARARs is generally considered protective.

Comment 4: Functioning Remedy? The answer to the first question, whether the remedies are functioning as intended, likewise depends on where the focus is. The records of decision (RODs) are a means to achieve the end-state of a clean environment. That is the overarching purpose of the cleanup. If observations lead one to suspect the current remedy will not achieve this result, then corrective actions and adjustments to the original plan must be made in order to put the project back on track toward the desired goal. If the attitude is, "Well there are a few problems now, but they will likely be corrected by the time everything is complete, therefore it is not necessary to alter the course," then the goal cannot be met. When the plan is not functioning as expected, the question should not be *whether* to alter the course. Rather, it should be *how much* to alter the course.

As an example of how the five-year review fails in this respect, the 100-B/C Area source removal did not lead to reduced concentrations of some contaminants as expected. According to the report, several wells in the 100-B/C Area showed sharp spikes in tritium concentration in the late 1990s, with subsequently declining levels. (*See* report at 1.25.) Then again in 2005, a well between the reactor buildings and the retention basins showed a spike of 161,000 pCi/L, 8 times the drinking water standard of 20,000 pCi/L. The report does not specify the magnitude of the 1990s spikes, but states that there was a pattern of spikes throughout the 100-B/C Area, and indicates they were significantly higher than the 2005 spike. The cause of the peaks is unknown. Yet the report goes on to conclude that "No issues or actions specific to the 100-B/C Area were identified during the review." This simply defies logic.

Nitrates and antimony have also been identified as contaminants of concern in this area by the initial ecological risk assessment, another reason why the 100-B/C Area remedy is not protective.

Response to Comment 4: The DOE agrees that selected remedies documented in RODs are the means to achieve the end-state of a clean environment. The 100 Area groundwater cleanup interim actions, designed to address principle threats, do not address all of the contaminants of potential concern. The protectiveness statements were revised to reflect that the cleanup decisions are for interim actions and further work may be required to meet remedy requirements that will be established in a final ROD. DOE also agrees that when it is known or suspected that a remedy is not working as intended, action should be taken to correct the situation. CERCLA and the Hanford Past Practice Strategy are designed to accommodate additional remedies if determined to be necessary throughout the cleanup process. For the purposes of a CERCLA five-year review, the focus remains on the performance of the remedies in meeting the remedial action objectives established by the RODs for interim actions.

Tritium, nitrate and antimony were not identified in the remedial action objectives of the RODs for interim action. Rather the interim measures taken under these RODs for interim action were focused on the key contaminants that drive risk. Per the Hanford Past Practice Strategy, DOE will complete the CERCLA RI/FS process, including a risk assessment to identify contaminants of concern to be considered and addressed as necessary in a final ROD. Per the Hanford Past Practice Strategy, the Interim RODs are not "Inadequate" but serve the intended purpose of accelerating the cleanup and remediating the known contaminants of potential concern.

Comment 5: Finally, when assessing protectiveness, the DOE leans far too heavily on current institutional controls at the site. Exposure assumptions cannot be based on a fallacious sense of current protectiveness. They must be grounded in the future end state goal of cleanup and provide a real means of controlling exposure. They do not. For instance one example of institutional controls is signage that warns those who pass by to keep out of a specific area due to the presence of a hazard. This is no control at all if the species passing by is other than human. Even when it is the human species passing by, there is no guarantee that the sign will be heeded.

A recent example of the fact that institutional controls are presently failing is given in the context of protection of endangered species from human encroachment at the Hanford site. A sign was placed in the middle of the road to prevent entrance to a bald eagle nesting site: "ALL ACCESS PROHIBITED." Within the space of only two months, a photo shows the sign had been ignored repeatedly to the point that a new roadway existed; it simply curved around the sign. (*See* June 4, 1999 email correspondence of Brett L. Tiller, Battelle Pacific Northwest National Laboratory.)

Response to Comment 5: As previously discussed in response to comment 3, during removal or remedial activities, institutional controls are required to ensure human health and the environment are protected by limiting access and exposure as much as possible. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. However, when residual contamination is left behind after cleanup is completed, institutional controls are necessary for protection of human health. Completing the actions in the 100 and 300 Area RODs for interim actions will leave residual contamination up to a specified depth, thus institutional controls are required. The current RODs use the assumption that cleanup for protection of human health will protect the environment. The River Corridor Baseline Risk Assessment will provide information with which DOE will be able to reassess and if necessary change this assumption, thereby resulting potentially in additional protection for biological resources and the environment.

DOE acknowledges that in some instances, such as the example cited, signs alone do not prevent individuals from improperly or illegally accessing restricted areas. However, signs constitute only one level of passive institutional controls. When necessary to ensure effectiveness, more than one institutional control is put in place. Various levels of passive and active controls are in place at Hanford. Whether for security reasons or to keep people out of harm's way during remediation, a graded approach is taken on the level of institutional controls required based on the protection required. (The photo and memo noted in the comment led to subsequent actions and measures to increase protection of the nesting area.)

Comment 6: DOE's reliance on these sorts of controls is a psychological smoke screen. It gives one a false sense of security. Furthermore, there is no strategic plan in place to fund these sorts of controls in the long term, even assuming they were effective in the short term. DOE simply passes the problem on to the Office of Legacy Management, which has no funding available to maintain these controls and is not a part of the decision-making process that selects the controls as a remedy. Similar problems are found in the idea of capping being a protective remedy.

Response to Comment 6: Institutional controls are an essential tool in conducting CERCLA remedial actions. During active remediation institutional controls are necessary to protect the public and environment from exposure as much as possible. Longer term institutional controls may be required to ensure long-term durability of engineered remedies and to protect human health and the environment from risks that cannot be mitigated.

In the National Contingency Plan (NCP), EPA emphasizes that ICs are meant to supplement engineering controls and that ICs will rarely be the sole remedy at a site. The DOE Policy on Use of Institutional Controls states DOE's intention to only use institutional controls where necessary. The following is excerpted from the DOE policy.

> In situations where unrestricted use or unrestricted release of property is not desirable, practical, or possible, institutional controls are necessary and important to DOE efforts to fulfill its programmatic responsibilities to protect human health and the environment (including natural and cultural resources). It is DOE policy to use institutional controls as essential components of a defense-in-depth strategy that uses multiple, relatively independent layers of safety to protect human health and the environment (including natural and cultural resources). This strategy uses a graded approach to attain a level of protection appropriate to the risks involved. DOE will use a graded approach to determine what types and levels of protective measures (e.g., physical, administrative, etc.) should be used.

There are many areas of the Hanford Site where unrestricted use is not desirable, practical, or possible. The Department will implement institutional controls, along with other mitigating or preventive measures as necessary, to provide a reasonable expectation that if one control temporarily fails, other controls will be in place, or actions will be taken, to mitigate significant consequences of the failure. Institutional controls are not used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required. As long as Hanford remains under federal control, institutional controls will remain in many forms, whether they are for security reasons or to keep people out of harms way during remediation.

Engineered barriers (caps) are an essential tool used in the remediation of CERCLA sites and in the closure of RCRA land fills, to protect human health and the environment when it is not feasible or practical to remove all contaminants or to complete the disposal of RCRA wastes.

Any barriers that might be built at Hanford would be required to meet performance criteria to ensure adequate long-term performance and include surveillance and maintenance plans.

Following the completion of cleanup and closure of Hanford, the DOE Office of Environmental Management, will transfer management of the lands that DOE retains to DOE's Office of Legacy Management (LM). LM will be responsible for the long-term management of lands required by DOE, and for compliance with the long-term requirements in the final ROD. Congress will annually appropriate funds to the LM program based on requests from the Administration and constituent interest. Currently, DOE does not seek or receive funds for the LM program at the Hanford Site, but certainly anticipates doing so when LM takes over management of Hanford lands.

Comment 7: Moreover, it is impossible for the DOE to assess protectiveness for the Columbia River Corridor, as it has not yet completed the ecological risk assessment for that Corridor. It cannot be stated that the current cleanup plan is protective when contaminants are being released to the River on a daily basis and these contaminants are being taken up by various species. If DOE is to ensure protectiveness as defined by the Yakama and Nez Perce Tribes, then these releases must be eliminated. Otherwise it ignores what is required by law under CERCLA and the required Trust Responsibility to protect cultural and natural resources. 40 CFR § 300.615.

Response to Comment 7: DOE disagrees that the River Corridor risk assessment must be completed to make near term protectiveness determinations on selected interim or final remedies. DOE agrees that long term protectiveness should be deferred until the risk assessments are completed. The short-term protectiveness determinations are based on evaluation of the performance of selected remedies. Risk assessments are part of the Remedial Investigation/Feasibility Study (RI/FS) process. The remedy selected through the RI/FS process must address the risks identified in the RI/FS process and mitigate the identified risks to be protective of human health and the environment. The five-year review process verifies that the selected remedy is or will be protective when final.

In response to the public dialogues and the many comments received, this document was revised. DOE agreed that in some cases the protectiveness statements in this Review overstated the level of protectiveness that can be determined based on the information available at this time. DOE concluded that in some cases a more conservative determination would more accurately reflect the situation. Therefore, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

DOE takes seriously its trust responsibilities and in consultation with affected Indian tribes considers the potential impacts of its actions on cultural and natural resources as required by law.

Comment 8: Changing exposure assumptions, toxicity data, cleanup levels, and remedial objectives?

In answering the second question, whether the exposure assumptions, toxicity data, cleanup levels and remedial action objectives used to select the remedy have continued validity, CRK reiterates a portion of the comments of Heart of America Northwest. Those comments, already incorporated herein, illustrate how the cleanup fails to reassess assumptions and toxicity data.

In the past year a new, formal scientific consensus on risk from exposure to radiation was issued by the National Academy of Sciences: Biological Effects of Ionizing Radiation VII (BEIR VII). The BEIR VII consensus is that exposure to fifteen millirem of radiation, the level previously relied upon by DOE as protective and on which cleanup decisions were based, would result in far more cancers than previously expected. U.S. Environmental Protection Agency (EPA) rules for CERCLA five-year reviews require that this sort of new data be considered in determining whether an adopted remedy will remain protective. It is now known that the selected remedies will meet neither Washington State Law, nor CERCLA parameters governing carcinogen risk assessment. Yet DOE has maintained the data was outside its scope of review.

Response to Comment 8: DOE disagrees. DOE has evaluated the BEIR VII Report as it relates to the CERCLA five-year review. Based on this evaluation, DOE-RL has concluded that the BEIR VII Report does not represent new information that would affect remedial action decisions being evaluated in this review, or the protectiveness of those decisions.

The cancer risk estimates reported in the BEIR VII Report are generally consistent with the risk estimates in the BEIR V Report, and the risk estimates currently reported and/or used by other national and international regulatory and scientific organizations. The Nuclear Regulatory Commission (NRC) in its review of the BEIR VII Report stated that the BEIR VII risk estimates "are numerically similar to risk estimates provided in BEIR V and in more recent UNSCEAR and ICRP reports", and "therefore, the NRC's regulations continue to be adequately protective of public health and safety and the environment." Therefore the statement that: "The BEIR VII consensus is that exposure to fifteen millirem of radiation, the level previously relied upon by DOE as protective and on which cleanup decisions were based, would result in far more cancers than previously expected" is incorrect. The hypothetical number of cancers calculated for a 15 millirem exposure based on the BEIR VII risk estimates would not be significantly different than previously calculated values.

In regards to non-cancer risks the BEIR VII Report concluded that there is no direct evidence of increased risk of non-cancer diseases in humans at low doses. In summary the BEIR VII Report states that the conclusions of the study "contributes to refining earlier risk estimates, but none leads to a major change in the overall evaluation of the relationship between exposure to ionizing radiation and human health effects."

DOE continues to review the implications of BEIR VII, but reviews to date indicate that it is generally consistent with the risk estimates in EPA's Federal Guidance Report #13. Federal Guidance Report #13 is the basis for EPA's cancer risk slope factors (Health Effects Assessment Summary Tables) used in DOE CERCLA risk assessments. Until BEIR VII results can be appropriately reviewed, evaluated and incorporated into applicable guidance such as EPA's Federal Guidance Report #13 and the cancer risk slope factors, it is of limited value for Hanford CERCLA radiation risk assessments.

Comment 9: New information?

As to the third question, whether any information has come to light that could call into question the protectiveness of the remedy, CRK offers the following items:

A 300 Area City of Richland study funded by DOE. This study finds that the land could never be used for industrial use only, because a private company would never assume liability for it. It was stated that the area should be a multi-use site and should be cleaned up for unrestricted use.

Other information exists about the 300 Area showing shoreline contamination of clams, riparian zone contamination, and ongoing groundwater contamination.

United States Geological Survey (USGS) chromium study results show that 100% of samples taken to assess genetic damage in fall Chinook salmon show such genetic damage.

Ongoing negotiations with Priest Rapids dam operators may affect fluctuations in the level of river water. Such fluctuations can cause more contaminants to enter the river from the vadose zone. Yet no corrective action for treatment or removal of the deep vadose contamination is cited.

If new information has come to light, DOE must assess this new information in light of the cleanup goals and the intent of the RODs. So far, DOE has not done so.

Response to Comment 9: New information pertaining to the Hanford Cleanup Project is assessed on an ongoing basis. As the information is received, it is evaluated for potential impacts on the cleanup. If the assessment of the new information indicated that it could trigger a reconsideration of requirements in a ROD, it was incorporated into the five-year review. The City of Richland study was reviewed and assessed. It did not require a change in ROD.

The 300 Area industrial re-use study conducted by the City of Richland was assessed to determine if it would affect any of the CERCLA remedial action decisions that have been established in records of decision. DOE concluded that the recommendations from the study are one of the factors that would be taken into consideration when the DOE evaluates its land use decisions made for Hanford. At this time the City of Richland study does not warrant a change to the current or reasonably anticipated future land uses for the 300 Area as established in the Hanford Comprehensive Land Use Plan. The DOE anticipates it may have future missions for the 300 Area; therefore, no decision has been made to transfer this parcel of land out of the DOE's administration in the foreseeable future.

The environmental contamination found in the 300 Area is consistent with the understanding of environmental conditions when the 300 Area records of decision, and subsequent revisions, were written. However, DOE is currently performing a limited field investigation that will lead to a CERCLA focused feasibility study/proposed plan designed to assess remedial options to meet groundwater cleanup goals consistent with 40 CFR 300.430(a)(1)(iii)(F).

The U.S. Geological Survey chromium study was a laboratory salmon study designed to create exposure conditions that would cause adverse effects such as genetic damage. The results of the study indicated possible DNA damage at some, but not all of the chromium concentrations selected for the study. The results of the study also indicated that the cleanup level specified in the 100-HR-3/KR-4 groundwater operable unit interim action ROD is protective of Chinook salmon. Initial findings appear to confirm the adequacy of the National Ambient Water Quality Standard for Chromium. The study results were incorporated into the design of the ecological portion of the River Corridor Baseline Risk Assessment.

Deep vadose zone contamination in certain cases will likely need to be addressed to meet CERCLA groundwater cleanup goals. Near-river groundwater levels are impacted by the stage (elevation) of the Columbia River. This condition can enhance or reduce groundwater contaminant concentrations and contaminant mass flux rates to the river. This condition can also impact the ability of groundwater remedies to meet groundwater cleanup goals if fluctuating groundwater levels provide a continuing source of contaminant to the groundwater. In general, high river stages, and corresponding high groundwater levels, were shown to result in increased concentrations of uranium in the 300 Area groundwater and strontium-90 in groundwater at the 100-NR-02 Operable Unit. Deep vadose zone sources are rewetted as the groundwater levels cycle through high water periods. In the 300 Area the influx of river water into bank storage can geochemically slow the flow of uranium towards the river, a potentially beneficial outcome for the goal of reducing uranium flux to the river. Technologies are currently being tested in both the 300 Area and 100-NR-02 that are designed to respond to the concerns raised by this comment. For the 300 Area, polyphosphate injection may immobilize uranium in the deep vadose zone that is rewetted by fluctuating water levels. The apatite barrier test at 100-N is designed to keep strontium-90 in the groundwater and deep vadose zone from reaching the river.

In the 100 Area chromium plumes, high river stages tend to push the chromium plumes away from the river. Concentrations of chromium in the pump-and-treat extraction wells near the river were observed to decrease during periods of high river stage. A "systems approach" is planned to be deployed in the 100 Area chromium sites utilizing source removal, reductive chemistries to convert chromium-6 to chromium-3 in the groundwater and vadose zone, repairing the existing barrier and up-scaled pump-and-treat systems. The dynamic nature of the 100 Area flow system will be considered in the design of these improved systems.

Comment 10: Miscellaneous

Failure of DOE to assess cumulative effects of multiple contaminants is unacceptable.

Response to Comment 11: DOE disagrees because the focus of the Five-Year Review is to assess protectiveness based on answering three questions:

1 Is/are the remedy(ies) functioning as intended by the decision document?
2 Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of remedy selection still valid?
3 Has any other information come to light that could call into question the protectiveness of the remedy?

The ongoing risk assessments that support final RODs will assess, to some degree, the effects of multiple contaminants.

Comment 11: 150-year planning assumptions for leaving groundwater contaminated violates state law, federal law, and the trust responsibility. DOE has no authority to take a state water resource.

Response to Comment 11: DOE conducts groundwater cleanup pursuant to CERCLA requirements and strives to meet CERCLA groundwater cleanup goals. Groundwater cleanup decisions will be based on meeting the nine CERCLA evaluation criteria for remedial actions, including meeting "applicable or relevant and appropriate" requirements (ARARs). DOE will meet CERCLA groundwater cleanup objectives, including the restoration of the aquifer to beneficial uses wherever practicable within a time frame reasonable given the particular circumstances of the Hanford Site. If, through the CERCLA process, restoration is determined to not be practicable, DOE expects to take appropriate actions will be taken to prevent further migration of the plume, prevent exposure to the contaminant and evaluate further risk reduction. This approach is consistent with 40 CFR 300.430(a)(1)(iii)(F).

Comment 12: The report relies too heavily on drinking water standards as an indication of protectiveness and completely ignores the phenomenon of bioaccumulation of contaminants.

Response to Comment 12: As stated above, the DOE reviews the effectiveness of implementation of the Interim Action RODs. Remedial action goal #2 of the 100 Area ROD focuses on control of sources of groundwater contamination to minimize the impacts to groundwater resources. Bioaccumulation is not addressed in the remedial action goals. The current sampling being done for the River Corridor risk assessment will provide some data on bioaccumulation that can be used in future cleanup decisions and evaluations.

Comment 13: The report is prone to bias in that DOE is evaluating its own work, and would have a tendency to express the progress in a more favorable light. An independent evaluation would likely be more credible.

Response to Comment 13: CERCLA mandates responsibility for conducting response actions on Federal facilities to the President of the United States, who delegated many of his CERCLA responsibilities to responsible federal agencies, including specifically, DOE, through Executive Order 12580 (EO 12580).

Under EO 12580, DOE is the lead agency responsible for conducting response actions (removal and remedial) at facilities under its control, including the Hanford Site. The NCP describes the CERCLA responsibilities of DOE. One of the key requirements of a lead agency is to conduct reviews of the status of the response actions where waste has been left in place, no less frequently than once every five years. Therefore, DOE must conduct five-year reviews in a manner consistent with the CERCLA, Executive Order 12580, and the NCP.

Pursuant to *Comprehensive Five-Year Review Guidance (June 2001)*, DOE as the lead agency submits the CERCLA Five-Year Review Report for the Hanford Site to EPA for its review and concurrence with the protectiveness determinations. If EPA does not concur with the DOE protectiveness statements it will inform DOE. EPA may issue a separate report that includes protectiveness statements reflecting that agency's opinions.

In 2000, EPA conducted the five-year review because EPA thought it should do so and the agencies were still sorting out lead agency responsibilities. DOE has used the 2000 EPA five-year review as a template for this review.

Comment 14: CRK again expresses appreciation for the chance to comment and implores DOE to seriously consider these and all other comments submitted in preparing the final five-year review report.

Response to Comment 14: DOE appreciates your comments. We value and consider all public input provided on Hanford cleanup decisions. The Department remains committed to keeping the public informed and involved on Hanford cleanup decisions.

COMMENTER 3: Physicians for Social Responsibility

Comment 1: We appreciate the opportunity to submit comments on the CERCLA Five-Year Review Report for the Hanford Site. As an overall comment, we strongly endorse the Hanford Advisory Board Consensus Advice No. 190, adopted June 2, 2006. On the one hand, it recognizes the time and effort DOE staff spent preparing the draft report; but on the other hand concludes that DOE's review missed critical parts of the intent of a five-year review. A key observation within the advice is that the five-year review would be more useful if it assessed the ongoing protectiveness of remedies ***beyond the institutional control period*** (emphasis in Advice 190).

Response to Comment 1: DOE appreciates the time spent on reviewing the draft document and providing comments.

The five-year review process is meant to verify that the remedies selected in Action Memoranda and records of decision are working as predicted. These remedies are expected to be protective when completed, unless the conditions and assumptions on which the decisions were based have changed significantly. These remedies may include institutional controls as part of an interim action or as part of a final action. The five-year review process is primarily retrospective in that it looks at actions taken to meet remedial action decisions made before the review is conducted to ensure that they have, or will, achieve the desired mitigation of the risks that were the basis for the action. Recognizing the interest in knowing the overall status of the Hanford Cleanup Project, this DOE five-year review also includes discussion of those areas where CERCLA removal or remedial actions are expected to be conducted and provides a description and discussion of the status of those areas

DOE disagrees that the protectiveness statements are based primarily on exposures being limited by institutional controls. Institutional controls are an element of many removal and remedial actions and are used during removal actions to ensure protection of human health and the environment until such time that a final remedy is completed. Institutional controls are also a fundamental part of some permanent remedies when it is not feasible to treat or remove all contaminants and some are left in place. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required.

Most of the work completed recently, or in progress, is being done under interim records of decision. Interim RODs are the appropriate tool to use in cases where waste sites may be added later or where additional data or analysis is needed to formulate the final cleanup decision. The interim ROD allows cleanup to proceed in the meantime and facilitates actions necessary to move the Hanford cleanup mission closer to its final goals. The remedies selected in the interim RODs must not be inconsistent with remedies selected in final records of decision. DOE anticipates that when the remedies selected in those records of decision are completed the results will be protective of human health and the environment. In some circumstances, additional work may be necessary and that ROD amendments may be required.

Comment 2: To amplify on that, we commend DOE for its candid assessment of the technical difficulties of remediating groundwater contaminated with radionuclides. DOE notes that remedial action objectives are not being met for groundwater contaminated with uranium in the 300 Area, and for groundwater contaminated with strontium-90 in the 100 Area. The draft review reports that alternative remedies have been tested for the strontium-90 contamination, and we understand that one such alternative method was selected and has recently been applied in the 100-N Area.

Response to Comment 2: That is correct. An alternative method for mitigating the strontium-90 contamination in the 100-N Area is being tested. If the technology performs as expected, the application of the technology will be expanded to cover the extent of contamination.

Comment 3: In addition, the remedy for groundwater contaminated with uranium in the 300 Area is "monitored natural attenuation." This term seemed puzzling at first glance, since half-lives of uranium isotopes can be hundreds of millions of years or longer. However, as described in the five-year review [p. 3.13], the remedy assumed that uranium levels in groundwater will be reduced as the groundwater flows into the Columbia River. Even so, the review reports that this remedy has not met remedial action goals because uranium contamination in the vadose zone has served as a resupply source by migrating into groundwater.

Response to Comment 3: The decision to rely on natural attenuation and continued monitoring for the 300 Area uranium plume made ten years ago in the 300-FF-05 ROD did not consider radioactive decay of uranium, given, as you suggest, uranium's very long half-life. DOE expected other physical flow and transport mechanisms to reduce the uranium concentration to drinking water standards within ten years. That has not occurred as expected. Deep vadose zone sources of uranium get rewetted as groundwater near the river rises, thus contributing additional uranium to the groundwater. The ongoing CERCLA field investigation and treatability testing activities are designed to evaluate this condition and provide a basis for selecting technology to address the problem.

Comment 4: Furthermore, in the 200 UP-1 Area, the review notes that remedial action goals are being met, but also states that those goals are not risk-based [p. 2.32]. The goals for uranium and technetium-99 (210,000 year half-life), represent levels 10-fold higher than levels that would be considered acceptable.

Response to Comment 4: The remedial action goal of the 200-UP-01 interim remedial action is to reduce uranium and technetium-99 concentrations to 10 times the drinking water standards for uranium and technetium-99. This goal was met and we are currently performing a rebound study to determine if these conditions will continue over time. This action is intended to reduce the mass of these two contaminants to levels where future migration of the plume will not exceed standards outside of the 200 Area core zone. Because this is an interim action, the final end state for the 200-UP-01 groundwater will be determined at a later date.

DOE intends to conduct groundwater cleanup pursuant to CERCLA requirements and will strive to meet CERCLA groundwater cleanup goals. Groundwater cleanup decisions will be based meeting the nine CERCLA remedial action evaluation criteria and CERCLA groundwater cleanup objectives, including the restoration of the aquifer to beneficial uses wherever practicable within a time frame reasonable given the particular circumstances of the Hanford Site. If, through the CERCLA process, restoration is determined to not be practicable, DOE will take appropriate actions to prevent further migration of the plume, prevent exposure to the contaminant and evaluate further risk reduction. This approach is consistent with 40 CFR 300.430(a)(1)(iii)(F). Aquifer restoration for 200-UP-01 operable unit must be evaluated on all of the contaminants that exceed drinking water standards. Hence, the ultimate cleanup levels for uranium and technetium will be based, in part, on the ability to meet standards for the co-contaminants, including carbon tetrachloride.

Comment 5: The five-year review only describes a few instances at Hanford where pilot projects for groundwater remediation have been initiated. The review further notes that for some nuclides, such as tritium and iodine-129 (15 million year half-life), no viable groundwater remediation technology exists [p. 2.35].

Response to Comment 5: Meeting CERCLA groundwater cleanup goals for the tritium, nitrate, and iodine-129 plumes are challenging. CERCLA feasibility studies and proposed plans will assess available technologies to address the contaminants of potential concern, including these contaminants, and the ability of technologies to meet CERCLA groundwater cleanup requirements and goals. The current groundwater cleanup actions are being performed under CERCLA records of decision for interim action and the systems are well beyond the "pilot stage."

Comment 6: In previous consensus advice, the HAB concluded that groundwater should be cleaned up to its highest beneficial use (Advice No. 145, April 4, 2003). But with acknowledged limits in both radioactive and nonradioactive remediation technologies, and the very long half-lives of some contaminants, this goal seems unlikely to be attained. One must ask how cleanup at Hanford will ever be considered complete, as long as groundwater remains contaminated.

Response to Comment 6: The question of when Hanford cleanup will be considered complete is one to be answered in the future. In the meantime, the Hanford cleanup will meet CERCLA groundwater cleanup objectives, including the restoration of the aquifer to beneficial uses wherever practicable within a time frame reasonable. If, through the CERCLA process, restoration is determined to not be practicable, DOE will take appropriate actions to prevent further migration of the plume, prevent exposure to the contaminant and evaluate further risk reduction. Therefore, CERCLA records of decision will determine the cleanup actions to address groundwater contaminant plumes and sources.

Comment 7: As the HAB notes in Advice No. 190, DOE concludes that current remedies are protective because institutional controls prevent Hanford groundwater uses. But DOE has traditionally assumed that institutional controls fail after 100 years, with the consequence that greater responsibility falls on "engineered" controls to contain contamination for periods far longer. Thus groundwater remediation must ultimately rely on the development of adequate technologies for radionuclides.

Response to Comment 7: DOE will continue to fund technology development for groundwater remediation and recently received an additional $10 million to fund such research. The Department will, as appropriate, apply new technologies to solve the complex Hanford groundwater issues. As decisions are required, they will be based on the effectiveness of current cleanup technologies and their ability to meet CERCLA groundwater cleanup objectives.

Comment 8: Lastly, we recognize that the five-year review was dedicated to CERCLA remediation, and remediation of the tank wastes falls outside this category. Nonetheless, the contamination in the tanks represents an enormous "source term" of potential contamination to the vadose zone and ultimately to groundwater. The adage of "an ounce of prevention" is highly applicable to the tank wastes: Groundwater contamination could be prevented by immobilizing the tank wastes through vitrification. To be effective, any program for groundwater/vadose zone integration must incorporate tank waste immobilization to prevent groundwater contamination.

Response to Comment 8: DOE agrees that tank waste retrieval, vitrification and the immobilization of the remaining contaminants from tank losses and residuals is an integral part of groundwater/vadose zone integration and groundwater protection DOE has initiated steps to assure integration of Hanford projects addressing groundwater and contamination sources in the soil.

COMMENTER 4: Oregon Department of Energy

Comment 1: Thank you for the opportunity to review DOE's CERCLA Five-Year Review Report for the Hanford Site. We recognize the effort that has gone into cleanup of Hanford during the past five years, and into your efforts to prepare this document. We are also appreciative that you, along with AMCP Mike Charbonneau and Karen Lutz, could come to discuss this review at the Oregon Hanford Cleanup Board meeting at Cascade Locks in March, and at recent public meetings in Portland and Hood River.

As noted in our comments at the Portland and Hood River meetings, it was Oregon's expectation that the five-year review would provide a comprehensive evaluation and discussion of cleanup on the site, and that DOE would use the review to do a critical self-evaluation of the status and effectiveness of Hanford cleanup. Unfortunately, as discussed in our remarks below, we believe DOE has fallen short on both these objectives.

Response to Comment 1: DOE appreciates the continued dialogue with the Oregon Department of Energy on Hanford cleanup issues and your comments on the draft report.

DOE believes the review satisfied the intent of the five-year review as outlined in CERCLA, Executive Order 12580, 40 CFR 300, and DOE and EPA guidance. The five-year review process is meant to verify that the remedies selected in Action Memoranda and records of decision are working as predicted. These remedies are expected to be protective when completed, unless the conditions and assumptions on which the decisions were based have changed significantly.

Comment 2: Determinations of protectiveness for most operating units are based not on the actual protectiveness of remedies, but primarily on some combination of institutional controls (ICs) and/or assumptions that work in progress will be effective. We believe this approach misses the spirit of the five-year review. The review should take a hard look at remedies being used, so as to determine whether they will be effective in the short- and long-term, after work is completed and the reliance on ICs has ended. Because the stated objective of cleanup, especially for the 100 Area, is cleanup to an unrestricted use standard, reliance on ICs and "work in progress" does not provide meaningful insight into the effectiveness of ongoing cleanup. Most of the work recently completed or in progress at Hanford is being done under interim action records of decision (RODs), so it is not unreasonable to expect that for at least some operating units, additional cleanup might be needed to get to final RODs. Unfortunately this report does not provide insight on whether additional work might be necessary, or at which operating units.

Response to Comment 2: Determinations of protectiveness take into account all of the factors that are part of the selected remedy, including institutional controls. Institutional controls are an essential tool in conducting CERCLA remedial actions. During active remediation institutional controls are necessary to protect the public and environment from exposure as much as possible. Longer term institutional controls may be required to ensure long term durability of engineered remedies and to protect human health and the environment where it is not feasible to remove all of the contaminants. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required. The report does evaluate the effectiveness of the current remedial actions and has identified several areas where additional cleanup actions are required.

DOE agrees that most of the work completed recently, or in progress, is being done under interim records of decision. Interim RODs are the appropriate tool to use in cases where waste sites may be added later or where additional data or analysis is needed to form the final cleanup decision. The interim ROD allows cleanup to proceed in the meantime and facilitates actions necessary to move the Hanford cleanup mission closer to its final goals. The remedies selected in the interim RODs will be consistent with remedies selected in final records of decision. In some cases, such as those where the remove, treat, and dispose remedy has been selected for contaminated soils, the interim actions are anticipated to be the final action. DOE anticipates that when the remedies selected in those records of decision are completed the results will be protective of human health and the environment. In some circumstances, additional work may be necessary and that ROD amendments may be required.

DOE had numerous discussions with the public and received over 300 written comments on the Public Review Draft of the *CERCLA Five Year Review Report for the Hanford Site*. In response to those comments, the document was revised. DOE agrees that in some cases the protectiveness statements in the Public Review Draft of the *CERCLA Five-Year Review Report for the Hanford Site* overstated the level of protectiveness that can be determined based on the information available at this time. DOE concluded that in some cases a more conservative determination would accurately reflect the situation. Therefore, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 3: We do not believe that information described in this document or work completed to date for Hanford, can support any assertion of protectiveness of the environment, as ecological risk assessments have not been completed. We believe that in all cases, assessment of protectiveness for the environment must be deferred, in accord with EPA guidance (Section 4.5 of OSWER 9355.7-03B).

Response to Comment 3: As stated in the previous response, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 4: Following on comment #1, it is not clear that for at least some operating units the current cleanup will be protective when completed. As an example, we looked at the status of groundwater in the 100-B/C Area, an area where most of the priority cleanup has been completed, and a site for which the five-year review states that remedies are protective ("No issues or actions specific to the 100-B/C Area were identified during the review.") Working with information in the March and May draft reports, we surmise that:

- DOE's approach for this operating unit is that groundwater remedial measures were not warranted because it was anticipated that source cleanups would resolve groundwater contaminant issues.
- Most priority cleanups at the B/C area have been completed (all priority liquid sites have been completed, along with 8 of 10 priority sites for buried solid waste). As such one should expect to see decreasing concentrations of contaminants at this site. However, as described in the March and May reports:
  - Chromium concentrations have been steady or declining.
  - DOE has acknowledged that for sites in the 100 Area, "deep vadose zone chromium residues continue to act as a reserve for future contamination of groundwater."
  - Strontium-90 concentrations are neither increasing not decreasing in monitoring wells.
  - Tritium concentrations have increased in some wells and aquifer tubes and declined in others. One well had a sharp increase in concentration (to eight times the drinking water standard) during 2005.

- The pilot ecological risk assessment for the B/C area identified antimony and nitrate as contaminants of concern, and also noted elevated concentrations of technetium-99, trichloroethylene (TCE), and TCE degradation products.

Response to Comment 4: The 100 Area cleanup interim action decisions for groundwater are designed to address principle threats, not all of the contaminants of potential concern. Tritium, nitrate, and antimony were not identified in the remedial action objectives of the records of decision for groundwater interim action. The cleanup actions taken under the records of decision for interim action were focused on the key contaminants that drive risk. Per the Hanford Past Practice Strategy, DOE will complete the CERCLA RI/FS process where all of the identified contaminants of concern will be considered.

DOE's approach for the 100-BC Operable Unit, working with the regulators, did not identify that groundwater conditions warranted interim measure response. It is anticipated that source cleanups would help resolve groundwater contaminant issues. We believe that current 100-B/C Area groundwater conditions still do not justify a groundwater interim action to protect the Columbia River. The CERCLA Remedial Investigation Feasibility Study (RI/FS) process will assess human and environmental risk and current technology's ability to meet CERCLA groundwater cleanup requirements and goals. This includes the restoration of the aquifer to beneficial uses wherever practicable within a time frame reasonable given the particular circumstances of the Hanford Site. If, through the CERCLA process, restoration is determined to not be practicable, appropriate actions will be evaluated to prevent further migration of the plume, prevent exposure to the contaminant and evaluate further risk reduction. This approach is consistent with 40 CFR 300.430(a)(1)(iii)(F). DOE will make a determination through this process if the source removal actions are sufficient to meet CERCLA requirements.

Comment 5: In contrast to DOE's finding of protectiveness, Oregon looked at the questions used for that assessment and finds answers different from DOE (for a finding of protectiveness, answers to these three questions need to be yes, yes, and no, respectively):

- Is the remedy functioning as intended? No. Concentrations of many contaminants in groundwater have not decreased. Some have increased. Moreover, the vadose zone has been recognized as a reservoir for chromium and as a source of chromium to groundwater.
- Are the exposure assumptions, toxicity data, etc. used at the time of remedy selection still valid? No. Cleanup has not led to decreased concentrations of contaminants in groundwater. Vadose zone soils have been found to be an important reservoir for chromium.
- Has any other information come to light that could call into question the protectiveness of the remedy? Yes. The pilot ecological risk assessment for the B/C area identified antimony and nitrate as contaminants of concern.

In other words, it can be argued that the B/C area does not satisfy any of the three questions, and the remedy is not protective of groundwater in this area. It could be that there will be a delayed response to source cleanups and that groundwater contaminant levels will decrease in the future. We believe that remedies should be deemed not protective, or the determination should be deferred until reduced contaminant concentrations are demonstrated by monitoring data and the ecological risk assessment for the area is completed.

Response to Comment 5: In general the remedies selected for source removal and groundwater contaminant removal in the B/C Area l are functioning as intended and appropriate for interim measures.

There are a few exceptions such as the pump-and-treat system at 100-N and the natural attenuation action at the 300 Area uranium plume. In some cases, such as the chromium pump-and-treat system at 100-K the remedy is functioning, but the system design needs improvements. The interim measures taken under the records of decision for interim action were not focused on all contaminants but only on the key contaminants that drive risk. Per the Hanford Past Practice Strategy, we will complete the CERCLA RI/FS process where all of the identified contaminants of concern will be considered.

A draft B/C pilot risk assessment report did list nitrate and antimony as contaminants of concern, however, the report did not put these contaminants into context. For example, it did not compare the values to background. The B/C pilot data will be further evaluated in the 100 Area and 300 Area Component of the River Corridor Baseline risk assessment. At this time, nothing in the draft report has necessitated the need to modify the existing interim RODs.

DOE believes the remedies completed to date for source waste sites are functioning as intended. That is, DOE continues to believe that removing sources of contamination is an effective remedy for reducing – not necessarily eliminating – groundwater contamination. As cleanup continues, sources of contamination that potentially impacts groundwater will continue to be remediated. As noted in response to Oregon's comment 2, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 6: The report uses a single statement of protectiveness for each NPL site, rather than assessing and reporting protectiveness on an operating unit by operating unit basis as called for in EPA guidance (OSWER 9355.7-03B). We believe this approach, together with the heavy reliance on ICs and assumptions about work in progress, contributes to DOE's failure to recognize and discuss potential shortcomings of selected remedies, and thus of protectiveness.

Response to Comment 6: When planning for this five-year review DOE recognized that OSWER 9355.7-03B recommend that at sites with multiple operating units, five-year reviews should address "all OUs and remedial actions that have been initiated at the time of review." Consistent with that guidance, DOE has evaluated all of the operating units and remedial actions that have been initiated on the Hanford NPL Sites. This is also consistent with the approach as EPA used in its 2000 review to evaluate the protectiveness of the selected remedies.

The protectiveness statements for the NPL sites took into account the status of remediation for all the operable units within the sites. Potential and actual shortcomings of selected remedies were identified, discussed, and taken into account in assessing the protectiveness of the selected remedies, which is the intent of five-year reviews.

As stated in response to Oregon's comment 2, DOE has revised the document and some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 7: We believe the document falls far short of being comprehensive in addressing "secondary" contaminant plumes. By "secondary contaminants," we refer to contaminants that occur in groundwater in concentrations higher than drinking water and/or aquatic life standards, but that are not the "big hitters" such as chromium at 100-D and 100-K, strontium 90 at 100-N, and uranium in the 300 Area. Secondary contaminants include things like nitrate, tritium, carbon-14, strontium-90 at 100-B/C, etc. The presence of these contaminants is often not even mentioned in the report and they are never addressed in assessing protectiveness or included in lists of issues and action items.

Response to Comment 7: DOE agrees not all of the contaminants of potential concern are addressed in the interim RODs that have been issued for Hanford cleanup actions. As these RODs are for interim measures, not all of the contaminants of potential concern are addressed in the remedial action objectives. The interim measures taken under the interim RODs were focused on the *key* contaminants that may drive risk. Where necessary, per the Hanford Past Practice Strategy, DOE will complete the CERCLA RI/FS process and identify and consider all of the contaminants of concern. Remedial action decisions documented in the final RODs will address all of the contaminants that present unacceptable risks to human health and the environment.

Comment 8: We are surprised and disappointed by DOE's failure to acknowledge that existing remedies are not working for chromium at the 100-D and 100-K Areas, and are not protective of groundwater or of the environment in near shore areas of the river corridor. Protectiveness statements as written are simply not credible. Concentrations of chromium are increasing in many wells and a new plume has reached the Columbia River at K-West. The ISRM barrier has failed and chromium is escaping around the pump and treat barrier at the 100-K Area. DOE is willing to identify issues and action items for chromium at these sites, but has not admitted that existing remedies are not protective. New remedies are being implemented, but they have not been installed so it cannot be assumed or asserted they will be protective. Similarly, the ongoing chromium story – increasing well and aquifer tube chromium concentrations, new plumes, failure of pump and treat to contain plumes – provides unambiguous evidence that current remedies are not effective.

Response to Comment 8: DOE believes that the selected interim remedies for chromium at 100-D and 100-K are effective and are working as intended *in the areas where the technology is deployed.* To be fully effective throughout the entire area, the scope of the selected remedies will need to be extended to cover a larger area. For example, not all of the contaminant sources have been identified and removed and the pump-and-treat system designs need to be extended to cover all the areas where contaminants have been found. DOE anticipates that the final RODs for the operating units in the 100-D and 100-K Areas will fully address all contaminants of concern over the entire area where the contaminants are located.

Prior to the CERCLA five-year review process, DOE identified deficiencies in the current D and K Area operable unit remedial action designs. DOE is working with the regulatory agencies to implement aggressive corrective actions to resolve these deficiencies and also assessing new technologies that may yield better and faster cleanup results. The five-year review documents these deficiencies and needs for new technology.

DOE did revise some of the protectiveness statements to reflect the level of knowledge on which the statements are based. In this case, DOE believes that the interim action is functioning as intended in the 100-D and 100-K Areas but that it does not fully address the extent of the contamination, as the final ROD will do.

Comment 9: In summary, we strongly recommend this report be extensively revised before it is finalized. We encourage DOE to rewrite statements of protectiveness to more fully characterize the actual protectiveness of remedies, without reliance on ICs or assumptions about work in progress, and to include consideration of all contaminants. We also encourage DOE to defer statements of protectiveness regarding the environment until ecological risk assessments are completed. We look forward to continuing to work with DOE on Hanford cleanup that will insure long-term protectiveness of human health and the environment.

Response to Comment 9: DOE does not agree this five-year review needs to be extensively revised, as discussed in various responses above. However, DOE has made revisions to the report, including modifying a number of the conclusions regarding protectiveness of interim remedies (as the State of Oregon suggests).

COMMENTER 5: Ken Gasper

Comment 1: The Executive Summary would be more useful if it contained a summary of what was achieved in the five-year period in the 100, 200, and 300 Areas in addition to what appears on page iv.

Response to Comment 1: The Executive Summary includes some information on what work occurred (e.g., 120 waste sites have been remediated in the 100 Area), but DOE believes highlighting the major findings in summary form is the best use of this high-level summary. Summaries of the cleanup work that has occurred in the 100, 200, and 300 Areas can be found under the "Remedy Implementation" section for each of the areas.

Comment 2: The Technical Assessment Summaries, Section 1.5 for the 100 Area, and Section 2.5 or the 200 Area would be more complete and more useful to the reader if they contained the level of detail (progress and analysis) provided in the Technical Assessment Summary for the 300 Area together with its three subsections 3.5.1, 3.5.2, and 3.5.3.

Response to Comment 2: We agree the Technical Assessment Summaries would be more complete if they contained additional detail. However, the significant number of operable units in the 100 and 200 Areas made such an undertaking too difficult.

Comment 3: The whole document would be more helpful if there were some discussion about:
a. What was achieved in the five-year period versus the schedule for the five-year period that was in place at the beginning of the five-year period: what was done sooner than expected, what was done as scheduled, and what took longer than scheduled.
b. The cost to achieve what was performed, versus the plan: what was done for less than plan, what was done for the planned amount, and what cost more than expected.
c. What can now be expected to be done regarding cost and schedule in the next 5 years, based upon the lessons learned in the last 5 years.

Response to Comment 3: While additional discussion about costs, schedules, and past and future performance may be of interest to you and other members of the public, the purpose of the five-year review is more limited and specific. Its purpose is to evaluate the remedies selected in Action Memoranda and/or records of decision and determine whether the remedial action objectives of the remedies are still valid and will result in protection of human health and the environment when the remediation is completed.

COMMENTER 6: Carol/Sue Brown

Comment 1: I still have questions and concerns. I learned a lot from the book on Hanford cleanup, by Roy Gephardt. I talked to the lady from Hanford Watch who was at the meeting. I can see how people would get very emotional about the situation. The Riverkeeper man(Greg?) was also very knowledgeable, and I was glad to meet him. I think that people are really scared; I know I am. And, like the Hanford Watch lady said; it is our earth, and the only one we have. We HAVE to try to take care of it. I am happy that this current "culture" is more about cleanup than creating more nuclear bombs. (Well, I guess we already DID that.)

Response to Comment 1: Thank you for sharing your thoughts and concerns. We agree cleanup is vital and must continue. You might consider speaking with a member of the DOE or regulatory agencies staff by calling the Hanford Line at 1-800-321-2008 or visiting our website at www.hanford.gov for additional information on the Hanford cleanup.

Comment 2: I am angry at the people in the 1940s who didn't seem to care about us and who dumped all this stuff on that site. I was unclear about all that you reported on. Well, that is, I can remember some of it, but not all. You were basically talking about what had been done on the site and what still needed to be done. I would like to know if you could perhaps repeat to me what areas you folks are still working on.

Response to Comment 2: We discussed the significant cleanup progress at the site. This includes:

- More than 2,300 tons of spent fuel have been moved away from the Columbia River;
- 20 tons of plutonium-bearing materials have been stabilized and packaged;
- Five of nine plutonium reactors have been partially demolished and placed in interim safe storage;
- More than 6.3 million tons of contaminated soil have been dug up along the Columbia River and disposed of in the Environmental Restoration Disposal Facility;
- Thousands of drums of transuranic waste are being retrieved and safely shipped to New Mexico for permanent disposal;
- Waste Treatment Plant construction is one-third complete;
- Over 3 million gallons of liquids have been removed from the single-shell tanks;
- Sludge or salt waste has been retrieved from 4 single-shell tanks and 3 others in progress; and
- Testing of Bulk Vitrification as a potential supplemental treatment for low-activity tank waste is ongoing.

Despite this progress, challenges remain at the Hanford Site. More than 53 million gallons of radioactive and chemical waste in 173 tanks must be treated and disposed. Approximately 25 million cubic feet of solid waste are buried or stored on site must be retrieved and re-disposed or be permanently entombed. Nearly 270 billion gallons of groundwater contaminated above drinking water standards must be remediated to the extent practicable. More than 1,700 waste sites and approximately 500 contaminated facilities still require remediation.

The Department's Office of Environmental Management will continue to focus on safe, cost-effective risk reduction and cleanup at Hanford and across the DOE complex.

Comment 3: I am, of course, more concerned about the river. I would like to know if any plutonium, uranium plumes have come down this way lately, or what IS coming down this way. I would like to know if you will get the plume under Hanford that they were talking about in *60 Minutes* away from the river. Will it really come down this way? Do you do pump and treat to remedy it? Will that get it all?

Response to Comment 3: The Washington State Department of Ecology has classified the general water use and water quality for the stretch of the Columbia through and below Hanford as "Class A, Excellent." Hanford currently has very little impact to the Columbia River. The only Hanford-derived contaminant that consistently shows a statistical increase in the river downstream of Hanford (measured at the City of Richland's municipal water supply intake) is tritium at very small quantities, such that the river meets safe drinking water standards for tritium.

The only areas of potential concern for Columbia River aquatic life in the Hanford area are in the very near shore or riverbanks where existing groundwater plumes discharge into the river. These areas are monitored by the DOE and the state of Washington. Information on specific findings are published annually and the most recent edition is the Hanford Site Environmental Report for 2005, which can be found at hanford-site.pnl.gov/envreport/.

Comment 4: My book that I read said something about solidifying the plume under the ground. Tim Hill from Dept. of Ecology (he was at the meeting), had told me, over the phone, that there was a "freezing" deal they could do with the underground plume. What is that all about?

Response to Comment 4: A number of technological solutions have been considered and tested to remediate soil at Hanford. Soil freezing is a common engineering tool used where tunnels or trenches need to be constructed in saturated soil. It is not a commonly used tool for long-term remedial action. Please contact Mr. Hill again and he may be able to direct you to a staff member at Ecology or DOE who could answer your questions about various technologies being researched for use at Hanford.

Comment 5: Also, am I considered a "downwinder?" What IS a downwinder?

Response to Comment 5: "Downwinder" is the term popularly used to describe people who lived in areas within the general wind direction of Hanford who may have been in the pathway of radioactive emissions released during the years Hanford created plutonium for the nation's defense. The term generally refers to those who lived in adjacent areas and counties during the 1940s and 1950s when emissions were at their highest. No Hanford plutonium production reactors have operated since the 1980s.

Comment 6: You all seemed like you were working hard on controlling the waste, and that you were concerned. I understood some of the meeting, but not all of it. WHY would *60 Minutes* report on it if it weren't extremely urgent? I am still scared. I really want to, in all honesty, know if I should move away from the river in a few years. I don't want to get cancer from this, and I don't want YOU to, either. I was shocked that Richland takes it's water from the Columbia River. As a Christian, I am concerned about you, and Bryant, and Karen, and all the other nice people I met from the Tri-Cities. I am not one of those people who says "well, it's too far enough away to really concern me," or "well, I can just move." I CARE about people whom I meet, and like it's not like I'm not concerned about my OWN welfare; but I have a lot of room in my heart for other people, also. Can't you talk to your city government about getting your water from elsewhere? I know Bryant made it sound like it was safe, but I don't believe that. Now I am (also) worried about you folks. Unless you get the water from up north of Hanford. Then I could see how it would be all right, since rivers seem to flow from north to south.

Response to Comment 6: The *60 Minutes* report focused on the potential for Hanford wastes to impact the river in the future from wastes in tanks stored about 7 miles from the Columbia River. The Columbia River meets all applicable state and federal drinking water standards and Washington State has classified the stretch of the Columbia River from the Grand Coulee Dam to the Washington-Oregon border, which includes the Hanford Reach, as Class A, "Excellent." Class A waters are suitable for essentially all uses, including raw drinking water, recreation, and wildlife habitat.

The river is safe for use, including as a source of drinking water for the City of Richland. The City of Richland maintains a diligent sampling program to assure city water users that their water meets applicable standards. Hanford and the State of Washington also conduct similar sampling programs to assess the quality of the Columbia River water. All of the cleanup efforts at Hanford, in some way, are focused on protection of the river and its users.

Comment 7: Are the old tanks really emptied? Dennis Faulk was telling me that they were, which is excellent work. He said there was just the sludge on the bottom to remove. I would say that is good because it takes strain off the plume. That's how we're all really going to get poisoned, at this point; if that gets into the Columbia. But I know you folks are extremely educated, and know a lot more about what you are doing than I ever will. Tell me this stuff won't hurt my river any more than it already has, please. As I said to Karen; what you folks are doing is very noble. It is noble to be cleaning up this earth, and I'm sure the Lord will look down on you and smile if you are giving it your best effort. It's not you people's fault, what these people in the 1940s did, creating all this crap for our generation to clean up.

Response to Comment 7: As noted in the responses above, DOE, Washington State Department Ecology, Washington State Department of Health, and the City of Richland regularly and comprehensively monitor the quality of the Columbia River water and potential sources of contamination to the river to ensure that it remains safe for all uses

Significant risk reduction has occurred at Hanford including the removal of more than 3 million gallons of liquids removed from the single-shell tanks. Additionally, workers have removed sludge or salt waste from four single-shell tanks and are working on three others.

However, many challenges remain at the Hanford Site. More than 53 million gallons of radioactive and chemical waste in 173 tanks still must be treated and disposed. DOE is actively working to ensure that these wastes are retrieved and treated to ensure the river is protected.

Comment 8: And I hope no one is bringing you more waste, because I feel that you all have your hands full taking care of all that is already there. I didn't know anything about any of this a year ago; I had no idea something so serious could exist right here in Washington State. I am very sad. Well, that's my long-winded message. Please reply, and take care.

Response to Comment 8: Our ability to clean up the Hanford Site, as well as all of the nation's weapons material production sites, depends on us being able to properly dispose of the various waste types at the facilities and locations best suited to handle them. For instance, Hanford's transuranic (plutonium-contaminated) waste is currently being shipped offsite to an underground repository in New Mexico, Hanford's spent nuclear fuel and glassified tank waste are slated to go to the national repository in Nevada, and Hanford is expected to begin shipments of excess stabilized plutonium offsite as part of a national consolidation plan. DOE has selected Hanford as one of the sites to dispose of some low-level radioactive waste and some mixed radioactive waste from other DOE sites. However, such shipments are hold until certain environmental analyses are complete, currently estimated to be in 2009.

COMMENTER 7: Russell Jim Yakama Nation

Comment 1: The Yakama Nation appreciates the opportunity to provide comments on the DOE's draft five-year report required under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

Response to Comment 1: The Department of Energy appreciates the time and effort of the Yakama Nation to review and provide comments on the draft five-year review report.

Comment 2: The Yakama Nation has reviewed the comments of the Department of the Interior Fish & Wildlife Service (DOI-FWS) and the Department of Commerce National Oceanic & Atmospheric Administration (NOAA). The Yakama Nation concurs with the faults found by those federal agencies in the draft five-year review report.

Response to Comment 2: DOE responded to the comments from Department of the Interior Fish & Wildlife Service and the Department of Commerce National Oceanic & Atmospheric Administration.

Comment 3: The draft report is not in compliance with the U.S. Environmental Protection Agency's (EPA) June 2001 Comprehensive Five-Year Review Guidance as noted in those federal comments. This noncompliance raised significant questions regarding the lawfulness of such a five-year review.

Response to Comment 3: DOE disagrees and believes this draft report complies with the EPA Comprehensive Five-Year Review Guidance. Both the EPA and DOE five-year review guidance were followed in conducting this five-year review.

Comment 4: The Yakama Nation takes strong exception to the "protectiveness" finding of the draft report. Such a finding is completely unsupportable without 1) the completion of sitewide comprehensive human health and ecological risk assessments, and 2) a comprehensive sampling and data collection from all areas where waste released by those operable unites being reviewed has come to be located.

Response to Comment 4: DOE disagrees that additional risk assessments must be completed to make short term protectiveness determinations on selected interim or final remedies. DOE agrees that long-term protectiveness should be deferred until the planned risk assessments are completed. The short-term protectiveness determinations from this review are based on evaluation of the performance of selected remedies.

Sampling and data collection and risk assessments are part of the remedial investigation/feasibility study (RI/FS) process. The role of the baseline risk assessment in the RI/FS process is to address the risk associated with a site in the absence of any remedial action or control, including institutional controls. It essentially is an evaluation of the no-action alternative. The results of the baseline risk assessment are used to understand the types of exposures and risks that may result from superfund sites and are used to help select the most appropriate remedy. The remedy selected through the RI/FS process will address the risks identified in the RI/FS process and mitigate the identified risks to be protective of human health and the environment. The five-year review process verifies that the selected remedy is or will be protective when final.

As pointed out in the Executive Summary/Introduction to this Comment Response Document, DOE had numerous discussions with the public and received over 300 written comments on the Public Review Draft of the *CERCLA Five Year Review Report for the Hanford Site.* In response to those comments, the document was extensively revised. DOE agrees that in some cases the protectiveness statements in the draft document overstated the level of protectiveness that can be determined based on the information available at this time. DOE concluded that in some cases a more conservative determination would accurately reflect the situation. Therefore, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 5: In the Yakama Nation's view, this draft report is so far out of compliance with applicable statutory, regulatory and Tri-Party Agreement requirements that the Yakama Nation recommends that the draft be withdrawn and work begin anew on a draft that meets the concerns expressed herein and in the comments of others.

Response to Comment 5: DOE disagrees. We believe the five-year review addressed the intent of the five-year review as outlined in CERCLA, Executive Order 12580, 40 CFR 300, and DOE and EPA guidance. EPA guidance states the purpose of a five-year review is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment when completed.

Comment 6: Because of these concerns, the Yakama Nation is simultaneously requesting EPA and the Washington State Department of Ecology to exercise the full extent of its regulatory authority under the Tri-Party Agreement and other authorities to ensure the rejection of any five-year review report in the nature of this draft and to ensure that a proper five-year review is conducted that meets all appropriate and required standards.

Response to Comment 6: Pursuant to **Comprehensive Five-Year Review Guidance (June 2001)** OSWER 9355.7-03B-P, EPA 540-R-01-007 the CERCLA Five-Year Review Report for the Hanford Site was provided to EPA for its review and concurrence with the protectiveness determinations. If EPA does not concur with the DOE protectiveness statements they will inform DOE. EPA may issue a separate report that includes protectiveness statements reflecting that agency's opinions.

COMMENTER 8: Washington State Department of Ecology

Comment 1: Ecology concludes that the draft report does not include the minimum requirements for technical assessments of a remedy. The report does not include accurate and complete answers to these questions:
Question A – Is the remedy functioning as intended by the decision documents?

Question B – Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?
Question C – Has any other information come to light that could call into question the protectiveness of the remedy?

Response to Comment 1: DOE disagrees. The draft report addressed all three questions for each operable unit for which a CERCLA decision document has been issued.

A CERCLA five-year review evaluates whether remedies selected in CERCLA decision documents have resulted in a final condition that is protective of human health and the environment or that they will be protective when completed. For the Hanford Cleanup Project most of the decision documents issued to date are for interim decisions. The responses to the three questions for those interim decisions are accurate and complete and legitimate institutional controls are in place to ensure protection of human health and the environment until final remedies are completed. They provide the basis for concluding that the interim remedies are protective. This approach to evaluate the protectiveness of the remedies is consistent with EPA guidance and was used by EPA in its five-year review for the Hanford Site issued in 2001.

However, DOE acknowledges that final RODs may include contaminants and/or areas of contamination that were not addressed in the interim decision documents. DOE also acknowledges that additional information developed through the ecological risk assessments being planned or conducted will provide new information that will have to be reviewed to determine if previously selected remedies are still protective. For new RODs the information will be part of the basis for remedy selection. For existing interim and final RODs, the new information may result in the need to revise the remedies through explanations of significant difference or ROD amendments, depending on the degree of change to the remedy.

Protectiveness is generally defined in the National Contingency Plan (NCP) by the risk range and the hazard index (HI). In reviewing protectiveness of remedies in this review, DOE accepted the definition of "protective" of the EPA-Office of Inspector General. According to that office, "CERCLA protective is defined as 'protective of human health and the environment as defined generally by a 10^{-4} to 10^{-6} risk range and a hazard index of 1 or less.'" A risk range of 10^{-4} to 10^{-6} is consistent with risk management decisions made in other EPA regulatory programs and in federal regulatory agencies in general. Therefore, promulgated regulations include, incorporate, or account for this risk range. Applicable or relevant and appropriate requirements (ARARs) are selected from regulations and cleanup remedies must comply with ARARs. Hence, compliance with ARARs is generally considered protective.

Comment 2: The enclosed comments show how the report is not accurate and complete. Three particular areas of concern are: The protectiveness evaluation did not consider new information such as the 2001 amendments to Washington Administrative Code 173-340, and the changes to the City of Richland comprehensive plan (relative to the 300 Area).

Response to Comment 2: New information pertaining to the Hanford Cleanup Project is assessed on an ongoing basis. As the information is received, it is evaluated for potential impacts on the cleanup. If the assessment of the new information indicated that it could trigger a reconsideration of requirements in a

ROD, it was incorporated into the five-year review. The 2001 amendments to Washington Administrative Code 173-340 and the City of Richland study were reviewed.

The 300 Area industrial re-use study conducted by the City of Richland was assessed to determine if it would affect any of the CERCLA remedial action decisions that have been established in records of decision. At this time the City of Richland 300 Area study does not warrant a change to the current or reasonably anticipated future land uses for the 300 Area as established in the Hanford Comprehensive Land Use Plan. The DOE may have future missions in the 300 Area. The DOE anticipates the federal government will own and, therefore, control the Hanford's land use for the foreseeable future.

The 2001 amendments to WAC 173-340 were reviewed each time an analysis of ARARs was performed as part of an Engineering Evaluation/Cost Assessment (EE/CA) or RI/FS since being promulgated. Any RODs signed since 2001 include requirements from the amendments if they were determined to be relevant and appropriate.

For RODs signed prior to the 2001 amendments being effective, DOE is following the EPA policy regarding consideration of newly promulgated or modified requirements. Once a ROD is signed and a remedy chosen, EPA will not reopen that decision unless the new or modified requirement calls into question the protectiveness of the selected remedy. EPA believes that it is necessary to "freeze ARARs" when the ROD is signed rather than at initiation of remedial action because continually changing remedies to accommodate new or modified requirements would, as several commenters noted, disrupt CERCLA cleanups, whether the remedy is in design, construction, or in remedial action. Each of these stages represents significant time and financial investments in a particular remedy. For instance, the design of the remedy (treatment plant, landfill, etc.) is based on ARARs identified at the signing of the ROD. If ARARs were not frozen at this point, promulgation of a new or modified requirement could result in a reconsideration of the remedy and a re-start of the lengthy design process, even if protectiveness is not compromised. This lack of certainty could adversely affect the operation of the CERCLA program, would be inconsistent with Congress' mandate to expeditiously cleanup sites and could adversely affect PRP negotiations, as noted by commenters. The policy of freezing ARARs will help avoid constant interruption, re-evaluation, and re-design during implementation of selected remedies.

A policy of freezing ARARs at the time of the ROD signing will not sacrifice protection of human health and the environment, because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently, if there is reason to believe that the remedy is no longer protective of health and environment. DOE concluded from this review that the 2001 amendments do not call into question the protectiveness of the selected interim or final remedies. Also, the 2001 amendments to WAC 173-340 are being considered in the River Corridor Ecological Risk Assessment.

Comment 3: The protectiveness evaluation incompletely addressed the Hanford Past Practice Strategy, specifically, the expectation of additional investigation after interim actions.

Response to Comment 3: It was not the purpose of the CERCLA five-year review to address the Hanford Past Practice Strategy. The review did take into account the fact that most of the removal or remedial actions being performed are interim actions. That has been stated more clearly in the some of these responses to comments (see the response to Ecology comment #1) and in the final CERCLA five-year review report.

The River Corridor is the area implementing the past practice strategy. Additional investigation is ongoing or is planned for the River Corridor. The River Corridor Risk Assessment and River Corridor groundwater RI/FS investigations for secondary contaminants both support final remedial decisions in accordance with the past practice strategy. The protectiveness statements have been modified by deferring long-term protectiveness until the River Corridor risk assessment is completed.

Comment 4: The protectiveness evaluation incompletely addressed the Treatment, Storage and Disposal Unit and Past Practice Units Interface (Section 5.5 of the Hanford Federal Facilities Agreement and Consent Order).

Response to Comment 4: The purpose of a CERCLA five-year review is to evaluate the implementation and performance of a remedy in order to determine if the CERCLA remedy is or will be protective of human health and the environment when completed. RCRA treatment, storage and disposal and RCRA past practice units are generally not addressed in CERCLA decision documents unless the closure or cleanup of the RCRA units has been deferred to or is directed associated with the CERCLA action. The CERCLA protectiveness determination would only include consideration of the RCRA unit if it was a specific part of the selected remedy.

Comment 5: Based on our conclusions, we recommend that the DOE protectiveness statement for most operable units should be that the protectiveness determination is deferred:

"A protectiveness determination of the remedy at OU X cannot be made at this time until further information is obtained. Further information will be obtained by taking the following actions (describe the actions). It is expected that actions will take approximately (insert time frame) to complete, at which time a protectiveness determination will be made."

Ecology requests that DOE revise its draft five-year review to emphasize: Additional characterization of many operable units is required or planned. Protectiveness of interim actions will be re-evaluated using the additional characterization data.

DOE has partially evaluated protectiveness for primary contaminants of concern (e.g., strontium-90 at 100-N Area). Additional characterization of potential contaminants of concern and/or "secondary" contaminants is required. Protectiveness of interim actions will be re-evaluated using the additional characterization data.

Human health and ecological risk assessments are in progress or planned across the Hanford Site. Those assessments may support the conclusion that existing clean-up levels are protective, or could redefine cleanup levels and remedial action objectives. DOE's protectiveness statement should be "deferred pending the outcome of the risk assessments."

Response to Comment 5: DOE agrees. As a result of public dialogue and over 300 written comments received on the draft document, DOE extensively revised the document and re-evaluated the protectiveness statements. In some cases, the protectiveness statements in the Public Review Draft of the

CERCLA Five-Year Review Report for the Hanford Site overstated the level of protectiveness that can be determined based on the information available at this time. DOE concluded that in some cases a more conservative determination would accurately reflect the situation. Therefore, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements.

Most of the CERCLA remedies reviewed in this five-year review are interim remedies. While interim remedies must be consistent with final remedies, they may not address all contaminants or the aerial extent of contaminants in an operable unit that will be addressed in the final selected remedy. Final RODs may include contaminants and/or areas of contamination that were not addressed in the interim decision documents. DOE acknowledges that additional information developed through planned ecological risk assessments is new information that requires review to determine if previously selected remedies are still protective. For new RODs the information will be part of the basis for remedy selection. For existing interim and final RODs, the new information may result in the need to revise the remedies through explanations of significant difference or ROD amendments, depending on the degree of change to the remedy. Also, DOE did identify the need for additional characterization data for some sites. Risk assessment and groundwater RI/FS provide additional data.

Comment 6: Innovative technologies will have to be deployed or developed for many operable units (e.g., 100-NR-2, 300-FF-5, 200 Area vadose zone). The protectiveness evaluation for affected operable units should be deferred pending technology development, treatability investigations, and feasibility studies.

Response to Comment 6: As stated previously DOE has extensively revised the protectiveness statements, where appropriate, to reflect the current level of knowledge.

Comment 7: The integration of treatment, storage, disposal (TSD) unit closure, and Resource Conservation and Recovery Act (RCRA) corrective action, with CERCLA remedial actions is an integral part of the Hanford Federal Facility Agreement and Consent Order (HFFACO). The protectiveness evaluation for many operable units should be deferred.

Response to Comment 7: As discussed in response to comment 4, CERCLA protectiveness determination would only include consideration of the RCRA unit if it was specifically part of the selected remedy.

Comment 8: New information calls into question the protectiveness of the 300 Area remedy. The new information includes the City of Richland reuse study and changes to the City's comprehensive plan. The protectiveness evaluation for the 300 Area is deferred, pending DOE re-evaluation of risk assessment exposure scenarios.

Response to Comment 8: As discussed in the response to comment 2, at this time the information presented in the City of Richland study does not warrant a change to its current or reasonably anticipated future land uses for the 300 Area as established in the Hanford Comprehensive Land Use Plan.

Comment 9: Executive Summary, page iii, 1st paragraph
The second sentence states: "During the period the site produced nuclear material to be used in the national defense, many activities resulted in the disposal of wastes containing hazardous constituents and/or radioactive materials."

It is recommended that the second sentence be revised to read: "During the period the site produced nuclear material to be used in the national defense, many activities resulted in the disposal and/or release of wastes containing hazardous constituents and/or radioactive materials."

Response to Comment 9: DOE agrees. As stated previously, DOE has extensively revised the previous draft five-year review plan to include new or revised information and to clarify some of the previous discussions. The document was changed as suggested.

Comment 10: Executive Summary, page iii, 1st paragraph: The last sentence states: "Adverse impacts on the environment from those activities are being remediated to the extent possible." Adverse impacts on the environment from all activities are not being remediated to the extent possible. This sentence needs to be written to more accurately reflect Hanford Site remediation.

It is recommended that the following be considered: "Some adverse impacts on the environment from those activities are being remediated to the extent possible while other adverse impacts are either being characterized or are being scheduled to be characterized."

Response to Comment 10: As stated previously, DOE has extensively revised the previous draft five-year review plan to include new or revised information and to clarify some of the previous discussions.

Comment 11: Pg. iii para 3. Editorial error – A key requirement is to conduct reviews of the status of response actions no less frequently than once every five years..."

Response to Comment 11: The editorial error was corrected.

Comment 12: Executive Summary, page iii, 3rd paragraph: The word "year" should be plural in the 2nd sentence.

Response to Comment 12: The editorial error was corrected.

Comment 13: Executive Summary, page iii, 5th paragraph: During the December 2005 CERCLA five-year ROD review public presentation, the following two additional scope questions were identified: 1) What corrective measures are required to address any identified deficiencies? and 2) Are there opportunities to optimize the long-term performance of the remedy to reduce life-cycle costs? As these were identified as scope, it is recommended they be included in the Executive Summary.

Response to Comment 13: The three questions quoted in the Executive Summary were taken directly from the EPA's *Comprehensive Five-Year Review Guidance* (June 2001) OSWER 9355.7-03B-P, and EPA 540-R-01-007.

The first question, "What corrective measures are required to address any identified deficiencies?" is only relevant if a deficiency has been identified. During this five-year review, deficiencies that were identified and the corrective measures associated with the deficiencies have been listed in tables in the Executive Summary and in the NPL site sections.

The second question, "Are there opportunities to optimize the long-term performance of the remedy to reduce life-cycle costs?" comes directly from DOE CERCLA five-year review guidance. While it is more related to the cost of implementing remedies than to protection of human health and the environment, DOE agrees that it is an important consideration and will add it to the Executive Summary.

Comment 14: Executive Summary, page iii, 5th paragraph. It is recommended that question number 3 be modified as: "Has any other information, including the identification of needed information, come to light that could call into question the protectiveness of the remedy?"

Response to Comment 14: DOE does not agree with the suggested modification to the text. The question as stated comes directly from published EPA guidance.

Comment 15: Page iii last paragraph: DOE claimed that DOE met interim actions for the groundwater operable units across the Hanford Site except for 300-FF-5 and 100-NR-2 which is not correct. The interim actions are carried out only at selected portions of the operable units which usually does not cover the entire unit (e.g., the D and H interim action does not cover the entire operable unit which contain contaminants above the remedial action objectives on the ROD).

Response to Comment 15: In the draft five-year review plan that was previously issued for public comment, the referenced paragraph (Page iii last paragraph) states, "With two exceptions, DOE has concluded that the selected remedies and interim actions for the groundwater operable units across the site are, or will be, protective of human health and the environment when the work is completed. The two exceptions are the 300-FF-5 and the 100-NR-2 Operable Units." DOE recognizes that the 100 Area cleanup decisions are interim actions, designed to address principle threats, not all of the contaminants of potential concern. The existing records of decision for interim action also do not address all of the areas where contamination exists. The CERCLA remedial investigation/feasibility study (RCRA Past Practice RCRA facility investigation/corrective measures study) processes are not complete. The protectiveness statements have been revised to also reflect that the cleanup decisions are for interim actions and further work is required to determine "protectiveness".

Comment 16: Executive Summary, page iv, 1st paragraph: In the first sentence, the term "monitored attenuation" is used to describe the selected remedy. Terms used in the ROD are "institutional controls" and "groundwater monitoring and natural attenuation". It is noted that the term "monitored natural attenuation" was not in use until after the institutional control remedy for groundwater was chosen (via the ROD). Therefore, it is recommended that the sentence use a term used in the ROD – either "institutional controls or "groundwater monitoring and natural attenuation."

Response to Comment 16: DOE agrees that the use of the term "monitored natural attenuation" is inappropriate, because it has a very specific regulatory connotation. The text was revised to clarify (a) the selected remedy for interim action, and (b) the remedial action objectives during the interim action, and (c) what activities will be completed in the foreseeable future (e.g., LFI, TT, Phase III FS report, River

Corridor Baseline Risk Assessment and draft Proposed Plan). The 1996 300-FF-05 ROD Declaration states: "The selected interim remedy includes: (a) Continued monitoring of groundwater that is contaminated above health-based levels to ensure that concentrations continue to decrease; and (b) Institutional controls to ensure that groundwater use is restricted to prevent unacceptable exposures to groundwater contamination." The ROD does not use the term "monitored natural attenuation." There is discussion of natural attenuation in the description of remedial action alternatives, but the selected remedy is institutional controls. That remedy includes continued monitoring to "verify modeled predictions of contaminant attenuation to evaluate the need for remedial measures" (pp. 61-62 of the ROD).

The remedial action objectives, as stated in the 300-FF-05 ROD, are:

1. Protect human and ecological receptors from exposures to contaminants in soils and debris by exposure, inhalation, or ingestion of radionuclides, metals, or organics.

2. Protect human and ecological receptors from exposure to contaminants in the groundwater and control the sources of groundwater contamination in 300-FF-1 to minimize future impacts to groundwater resources.

3. Protect the Columbia River such that contaminants in the groundwater, or remaining in the soil after remediation, do not result in an impact to the Columbia River that could exceed the Washington State Surface Water Quality Standards.

Institutional Control on use of groundwater (GW-2) is the primary means of protecting humans until remedial measures bring the uranium concentrations to below drinking water standards

DOE agrees that the natural attenuation action is not meeting the remedial action objectives in the ten year time frame envisioned when the 300-FF-05 ROD was written in 1996. Therefore, the statement, "The interim remedy selected as part of the initial ROD for the 300 Area NPL site remains appropriate for the operable unit" was changed.

Comment 17: Executive Summary, page iv, 1st paragraph: The paragraph is silent about organic contamination. The ROD addressed organic contamination by the following: "Trichloroethene and dichloroethene may remain in a very small region of the water table aquifer at concentrations around the MCL. Because of attenuation, trichloroethene and dichloroethene would not reach the Columbia River in concentrations exceeding the MCLs or surface water quality standards. Monitoring would continue until remediation goals are met." Chlorinated hydrocarbons have been present in groundwater since the mid-1980s and concentrations above DWS have occurred in well 399-1-16B since the start of monitoring in 1987. Chlorinated hydrocarbons are present at the bottom of the aquifer in the vicinity of the 300 APT and the extent and maximum concentrations within the plume are unknown. A reasonable conceptual model for the fate and transport of the chlorinated hydrocarbons includes chlorinated hydrocarbon contaminants entering the Columbia River off shore where the Ringold mud intersects the river bed.

It is recommended that the Executive Summary acknowledge chlorinated hydrocarbon contamination emanating from the 300 Area.

Response to Comment 17: Although monitoring data reveal the presence of chlorinated hydrocarbons in 300 Area groundwater, there is very little evidence that such contaminants are "emanating from the 300 Area" at levels of concern. Discharge across the aquifer/riverbed interface at levels of concern is considered unlikely, and if present, those contaminants would rapidly dissipate because of their volatility. Therefore, the Executive Summary was not changed.

The organic chemical cis-1,2-DCE is found in one well in the lower portion of the unconfined aquifer in the vicinity of the 300 APT. The river channel does not intersect the principal Ringold mud unit (i.e., the Lower Mud), but could intersect less-transmissive units within Unit E. Also, flow modeling indicates that groundwater in the lower part of the unconfined aquifer will discharge to the river bed farther offshore in deeper water, and over a more broad area, compared to groundwater flowing in the upper part of the unconfined aquifer. Aquifer tubes at the shoreline have not revealed cis-1,2-DCE contamination at depths in the aquifer likely to be intersected by the channel.

Volatile organic compounds are detected in 300 Area groundwater, with trichloroethene (TCE) being the most widespread and from multiple sources, including offsite sources. Tetrachloroethene (PCE) and cis-1,2,-dichloroethene (DCE) are also detected, and are probably from past disposal to 300 Area disposal sites. DCE may represent the degradation of TCE and/or PCE in the aquifer. The final product of that degradation chain, vinyl chloride, has not been detected in 300 Area groundwater. (Groundwater Report for FY 2004—PNNL-15127, pp. 2.18-2.19 and tables 2.4 to 2.7). Water samples collected during the recent drilling of boreholes as part of the 300-FF-5 Limited Field Investigation in the 300 Area revealed evidence for volatile organic compounds (VOC), primarily trichloroethylene (TCE), at depths in the aquifer that are below the normal screened interval used for monitoring groundwater conditions. In samples from two of these boreholes, the concentrations exceeded the drinking water standards for these constituents. Investigation of the significance of this contamination at depth in the unconfined aquifer is continuing.

DCE currently exceeds the drinking water standard (70 μg/L) at one well, which is screened in the lower portion of the unconfined aquifer. Based on the distances to the nearest additional monitoring wells for that horizon, it is reasonable to state that the DCE occurrence is limited in aerial extent, is primarily at depth in the aquifer (i.e., not at the water table), and probably associated with past disposal to the 300 Area Process Trenches. Volatile organic compounds are generally short-lived in the near-surface environment because of their volatility; they do not readily adsorb to soil; they persist as dissolved constituents in groundwater; and are short-lived in surface waters. So even if VOCs get to the river via groundwater flow, the exposure risk period in the river is short, and the concentrations are likely to be very low because of volatilization and dilution.

Comment 18: Executive Summary, page iv, 1st paragraph: The paragraph is silent about contaminants from the 300 Area that are seeping directly into the river. While the paragraph states that institutional controls are in place to prevent use of the groundwater, it does not indicate if controls are in place to address contaminants seeping into the Columbia River.

It is recommended that the paragraph identify what controls are in place to address contaminants seeping directly into the Columbia River.

Response to Comment 18: As stated previously, DOE has extensively revised the previous draft five-year review plan to include new or revised information and to clarify some of the previous discussions. This has resulted in an extensive rewrite and reformatting of the five-year review report. The discussion in Section 3.4.2 addresses discharges to the Columbia River shoreline and near-shore river bottom. Section 3.5.1 indicates that DOE currently controls the 300 Area and use of the groundwater, and that existing institutional controls are expected to remain protective until the final remedy is identified and selected.

Comment 19: Executive Summary, page iv, 2nd paragraph: The paragraph is silent about contaminants from the N Area that are seeping directly into the river. While the paragraph states that institutional controls are in place to prevent use of the groundwater, it does not indicate if controls are in place to address contaminants seeping into the Columbia River.

It is recommended that the paragraph identify what controls are in place to address contaminants seeping directly into the Columbia River.

Response to Comment 19: Institutional controls prevent the consumptive use of contaminated groundwater at Hanford by humans. There are no current uses of "institutional controls" to prevent or reduce the exposure of biota to contaminants seeping into the Columbia River. The use of pump-and-treat technology has proved to be ineffective at reducing the strontium-90 concentrations at the shoreline. A new technology is being tested that sequesters (binds-up) strontium-90 to mineral apatite that is formed in a treatment zone adjacent to the 100-N shoreline. Phytoremediation is also being tested as a "polishing step" in conjunction with the apatite barrier. Polyphosphate sequestration is being tested to address uranium in the 300 Area. A combination of geochemical and biogeochemical technologies are being tested to convert chromium-6 to non-toxic chromium-3, coupled with pump-and-treat technologies are being tested for chromium.

Comment 20: Executive Summary, page iv, 5th paragraph: The paragraph is silent about 1100 Area institutional controls and/or monitoring.

As the summary indicates that contamination was left in place and that the 1100 Area will continue to be included in future five-year reviews, it is recommended that the paragraph identify what controls and/or monitoring are in place and/or performed.

Response to Comment 20: The following wording was added in the discussion of the 1100 Area NPL Site in the Executive Summary: "DOE will continue to maintain the integrity of the cap and fencing at the Horn Rapids Landfill per the Superfund Site Closeout Report requirements."

Comment 21: Executive Summary, page v, table: In the "100/300 Crosscutting" column, an additional item that should be identified is the collection of additional characterization information to support completion of interim response actions.

It is recommended that the following row be added to the table: "Issue 3. Additional contamination characterization information is needed to support completion of response actions prescribed within the TPA and the records of decision to develop final cleanup decisions and to support final cleanup actions."

Response to Comment 21: DOE does not agree that a new issue is needed. Tri-Party Agreement milestones exist to complete the remedial investigation and feasibility study process and obtain final RODs. On a case-by-case basis more characterization information may be needed, e.g., the 300 Area. However, for most sites characterization completed during remediation will be sufficient to assess the risks and reach final remedial decisions.

Action 2-1, identifies an action to create an integrated strategy for achieving final cleanup decisions in the River Corridor

Comment 22: Executive Summary, page v, table: In the "100/300 Crosscutting" column, an additional action that should be identified to support the collection of additional characterization information is development of schedule, workscope, and plan implementation associated with primary characterization documents (i.e., RI/FS, RFI/CMS, LFI, FFS, IRM, etc.).

It is recommended that the following row be added to the table: "Action 3-1. Submit a five-year characterization master plan for the 100 and 300 Areas which identifies additional characterization information needs and provides a schedule for beginning the administrative process of obtaining the information."

Response to Comment 22: DOE does not agree that a new action is needed. Tri-Party Agreement milestones exist to complete the RI/FS process and obtain final RODs. On a case-by-case basis more characterization information may be needed, i.e. 300 Area. However, for most sites characterization completed during remediation will be sufficient to assess the risks and reach final remedial decisions.

In, addition, Action 2-1, identifies an action to create an integrated strategy for achieving final cleanup decisions in the River Corridor.

Comment 23: Executive Summary, page v, table: In the "Issue 1" row of the "100/300 Crosscutting" column, under "Affects Current Protectiveness" the table indicates "No." Unless all of the data has been collected and evaluated, this cannot be answered as "No."

It is recommended that the table indicate that it is unknown at this time.

Response to Comment 23: In response to your comment, additional text was added to the final document to explain the table headings.

The protectiveness determination is always based upon what is known at the time the determination is made. If the identified issue or action indicates there is a known problem with the protectiveness, then it is considered to be affecting current protectiveness. This is consistent with the three basic questions that form the basis for deciding whether a remedy is protective.

Information gathered in the future has the potential to identify that a remedy previously considered to be protective may not be. This is the reason for asking the second and third questions. Question 2 - Are the exposure assumptions, toxicity data, cleanup levels and remedial actions objectives used at the time of the remedy selection still valid? Questions 3 - Has any other information come to light that could call into questions the protectiveness of the remedy?

Comment 24: Executive Summary, page vi, table: In the "100-N Area" column, it is recommended that the additional row be added to the table: "Issue 8. Additional characterization information is needed to support development of an FFS to support completion of interim response actions for the 100 N Area."

Response to Comment 24: DOE does not agree that a new issue is needed. Tri-Party Agreement milestones exist to complete the remedial investigation and feasibility study process. This issue is sufficiently captured in Issue 2 and is addressed in Action 2-1.

Comment 25: Executive Summary, page vi, table: In the "100-N Area" column, it is recommended that the additional row be added to the table: "Action 8-1. Submit a characterization plan for approval and implementation to provide additional characterization information to support a FFS for N Area units for which it is known that contaminated waste, vadose zone, and/or groundwater exists and/or will remain (i.e., 1324-N/NA, 1301-N LWDF, and 1325-N LWDF)."

Response to Comment 25: DOE does not agree that a new action is needed. Significant work was completed that supports the 100-N Focused Feasibility Study (FFS). Much of this effort is described in *The 100-N Sr-90 Project Remediation Options Evaluation Report.* The ongoing treatability study described in *Strontium-90 Treatability Test Plan for 100-NR-02 Groundwater Operable Unit* (DOE 2005c) will provide the additional characterization information needed to evaluate the permeable reactive barrier option. DOE and Ecology established a TPA milestone for the delivery of a focused feasibility study/proposed plan (FFS/PP) with the mutual agreement that the wealth of existing data together with the data provided by the ongoing test plan, will be sufficient to develop an acceptable FFS/PP.

DOE agrees that on a case-by-case basis, more characterization information may be needed, e.g., the 300 Area. For most sites, however, characterization completed during remediation will be sufficient to assess risks to reach final remedial decisions. This issue is sufficiently captured in Issue 2 and is addressed in Action 2-1.

Comment 26: Executive Summary, page vi, table: General comment. Issues and actions that will be added to the review as a result of comments should also be added to the table.

Response to Comment 26: DOE agrees. The Executive Summary table incorporates this new information.

Comment 27: Executive Summary, page iv, 6th paragraph. To this ("DOE Richland ...protectiveness concerns.") add the following: All response or corrective actions, excluding situations where there is an imminent threat to the public health or environment will be conducted in a manner which ensures compliance with the technical requirements of the Hazardous Waste Amendment Act (Chapter 70.105 RCW and it implementation regulations).

Response to Comment 27: While the substantive requirements of the Hazardous Wastes Amendment Act and the implementing regulations are potential ARARs for CERCLA removal or remedial actions, this does not mean that they apply or are relevant/appropriate in all circumstances. No change to the existing text was made.

Comment 28: Introduction, page xvi, 6th paragraph. Add as last sentence; Although the closure and corrective action were integrated with the CERCLA remedial action, Ecology retains post-closure authority over the TSD units.

Response to Comment 28: Jurisdictional matters concerning the integration of treatment, storage and/or disposal units into a CERCLA remedial action are addressed by the record of decision. No text change was made.

Comment 29: Page 1.3, Section 1.1, 1st paragraph: The text indicates four categories of contamination. The four categories may not adequately represent contamination that is a result of contaminated biological material.

It is recommended that a fifth category be included which identifies contaminated biological materials.

Response to Comment 29: DOE does not agree that a fifth category is needed. The fourth contamination category, burial grounds contains many types of materials, including biological material. No text change was made.

Comment 30: Page 1.7, Section 1.3, 3rd paragraph: The text differentiates between "contaminant sources" and the "underlying groundwater" but does not describe or indicate which operable unit addresses contaminated vadose zone remaining under liquid disposal sites.

It is recommended that the text acknowledge contaminated vadose zone underlying (and mounded around) the liquid disposal sites and provide an explanation of how this contamination is addressed by the RODs.

Response to Comment 30: DOE agrees. A listing of the source operable unit remedial action objectives was added in Table 1-4. The remedial action objectives specifically discuss contamination remaining in the soil after remediation." No further text revision is needed.

Comment 31: Section 1.4.1 Page 1.4.1 Para 2. Editorial error – "...is more stringent than the 100 µg/L drinking water standard..."

Response to Comment 31: The suggested edit was made.

Comment 32: Section 1.4.1, page 1.14, **1999 ROD for 100-NR-1 and 100-NR-2**: The text states the following:

"The remedial action for unplanned releases (past-practice site) for 100-NR-1 consists of a remove, treat, and dispose remedy for 37 radioactive sites, 6 inorganic waste sites, 6 burn pits, and 9 surface solid waste and miscellaneous source waste sites. The actions include excavate and treat soil using ex situ bioremediation and dispose of the treated soil for 20 near-surface petroleum sites; in situ bioremediation for two deep petroleum sites; and institutional controls for one shoreline site...(see following paragraph, 2000 ROD for 100-NR-1)"

Based on the text, 100-NR-1 consists of a total of 58 unplanned releases. However the planned actions have only been presented for 23 of these waste sites. Please include a table within the CERCLA five-year ROD review which specifies the Waste Information Data System (WIDS) designation for each of the unplanned release sites within the 100-NR-1 Operable Unit. Include the planned action for each site within the table, and the anticipated date for each final remedy to occur.

Response to Comment 32: The text in Section 1.4.1 of the document was changed to include the following wording:

"There are 81 waste sites in the 100-NR-1 OU identified as requiring interim remedial actions under this ROD (see Table 1 in the ROD). For 58 of the sites, the remove, treat, and dispose remedy was selected (37 radioactive sites, 6 inorganic waste sites, 6 burn pits, and 9 surface solid waste and miscellaneous source waste sites.) Other actions for 22 petroleum sites include: excavate and treat soil using ex-situ bioremediation and dispose of the treated soil for 20 near-surface petroleum sites, and in-situ bioremediation for two deep petroleum sites. The final site is the shoreline where institutional controls were the selected remedy."

Comment 33: Section 1.4.1, page 1.15. **2000 ROD for 100-NR-1**: The text states the following:

"The remedy for the three waste sites in the 100-NR-1 ROD is remove, treat if necessary, and dispose. Remediation of these sites began in July 2000 and is continuing. Expected completion is December 2006. Portions of the 1301-N treatment, storage, and disposal unit piping are deferred to future remedial actions in the 100-NR-1 area under the 100-NR-1 and 100-NR-2 ROD."

Please revise the text to specify which portions of 1301-N are being deferred, the anticipated date for remediation, and the basis for the deferral. In addition to the additional language, please include a complete map of 1301-N, which shows the location (i.e., coordinates) of the deferred portion.

Response to Comment 33: Section 1.4.1 of the document was changed to include the following wording: "Approximately 600 feet of piping that is associated with the 1301-N (or 116-N-1) TSD Waste Site and the 116-N-2 Facility and support facilities (1322-NA, NB, NC) will be deferred until decontamination and decommissioning (D&D) of these facilities. This deferral is due to safety concerns with remediating the piping and the radiological dose exposure to remedial action workers. Remediation will require excavation of the earthen berm at the 116-N-2 Facility, which provides radiological shielding. This work is scheduled to begin in 2009.

Additionally, approximately 5,600 feet of piping that is associated with 116-N-1, 105-N and 109-N Facilities (part of the N Reactor Facility Complex) will be deferred until D&D activities of the 105-N Reactor Facility Complex. This deferral is also due to safety concerns with remediating the piping. Remediation will require excavation up to foundation walls of these facilities, thus, jeopardizing the integrity of the facilities. The pipelines intersect and/or follow active underground power lines and potable water lines. Finally, remediation will block the access routes to the ongoing pump-and-treat operations at the 100-N Springs and other active facilities in the 100-N Area. This work is scheduled to begin in 2011.

The deferred piping associated with the 105-N and 109-N Facilities will be remediated as part of D&D of the 105-N Reactor Facility Complex in accordance with Tri-Party Agreement Milestone M-093-20."

Two figures in Attachment 41 of the RCRA Permit describe the piping being deferred:

Figure 2.1. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation
Figure 2.2. 116-N-1 Crib Influent Piping to be Rescheduled for Remediation

Comment 34: Page 1.15, Section 1.4.1. Include a documentation reference at the end of the sentence stating: "Portions of the 1301-N treatment, storage, and disposal unit piping are deferred to future remedial actions in the 100-NR-1 area under the 100-NR-1 and 100-NR-2 ROD."

Response to Comment 34: As noted in the previous response, new text was added to the final report.

Comment 35: Section 1.4.1, p. 1.21, paragraph after #4. Modify the second sentence of the paragraph as follows:

The principal cleanup levels for surface soil to 4.6 meters (15 feet) below ground surface ~~are~~ <u>were</u> 15 millirem above background for radionuclides and <u>the direct contact exposure levels in</u> the Washington State *Model Toxics Control Act* (WAC 173-340) Method B for chemicals <u>calculated using chemical toxicity values available at the time of the remediation</u>, plus protection of groundwater and the Columbia River <u>as evaluated using methods and toxicity values available at the time of remediation</u>.

Response to Comment 35: The text of the Section 1.4.1 of the document was changed to read: "The principal cleanup levels for surface soil to 4.6 meters (15 feet) below ground surface were 15 millirem/year above background for radionuclides and the direct ingestion exposure levels in the Washington State *Model Toxics Control Act* (WAC 173-340) Method B for chemicals calculated using chemical toxicity values available at the time of the remediation, plus protection of groundwater and the Columbia River as evaluated using methods and toxicity values available at the time of remediation."

Comment 36: 1.4.3.2, page 1.22, 3rd paragraph. Change: hexavalent to <u>**total**</u> chromium is 100 µg/l.

Response to Comment 36: The document was changed as suggested.

Comment 37: Section 1.4.5: Innovative Technology Demonstration: Both DOE and Ecology agreed to demonstrate two technologies: apatite sequestration and phytoremediation. The document failed to mention about the phytoremediation and the corresponding action items.

Response to Comment 37: The text of the document in Section 1.4.5.2 was changed as follows: "Phytoremediation, as a "polishing" step to the barrier, is also being tested. As the barrier is designed to operate as a natural gradient passive reactive barrier, the pump-and-treat system has been placed in a cold stand-by configuration. Extraction, injection, and monitoring wells associated with the pump-and-treat system are also being maintained in cold standby status."

Comment 38: Section 1.4.5.4, Page 1.30: Wells in 100-N Area monitor a 300,000 L petroleum spill that occurred along the shoreline in the 1960s. Elevated concentrations of TP-diesel and floating product are observed in monitoring wells. Recommendations for improving the 100 Area groundwater remediation recently made in *Calendar Year 2005 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations* (DOE/RL-2006-08, Rev. 0) include an evaluation of water-quality impacts related to the spill.

A draft report on ecological impacts at the 100-N Area was transmitted to Ecology in June 2006. It evaluates biological impacts of spilled petroleum, but the report has not been reviewed and approved by Ecology.

Add issue: "The extent of shoreline water quality impacts related to the diesel spill that occurred circa 1963 are not well known."

Add action: "Provide previously collected data and coordinate with River Corridor sampling efforts to collect additional pore water data from new and existing aquifer tubes along the 100-NR-2 shoreline in order to assess water quality impacts."

Action Due: 12/2007

Response to Comment 38: DOE agrees to provide previously collected data and coordinate with River Corridor sampling efforts to collect additional pore water data from new and existing aquifer tubes along the 100-NR-2 shoreline in order to assess water quality impacts of the remnants of the diesel spill. In the interim, the free-floating product found in existing wells will be collected per the requirements of the 1999 ROD for Interim Action. A new issue and action were added.

Comment 38: Section 1.4.5.4, Page 1.30: The recently published *Calendar Year 2005 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations* (DOE/RL-2006-08, Rev. 0) identifies several changes that are possible following standby of the 100-N Area strontium pump-and-treat system. These changes may include increases in shoreline tritium, increases in specific conductance, and increases in extraction well concentrations of strontium-90. The report recommends action to actively monitor these changes.

Add: "Issue: The strontium-90 pump-and-treat system will be in standby during the apatite treatability test. Water level and water-quality parameters are expected to change during this time."

Add: "Action: Expand (i.e. increase the frequency of sampling) the near-shore water level monitoring and sampling efforts to document changes during and after pump-and-treat system standby."

Action Due: During and after system standby.

Response to Comment 38: Although DOE agrees with the comment, we do not feel there is a need to add the suggested "issue and action" to the CERCLA five-year review, because the projected water level and chemistry changes are documented and sampling and analysis plans have been implemented to document changes during and after pump-and-treat system standby.

Comment 39: Section 1.4.5.4, page 1.30, Issue 7: Issue 7 identifies a deficiency related to risk assessment. State the effect this deficiency has on the current protectiveness, and give expected improvements. Also state the work that will be conducted (i.e., the questions that will be answered with the 100-N area ecological risk assessment), and provide any associated milestones for the risk assessment.

Response to Comment 39: DOE has obtained new data. The 100-N ecological data published in *Aquatic and Riparian Receptor Impact Information for the 100-NR-02 Groundwater Operable Unit* (DOE/RL-2006-26 Draft A Reissue) is consistent with previously identified data and analyses that the pump-and-treat system, operating in that location for the last ten years, has not appreciably reduced the strontium-90 concentrations in groundwater that upwells into the Columbia River.

The permeable reactive barrier currently being tested at 100-N is being designed to meet a goal of ninety percent reduction of strontium-90 concentrations at the river's edge. Further discussion with regulators, tribes and stakeholders is necessary before we can articulate what further work will be done and the schedule for performing such work. Any further ecological work at 100-N will be integrated into the overall 100/300 ecological risk studies that are currently being planned.

Comment 40: Section 1.4.6.1, Page 1.30: Change text as follows: "Due to groundwater contamination in the 100-HR-3 Operable Unit, Ecology requested DOE to perform additional 100-D source characterization in soil at the rail line that runs ~~east~~ west from the sodium dichromate station. The investigation included 12 test pits and ~~nearly~~ approximately 116 soil samples. The sampling did not identify a shallow vadose source of hexavalent chromium in this area."

The samples collected for this study were taken from the shallow zone to a depth of 12 ft. Hexavalent chromium was found at greater depth during sampling at railway tracks in the 100-B/C Area.

Response to Comment 40: The suggested change was made to Section 1.4.6.1 in the document.

Comment 41: Page 1.28, Section 1.4.5.1, 1st paragraph: The last sentence states: "The 120-N-1 and 120-N-2 waste sites (chemically contaminated; no radionuclides) were also completely remediated, backfilled, and re-vegetated." Remediation has not been completed at the waste management unit as contaminated vadose zone and groundwater remain. Therefore, the statement should be re-written to reflect this.

Recommended wording is: "Remediation of the 120-N-1 and 120-N-2 waste sites (chemically contaminated; no radionuclides) has been initiated with waste removal, backfilling, and re-vegetation; however, contamination remains."

Response to Comment 41: The following revision was made to the text in Section 1.4.5.1: "Remediation activities for the 120-N-1 and 120-N-2 as specified in the Closure sections of the RCRA permit have been completed. Closure activities consisted of excavation and disposal followed by verification sampling of remaining soils. Verification sample results confirm residential cleanup levels were achieved for these sites. Groundwater contamination attributed to these facilities remains above the secondary drinking water standard for sulfates. Continued groundwater monitoring is required by the RCRA permit."

Comment 42: Page 1.30, Section 1.4.5.3 or 1.4.5.4: The text describes the inefficiencies of the pump-and-treat system (Section 1.4.5.3). The date of the review is May 2006 and the "issues and actions" section (1.4.5.4) does not identify an action of changing the pump-and-treat system. It is ether recommended that in Section 1.4.5.3 that it be identified that the pump-and-treat system has been placed in "cold stand-by" or that Section 1.4.5.4 identify an action of the pump-and-treat system having been placed in "cold stand-by."

Recommended wording for Section 1.4.5.4, Action 6-1 is: "Implement the treatability test plan.... As the barrier is designed to operate as a natural gradient passive reactive barrier, the pump-and-treat system has been placed in a "cold stand-by" configuration."

Response to Comment 42: The document was changed as suggested

Comment 43: Page 1.30, Section 1.4.5.4: After the success and/or effectiveness of the apatite barrier has been determined, the treatability plan identifies an intent to extend the barrier's length and to perform a "secondary polishing treatment" if necessary. Also, a project work plan entitled *100-N Area Strontium-90 Treatability Demonstration Project: Phytoremediation Along the 100-N Columbia River Riparian Zone* has been generated which describes the secondary polishing treatment under consideration. Therefore, in the event that the apatite barrier is determined to be effective and the secondary treatment is necessary, it is recommended that an additional issue be included which achieves these objectives.

The following wording is recommended for an additional action: "Issue 8-1. In the event that the apatite barrier is determined to be effective, an expansion of the barrier is necessary. Furthermore, during the evaluation of the apatite barrier, it may be determined that a secondary polishing treatment is necessary."

The following wording is recommended for an additional action: "Action 8-1. Evaluate the effectiveness of the apatite barrier as a primary remediation. Based on the evaluation, make recommendations regarding the expansion of the barrier, the potential need for a secondary remediation, and/or the need to evaluate an alternative remediation.

Response to Comment 43: DOE does not agree that an additional issue and action are needed. It is not a foregone conclusion that the proposed barrier will need to be expanded beyond the current 300 ft, configuration or that additional treatment will be necessary. We agree that, consistent with the treatability test plan, expansion of the barrier, the need for additional treatment, and/or the need to evaluate an alternative technology will continue to be evaluated and reported.

Comment 44: Page 1.30, Section 1.4.5.4: Due to the configuration of groundwater monitoring wells in relation to the 116-N-1, 116-N-3, 120-N-1, and 120-N-2 waste sites and the current groundwater monitoring program, it is unknown if 1) the remedies are protective of groundwater resources and 2) if the soil and groundwater remedies are meeting groundwater protection standards of WAC 173-303-645. In addition, by a recent letter (dated April 11, 2006), Ecology has communicated the necessity of accumulating data and determining minimum data needs. The letter states: "The results of the additional field investigations, and the previously accumulated data, will have to be evaluated in a Focused Feasibility Study (studies) as shown in Figure 1 of DOE/RL-91-40."

Therefore, it is recommended that an additional issue be included which addresses the need for a FFS. The following wording is recommended for an additional issue: "Issue 9. Data needs to be accumulated and a determination made regarding additional data needs."

The following wording is recommended for an additional action: "Action 9-1. Submit a plan for Ecology approval that specifies how it will be determined which additional data is needed, how that data will be obtained, and the schedule for obtaining the additional data. Implement the approved plan."

Response to Comment 44: The selected remedy (source removal and pump-and-treat) does not meet the remedial action objective of reducing the strontium-90 concentrations at the river. As with all of the operable units with RODs for interim action, the need for additional data will be assessed to determine if a FFS/PP can be prepared and submitted with the data collected to date. Per the Hanford Past Practice Strategy, if additional data is required, it will be collected under a "Limited Field Investigation" of remedial investigation/feasibility study." No additional changes to the text were made.

Comment 45: Page 1.30, Section 1.4.5.4: Due to the configuration of groundwater monitoring wells in relation to the 116-N-1, 116-N-3, 120-N-1, and 120-N-2 waste sites and the current groundwater monitoring program, it is unknown if 1) the remedies are protective of groundwater resources and 2) if the soil and groundwater remedies are meeting groundwater protection standards of WAC 173-303-645. The 100-NR-2 groundwater OU selected remedy #6 (page 53) states: "DOE will continue to monitor the network of wells within the 100-N Area groundwater system...... The continued monitoring will: (1) assess the performance of the chosen interim action;....(4) further define the extent and nature of contaminant plumes for the other contaminants of concern;..."

Considering the N Area groundwater monitoring networks and programs associated with the 4 waste sites, it can be argued that the deficiencies of the networks and programs do not allow the specified remedy to be achieved. In addition, the deficiencies associated with the networks and programs are evidenced by Ecology's draft permit conditions for these 4 waste sites.

Therefore, it is recommended that an additional issue be included which addresses the deficiencies associated with the groundwater monitoring networks and programs. The following wording is recommended for an additional issue: "Issue 10. Groundwater monitoring well networks and programs are not adequate to monitor waste site contamination impacts to groundwater."

The following wording is recommended for an additional action: "Action 10-1a. Submit a groundwater monitoring plan for Ecology approval that specifies network and program monitoring that will satisfy groundwater protection standards of WAC 173-303-645."

The following wording is recommended for an additional action: "Action 10-1b. Submit a groundwater monitoring well installation plan for 116-N-1 and 116-N-3 that satisfies groundwater protection standards of WAC 173-303-645. Upon Ecology's approval, implement the groundwater monitoring well installation plan as per the schedule specified in the plan."

Response to Comment 45: DOE does not agree that an additional issue and action are needed. The current groundwater monitoring well system was optimized in cooperation with Ecology and is adequate to determine the effectiveness of current and planned remedies, and continued protectiveness and compliance with applicable standards. Appropriate Past Practice and RCRA processes, per the Tri-Party Agreement, will determine the scope and schedule.

Comment 46: Section 1.4.5.1, Page 1.28: The text states the following: "The 116-N-1 and 116-N-3 sites were remediated; at the time of this review was in process, and 116-N-3 had been backfilled and revegetated. Backfilling and re-vegetation of the 116-N-1 waste site is scheduled to occur in 2006...and revegetated."

Please revise the text to accurately state that the Cleanup Verification Package (CVP) for 116-N-1 has not been approved by Ecology, and therefore the site is not considered remediated. Also, state that the 116-N-1 site includes a deferred portion for future remediation. Verify if the deferred portion is UPR-100-N-31, which was initially planned to be on the same remediation schedule as the 116-N-1 Trench and Crib.

Response to Comment 46: The following revision was made to the text in Section 1.4.5.1: "Remediation of the 116-N-1 and 116-N-3 sites was initiated in accordance with the RCRA Permit Closure requirements. The 116-N-3 site was excavated, verification samples taken, and the site was backfilled and re-vegetated. Additionally, at the 116-N-1 site all excavation and verification sampling were completed. At the time this review was in process, backfilling of the 116-N-1 site was initiated and is scheduled to be completed in 2006."

Comment 47: Section 1.4.5.1, Page 1.28: **last sentence, spelling error**: Please correct "intuitional" to "institutional."

Response to Comment 47: The spelling error was corrected.

Comment 48: Section 1.4.5.4, page 1.30: Please include the following as "Issue 8: **Issue 8.** The lists of non-radionuclide contaminants of concern (COCs) for the 100-NR-1 Trenches and Cribs (116-N-3 and 116-N-1) were not adequate; and therefore not protective of the environment. Since the Cleanup Verification Package (CVP) has yet to be completed for UPR-100-N-31 Unplanned Release, there is an opportunity to rectify this inadequacy, and re-evaluate the COCs for the site.

Action 8. The non-radionuclide list of contaminants of concern (COCs) which has been identified for UPR-100-N-31 Unplanned Release will be expanded to include the following constituents: antimony, arsenic, barium, boron, cadmium, calcium, chromium (total), chromium (VI), lead, magnesium, mercury, selenium, silver, sodium, strontium, tin, zinc, chloride, fluoride, nitrate, nitrite, phosphate, and sulfate. These are also the COCs which Ecology has identified (via draft permit conditions) to be monitored for in the groundwater for the 1301-N site.

Response to Comment 48: DOE does not agree that an additional issue and action are needed. It is premature to identify this issue during this five-year review.

Comment 49: Section 1.4.5.4, page 1.30: Please include the following as "Issue 9": **Issue 9**. The next steps in the Hanford Past Practice (HPP) Strategy, DOE/RL-91-40, Revision 0, for the 1301-N site are to assess the accumulated data and determine minimum data needs. Ecology's assessment of the accumulated data is that additional field investigations will be required at 100-N Area.

Action 9. The requirement for the Focused Feasibility Study (FFS) will be incorporated into the 1301-N chapter of the Hanford Facility Resource Conservation and Recovery Act Draft Permit (Site-Wide Permit). The FFS will have to consider the alternative of capping the unit if necessary to protect human health and the environment. Administratively, a permit modification is necessary to support completion of Hanford Federal Facility Agreement and Consent Order Milestone M-16-55, "Complete the interim response actions for the 100 Area" (12/31/2012).

Response to Comment 49: DOE does not agree that an additional issue and action are needed. On a case-by-case basis, more characterization information may be needed, e.g., the 300 Area. For most sites, however, characterization completed during remediation will be sufficient to assess risks to reach final remedial decisions. This issue is adequately captured in Issue 2 and addressed in Action 2-1.

Comment 50: Section 1.4.6.1, page 1.30, add text: "An extensive effort was recently made to conduct historical research review of documents, photographs, and construction drawings to investigate sodium dichromate use in the 100-D/DR Reactor Area. This investigation identified at least 31 potential point source locations for sodium dichromate contamination, including ten primary potential sources."

Response to Comment 50: The document was changed as suggested.

Comment 51: Section 1.4.6.4, page 1.33, Issue 8: Change text to, "Groundwater monitoring data indicate there is an unidentified chromium vadose source in the 100-D Area, ~~near~~ possibly in the vicinity of the demolished 190-DR clear wells."

Response to Comment 51: The proposed text change does not add additional clarity to the current text. No changes to the text were made.

Comment 52: Section 1.4.6.4, page 1.33, Action 8-1: Change text to: "Aggressively search for the vadose zone source of chromium in the 100-D Area by conducting field investigations, which include follow-up on information gathered through the historical research investigation."

Response to Comment 52: DOE agrees that aggressive source characterization and remediation are appropriate. New work scope was recently added to perform this work in the 100-D Area. A test plan for this new work can be found at http://www.hanford.gov/cp/gpp/science/em21.cfm. No additional text changes were made.

Comment 53: Section 1.4.6.4 page 1.33: DOE recently received $10 million from Congress to address contaminant migration to the Columbia River. One of the proposals submitted involved refining the location of the chromium source through geophysical methods. The peer review panel rejected this proposal, but in order to aid the search for chromium suggested research to define the geologic and geochemical vadose zone environment in the 100-D Area.

Add Action 8-2: "Perform additional geologic and geochemical investigation of the vadose zone in the 100-D Area." Action Due: 12/2007.

Response to Comment 53: The document was changed as suggested. When the draft five-year review document was being written, the technology selections were not finalized. With the selection process complete, the document was revised to reflect this scope.

Comment 54: Section 1.4.7.1, the text states, "Additional site characterization activities for the remaining soil sites and solid waste burial grounds will be initiated in 2006." Follow this up with an issue and associated action:

Add Issue: "The remaining soil sites and solid waste burial grounds in the 100-H Area have not been adequately characterized."

Add Action: "Initiate additional site characterization activities in 2006 for the remaining soil sites and solid waste burial grounds."

Action Due: 12/2006

Response to Comment 54: DOE does not agree that an additional issue and action are needed. On a case-by-case basis, more characterization information may be needed, e.g., the 300 Area. For most sites, however, characterization completed during remediation will be sufficient to assess risks to reach final remedial decisions. This issue is adequately captured in Issue 2 and Action 2-1.

Comment 55: Section 1.4.7.2, page 1.34, Para 2: The recently published report on the efficiency of the pump-and-treat systems (*Calendar Year 2005 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations*, DOE/RL-2006-08, Rev. 0) indicates that uranium concentrations were above the MCL in two wells and nitrate concentrations were above the MCL in four wells.

Change text to: "Secondary contaminants uranium, technetium-99, and nitrate have also declined, ~~and now only a single well adjacent to the 183-H basins exceeds the maximum contaminant limits~~ with only a few wells now exceeding the maximum contaminant limits."

Response to Comment 55: The document was changed as suggested.

Comment 56: Section 1.4.7.2, page 1.34: Add issue: The Washington State Ambient Water Quality Standard for chronic exposure to chromium changed from 11 μg/L to 10 μg/L for chromium. This is a change in a standard that was identified as an ARAR in 100 Area decision documents (1995 ROD as amended in 1997, 1996 ROD for Groundwater at 100-HR-3 and 100-KR-4). The first CERCLA five-year review report states that this change is not believed to call into question the protectiveness of the groundwater pump-and-treat remedy. However, comments responses in the first five-year review refer to studies indicating potential injury to fall Chinook salmon at hexavalent chromium concentrations between 11 μg/L and 24 μg/L.

Add – "Action: DOE shall revisit this issue by providing scientific justification or conducting scientific review to determine if 11 μg/L is insignificantly different from 10 μg/L and address whether the previous standard of 11 μg/L is protective of the health of aquatic organisms". Action Due: 12/2006

Response to Comment 56: DOE does not agree that an additional issue and action are needed. The USGS chromium study was a laboratory salmon study designed to create exposure conditions that would cause adverse effects such as genetic damage. The results of the study indicated possible DNA damage at some, but not all of the chromium concentrations selected for the study. The results of the study also indicated that the cleanup level specified in the 100-HR-3/KR-4 groundwater operable unit interim action ROD is protective of Chinook salmon. Initial findings appear to confirm the adequacy of the National Ambient Water Quality Standard for Chromium. The results of the study were incorporated into the design of the ecological portion DOE's River Corridor Baseline Risk Assessment.

For purposes of future CERCLA 100 Area RODs, when the "final" ROD is written, it will incorporate as appropriate (as an ARAR) the chromium ambient water quality standard that is promulgated at that time. The chromium standard and measurement assessment methodology, as defined in the remedial action objectives of the current interim action RODs, will remain until "final" RODs are established.

Comment 57: Section 1.4.7.4, page 1.36: Data collected at the H-Area pump-and-treat system show that wells screened in the deeper Ringold aquifer are significantly elevated in chromium (above the RAO and as high as 96 μg/L) compared to shallow wells screened in the Hanford Formation Aquifer. Recommendations for improving the 100 Area groundwater remediation were recently made in *Calendar Year 2005 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations* (DOE/RL-2006-08, Rev. 0), and specify that action must be taken to assess the communication between the Ringold and Hanford aquifers. Add action under Issue 12:

"Action 12-2: Conduct aquifer/tracer test in a well cluster to assess communication and flux between the deep Ringold confined aquifer and the upper Hanford Formation aquifer."

Action Due: 12/2007

"Action 12-3: Remediate chromium in the deep aquifer to the established remedial action objective."

Action Due: 09/2009

Response to Comment 57: DOE does not agree that additional actions are needed. The five-year review documents this activity as Issue 12, Action 12-1, with a due date of 09/2009. Remediation of the deeper contamination will be addressed after characterization and assessment are completed.

Comment 58: Section 1.5, page 1.40, 1st bullet and related statements: Delete the statement: The exposure assumptions, toxicity data, cleanup levels and remedial action objectives used at the time of remedy selection are still valid for all operable units.

Replace the statement with: Evaluation of changes in exposure assumptions, toxicity data and cleanup levels has not been completed. A newer version of the Model Toxics Control Act (WAC 173-340) was promulgated in 2001, after the last five-year ROD review and after remediation of many of the 100 Area sites. The WAC 174-340 regulations changed significantly in 2001 with regard to (1) calculation of soil cleanup levels; (2) consideration of the risk posed by additional potential pathways of exposure: dermal, inhalation, and terrestrial ecological; and (3) requirements associated with the use of site-specific parameters, alternate fate and transport models, and empirical demonstrations. The 1996 WAC 173-340 did not specify the requirements for assessing protection of groundwater with alternate approaches. The application of the amended WAC 173-340 frequently results in more practicable soil cleanup levels than the 1996 WAC 173-340, alleviating the need for site-specific fate and transport modeling. The newly promulgated requirements are necessary for protecting terrestrial ecological receptors from the impacts of contaminated soil.

<u>Action:</u> Re-examine all Cleanup Verification Packages (CVPs) from remediated (or interim remediated) sites in the 100 areas; compare verification data, from samples taken prior to backfilling, with default values for soil calculated using the methods in sections WAC 173-340-720 through -750 of the 2001-

amended WAC 173-340. Also, compare CVP data with ecological protection values given in WAC 173-340-7490 through -7494. Present the comparison to Ecology and EPA prior to completion of the River Corridor Baseline Risk Assessment (RCBRA), to obtain regulatory approval of the conclusions of the RCBRA.

This comparison will allow consideration of the many revisions in toxicity values since the time of remediation, as well as provide a comparison with revised ARARs.

Response to Comment 58: The 2001 amendments to WAC 173-340 were reviewed each time an analysis of ARARs was performed as part of an Engineering Evaluation/Cost Assessment (EE/CA) or RI/FS since being promulgated. Any ROD signed since 2001 includes requirements from the amendments, if they were determined to be relevant and appropriate.

For RODs signed prior to the 2001 amendments being effective, DOE is following the EPA policy regarding consideration of newly promulgated or modified requirements. Once a ROD is signed and a remedy chosen, EPA will not reopen that decision unless the new or modified requirement calls into question the protectiveness of the selected remedy. EPA believes that it is necessary to "freeze ARARs" when the ROD is signed rather than at initiation of remedial action because continually changing remedies to accommodate new or modified requirements would, as several commenters noted, disrupt CERCLA cleanups, whether the remedy is in design, construction, or in remedial action. Each of these stages represents significant time and financial investments in a particular remedy. For instance, the design of the remedy (treatment plant, landfill, etc.) is based on ARARs identified at the signing of the ROD. If ARARs were not frozen at this point, promulgation of a new or modified requirement could result in a reconsideration of the remedy and a re-start of the lengthy design process, even if protectiveness is not compromised. This lack of certainty could adversely affect the operation of the CERCLA program, would be inconsistent with Congress' mandate to expeditiously cleanup sites and could adversely affect PRP negotiations, as noted by commenters. The policy of freezing ARARs will help avoid constant interruption, re-evaluation, and re-design during implementation of selected remedies.

A policy of freezing ARARs at the time of the ROD signing will not sacrifice protection of human health and the environment, because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently, if there is reason to believe that the remedy is no longer protective of health and environment. DOE has concluded from this review that the 2001 amendments do not call into question the protectiveness of the selected interim or final remedies. DOE also notes that the 2001 amendments to WAC 173-340 are being considered in the River Corridor Ecological Risk Assessment. In addition, final RODs will be developed in the future. During the RI/FS processes leading to issuance of the final RODs, the ARARs will be re-examined. If it is determined that the more recent revision to WAC 173-340 would result in a more protective, relevant and appropriate standard, that will be documented in a final ROD.

The River Corridor Risk Assessment is utilizing the data collected in cleanup verification packages (CVP) and supplemental characterization for the risk assessment. The risk assessment utilizes current regulations and standards. CVP's completed to date are interim. CVP's are closed out after actions required by final ROD(s) are completed. No immediate action is required.

Comment 59: Section 1.5, page 1.40, 2nd bullet and associated statements: Delete the statement: No new information has come to light that could call into question the protectiveness of the remedy for all operable units except for 100-NR-2. This statement cannot be true, because there is currently a River Corridor Baseline Risk Assessment in progress to address this very issue. Note also that this five-year record of decision review document does not mention the RCBRA by name or provide a description of the risk assessment.

Replace the statement with: The River Corridor Baseline Risk Assessment (RCBRA) is in progress to evaluate protectiveness of remediation activities in the 100 and 300 areas. The RCBRA will evaluate post-remediation contaminant concentrations with regard to protection of human health and the environment, as well as provide support for final cleanup levels for interim-remediated and unremediated sites.

Response to Comment 59: The recommended description of the River Corridor baseline risk assessment was added to the appropriate section in the document.

DOE agrees that the River Corridor Baseline Risk Assessment (RCBRA) is proceeding and this is specifically called out in Action 1-1. Once the RCBRA is completed, it will provide new information that DOE will review to determine if the previously selected remedies are still protective. DOE will use the new information in future remedial investigation documents to assist in selection of final remedies that will be protective.

Comment 60: Table 1.5. There is no action item to carry out groundwater remediation once the characterization of the "horn area" is complete. There is also possibility of conducting both remediation and characterization simultaneously. Therefore appropriate action items to remediate the "horn area' must be identified.

Response to Comment 60: DOE agrees. Action 9.2 is a new action that incorporates the horn area into the 100-HR-3 Operable Unit treatment zone.

Comment 61: Table 1.5. There is no action item to carry out groundwater remediation once the characterization of the "horn area" complete. There is also possibility of conducting both remediation and characterization simultaneously. There fore appropriate action items to remediate the "horn area' must be identified.

Also identify any presence of deep chromium contamination in the area and action items to address it.

Response to Comment 61: DOE agrees that the chromium plume between 100-H and 100-D needs to be characterized and such work is planned for FY 2007. If chromium concentrations are found to be exceeding the remedial action objectives defined in the ROD in this area, actions will be initiated to address the potential threat. A new Action 9.2, Incorporate the horn area into the 100-HR-3 Operable Unit treatment zone, has been added.

We are unclear if the comment, "identify any presence of deep chromium contamination in the area and action items to address it," refers to chromium between the soil excavation zone and the groundwater or chromium contamination that may be deep in the unconfined aquifer. Soils containing chromium, between the excavations and the groundwater, must not impact underlying groundwater to the extent that drinking water standards are exceeded. Analyses are also performed to assure chromium levels do not exceed ambient water quality standards at the point of exposure for aquatic life. It is unclear at this time what risk chromium contamination within a deep confined aquifer may cause and what actions would be appropriate to address it. This was specifically recognized in the 100-HR-3 interim ROD with the determination that further investigation was needed before an appropriate remedial action could be determined. Previous information was that this water was poised no immediate threat. Insufficient information has come to light to change this determination. However, action 12-1 required that more information specific to this concern be gathered. An additional action, Action 12-2, was added. This action will assess the characterization data gathered in Action 12-1 to determine whether an interim action needs to be identified prior to completing the final ROD.

Comment 62: Pages 1.41 – 1.43, Table 1.5: General comment. Issues and actions that will be added to the review as a result of comments should also be added to the table and renumbered.

Response to Comment 62: DOE agrees. The table includes additional issues and actions that resulted from comments received.

Comment 63: Section 1.7, page 1.44, last paragraph: Please revise the paragraph as follows: "For the 100-NR-2 Groundwater Operable Unit, the remedial action objectives for the strontium-90 contaminant in the groundwater established in the ROD are being met. Alternative remedies are being tested. Institutional controls are in place to prevent use for the groundwater. Therefore, for this operable unit, the remedy is considered protective in the short-term because institutional controls are in place. <u>However, in order for the remedy to be determined to be protective in the long-term, a focused feasibility study must be completed, and a final remedy must be selected.</u>

Response to Comment 63: DOE agrees with the last statement in the comment. Our protectiveness statements were revised to reflect that the cleanup decisions are for interim actions and further work may be required to determine "protectiveness."

However, DOE disagrees with the comment concerning remedial action objectives for strontium-90 in the groundwater being met. Data from wells located on the shoreline demonstrate that the strontium-90 concentrations were not impacted by the pump-and-treat system. As stated in the five-year review plan, the selected remedy (source removal and pump-and-treat) does not meet the remedial action objective of reducing the strontium-90 concentrations at the river. As with all of the operable units with interim action RODs, the need for additional data will be assessed to determine if a FFS/PP can be prepared and submitted with the data collected to date. Per the Hanford Past Practice Strategy, if additional data is required, it may be collected under a "Limited Field Investigation."

Comment 64: Page 1.15, Section 1.4.1. Revise text to include "Maintain Ecology approved groundwater monitoring well networks to monitor pump and treat operations and impacts to groundwater" in the description of the 100-NR-2 OU selected remedy.

The following is recommended text: "The remedy for 100-NR-2 is the continuation of a pump-and-treat system for strontium-90, which was begun as a removal action in 1995, the disposal of free-floating petroleum from any monitoring wells, removal of petroleum contaminated solid waste (including necessary treatment and disposal to ERDF), and maintenance of Ecology approved groundwater monitoring well networks to monitor pump and treat operations and impacts to groundwater."

Response to Comment 64: DOE agrees that the current monitoring well networks will be maintained. However, no additional text changes were considered to be necessary.

In accordance with Tri-Party Agreement Change Package M-016-06-01, Ecology agreed that DOE would construct and evaluate the effectiveness of a permeable reactive barrier, utilizing apatite sequestration technology as part of the CERCLA Remedial Investigation/Feasibility Study process. This action is consistent with remedial action objectives (RAOs) and the requirement to evaluate alternative remedial technologies of the 1999 Interim Remedial Action Record of Decision for the 100-NR-01 and 100-NR-02 Operable Units. The pump-and-treat as currently configured has been demonstrated to not meet the RAOs of the 1999 Interim Action ROD. It has been determined that the barrier technology should be tested under ambient field conditions to best evaluate the technology's effectiveness. The Interim Action ROD allows the pump-and-treat system to be shut-down with Ecology approval; therefore no Explanation of Significant Difference (ESD) to the 1999 ROD is needed to shut-down the system. Therefore, any description of the approved remedy must reflect the agreement to place the pump-and-treat system in cold standby status until a draft proposed plan to amend the Interim Action ROD or to propose a new ROD is submitted to Ecology by March 2008, per Milestone M-016-14(b). Thereafter, the pump-and-treat system will remain in cold standby and DOE will continue to monitor barrier performance until the draft proposed plan is approved. The proposed plan will evaluate the performance of the 300-ft barrier as well as other alternatives including the pump and treat and select an appropriate effective alternative or combination of alternatives in accordance with CERCLA requirements. Other alternatives have been evaluated (e.g. the existing pump and treat system and technologies identified in DOE-RL, 2004. "Evaluation of Strontium-90 Treatment Technologies for 100-NR-2", Letter Report submitted to Ecology, October 2004).

Comment 65: Page 1.28, Section 1.4.5.1, 1st paragraph: The first two sentences state: "The 116-N-1 and 116-N-3 sites were remediated; at the time of this review was in process, and 116-N-3 had been backfilled and revegetated. Backfilling and re-vegetation of the 116-N-1 waste site is scheduled to occur in 2006." Remediation has not been completed at either unit as contaminated vadose zone and groundwater remain associated with each unit. Therefore, the statement should be re-written to reflect this.

Recommended wording is: "Remediation of the 116-N-1 and 116-N-3 sites has been initiated. While the 116-N-3 site has been backfilled and revegetated, contamination remains (i.e., vadose zone and groundwater) and thus remediation is not complete. At the time this review was in process, backfilling of the 116-N-1 site has been initiated and is scheduled to be completed in 2006."

Response to Comment 65: The following text change was made to Section 1.4.5.1 of the final document that reflects the current status of these sites:
"Remediation of the 116-N-1 and 116-N-3 sites has been initiated in accordance with the RCRA Permit Closure requirements. The 116-N-3 site has been excavated, verification samples taken, and the site has been backfilled and revegetated. Additionally, at the 116-N-1 site all excavation and verification sampling has been completed. At the time this review was in process, backfilling of the 116-N-1 site has been initiated and is scheduled to be completed in 2006."

Comment 66: Page 1.33, Section 1.4.7.1. The text states: "All of the high-priority 100-H Area liquid waste sites, including cribs, ditches, trenches, and retention basins, have been remediated and backfilled with clean soil." Remediation has not been completed at the 183-H Solar Evaporation Basin as contaminated vadose zone and groundwater remain associated with the unit. Therefore, the statement should be re-written to reflect this.

Recommended wording is: "Remediation of all the high-priority 100-H Area liquid waste sites, including cribs, ditches, trenches, and retention basins has been initiated. While the all the high-priority units have been backfilled, contamination remains (i.e., vadose zone and groundwater) associated with the 183-H Solar Evaporation Basins and post-closure maintenance of the unit is required."

Response to Comment 67: The suggested changes were made to the report.

Comment 68: Page 1.33, Section 1.4.6.4. Recommendations for improving the 100 Area groundwater remediation were recently made in *Calendar Year 2005 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations* (DOE/RL-2006-08, Rev. 0). Specifically, one recommendation was for the existing pump-and-treat system to be expanded and an electrocoagulation system to be applied which is capable of treating high flow rates.

Therefore, it is recommended that an additional issue and action be included in the review. Recommended wording for the issue is: "Issue 12: Contaminant sources are currently unknown and chromium concentrations remain well above the remedial action objective. A proposal has been developed to conduct a field test to apply an electrocoagulation system to accelerate remediation of the northeastern chromium plume."

Recommended wording for the action is: "Action 12-1: Propose and implement an Ecology-approved treatability test plan for expanding the existing pump-and-treat system and applying an electrocoagulation system which is capable of treating high flow rates."

Response to Comment 68: DOE does not agree that an additional issue and action are needed. A treatability test plan, *"Field Test Electrocoagulation for Accelerated Clean Up of the Northeastern Chromium Plume in the 100-D Area"* was provided to Ecology for review and approval. This test plan addresses this issue and action.

Comment 69: Page 1.33, Section 1.4.6.4. Recommendations for improving the 100 Area groundwater remediation were recently made in *Calendar Year 2005 Annual Summary Report for the 100-HR-3, 100-KR-4, and 100-NR-2 Operable Unit Pump-and-Treat Operations* (DOE/RL-2006-08, Rev. 0). Specifically, one recommendation was for immobilizing chromium mass in the ISRM plume by circulating a strong reductant, calcium polysulfide, in the aquifer.

Therefore, it is recommended that an additional issue and action be included in the review. Recommended wording for the issue is: "Issue 13: Chromium mass in the ISRM plume is mobile and chromium concentrations remain well above the remedial action objective."

Recommended wording for the action is: "Action 13-1: Propose and implement an Ecology-approved treatability test plan for immobilizing chromium mass in the ISRM plume by circulating a strong reductant (e.g., calcium polysulfide), in the aquifer."

Response to Comment 69: DOE does not agree that an additional issue and action are needed. A treatability test plan, *"Hanford 100-D-Area Treatability Demonstration: Accelerated Bioremediation through Polylactate Injection"* was provided to Ecology for review and approval. This test plan addresses this issue and action. The test will provide supplemental treatment up-gradient of the ISRM barrier by directly treating chromium and other oxidizing species in groundwater (i.e., nitrate and dissolved oxygen), which will increase the longevity of the ISRM barrier and protect the ecological receptors and human health at the river boundary.

Comment 70: Page 1.36, Section 1.4.7.4. Due to the configuration of groundwater monitoring wells in relation to the 183-H Solar Evaporation Basin and the current groundwater monitoring program, it is unknown if 1) the remedies are protective of groundwater resources and 2) if the soil and groundwater remedies are meeting groundwater protection standards of WAC 173-303-645. The deficiencies associated with the unit's groundwater monitoring network and program are evidenced by Ecology's draft permit conditions for this unit. Therefore, it is recommended that an additional issue be included which addresses the deficiencies associated with the groundwater monitoring networks and programs.

The following wording is recommended for an additional issue: "Issue 13. The groundwater monitoring well network and program are not adequate to monitor waste site contamination impacts to groundwater."

The following wording is recommended for an additional action: "Action 13-1. Submit a groundwater monitoring plan for Ecology approval that specifies network and program monitoring that will satisfy groundwater protection standards of WAC 173-303-645."

Response to Comment 69: DOE does not agree that an additional issue and action are needed. The CERCLA five-year review is not the appropriate forum to resolve RCRA permit issues.

Comment 70: Page 1.36, Section 1.4.7.4: At least two wells were constructed in 1962 in the area known as the "horn." Wells 699-97-43 and 699-96-49 were constructed with perforations extending across the Ringold/Hanford formation contact that separates the confined and unconfined aquifers. Well 699-96-49 was remediated in 1977 by cementing across the contact. Well 699-97-43 was remediated in 1976 by installing a cement plug from 83-100 ft. depth. However, the conduit from the Hanford unconfined aquifer to the deeper aquifer remains open. It is recommended that an additional issue be included which completes the remediation of well 699-97-43.

The following wording is recommended for an additional issue: "Issue 14. Remediation of groundwater well 699-97-43 has not been completed (i.e., the conduit from the Hanford unconfined aquifer to the deeper aquifer remains open)."

The following wording is recommended for an additional action: "Action 14-1. Complete remediation of groundwater well 699-97-43."

Response to Comment 70: DOE does not agree that an additional issue and action are needed. The CERCLA five-year review is not the appropriate forum to resolve well decommissioning issues as this work is not currently an integral part of CERCLA cleanup actions under existing records of decision. DOE agrees, however, to address the well decommissioning through the Hanford Site Well Decommissioning Plan, DOE/RL-2005-70, Revision 0. This plan outlines our strategic approach for managing well decommissioning at Hanford.

Comment 71: Page 1.36, Section 1.4.7.4: At least two wells were constructed in 1962 in the area known as the "horn." Wells 699-97-43 and 699-96-49 were constructed with perforations extending across the Ringold/Hanford formation contact that separates the confined and unconfined aquifers. Well 699-96-49 was remediated in 1977 by cementing across the contact. However, considering water level measurements, there is concern that the remediation (cement plug) may not be providing an effective seal between aquifers. Therefore, it is recommended that an additional issue be included which evaluates the effectiveness of the remediation of well 699-96-49.

The following wording is recommended for an additional issue: "Issue 15. Remediation of groundwater well 699-96-49 occurred in 1977 by cementing across the confined and unconfined aquifer contact. Based on water-level measurements, the effectiveness of the remediation is unknown."

The following wording is recommended for an additional action: "Action 15-1. Evaluate the effectiveness of the 1977 remediation of well 699-96-49."

Response to Comment 71: DOE does not agree that an additional issue and action are needed. As stated in the previous response, the CERCLA five-year review is not the proper mechanism to resolve well decommissioning issues. They will be addressed through the Hanford Site Well Decommissioning Plan, DOE/RL-2005-70, Revision 0.

Comment 72: Page 1.36, Section 1.4.7.4. Well 699-99-42 may be an old farm well. The information provided in the Hanford Well Information System (HWIS) database indicates the well is a 12" pipe, the depth to bottom is 35 feet, and the well is dry. The HWIS also indicates that construction design is unknown. It is unknown if this well is providing a conduit for contaminant migration. It is recommended that this well be evaluated for decommissioning priority.

The following wording is recommended for an additional issue: "Issue 16: Well 699-99-42 should be evaluated to determine its decommissioning priority."

The following wording is recommended for an additional action: "Action 16-1. Decommission well 699-99-42 as prioritized."

Response to Comment 72: DOE disagrees. As stated in responses to comments 70 and 71, the CERCLA five-year review process is the not appropriate forum to address this issue.

Comment 73: 200-14th paragraph. To this paragraph ("This five-year review . . . not included in this review.") add the following two sentences:
"The Tri-Parties are integrating the closure of inactive treatment storage, and disposal facilities with waste site cleanup [note: derived from TPA, but could also refer to the 1998 200 Areas RI/FS

Implementation Plan]. The Tri-Parties are also applying a strategy for groundwater cleanup that integrates the authorities and requirements of the AEA, CERCLA and RCRA [ref. to Hanford Groundwater Strategy]."

Response to Comment 73: DOE agrees. The following text was added to the Introduction section of the report: "Although this five-year review does not include RCRA treatment, storage, and disposal activities, the Tri-Parties are integrating the closure of inactive treatment storage, and disposal facilities with CERCLA waste site cleanup as intended by the TPA. The Tri-Parties are also applying a strategy for groundwater cleanup that integrates the authorities and requirements of the AEA, CERCLA and RCRA [ref. to Hanford Groundwater Strategy]."

Comment 74: Page 2.4 Page 2.5. The operable unit designations in the Figures 2.1 and 2.2 appear to be archaic designations, and should be updated.
Also, it is generally difficult to display the [process-based] 200 Area operable units w/o color-coding them.

Response to Comment 74: In the draft *CERCLA Five-Year Review Report for the Hanford Site* approved for public release, these changes were made.

Comment 75: Table 2.2 Page 2.8 – 2.1. There are 2+ pages discussing the canyon processes, which can be appropriate because these were the central waste generating processes. However, there should be (and there is no) corresponding description of the operable units. For example, the non-Hanford reader will not know what a "Scavenged Waste" (200-TW-1) is. A concise description of the different types of waste sites (cribs, chemical sewers, ponds, unplanned releases, etc.) would be helpful. Also note that despite the 2+ pages discussing the canyons, they are not the focus of the five-year review. It would also be appropriate to relate the groundwater operable units: especially the 2 that have RODs: to the canyons, waste sites/types, and operable units.

Response to Comment 75: DOE revised Section 2.4 of the report to include more information on the different types of waste sites.

Comment 76: 200-ZP-1. Although Table 2.5 acknowledges other sources of contamination, and other contaminants, the entire focus of the section is on carbon tetrachloride. This is the largest groundwater concern in the 200-ZP-1 operable unit. This focus, however, leads to an incomplete protectiveness evaluation.

A DQO supplement to address high Tc-99 (as well as Cr, NO3) is underway, but is only briefly mentioned. The evaluation should be revised to increase the emphasis on the DQO.

Response to Comment 77: In the draft *CERCLA Five-Year Review Report for the Hanford Site* approved for public release, this issue was identified. Issue #13 emphasizes the need to further characterize the technetium-99 plume near the T Tank Farm and Action 13-1 specifically focuses on completing the DQO and sampling and analysis plan to address the issue.

Comment 78: 200-ZP-1. The entire emphasis is on characterization, with little to no attention paid to remediation of the [other] contaminants and what specific technology development might be needed to effectively treat all the contaminants in 200-ZP-1. Pump & Treat was an Expedited Response Action (ERA) agreed to by parties in ~1995, but the part of that agreement to develop more effective technologies to replace the P&T has been ignored and shouldn't be. Characterization has shown that a P&T that addresses only the top 50 ft. of an aquifer that is over 200 ft. thick ignores CCl4 that is present deeper in the aquifer and all the way to its base in certain areas. Remediation of [potential contaminant source] metals in soils, especially radioactive isotopes of these metals in the deep vadose zone like in the 200 Areas, has not been studied to the extent it should have been.

The text should be revised to give greater emphasis to technology development.

Response to Comment 78: The 200-ZP-1 Remedial Investigation/Feasibility Study is currently underway. Additional characterization of all the contaminants of concern, including contamination in the deeper aquifer, will be assessed as part of the RI. The feasibility study, which will be completed by the end of FY07, will provide evaluation of remedial technologies and discussion on technology development. No additional text change was made.

Comment 79: 200-ZP-1: No mention is made of vadose zone characterization being conducted under the RFI/CMS program for tank farms which are sources of contaminants in the groundwater in 200-ZP-1. Although this characterization is being done under RCRA regulations that are outside of the scope of the five-year record of decision review, the Hanford Tri-Party Agreement gives major emphasis to the CERCLA-RCRA interface. The text should be revised to integrate into the technical assessment, the RCRA characterization program.

One specific element that should be emphasized in the text is the use of high resolution resistivity/surface geophysics (HRR/SGE). It could be helpful in identifying sources in and surrounding tank farms and it should probably be at least mentioned. The T Farm demonstration of HRR/SGE included not only tanks, but several liquid disposal sites surrounding this farm.

Response to Comment 79: Information from the RCRA Facility Investigation/Corrective Measures Study (RFI/CMS), especially the high resolution resistivity/surface geophysics (HRR/SGE), was reviewed and will be incorporated into the overall analysis for the ZP-1 operable unit as part of the Feasibility Study and Proposed Plan.

Comment 80: 200-ZP-1. Given the vertical distribution of contaminants in the aquifer that is just now being discovered (page 2.22), further characterization of the deeper aquifer is needed to revise the conceptual model that forms the basis for any computer modeling that might be performed. This should be added to the Recommendations (page 2.46).

Response to Comment 80: The 200-ZP-1 Remedial Investigation/Feasibility Study is currently underway. Additional characterization of all the contaminants of concern, including contamination in the deeper aquifer, will be assessed as part of the RI. The conceptual model will be revised as necessary based on the results of the remedial investigation.

Comment 81: 2.4.3.3. The Technical Assessment Summary of 200-PO-1 incompletely integrates the previous actions under the Resource Conservation and Recovery Act (RCRA).

Where the text states that "Remediation of the contaminated groundwater" has not been evaluated since then, it would be appropriate to provide the background:

- Because this OU is designated as a RCRA Past Practice OU, a RCRA CMS was prepared (and approved) in 1996.
- A draft permit modification was prepared by DOE in 1997 and submitted to Ecology, but was never incorporated in the Hanford Facility RCRA Permit.
- The recommended action in the draft permit modification was continued monitoring and institutional controls for iodine-129 and tritium
- Since the draft permit modification was submitted there have been several technical and non-technical developments that potentially impact recommendations for the 200-PO-1 operable unit:
    - Both EPA and DOE have released guidance documents for developing monitored natural attenuation remedies (give ref).
    - EPA has released guidance on institutional controls
    - DOE has prepared and submitted TPA-required reports on the available technologies to treat tritium (M-26) and iodine [don't have the milestone #]
    - Continued monitoring and characterization of the groundwater and vadose zone have contributed to a better conceptual site model of the sources and migration of contamination overlying and within the 200-PO-1 OU
    - The groundwater "divide" under the B Pond, that originally distinguished between the 200-PO-1 and 200-BP-5 OUs, has disappeared

It might also be worth noting that although nitrate was dropped as a COC in the 1996 CMS, it would probably be considered in a current assessment.

Response to Comment 81: The text of Section 2.4.3.3 of the document was revised to include the following:

- Because this OU is designated as a RCRA Past Practice OU, a RCRA CMS was prepared (and approved) in 1996.
- A draft permit modification was prepared by DOE in 1997 and submitted to Ecology, but was never incorporated in the Hanford Facility RCRA Permit.
- The recommended action in the draft permit modification was continued monitoring and institutional controls for iodine-129 and tritium
- Since the draft permit modification was submitted there have been several technical and non-technical developments that potentially impact recommendations for the 200-PO-1 operable unit:
    - Both EPA and DOE have released guidance documents for developing monitored natural attenuation remedies
    - EPA has released guidance on institutional controls
    - DOE has prepared and submitted TPA-required reports on the available technologies to treat tritium (M-26) and iodine
    - Continued monitoring and characterization of the groundwater and vadose zone have contributed to a better conceptual site model of the sources and migration of contamination overlying and within the 200-PO-1 OU

- The groundwater "divide" under the B Pond, that originally distinguished between the 200-PO-1 and 200-BP-5 OUs, is being investigated as part of the BP-5 and PO-1 characterization effort.

Comment 82: 2.36: 2nd to last paragraph: the fact that in 1998 the *Screening Assessment and Requirements for a Comprehensive Assessment* concluded that there is no adverse impact, is of little significance to this CERCLA five-year review. We recommend deleting the sentence (which is a 1-sentence paragraph).

Response to Comment 82: DOE agrees. The sentence was deleted.

Comment 83: 2.3.6: Given the regulatory and technical history for 200-PO-1, especially that there is no remedial decision, the protectiveness evaluation should be "deferred."

Response to Comment 83: DOE does not agree that protectiveness statement should be deferred because no remedy has been selected for this operable unit. Until a CERCLA remedy is selected and implemented through the remedial investigation/feasibility study record of decision process, the operable unit is not subject to the requirement for a five-year review. A description of the OU was included as part of DOE's effort to cover all Hanford Site CERCLA operable units, even those for which no remedy has been selected.

Although DOE did choose to review the status of all Hanford Site CERCLA activities in this five-year review process, we did not commit to conducting protectiveness evaluations for those operable units that do not have records of decision.

Comment 84: 2.52: We recommend adding text to the Protectiveness Evaluation: "Ecological risk at the Columbia River is not being addressed in an integrated manner, at least to the satisfaction of stakeholders. This has surfaced as comments on the Columbia River Corridor Baseline Risk Assessment and during 2005 workshops on risk integration."

The recommended action should be for DOE to prepare an integration plan, and present it through public processes.

Response to Comment 84: DOE did not agree with the suggested changes to the text. An integrated 100/300 Area ecological risk assessment is being conducted with technical assistance from the Hanford Natural Resource Trustee Council representatives. The plans for this activity have and will continue to be presented through public processes. The ongoing risk assessments were not addressed in this five-year review in determining protectiveness since they are not complete.

The recommended action is already covered in Action 2-1, which is an integration strategy document for final cleanup decision in the River Corridor. No additional text changes were made.

Comment 85: Table 2.10: Add a heading and a bullet for **200-UP-1**: "Take advantage of the current pump-and-treat system at 200-UP-1 to address the revised, current MCL of 30 μg/L for uranium. Better integrate the interim measure for technetium-99 at S/SX Tank Farm, and evaluate other opportunities for pumping to remediate technetium-99."

Response to Comment 86: Issue #18 and Action #18-1 already address this comment. The feasibility of using the existing pump-and-treat system to address the revised, current MCL of 30 μg/L for uranium will be evaluated in the Explanation of Significant Difference. No additional text changes were made.

Comment 87: Table 2.10; Add a heading and a bullet for **200-PO-1**: "Develop data quality objectives, and prepare a plan to update the analysis of alternatives included in the 1996 CMS and 1997 draft permit modification. Reconsider the original recommendations considering more recent guidance and a conceptual site model that has improved because more recent characterization and monitoring."

Response to Comment 87: DOE did not agree with the suggested changes to the text. This issue will be addressed and incorporated into future FS/PP activities.

Comment 88: Page 3.3, Section 3.3: The first complete paragraph identifies uranium as the "primary contaminant" in many of the waste sites and "additional contaminants such as plutonium, beryllium, metals, and petroleum." The 300-FF-1 and 300-FF-5 Operable Unit ROD identifies organics (trichloroethene, chloroform, 1,2-dichlorethylene (cis), 1,2-dichloroethylene (total), dichloroethene (trans), etc.) as groundwater contaminants. It is recommended that this paragraph identify chlorinated organics as contaminants.

Response to Comment 88: A sentence was added in Section 3.3 to clarify that, "Chlorinated organics have also been identified as contaminants."

Comment 89: Page 3.5, Table 3.2: The table identifying the 300-FF-1 and FF-5 Operable Unit RAOs appears to have been formatted as Table 4 from the 300-FF-2 Operable Unit ROD (page 32). However, the position of the regulatory citation in the five-year review has been changed and could thus be interpreted to change the meaning of the RAO.

Specifically, the ROD RAO description states: "This RAO will be achieved through compliance with the MTCA cleanup values for organic and inorganic chemical constituents in soil to support industrial land use (WAC 173-340-745), and the Draft EPA and the draft Nuclear Regulatory Commission proposed protection of human health standards of 15 mrem/year in soils above background for radionuclides." It is recommended that the wording in Table 3.2 be changed to the exact language used in the ROD.

Response to Comment 89: The suggested change was made. The following ROD language was incorporated into Table 3.2 of the document.: "This RAO will be achieved through compliance with the MTCA cleanup values for organic and inorganic chemical constituents in soil to support industrial land use (WAC 173-340-745), and the Draft EPA and the draft Nuclear Regulatory Commission proposed protection of human health standards of 15 mrem/year in soils above background for radionuclides."

Comment 90: Page 3.5, Section 3.4.1.3: The last sentence on the page states: "Institutional controls are required as part of the remedy because the cleanup will leave waste in place and not allow for unrestricted use." It is recommended that context be provided. In particular, it is recommended that a statement be added which identifies the remediation timeframe as specified by the ROD by the following: "Preliminary estimates for the waste sites in 300-FF-1 indicate that the sites could be cleaned up in approximately 4 to 7 years. Modeling of the 300-FF-5 groundwater indicates that remediation time frames vary from 3 to 10 years."

Response to Comment 90: DOE did not agree with the suggested changes to the text. DOE agrees that the natural attenuation alternative for 300-FF-05 did not achieve the remediation goals within ten years as envisioned when the current ROD was signed. The need for institutional controls and the timeframe for reaching groundwater cleanup goals will be established through the ongoing CERCLA decision process. As noted in other comment responses and in the report, the natural attenuation with monitoring remedy has not worked as expected and other options are being examined. Therefore, a timeframe for successful remediation of the 300-FF-5 Operable Unit can not be estimated.

Comment 91: Section 3.5.3, page 3.15, 2nd bullet and associated statements: Delete all of the statements: No, no new information has come to light that would call into question the protectiveness of the remedy. Replace with: Yes; land use changes, including some residential use, have been proposed by the city of Richland.

Actions:
A. Compare contaminant concentrations in source units and remediated areas with 2001 WAC 173-340 soil cleanup levels for direct contact, protection of groundwater, and protection of ecological receptors; use default values for soil as specified in sections WAC 173-340-720 through -750 and -7490 through -7494 of the 2001-amended WAC 173-340.
B. Develop revised exposure scenarios consistent with the City of Richland plan changes, and evaluate the risk for protectiveness.

Response to Comment 91: New information pertaining to the Hanford Cleanup Project is assessed on an ongoing basis. As the information is received, it is evaluated for potential impacts on the cleanup. If the assessment of the new information indicates that it could trigger a reconsideration of elements in a Record of Decision, it was incorporated into the five-year review.

DOE did review the City of Richland study and determined it did not warrant a change to the current or reasonably anticipated future land uses for the 300 Area as established in the Hanford Comprehensive Land Use Plan. The DOE anticipates it potentially may have future missions for the 300 area; therefore, no decision has been made to transfer this parcel of land out of the DOE's administration in the foreseeable future.

Comment 92: Page 3.7, Table 3.3. The table identifying the 300-FF-2 Operable Unit RAOs appears to have been taken from the 300-FF-2 Operable Unit ROD (Table 4, page 32). It is recommended that exact wording from the ROD be used in Table 3.3.

For example, in the first row describing RAO 1, it is recommended that the WAC citation placed after *Model Toxic Control Act* be deleted as that particular regulation was not specified in Table 4, row 1 of the 300-FF-2 Operable Unit ROD.

As another example, it is recommended that in the second row describing RAO 2, the first sentence read as follows (and as stated in the 300-FF-2 Operable Unit ROD): "Prevent migration of contaminants through the soil column to groundwater and the Columbia River such that concentrations…".

Response to Comment 92: DOE believes it is helpful to the public to provide the specific WAC citation identifying the referenced regulatory requirement.

The identified typographical error was corrected. The text for RAO2 in Table 3.3 now reads, "Prevent migration of contaminants through the soil column **to** groundwater and the Columbia River such that concentrations reaching groundwater and the river do not exceed maximum contaminant levels (MCLs)/non-zero maximum contaminant level goals (MCLGs) under the Federal Safe Drinking Water Act (40 CFR 141)**c** and/or State of Washington drinking water standards (WAC 246-290), ambient water quality criteria (AWQC) for protection of freshwater aquatic organisms under the Federal Clean Water Act (40 CFR 131) and/or State of Washington surface water quality standards (WAC 173-201A), and the MTCA groundwater cleanup standards (WAC 173-340-720)."

Comment 93: Page 3.8, Section 3.4.2: The second sentence states: "The seeps and the pore water are routinely monitored by DOE and Washington Department of Health." The sentence can be interpreted to imply that all seeps and pore water carrying contaminated discharges to the river are monitored. This is not the case. For example, chlorinated hydrocarbons that are very likely discharging into the river at the base of the aquifer are not being monitored as they are very likely being discharged into the river well beyond the shoreline.

Recommended re-wording is: "Near-shore seeps and pore water are sampled at a number of locations and are scheduled for regular monitoring. Monitoring is condition dependent (i.e., aquifer tubes cannot be sampled during high river levels) and performed by DOE and Washington Department of Health."

Response to Comment 93: DOE agrees that all seeps and pore water carrying contaminated discharges are not routinely monitored. The text of Section 3.4.2 was revised to read, "Near-shore seeps and pore water are sampled at a number of locations and are scheduled for regular monitoring. Monitoring is condition dependent (i.e., aquifer tubes cannot be sampled during high river levels) and performed by DOE and Washington Department of Health." DOE does not agree with the statement that chlorinated hydrocarbons are very likely discharging into the river at the base of the aquifer. Chlorinated hydrocarbon occurrences are limited, without a well defined plume.

Comment 94: Page 3.8, Section 3.4.2: The third sentence states: "Neither agency has identified any actual or potential acute or chronic effects from contaminant discharges to the Columbia River and its shoreline." Monitoring of the base of the unconfined aquifer at the groundwater and surface water interface (which likely occurs in the river where the river bed intersects the Ringold lower mud and not at the shore-line) is not being conducted. The statement should more accurately put the observation in context.

Recommended re-wording is: "From the near-shore seeps and pore water monitoring conducted, neither agency has identified any actual or potential acute or chronic effects from contaminant discharges to the Columbia River's shoreline."

Response to Comment 94: The recommended text limits the assessment to near-shore seeps and pore water monitoring, whereas, the identification of actual or potential acute or chronic effects from contaminant discharges to the Columbia River's shoreline must include the wealth of previous monitoring and research performed at Hanford as well as current monitoring being performed. DOE has an extensive Columbia River monitoring program. Results from that program are reported in Section 8.4, Surface-Water and Sediment Monitoring, *Hanford Site Environmental Report for Calendar Year 2004*. The report can be accessed at http://hanford-site.pnl.gov/envreport. No additional text changes have been made.

Comment 95: Page 3.8, Section 3.4.2: Regarding potential acute or chronic effects from contaminant discharges to the Columbia River's shoreline, the text should identify that off-shore monitoring is not being conducted and therefore, it is unknown if there are any potential acute or chronic effects from contaminant discharges to the Columbia River.

Note: Chlorinated hydrocarbons in well 399-1-16B have exceeded drinking water standards since construction in 1987. The chlorinated hydrocarbon contaminant source is apparently associated with the 300 Area Process Trenches (300 APT).

Response to Comment 95: DOE disagrees. As noted in the response to the previous comment, DOE has an extensive Columbia River monitoring program that includes monitoring water quality in the river.

Exceeding the drinking water standard at a well does not necessarily imply acute/chronic effects on ecological receptors. A pathway is needed from the plume to the receptor, and the receptor has to be vulnerable to the method of exposure (...along with all the other toxicity considerations).

The organic chemical cis-1,2-DCE is found in one well in the lower portion of the unconfined aquifer in the vicinity of the 300 APT. The river channel does not intersect the principal Ringold mud unit (i.e., the Lower Mud), but could intersect less-transmissive units within Unit E. Also, flow modeling indicates that groundwater in the lower part of the unconfined aquifer will discharge to the river bed farther offshore in deeper water, and over a more broad area, compared to groundwater flowing in the upper part of the unconfined aquifer. There is no evidence that cis-1,2-DCE discharges to the river at measurable concentrations.

Volatile organic compounds are detected in 300 Area groundwater, with trichloroethene (TCE) being the most widespread and from multiple sources, including offsite sources. Tetrachloroethene (PCE) and cis-1,2,-dichloroethene (DCE) are also detected, and are probably from past disposal to 300 Area disposal sites. DCE may represent the degradation of TCE and/or PCE in the aquifer. The final product of that degradation chain, vinyl chloride, has not been detected in 300 Area groundwater (Groundwater Report for FY 2004—PNNL-15127, pp. 2.18-2.19 and tables 2.4 to 2.7).

Only DCE currently exceeds drinking water standards, and only at one well, which is screened in the lower portion of the unconfined aquifer. Based on the distances to the nearest additional monitoring wells for that horizon, it is reasonable to state that the DCE occurrence is limited in aerial extent, is primarily at depth in the aquifer (i.e., not at the water table), and probably associated with past disposal to the 300 Area Process Trenches. Volatile organic carbon chemicals (VOCs) are generally short-lived in the near-surface environment because of their volatility; they do not readily adsorb to soil; they persist as dissolved constituents in groundwater; and are short-lived in surface waters. So even if VOCs get to the river via groundwater flow, the exposure risk period in the river is short, and the concentrations are likely to be very low because of dilution.

Comment 96: Page 3.8, Section 3.4.2.1. The first sentence of the 3rd paragraph states: "The remedy selected was monitored natural attenuation with institutional controls to prevent human exposure to groundwater." The use of the term "monitored natural attenuation" is inappropriate. At the time this ROD was made, the remedy and term "monitored natural attenuation" (MNA) did not exist. Furthermore, when the remedy and term MNA was developed, it is doubtful that the 300 Area groundwater contamination would have met MNA criteria and would therefore, not have been selected as the remedy.

It is recommended that the sentence be re-worded as: "The remedy selected was natural attenuation with continued groundwater monitoring and institutional controls to prevent human exposure to groundwater."

Response to Comment 96: DOE agrees that the use of the term "monitored natural attenuation" is inappropriate as it currently has a very specific regulatory connotation. Text was revised to clarify (a) the selected remedy for interim action, and (b) the remedial action objectives during interim action, and (c) what activities will be completed in the foreseeable future (e.g., LFI, TT, Phase III FS report, RCBRA, and draft Proposed Plan). The 1996 ROD Declaration states: "The selected interim remedy includes: (a) Continued monitoring of groundwater that is contaminated above health-based levels to ensure that concentrations continue to decrease; and (b) Institutional controls to ensure that groundwater use is restricted to prevent unacceptable exposures to groundwater contamination." The ROD does not use the term "monitored natural attenuation". There is discussion of natural attenuation in the description of remedial action alternatives, but the selected remedy is Institutional Controls. That remedy would include continued monitoring to "verify modeled predictions of contaminant attenuation to evaluate the need for remedial measures" (pp. 61-62 of the ROD).

The remedial action objectives, as stated in the ROD, are:

1. Protect human and ecological receptors from exposures to contaminants in soils and debris by exposure, inhalation, or ingestion of radionuclides, metals, or organics.

2. Protect human and ecological receptors from exposure to contaminants in the groundwater and control the sources of groundwater contamination in 300-FF-1 to minimize future impacts to groundwater resources.

3. Protect the Columbia River such that contaminants in the groundwater, or remaining in the soil after remediation, do not result in an impact to the Columbia River that could exceed the Washington State Surface Water Quality Standards.

Institutional Control on use of groundwater (GW-2) is the primary means of protecting humans until remedial measures bring the uranium concentrations to below drinking water standards.

Comment 97: Page 3.8, Section 3.4.2.1. The first sentence of the 3rd paragraph states: "The remedy selected was monitored natural attenuation with institutional controls to prevent human exposure to groundwater." The last paragraph on the page states: "The interim remedy selected as part of the initial ROD for the 300 Area NPL site remains appropriate for the operable unit. The remedial action objectives for the operable unit also remain appropriate for the foreseeable future."

From the way the text is written, it is not understood if the statements reflect current positions/ conclusions/determinations or if they reflect positions/conclusions/determinations made in 1996. The text should be clarified. Furthermore, if the text reflects current positions/conclusions/determinations, it is not understood how the selected remedy has ensured protection of ecological receptors when the ecological assessment has not been completed.

Response to Comment 97: DOE agrees that the natural attenuation action is not meeting the remedial action objectives in the ten year time frame envisioned when the 300-FF-05 ROD was written in 1996. Therefore, the statement, "The interim remedy selected as part of the initial ROD for the 300 Area NPL site remains appropriate for the operable unit" was changed. The remedial action objectives for groundwater remediation remain as "restoration of the aquifer". Groundwater cleanup decisions will be based on the effectiveness of current cleanup technologies and their ability to meet CERCLA groundwater cleanup objectives, including the restoration of the aquifer to beneficial uses wherever practicable within a time frame reasonable given the particular circumstances of the Hanford Site. If, through the CERCLA process, restoration is determined to not be practicable appropriate actions will be taken to prevent further migration of the plume, prevent exposure to the contaminant and evaluate further risk reduction. This approach is consistent with 40 CFR 300.430(a)(1)(iii)(F).

The cleanup goals for the Hanford CERCLA sites are established through the CERCLA Engineering Evaluation/Cost Analysis (EE/CA), Action Memorandum or Preliminary Assessment/Site Investigation (PA/SI), Remedial Investigation/Feasibility Study (RI/FS), and Record of Decision (ROD) processes. A fundamental factor in these processes is that the remedies selected must be protective of human health and the environment upon completion of the actions. The removal or remedial action goals must be based on promulgated regulatory requirements established to ensure that public and health and the environment will be protected if the contaminants are below the established levels.

Risk assessments are not conducted to determine whether current remedies are protective. The purpose of these assessments is to establish a baseline for future remedial action decisions, if necessary.

Comment 98: Page 3.9, Section 3.4.2.1. The section does not identify observed (from groundwater monitoring) impact of all of the source removals in the mid-90s. Groundwater contamination concentrations not only didn't decline as predicted, but elevations were observed. Such observations were likely the result of source removals combined with surface- and ground-water mobilizing contaminants in the vadose zone.

Response to Comment 98: Section 3.5.1, Groundwater Uranium Contamination in the 300 Area Sub-Region, describes the groundwater conditions raised in this comment. The immediate impact of source removal actions on the uranium problem may have included remobilization of some contamination, which has now migrated down gradient and appears to be dissipating. At many locations where concentrations went up, it represented the arrival of the core of the plume, and concentrations are now declining at those wells. Data from the four LFI boreholes and the S&T investigation at the shoreline are providing more details on the distribution of uranium, and interpretations/conceptual models will likely evolve.

Comment 99: Page 3.10, Section 3.4.4. The fourth bullet regarding "installation of new groundwater monitoring facilities" includes an identification of the installation of 8 additional aquifer tubes along the 300 Area shoreline. The text describes the shoreline monitoring as providing "comprehensive coverage for monitoring groundwater as it passes across the groundwater/river water interface".

Recommended re-wording is: "...providing comprehensive near-shore coverage for monitoring groundwater as it passes..."

Response to Comment 99: Aquifer tubes are constructed at various elevations with the objective of monitoring various levels within the aquifer. Coupled with monitoring well and river transect data taken over the years, adequate information exists to support the statement as written. No additional changes to the text were made.

Comment 100: Section 3.5, General Comment: A new section needs to be added to Section 3.5 which addresses chlorinated hydrocarbons. The section should include the following information and observations. Chlorinated hydrocarbons in well 399-1-16B have exceeded drinking water standards since construction in 1987. The chlorinated hydrocarbon contaminant source is apparently associated with the 300 Area Process Trenches (300 APT) and has a potential for releasing vinyl chloride to the Columbia River.

Response to Comment 100: Chlorinated hydrocarbons in the 300 Area have a limited distribution and will likely not result in a significant release of contaminants, including degradation products, to the Columbia River. No additional changes to the text were made.

Comment 101: Page 3.14, Section 3.5.3. The first bullet (related to protectiveness determination criteria) uses the term "monitored natural attenuation." It is recommended that this term not be used as the remedy did not exist when "groundwater monitoring and natural attenuation" with institutional controls was selected as the remedy.

The following wording is recommended: "No, natural attenuation is not functioning as planned."

Response to Comment 101: As stated in response to comment 96, DOE agrees that the use of the term "monitored natural attenuation" is inappropriate, because it has a very specific regulatory connotation. The text has been revised.

Comment 102: Page 3.14, Section 3.5.3. The 300-FF-5 ROD selected remedy includes institutional controls. Currently, it is unknown if institutional controls are functioning as intended in relation to protectiveness of ecological receptors.

It is recommended that an additional item be listed under the first bullet which states: "- 300-FF-5 ROD Unknown whether institutional controls are protective of ecological receptors".

Response to Comment 102: DOE does not agree that an additional item is needed. The 300-FF-5 has no institutional controls for ecological receptors.

Comment 103: Page 3.15, Section 3.5.3. The 3rd sentence in the paragraph states: "In addition, confirmation that access and institutional controls are in place and successfully prevent exposure." The sentence needs to indicate that the controls prevent exposure to humans.

Recommended wording is: "In addition, confirmation that access and institutional controls are in place and successfully prevent human exposure."

Response to Comment 103: The suggested wording change was made.

Comment 104: Page 3.15, Section 3.5.3; The second bullet addresses validity of exposure assumptions, toxicity data, cleanup levels, and remedial action objectives. Since the last five-year ROD review, EPA decreased the MCL for uranium. Also since the last five-year ROD review, the technical community has acknowledged (through publication) a lack of understanding of uranium fate and transport. Also since the last five-year ROD review, there has been an acknowledgement that uranium has not attenuated as previously modeled. Also since the last five-year ROD review, the City of Richland has identified the need for re-evaluation of the cleanup.

At a minimum, for the reasons listed above, supporting assumptions, cleanup levels, data, and remedial action objectives, the answer associated with the three RODs should be "no."

Response to Comment 104: DOE disagrees. The remedial action objectives for groundwater remediation in the 300 Area remain as "restoration of the aquifer." This goal is independent of land use decisions. Groundwater cleanup decisions will be based on the effectiveness of current cleanup technologies and their ability to meet CERCLA groundwater cleanup objectives, including the restoration of the aquifer to beneficial uses wherever practicable within a time frame reasonable given the particular circumstances of the Hanford Site. If, through the CERCLA process, restoration is determined to not be practicable, it is expected that appropriate actions will be taken to prevent further migration of the plume, prevent exposure to the contaminant and evaluate further risk reduction. This approach is consistent with 40 CFR 300.430(a)(1)(iii)(F). The proposed plan that will be submitted at the conclusion of the current limited field investigation will be consistent with CERCLA ARARS, including uranium MCLs. The land use planning decision is the record of decision for the Comprehensive Land Use Plan (CLUP); cleanup levels established by the 300-FF-01 and 300-FF-02 records of decision are consistent with the CLUP. Land use decisions have little impact on CERCLA groundwater standards.

Comment 105: Page 3.15, Section 3.5.3; On page 3.14, it is acknowledged that natural attenuation isn't functioning as planned. This acknowledgement is based on new information (i.e., monitoring data). Since the last 5 year ROD review, EPA decreased the MCL for uranium. EPA's basis for the change can be considered to represent new information. Therefore, significant additional information has come to light that could call into question the protectiveness of the remedies chosen for all three RODs. Therefore, the answer associated with the three RODs should be "yes."

Response to Comment 105: For the reasons stated in the previous response, DOE disagrees.

Comment 106: Page 3.16, Table 3.4: On the first row under the column entitled "Affects Current Protectiveness," the answer should be "unknown" for issue 1 and action 1-1.

Response to Comment 106: DOE disagrees with the suggested wording change. The "yes" indication under "May Affect Future Protectiveness" is sufficient.

Comment 107: Page 3.16, Table 3.4: The issue associated with characterization and remediation of chlorinated hydrocarbons should be added to the table.

The following wording is recommended: "Issue 3. Additional characterization of the chlorinated hydrocarbon groundwater contamination is needed to support remedy selection for this contamination."

The following wording is recommended: "Action 3-1. Implement the CERCLA characterization process that will allow development of a conceptual model, evaluation of human and ecological exposure, and evaluation of treatment and/or remedy alternatives."

Response to Comment 107: Chlorinated hydrocarbons in the 300 Area have a limited distribution and will likely not result in a significant release of contaminant, including degradation products, to the Columbia River. No additional text changes were made.

Comment 108: Page 3.16, Table 3.4; A Project Work Plan entitled *300 Area Uranium Plume Treatability Demonstration Project: Uranium Stabilization Through Polyphosphate Injection* (April 2006, PNNL-SA-49954) has been posted on the EM-21 website. Prior to the implementation of this demonstration, it is recommended that the proposal be submitted to EPA for review and approval.

Therefore, the following is recommended for an additional issue and action: "Issue 5. Uranium stabilization through polyphosphate injection is currently being considered as a potential groundwater remediation.

The following is recommended: "Action 5-1. After the LFI findings and conclusions have been evaluated and if uranium stabilization through polyphosphate injection is recommended for groundwater remediation, propose and implement an EPA-approved treatability test plan."

Response to Comment 108: DOE will work closely with EPA to assure the testing of the referenced technology is adequate for incorporation into the 300-FF-05 focused feasibility study/proposed plan. The DOE is investigating a potential in situ treatability option for addressing the uranium plume in the 300 Area, i.e., injection of polyphosphate into the aquifer to immobilize the uranium and reduce the concentration of dissolved uranium. Bench-scale tests on the method have been completed and are promising. A field-scale test has been designed and will soon be implemented in the 300 Area. The results will be included in a Phase III Feasibility Study report, which will contain recommendations leading toward a Proposed Plan for remedial action. The Proposed Plan will be made available to regulatory agencies and other stakeholders, for review consistent with Tri-Party Agreement requirements.

COMMENTER 9: Portland, Oregon, Public Workshop Comments

Comment 1: You take the full intent and spirit of the law!

Response to Comment 1: It is unclear exactly what the context of this comment was or what is meant by the "full intent and spirit of the law." However, it is DOE's intent to comply fully with the requirements of CERCLA.

Comment 2: You never have a self assessment by those doing the work; industry/academia does not allow this.

Response to Comment 2: CERCLA places responsibility for conducting response actions on federal facilities with the President of the United States, who delegated many of his CERCLA responsibilities to responsible federal agencies through Executive Order 12580 (EO 12580).

Under EO 12580, DOE is the lead agency responsible for conducting response actions (removal and remedial) at facilities under its control, including the Hanford Site. The NCP describes the CERCLA responsibilities of DOE. One of the key requirements of a lead agency is to conduct reviews of the status of the response actions where waste has been left in place, no less frequently than once every five years. Therefore, DOE must conduct five-year reviews in a manner consistent with the CERCLA, Executive Order 12580, and the NCP.

Pursuant to *Comprehensive Five-Year Review Guidance* (June 2001*)*, DOE as the lead agency submits the CERCLA Five-Year Review Report for the Hanford Site to EPA for its review and concurrence with the protectiveness determinations. If EPA does not concur with the DOE protectiveness statements it will inform DOE. EPA may issue a separate report that includes protectiveness statements reflecting that agency's opinions.

In 2000, EPA conducted the five-year review because EPA thought it should do so and the agencies were still sorting out lead agency responsibilities. DOE has used the 2000 EPA five-year review as a template for this review.

Comment 3: Caps are just psychological barriers for humans. They do not protect the ecosystem.

Response to Comment 3: DOE does not agree that caps are just psychological barriers for humans. Properly designed, constructed, and maintained caps isolate the contamination from the environment outside of the disposal site and prevent migration of contaminants as much as possible, thereby protecting human health and the environmental ecosystem.

The use of engineered caps for land disposal facilities is an accepted practice for those situations where the contaminants cannot be removed. Properly designed, constructed, and maintained barriers have been determined to be protective of human health and the environment by regulatory agencies, including the U.S. Environmental Protection Agency and the Washington State Department of Ecology. Both agencies have used engineered caps in conducting cleanup projects under their jurisdiction.

While DOE utilizes the remove, treat, and dispose (RTD) approach for environmental contaminants that result from spills or releases to the environment as much as possible, there are some cases where RTD after evaluated against the nine CERCLA criteria is not selected as the preferred alternative. In those instances caps (barriers) might be the preferred alternative. Any barriers that might be built at Hanford would be required to meet performance criteria to ensure adequate long-term performance and include surveillance and maintenance plans.

Comment 4: What do you mean by institutional controls (ICs)?
Response to Comment 4: EPA defines institutional controls (ICs) as non-engineered instruments, such as administrative and/or legal controls, that help to minimize the potential for human exposure to contamination and/or protect the integrity of a selected cleanup action. ICs work by limiting land or resource use and/or by providing information that helps modify or guide human behavior at the site. Some common examples of ICs include zoning restrictions, building or excavation permits, well drilling prohibitions and easements and covenants.

Comment 5: The term "IC" worries us.

Response to Comment 5: In some cases, institutional controls may be required as part of the final remedy. The use of ICs is not a way "around" treatment, but rather part of a balanced, practical approach to site cleanup that relies on both engineered and non-engineered remedies.

Comment 6: Further define ICs.

Response to Comment 6: In the National Contingency Plan (NCP), EPA emphasizes that institutional controls (ICs) are meant to supplement engineering controls and that ICs will rarely be the sole remedy at a site. The DOE Policy, DOE P 454.1, *Use of Institutional Controls, April 2003,* which is being followed by the DOE, states our intention to use institutional controls only where necessary. The following is an excerpt from that policy.

"In situations where unrestricted use or unrestricted release of property is not desirable, practical, or possible, institutional controls are necessary and important to DOE efforts to fulfill its programmatic responsibilities to protect human health and the environment (including natural and cultural resources). It is DOE policy to use institutional controls as essential components of a defense-in-depth strategy that uses multiple, relatively independent layers of safety to protect human health and the environment (including natural and cultural resources). This strategy uses a graded approach to attain a level of protection appropriate to the risks involved. DOE will use a graded approach to determine what types and levels of protective measures (e.g., physical, administrative, etc.) should be used.

The Department will implement institutional controls, along with other mitigating or preventive measures as necessary, to provide a reasonable expectation that if one control temporarily fails, other controls will be in place, or actions will be taken, to mitigate significant consequences of the failure. Institutional controls are not to be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required."

Comment 7: The process needs to be re-evaluated. Define process. Can you change the protocols of the five-year review?

Response to Comment 7: The basic requirements for five-year reviews are mandated in the CERCLA law, Executive Order 12580, and the NCP. Additional details for conducting the five-year review process are prescribed in both EPA and DOE guidance. These guidance documents provide some discretion in how the review is conducted. For example, DOE included all ongoing CERCLA actions, in addition to the minimal requirement of reviewing final Record of Decisions (ROD). Also, based on DOE outreach efforts and stakeholder interest, three public workshops (Richland, Portland, OR and one in Hood River, OR) were conducted and a 30-day public comment period was held.

Comment 8: Concern with plumes reaching the river and Oregon.

Response to Comment 8: The state of Washington has classified the general water use and water quality for the stretch of the Columbia through and below Hanford as "Class A, Excellent." Hanford currently has little impact to the Columbia River. The Hanford-derived contaminant that consistently shows a statistical increase below Hanford (measured at the City of Richland's municipal water supply intake) is tritium. The tritium is 0.24% of the drinking water standard which means it does not exceed the level that EPA has determined, in regulations issued under the Safe Drinking Water Act, is safe from a public health perspective.

Comment 9: Why isn't more cleanup occurring to prevent further contamination?

Response to Comment 9: Significant cleanup progress has occurred at Hanford, to date:

- More than 2,300 tons of spent fuel moved away from the Columbia River;
- 20 tons of plutonium-bearing materials stabilized and packaged;
- Five of nine plutonium reactors partially demolished and placed in interim safe storage;
- More than 6.3 million tons of contaminated soil dug up along the Columbia River and disposed of in the Environmental Restoration Disposal Facility;
- Thousands of drums of transuranic waste retrieved and safely shipped to New Mexico for permanent disposal;
- Construction of the Waste Treatment Plant one-third complete;
- Over 3 million gallons of liquids removed from the single-shell tanks;
- Sludge or salt waste retrieved from 4 single-shell tanks and 3 others in progress; and
- Ongoing testing of Bulk Vitrification as a potential supplemental treatment for low-activity tank waste.

Despite this progress, challenges do remain at the Hanford Site. More than 53 million gallons of radioactive and chemical waste in 173 tanks must be treated and disposed. Approximately 25 million cubic feet of solid waste are buried or stored on site. Nearly 270 billion gallons of groundwater are contaminated above drinking water standards and are spread over 80 square miles. More than 1,700 waste sites and approximately 500 contaminated facilities require remediation.

The Department's Office of Environmental Management will continue to focus on safe, cost-effective risk reduction and cleanup at Hanford and across the DOE complex. The Department remains committed to keeping the public involved and informed and to seeking advice that will best assist us as we move toward completion of this important job in Washington State.

Comment 10: Funding constraints

Response to Comment 10: In developing the FY 2007 budget request to Congress, the Office of Environmental Management took into account the notable progress made to date at Hanford as well as those challenges that lay ahead. An investment of nearly $1.9 billion for Hanford in FY2007 will allow the Department to address challenges and reduce risk, including characterization of groundwater beneath the Central Plateau, removing sludge from the K Basins, retrieving transuranic waste from the burial grounds, demolition of facilities in the River Corridor, retrieval of sludge and salt waste from single-shell tanks, and continued construction of the Waste Treatment Plant.

Comment 11: The review does not assess long-term effectiveness.

Response to Comment 11: Most of the Hanford Cleanup Project work completed recently, or in progress, is being done under Interim Records of Decision. As a result, most of the CERCLA remedies reviewed in this five-year review are interim remedies. While interim remedies must be consistent with final remedies, they may not address all contaminants or the aerial extent of contaminants in an operable unit that will be addressed in the final selected remedy. DOE anticipates that when the remedies selected in the interim Records of Decision are completed the results will be protective of human health and the environment for the contaminants and areas addressed. In some circumstances, additional work may be necessary and RODs revisions or amendments may be required. The final RODs will address long-term effectiveness.

Comment 12: How many wells?

Response to Comment 12: It is unclear if the comment concerns the number of wells needed to be decommissioned at Hanford or the number of wells sampled at Hanford. The U.S. Department of Energy Richland Operations Office (DOE-RL) has published a Hanford Site Well Decommissioning Plan, DOE/RL-2005-70, Revision 0. The plan outlines our strategic approach for managing well decommissioning at Hanford. This plan is consistent with the "Hanford Groundwater Management Plan" and the "Hanford Management Plan for Accelerated Cleanup of the Hanford Site." The plan does not outline a specific schedule for decommissioning all of Hanford's wells, recognizing that the yearly scope and schedule for well decommissioning will be defined in the Hanford budget process, balanced against other competing cleanup needs. The overall goal, however, is to complete well decommissioning on a schedule consistent with cleanup completion, while prioritizing the work on a risk-basis as described in the plan. Significant progress has been made in well decommissioning at Hanford. As of July 2005, 7,677 well identification numbers were assigned at Hanford. Of these well numbers:

- 2,442 wells were verified as previously decommissioned;
- 1,887 wells, aquifer tubes and piezometers are currently in use;
- During FY 2005, 674 wells and 175 aquifer tubes were sampled;
- We currently plan to physically decommission 140 additional wells in FY 2007;
- Our contractor has administratively confirmed the decommissioning of over 1,600 wells;
- There are approximately 1,914 wells that are potential candidates for decommissioning.

Comment 13: Concern with wording in EPA Guidance objectives – "to confirm."

Response to Comment 13: The word "confirm" will be replaced by "verify," which means, "to test the truth or accuracy of, as by comparison, investigation, or reference."

The purpose of this five-year review is to:

1. Evaluate the performance of the selected remedies for active and no action source and groundwater operable units in the 100, 200, 300, 1100 Areas and other areas on the Hanford Site to determine whether they are protective of human health and the environment.

2. Verify that immediate threats have been addressed where the operable unit has a remedial action that is still in the Remedial Action Construction phase or Remedial Action Operation phase or where a removal action is in progress and that the selected remedy(ies) will be protective when complete.
3. Verify that the selected remedy remains protective where a removal or remedial action site is in the long-term operation and maintenance phase.
4. Recommend actions to improve performance when the five-year review indicates that a remedy is not performing as designed.

Comment 14: Concern with use of caps.

Response to Comment 14: The use of engineered caps for land disposal facilities is an accepted practice for those situations where the contaminants cannot be removed. Properly designed, constructed, and maintained barriers have been determined to be protective of human health and the environment by regulatory agencies, including the U.S. Environmental Protection Agency and the Washington State Department of Ecology. Both agencies have used engineered caps in conducting cleanup projects under their jurisdiction.

While DOE tries to remove, treat, and dispose (RTD) of environmental contaminants that result from spills or releases to the environment, there are some cases where RTD after evaluated against the nine CERCLA criteria is not selected as the preferred alternative. In some instances caps (barriers) are the preferred alternative. Any barriers that might be built at Hanford would be required to meet performance criteria to ensure adequate long-term performance and include surveillance and maintenance plans.

Comment 15: U.S. Fish and Wildlife Services – cleaned up to unrestricted use.

Response to Comment 15: The U.S. Fish and Wildlife Service (USFWS) has an internal policy and process for accepting lands into the National Wildlife Refuge. This policy specifies that before lands can be accepted they must meet specific contamination criteria that are protective of biota. Currently DOE is working to meet the cleanup standards promulgated by the regulatory agencies, which are protective of the human health and the environment, and in discussions with the USFWS to resolve the policy issues concerning potential contamination levels below regulatory standards that prevent the administrative transfer of land from DOE to the USFWS.

Comment 16: Integration of risks

Response to Comment 16: The River Corridor Baseline Risk Assessment is ongoing. A risk assessment report, due out for review on June 30, 2007, will report integrated risk for the 100 and 300 Areas.

Comment 17: Lack of educational risks to the public

Response to Comment 17: DOE agrees. We struggle with how to meaningfully communicate "risk" to the public. DOE does provides information on the inherent risks associated with past production and cleanup activities at the Hanford Site through public meetings, public comment periods, presentation materials, fact sheets, website, etc. We will continue to look for better tools and processes for communicating risk to the public.

Comment 18: Bioconcentration needs to be part of the assessment and review

Response to Comment 18: DOE reviewed the effectiveness of implementation of the Interim Action RODs. The Interim Action RODs, for the 100 Area, for example, are designed to:

"1. Protect human and ecological receptors from exposure to contaminants in soil, structures, and debris by dermal exposure, inhalation, or ingestion of radionuclides, inorganics, or organics.
2. Control the sources of groundwater contamination to minimize the impacts to groundwater resources, protect the Columbia River from further adverse impacts, and reduce the degree of groundwater cleanup that may be required under future actions."

Current ecological risk assessment field sampling will provide some information on bioconcentration, which can be evaluated in future assessments.

Comment 19: Need independent review.

Response to Comment 19: As discussed in response to comment 2, under Executive Order 12580, DOE is the lead agency responsible for conducting response actions (removal and remedial) at facilities under its control, which includes the Hanford Site. One of the key requirements of a lead agency is to conduct reviews of the status of the response actions no less than once every five years. These reviews are subjected to public comment, and the report has been submitted to EPA, for an independent review of the protectiveness statements.

COMMENTER 10: Hood River, Oregon, Public Workshop Comments

Comment 1: Page 3.1.5 – 300 Area attenuation

Response to Comment 1: DOE agrees that the natural attenuation action is not meeting the remedial action objectives in the ten year time frame envisioned when the 300-FF-05 ROD was written in 1996. The statement, "The interim remedy selected as part of the initial ROD for the 300 Area NPL site remains appropriate for the operable unit" was changed to read:

Remediation of the uranium plume in the 300 Area groundwater through natural attenuation with monitoring has not achieved the remedial action objectives in the ten-year time frame envisioned when the ROD for interim action for groundwater was established. Under the existing ROD, institutional controls to prevent use of the groundwater is the primary means of protecting human health until remedial measures bring the uranium concentrations to below drinking water standards are completed. Therefore, for this operable unit, the interim remedy is considered protective for human health in the short-term because institutional controls remain in place. DOE is currently performing additional characterization activities and has initiated treatability studies supporting more aggressive treatment options. Selection of more effective remedies is anticipated in the near future. Protectiveness of the selected remedies will be evaluated in future five-year reviews.

Comment 2: Definition of protectiveness; accessing areas; what is DOE's basis for protectiveness?

Response to Comment 2: Protectiveness is generally defined in the National Contingency Plan by the risk range and the hazard index. In evaluating the protectiveness of remedies in this review, DOE used the definition of "protective" developed by the EPA-Office of Inspector General. According to that office, "CERCLA protective is defined as 'protective of human health and the environment as defined generally by a 10^{-4} to 10^{-6} risk range and a hazard index of 1 or less.'" A risk range of 10^{-4} to 10^{-6} is consistent with risk management decisions made in other EPA regulatory programs and in federal regulatory agencies in general. Therefore, promulgated regulations include, incorporate, or account for this risk range. Applicable or relevant and appropriate requirements (ARARs) are selected from regulations and cleanup remedies must comply with ARARs. Hence, compliance with ARARs is generally considered protective.

Comment 3: Haven't defined what protectiveness means for critters.

Response to Comment 3: Although ARARs and protectiveness are often related, they are not synonymous. ARARs can be waived, but protectiveness must be attained and maintained in a CERCLA action. ARARs can be modified and made more stringent if needed to ensure protection of a resource, such as wildlife. The protection of biological resources occurs on two levels. One level is operational at the population level and is routinely associated with those species not covered under the Endangered Species Act as either a threatened or endangered species. At this level, some impact or loss may be deemed "acceptable" as long as the population as a whole is not compromised. For threatened and endangered species, each individual is protected. The Endangered Species Act requires a consultation with the managing agency, either U.S. Fish and Wildlife or NOAA Fisheries, depending on the species in question when an action may impact a threatened or endangered species. Therefore, protectiveness levels vary depending upon the overall health of a specific species.

Standards deemed protective of human health may not be protective of other species and there are certain contaminants whose effects on other biological species have been demonstrated at levels below those established for humans. There is no standard definition of protectiveness for non-human species and protectiveness for one species may not be protective of another species.

Many of the Hanford-derived contaminants have ecologically protective contaminant limits such as the ambient water quality criteria. For those contaminants without such limits it is common practice to assume human limits are protective of other biota unless site-specific risk assessments provide more definitive information.

Comment 4: Availability of studies (fish)

Response to Comment 4: DOE reviews studies done by U.S. Geological Survey and other agencies and uses relevant information from those studies in its risk assessments. In addition, DOE has an ongoing environmental monitoring program that includes monitoring of the river and adjacent areas. Results from that program are reported in Section 8.4, Surface-Water and Sediment Monitoring, *Hanford Site Environmental Report for Calendar Year 2005*. The report can be accessed at http://hanford-site.pnl.gov/envreport.

Comment 5: Funding concerns to conduct cleanup

Response to Comment 5: In developing the fiscal year (FY) 2007 budget request to Congress, the DOE Office of Environmental Management took into account the notable progress made to date at Hanford as well as those challenges that lay ahead and sought nearly $1.9 billion. An investment of nearly $1.9 billion for Hanford in FY 2007 will allow the Department to address challenges and reduce risk, including characterization of groundwater beneath the Central Plateau, removal of sludge from the K Basins, retrieval of transuranic waste from the burial grounds, demolition of facilities in the River Corridor, retrieval of sludge and salt waste from single-shell tanks, and continued construction of the Waste Treatment Plant.

Comment 6: CERCLA report should be a roadmap to end state

Response to Comment 6: EPA guidance states the purpose of a five-year review is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment when completed. The basic requirements for five-year reviews are mandated in CERCLA, Executive Order 12580, and the National Contingency Plan.

Comment 7: Information that is put out is crude and "scares me to death."

Response to Comment 7: DOE strives to inform the public by providing clear, concise and meaningful information and welcomes comments about information that does not meet those objectives. For information on cleanup activities and to get assistance about your concerns, please contact the Hanford Line at 1-800-321-2008 and/or visit our website at www.hanford.gov.

Comment 8: Concerned with plumes reaching the river.

Response to Comment 8: The state of Washington has classified the general water use and water quality for the stretch of the Columbia River through and below Hanford as "Class A, Excellent." Hanford currently has very little impact to the Columbia River downstream of Hanford. The Hanford-derived contaminant that has a consistent statistical increase below Hanford, measured at the City of Richland's municipal water supply intake, is tritium. The amount of tritium recorded (0.24% of the federally-established drinking water standard) is small enough that the EPA considers the water safe to consume.

Comment 9: Report hasn't addressed deep vadose zone.

Response to Comment 9: The 100 and 300 Area records of decision are intended to be protective of groundwater, including the zone between the bottom of the excavation and the groundwater. DOE will perform an analysis to determine if contaminants remaining below the excavation pose a threat to groundwater in the close-out verification reports. It is clear that "deep vadose zone" uranium in the 300 Area and strontium-90 in the 100-N Area are continuing sources of groundwater contamination.

COMMENTER 11: Oregon Department of Energy, Technical Comments

Comment 1: Thank you again for the opportunity to review DOE's CERCLA Five-Year Review Report for the Hanford Site, and for your participation in several meetings to discuss the review with us. The

2006 five-year CERCLA review marks an important event at Hanford because it provides an opportunity for critical review and mid-course adjustment as DOE is moving from interim actions toward final cleanup decisions, particularly for the river corridor. To supplement the comments we previously provided on the five-year report, the attached technical comments provide a set of more narrowly-focused technical comments and recommendations on the May 8 review draft.

Response to Comment 1: DOE appreciate the time you spent to review the document and provide us these in-depth comments.

Comment 2: The report is very much an insider's document, and is often hard or confusing to use. Descriptions are often cryptic (e.g., description of new technologies for 100-K, Section 1.4.5.3) and not very informative for those not already conversant with details of the Hanford Site and issues. Remedial action objectives are not listed for the 100 Area operating units (OUs), so readers have no basis for assessing whether remedies are working. Maps of individual reactor areas or OUs do not have labels to identify waste sites or wells, so readers are unlikely to know what part of an area is being discussed.

Response to Comment 2: DOE agrees that the remedial action objectives would help readers assess whether remedies are working and changed the document to include such objectives for each operable unit.

DOE considered including maps with all waste sites and wells and concluded that adding this level of detail would make the maps too difficult to read. Also, there are security limitations on the type of information that can be provided in public documents.

Comment 3: We appreciate the revised format for listings of issues and action items in the May draft. This style is much easier to understand than the separate sets of statements in the March draft.

Response to Comment 3: DOE appreciates the positive feedback on the document style and format.

Comment 4: This report lumps statements of protectiveness into one all-encompassing statement for all OUs in each NPL site. We believe the process would be better served by summarizing, assessing, and discussing data for each individual OU in each NPL site, as this would encourage DOE to more thoroughly review cleanup status and monitoring data for each site and OU.

Response to Comment 4: Individual OUs have been reconfigured and altered over time. However, the approach taken in developing the protectiveness statements definitely included a thorough review of the cleanup status and monitoring data for each waste site and OU.

Comment 5: One of Oregon's concerns with the review is that DOE has taken a very narrow perspective on protectiveness. By relying on ICs and work in progress, DOE has simplified the process to the point that only the most egregious remedy failures are likely to be recognized and acknowledged as non-protective. We believe this trivializes a process that should be providing a critical self-review of the effectiveness of cleanup. We advocate a much broader scope that looks past the short-term (i.e., beyond ICs and work in progress) to examine in detail whether remedies are really working and will be effective in the long term.

Response to Comment 5: DOE believes this five-year review meets the objectives for which it was designed. The five-year review process is meant to validate that the remedies selected in Action Memoranda and records of decision are working as predicted. These remedies are expected to be protective when completed, unless the conditions and assumptions on which the decisions were based have changed significantly.

Some remedies include cleanup alternatives (e.g., remove, treat and dispose and natural attenuation) and interim ICs. The five-year review must include an evaluation of those ICs for a given period of time in determining protectiveness. When they are no longer necessary, the protectiveness assessment of the remedy will not include them. In other cases, ICs are part of the final selected remedy to ensure that it is protective over a longer period of time. These ICs will always be considered when determining protectiveness.

Most of the work completed recently, or in progress, is being done under interim RODs. An interim ROD allows cleanup to proceed and facilitates actions necessary to move the Hanford cleanup mission closer to its final goals. In some cases, such as those where the remove, treat and dispose remedy has been selected for contaminated soils, the interim actions are anticipated to be the final action. DOE anticipates that when the remedies selected in those RODs are completed the results will be protective of human health and the environment. In some circumstances where this is not the case, additional work may be necessary and ROD amendments may be required.

Comment 6: Section 1.4.1 describes the 1995 interim ROD for the 100 Area waste sites and describes removal of wastes to a depth of 15 feet. The continued presence of waste in vadose zone soils provides an ongoing source for contaminants to groundwater, as is noted in this report for chromium in the 100 Area. In making evaluations of protectiveness, this is exactly the kind of issue that should be triggering an answer of "No" in determining whether remedies are working as intended, and/or as a "Yes" is describing whether new information has come to light. Because DOE has relied on ICs and "will be protective when completed" in determining protectiveness, these kinds of issues are not adequately addressed and it is unclear whether they have been seriously considered in DOE's analyses.

Response to Comment 6: If "remove, treat and dispose" methods outlined in the 100 Area RODs are found not to be protective, CERCLA processes are available to amend the decision. For example, the ROD for 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units – Soil Remediation, published September 1995, amended by the amended ROD for 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units, published May 1997, provide a mechanism to determine acceptable levels of contaminants that may be left in-place, on the basis of surface exposure and groundwater resource protection. The 100 Area cleanup has been consistent with these requirements. All of the sources of chromium that impact groundwater have not been found and remediated; however, the work to identify, remove, treat and dispose of the source sites is ongoing. Efforts will continue to find and remediate the chromium sources in the 100 Area. Performing the source cleanup in accordance with the remedial action objectives outlined in the 100 Area RODs, as amended, will be protective of groundwater resources, the environment and human health.

Comment 7: DOE's claims of protectiveness, based on ICs, ignores the fact that those controls do not prevent discharges of contaminated groundwater to the Columbia River, nor do they prevent exposure to riparian and aquatic flora and fauna.

Response to Comment 7: DOE agrees and in response to the many comments received on the protectiveness statements, has reviewed the EPA and DOE guidance on protectiveness statements and concluded that the commenters are correct in pointing out that in some cases the protectiveness statements in the Public Review Draft of the *CERCLA Five-Year Review Report for the Hanford Site* may have overstated the level of protectiveness that can be determined based on the information available at this time. While the determination of protectiveness is somewhat subjective and the EPA and DOE guidance rather flexible, DOE has concluded that in some cases a more conservative determination would more accurately reflect the situation. Therefore, some of the protectiveness statements were revised to more conservatively reflect the level of knowledge on which the statements are based.

Comment 8: It also appears that in making assessments of protectiveness, DOE has not considered tribal use scenarios. Exposures under various tribal use scenarios will need to be run and analyzed as part of the risk assessment process and in assessing cleanup for final RODs.

Response to Comment 8: DOE has in the past and is also now working with tribal representatives to establish appropriate tribal use scenarios to be used in the risk assessment process. Hanford cleanup goals are established through regulatory processes. Records of decision are the decision documents from these processes that identify the selected remedies to address the identified risks. The five-year review process is meant to validate that the remedies selected in Action Memoranda and records of decision are working as predicted.

Comment 9: Throughout the report, DOE reports groundwater concentrations of contaminants based on what appears to be dissolved concentrations. For risk assessment purposes, total (dissolved plus suspended) concentrations need to be used. This needs to be factored into analyses of protectiveness.

Response to Comment 9: You are correct that most of the groundwater monitoring performed at Hanford uses dissolved concentrations. The use of total (dissolved plus suspended) concentrations for risk assessment purposes will be developed through appropriate data quality objective processes and incorporated thereafter into each risk assessment's controlling document. In this review, we have deferred the long-term protectiveness statements because final remedies for many of the operable units have not yet been selected.

Comment 10: Protectiveness assessments seem to be based on evaluation of single contaminants. Risk assessments need to consider cumulative exposure and cumulative risk for multiple contaminants, and protectiveness analyses need to do the same. This is another reason that determinations of protectiveness should be deferred pending completion of risk assessments.

Response to Comment 10: As discussed in response to comment 5, most of the Hanford Cleanup Project work completed recently, or in progress, is being done under interim RODs. As a result, most of the CERCLA remedies reviewed in this five-year review are interim remedies. While interim remedies must be consistent with final remedies, they may not address all contaminants or the aerial extent of contaminants in an operable unit that will be addressed in the final selected remedy. DOE anticipates that when the remedies selected in the interim RODs are completed the results will be protective of human health and the environment for the contaminants and areas addressed. In some circumstances, additional work may be necessary and RODs revisions or amendments may be required for additional contaminants or for other issues. The final RODs will address long-term effectiveness.

As previously stated, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 11: In describing the Explanation of Significant Differences for 100-NR-1 (page 1.15), the report states that "modeling the contaminants remaining still demonstrated protectiveness of the groundwater." Given the long history of problems with groundwater modeling at Hanford, model projections should not be relied on as the basis for protectiveness. This is certainly true at 100-N, where significant ongoing release of strontium 90 to riparian and near-shore areas is a significant problem for the environment.

Response to Comment 11: DOE believes the remedy of soil removal is protective in that it allows unrestricted use of the surface lands. Further soil excavation would not significantly affect groundwater contaminant levels or strontium-90 levels measured at the river shoreline. The source of strontium-90 in the groundwater is from the strontium-90 that is bound to the soil matrix in the aquifer and that part of the soil column that is rewetted as the aquifer rises in elevation in response to rising river stage. The amount of strontium-90 impacting groundwater from meteoric recharge through the vadose zone is inconsequential. This conceptual model has been developed through years of field observation and confirmed by numerical models. The selected remedy (source removal and pump-and-treat) has not reduced the strontium-90 at the river. DOE is testing new technologies at 100-N, which will be assessed by field observation and analyses of groundwater/river samples. Only after sufficient samples of the barrier and the surrounding environment are taken will projections be made as to future protectiveness.

Comment 12: Section 1.4.2.4 notes that "...deep vadose zone chromium residues continue to act as a reserve for future contamination of groundwater." This statement should be factored into any determinations of protectiveness for groundwater, but it seems unlikely this was done.

Response to Comment 12: DOE agrees that there are unremediated deep vadose zone chromium sources that appear to continue to act as a reserve for future contamination of groundwater. The protectiveness statements have been revised to reflect the improvements needed to achieve the remediation goals.

Comment 13: Discussions of the river corridor should identify and discuss status and trends for all contaminants that are present in concentrations above drinking water and/or aquatic life standards. This report does a poor job of identifying and discussing the "second-tier contaminants" such as tritium, carbon-14, nitrate, TCE, and strontium 90 at reactors other than 100-N (the second tier is really everything except the big hitters - chromium at 100-D and 100-K; strontium 90 at 100-N; and uranium in the 300 Area). Mention of these contaminants is hit-and-miss, and they are virtually never considered in identifying issues and action items. If there is an implicit assumption that cleanup of source areas will take care of these contaminants, the report should say so and provide evidence to support the assumption. If no such assumption is made, DOE needs to define a path forward in issues/action items for managing these materials.

Response to Comment 13: The 100 and 300 Area cleanup decisions are interim actions, designed to address principle threats, not all of the contaminants of potential concern. The protectiveness statements were revised to also reflect that the cleanup decisions are for interim actions and further work is required to determine "protectiveness."

For the purposes of a CERCLA five-year review, DOE is concerned with the performance of the remedies in meeting the remedial action objectives established by the RODs for interim actions. The interim measures taken under the records of decision for interim action were focused on the key contaminants that drive risk. Per the Hanford Past Practice Strategy, DOE will complete the CERCLA RI/FS process where all of the identified contaminants of concern will be considered.

Comment 14: Arguably, DOE should be stating an "issue" for every contaminant at every OU where concentrations remain about a standard, and should identify one or more actions to define the path forward for resolution.

Response to Comment 14: DOE disagree. The CERCLA RI/FS process will adequately address the identified contaminants of potential concern at all of the operable units remaining on the NCP.

Comment 15: Continuing on the issue of second-tier contaminants, the 100-F Area provides an example of the importance of addressing these contaminants. While chromium concentrations seem to be generally decreasing at this site, they remain well above standards. In addition, concentrations of nitrate are increasing, concentrations of strontium are "neither increasing nor decreasing," and TCE, tritium, and uranium are present. Observations at this site show that dynamics of chromium and the other contaminants are independent, and that a cleanup strategy focused on chromium might not resolve the secondary contaminant plumes. We note that there are other examples of concentration trends for chromium and other contaminants behaving differently at other reactor areas, highlighting the need to address all contaminants in identifying issues and action items and in planning cleanup.

Response to Comment 15: DOE recognizes the dynamic contaminant responses and that not all of the contaminants of potential concern are addressed in the records of decision for interim action for the 100 and 300 Areas and therefore, are not fully addressed in this document. We also recognize that final protectiveness statements cannot be made until the CERCLA RI/FS process is complete. The purpose of a CERCLA five-year review is to evaluate the implementation and performance of selected remedies in order to determine if the remedies are or will be protective of human health and the environment when completed. The remedies selected to date are, for the most part, CERCLA records of decision for interim action and the cleanup requirements are defined by the remedial action objectives outlined in these records of decision. As these records of decision are for interim measures, not all of the contaminants of potential concern are addressed in the records of decision and remedial action objectives. All of the identified contaminants of potential concern will be addressed in the RI/FS process.

Comment 16: We strongly disagree with DOE's determination that current remedies are protective for groundwater at the 100-K area. Chromium concentrations in some wells are "steadily increasing," a new chromium plume has reached the river, the plume has escaped the eastern end of the pump-and-treat system, and several secondary contaminants (strontium 90, carbon 14, tritium, and nitrate) are present at high levels, with the report acknowledging that at least one of them (tritium) is unlikely to be successfully controlled by cleanup of waste sites. In spite of all these major problems, DOE states that current remedies are protective.

Response to Comment 16: DOE believes that the selected remedy (source removal and pump-and-treat) will protect aquatic resources from chromium. However, as the review concludes, the pump-and-treat system design needs to be improved. The report was revised to reflect that the current system has not achieved protectiveness goals.

Comment 17: Findings of the 100-N ecological impacts assessment report need to be incorporated into this report.

Response to Comment 17: The 100-N ecological impacts assessment report was published after the cut-off date for incorporation into the five-year review. The findings of the 100-N ecological impacts assessment report support other data showing that the pump-and-treat system was ineffective at reducing strontium-90 concentrations at the shoreline. The data and analyses from the report, however, are being utilized in the design of the treatability tests and will be considered in the FFS/PP for 100-NR-02.

Comment 18: Discussion in Section 1.4.5 probably understates the effectiveness of the pump-and-treat at the 100-N Area. The report dwells on the rate of strontium 90 removal by pump-and-treat and compares it unfavorably to the rate of decay. The remedial action objective for the 100-N Area interim ROD was not removal of strontium from groundwater, but to intercept and capture strontium flowing into the Columbia River in groundwater. The effectiveness of achieving that goal is undetermined. The interim ROD identified a stopgap procedure (pump-and-treat) for use until better technologies could be developed and implemented. While the pump-and-treat might not be a resounding success, the actual success of the pump-and-treat in reducing contaminant flow to the river is unknown.

Response to Comment 18: DOE disagrees. Strontium-90 measurements in wells and drive-points along the Columbia River and in clam shells provide sufficient data that the pump-and-treat system did not reduce strontium-90 concentrations at the river.

Comment 19: The description of ISRM in Section 1.4.6.2 places an optimistic spin on a remedy that has failed. This section should be rewritten. Action 11-1 indicates that iron amendments will be emplaced above the ISRM barrier and evaluated to determine whether they improve performance of the ISRM system. Does DOE have expectations for the longevity of the modified system, and do they have plans to assure long-term performance of this system for protection of groundwater and the river corridor? More importantly, by shifting to a new approach for trying to control chromium, DOE is implicitly acknowledging failure of the original ISRM system.

Response to Comment 19: The In-situ Redox Manipulation (ISRM) system has not failed. There are areas of chromium breakthrough, but the technology works. The injected iron amendments are intended to enhance the native iron to improve the barrier's performance. Reductive chemistry technologies are being evaluated that would be utilized up-gradient of the barrier. This combination of technologies should prove more effective at stopping the contaminant from reaching the river.

Comment 20: Section 1.4.6.2 describes the efficiency of the 100-HR-3 pump-and-treat as "over 95%." What does this mean - it has operated 95% of the time; it removes 95% of chromium in solution; something else?

Response to Comment 20: The system is operational 95% of the time, removing chromium at an acceptable level.

Comment 21: As was the case for the 100-K Area, we disagree with the assessment that the current remedy at 100-D is protective of groundwater and of the environment in the river corridor. ISRM has failed and efforts to locate chromium sources have been unsuccessful. DOE needs to look past ICs to assess the real protectiveness of the existing remedies.

Response to Comment 21: DOE has initiated an aggressive evaluation of technologies to address the chromium at 100-D. These technologies are intended to locate and remediate the chromium sources, repair the ISRM barrier, evaluate reductive chemistries to convert chromium to a less toxic and less mobile form and support much larger pump-and-treat systems. While ICs are mandatory during conduct of remedial actions and may be part of final remedies, DOE has and continues to look past ICs when evaluating the protectiveness of selected remedies.

Comment 22: Concentrations of chromium at 100-F are described in the context of drinking water standards, not the much lower aquatic life standard.

Response to Comment 22: It is appropriate for inland areas to describe the chromium in the context of drinking water standards. The ambient water quality criterion for chromium is an applicable ARAR where aquatic biota is exposed to chromium-contaminated discharges. Inland, the drinking water maximum contaminant level (i.e. drinking water standard) for chromium is applicable. It is DOE's goal, consistent with CERCLA, to keep hexavalent chromium below levels of environmental risk (ambient water quality criterion) and to restore the aquifer (drinking water standards). Site-specific determinations will be made to determine if the restoration to drinking water standards in the inland portions of the plumes is sufficient to assure hexavalent chromium levels are below ambient water criterion at the points where aquatic biota are exposed.

Comment 23: For all discussions of non-radiological contaminant concentrations at all sites and in all groundwaters, DOE needs to review whether new standards have been promulgated since RODs were written or since the previous five-year review in 2001. If so, these need to be factored into assessments of protectiveness and noted as a change in assumptions or as new information.

Response to Comment 23: Under CERCLA ARARs selected by records of decision are "frozen" as long as the record of decision is in effect, thus there is not a need to review new standards under the CERCLA five-year review. ARARs will, however, be reviewed when "final" records of decision" are developed that supersede the records of decision for interim action.

Comment 24: As indicated by other comments, we believe that Section 1.5 needs to be completely rewritten to address protectiveness for each OU, and to modify unsupportable assertions of protectiveness.

Response to Comment 24: DOE evaluated each operable unit to determine if the selected remedy(ies) for each OU was/were performing as intended. However, as discussed previously, DOE followed EPA's lead in the 2001 five-year review and made protectiveness determinations on an NPL Site basis. As noted, DOE has revised the protectiveness statements, where appropriate, to reflect the current level of knowledge. Section 1.5 was revised as needed to reflect the approach taken on evaluating the protectiveness of selected remedies.

Comment 25: Section 1.7 asserts that in OUs where work has not been completed, "exposure pathways that could result in unacceptable risks are being controlled." We believe this assertion is incorrect for exposure and risk for the environment, and needs to be modified to indicate that risks are being controlled only for human exposure and only through use of ICs.

Response to Comment 25: DOE disagrees, waste sites yet to be remediated are, for the most part, covered by a layer of soil thus limiting environmental exposure.

Comment 26: RAOs are listed for the 200 and 300 Area RODs; these make understanding remedies and evaluating their effectiveness much easier. Discussion for the 100 Area would benefit from inclusion of the RAOs.

Response to Comment 26: DOE agrees. The remedial action objectives for the 100 Area were added to the report.

Comment 27: The failure to locate waste drums at the 618-7 burial ground raises a number of concerns. First, this went unacknowledged in the assessment of protectiveness for the 300-FF-2 OU. Second, this calls into question the reliability of existing information regarding the nature and location of buried wastes, and of plans based on that information.

Response to Comment 27: DOE agrees there is a lack of detailed information on the content and form of materials in the burial grounds. As the review points out at page 3-8, the 618-7 waste drums have not been located, which may necessitate revision or re-evaluation of the treatment plan. Because of lack of information, numerous protective measures have been put in place as part of the selected remedy. These measures are needed to ensure the exhuming of the River Corridor burial grounds are done safely. The five-year review process is meant to validate that the remedies selected in Action Memoranda and records of decision are working as predicted. As stated previously, DOE's determination of protectiveness is made based upon the remedy selected and whether it is achieving its objectives of protecting human health and the environment. Therefore, the lack of detailed information on the specific locations of waste drums is not a factor in evaluating the protectiveness of the remedy.

Comment 28: Section 3.5.3 of the report acknowledges that the interim remedy for 300-FF-5 (monitored natural attenuation, or MNA) is not working as planned, but Section 3.4.2.1 states that the interim remedy "remains appropriate" and that RAOs for the unit "also remain appropriate." These statements are inconsistent and we suggest that Section 3.4.2.1 be changed.

Response to Comment 28: The statements were inconsistent and were corrected. Natural attenuation is not reducing uranium levels to remedial action goals and we are evaluating remedial action alternatives.

Comment 29: Section 3.4.2.1 cites reliance on ICs to make the case that interim remedies for 300 Area groundwater are protective of the environment. This argument is unsupportable, since no risk assessment data are available. Assessments of protectiveness of the environment, for this area and for all of Hanford, must be deferred until appropriate risk assessments have been completed.

Response to Comment 29: The use of institutional controls for groundwater is appropriate where cleanup actions are ongoing and the groundwater has not yet met standards. Institutional controls are also appropriate where it is technically impracticable to meet groundwater cleanup goals.

As previously stated, DOE did conclude that in some cases the protectiveness statements in the draft report were more optimistic in describing the final level of protectiveness than can be determined based on available information. Therefore, DOE did revise the protectiveness statements, where appropriate, to reflect the current level of knowledge.

Comment 30: Section 3.4.4 states that "computer simulation models are under development to provide better estimates for the flow of groundwater and transport of contaminants of concern beneath the 300 Area…" The failure of MNA and the ongoing limited field investigation in the 300 Area speak to the lack of an adequate understanding of uranium inventories and solubility controls in the 300 Area. It is premature to model when a fundamental understanding of processes and critical data are lacking. We note and support ongoing hydrologic modeling in the 300 Area, but would argue that hydrologic models that do not incorporate behavior in three dimensions (no data are available for movement parallel to the river) are insufficient for understanding or predicting contaminant movement.

Response to Comment 30: Significant geochemical, hydraulic, and geologic data are currently being collected to refine the conceptual model. The conceptual and numerical models will evaluate groundwater flow and contaminant transport in three dimensions.

Comment 31: We are disappointed by report language regarding the issue of future land uses in the 300 Area. Given the divergent perspectives of DOE and the City of Richland regarding future land uses of this area, we strongly encourage DOE to plan and clean to standards consistent with the least restrictive land use. While the five-year review is not a decision document for land use decisions and cleanup plans, language in this and other recent documents indicates a preference by DOE to clean up to the lowest possible standard. Cleanup to a lower standard means several things, none of which we view as favorable.

- DOE is either precluding options for future use of the area, or is forcing additional cleanup in the future when land use decisions for the 300 Area are modified to be consistent with needs of the City of Richland.
- DOE would be required to monitor and review status of the area for the indefinite future; has the Department fully evaluated the relative life cycle costs of full cleanup as compared to partial cleanup, followed by long term monitoring and land use controls?

A lower level of cleanup compromises environmental protection by allowing long-term releases of uranium via groundwater.

Response to Comment 31: DOE assessed the 300 Area industrial re-use study conducted by the City of Richland to determine if it affected any of the CERCLA remedial action decisions that were established in RODs. At this time the City of Richland study does not warrant a change to the current or reasonably anticipated future land uses for the 300 Area as established in the Hanford Comprehensive Land Use Plan. DOE anticipates the Department potentially may have future missions for the 300 Area. Therefore, no decision has been made to transfer this parcel of land out of the DOE's administration in the foreseeable future

DOE also reviewed the end state vision for the 300 Area. The recommendations from the *Hanford Site End State Vision*, DOE/RL-2005-57, are:

- Continue remediation of waste sites to industrial standards as required under the current interim action record of decision.
- Complete the risk assessment for the River Corridor to support final remedial decisions. The outcome of the River Corridor risk assessment, the final remedy for groundwater, the five-year review of land use decisions and the data gathered during the early stages of cleanup will be considered along with public input before final 300 Area site remedies are identified.

DOE currently is conducting the Columbia River Baseline Risk Assessment. The report adequately states the current issues with regards to groundwater cleanup.

DOE believes the source of continued uranium release to the groundwater is from the area rewetted by the rising aquifer resulting from high river stages. This conceptual model and the potential effects of uranium left below the excavation depth will be evaluated in the 300-FF-05 FFS/PP.

Comment 32: Section 3.5.1 could be shortened to a few critical issues - MNA is not working, and DOE does not understand uranium inventories and controls. We're not sure we see the need to restate what turned out to be incorrect assumptions, or to speculate about what might explain the failure. We also ask that the statement of protectiveness near the bottom of page 3.13 be modified. Since the remedy has failed, the statement is irrelevant. Moreover, statements of protectiveness for the environment need to be deferred until ecological risk assessments are completed.

Response to Comment 32: DOE believes the information contained in Section 3.5.1 is relevant to this five-year review. As stated previously, per CERCLA, five-year reviews provide an opportunity for the lead agency in a cleanup to review what actions are protective and which are less so. Results from ongoing studies and assessments will be fed into remedial actions as appropriate, but need not delay this five-year review.

The document states that the 300-FF-05 remediation decision and action have not reached protectiveness goals. It is not necessary to wait for the ecological risk to be completed to make a protectiveness statement, as the ten-year record of performance indicates that groundwater goals will not be achieved in a reasonable timeframe. It is important to the objectives of the CERCLA five-year review to evaluate the failure mechanism(s) of cleanup decisions.

Comment 33: We don't understand the statements of protectiveness for the 300-FF-2 OU. DOE was unable to locate source material at 617-8, and the tritium plume at 618-11 is not yet understood. There is apparently no knowledge of the tritium source, no information whether similar releases might occur in the future, and plume migration is not well understood. These suggest to us that determination of protectiveness should be deferred until these waste areas and groundwater plumes can be better characterized.

Response to Comment 33: Most of the Hanford Cleanup Project work completed recently, or in progress, is being done under interim records of decision, including 300-FF-2. As a result, most of the CERCLA remedies reviewed in this five-year review are interim remedies. DOE provided its assessment of the protectiveness of these interim remedies per DOE and EPA guidance for five-year reviews. While interim remedies must be consistent with final remedies, they may not address all contaminants or the aerial extent of contaminants in an operable unit that will be addressed in the final selected remedy. DOE anticipates that when the remedies selected in the interim records of decision are completed the results will be protective of human health and the environment for the contaminants and areas addressed. It is acknowledged that in some circumstances, additional work may be necessary and that RODs revisions or amendments may be required. The final RODs will address long-term effectiveness.

DOE has revised the protectiveness statements, where appropriate, to reflect the current level of knowledge.

Comment 34: For the 1100 Area, please explain why a "memo to file" was used as the vehicle for removal of DDT during 2005. We don't understand why the 2005 cleanup was done outside the CERCLA process, and why the removal is deemed a "non-significant change." It is hard to understand how a site can go through cleanup and delisting and can have remedies deemed protective, then need additional cleanup. This failure of the original process at this site raises significant doubt about the comprehensiveness and reliability of this and other cleanups on the site. We also wonder how remedies can be called protective and how it can be asserted that there was no new information during the past five years when additional cleanup was required. Section 4.5 should be rewritten to reflect the additional work done in the 1100 Area during 2005.

Response to Comment 34: Post-remediation monitoring and soil sampling indicated that a portion of the Horseshoe Landfill still contained DDT contaminated soil above the 1100 Area ROD specified cleanup level. The remedy was assessed pursuant to EPA guidance to consider whether it was protective of human health and the environment and whether the additional removal of contaminated soil was a significant change. DOE and EPA determined that the remedy was protective and the additional removal work was a non-significant change. To correct any perceived deficiency, DOE and EPA wrote a memo-to-file to permit excavation of the additional contaminated soil as EPA guidance indicated would be appropriate. Since there was no need to significantly change the remedial action requirements of the existing ROD, the additional excavation was documented by DOE and EPA in the memo-to-file as a "non-significant" change to the ROD. The additional soil was subsequently excavated and disposed of in Hanford's Environmental Restoration Disposal Facility (ERDF). DOE also voluntarily utilized a cleanup level that was slightly lower than the level specified in the ROD.

Comment 35: Issue 20 indicates that DOE wishes to end groundwater monitoring for TCE in the 1100 Area. We would support a reduction in frequency of monitoring, but given the often erratic dynamics of contaminants in Hanford groundwater and the stochastic nature of events, we believe it is premature to call for cessation of monitoring.

Response to Comment 35: There is no intent to cease monitoring of trichloroethene (TCE) in the 1100 Area. We agree that a significantly reduced frequency is appropriate at this time.

Comment 36: Section 4.3.2 notes that the 1100 Area ROD required monitoring of nitrate in the vicinity of Horn Rapids Landfill. There is no mention of nitrate monitoring or of nitrate status in groundwater in this report. What is the status of nitrate, and how would monitoring be affected by the proposed cessation of monitoring for TCE?

Response to Comment 36: Nitrate levels from offsite agricultural and industrial sources continue to be elevated. Cessation of TCE monitoring would not affect nitrate status in the groundwater. However, as noted in the prior comment response, DOE is not recommending cessation of TCE monitoring, but is recommending that it be done less frequently.

Comment 37: We look forward to working with DOE to plan continued cleanup of Hanford in a manner that is efficient and protective of human health and the environment. As a step toward that goal, we encourage you to carefully consider our comments as you develop the final five-year report.

Response to Comment 37: DOE appreciates the Oregon Department of Energy's on-going interest in the Hanford cleanup and will continue to work with the state of Oregon on future cleanup decisions and CERCLA five-year reviews.

COMMENTER 12: Gerry Pollet, Heart of America Northwest

Comment 1: DOE's Five-Year Review of Hanford Clean-Up is Not Credible – EPA Must Reject: The DOE's five-year review of Hanford clean-up remedies (a requirement of the federal Superfund law, CERCLA) fails to meet basic requirements and clearly ignored public input. EPA should reject this review and its conclusions that all but two of the remedies will be effective in protecting human health and the environment.

Response to Comment 1: DOE disagrees and believes the review addressed the intent of the five-year review as outlined in CERCLA, Executive Order 12580, 40 CFR 300, and DOE and EPA guidance. EPA guidance states the purpose of a five-year review is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment when completed.

Additional details for conducting five-year review process are prescribed in both EPA and DOE guidance. These guidance documents provide some discretion in how the review is conducted. For example, DOE included all CERCLA actions, in addition to the minimal requirement of final RODs.

DOE takes seriously its obligation to consult with tribal nations and solicit and consider comments from stakeholders and the public. DOE believes input from the public is fundamental to the successful execution of its missions and responsibilities. Based on DOE outreach efforts and stakeholder interest, DOE held three public workshops (in Richland, WA, Portland, OR, and Hood River, OR) and a 30-day public comment period.

Comment 2: The law required that this review be done, and done right. It was not. Public review meetings were not meaningful, as evidenced by the failure to include or offer meaningful response to comments. (Hanford Advisory Board advice does not even appear in the document or the publicly accessible record of comments on the website, much less others' comments from 2005.) The Board spent a great deal of effort providing input. DOE did not reciprocate by spending even the required effort to consider Board and public input.

Response to Comment 2: This five-year review was performed as required by law and EPA and DOE guidance.

As stated in the previous response to comment, DOE provided several forums and opportunities for public input and considered the input received. The comments and responses to those comments are posted on the CERCLA five-year review website (www.hanford.gov/?page=182&parent=0). Although not required, DOE held a workshop in December 2005 to discuss the scope of the CERCLA five-year review, a 30-day public comment period on the draft report, and two regional public workshops requested by stakeholders.

The Hanford Advisory Board issued one piece of advice, Advice #190, on the CERCLA five-year review at its June 2006 meeting. This advice, along with all comments received, was posted to the publicly accessible CERCLA five-year review website during the public comment period. The responses to that advice are included in this comment-response document.

Comment 3: We voiced concern to EPA allowing DOE to proceed with this review on its own. Everyone said trust DOE - but, that EPA retains its ultimate authority to approve or reject the conclusions of this review. The Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S. Code 103 (CERCLA) mandates responsibilities for conducting response actions on federal facilities to the President of the United States. CERCLA Section 9615 specifically authorized the President to delegate his CERCLA responsibilities to responsible federal agencies.

Response to Comment 3: Through Executive Order 12580 (EO 12580), the President has delegated many of those responsibilities to Executive Branch agencies, including specifically, DOE. Under EO 12580, DOE is the lead agency responsible for conducting response actions (removal and remedial) at facilities under its control, which includes the Hanford Site. One of the key requirements of a lead agency is to conduct reviews of the status of the response actions no less frequently than once every five years. Therefore, DOE must conduct five-year reviews in a manner consistent with the CERCLA, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300), and Executive Order 12580.

The specific legal requirements are stated below:

"Sec. 9615. Presidential delegation and assignment of duties or powers and promulgation of regulations

The President is authorized to delegate and assign any duties or powers imposed upon or assigned to him and to promulgate any regulations necessary to carry out the provisions of this subchapter."

CERCLA §121(c), as amended, states:
"If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each

five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented."

Executive Order 12580, Sections 2 (d) and (e) state:
(d) Subject to subsections (a), (b), and (c) of this Section, the functions vested in the President by Sections 104(a), (b), and (c)(4), 113(k), 117(a) and (c), 119, and 121 of the Act are delegated to the Secretaries of Defense and Energy, with respect to releases or threatened releases where either the release is on or the sole source of the release is from any facility or vessel under the jurisdiction, custody or control of their departments, respectively, including vessels bare-boat chartered and operated. These functions must be exercised consistent with the requirements of Section 120 of the Act.
(e)
(1) Subject to subsections (a), (b), (c), and (d) of this Section, the functions vested in the President by Sections 104(a), (b), and (c)(4), and 121 of the Act are delegated to the heads of Executive departments and agencies, with respect to remedial actions for releases or threatened releases which are not on the National Priorities List ('the NPL') and removal actions other than emergencies, where either the release is on or the sole source of the release is from any facility or vessel under the jurisdiction, custody or control of those departments and agencies, including vessels bare-boat chartered and operated. The Administrator shall define the term 'emergency,' solely for the purposes of this subsection, either by regulation or by a memorandum of understanding with the head of an Executive department or agency.
(2) Subject to subsections (b), (c), and (d) of this Section, the functions vested in the President by Sections 104(b)(2), 113(k), 117(a) and (c), and 119, of the Act are delegated to the heads of Executive departments and agencies, with respect to releases or threatened releases where either the release is on or the sole source of the release is from any facility or vessel under the jurisdiction, custody or control of those departments and agencies, including vessels bare-boat chartered and operated.

The NCP Part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:
"If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action."

Comment 4: Because the review fails to meet basic requirements; and, failed to even consider relevant legal standards and new data, it is necessary for EPA to reject the determinations proposed by DOE. This is a fundamental test of EPA's credibility and independence. The public is watching what EPA will do. The review is clearly inadequate. It is up to EPA to make the determination of protectiveness, including whether it is still credible that the 300 Area (the southern gateway to the Hanford Reach National Monument) will be industrial after all buildings are removed, whether the groundwater remedies are effective based solely on claims that institutional controls exist (without assessing if they will be effective in the face of reasonably foreseeable public use pressure), and whether new data on risk has been incorporated.

Response to Comment 4: DOE met the requirements set out for this review and did consider relevant legal standards and new data.

Pursuant to *Comprehensive Five-Year Review Guidance* (June 2001) OSWER 9355.7-03B-P, EPA 540-R-01-007 the CERCLA Five-Year Review Report for the Hanford Site was provided to EPA for its review and concurrence with the protectiveness determinations. If EPA does not concur with the DOE protectiveness statements, it will inform DOE. EPA may issue a separate report that includes protectiveness statements reflecting that agency's opinions.

Comment 5: In regard to the high profile 300 Area exposure scenario, and the fundamental question of whether the presumed scenario on which the remedies are based is protective, DOE fails to address the legal criteria for exposure scenarios in the review. Instead, DOE asserts that it determines land use while it owns the land. DOE acknowledges in the review that DOE has no foreseeable industrial use for the 300 Area, and the land may be, in fact, used for recreation and other non-industrial uses, and that the City of Richland's planning documents now recognize that the likely future uses of this area involve exposure to the public from commercial, recreational and similar uses. Nonetheless, DOE's review utterly fails to consider or even offer a discussion of the relevant standards for exposure scenarios under MTCA (the state law which is legally required to be met) or CERCLA. State law – which must be complied with pursuant to CERCAL Sections 120 and 121 – requires that an industrial cleanup exposure scenario may only be used when there is no reasonably foreseeable use of the area by children and people other than adults working in the area in buildings or on asphalt for 2000 hours a year. DOE's approach for the 300 Area is symptomatic of the entire review. It simply reasserts that DOE has made a decision, or that a ROD was issued and that ends the discussion of protectiveness.

Response to Comment 5: DOE assessed the 300 Area industrial re-use study conducted by the City of Richland to determine if it would affect any of the CERCLA remedial action decisions that have been established in RODs. DOE concluded that the recommendations from the study are one of the factors that would be taken into consideration when the DOE evaluates its land use decisions made for Hanford as a whole, or the 300 Area specifically. At this time the City of Richland study does not warrant a change to DOE's current or reasonably anticipated future land uses for the 300 Area as established in the Hanford Comprehensive Land Use Plan. DOE anticipates the Department may have future missions for the 300 Area and believes the current and reasonably anticipated future land use for the 300 Area is and will be industrial. DOE does not intend to transfer this parcel of land out of DOE's administration in the foreseeable future.

The five-year review process assesses the current and future protectiveness of the remedies selected in Action Memoranda and RODs. The remedies selected and documented in the Action Memoranda and RODs were selected based on the expectation that they would be protective when complete.

The use of the Washington Model Toxics Control Act in the CERCLA cleanup of Hanford has been addressed by the Washington Office of the Attorney General. The Attorney General's statement is as follows:

"Ecology elected not to assert MTCA authority at Hanford based on several considerations. First, there have been legal questions concerning the application of MTCA to address those radionuclides regulated by the federal Atomic Energy Act of 1954 (AEA) (i.e., source, special nuclear, and byproduct materials as defined by the AEA). Federal courts have held that the AEA preempts state regulation of the radiation hazards of such materials in non-cleanup scenarios, and it is undetermined whether these decisions extend to preclude the application of MTCA to remediate radiation risks. While Ecology has never conceded any authority granted through MTCA, in light of these decisions, Ecology chose to focus its regulation under MTCA where its authority is clearest. Therefore, Ecology has not previously made provisions to regulate the radiation hazards of AEA-regulated radionuclides."

Comment 6: Similar examples can be found for the use of an uranium cleanup standard that is far in excess of the drinking water standard established in recent years, total cancer risk requirements, and numerous other issues. DOE's approach ignores the entire purpose of the five-year review mandated by CERCLA.

Response to Comment 6: DOE does not agree that a review of new standards is necessary to perform a CERCLA five-year review of the cleanup progress at Hanford.

Once a ROD is signed and a remedy chosen, EPA will not reopen that decision unless the new or modified requirement calls into question the protectiveness of the selected remedy. EPA believes that it is necessary to "freeze ARARs" when the ROD is signed rather than at initiation of remedial action because continually changing remedies to accommodate new or modified requirements would disrupt CERCLA cleanups.

The policy of freezing ARARs at the time of the ROD signing will not sacrifice protection of human health and the environment, because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently, if there is reason to believe that the remedy is no longer protective of health and environment.

At the completion of the 300-FF-05 CERCLA Limited Field Investigation, a feasibility study/proposed plan (FS/PP) will be submitted by DOE to EPA. This FS/PP will evaluate alternative technologies to address the uranium plume and the other contaminants of potential concern. If a new ROD is determined to be necessary, all promulgated standards, applicable or relevant and appropriate to federal facilities will be used as CERCLA ARARs.

Comment 7: In regard to total cancer risk – not one of the current remedies are protective of human health as required by CERCLA and MTCA. Cleanup decisions considered in the review utilize alternatively either 15 mrem of radiation exposure as "allowable" or state that the remedy must meet the CERCLA cancer risk range of $1x10^{-4}$ (one additional fatal cancer for every ten thousand people exposed) to $1x10^{-6}$ (one additional fatal cancer for every one million persons exposed). The federal Superfund law mandates that the allowable risk remaining must meet Washington State's standards for cancer risk at hazardous waste release sites – which is one additional cancer in one hundred thousand exposed children or other sensitive populations ($1x10^{-5}$). Both Washington State law and EPA's own CERCLA guidance require that all the cancer risk from all carcinogens be summed together to meet this standard – radionuclides are not legally allowed to be considered separately from other carcinogens. 15 mrem was known at the time of these remedies to result in a cancer risk exceeding the CERCLA allowable risk range of $1x10^{-4}$ to $1x10^{-6}$. 15 mrem was estimated to result in 3 to 5 fatal cancers in adults for every 10,000 exposed. EPA's own research and guidance documents establish that the incidence of cancer in children is three to ten times greater than adults for the same exposure. Thus, conservatively, the remedies allowed 9 times greater risk to children than CERCLA standards allowed five years ago – before adding in the risk from all other carcinogens at the unit or in the groundwater or surface water. This would be 90 times greater than the risk allowed under Washington's Model Toxics Control Act (MTCA). The federal law (CERCLA) specifies that DOE and EPA must meet the more stringent state standards.

Response to Comment 7: DOE disagrees. Current EPA guidance states that EPA "has consistently concluded that levels of 15 mrem/yr EDE, which equate to approximately a 3 x 10^{-4} cancer risk or less, are protective and achievable," and further reiterates that EPA has concluded that "a risk level of 3 x 10^{-4} is essentially equivalent to the presumptively safe level of 1 x 10^{-4}." This comparison generally over estimates the risk in that it presumes the maximum exposure rate of 15 mrem per year each year following remedial action while actual exposure rates over the exposure period typically are likely to be lower.

In guidance issued in March 2005 EPA provided general, default adjustments for childhood cancer risk versus adult risk. However, these default adjustments are intended for general application to chemical carcinogens where actual data are not sufficient to support chemical-specific estimates, and the guidelines indicated that "these cancer guidelines are not intended to provide the primary source of, or guidance for, the Agency's evaluation of the carcinogenic risks of radiation." Rather, EPA stated that "assessment of risk from radiation sources is informed by the continuing examination of human data by the National Academy of Sciences/NRC in its series of numbered reports: "Biological Effects of Ionizing Radiation" [BEIR], and that "further information relevant to comparing cancer risks from juvenile versus adult exposure from UNSCEAR (2000) and EPA (1994; 1999) [i.e., Federal Guidance Report (FGR) #13] is presented as representative findings to determine whether the radiation data are similar qualitatively to the chemical findings."

A review of the data and conclusions in the UNSCEAR, FGR #13, and BEIR reports show that the general, default adjustments for childhood cancer risks are not applicable to radiation exposure. The EPA cancer risk slope factors, which are based on Federal Guidance Report #13 data, are population-averaged values, i.e., they incorporate risk data from all age groups, including childhood age groups, and both genders. Therefore, given that the EPA guidance on carcinogenic risk assessment is not directly applicable to radiation risk, and the EPA cancer risk factors used in Hanford CERCLA risk assessments include increased radiation risk in childhood, DOE believes that higher childhood radiation risk factors have been adequately addressed.

As discussed above in response to your Comment 5, the Washington State Department of Ecology has elected not to assert MTCA authority at Hanford based on several considerations. Section 5 of the Cleanup Priority Act (CPA) attempts to mandate that Ecology treat radionuclides as hazardous substances under MTCA and apply MTCA cleanup levels to radionuclides (e.g., 10^{-5} Excess Lifetime Cancer Risk). The federal district court declared the CPA invalid in its entirety and the Act is therefore not being implemented anywhere.

As a practical matter, numerical cleanup levels for radionuclides cannot be developed using the current MTCA methods A, B and C, because the MTCA methodology does not include methods to calculate risk from external radiation. Therefore, the MTCA carcinogenic risk standard can not be applied to radionuclides using the MTCA regulations as written.

Comment 8: In the last year, a new formal scientific consensus on the risk from exposure to radiation has been issues by the National Academy of Sciences, which is supposed to be binding on EPA, Ecology and DOE. This is found in the report published in June 2005 by the NAS: Biological Effects of Ionizing Radiation VII (BEIR VII). As discussed in our prior comments, and in the advice of the Hanford Advisory Board to DOE, Ecology and EPA, the BEIR VII consensus opinion is that the exposure to fifteen millirem of radiation would result in far more cancers than previously acknowledged and used in the Hanford cleanup decisions. This is new data which the EPA rules for CERCLA five-year reviews require to be considered in determining if an adopted remedy will remain protective. The data and findings of the new National Academy of Sciences BEIR VII Report establishes that 15 millirem per year of radiation exposure from contamination at Hanford (or other contaminated sites) would result in far more than 1 additional fatal cancer for every ten thousand persons exposed. Thus, the new report establishes conclusively that the cleanup level for Hanford sites (including the "remedial action objectives") do not achieve EPA's own excess cancer risk threshold standard – and falls far short of the more protective state MTCA standard. In fact, the BEIR VII data establishes that 15 mrem/year of exposure to an adult would be estimated to result in 8 additional cancers per ten thousand exposed adults (8×10^{-4}), or 8 times the EPA standard when considering only exposed adults, and at least 80 times the state MTCA standard. Unlike the EPA standard, the state standard under MTCA requires protection of the most vulnerable individuals who are likely to be exposed. Children are 3 to 10 times more susceptible to cancer from the same dose of ionizing radiation or other carcinogens as are adults. [March 3, 2003. http://epa.gov/ncea/raf/cancer2003.html "Draft Final Guidelines for Carcinogen Risk Assessment"]. Thus, the cleanup levels used in these remedies may result in exposures with risks to children which are 240 to 800 times the allowable risk – allowing the cancer risk to exposed children to be nearly one percent from the radioactive releases alone (0.8%). We urged that this data be considered in the five-year review (comments submitted in fall 2005). DOE (Cliff Clark) responded that it was outside the scope of what DOE would consider. Yet, we pointed out that the review is legally required to consider if the remedies in place are protective and if there is new data about exposure and risk. This data and the relevant standards are not addressed anywhere in the review. Childhood risks from exposure to the proposed cleanup levels in the 300 Area should have been explicitly considered in this review – because it is now established that it is reasonably foreseeable that children will be exposed to the contamination. An exclusive industrial use of this area, in which access is prohibited to anyone except adults working in buildings or on asphalt, is no longer credible. The cancer risk to children and adults (including Native Americans under Treaty Rights) needs to be calculated based on the current plans to leave contamination based on 15 mrem exposure to an adult worker in a building or on an asphalt pad. This exposure is likely to be at least four times greater than presumed in the current remedy. This would increase the childhood cancer risk to 4 percent.

Response to Comment 8: DOE evaluated the BEIR VII Report as it relates to the CERCLA five-year review. Based on this evaluation, DOE concluded that the BEIR VII Report does not represent new information that would affect remedial action decisions being evaluated in this review, or the protectiveness of those decisions.

The cancer risk estimates reported in the BEIR VII Report are generally consistent with the risk estimates in the BEIR V Report, and the risk estimates currently reported and/or used by other national and international regulatory and scientific organizations. The Nuclear Regulatory Commission (NRC) in its review of the BEIR VII Report stated that the BEIR VII risk estimates "are numerically similar to risk estimates provided in BEIR V and in more recent UNSCEAR and ICRP reports," and "therefore, the NRC's regulations continue to be adequately protective of public health and safety and the environment." Using the BEIR VII estimated total cancer risk of 5.7×10^{-4} per rem for a 15 millirem per year exposure for 30 years (exposure period for a residential scenario per CERCLA guidance) would give an estimated 3 additional cancers per ten thousand exposed adults (3×10^{-4}). A total of 8 additional estimated cancers per ten thousand exposed adults (8×10^{-4}) would require a much longer exposure period (approximately 90 years).

In regards to non-cancer risks the BEIR VII Report concluded that there is no direct evidence of increased risk of non-cancer diseases in humans at low doses. In summary the BEIR VII Report states that the conclusions of the study "contributes to refining earlier risk estimates, but none leads to a major change in the overall evaluation of the relationship between exposure to ionizing radiation and human health effects."

Comment 9: DOE's review lacks any credibility. Heart of America Northwest urges that the EPA reject this review and conduct a credible review and reach independent determinations.

Response to comment 9: As stated in response to comment 3, the responsibility for conducting five-year reviews is delegated to DOE through Executive Order 12580. A copy of this report has been provided to EPA for review and concurrence with the protectiveness determinations. If concurrence is not given, EPA may write its own protectiveness statements that would be issued separately from the five-year review report.

COMMENTER 13: Gerry Pollet, Heart of America Northwest (second comment)

Comment 1: The five-year review failed to consider a long record of public, Tribal, and Hanford Advisory Board (HAB) comments about the adequacy of CERCLA cleanup remedies. Our prior comments referenced disappointment that DOE had not made those comments and HAB advice available for other commenters to utilize in reviewing and commenting upon the five-year review. The review is inadequate for failing to consider those comments and for failing to provide the notices of use restrictions and institutional controls which DOE relies upon to claim that remedies are protective of human health and the environment.

Response to Comment 1: DOE disagrees. DOE values and considers the input from tribal consultation, the HAB and the public on Hanford cleanup decisions. The HAB comments (Advice #190) along with all other comments received were posted on the CERCLA five-year website (www.hanford.gov/?page=182&parent=0). HAB advice/responses and public meeting minutes are also publicly available on the Hanford website at www.hanford.gov/ under the public involvement section.

Comment 2: DOE staff noted in discussions that they were uncertain which HAB advice was relevant and should have been considered. Therefore, in this supplement to our comments, we provide specific examples along with citing some of the relevant requirements of the Model Toxics Control Act which have not been met for the review.

The DOE review failed to utilize "Considerations for Barrier Application:" HAB Advice #174 June, 2005 and "Advice on Central Plateau Values," June, 2005, HAB Advice #173.

Response to Comment 2: DOE disagrees. HAB Advice # 173, Considerations for Barrier Application, and Advice #174, Advice on Central Plateau Values, were considered in the development of initial remedial actions and are consistent with criteria critical to CERCLA decision making, the process used to characterize hazards, evaluate remedial alternatives, and select cleanup remedies.

Comment 3: Directly relevant and applicable to the five-year review, for instance are the following excerpts from Advice #174 regarding Barrier Use – heavily relied upon for the 100, 300, and 200 Area remedies reviewed in the five-year review:

> "Engineered barriers should not be considered permanent. Risk assessments should examine the magnitude of barrier failure, the likelihood of failed Institutional Controls, and the resulting consequences to human health and the environment."
>
> "There should always be a public review process associated with ongoing reviews, including input on exposure scenarios, future use restrictions, and the failure of institutional controls."
>
> - The above advice (#174) was intended for DOE use in the five-year review, as well as preparation of initial remedial decisions. As discussed, below, DOE utterly failed to do what this advice urged – despite the requirements of MTCA and CERCLA.

"Required relevant standards call for retrieval and permanent remedies to the extent practical, rather than reliance on institutional controls and caps..." HAB Advice #181, November 4, 2005 – adopted at the same meeting at which the Board was discussing the five-year review.

Response to Comment 3: DOE disagrees. HAB advice #174 and #181 are being seriously considered in the development of current RODs, e.g., 200-UW-1 OU and will be considered in future CERCLA remedial decisions.

While DOE tries to remove, treat, and dispose (RTD) of environmental contaminants that result from spills or releases to the environment, there are some cases where RTD is evaluated against the nine CERCLA remedial action criteria and is not selected as the preferred alternative. In some instances caps (barriers) are the preferred alternative. Any barriers that might be built at Hanford would be required to meet performance criteria to ensure adequate long-term performance and include surveillance and maintenance plans.

Comment 4: The advice goes on to note that contamination at sites deeper than excavated may require additional excavation, technology application, and that institutional controls is not a solution. The Board urged deeper excavation – which is a principle directly relevant, for example, to the 100-N Area remedy considered in the five-year review. At 100-N, DOE stopped excavation despite massive contamination (including strontium-90 and other contaminants) within a few feet of where DOE stopped excavating. No risk assessment – and no process regarding the reliability of institutional control mechanisms and acceptability of the resource restrictions – has been undertaken to support conclusions of the five-year review.

Response to Comment 4: DOE is committed to fulfilling the cleanup requirements identified in the RODs. Any changes to the RODs would be made through an amendment to the ROD or an Explanation of Significant Difference. There are public involvement processes associated with both. DOE values the HAB's past and future involvement in those processes.

Institutional controls are used in conjunction with the physical remedy to protect human health and the environment and generally include non-engineered restrictions on activities, access or exposure to land, groundwater, surface water, waste and waste disposal areas, and other areas or media. Some examples include zoning, governmental permitting, public advisories or installation master plans. Institutional controls are necessary where hazardous substances will remain on-site at levels that prevent unrestricted and unlimited use of the site. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required.

The Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions summarizes the institutional control requirements that are found in the Hanford Records of Decision documents and the 2003 and 2004 Sitewide Institutional Controls Assessment for Hanford CERCLA Response Actions. The five-year process is intended to evaluate institutional controls to see if they are working as intended and identify institutional controls that are not meeting the cleanup objective. In these instances, corrective actions are identified and additional remedial actions are addressed through a ROD amendment or an Explanation of Significant Difference.

Comment 5: Other directly relevant Board Advice included #170 (March, 2005) on buried waste and the need for further characterization.

Response to Comment 5: HAB Advice #170 addresses materials buried at the Hanford site prior to 1970. It provides:

- DOE should appropriately plan for environmental restorations activities by characterizing all areas on the Hanford Site containing radioactive or chemical contamination. Decisions should be supported by field sampling and analysis, and adequate funds should be requested for this characterization work.

As stated in DOE's response to HAB Advice #170, DOE entered into a series of collaborative workshop discussions with Ecology, the lead regulatory agency. Based on these discussions, the agencies agreed (March 2005 Agreement) to a phased, collaborative planning approach on remediating the 200 SW-1 and SW-2 Operable Units (OUs). These OUs contain solid waste. This approach will provide the information necessary to examine these burial grounds for potential remediation actions under CERCLA. A CERCLA ROD for these burial grounds is anticipated in fiscal year 2009. The tribes, HAB, stakeholders and public will have an opportunity to provide input on the proposed plan when it goes out for public review and comment.

During the past 12 months, the agencies reviewed historical data on these burial grounds and have worked together to create a detailed data quality objectives process. This process identified a non-intrusive sampling strategy to obtain information. The agencies are working together to create a second data quality objective process to identify other characterization methods (intrusive and non-intrusive) to assess contamination. This information will support the remedial investigation/feasibility study process and appears to address HAB's and your concerns about sampling and analysis.

Comment 6: The five-year review neither took note of, nor responded to, Board advice and public comments on the proposed remedies and exposure scenarios, resource restrictions, reliance on institutional controls, and critique of remedies. No effort was made to collect and consider these prior public comments – even the comments on the very remedies under review.

Response to Comment 6: As previously stated, DOE did consider input from the tribes, HAB, and the public during this review process. As also stated, DOE reviewed several pieces of related HAB advice, although admittedly did not review all past HAB advice to determine whether some of it may be applicable to this review. DOE received and responded to the HAB advice on this review.

Comment 7: The DOE's review asserts – without the notice, public comment or basis as required for such conclusions – that remedies relying on institutional controls are protective.

Response to Comment 7: DOE had numerous discussions with the public and received over 300 written comments on the draft document. In response to those comments, DOE revised this document. Specifically, DOE agrees that in some cases the protectiveness statements in the Public Review Draft of this review overstated the level of protectiveness that can be determined based on the information available at this time. DOE concluded that in some cases a more conservative determination would accurately reflect the situation and revised this review.

Comment 8: The HAB advice called for input on the likelihood of failure of existing institutional controls in remedies, input on exposure scenarios utilized and public comment on the acceptability of resource/land use restrictions (as well as whether they were realistic and whether they fail to recognize the likelihood of greater exposure from more realistic reasonable maximum exposure scenarios. This advice should have been particularly applied in the five-year review to the 300 Area exposure scenario as well as groundwater units.

Response to Comment 8: Institutional controls are an element of many removal and remedial actions at Hanford. Institutional controls are used during removal actions to ensure protection of human health and the environment until such time that a final remedy is completed. Institutional controls are also a fundamental part of some permanent remedies when it is not feasible to treat or remove all contaminants and some are left in place.

The Department agrees with the HAB and will implement institutional controls as necessary, along with other mitigating or preventive measures, to provide a reasonable expectation that if one control temporarily fails, other controls will be in place, or actions will be taken, to mitigate significant consequences of the failure. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required.

Comment 9: The review failed to address the requirements of the Model Toxics Control Act, reflecting the same requirements for: notice; input; adopting conclusions that reliance on restrictions will be consistent with maximum reasonable exposure scenarios; and, for concluding that institutional controls will not fail over the life of the remedy. These are required elements to be met, and CERCLA recognizes that if they are not met in the CERCLA remedy, the state may take independent action to require meeting:

Specific examples include:

> "If the variables proposed to be modified in a (SSRA) or alternative reasonable maximum exposure scenario may affect the significant public concerns regarding land uses, then the department shall assure appropriate public involvement and comment..." -WAC 173-340- 600(9)(e)

- requires early public comment (workshops may be best), at outset, on current and future uses, public/community values for use of affected lands and resources. Reliance on zoning or planning alone is not adequate.
- - e.g..: Does a segment of the community have longstanding plans for a park or public access waterway? (as with the southern gateway to the Hanford Reach national Monument). Do children currently use the vicinity for recreation? Do Native Americans view an area or natural resource as having special significance? Does a portion of the public use the fish or vegetation differently than the general public?

Notices must explicitly identify, and seek comment on, **restrictions on land and resource use (institutional controls)** proposed in decrees, orders, draft cleanup plans, interim actions – WAC 173-340-600(4)(g);(9)(e); and, (10) et seq.

Response to Comment 9: While the Hanford Site remains on the National Priority List, it is subject to CERCLA. MTCA substantive cleanup standards are considered through the ARAR analysis conducted under the CERCLA cleanup process. The MTCA five-year review notice, input and conclusions are not substantive cleanup standards. The HAB, Tribes, and public have numerous opportunities to comment on cleanup documents and decisions, e.g., proposed plans, engineering evaluations/cost analyses, Tri-Party Agreement draft change packages.

Comment 10: The 300 Area relied upon both a site specific risk assessment and alternative maximum reasonable exposure scenario (utilizing an industrial cleanup standard). However, the five-year review and initial plan both rely upon a DOE land use plan, rather than consider the Richland planning process and reasonable maximum exposure scenario, or public concerns about restricting land use to industrial – adult only exposure.

Response to Comment 10: As discussed above in greater detail, DOE anticipates it may have future missions for the 300 Area; therefore, no decision has been made to transfer this parcel of land out of the DOE's administrative control in the foreseeable future. The existing Comprehensive Land Use Environmental Impact Statement and ROD for Hanford will provide the assumptions upon which cleanup decisions will be made.

Comment 11: The five-year review utterly failed to discuss and consider if the remedies met the requirements for protectiveness under the reasonable maximum exposure scenario: "the highest exposure that is reasonably expected to occur under current and potential future site conditions considering…. the potential for institutional controls to fail…" -708(3)(d)(i). For example, the 300 Area and all 100 and 300 Area groundwater units have likely uses that have not been considered, and which institutional controls are not likely to prevent in the future.

It is no longer defensible to assert that the 300 Area maximum exposure scenario is adult industrial use – with fences and protective zoning, no commercial or recreational use, and asphalt paving or buildings. Richland's planning process ahs found that there is no demand for such industrial use. Without such demand, it is extremely unlikely that the areas will be paved, fenced, and utilized solely for traditional industrial uses. The city planning process did foresee pressure for recreational and commercial development – requiring that the remedy be revised to reflect the reasonable maximum exposure scenarios for children, Native American uses, etc... SEE WAC 173-340-708(3) and 745.

Response to Comment 10: In responses to comments on the National Contingency Plan, EPA stated, "In the Superfund program, the exposure assessment involves developing reasonable maximum estimates of exposure for both current land use conditions and potential future land use conditions at each site. The exposure analysis for current land use conditions is used to determine whether a human health or environmental threat may be posed by existing site conditions. The analysis for potential exposures under future land use conditions is used to provide decision-makers with an understanding of exposures that may potentially occur in the future. This analysis should include a qualitative assessment of the likelihood that the assumed future land use will occur. The reasonable maximum exposure estimates for future uses of the site will provide the basis for the development of protective exposure levels." DOE has gone far beyond a qualitative assessment of future land use in the 300 Area. The Hanford Comprehensive Land Use Plan Environmental Impact Statement and Record of Decision issued in 1999 evaluated potential Hanford Site land uses 50 years out into the future. More recently, DOE conducted a series of public workshops on desired Hanford End States. And most recently, DOE has reviewed the City of Richland industrial re-use study that was funded by DOE. The result is that DOE believes the current and reasonably anticipated future land use for the 300 Area is and will be industrial.

As stated above, while the Hanford Site remains on the NPL, it is subject to CERCLA. MTCA substantive cleanup standards are considered through the ARAR analysis conducted under the CERCLA cleanup process. The MTCA five-year review notice, input and conclusions are not substantive cleanup standards. EPA will continue to use the reasonable maximum exposure scenario in risk assessment, although it does not believe it necessary to include it as a requirement in the rule.

Comment 11: The 300 Area fails to meet the criteria in MTCA and WAC 173-340-745 for use of industrial cleanup standard and adult industrial exposure as the reasonable maximum exposure scenario. The rule precludes use of fences as an effective institutional control, yet DOE appears to rely on fences along the river and recreational areas for the short-term for some areas, and shockingly, nothing at all for some areas and the longer term. WAC 173-340-745(1)(b)(iii)(B) and (2) preclude use of the industrial cleanup standard where, as is undisputed for the 300 Area, there is subsurface lateral migration of contamination to offsite and the river.

Response to Comment 11: The Comprehensive Land Use Plan, not MTCA, establishes the land use for the Hanford Site. Fences must be used during cleanup and may remain after cleanup depending on the types of industry that DOE may allow to occupy the land.

Comment 12: Both the initial remedial action plan and the review failed to meet MTCA requirements for notice and comment for use of an industrial cleanup standard and exposure scenario – limiting all future public uses:

- Use of Industrial Exposure Scenarios to set Clean-Up Standards or Change Clean-Up Levels is similar to Changing Defaults and Alternate Maximum Reasonable Exposure Scenario:
  - Is industrial exposure really the highest exposure reasonably foreseeable? -708(3)(d)(i)
  - Does this proposed restriction impact significant public values for future land or resource use?
  - Do public comments reveal that public access does occur and is likely to continue?
  - Must consider potential for institutional controls to fail -708(3)(d)(i); e.g., restrictive covenant to fail when commercial leases are primary instrument.

Notice must be explicit. - 600(4)(g)

Response to Comment 12: As discussed in response to comment 9, MTCA substantive cleanup standards are considered through the ARAR analysis conducted under the CERCLA cleanup process.

Comment 13: Our previous comments and materials identified the following as the example of what notice should look like for the 300 Area, pursuant to the 2001 MTCA rule amendments (which DOE never references in the five-year review, which renders the review inadequate):

Your Comments Sought: on Ecology's Preferred Cleanup Plan for Hanford 300 Area Along Columbia River

- Fences would permanently restrict public access to river shoreline and interrupt proposed bike trail route
- Rationale and alternatives to this proposed action are described in a fact sheet available by calling ____-____
- A public meeting will be held upon request of 10 or more individuals

Assistance to organizations or individuals in understanding and commenting on this proposal is available from Ecology's Citizen Technical Advisor: ___-_____.

Response to Comment 13: MTCA substantive cleanup standards are considered through the ARAR analysis conducted under the CERCLA cleanup process. The MTCA five-year review notice, input and conclusions are not substantive cleanup standards.

DOE follows the criteria outlined in the Hanford Site Tri-Party Agreement Public Involvement Community Relations Plan for public notifications and effective public notice. DOE sought public input and dialogue, and based on public interest, conducted three public workshops on this five-year review.

COMMENTER 14: Don Stephens

Comment 1: I am writing to comment on the Draft CERCLA Five-Year Review Report. I feel that the cleanup is proceeding too slowly, and that more budget funding should be dedicated to speeding up the cleanup at Hanford. The vitrification program should not be delayed. Please follow the will of the voters in fixing the mess that Hanford has become.

Response to Comment 1: The DOE appreciates your review of the Draft CERCLA Five-Year Review Report and your comment that the cleanup is proceeding too slowly. DOE is cleaning up the Hanford Site as outlined in the Tri-Party Agreement within the resources provided by Congress and in a manner that is protective of the workers, the public and the environment.

In developing the nearly $1.9 billion fiscal year 2007 budget request to Congress, the DOE Office of Environmental Management took into account the notable progress made to date at Hanford as well as those challenges that lay ahead. This investment of nearly $1.9 billion for Hanford will allow the Department to address challenges and reduce risk, including characterization of groundwater beneath the Central Plateau, removal of sludge from the K Basins, retrieval of transuranic waste from the burial grounds, demolition of facilities in the River Corridor, retrieval of sludge and salt waste from single-shell tanks, and continued construction of the Waste Treatment Plant.

COMMENTER 15: Richard Gurske

Comment 1: I hope the accolades are coming in for this report because it definitely sets the standard for five-year CERCLA updates. It certainly a little more comprehensive then the 2001 report. Good Job!

Response to Comment 1: Thank you. DOE appreciates your feedback on the draft report.

Comment 2: One thing I would like to know is the commitment dates by GRP and others. Were these commitments negotiated between GRP and DOE and because some commitment dates extend beyond GRP's contract extension, were these just SWAG or commitments based on experience?

Response to Comment 2: The CERCLA five-year review is a DOE document. DOE has multi-year contracts with several prime contractors and many subcontractors to accomplish the work required under the Tri-Party Agreement, CERCLA RODs, and other requirements documents. Commitment dates were developed based on experience and in consultations with the contractors responsible for planning and/or performing the work.

COMMENTER 16: Louthea Griffin

Comment 1: As a resident of the Columbia River gorge, I believe protection of the river is the highest priority. Specifically, radioactive and/or toxic underground water must be prevented from reaching the river and polluting it. Once polluted, reclaiming the river may not be possible at all – at any cost, over any length of time. It would constitute "irreparable" harm and must be avoided. I urge that this priority guide the new cleanup budget.

Response to Comment 1: DOE agrees that protection of the Columbia River and its users is a primary goal of the Hanford Site cleanup mission.

COMMENTER 17: U.S. Department of Commerce – National Oceanic and Atmospheric Administration (NOAA)

Comment 1: We appreciate the opportunity to provide comments on the draft five-year review report of the Hanford Site prepared by the Department of Energy (DOE) under requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). As a natural resource co-trustee with DOE at the Hanford Site, the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) looks forward to continuing to work with the DOE on multiple issues of joint interest and responsibility. We are very interested in working with DOE on habitat improvement projects either as part of cleanup through mitigation, or as restoration through the damage assessment process, or both.

Response to Comment 1: DOE appreciates your time and effort to review the document and provide comments. DOE intends to work with NOAA on habitat mitigation both through the CERCLA and National Environmental Policy Act processes, as well as, the Hanford Natural Resource Trustee Council when appropriate. The DOE has an Ecological Resources Working Group that meets regularly where mitigation issues are discussed. DOE anticipates working collaboratively with NOAA and the USFWS in habitat restoration activities.

Comment 2: NOAA has several comments on the draft five-year review report:

1) Protectiveness of Interim Remedies
Based on the June 2001 EPA *Comprehensive Five-Year Review Guidance,* NOAA feels that the appropriate protectiveness finding for the Hanford Site five-year review should be that "Protectiveness cannot be determined until further information is obtained." (EPA 540-R-01-007). Specifically, risk assessment has not been completed for Hanford, and until the risk assessment is complete, it is not possible to determine if the interim remedies are protective. Therefore, at this time, we are not able to make conclusions about the protectiveness of interim remedies, particularly for areas of the river where contaminants may have come to be located.

Response to Comment 2: DOE disagrees that risk assessments must be completed prior to making protectiveness determinations on selected interim or final remedies. Protectiveness determinations are based on evaluation of the performance of selected remedies not risk assessments. Risk assessments are part of the Remedial Investigation/Feasibility Study (RI/FS) process. The remedy selected through the RI/FS process must address the risks identified in the RI/FS process and mitigate the identified risks to be protective of human health and the environment. The five-year review process verifies that the selected remedy is or will be protective when final.

While most of the remedies selected to date for the Hanford Cleanup are interim actions, under the EPA guidance, it is appropriate to evaluate the protectiveness of those remedies using the same criteria as for final actions. The protectiveness statements would be limited to the extent of the interim action. That is the approach that EPA used in the first five-year review and the one DOE used in this document.

DOE had numerous discussions with the public and received over 300 written comments on the draft document. In response to those comments, the document was revised. DOE agrees that in some cases the protectiveness statements in the Public Review Draft of the *CERCLA Five-Year Review Report for the Hanford Site* overstated the level of protectiveness that can be determined based on the information available at this time. DOE concluded that in some cases a more conservative determination would accurately reflect the situation. Therefore, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 3: Since more information (risk assessment) is needed in order to determine protectiveness, the determination of protectiveness should be deferred, and an addendum stating follow-up actions and a time frame for addressing information gap should be added to the five-year review report.

Response to Comment 3: As noted in the response above completion of risk assessments is not necessary to review the protectiveness of selected interim remedies. However, based on public input, DOE did revise some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 4: 2) Protectiveness of Groundwater Remedies

Remedies for groundwater contamination are either not complete or not yet meeting remedial action goals (for example: concentrations of Cr6 in groundwater exceed ambient water quality in wells at the rivers' edge). Therefore, it appears that the remedies are not yet protective. NOAA is concerned about ecological risks from the groundwater contamination as well as the DOE reliance on institutional controls.

Response to Comment 4: DOE agrees that groundwater remedies are not complete for operable units remaining in active NPL Sites. Groundwater remedies are interim measures identified in the records of decision for interim action. These may not be the final remedies selected. The 100-N and 300-FF-05 remedies will not meet the remedial action objectives of the records of decision for interim action, and DOE does not consider them to be protective. The actions required by the other records of decision for interim action are considered to be, or will be (when final) "protective." Improvements in the design of some of the remedial systems are necessary to meet the remedial action objectives. Where cleanup actions are ongoing and the groundwater has not yet met standards, the use of institutional controls is appropriate. Institutional controls are also appropriate where it is technically impracticable to meet groundwater cleanup goals.

As previously stated, DOE did revise some of the protectiveness statements.

Comment 5: 3) Ecological Risk Assessment

NOAA agrees with the Department of the Interior that the current ecological risk assessment approach at Hanford of NPL site-specific ecological risk assessments be modified to include a holistic, integrated, Hanford-wide ecological risk assessment.

Response to Comment 5: The current 100/300 and 200 Area integrated ecological risk assessments address most, if not all, of the ecological risks at the Hanford Site and are intended to provide a holistic view of each of these National Priority List areas (i.e. the River Corridor and the Central Plateau). DOE also has a site-wide environmental surveillance program to monitor for changes or effects on the environment.

Comment 6: The Hanford Site is large and complex, which has lead the Tri-Parties to divide the site into smaller more manageable sections. The Hanford Site has been listed as multiple CERCLA sites (i.e., 100, 200, 300, etc., areas) and each of the areas further subdivided into operable units. While this makes sense from an engineering and logistical standpoint, it does not make sense from an ecological risk assessment standpoint. Just as the Columbia River runs through the entire Hanford Site, we know that contaminants are migrating between sites, and biological organisms including fish, birds, and large mammals readily move among the various areas. We believe it is imperative to integrate the ecological risk assessments in a holistic manner in order to accurately evaluate impacts to natural resources and determine appropriate cleanup alternatives.

Response to Comment 6: As stated in the previous response, DOE has/is conducting integrated risk assessments for the 100/300 Areas and the 200 Area.

Comment 7: Contaminants from multiple waste sites and areas have been mobilized resulting in groundwater contamination that in some cases is being released to the Columbia River. A specific constituent (i.e., uranium, chromium, strontium-90, PCBs, etc.) at a single site may not be a risk, but releases to the Columbia River from multiple sources when added together could result in a risk. This scenario would occur, for instance, when young of the year salmonids move down the Columbia River and are exposed to contaminants from the various reactor sites and groundwater from the 200 and 300 Areas. Because there are multiple sites and multiple constituents that can additively or synergistically adversely affect natural resources, the integration of the approximately 50 different risk assessments must be fully considered. These integrated risk assessments could influence and potentially modify cleanup decisions made based on only a series of individual single-contaminant based evaluation. We recommend that a site-wide ecological risk statement be compiled. We also support the re-establishment of a multi-disciplinary, multi-agency work group to develop a strategy for integration.

Response to Comment 7: Cumulative risks are being addressed in the 100/300 Area risk assessments. The rate of movement of groundwater and any contaminants in the groundwater is very slow compared to the significant volume of water that flows by the Hanford Reach. When combined with the relatively small concentrations of contaminants that enter the river from Hanford groundwater, they are generally undetectable in the River or are many orders of magnitude below any aquatic or environmental threshold. Information on specific findings are published annually and the most recent publication is the *Hanford Site Environmental Report for 2005*, which can be found at hanford-site.pnl.gov/envreport/.

Comment 8: NOAA looks forward to continuing to work with DOE at Hanford on natural resource and habitat restoration issues.

Response to Comment 8: The DOE appreciates the technical assistance NOAA continues to provide.

COMMENTER 18: U.S. Department of the Interior Fish and Wildlife Services

Comment 1: We appreciate the opportunity to participate in previous workshops and provide comments on the draft five-year review report of the Hanford Site prepared by the Department of Energy (DOE) under requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The U.S. Fish and Wildlife Service (Service) and DOE have numerous joint interests at Hanford including authorities under the Hanford Reach National Monument, management of natural resources for large portions of the site as described in the Service's draft Comprehensive Conservation Plan (CCP), and trusteeship for various natural resources under CERCLA. We look forward to continuing to work with the DOE on multiple issues of joint interest and responsibility. We have several general comments and comments of a more specific nature.

Response to Comment 1: The DOE appreciates your efforts in reviewing and providing comments on this draft document. We look forward to our continued partnership in protecting and managing the resources of the Hanford Reach National Monument.

Comment 2: General Comments

The Service looks forward to working with the DOE on CERCLA related issues for both past and future actions. The establishment of the Hanford Reach National Monument in June 2000 provided both our agencies with increased coordination and protective responsibilities for both cultural and natural resources. The CERCLA process should be coordinated with both our agencies' land management/ stewardship responsibilities as we provide for appropriate use of Hanford lands. The CPP proposed to modify public and Tribal use patterns and we believe that additional information may be needed to ensure protection of human health and the environment. Additionally, we are very interested in working with DOE on habitat improvement projects either as part of cleanup through mitigation or as restoration through the damage assessment process of CERCLA. In addition to our statutory role in these processes, the Service is interested in providing our on-the-ground restoration experience on a cost reimbursable basis.

Response to Comment 2: DOE will coordinate with the Service, especially as a cooperating agency on the Comprehensive Conservation Plan – Environmental Impact Statement. We invite the Service to remain active in Hanford issues through the Hanford Natural Resource Trustee Council, the Ecological Resources Working Group, and other, informal and formal capacities. As in the past the Service will be considered, when feasible, to provide on-the-ground restoration experience.

Comment 3: The Hanford Site is large and complex, which has lead the Tri-Parties to divide the site into smaller more manageable sections. The Hanford Site has been listed as multiple CERCLA sites (i.e., 100, 200, 300, etc. areas) and each of the areas further subdivided into operable units. This makes sense from an engineering and logistical standpoint. However, just as the Columbia River runs through the entire Hanford Site, we know that contaminants are migrating between sites, and biological organisms including fish, birds, and large mammals readily move among the various areas. We believe it is necessary to integrate the ecological risk assessments in a holistic manner in order to accurately evaluate impacts to natural resources and determine appropriate cleanup alternatives.

Response to Comment 3: The current 100/300 and 200 area integrated ecological risk assessments address most if not all of the ecological risks an the Hanford Site and are intended to provide a holistic view of each of these National Priority List areas (i.e., the River Corridor and the Central Plateau). DOE also has a site wide environmental surveillance program to monitor for changes or effects on the environment. Information on specific findings are published annually and the most recent publication is the *Hanford Site Environmental Report for 2005*, which can be found at hanford-site.pnl.gov/envreport/.

Comment 4: Contaminants from multiple waste sites and areas have been mobilized resulting in groundwater contamination that in some cases is being released to the Columbia River. A specific constituent (i.e., uranium, chromium, strontium-90, PCBs, etc.) at a single site may not be a risk, but in combination could threaten young of the year salmonids moving down the Columbia River. Because there are multiple sites and multiple constituents that can additively or synergistically adversely affect natural resources, the integration of the approximately 50 different risk assessments must be considered. These integrated risk assessments could influence and potentially modify cleanup decisions. We recommend that a sitewide ecological risk statement be compiled. We also support the re-establishment of a multi-disciplinary, multi-agency work group to develop a strategy for integration.

Response to Comment 4: Cumulative risks are being addressed in the 100/300 Area risk assessments. The rate of movement of groundwater and any contaminants in the groundwater is very slow compared to the significant volume of water that flows by the Hanford Reach. When combined with the relatively small concentrations of contaminants that enter the river from Hanford groundwater, they are generally undetectable in the River or are many orders of magnitude below any aquatic or environmental threshold.

Comment 5: The five-year review report concludes that the remedies selected thus far are, or will be, protective of human health and the environment. We believe this conclusion is premature because the human health and ecological risk assessments for the site have yet to be completed. It is our understanding that the purpose of the risk assessments is to determine the cleanup levels that will be protective. We recommend that the decision on the protectiveness of the cleanup be placed in abeyance until the risk assessment process has been conducted.

Response to Comment 5: A CERCLA five-year review evaluates whether remedies selected in CERCLA decision documents have resulted in a condition that is protective of human health and the environment or will be when completed. For the Hanford Cleanup Project most of the decision documents issued to date are for interim decisions. The responses to the three protectiveness questions for those interim decisions are accurate and complete. Also, legitimate institutional controls are in place to ensure protection of human health and the environment until final remedies are completed. This provides the basis for concluding that the interim remedies are protective. This approach to evaluate the protectiveness of the remedies is consistent with EPA guidance and was used by EPA in the First Five-Year Review for the Hanford Site issued in 2001.

DOE had numerous discussions with the public and received over 300 written comments on the draft document. In response to those comments, DOE revised this document. Specifically, DOE agrees that in some cases the protectiveness statements in the draft five-year review overstated the level of protectiveness that can be determined based on the information available at this time. DOE concluded that in some cases a more conservative determination would accurately reflect the situation. Therefore, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 6: In addition to remediation, CERCLA also provides for the restoration of natural resources injured as a result of releases of hazardous substances. In our experience, there are efficiencies to be gained by coordinating remedial and natural resource damage assessment (NRDA) actions. The Hanford Natural Resource Trustee Council (Council) has been established to promote the coordination of trustee actions for the cleanup and restoration of natural resources portions of CERCLA. We suggest that DOE develop a NRDA strategy that complements the cleanup decisions for the Hanford Site, and work together with our Council co-trustees to meet the joint restoration responsibilities of CERCLA.

Response to Comment 6: We also continue to believe that the important issues facing Hanford's natural resource trustees are best addressed through the Trustee Council, which operates on the basis of collaboration and consensus. DOE will continue to coordinate its actions with the Council and to work together with other trustees regarding the appropriate strategies to restore resources.

Comment 7: As part of the cleanup recommendations being selected by the Tri-Party agencies, institutional controls have been a mechanism used to protect the public from exposure and effects of contaminants. The Service currently manages a large portion of the Hanford Site that is under National Monument status, in cooperation with the DOE. We recommend that long-term plans, strategies, and budgeting be developed by DOE to ensure that institutional controls are effective far into the future to address the contaminants left in place. Adverse effects to biota may continue when contaminants are left in place, leading to continuing injury. We recommend that this factor be fully considered in any cleanup decisions made. Additional short-term cleanup costs may be more cost effective than long-term restoration costs associated with continuing injury. We are interested in working with DOE in planning for the long-term success of cleanup and restoration efforts including institutional controls.

Response to Comment 7: DOE appreciates your positive suggestions. As noted, institutional controls are an element of many removal and remedial actions. Institutional controls are used during removal actions to ensure protection of human health and the environment until such time that a final remedy is completed. Institutional controls are also a fundamental part of some permanent remedies when it is not feasible to treat or remove all contaminants and some are left in place.

The Department will implement institutional controls as necessary, along with other mitigating or preventive measures, to provide a reasonable expectation that if one control temporarily fails, other controls will be in place, or actions will be taken, to mitigate significant consequences of the failure. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required.

Comment 8: The increase of technical environmentally-related knowledge is ongoing, which inevitably leads to improvements in laws and regulations for better protection of natural resources. For instance, we understand that the Washington State standards for uranium have been recently revised. We recommend that future records of decision include reopeners to address potential future state and/or federal regulation changes.

Response to Comment 8: A fundamental premise of CERCLA, the National Contingency Plan, and EPA and DOE guidance is that the preliminary assessment/site investigation, engineering evaluation/cost analysis, action memorandum, remedial investigation/feasibility study, record of decision processes will identify and document the selection of a remedy, or remedies, that will result in a final site condition that is protective of human health and the environment.

The EPA specifically addressed comments similar to your suggestion in the Preamble to the National Contingency Plan. The following four paragraphs are excerpted from the preamble to the National Contingency Plan.

> Once a ROD is signed and a remedy chosen, EPA will not reopen that decision unless the new or modified requirement calls into question the protectiveness of the selected remedy. EPA believes that it is necessary to "freeze ARARs" when the ROD is signed rather than at initiation of remedial action because continually changing remedies to accommodate new or modified requirements would, as several commenters noted, disrupt CERCLA cleanups, whether the remedy is in design, construction, or in remedial action. Each of these stages represents significant time and financial investments in a particular remedy. For instance, the design of the remedy (treatment plant, landfill, etc.) is based on ARARs identified at the signing of the ROD. If ARARs were not frozen at this point, promulgation of a new or modified requirement could result in a reconsideration of the remedy and a re-start of the lengthy design process, even if protectiveness is not

compromised. This lack of certainty could adversely affect the operation of the CERCLA program, would be inconsistent with Congress' mandate to expeditiously cleanup sites and could adversely affect PRP negotiations, as noted by commenters. The policy of freezing ARARs will help avoid constant interruption, re-evaluation, and re-design during implementation of selected remedies.

EPA believes that this policy is consistent with CERCLA section 121(d)(2)(A), which provides that "the remedial action selected...shall require, at the completion of the remedial action," attainment of ARARs. EPA interprets this language as requiring attainment of ARARs identified at remedy selection (i.e., those identified in the ROD), not those that may come into existence by the completion of the remedy. Neither the explicit statutory language nor the legislative history supports a conclusion that a ROD may be subject to indefinite revision as a result of shifting requirements. Rather, given the need to ensure finality of remedy selection, in order to achieve expeditious cleanup of sites, and given the length of time often required to design, negotiate, and implement remedial actions, EPA believes that this is the most reasonable interpretation of the statute.

As EPA discusses elsewhere in this preamble, one variation to this policy occurs when a component of the remedy was not identified when the ROD is signed. In that situation, EPA will comply with ARARs in effect when that component is identified (e.g., during remedial design), which could include requirements promulgated both before and after the ROD was signed. EPA notes that newly promulgated or modified requirements may directly apply or be more relevant and appropriate to certain locations, actions or contaminants than existing standards and, thus, may be potential ARARs for future responses.

A policy of freezing ARARs at the time of the ROD signing will not sacrifice protection of human health and the environment, because the remedy will be reviewed for protectiveness every five years, considering new or modified requirements at that point, or more frequently, if there is reason to believe that the remedy is no longer protective of health and environment.

Comment 9: Specific Comments

Executive Summary, page iii, second paragraph: It is stated that the Hanford Site was divided into four sites (100, 200, 300, and 1100). In order to clarify this issue, we suggest that you explain the status of the Hanford Site outside these four areas such as the 400 Area, 600 Area, Energy Northwest, etc.

Response to Comment 9: That is a good suggestion and DOE has modified the document accordingly.

Comment 10: Executive Summary, page iii, last paragraph (and elsewhere in the document): Two exceptions are identified where cleanup is not meeting protective standards (uranium in the 300 Area and strontium-90 at 100-NR-2). Although identified as problematical in the Issues and Actions table, we suggest that chromium in several 100 Area locations also be identified as an exception because cleanup criteria are currently not being met.

Response to Comment 10: DOE believes that the selected remedy (source removal and pump-and-treat) will prove to be protective for protecting aquatic resources from chromium. However, the pump-and-treat system design needs to be improved. In the cases of strontium-90 at 100-N and natural attenuation of uranium at 300-FF-05, the selected remedies will not meet the remedial action objectives.

Comment 11: Ecological Risk Assessment Process: Public and Tribal consumptive use of natural resources will increase as cleanup actions are implemented and successfully completed. We recommend that all risk assessments include a specific section evaluating consumptive use of natural resources and potential risks for public and Tribal use scenarios.

Response to Comment 11: Risk assessments will consider/are considering these scenarios, as appropriate.

Comment 12: 100 Area: We fully support increased efforts by DOE to include new ideas and technologies to address contaminant release issues to the Columbia River. We encourage DOE to expand efforts to identify chromium sources and to permanently eliminate all releases of oil and hazardous substances to the Columbia River.

Response to Comment 11: DOE and USFWS share the same objective. Nine projects were recently initiated to test innovative technologies that may reduce contaminant concentrations and flux to the river from groundwater and deep vadose zone contamination.

Comment 12: Recent studies and negotiations associated with Priest Rapids Dam operations indicate that Columbia River water levels will continue to fluctuate in the vicinity of the 100 Area as a result of hydroelectric generation. We recommend that the effect of water-level fluctuations on the mobilization of contaminants left in the vadose zone in the 100 Area be further evaluated. In our opinion, the remedy is not protective of the environment without further evaluation of this issue. If the water-level fluctuations will result in continuing contaminant releases, we suggest that full removal of contaminated soil be considered to protect human health and the environment.

Response to Comment 12: DOE agrees that the fluctuations of the river stage, and resultant aquifer dynamics, are an important part of the conceptual models for 100 and 300 Area sites. We are planning to evaluate the effects of the dynamic, groundwater-level response to river fluctuations on contaminant transport. The fluctuating groundwater response will be incorporated into the remedial design evaluated in the feasibility studies, proposed plans and records of decision. The current records of decision for interim action require an evaluation of the impact to underlying groundwater from contaminants left below the depth of excavation where remove, treat and dispose remedial actions are performed. The remedial action objective is to restore the aquifer and ensure the contaminants remaining do not recontaminate the aquifer above drinking water standards. In those cases where further excavation is impracticable and there is a reasonable expectation for continued groundwater contamination, a combined deep soil/groundwater remediation action may be the most likely response.

Comment 13: 200 Area: We have been participating with DOE, contractors, the Environmental Protection Agency (EPA), and co-trustees on an ecological risk assessment (ERA) for the entire 200 Area. We appreciate the opportunity to provide technical assistance; however, we suggest that the number of biological samples be increased for this effort. The ERA has been centralized for all terrestrial evaluation efforts in the 200 Area, with other remedial investigation/feasibility study (RI/FS) work being done at the operable unit subsection level. The funding allocated for he ERA in comparison to all the other RI/FS work on the 200 Area seems disproportionately small. This is especially true for biological data where there is relatively little information. For instance, it is our understanding that only two samples can be afforded to address potential spaying of PCB-contaminated oil on many miles of roads for dust control. We recommend that additional funding for a variety of sampling be increased, and we would be happy to work with DOE, the contractors, and the Trustees to further address this issue.

Response to Comment 13: Thank you for your comment. We have sent it to those at DOE in charge of the 200 Area Ecological Risk Assessment.

Comment 14: The Service foresees the potential for refuge workers to be located throughout Hanford in the future, even if the future is many years from now. We request that an on-site, resident refuge worker scenario be used for al future human health risk assessments.

Response to Comment 14: DOE agrees. A park ranger/refuge worker-type scenario is analyzed.

Comment 15: It is our understanding that DOE is using the "analogous site" methodology for sampling of waste sites in the 200 Area. This method assumes that some grouping of sites have similar constituents and other parameters, hence only a single site in the group is sampled and it is assumed the other sites will be identical. We have problems with this methodology because the waste sites at Hanford have many complexities and undocumented releases and therefore potential for variability. There must be a clearly developed technique and documented data to ascertain site variability before the analogous site methodology should be used. Our experience with analogous sampling on the North Slope and ALE indicates the waste sites in the same area can vary considerably in constituents and concentrations.

Response to Comment 15: Thank you for your comment. We have forwarded it to appropriate DOE staff working on the 200 Area risk assessment.

Comment 16: 1100 Area: Page 4.1 Horn Rapids Landfill (1100-EM-1): We agree that the contaminant levels are below the allowable maximum contaminant level and that a modification of groundwater monitoring is warranted. We suggest that monitoring continue at a reduced number of wells on at least an annual basis.

Response to Comment 16: DOE agrees. Monitoring of the Horn Rapids Landfill will occur at least annually as part of the site-wide groundwater monitoring plan.

Comment 17: Page 4.2, lines 8-10: The ALE headquarters mentioned here is no longer in use. We recommend ending the sentence after the word "center" and adding the sentence: "These buildings were formerly used as the ALE headquarters but are now scheduled for cleanup, demolition, and removal.

Response to Comment 17: The document was changed to read: "The facilities that comprise the 1100-IU-1 Operable Unit are a former NIKE missile base and control center. These buildings were formerly used as the ALE headquarters but are now scheduled for cleanup, demolition, and removal."

Comment 18: Page 4.2, 4.31: We appreciate the additional cleanup completed at the Horseshoe Landfill based on monitoring data collected between 1998 and 2003. We also support the decision to reduce the DDT/DDE/DDD cleanup level. We are interested in the methodology used to support the reduction in the cleanup level. We would be interested in conducting any additional habitat restoration and monitoring at Horseshoe Landfill, or other areas on the Hanford Site, on a cost-reimbursable basis.

Response to Comment 18: With regards to the cleanup level, DOE agreed to use the "Ecological Indicator Soil Concentration for Protection of Terrestrial Plants and Animals" for DDT/DDD/DDE (Dichloro-Diphenyl-Trichloroethane, Dichloro-Diphenyl-Dichloroethane, and Dichloro-Diphenyl-Dichloroethylene) that is listed in Washington Administrative Code 173-340-900, Table 749-3, which is a part of the regulations developed for the Model Toxics Control Act.

We acknowledge USFWS's support for habitat restoration and monitoring and look forward to continuing to work with and obtain support from USFWS in the future.

Comment 19: Monitoring: The Service's comments during the first five-year review at the Hanford Site included recommendations for monitoring in the 1100 and North Slope areas. Those recommendations were not addressed. Post remediation monitoring is a basic premise in CERCLA and EPA guidance. Without this monitoring data, we believe the remedy is not protective of the environment. CERCLA requires post-cleanup monitoring to ensure that remedial actions are appropriate and working properly. The Service continues to recommend that specific monitoring be conducted for the technical assistance areas previously identified by the Service on the North Slope and ALE. As demonstrated at Horseshoe Landfill, monitoring is helpful to document ongoing issues of concern for subsequent action. We recommend that biological monitoring be the main method used to reduce costs and directly address potential effect questions. We look forward to a collaborative effort.

Response to Comment 19: The Tri-Parties agreed to a CERCLA process for cleaning up the 1100 Area and the North Slope that does not require post-cleanup monitoring. The post-cleanup monitoring that DOE conducted at the Horseshoe Landfill was done voluntarily. Any monitoring that might be performed at the "technical assistance areas" identified by the Service would be done outside of the CERCLA process. While there may be some benefit from performing additional post-cleanup monitoring within the 1100 Area and North Slope, there is no CERCLA requirement to do so.

Comment 20: We appreciate the excellent working relationship between the DOE and the Service and look forward to continuing joint efforts at Hanford pertaining to cleanup, land and natural resource management, and habitat restoration. If you have any questions or would like to discuss issues raised in this letter, please contact Don Steffeck, Chief of our Division of Natural Resource Conservation in the Regional Office (503) 231-6223, and/or Greg Hughes, Refuge Manager, at (509) 371-1801.

Response to Comment 20: DOE appreciates the constructive feedback from USFWS and will continue to work closely with the Service on the cleanup, land and natural resource management, and habitat restoration.

COMMENTER 19: Nez Perce Tribe

Comment 1: The technical staff of the Nez Pre Tribe (NPT) Environmental Restoration and Waste Management Program (ERWM) has completed a review of the draft CERCLA Five-Year Review Report for the Hanford Site. Our comments are included in this letter.

Response to Comment 1: DOE appreciates the time and resources the Nez Perce Tribe took to review the draft document and provide comments.

Comment 2: Since 1855, reserved treaty rights of the NPT in the Mid-Columbia have been recognized and affirmed through a series of federal and state actions. These actions protect Nez Perce rights to utilize our usual and accustomed resources and resource areas in the Hanford Reach of the Columbia River and elsewhere. Accordingly, the NPT ERWM Program responds to actions that impact the Hanford ecosystem.

The NPT recognizes the CERCLA five-year review process as one of the few which currently offer a more integrated overview of the status of the Hanford Site as a whole. With that in mind, we offer below as a reminder of the interests of the NPT, a copy of Tribal Resolution NP-05-4111, *Nez Perce Hanford End-State Vision.* It is towards that vision that our comments relative to the five-year review are directed.

Nez Perce Hanford End-State Vision

Policy Statement and Conditions

The Nez Perce Tribe believes that the Endstate Vision of the Hanford Site should allow for Nez Perce Tribal members to utilize the area in compliance with the Usual and Accustomed treaty rights reserved and guaranteed in the 1855 treaty between the United State Government and the Nez Perce Tribe.

The Nez Perce Tribe believes that the ultimate goals of the Hanford cleanup should be to restore the land to uncontaminated pre-Hanford conditions for unrestricted use. This includes air, soil, groundwater and surface water. Tribal members, ecological resources, and cultural resources within Usual and Accustomed areas should not be exposed to any potential adverse risk above that which has always existed for the tribe prior to the establishment of the federal government projects and facilities at Hanford in 1942.

To accomplish this long term cleanup goal the Nez Perce Tribe recognizes the following:

1. The Nez Perce Tribe will continue to work with DOE via its cooperative agreement on cleanup issues to ensure that treaty rights and cultural and natural resources are being protected and that interim cleanup decisions are protective of human health and the environment.

2. This goals will require the responsibility of future generations until it is finally completed.

3. Technology to cleanup or dispose of some contaminants may not be currently available, but as it becomes available the Nez Perce Tribe will work with the Federal government to further reduce the levels of any residual contamination.

4. Based on the history of man, we do not believe that institutional controls are necessarily a viable option to be used until land and water can be cleaned up.

Response to Comment 2: Thank you for providing DOE a copy of your Hanford End-State vision as a reminder of the Nez Perce Tribe's expectations for consideration in cleanup decisions. DOE also appreciates the Nez Perce Tribe's willingness to help ensure that treaty rights and cultural and natural resources are being protected and that interim cleanup decisions are protective of human health and the environment. We agree that cleanup at Hanford will require the responsibility of future generations and the technology to cleanup some contaminants is not currently available.

DOE believes institutional controls are a viable option. Institutional controls are an element of many removal and remedial actions. They are used during removal actions to ensure protection of human health and the environment until such time that a final remedy is completed. Institutional controls are also a fundamental part of some permanent remedies when it is not feasible to treat or remove all contaminants and some are left in place.

The Department will implement institutional controls as necessary, along with other mitigating or preventive measures, to provide a reasonable expectation that if one control temporarily fails, other controls will be in place, or actions will be taken, to mitigate significant consequences of the failure. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required.

Comment 3: <u>General Comments</u>
The NPT recognizes that by regulation the five-year review is limited to operable units described in the Tri-Party Agreement as past practice units, remediated under CERCLA. By regulation, the review is to ensure the long-term effectiveness of engineered or institutional measures placed to protect human and the environment; and it is to serve to optimize the effectiveness and implementation of remedy requirements.

However, the CERCLA five-year review process is the only site-wide view of status of efforts towards cleanup that currently exists of which the NPT is aware. In order to encompass the problems in an integrated manner, the NPT recommends that the five-year review process at Hanford be expanded beyond its currently limited regulatory scope. It is otherwise difficult to maintain an overview of the status of the site as a whole.

For example, RCRA corrective action should be taken to begin the remediation of the groundwater plumes resulting from past leaks in the single-shell tank farms. The remediation of these plumes should not be postponed because of their assignment to CERCLA groundwater units. At a minimum, remediation of groundwater plumes caused by tank leaks in A, BX, BY, C, SX, T and TX single shell tank farms should begin immediately. In the case of the BX-102 tank leak, uranium contamination, which first violated drinking water standards in 1994, has gone un-remediated for 12 years.

The health of the environment and the associated progress toward clean up should not be held hostage to the integration issue between CERCLA and RCRA units and operations, between RL and ORP responsibilities, and/or between various contractor baselines.

The NPT acknowledges the guidelines both EPA and DOE have developed for the five-year review process, which asks and/or states the following:

Is the selected remedy operational and functional?
Are assumptions critical to the effectiveness of the measures or protections still valid?
What may be needed to address any current remedial deficiencies?
Opportunities to optimize long-term performance of measures or reduction of life-cycle cost need to be evaluated.

Response to Comment 3: DOE considered your recommendation that the CERCLA five-year review process be expanded beyond the regulatory scope. However, DOE is required to fulfill its legal obligation to complete the review consistent with the requirements on conducting a five-year review identified in CERCLA, Executive Order 12580, the National Contingency Plan, and DOE and EPA guidance. Meeting that obligation is a complex and time-intensive activity. Expanding the scope beyond CERCLA requirements and including RCRA activities would result in an even more complex and time-consuming process and something to which DOE cannot commit.

DOE agrees optimal protection of the environment occurs when there is integration among legal requirements, organizations, and contractor baselines. We believe it is imperative that groundwater contamination be managed as an integrated program that addresses all groundwater contamination from all sources to be efficient, successful and cost effective. DOE has initiated steps to assure better integration of projects addressing groundwater and sources in the soil and acknowledges there remain integration challenges at the Hanford Site.

Comment 4: In addition, referencing the NPT end-state vision stated above, the NPT will also utilize the CERCLA five-year review process as a tool to determine to what degree the sites are being or have been remediated so as to be usable for tribal Usual and Accustomed rights by treaty. It would appear general that Lessons Learned for DOE since the first five-year review should include the recognition of the inadequacy of their knowledge of extent of contamination and how to deal with it. The NPT remains concerned about remediation efforts which rely heavily on attenuation and dilution concepts.

Response to Comment 4: DOE appreciates and endorses the NPT use of the CERCLA five-year review as a tool to determine the degree to which sites are being or have been remediated so they can be usable for tribal Usual and Accustomed treaty rights. We also recognize current limitations of existing data to determine the extent of contamination. Ongoing risk assessments should provide additional information about the extent of contamination and assist DOE in future decision making about remedies.

Comment 5: Future Issues

One of the main concerns is how does one evaluate a site in the five-year review process and make assertions about protectiveness to the environment when in most cases there is no biological data to back that assertion up.

At the last five-year review the ERWM had some concerns with how these statements were made regarding the persistent low levels of DDT that existed at the Horse Shoe Landfill. The resolution to that situation was that Horse Shoe Landfill be added to PNNL's annual surveillance and monitoring program.

The results of that effort would then determine if any future action was warranted. Based on that effort, more contaminated soil was removed from that site. The concern is that there could be other sites similar to Horse Shoe Landfill that might have levels of contamination that may be incorporated into the food chain. The only way to assure the public in a five-year review that this is not the case is to actually have some biological sampling results that show levels of protectiveness.

Response to Comment 5: DOE agrees that biological sampling at remediated sites would provide a means of confirming the effectiveness of clean-up and demonstrating its protectiveness of ecological receptors. Subject to available funding such sampling will be incorporated into the annual design review process for the Public Safety and Resource Protection Program (PSRPP), which conducts the Hanford Site Surface Environmental Surveillance Project. During the review process, 3-5 sites will be identified and a sampling plan developed that addresses the primary contaminants of concern for each specific site, as well as the biological media that would best serve to meet the sampling objectives. In subsequent years a new set of 3-5 sites would be selected.

Comment 6: Resolution

We are not advocating that all the sites that are included in the five-year review need to be sampled, but we think sampling at selected sites would be appropriate. We suggest DOE select 3-5 sites per year and have PNNL, as part of its annual program, do some biological sampling (burrows, insects, plants, etc.) for one year at these sites. Each year pick 3-5 new sites. At the next five-year review DOE would be able to report that over the past 5 years biological monitoring was done at 15-25 sites. Results could then be shared which would hopefully show that there is not a problem and that indeed the remedy is protective of the environment.

From our perspective this would be cost effective and would go a long ways in developing some positive public relations and credibility. We have talked this over with EPA staff and the response has been positive. This is actually an action item that could be put into the current five-year review. For example, "Action Item: DOE plans on doing some biological monitoring at selective sites to address concerns raised by stakeholders and tribes for the next five-year review."

Response to Comment 6: As stated in the previous response to comment, DOE agrees with this recommendation and is taking steps to implement it.

Comment 7: <u>Specific Comments</u>

100 Area: page 1.27 – What is the status of the remediation efforts for the 118-K-1 burial ground?

Response to Comment 7: Remediation efforts for the 118-K-1 Burial Ground started on May 30, 2006 and are expected to be completed (with the exception of the six silos) by March 2007. The six silos within the burial grounds require additional planning.

Comment 8: page 1.30 – The NPT encourages additional consideration of the ESD issued in 2004 for the 116-N-1 trench. Institutional controls as a remedy for ^{90}Sr at this location are inappropriate when ambient water quality criteria for aquatic organism for strontium (and most if not all radionuclides) are unavailable to access risk.

Response to Comment 8: DOE disagrees that additional consideration of the Explanation of Significant Difference (ESD) is needed at this time. Currently, no viable remediation alternatives, other than those described in the ESD are available for consideration. Institutional controls are also a fundamental part of some permanent remedies when it is not feasible to treat or remove all contaminants and some are left in place.

The Department will implement institutional controls as necessary, along with other mitigating or preventive measures, to provide a reasonable expectation that if one control temporarily fails, other controls will be in place, or actions will be taken, to mitigate significant consequences of the failure. Institutional controls will not be used to circumvent or substitute for permanent solutions when such solutions are reasonably achievable. Institutional controls will not be applied, or will be terminated, when DOE determines that such controls are not necessary or required.

Comment 9: page 31 – It is the understanding of the ERWM that the TPA required ecological impact assessment for the 100-N has not been finalized (draft issued in 10/05), and in fact is currently undergoing massive rewrites to comply with the needs of the regulators.

Response to Comment 9: The ecological impact assessment for the 100-N was finalized and results published in Aquatic and Riparian Receptor Impact Information for the 100-NR-2 Groundwater Operable Unit, DOE/RL-2006-26, Draft A, transmitted to the Washington State Department of Ecology on June 1, 2006. Any follow-on work will be performed in the River Corridor Baseline Risk Assessment which is currently underway.

Comment 10: page 1.36 – The reservoir 182-D in D-Area still leaks and may be adding to the chromium movement in the plume. Suggestions for resolving this are to quit using the reservoir and obtain fire protection water directly from the river; or consider maintaining the reservoir in a reductive state, which would enhance the permeable reactive barrier on site.

Response to Comment 10: DOE currently is evaluating engineering options to reduce leakage of uncontaminated water from the 182-D reservoir in D Area. The results of this evaluation will be considered in the feasibility study and proposed plan and will assist with developing possible remedies for this problem.

Comment 11: 200 Area

The NPT acknowledges that the Hanford tank farms are not currently included in the CERCLA five-year review. However, the Tribe, as well as the preparers of the CERCLA five-year review, recognizes the need to include those items from the tank farm areas for review that relate to the groundwater operable units which are currently under Interim ROD action, and/or already contain active groundwater plumes.

Response to Comment 11: The CERCLA five-year review process is limited to cleanup decisions under CERCLA records of decision. Current characterization activities for 200 Area groundwater includes any impacts of releases of contaminants from tank farms to groundwater. Future 200 Area groundwater remediation decisions will include and address all contaminants, regardless of source.

Comment 12: page 2.7 Section 2.3.2 Tank Farms – The evidence that supports the claim that soil contamination resulting from tank leaks and discharges to the cribs and trenches have commingled should be stated and referenced. In fact, visualizations in an un-issued document (DOE/GJO, 2004. B-BY-BY-WMA and Adjacent Waste Sites Summary Report (draft), control number: GJO-2003-545-TAC prepared by S.M. Stoller Corp for the Grand Junction Office, Grand Junction, Colorado) clearly demonstrate that these waste streams have not commingled in the vadose zone in the B-BX-BY Area.

Response to Comment 12: DOE disagrees with the conclusion based solely on inferential subsurface techniques. Given the volumes of waste discharged to trenches and cribs adjacent to the tank farms and the geology, it is reasonable to include lateral migration from these sources into the zone below the tank farms. In addition, DOE would not be able to use an unofficial, unpublished source.

Comment 13: page 2.19 Table 2 – The Z cribs and trenches are potential sources of transuranic contaminants. The single-shell tank farms are potential sources of uranium, tritium, nitrate, chromium, and iodine-129.

Response to Comment 13: DOE agrees in part with the comment. The Z cribs and trenches are potential sources of transuranic contaminants. However, the list of contaminants is far more complex and, in many cases, is the same as for process wastes from single-shell tanks, specific retention trenches and cribs. There are other potential contaminants from these sources besides those noted in this comment.

Comment 14: page 2.21 & Progress Since Last Review – Since the measurements of the concentrations have been collected at the top of the aquifer, it is premature to claim that the declining concentrations at the top of the aquifer is due solely to the pump and treat. The contaminated areas of lower concentration have increased dramatically in size, suggesting dispersion. The apparent decline in the concentrations could also be attributed to this DNAPL plume moving deeper into the aquifer past the screened interval of the groundwater monitoring wells. DOE does not yet have a good three-dimensional understanding of this plume.

Response to comment 14: DOE disagrees with the statement that "it is premature to claim that the declining concentrations at the top of the aquifer is due solely to the pump and treat." The CCl-4 at the top of the aquifer is in aqueous form. The mass removed by the pump-and-treat system, and the source removal in the soil, can account for the concentration reductions within the zone of influence of the pump-and-treat system. There is limited knowledge concerning the temporal changes in the lower contaminated areas; however, all data collected to date support a non-DNAPL, free phase, CCl-4 source. The conceptual models are currently being revised to reflect recent characterization data and an appropriate range of conceptual models, addressing reasonable uncertainties, will be used in developing the CERCLA feasibility study/proposed plan (FS/PP). We believe that there is sufficient information to proceed with the FS/PP, but recognize that additional data on the deep portion of the system will still need to be gathered, and may be accomplished by the installation and operation of an expanded treatment system.

Comment 15: page 2.22 Technical Assessment Summary #1 – Same as above - it is premature to claim that the declining concentrations at the top of the aquifer are due solely to the pump and treat.

Response to Comment 15: See response to previous comment.

Comment 16: page 2.22 Technical Assessment Summary #3 – The recent discoveries of Tc-99 and carbon tetrachloride at depth within the 200 West Area should not be attributed to changes in water-table evaluations without supporting evidence.

Response to Comment 16: The current characterization data support downward migration from artificial recharge. The feasibility study/proposed plan will consider alternative conceptual models.

Comment 17: page 2.24 Section 2.4.3.2 – The S, SX and U single-shell tank farms should be identified as sources of groundwater contamination.

Response to Comment 17: The S, SX, and U single-shell tank farms have impacted groundwater. The nature and extent of this impact are being determined through the RCRA Facility Investigation which is currently underway, and will be followed by a Corrective Measures Study.

Comment 18: It is important to remember that the RAOs for uranium and ^{99}Tc were somewhat tentatively established as "ten times MCLs" (480 μg/L and 9, 000 pCi/L) in the Interim ROD for Up-1 in 1997. It should be recognized that these standards exceed drinking water standards and that the remediation efforts have not restored the groundwater to its highest beneficial use.

Response to Comment 18: Groundwater cleanup objectives are to restore the aquifer to beneficial uses wherever practicable within a reasonable time frame, given the particular circumstances of the Hanford Site. If, through the CERCLA process, restoration is determined not to be practicable, it is expected that appropriate actions will be taken to prevent further migration of the plume, prevent exposure to the contaminant, and evaluate further risk reduction. This approach is consistent with 40 CFR 300.430(a)(1)(iii)(F). Restoration of the aquifer within the 200 Area plateau will likely prove to be problematic. The remedial action objectives defined by the interim action ROD are not intended to "restore the aquifer." Rather, the RAOs were intended to reduce the magnitude of the plume. To meet a goal of aquifer restoration, all of the contaminants above drinking water standards would need to be reduced to meet those standards. The technical feasibility of reducing all of the contaminants to drinking water standards will be considered in setting a lower RAO for U and Tc-99 when the feasibility study/proposed plan is submitted in support of the "final record of decision." (Please see response to Comment #23 above, which is on the same subject, and make sure the 2 responses are consistent with each other. Right now, they have slightly different responses.)

Comment 19: page 2.25 Technical Assessment Summary – A reference should be given that lists the data needs for the groundwater operable unit. It would appear that the source units haven't been fully characterized yet. The report published in September 2004 should also be referenced, as it is unclear what report this is.

Response to Comment 19: The five-year review process is meant to verify that the remedies selected in Action Memoranda and records of decision are working as predicted. These remedies are expected to be protective when completed, unless the conditions and assumptions on which the decisions were based have changed significantly. The Technical Assessment Summary section of the five-year review report provides an overview for purposes of a CERCLA five-year review and is not intended to include exhaustive references. However, the CERCLA RI/FS will incorporate the data needs identified during the data quality objectives (DQO) process and accompanying references, and will incorporate previous activities resulting in characterization data.

Comment 20: page 2.27 Section 2.4.3.3 – Tank leaks (i.e., the leak from tank A-105) should be listed as contributing to groundwater contamination. This tank's history is documented and must be included in any review document attempting to maintain an overview of the site's remediation.

Response to Comment 20: The table in Section 2.4.3.3 does list the T, TX, and TY Tank Farms as possible sources of contamination for the ZP-1 operable unit.

Comment 21: page 2.27, 200 UP-1 – Source control remedies are needed for 200-UP-1 OU.

Response to Comment 21: The UP-1 discussion is in Section 2.4.3.3. Source control remedies will be considered in the CERCLA feasibility study/proposed plan.

Comment 22: page 2.27, 200-PO-1 – Operable Unit. 200-PO-1 is contaminated primarily with tritium and ^{129}iodine, yet no decision document is in place, and allegedly there are no technologies available to deal with the contaminants. However, potential remediation technologies applicable to the groundwater in 200-PO-1 have not been evaluated since the Corrective Measures Study in 1996. A DQO is underway for the 200-PO-1 Operable Unit, and this DQO should be mentioned in the text.

Response to Comment 22: The Data Quality Objectives process was initiated after the cutoff date for inclusion of new information in this document.

297 **Comment 23:** page 2.28 Section 2.4.3.3 – Given the limited amount of data, it is premature to report that the trend is decreasing concentrations of Tc-99 near A tank farm.

Response to Comment 23: The data is not sufficient to determine "long-term trends"; however, the "short-term trend" is lower Tc-99 concentrations. See Section 2.11.3.3 of the annual *Hanford Site Groundwater Monitoring Report for Fiscal Year 2005*, PNNL-15670, for a more complete description of groundwater conditions at A-AX Tank Farm. This document has previously been transmitted to the Nez Perce Tribe.

Comment 24: page 2.32, Table 2.8 – The symbol m^2 is generally equated with "meters squared", as is, therefore, confusing when as "miles squared" in the table. A comparison of the plumes between 1996 and 2004 should be given.

Response to Comment 24: Table 2.8 was changed from m^2 to $(mile)^2$. DOE recognizes the value of comparing the sizes of the plumes since the last CERCLA five-year review and has provided this data in the final document (see Section 2.4.3.4).

Comment 25: page 2.32, Remedial Action Chronology – The statement that "The aquifer conditions did not allow meaningful removal of contaminants from the aquifer to justify continuation of treatability test operations" is misleading as it suggests that the entire aquifer in the northern half of 200 East is unsuitable.

Response to Comment 25: The conclusion is only intended to address the area impacted by the treatability test. The conclusion may also be valid in areas showing similar hydrologic conditions, but such a determination would be made on a site-specific basis. In addition, the text has been revised in Section 2.4.3.4 to make this clear.

Comment 26: page 2.32 & 2.34, Tc-99 and Uranium – According to Figures K-9 and K-10 (DOE-RL, 1993c, *Phase I Remedial Investigation Report for 200-BP-1 Operable Unit*, DOE/RL-92-70, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington), Tc-99 and uranium were not reported above the DWS in the northern portion of 200 East Area. Thus, these are new groundwater plumes that have developed concurrently since 1992 while the environmental cleanup at Hanford was ongoing. In the B-BX-BY area, the only identified source of the uranium (as detailed in an un-issued report control #DOE/GJO-2003-545-TAC) in groundwater is the 1951 tank leak from BX-102.

Response to Comment 26: Uranium was historically disposed of in the cribs and trenches surrounding the B-BX-BY tanks (known inventories are quite high). Groundwater measurements underneath the cribs north of the tank farms showed uranium break-through in the 1950s, whereas similar measurements near BX-102 do not show such plumes.

Comment 27: The wording in the text (third paragraph on page 2.34) suggests by their physical location that the BY Cribs and the 216-B-7A and B Cribs are potential sources of uranium in groundwater; however, there is no field evidence that supports this inference (as detailed in an un-issued report control # DOE/GJO-2003-545-TAC).

Response to Comment 27: Groundwater measurements underneath the cribs north of the tank farms show uranium break-through in the 1950s. Also, there is a spatially extensive perched water layer (presumably from the large amount of water discharged to the cribs) that is likely to distort simple spatial relationships between sources and entrance into the groundwater.

Comment 28: The text claims makes claims about the lateral extent of the uranium plume in 1997 while the Hanford Site Annual Monitoring Reports for FY 1996, FY 1997, FY 1998, and 1999 (PNNL-11470,-11793, -12086, -13116) don't include maps of the uranium plume in the B-BX-BY area. Please provide a reference for the 1997 map of uranium groundwater concentrations.

Response to Comment 28: The primary source for the data on the uranium plume uranium plume near B-BX-BY is the Hanford Environmental Information System (HEIS) data base. The most recent reference containing a plot of the uranium groundwater concentrations in 1997 is Narbutovskih, SM., "Groundwater at Waste Management Area B-BX-BY," PNNL-SA-50098, RI/FS BP-5 Workshop, 2006, Pacific Northwest National Laboratory, Richland, WA."

Comment 29: In regards to the Tc-99 and uranium plume, the text states that the "patterns of contamination in this area indicate multiple sources and contaminant migration pathways in the vadose zone." The text should be clarified to indicate that the sources of the new Tc-99 and uranium plumes in 200-BP-5 OU are past leaks from single-shell tanks.

Response to Comment 29: This issue will be addressed through additional characterization. This characterization will be performed under both the RCRA Facility Investigations/Corrective Measures

Study (for soils under the tank farms) and the CERCLA RI/FS processes (for non-tank farm sources, including soils impacted adjacent to the tank farms).

Comment 30: page 2.37, Tritium – Contrary to the text, the distribution of tritium in 200-BP-5 OU differs substantially between 1996 and 2004. Compare Plate 3 (PNNL-11470) and Figure 2.10-4 (PNNL-15070), the distribution of tritium is substantially different in the northeast portion of 200 East Area. Comparing Plate 3 (PNNL-11470) and Figure 2.10-4 (PNNL-15070), the concentrations of tritium have increased in the B-BX-BY area since 1996. The text should be rewritten to accurately describe the changes in tritium distribution in the 200-BP-5 OU since 1996.

Response to Comment 30: A more detailed description of the 200-BP-05 Operable Unit groundwater tritium plume can be found in Section 2.10.1.1 of the *Hanford Site Groundwater Monitoring for Fiscal Year 2005* (PNNL-15670). This document has previously been transmitted to the Nez Perce Tribe.

Comment 31: page 2.37, Cobalt-60 and Cyanide – The present cobalt-60 and cyanide groundwater contamination probably has resulted from past tank leaks in BY tank farm rather than the BY Cribs, which contaminated groundwater in the 1950s.

Response to Comment 31: This issue will be addressed through additional characterization. This characterization will be performed under both the RCRA Facility Investigations/Corrective Measures Study (for soils under the tank farms) and the CERCLA RI/FS processes (for non-tank farm sources, including soils impacted adjacent to the tank farms).

Comment 32: page 2.39, Progress Since Last Review – Unfortunately, only one of the nine groundwater monitoring wells, installed in the B-BX-BY areas, have been located down gradient of the tank farms, which has severely restricted the usefulness of groundwater data in the area to identify the vadose zone sources. In this document, the uranium groundwater plume is reported as moving "some in the northwest direction" while the "nitrate contamination migrated north." The text should be revised so that the migration of the various contaminants is consistent with the groundwater flow direction. An opportunity was missed to place monitoring wells in optimal locations.

Response to Comment 32: It is difficult to determine the "gradient" as the groundwater is "flat" in this area. Localized flow may be slightly different due to geologic conditions. Monitoring well locations are decided with DOE involvement. This issue will be addressed through additional characterization. This characterization will be performed under both the RCRA Facility Investigations/Corrective Measures Study (for soils under the tank farms) and the CERCLA RI/FS processes (for non-tank farm sources, including soils impacted adjacent to the tank farms).

Comment 33: page 2.39, Technical Assessments Discussion – The text should be revised to include the groundwater and vadose modeling done in RPP-10098 and DOE/RL-2002-42 with an explanation of why these two modeling efforts failed to model uranium reaching groundwater in the B-BX-BY area.

Response to Comment 33: RPP-10098 (B-BX-BY FIR) stated that is was likely that uranium and other contamination went down the borehole at the 4 o'clock position of BX-102, but that the inventory was small. At this time, there is insufficient data to determine that a significant amount of the uranium seen in the area comes from the tank farms. This issue will be addressed through additional characterization.

This characterization will be performed under both the RCRA Facility Investigations/Corrective Measures Study (for soils under the tank farms) and the CERCLA RI/FS processes (for non-tank farm sources, including soils impacted adjacent to the tank farms).

Comment 34: page 2.40, Technical Assessments Discussion, third bullet – Refer to the previous comment for page 2.39, Progress Since Last Review.

Response to Comment 34: As stated in the previous response to comment, more characterization data is needed.

Comment 35: 2.6 Issues, 2.7 Recommendations & 2.8 Action Items – The ongoing degradation of groundwater quality underneath the tank farms in 200 East Area should be addressed. These groundwater plumes caused by tank leaks in A, BX, BY and C single-shell tank farms will not dissipate by natural attenuation. From the NPT perspective, the continued growth of the Tc-99 and uranium groundwater plumes near these tank farms is a higher priority than an interpreted soil conductivity anomaly based upon indirect geophysical measurements collected in the B/C Cribs and Trenches area.

Response to Comment 35: The Tc-99 plumes emerging in the S/SX and T, TX, TY tank farm areas are currently being characterized. This characterization will be the basis of remedial action decisions in the future.

Comment 36: 300 Area: page 3.6 – 300-FF-1 – A summary of the evaluation of the completion of remedial actions is important, specifically if there remain institutional controls and monitoring efforts in the area. Citing the remedial action report does not give the reader an overview of what that report concludes. In other words, other than citing the report, what has the CERCLA five-year review process done to ascertain that RAO's have been met? By regulation, the review is to ensure the long-term effectiveness of engineered or institutional measures placed to protect human health and the environment; and it is to serve to optimize the effectiveness and implementation of remedy requirements.

Response to Comment 36: The 300-FF-1 Operable Unit Remedial Action Report DOE/RL-2004-74 Rev 0 was completed after the first five-year review (2001). This report documents that *Evaluation of the Fate and Transport of Tritium Contaminated Groundwater from the 618-11 Burial Ground*, PNNL-15293, August 2005 issues in the report addresses long-term protectiveness issues.

Comment 37: page 3.11 – Technical Assessment Summary, fifth paragraph – This paragraph strongly states that the federal government will use the *Hanford Comprehensive Land Use Plan* (DOE-1999) as its legal tool for determining cleanup levels in the 300 Area, and that use determinations are not subject to local and regional plans. As such, it would seem that RAOs based on CLUP have already been determined, and that Tribal nations and stakeholders will have little meaningful input. If this is the case, the NPT questions why DOE sponsors end-state workshops for this and other areas on the Hanford Site.

Response to Comment 37: The End States Workshops were a forward-looking tool to gather additional input on desired end states. For the 300 Area, the land use planning decision is the record of decision for the Comprehensive Land Use Plan (CLUP); cleanup levels established by the 300-FF-01 and 300-FF-02 records of decision are consistent with the CLUP.

Comment 38: page 3.12, Section 3.5.1, second paragraph – The NPT is pleased to see that DOE recognizes that drinking water standards for uranium may not be appropriate regarding uranium toxicity to aquatic organisms, and recognizes that no standards have evolved upon which to base ecological risk. This begs the question as to how well the risk to the environment is understood with respect to uranium toxicity, either chemically or radiologically.

Response to Comment 38: Uranium toxicity has been extensively studied and there is a large body of published information that can be used in determining protective cleanup levels.

Comment 39: page 3.14 – Based on computer simulations of future plume behavior, the tritium plume at 618-11 is not expected to create an exposure risk to the Columbia River. Such an expectation is premature. The potential for "more surprises" and thus future high peaks certainly exists, and this could change the simulations dramatically.

Response to Comment 39: DOE disagrees. The tritium plume is well characterized and actively monitored. Current predictions indicate that the tritium plume in the groundwater is not migrating at an appreciable rate due to the local hydro-geological conditions. (*Evaluation of the Fate and Transport of Tritium Contaminated Groundwater from the 618-11 Burial Ground*, PNNL-15293, August 2005). The plume will continue to be monitored and evaluated under the CERCLA process.

COMMENTER 20: Confederated Tribes of the Umatilla Indian Reservation

Comment 1: We thank DOE and EPA for the opportunity to comment on the second Hanford five-year review. This is a very important document. Some general comments are included in the cover letter, and more specific comments on many technical issues that have not been resolved are included in the attachment.

Response to Comment 1: U.S. DOE appreciates the time and resources provided by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) to review and submit comments on the draft document.

Comment 2: This document is a good catalog of regulatory actions, and with a few additions (such as the regulatory status and schedule of each operable unit, and a linkage of each operable unit to its milestone number), it will be a valuable resource. Please include some introductory language related to major milestone goals, such as to remove all contaminated soil to background in the River Corridor by 2012.

Response to Comment 2: While it was not the intent of the CERCLA five-year review report to provide a catalog of regulatory actions or a status of project performance against TPA Milestones, we are glad you find it useful for that purpose. The purpose of a five-year review is to evaluate the implementation and performance of CERCLA clean up action remedies to determine if the remedies are or will be protective of human health and the environment when completed.

Comment 3: Also, please include a discussion of tanks and other RCRA sources/actions compared to CERCLA sources/actions, or at least show very clearly which source terms are not covered by this document. For example, we have heard that tanks are covered by RCRA but not by CERCLA, but the

200 Area NPL site does not appear to have 'holes' in it that are not covered by CERCLA. Therefore, a list or ARARs would also be helpful, including Washington Model Toxics Control Act (MTCA).

Response to Comment 3: The purpose of a CERCLA five-year review is to evaluate the implementation and performance of a remedy in order to determine if the CERCLA remedy is or will be protective of human health and the environment when completed. RCRA treatment, storage, and disposal units are generally not addressed in CERCLA decision documents unless the closure or cleanup of the RCRA units has been deferred to, or is directly part of, the CERCLA action. The CERCLA protectiveness determination would only include consideration of the RCRA unit if it were specifically part of the selected remedy. The large waste storage tanks (single shell and double shell) in the 200 Areas will be closed under RCRA regulatory requirements. The closure activities will meet the requirements defined in RCRA closure plans written specifically for the tanks. When the RCRA closure actions are completed, it is possible that cleanup of residual contamination, if there is any, could be deferred to CERCLA. But, that hasn't happened yet. Since there has not been a CERCLA decision issued that covers the tanks, they are not included in this five year review. A list of ARARs is not part of a CERCLA five year review. ARARs are established as part of the CERCLA RI/FS Proposed Plan/Record of Decision process. The MTCA is not applicable to CERCLA actions on the Hanford Site. Whether any substantive requirements from MTCA are relevant and appropriate is determined on a case by case basis as CERCLA decisions are formulated.

Comment 4: Overall, we believe that DOE cannot make protectiveness statements yet because the cumulative risk assessments have not been done. We do not know whether individual remedies or the sum total of all the remedial actions are protective on a sitewide basis, including disposal sites, landfills, groundwater, capped sites, deep vadose contamination, US Ecology, ERDF, and so on either now or far into the future. This is true even in the 300 Area which has a final ROD but no cumulative baseline risk assessment yet. Will the remedies result in "unlimited use and unrestricted exposure" for all media in each area or among areas without institutional controls? How confident are we that UU/UE will be reached by publicly stated goals such as 2012 when we know that groundwater will not be clean enough to use?

Response to Comment 4: The five-year review process assesses the current and future protectiveness of the remedies selected in action memoranda and RODs. The protectiveness statements in the five-year review report Public Review Draft reflected an evaluation of whether the selected remedies, that were designed to be protective of human health and the environment are performing as expected. However, in response to the many comments received on the protectiveness statements, the Department of Energy concluded that the commenters are correct in pointing out that in some cases the protectiveness statements in the Public Review Draft of the CERCLA five-year review report for the Hanford Site may overstate the level of protectiveness that can be determined based on the information available at this time. DOE has concluded that in some cases a more conservative determination would more accurately reflect the situation. Therefore, some of the protectiveness statements were revised to more conservatively reflect the level of knowledge on which the statements were based.

Comment 5: DOE cannot rely on assertions that groundwater use will remain restricted; therefore, there is no public health threat. In fact, the converse is true: groundwater is unsafe to use, therefore institutional controls are required.

Response to Comment 5: The purpose of a CERCLA five-year review is to evaluate the implementation and performance of a remedy in order to determine if the CERCLA remedy is or will be protective of human health and the environment when completed. If the remedy includes institutional controls, the five-year review evaluates the effectiveness of those controls.

Comment 6: In particular, the "exposure assumptions, cleanup levels, and remedial action objectives" are not valid because our exposure scenario was not complete when the interim and/or final RODs were written. By definition, then, no remedy has ever based on protecting our health, and therefore no remedy is "protective." The only exception to this is where background conditions have been met and there is no residual contamination in the deep vadose zone.

Response to Comment 6: The five-year review process assesses the current and future protectiveness of the remedies selected in action memoranda and RODs. The protectiveness statements in the public review draft of the five-year review report reflected an evaluation of whether the selected remedies, that were designed to be protective of human health and the environment are performing as expected. Specifically, interim RODs were evaluated based on whether they protected human and environmental health during this interim period.

Comment 7: Most of the recommendations state the need to complete, continue, evaluate, or develop remedy components pursuant to the interim RODs.

- It is not clear what endstates these interim actions and interim remedies will result in, since the cumulative risk assessments have not been done. For example, interim groundwater RODs focus on characterization and monitoring, rather than on a final endstate RAO, such as cleanup to both drinking water standards for the general population and to health based standards for Native Americans using the cumulative multipathway risks calculated by using the CTUIR exposure scenario.

Response to Comment 7: As noted in the report, most of the remedies selected to date are interim which indicates a need to evaluate, complete and/or further develop the remedies into final remedies that will be documented in final decision documents.

The interim remedies that have been selected through the CERCLA processes have remedial action objectives consistent with the remedies selected. The "list of things to do" includes the actions or activities that must be completed to meet the interim remedial action objectives.

Comment 8: Similarly, caps, barriers, pump and treat systems, institutional controls, and other interim remedies have no clear final RAO, just a list of things to do on an interim basis.

Response to Comment 8: The use of engineered caps and barriers for land disposal facilities is an accepted practice for final remedial actions where the contaminants cannot be practicably removed. Properly designed, constructed, and maintained caps and barriers have been determined to be protective of human health and the environment by regulatory agencies, including the EPA and the Washington State Department of Ecology. Both agencies have used engineered caps in conducting cleanup projects under their jurisdiction. Similarly, pump-and-treat systems and institutional controls can be included in final remedies. Therefore, they are not just a list of things to do on an interim basis.

In the Hanford Cleanup Project, barriers, pump-and-treat systems, and institutional controls are being utilized as part of the interim remedial actions because they allow cleanup progress to be made while preliminary assessments and final remedial design activities are proceeding. Interim remedial action objectives have been established that are expected to be consistent with final remedies when they are established in final RODs.

Comment 9: Related to this, the draft WCH Closure Plan is terribly naive in that the endstate environmental quality is not discussed. Rather, it is simply a laundry list of things that will still need to be done (e.g., groundwater monitoring) once sites are delisted.

Response to Comment 9: While there is no document titled, "WCH Closure Plan," the commenter may be referring to the document, *River Corridor End State Strategy*, WCH-8, December 2005. DOE agrees that environmental quality could have been added to the text and the document would have been more helpful.

Comment 10: It is further unclear to what level these recommendations in the five-year review are being supported by funding and how these recommended actions are incorporated into milestone and budget planning.

Response to Comment 10: Actions identified in the CERCLA five-year review are included in the Hanford baseline. Near-term funding of these actions is dependant on congressional funding levels.

Comment 11: Our conclusion is that the 300 Area ROD should be reopened, and that interim RODs cannot be converted into final RODs without revising the ARAR lists to include MTCA and until the cumulative multi-pathway, multi-contaminant risks using the Tribal exposure scenario without institutional controls are known.

Response to Comment 11: The limited field investigation (LFI) currently underway at the 300-FF-05 Operable Unit is focused on achieving the remedial action objection established in the 300-FF-05 ROD for restoration of the aquifer to drinking water standards for uranium. We are also characterizing the recently-discovered localized occurrence of plutonium in the 618-2 burial ground and TCE discovered in the Ringold Formation in two of the four wells drilled during the LFI drilling campaign. DOE-RL cannot simply convert the ROD for interim action into a "final" ROD. The final ROD will be developed in accordance with the CERLCA processes. The risk assessments will be considered and the ARARs established through those processes. The MTCA is one of the many laws and regulations that will be evaluated to determine if there are substantive requirements that are applicable or relevant and appropriate as part of the selected remedy.

Comment 12: The purpose of conducting five-year reviews is:

> (*from the Preamble of the EPA Guidance*): "Section 121 of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), requires that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site be subject to a five-year review. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) further provides that remedial actions which result in any hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for **unlimited use and**

unrestricted exposure be reviewed every five years to **ensure protection of human health and the environment**." [emphasis added]

> (*from Page 1-1 of the EPA Guidance*): "The purpose of a five-year review is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment. Protectiveness is generally defined in the National Contingency Plan (NCP) by the **risk range and the hazard index** (HI). Evaluation of the remedy and the determination of protectiveness should be based on and sufficiently supported by data and observations." [emphasis added]

The purpose of the five-year review as defined by DOE is too narrow. DOE is attempting to narrow the purpose of the five-year review to only "evaluate the implementation and performance of a remedy." This avoids answering the protectiveness question. Protectiveness can only be demonstrated if it is addressed directly – "Is the remedy protective" according to the definition of protectiveness in EPA guidance? This means that cumulative risks, including CTUIR Exposure Scenario, must be mapped across the entire Hanford Site (as well as down river, wherever the contamination has come to be located) and through time. If DOE truly answers the question of protectiveness by asking only whether assumptions, cleanup levels, and RAOs are still valid, then no remedy is protective because there are new assumptions and information (such as our exposure scenario) that apply sitewide and to every component of every operable unit.

Response to Comment 12: Section 1.1 of the EPA Comprehensive Five-Year Review Guidance, EPA 540-R-01-007, OSWER No. 9355.7-03B-P, June 2001, states:

"The purpose of a five-year review is to evaluate the implementation and performance of a remedy in order to determine if the remedy is or will be protective of human health and the environment." This is what DOE has done. The Guidance further states: "Protectiveness is generally defined in the National Contingency Plan (NCP) by the risk range and the hazard index (HI). Evaluation of the remedy and the determination of protectiveness should be based on and sufficiently supported by data and observations." Section 4.0 of the Guidance identifies the following three questions to provide a framework for organizing and evaluating data and information and ensure that all relevant issues are considered when determining the protectiveness of the remedy:

• Question A – Is the remedy functioning as intended by the decision documents?
• Question B – Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?
• Question C – Has any other information come to light that could call into question the protectiveness of the remedy?"

As stated in the report, these are the questions that DOE used to help evaluate the protectiveness. In response to the many comments received on the protectiveness statements, DOE has reviewed the protectiveness statements and concluded that the commenters are correct in pointing out that in some cases DOE overstated the level of protectiveness that can be determined based on the information available. Therefore, some of the protectiveness statements were revised.

Comment 13: (from E.O. 12580): "(h) The functions vested in the President by Section 104(c)(3) of the Act are delegated to the [EPA] Administrator, with respect to **providing assurances for Indian tribes**, to be exercised in consultation with the Secretary of the Interior." [emphasis added]

Response to Comment 13: DOE agrees that this provision of the Executive Order 12580 delegated responsibility for Presidential functions with respect to providing assurances for Indian tribes to the EPA Administrator. DOE anticipates that the EPA Administrator will carry out the functions as required.

Comment 14: (from DOE 1992) Under Sections 104 and 121 of CERCLA, the Environmental Protection Agency (EPA) is required to assess the risks to human health posed by uncontrolled hazardous waste sites on the National Priorities List (NPL). That assessment is conducted in the RI/FS phase of the site cleanup process. When applied to the evaluation of human health impacts caused by uncontrolled CERCLA sites (i.e., no remedial action is taken), this process is termed the "baseline risk assessment."

Response to Comment 14: DOE agrees that risk assessments are part of the RI/FS process. DOE also agrees that the role of the baseline risk assessment in the RI/FS process is to address the risk(s) associated with a site in the absence of any remedial action or control, including institutional controls. It essentially is an evaluation of the no-action alternative. The results of the baseline risk assessment are used to understand the types of exposures and risks that may result from superfund sites and are used to help select the most appropriate remedy. The remedy selected through the RI/FS process will address the risks identified in the RI/FS process and mitigate the identified risks to be protective of human health and the environment. The five-year review process is to evaluate whether that the selected remedy is or will be protective when final.

When the Hanford cleanup project was initiated in 1989 with the signing or the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989), known as the Tri-Party Agreement (TPA), efforts were initiated to fully characterize known and suspected contamination. Early remedial investigation/ feasibility study and *Resource, Conservation and Recovery Act* (RCRA) facility investigation/corrective measures study (RFI/CMS) work plans indicated it would require seven to ten years of characterization before cleanup decisions could be evaluated and determined.

Based on past Hanford Site waste disposal practices and knowledge of spills and releases to the environment, it was known that there were adverse environmental impacts that might cause the Hanford Site to qualify to be listed on the CERCLA NPL. This initiated a preliminary assessment/site investigation process, conducted by DOE.

The preliminary assessment/site investigation included a comprehensive review of historical records including facility operating records, data from groundwater, surface water, soil and air monitoring and sampling; aerial photographs; interviews with workers; and walking the site to identify potentially disturbed areas. Using the information gathered, it was determined that the Hanford Site qualified for inclusion on the NPL and four areas of the site (the 100, 200, 300 and 1100 Areas) were listed.

The preliminary assessment/site investigation identified that some contaminants posed a potential immediate threat to human health and the environment. As a result, DOE established a "bias for action" approach to the cleanup. The "bias for action" allowed DOE (with regulatory agency approval) to conduct removal actions in areas that posed a potential immediate threat to human health and the environment. The "bias for action" resulted in interim removal actions prior to full characterization of the type, level, and extent or degree of contamination and prior to development of final CERCLA remedy selection decision documents (final RODs).

Because sufficient information on the severity and extent of contamination was not available to support final decisions, "interim action" decision documents were developed (RODs for interim actions, expedited response action approvals, and action memorandums). During interim cleanup actions, samples are collected and analyzed to evaluate the progress of the action and to enable a more complete understanding of the types, levels, and extent of the contamination and more complete remedial actions.

The remedial actions selected addressed the contaminants of greatest concern in the areas where the environmental threat was known to be highest. As a result cleanup focused for several years in areas that posed the highest risk to the Columbia River (the "River Corridor"). In particular, the focus has been on activities intended to protect the Columbia River through contaminant source removal actions and groundwater pump-and-treat systems designed to remove source contaminants in the soil and groundwater from reaching the river.

Comment 15: Comments about "protectiveness"

Conclusion (e.g., Executive Summary, page iii).
We do not think that DOE can demonstrate that the actions are protective of *our* health and the environment, because our exposure scenario was not used to derive cleanup goals. Even though any particular ROD might not have specifically required protection of tribal health, we would like DOE to add a statement to the effect that it is aware that our scenario was not used for any ROD or risk assessment yet.

Response to Comment 15: DOE is aware and appreciative of the work the tribes have done to develop tribal use scenarios. That information will be considered in DOE decision documents, including the River Corridor Baseline Risk Assessment and final RODs, but was not available when most of the decision documents reviewed in this report were written.

Comment 16: We recognize that the two major risk assessments (River Corridor and River; TC-WM EIS) are not complete. Therefore, cumulative risks are not known and protectiveness cannot be demonstrated.

Response to Comment 16: See response to Comment 15.

Comment 17: The phrases "will be protective" is problematic because no time frame is ever indicated.

Response to Comment 17: As stated above, in the final five-year review report, DOE was more conservative in some areas about its level of protectiveness determination.

Comment 18: Circular reasoning is an issue with the "will be protective" phrases. For example, it is asserted that groundwater actions will be protective when the work is completed, and work will be complete when protectiveness criteria are met. However, this could be in 30 years or 30,000 years. There is no clear path from short-term pump-and-treat to actually demonstrating that health-based and standards-based criteria have been met without the need for institutional controls, other than pumping and treating for potentially hundreds of years.

Response to Comment 18. Since the ROD for interim action was issued, the uranium drinking water standard was reduced from 48 to 30 ppb, not 10 ppb. An Explanation of Significant Difference (ESD) to the *Record of Decision for Interim Action for the 200-UP-01 Operable Unit*, signed in February 1997, is being prepared to update the administrative record and official decision documentation to include operational agreements between DOE and EPA that have been made since 1997.

The remedial action goal established by the 200-UP-01 interim remedial action is to reduce uranium and technetium-99 concentrations to ten times the drinking water standards for uranium and technetium-99. When the ROD was signed in 1997, the uranium standard was 48 ppm; hence, the remedial action goal for the interim action is 480 ppb for uranium. This interim action goal has been met and we are currently performing a rebound study to determine if these conditions will continue over time. The interim action is intended to reduce the mass of these two contaminants to levels where future migration of the plume will not exceed standards outside of the 200 Area core zone.

Because this interim action is not the final remedy, the final end state (remedial action objective for uranium) for the 200-UP-01 groundwater has not been determined. For the interim action, DOE is currently following the EPA policy and 40 CFR 300.430(f)(1)(ii)(B)(1) regarding consideration of newly promulgated or modified requirements for RODs signed prior to the 2001 amendments being effective. Once a ROD is signed and a remedy chosen, EPA policy does not require the decision to be reopened unless the new or modified requirement calls into question the protectiveness of the selected remedy as discussed in the response to Commenter 8 on page B.32.

If a new ROD is issued, the new ROD would reflect current ARARs. DOE intends to conduct groundwater cleanup pursuant to CERCLA requirements and will strive to meet CERCLA groundwater cleanup goals. Groundwater cleanup decisions will be based on meeting the CERCLA nine criteria, including meeting ARARs. DOE will meet CERCLA groundwater cleanup objectives, including the restoration of the aquifer to beneficial uses wherever practicable within a time frame reasonable given the particular circumstances of the Hanford Site. If, through the CERCLA process, restoration is determined to not be practicable, it is expected that appropriate actions will be taken to prevent further migration of the plume, prevent exposure to the contaminant and evaluate further risk reduction.

This approach is consistent with 40-CFR 300.430(a)(1)(iii)(F). Aquifer restoration for 200-UP-01 Operable Unit must be evaluated on all of the contaminants that exceed drinking water standards. Hence, the ultimate cleanup levels for uranium and technetium will be based, in part, on the ability to meet standards for the co-contaminants, including carbon tetrachloride.

Comment 20: Criteria for demonstrating protectiveness should be listed at the front of the document. A list of criteria should be added, particularly those addressing the cumulative health risk implied by the phrase "protective of human health." Protecting human health has two components: meeting standards or ARARs and meeting cumulative risk levels (using our exposure scenario to determine risk). Please be very specific that this includes MTCA as well as CERCLA.

Response to Comment 20: DOE does not agree that criteria for demonstrating protectiveness should be listed in the front of the five-year review report. The criteria are specific for each remedial action and are included in the RI/FS reports and a primary element of the basis for the remedial action objectives. DOE agrees that CERCLA protectiveness evaluations include consideration of whether the ARARs have been met. Selection of ARARs is based on the need to mitigate the risks to human health and the environment that have been identified as the basis for conducting the remedial action(s). The MTCA is not applicable to the Hanford CERCLA sites per section 9620(a)(4) of CERCLA. Whether an element of the MTCA is selected as an ARAR is dependent on the specific remedial action.

Comment 21: Specific cumulative risk criteria (e.g., 1E-5 under MTCA) should be listed.

Response to Comment 21: The specific cumulative risk criteria utilized in conducting risk assessments are listed in the risk assessment report. It is not appropriate to list out all of those criteria in the CERCLA five-year review report.

Comment 22: Cumulative risk pertains to soil and groundwater exposure pathways combined. A mention of integration of soil, deep vadose, groundwater, and biota risks should be added, along with a description of the integration processes that are underway.

Response to Comment 22: The purpose of a CERCLA five-year review is to evaluate the implementation and performance of a remedy in order to determine if the CERCLA remedy is or will be protective of human health and the environment when completed. DOE added to the final report that risk assessments are ongoing.

Comment 23: When doing the sitewide cumulative risk assessment, risks must be evaluated as if there are no institutional controls. In other words, we need to know what the risks would be now if groundwater is used and if the deep vadose is drilled inadvertently. The final remedies may, indeed..........

Response to Comment 23: See response to Comment 22 above.

Comment 24: A definition of "Unrestricted use and unlimited exposure" should be added. It is mentioned on page xi, but no definition is given.

Response to Comment 24: This terminology was taken directly from the National Contingency Plan Part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR). DOE has not formally adopted a definition. However, the U.S. Army Corps of Engineers defines the phrase as follows: "Unrestricted use and unlimited exposure" means that the property owner can use the land for any purpose with no institutional or engineering controls. Cleanup to "unrestricted use" is not always practical. Areas where contamination is present under permanent structures (such as roads, buildings, railroads or bridges) and poses little to no risk to human health or the environment in its current state. Areas where efforts to cleanup to "unrestricted use" would present a significant safety risk or where such cleanup would be prohibitively costly are best addressed by using institutional and/or engineering controls." This definition is consistent with how the phrase is used in this report.

Comment 25: Who decides whether new information is relevant to the determination of protectiveness, especially since sitewide risk assessments are not completed yet?

Response to Comment 25: The DOE is responsible for decisions regarding whether new information is relevant to the determination of protectiveness. The primary basis for deciding whether new information is relevant to protectiveness is whether the information calls into question whether the ARARs and remedial action objectives have been, or will be met.

Comment 26: Action Status and Schedule.
It would be helpful to us if a column were added in Table 1 (and similar Tables) that shows the status of the action, such as 'construction complete' or 'scheduled for completion in 200x.' For example, we can't tell from the tables or the text whether a construction complete letter was issued for 300-FF-1; the text merely says "RAOs have been met," which might or might not be an official statement as opposed to a hopeful assertion. It is hard to tell whether a site is really "done" and whether EPA has officially agreed by issuing a concurrence letter. The columns about affecting current and future protectiveness are not very useful.

Response to Comment 26: The action status table format is from EPA guidance that EPA has informed DOE must be adhered to very closely. DOE does not believe it would be appropriate to add additional columns as suggested. DOE also notes that the information suggested is available in the text of the report.

Comment 27: The Issues and Actions table on page v has two columns on protectiveness. It is not clear if they add much, since every action affects protectiveness directly or indirectly, and the distinction between current and future protectiveness is fuzzy.

Response to Comment 27: The format of the Issues and Actions table was developed following EPA guidance. DOE agrees that these columns can be confusing. In the final report an explanation has been added to help the reader understand the basis for the response in each column.

Comment 28: All RODs should have a final step of restoration and revegetation. Please indicate whether these steps have been finished in the same column as above or in a separate column.

Response to Comment 28: DOE cannot agree that <u>all</u> RODs should have a final step of restoration and revegetation. In some situations that may be part of the final remedy; in others it may not be possible or practicable. Whether the final step of a remedial action is restoration and revegetation is a decision that must be made through the remedial investigation/feasibility study/record of decision process. The five-year review cannot add requirements to RODs.

Comment 29: A TPA Milestone table would also be useful, showing links to each operable unit.

Response to Comment 29: The CERCLA five-year review has a specific purpose, as discussed above. While links to other cleanup objectives like TPA milestones might be useful, DOE chose to remain focused on the CERCLA five-year review requirements.

Comment 30: Treaty-reserved rights should be mentioned (they are not included in the land use plan).

Response to Comment 30: Consideration of Tribal treaty-reserved rights is part of the RI/FS process. It is not a subject that would be discussed in the five-year review unless it was a newly identified issue.

Comment 31: Boundaries are very confusing. Although RCRA is not included, there is no visible "donut hole" in the 200 Area.

Response to Comment 31: The boundaries of CERCLA sites are not defined geographically; they are defined by the geographical extent of the hazardous contaminant(s) that caused the CERCLA site to be listed. The boundaries of RCRA treatment, storage, and disposal units are specifically defined and closure plan requirements apply to those defined areas for the specific contaminants that were managed in the unit. On the Hanford Site RCRA units are circumscribed by the CERCLA sites due to the overlap with areas where CERCLA contaminants have been identified.

Comment 32: The boundaries in Figures 1-4 do not match existing maps for the 100 Area. For example, the 100 Area is variously drawn as the entire River Corridor, a string of pearls (the Reactor Areas), large amorphous areas of groundwater plumes, or larger areas that encompass all of Hanford except the 200 and 300 Areas.

Response to Comment 32: Figure 1-4 shows the 100-N Area operable units. It is unclear which maps it is being compared against. See the previous response to Comment 31.

Comment 33: Since NPL closure cannot occur in a layer-cake fashion (i.e., we cannot close and delist soil sites separate from the underlying groundwater, even if the groundwater contamination comes from a distant location), true sitewide integration and risk mapping must occur before any final Hanford RODs can be written.

Response to Comment 33: NPL sites are not "closed" per se. When the requirements of an ROD have been met, i.e., remedial action objectives have been met and the remedial actions completed, CERCLA sites or portions of CERCLA sites, such as operable unit or portions of operable units, may be deleted from the NPL. Final RODs can be written for operable units when the contaminants of concern for the operable unit are sufficiently well characterized to enable a knowledgeable evaluation of the risks from the contaminants and development of remedies to mitigate those risks. Soil contamination sites can be remediated and deleted from the NPL independent of the contaminated groundwater. CERCLA sites where contaminants have been left in place may be deleted from the NPL but will be subject to five-year reviews to ensure that the remedies continue to work at designed. If a five-year review finds that a remedy is not working as designed or new information has been identified to indicate that a remedy is no longer protective of human health and the environment, additional remedial action may be necessary.

Comment 34: Figure 2 shows only one small area in the 200 Area, although there are many scattered sites and 24 soil OU groupings.

Response to Comment 34: DOE agrees, the figure does not adequately show the 200 Area operable units. The 200 Area source operable units are shown on Figures 2.1 and 2.2.

Comment 35: Does the 100 Area include interim sites and orphan sites? Does the 100/300 Area risk assessment match the boundary of all the 100 Area maps shown in this document?

Response to Comment 35: Many of the waste sites in the 600 Area (i.e. sites located in the Hanford town site) are covered in the remaining sites ROD for the 100 Area. The ROD for 300-FF-2 Operable Unit also contains waste sites in the 600 Area (i.e. 618-10 and 618-11 burial grounds). Any new sites that may be discovered and require remediation are assigned to a ROD, based on location.

The 100/300 Area risk assessment is evaluating waste sites that have completed remediation under current 100 or 300 Area RODs, regardless of location.

Comment 36: Comparing Figures 2 and 3 shows widely divergent Area boundaries – small sources at the surface and huge areas for groundwater. In a 3-D perspective, then, each operable unit would actually be a misshapen cone with the source at the tip, the groundwater at the bottom, and an unknown mass of contaminated soil in between.

Response to Comment 36: The operable units are typically described by two-dimensional surface boundaries. However, as this comment highlights, the actual boundaries can be three-dimensional and determined by the extent of contamination.

Comment 37: Page xiii. What is the area in square miles – 560 or 586 m2? Does this include the 1100 Area? Perhaps a small table with each the square miles of each Area and each NPL site should be added.

Response to Comment 37: The area of the site, inclusive of the Columbia River, islands, the Wahluke Slope and Wildlife Area north of the River, the Fitzner-Eberhard Arid Land Ecology Reserve, etc. is 586 square miles. DOE does not believe it is appropriate to include the suggested table in the CERCLA five-year review report.

Comment 38: Given the confusion about NPL boundaries, this will be a challenge, but will indicate whether or not the entire Hanford site is included in one or another NPL site – our understanding is that there are no holes in the NPL coverage, and that all of the 200 Area is included in the 200 Area NPL even if tanks are covered by RCRA as well. In fact, the designation of "200 Area" is an NPL designation, and is never drawn with holes in it for tank farms.

Response to Comment 38: As noted above, the boundaries of CERCLA sites are not defined geographically; they are defined by the geographical extent of the spread of hazardous contaminant(s) that caused the CERCLA site to be listed. And, yes, the entire 200 Area is included in the NPL

The tanks are within the NPL site but will be closed under RCRA requirements. Upon completion of the RCRA closure, if there is residual contamination, the final remedial action may be deferred to CERCLA and completed as part of a CERCLA action.

Comment 39: Clean Fill. The total amount of clean fill needed for each NPL Area should be discussed.

Response to Comment 39: It is not appropriate to address the amount of clean fill needed for each NPL in the five-year review report. That type of information is addressed in the RI/FS record of decision/remedial action work plan process. From a practical standpoint, the amount of clean fill needed for each NPL area is not specifically tracked. However, preliminary estimates for clean-backfill requirements for the remove, treat, and dispose (RTD) sites on the Central Plateau have been made and will be used in developing the final remedies for those waste sites.

Comment 40: 200 Area vadose and groundwater.
The text recognizes that tanks (RCRA) and soil-groundwater and waste sites (CERCLA) are co-mingled (page 2.9). Since the human health and eco risk assessments will not be complete for several years (under the TC-WM EIS?), the overall cumulative risks for the 200 Area are unknown. DOE certainly cannot conclude that the remedies "are or will be protective of human health and the environment."

Response to Comment 40: DOE had numerous discussions with the public and received over 300 written comments on the draft document. In response to those comments, the document was revised. DOE agrees that in some cases the protectiveness statements in the report overstated the level of protectiveness. Therefore, DOE revised some of the protectiveness statements to reflect the level of knowledge on which the statements are based.

Comment 41: There is considerable disagreement about the tank leaks for the B and T Tank Farms, so the oversimplification in this document is problematic.

Response to Comment 41: DOE recognizes the uncertainties concerning the extent to which tank leaks have impacted groundwater. Investigations are underway and planned to reduce these uncertainties.

Comment 42: Page xi, xviii and elsewhere. Does the term 'remedial action' include restoration?

Response to Comment 42: No, the referenced term 'remedial action' does not include restoration, at least not as defined by the Department of Interior's Natural Resource Damage Assessment regulations. However, the term 'remedial action' can include certain actions to address impacts to natural resources. Whether a remedial action includes actions to address impacts to natural resources is dependent on many factors that are evaluated during the remedial investigation/feasibility study process. The decision on whether to address impacts to natural resources as part of the remedy is documented in the record of decision. One example is the inclusion of native plant revegetation in the remedies documented in the records of decision for the 100 and 300 Area NPL Sites.

Comment 43: Page 1.12, #4. Actions for the 100 Area include "re-vegetate." Please rephrase to "re-vegetate with appropriate native species" and add "recontouring, erosion minimization, maintenance, and five-year monitoring" as part of the general remedy.

Response to Comment 43: While DOE agrees conceptually with the comment, remedial decisions, including type of revegetation, are documented in RODs and cannot be changed by the five-year review report.

Comment 44: Page xii. Could you provide definitions that are in common Hanford usage, such as 'past practice units' for the uninitiated reader?

Response to Comment 44: In the Tri-Party Agreement, a past-practice unit is described as a waste management unit where wastes or substances (intentionally or unintentionally) have been disposed that are not subject to regulation as a treatment, storage and disposal unit but are subject to either CERCLA removal or remedial action or the corrective action provisions of RCRA.

Comment 45: Page xix, Site Visits. Please add Tribes to the list of entities that perform field evaluations.

Response to Comment 45: While DOE agrees that in some situations the Tribes do perform field evaluations, the field evaluations being discussed in this section of the report are specific to this five-year review and the Tribes did not participate in those evaluations.

Comment 46: Page 1.35. Please add a short discussion of what has not been chosen and the reasons. For example, was a cryogenic sweep considered in the100-D Area?

Response to Comment 46: It is not appropriate to include this type of discussion in the five-year review report. However, discussions of the alternatives may be found in the RODs.

Comment 47: We disagree with apatite injection in the 100-N Area (Action 6-1) unless there is a closure plan that removes the apatite with its adsorbed strontium. Was an Environmental Assessment done? Was an EA done for the other pilot projects?

Response to Comment 47: The apatite injection planned for the 100-N Operable Unit is being performed as a CERCLA treatability test per the requirements and authority of the CERCLA ROD. The results of the test will be incorporated into a proposed plan supporting a CERCLA ROD. Per DOE's most recent statement concerning its NEPA/CERCLA integration policy, "DOE relies on the CERCLA process for review of actions to be taken under CERCLA, i.e., no separate NEPA document or NEPA process is ordinarily required. In conducting the CERCLA process, DOE addresses NEPA values (such as analysis of cumulative, off-site, ecological, and socioeconomic impacts) to the extent practicable and includes a brief discussion of impacts in CERCLA documents or other site environmental documents as appropriate."

Comment 48: Appendix 1 – Institutional Controls
Please add Tribal members to each box in the "Who it Protects" column (Tribal members are not included in 'site visitors.'

Response to Comment 48: Tribal members are included in the "Non-DOE entities using DOE land - individuals who are associated with an organization, other than DOE or its contractors, that is located on the Hanford Site or is conducting activities on the Hanford Site."

Comment 49: Please add a discussion of how cultural and natural resources are protected from people (in addition to the discussion of how people are protected from contaminants).

Response to Comment 49: The purpose of a CERCLA five-year review is to evaluate the implementation and performance of a remedy in order to determine if the CERCLA remedy is or will be protective of human health and the environment when completed. Consideration of how cultural and natural resources are protected from people is part of the remedial investigation/feasibility study, record of decision/remedial action work plan process. It is not a subject to be discussed in the five year review report.