Using GIS Analysis to Estimate MEC Clearance Costs
Introduction

- Project Objectives
  - Conduct munitions and explosives of concern (MEC) military range reconnaissance and site characterization (RECON) in support of planned military range construction activities
  - Produce documentation to be used in site design, construction planning, and remediation cost estimation

- Components of the RECON
  - Surveying a small percentage of the entire site (transects)
  - Estimating MEC contamination using survey results
  - Preparing written report and maps describing the findings

- Presentation will focus on GIS use
  - Managing and setting-up the project
  - Collecting necessary and relevant field data
  - Processing, interpreting, and using the results
  - Evaluating the accuracy of the estimating model
  - Recommendations for the future
Team Members

- Full Service environmental, facilities, infrastructure, and military munitions response firm
- Under contract with USAESCH for UXO/MEC projects since 2000

- US Army Engineering and Support Center, Huntsville
- Contracted by Directorate of Ordnance & Explosives
- Analysis by Geographic Information System (GIS) Team in Environmental Branch.
RECON Projects Completed

- Fort A.P. Hill, VA
  - UAC / Shoot House
- Fort Benning, GA
  - IPBC, MRF5, SGR1, FM2, and SGR2
- Fort Bliss, TX.
  - IPBC, UAC, DMPRC, DMPTR, and MPMG
- Fort Bragg, NC
  - DMPRC AVN
- Fort Hood, TX
  - CACTF, DAQR, DMPTR, QTR, and SQR
- Fort McCoy, WI
  - CACTF and SDR
- Fort Riley, KS
  - Trench, DMPRC and DMPTR
- EUSA Rodriguez, Korea
  - DMPTR
- Schofield Barracks, HI
  - CACTF, MOUT LF UAC Shoot House, and QTR
- Fort Stewart, GA
  - CACTF, DMPRC, and DMPTR
- Fort Irwin, CA
  - MOUT
- Fort Carson, CO
  - CACTF and DMPRC
Project Execution

- Development and Planning
  - Develop and customize handheld tools and forms
  - Design preliminary survey coverage for client approval

- Field Effort
  - Setup PDAs with GIS data and site specific dropdown lists
  - Deploy field teams onto the site
  - Process and conduct QA/QC of collected data daily
  - Produce status maps and make appropriate PDA revisions

- Data Analysis and Interpretation
  - Compile all daily datasets upon field demobilization
  - Analyze datasets and develop prediction models
  - Produce maps series and document processes used

- Model Evaluation
  - Evaluate predicted results against actual removal data
  - Analyze findings and discuss future course of action
Development and Planning

- **System Development goals**
  - Conduct all field work digitally
  - Easy-to-use for varied workforce
  - Collect necessary data for analysis
  - Reduce data entry using menus
  - Take corresponding photographs
  - Relatively light-weight and rugged
  - Powered to last in excess of 8 hours

- **Preliminary Planning**
  - Train field crews on collection techniques
  - Configure system appropriately for site
  - Planning for required coverage
  - Test system before deployment
Field Effort

Field teams Deploy for RECON

- Test equipment daily to ensure proper working order
- Follow planned routes and deviate only when necessary
- Locate, record position, and photograph surface items
- Count and record subsurface anomalies at regular intervals
- QC / QA Daily
- Update transects in PDAs removing those already completed
- Produce daily progress maps for client and field teams
Data Analysis and Interpretation

- **Prepare Data for Analysis Input**
  - Final QA/QC of raw field data
  - Calculate counts (per acre units)

- **Produce Prediction Models**
  - Use per acre counts for subsurface anomaly estimation grid creation
  - Use surface item counts for surface item estimation grid creation
  - Upon reality check, output values may require manipulation

- **Data Assembly Tasks**
  - Link photos with surveyed items
  - Format data into accepted standard
  - Prepare maps displaying results
Types of Data Captured

- GPS Grid Lines (Transects)
- Individual Points Data
  - Number Sub-surface Hits
  - Number of Surface Hits
  - Surface Hit Types & Quantity
    - Ferrous or Non-ferrous
    - UXO, DMM, MD, or CD
      - Nomeclature or Attributes of UXO (40mm, 125mm, flare, rockets)
  - Picture ID
  - Vegetation
  - Notes or Additional Description
Model Flow Diagram
Model Evaluation

- Determining the Models Accuracy
  - Compare predicted values to actual results from removal
  - Develop program that would automate evaluation process

- Current Results
  - Fairly accurate for total counts within removal area
    - Predicted 128,206 Anomalies
    - Conducted 92,968 Digs
    - A prediction in excess of 35,238
  - Sub-area predictions fluctuated significantly
    - On average predicting values in excess by 73
    - Values ranged from shortages of 1176 to excesses of 1167
RECON Applicability

- Currently Acceptable Uses
  - General site layout and area avoidance
  - Small scale contaminant mitigation costing
  - Identifying spatial trends of contamination
  - Overall site comparisons for more educated spending

- Unproven / Unadvisable Uses
  - Determining large scale contamination estimates
  - Least cost path analysis for utility trenching
  - Site engineering for least cost layout design
  - Assigning risk levels based solely on predicted levels
Development and Planning - Challenges

- **Preliminary Planning Challenges**
  - Keeping all team members on task with client expectations
  - Knowledge of Site geography was limited
  - GPS accuracy and transect separation
  - Testing equipment for extreme field conditions

- **System Development Challenges**
  - Assembling software and hardware solution
  - Technical limitation of hardware
  - Data output from system conforming to standards
  - Capturing adequate data for analysis and modeling
Development and Planning - Lessons Learned

- **Preliminary Planning Lessons Learned**
  - Communicate requirements and goals to all team members
  - Convey technical approach to client to ensure goals are met
  - Include GIS staff in planning stages and costing
  - Collect all possible data sources to establish survey transects
  - Keep GPS limitation in mind when creating survey transects
  - Document equipment performance in different environments

- **System Development Lessons Learned**
  - Standardize equipment to eliminate system variability
  - Using attached camera could crash system
  - Long menus impeded system processing speed
  - Collect only vital data to limit processing time
  - Engineer system for data standards compatibility
  - Programmatically force data entry to limit data gaps
Field Effort - Challenges

- **Personnel Challenges**
  - New set of contamination terminology
  - Change from normal operating procedures
  - Maintain core team members
  - Field team members technology savvy

- **Equipment Challenges**
  - Vegetation tangled and damaged cords
  - Battery life and camera failure
  - Data loss from system failure
  - Maintaining data integrity

- **Situational Challenges**
  - Actual distances exceeded planned routes
  - Reduced production from range conditions
  - Weather and terrain related errors and limits
  - Incomplete site communication coverage
Field Effort - Lessons Learned

- Personnel Lessons Learned
  - Maintain all team members proficiency with the system
  - Maintain consistent field team members

- Equipment Lessons Learned
  - Use rugged and waterproof equipment whenever possible
  - Carry backup batteries for all equipment
  - Consistently backup data throughout day
  - Devise equipment backup plan for failures

- Situational Lessons Learned
  - Cover planned transects for adequate model input
  - Use analog positioning for GPS coverage failures
  - Develop protocols for various weather and terrain
  - Set production goals based on actual field conditions
  - Bring multiple communication devices
Data Analysis and Interpretation - Challenges

- **Data Preparation Challenges**
  - Data QA/QC was hard from the office
  - Some per acre counts created high results
  - Various input data did not fit the model
  - Unordered photos created problems

- **Prediction Model Development Challenges**
  - Ambiguous terminology used in scope of work
  - Data interpretations produced erroneous results
  - Model changes led to spurious conclusions
  - Assumptions caused model fluctuations
  - UXO techs search for items regardless of location
  - Model validation not planned to verify accuracy
Data Analysis and Interpretation - Lessons Learned

- **Data Preparation Lessons Learned**
  - Have data manager on site to conduct daily QA/QC
  - ID bad data and exclude or correct before further analysis
  - Define acceptable limits for reporting and analysis

- **Model Development Lessons Learned**
  - Have client approve analysis methodologies ahead of time
  - Examine how input variables can alter data output
  - Stress the importance of data collection standards to team
Model Evaluation - Challenges

- Inherent Inaccuracies
  - Rounding / estimation of removal records
  - Surface items not counted during removal
  - Limitations of physical site characteristics
  - Surface debris masking subsurface counts
  - Human error

- Equipment
  - Equipment differences between RECON and removal work
  - Clearance depth and limitation of anomaly detection devices
  - Accuracy of GPS used in RECON effort
Model Evaluation - What’s Next?

- **Recommendations for Future**
  - Compare results as removal work occurs at RECON sites, and determine any disparity
  - Research potential improvements to model
  - Revise methodologies for RECON and removal efforts
  - Incorporate previous range type, and future range type into prediction model
  - Incorporate OE Risk model with Recon Risk (Encountering) model to automate process
Overall Recommendations

- **Procedural**
  - Establish data requirements early
  - Force data collection to match project requirements
  - Continue to revisit and modify processes
  - Between projects, allow time to train team on known issues and process improvements
  - Ensure field teams understand how small data variances on the front end may impact the data results on the back end
  - On-site data manager role

- **Equipment**
  - Fully train team on HW/ SW components
  - Invest in rugged equipment

- **Contractual**
  - Clear understanding of client needs vs. SOW requirements
QUESTIONS?
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