MR-QAPP MODULE 2 MQO DISCUSSION
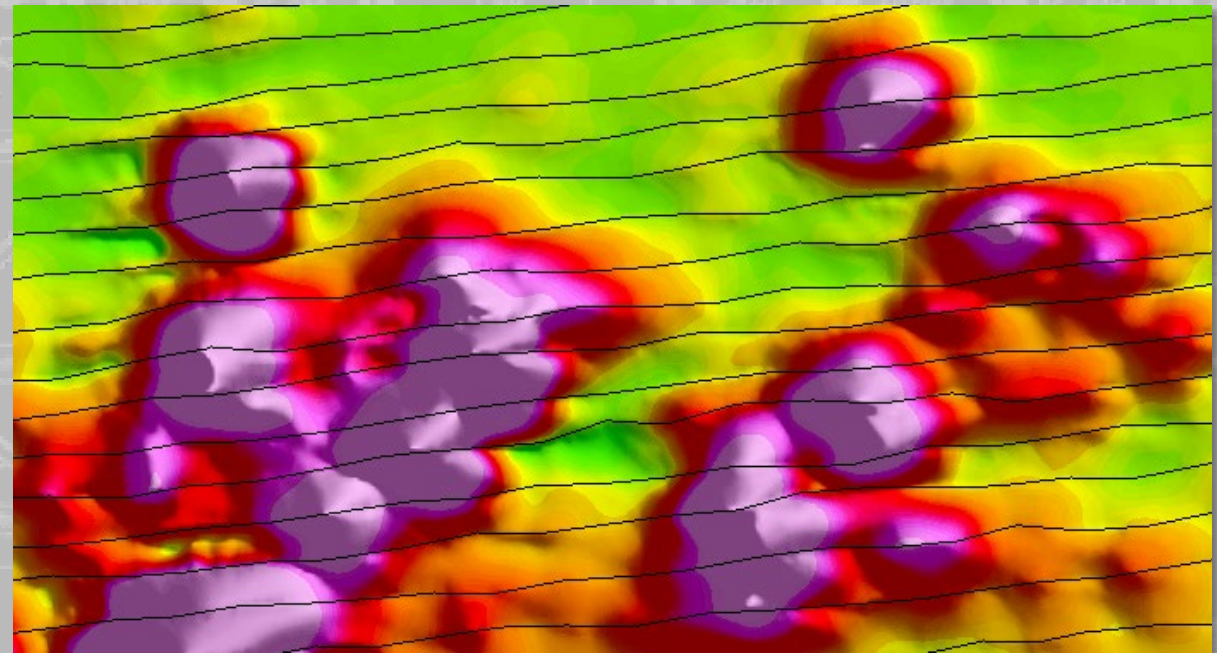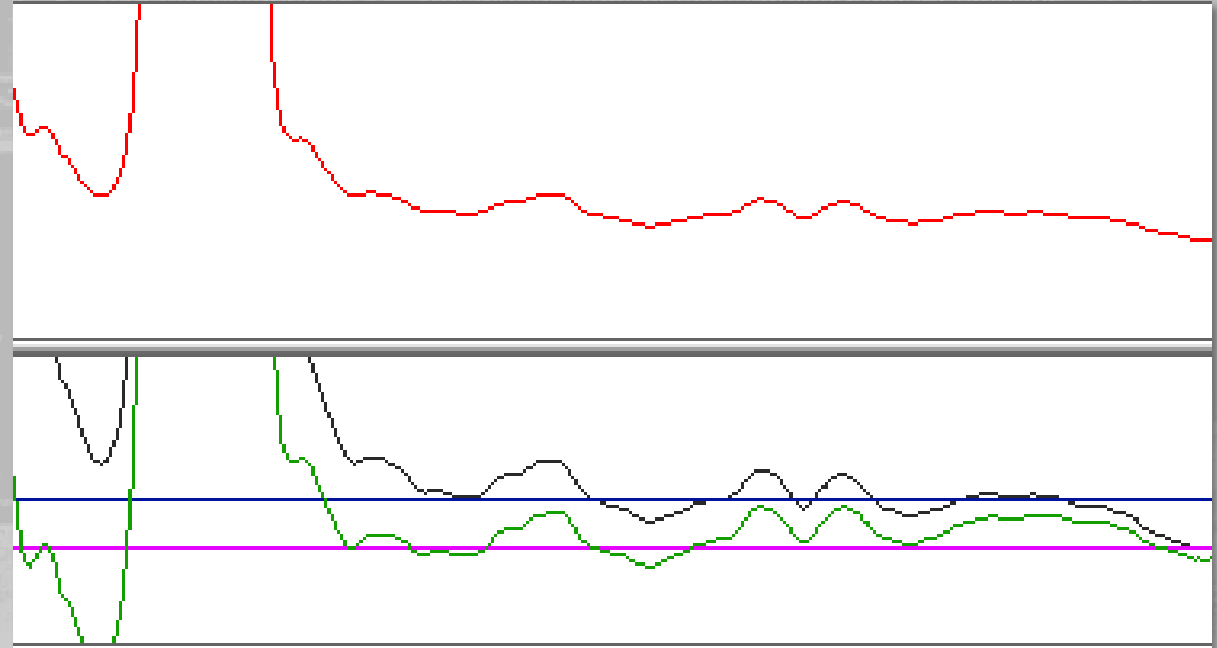
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PURPOSE

- Walk through a subset of MR-QAPP Module 2 MQOs
  - Post-dig verification
  - Leveling
  - Target selection
- Provide examples to illustrate the intent of the requirements and potential ways to document achievement
- These examples are not meant to be the only way to meet these requirements

INTERGOVERNMENTAL DATA QUALITY TASK FORCE

Uniform Federal Policy
For
Quality Assurance Project
Plans

Munitions Response QAPP Toolkit

Module 2:
Remedial Action (RA)

External Review Draft, March 2022

POST-DIG VERIFICATION MQOS

- We have been pretty good at ensuring the quality of geophysical data, but struggle at ensuring holes were cleared properly

- Sources of error include:

  - Reacquisition error

  - Flag movement

  - Failure to remove all sources

- These are now all addressed with MQOs:

  - Recovered item positions must be within tolerance of predicted positions

  - 100% Analog anomaly resolution

  - Digital maps over a subset of targets to verify analog process is effective

GROUND TRUTH MQOS (NON-AGC DGM)

Measurement Quality Objective	MQO#	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Confirm derived features match ground truth **(1 of 2)**		Evaluated for all recovered items including seeds (applies only to single, compact objects [e.g., does not apply to a bed of nails or long wires])	Project Geophysicist/ Running QC Summary or Intrusive Database/ QC Geophysicist	100% of recovered item positions ≤ 0.75m from predicted position (x, y);	RCA/CA
Confirm derived features match ground truth (2 of 2)		Evaluated for all recovered items including seeds	Project Geophysicist/ Dig List and Intrusive Database/ Project or QC Geophysicist	Recovered items match expected size, shape, and depth of instrument response	RCA/CA

- Requires documentation to confirm that the item that came out of the ground was 1) in the right place, and 2) qualitatively makes sense with the data
- How to document #1?
  - Record item locations with RTK or similar
  - Record reacquisition locations with RTK or similar and measure distance from flag to item
  - All the above

GROUND TRUTH MQOS (AGC)

Measurement Quality Objective	MQO#	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Confirm derived features match ground truth (1 of 2)		Evaluated for all recovered items including seeds (applies only to single, compact objects [e.g., does not apply to a bed of nails or long wires])	Project Geophysicist/ Running QC Summary or Intrusive Database/ QC Geophysicist	100% of recovered item positions (excluding inconclusive category) ≤ 0.25m from predicted position (x, y); Recovered item depths are recorded within 15cm of predicted depth	RCA/CA
Confirm derived features match ground truth (2 or 2)		Evaluated for all recovered items including seeds	Project Geophysicist/ Dig List and Intrusive Database/ Project or QC Geophysicist	Cued data analysis shows 100% of seeds & recovered items have polarizability parameters that are consistent with their actual size, shape/symmetry, and wall thickness	RCA/CA

- Same documentation required here, just different tolerances

POST-DIG VERIFICATION MQO #1

Measurement Quality Objective	MQO#	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Post-dig verification (non-AGC DGM)		100% of intrusive investigations	Field Geophysicist/ QC Summary/QC Geophysicist	Response from properly nulled EM61 is lower than the selection threshold for the entire anomaly footprint.	RCA/CA

- Failure Response is initiated if QC or QA identifies an anomaly where this process wasn't completed properly (e.g. - missing documentation, field inspections, etc.)

POST-DIG VERIFICATION MQO #2

Measurement Quality Objective	MQO#	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Post-dig verification (non-AGC DGM)		200 dig locations per survey unit (or all dig locations if there are less than 200)	Project Geophysicist / Post-dig digital remapping / QC Geophysicist	All targets with post-excavation responses above threshold and within the anomaly footprint are reinvestigated and no recovered metallic object is larger than the smallest IOC.	RCA/CA

- This is intended to verify the analog process was done properly
- Failure Response is initiated if any an object larger than the smallest IOC is recovered during post-dig verification
- Postage stamps may be difficult to level, so procedures should still ensure sensor is properly nulled

TARGET SELECTION AND LEVELING MQOS

- Replaces the re-processing requirements and still gives regulators confidence that the data processing routines aren't missing targets
- Intended to put a typical QC process into the MQO format
  - Leveling limitations are identified and reviewed to ensure no targets are missed
  - Target selection and dig procedures ensure entire anomaly footprints are resolved
 - Over-filtering is addressed to eliminate impacts of anomaly amplitude suppression
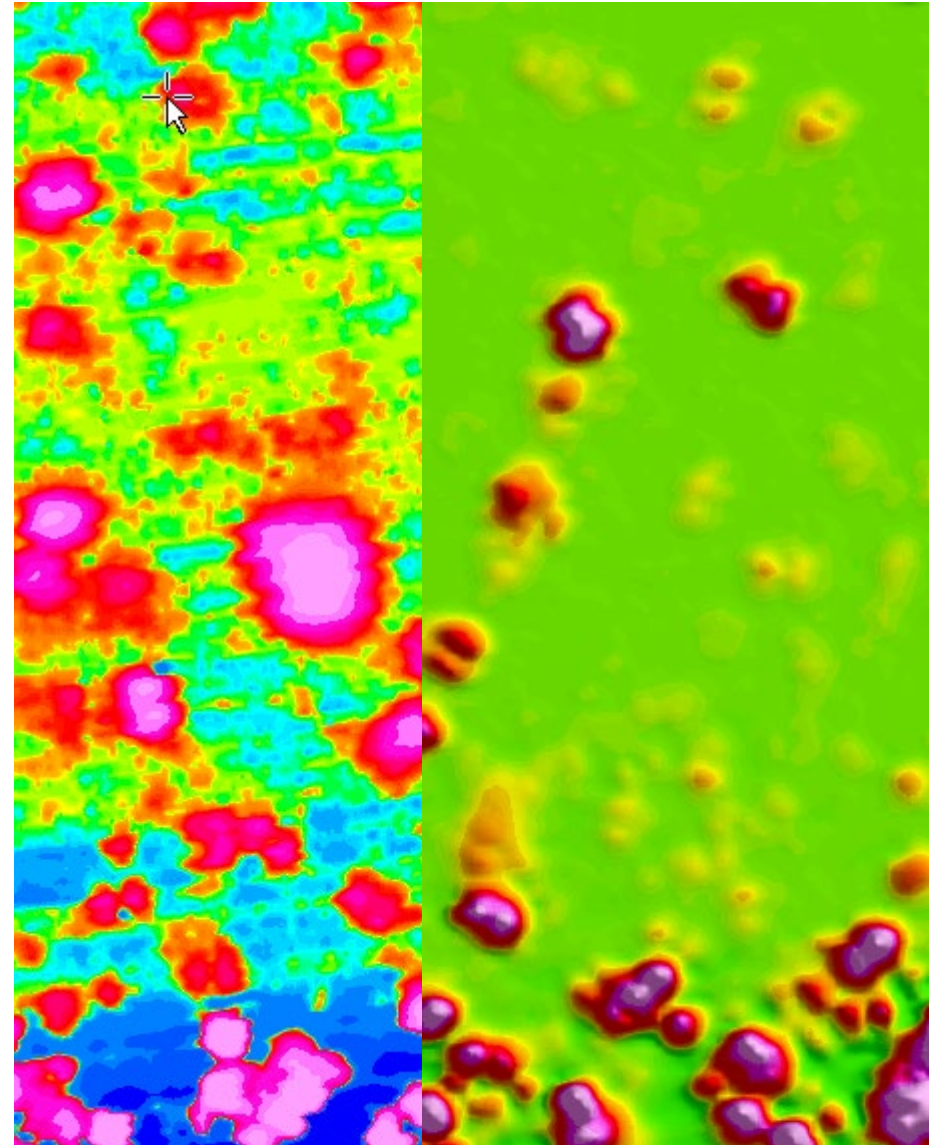
LEVELING MQO #1

| Measurement Quality Objective	MQO#	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Verification of leveling (non-AGC DGM)		Evaluated for each survey unit	Project Geophysicist/QC Summary/QC Geophysicist	Leveled data with an amplitude less than negative 3x RMS noise is identified and reviewed to ensure no additional targets are present.	RCA/CA

- Failure Response is initiated if QC or QA finds an anomaly in a negative response area that has a true amplitude greater than the target selection threshold
- This accounts for the tendency of leveling routines to produce a negative response adjacent to large amplitude anomalies
- The routine does not require manual correction of these instances, but requires that they be identified and reviewed to ensure no target is missed

LEVELING EXAMPLE #1
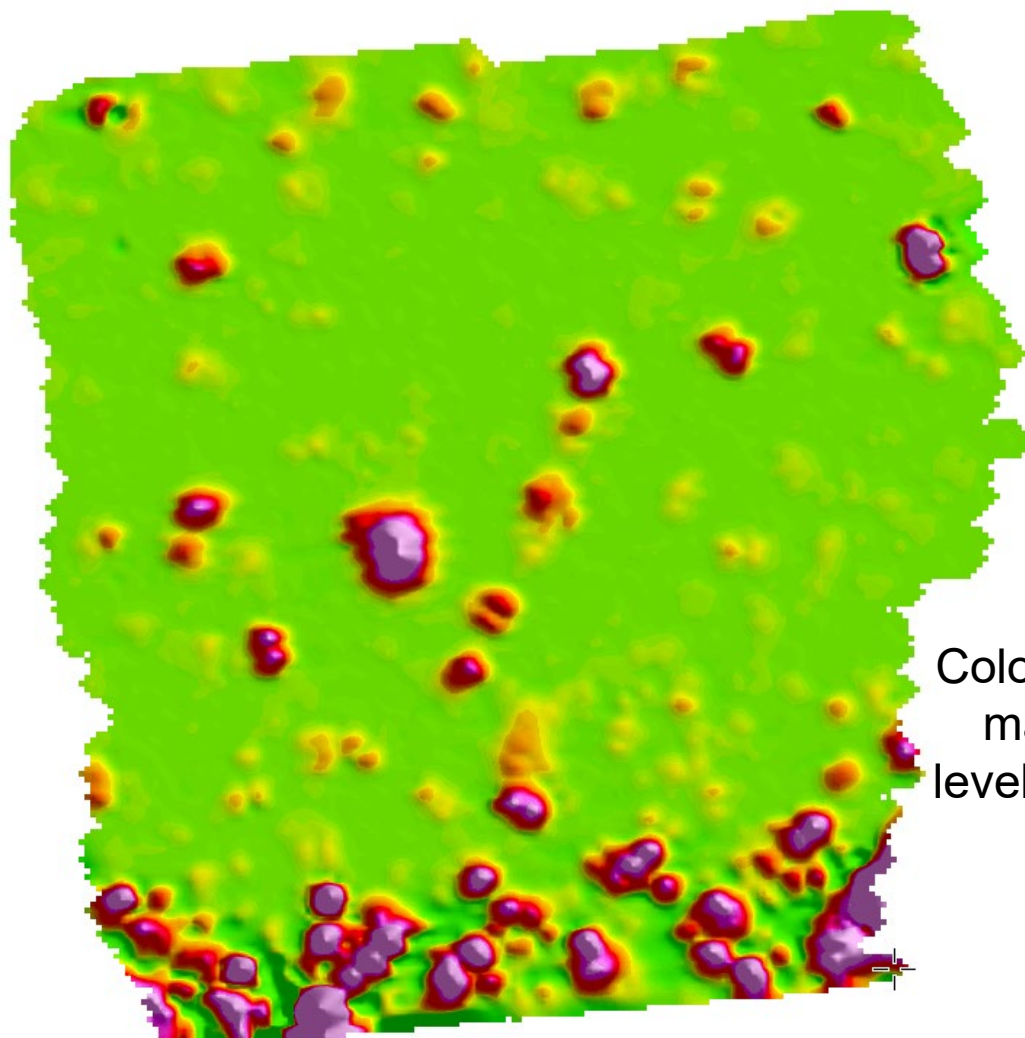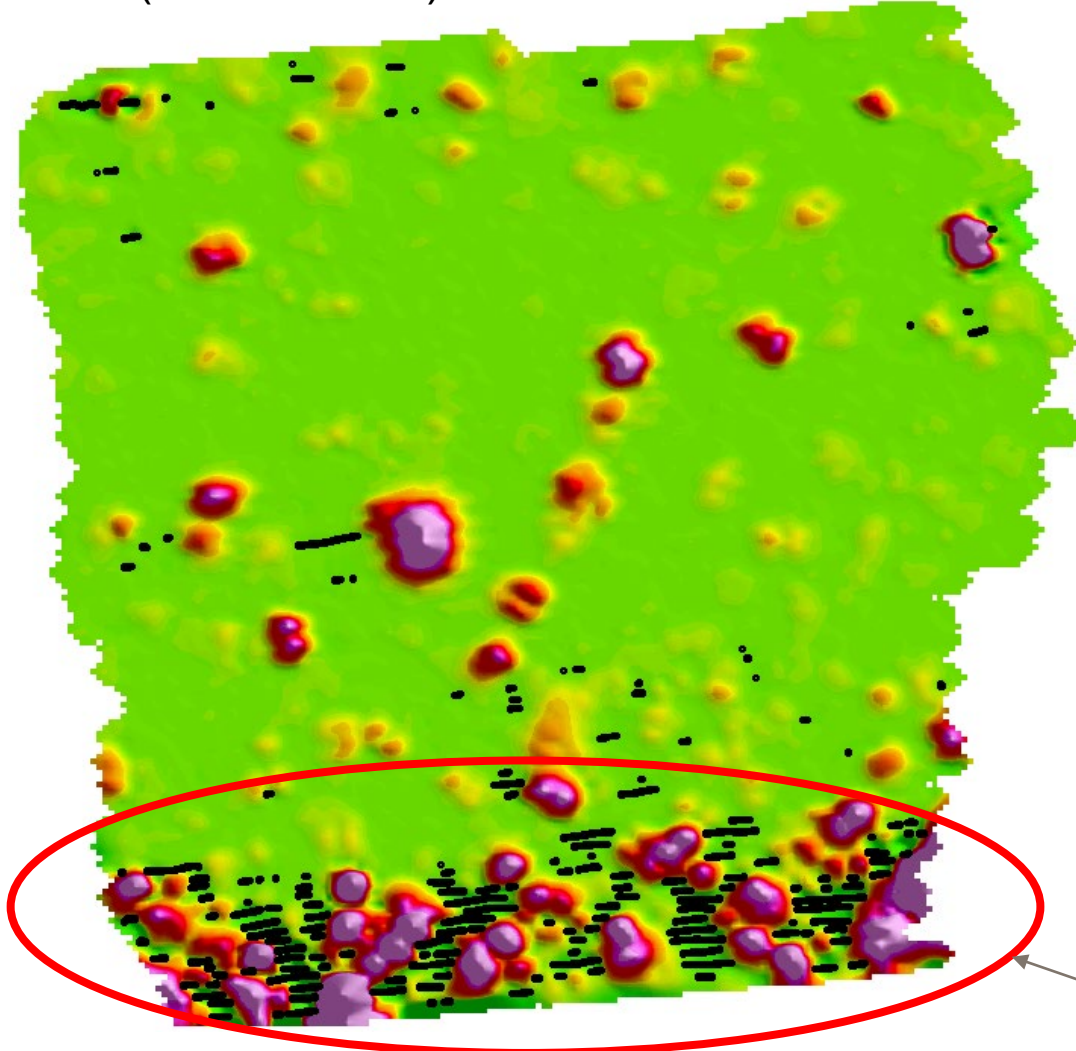

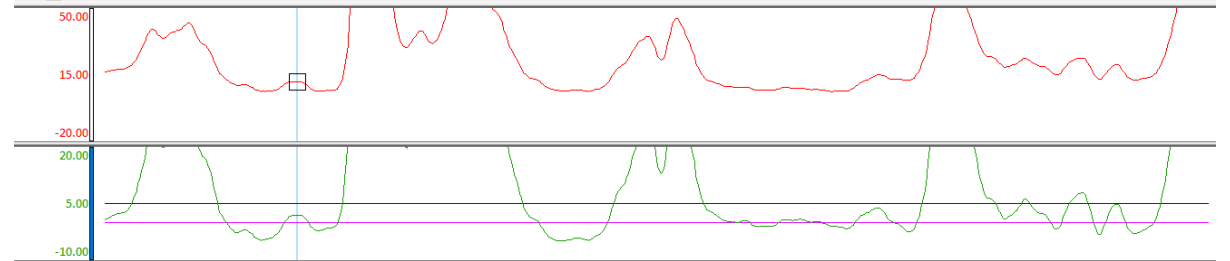Color scales can make poorly leveled data look great
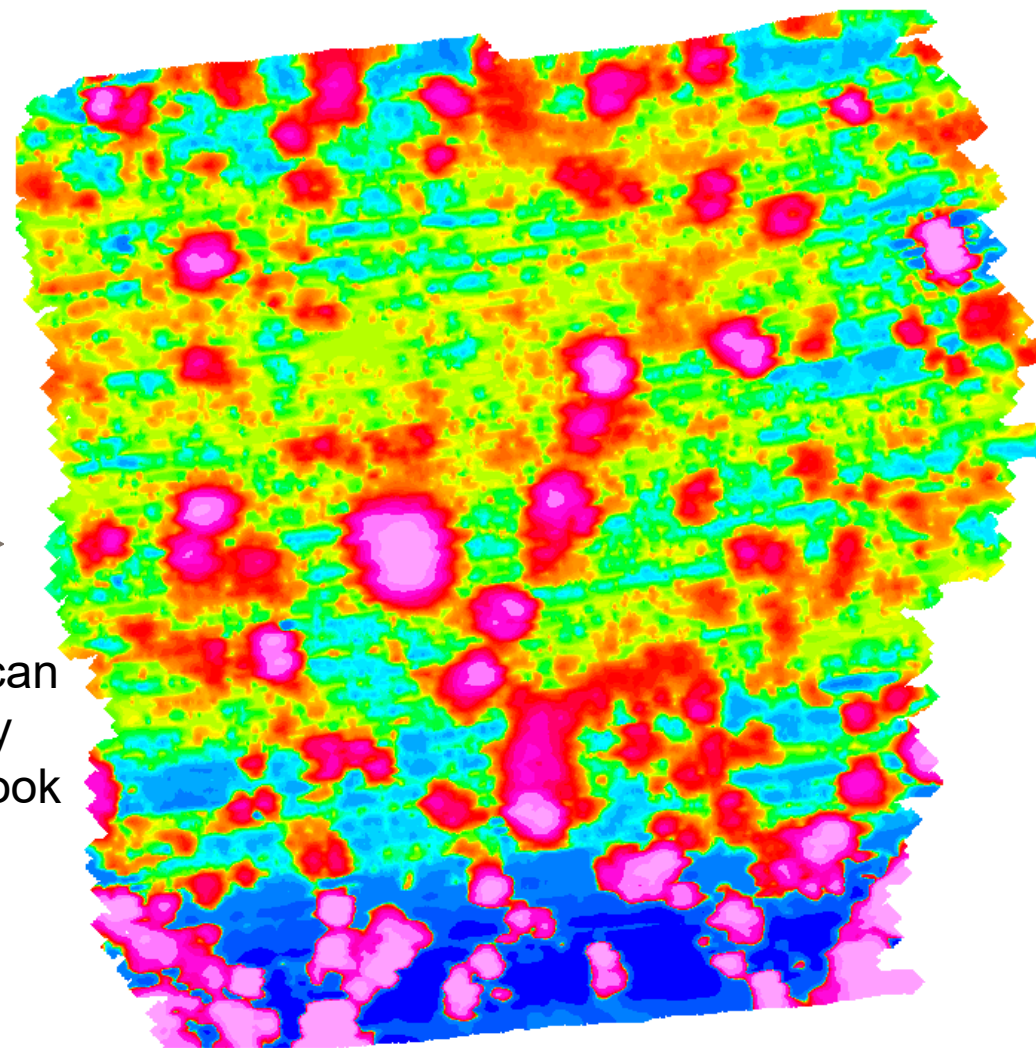
LEVELING EXAMPLE #1

Black dots represent profile responses less than -0.6mV (RMS=0.2mV) on Chan 2

Raw Chan 2   Leveled Chan 2

Zero   5mV on Chan 2

- Multiple large amplitude anomalies throughout the area
- Leveling filter can't handle this properly

What's going on here?

LEVELING EXAMPLE #1

Raw Chan 2   Leveled Chan 2

Zero   5mV on Chan 2

To meet the MQO we have two options here:
1. Review and document the review of every black dot in this part of the grid, and add any targets missed due to poor leveling
2. Re-level this part of the dataset

(I recommend option #2)

- This anomaly wasn't selected
- Raw Amplitude (peak – background) is 11.56mV – 6.45mV = 5.11mV
- <u>Leveling has impacted target selection</u>

LEVELING EXAMPLE #1

- After manually leveling the area by defining DC offsets for each line, our negative responses are few and far between (purple dots)
- After re-leveling we also see that the bottom of the grid is a potential SRA
- I would just send my dig team to clear this area with analog methods and then remap rather than trying to pick individual targets in this area
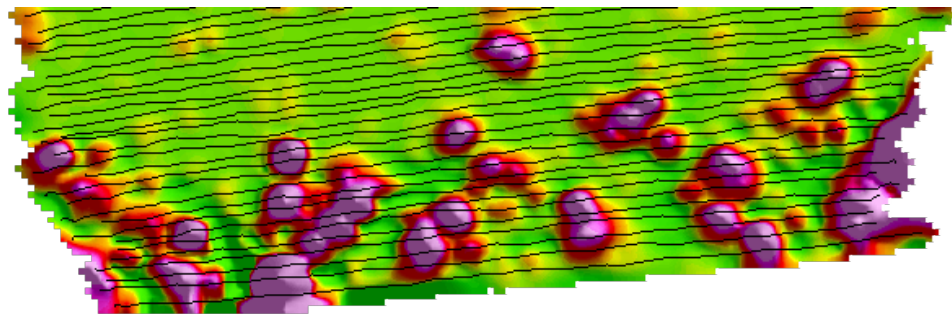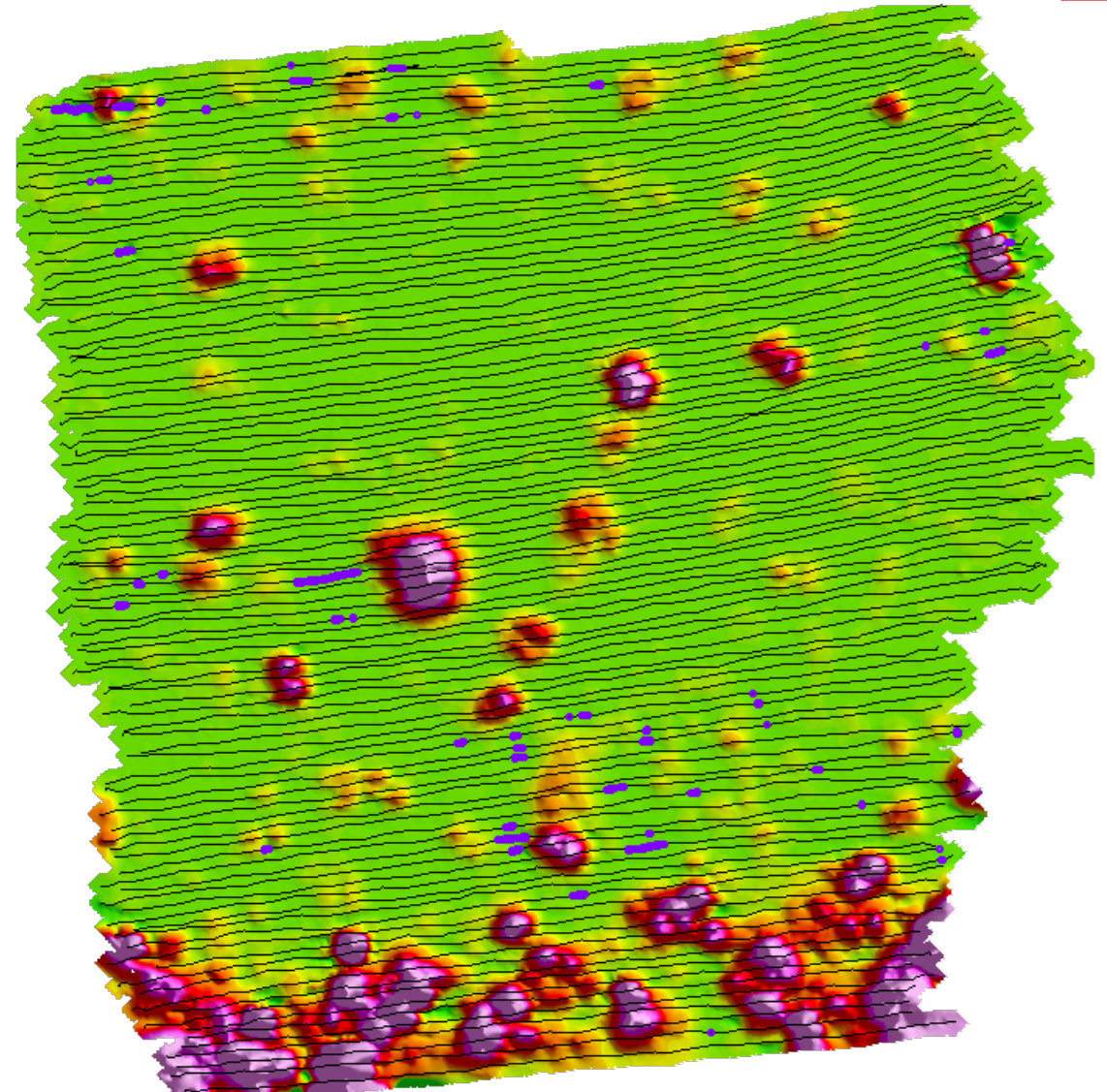
Before   →   After

LEVELING EXAMPLE #1
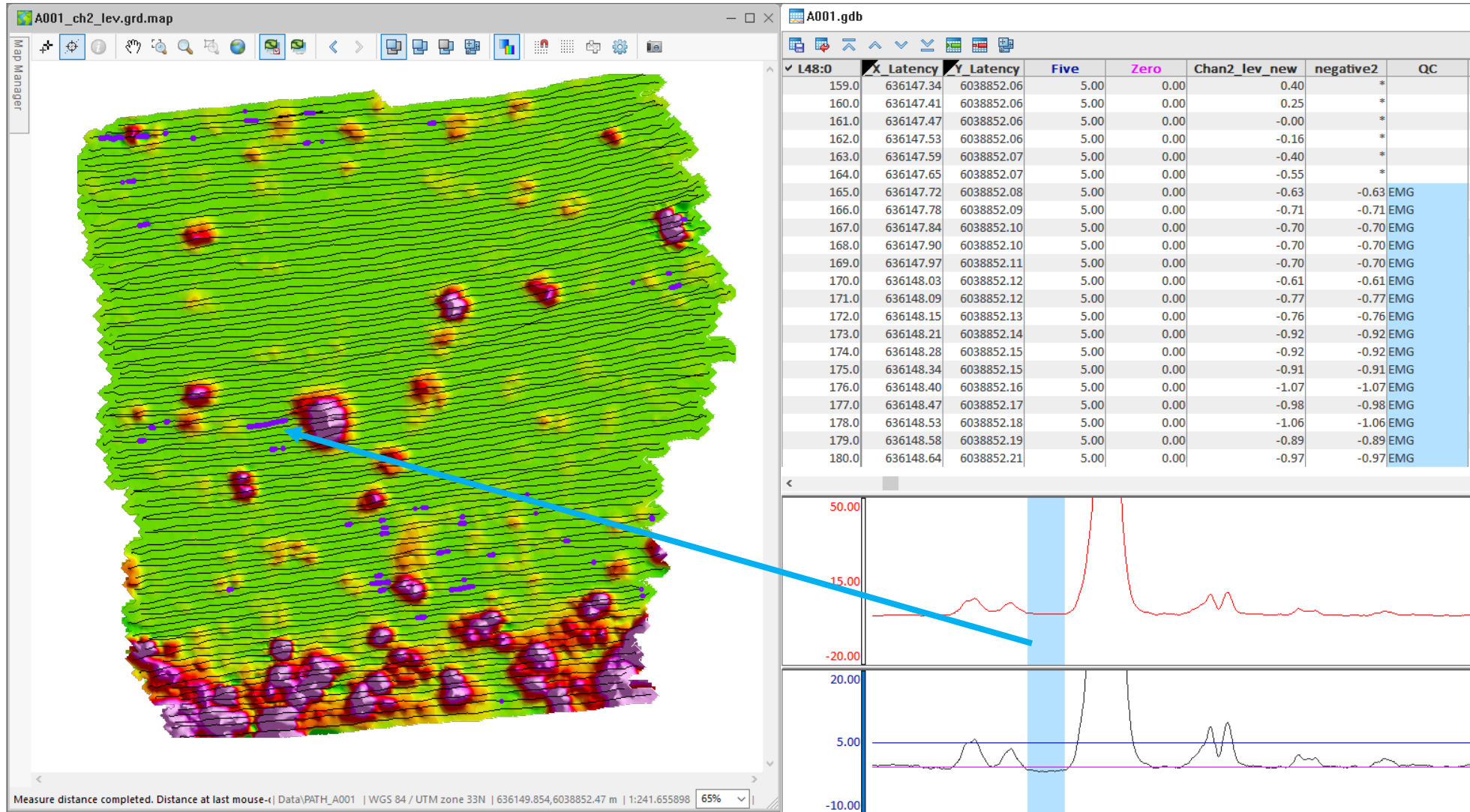
Review documentation for remaining negatives can be handled in the database

TARGET SELECTION MQO

Measurement Quality Objective	MQO#	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Verification of Target Selection (non-AGC DGM)		Evaluated for each survey unit (post SRA)	Project Geophysicist/QC Summary/QC Geophysicist	All leveled data with an amplitude greater than or equal to the selection threshold are accounted for in the final selected targets and associated dig radius 0.5m or cued footprint 0.4m. (cued measurements cover the entire anomaly footprint)	RCA/CA

- Failure Response is initiated if QC or QA finds that target selection and associated dig radius doesn't resolve the entire anomaly footprint.
- Multiple targets can be selected to cover footprint with standard dig radius;
- Or, a procedure can be implemented to modify the dig radius for larger footprint anomalies
- Contractors must also have a procedure to define an SRA. There must be a limit to how far you can extend the dig radius

TARGET SELECTION EXAMPLE

SRA_001
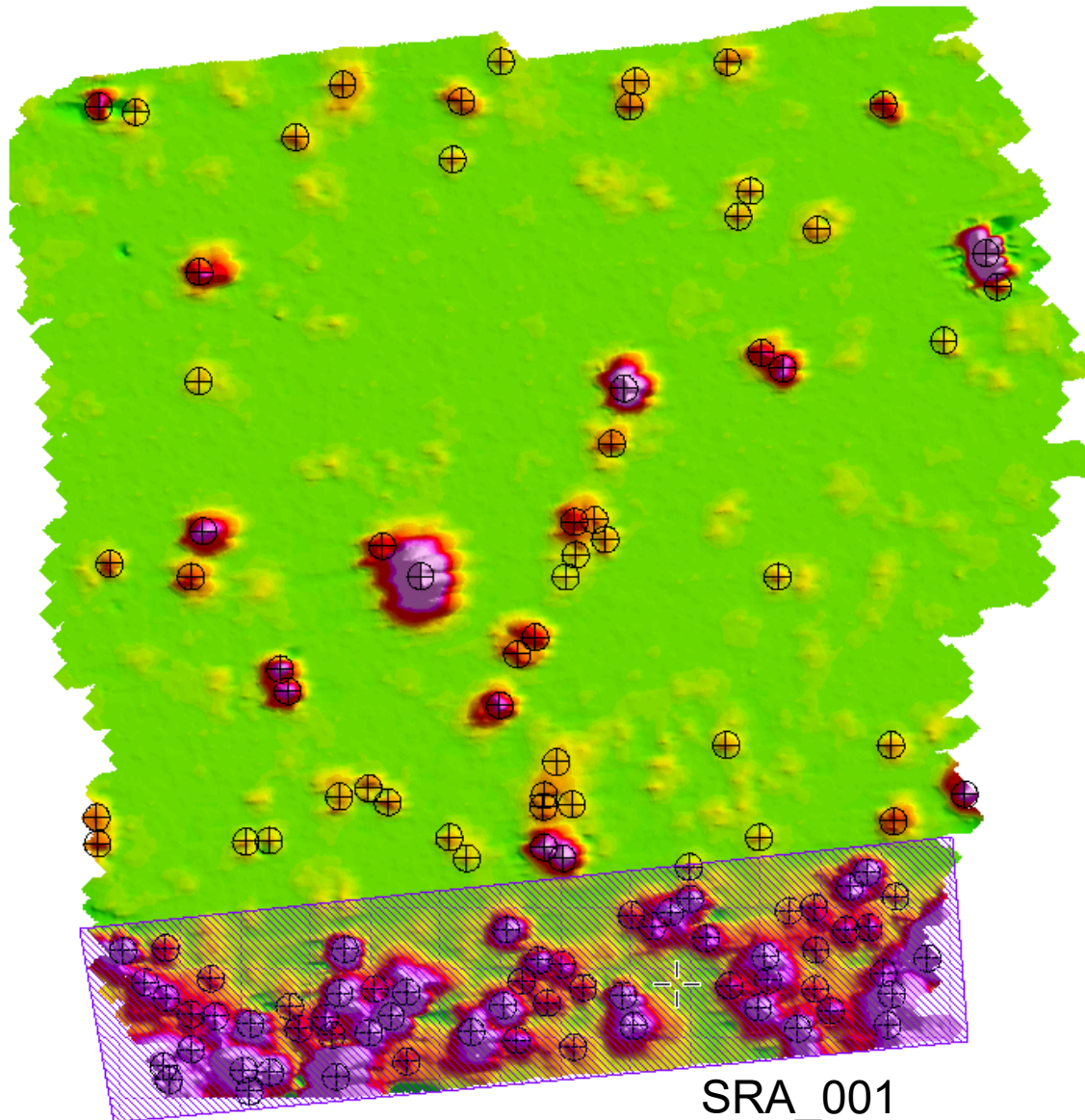
- EM61 and Dig
- Blakely target selection
- Normal peak detection
- 5mV Chan 2 Threshold
- Merge distance is 0.7m
- Symbols are 1m diameter

Are we achieving the MQO?

TARGET SELECTION EXAMPLE

Chan 2
mV

SRA?

SRA_001
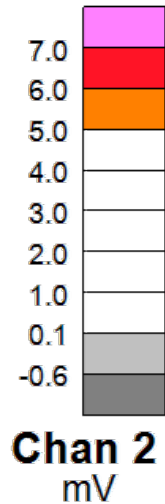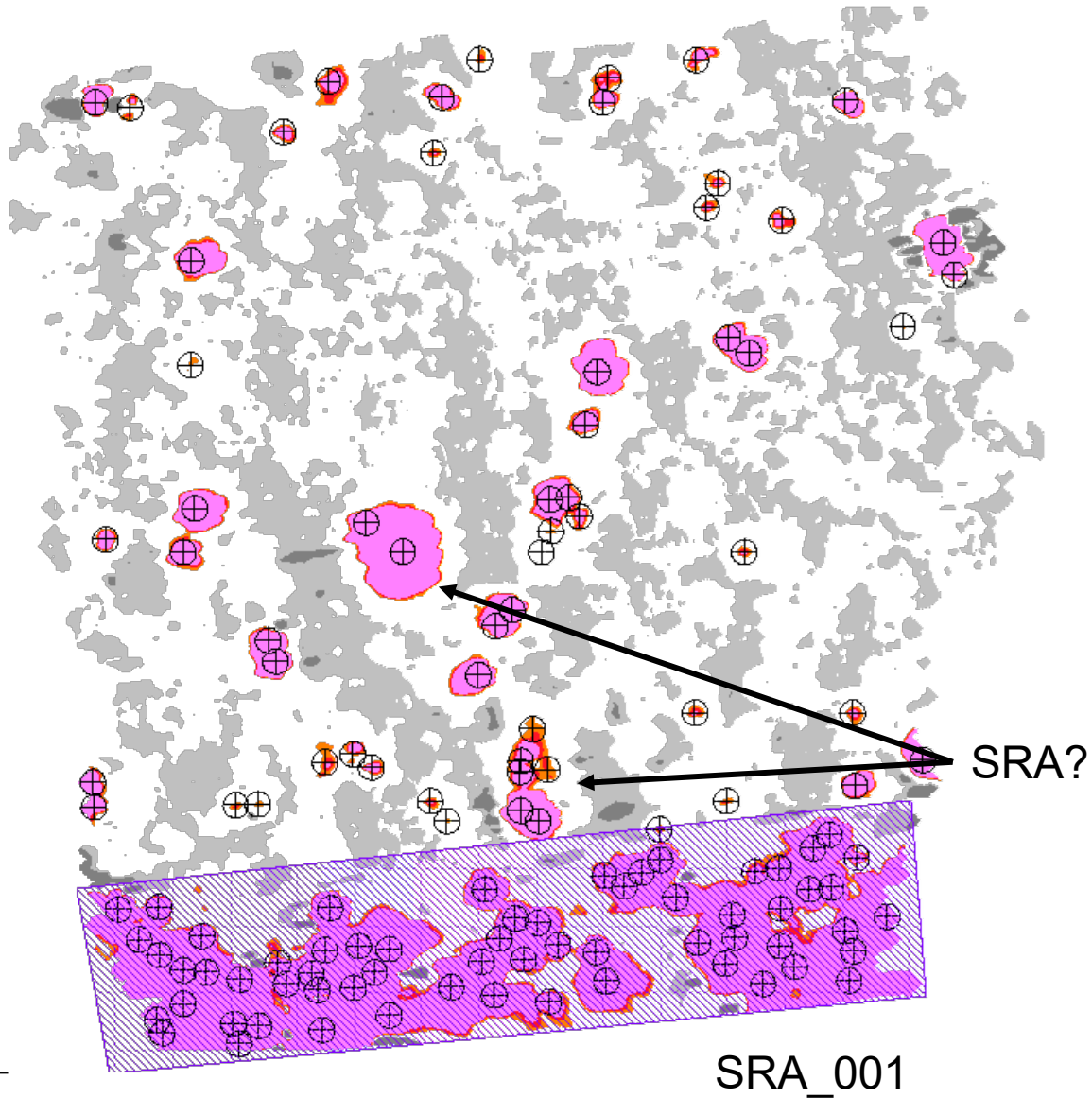
- A color scale that clearly shows the target selection threshold is needed to ensure entire anomaly footprint is accounted for and resolved

- Symbol size represents standard dig radius, so we know the target selection is not currently meeting the MQO

- For this example, we will use a <u>very conservative</u> SRA rule:
Any anomaly footprint with a radius greater than 3x the standard dig radius (0.5x3=1.5m) is an SRA

- Using this rule, both of these anomalies are SRAs

  - SRAs must be cleared with analog methods until individual targets can be selected in the data

TARGET SELECTION EXAMPLE
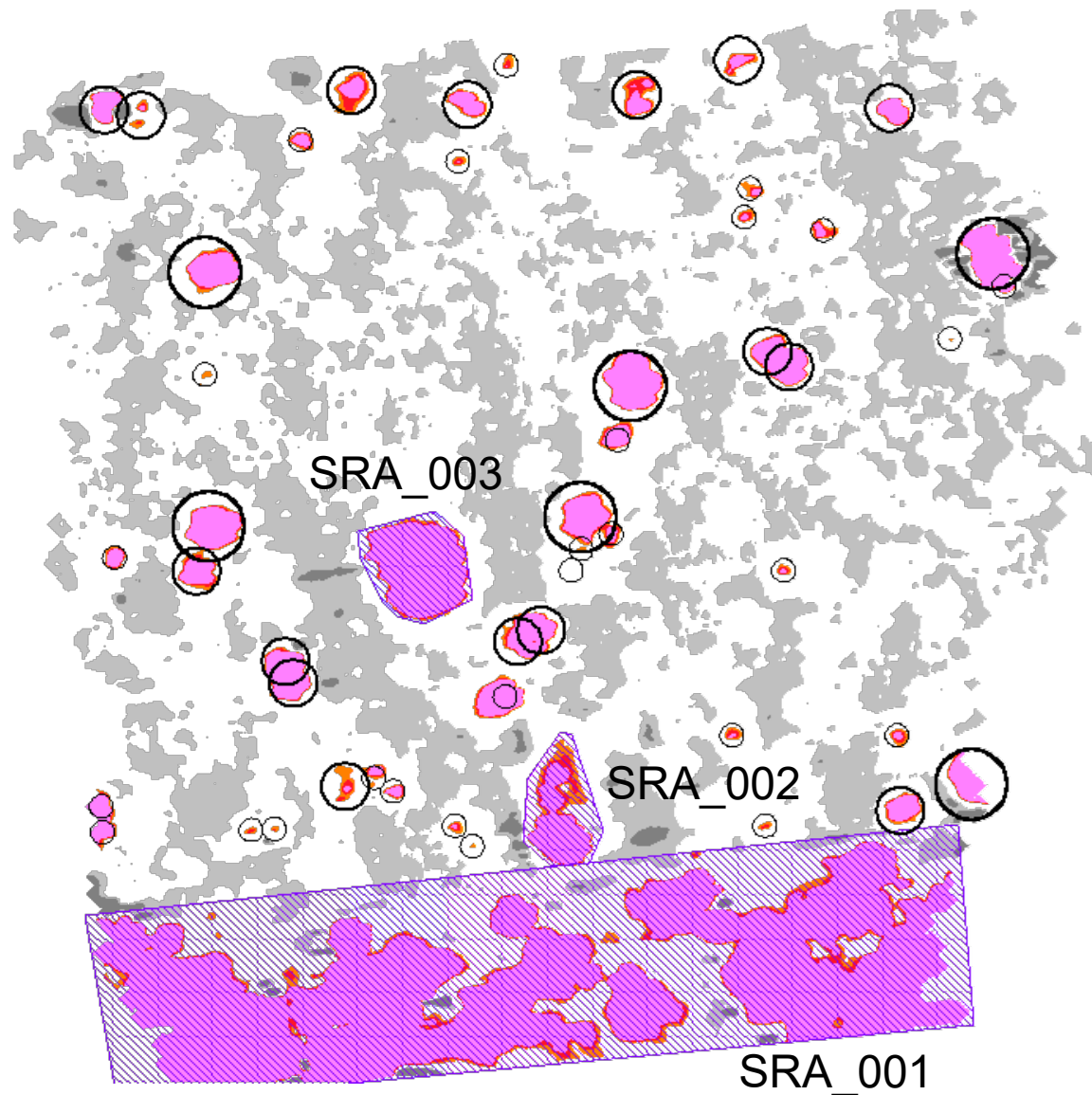
✓ Merged	X	x	Y	y	Target_ID	Ch2	Mask	SR
3.0	636141.0		6038871.4		6	3.2	1	1.00
4.0	636143.7		6038860.6		15	5.3	1	0.50
5.0	636145.6		6038841.5		21	6.5	1	0.50
6.0	636146.5		6038841.6		24	6.4	1	0.50
7.0	636147.0		6038848.6		26	59.7	1	1.00
8.0	636147.3		6038847.7		27	47.5	1	1.00
9.0	636147.6		6038870.4		29	10.6	1	0.50
10.0	636150.6		6038843.7		39	5.4	1	0.50
11.0	636151.4		6038843.2		42	11.1	1	0.50
12.0	636153.9		6038841.7		47	7.8	1	0.50
13.0	636154.0		6038869.5		48	7.2	1	0.50
14.0	636154.6		6038840.9		50	5.5	1	0.50
15.0	636156.0		6038847.1		52	37.6	1	0.50
16.0	636156.0		6038873.5		53	7.1	1	0.50
17.0	636156.5		6038849.4		56	18.9	1	1.00

- Manually adjusted target positions and defined extended search radius in the Target gdb
- Added proportional symbols to show that the entire footprint is accounted for with the extended search radius
- Procedure includes writing SR on flags
- This process is verified through post-dig verification

LEVELING MQO #2

Measurement Quality Objective	MQO#	Frequency	Responsible Person/ Reporting Method/ Verified by:	Acceptance Criteria	Failure Response
Verification of leveling (amplitude suppression) (non-AGC DGM)		Evaluated for 200 of the lowest amplitude anomalies selected as targets, per survey unit	Project Geophysicist / QC Summary/ QC Geophysicist	Raw anomaly peak amplitude minus local background amplitude is within 3x RMS noise of leveled anomaly peak amplitude minus leveled local background amplitude.	RCA/CA

- Failure Response is initiated if QC or QA finds that the amplitude has been suppressed in the lowest amplitude targets of each survey unit
- This addresses the potential of leveling filters to suppress the amplitude of anomalies

LEVELING EXAMPLE #2
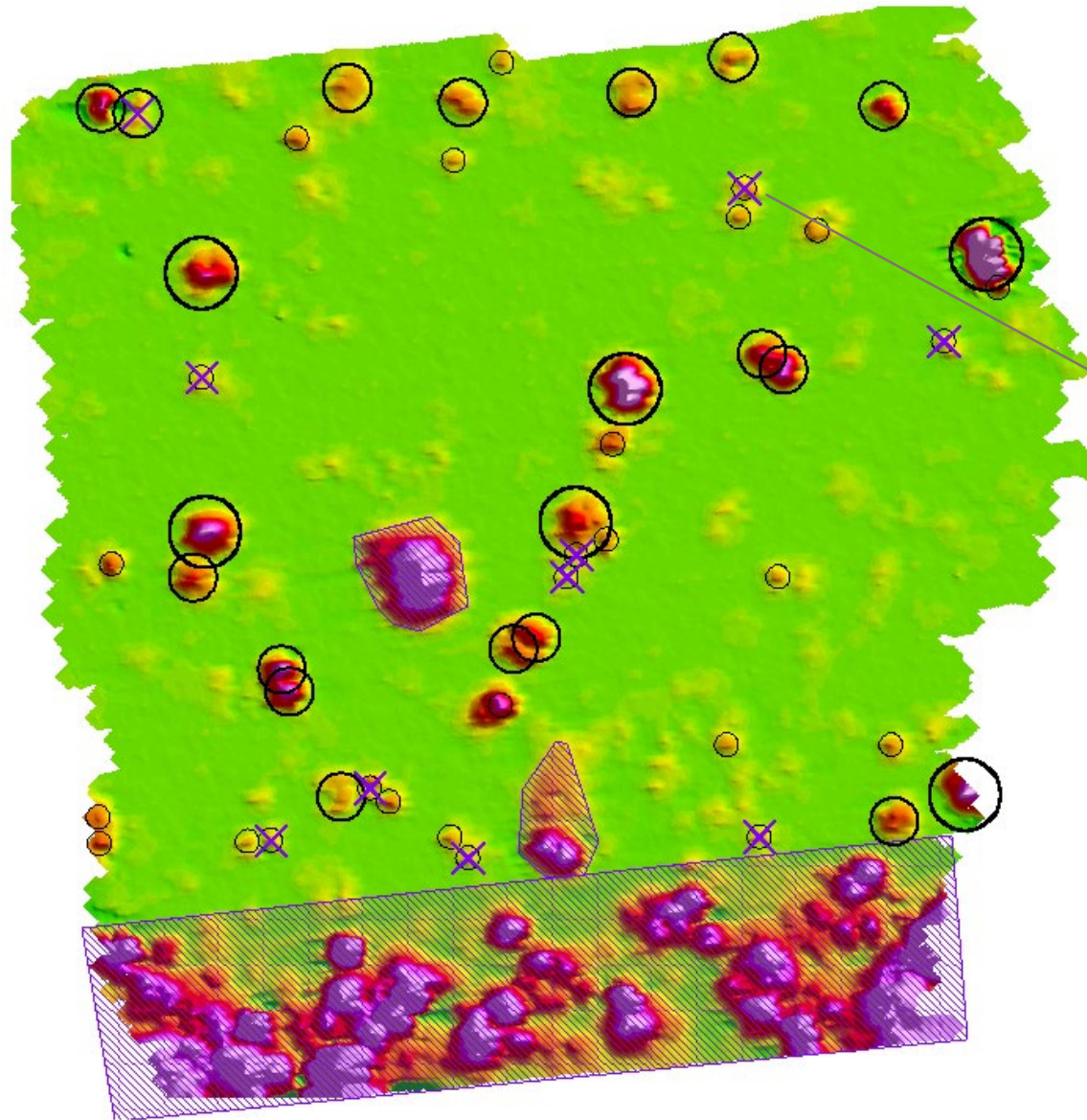
- 49 targets were selected so we must check all targets (purple Xs represent 10 lowest amplitude targets)
- Threshold is 0.6mV (3 x 0.2mV)

Applies to the closest profile peak

LEVELING EXAMPLE #2

- This can be a little time consuming, but it is only required for a limited population
- May be able to script this to some degree
- 3x RMS = 0.6mV

Target ID	Raw Peak	Raw BG	Raw Amp	Lev Peak	Lev BG	Lev Amp	Delta
28	9.31	-0.16	9.47	8.35	-0.64	8.99	**0.32**
21	8.14	-0.63	8.77	8.48	-0.38	8.86	**0.11**
15	6.85	1.63	5.22	5.13	-0.17	5.3	**0.08**

A001.gdb

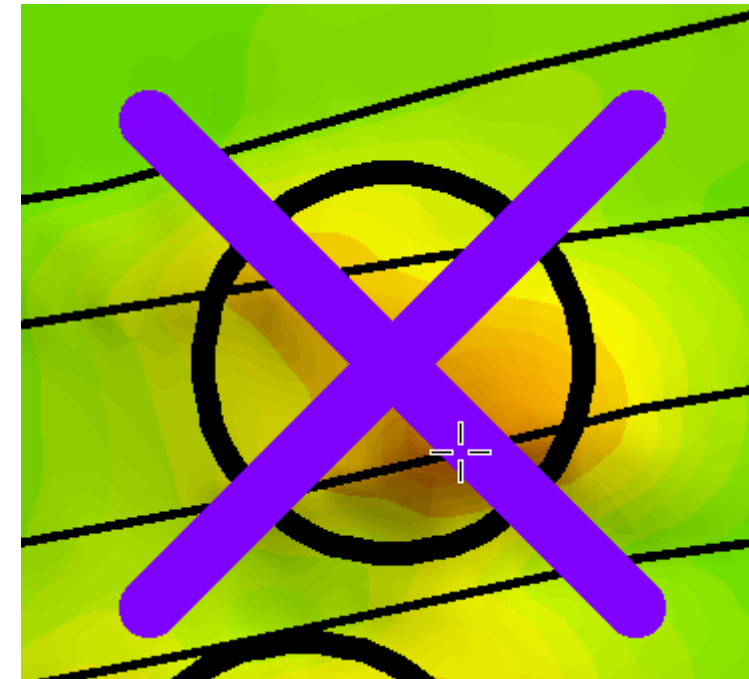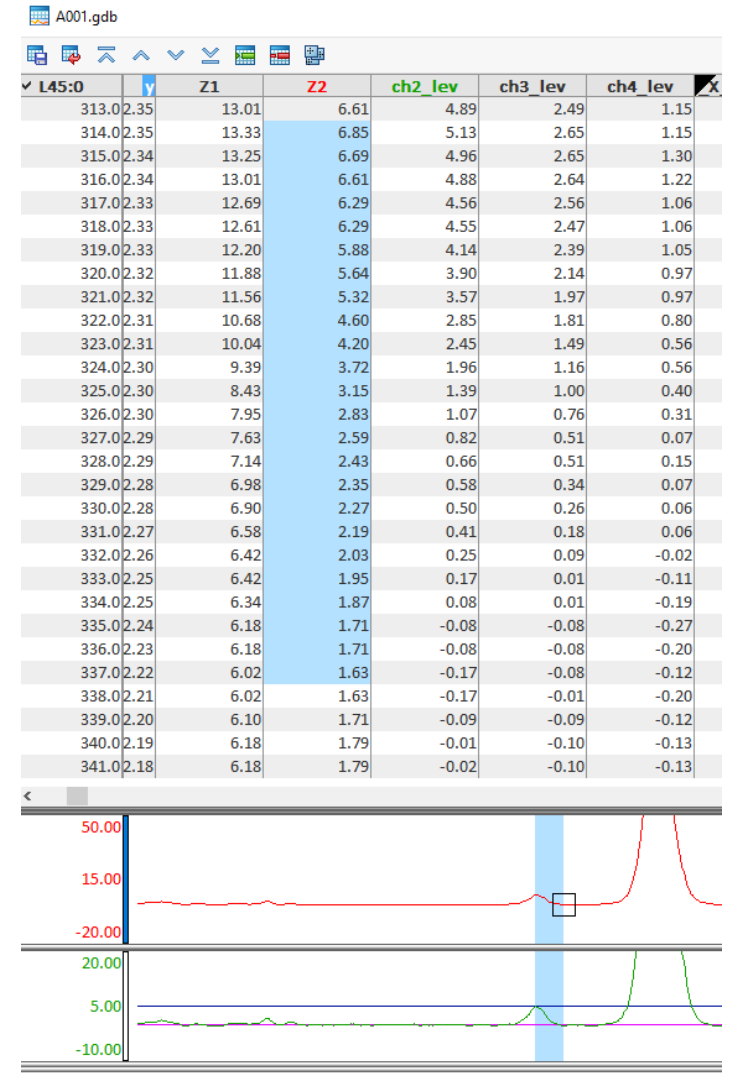| L45:0	Y	Z1	Z2	ch2_lev	ch3_lev	ch4_lev	X
313.0	2.35	13.01	6.61	4.89	2.49	1.15	
314.0	2.35	13.33	6.85	5.13	2.65	1.15	
315.0	2.34	13.25	6.69	4.96	2.65	1.30	
316.0	2.34	13.01	6.61	4.88	2.64	1.22	
317.0	2.33	12.69	6.29	4.56	2.56	1.06	
318.0	2.33	12.61	6.29	4.55	2.47	1.06	
319.0	2.33	12.20	5.88	4.14	2.39	1.05	
320.0	2.32	11.88	5.64	3.90	2.14	0.97	
321.0	2.32	11.56	5.32	3.57	1.97	0.97	
322.0	2.31	10.68	4.60	2.85	1.81	0.80	
323.0	2.31	10.04	4.20	2.45	1.49	0.56	
324.0	2.30	9.39	3.72	1.96	1.16	0.56	
325.0	2.30	8.43	3.15	1.39	1.00	0.40	
326.0	2.30	7.95	2.83	1.07	0.76	0.31	
327.0	2.29	7.63	2.59	0.82	0.51	0.07	
328.0	2.29	7.14	2.43	0.66	0.51	0.15	
329.0	2.28	6.98	2.35	0.58	0.34	0.07	
330.0	2.28	6.90	2.27	0.50	0.26	0.06	
331.0	2.27	6.58	2.19	0.41	0.18	0.06	
332.0	2.26	6.42	2.03	0.25	0.09	-0.02	
333.0	2.25	6.42	1.95	0.17	0.01	-0.11	
334.0	2.25	6.34	1.87	0.08	0.01	-0.19	
335.0	2.24	6.18	1.71	-0.08	-0.08	-0.27	
336.0	2.23	6.18	1.71	-0.08	-0.08	-0.20	
337.0	2.22	6.02	1.63	-0.17	-0.08	-0.12	
338.0	2.21	6.02	1.63	-0.17	-0.01	-0.20	
339.0	2.20	6.10	1.71	-0.09	-0.09	-0.12	
340.0	2.19	6.18	1.79	-0.01	-0.10	-0.13	
341.0	2.18	6.18	1.79	-0.02	-0.10	-0.13	

Discussion

…one more request after discussion is complete…