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Case Study: Improving Volume Estimates through Dynamic Work Strategies

Real-Time Remedial Demonstration Project Kickoff Meeting

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Case Study Background: Rattlesnake Creek Location and Layout

- Located in a heavily industrialized area near Buffalo, New York

- Seasonal stream approximately two kilometers long

- Relatively narrow meandering channel bracketed by wetlands approximately 100 meters wide

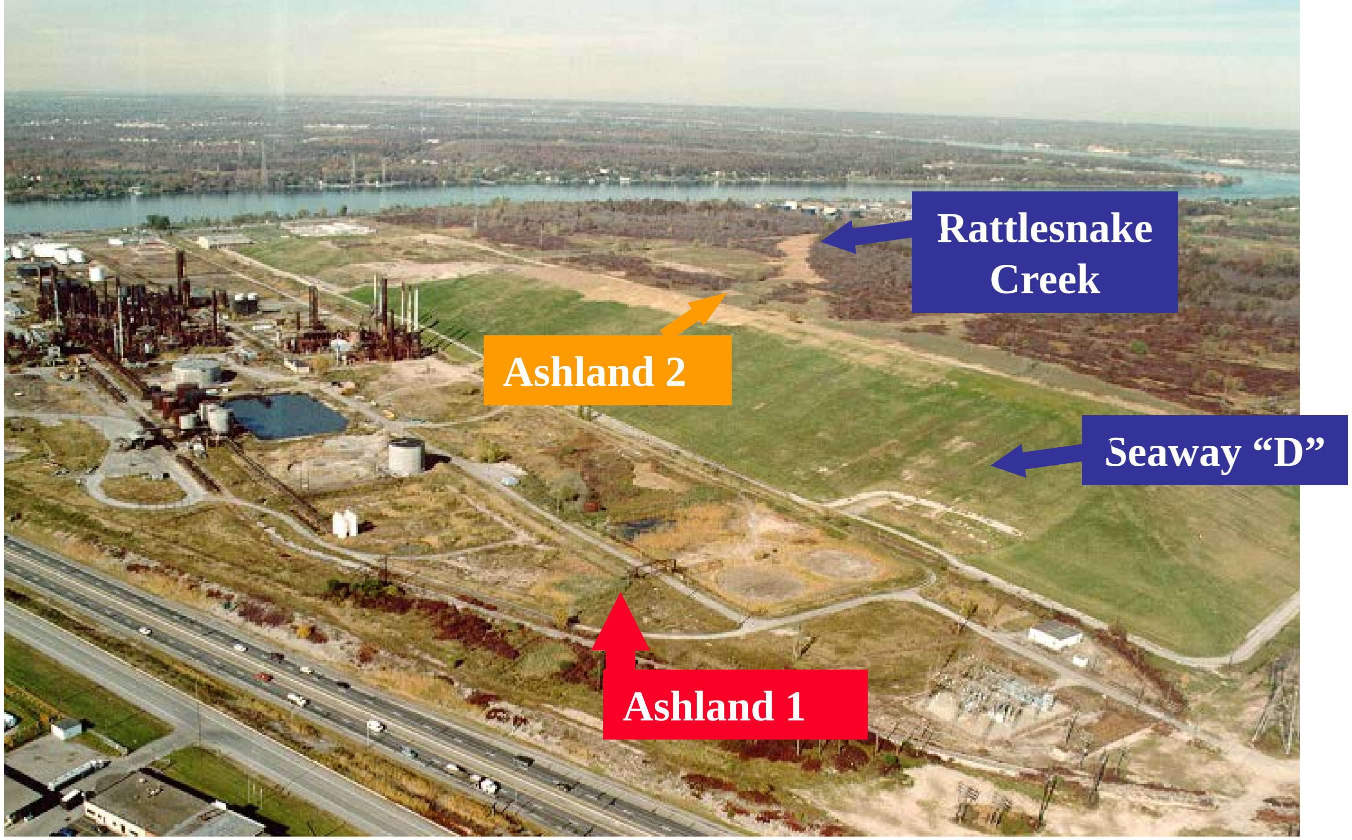
- Channel reworked over the years in a number of places

Case Study Background: RSC Location and Layout (cont.)

Case Study Background: RSC History

- MED-related activities underway at nearby Linde site in the 1940s and 1950s (uranium ore processing)
- Linde solid waste streams placed in Rattlesnake Creek watershed
- Waste streams contaminated with radionuclides
- Original RI/FS and associated ROD completed by DOE FUSRAP in early 1990s for Tonawanda sites
- Ashland 1 and Ashland 2 addressed by USACE FUSRAP program in late 90s
- Surrounding vicinity property work identified Rattlesnake Creek as a possible concern in 1998
- Attempted close-out of the creek failed in 2000 and 2001

Rattlesnake Creek
Tonawanda, NY



Case Study Difficult Issues
What Happened?

- USACE inherits RI/FS and ROD from DOE
- USACE Buffalo FUSRAP program making steady progress with Tonawanda sites until Rattlesnake Creek encountered
- Remediation at Ashland 2 pursues contamination into creek sediments
- ROD already signed, closure attempted without success
- Rattlesnake Creek an un-quantified liability and an obstacle to completion/ROD closure
- Community eager to redevelop the area

Case Study Background
Contamination Issues

- Contaminated sediments
- Contaminants of concern:
  - Radium (radium-226)
  - Uranium (uranium-238) (NYSDEC concern)
  - Thorium (thorium-230) (risk driver)
- Incomplete information on extent
  - Horizontal extent
  - Vertical extent

Case Study Background
Project Challenges

- ROD pre-dated knowledge of Rattlesnake Creek
- Thorium-230 impossible to “get” with real-time technologies, but driving COC
- Contamination buried for majority of creek with thickness and depth of contaminated layer unknown
- Costs driven by transportation and disposal, and consequently by excavated volume
- Water management huge cost issue
- Significant pressure to implement a fixed price contract
- Significant pressure to “get the volumes right”

Case Study Difficult Issues
Which Ones?

Laws & Regs Application Issues

- ROD signed that was written w/o an awareness of Rattlesnake Creek
- NYSDEC unhappy with uranium cleanup numbers

Very Incomplete CSM

- Little data to support nature and extent

Technical Limitations

- Thorium-230 risk driver, but analytics are very expensive (alpha spec analysis)
- No good real-time technique available
- Buried sediments/water management

Institutional Issues

- Heavy pressure to get volumes right
- Heavy pressure to use fixed price contract

Case Study Difficult Issues
Traditional Approach

- Apply ROD to Rattlesnake Creek issues
- Design excavation based on RI data set
- Develop closure data collection plan as part of remedial design
- Implement process as a time and materials contract
- Collect closure samples once excavation is complete

Case Study Difficult Issues
Traditional Approach Problems

- ROD not necessarily appropriate for Rattlesnake Creek
- RI data inadequate for accurate remedial design
- ***Excavated volumes always significantly exceeded project expectations***
- Closure issues emerge during course of closure sampling (i.e., results indicate unacceptable residual contamination)
- Time and materials contracts appear to be not cost-effective

Best Practices to the Rescue!

- "Explanation of Significant Differences" used to reconcile ROD with Rattlesnake Creek
- Explicitly state CSM and related conclusions
- Overall approach revamped to support a fixed price contract for remediation (i.e., Triad)
- Aim was to obtain a sufficiently mature CSM for remedial design purposes.

The CSM is your working hypothesis about the site's physical and programmatic realities

Best Management Practices
Draft Closure (Remedial) Strategy

- As part of ESD, derived site-specific activity concentration cleanup goals consistent with ROD
- Developed closure strategy (Final Status Survey Plan) consistent with MARSSIM
- Gained State and EPA concurrence on FSSP
- Based on existing data, estimate volumes and determine volume uncertainties
- Implemented an intensive pre-design/post-RI data collection program to:
  - Partially complete FSSP for areas believed to be clean
  - Assist in “nailing” extent for areas thought to be contaminated
- Make use of real-time techniques to gain some flexibility (i.e., dynamic work strategy) during data collection.

Pre-Design Investigation Objectives
Address CSM Uncertainty

- Demonstrate and deploy workable real-time methods
- Get estimated contaminated volumes good to +/- 5%
- Define excavation footprint (laterally/vertically) for fixed price contract
- "Test" CSM assumptions
- Fine tune final status survey process
- Close out areas that are expected to be clean

Best Management Practices
Investing in Social Capital

- Trust established between Buffalo District FUSRAP program and NYSDEC through Ashland 1 and Ashland 2
- Briefings held with EPA Region 2 to gain concurrence with overall approach
- EPA and NYSDEC involved at each step of process
- Secure web site established for sharing site data as it became available
- Local activists (CANiT) not consulted early on…more on that later…

Stakeholder issues and interactions are difficult issues.
Social capital is built by meeting commitments.

Best Management Practices
Social Capital Gains

- Clear definitions of acceptable and unacceptable site conditions and how they are defined
- Early identification of points of contention
- Transparent data sets to explain decision-making and support triage as necessary

Reduce off-line conversations as much as possible.
Remember to ask "why?"; don't just say "No."
Practice speaking with everyone.

Best Management Practices
Dealing with Contention

Contention:

1. What's the area of concern (CANiT)?
2. Can subsurface composite samples be used?
3. Definition of uranium goals (NYSDEC)
4. Class 3 area contamination status (NYSDEC)
5. Accounting for background (EPA)

How it was managed:

1. Identify with CANiT areas of specific concern and sample
2. Screen cores to look for elevated intervals
3. Agree to disagree, with remediation and sampling structured to avoid disagreements
4. Gain concurrence early and document
5. "Eat" background when interpreting sample data

Confront and deal with disagreements as they arise.

Best Management Practices
CSM Development

- Based on:
  - Historical disposal information
  - Ashland 1 and 2 remedial experience
  - Several hundred samples sprinkled sporadically down the creek's length (surface plus subsurface composites)
  - Recent aerial photographs
  - Crude topographic maps

Best Management Practices
Rattlesnake Creek CSM

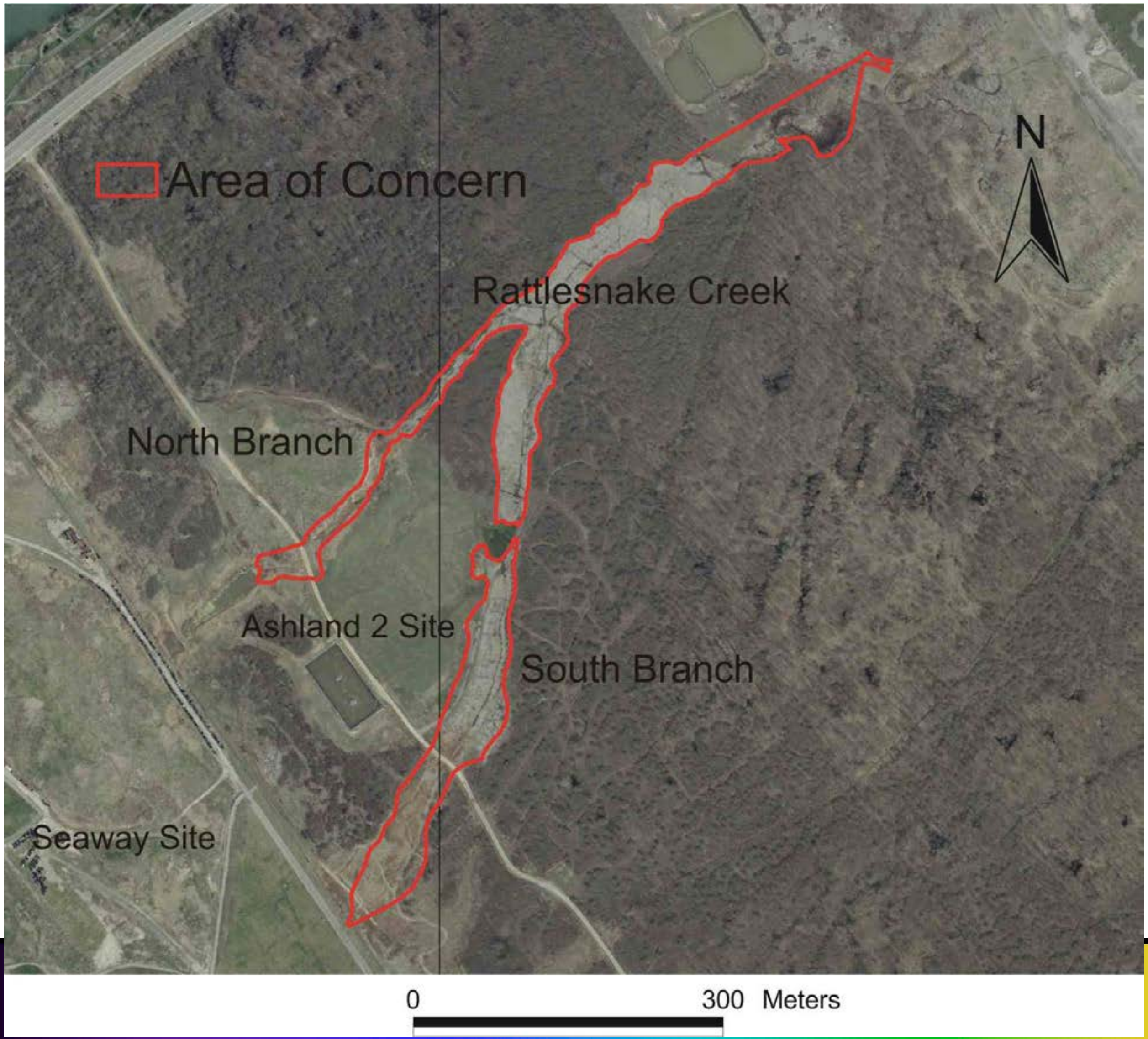
- Contamination in creek bed came from erosion and deposition of solid waste material:
  - Contamination should conform to flood plain of creek
  - Contamination should be in a clearly defined layer
  - Contaminant depth < 1 meter
  - Contaminants of concern should reflect Ashland experiences
  - Contaminants of concern should be reliably collocated
  - Contamination levels and vertical/lateral extent should be greatest closest to original solid waste and decrease down the creek

CSM concurrence critical for success.

Best Management Practices
Dynamic Work Strategy: High Level

- Addressed:
  - Area of concern definition uncertainty
  - Closure process uncertainty
  - Closure of “clean” areas
  - Data collection strategy performance uncertainties
  - Assumptions implicit in CSM

Best Management Practices
Area of Concern



Best Management Practices
DWS: High Level (cont.)

- Perform method applicability studies
- Develop Final Status Survey Plan
- Implement as part of pre-design data collection
- Revisit:
  - CSM
  - Area of concern
  - Definition of Class 1, Class 2, and Class 3 areas
  - Use of real-time methods
  - Process embodied in FSSP

Best Management Practices
Real-Time Technologies

- Real-time technologies key to containing costs while meeting performance goals
- X-Ray Fluorescence (XRF) identified for uranium quantification and (gamma walkover surveys) for surface soil screens (radium-226)
- Method applicability studies used for both to determine effectiveness and optimize for site

Best Management Practices
Real-Time Technologies

Rattlesnake Creek Experience
Methods Applicability Studies: XRF

- USACE/NYSDEC: no prior experience with XRF for uranium
- DOE Ashtabula site experience indicated XRF could be cost-effective and accurate
- Three fundamental questions:
  - What performance could be expected from an XRF for uranium?
  - What was the best deployment strategy for the XRF?
  - Would uranium work as a surrogate for thorium-230 in the field?

Rattlesnake Creek Experience
Methods Applicability Studies: GWS

- GWS successfully used for Ashland 1 and 2 targeting radium-226
- Observed radium-226 levels in RSC much lower and water a potential issue
- Performance of GWS for RSC an open question
- Two fundamental questions:
  - Could an investigation level be derived that consistently caught contamination issues w/o too many false positives?
  - If not, what alternative data evaluation techniques could be used to identify contaminated areas?

Best Management Practices
Dynamic Work Strategy: Field Level

- Address:
  - Definition of area of concern
  - Volume of contaminated material
  - Lateral extent of contamination
  - Vertical location and extent of contamination
  - Performance of real-time technologies
  - Assumptions implicit in CSM

Best Management Practices
DWS: Field Level (cont.)

- GWS scans used initially for banks to look for “CSM busters”, later for excavated surface surveys
  - Samples required for alpha spec analysis?
  - Excavation sufficient?
- XRF used to screen GeoProbe cores for presence and vertical position of contamination
  - Deeper?
  - Which samples for alpha spec analysis?
  - Stepping outside of presumed area of concern necessary?
- Lab results used to monitor performance of real-time techniques and satisfy FSSP data needs

High sample density was the appropriate technique for resolving uncertainty about nature and extent.

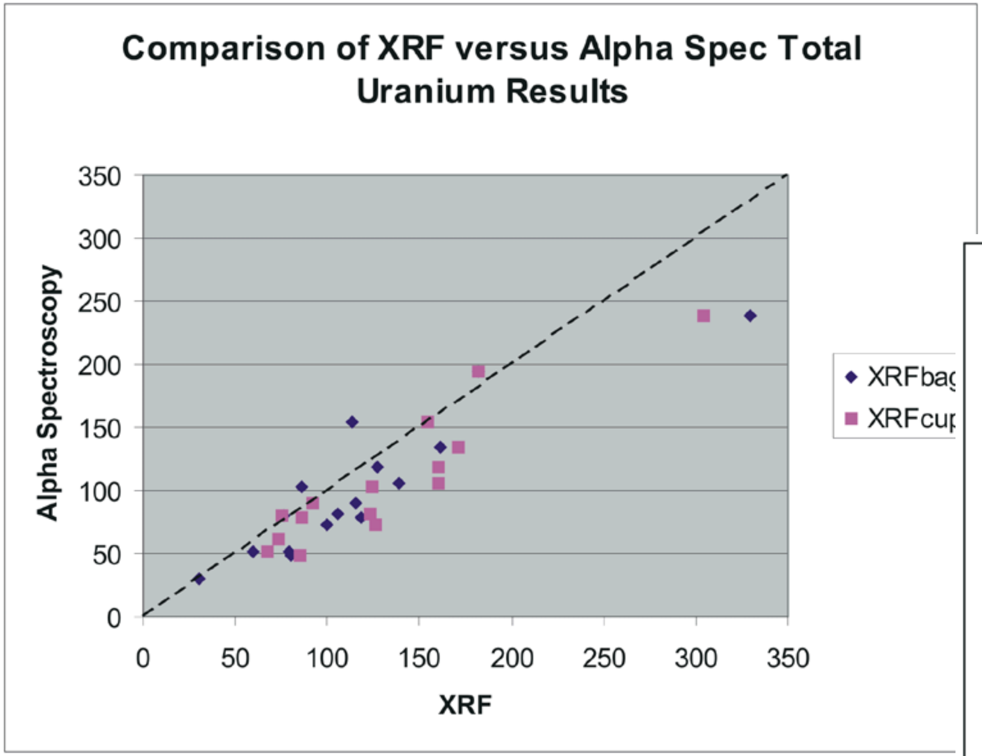
Rattlesnake Creek Experience
Applicability Study Results: XRF

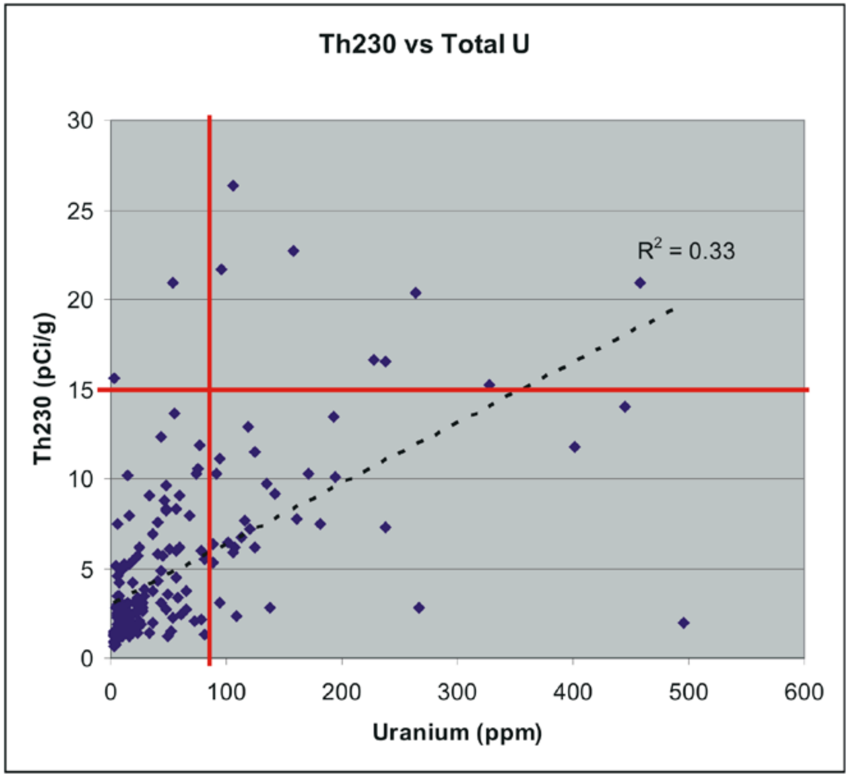
- Select archived samples measured by XRF in bags and in cups
- XRF work included evaluating measurement times and analytical error via replicates
- Regression used to compare XRF results with alpha spectroscopy data
- Non-parametric approach used to evaluate relationship between thorium-230 and total uranium levels.

Rattlesnake Creek Experience
Applicability Study Results: XRF (cont.)

- XRF showed excellent agreement with alpha spec (as good as gamma spec)
- XRF detection limits for uranium < 40 ppm
- XRF relative error less than 8% when uranium levels around 100 ppm
- Investigation levels derived using uranium as a predictor of thorium cleanup level exceedances:
  - < 90 ppm total U, thorium problems unlikely
  - > 300 ppm total U, thorium problems very likely

Rattlesnake Creek Experience
Applicability Study Results: XRF (cont.)





Rattlesnake Creek Experience
Applicability Study Results: GWS

- Targeted a “background” area within creek wetlands, and an area believed impacted
- Background area used to develop distribution of results (several hundred data points)
- Impacted area used to develop similar distribution and obtain paired locations where soil samples were obtained for analysis

Rattlesnake Creek Experience
Applicability Study Results: GWS (cont.)

- Initial attempts foiled due to extremely wet weather and standing water conditions within creek wetlands
- Data sets not promising:
  - Background showed a wide distribution of values that had significant overlap with “impacted” area
  - Likely background would change with changing soil moisture conditions and soil type as excavations proceeded
- GWS retained because still able to identify “screaming” areas

Rattlesnake Creek Experience
Pre-Design Data Collection Strategy

- GeoProbe on set grid (30’ spacing) to 1 meter depth
- Core split, dried, and each 6’ interval screened by XRF
- Decision logic:
  - XRF > 300: remediate, no alpha spec analysis
  - XRF < 90: clean, send surface and subsurface composite for confirmatory alpha spec
  - XRF interval > 90 but < 300 sent off for alpha spec analysis
  - Elevated uranium in bottom interval: deeper core required
- GWS conducted on all accessible areas with area of concern and along edges
- Biased surface sampling based on GWS data as needed
- Monitor XRF investigation levels, tweak as necessary
- Work captured in fixed price contract

Rattlesnake Creek Experience
Pre-Design Data Collection Strategy

Rattlesnake Creek Experience
Pre-Design Data Collection Reality

- For several cores, deeper coring was required to bound contamination depth *(expected)*
- Spoils piles along south branch encountered that turned out to be contaminated *(expected)*
- As work progressed, discovered that total U investigation level had to be changed *(expected)*
- Also discovered contaminants were not always collocated (***not anticipated!)***
- Brushing and characterization field work indicated original area of concern wrong in some areas ***(not anticipated!)***
- Heavy metal contamination flagged by XRF in addition to known COCs (raised mixed waste disposal issues) ***(not anticipated!)***

Rattlesnake Creek Experience
Pre-Design Data Collection Reality

- Wet spring weather prevented GWS access for bulk of area of concern ***(not anticipated!)***
- Contamination much more extensive than previously thought laterally and running down the creek ***(not anticipated!)***
- Encountered significant solvent contamination at toe of a push-out area along creek bed ***(not anticipated!)***
- Lots of contract change orders…***(not anticipated!)***…leading to…
- Another round of field work in fall of new fiscal year:
  - Extensions to area of concern
  - Push-out area
  - Bounding contamination
  - Acquiring better GWS data sets
  - Stakeholder concerns

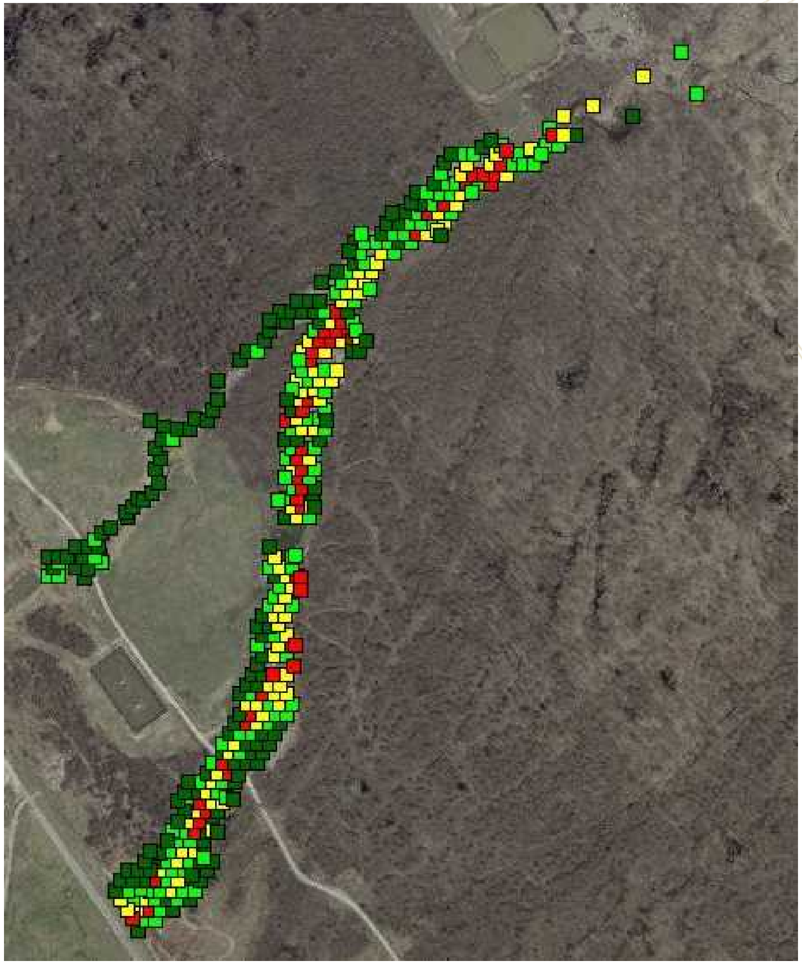
Rattlesnake Creek Experience
Pre-Design Data Collection Reality

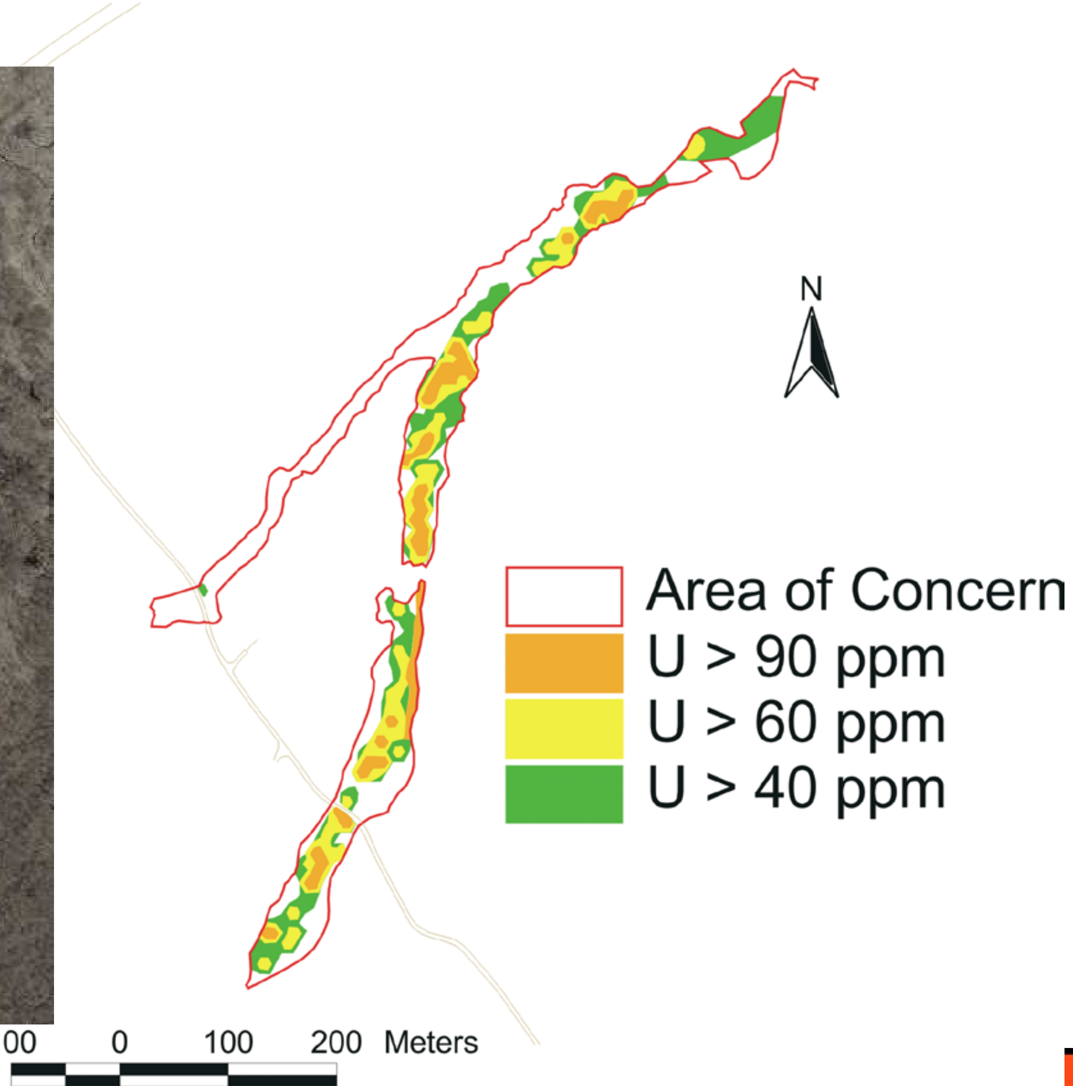
Rattlesnake Creek Experience
Pre-Design Data Collection Reality

Rattlesnake Creek Experience
XRF Performance

- 230 samples with total U from XRF analyses and alpha spectroscopy.
- Linear regression R^2 was 0.74: not great but adequate.
- Slope of 1.02 and y-intercept of -3 ppm indicating excellent calibration with no bias.
- Replicate measurements with the XRF yielded a relative standard deviation of less than 6% which was excellent.
- Cost per sample ~ $50
- XRF data became the foundation for volume estimation and excavation footprint design for bulk of creek (~3,000 results)

Rattlesnake Creek Experience
XRF Performance (cont.)





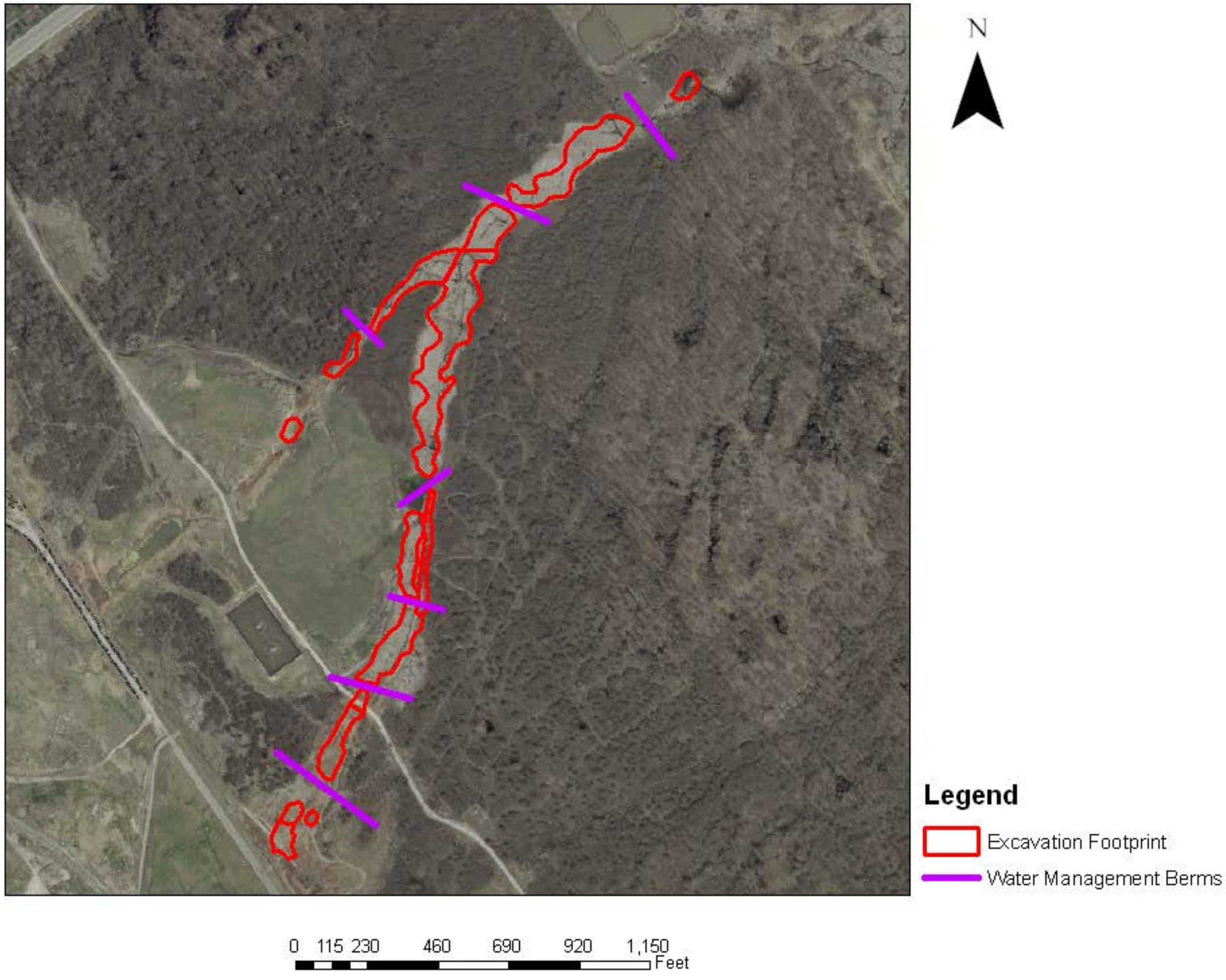
Rattlesnake Creek Experience
Gamma Walkover Survey Performance

- GWS data sets yielded too many false positives
- At best, GWS data allowed visual cues for spatial trends present and “screamer” identification
- Not necessarily reliable for demonstrating absence of contamination
- Consequently changed FSSP process to use multi-increment sampling for surface samples to improve FSS decision-making

Rattlesnake Creek Experience
Remedial Strategy

- Creek broken into water management units
- Water controlled by berms around each unit
- Creek remediated from upstream down, unit by unit
- Each unit held open max 3 days for FSSP sampling and evaluation to minimize water management costs
- Water from within unit treated while unit open
- Unit backfilled and free flow established after 3 days
- Work captured in fixed price contract

Rattlesnake Creek Experience
Planned Excavation Footprints

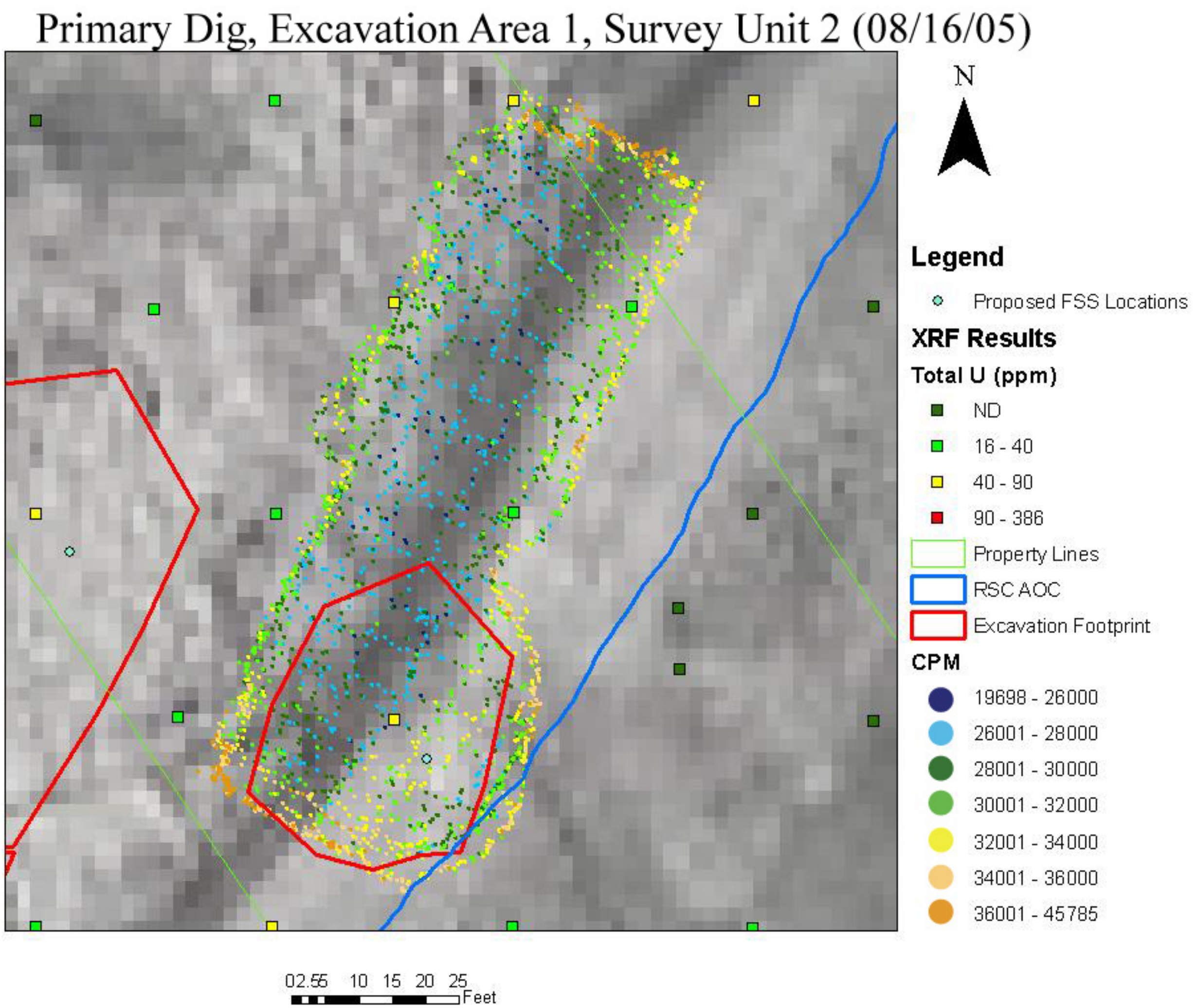


Rattlesnake Creek Experience
Remedial Reality

Rattlesnake Creek Experience
Remedial Reality (cont.)

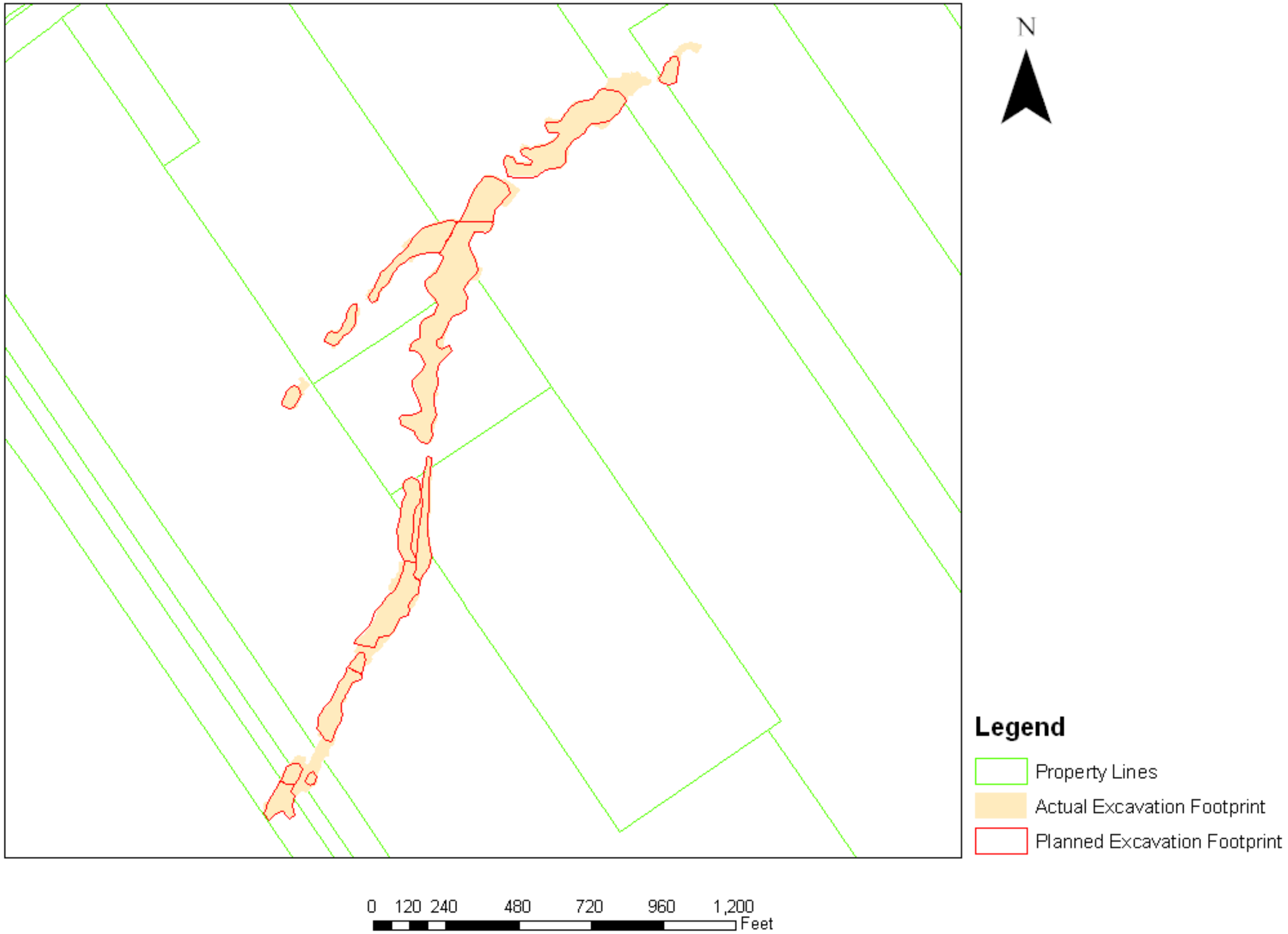
- Digs extended in some cases to capture buried contamination
- Most digs held open for two days at most before backfill
- In a couple of locations, needed to come back and re-excavate
- Tackled push-out pile successfully
- Finished on time and within budget
- Large uncertainty regarding actual excavated volumes

Rattlesnake Creek Experience
Remedial Reality (cont.)



Rattlesnake Creek Experience
Remedial Reality (cont.)

Rattlesnake Creek Experience
Final Excavation Footprints



Rattlesnake Creek Experience
Stakeholder Involvement

- CANiT: not involved with early planning
  - Had issues with area of concern definition
  - Identified locations where samples were desired
  - Fortunately second round of sampling allowed these to be addressed
- NYSDEC: fully engaged
  - Purchased own XRF for use during remediation
  - Staff person in the field for much of the dig, identifying areas of concern to NYSDEC using XRF
  - Early engagement paid off with closure of Class 3 area
- EPA Region 2: checked-out

Best Management Practices
Remediation Performance

What Has Triad Done for Rattlesnake Creek?

- Project completed on-time and within budget, a first for Buffalo FUSRAP
- First implementation of fixed-price contracts for Buffalo FUSRAP program
- Excavated volumes were within 10% of projected
- Concurrence obtained from State and local stakeholders

Best Management Practices
End State Achieved!

US Army Corps of Engineers.
Buffalo District

The Honorable John Paul Woodley, Jr.
Assistant Secretary of the Army
and
Lieutenant Colonel John S. Hurley
US Army Corps of Engineers
request the pleasure of your company at the
Ashland FUSRAP Sites
Closeout Ceremony
on
Thursday, the fourteenth of September 2006
at ten o'clock in the morning
at the project site
located on River Road
in the Town of Tonawanda, New York

RSVP by 24 August 2006
(716)879-4410
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Military: Duty Uniform
Civilian: Business Casual

Module Take-Aways

- CSM development and testing within a systematic planning framework critical to success
- Close coordination with stakeholders extremely important
- Implementing a Triad approach will change the way remedial actions are designed
- Addressing uncertainties pre-design can increase the likelihood of success in a remedial fixed-price contracting environment
- Availability of real-time technologies allows rapid identification and rectification of complications…expected and unexpected