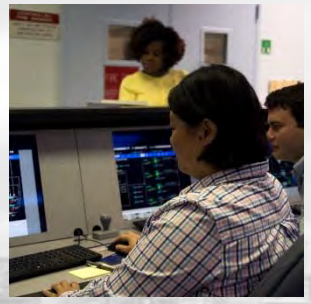
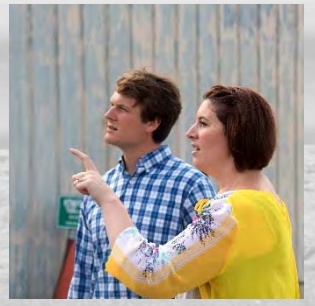
Savannah River Remediation
AECOM | BECHTEL | CH2M | BWXT

SRR-CWDA-2019-00028, Revision 0





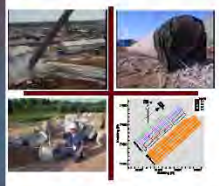
GENERAL SEPARATIONS AREA GROUNDWATER FLOW MODELING

Discussion Supporting NRC Onsite Observation Visit
March 18-19, 2019

Greg Flach
Waste Disposal Authority

Modeling History

GSA Groundwater Flow Model History



SRNL
SAVANNAH RIVER NATIONAL LABORATORY
We Put Science To Work

Greg Flach
4 April 2008

March 2019 Updates

GSA Model Versions

- GSA FACT rev 0
- GSA FACT rev 1
- GSA FACT rev 2
- GSA FACT rev 0.1
- GSA PORFLOW rev 0
- GSA_2016
- GSA_2018

SRNL

GSA FACT rev 0

- August 1997, WSRC-TR-96-0399 rev 0
- Green clay vertical conductivity = 1.e-4 ft/d
  - data indicates ~4.e-4 ft/d (Aadland et al. 1995)
  - GeoTrans (1992) model used 1.5e-4 ft/d
  - GeoTrans (1993) model used 1.25e-5 ft/d (H-basins H-3 plume)
  - Sadler (1995) H-area model used 1.e-6 ft/d (H-basins plume)
- Water table mound over H-area reproduced with
  - lower conductivity
  - artificial recharge over H-area

SRNL

GSA FACT rev 1

- late 1997, ?
- revised topography around Old F-area Seepage Basin
- used for ER work

SRNL

Unpublished

Modeling History (cont'd)

GSA FACT rev 2

- January 1998, SRT-EST-98-154
- Green clay vertical conductivity = 1.e-5 ft/d (was 1.e-4)
  - lower value needed to match Old Burial Ground H-3 plume
- used for ER and PA/CA work

SRNL

GSA FACT rev 0.1

- April 1998, WSRC-TR-96-0399 rev 1, WSRC-TR-99-00106
- Enhanced QA and documentation
- Insignificant changes from rev 0:
  - Green clay vertical conductivity = 1.e-4 ft/d
  - enhanced recharge over H-area
- ER use?

SRNL

GSA PORFLOW rev 0

- July 2004, WSRC-TR-2004-00106
- Porting from FACT code to PORFLOW code
- Modifications to grid layering
- Revisited model calibration in general
  - Green clay vertical conductivity = 1.e-5 ft/d, based on GSA FACT rev 2
  - natural recharge over H-area, with conductivity adjustments
- Used for subsequent PA/CA work

SRNL

March 2019 Update: GSA_2016 and GSA_2018

- September 2017, SRNL-STI-2017-00008 Rev. 1
  - "GSA_2016"
  - Updated calibration targets, PEST calibration
  - Green clay Kv = 0.75e-4 ft/d = 7.5e-5 ft/d
- January 2019, SRNL-STI-2018-00643 Rev. 0
  - "GSA_2018"
  - Targets updated again, comparison to plume data
  - Green clay vertical conductivity = 1.0e-5 ft/d

SRNL

Unpublished

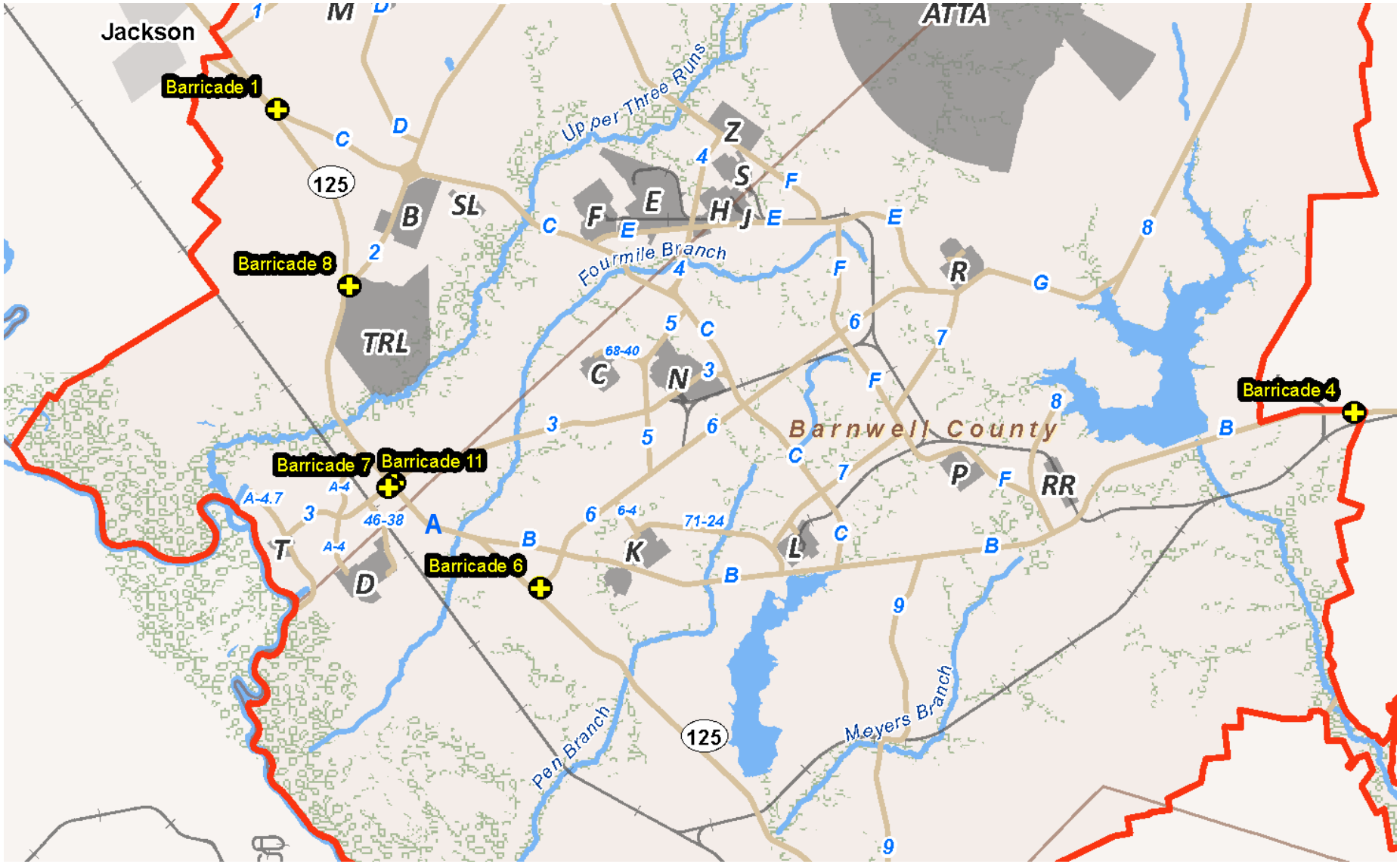
GSA_1999 (WSRC-TR-96-0399)

Discussion Items regarding WSRC-TR-96-0399, Rev. 1, Vol. 2.

1. **Stream baseflow (pp. 7-8): Could a map be provided that shows the locations discussed, e.g., Roads A-F, Road 4, Sections 3 & 4.**
   [Slide 5]
2. **Please discuss technical bases for boundary conditions discussed in the section titled "Boundary Conditions" on pp. 11-12 and the figures on p. 75.**
   [Slides 8-9 in GSA_2004 section for Item 4]
3. **Discussion on Figures 43 and 44 and simulated flowpaths from the H Area passing the Crouch Branch.**
   [Slide 6]

Discussion questions provided by NRC via email dated 3/6/2019

Road Names [#1]



Portion of https://gis.srs.gov/GISHomepageMaps/SRS_Map.pdf

Groundwater Flow Directions [#3]

WSRC-TR-96-0399, Rev. 1, GSA_1999

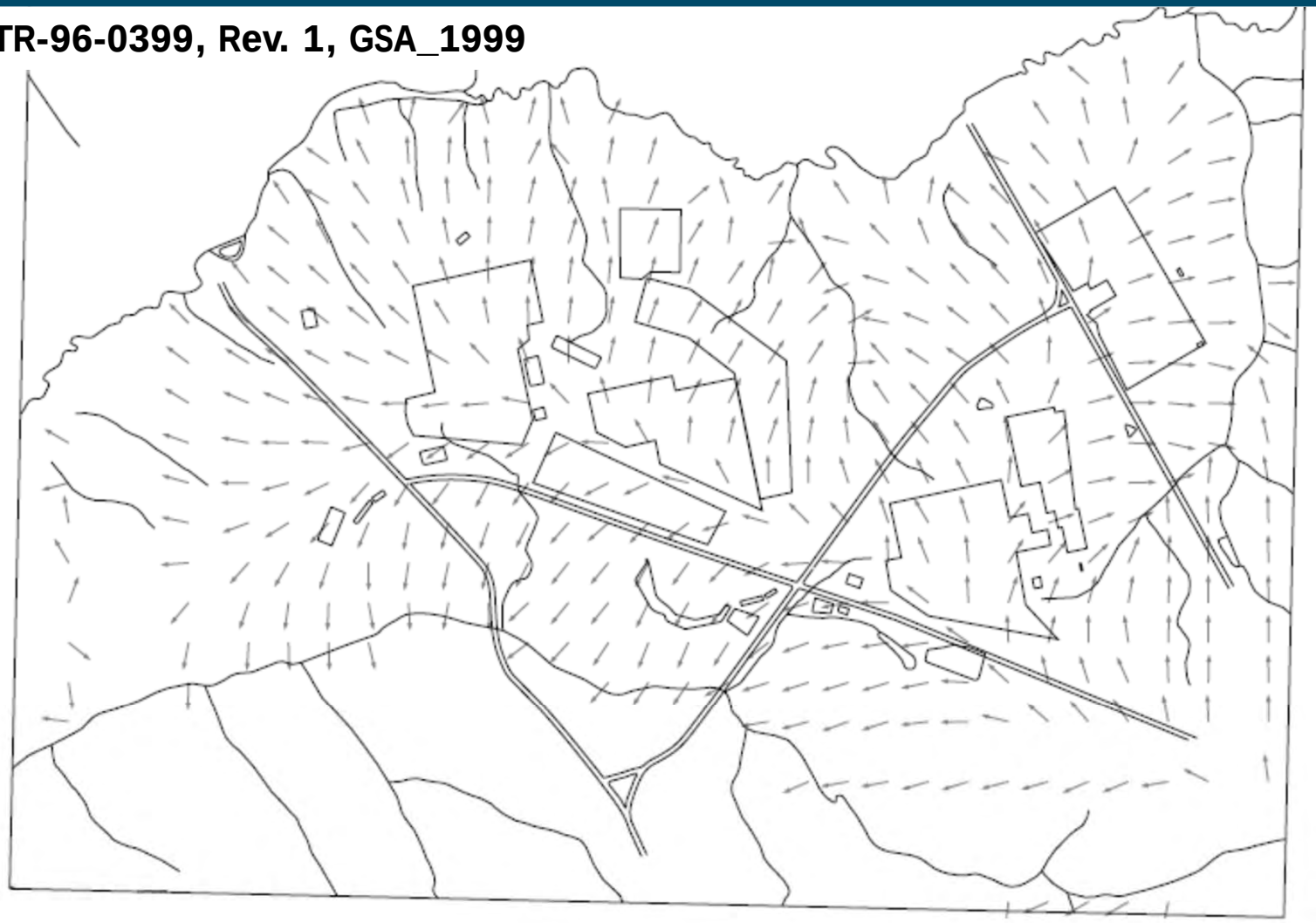


Figure 43. Simulated flow direction in the "lower" aquifer zone, averaged over the aquifer thickness.

GSA_2004 (WSRC-TR-2004-00106)

Discussion Items regarding WSRC-TR-2004-00106, Rev. 0.

4. **Discussion and comparison of Figures 2-2, 2-5, and 2-8.**
   [Slides 8-9]

Discussion questions provided by NRC via email dated 3/6/2019

Model Boundary Conditions [#2,4]

WSRC-TR-2004-00106, GSA_2004

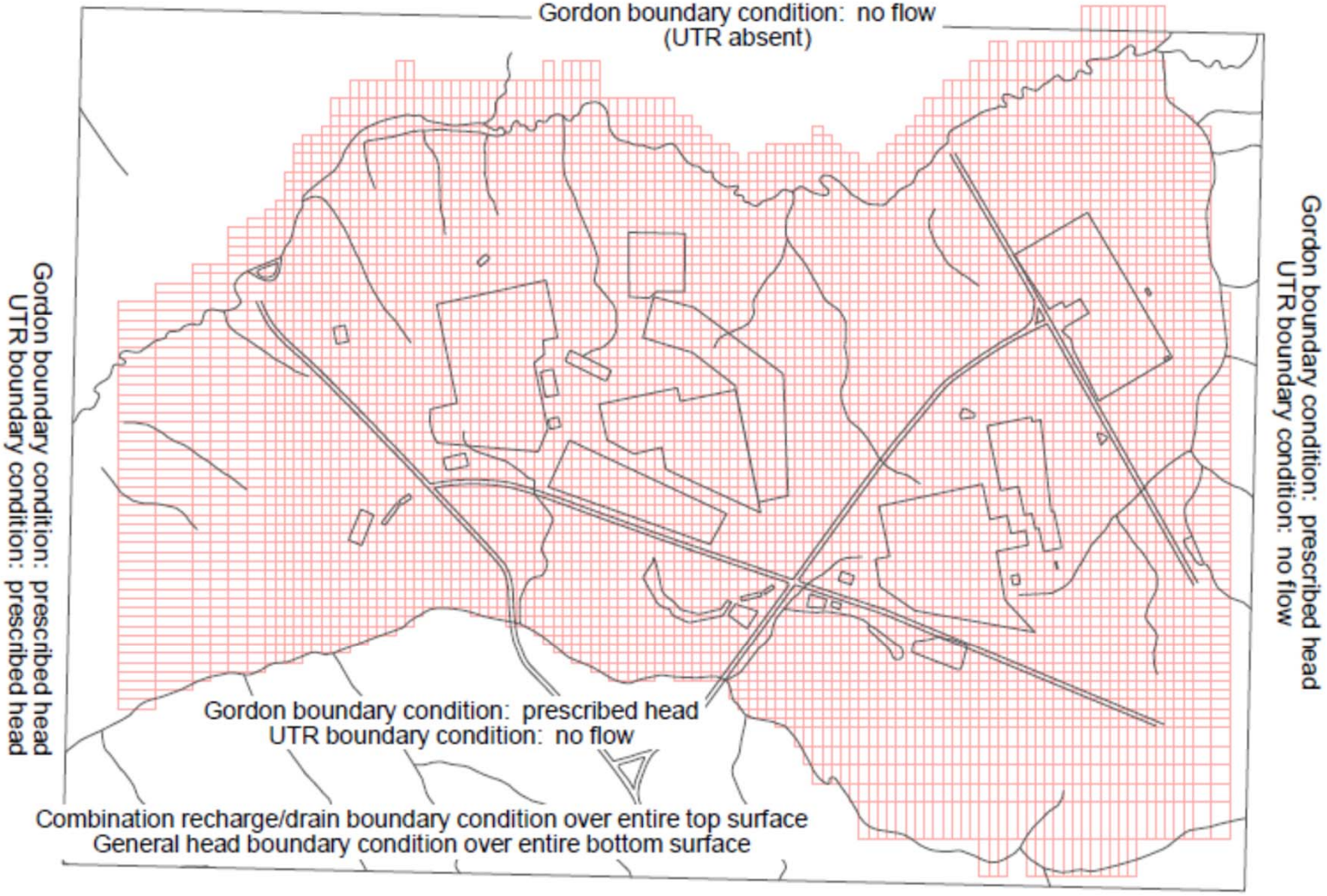
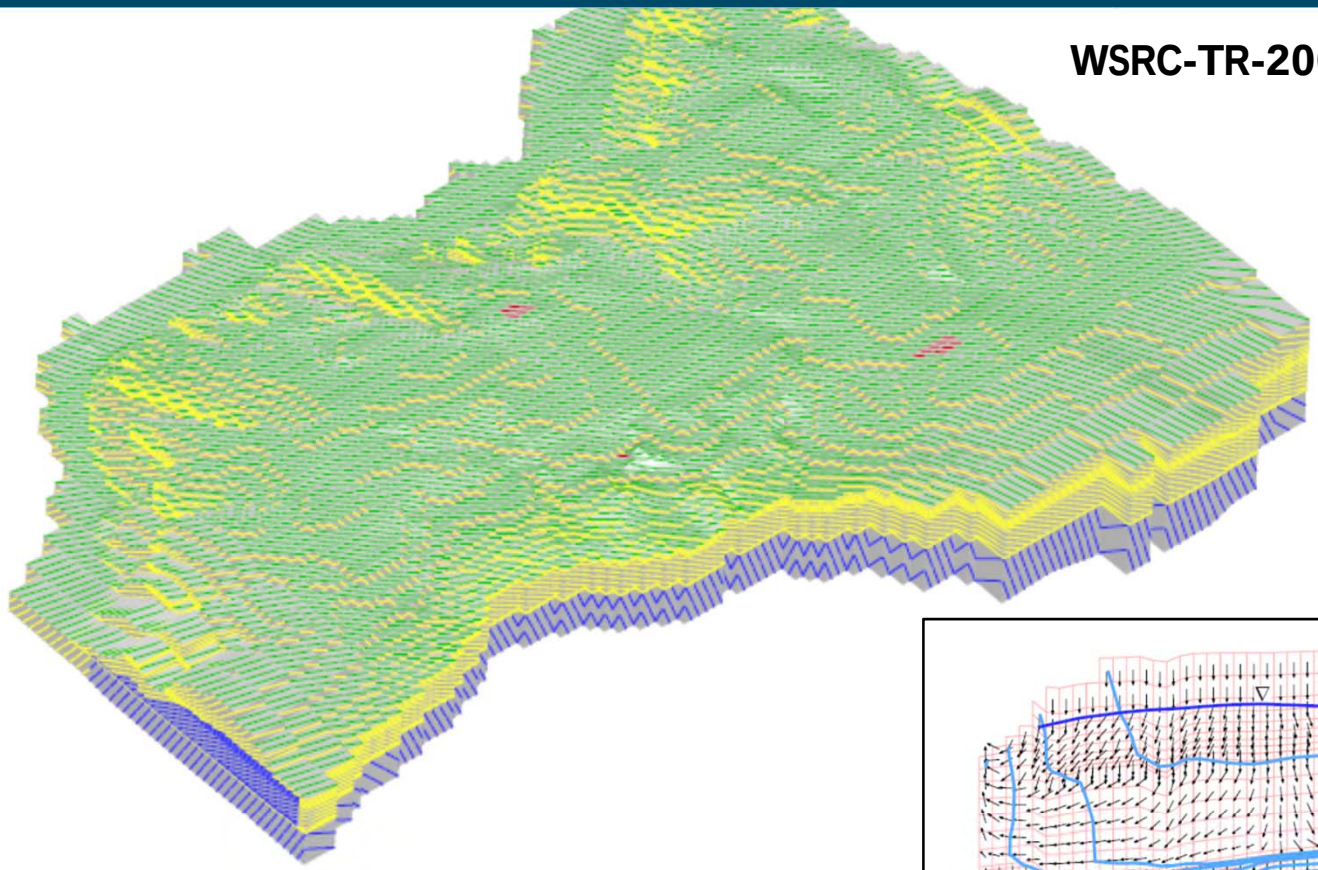


Figure 2-2. Plan view of GSA/FACT and GSA/PORFLOW computational meshes.

Model Boundary Conditions (cont'd) [#2,4]

WSRC-TR-2004-00106, GSA_2004



Cross-hatching key
blue = prescribed head
red = general head
green = recharge/drain
yellow = no flow

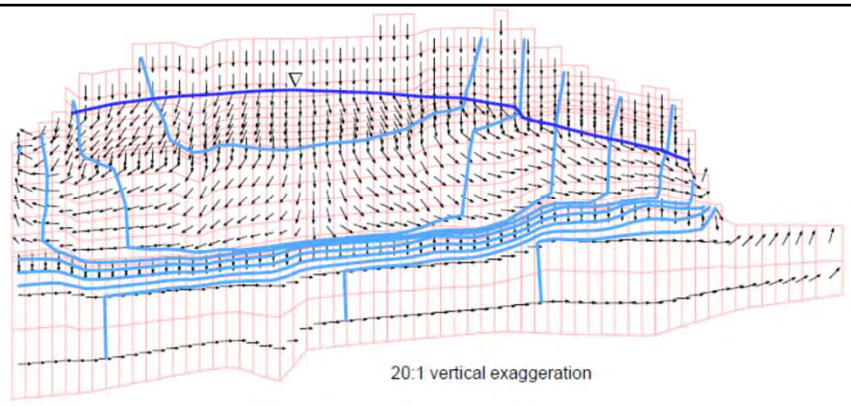


Figure 2-8. Example velocity field showing predominantly downward flow in the vadose zone; vectors are fixed length showing flow direction only.

Figure 2-5. Boundary conditions applied to GSA/PORFLOW computational mesh.

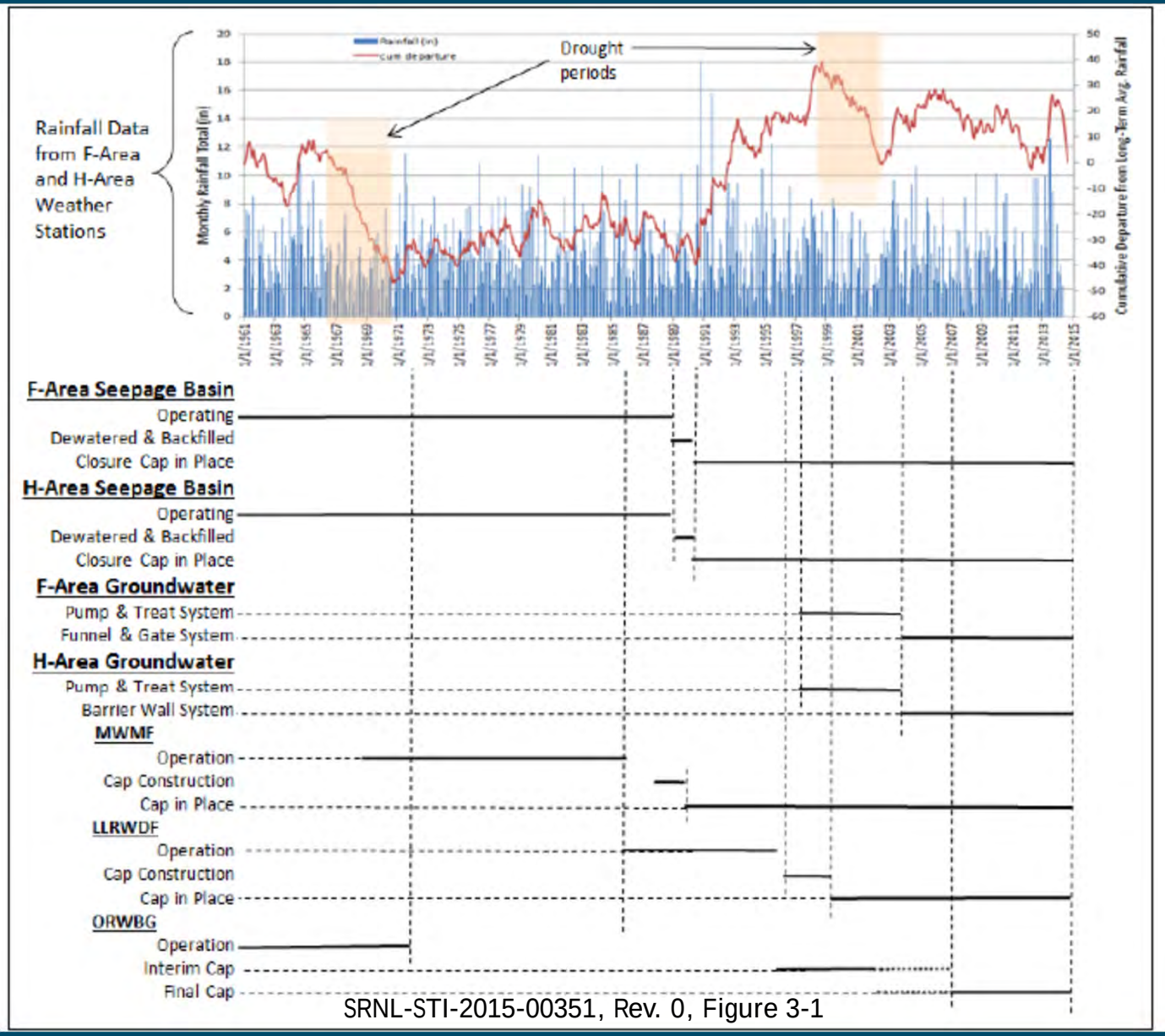
GSA_2016 (SRNL-STI-2015-00351)

Discussion Items regarding Head Calibration Target Documents SRNL-STI-2015-00351, Rev. 0, and SRNL-STI-2018-00336, Rev. 0

5. **Discuss criteria and assumptions stated in the document, e.g., the avoidance of extended time-periods where anomalously low or anomalously high patterns of precipitation occurred.**
   [Slides 11-12]

Discussion questions provided by NRC via email dated 3/6/2019

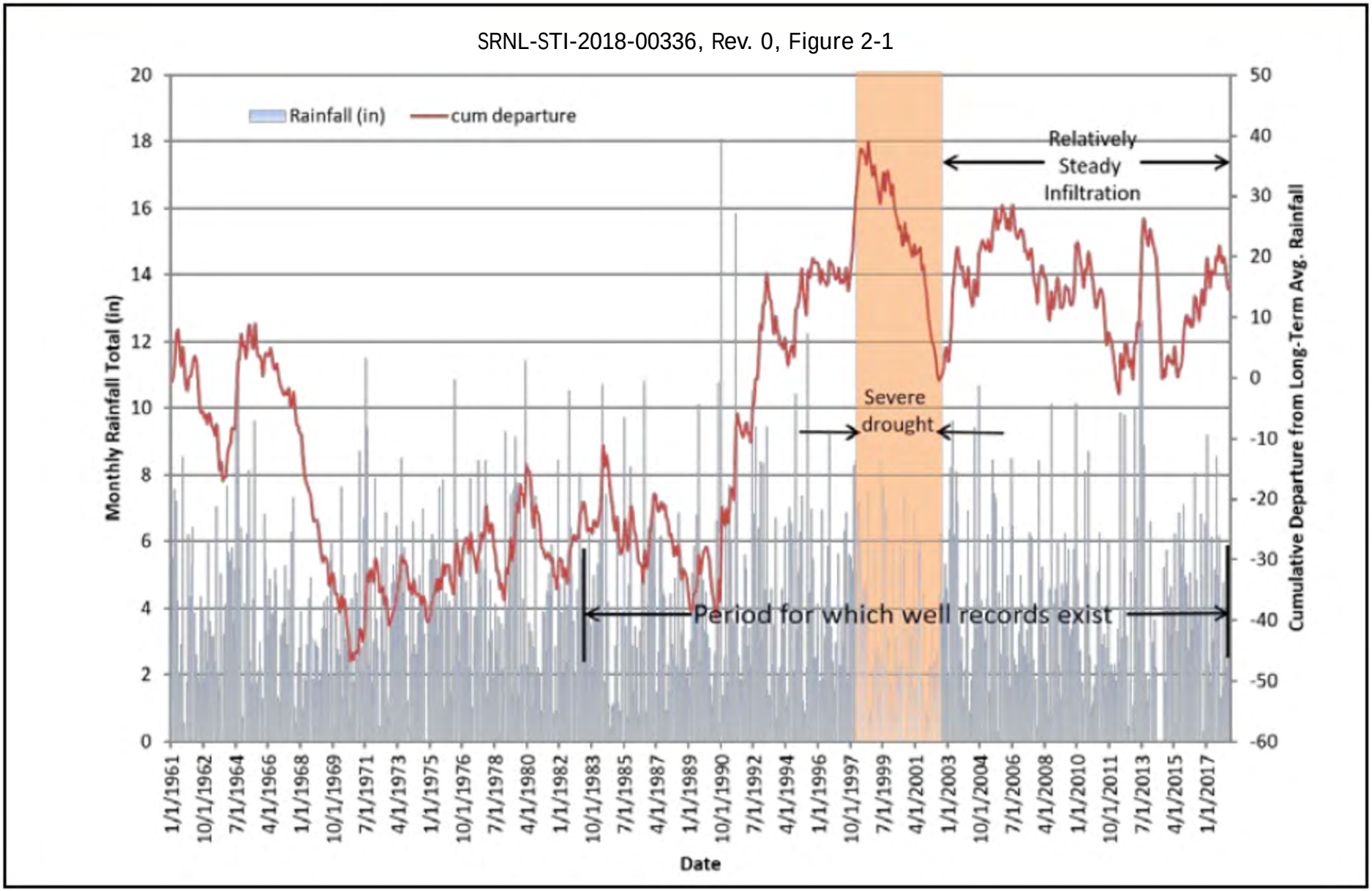
2015 Targets: 2004-2014 Average [#5]



SRNL-STI-2015-00351, Rev. 0, Figure 3-1

2018 Targets: 2004-2018 Average [#5]

SRNL-STI-2018-00336, Rev. 0, Figure 2-1



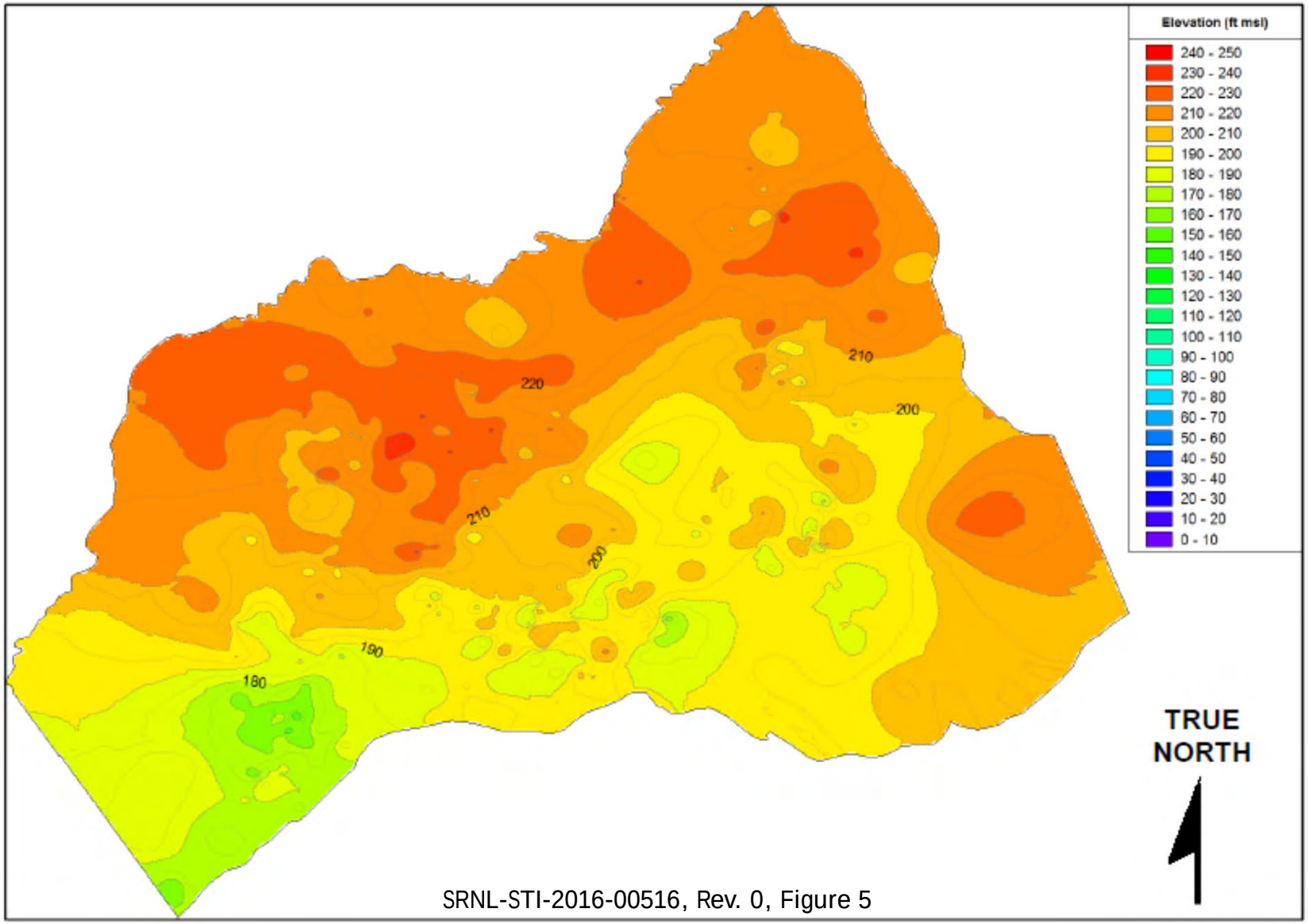
GSA_2016 (SRNL-STI-2016-00516)

Discussion Items regarding Hydrostratigraphic Surfaces Document SRNL-STI-2016-00516, Rev. 0

6. **Discussion and comparison of SRNL-STI-2016-00516, Figures 5 – 9 with WSRC-TR-96-0399, Figures 3 – 7.**
   [Slides 14-15; comparison to GSA_2016/2018]

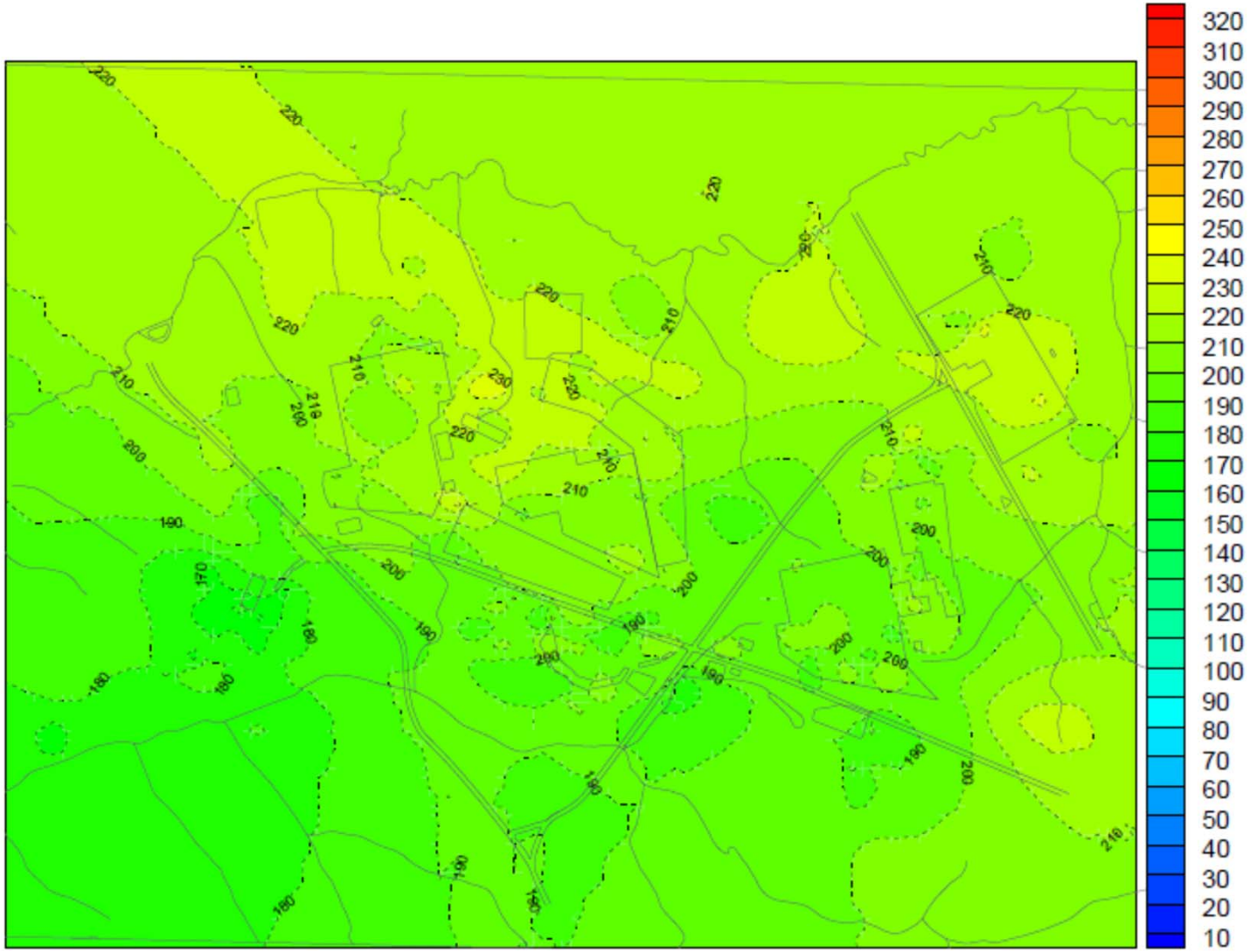
Discussion questions provided by NRC via email dated 3/6/2019

TCCZ: SRNL-STI-2016-00516 [#6]



SRNL-STI-2016-00516, Rev. 0, Figure 5

TCCZ: SRNL-STI-2017-00008, Rev. 1 [#6]



SRNL-STI-2017-00008, Rev. 1, Page A-2

GSA_2016 (SRNL-STI-2017-00445)

Discussion Items regarding SRNL-STI-2017-00445, Rev. 0.

7. **Discussion and comparison of Fig. 3 with Fig. 4.**
   [Slides 17-20; updated to GSA_2018]
8. **Discussion plumes in Figures 4 and 5 (5 and 6?) and flow and transport influence of TCCZ.**
   [Slides 21-23; updated to GSA_2018]
9. **Discussion on Fig. 8.**
   [Slides 24-25; updated to GSA_2018]
10. **Where is the seepline located for Figure 10?**
    [Slide 26; updated to GSA_2018]

Discussion questions provided by NRC via email dated 3/6/2019

SRNL-STI-2017-00445, SDU 1 [#7]

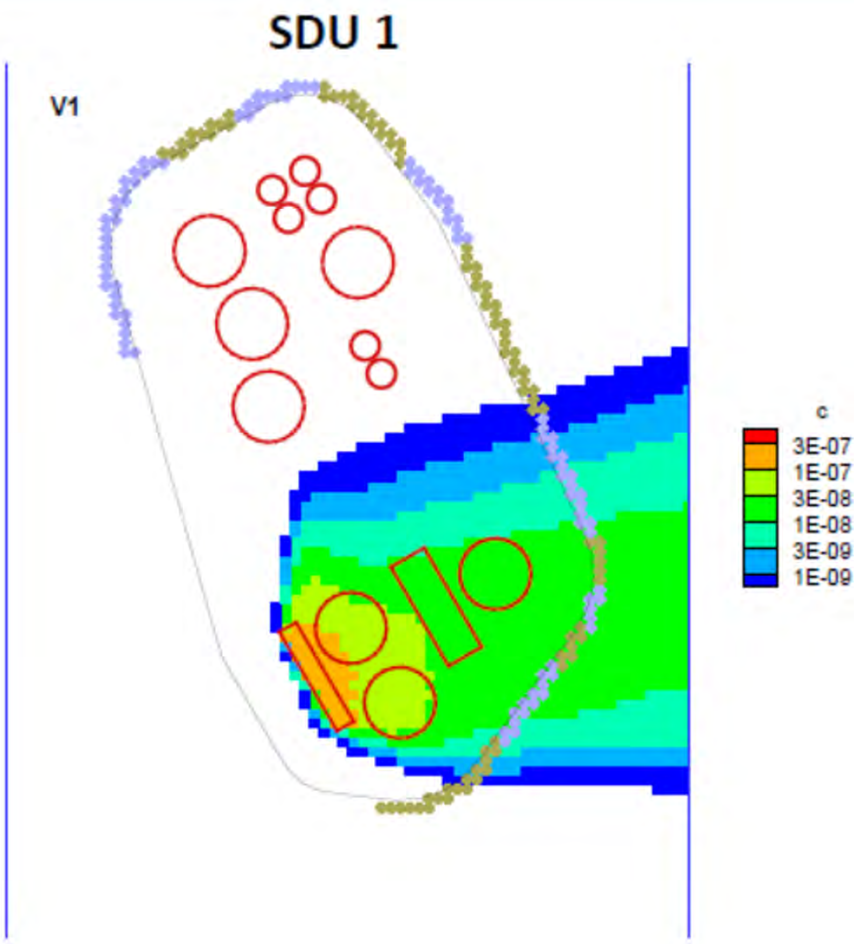


Figure 3
[SDF GSA_2004 Tracer Plume Simulation of Steady-State Sources (Ci/L)]

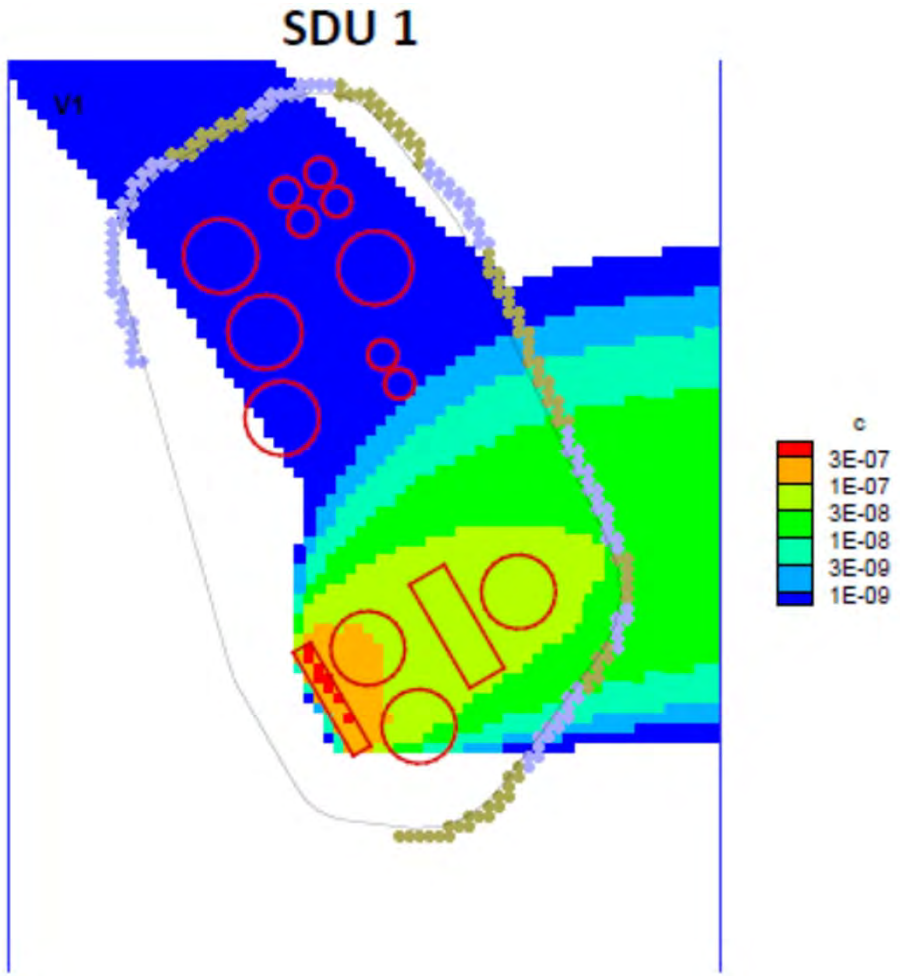


Figure 4
[SDF GSA_2016 Tracer Plume Simulation of Steady-State Sources (Ci/L)]

GSA_2018, SDU 1 [#7]

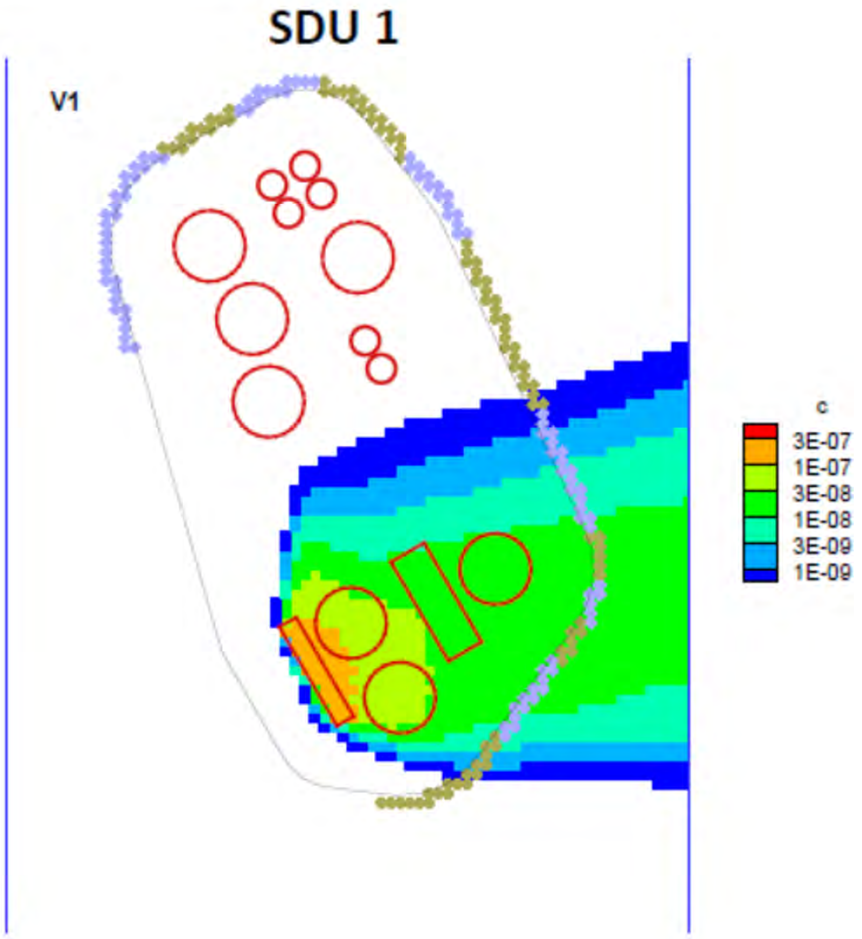
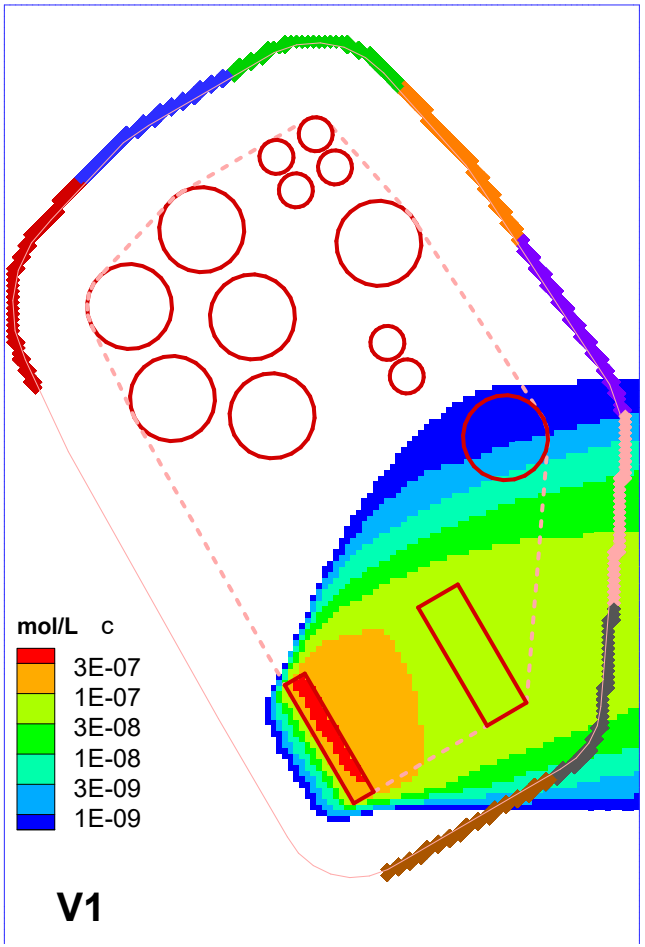


Figure 3
[SDF GSA_2004 Tracer Plume Simulation of Steady-State Sources (Ci/L)]



Unpublished
[SDF GSA_2018 Tracer Plume Simulation of Steady-State Sources (Ci/L)]

SRNL-STI-2017-00445, Rev. 0

SRNL-STI-2017-00445, SDU 6 [#7]

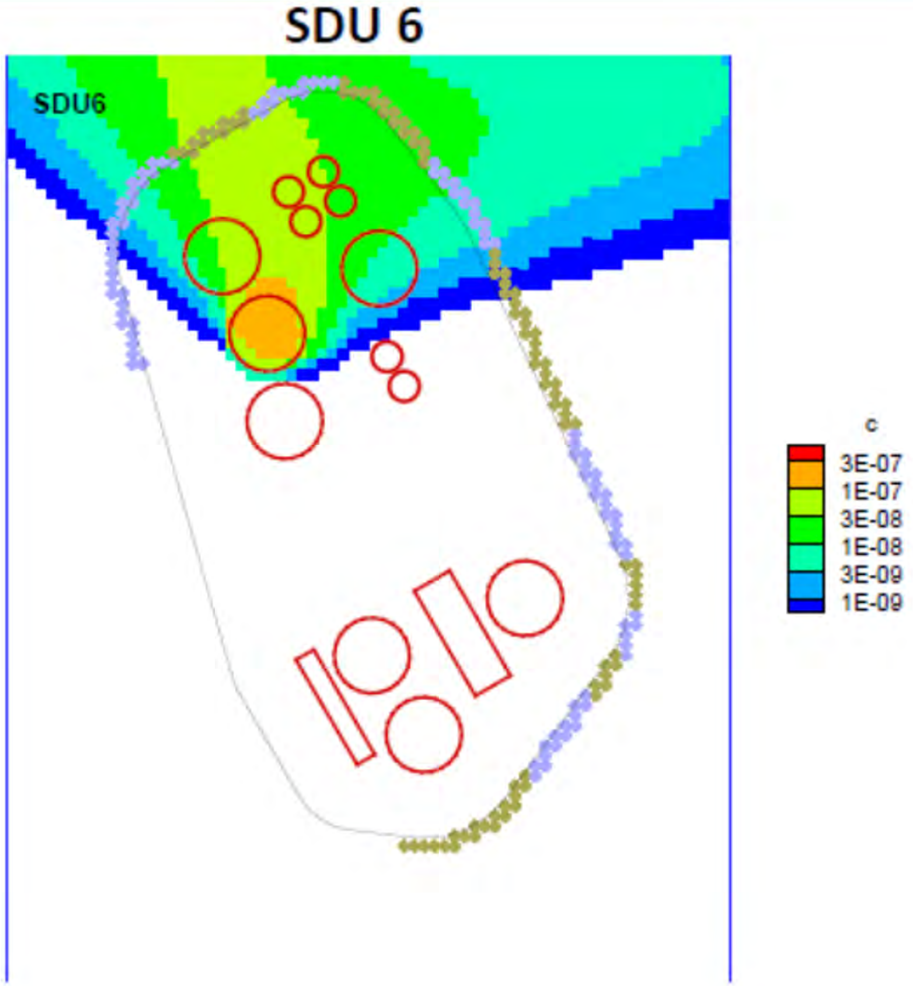


Figure 3
[SDF GSA_2004 Tracer Plume Simulation of Steady-State Sources (Ci/L)]

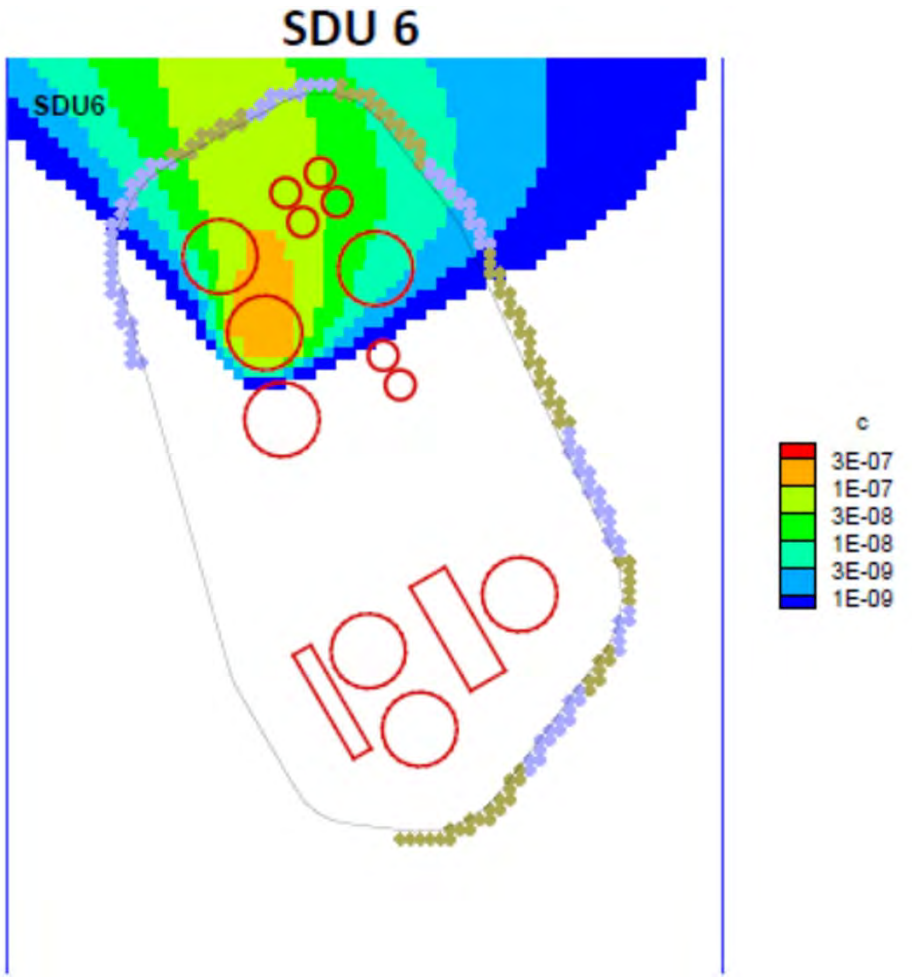


Figure 4
[SDF GSA_2016 Tracer Plume Simulation of Steady-State Sources (Ci/L)]

GSA_2018, SDU 6 [#7]

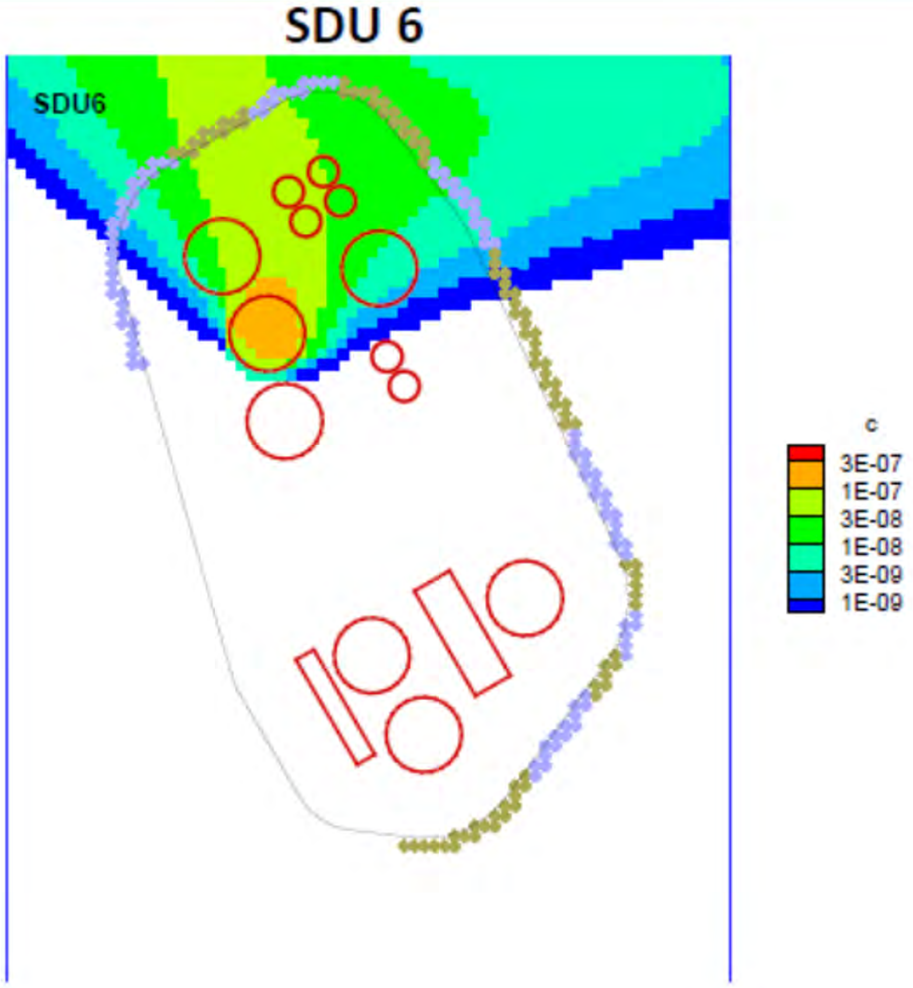
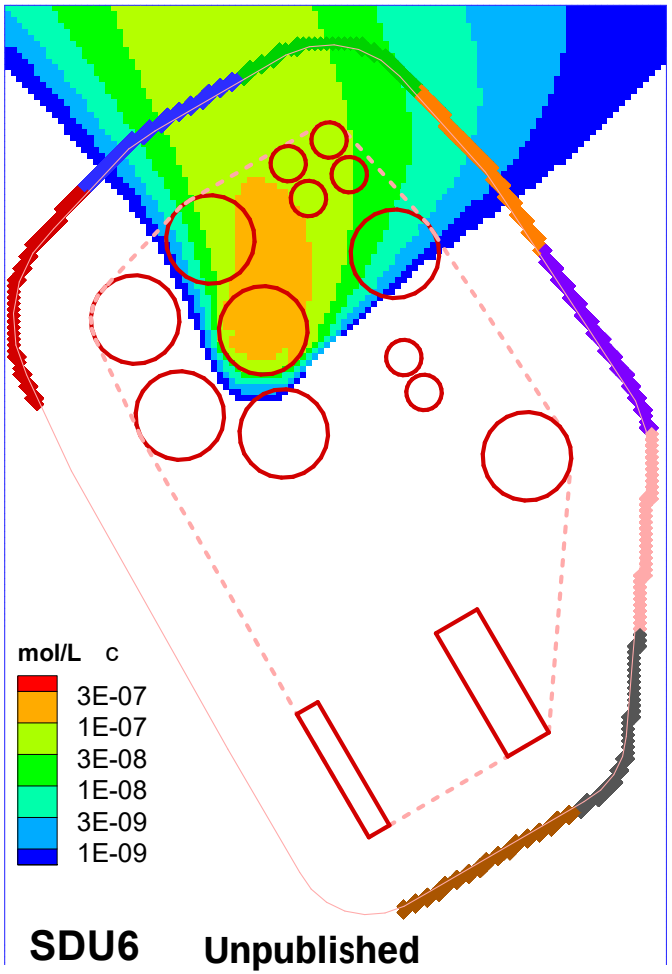


Figure 3
[SDF GSA_2004 Tracer Plume Simulation of Steady-State Sources (Ci/L)]



[SDF GSA_2018 Tracer Plume Simulation of Steady-State Sources (Ci/L)]

SRNL-STI-2017-00445, Rev. 0

SRNL-STI-2017-00445, Figure 5 [#8]

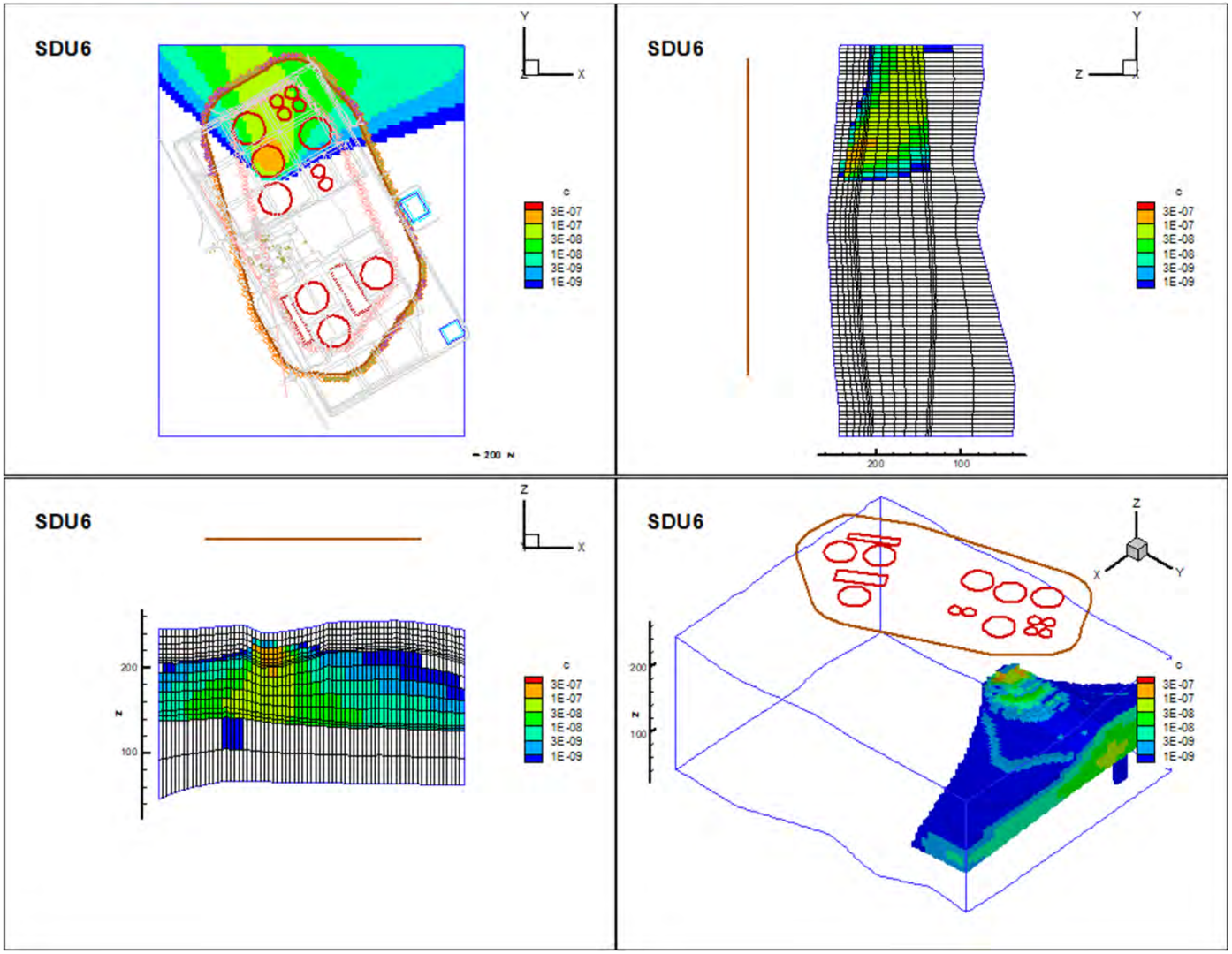


Figure 5 [GSA_2004 Steady-State Plumes for SDU6 (Ci/L)]

SRNL-STI-2017-00445, Rev. 0

SRNL-STI-2017-00445, Figure 6 [#8]

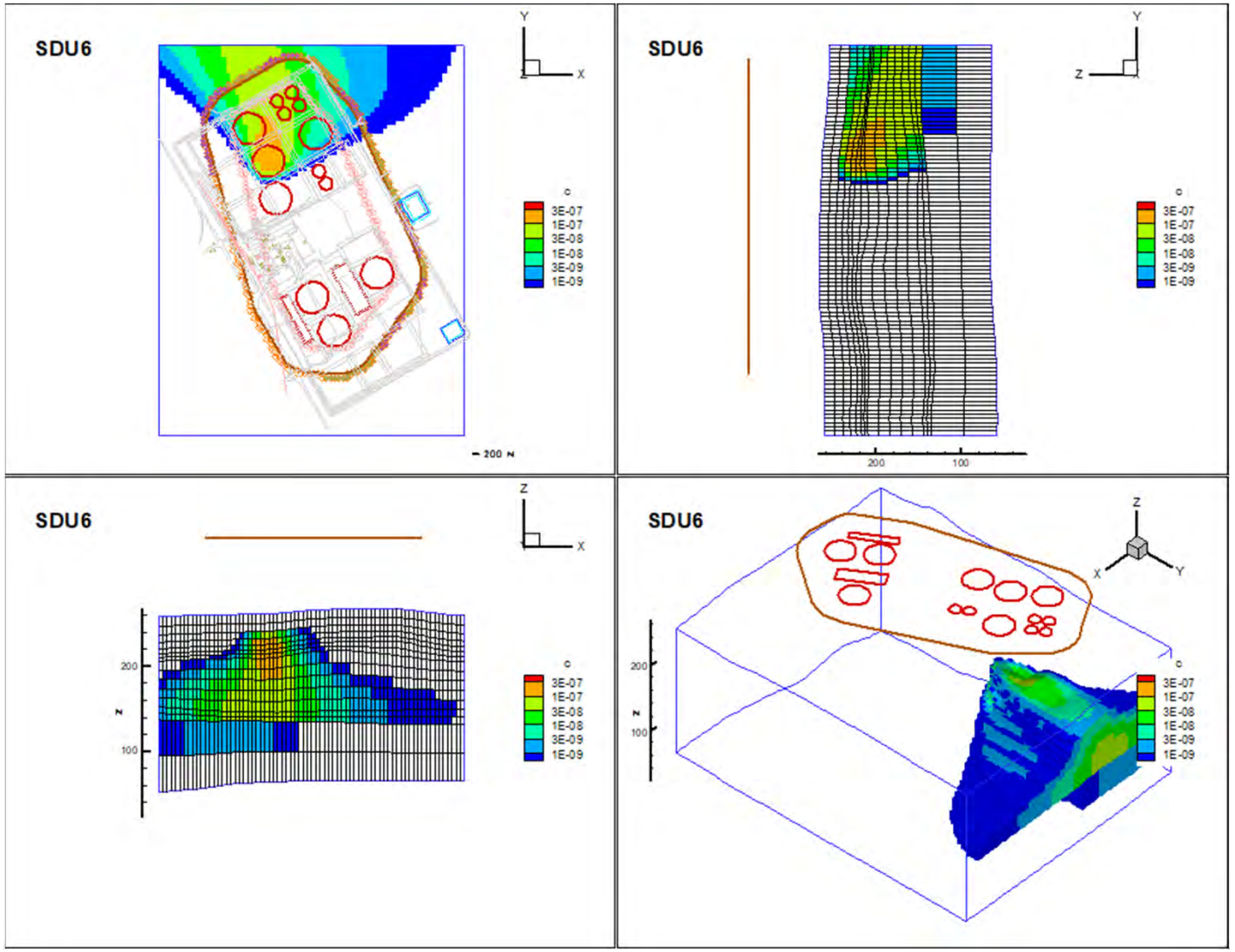
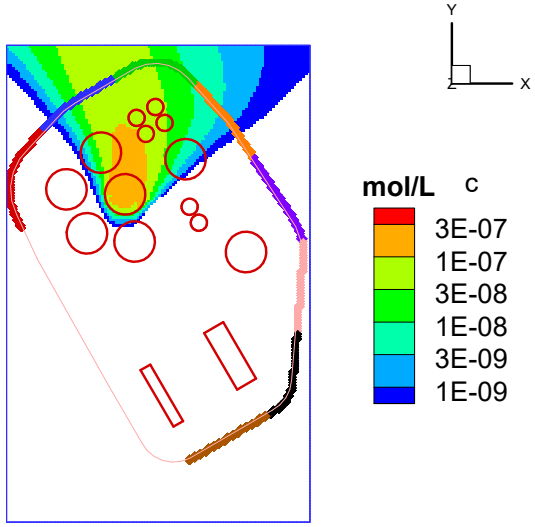


Figure 6 [GSA_2016 Steady-State Plumes for SDU6 (Ci/L)]

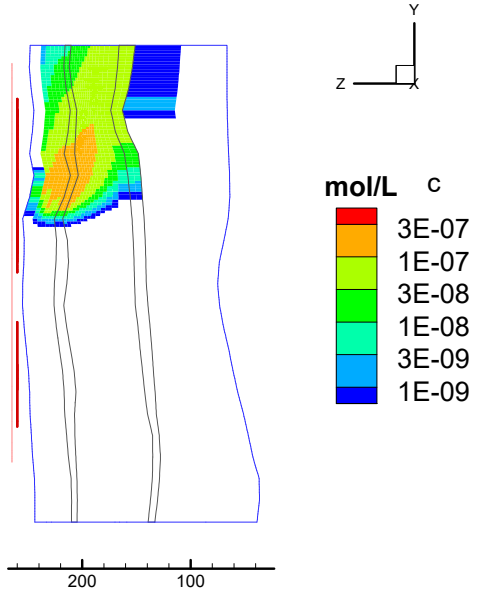
SRNL-STI-2017-00445, Rev. 0

GSA_2018 [#8]

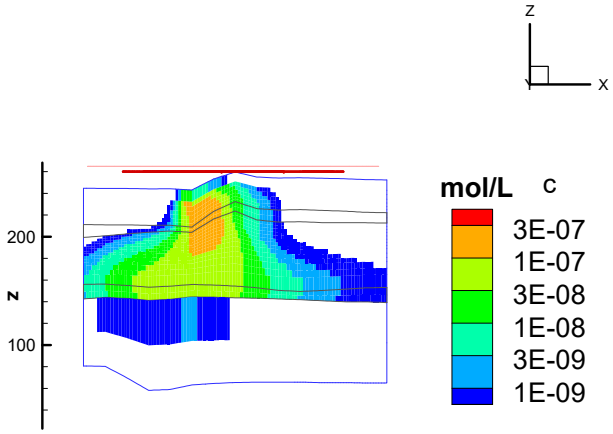
SDU6



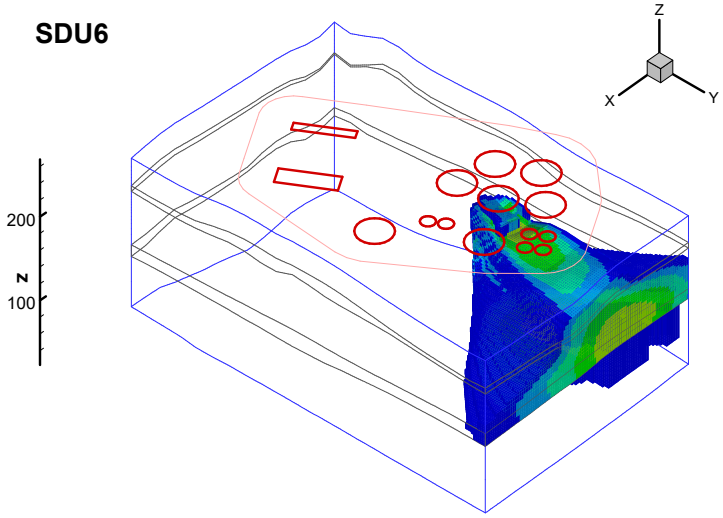
SDU6



SDU6



SDU6



Unpublished

SRNL-STI-2017-00445, Figure 8 [#9]

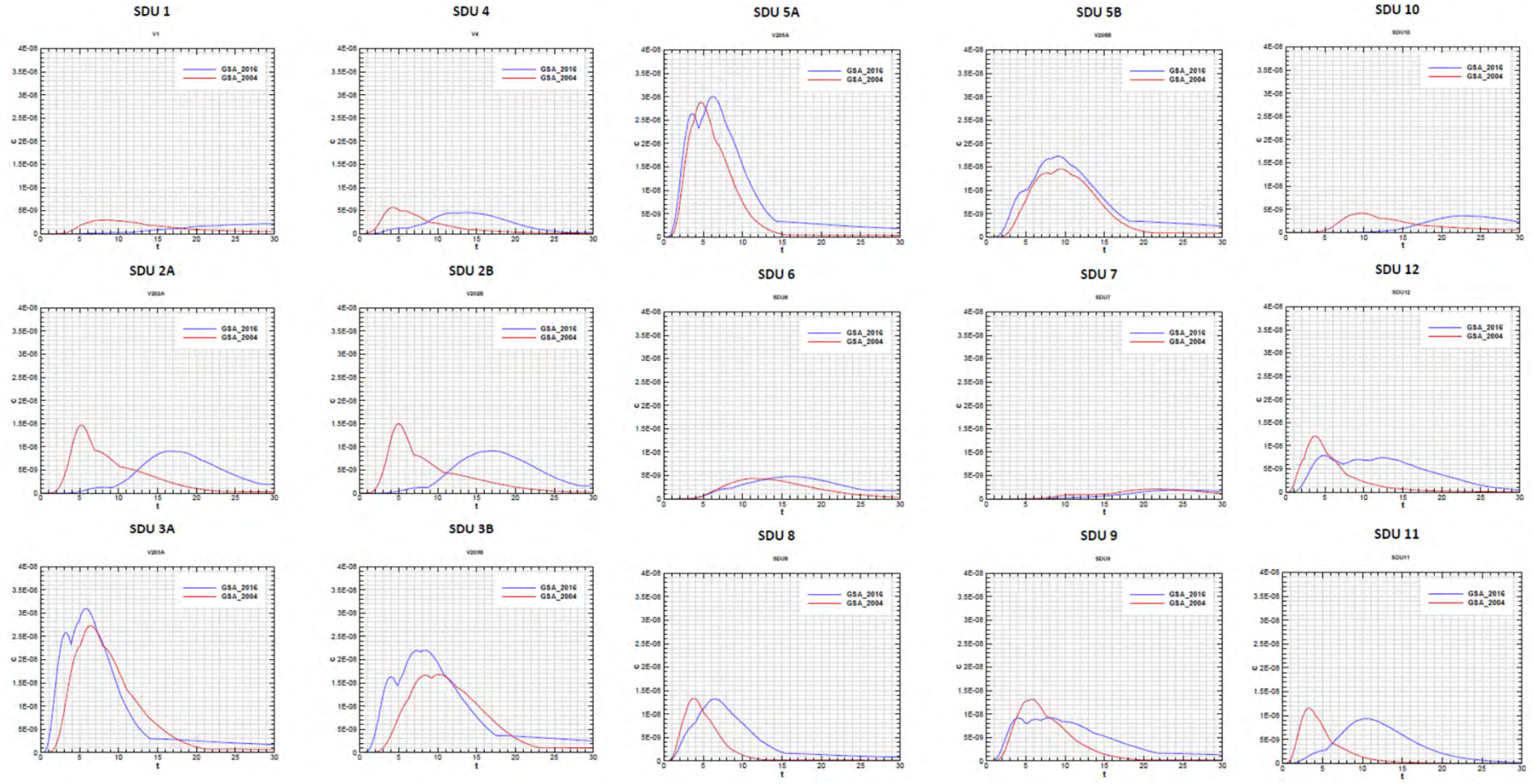
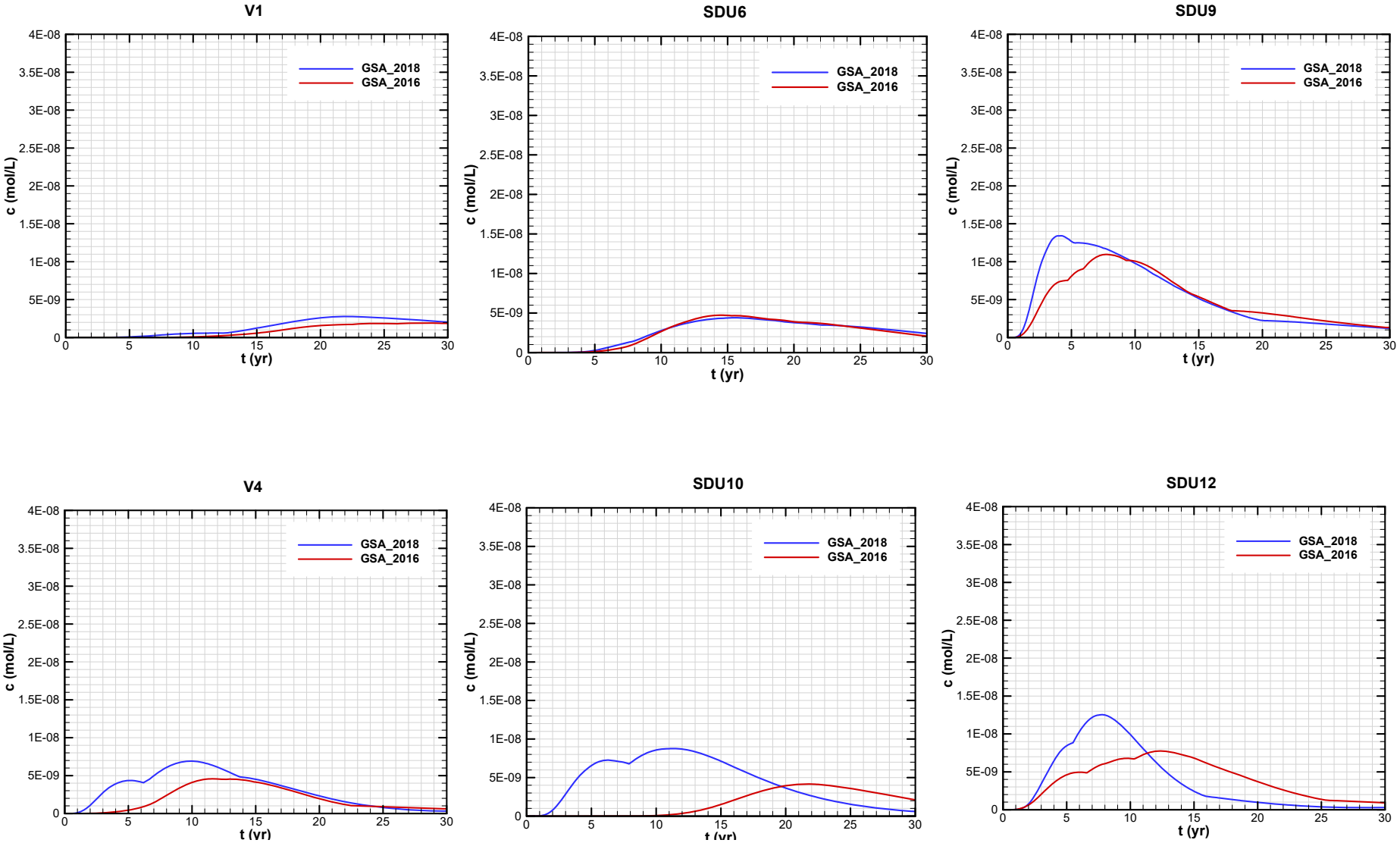


Figure 8 [Comparison of SDF Pulsed Source Concentrations (concentration, C in Ci/L, time, t in years)

GSA_2018 versus GSA_2016 [#9]



Unpublished

SRNL-STI-2017-00445, Figure 10 [#10]

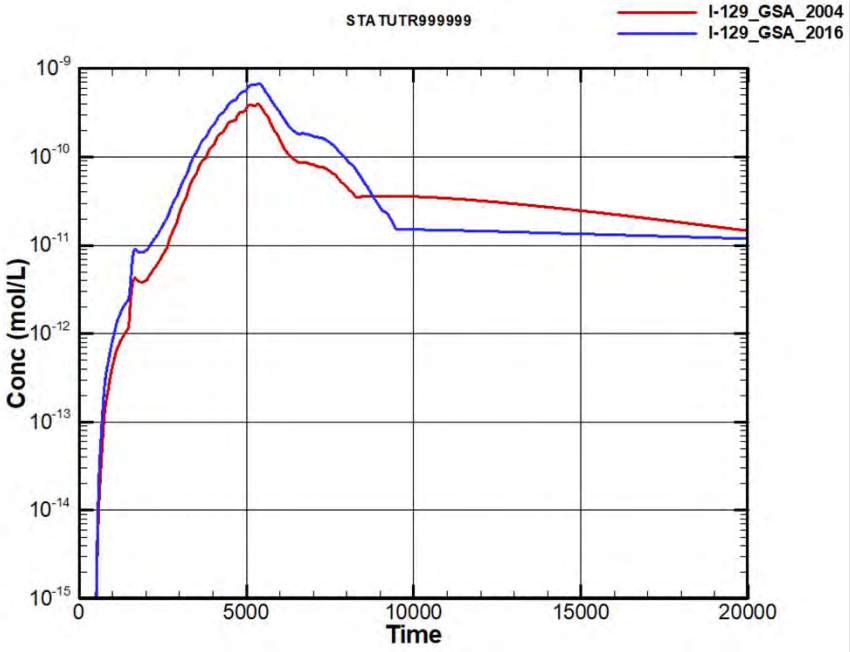
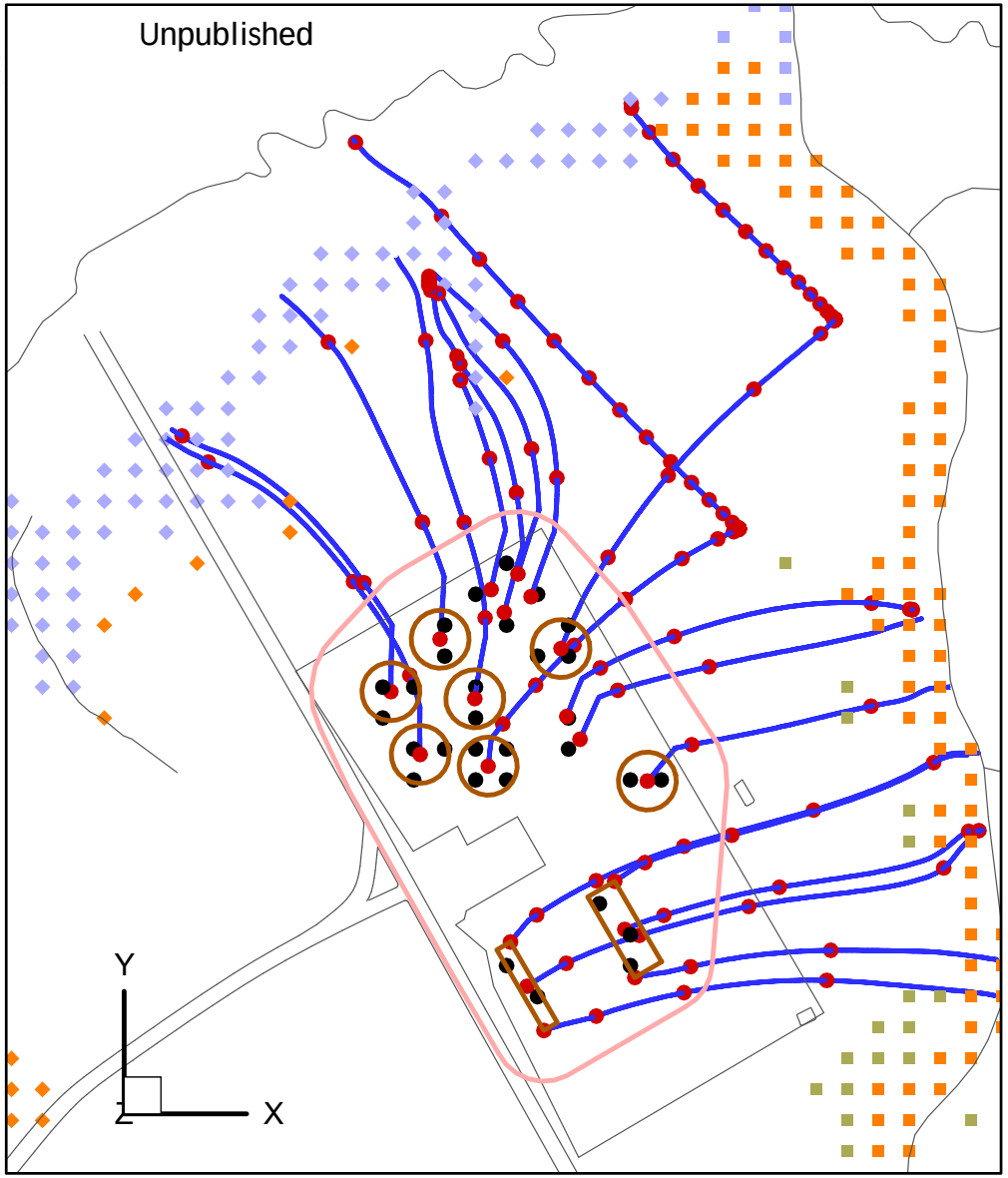


Figure 10 [SDF I-129 Concentrations at the Seepline (Time in years)]

SRNL-STI-2017-00445, Rev. 0



GSA_2016 (SRNL-STI-2017-00008)

Discussion Items regarding SRNL-STI-2017-00008, Rev. 1.

11. **Discussion of the technical basis for subdividing the Upper Aquifer Zone into a Transmissive Zone (TZ) and a combined A and AA zone (AAA). Discussion on the hydrogeologic conceptual models associated with the F-Area seepage basins, Old Burial Ground, and H-Area seepage basins as presented in WSRC 2000, SAIC 2000, and SRNS 2017, including exclusion of H-Area and Z-Area.**
    [Slide 28]
12. **Discussion of technical basis for judging the stream baseflow estimates from 1997 to be adequate for validating an updated GSA groundwater flow model.**
    [Discussion]

Discussion questions provided by NRC via email dated 3/6/2019

Hydrostratigraphy [#11]

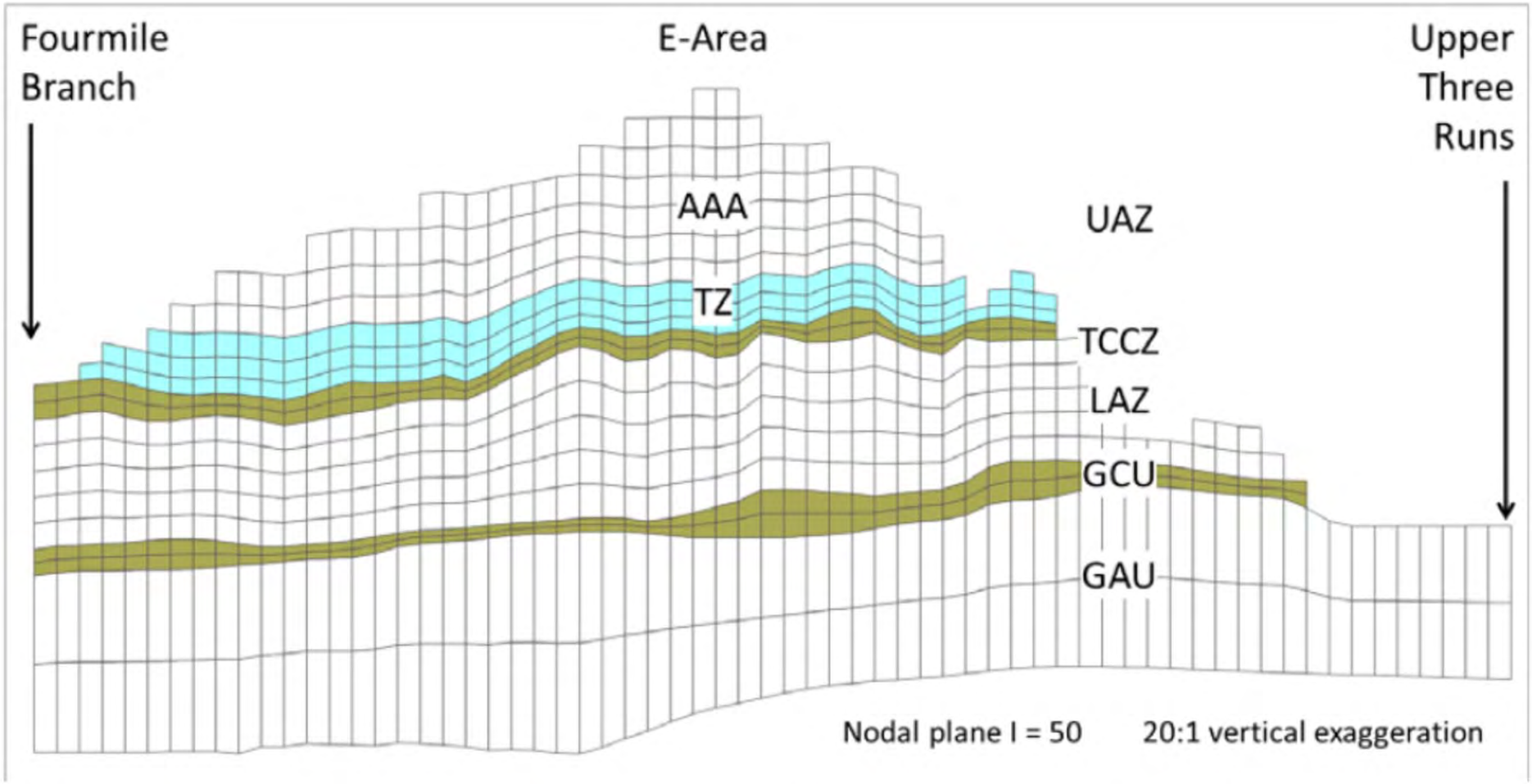


Figure 3-1. Stratigraphy and permeability zones in the GSA2016 computational grid.

SRNL-STI-2017-00008, Rev. 1

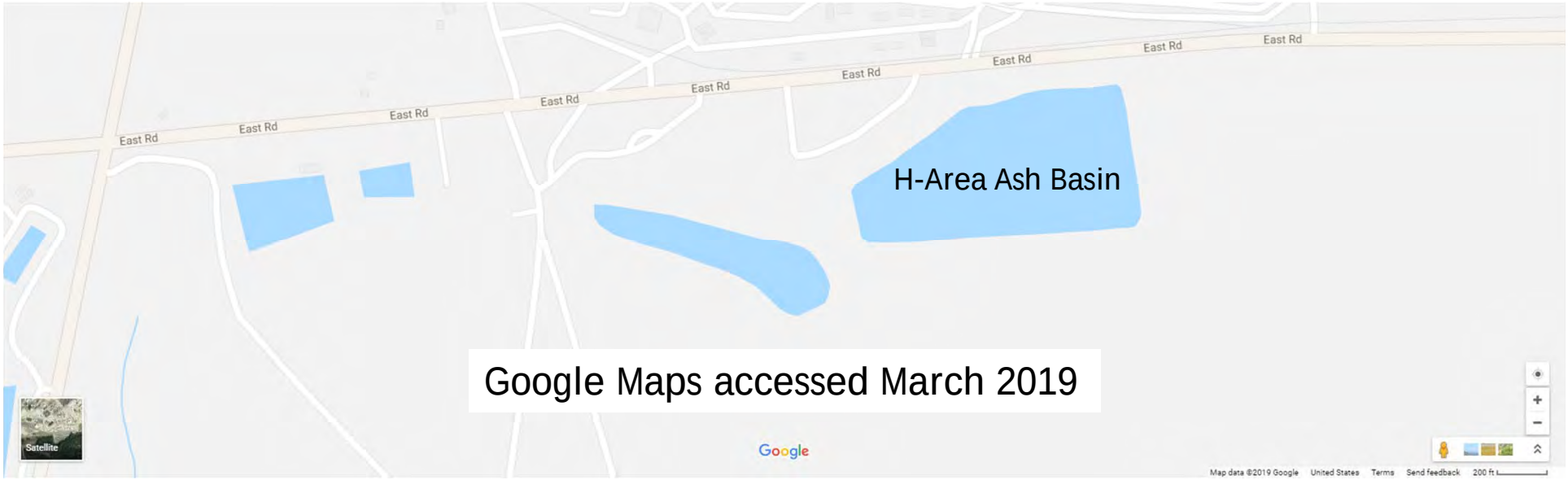
GSA_2018 (SRNL-STI-2018-00643)

Discussion Items regarding SRNL-STI-2018-00643, Rev. 0.

13. **Discussion on H-Area Ash Basin no longer being a source of enhanced infiltration in the groundwater flow model.**
    [Slide 30]
14. **Discussion of unsaturated flow paths as presented in Figures 3-2 thru 3-5.**
    [Slides 31-34]
15. **Can a velocity field figure be generated and provided from the 2018 GSA model, similar to that shown in WSRC-TR-2004-00106 Figure 2-8, but with an orientation that is perpendicular to that shown in Figure 2-8?**
    [Slides 35-36]

Discussion questions provided by NRC via email dated 3/6/2019

H-Area Ash Basin [#13]



SRNL-STI-2018-00643 Figure 3-2 [#14]

Figure 3-2. Simulated groundwater pathlines for GSA_2016 model prior to placement of low-infiltration covers.

SRNL-STI-2018-00643 Figure 3-3 [#14]

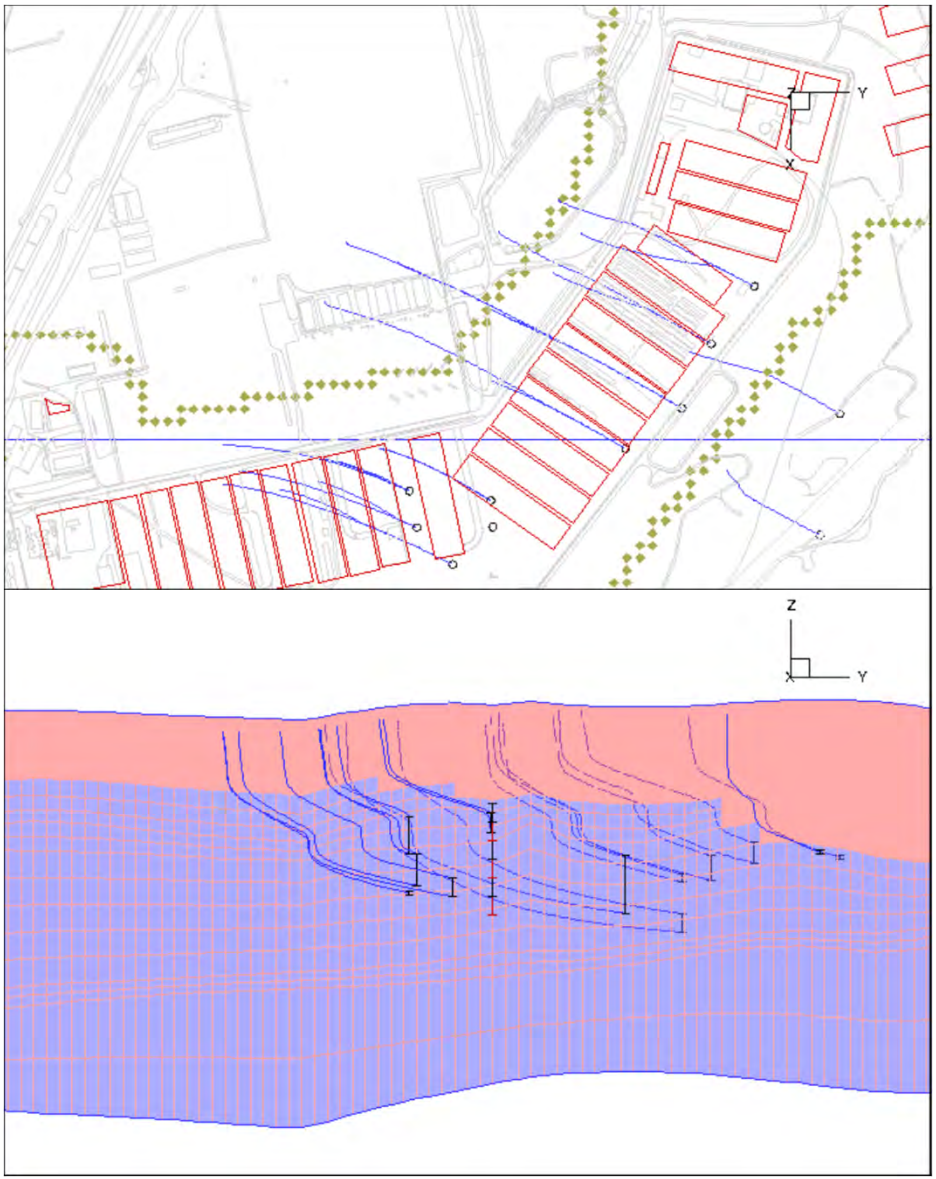


Figure 3-3. Simulated groundwater pathlines for GSA_2016 model after placement of low-infiltration covers.

SRNL-STI-2018-00643 Figure 3-4 [#14]

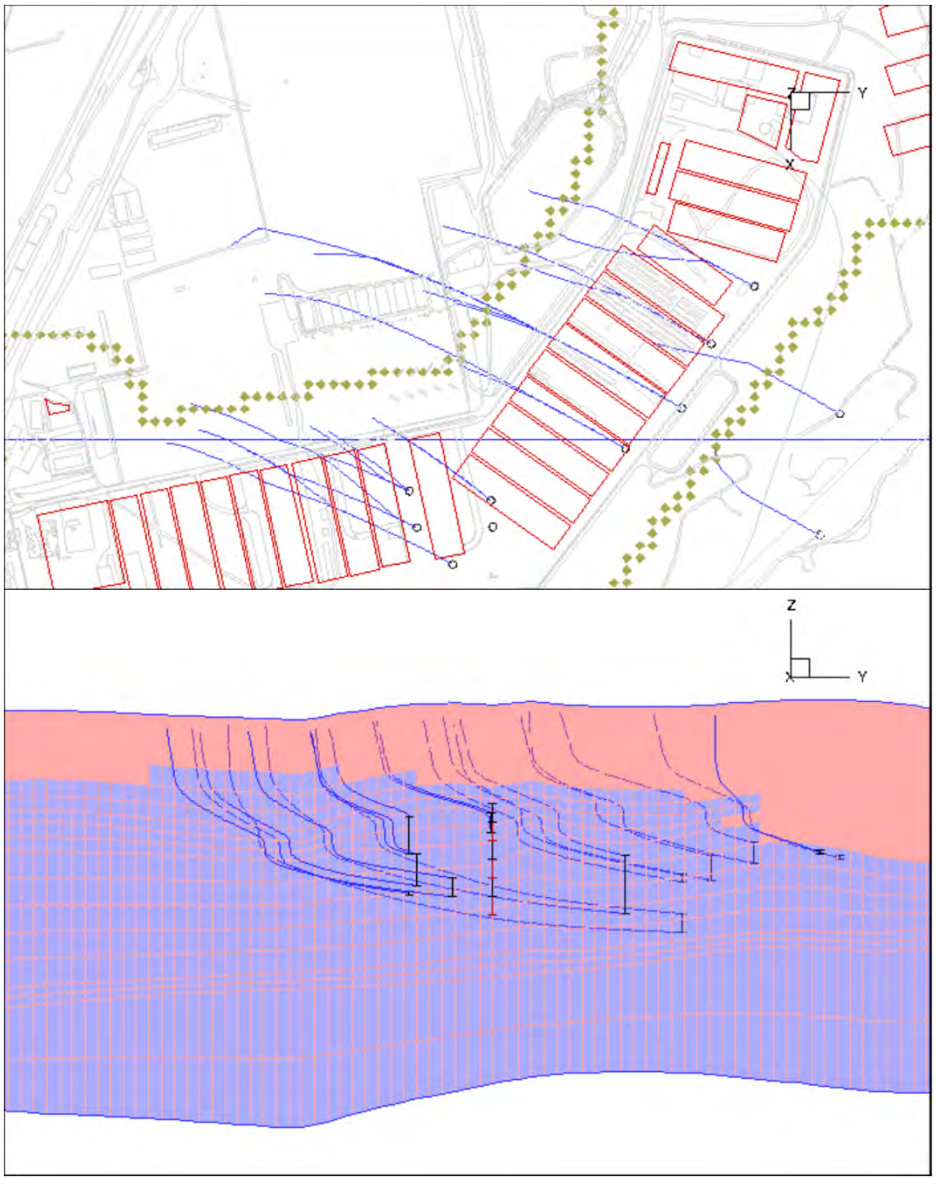


Figure 3-4. Simulated groundwater pathlines for GSA_2018 model prior to placement of low-infiltration covers.

SRNL-STI-2018-00643 Figure 3-5 [#14]

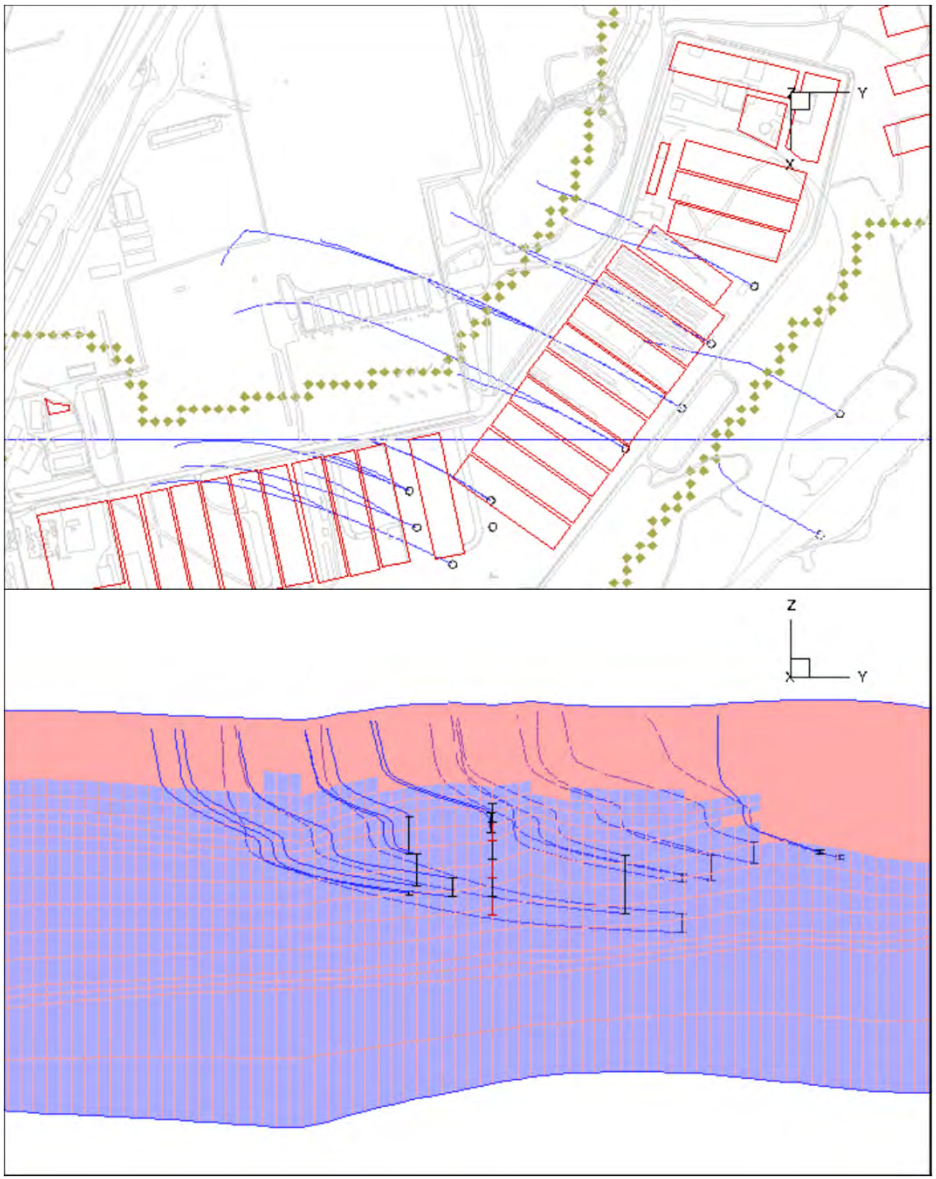


Figure 3-5. Simulated groundwater pathlines for GSA_2018 model after placement of low-infiltration covers.

WSRC-TR-2004-00106 Figure 2-8 [#15]

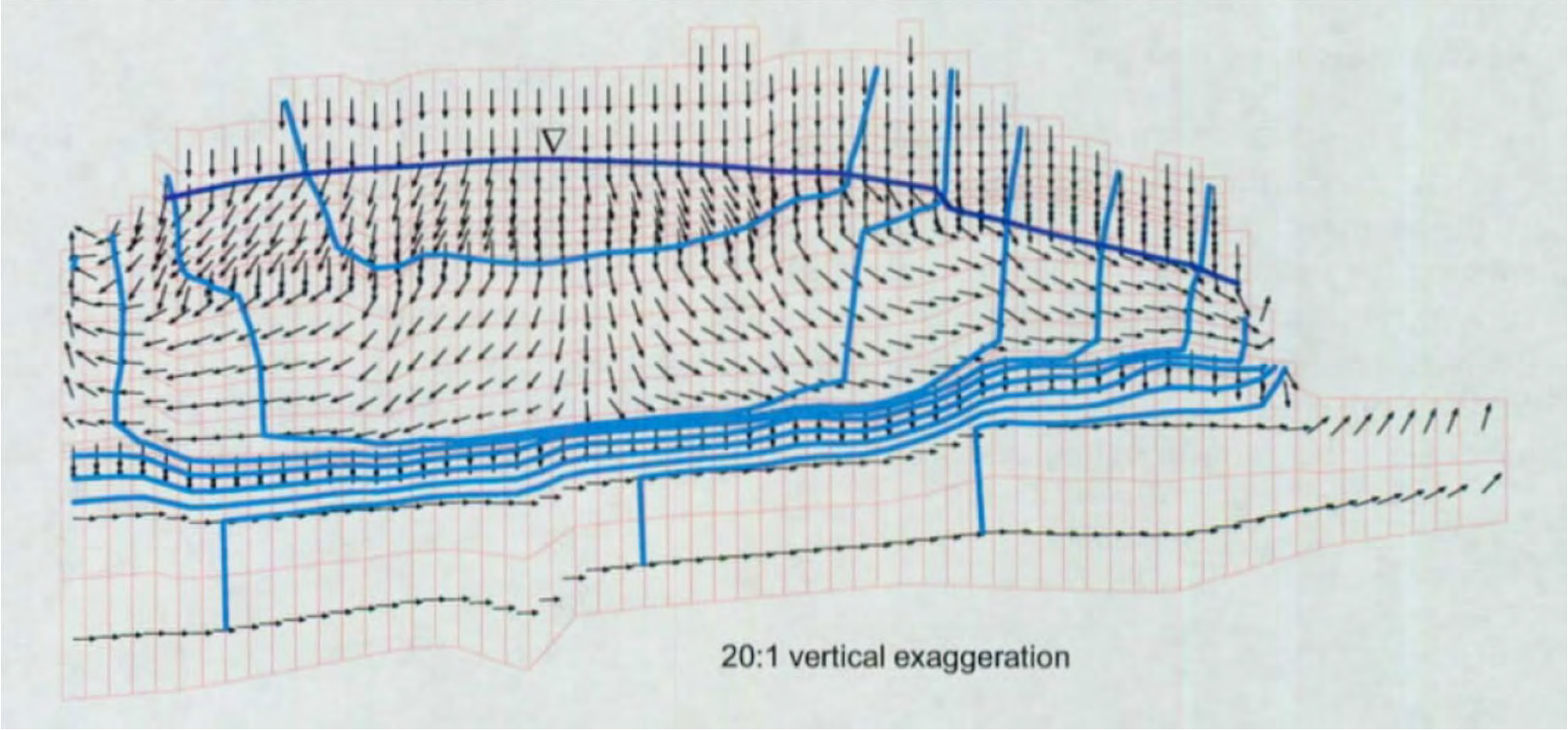
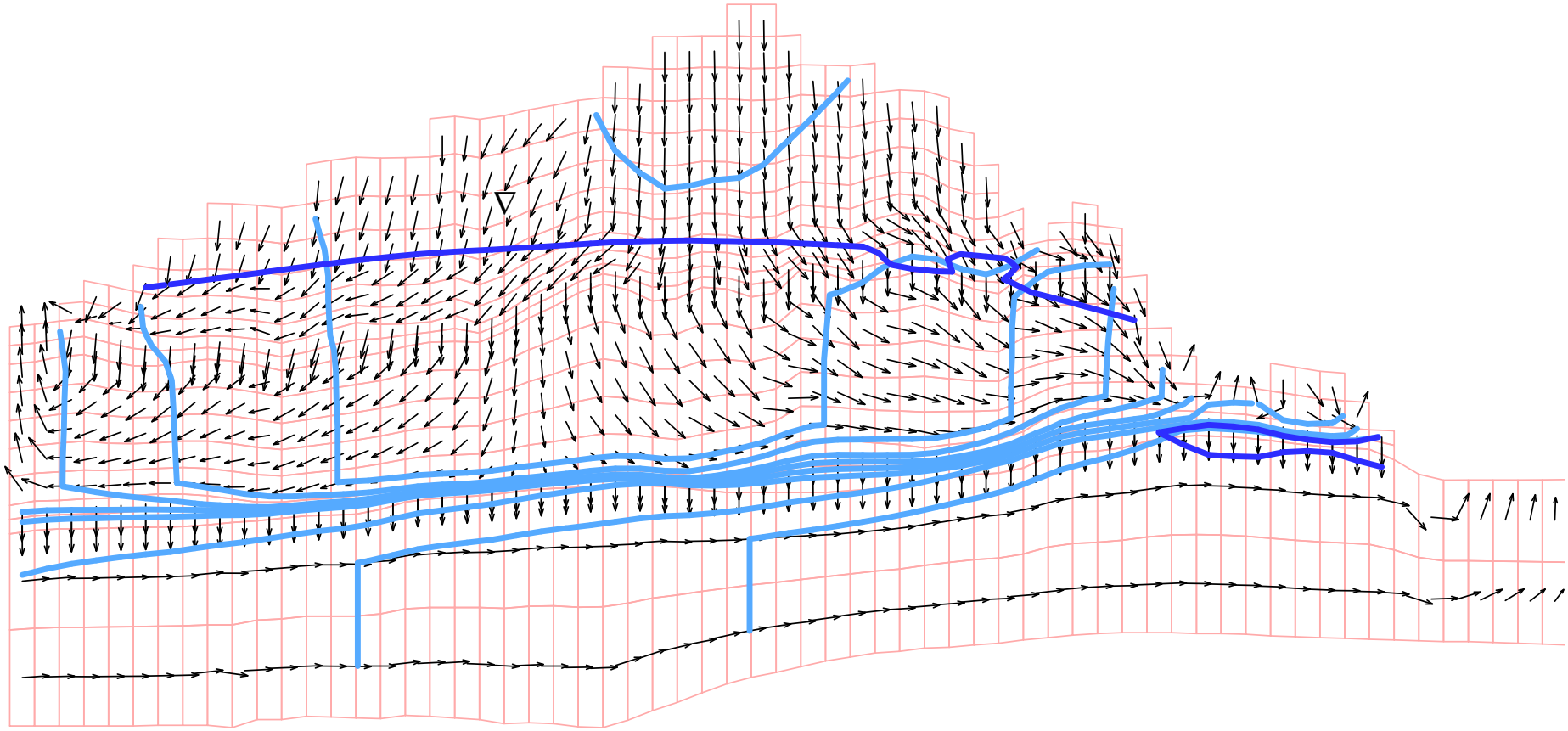


Figure 2-8. Example velocity field showing predominantly downward flow in the vadose zone; vectors are fixed length showing flow direction only.

GSA_2018 Update [#15]

Same grid index as Slide 35, but shifted physical location



20:1 vertical exaggeration

Unpublished

References

- **SRNL-STI-2015-00351, Hiergesell, R. A., Taylor, G. A., Phifer, M. A., Whiteside, T. S., and Flach, G. P.** *General Separations Areas Groundwater Model Calibration Targets*, **Rev. 0, August 2015.**
- **SRNL-STI-2016-00516, Bagwell, L. A., P. L. Bennett and G. P. Flach.** *General Separations Area (GSA) Groundwater Flow Model Update: Hydrostratigraphic Data,* **Rev. 0, February 2017.**
- **SRNL-STI-2017-00008, Flach, G.P., Bagwell, L.A., and Bennett, P.L.,** *Groundwater Flow Simulation of the Savannah River Site General Separations Area*, **Rev. 1, September 7, 2017.**
- **SRNL-STI-2017-00445, Flach, G.P and Hang, T.H.,** *Impacts of Updated GSA Groundwater Flow Model on the FTF, HTF and SDF PAs*, **Rev. 0, September 2017.**
- **SRNL-STI-2018-00336, Wohlwend, J. L.,** *Updated General Separations Areas (GSA) Groundwater Model Calibration Targets*, **Rev. 0, July 2018.**
- **SRNL-STI-2018-00643, Flach, G.P,** *Updated Groundwater Flow Simulations of the Savannah River Site General Separations Area*, **Rev. 0, January 15, 2019.**
- **WSRC-TR-96-0399, Flach, G. P. and M. K. Harris.** *Integrated Hydrogeological Model of the General Separations Area (U); Volume 2: Groundwater Flow Model (U)*, **Rev. 1. 1999.**
- **WSRC-TR-2004-00106, Flach, G. P.** *Groundwater Flow Model of the General Separations Area Using PORFLOW (U)*, **Rev. 0. July 2004.**

Notes

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