Saltstone Disposal Facility Performance Assessment Briefing

Presentation to the Nuclear Regulatory Commission

Kent Rosenberger
(803) 557-9328 Office
(803) 645-2835 Cell
kent.rosenberger@srs.gov
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Presentation Overview

- General discussion of Savannah River Site (SRS) and Saltstone Facility
- Incorporation of Salt Waste Disposal Technical Evaluation Report (TER) Factors
- Revised Performance Assessment (PA) details

Salt Waste Disposal History

- SRS initiated a PA revision in October 2007 to account for a new disposal cell design and new research data since 2005
- Revision A was submitted for review by a DOE Savannah River Operations Office appointed team in March 2009
- Revision B was submitted for review by a DOE Low Level Waste Federal Review Group (LFRG) appointed team in June 2009

Salt Waste Disposal History

- The LFRG on-site review was conducted August 10-14, 2009 and NRC staff were observers
  - NRC issued observation report (ML092710477)
- Revision 0 was submitted to NRC in November 2009

General Discussion of SRS and Saltstone Facility

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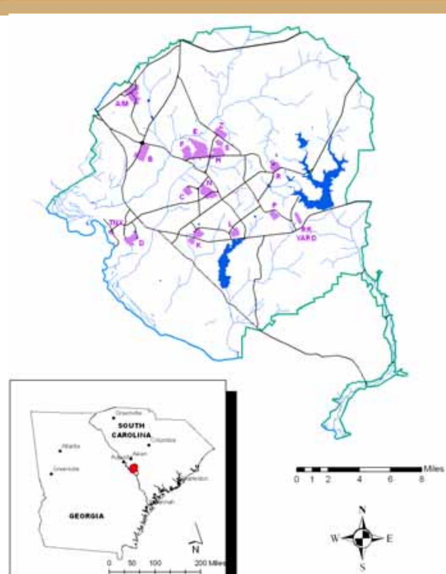
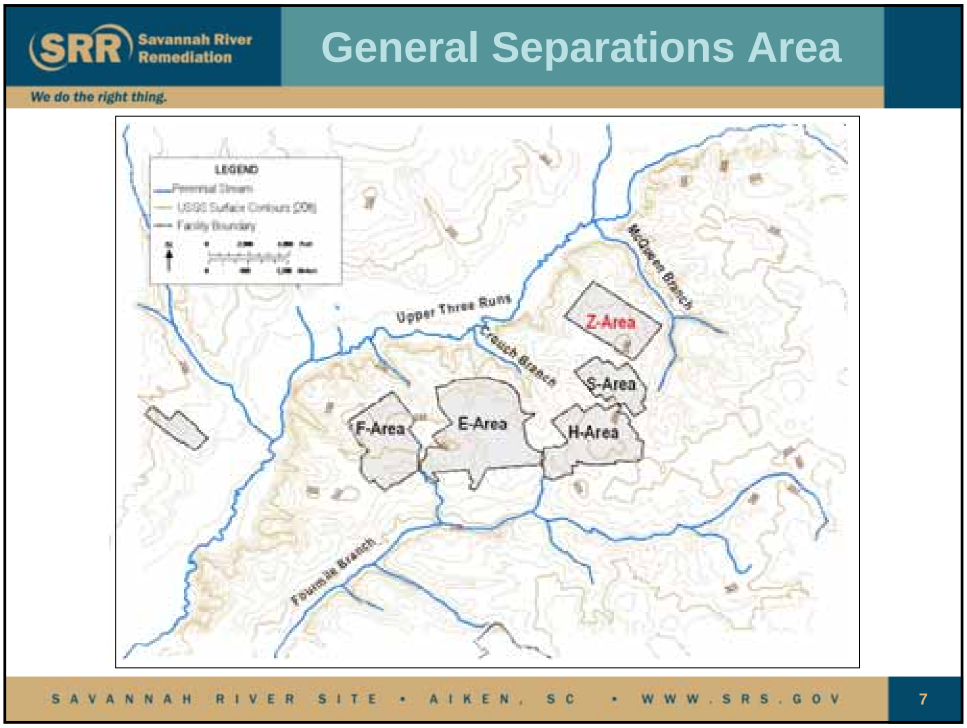
Savannah River Site





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General Separations Area
LEGEND
Upper Three Runs
Crouch Branch
McQueen Branch
Z-Area
S-Area
F-Area
E-Area
H-Area
Fourmile Branch
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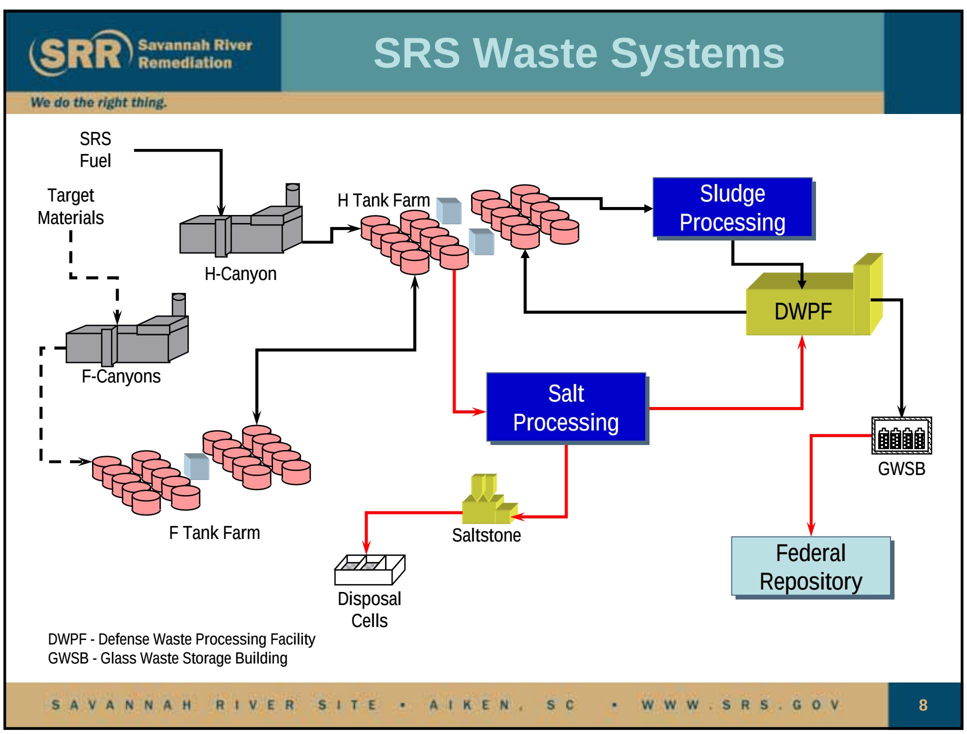

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SRS Waste Systems
SRS Fuel
Target Materials
H-Canyon
H Tank Farm
Sludge Processing
DWPF
F-Canyons
Salt Processing
GWSB
F Tank Farm
Saltstone
Federal Repository
Disposal Cells
DWPF - Defense Waste Processing Facility
GWSB - Glass Waste Storage Building
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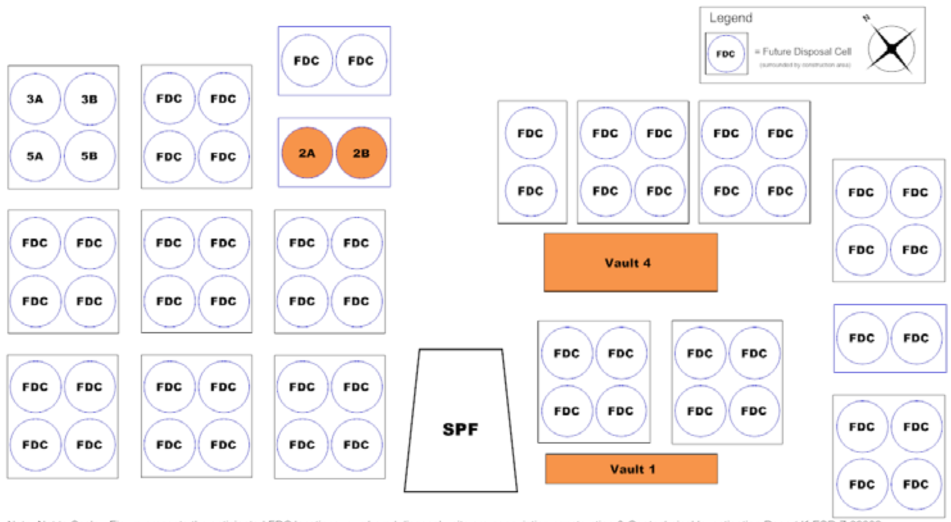
Saltstone Disposal Facility



Note: Not to Scale - Figure presents the anticipated FDC locations, numbered disposal units are per existing construction & Geotechnical Investigation Report K-ESR-Z-00002

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Vault 1

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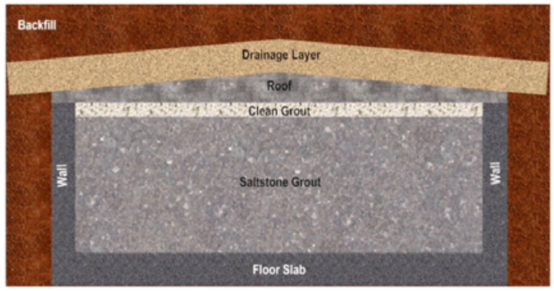
Vault 1



[NOT TO SCALE]

Model Zone	*Thickness*	*Modeled Material*
Backfill Layer	**4 feet (min)**	**Backfill**
Drainage Layer	**2 feet**	**Sand**
Roof (2 % slope)	**6 inches (min)**	**Ordinary Concrete**
Clean Grout Cap	**6 inches**	**Saltstone**
Saltstone	**24 feet**	**Saltstone**
Floor Slab	**2 feet**	**High Quality Concrete**
Wall	**18 inches**	**High Quality Concrete**

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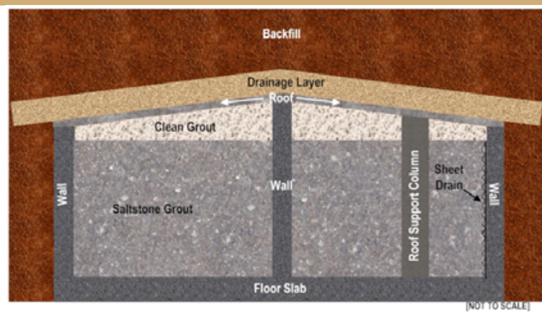
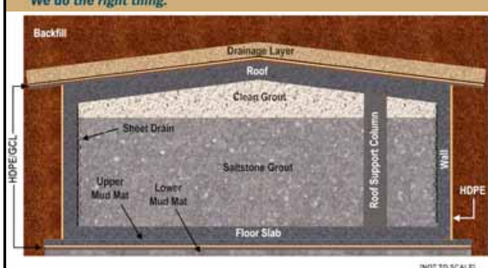
Vault 4

Vault 4



Model Zone	*Thickness*	*Modeled Material*
Backfill Layer	**24 feet (min)**	**Backfill**
Drainage Layer	**2 feet**	**Sand**
Roof (2 % slope)	**4 inches**	**Ordinary Concrete**
Clean Grout Cap	**17.4 inches (min)**	**Saltstone**
Saltstone	**24.75 feet**	**Saltstone**
Floor Slab	**2 feet**	**High Quality Concrete**
Wall	**18 inches**	**High Quality Concrete**

Future Disposal Cells



<u>Advantages of new design</u>

- Designed for ease of construction with PA informed features
- Advantage of water tightness during pouring operations

Model Zone	*Thickness*	*Modeled Material*
Backfill Layer	**7 feet (min)**	**Backfill**
Drainage Layer	**2 feet**	**Sand**
HDPE-GCL	**1 inch**	**HDPE-GCL**
Roof (2 % slope)	**8 inches**	**High Quality Concrete**
Clean Grout Cap	**2 feet (min)**	**Saltstone**
Saltstone	**20 feet**	**Saltstone**
Floor Slab	**8 inches**	**High Quality Concrete**
Upper Mud Mat	**4 inches (min)**	**High Quality Concrete**
HDPE-GCL	**1 inch**	**HDPE-GCL**
Lower Mud Mat	**4 inches**	**Low Quality Concrete**
Radial Orientation		
Wall	**8 inches**	**High Quality Concrete**
Shotcrete	**6 inches**	**Backfill**
HDPE	**1 inch**	**HDPE**

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Vault 2–Future Disposal Cells

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Vault 2–Future Disposal Cells

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Vault 2–Future Disposal Cells

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Vault 2–Future Disposal Cells

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Vault 2–Future Disposal Cells

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Vault 2–Future Disposal Cells

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Vault 2–Future Disposal Cells

9/24/2009
Roof Pour

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Vault 2–Future Disposal Cells

10/2/2009
Roof Complete

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Vault 2–Future Disposal Cells

10/14/2009
Cell Interior

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Vault 2–Future Disposal Cells

10/28/2009
Prestress wires

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Vault 2–Future Disposal Cells

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Incorporation of Salt Waste Disposal TER Factors

Incorporation of TER Factors

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- NRC Technical Evaluation Report (ML053010225) issued in December 2005 included eight factors to be monitored for reasonable assurance of complying with 10CFR61 performance objectives
- The revised PA incorporates new information related to the eight factors
- This is a brief description of the modeling information that will be expanded in the rest of the presentation

Incorporation of TER Factors

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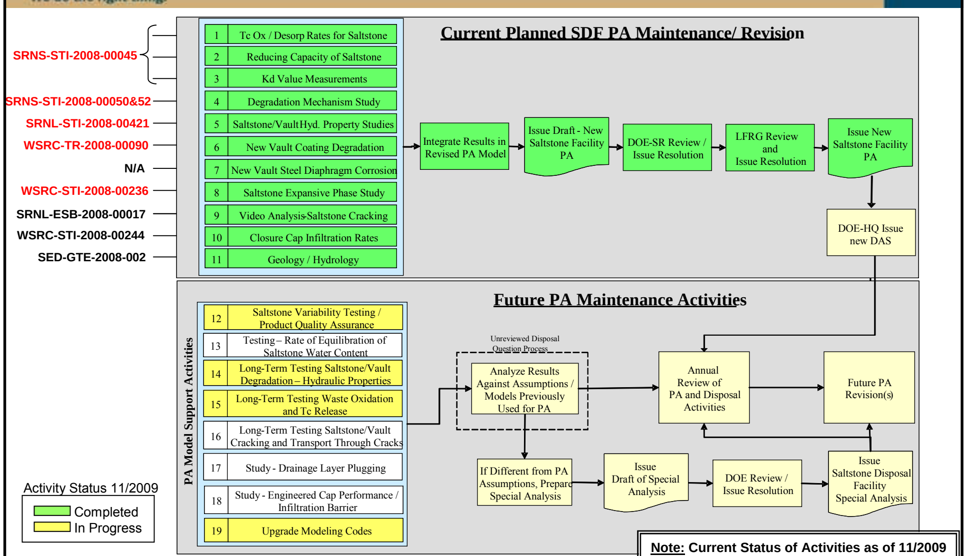

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Incorporation of TER Factors

Number	Factor	Incorporated in Current PA
1	Oxidation of saltstone	• New reduction capacity measurements of saltstone and concrete • Saltstone not modeled as a monolith but as a "shrinking core" for Tc • Deterministic sensitivity case for gas phase oxidation

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Incorporation of TER Factors

Number	Factor	Incorporated in Current PA
2	Hydraulic isolation of saltstone	• Vault 1 and 4 walls hydraulically degraded as initial condition • New concrete and saltstone parameter measurements • New sulfate attack / degradation work by SIMCO model • Deterministic sensitivity runs for varying degrees of saltstone hydraulic degradation and a cracked saltstone run

Incorporation of TER Factors

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Number	Factor	Incorporated in Current PA
3	Model support: moisture flow, saltstone oxidation, extent of fractures, drainage layer plugging, and cap performance	• See Factors 1 and 2 for first three items • Deterministic sensitivity run for no closure cap • Deterministic sensitivity run including early cap degradation

Incorporation of TER Factors

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Number	Factor	Incorporated in Current PA
4	Erosion control design	• Current closure cap erosion control design incorporates NUREG-1623 methodology
5	Infiltration barrier performance	• Current closure cap erosion control design incorporates NUREG-1623 methodology • Deterministic sensitivity run for no closure cap • Deterministic sensitivity run including early cap degradation

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Incorporation of TER Factors

Number	Factor	Incorporated in Current PA
6	Feed tank sampling	• Updated modeled inventory includes current inventory as defined by sampled facility feed streams and projections based on minimum decontamination factors from processing facilities
7	Tank 48 wasteform	• Tank 48 to be treated by steam reforming to destroy organics • Modeled inventory assumes Tank 48 material treated via Salt Waste Processing Facility after steam reforming

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Incorporation of TER Factors

Number	Factor	Incorporated in Current PA
8	Waste removal efficiencies	• Updated modeled inventory includes current inventory as defined by sampled facility feed streams and projections based on minimum decontamination factors from processing facilities

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Input Parameters

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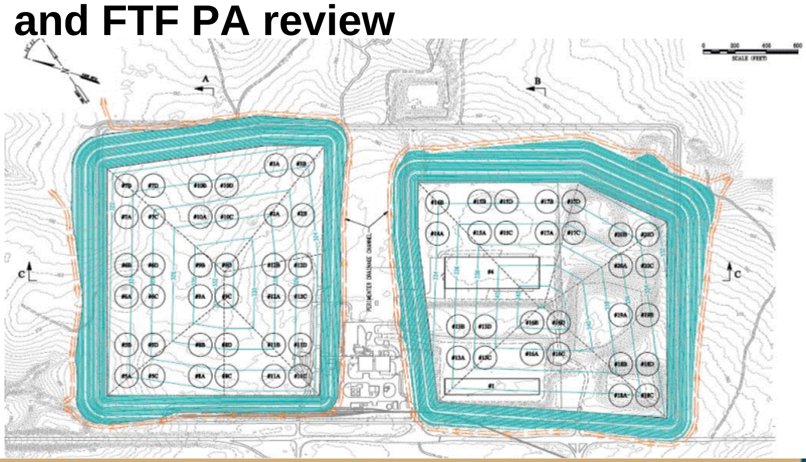
Closure Cap Design

- Similar design to that reviewed during the Salt Waste Disposal consultation and FTF PA review



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Closure Cap Design

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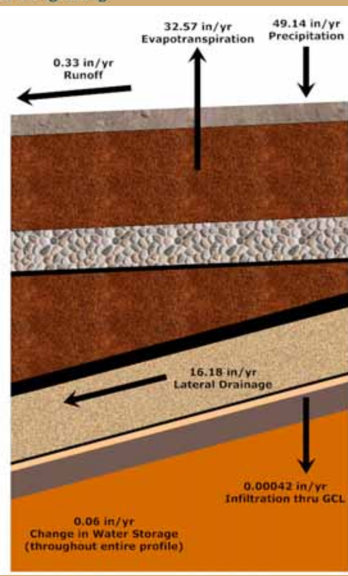
Closure Cap Design



Year	Average Annual Infiltration thru GCL (in/yr)
0	0.00042
100	0.00333
180	0.04520
220	0.05676
300	0.17110
380	0.47236
460	0.72342
560	1.0211
1,000	2.2638
1,800	4.340
3,200	6.795
5,412	10.6
5,600	10.6
10,000	10.6
>10,000	10.6

Grout & Concrete Properties

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- Area of significant investment for model support
- Tested physical (e.g., density, strength, flowability) and hydraulic (e.g., saturated hydraulic conductivity, moisture characteristics) properties of saltstone and concretes
- Tested the distribution coefficient (K_d) for reduced and oxidized conditions for 16 elements of interest
- Tested reduction capacity of saltstone and concrete
- Concrete degradation rate estimated from work by SIMCO which will be a multi-year effort

Grout & Concrete Properties

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Material	Porosity (%)	Dry Bulk Density (g/cm^3)	Particle Density ρ_p (g/cm^3)	Hydraulic Conductivity $k_{h,v}$ (cm/sec)	Effective Diffusion Coefficient D_e (cm^2/sec)
Low quality concrete	21.1	2.06	2.61	1.0E-08	8.0E-07
Medium (ordinary) quality concrete – Vault 1 roof	14.5	2.20	2.57	5.0E-09	1.0E-07
Medium (ordinary) quality concrete – Vault 4 roof	13.6	2.21	2.56	5.0E-09	1.0E-07
High quality concrete – Vaults 1 & 4 walls and base	12.0	2.24	2.55	3.1E-10	5.0E-08
Fractured walls in Vault 1 and 4	12.0	2.24	2.55	1.7E-01	5.0E-08
High quality concrete – FDCs	11.0	2.22	2.49	9.3E-11	5.0E-08
Saltstone and clean grout cap	58.0	1.01	2.40	2.0E-09	1.0E-07

Grout & Concrete Properties

Age-Redox State Transition	Number of Pore Liquid Volumes	
	Saltstone	Disposal Unit Concrete
Region II Reducing → Region II Oxidizing	2,806	N/A
Region II Oxidizing → Region III Oxidizing	10,422	N/A
Region II Reducing → Region II Oxidizing	N/A	3,230
Region II Oxidizing → Region III Oxidizing	N/A	4,206

Grout & Concrete Properties

- Release from Saltstone based on K_d as a monolith except for Tc-99
- Tc-99 release modeled as a "shrinking core" based on reduction capacity changes from infiltrating water in subdivided monolith region

Hydrogeology

- Using same GSA Database with PORFLOW as utilized in 2005 Special Analysis modeling and FTF PA modeling
- Performed a review of recent core information and concluded that Tan Clay Confining Zone was present in all boreholes in Z-Area

Bioaccumulation/Consumption Rates

- Utilized the work done during FTF PA
- Evaluated recent publications and used either SRS-specific values or recent hierarchy of reports for a baseline value and a distribution for each input
- As done for FTF PA, used a water consumption rate of less than 2 liters/day for resident but utilized EPA MCLs for groundwater protection which are based on 2 liters/day of water consumption
- One change in carbon water-to-fish factor

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Dose Calculation Inputs

- Dose scenario baselines are a resident utilizing water from a 100 meter well and utilizing the streams for recreational activities
- Same pathways considered as FTF PA which were discussed in scoping meetings
- Utilized ICRP-72 internal dose conversion factors and FRG-12 external dose conversion factors

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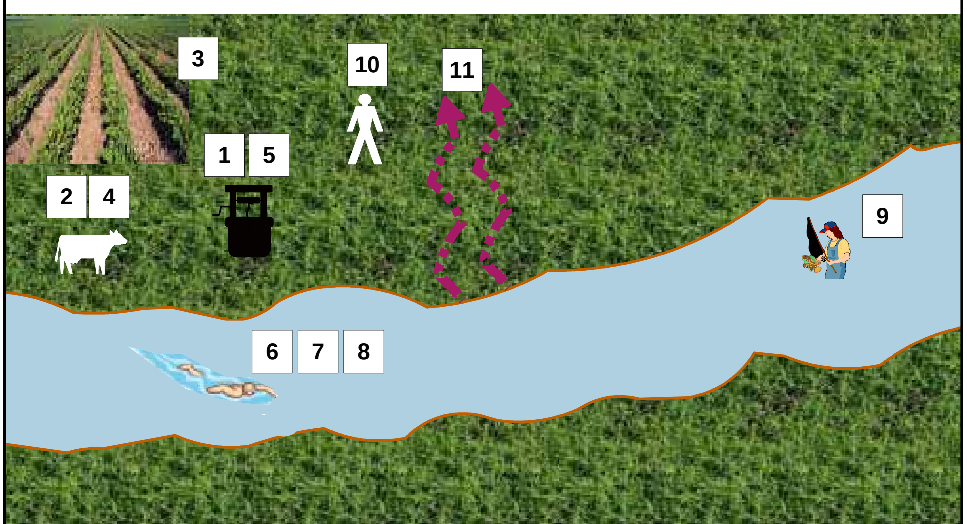
Resident Scenario Pathways



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Modeling

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Hybrid Modeling Approach

- Modeling is a hybrid approach with the deterministic (PORFLOW) results as the baseline and the sensitivity/uncertainty analyses performed with a probabilistic code (GoldSim) to evaluate all parameters at once
- PORFLOW also used for one-off sensitivity analyses

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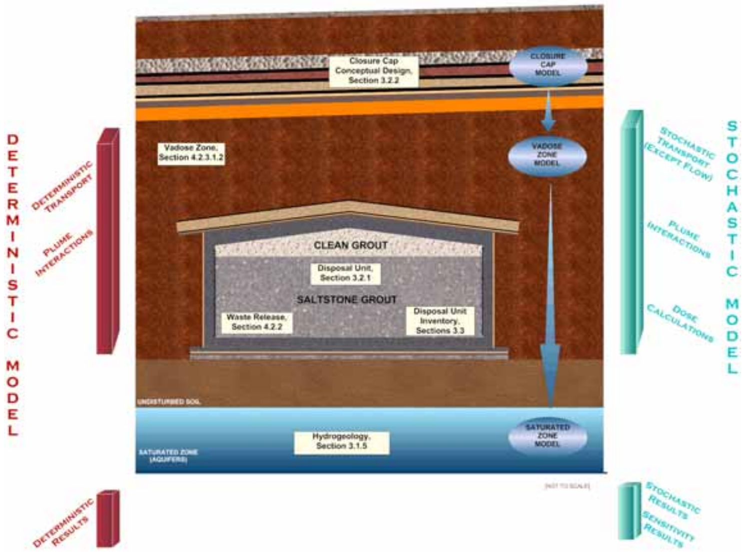
Conceptual Model



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Conceptual Model Interactions

- Model factors multiple layers degrading at different times
- Modeled various potential configurations
- Disposal units modeled independently
- Complex results due to multiple disposal units and unit designs releasing inventory over time and varying flow directions
- Vault 1 and 4 walls assumed fractured initially and pores filled with inventory to full wall height

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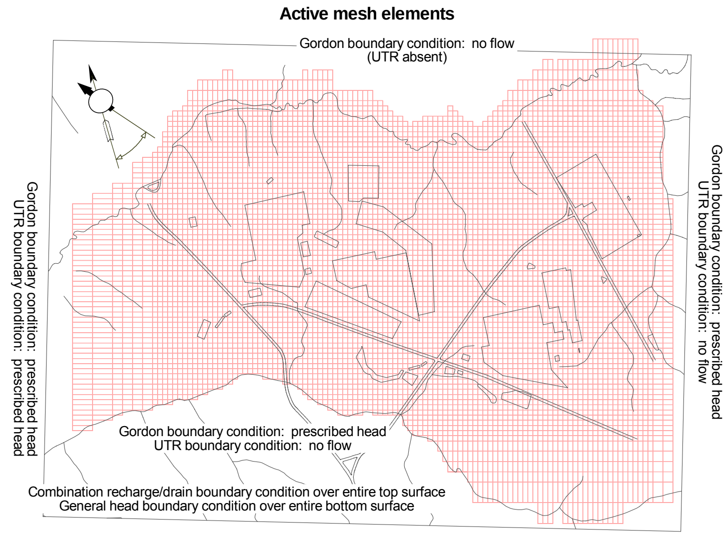
GSA/PORFLOW Model



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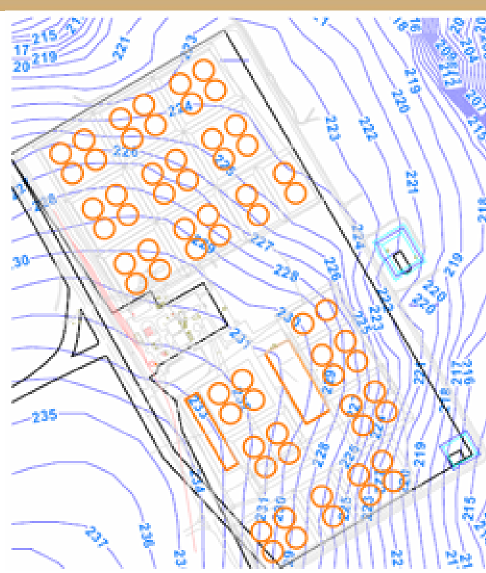
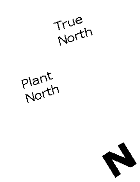
Saltstone PORFLOW Model





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Vadose Zone Thicknesses

SDF Disposal Unit	Disposal Unit Base Elevation (Ft above MSL)	Estimated Elevation of Water Table (Ft above MSL)	Estimated Depth of Vadose Zone (Feet)
Vault 1 (existing)	281.5	233.5	48
Vault 4 (existing)	269	230.6	38.4
Disposal Cells 2A / 2B (future)	269	225.5	43.5
Disposal Cells 3A / 3B (future)	265	224.3	40.7
Disposal Cells 5A – 5D (future)	270	226.5	43.5
Disposal Cells 6A – 6D (future)	270	224.2	45.8
Disposal Cells 7A – 7D (future)	260	223.7	36.3
Disposal Cells 8A – 8D (future)	270	228.8	41.2
Disposal Cells 9A – 9D (future)	270	226.8	43.2
Disposal Cells 10A – 10D (future)	260	224.4	35.6
Disposal Cells 11A – 11D (future)	275	230.4	44.6
Disposal Cells 12A – 12D (future)	275	228.4	46.6
Disposal Cells 13A – 13D (future)	270	232.1	37.9
Disposal Cells 14A / 14B (future)	270	229.2	40.8
Disposal Cells 15A – 15D (future)	270	228.3	41.7
Disposal Cells 16A – 16D (future)	270	230.9	39.1
Disposal Cells 17A – 17D (future)	270	225.5	44.5
Disposal Cells 18A – 18D (future)	270	229.8	40.2
Disposal Cells 19A / 19B (future)	270	226.5	43.5
Disposal Cells 20A – 20D (future)	270	222.3	47.7

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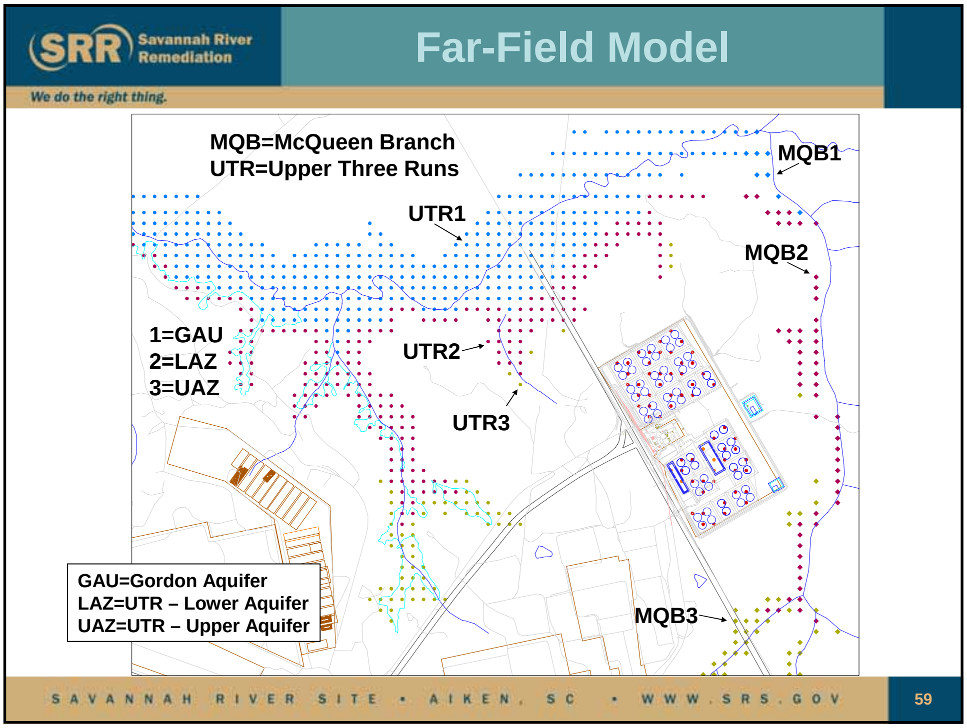
Near-Field Model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Far-Field Model
MQB=McQueen Branch
UTR=Upper Three Runs
MQB1
UTR1
MQB2
1=GAU
2=LAZ
3=UAZ
UTR2
UTR3
GAU=Gordon Aquifer
LAZ=UTR – Lower Aquifer
UAZ=UTR – Upper Aquifer
MQB3
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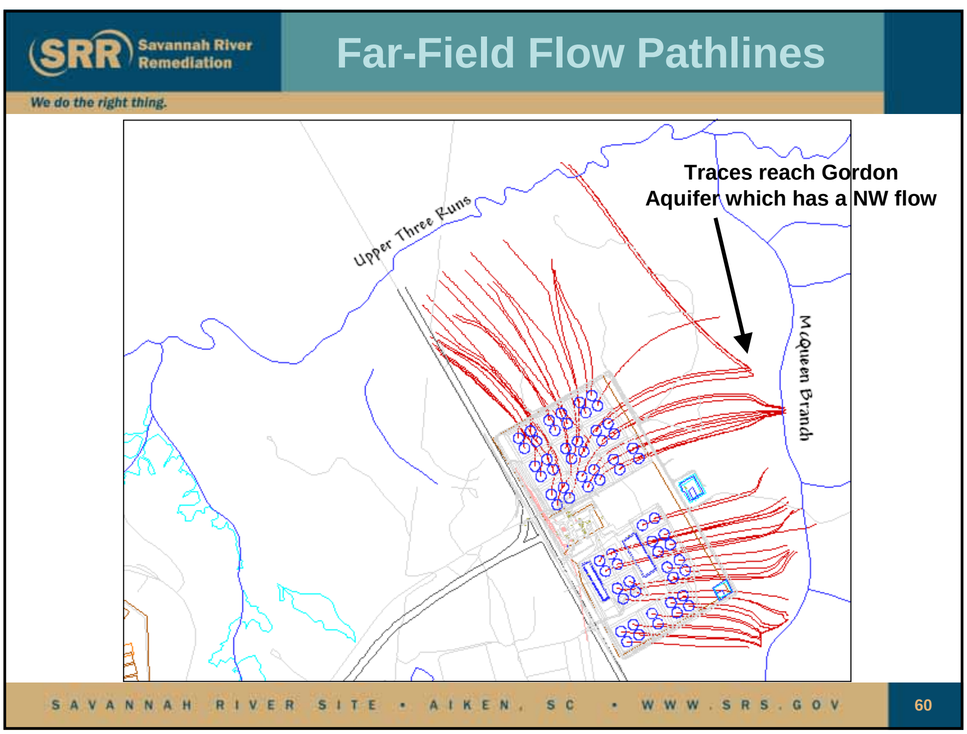
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Far-Field Flow Pathlines
Traces reach Gordon Aquifer which has a NW flow
Upper Three Runs
McQueen Branch
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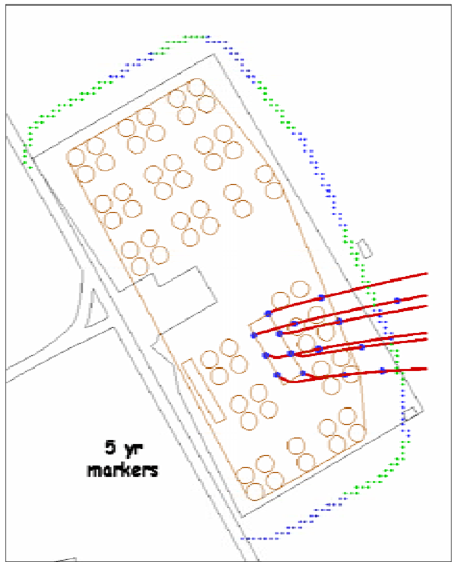
Flow Pathlines - Vault 4



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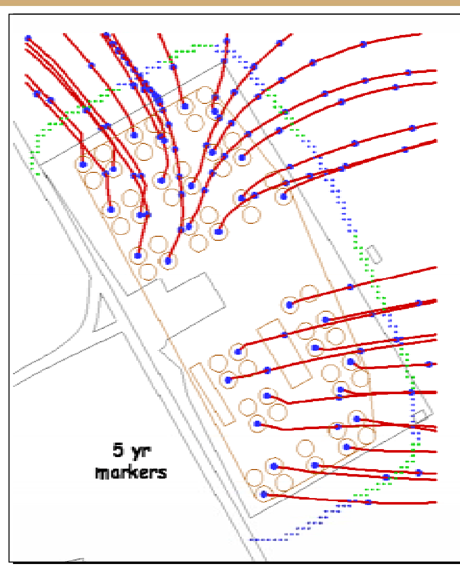
Flow Pathlines - FDCs



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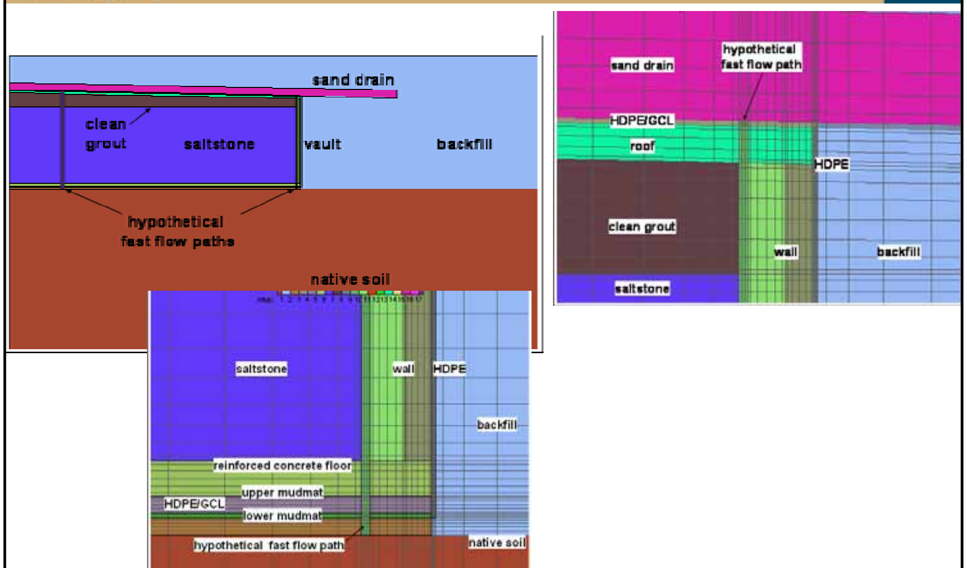
FDC PORFLOW Model



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Modeled Cases

Case	Vault 1	Vault 4	FDCs
A	Base Case vault wall degraded, saltstone intact	Base Case vault wall degraded, saltstone intact	Base Case disposal unit wall intact, saltstone intact
B	N/A (no sheet drains)	Fast flow walls fast flow along walls from roof thru floor, vault wall degraded	Fast flow walls fast flow along walls from roof thru floor (including upper and lower mud mats)
C	Fast flow walls & crack fast flow along cracks from roof thru floor, vault wall degraded	Fast flow walls & crack fast flow along walls and cracks from roof thru floor vault wall degraded	Fast flow walls & columns fast flow along walls and columns from roof thru floor (including upper and lower mud mats)
D	N/A (no sheet drains)	Capillary break Base Case with capillary break at sheet drains	Capillary break Base Case with capillary break at sheet drains
E	Saltstone severely degraded vault wall degraded	Saltstone severely degraded vault wall degraded	Saltstone severely degraded disposal unit wall intact

Modeling Results

- PA presents peak groundwater concentrations for each modeled radionuclide at 100 meters for each modeling sector at each of the three aquifer zones within 10,000 years and the year of each peak
- Doses calculated for each modeling sector by picking maximum concentration for each modeled radionuclide at each time interval regardless of aquifer

Modeling Results

- Peak air pathways dose less than 4E-9 mrem/year
- Peak radon flux approximately 2.0E-13 $pCi/m^2/sec$
- All-pathways dose driven by water pathways

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Modeling Results

Sector	Peak Dose in 10,000 Years	Peak Dose in 20,000 Years
A	1.2 mrem/yr	2.6 mrem/yr (year 15,080)
B	1.4 mrem/yr	2.9 mrem/yr (year 15,080)
C	0.7 mrem/yr	2.0 mrem/yr (year 15,080)
D	0.5 mrem/yr	1.6 mrem/yr (year 15,080)
E	1.0 mrem/yr	2.3 mrem/yr (year 15,080)
F	0.3 mrem/yr	1.3 mrem/yr (year 15,080)
G	0.4 mrem/yr	2.8 mrem/yr (year 15,080)
H	0.4 mrem/yr	2.8 mrem/yr (year 15,080)
I	0.4 mrem/yr	3.1 mrem/yr (year 15,080)
J	0.4 mrem/yr	2.7 mrem/yr (year 15,080)
K	0.4 mrem/yr	2.8 mrem/yr (year 15,080)
L	0.4 mrem/yr	2.3 mrem/yr (year 15,080)

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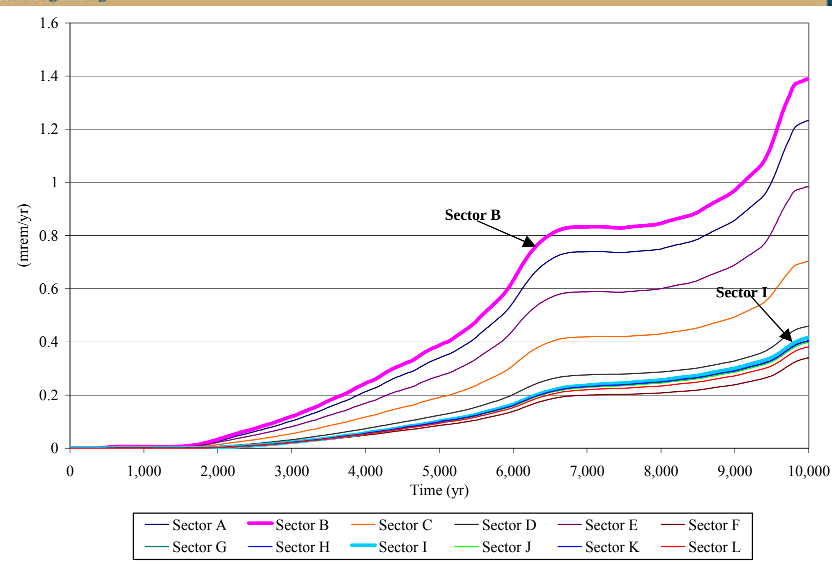
Modeling Results 10,000 yr



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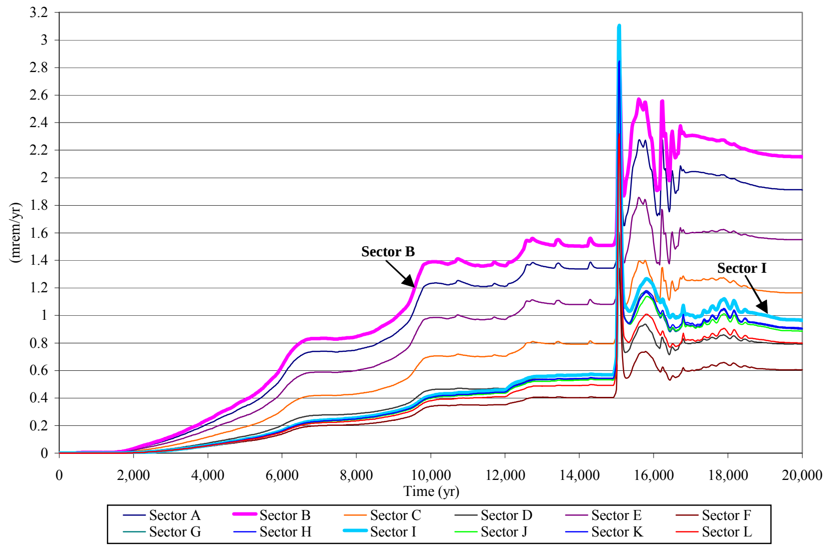
Modeling Results 20,000 yr



Modeling Insights

- Note that for the FDCs all cells change parameters at the same time in the deterministic runs
- 10,000 year compliance period peak dose is in Sector B and driven by Vault 4 wall inventory
- Sector I peak in 20,000 years driven by hydraulic conductivity change in FDC walls

Modeling Transitions Vault 4

Change in Model Parameters	Time of Occurrence for Given Case (years after closure)					
	Analytical Value	Value in Model				
	Case A	Case A	Case B	Case C	Case D	Case E
Degradation of closure cap	5,412	5,500	5,500	5,500	5,500	5,500
Vault roof degrades to backfill properties	10,000	10,000	10,000	10,000	10,000	10,000
Wall concrete transitions from reducing to oxidizing	15,519	15,519	3,987	3,069	15,555	5,134
Wall concrete transitions from middle age to old age	16,018	16,018	5,016	3,363	16,052	5,836
Lateral drainage layer degrades to backfill properties	19,013	20,000	20,000	20,000	20,000	20,000

Modeling Transitions FDCs

Change in Model Parameters	Time of Occurrence for Given Case (years after closure)					
	Analytical	Value in Model				
	Case A	Case A	Case B	Case C	Case D	Case E
Degradation of HDPE layer outside FDC wall	6,000	6,000	6,000	6,000	6,000	6,000
Degradation of HDPE-GCL above & below FDCs	7,500	7,500	7,500	7,500	7,500	7,500
Complete degradation of closure cap	5,412	5,500	5,500	5,500	5,500	5,500
Wall concrete transitions from reducing to oxidizing	16,344	16,344	15,784	15,803	16,349	15,631
Wall concrete transitions from middle to old age	16,753	16,753	16,027	16,052	16,757	15,841
Wall degrades to backfill properties	18,000	20,000	20,000	20,000	20,000	20,000
Lateral drainage layer degrades to backfill properties	19,013	20,000	20,000	20,000	20,000	20,000
Upper mud mat transitions from reducing to oxidizing	22,177	22,177	20,079	20,896	22,207	20,262
Floor concrete transitions from reducing to oxidizing	22,498	22,498	21,820	21,559	22,514	22,198
Upper mud mat transitions from middle to old age	22,871	22,871	21,421	21,118	22,906	22,304
Floor concrete transitions from middle to old age	23,274	23,274	22,385	22,043	23,293	22,938
Floor and upper mud mat degrade to native soil properties	40,000	50,000	50,000	50,000[1]	50,000	50,000
Roof degrades to backfill properties	40,000	20,000	20,000	20,000	20,000	20,000

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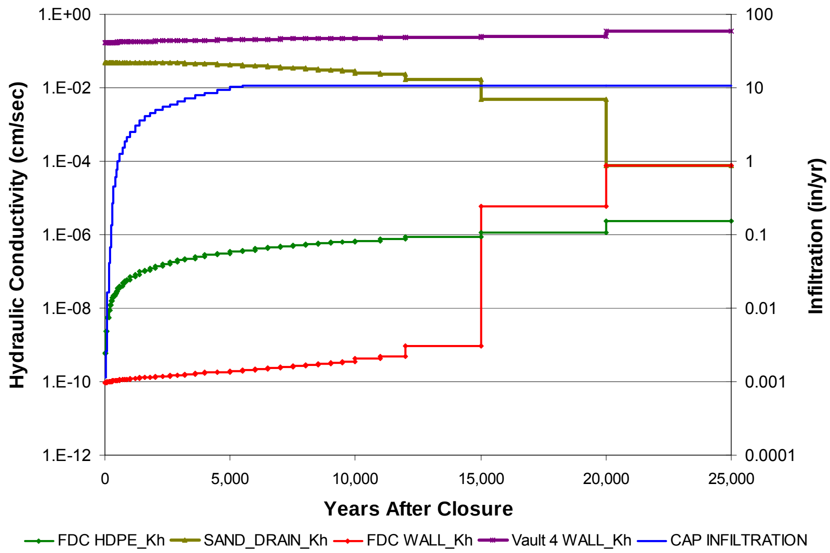
Key Parameter Transitions



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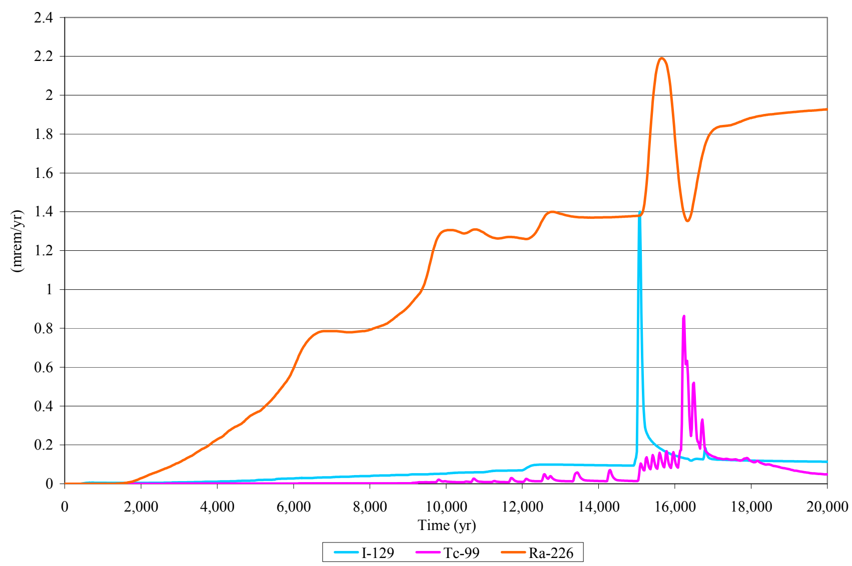
Modeling Results-Sector B



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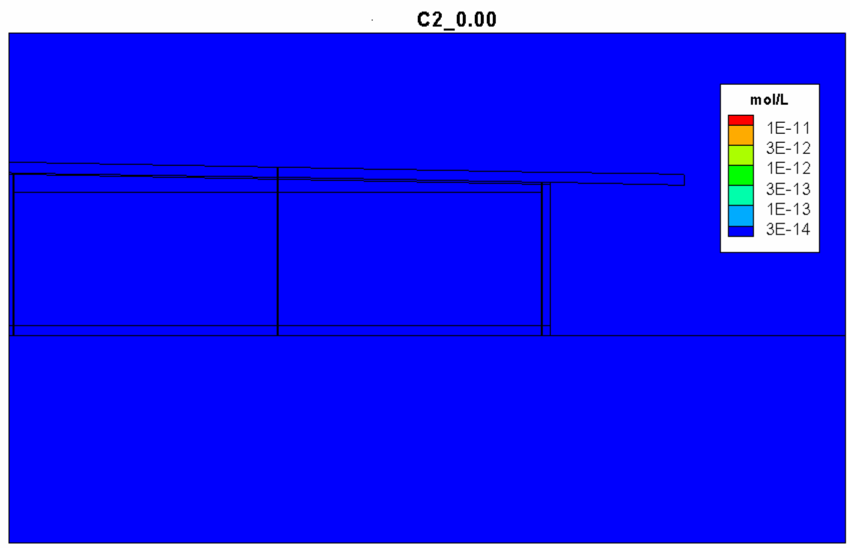
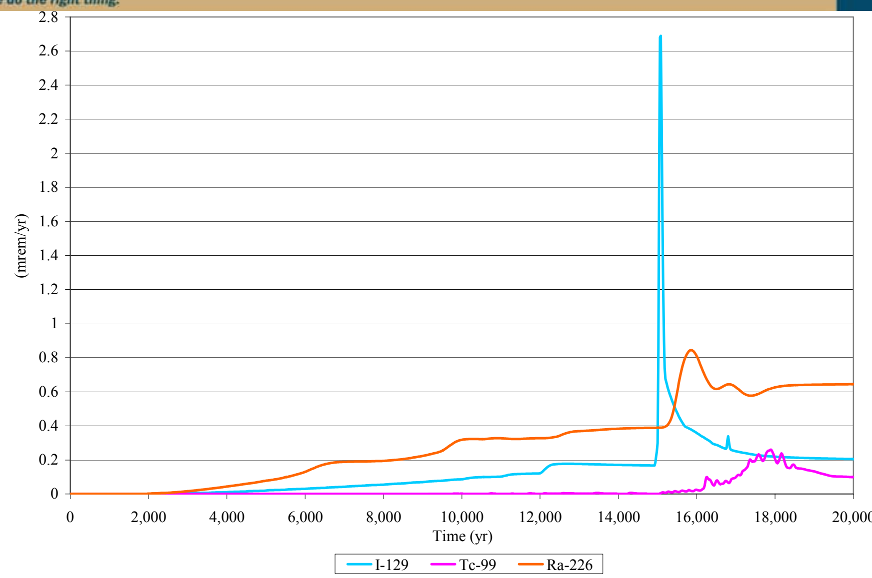
Vault 4 Ra-226 Release



Modeling Results-Sector I



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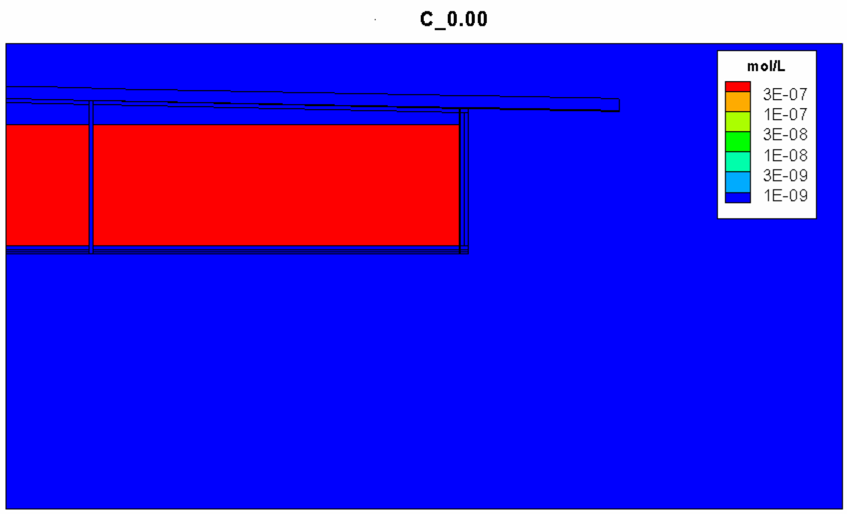
FDC I-129 Release



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Modeling Results-Sources

Waste Source	Contribution to the Sector B Peak Dose at year 10,000 (mrem/yr)	Percentage of Total Peak Dose (%)	Contribution to Sector I Peak Dose at year 15,080 (mrem/yr)	Percentage of Total Peak Dose
Vault 1	<0.1	3%	<0.1	<1%
Vault 4	1.3	92%	0.3	10%
FDCs	0.1	5%	2.8	90%
TOTAL	**1.4**	**100%**	**3.1**	**100%**

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Modeling Results-Pathways

Pathway	Associated Contribution to Sector B peak at year 10,000 (mrem/yr)	Percentage of Sector B Total Peak Dose	Sector B Principal Radionuclide Pathway Dose
Water Ingestion	0.7	49.4%	Ra-226 (95%)
Fish Ingestion	0.3	22.3%	Ra-226 (94%)
Vegetable Ingestion	0.3	22.2%	Ra-226 (95%)
Other Pathways	<0.1	6.1%	Ra-226 (% varies by pathway)
TOTAL	**1.4**	**100%**	

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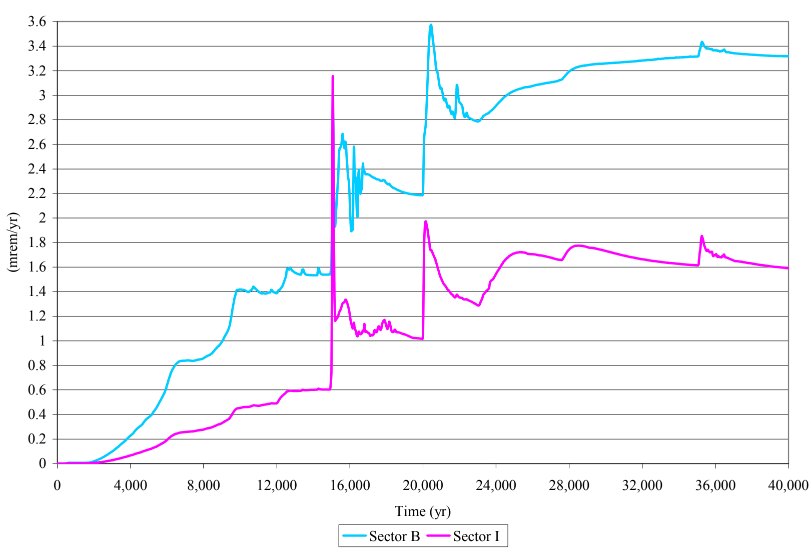
Modeling Results 40,000 yr



Uncertainty / Sensitivity

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- Probabilistic uncertainty and sensitivity analyses done utilizing GoldSim
- Large number of stochastic parameters evaluated at once
- Sensitivity analyses done for Cases A and C alone to identify sensitive parameters without interference of multiple case differences

Uncertainty Results All Cases

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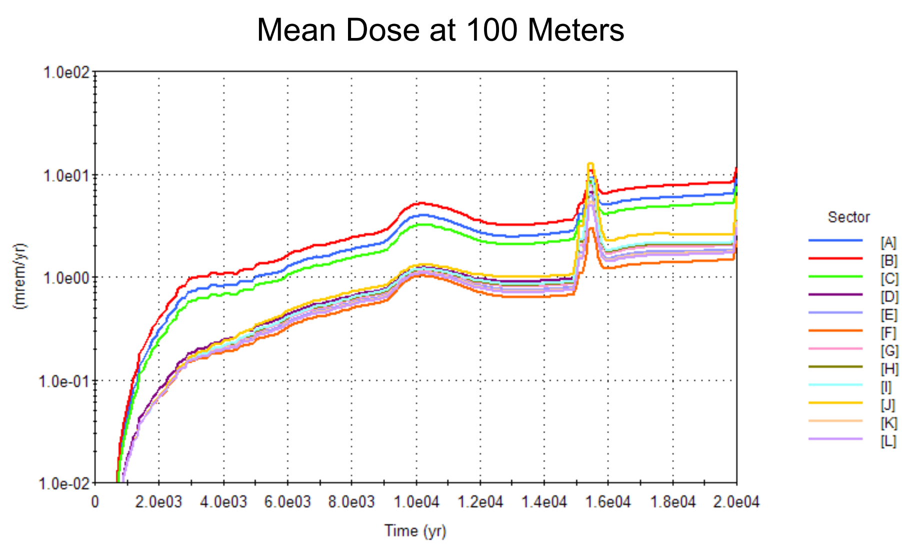

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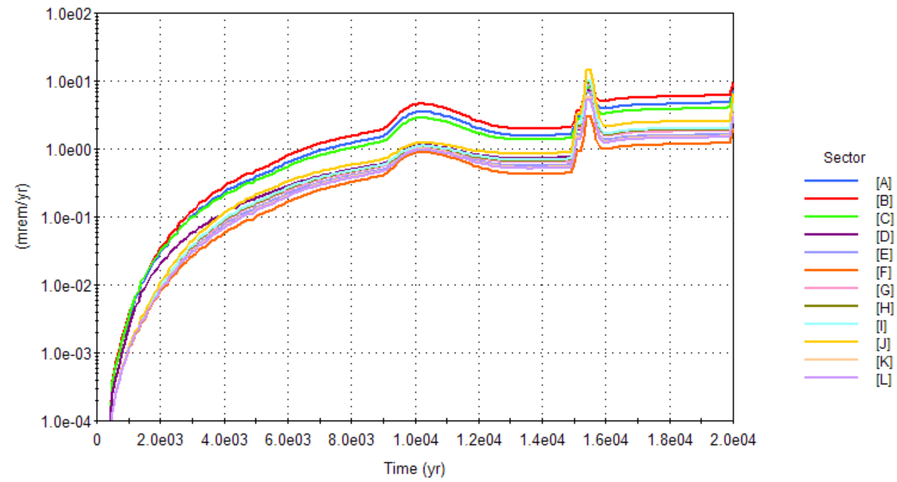
Uncertainty Results Case A

Mean Dose at 100 Meters



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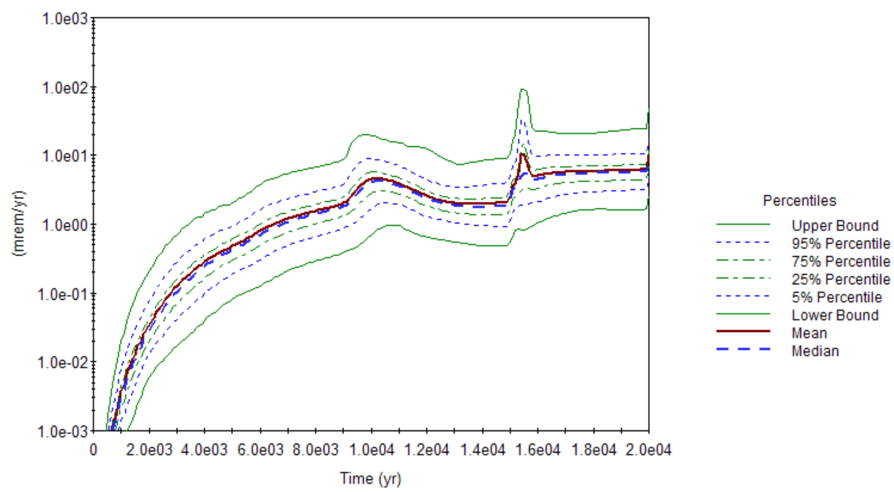
UA Results Case A Sector B

Dose at 100 Meters



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Sensitivity Analysis Results

Case A

Endpoint	SI Rank	Input Parameter	Sensitivity Index
Max. MOP dose at any Sector within 10,000 years	1	K_d for Ra in sandy soil	53
	2	Vegetable consumption – local fraction	9.7
	3	Saturated zone thickness	8.1
Max. MOP dose at any Sector within 20,000 years	1	K_d for I in reducing middle aged concrete	47
	2	Vegetable production yield	5.5
	3	Pore volumes to 2nd stage – concrete	5.3

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Sensitivity Analysis Results

Case C

Endpoint	SI Rank	Input Parameter	Sensitivity Index
Max. MOP dose at any Sector within 10,000 years	1	K_d for Pu in clayey soil	19
	2	Unsaturated zone thickness – FDCs	11
	3	K_d for Pu in sandy soil	8.8
Max. MOP dose at any Sector within 20,000 years	1	K_d for Pu in sandy soil	63
	2	Unsaturated zone thickness – FDCs	5.5

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Deterministic Sensitivities

- Deterministic sensitivity analyses also run
- Ran Cases B-E for Tc-99, I-129, Ra-226, Np-237, Pa-231, U-235 (for Pa-231), Th-230 (for Ra-226), U-234 (for Ra-226), and Pu-238 (for Ra-226)
- No closure cap case
- Differing concrete material degradation rates
- Synergistic degradation case
- Oxidized Vault 1 and 4 case
- Increased saltstone hydraulic conductivity case

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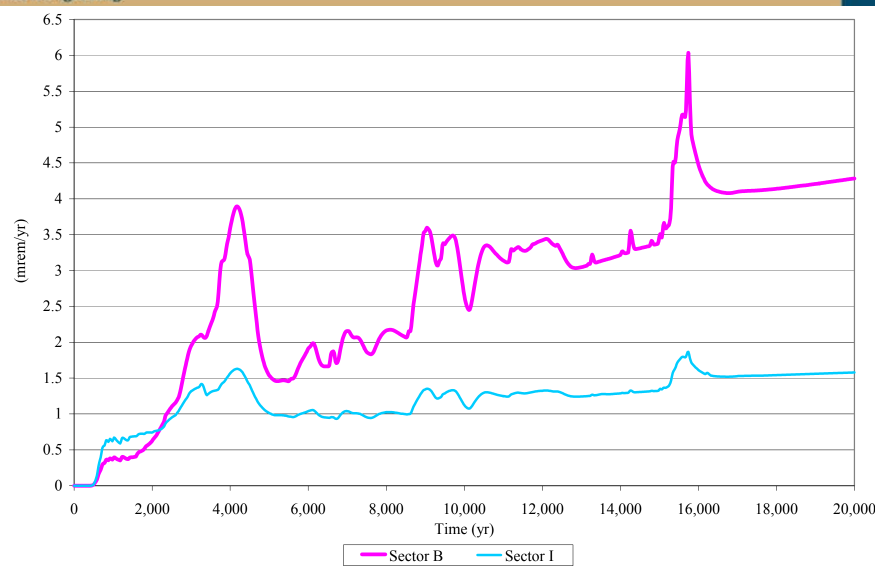
Case B Results



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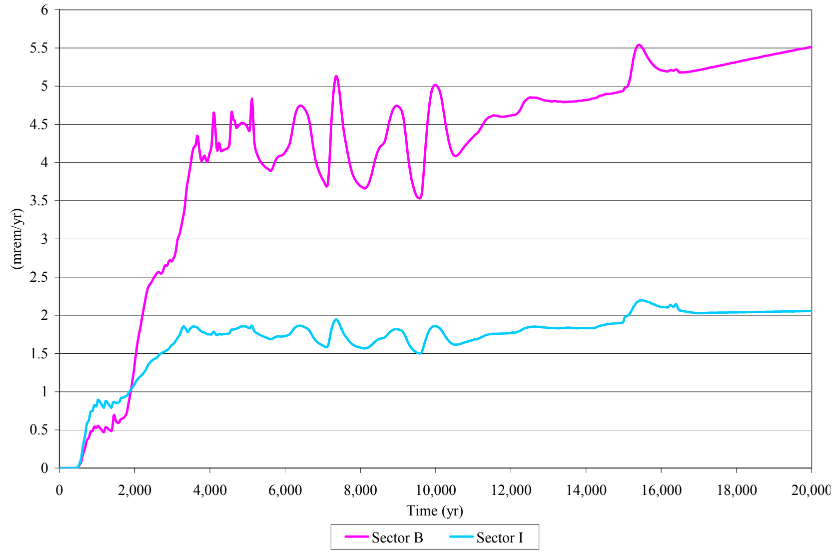
Case C Results



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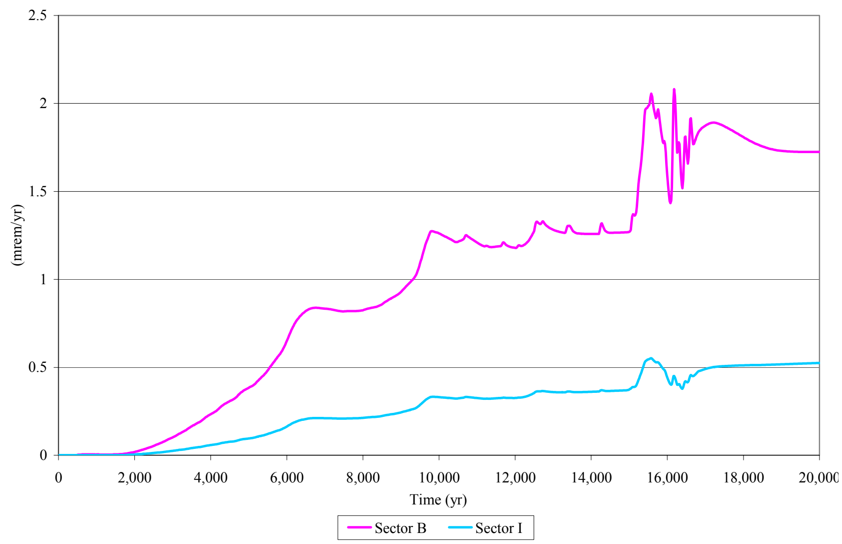
Case D Results



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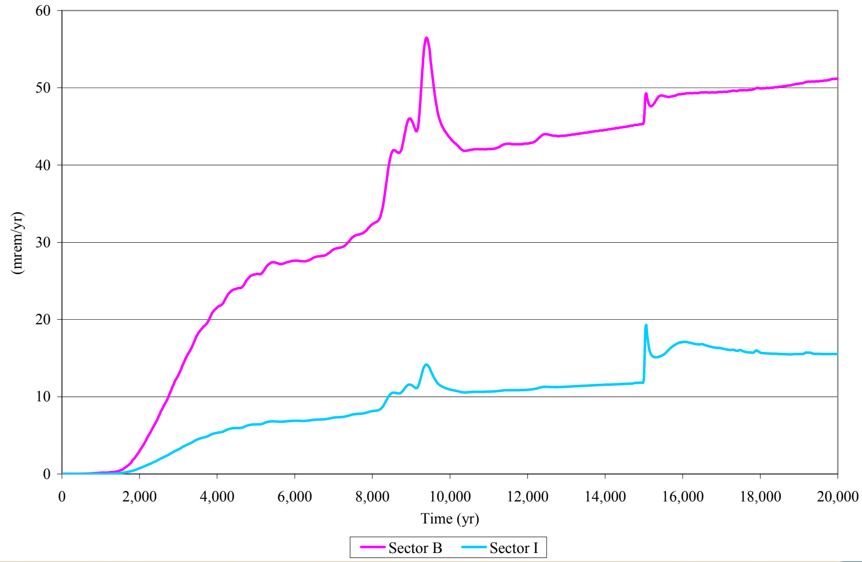
Case E Results



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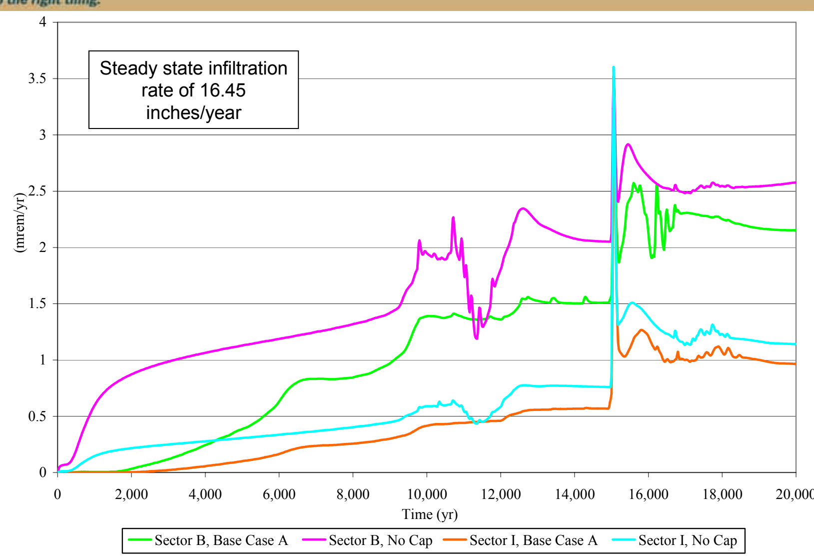
No Closure Cap Results



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Material Degradation Results

Degradation Location	Time to Complete Failure	
	Base Case (year)	10 times Sulfate Case (year)
FDC floor (including upper mud mat)	40,000	5,000
FDC roof	40,000	7,000
FDC wall	18,000	3,000
Vault 1 floor	>100k	25,000
Vault 1 roof	50,000	12,000
Vault 1 wall	>100k	16,000
Vault 4 floor	>100k	25,000
Vault 4 roof	10,000	3,000
Vault 4 wall	>100k	16,000

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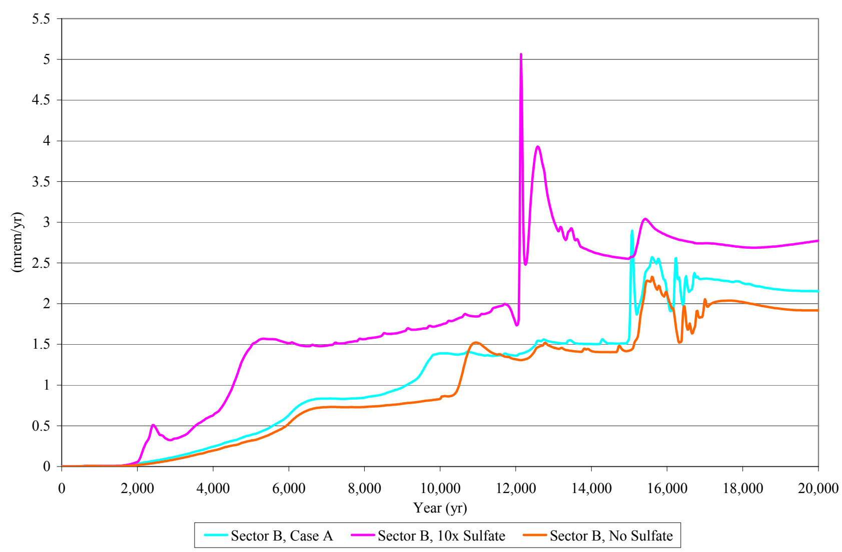
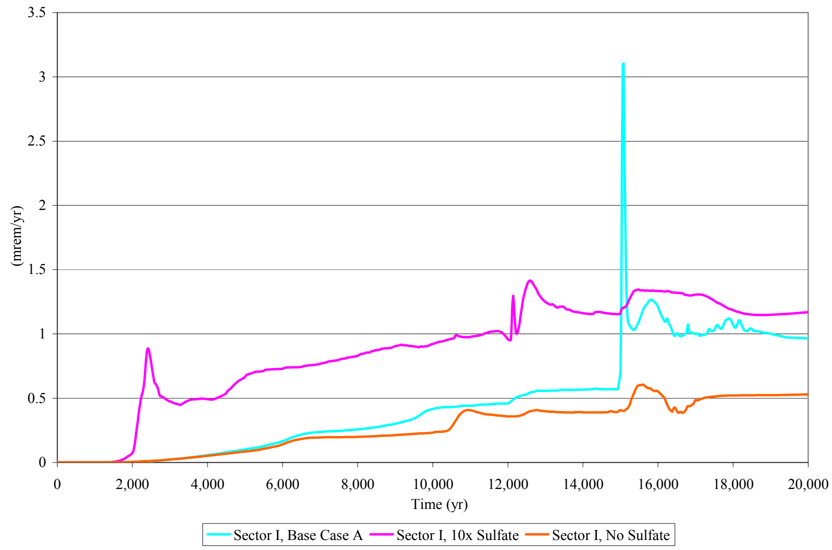
Material Degradation Results

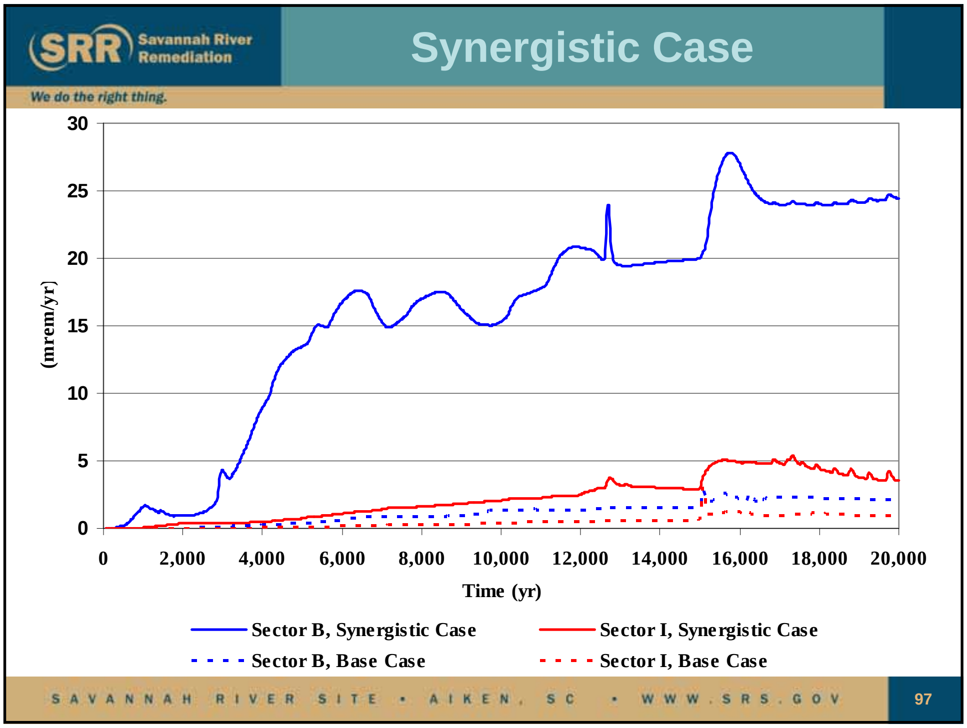


Material Degradation Results



Synergistic Case

- Infiltration rate at year 560 is present from year 0 to year 560 (1.02 in/yr) and the cap will degrade after year 560 as in the base case
- At year 500 the wall, floor and roof concrete is fully degraded due to rebar corrosion: 4.1E-05 cm/sec and to oxidized-old age K_ds
- Vault 1 and 4 walls oxidized initially
- Saltstone assumed to be cracked to allow gaseous oxygen diffusion: 2.5 foot intervals as a full vertical crack (2.4 feet saltstone & 0.1 feet crack) and oxygen fixed at 100% saturation so will not deplete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Synergistic Case
30
25
20
15
10
5
0
(mrem/yr)
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
Time (yr)
Sector B, Synergistic Case
Sector I, Synergistic Case
Sector B, Base Case
Sector I, Base Case
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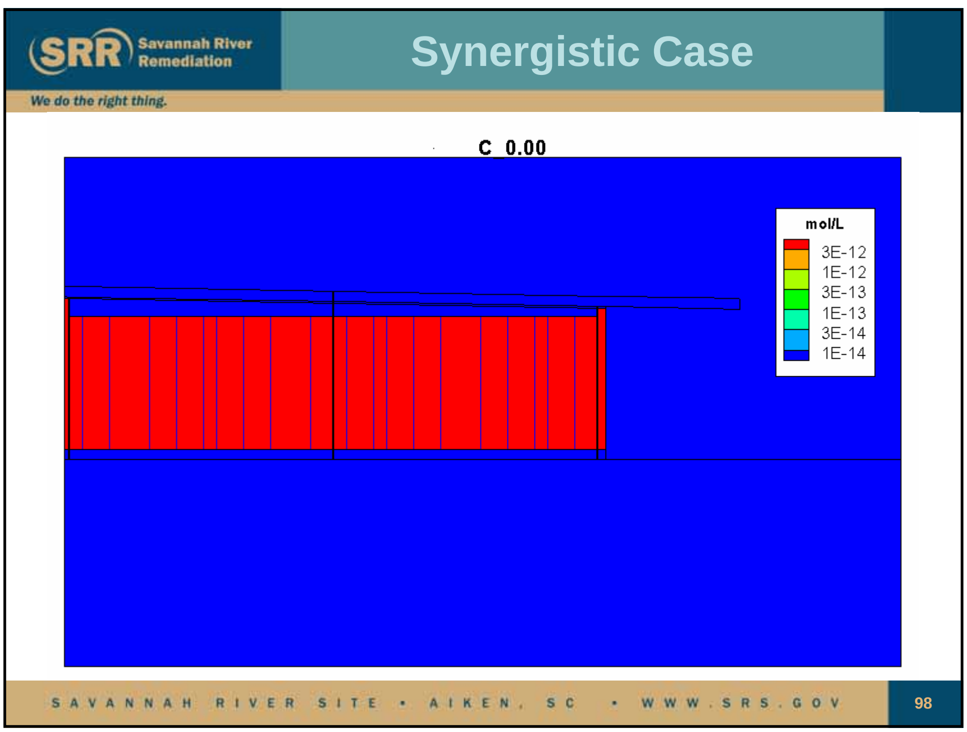
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Synergistic Case
C 0.00
mol/L
3E-12
1E-12
3E-13
1E-13
3E-14
1E-14
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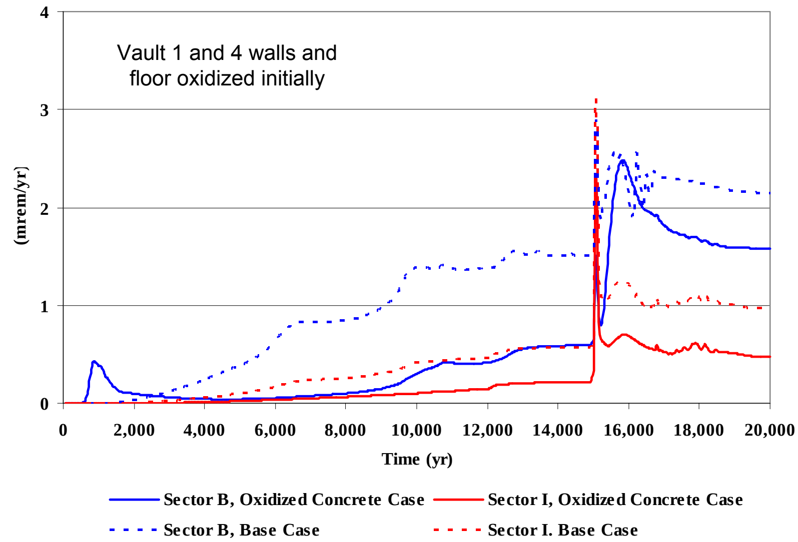
Oxidized Vault 1 and 4 Case



Saltstone Conductivity Case

- Case A parameters except saltstone hydraulic conductivity set to 1.0E-7 cm/sec at closure vs. base case of 2.0E-9 cm/sec
- Provide information into the importance of hydraulic conductivity at a higher value than the base case but not as bounding as in Case E (cracked grout at 1.7E-3 cm/sec)

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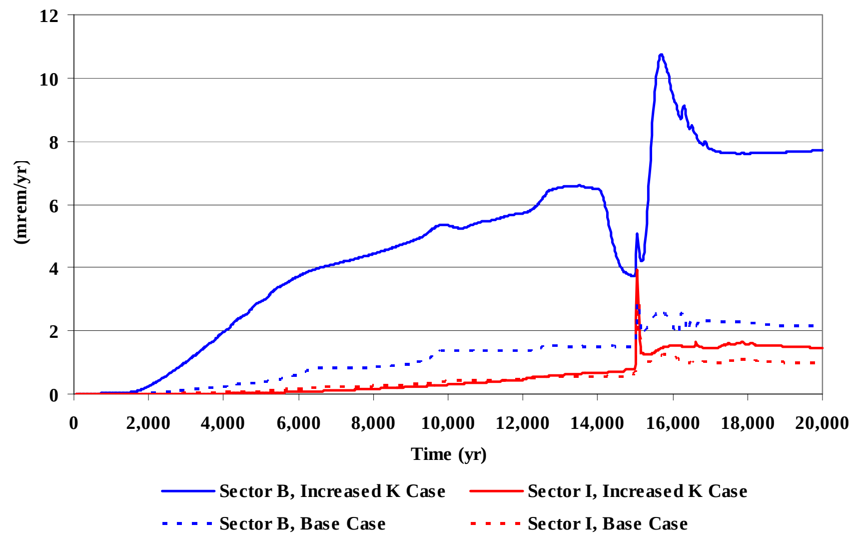
Saltstone Conductivity Case



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Intruder Results

- No credible drilling scenarios based on erosion barrier, cell roof, clean cap, and regional drilling practices
- Resident living on the disposal site is a credible chronic intruder scenario
- Groundwater at 1 meter boundary for facility used
- Radionuclide concentrations used are maximums for any sector and any aquifer for each time interval

Intruder Scenario Pathways

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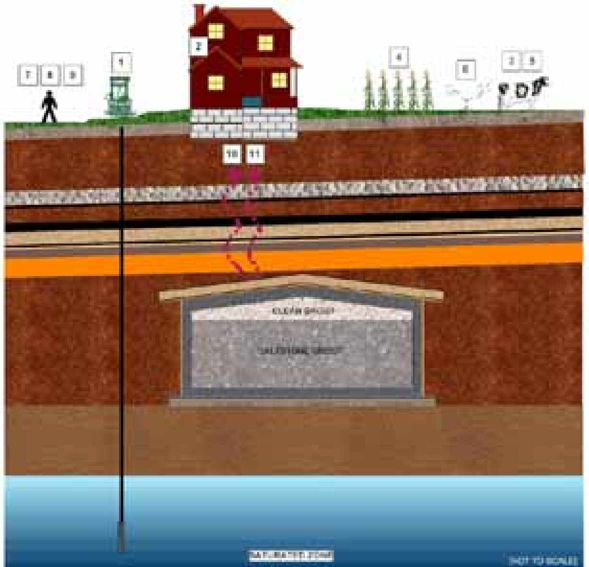

Chronic Intruder Results

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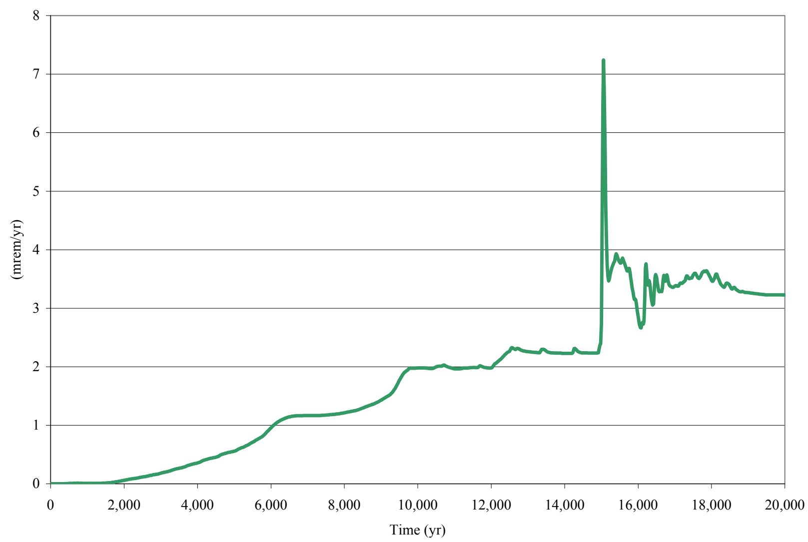

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Chronic Intruder Results

Chronic Intruder Pathway Contributors	Contribution to Peak (mrem/yr)	Principal Radionuclide Pathway Dose (%)
Water Ingestion	0.9	91% (Ra-226)
Fish Ingestion	0.3	94% (Ra-226)
Vegetable Ingestion	0.7	91% (Ra-226)
Other Pathways	<0.1	N/A
Total	**1.9**	N/A

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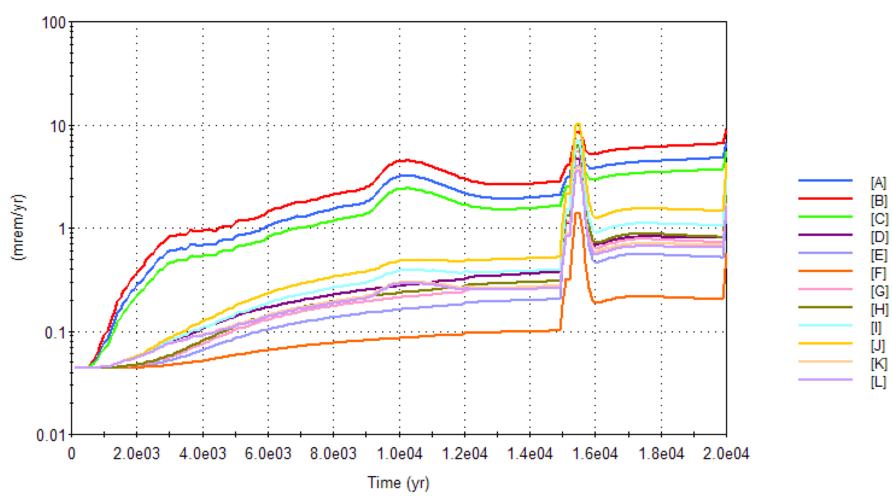
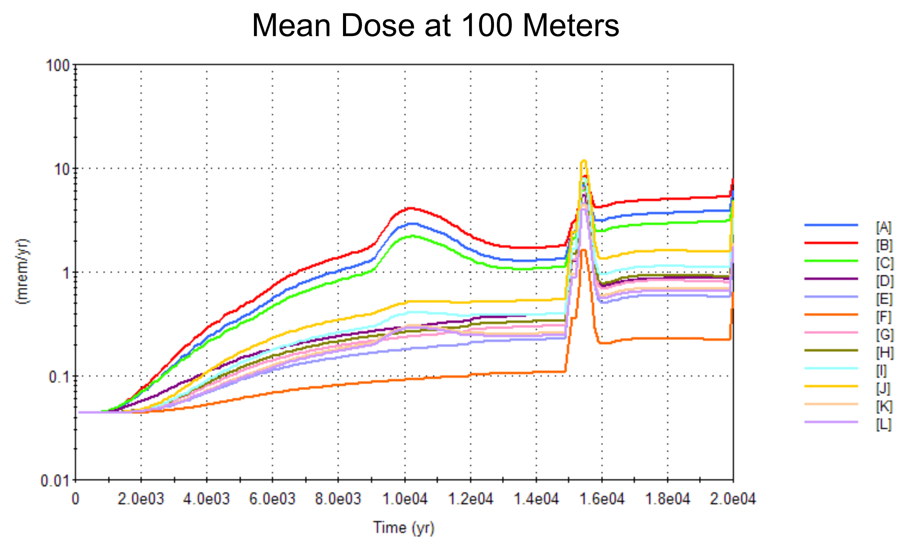
Uncertainty Results All Cases

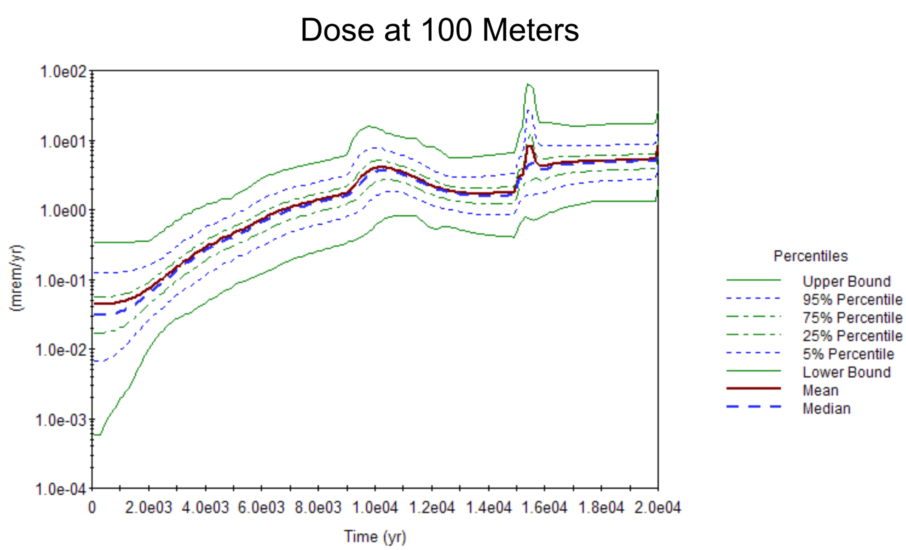
Mean Dose at 100 Meters



Uncertainty Results Case A



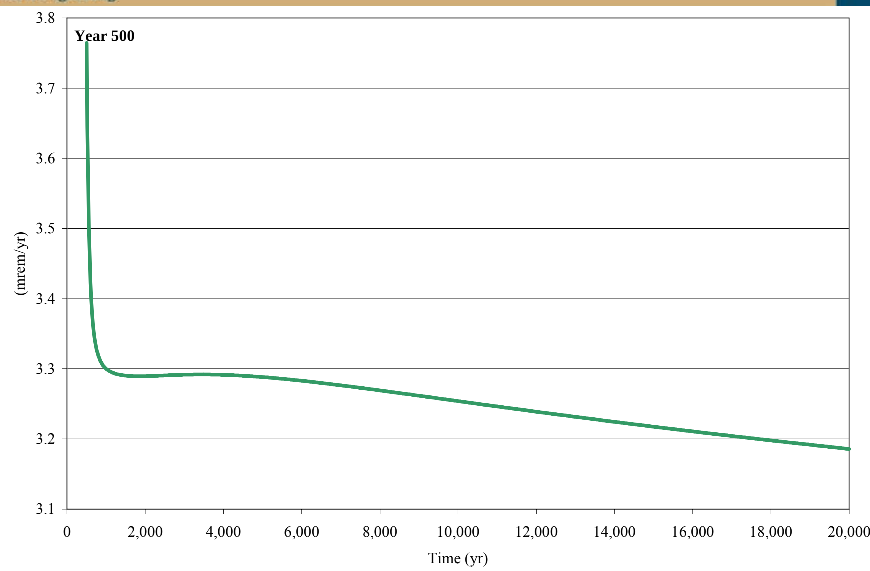
UA Results Case A Sector B



Intruder Deterministic Sensitivity

- Sensitivity analysis also done for scenario of drilling into a disposal cell
- Based on previous work for F-Tank Farm PA, scenario not assumed to happen until 500 years after closure and degraded engineered barriers

Acute Intruder Sensitivity



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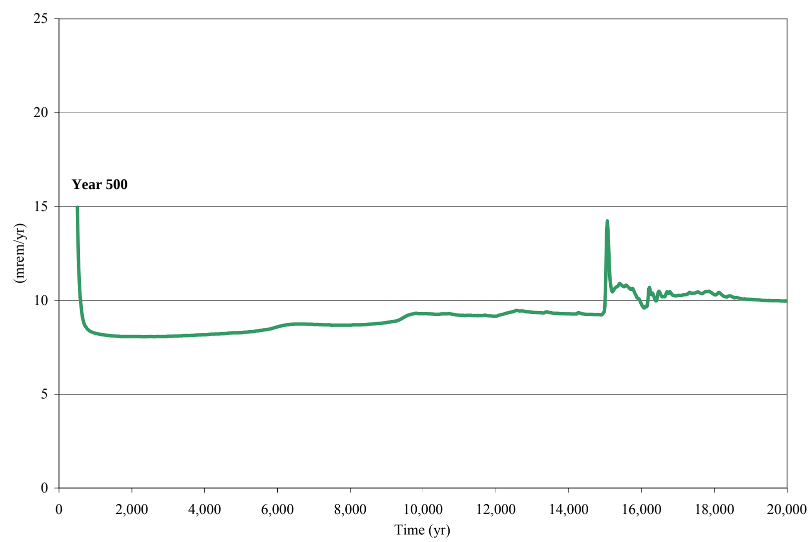
Chronic Intruder Sensitivity



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Conclusions

Performance Measure		Limit	Result
DOE O 435.1-1	**All-Pathways Dose**	**25 mrem/yr**	**1.4 mrem/yr**
DOE O 435.1-1	**Intruder Dose**	**500 mrem acute 100 mrem/yr chronic**	**N/A – acute 1.9 mrem/yr - chronic**
DOE O 435.1-1	**Air Pathways Dose**	**10 mrem/yr**	**<4E-09 mrem/yr**
DOE O 435.1-1	**Radon Flux**	**20 pCi/m²/s At ground surface**	**2.0E-13 pCi/m²/s**
DOE O 435.1-1	**Groundwater Protection**	**Total β/γ 4 mrem/yr Total α 15 pCi/L Total U 30 mg/L Total Ra 5 pCi/L**	**1.16 mrem/yr 1.9 pCi/L 8.0E-9 mg/L 1.9 pCi/L**
10 CFR 61.41	**All-Pathways Dose**	**25 mrem/yr**	**1.4 mrem/yr**
10 CFR 61.42	**Intruder Dose**	**500 mrem/yr**	**1.9 mrem/yr**

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Conclusions

- Based on various modeling cases, probabilistic uncertainty and sensitivity analyses, and deterministic sensitivity analyses have reasonable assurance that performance objectives at the Saltstone Disposal Facility under closure conditions will be met

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Further Work

- Continue model parameter understanding
  - Understanding of saltstone oxidation, Tc-99 release rate, gas phase transport of oxygen, saltstone fracturing and Ra release modeling
- Impacts of saltstone production variability
- Enhanced understanding of drainage layer and erosion barrier degradation mechanisms
- Improve probabilistic model for PA-informed sensitive parameters such as K_ds for Ra and Pu in soil