Overview of Tank Farms Performance Assessment

September 20, 2005

U.S. Department of Energy
Office of River Protection

CH2MHILL
Hanford Group, Inc.

Purpose of Meeting

- Briefing on the PA draft document contents
- Facilitate a preliminary review of the technical approach taken in the PA
- Receive NRC feedback prior to the final PA

Role in Decision Making

- NRC consultation as required by the Tri-Party Agreement
- Provides estimate of dose/risk for all source terms to support risk informed decisions
- Provides performance information to support the completion of retrieval.
- Support RCRA closure permit modifications
- Support CERCLA remediation decisions
- Fulfill the substantive requirements of DOE Order 435.1

Approval Process for Full PA

- Produced by the Tank Farm Contractor
- Approved and Released by DOE
- NRC Consultation as per DOE 435.1
- Ecology approves portions of the PA that are subject to its RCRA authority.
- EPA would be involved to support Ecology to determine that closure “is proceeding in a manner not inconsistent … under CERCLA remedial authority” Appendix I, Sec 3.1 HFFACO.

Document Outline
Single Shell Tank System Performance Assessment

- Chapter 1
  - Purpose, approach and methods
- Chapter 2
  - General data on site and specific data on each Waste Management Area (Tank Farm)
- Chapter 3
  - Conceptual Model and Sensitivity Analysis
- Chapter 4 thru 6
  - Analytical Results
- Chapter 7
  - Summary and Conclusions
- Appendices
  - A thru G contain detailed supporting information

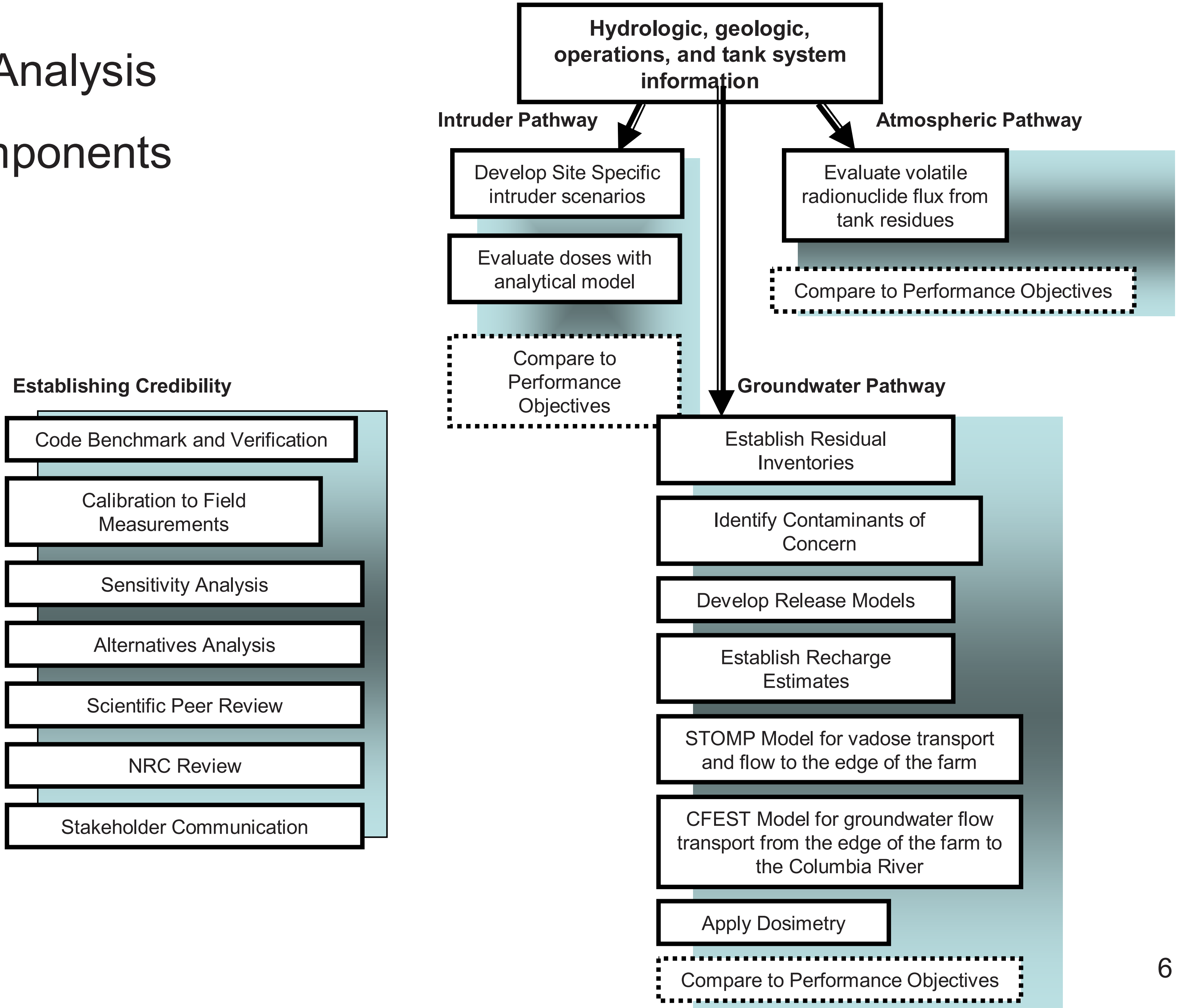
Alignment with Previous Performance Assessments

- Structure and content is similar to a PA as defined under the DOE Order 435.1 and produced within the DOE complex

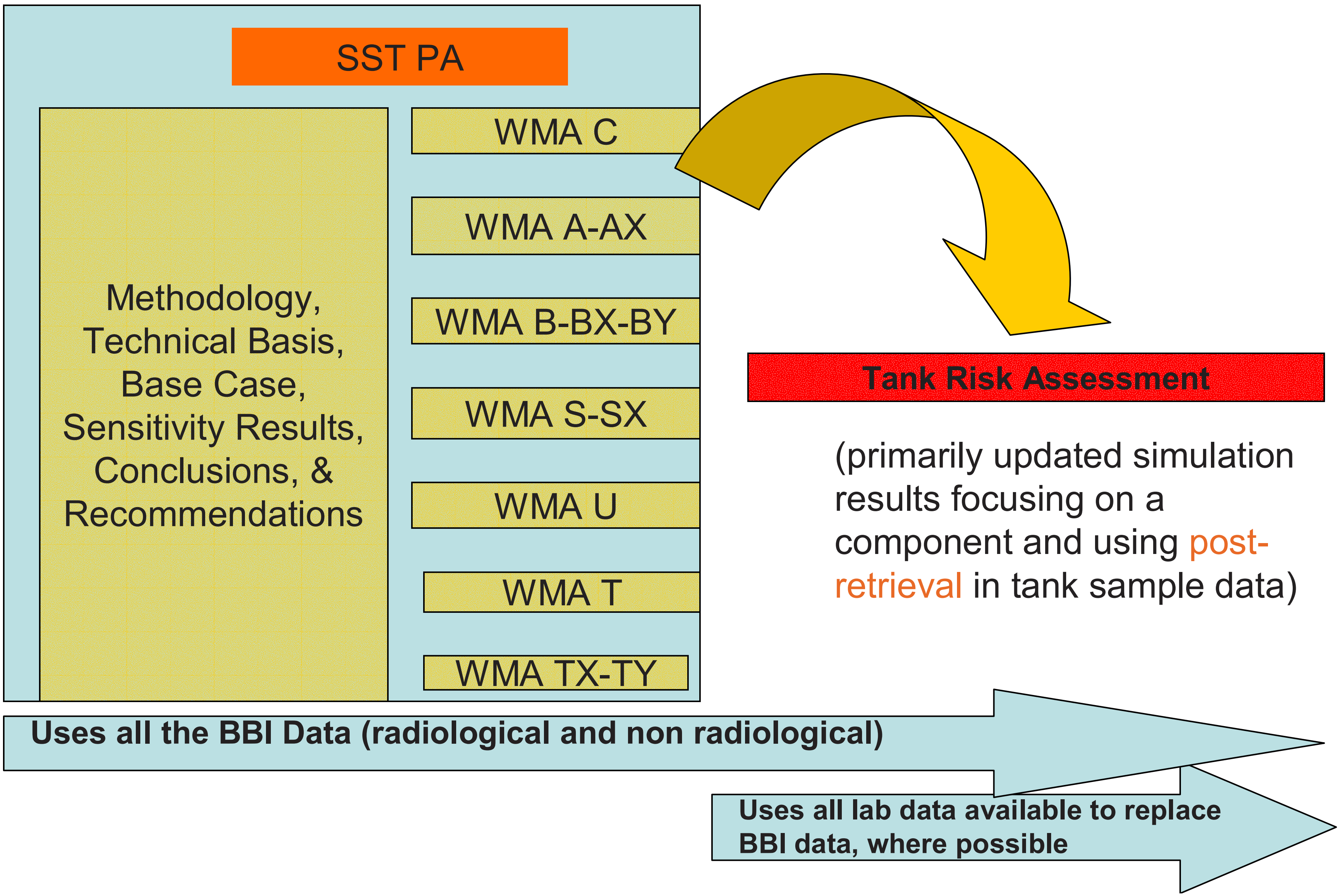
- Addresses the substantive requirements of DOE Order 435.1 and draws from the original C Farm Performance Assessment I

- The SST PA is a unique document addressing multiple DOE, federal and state requirements and commitments, particularly Appendix I to the HFFACO
  - Draws guidance from multiple sources including EPA's CERCLA program, State of Washington HWMA, and various NUREGs.

PA Analysis Components



Relationship Between the SST PA and Post Retrieval Risk Assessments



PA makes direct use of an extensive field, laboratory and analysis program

Field and Laboratory

(Contamination extent and mobility)

- Extensive historic data on past contamination
- Supplemented by direct sampling and analysis of major plumes and waste types
- Extensive laboratory analysis
- Complements the tank contents sampling program

Scientific Program

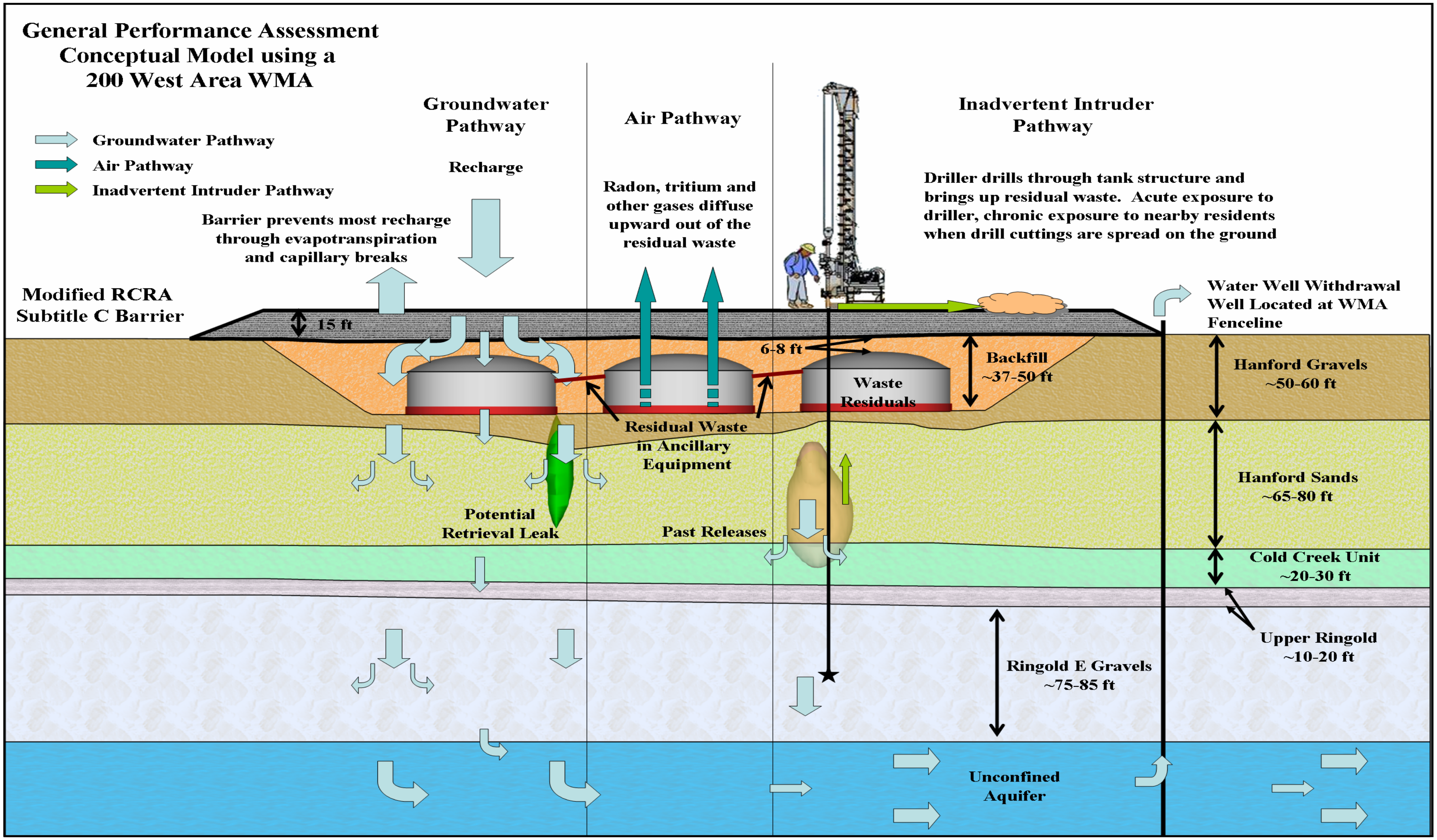
(Improving the Conceptualization)

- Cesium, technetium, chromium and uranium mobility
- Tank residue waste release mechanisms
- Effects of high heat tanks on moisture movement
- Effects of 2D vs. 3D implementation

Organizing Principles

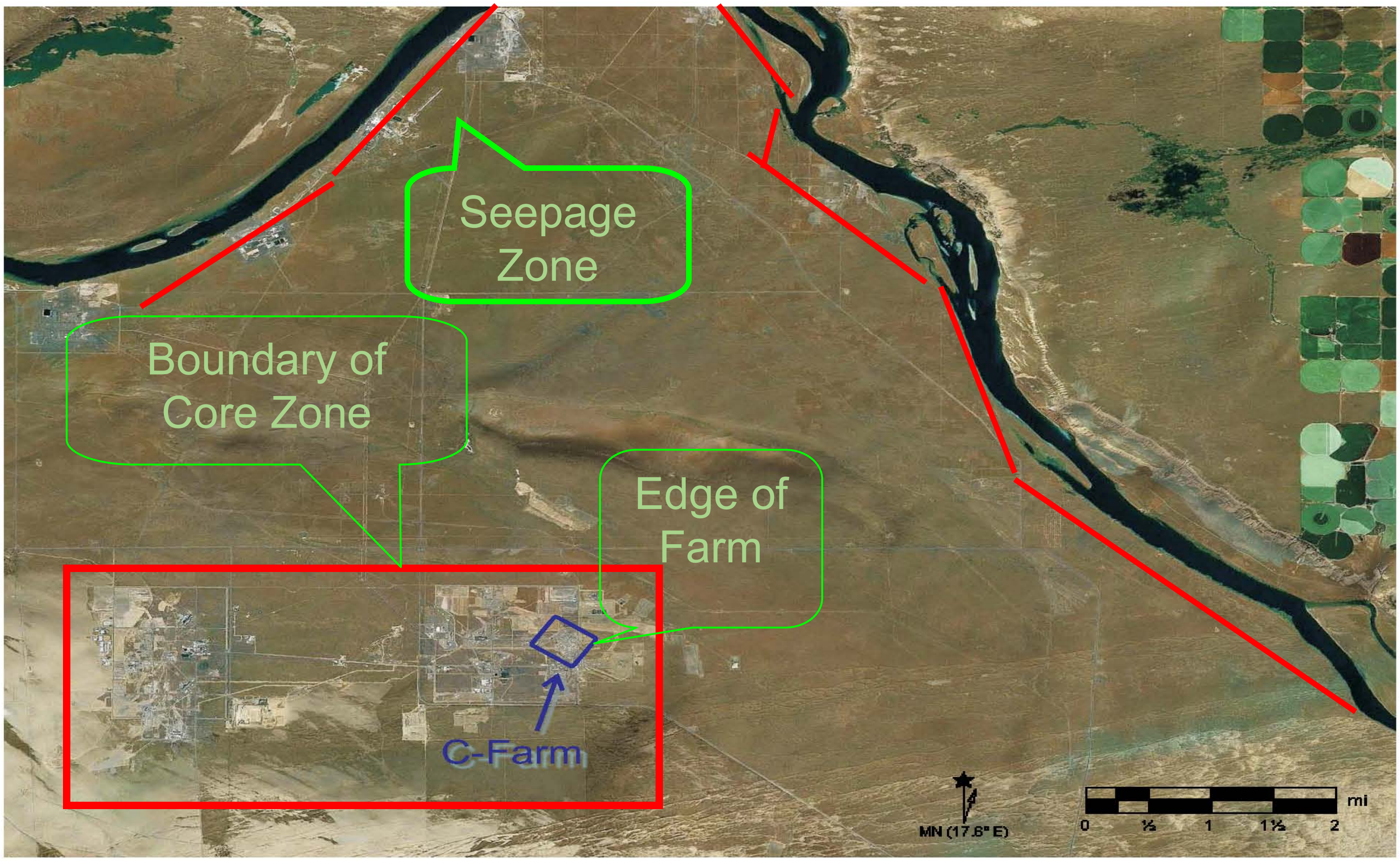
- Defense in Depth philosophy
  - Identification of engineered barriers and geologic features
- Analysis of controlling engineered components, and site features and processes
- Examination of alternative scenarios to the base case to address the robustness of the disposal system to meet performance objectives

Conceptual Model*



*Assumes landfill closure is the selected alternative in the final Tank Closure EIS/Record of Decision, presented for illustrative purposes only.

Approximate Locations for Points of Calculation
Length of Simulation –10,000 years



Each individual facility boundary is not shown

General Performance Objectives for Tank Closure

Protection of General Public and Workers [b, c, d]	
All-pathways dose from only this facility	25 mrem in a year [e,p]
All-pathways dose including other Hanford Site sources	100 mrem in a year [e]
Chemical Carcinogens (Incremental Lifetime Cancer Risk)	10^{-5} [f]
Non cancer-causing chemicals (hazard index)	1 [f]
Protection of an Inadvertent Intruder [e,g,o]	
Acute exposure	500 mrem
Continuous exposure	100 mrem in a year
Protection of Groundwater Resources [b, c, d, h, j]	
Alpha emitters	
^{226}Ra plus ^{228}Ra	5 pCi/R
All others (excluding uranium)	15 pCi/R
Beta and photon emitters	4 mrem in a year
Protection of Surface Water Resources [b, k]	
Alpha emitters	
^{226}Ra plus ^{228}Ra	0.3 pCi/R [m]
All others (excluding uranium)	15 pCi/R [m]
Beta and photon emitters	1 mrem in a year [m]
Protection of Air Resource [b, n]	
Radon (flux through surface)	20 pCi m^{-2} s^{-1}
All other radionuclides	10 mrem in a year

[a]. Values given are in addition to any existing amounts or background.
[b] Evaluated for 1,000 years, but calculated to the time of peak or 10,000 years, whichever is longer.
[c] Groundwater use starts at the time when groundwater contaminated by historical Hanford Site operations (e.g., before the year 2000) is estimated to be potable.
[d] Evaluated at the point of maximal exposure, but no closer than the fence line of the waste management area in which the tank farm belongs. Also calculated at the edge of the 200 Area Core Zone and just before groundwater enters the Columbia River.
[e] DOE Order 435.1, *Radioactive Waste Management* (DOE 1999a).
[f] Washington State Model Toxics Control Act (WAC 173-340), as applicable.
[g] Evaluated for 500 years, but calculated from 100 to 1,000 years.
[h] All concentrations are in water taken from a well.
[j] National Primary Drinking Water Regulations (40 CFR 141), as applicable.
[k] Evaluated at well at the edge of the Columbia River, no mixing with the river is assumed.
[m] Washington State Surface Water Standards (WAC 173-201A), as applicable.
[n] National Emission Standards for Hazardous Air Pollutants (40 CFR 61H and 40 CFR 61Q).
[o] 10 CFR 20 Standards for the Protection Against Radiation
[p] 10CFR 61 Licensing Requirements for Land Disposal of Radioactive Waste

Assumed Reference Case Scenarios

Future Land Use and Time Frame Assumptions Base Case Analysis		
Time Frame	**Scenario**	**Comment**
2000 – 2032	DOE Cleanup/Closure Activities	Current conditions
2032 – 2332	Industrial Land Use, No Groundwater Use	The combination of active and passive institutional controls assumed effective for a period of 300-500 years after closure. Other time periods will be evaluated in sensitivity analyses.
2332 – 12032	Industrial Land Use, Groundwater Use	Drilling may occur after 300 yrs. No waste exhumation occurs.
2532	Inadvertent Intruder, Rural Pasture Use	Institutional controls are assumed to end in 2532 and intrusion into the waste site occurs, bringing waste to the surface.

Active and passive institutional controls are under discussion within DOE and the NRC, and the values given are for discussion purposes only at this time

Assumed Alternative Land Use Scenarios

Alternative Land Use Scenarios	
Receptor	**Location**
Future Alternative Plausible Exposure Scenarios	
Residential	Edge of the Waste Management Area after 300 years
All pathway farmer	Edge of the Waste Management Area after 300 years
DOE Order 435.1 Inadvertent Intruder Exposure Scenarios	
Intruder into the Waste Site	Onsite ground maximum[1]
Post Intrusion: Suburban Gardener Commercial Farmer	Onsite ground maximum[1]
Notes: 1 - Ground maximum is defined as within the closed waste management area	

Sensitivity Analysis
Infiltration Assumptions

Groundwater Pathway – Partial Summary of Base Case Parameters and Expected Ranges				
Natural and Engineered Barriers/Features	**Feature/Process**	**Base Case**	**Sensitivity Analysis**	
			Minimum	**Maximum**
Surface	Infiltration	An infiltration rate of 100 mm/yr for the base case during tank farm operation up to 2032 **(Fayer, 2004, Wittriech, 1998)**	40 mm/yr	140 mm/yr
	Infiltration	An infiltration rate of 0.5 mm/yr for the base case for the barrier from 2032 to 2532. (**Fayer, 2004, Ward and Fayer, 1995)**	0.1 mm/yr	1.0 mm/yr
	Infiltration	An infiltration rate of 1.0 mm/yr for the base case for the barrier from 2532 to 12,032	0.5	3 mm/yr – 200 East 4 mm/yr -200 West (**GOSPL, 2004**)

Additional Sensitivity Analyses to Determine the Impact of an Alternative not Considered in the Reference Case on the Performance of the System

Sensitivity Analyses

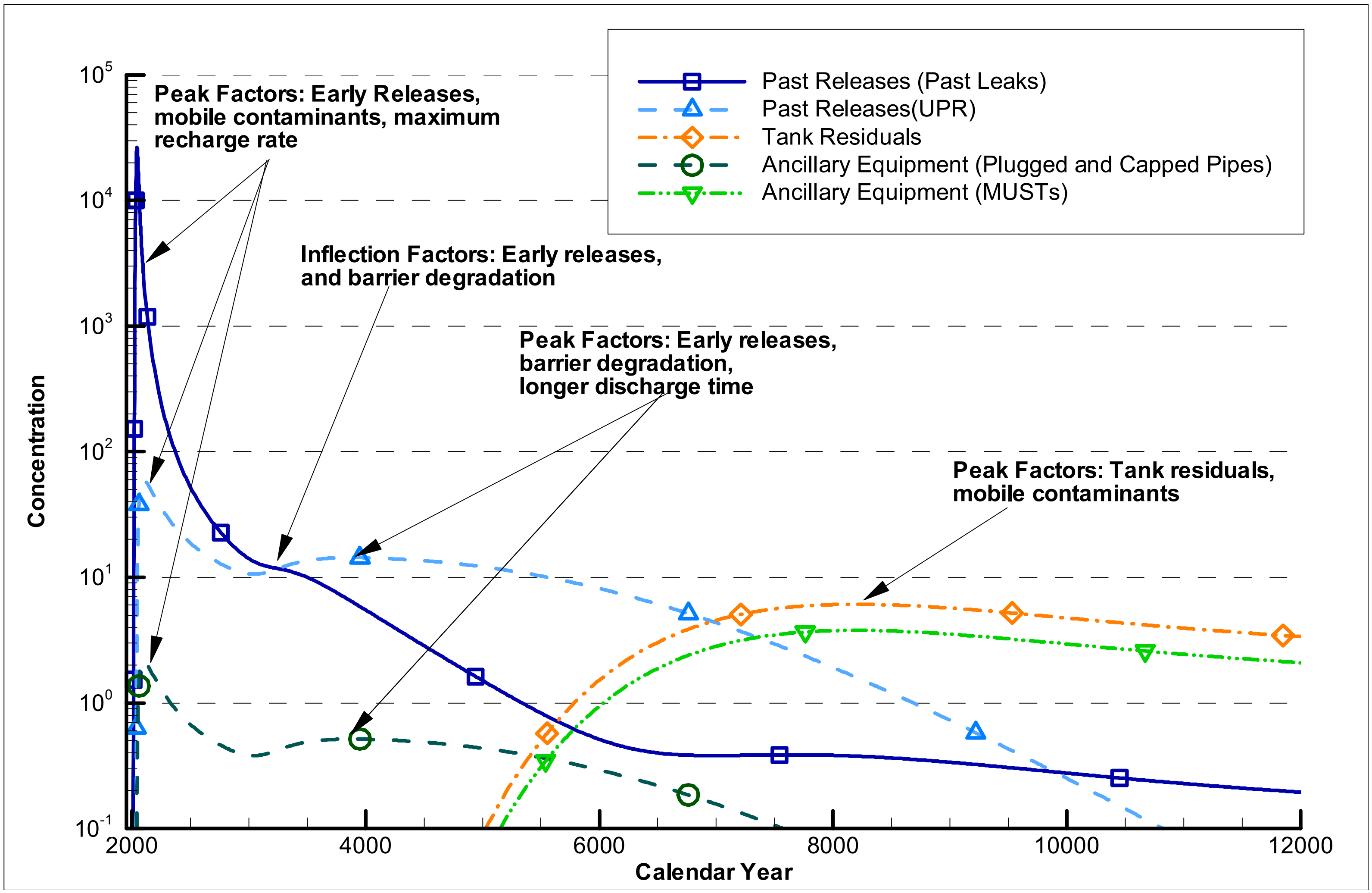
Sensitivity Analysis -- "What if" Conditions for the Examination of the Level of Protectiveness Provided by the Reference Case for the Protection of Groundwater (2 pages)		
Barrier/Feature	**Alternative**	**Condition**
Surface Cover	1	What is impact of closing the farm before 2032?
	2	What is the impact of closing the farms after 2032?
	3	What is the impact of an interim barrier by 2010 over major leaks?
	4	What is the impact of episodic infiltration?
	5	What if the barrier subsides?
	6	What if irrigated farming occurs after the end of active institutional control?
	7	What if the barrier fails at the end of passive controls?
	8	What if the barrier fails prior to the end of passive controls?
Grouted Tank/ Structure	9	What if the 100-series tanks leak more than the assumed 8000 gallons/tank?
	10	What if retrieval leaks occur at the 200-series tanks, regardless of the use of dry retrieval methods?
	11	What if the grout does not provide the level of encapsulation expected?
	12	What if more tank waste residue is left than expected?
	13	What if a water line breaks over a past spill prior to tank stabilization?
	14	What if the tanks behave like a "bath tub" and collect water, which then releases suddenly?

Sensitivity Analysis

Alternatives to the Base Case or "What if" Conditions for the Examination of the Level of Protectiveness Provided by the Base Case for the Protection of Groundwater (2 pages)		
Barrier/Feature	**Alternative**	**Condition**
Vadose Zone	15	What if potential preferential paths were missed during characterization?
	16	What if the groundwater level does not decline as projected?
	17	What if the depths of past leaks were underestimated?
	18	What if past leak contamination was underestimated?
	19	What if remediation of up to 50% of past leaks were possible?
Unconfined Aquifer	20	What if the plume moves faster in the aquifer than predicted?

Preliminary Results

Typical WMA Result



Peak Groundwater Dose[1] from the Reference Case Estimated at the Waste Management Area Fenceline for the All Pathways Scenario (10 CFR 61) (Performance Objective is 25 mrem)

Waste Management Area	Waste Source			
	Tank Residuals		Past Releases	
	Dose (mrem)	Perf. Obj./Dose Ratio	Dose (mrem)	Perf. Obj./Dose Ratio
S-SX	0.063	397	1.70	15
T	0.013	1923	3.10	8
TX-TY	0.25	100	0.04	625
U	0.35	71	0.35	71
C	0.011	2273	0.31	81
B-BX-BY	0.012	2083	0.54	46
A-AX	0.035	714	0.47	53

1. Period of Calculation begins 300 years after closure and continues until the conclusion of the simulation.

Intruder Scenario Dose Estimates at 500 Years After Closure

WMA	Worst Source Location	Well Driller mrem	Rural Pasture mrem	Suburban Garden mrem	Commercial Farm mrem
A-AX	AX-102 (tank plus leak)	18	4.8	108	0.13
B-BX-BY	B-101	4.2	1.0	23	0.029
C	C-201 (tank plus leak)	12	2.9	65	0.082
S-SX	SX-115 (tank plus leak)	29	6.6	147	0.18
T	T-106 (tank plus leak)	1.3	0.46	22	0.0072
TX-TY	TX-118	30	6.7	148	0.19
U	U-106	6.4	1.4	31	0.039

The times in parentheses are measured from WMA closure, which is the beginning of calendar year 2032.

WMA = waste management area

Inadvertent Human Intrusion

- Inadvertent human intrusion into closed tanks was assumed not to occur for 500 years after closure, however, analyses were performed to evaluate earlier intrusion.
- Documentation of our approach to forestalling inadvertent human intrusion for 300 – 500 years will be provided with the SST PA.
- Our approach uses a combination of active and passive institutional controls. It leverages information from WIPP (which EPA approved in the WIPP CCA), Yucca Mountain (under development), and DOE UMTRA and CERCLA approaches.
- Primary emphasis is placed on communicating knowledge of the SSTs over long time periods, e.g.,
  - Permanent on-site markers/monuments
  - Durable, widely dispersed permanent records and publicly accessible documents,
  - Regional strategies for perpetuating knowledge that would alert potential intruders and local (governments/tribes/inhabitants)

Sensitivity Analysis
peak / (reference case peak)

- Analysis is still ongoing
- Preliminary observations
  - Sensitivity varies with contaminant mobility and contaminant source
  - Past releases show a greater sensitivity than tank residual releases
  - Tanks residual impacts are generally robust in relation to alternative conceptualizations
  - The expected and high range predictions for past releases yields the same potential groundwater compliance status.

Preliminary Conclusions

- The SST PA supports the following potential decisions:
  - Retrieval and grouting of SSTs
  - Institution of interim measures to reduce the impacts to the groundwater
  - Examination of the potential for effective final corrective measures