Savannah River Remediation
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We do the right thing.

Savannah River Site F-Tank Farm
NRC Onsite Observation Visit
Follow-up Discussions
Waste Tank Mapping Methodology

May 15, 2013

SRR-CWDA-2013-00072

Mapping

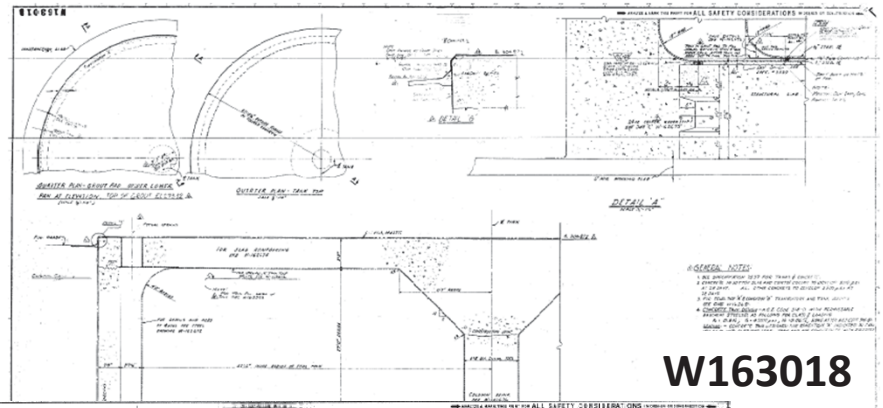
- Performed by a team of mappers after the residual liquid has evaporated.
- A mapping team for final mapping is typically three people representing the Inspection and Monitoring Group, Closure Engineering, and Closure and Waste Disposal Authority.
- Uses high definition digital photographs and video footage (typically, during the sampling process).
- Mapping is performed using a HD TV screen with photo enhancement software.
- Tank landmarks and sample equipment landmarks are used as references to determine the material height.

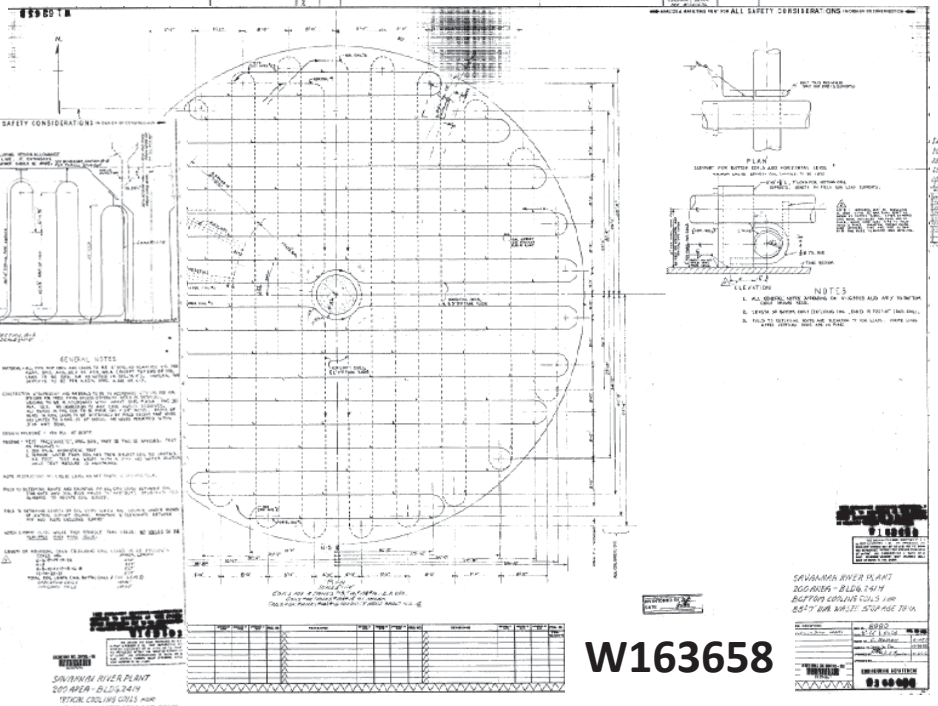
High Definition Digital Photo

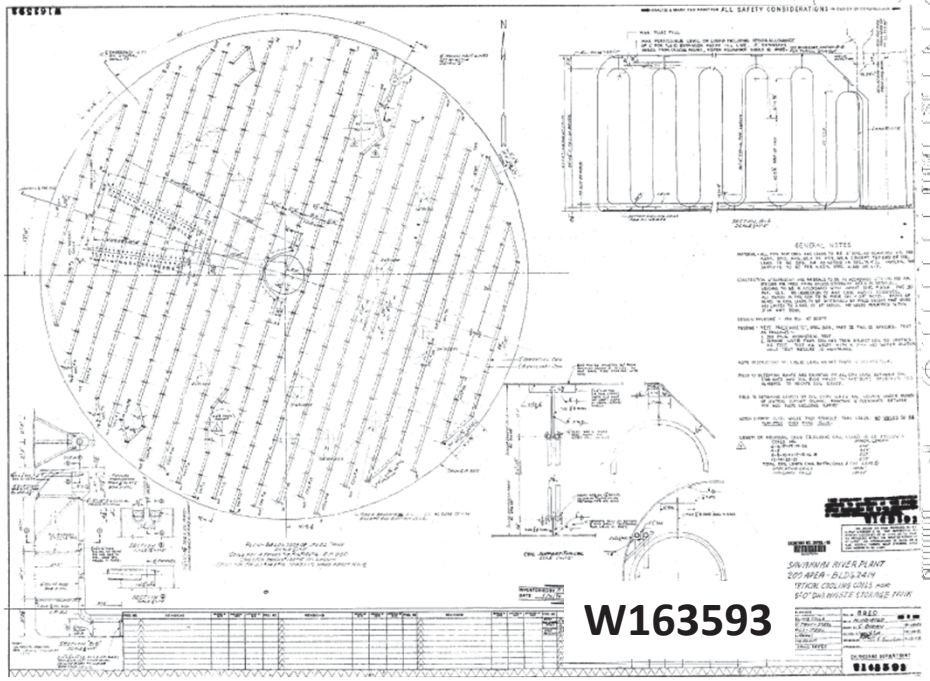
Still photo from crawler camera video

Mapping - Preparation

- Gather mapping landmark reference drawings/documentation.

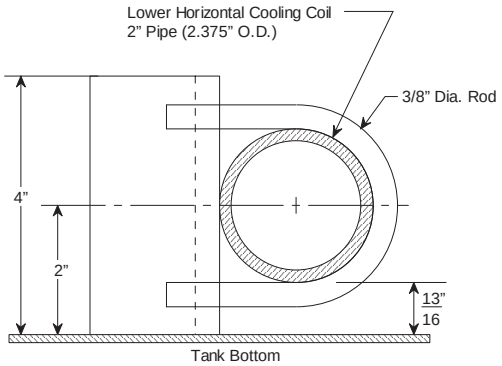


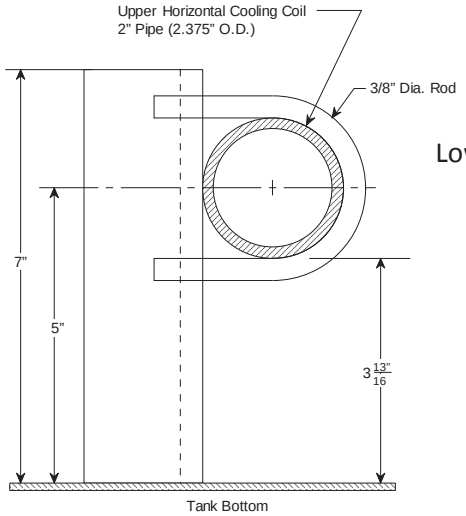




Mapping - Preparation

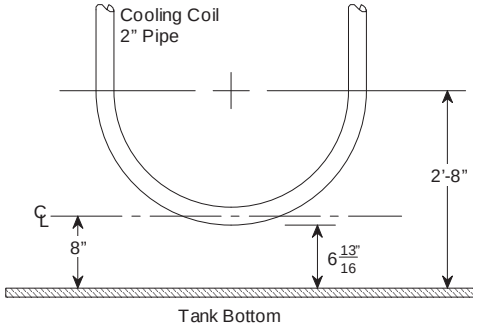
Landmark - Examples





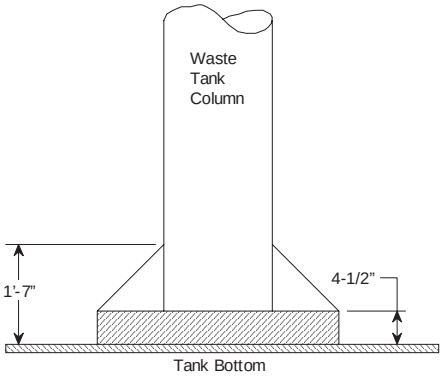
Lower and Upper Horizontal Coils

Ref: D116001, Rev. 10



Vertical Coil

Ref: D116048, Rev. 37



Lower Column Details

Ref: BPF 201143, Sheet 8

W145379, Rev. 2

Mapping - Preparation

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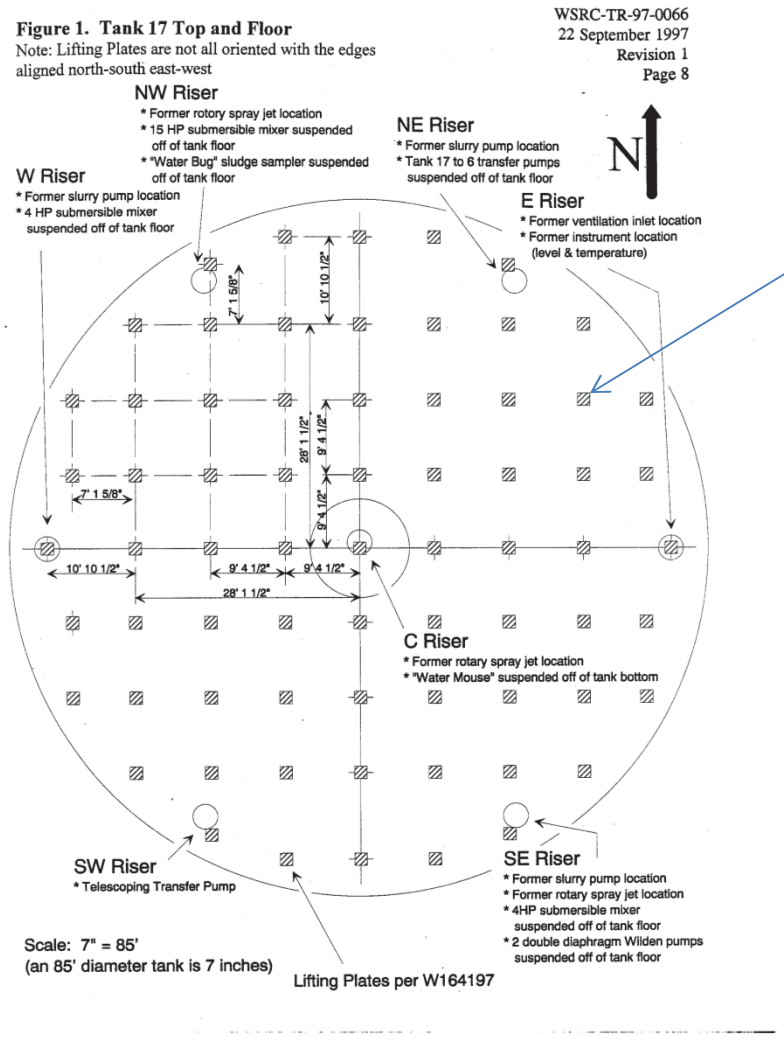
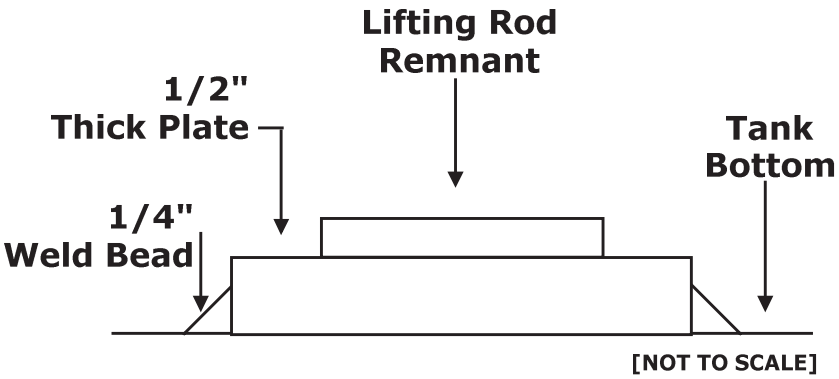
Landmarks

Examples

Lifting Plate

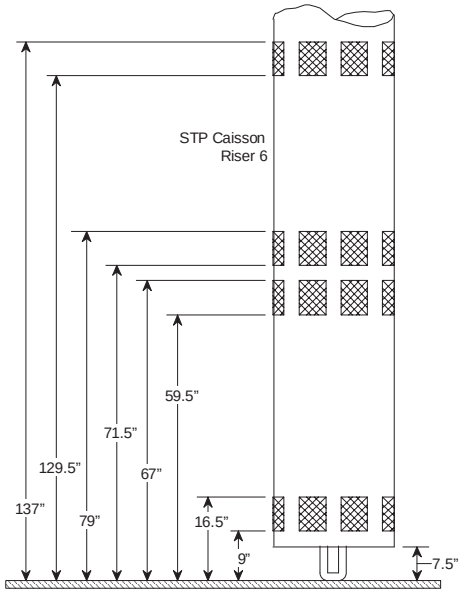




Mapping - Preparation

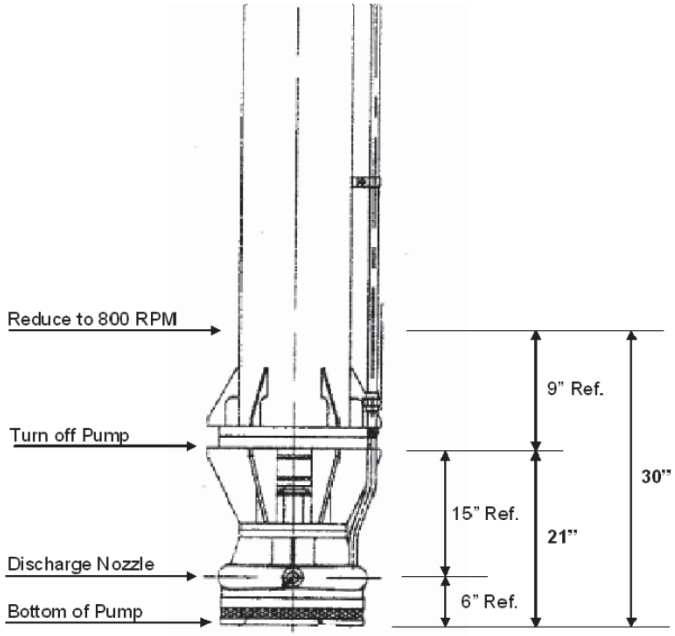
Waste Removal Equipment Landmarks

Examples



Caisson

Ref: P-PA-F-3480, Rev. 1



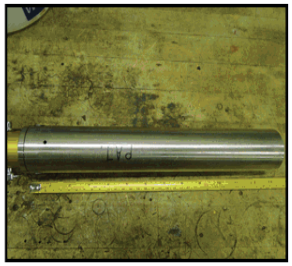
Standard Slurry Pump

Ref: AB16788C

Mapping - Preparation

- Obtain measurements of sample tool/crawler features to use as landmarks to support mapping.

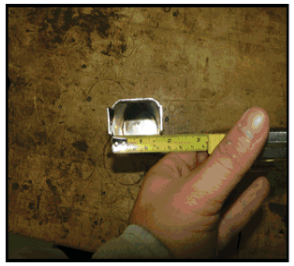
Sample Equipment Landmarks - Examples



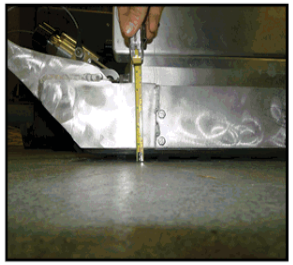
Core Sampler

Scrape Sampler Cup

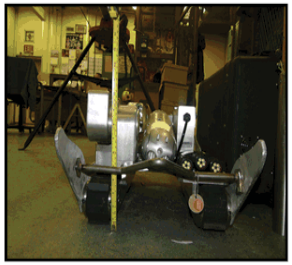
Cup Diameter 1



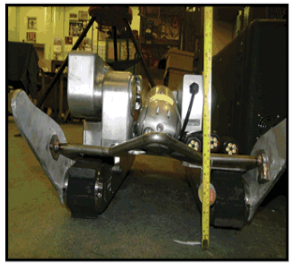
Cup Diameter 2



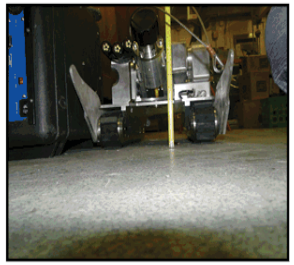
Crawler



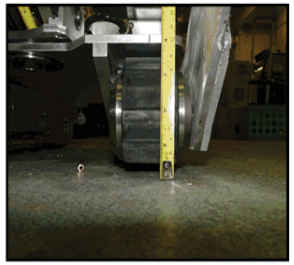
Crawler Front 1



Crawler Front 2



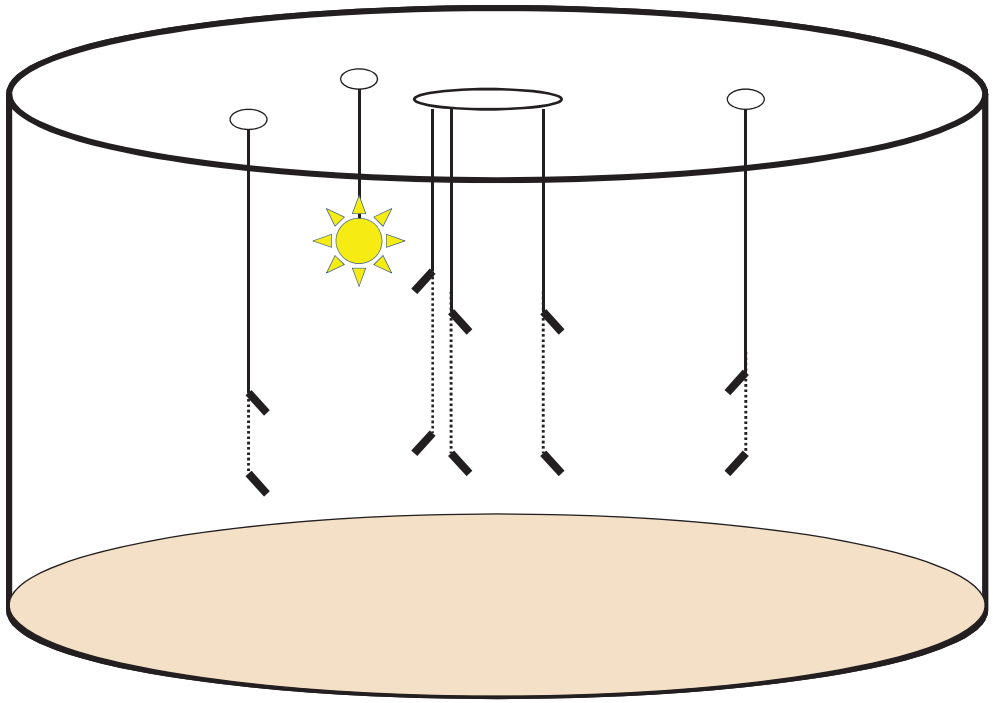
Crawler Back 1



Crawler Back 2

Final Mapping - Preparation

- Participate in the selection of camera and light locations for high definition digital photography. Mappers have the opportunity to provide input to the inspection plan.
- Observe high definition digital photographing activities, as needed, to confirm adequacy of photo and coverage.
- As needed, include photographs of the walls and internal surfaces in addition to floor.



Final Mapping - Methodology

- Establish material height criteria.

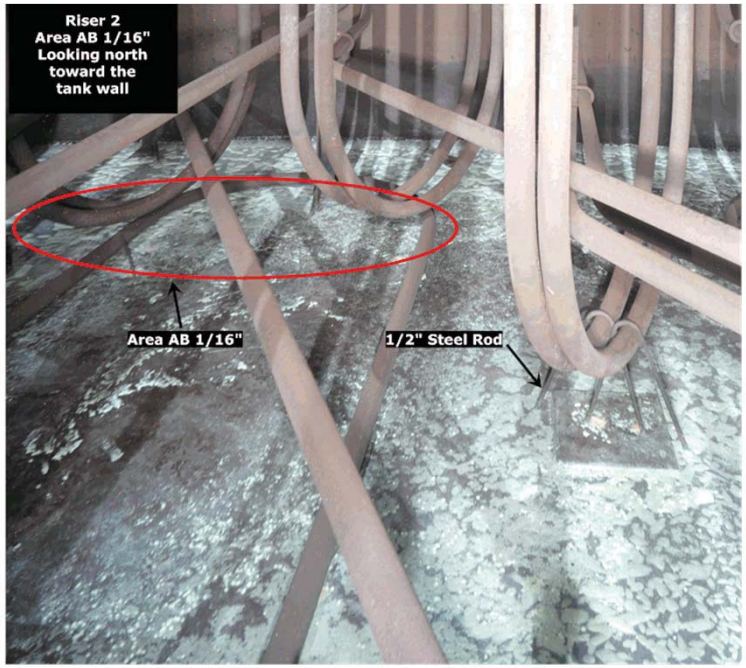
Type IV Tank (example)

Material height (Inches)	Criteria
1/8	Dusting of Solids evident with some clean steel floor visible.
1/4	Sides of lifting plate visible. Solids are mostly well below the top of lifting plate.
1/2	The shape of the lifting plate is clearly visible but the material appears to be the same height as the top of the lifting plate.
3/4	Shape of lifting plate can be discerned through solids.

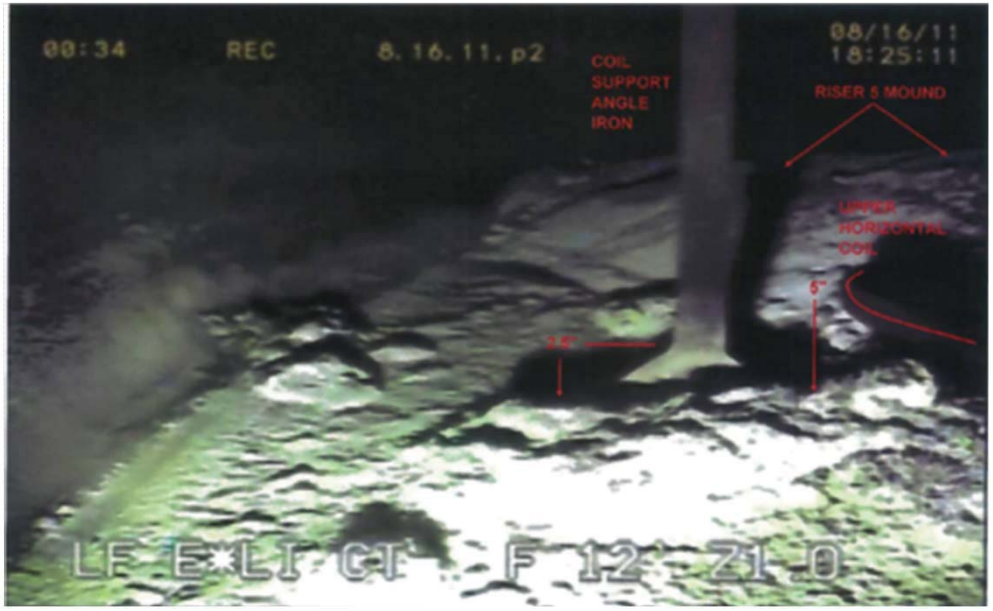
Mapping - Methodology

- Review high definition digital photographs and video (typically from sampling) on high definition large screen with enhancement software.
  - Someone experienced with the photo enhancement software (typically the representative from the Inspection and Monitoring group) should make adjustments (color, brightness, contracts, etc.) for the best view.

Example of enhanced digital photo

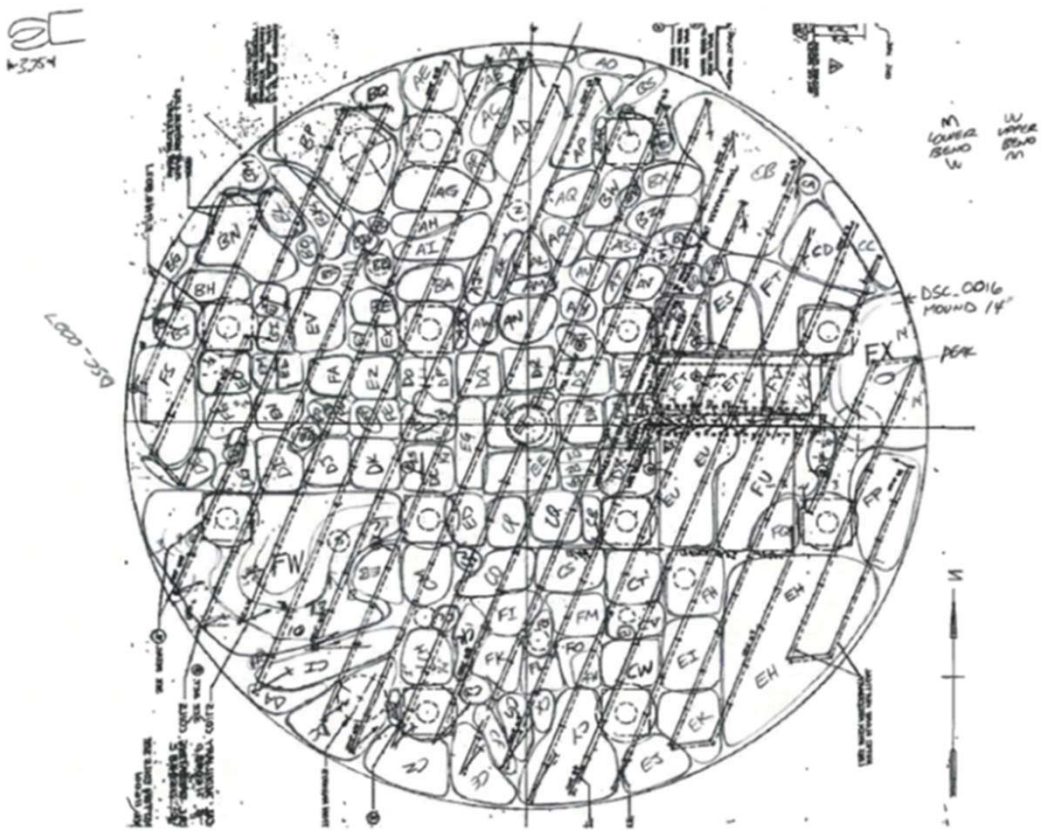


Example of a still shot from sampling video



Mapping - Methodology

- Draw sketch and record best estimate material height data.
- Reference photograph number/video date/time.
- Reach consensus.



Mapping - Methodology

- Best estimate for solids height –
  - Not intended to be conservative (high value) or non-conservative (low value).
  - It is intended to be the height value that reflects the mapping team's true belief based on the information available.

Mapping - Methodology

- Record photograph number or video date/time for the basis of solids heights in each region.

Hand-written data

Hand-written data converted to table for report.

Area	Residual Material Height (inch)	Reference Photo/Video
FG	2" - 1/8"	P1123734 (C)
FH	1/8"	P1123724 (C)
FI	1/8"	P1123727 (C)
FJ	1/8"	P1123727 (C)
FK	1/8"	P1123727 (C)
FL	1/8"	P1123727 (C)
FM	1/8"	P1123727 (C)
FN	1/4"	P1123727 (C)
FO	1/8"	P1123727 (C)
FP	1/8"	P1123724 (R7)
FQ	1/8"	P1123724 (R7)
FR	VARIES	Sample Crawler Video: Job 3 on 8/16/11 video 21-18-31
FS	1/8"	Riser 5 Inspection Video on 9/1/11
FT	1/4"	P1123619 (R2)
FV	1/4"	P1123721 (C)
FW	VARIES	Sample Crawler Videos: Job 3 on 8/16/11 video 21-18-31; Job 5 on 8/17/11 video 00-20-46
		Riser 5 Inspection Video on 9/1/11
FX	VARIES	Sample Crawler Videos: Job 7 on 8/17/11 video 16-09-30; Job 20 8/29/11 video 10-56-36

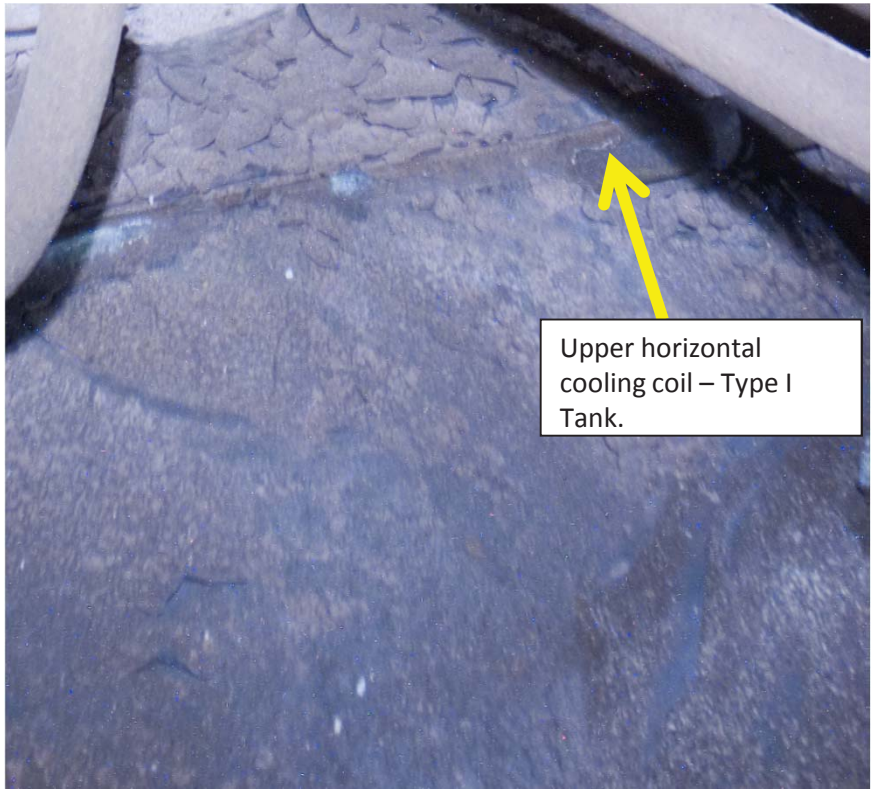
Mapping - Methodology

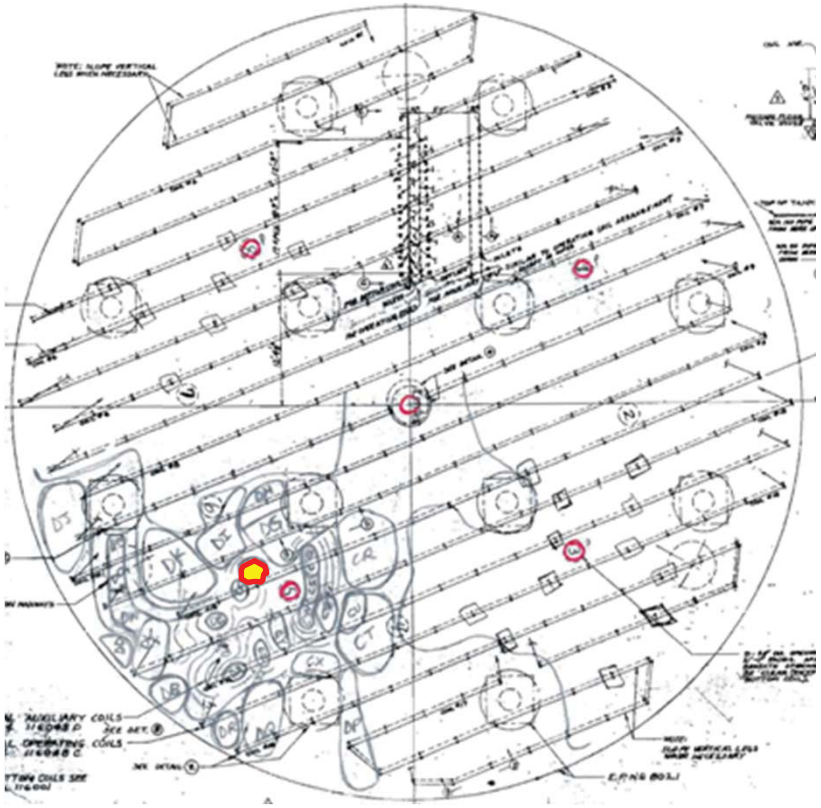
- Determine uncertainty in material heights.
  - Assign low end and high end material heights by regions with the same height.
  - Low end values are the lowest possible reasonable material height.
  - High end value are the highest possible reasonable material height.

Example

Best Estimate Height (in)	High Estimate (in)	Low Estimate (in)
1/32	1/16	1/32
1/16	1/8	1/16
1/8	1/4	1/16
1/4	1/2	1/8
1/2	1.0	1/8
3/4	1.5	1/4
1.0 – 5.0	+1/2 (1.5 – 5.5)	-1/2 (.5 – 4.5)
6.0 – 10.0	+2.0 (8 – 12)	-2.0 (4 - 8)
10.0 – 13.0	+2.0 (12 – 15)	-2.0 (8 – 11)

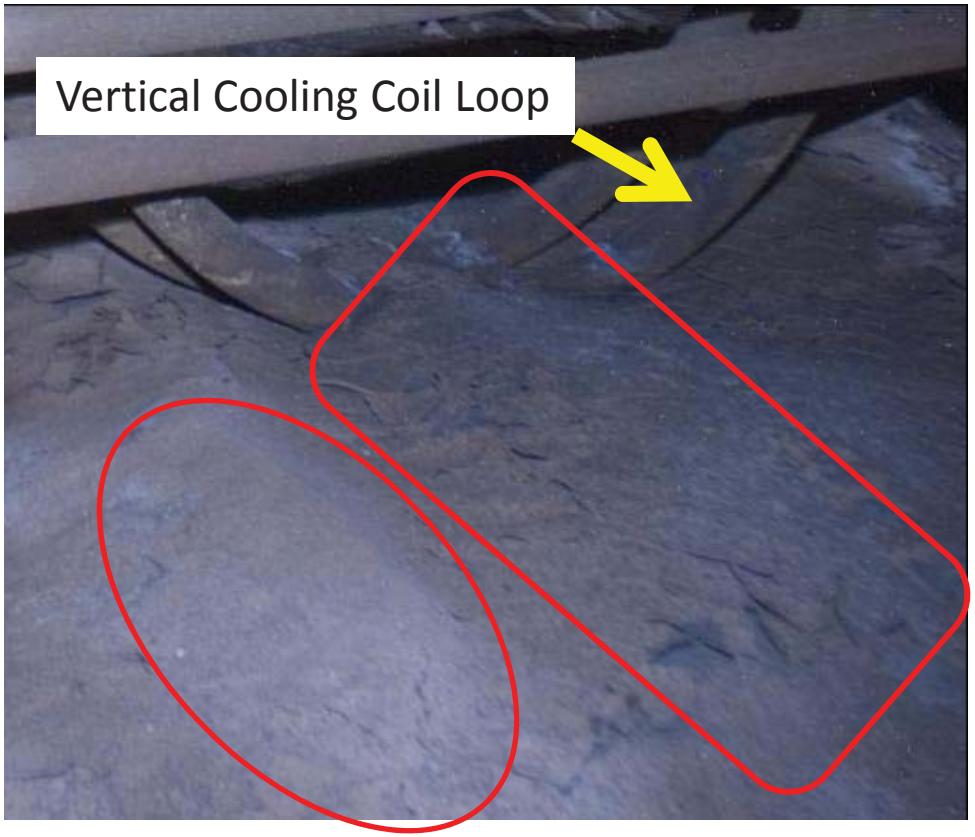
Example - high definition photograph and map from Tank 5 final mapping.

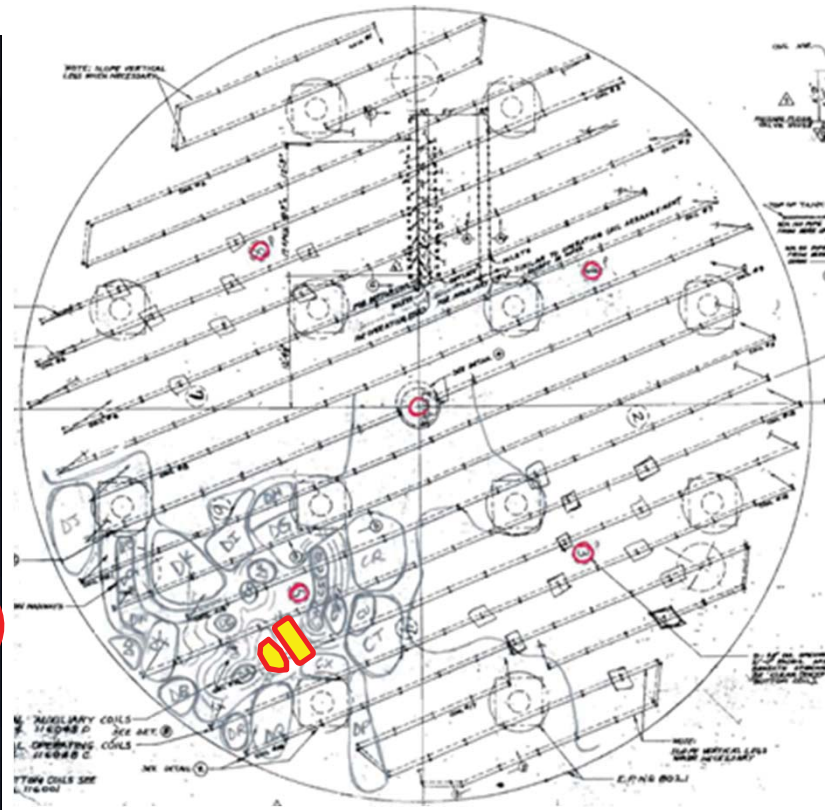




Assigned material height: 5”

Example - high definition photograph and map from Tank 5 final mapping.

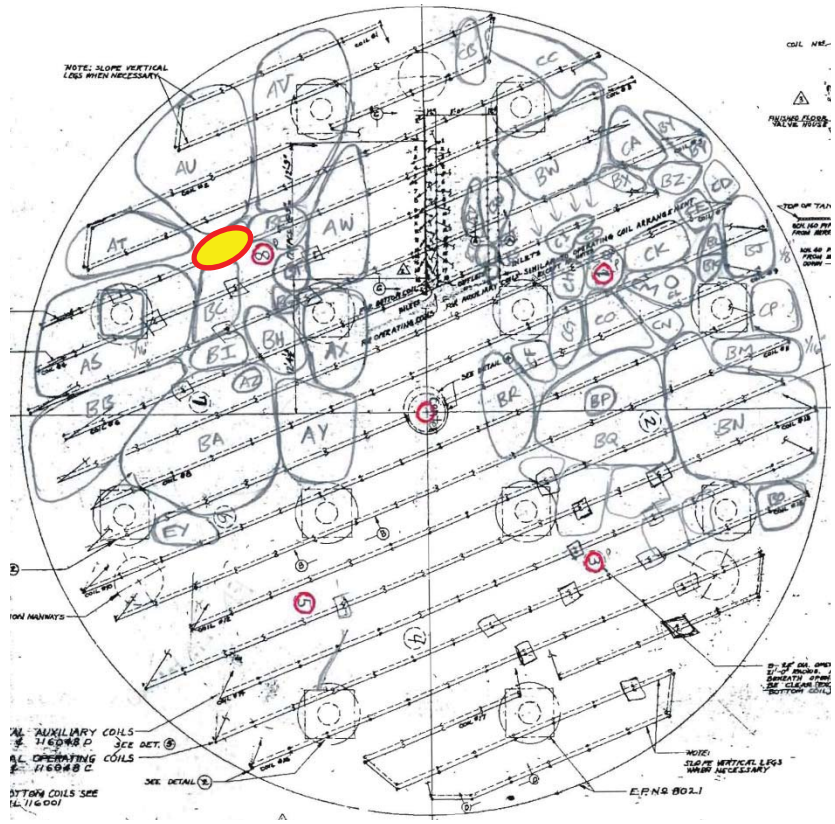




Assigned material height: 8”

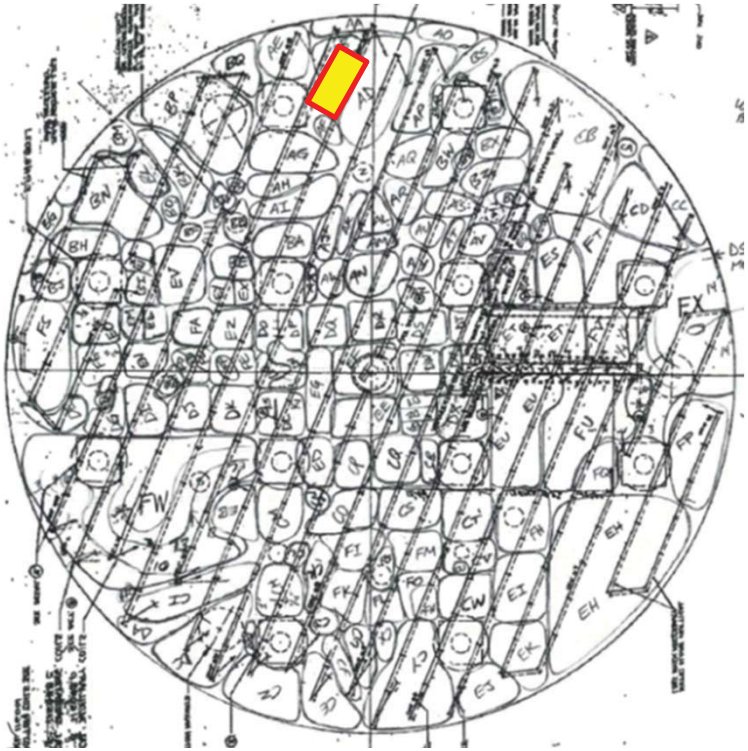
Assigned material height: 9”

Example - high definition photograph and map from Tank 5 final mapping.



Assigned material height: 1/16”

Example - high definition photograph and map from Tank 6 final mapping.



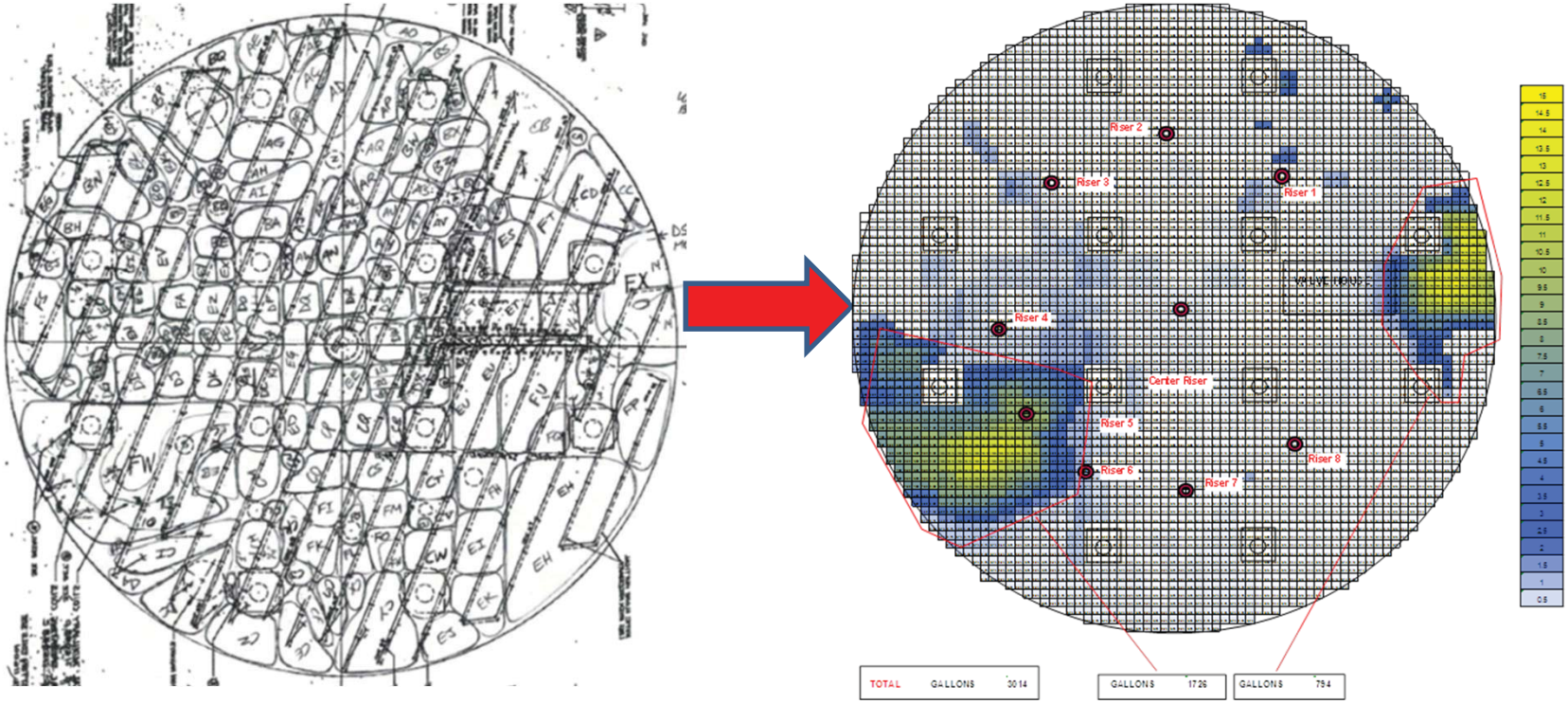
Assigned material height: 1/32”

Example - high definition photograph and map from Tank 6 final mapping.

Assigned material height: 1/8”

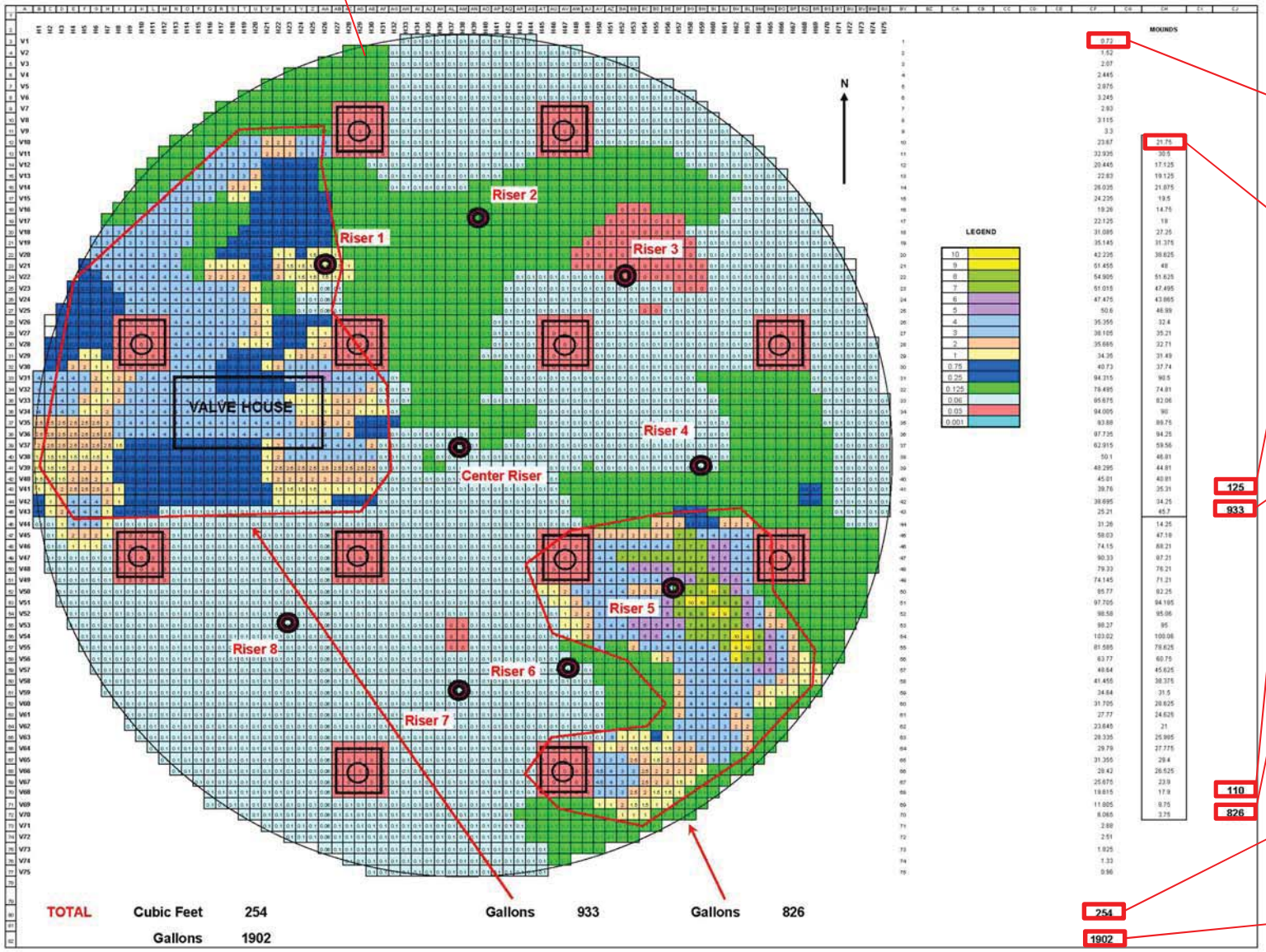
Final Mapping - Methodology

- Enter field sketch data into Excel spreadsheet.
- Create spreadsheets for best estimate, low end estimate, and high end estimate.



Final Mapping - Methodology

Each cell represents 1 ft² of floor area
Height in inches input into cell
{e.g., "0.125"}



Summation of all cells
In the particular row
{e.g., "=SUM(B3:BX3)"}

Summation of all cells
In the particular row
associated with the mound
{e.g., "=SUM(N12:AA12)"}

Calculation of volume associated
with NW mound in ft³
{i.e., "=SUM(CH12:CH45)/12"}

Calculation of volume associated
with NW mound in gallons
{i.e., "=CJ43*7.481"}

Calculation of volume associated
with SE mound in ft³
{i.e., "=SUM(CH46:CH72)/12"}

Calculation of volume associated
with SE mound in gallons
{i.e., "=CJ70*7.481"}

Calculation of volume associated
with entire floor in ft³
{i.e., "=SUM(CF3:CF77)/12"}

Calculation of volume associated
with entire floor in gallons
{i.e., "=CF80*7.481"}

Mapping - Methodology

- Perform Technical Review of Spreadsheet
  - Items to check include
    - Correct number of cells representing the square footage of the tank floor.
    - Accurate transposition of solids height from sketch to spreadsheet.
    - Proper formulas for converting solids height to volume.
    - Consistent color code.

Final Mapping – Generate Report

- Based on Closure Engineering direction, the report may contain the following
  - Brief summary of waste removal activities. Reference operations plan/mixer strategy.
  - Date(s) that mapping was performed.
  - Summary of mapping methodology.
  - Criteria for solids heights
  - Attach key landmarks diagram.
  - Summary of results (with volume rounded appropriately). Include uncertainty.
  - Hand-drawn field sketch - attached.
  - Hand-drawn height data - attached.
  - Table with height data - attached.
  - Table of photograph numbers and video footage used as basis for solids heights - attached.
  - Excel color-coded map - attached.
  - Graph of solids removal history - attached.
  - Examples of photographs and still shots taken from mapping video - attached.

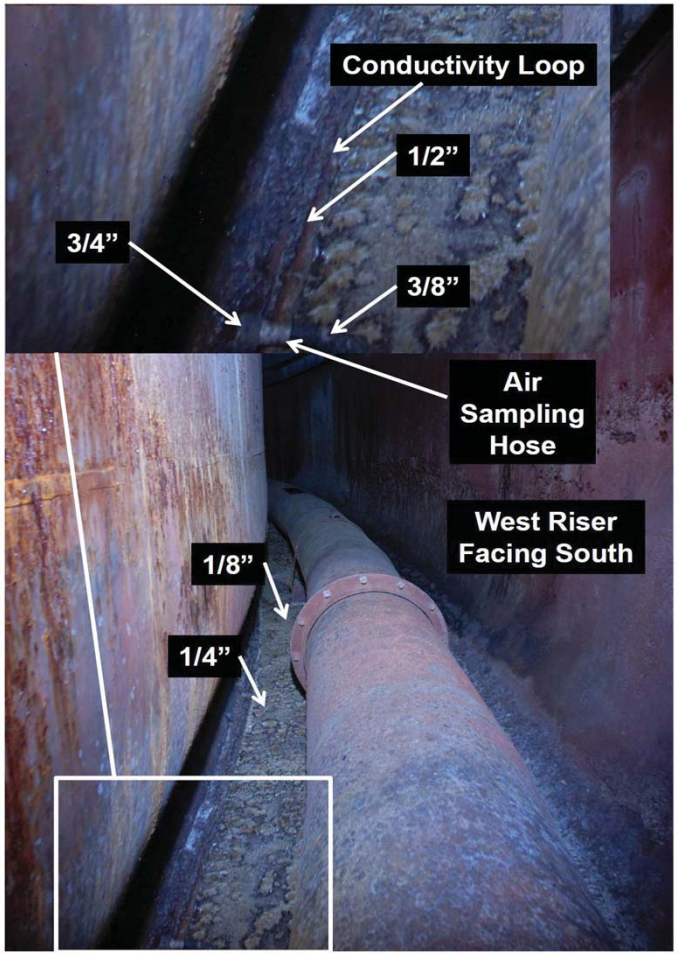
Examples: - *Tank 5 Final Volume Determination and Uncertainty Estimate Report*, U-ESR-F-00048
- *Tank 6 Final Volume Determination and Uncertainty Estimate Report*, SRR-LWE-2011-00245

Annulus Mapping

SRR-CWDA-2013-00072

- Same approach as final mapping
- Digital still high definition photographs and wall crawler video have been used to map Tank 6.

West Annulus Riser Facing South



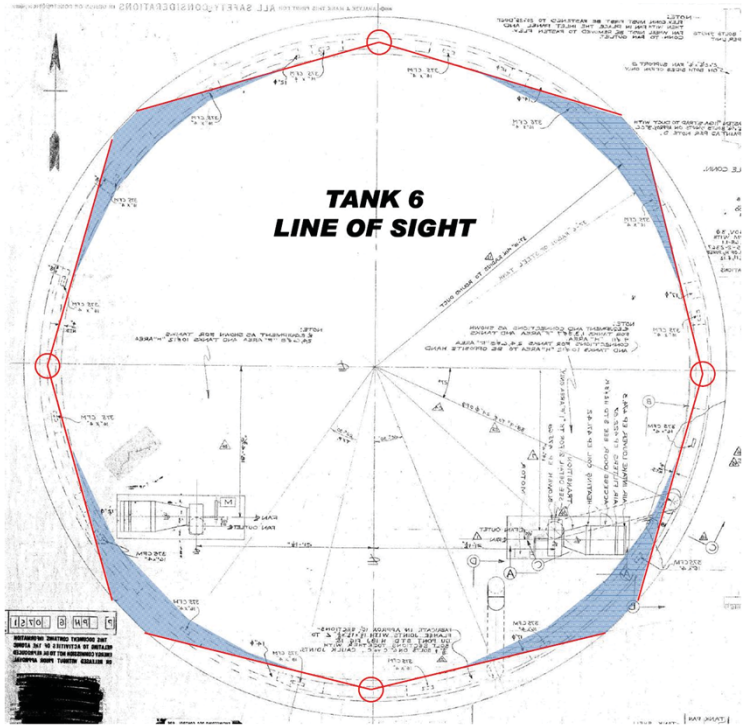
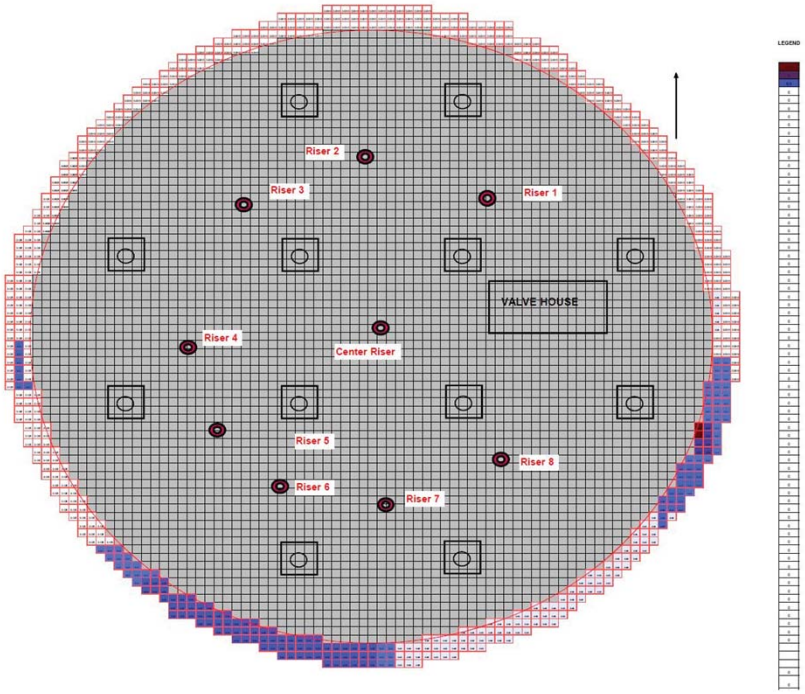
Annulus Mapping

SRR-CWDA-2013-00072

- There is greater uncertainty due to obstructed views due the curvature of the tank wall and the ventilation duct.
- Provide reasonable justification for residual solids heights in obstructed area.
- Inspections with a camera mounted on a wall crawler my be used for more coverage of the annulus.

Tank 6 Annulus Area Visible from Risers

(shaded area not visible)



Tank 6 Annulus Residual Material Map