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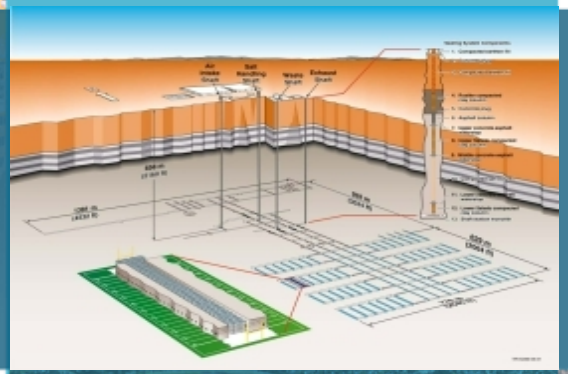
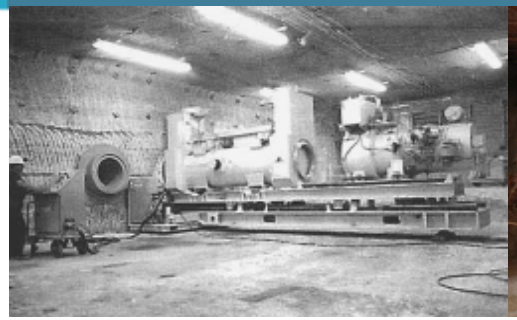
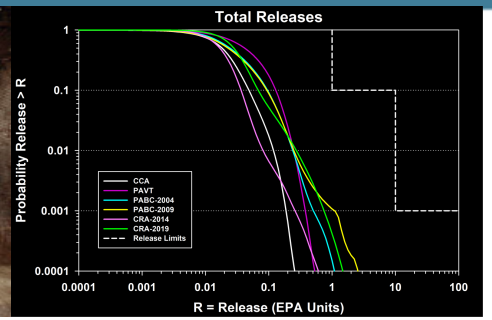


# Performance Assessment of the Waste Isolation Pilot Plant with Additional Waste Storage Volume



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March 9, 2022

U.S. DEPARTMENT OF ENERGY NNSA

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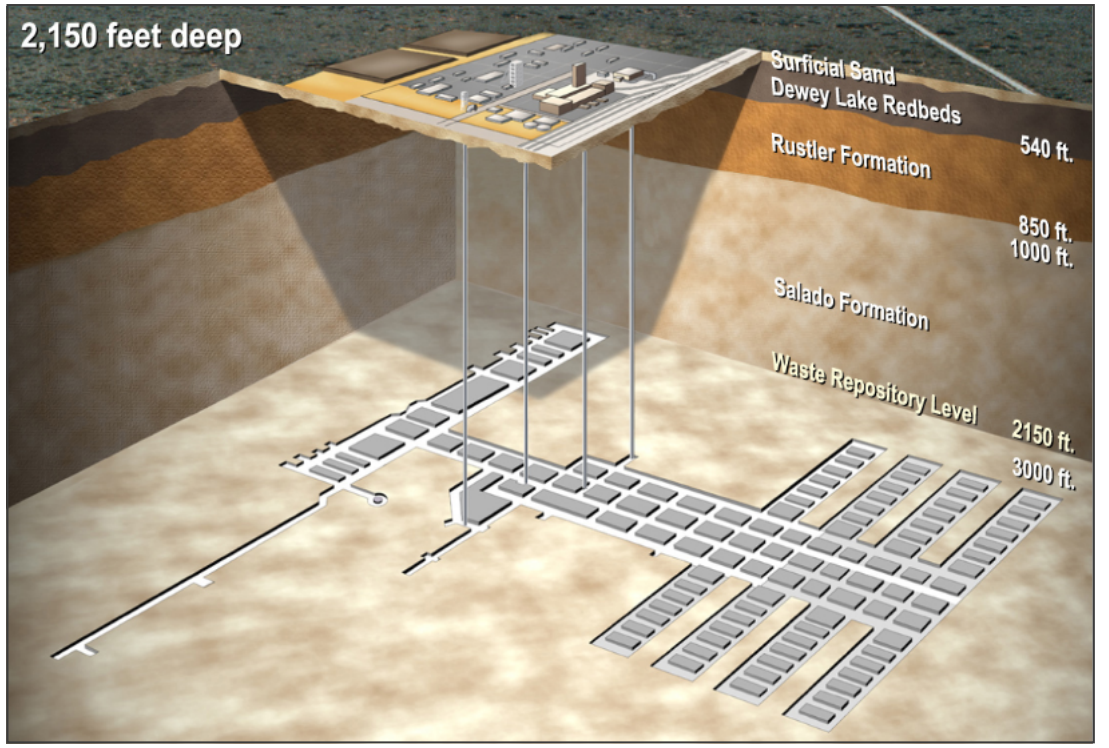
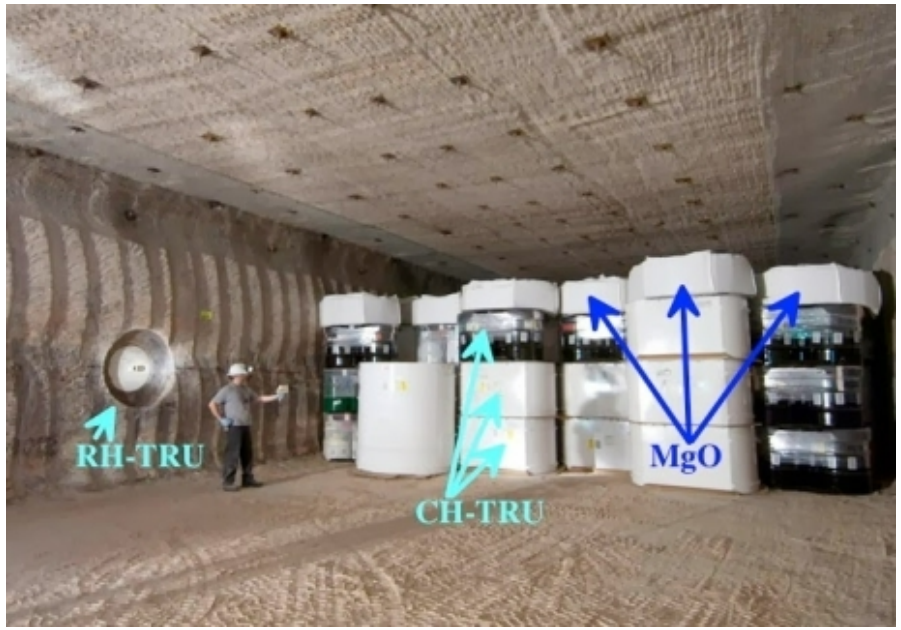
# About The WIPP

**WIPP is a permanent disposal facility for transuranic (TRU) waste**

- The nation's only licensed deep geologic repository for nuclear waste.
- Located in southeast New Mexico.
- Owned by U.S. Department of Energy (DOE).
- Certified by U.S. Environmental Protection Agency (EPA) .
- Defense-related TRU waste is emplaced in a salt formation deep underground.
- Long-term regulatory compliance is demonstrated via Performance Assessment (PA) undertaken by SNL Carlsbad.

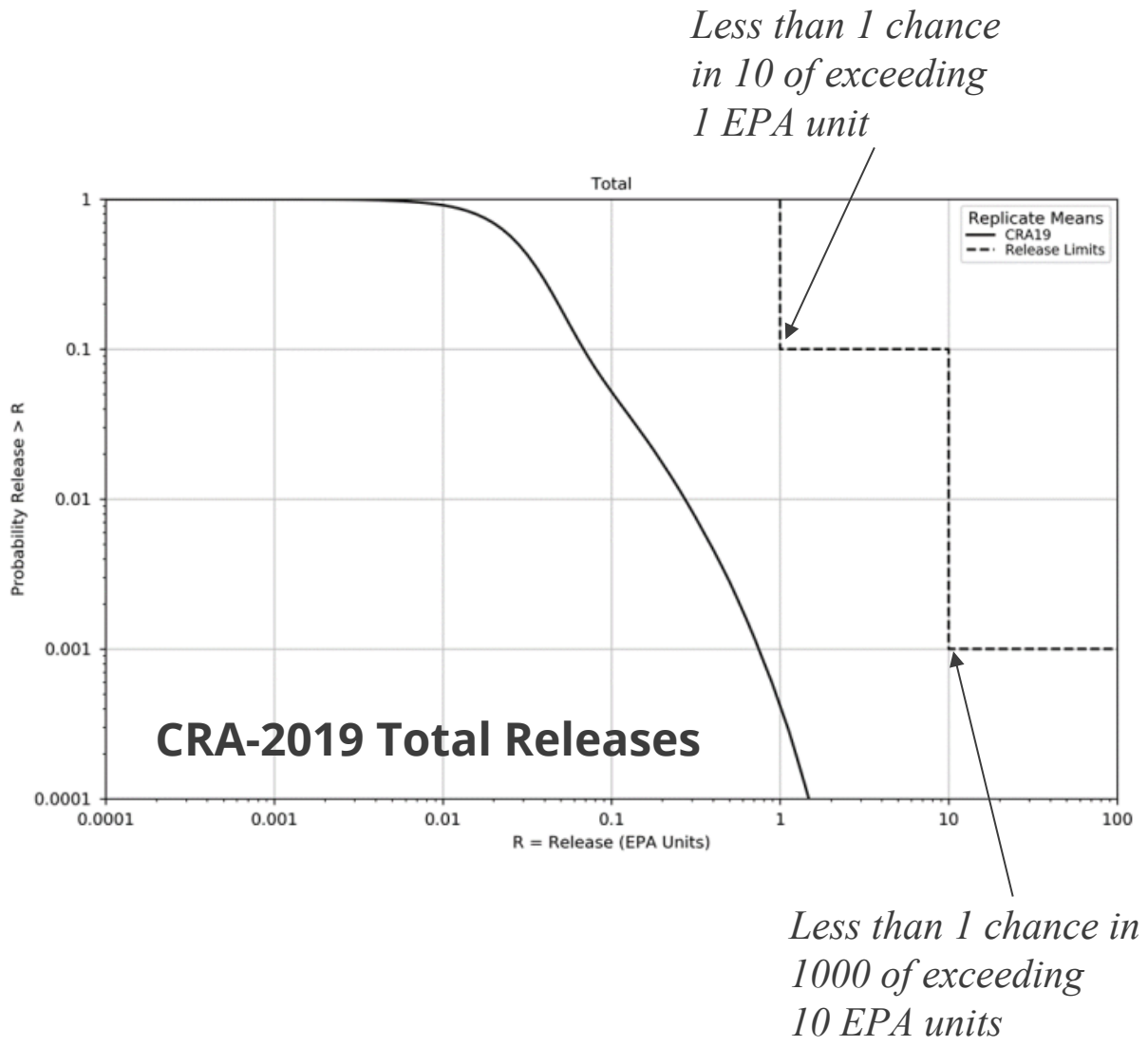


# The Waste Isolation Pilot Plant (WIPP)

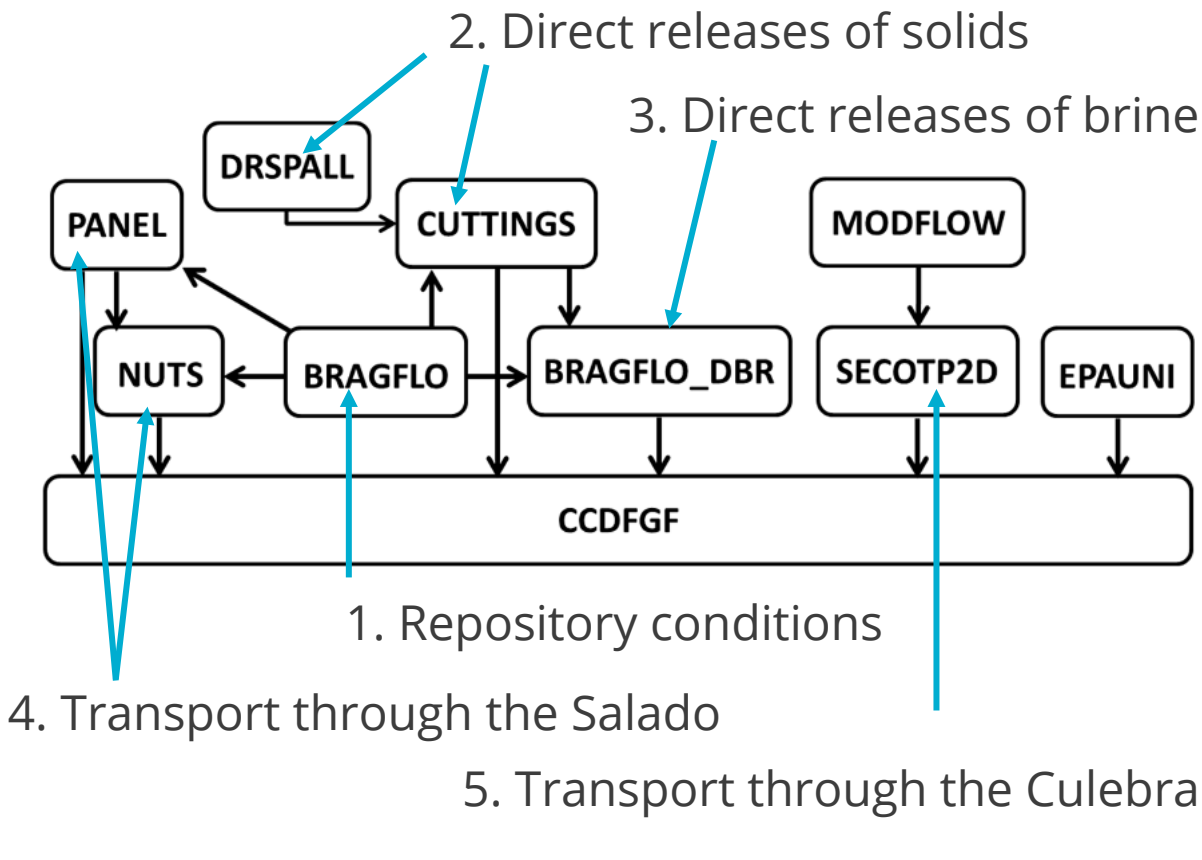
**By regulation, PA results are presented as a distribution of CCDFs of releases.**

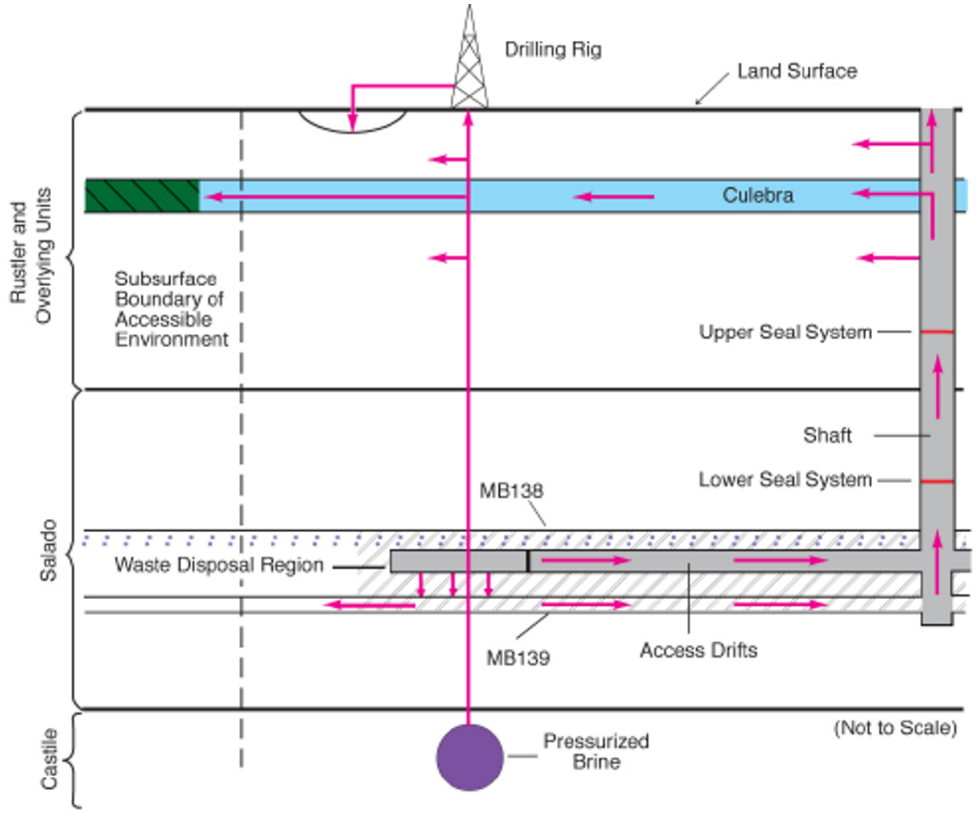
- Process models are used to calculate repository behavior over a range of sampled parameter values to account for epistemic uncertainty.
- Random sequences of future events (e.g. intrusion times and locations) are generated to account for aleatory uncertainty.
- An individual CCDF summarizes the likelihood of release across all futures for one set of sampled parameter values.
- The CCDF curve is the metric of compliance.



# CCDFs – Constructing Potential Releases

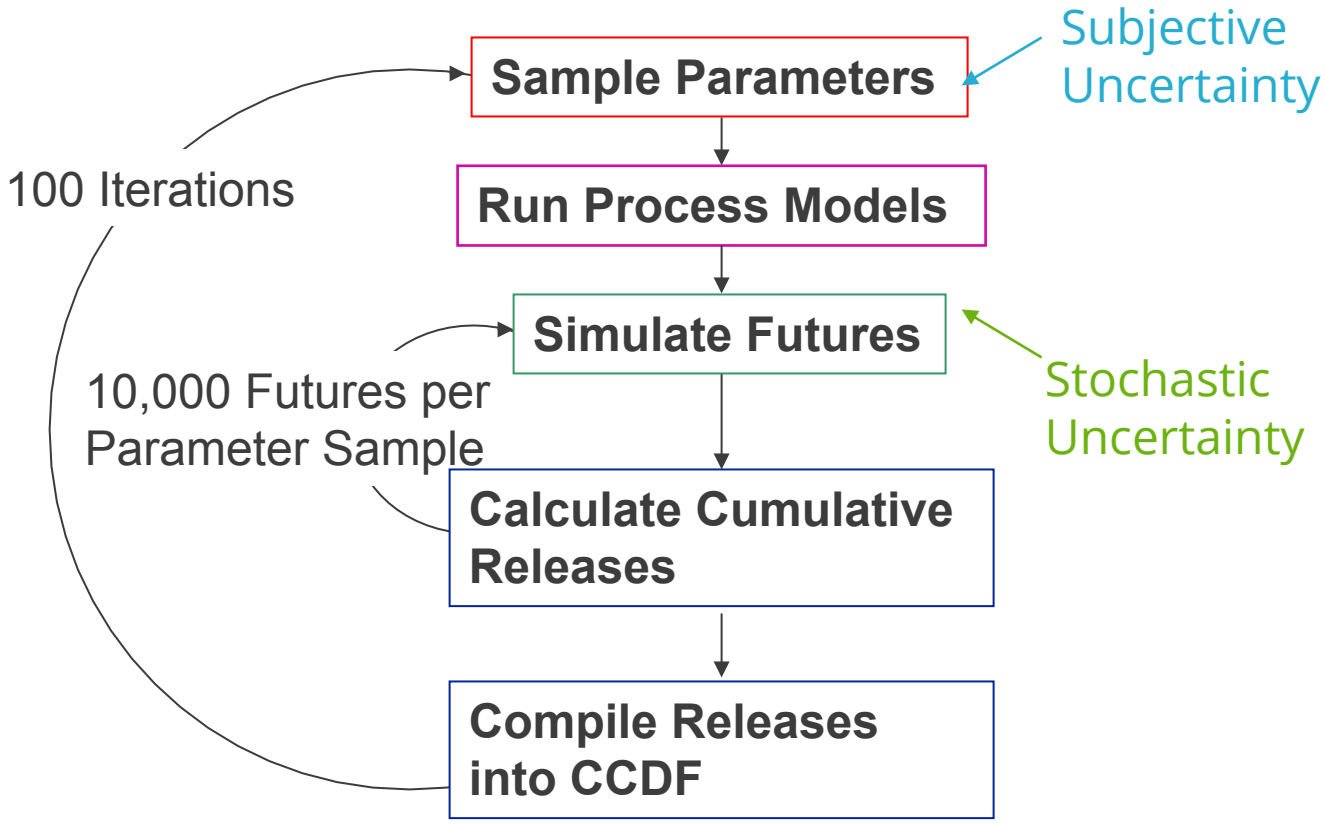
- Multiple release pathways.
- Computationally too intensive to explicitly model each future's sequence of random intrusions.
- Model representative scenarios, shift and interpolate on scenario results to determine releases from each intrusion and future.



# CCDFs of potential releases - overview

- A CCDF defines the probability that cumulative normalized releases will exceed a given level.
- One complementary cumulative distribution function (CCDF) is constructed for each set of sampled parameter values.
- Each future comprises a sequence of random borehole intrusions and a random time of complete mining.
- Cumulative releases for each future are assembled from results from other WIPP PA codes.



# Conceptual Approach to the Additional Panels PA

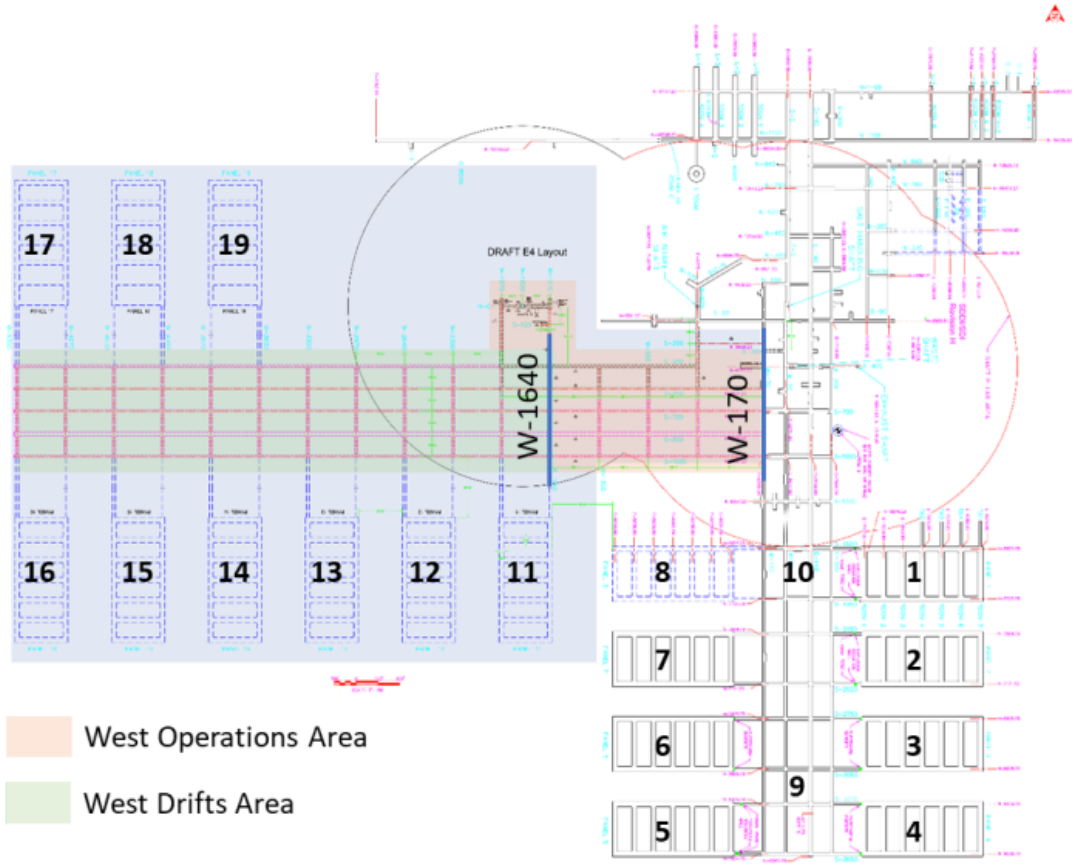
**The DOE is looking at options to potentially excavate replacement (11-12) and additional (13-19) panels for waste disposal.**

## Changes for the APPA

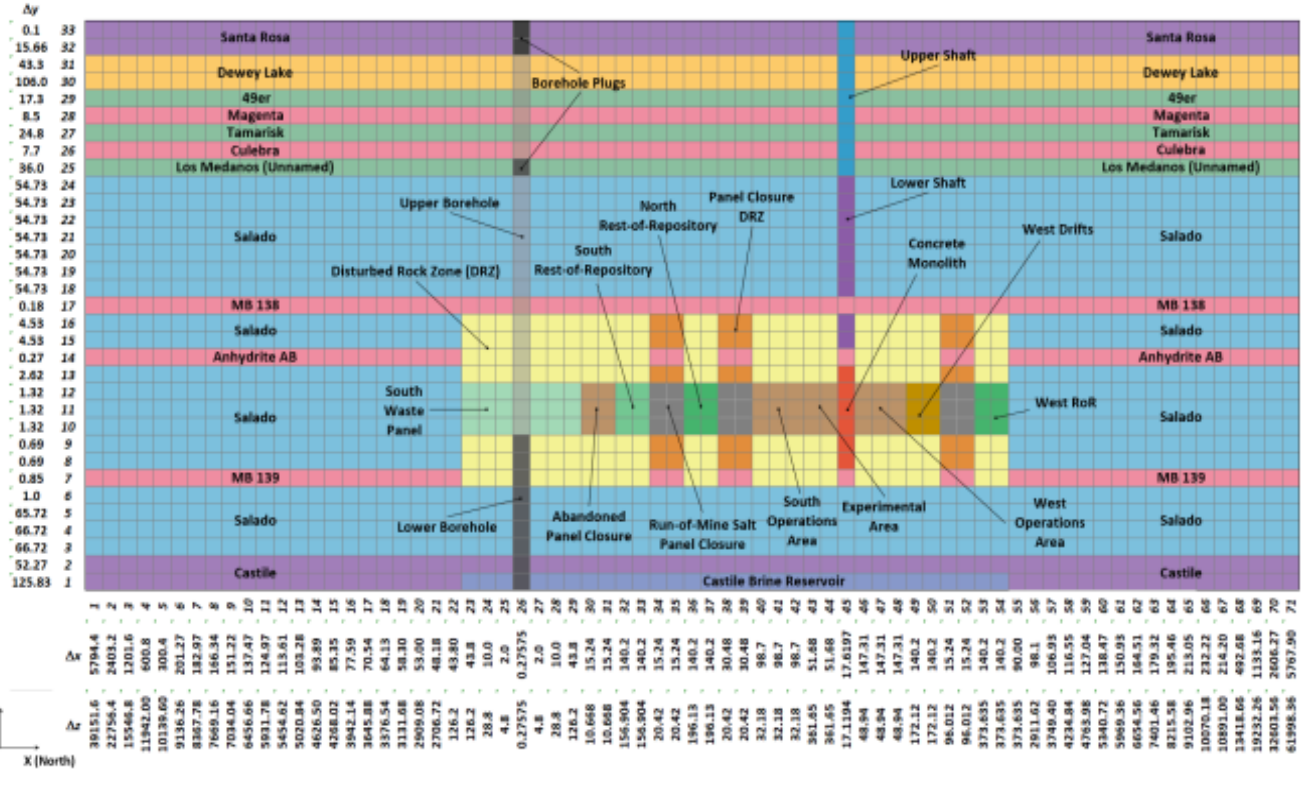
- Modified Salado flow grid.
- Modified DBR grid.
- Updated model input parameters related to repository dimensions.
- Updated panel neighboring assignments.
- Computational code changes to implement the above.

## Inventory Scaling

- The APPA analysis uses the same inventory as the CRA19 PA, which is scaled to the Land Withdrawal Act (LWA) legislated waste capacity of 175,564 $m^3$.
- The increased waste storage area of the APPA increases the physical volume where waste can be emplaced but does not increase the volume of the waste emplaced in the repository.
- Waste concentrations (radionuclides, steel, CPR) decrease in the APPA as compared to the CRA19.

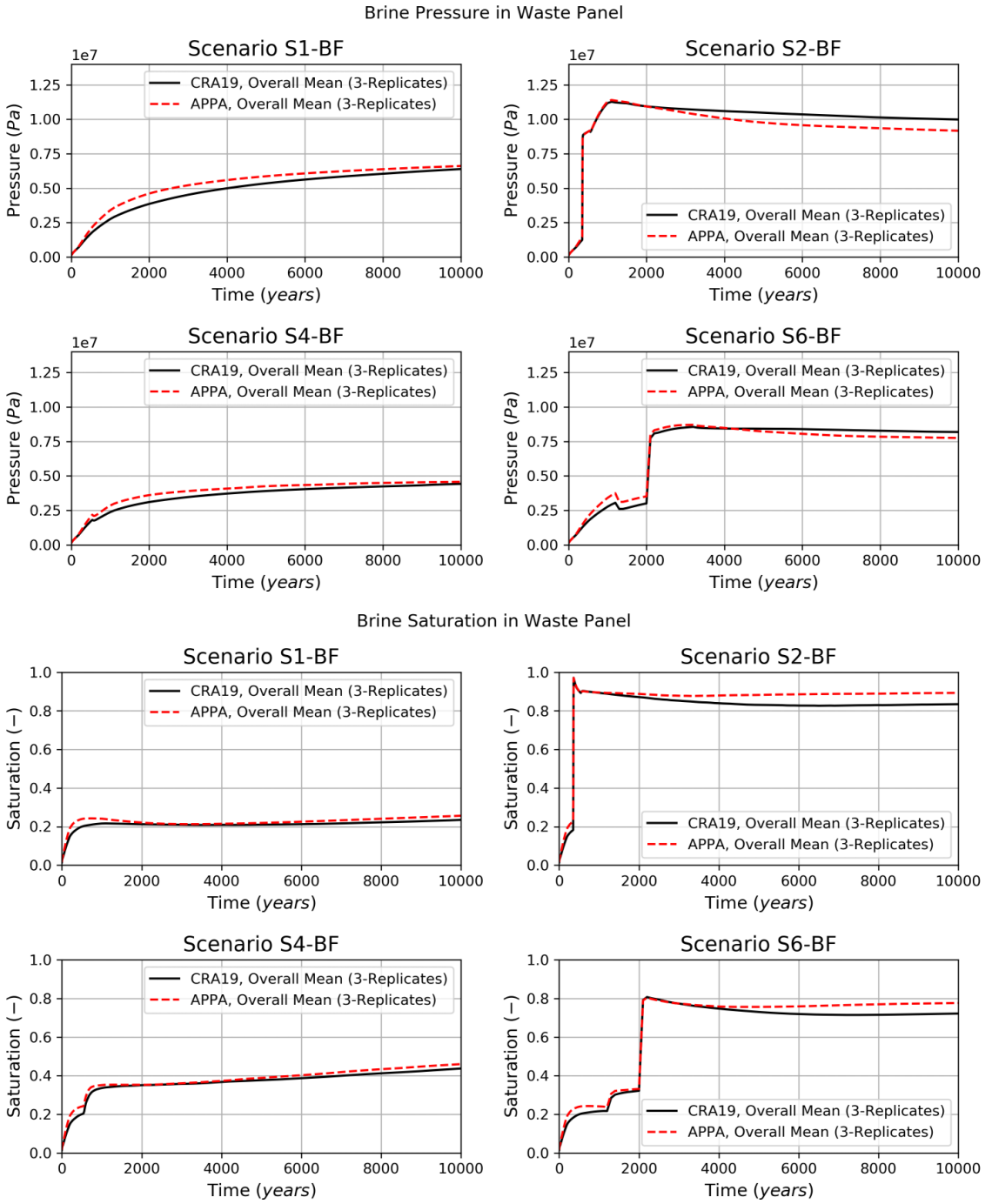


# Salado Flow Results

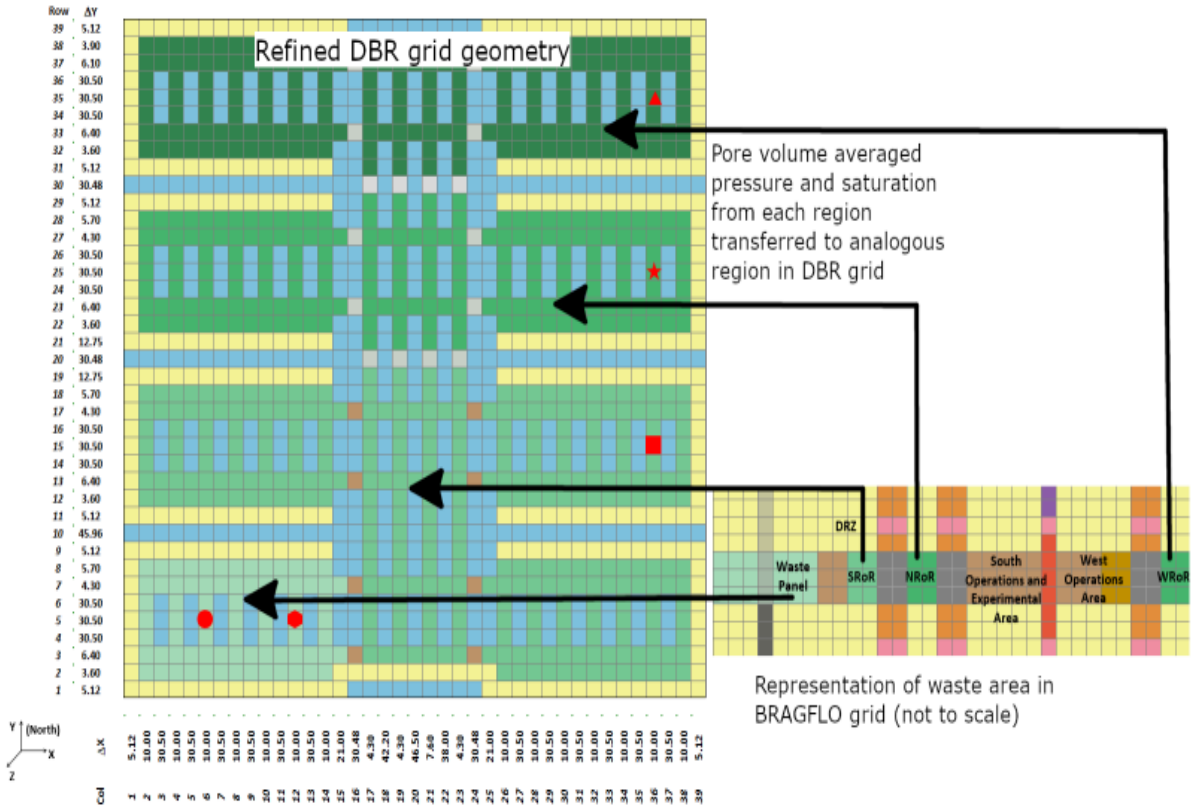


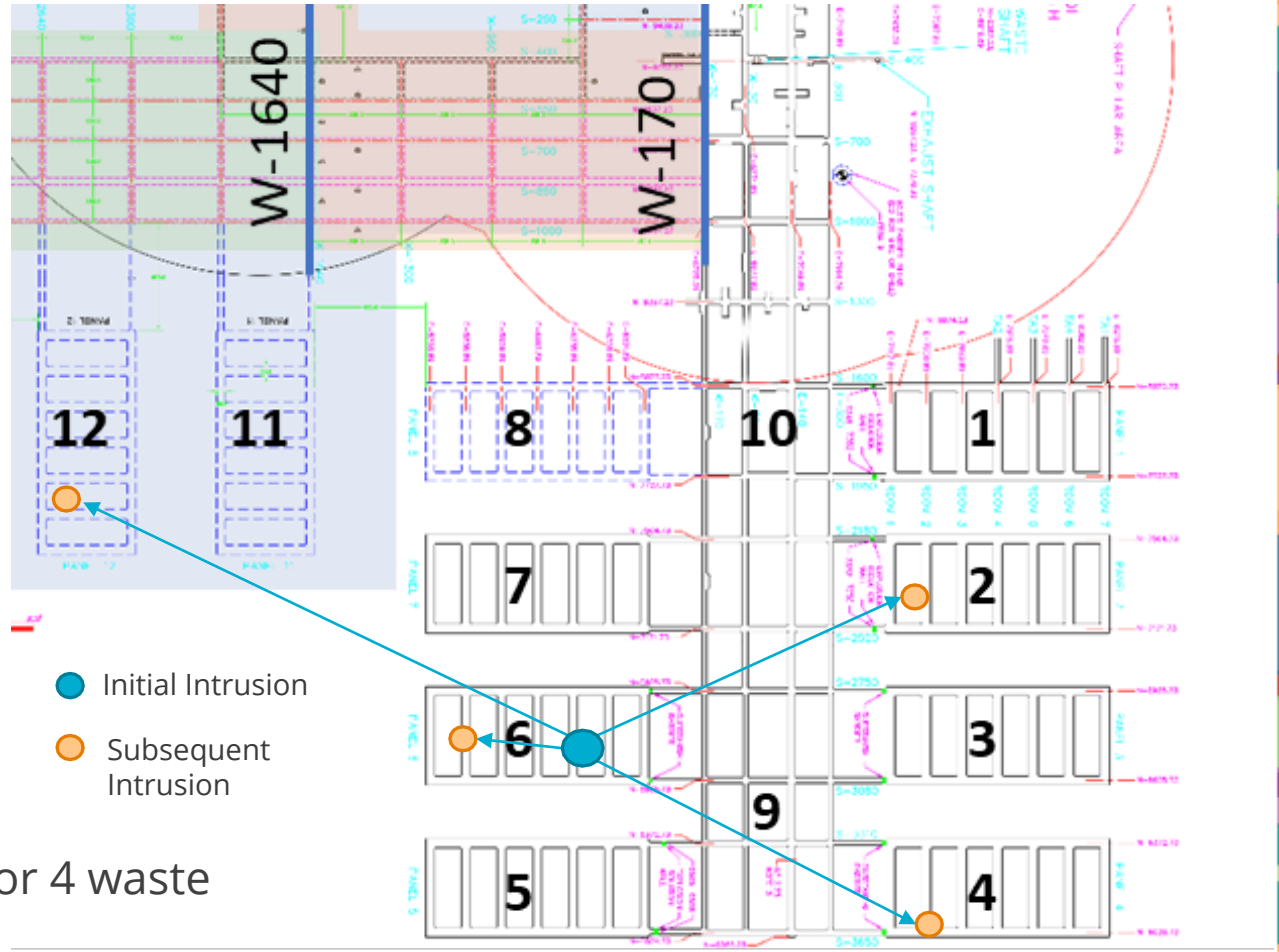

- Mean brine pressures have not drastically changed.
  - Maximum pressures have decreased.
- Mean brine saturations are slightly increased.
  - Increased repository area increases communication with the Salado formation
  - Allows more brine flow into the repository

See King (2021b) for more detail on the Salado Flow model and results.



# DBRs and Panel Neighbor Relationships



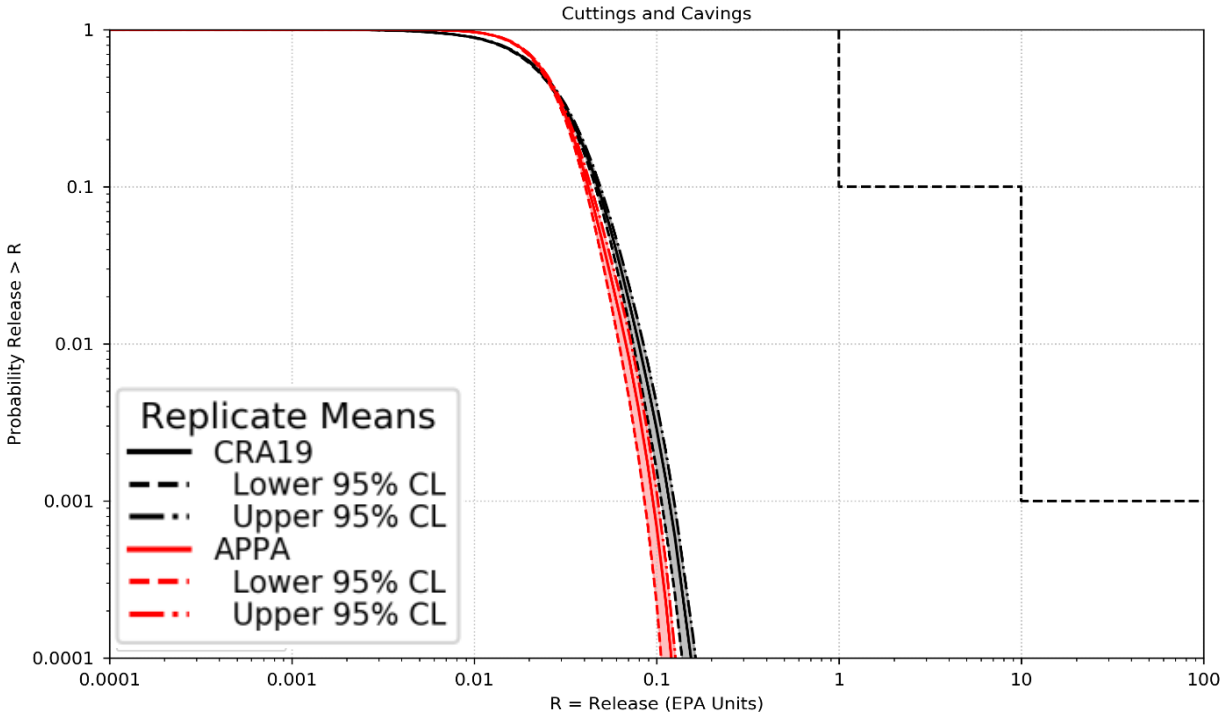




- DBR conditions are mapped from Salado Flow model for 4 waste areas.
- Panels are assigned a relationship to every other panel based on their physical location in the repository.

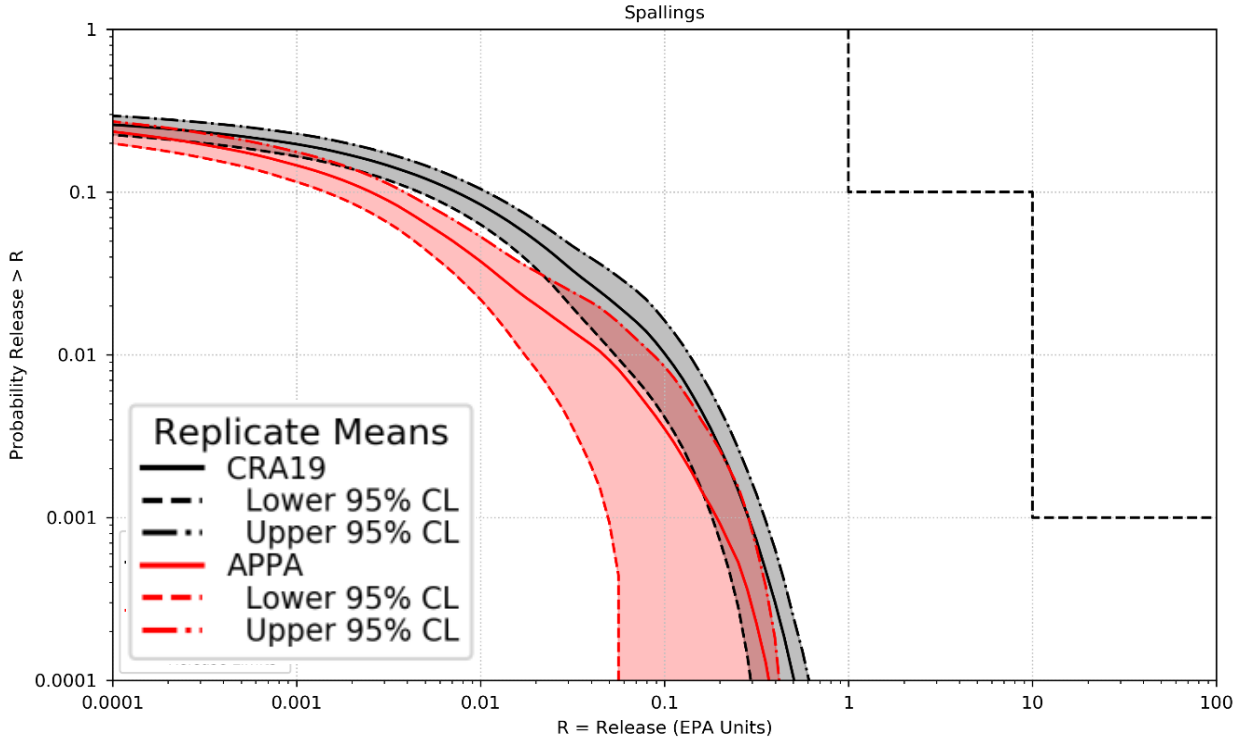
See Table 5 in AP-185 for a list of panel neighboring relationships (Hansen, 2020).
See King (2021a) for more detail on the DBR model.

# Cuttings, Cavings, and Spallings

- Cuttings and cavings parameters are the same between CRA-2019 and APPA.
- Cuttings and cavings areas are identical, waste concentrations are similar but not identical due to the increased frequency of boreholes (from the increased footprint) resulting in a different selection of waste streams for each future.
- Extracted volumes increased due to increased number of boreholes.
- Mean releases are similar.

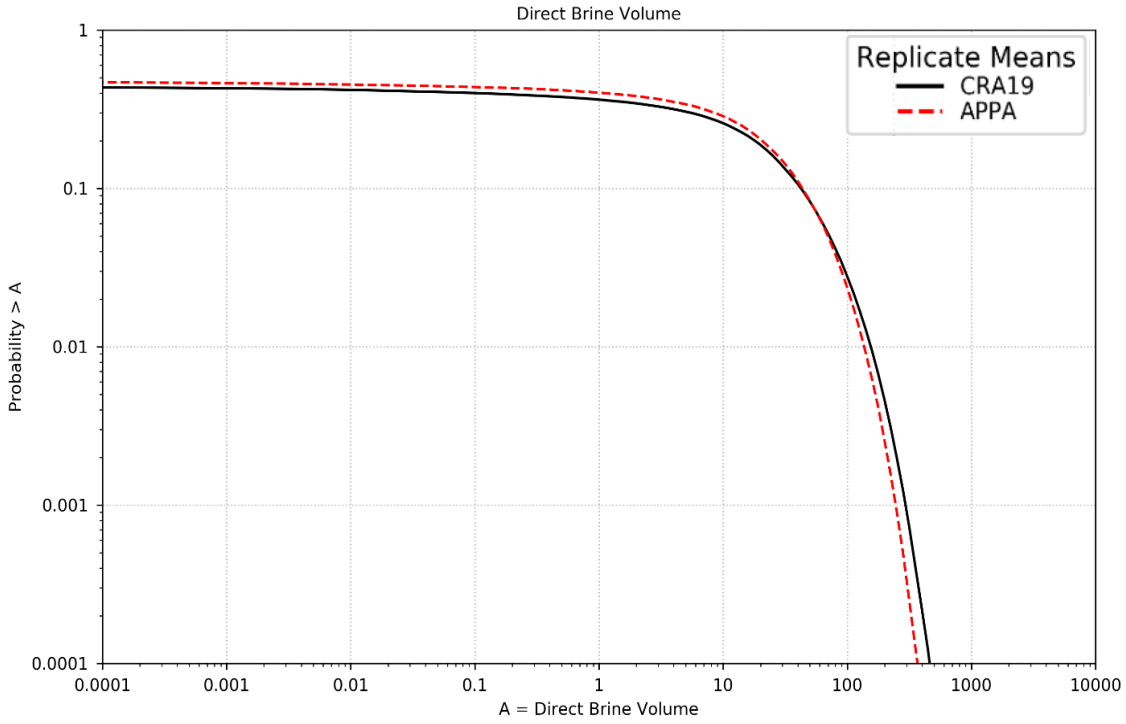



- Spalled volumes for individual releases are similar.
- Average waste stream activity concentrations are identical.
- Spalled volumes scaled by fractional volume of repository containing waste.
- Mean releases are decreased at all probabilities.

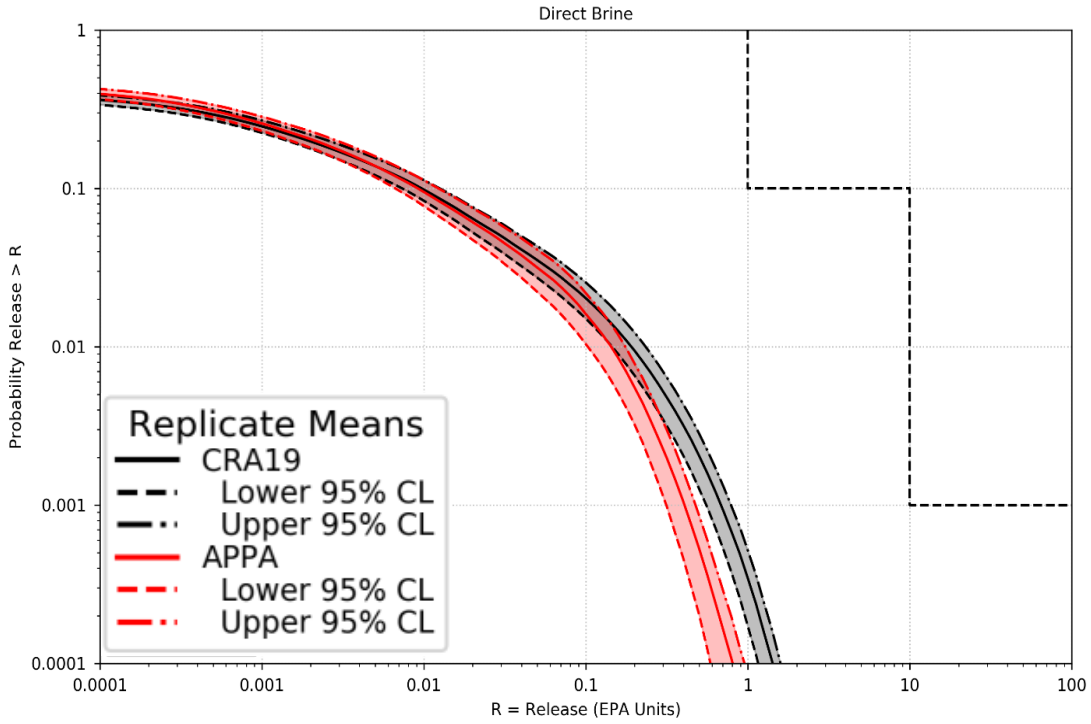


# Direct Brine Releases

- DBR volumes increased at high probabilities, decreased at low probabilities.
- Concentrations of lumped radionuclides in brine are similar.

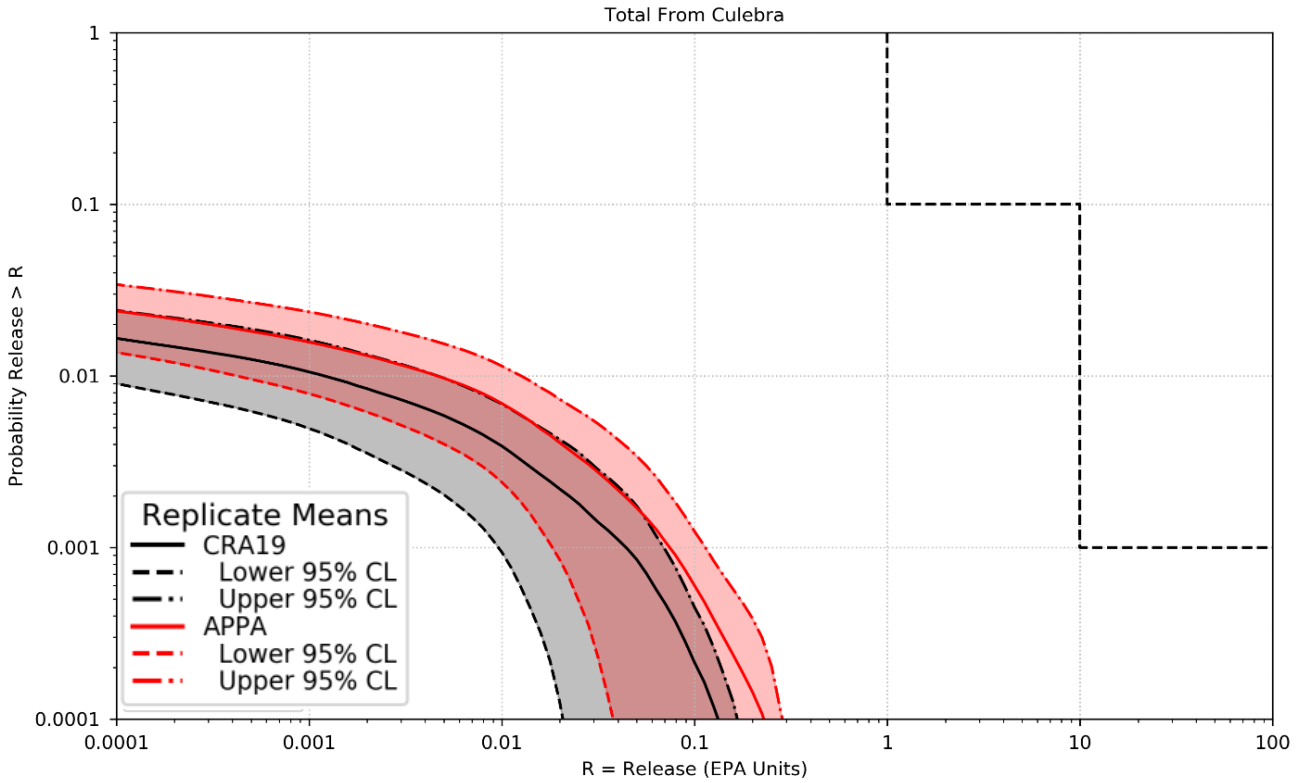



- Releases increased at high probability and decreased at low probability.
- Releases decrease at both compliance points.



# Culebra Releases

- Cumulative releases through the Culebra are increased as compared to the CRA-2019 PA
- Concentrations of lumped radionuclides in brine are similar
- Cumulative releases to the Culebra are increased due to the increased number of boreholes



# Conclusions

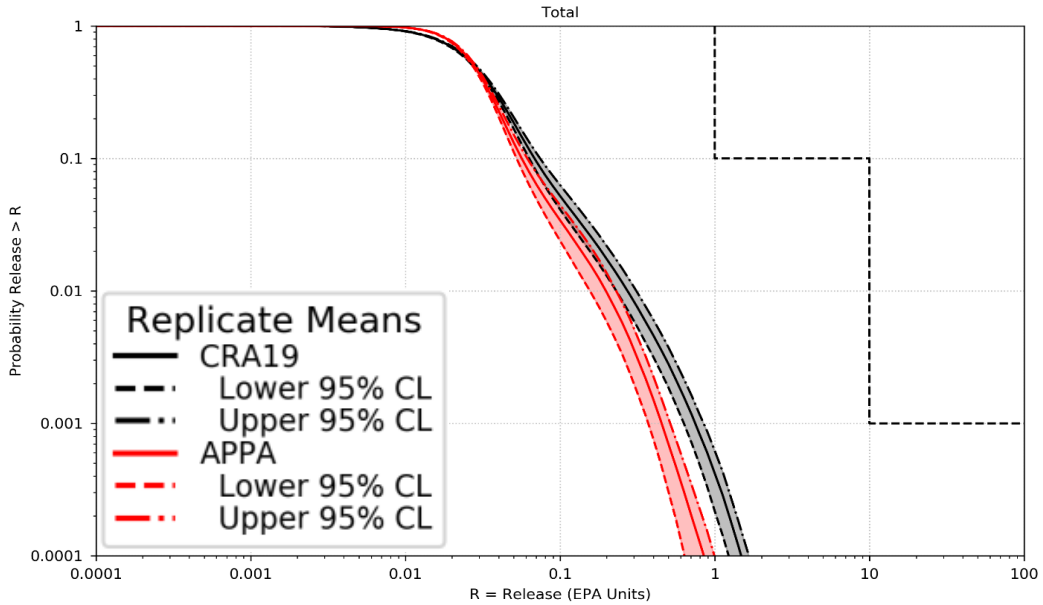
Overall Results:

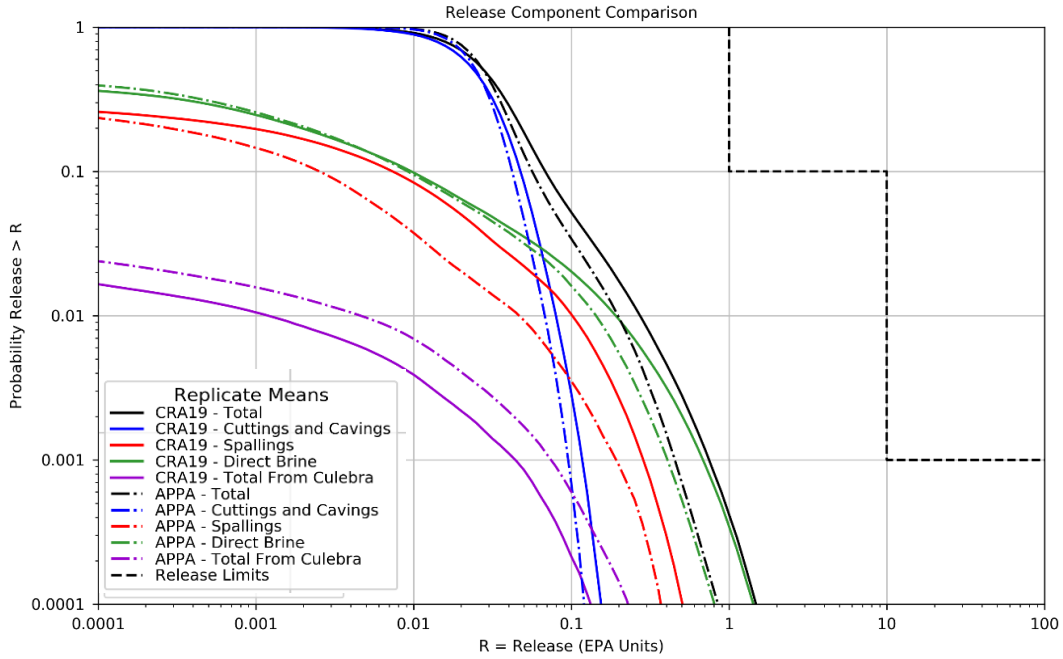
- Increased at highest probabilities
- Decreased at lower probabilities
- Decreased at both compliance points

Total Potential Releases by Release Mechanism:

- Cuttings and cavings dominate at high probabilities
- DBRs dominate at low probabilities
- From-Culebra releases increased at all probabilities
- Releases generally decreased for all other release mechanisms.

See Brunell et al. (2021) for additional details on the APPA model. Zeitler et al. (2019) describes the CRA-2019 model.



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