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FINAL REPORT FOR THE

EVALUATION OF UNEXPLODED ORDNANCE (UXO)

DETECTION TECHNOLOGY AT THE

STANDARDIZED UXO TEST SITES

ABERDEEN AND YUMA PROVING GROUNDS

MILITARY ENVIRONMENTAL TECHNOLOGY DEMONSTRATION CENTER
SURVIVABILITY/LETHALITY DIRECTORATE

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2. I, the undersigned, am aware of the intelligence interest in open source publications and in the subject matter of the information I have reviewed for intelligence purposes. I certify that I have sufficient technical expertise in the subject matter of this report and that, to the best of my knowledge, the net benefit of this public release outweighs the potential damage to the essential secrecy of all related ATC, DTC, ATEC, Army or other DOD programs of which I am aware.

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None.

14. ABSTRACT

The U.S. Army Environmental Command (USAEC) issued a Test Execution Directive to Aberdeen Test Center (ATC), Aberdeen Proving Ground (APG), Maryland, to plan, perform, and report the evaluation of unexploded ordnance (UXO) detection technology. The standardized UXO test sites at APG and Yuma Proving Ground (YPG) were used to (1) determine detection and discrimination effectiveness under realistic scenarios that varied targets, geology, clutter, topography, and vegetation; (2) determine cost, time, and manpower requirements to operate the technology; (3) determine the demonstrator’s ability to analyze survey data in a timely manner and provide prioritized “target lists” with associated confidence levels; and (4) provide independent site management to enable the collection of high quality, Ground Truth (GT), geo-referenced data for postdemonstration analysis. Testing emphasized the demonstration and evaluation of government and private industry ordnance detection systems.

15. SUBJECT TERMS

Overarching Report for the UXO Standardized Technology Demonstration Sites, APG and YPG, MEC.

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1.1 SUMMARY

1.1.1 Introduction

a. Technologies under development for the detection and discrimination of Munitions and Explosives of Concern (MEC), which include Unexploded Ordnance (UXO) and Discarded Military Munitions (DMM), require testing so that the performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland, and Yuma Proving Ground (YPG), Arizona. The test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in ordnance and clutter. Testing at the sites has been independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments. By hosting the demonstration of detection systems since 2001 and publishing performance results in a standard format on the Internet, the program has served as a tool to quickly assess the abilities of off-the-shelf (OTS), developmental, and state-of-the-art (SOTA) technologies. The following is a summary of where UXO detection technology stands based on the results from the program through May, 2006.

b. The task of assessing the performance ability of detection systems is difficult. One reason for this is that in real world UXO remediation sites, no two sites contain the same type, distribution, depth, and orientation of ordnance. Clutter distributions and anomalous magnetic signals also vary at each site. Lastly, terrain varies from site to site. Therefore, one system may excel at one site and perform poorly at another, depending on the system's abilities. This variability has also existed over the years at different UXO test sites and can bias the results when comparing different detection systems demonstrated at different test areas. Further, different performance metrics used between these areas can make comparisons difficult. For these and other reasons, the standardized sites have been established. The sites provide a continuing test bed with standardized test metrics to evaluate detection systems. Because of the large number and variety of Ground Truth (GT) items (GT simply refers to a test group of buried ordnance and clutter) at the sites, general performance merit can be evaluated with good confidence in results.

c. A summary of basic system types and test configurations used at the sites are set forth as follows. Three basic sensor types were tested at the sites, which include electromagnetic induction (EMI or EM), magnetometer (MAG), and radar varieties. These sensors were sometimes combined so that two types would be a part of one system. Such a system is referred to as a dual system. The sensors were typically mounted on one of five platform types for carriage. These types were towed, pushcart, hand held, sling, and litter (will be referred to as 2-man) varieties. The latter three types are considered man-portable types. The basic types of test areas used include open field (flat open), mogul (small mounds), wooded, and extreme desert types of terrains with YPG providing a sand soil and APG a silty loam type soil. A test grid, referred to as a blind grid, where potential item positions are known, is also part of the test areas. All test areas typically contained 14 standard ordnance types ranging from small submunitions to

155-mm projectiles. Many types of ferrous-based clutter items typically ranging in mass from approximately 0.005 to 25 kg were inter-dispersed in the test areas with the ordnance items.

d. Results from the sites should be viewed as those gained from a unique test instance. The merit of a system may not be fully represented because of variables such as system health, human error, operator skill levels, and environmental conditions. Nonetheless, results presented represent "what is possible" in various arrangements of the GT used and in that sense characterize SOTA technology.

e. The reader should be aware that detection rules at the sites were set up so that a "detection" is considered the ability to "discern" an "individual" item in the ground. The problem with this approach is that some items are very close together in the ground and signal returns from the combined items appear as "one" anomalous signal. Thus, if two items are side by side in the ground and the detection system indicates one anomaly, then only one detection is granted. These rules apply when items are closer than one meter to each other or equivalently, when half meter radii around each item "overlap". While the number of ordnance with overlap are small in the GT, the use of these rules will reduce and hence misrepresent detection scores if it is only desired to see if signals, whether from single or combined items, were detected. For the reader wanting to see results free from the effects of overlaps, GT variants have been created and are noted as having "no overlaps" or noted that distances between items are greater than one meter (all blind grid test areas inherently have no overlaps). Such results are the best indicator of detection ability for individual items. Conversely, results with overlaps have merit when comparing the performance of multiple systems to see if one system can better discern multiple items in close proximity than another. Also, comparing scores with and without overlaps gives some indication of the effect of signal masking from items in close proximity to each other.

f. The GT at the standardized sites contain items at or beyond (in some cases) the detection depth range of SOTA detection systems. This allows system limits to be determined. In real world cleanup sites, systems are not typically required to detect beyond ordnance depths of 11 diameters. Further, systems are typically evaluated in GT configurations that do not exceed this depth. Therefore, a majority of the results shown will use this GT depth limit when possible.

g. Finally, it is noted that sometimes discussion of GT details and their effect on scores are intentionally kept vague so proprietary GT information is not disclosed. This prevents gaming by demonstrators still using the sites. In time, as the sites are reconfigured, detailed information will be released.

1.1.2 Results/Findings

a. For the benefit of readers unfamiliar with the scoring metrics to be presented, the following short list of definitions is provided for easy reference (a more comprehensive list can be found in section 2.1.3). Further, to promote understanding of the naming conventions used in the plots, legend names consist of a basic sensor or system name followed by a platform type followed by a published report number (see section 2.3.1d for more details). Lastly, MAG systems can only detect ferrous (iron) items, so for these systems all non-ferrous items are removed from the GT for scoring unless otherwise noted.

(1) Probability of Detection in the Response Stage (P_d^{res}) - the number of ordnance detected divided by the total number of ordnance present in a test area (alternately, the percentage of ordnance detected divided by 100).

(2) Background Alarm - similar to a false alarm, a system response indicating an ordnance or clutter item is present where none exists.

(3) Probability of Background Alarm in the Response Stage (P_{ba}^{res}) - used only in blind grid test areas, the metric is the number of empty grid cells in which the system indicates an item is present, divided by the total number of empty cells (alternately, the percentage of empty cells indicated not to be empty divided by 100).

(4) Background Alarm Rate (BAR^{res}) - the number of system background alarms in a test area divided by an undisclosed constant and multiplied by an acreage ratio (open field/test area). The measure allows relative comparisons to be made between systems and test areas at a given proving ground.

(5) False Positive - a clutter item indicated to be an ordnance item after discrimination has occurred.

b. Blind grid values of P_d^{res} typically ranged from 0.7 to 1.0 at APG and 0.8 to 1.0 at YPG for all systems demonstrated when the GT was limited to an 11 diameter (D) depth. The lower scores at APG are attributed to a greater average GT depth. The APG results are shown in Figure 1. The APG blind grid results are shown because the grid had the highest number of systems demonstrated when compared with all other test areas and reflects a large cross section of UXO detection systems available. It is noted that the APG blind grid was dug up and reconfigured in the November, 2004 to April, 2005 time frame. Demonstrators with report numbers 680 and higher tested in the post-reconfiguration version of the blind grid. The new configuration is very similar to the old, so results should be comparable and are plotted for the reader's benefit (use for general comparison only).

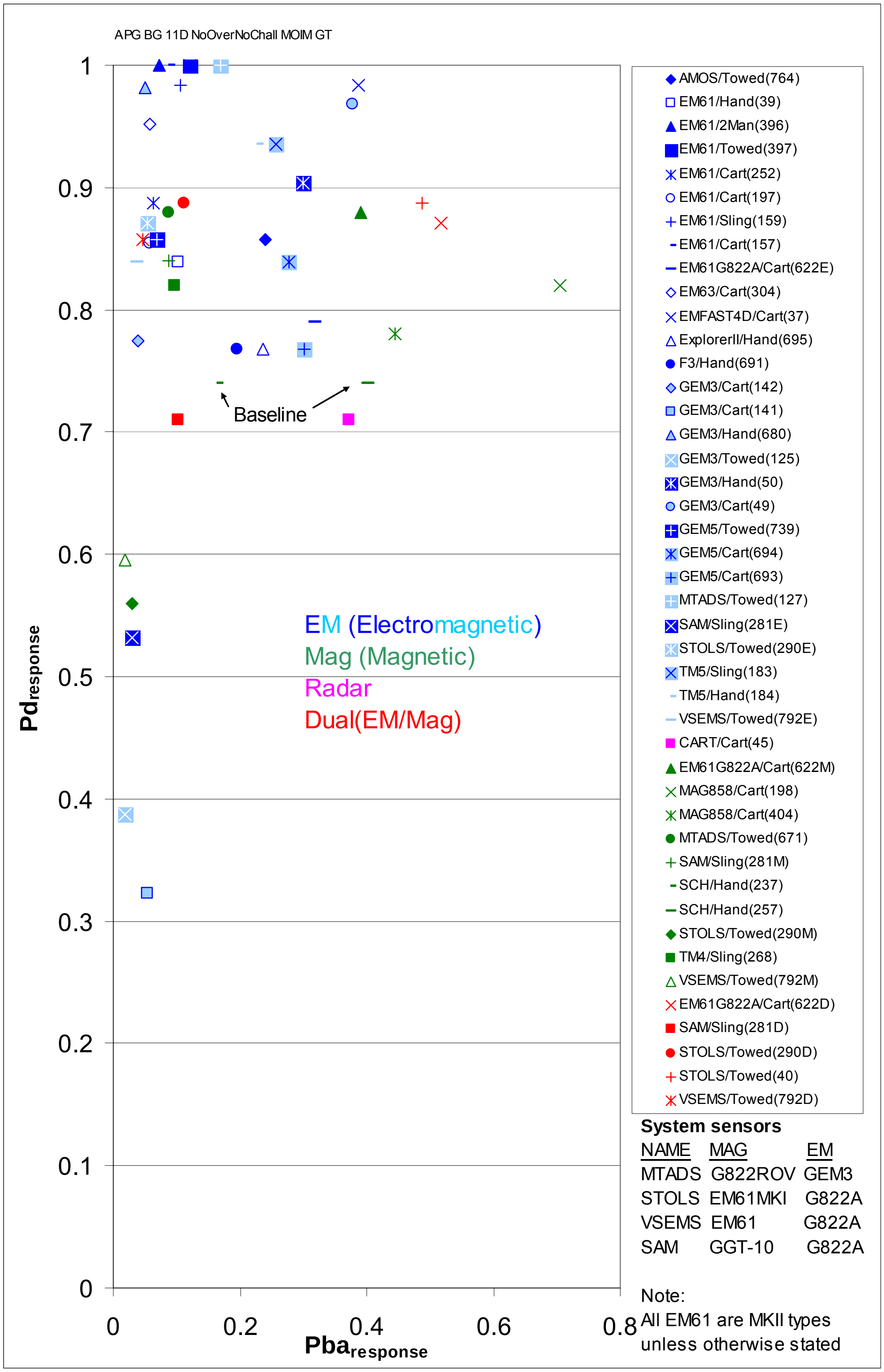

Figure 1. P_d^{res}, versus probability of background alarm (P_{ba}^{res}), APG blind grid results.

c. The blind grids at APG and YPG contain well spaced (2 meter) ordnance and clutter items buried at the center of grid cells in a flat, open area. Cell locations are known by demonstrators; therefore, their systems need only discern whether or not an item is present from a sensor response. Based on the results from both sites, it can be said that the best detection system sensors can find 100 percent of ordnance items in these simplest of test areas at the sites. The better systems had a 0.1 or less P_{ba}^{res} score, which means about 10 percent of empty cells were incorrectly declared to be occupied by an item. EM61 MKII and GEM3 sensors proved to be the best performers in the blind grid areas (both are EM types) with perfect detection rates and a small fraction of background alarms (in some cases zero).

d. A common result seen not only in the blind grids but also most test areas was that Schonstedt systems (the most common hand held system used in real-world applications, technically a flux-gate-type MAG) were outperformed by more complex systems with integrated Global Positioning System (GPS) and sensor data (digital geophysical mapping ability). Two Schonstedts were tested to provide a baseline result, which is shown in Figures 1 and 2.

e. Values of P_d^{res} versus BAR^{res} are shown in Figure 2 for systems demonstrated at the APG open field. This 13.7-acre field is filled with a much larger population of ordnance and clutter than the blind grids and has items at varying distances from one another. The results in Figure 2 are from a GT limited to an 11 D depth and with no items within 1 meter of each other (no overlap). Further, any areas of the field with power-lines, fences or wet areas are eliminated in the GT. A small portion of the field was reconfigured in the November, 2004 to April, 2005 time frame but was kept characteristically similar except for background noise (many items causing background alarms were removed). Demonstrators with report numbers 740 and 802 tested in the new version of the field. Their results are shown for general comparison only and likely have lower BAR scores than they would have had in the original field configuration (also, some noisy items were removed in an exploratory phase prior to reconfiguration which may have slightly reduced the BAR scores of report numbers 657, 298, 802, 740, 231, 406, 411 and 229).

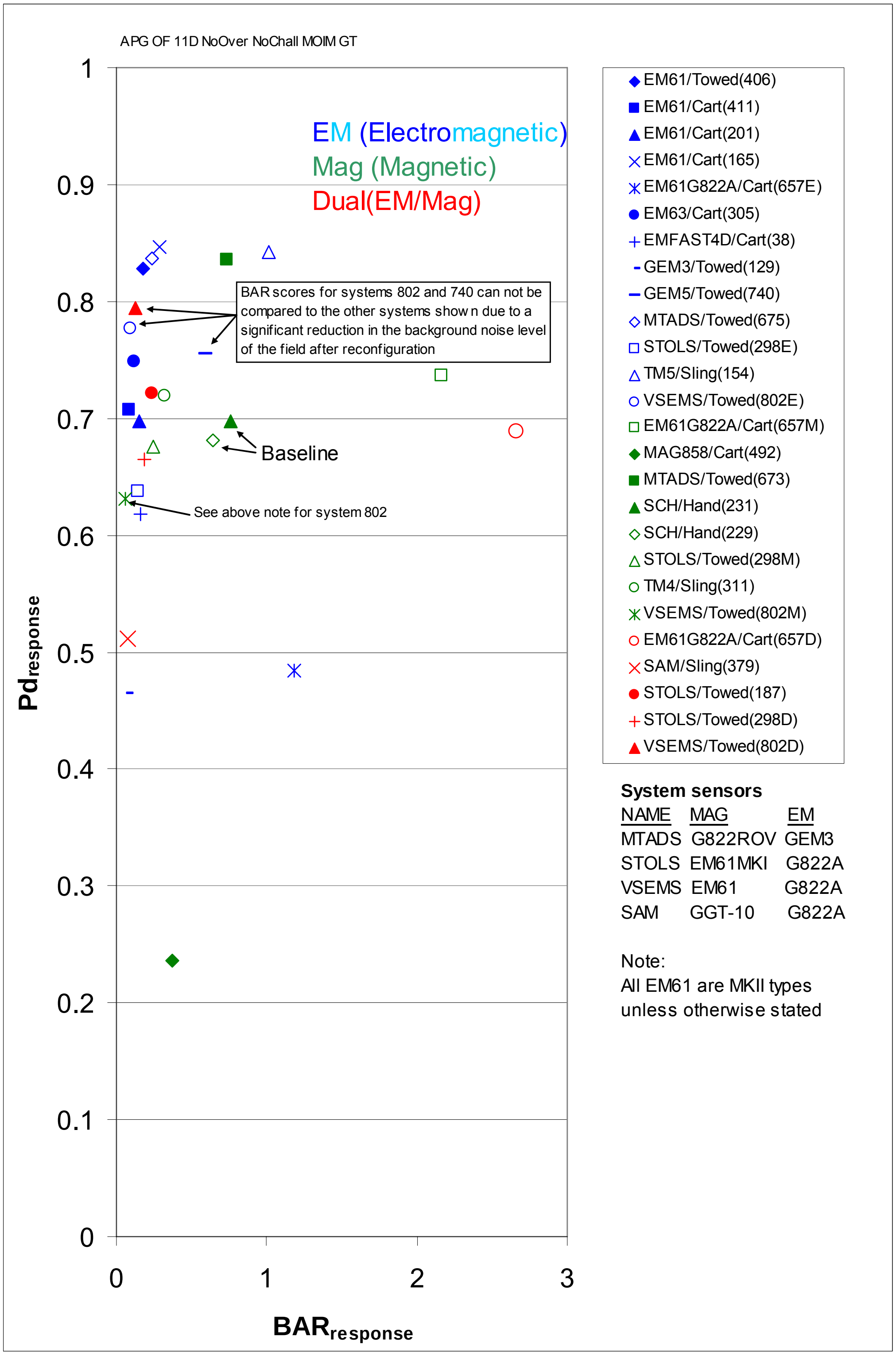

Figure 2. P_d^{res} versus BAR^{res}, APG open field results.

f. A significant reduction (~15%) in P_d^{res} when compared with the blind grid results is shown in Figure 2. This reduction is primarily driven by the potential locations of items being unknown (potential locations were known for blind grid), items closer to other GT causing signal interference (1 meter minimum spacing for open field, 2 meter minimum for blind grid), and a greater population of items of small mass/size. These and other drivers are discussed in greater detail later in this section.

g. As shown in Figure 2, better performers can keep the number of background alarms they produce to a relatively low level compared with all other systems demonstrated in the field. The number of background alarms at the APG open field was typically a few thousand or less for most systems. This number changed little after demonstrators reviewed their response stage lists to reject what they thought were non-ordnance items (termed “discrimination” stage processing).

h. Better performers in the open field areas were typically GEM-3, EM61 MKII, and TM-5 types of EM sensors, and an 822ROV MAG sensor. The 822ROV sensor had a relatively high (3x) background alarm value compared to the EM systems. An EM61 MKII/G822A dual system (EM/MAG) performed well but not as well as systems with the same sensors operating independently. All of the better performers were typically on a towed, cart, or sling type platform.

i. All systems demonstrated generally detected the same percentage, or less (APG), of intentionally buried clutter as ordnance in the open fields.

j. Relative performance results, as expressed by the percent difference from open field P_d^{res} results (100% represents twice the open field Pd result) for the various test areas, are shown in Figure 3, which are included to demonstrate the impact of various terrains on detection performance. Not all systems demonstrated are included in the figure. The GT used in the figure between a given test area and the open field baseline is the same (number, type, depth, orientation). Compared to performance in the open field, most systems experience an approximate 30 percent reduction in detection ability in rough or brush-laden terrains. Schonstedt systems are the exception to this generalization. It is also seen that the blind grids are much easier for systems than the open fields.

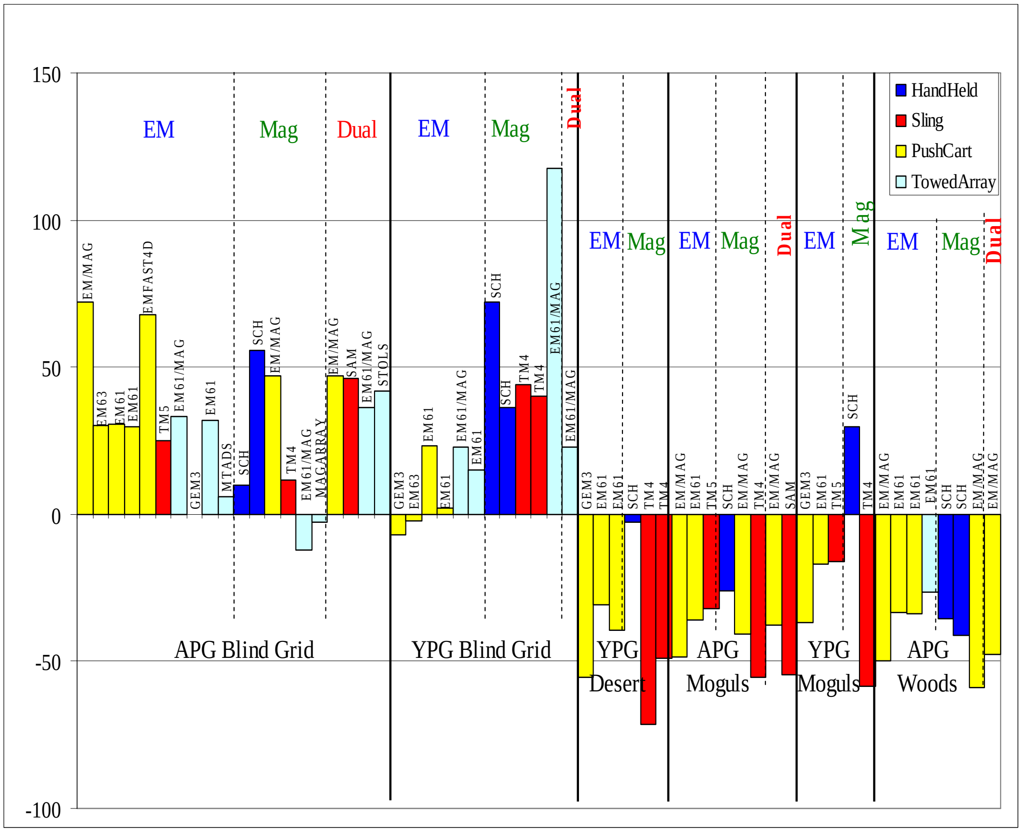

Figure 3. Percent difference in P_d^{res} score from open field baseline performance.

k. It was observed that towed array systems performed very well in both open field test areas and had some of the best detection scores. This platform technology is mature and has proven itself at the test sites. Further, it offers time and cost savings in large open terrains. The platforms do have accessibility issues as terrain becomes increasingly rough or filled with obstacles. In the more difficult areas to traverse or access, both carts and man-portable platforms typically performed best. In extremely rough or obstacled terrain like the woods or the moguls at APG, it appears that man-portable platforms perform best.

l. The discrimination abilities (ability to reject non-ordnance responses; see section 2.1.3 for more details) of the demonstrators/systems was minimal at best for the GT configurations at the sites. A test area with a more rudimentary GT configuration is needed at the sites to better evaluate what the technologies are capable of.

m. Analysis was performed on how well systems were maintaining proper lane spacing (spacing specified by the demonstrator). Most systems miss 1 to 5 percent of items they are capable of finding by not maintaining proper spacing. This is manifest as a quality control (QC) issue related to navigation for systems demonstrating.

n. Location error manifest by detection systems at the sites typically averaged from 0.15 to 0.35 m. One configuration achieved a 0.09-m value of average location error in the YPG open field. This system is the multi-sensor towed array detection system (MTADS) GEM-3/towed configuration (report no. 245). Uncertainty in the location of the GT by the test authority is estimated to be about 0.06 m. Therefore, the best location error may approach 0.03 m when this uncertainty is accounted for. Further analysis is needed to discern location error from signal interpretation error (in the sense of pinpointing the center of ordnance).

o. While location errors were in a good range for most systems, they tended to be distributed about their mean value in such a way that from 1 to 3 percent of the detectable population was not being scored as a hit. The location error in such instances exceeded the set radius about the GT, 0.5 m, which was considered a valid detection range. Better QC may eliminate this trend in the test results.

p. Detection rates at various depths were analyzed in terms of ordnance diameters, and results are presented in Figure 4 for the APG open field test area. In general, most systems start to experience a reduction in detection rates at depths between 5 and 11D. The GT used in Figure 4 contains no items within one meter of each other or items in challenge and wet areas. A more in-depth analysis of probability of detection versus depth was performed for systems demonstrated at the standardized sites (ref 5).

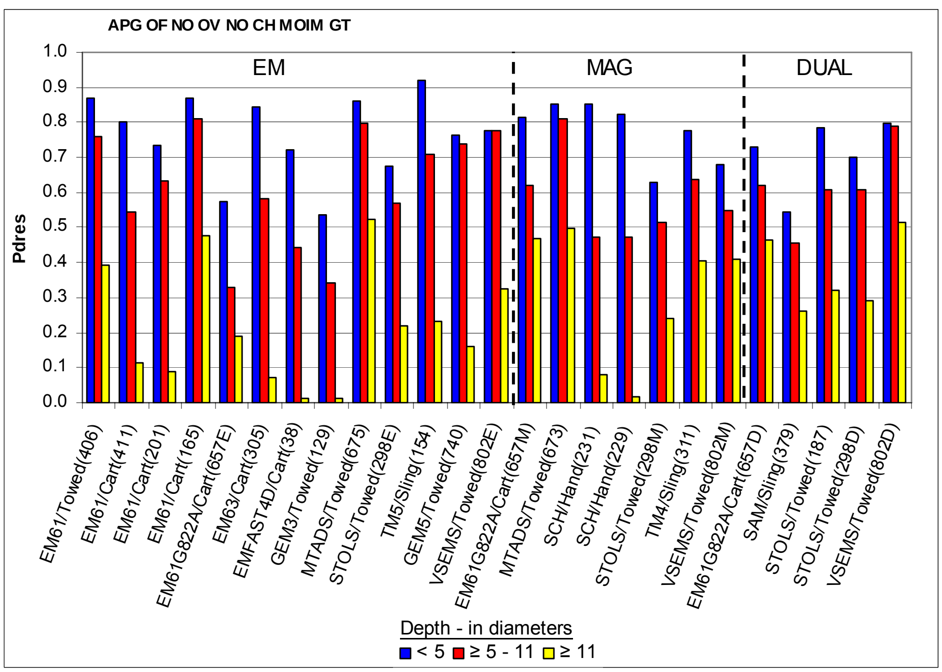

Figure 4. P_d^{res} as a function of depth in ordnance diameters, APG open field.

q. Detection rates for ordnance items at various distances to other ordnance or clutter items were examined for all systems. When an ordnance or clutter item is within approximately 1.5 m from a target ordnance item, P_d^{res} will typically start to decrease.

r. Two ordnance types were problematic for the detection systems tested: 20-mm projectiles and MK118 rockeye submunitions. Analysis of 20-mm projectile signals (magnetic field strengths) from MAGs indicates that signal-to-noise ratios of 2 to 1 or less are not uncommon for the deeper (>0.13-m) items. Further, a good portion of these items are affected by signal bleed over (i.e., signals from nearby items confusing detection) from items in close proximity. The MK118 items are aluminum-based and are not detectable by MAGs. Notable performance difficulties for these items were observed in the EM systems.

s. Detection rates for each ordnance type for all systems demonstrated at the open fields are included in Appendix G. The GT used was limited to 11D depth and contained items minimally spaced at 1 meter. Further, items in areas that were intermittently underwater, as well as items located next to fences and power lines, were removed from the GT used.

t. To account for all performance drivers affecting the detection systems, a limited (LIM) GT subset was created for the APG open field. This subset eliminates all identified contributors to performance degradation to see if resulting detection scores will approach 100 percent. The adjustments made are as follows.

(1) A minimum spacing of 1.5 meters was required for GT items (i.e., if an item was within 1.5 m of another item, both items were eliminated from the GT).

(2) If a GT item was not within one-half of the lane spacing (specified by the demonstrator) from a sensor of a system, it was eliminated from the GT set for that system. This could be done only for geophysical mapping systems, which provided proper data.

(3) GT depth was limited to 11D (i.e., items below 11D were eliminated from the GT).

(4) 20-mm projectiles and MK118 submunitions were eliminated from the GT.

(5) Items in challenge areas (e.g., power line, metal fence) were eliminated from the GT. Items in wet areas that were sometimes difficult to traverse were also eliminated.

u. Results for the LIM GT set at the APG open field are shown in Figure 5. APG LIM blind grid results, using GT modifications 2, 3, and 4 above, are also shown for comparison. New P_d^{res} levels in the open field are not at 1.0 but are higher, 30 to 66 percent, than standard GT results and ~10% higher than Figure 2 results. Four systems detected between a 0.92 and 0.94 level (see fig. 2 for background alarm scores). Other analysis shows that some of the P_d deficiency remaining is due to depth issues between 5 and 11D depths. It also seen that four systems achieve P_d^{res} = 1.0 in the blind grids using the modified GT (same as fig. 1). Some LIM predictions are not shown because raw data were not in a format conducive to processing.

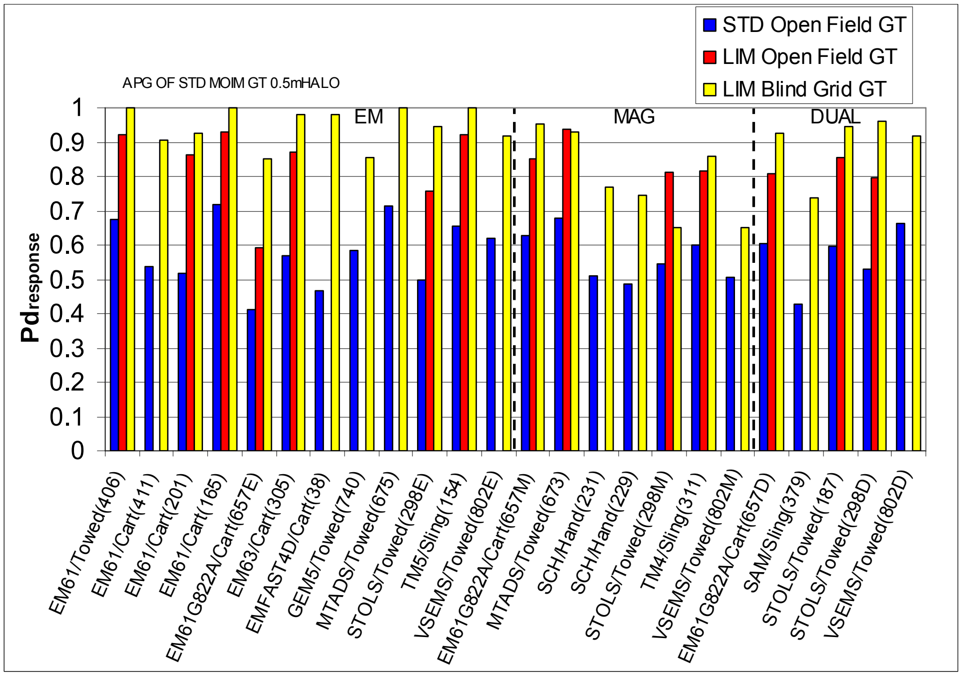

Figure 5. P_d^{res} for standard and LIM GT sets at APG.

v. Estimated production costs for the better performing systems are presented in Table 1 for each test area. The costs include setup, calibration, and demobilization efforts but not data processing, travel expenses, or costs to reacquire targets for flagging (i.e., mark for digging), as these excluded costs are highly variable. A wide range of costs due to terrain requirements are presented in Table 1; costs increased as terrain became rougher or more cluttered with brush. All costs shown are based on time, and number of personnel used (as demonstrated), and are estimated from the testing authority, not the demonstrators.

w. An estimate of site cleanup costs using a towed array system for UXO detection in the APG open field is shown in Figure 6. The system had a background alarm rate and false positive rate consistent with the best technologies demonstrated at the field. Reacquisition costs, digging costs for the false positives, and background alarms drove the overall site cleanup cost (43 percent). Thus, the need for better discrimination to reduce these numbers is evident.

TABLE 1. APPROXIMATE PRODUCTION COSTS BASED ON BEST P_d^{res}

Test Site Area	Cost/Acre	Associated Platform
APG open field	$500	Towed
YPG open field	$700	Sling, towed, cart
YPG moguls	$900	Sling
APG moguls	[a]$1900	[a]Sling
Desert extreme	$3000	2-man
Woods	$3200	Sling, 2-man, hand held

[a]This data point represents the second-best P_d score. The system with the best P_d score (32 percent above second-best) had a very high background alarm rate associated with it and took a very long time to survey. The cost would be about $10,700 per acre.

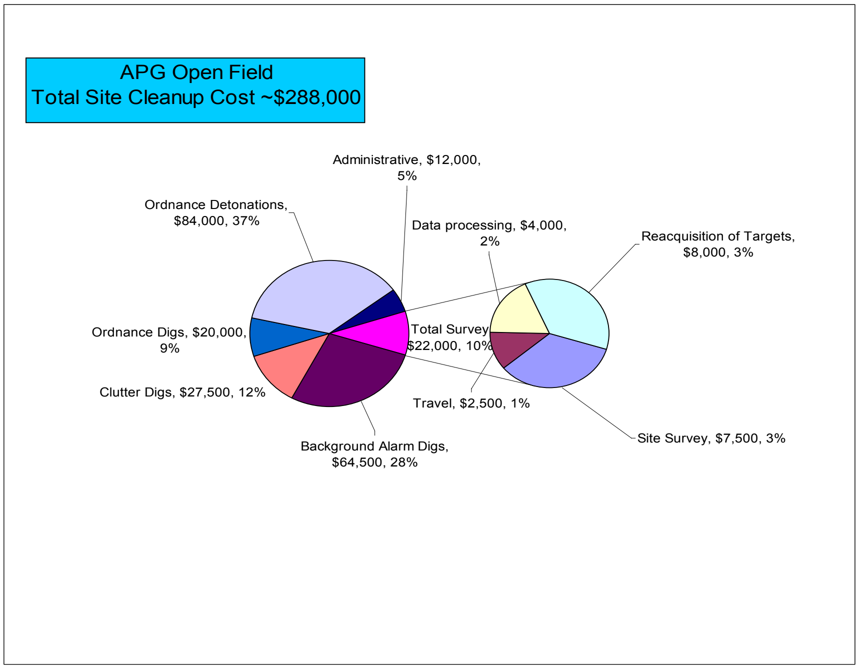

Figure 6. Total cost estimate for site cleanup.

x. Ranges of current production rates for the SOTA systems demonstrated at the sites are shown in Figure 7. The towed array systems in open field areas are leading the way for efficient use of time. Conversely, in the most extreme terrains, where man-portable units provide the only access, the best detection performance requires the most time (low production rate) in surveying. Production rates include setup, calibration, and demobilization. The rates shown will likely increase for larger site sizes as setup, calibration, and demobilization become a smaller part of overall time spent. Further, the test environment may have been somewhat more relaxed than a production environment, in which cost and time are of greater importance. The same considerations should be applied to cost estimates.

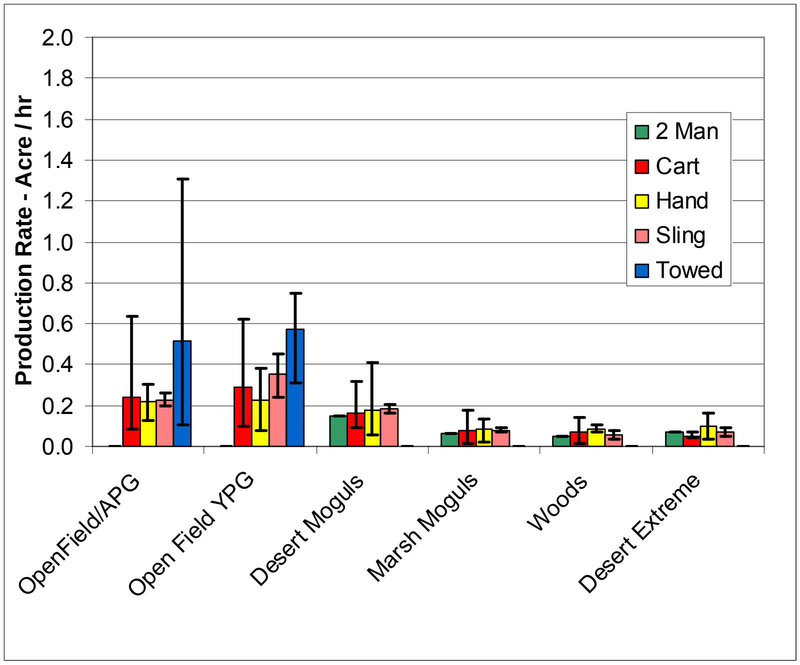

Figure 7. Production rates demonstrated at standardized sites.

y. Digital Geophysical Mapping (DGM) technology (mapping signal strength versus GPS derived location and then interpreting data) was typically used by more than 90 percent of the systems demonstrating. These systems commonly outperformed MAG and flag technology represented by two Schonstedt baseline systems. The Schonstedt systems performed well in harsh terrains and demonstrated some of the best location errors. Trade-off studies on reacquisition cost requirements for geophysical systems versus flagging systems were performed (flagging technology marks targets in real time and does not need to reacquire positions). A total cost analysis for a geophysical mapping system, as shown in Figure 6, indicated reacquisition costs were significant. However, it was found that the reacquisition costs for geophysical mapping systems were much less than the increase in dig costs from high false positive, and background alarm rates produced by a MAG and flag system (Schonstedt), in the APG open field.

z. Dual system technology first demonstrated at the standardized sites had detection rates that were near average when compared with all systems demonstrated. The fusing of data in these systems yielded performance gains when compared with constituent sensor performance from the same platform, but by a few percentage points or less. The most recent dual system brought into the sites performed well above average, and fused data results yielded significant improvement, 8 percent, over best constituent performance. Typical detection scores of SOTA dual systems are shown in Figure 8 for the APG open field. The full standard GT is used for the EM and MAG constituents, as well as the fused “dual” result, and contains both ferrous and non-ferrous items (MAG constituents can detect only ferrous items, which is why the scores are lower). This was done so the performance contributions of the parts and the whole could be compared. It is noted that the VSEMS system shown was tested after the APG open field reconfiguration. The new field configuration is very similar to the original except that a large amount of items causing background noise were extracted. This likely contributed to the lower BAR score that the VSEMS demonstrated (see section 2.3.9.1 for further details).

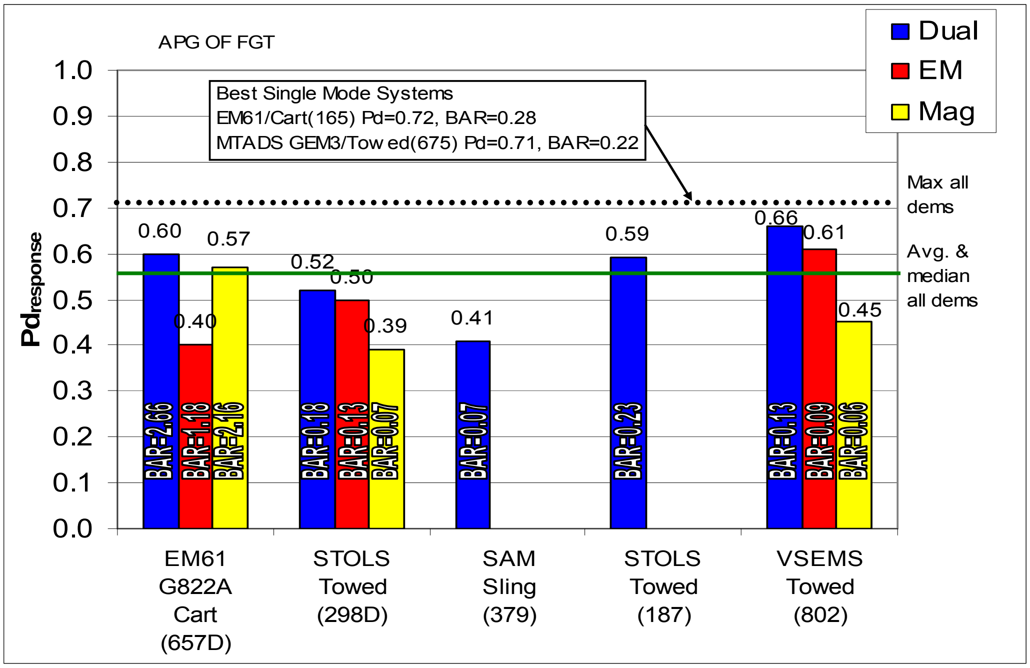

Figure 8. Dual system performance at APG open field, ferrous and non-ferrous items in GT.

aa. Data sampling trends for the detection systems demonstrated were analyzed. The purpose of the analysis was to look for a correlation between the number of data samples taken within a 0.5-meter radius (detection halo radius) of a target, versus the probability of a target's being detected. The number of samples divided by the halo area was defined as sample density. For the better performing EM systems, a well-defined trend existed between P_d^{res} and sample density. The best performer had the highest sample density. More analysis is needed with regard to parameters that drive sample density and how they relate to detecting GT at the sites for given sensor characteristics. Such trends may provide insight into design considerations or operational considerations for detection systems. More data are needed from MAG systems to establish trends.

bb. An analysis was also performed on combining dig lists from different systems to see how many systems were needed to optimize detection at a site (assuming best combinations). At the YPG open field, three systems were required before diminishing P_d^{res} gains resulted. If the GT spacing is set at a minimum of 1.5 meters, the number of systems required approached two. The best combinations were different EM systems.

1.1.3 Recommendations

a. Navigation Quality. Educate vendors on performance penalties possible when lane spacing is not rigidly maintained at the test sites. Encourage vendors to implement or improve quality checks on sensor coverage at survey sites.

b. Discrimination and Test Site.

(1) The most challenging aspect of the test sites for discrimination may be the large number of ordnance types that demonstrators are expected to handle at one time. The standardized test sites need easier GT configurations (at graduated levels of difficulty) set aside for the development of discrimination ability. More robust calibration lanes with items mimicking exact depths and orientations of items in the test areas may be helpful. Periodic releases of GT are needed from the test sites to provide demonstrators with data to refine discrimination algorithms.

(2) A possible QC would be to require real-time processing/discrimination at the test sites in the future and require resurvey of low confidence items in the discrimination stage.

c. Test Site.

(1) As the standardized test sites will have continued use, any reconfiguration efforts should strive to retain an area in which the original GT configurations are maintained so that technology advancement can be tracked in the coming years by comparative means.

(2) Implement better emplacement controls upon reconfiguration efforts at the standardized sites to ensure less positional error in the GT.

1.1.4 Conclusions

a. The SOTA UXO detection systems are currently challenged by targets close to other ordnance/clutter, by targets at depths approaching 11D and beyond, and by the smallest of munitions (20-mm projectiles). Such target distributions are site-specific; thus, the level of their occurrence in real-world cleanup sites will dictate development emphasis. When these types of targets do not exist at a survey or test site, and good QCs are in place for navigation, detection rates of 0.90 to 0.95 would be expected by the best detection technologies in a UXO field of "diverse" composition. In the same type of UXO field with only large types (>~105mm) of ordnance, probability of detection would be at or near 1.0. Detection rates may drop by as much as 30 to 40 percent in severe terrains.

b. The percentage of GT detected at a site similar to the test sites can be increased by employing additional systems to survey the site. Results from the test sites indicate that the benefits of this practice diminish past the addition of one or two systems depending on the spacing or density of the GT.

c. Geophysical mapping technology has consistently outperformed Schonstedt systems in all but the most severe of terrains. Results have demonstrated that this technology should be used when at all possible/practical.

d. Minimal discrimination ability of SOTA UXO detection systems is seen at the standardized sites. Based on cost payoffs of any discrimination ability, justification for investments in the sites to promote the development of this ability appears warranted.

e. Performance measures of detection and discrimination ability for UXO detection systems representing the SOTA were evaluated, and the results presented were based on testing performed at the standardized UXO testing sites. The standard GT composition and test metrics at the sites allowed comparative analysis of various system technologies. Insight was gained into identifying parameters affecting system performance. Possible QC issues were identified. Optimal configurations were identified. Furthermore, improvements to the test sites have been suggested on the basis of the test result findings. In summary, SOTA UXO detection technology, as demonstrated at the standardized UXO testing sites, has been characterized and evaluated on a broad but general level. Therefore, the objectives of the standardized UXO test sites have been met.

1.2 TEST OBJECTIVES

a. The objective of the Standardized UXO Technology Demonstration Site Program is to evaluate the detection and discrimination capabilities of a given technology. The evaluation is to take place under various field and soil conditions using inert munitions and clutter items positioned in various orientations and depths in the ground.

b. The evaluation objectives are as follows:

(1) To determine detection and discrimination effectiveness under realistic scenarios that vary targets, geology, clutter, topography, and vegetation.

(2) To determine cost, time, and manpower requirements to operate the technology.

(3) To determine the demonstrator's ability to analyze survey data in a timely manner and provide prioritized target lists with associated confidence levels.

(4) To provide independent site management to enable the collection of high quality, GT, geo-referenced data for post-demonstration analysis.

1.3 TESTING AUTHORITY

a. The Standardized UXO Technology Demonstration Site Program is a multiagency program spearheaded by the U.S. Army Environmental Command (USAEC). The U.S. Army Aberdeen Test Center (ATC), Aberdeen Proving Ground (APG), Maryland, and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP), and the Army Environmental Quality Technology Program (EQT).

b. USAEC issued a Test Execution Directive (app H, ref, 1) to ATC, APG, Maryland, to plan, perform, and report the evaluation of UXO detection technology at the Standardized UXO Test Sites, DTC Project No. 8-CO-160-UXO-021.

1.4 TEST CONCEPT

This test utilized the UXO test sites created at APG and YPG with emphasis on the demonstration and evaluation of government and private industry ordnance detection systems.

1.5 SYSTEM DESCRIPTION

a. Sensor Types.

(1) EM induction. EM sensors are typically packaged with one or more induction coils, which typically include transmitter and receiver types. When varying current is passed through the transmitter coil(s), current will be induced in any metallic object nearby. The nearby metallic objects will therefore change the inductance of the coils in the sensor. Mutual induction between the receiver and transmitter coils is often determined by sending large pulses of current through the transmitter coils and then measuring the electric potential induced in the receiver coil as a function of time. Another method is to measure the electric potential induced in the receiver coil as a function of frequency while alternating current (AC) at several frequencies is passed through the transmitter coil. EM sensors not only detect all metallic objects, but they can also begin to measure material properties such as the conductivity of buried objects. By mapping the measurements of an EM system as a function of location, it is possible to estimate the depth and some geometric parameters of any metallic object that is buried in the ground.

(2) MAG. MAGs utilize the characteristic of most UXO items being made with iron (ferromagnetic material). MAGs passively measure the magnitude of the magnetic field around an item as a function of location over the area to be surveyed. By taking into account the magnetic field of the earth, the magnetic field of ferromagnetic items buried in the ground can be calculated. There are numerous ways a MAG can measure a magnetic field in a given direction. One popular method is to measure the optical transmissivity of a chamber filled with a gas whose absorption coefficient varies as a function of the applied magnetic field. Another popular method is to build an inductor around a material whose magnetic permeability varies as a function of the total applied magnetic field. MAG systems typically consist of at least three

devices measuring the magnitude of the magnetic field in different directions so that the total magnitude and direction of the magnetic field vector can be accurately measured. By measuring the magnitude of the magnetic field as a function of location, it is possible to estimate the depth and shape of any ferromagnetic item buried in the ground.

(3) Dual mode. As both EM and MAG sensors have advantages and disadvantages, it is often advisable to survey a site using both sensor types. It would save time and money to conduct both surveys simultaneously by mounting EM and MAG sensors on the same platform. Such an arrangement must overcome the fact that the magnetic field induced by the EM sensor's transmitter coils will interfere with the MAG sensor's measurements. However, system designers have produced several methods to overcome this limitation. One method is to synchronize the MAG measurements with the pulses sent through the transmitter coil of the EM sensor so that the effects of the EM sensor can be taken into account. Another method is to mount the MAG sensor in locations near the EM sensor where the magnetic field produced by the transmitter coils is minimized. Such dual mode systems are designed so that they combine the advantages of both the EM and MAG sensors.

(4) Ground-penetrating radar (GPR). GPR systems work by transmitting electromagnetic radiation into the ground (frequency ranges are typically between 50 and 700 MHz). This radiation will bounce off of any metallic object buried in the ground or any dielectric discontinuity and then return to the surface. By analyzing the signal that returns from the ground, GPR systems can estimate the size, shape, and depth of the objects that are buried.

b. Platforms. Depending on the size of the sensors, performance considerations, and the terrain to be surveyed, it becomes necessary to configure UXO detection systems in many different ways. The platforms on which sensors are mounted can affect accessibility, ease of navigation, and, ultimately, detection performance. The platforms of the systems that have surveyed the Standardized UXO Test Sites are classified based on their architecture. Below is a list of the different platform types that have surveyed the sites:

(1) "Hand held" platforms are small enough for a single person to carry the detection system. Although some operators may attach these platforms to their body, the platforms are small enough that this is unnecessary. They can be operated by holding them with hands alone.

(2) "Sling" platforms are small enough to be carried by a single person but are large enough that it is not possible to carry them without attaching them to the operator's body with a sling or some other device.

(3) "2-man" platforms are small enough to be carried by hand but large enough to require more than one person. Only one type has been used at the sites to date and is more properly referred to as a "litter" platform (resembling a rigid hospital stretcher).

(4) "Cart" or "pushcart" platforms are large enough to require wheels to support the size or weight of the system but small enough that the operator can still push or pull the detection system without the need of a vehicle.

(5) "Towed" (often referred to as "towed array") platforms are so large that they must be towed using some type of vehicle. Usually, multiple sensors (typically in an array) drive the size requirement.

c. Some systems have separate data processing units connected by a cable to the survey platform and carried by an individual. The above definitions refer only to the platform carrying the sensors.

d. Systems that can be carried are also typically designated as "man-portable" systems. Thus, the three general types of platforms used are man-portable, cart, and towed platforms.

SECTION 2. SUBTESTS

2.1 STANDARDIZED UXO TEST AND EVALUATION PROGRAM

2.1.1 Introduction

a. Technologies under development for the detection and discrimination of munitions and explosives of concern (MEC) (i.e., unexploded ordnance (UXO) and discarded military munitions (DMM)) require testing to characterize performance. To that end, Standardized Test Sites were developed at APG and U.S. Army Yuma Proving Ground (YPG), Arizona. The test sites provide diversity in geology, climate, terrain, and weather as well as in ordnance and clutter. Testing at the sites was independently administered and analyzed by the government to characterize technologies, track performance with system development, and compare performance of different systems in different environments. Daily weather logs were maintained and are provided in Appendix B.

b. The Standardized UXO Technology Demonstration Site Program is a multiagency program spearheaded by the USAEC. ATC and ERDC provide programmatic support. The program is funded and supported by ESTCP, SERDP, and EQT.

2.1.2 Test Site Description

Tests were performed at APG and YPG. Each test center contains one calibration area and four test areas for evaluating UXO detection systems. The APG and YPG sites are shown in Figures 2.1-1 and 2.1-2. Descriptions of the test sites are presented in Tables 2.1-1 and 2.1-2.

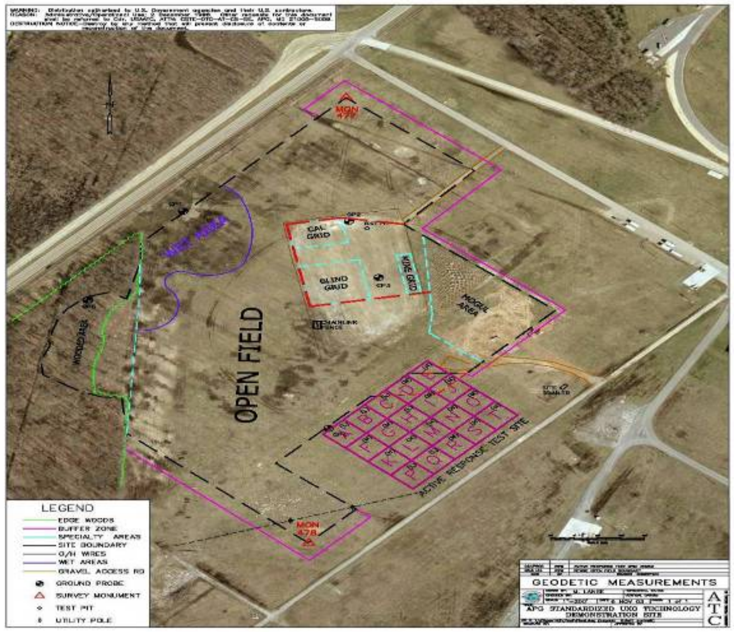

Figure 2.1-1. Layout of the APG UXO test site.

TABLE 2.1-1. APG TEST SITE AREAS

Area	Description
Calibration grid	Contains 14 standard ordnance items buried in six positions at various angles and depths to allow demonstrator to calibrate their equipment.
Blind grid	Contains 400 grid cells in a 0.48-acre site. The center of each grid cell contains ordnance, clutter, or nothing.
Open field	A 13.68-acre site containing open areas, dips, ruts, and obstructions that challenge platform systems or hand held detectors. The challenges include a gravel road, wet areas, and trees. The vegetation height varies from 15 to 25 cm.
Woods	1.35-acre area consisting of cleared woods (tree removal with only stumps remaining), partially cleared woods (including all underbrush and fallen trees), and virgin woods (i.e., woods in natural state with all trees, underbrush, and fallen trees left in place).
Mogul	A 1.30-acre area consisting of two areas (the rectangular or driving portion of the course and the triangular section with more difficult, non-drivable terrain). A series of craters (as deep as 0.91 m) and mounds (as high as 0.91 m) encompass this section.

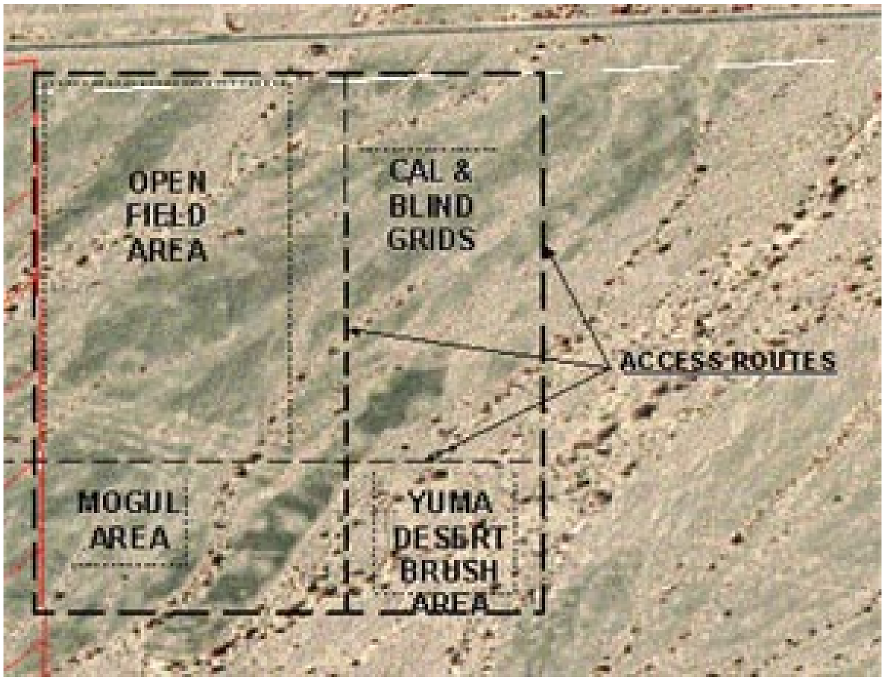

Figure 2.1-2. Layout of the YPG UXO test site.

TABLE 2.1-2. YPG TEST SITE AREAS

Area	Description
Calibration grid	Contains the 15 standard ordnance items buried in six positions at various angles and depths to allow demonstrator equipment calibration.
Blind grid	Contains 400 grid cells in a 0.43-acre site. The center of each grid cell contains ordnance, clutter, or nothing.
Open field	A 15.38-acre site containing open areas, dips, ruts, and obstructions, including vegetation.
Desert extreme	A 1.23-acre area consisting of a sequence of man-made depressions, covered with desert-type vegetation.
Mogul	A 2.64-acre area consisting of two areas (the rectangular or driving portion of the course and the triangular section with more difficult, non-drivable terrain). A series of craters (as deep as 0.91 m) and trenches (as deep as 0.91 m) encompass this section.

2.1.3 Scoring Methodology

a. Terms and definitions relevant to scoring can be found in Appendix A. The appendix is an excerpt from The Standardized UXO Technology Demonstration Site Scoring Records that are produced and published by ATC. The following paragraphs are a summary of metrics from the appendix that are most relevant to analysis performed in this report.

b. Scoring in its most basic form requires the understanding of three definitions, which are:

(1) Ground Truth (GT) - Represents a set of items buried (emplaced) by the test authority at known locations, depths, and orientations in a given test area. The GT comprises both ordnance (submunitions, grenades, mortars, and projectiles) and clutter (scrap steel) items.

(2) Anomaly - Location of a response (signal) from a detection system deemed to warrant further investigation by the demonstrator for consideration as an emplaced ordnance item.

(3) Detection Radius or Halo Radius - The radius about the center of a ground truth item which traces out a detection circle or halo. An anomaly within this radius is considered a detection. This radius is set at 0.5 meter at the standardized sites. For ordnance items that are greater than 0.6 meter long, an elliptical halo is used. The minor axis of the halo is 1 meter wide and the major axis is the length of the ordnance projected onto the horizontal plane plus 1 meter (0.5 m on each end).

c. A demonstrator will submit a diglist of anomalies to the test authority for scoring. The list will typically contain "response stage" data, which include location coordinates and signal strengths from anomalies in a given test area. When the scoring committee processes the list it counts the number of ordnance and clutter items in the GT with anomalies located within their halos. These numbers are respectively divided by the total number of ordnance and clutter in the GT for the area. The result is P_d^{res} (probability of detection in the response stage or fraction of overall ordnance detected) and P_{fp}^{res} (probability of false positive in the response stage or fraction of overall clutter detected).

d. All anomalies outside of halos are considered background alarms (similar to false alarms). The total number of background alarms is divided by a constant (known only by the scoring committee) proportional to the test area size and the resulting metric is termed BAR^{res} (background alarm rate in the response stage). Since the constant used in the calculation is unknown, BAR^{res} can only be used as a relative means of comparing background alarm rates between areas or between systems.

e. Based on the configuration of the GT at the standardized sites and the defined scoring methodology; there exists the possibility of having anomalies within the overlaps of halos and/or multiple anomalies within a single halo. Overlaps typically occur in dense areas of GT called "clusters" where items are closer than one meter to each other. The challenge to score such areas is whether to consider an anomaly representing the combined signals of multiple items as a detection of all GT items involved or to allow only one anomaly to be associated with one GT item (closest to the anomaly) in the cluster. The former approach is a legitimate means of detecting multiple items. The latter approach has been used to date in scoring reports from the sites and is used in this report. This approach provides a measure of how well individual items can be "discerned" in such difficult areas. It can be argued that the drawback of the approach is that a system may not be able to discern many items in a cluster, consequently getting a low Pd, but it may very well be detecting all of the items, through one combined signal, and therefore the Pd is misrepresentative. Further, it can be argued that cluster results should be separate, regardless of scoring approach, because they bias the measurement of true ability to detect an individual ordnance item (this problem is addressed in this report by creating an alternate GT set which does not include overlapping items, i.e. closer than one meter to each other). The following scoring logic is implemented for overlaps and multiple anomalies:

(1) When multiple anomalies exist within a single halo, the anomaly with the strongest response is assigned to that particular GT item (smallest distance from GT item is used if strengths are equal).

(2) For overlapping halo situations, ordnance has precedence over clutter (anomalies are first matched with ordnance, remaining anomalies are matched with clutter). The anomaly with the strongest response is first assigned to a GT item (smallest distance from GT item is used next). Remaining anomalies are retained until all matching is complete.

(3) If anomalies remain "within" halos after matching is complete they are thrown out (one anomaly allowed per GT item) and are not considered in the analysis. In a sense they are considered redundant (target halo they are in has already been detected).

f. The scoring methodology for the blind grids is slightly different. There are no "halos," only one meter square grid cells. The grid cells contain either ordnance, clutter or are empty. If a cell contains an emplaced item, that item is located at the center of the cell. The demonstrators submit a list of cell addresses and indicate a response level for each cell. They also submit a threshold response value. Any response values above this threshold are considered anomalies and any at or below are considered noise (empty cell). If an anomaly exists in a cell with an emplaced GT item, the item is considered detected. Knowing the total number of ordnance and clutter emplaced in a grid, P_d^{res} and P_{fp}^{res} can be calculated. The background alarm metric for the grids is P_{ba}^{res} and is the total number of empty cells with anomalies in them divided by the total number of empty cells (or the fraction of total empty cells which were indicated "not" to be empty).

g. Demonstrators not only provide anomaly signal strengths and locations but they also provide a ranking of how likely any given anomaly is an ordnance item (higher number equals greater confidence level). This ranking may be based on algorithms or human judgment. A threshold ranking value is provided by the demonstrator above which it is believed all ordnance items are included. The scoring committee scores the list in what is termed "discrimination stage" processing.

h. In the discrimination stage, Pd is calculated again based on the number of detected ordnance in the dig list that are above the discrimination threshold value. The result is P_d^{disc}, which is the fraction of total ordnance in a testing area that have been detected and correctly identified.

i. P_{fp} is also calculated again counting all detected clutter items above the discrimination threshold value (clutter being called ordnance) and dividing by the total number of clutter. The result is, P_{fp}^{disc}, which is the fraction of total clutter in a test area that have been detected and called ordnance.

j. Background alarm metrics are calculated in a similar manner as above, counting all anomalies above the discrimination threshold for which no ordnance or clutter can be associated. This number is divided by the same constant as in the response stage to find BAR^{disc}. In the grids, the number of empty cells with anomaly rankings above the discrimination threshold is divided by the total number of empty cells to find a background alarm probability or P_{ba}^{disc}. P_{ba}^{disc} is the fraction of total empty cells in which it has been indicated that ordnance resides after discriminating.

k. Systems are also scored on EFFICIENCY (E) and REJECTION RATIOs (R_{fp} & R_{ba}), which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list while rejecting the maximum number of anomalies arising from non-ordnance items. E measures the fraction of detected ordnance (response stage) retained after discrimination while R_{fp} and R_{ba} measure the fraction of false positives and background alarms from the response stage that have been rejected. Optimum scores for these metrics are 1.0 (indicating 100 percent retention of ordnance and 100 percent rejection of false positives and background alarms after discriminating).

2.1.4. Description of Ordnance

Typical ordnance items embedded throughout the UXO test sites are shown in Figures 2.1-3 through 2.1-18. All ordnance together, with the exception of the 500-pound bomb and the M75 submunition (these two types are buried at limited test areas), is shown in Figure 2.1-19. A description of these ordnance items, as well as additional embedded clutter is presented in Table 2.1-3.

Figure 2.1-3. CTG, 81-mm, M374, mortar inert with fuze.

Figure 2.1-4. CTG, 60-mm, M49, mortar inert with fuze.

Figure 2.1-5. Projectile, 57-mm, inert.

Figure 2.1-6. Bomb, Mark (MK) 118 rockeye, submunition, inert (with plastic fin).

Figure 2.1-7. Bomb, BLU 26, inert submunition.

Figure 2.1-8. Warhead (WHD), M230 inert projectile for 2.75-inch rocket with inert fuze.

Figure 2.1-9. Projectile, 105-mm, HEAT, M456 A1, inert.

Figure 2.1-10. Projectile, 105-mm, M603, inert.

Figure 2.1-11. Bomb, inert submunition, BDU 28.

Figure 2.1-12. Projectile, 155-mm, M483A1, inert.

Figure 2.1-13. Projectile, 40-mm, MKII, inert.

Figure 2.1-14. Projectile, 20-mm, M55, inert.

Figure 2.1-15. Grenade, 40-mm, M385 inert.

Figure 2.1-16. Bomb, M42, submunition, inert.

Figure 2.1-17. Bomb, M75, submunition, inert (found only at YPG).

Figure 2.1-18. Bomb, 500-pound, inert.

Figure 2.1-19. Composite of ordnance items.

TABLE 2.1-3. MUNITION TARGETS

Type	Nomenclature	Length, mm	Width, mm	Aspect Ratio	Weight, lb	Description	Size
20MM	20MM M55	25	20	1.25	0.25	The projectile is composed of alloy steel and has a small copper-rotating band.	S
40MM	40MM MK II	179	40	4.48	1.55	The thin-walled projectile is composed of steel. The projectile nose is internally threaded to receive the fuze. The projectile is assembled with either a brass or steel cartridge case containing a percussion primer that is crimped to the projectile by means of a 360^{o} crimp. There is a thin copper-rotating band affixed at the base of the munitions.	S
40MM	40MM M385	80	40	2	0.55	The cartridge is a fixed round of ammunition. It consists of a one-piece solid inert aluminum projectile body together with a copper-rotating band that is press-fitted into an aluminum bichambered cartridge case assembly. The chamber is sealed at the bottom with an aluminum base plug that is crimped to the base of the cartridge case.	S
M42	SUBMUNITION	62	40	1.55	0.35	The projectile is composed of steel.	S
BDU-26	SUBMUNITION	66	66	1	0.95	This item is composed of ferrous metal.	S
BDU-28	SUBMUNITION	97	67	1.45	1.7	This item is composed of ferrous metal.	S
57MM	57MM M86	170	57	2.98	6	The projectile is composed of steel and has a thin copper-rotating band affixed at the base of the munitions.	M
MK118	MK118 ROCKEYE	344	50	6.88	1.35	This item is composed of cast aluminum with a thin ferrous ring.	M
60MM	60MM M49A3	243	60	4.05	2.9	The projectile body is of pearlitic malleable iron/forged steel and is threaded internally at the nose to accept the fuze and at the base to accept the fin assembly.	M
81MM	81MM M374	480	81	5.93	8.75	The projectile body is of pearlitic malleable iron/forged steel and is threaded internally at the nose to accept the fuze and at the base to accept the fin assembly.	M

TABLE 2.1-3 (CONT'D)

Type	Nomenclature	Length, mm	Width, mm	Aspect Ratio	Weight, lb	Description	Size
M230	2.75" ROCKET	761	75	10.15	18.2	The warhead consists of two main parts, a nose and a base, brazed together. The nose section is threaded to receive e fuze. The base is made of steel or cast iron and is threaded for the attachment to rocket motor.	M
105MM	M456 HEAT RD	640	105	6.1	19.65	The forged steel body projectile is fitted with a plastic obturator, a threaded standoff spike assembly, a fin and boom assembly, and a point-initiating point-detonating fuze. There is a thin copper-rotating band affixed at the base of the munitions item.	L
105MM	105MM M60	426	105	4.06	28.35	The projectile consists of forged hollow steel forging with a boat tail base, a streamlined ogive, and copper-rotating band. A steel nose adapter is threaded into the nose of the projectile providing a seal for the filler.	L
155MM	155MM M483A1	870	155	5.61	56.45	The projectile is composed of forged steel/aluminum with a thin copper-rotating band affixed at the base of the munitions.	L
500 LB	BOMB	1680	273	.163	500	Cast iron, cylinder hollow.	L
M75	SUBMUNITION	69	64	.928	1.19	Steel.	S

2.2 SYSTEMS TESTED

Various detection systems were demonstrated at both APG and YPG. A complete list of the systems tested is presented in Table 2.2-1. The table shows each system's test dates, demonstrator, areas surveyed, report numbers, basic sensor type, sensor technology (system name also included in parenthesis where applicable), and platform type. Detailed information about configurations can be found in the published reports on the Web at http://aec.army.mil/usaec/technology/uxo03f.html. Environmental conditions such as weather and soil moisture content are included in Appendixes B and C. Test logs (time, estimated costs) for each test are presented in Appendix D.

TABLE 2.2-1. SYSTEM/DEMONSTRATOR TEST

Aberdeen Proving Ground Demonstrations					
Demo. Date	**Demonstrator**	**Surveyed Area/(Rep. No.)**	**Sensor**	**Technology**	**Platform**
Oct. 2002	AETC	Blind Grid (39)	EM	EM61	hand
Apr. 2005	ARM	Blind Grid (695)	EM	Explorer II	hand
Apr. 2005	ARM	Blind Grid (691)	EM	F3	hand
Sep. 2004	BH	Blind Grid (622)	Dual	EM61MKII G822A	cart
Sep. 2004	BH	Moguls (642)	Dual	EM61MKII G822A	cart
Sep. 2004	BH	Open Field (657)	Dual	EM61MKII G822A	cart
Sep. 2004	BH	Woods (636)	Dual	EM61MKII G822A	cart
Apr. 2004	ERDC	Blind Grid (304)	EM	EM63	cart
Apr. 2004	ERDC	Open Field (305)	EM	EM63	cart
Sep. 2003	ERDC	Blind Grid (142)	EM	GEM-3	cart
Sep. 2003	ERDC	Blind Grid (141)	EM	GEM-3	cart
Oct. 2002	Geocenters	Blind Grid (40)	Dual	EM61MKI G822A (STOLS)	towed
Aug. 2004	Geocenters	Blind Grid (290)	Dual	EM61MKI G822A (STOLS)	towed
Oct. 2002	Geocenters	Open Field (187)	Dual	EM61MKI G822A (STOLS)	towed
Aug. 2004	Geocenters	Open Field (298)	Dual	EM61MKI G822A (STOLS)	towed
Apr. 2006	Geocenters	Blind Grid (792)	Dual	EM61MKII G822A (VSEMS)	towed
Feb. 2006	Geocenters	Open Field (802)	Dual	EM61MKII G822A (VSEMS)	towed
May. 2003	Geophex	Blind Grid (50)	EM	GEM-3	hand
Apr. 2005	Geophex	Blind Grid (680)	EM	GEM-3	hand
May. 2003	Geophex	Blind Grid (125)	EM	GEM-3	towed
May. 2003	Geophex	Blind Grid (49)	EM	GEM-3	cart
May. 2003	Geophex	Moguls (451)	EM	GEM-3	cart
Apr. 2005	Geophex	Moguls (665)	EM	GEM-3	hand
May. 2003	Geophex	Open Field (129)	EM	GEM-3	towed
May. 2003	Geophex	Woods (449)	EM	GEM-3	cart
Apr. 2005	Geophex	Blind Grid (694)	EM	GEM-5	cart
Oct. 2005	Geophex	Blind Grid (739)	EM	GEM-5	towed
Apr. 2005	Geophex	Blind Grid (693)	EM	GEM-5	cart
Oct. 2005	Geophex	Open Field (740)	EM	GEM-5	towed
Oct. 2003	G-TEK	Blind Grid (184)	EM	TM-5	hand
Oct. 2003	G-TEK	Blind Grid (183)	EM	TM-5	sling
Oct. 2003	G-TEK	Mine Grid (146)	EM	TM-5	sling
Oct. 2003	G-TEK	Moguls (545)	EM	TM-5	sling

TABLE 2.2-1 (CONT'D)

Aberdeen Proving Ground Demonstrations					
Demo. Date	**Demonstrator**	**Surveyed Area/(Rep. No.)**	**Sensor**	**Technology**	**Platform**
Oct. 2003	G-TEK	Open Field (154)	EM	TM-5	sling
Oct. 2003	G-TEK	Woods (452)	EM	TM-5	hand
Oct. 2003	G-TEK	Blind Grid (268)	MAG	TM-4	sling
Oct. 2003	G-TEK	Moguls (547)	MAG	TM-4	sling
Oct. 2003	G-TEK	Open Field (311)	MAG	TM-4	sling
Oct. 2003	G-TEK	Woods (454)	MAG	TM-4	sling
Jun. 2004	G-TEK	Blind Grid (281)	Dual	GGT-10 G822A (SAM)	sling
May. 2004	G-TEK	Moguls (380)	Dual	GGT-10 G822A (SAM)	sling
May. 2004	G-TEK	Open Field (379)	Dual	GGT-10 G822A (SAM)	sling
Apr. 2004	G-TEK	Woods (381)	Dual	GGT-10 G822A (SAM)	sling
Jul. 2004	HFA	Blind Grid (237)	MAG	Schonstedt	hand
Jul. 2004	HFA	Moguls (676)	MAG	Schonstedt	hand
Jul. 2004	HFA	Open Field (231)	MAG	Schonstedt	hand
Jul. 2004	HFA	Woods (486)	MAG	Schonstedt	hand
Aug. 2004	NAEVA	Mine Grid (647)	EM	EM61MKII	towed
Aug. 2004	NAEVA	Blind Grid (396)	EM	EM61MKII	2man
Aug. 2004	NAEVA	Blind Grid (397)	EM	EM61MKII	towed
Sep. 2004	NAEVA	Moguls (597)	EM	EM61MKII	2man
Aug. 2004	NAEVA	Open Field (406)	EM	EM61MKII	towed
Aug. 2004	NAEVA	Woods (494)	EM	EM61MKII	2man
Sep. 2003	NRL	Blind Grid (127)	EM	GEM3 (MTADS)	towed
Jun. 2004	NRL	Open Field (675)	EM	GEM3 (MTADS)	towed
Jun. 2004	NRL	Blind Grid (671)	MAG	G822ROV (MTADS)	towed
Jun. 2004	NRL	Open Field (673)	MAG	G822ROV (MTADS)	towed
Oct. 2004	Parsons	Blind Grid (252)	EM	EM61MKII	cart
Oct. 2004	Parsons	Moguls (572)	EM	EM61MKII	cart
Oct. 2004	Parsons	Open Field (411)	EM	EM61MKII	cart
Oct. 2004	Parsons	Woods (496)	EM	EM61MKII	cart
Oct. 2004	Parsons	Blind Grid (257)	MAG	Schonstedt	hand
Oct. 2004	Parsons	Moguls (573)	MAG	Schonstedt	hand
Oct. 2004	Parsons	Open Field (229)	MAG	Schonstedt	hand
Oct. 2004	Parsons	Woods (499)	MAG	Schonstedt	hand
Dec. 2003	Shaw	Blind Grid (197)	EM	EM61MKII	cart
Dec. 2003	Shaw	Moguls (552)	EM	EM61MKII	cart
Dec. 2003	Shaw	Open Field (201)	EM	EM61MKII	cart
Dec. 2003	Shaw	Woods (461)	EM	EM61MKII	cart
Dec. 2003	Shaw	Blind Grid (198)	MAG	MAG858	cart
Dec. 2003	Shaw	Blind Grid (404)	MAG	MAG858	cart
Dec. 2003	Shaw	Moguls (206)	MAG	MAG858	cart
Dec. 2003	Shaw	Open Field (492)	MAG	MAG858	cart
Dec. 2003	Shaw	Woods (376)	MAG	MAG858	cart
Nov. 2003	TTF	Blind Grid (157)	EM	EM61MKII	cart
Nov. 2003	TTF	Blind Grid (159)	EM	EM61MKII	sling
Nov. 2003	TTF	Moguls (549)	EM	EM61MKII	sling
Nov. 2003	TTF	Open Field (165)	EM	EM61MKII	cart
Nov. 2003	TTF	Woods (457)	EM	EM61MKII	sling
Jan. 2006	VF Warner	Blind Grid (764)	EM	AMOS	towed
Dec. 2002	Witten	Blind Grid (45)	GPR	Cart	cart
Dec. 2002	Witten	Mine Grid (126)	GPR	Cart	cart

TABLE 2.2-1 (CONT'D)

Demo. Date	Demonstrator	Surveyed Area/(Rep. No.)	Sensor	Technology	Platform
Aberdeen Proving Ground Demonstrations					
Aug. 2002	Zonge	Blind Grid (37)	EM	EM FAST4D	cart
Aug. 2002	Zonge	Open Field (38)	EM	EM FAST4D	cart
Yuma Proving Ground Demonstrations					
May. 2004	BH	Blind Grid (383)	Dual	EM61MKII G822A	cart
May. 2004	BH	Desert Ext (607)	Dual	EM61MKII G822A	cart
May. 2004	BH	Moguls (655)	Dual	EM61MKII G822A	cart
May. 2004	BH	Open Field (651)	Dual	EM61MKII G822A	towed
May. 2003	ERDC	Blind Grid (216)	EM	EM63	cart
May. 2003	ERDC	Open Field (249)	EM	EM63	cart
May. 2003	ERDC	Blind Grid (134)	EM	GEM-3	cart
May. 2003	ERDC	Desert Ext (509)	EM	GEM-3	cart
May. 2003	ERDC	Moguls (136)	EM	GEM-3	cart
May. 2003	ERDC	Open Field (135)	EM	GEM-3	cart
May. 2003	ERDC	Blind Grid (362)	MAG	TM-4	sling
May. 2003	ERDC	Desert Ext (544)	MAG	TM-4	sling
May. 2003	ERDC	Moguls (571)	MAG	TM-4	sling
May. 2003	ERDC	Open Field (364)	MAG	TM-4	sling
Feb. 2006	Forester	Blind Grid (769)	MAG	FEREX	Sling
Feb. 2006	Forester	Open Field (770)	MAG	FEREX	Sling
Oct. 2004	Geocenters	Blind Grid (293)	Dual	EM61MKI G822A (STOLS)	towed
Oct. 2004	Geocenters	Open Field (299)	Dual	EM61MKI G822A (STOLS)	towed
Oct. 2003	G-TEK	Blind Grid (186)	EM	TM-5	hand
Oct. 2003	G-TEK	Desert Ext (144)	EM	TM-5	sling
Oct. 2003	G-TEK	Moguls (579)	EM	TM-5	sling
Oct. 2003	G-TEK	Open Field (148)	EM	TM-5	sling
Oct. 2003	G-TEK	Blind Grid (431)	MAG	TM-4	sling
Oct. 2003	G-TEK	Desert Ext (536)	MAG	TM-4	sling
Oct. 2003	G-TEK	Moguls (581)	MAG	TM-4	sling
Oct. 2003	G-TEK	Open Field (147)	MAG	TM-4	sling
Apr. 2004	HFA	Blind Grid (238)	MAG	Schonstedt	hand
Apr. 2004	HFA	Desert Ext (528)	MAG	Schonstedt	hand
Jul. 2004	HFA	Moguls (587)	MAG	Schonstedt	hand
Apr. 2004	HFA	Open Field (442)	MAG	Schonstedt	hand
Dec. 2004	NAEVA	Blind Grid (667)	EM	EM61MKII	towed
Dec. 2004	NAEVA	Blind Grid (666)	EM	EM61MKII	2man
Dec. 2004	NAEVA	Desert Ext (670)	EM	EM61MKII	2man
Dec. 2004	NAEVA	Moguls (669)	EM	EM61MKII	2man
Dec. 2004	NAEVA	Open Field (668)	EM	EM61MKII	towed
Nov. 2003	NRL	Blind Grid (213)	EM	GEM3 (MTADS)	towed
Nov. 2003	NRL	Open Field (245)	EM	GEM3 (MTADS)	towed
Sep. 2004	Parsons	Blind Grid (690)	EM	EM61MKII	cart
Sep. 2004	Parsons	Desert Ext (532)	EM	EM61MKII	cart
Sep. 2004	Parsons	Moguls (588)	EM	EM61MKII	cart
Sep. 2004	Parsons	Open Field (425)	EM	EM61MKII	cart
Sep. 2004	Parsons	Blind Grid (606)	MAG	Schonstedt	hand
Sep. 2004	Parsons	Desert Ext (601)	MAG	Schonstedt	hand
Sep. 2004	Parsons	Moguls (602)	MAG	Schonstedt	hand

TABLE 2.2-1 (CONT'D)

Yuma Proving Ground Demonstrations					
Demo. Date	**Demonstrator**	**Surveyed Area/(Rep. No.)**	**Sensor**	**Technology**	**Platform**
Sep. 2004	Parsons	Open Field (426)	MAG	Schonstedt	hand
Jan. 2003	Shaw	Blind Grid (199)	EM	EM61MKII	cart
Jan. 2003	Shaw	Desert Ext (211)	EM	EM61MKII	cart
Jan. 2003	Shaw	Moguls (207)	EM	EM61MKII	cart
Jan. 2003	Shaw	Open Field (354)	EM	EM61MKII	cart
Jan. 2003	Shaw	Blind Grid (312)	MAG	MAG858	cart
Jan. 2003	Shaw	Desert Ext (541)	MAG	MAG858	cart
Jan. 2003	Shaw	Moguls (594)	MAG	MAG858	cart
Jan. 2003	Shaw	Open Field (638)	MAG	MAG858	cart
Dec. 2003	TTF	Blind Grid (168)	EM	EM61MKII	cart
Dec. 2003	TTF	Desert Ext (171)	EM	EM61MKII	cart
Dec. 2003	TTF	Moguls (170)	EM	EM61MKII	sling
Dec. 2003	TTF	Open Field (169)	EM	EM61MKII	cart
May. 2006	USGS	Blind Grid (805)	EM	All TEM	towed
May. 2006	USGS	Blind Grid (806)	MAG	TMGS	towed

2.3 SYSTEM PERFORMANCE

2.3.1 Introduction

a. The following sections will present measures of performance for those detection systems demonstrated at the Standardized UXO Test Sites from the beginning of testing through the summer of 2006. The results are presented at a general level yet cover a broad spectrum of metrics. Because of time constraints associated with examining a large number of test parameters, which include variables associated with GT, system characteristics, and performance measures, discussion will be limited. Trends presented and analyzed will provide a snapshot of SOTA UXO detection capability.

b. All results that are presented should be understood to be those associated with a "test instance" that is characteristically unique. If tests were to be repeated, results would change. This change would be caused by but not limited to variations in environment, system health, human error, and human judgment. Because of expected variation in results, when best performers are mentioned or systems are ranked in any way, it should be understood to be pertaining to the one test instance the systems were demonstrated at.

c. The standardized sites are unique in configuration. While the standardized sites contain a variety of ordnance common to remediated sites, with depth distributions that are similar, the sites do not match the distribution of ordnance at any particular site. Varying the distribution of ordnance and clutter will cause detection results to vary to differing degrees from system to system. Therefore, any rankings noted or observed in this report are unique to the standardized sites and may change significantly for a real world site with its own distribution of clutter and ordnance at varied depths. Nonetheless, the standardized sites contain several thousand ordnance/clutter items and because of the quantity/variety of items they contain, they provide an outstanding tool to evaluate UXO detection technology in general.

d. Most data presentations will refer to a system using three descriptive fields. The first will include the sensor type or designator, the second will describe the platform type and the third will give a report number. If a system comprises dual sensor types, the report number will usually be followed by an E (EM), M (MAG), or D (dual) to indicate non-fused and fused results (note that E and M constituents of a dual system are not necessarily optimized for independent use). The report numbers can be used to find detailed information about a system by going to the Standardized UXO website (http://aec.army.mil/usaec/technology/uxo03.html) and clicking on the report number. The report number can also be correlated with detailed information presented in Table 2.2-1 of this report.

e. One of the GT sets used in the following sections is referred to as the "standard GT". It represents all items in the ground (except when scoring MAG systems, only ferrous items used). Elsewhere in this report select items or areas within the standard GT are used as a subset and are noted as such. Results using the standard GT are those which are published on the standardized UXO web site. The standard GT contains a host of challenges that push the detection limits of current technology. Such challenges may include dense areas of clutter, overlapping halos (i.e., items within 1 m of each other), items (few) that are deeper than typically remediated, metallic objects above ground, electromagnetic interference (minimal) from power lines, and a wet area. The wet area was not by design and proved to limit some demonstrators in the APG open field. The area was dry most of the time but at other times was marshy and under a couple inches of water. It comprises about 10 percent of the APG open field. This area is eliminated from scoring in the 11D, no challenge (wet area considered a challenge), no overlap GT variant commonly used throughout this report which allows a better comparison of performance of individual systems.

f. The standard GT is comprised of only ferrous items for MAG systems.(since these systems are incapable of detecting non-ferrous items). Ferrous and non-ferrous items are used in the GT for EM, radar, and dual systems. Plots will typically have a small acronym (MOIM, which stands for Magnetic Only If Magnetometer) on them to indicate that all ferrous GT was used only for the MAG systems. If the non-ferrous items are not removed then the MAG systems are penalized in performance by the proportion of non-ferrous items chosen.

g. Some of the GT subsets will commonly be limited in depth to 11D. In such cases, all GT items buried at depths greater than 11 times their diameter are eliminated from scoring. The 11D restriction is implemented to include items at depths that are commonly required for testing and, by doing so, to make results more comparable to typical GPOs. The 11D value is the industry rule (per ERDC) for range of depth within which current systems can detect ordnance. The rule defines depth from the ground surface to the highest point on a buried ordnance item in the ground. In this compilation of work, depth to the center of a buried ordnance item is used instead of the highest point in the ground. The effect is that the 11D GT will be slightly shallower. Sensitivity studies indicate P_d^{res} scores will be approximately 1 to 2 percent higher (APG open field site) when 11D is referenced to the center of the ordnance instead of the highest point of the ordnance in the ground.

h. One type of system in the results presented will be considered a baseline. This system, the Schonstedt, is a hand held MAG. The system is one of the most commonly used systems in current UXO remediation. Two Schonstedts were demonstrated to provide a comparison.

i. The reader should be aware that detection rules at the sites were set up so that a "detection" is considered the ability to "discern" an "individual" item in the ground. The problem with this approach is that some items are very close together in the ground and signal returns from the combined items appear as "one" anomalous signal. Thus, if two items are side by side in the ground and the detection system indicates one anomaly, then only one detection is granted. These rules apply when items are closer than one meter to each other or equivalently, when half meter radii around each item "overlap". While the number of ordnance with overlap are small in the GT, the use of these rules will reduce and hence misrepresent detection scores if it is only desired to see if signals, whether from single or combined items, were detected. For the reader wanting to see results free from the effects of overlaps, GT variants have been created and are noted as having "no overlaps" or noted that distances between items are greater than one meter (all blind grid test areas inherently have no overlaps). Such results are the best indicator of detection ability for individual items. Conversely, results with overlaps have merit when comparing the performance of multiple systems to see if one system can better discern multiple items in close proximity than another. Also, comparing scores with and without overlaps gives some indication of the effect of signal masking from items in close proximity to each other.

j. The blind grids and open fields at APG and YPG were reconfigured in the 2004-2005 time frame. The GT in these areas were fully extracted in the blind grids and partially extracted in the open fields. New items were put back into the ground in these areas with an overall characteristic that was similar to what was extracted. Some systems that were tested after the reconfiguration are included on the comparative plots shown in this report to add to the variety displayed. Their results should be adequate for general comparison but should not be used for decision making purposes beyond a general level. The post-reconfiguration systems are listed by report number as follows: 1) APG open field, 740 and 802, 2) APG blind grid, 680, 691, 693, 694, 695, 739, 764 and 792, 3) YPG open field, 770, 4) YPG blind grid, 769, 805 and 806. The APG open field had several hundred "noisy" items removed from it during reconfiguration which no doubt effects post-reconfiguration BAR scores. Therefore, for system numbers 740 and 802, BAR scores can not be compared with pre-reconfiguration results from other systems. It is also noted that some noisy items were removed in an exploratory phase prior to reconfiguration which "may" have slightly reduced the BAR scores of report numbers 657, 298, 802, 740, 231, 406, 411 and 229.

k. Finally, a note of caution when interpreting overall Pd results. Overall Pds are influenced by target mix and depths, presence of clusters, unsurveyable areas, etc. All of the identified factors will reduce overall Pd compared to a typical GPO. When possible, the effects on Pd by such factors are mitigated by the use of GT variants.

2.3.1.1 *Probability of Detecting Ordnance*

a. This section shows system results using P_d, and BAR (P_{ba} for blind grid), as measures of performance. P_d is in the response stage and therefore reflects the number of ordnance found divided by the total number of ordnance emplaced. BAR, also in the response stage, is a number that is proportional to the number of items declared to be potential ordnance (i.e., anomalies) that turn out to be neither ordnance nor clutter. The actual number of background alarms has not been given to help preclude discovery of GT proportion. Nonetheless, BAR allows relative comparisons between systems and between test areas (except blind grid) within a given proving ground.

b. P_d^{res} versus background alarm metrics for the systems demonstrated at the APG and YPG test sites using a GT variant are shown in Figures 2.3.1-1 through 2.3.1-8. The GT variant contains no items deeper than 11D, items closer than one meter to each other (no overlaps) or items in challenge areas (includes intermittently wet areas). The elimination of overlap items will help give a best estimate of Pd on individual items (not combined items). The elimination of challenge items will reduce environmental variability to give a more standard result.

c. Blind grid results are shown in Figures 2.3.1-1 and 2.3.1-2. The blind grids are set up to allow an objective binary type response from the sensors alone to indicate whether an anomaly is present or not. Potential locations of items are known beforehand. Further, the grids are free from overlap and dense areas of clutter to confuse signals. Albeit the APG blind grid did have some clutter items with signals that bled over into other grid locations even though the grids were spaced 2 meters apart. Thus, signal interpretation in the blind grids should be easier than in other test areas and platform navigation issues minimized (since potential locations of the items are known). This ease of detection is manifest in the higher detection rates realized in the blind grid areas when compared to other test areas.

d. The best systems demonstrated a P_d^{res} of 1.0 in both blind grids. All systems typically performed better at the YPG blind grid than they did at the APG blind grid. This is likely because of the greater GT depth at the APG grid. EM61 MKII sensors, irrespective of platform type, and the MTADS GEM3 sensor typically did best in the YPG blind grid with P_d^{res} scores as high as 1.0 and P_{ba} as low as 0.0. The same sensors were the best demonstrated at the APG blind grid also with P_d^{res} scores as high as 1.0 but with P_{ba} scores higher than at YPG at 0.07 to 0.17.

e. The best P_d^{res} scores with lowest P_{ba} that were achieved by MAG systems were 0.88 at APG with a G822ROV towed system and 0.95-0.98 at YPG with a TMGS towed and an TM-4 sling system.

f. The only ground penetrating radar system analyzed was demonstrated at the APG blind grid. The performance of this system was along the lower P_d^{res} vs. P_{ba} boundary of all other system types. More of these systems are needed to evaluate the technology better.

g. The dual systems did not excel in either of the blind grids. More analysis of dual systems is included in section 2.3.9.1.

h. Two Schonstedts were typically demonstrated in most areas. The majority of the technologies surpassed Schonstedt performance in the blind grids. This is a favorable indicator regarding the SOTA of the sensor community in general.

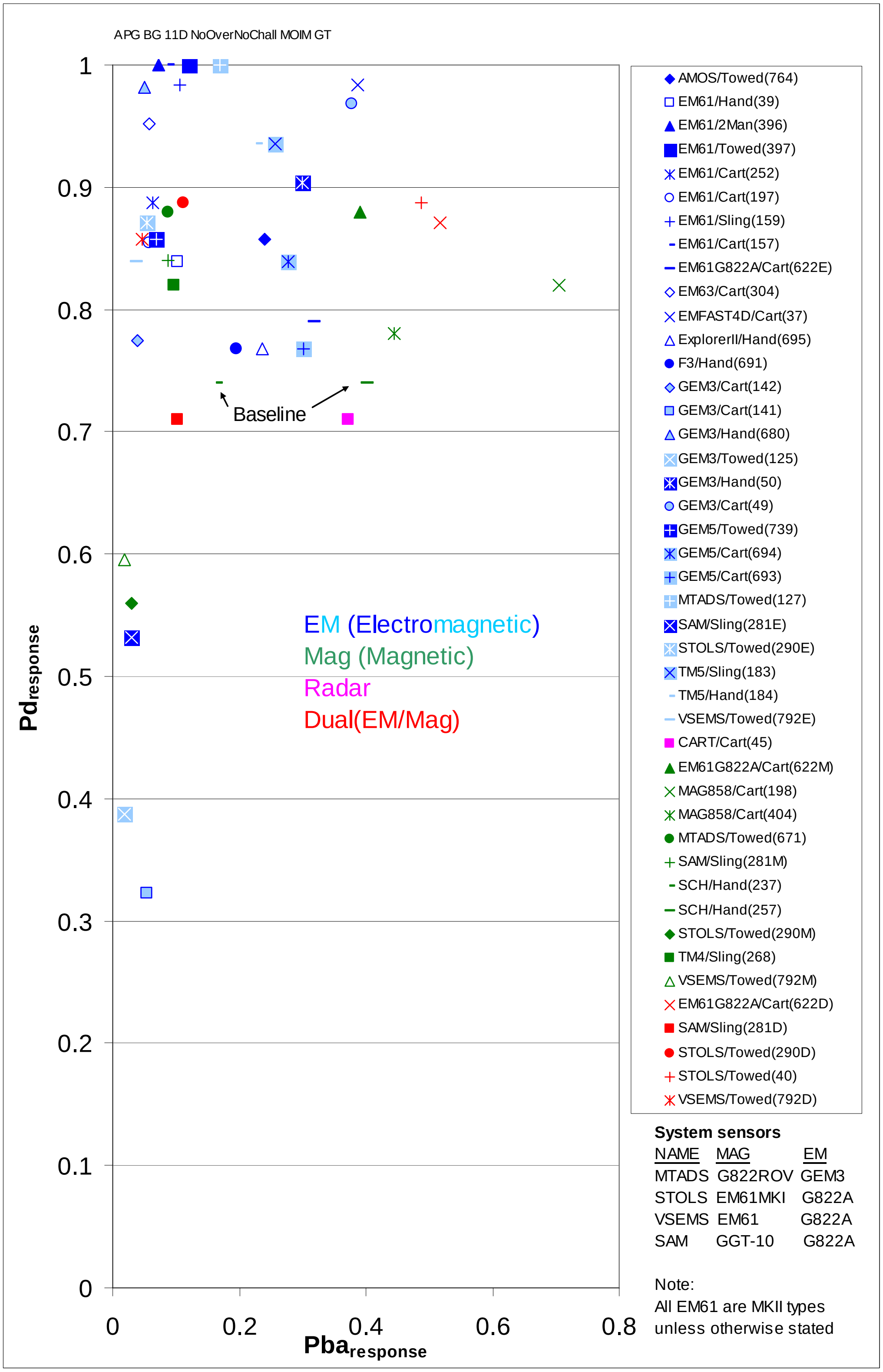

Figure 2.3.1-1. P_d^{res} versus P_{ba}^{res}, APG blind grid, 11D, No Overlap, No Challenge GT.

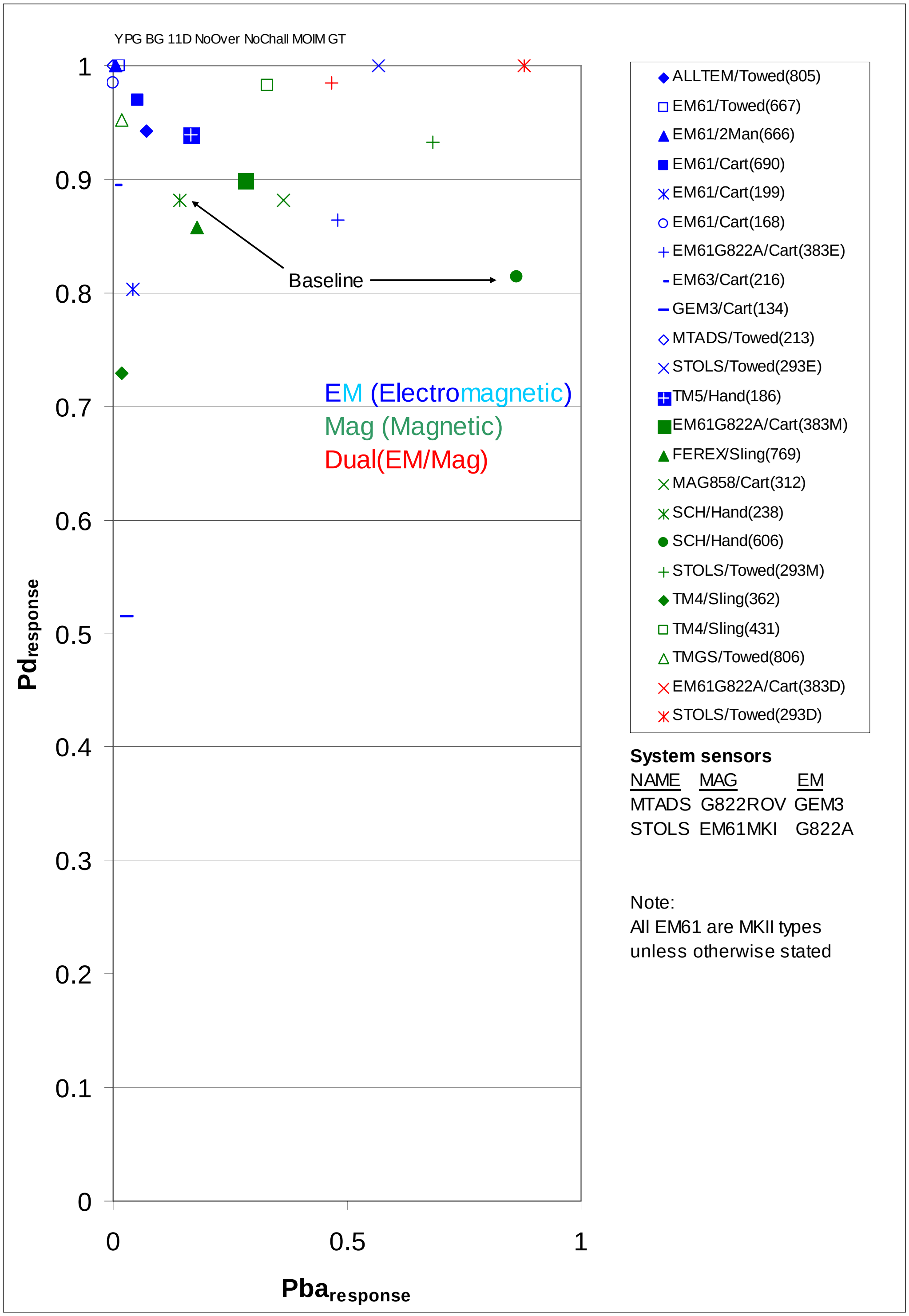

Figure 2.3.1-2. P_d^{res} versus P_{ba}^{res}, YPG blind grid, 11D, No Overlap, No Challenge GT.

i. P_d versus BAR results for the APG and YPG open field areas are shown in Figures 2.3.1-3 and 2.3.1-4.

j. In the open fields, the P_d^{res} of the systems are substantially lower when compared to the blind grid results. Based on the fact that the positions of potential ordnance/clutter are known beforehand in the blind grids, it has to be concluded that this advantage in the blind grids contributes some measure to the observed disparity. The terrain has little influence on the disparity since the open fields are indeed open and relatively flat like the blind grids. The GT in the intermittently wet area in the APG open field has been eliminated so no performance degradation is expected. Therefore, the remaining parameter likely driving disparity is the GT configuration/distribution differences between the two areas. Contributors to this and other disparities will be examined throughout this report.

k. Approximately 84 percent ($P_d^{res} = 0.84$) of the ordnance was found by the best performers in the APG open field (fig. 2.3.1-3). An EM61 MKII pushcart and MTADS GEM-3 towed array system achieved this level with a relatively low BAR score. The best score achieved in the YPG open field (fig. 2.3.1-4) was a P_d^{res} of 0.96 by the MTADS GEM-3 towed system with TM-5, EM61MKII and EM63 systems not far behind. The GEM-3 and EM61 systems had better BAR scores. Thus, P_d scores in the APG area were about 10% lower than in the YPG area. The BAR scores are very low and very tight for the YPG open field suggesting environmental noise in the YPG field may have been at a lower level than at APG.

l. The dual systems performed slightly above average in the open fields when compared to all other systems demonstrated. They typically trend between the EM and MAG sensors with regard to performance. Analysis performed later in section 2.3.9.1 will show that the performance of the dual systems surpasses the separate EM and MAG constituent performance of those same systems. Therefore, better combinations of systems may prove to have superior performance once matched up.

m. In the APG open field an MTADS towed system of eight 822ROV sensors was the best performer among MAG systems with a $P_d = 0.84$. The MAG constituent, G822A sensor, of a dual system, had the best MAG P_d^{res} score, 0.85, in the YPG open field however, the BAR value was extremely high relative to other systems demonstrated. The next best MAG system at YPG was a TM-4 sling with a $P_d^{res} = 0.77$ but also with a high BAR (about 20 times greater than EMs).

n. Again, most systems out performed the Schondstedt baseline results.

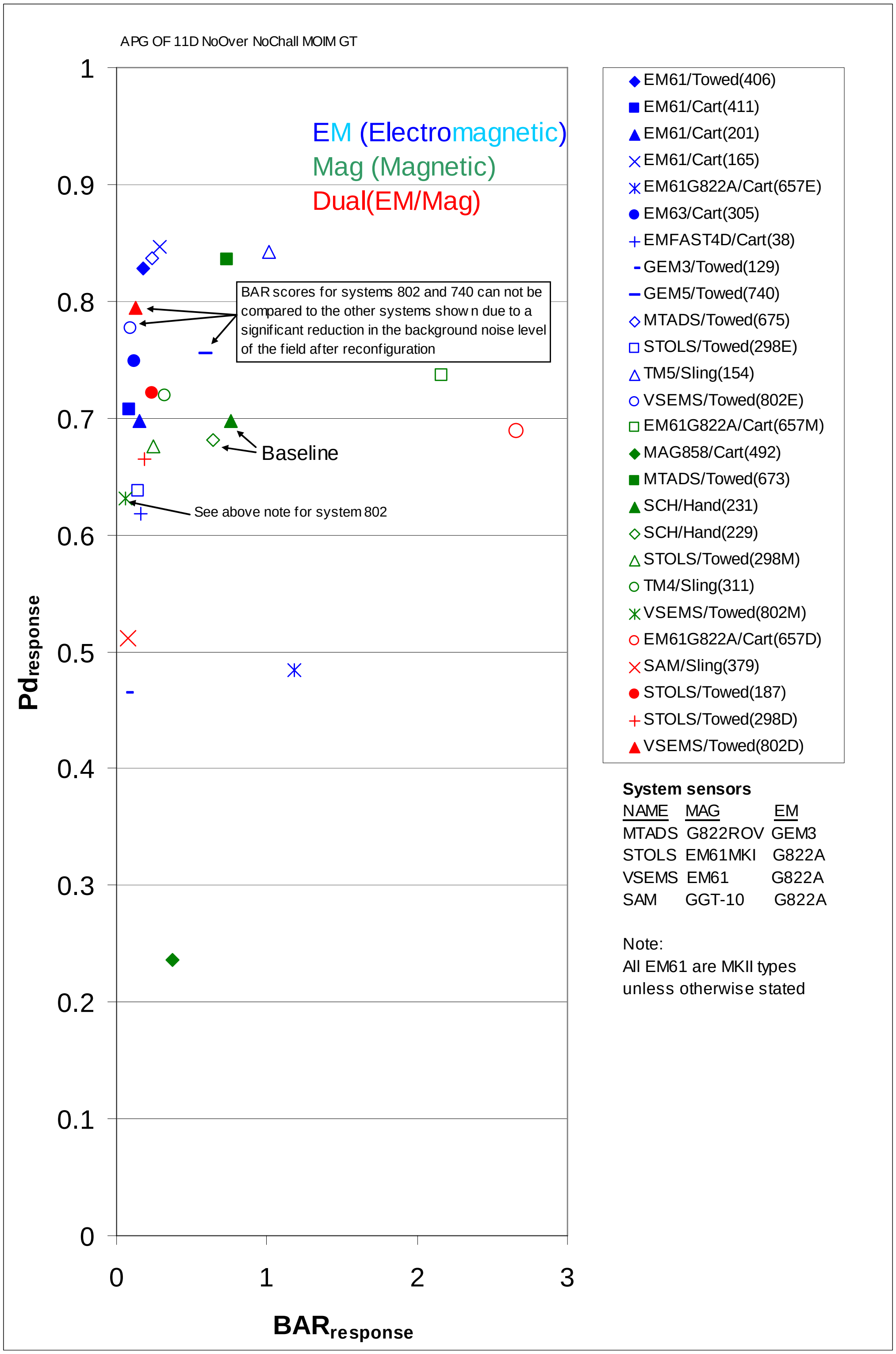

Figure 2.3.1-3. P_d^{res} versus BAR^{res}, APG open field, 11D, No Overlap, No Challenge GT.

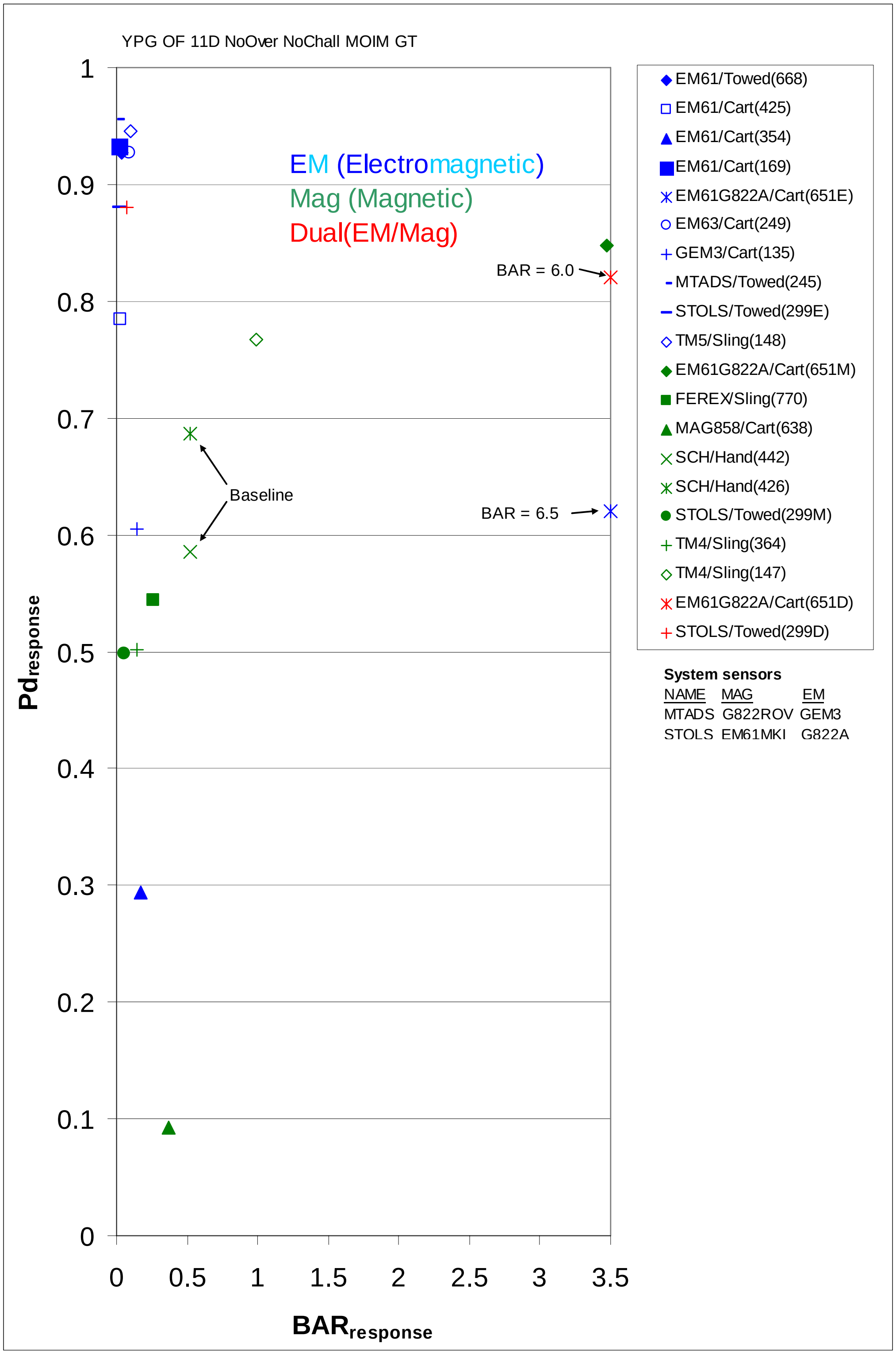

Figure 2.3.1-4. P_d^{res} versus BAR^{res}, YPG open field, 11D, No Overlap, No Challenge GT.

o. P_d^{res} versus BAR^{res} results for the mogul areas are shown in Figures 2.3.1-5 and 2.3.1-6.

p. A significant reduction in P_d^{res} occurs when comparing the APG mogul results to the APG blind grid results. The reduction is about twice that realized in the APG open field. This reduction is understandable when the APG mogul terrain is inspected first hand. The APG moguls are not able to be traversed by most wheeled vehicles. There are no moguls higher than about 1 meter but they have very steep sides kept from erosion by large clumps of grass. Further the valleys between moguls can fill up with water and become marsh like.

q. The highest P_d^{res} achieved in the APG moguls was 0.82. This score was produced by a GEM-3 hand held unit. The next closest P_d^{res} value is 24 percent lower and the overall average P_d^{res} is about 0.45 for all systems combined. The only other hand held units demonstrated in the APG moguls were Schonstedts (MAG systems), which yielded P_d^{res} scores of 0.42 and 0.48. The GEM-3 hand held unit outperformed pushcarts and slings of EM and MAG varieties. The GEM-3 system has a BAR that is about six times greater than the next best system result. As will be shown in section 2.3.8, the GEM-3 system spent much more time surveying than did other systems. No towed platforms were tried in the area. If such platforms did try to survey these moguls they would likely destroy the terrain in an effort to negotiate it. All results demonstrated in the APG moguls are currently unacceptable.

r. The results in the YPG moguls were comparable to YPG open field results. This is because the variation in the grade at the YPG moguls is not that severe. The sand mounds originally constructed were easily eroded and thus smoothed over time. Erosion was not monitored but it is likely earlier demonstrators had more difficulty traversing the moguls. Further analysis should date the demonstrations to look for trends.

s. The Schonstedt baseline performance falls in the mid detection range of technologies demonstrated at the moguls. This is a better result for the Schonstedts, relative to other systems, than is exhibited in the open fields and blind grids. This in combination with the GEM-3 hand held performance shows how the platform is becoming a driver (hand held’s exhibiting better performances) in detection ability for the rougher terrains.

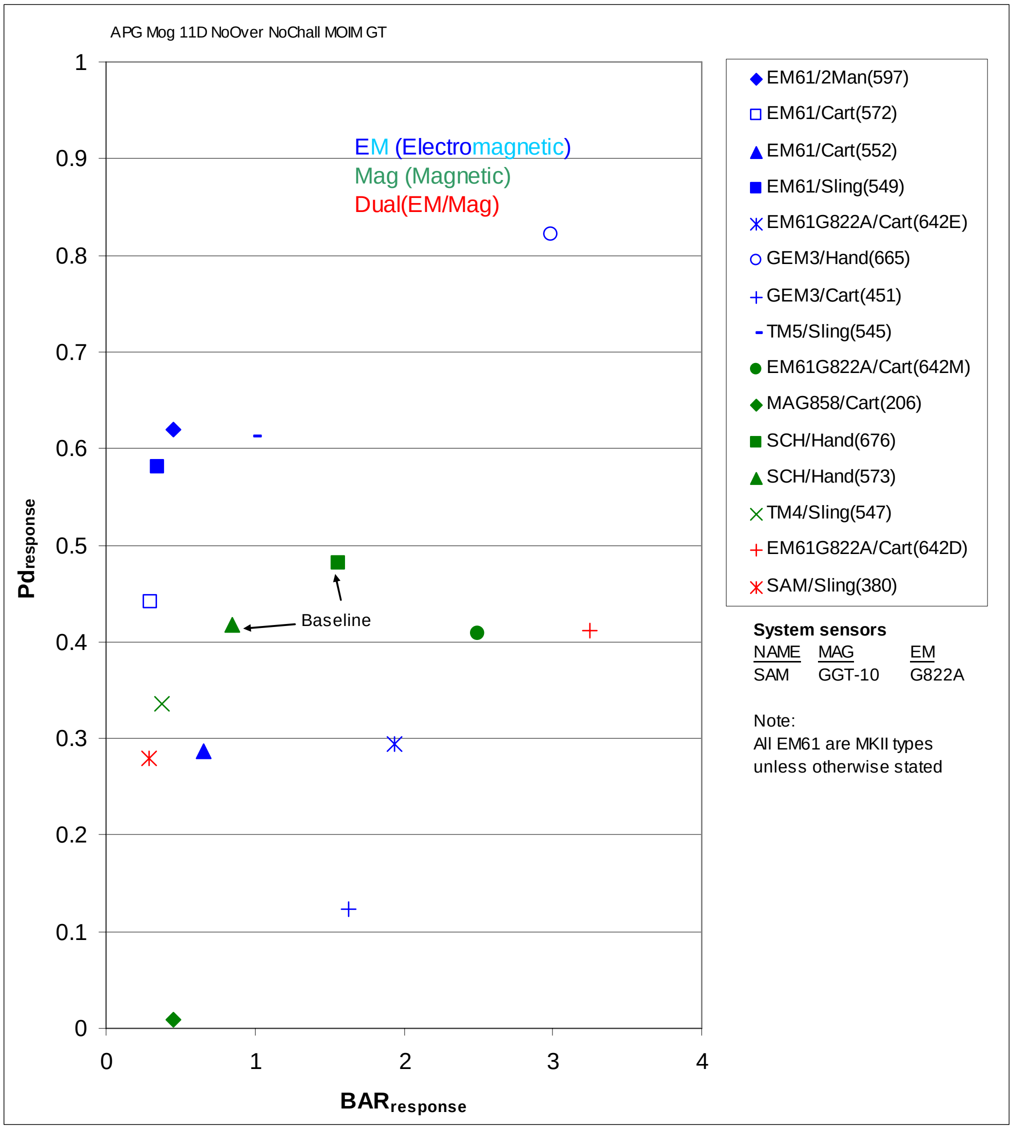

Figure 2.3.1-5. P_d^{res} versus BAR^{res}, APG moguls, 11D, No Overlap, No Challenge GT.

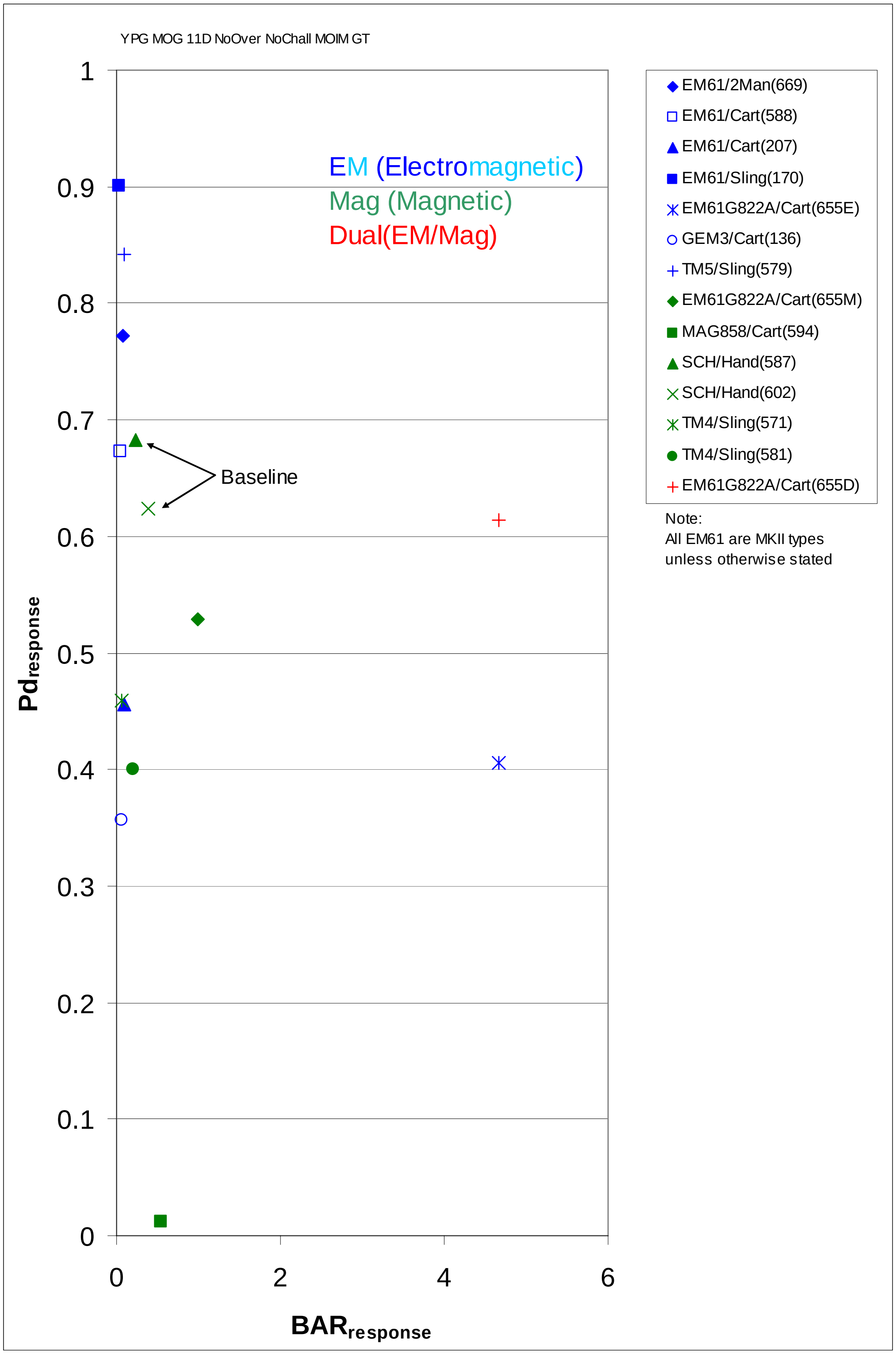

Figure 2.3.1-6. P_d^{res} versus BAR^{res}, YPG moguls, 11D, No Overlap, No Challenge GT.

t. P_d^{res} versus BAR is shown in Figure 2.3.1-7 for systems demonstrated at the desert extreme area at YPG. The performance of the systems in the extreme area decreased by about 30 percent compared to the YPG open field performance. The extreme area comprises uneven terrain characterized by gulleys and also contains brush.

u. The best performer in the desert extreme used an EM61 MKII sensor on a 2-man platform (litter type) and had a P_d^{res} of 0.67. The next best performer was a Schonstedt followed by an EM61 MKII push cart system, both with a P_d^{res} of about 0.6. BARs for these systems were about the same except for the pushcart system which had a very low value relative to the others.

v. Again, with more extreme terrain, hand held units are among top performers.

w. P_d^{res} versus BAR is shown in Figure 2.3.1-8 for the APG wooded area. This area along with the APG moguls turned out to be the most difficult of all the areas in the Standardized Test Sites. The best performers in the woods were the EM61 MKII/2-man and EM61 MKII/sling systems, both with a P_d^{res} score of approximately 0.64. The sling had a BAR score that was three times less than the 2-man platform system. A TM-5 hand held unit was close behind as one of the better performers. The next best performer was an EM61 cart system with a P_d^{res} score about 30 percent lower. The wooded area is actually very flat but is cluttered with large trees both living and fallen. Root systems also pervade the area. Further the area has standing water at times and contains brush. Navigation is very difficult. The results indicate pushcarts are not well suited for such close-in terrains and that man-portable platforms provide the best access. All results indicate a level of performance that would be unacceptable for ordnance detection.

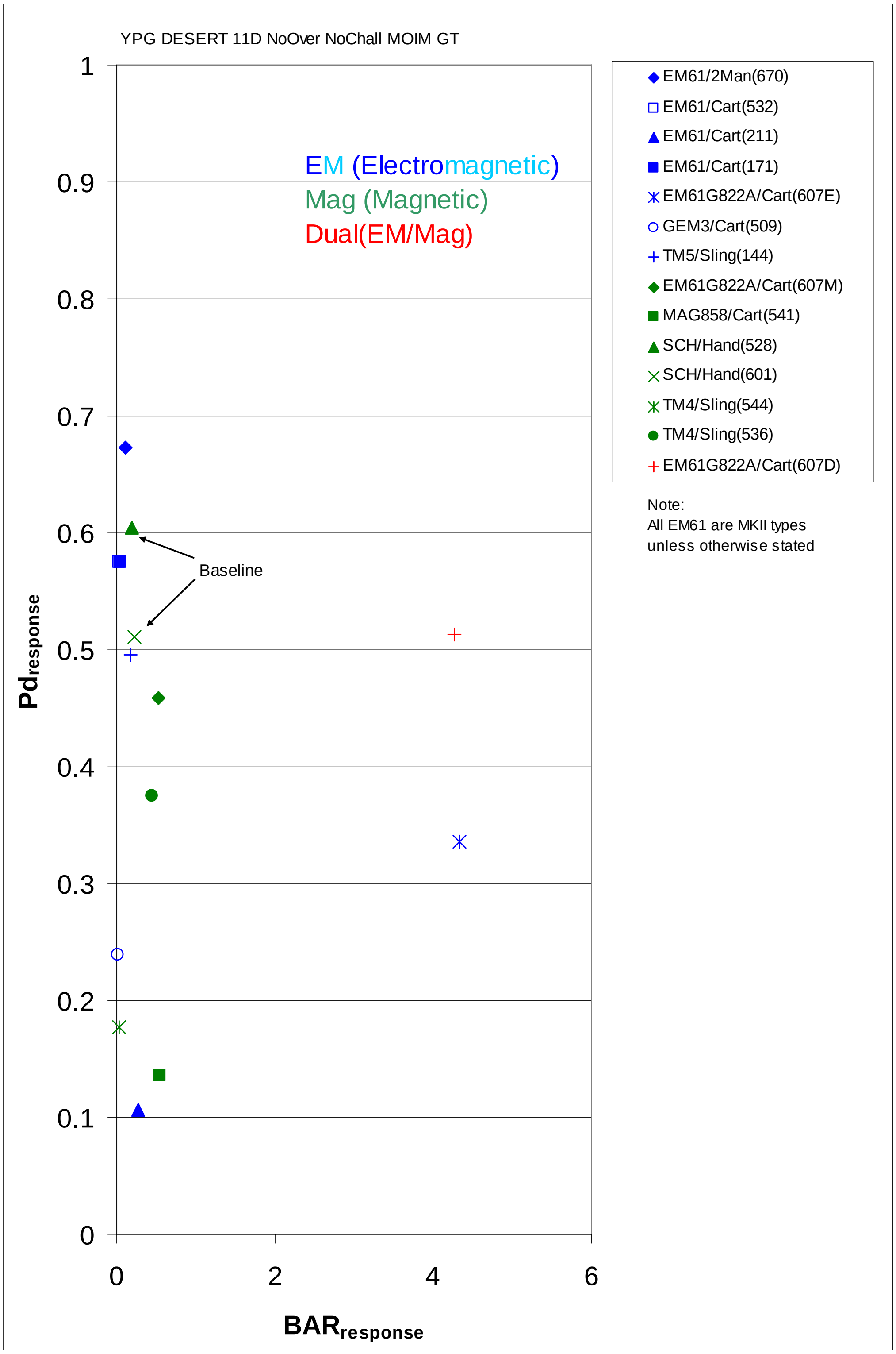

Figure 2.3.1-7. P_d^{res} versus BAR^{res}, YPG desert extreme, 11D, No Overlap, No Challenge GT.

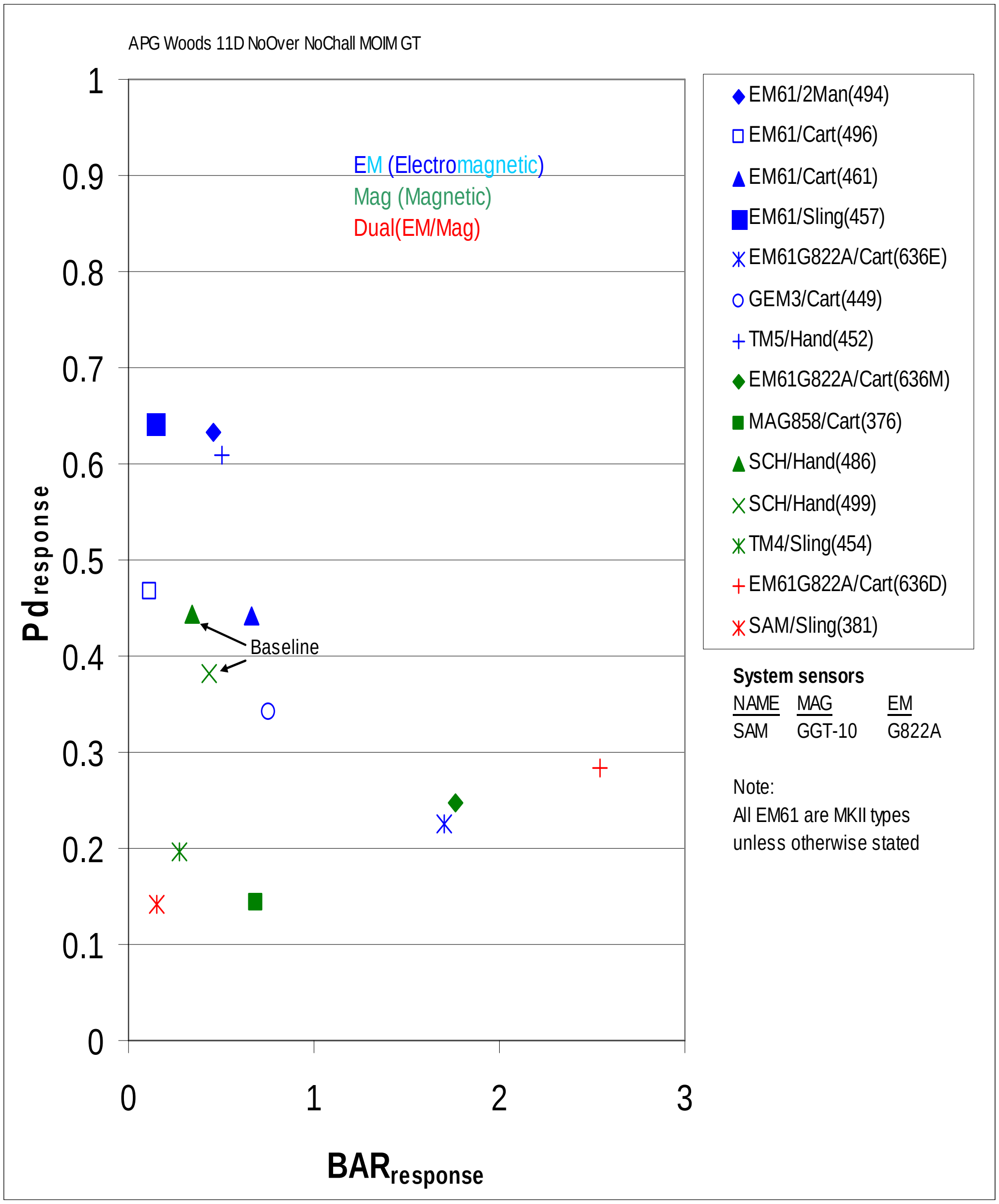

Figure 2.3.1-8. P_d^{res} versus BAR^{res}, APG woods, 11D, No Overlap, No Challenge GT.

2.3.1.2 *Performance Using All Ferrous GT*

a. P_d^{res} versus BAR results are shown in Figures 2.3.1-9 and 2.3.1-10 for all systems demonstrated in the APG and YPG open fields, respectively, using an all ferrous GT. This variant of the GT allows a direct comparison between EM and MAG systems since the same GT set is used for each (no longer ferrous and non-ferrous GT used for EM and ferrous GT used for MAG). Since the same GT is applied to both types of sensors, dual system component results can be compared with the fused results found in an all ferrous environment. This GT is similar to the one used in the previous section in that there are no items buried below 11D, no items in challenge areas (including wet areas) and no items within one meter of each other (no overlaps).

b. The results indicate that the EM based systems typically performed better than all other basic system types when using the same all ferrous GT.

c. The best dual systems were typically among the better performers in the all ferrous GT. In the APG open field the VSEMS/towed configuration was the best dual performer and benefited from combining its EM and MAG counterparts. The combined P_d^{res} score was 0.83, while the EM component score was $P_d^{res} = 0.81$ and the MAG score $P_d^{res} = 0.63$. The VSEMS uses the EM61 MKII (EM) and the G822A (MAG) sensors. The VSEMS tested after the APG open field was reconfigured and a large number of items causing background noise were extracted. Because of this, the BAR score for the VSEMS system (system 740 also) could be as much as 0.2 lower than a pre-reconfiguration result.

d. The best performing MAG system demonstrated at APG had a P_d^{res} score of 0.84. This score was near the best EM score (0.87) and was from a towed array of eight geometrics 822ROV sensors (MTADS, report No. 673). The BAR score, however, was about three times higher than the best EM system.

e. When comparing the all ferrous results for the EM against the ferrous/nonferrous results of Figures 2.3.1-3 and 2.3.1-4, the P_d^{res} scores improve a few percent in the all ferrous GT. This indicates that the EM sensors are having a more difficult time detecting the non-ferrous items than they are the ferrous items (the non-ferrous items are M385 aluminum grenades and aluminum MK118 submunitions). Size may be a contributing factor to this result.

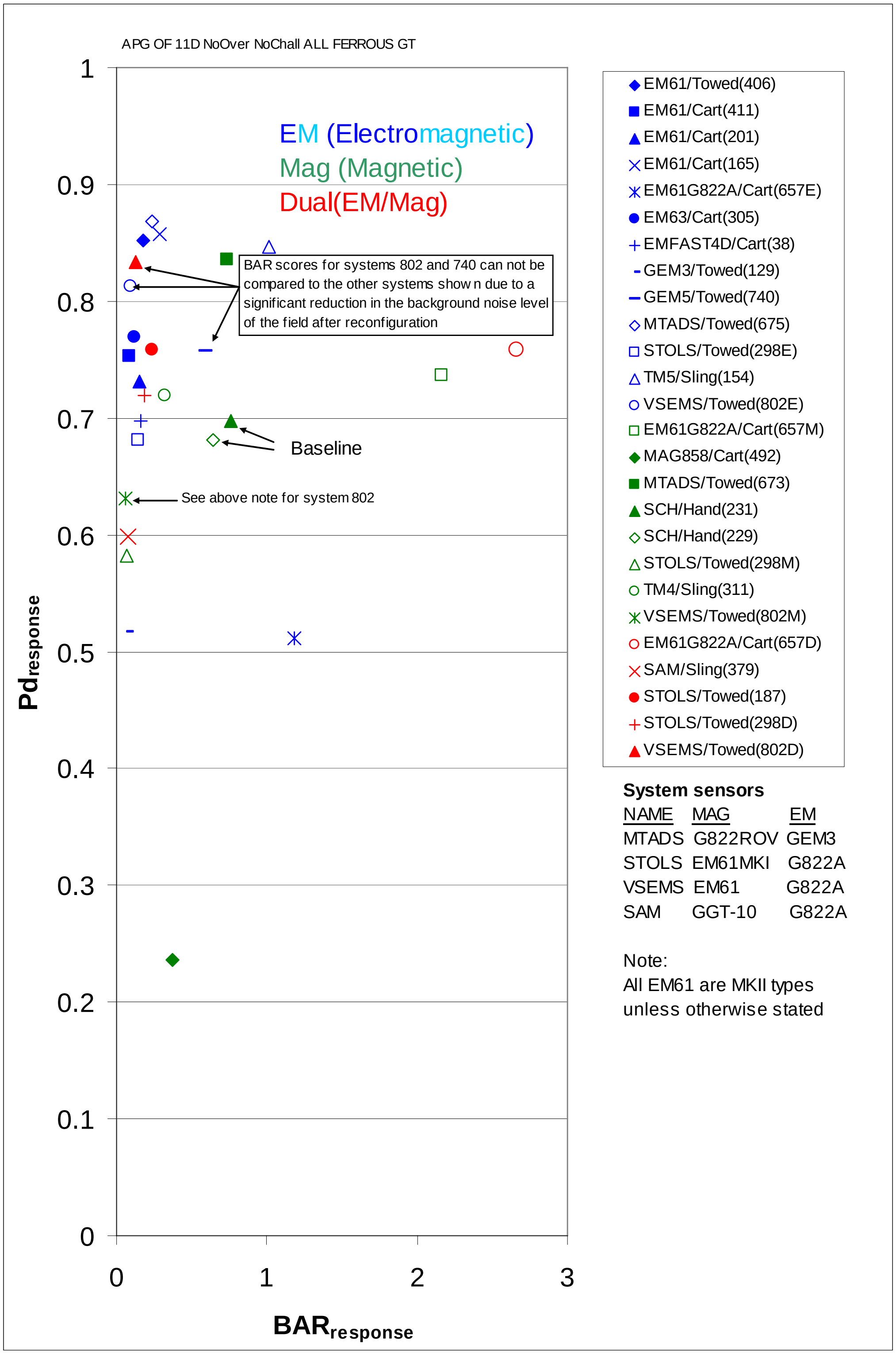

Figure 2.3.1-9. P_d^{res} versus BAR^{res}, APG open field, All ferrous, 11D, No Overlap, No Challenge GT.

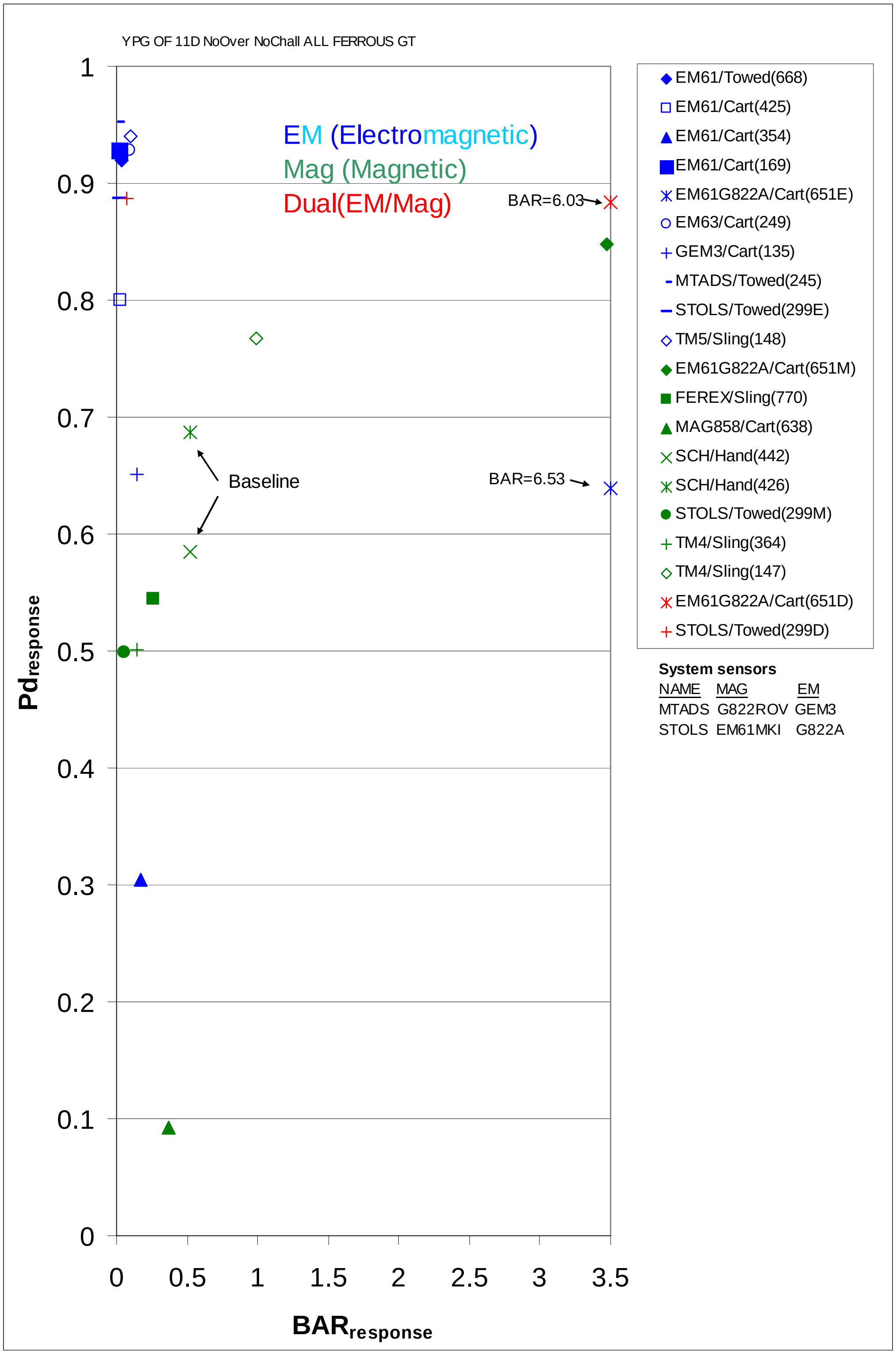

Figure 2.3.1-10. P_d^{res} versus BAR^{res}, YPG open field, All ferrous, 11D, No Overlap, No Challenge GT.

2.3.1.3 *Performance Using the Standard GT*

a. System results in the APG and YPG open fields using the standard GT are shown in Figures 2.3.1-11 and 2.3.1-12.

b. The figures show that most of the systems realized a P_d^{res} decrease of about 0.10 to 0.20 when compared with section 2.3.1.1 results. Nonetheless with this GT, trends between the EM, MAG, and dual systems are, for the most part, maintained. The EM systems are still outperforming the MAG systems.

c. The standard GT is more difficult since items are closer together (harder to discern individual signals) and deeper (harder to discern signals). Further, challenges such as power lines and fences are present to interfere with signals. This GT is more suited to test system limits. Unfortunately, in the APG open field, this GT included items in intermittently wet areas (prohibited ~5% of total area from being surveyed for some systems). Therefore comparisons between systems are restricted for this GT at APG open field. Systems that had to survey when the field was wet in these areas included those represented by report numbers 231, 298, 406, 673, and 675.

d. It is noted that one system that performed relatively (compared to results in previous sections) better in the more difficult standard GT was the TM5 sling system (report 148) at YPG open field.

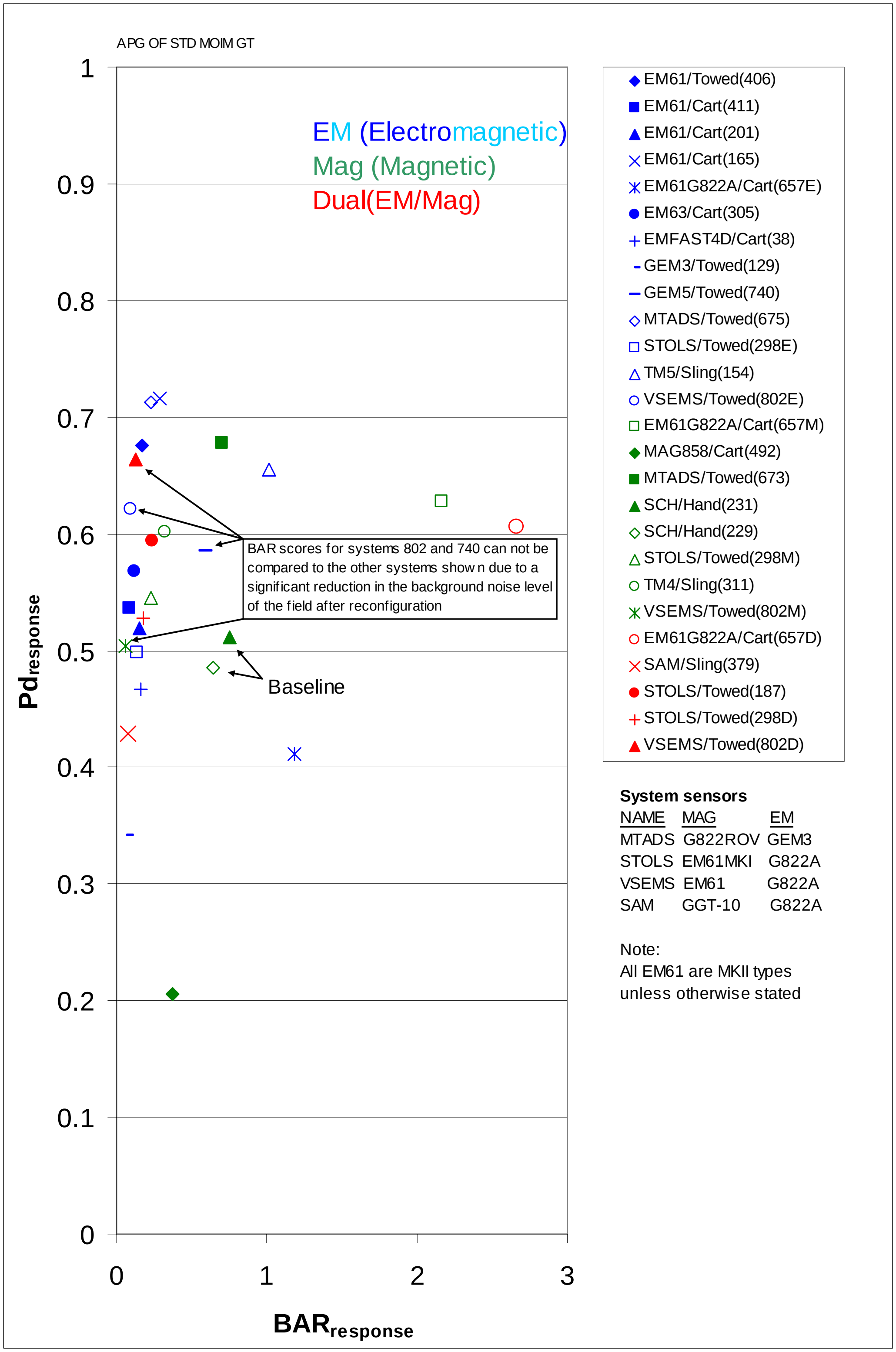

Figure 2.3.1-11. P_d^{res} versus BAR^{res}, APG open field, Standard GT.

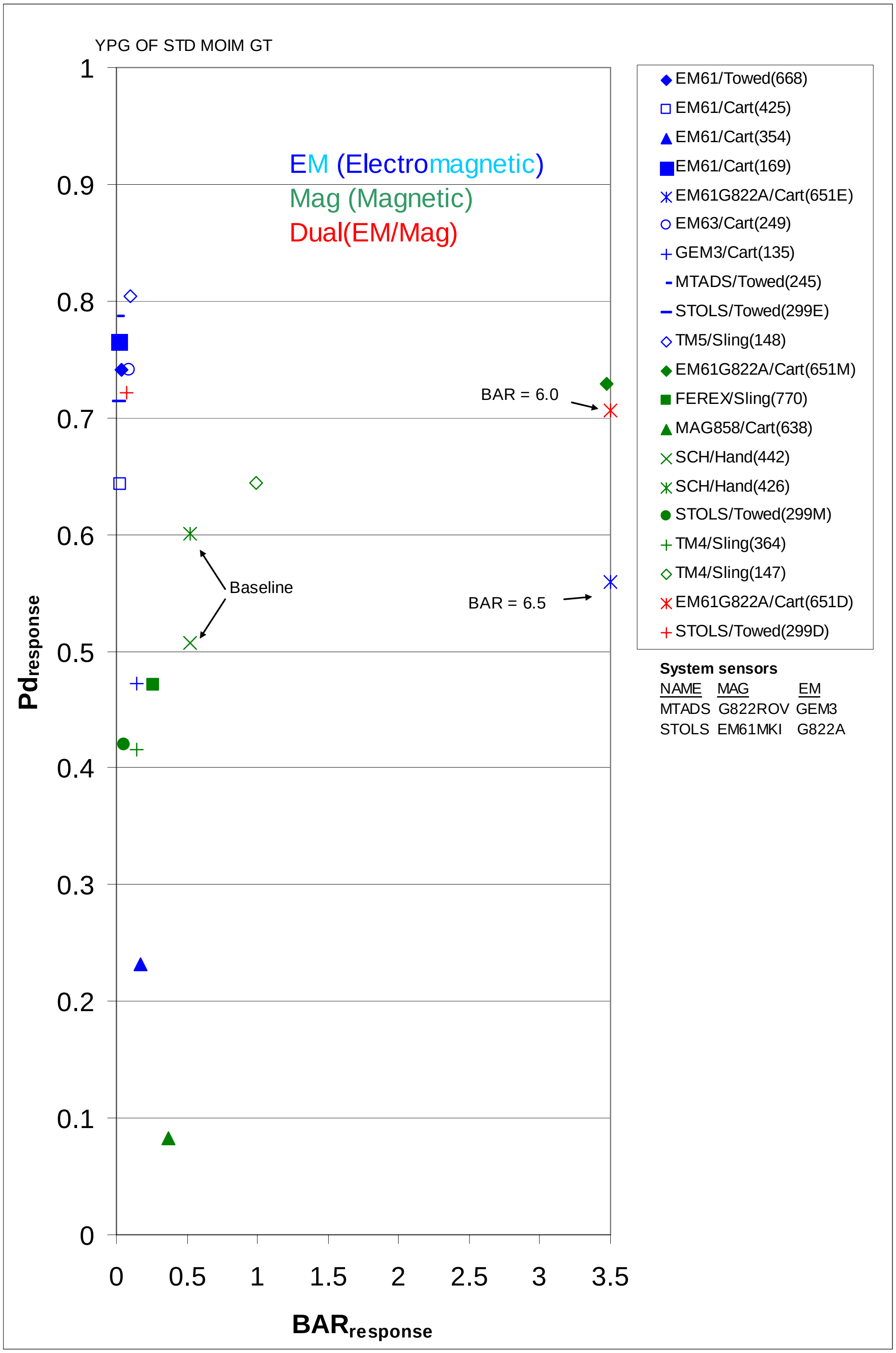

Figure 2.3.1-12. P_d^{res} versus BAR^{res}, YPG open field, Standard GT.

2.3.2 Probability of Detecting Clutter

a. Figures 2.3.2-1 through 2.3.2-8 are plots of the probability of false positive in the response stage (P_{fp}^{res}) versus BAR for all systems in all test areas. P_{fp}^{res} is the fraction of emplaced clutter items in a test area that have been detected by a system. The GT used contains no items in challenge areas or wet areas and has no items closer than one meter to another item (no overlaps). An 11D depth restriction could not be applied to the clutter since the objects buried were not cylindrical or spherical and could not be characterized by a common dimension. It can be said that only the most massive clutter (~18kg) were buried the deepest and that average depths of the larger clutter did not exceed 0.6 meters.

b. Results in the blind grids, Figures 2.3.2-1 and 2.3.2-2, APG and YPG respectively, show that clutter was less readily detected than ordnance when compared with Figures 2.3.1-1 and 2.3.1-2 of the previous section. This is likely due to a majority of clutter items being of small mass (<2kg) relative to the ordnance mass.

c. When comparing APG results versus YPG results in the blind grid, the clutter at YPG was more readily detected. At YPG most systems had P_{fp}^{res} scores above 0.95, with scores mostly below 0.9 at APG. This is likely due to the shallower depths of the clutter at YPG (0.21-m average) versus APG (0.31-m average).

d. The dual systems demonstrated in the blind grid areas typically exhibited average performance in relation to the other systems. At the YPG blind grid the dual systems had some of the highest P_{fp}^{res} scores but at the price of a very high BAR value.

e. The radar system demonstrated at the APG blind grid was one of the poorer performers when finding clutter items. This is one radar system in one test instance. More systems are needed to properly assess the technology.

f. The Schonstedt baselines were outperformed by a majority of the systems at the APG blind grid. At YPG one Schonstedt performed at a level similar to most other systems demonstrated.

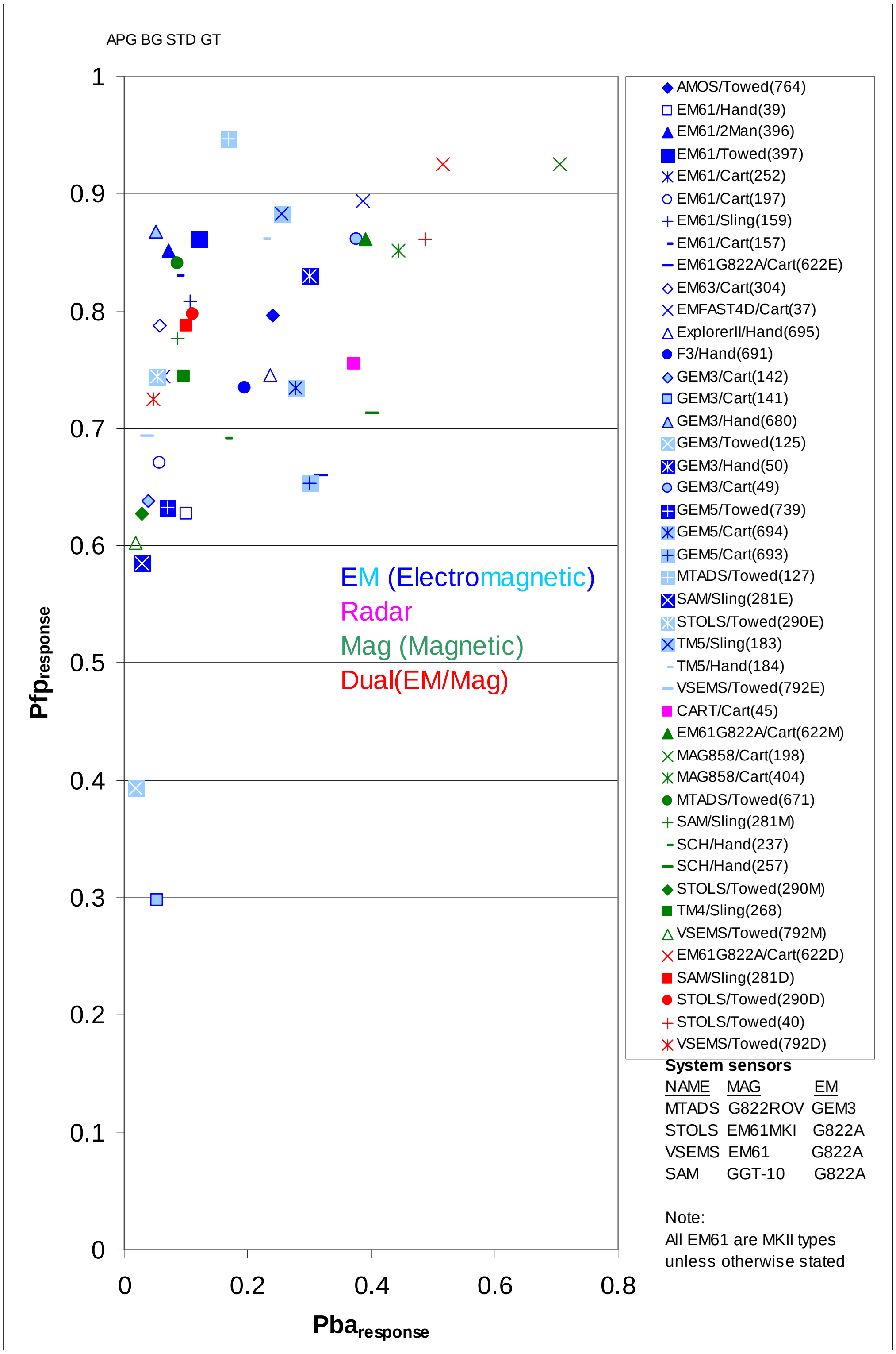

Figure 2.3.2-1. P_{fp}^{res} versus P_{ba}^{res}, APG blind grid, STD GT

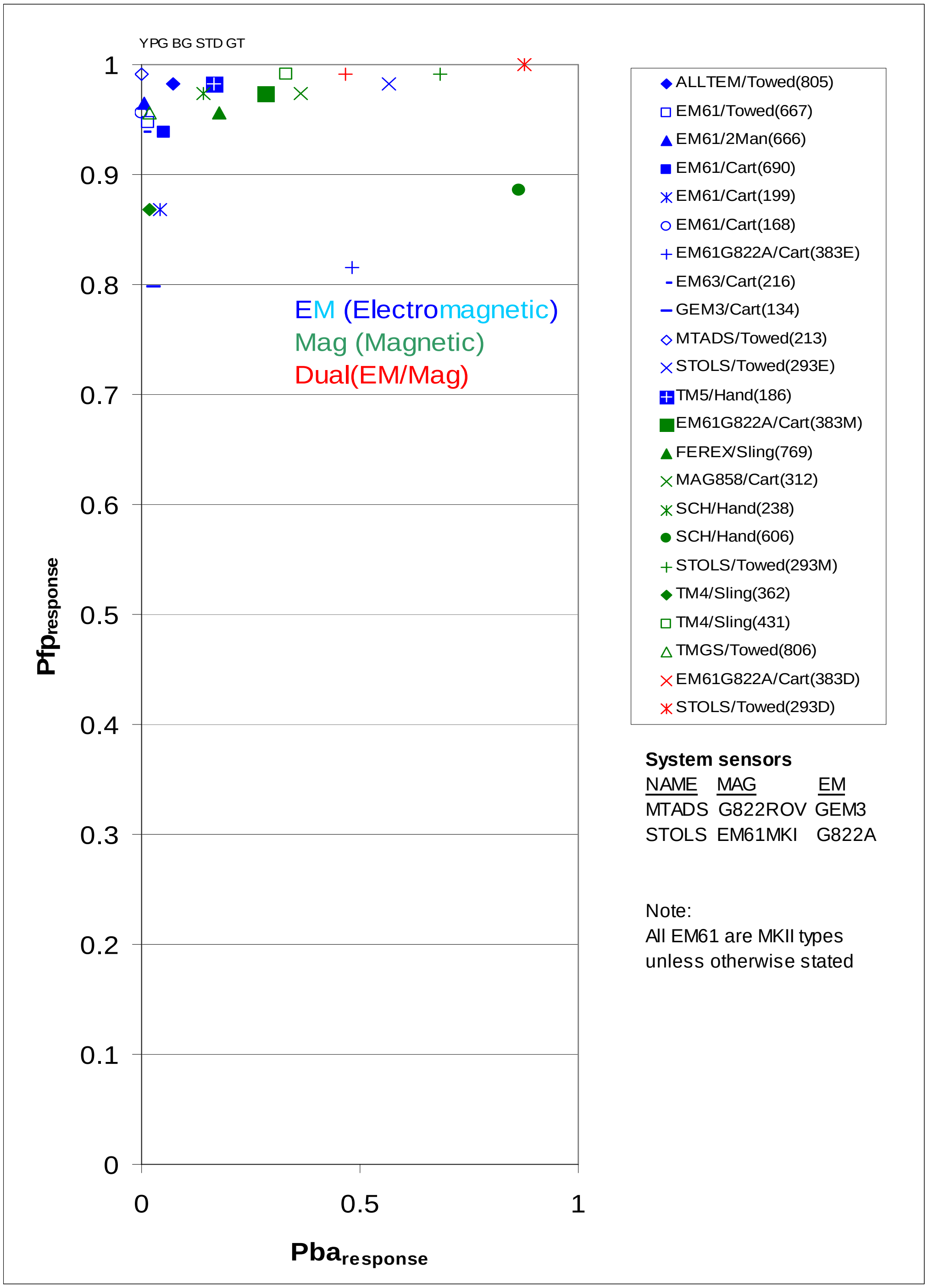

Figure 2.3.2-2. P_{fp}^{res} versus P_{ba}^{res}, YPG blind grid, STD GT

g. P_{fp}^{res} versus BAR^{res} results from the open field test areas are shown in Figures 2.3.2-3 and 2.3.2-4. The YPG open field P_{fp}^{res} results are, on average, about 20 percent lower than the YPG blind grid results. The APG open field P_{fp}^{res} results are typically about 25 percent lower than the APG blind grid results. Only about 68 percent (P_{fp}^{res} = 0.68) of the clutter items were detected at the APG open field by the best performers. The average clutter depth at APG is 0.37 m.

h. The best EM, MAG, and dual systems had similar P_{fp}^{res} scores in the APG open field. However, the MAG system had a significantly higher BAR^{res} value.

i. P_{fp}^{res} versus BAR^{res} for all the systems in the mogul areas are shown in Figures 2.3.2-5 and 2.3.2-6 for the APG and YPG areas, respectively. Similar trends existing in the open field areas are seen in the moguls in terms of P_{fp}^{res} and BAR^{res}. The exception is the GEM-3 hand held system that had a much higher P_{fp}^{res} than the other systems (0.68 versus 0.54 for next best) at the APG moguls. This score came at the price of a BAR^{res} value that was almost seven times greater than the next best performer..

j. Hand carried systems were among the top performers in the APG moguls which had a very challenging terrain.

k. It appears that no system currently exhibits performance that would be acceptable in a mogul environment.

l. P_{fp}^{res} versus BAR^{res} results for the YPG desert extreme test area are shown in Figure 2.3.2-7. Clutter was more easily detected than ordnance in this test area (P_{fp}^{res} about 0.2 greater than P_d^{res}, on average). A Schonstedt had the best score in this area with a P_{fp}^{res} = 0.85 with a relatively low BAR^{res}.

m. P_{fp}^{res} versus BAR^{res} results are shown in Figure 2.3.2-8 for the APG woods. The P_{fp}^{res} results are about 0.1 lower than P_d^{res} results for ordnance in the same area. The highest P_{fp}^{res} value, 0.54, with the lowest relative BAR^{res} value was achieved by an EM61 MKII/Sling system. It appears no system is demonstrating acceptable performance in the wooded area.

Note: Section 2.3.5.8 provides further analysis of clutter results by mass categories.

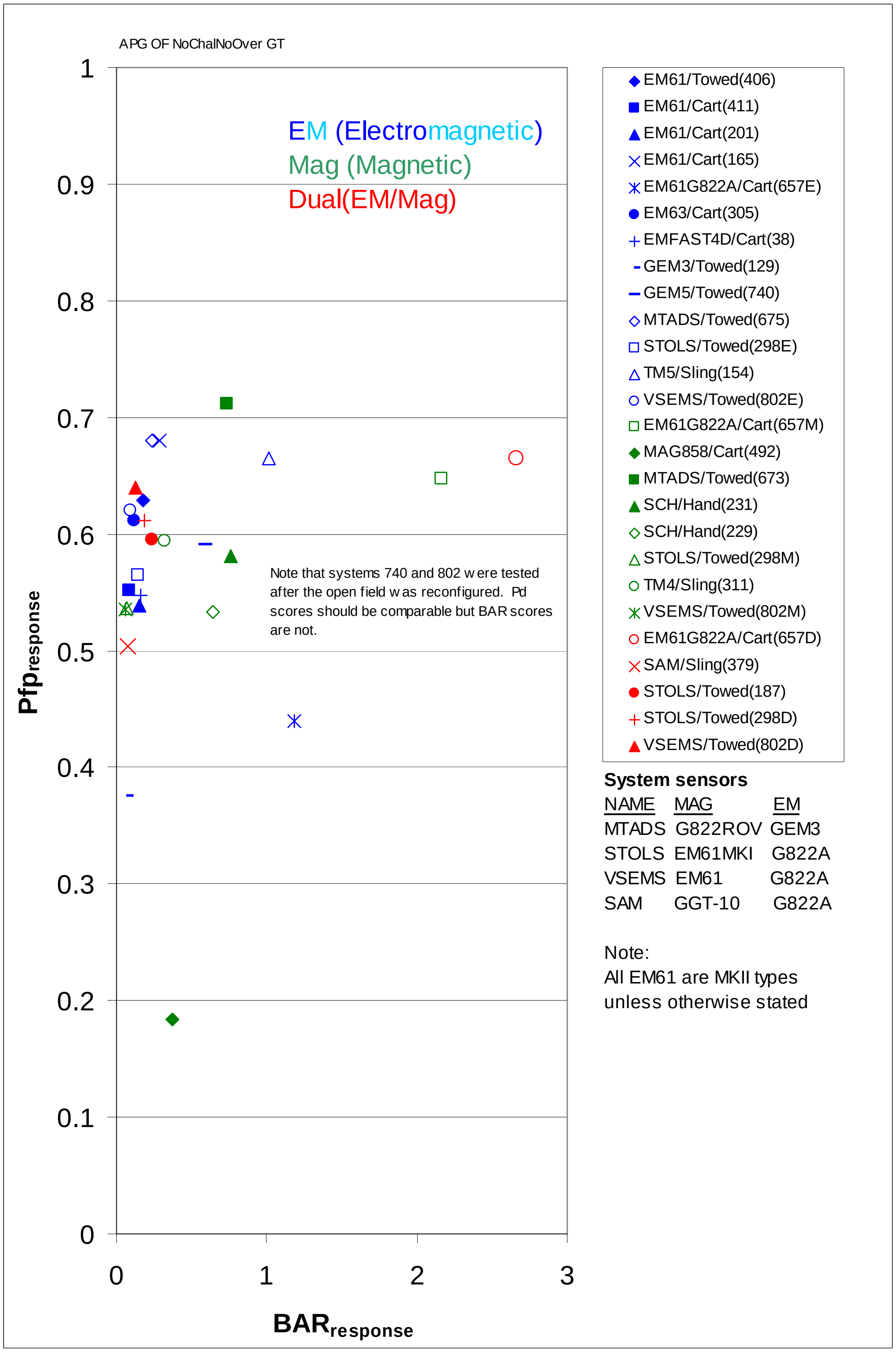

Figure 2.3.2-3. P_{fp}^{res} versus BAR^{res}, APG open field, No Challenge, No Overlaps GT

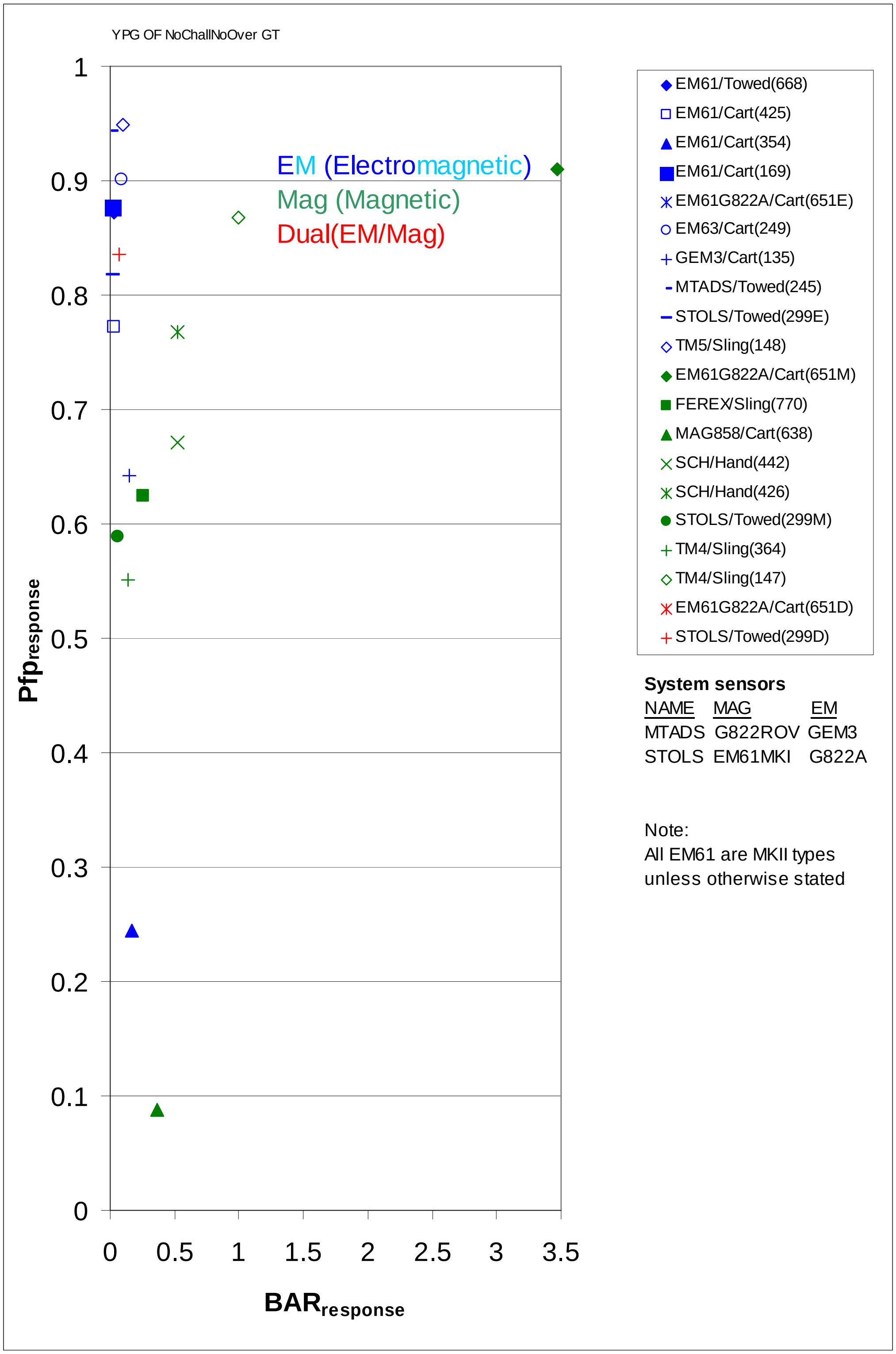

Figure 2.3.2-4. P_{fp}^{res} versus BAR^{res}, YPG open field, No Challenge, No Overlaps GT

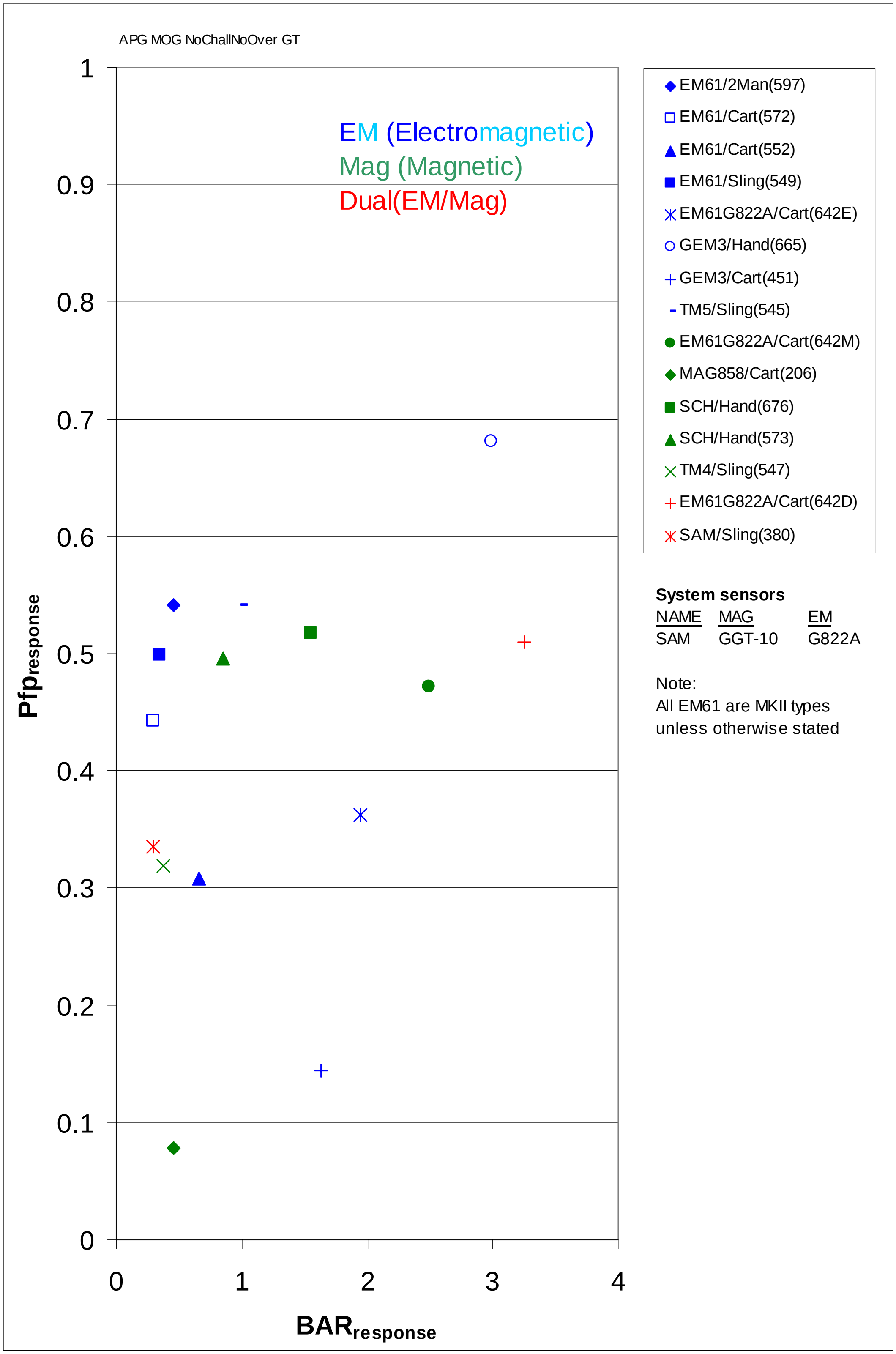

Figure 2.3.2-5. P_{fp}^{res} versus BAR^{res}, APG moguls, No Challenge, No Overlaps GT

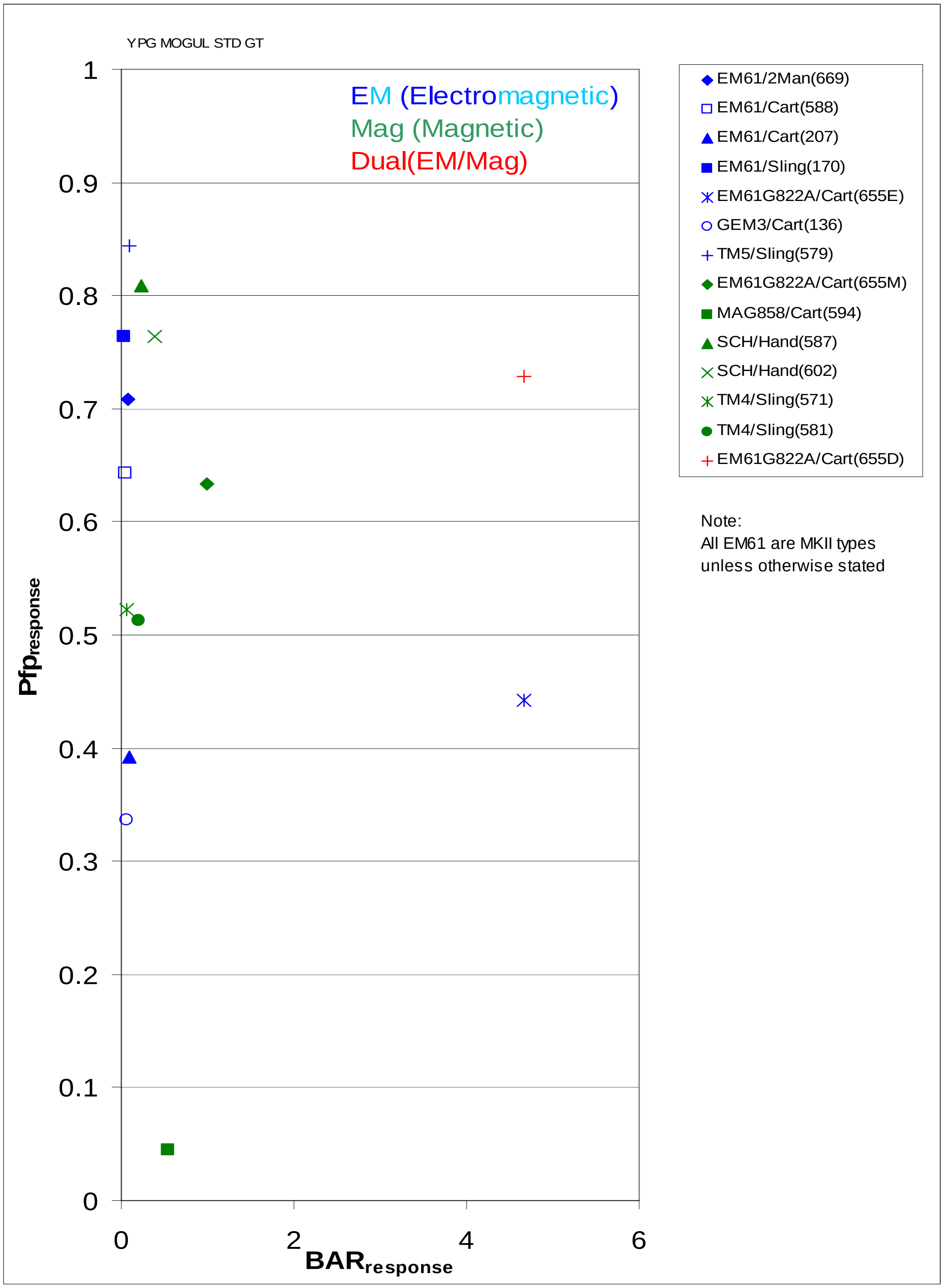

Figure 2.3.2-6. P_{fp}^{res} versus BAR^{res}, YPG moguls, No Challenge, No Overlaps GT

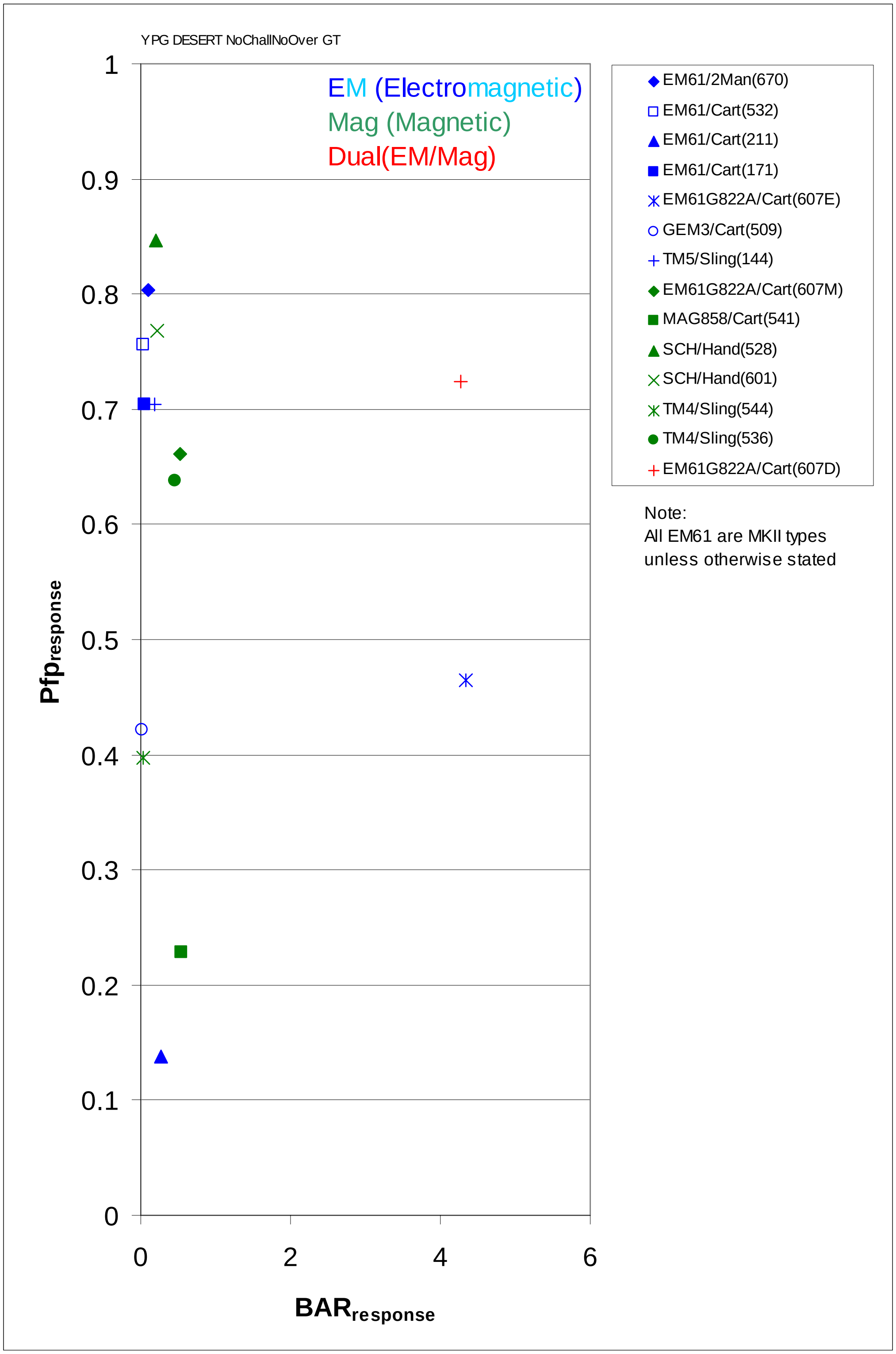

Figure 2.3.2-7. P_{fp}^{res} versus BAR^{res}, YPG desert extreme, No Challenge, No Overlaps GT

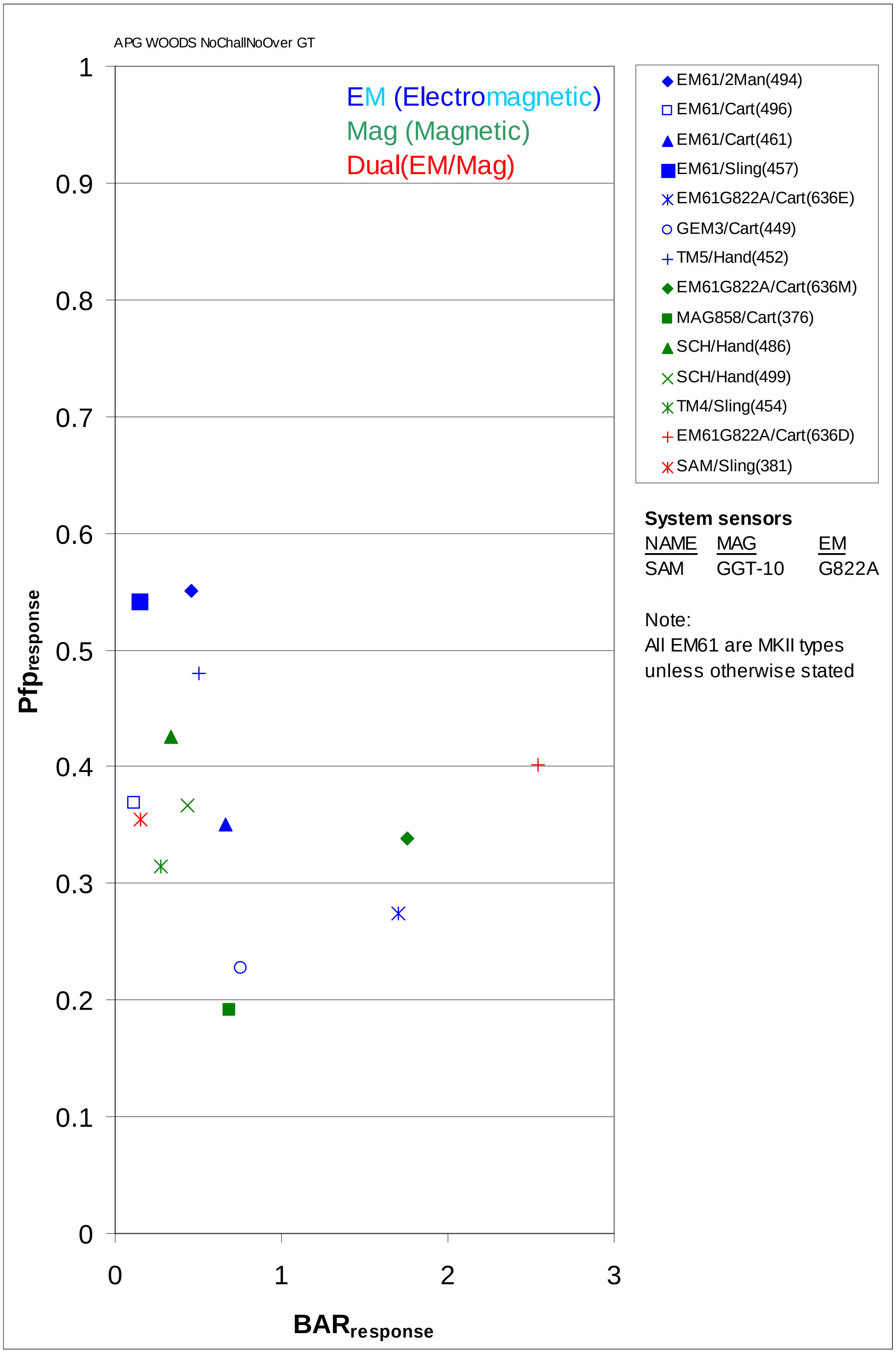

Figure 2.3.2-8. P_{fp}^{res} versus BAR^{res}, APG woods, No Challenge, No Overlaps GT

2.3.3 Ability to Discriminate

In this section various metrics will be used to show how well demonstrators were able to discriminate the items they detected using their systems. Results from standard GT sets are typically used. Time prohibited a full development of 11D, no challenge, no overlap results. However, section 2.3.3.2 will show results from both GT sets and it will be seen that little difference exists in the overall conclusion. Discrimination is defined as that ability to separate out ordnance items from clutter items in a list of anomalous targets (i.e., dig list) identified in the response stage. In the response stage, a list of potential ordnance items is submitted. In the discrimination stage, the items are identified as ordnance or nonordnance.

Note: Refer to section 2.1.3 for a thorough description of the discrimination process.

2.3.3.1 P_d^{disc} *versus* P_{fp}^{disc} *Standard GT*

a. Two of the more common metrics used (in published scoring reports from the sites) for evaluating discrimination capability are P_d^{disc} and P_{fp}^{disc}. While not the best metrics for showing discrimination ability alone, they do show "effective" detection results if discrimination is used. For review, P_d^{disc} is the number of ordnance items detected and correctly identified as ordnance, divided by the total number of ordnance in the GT. Up to this point only P_d^{res} has been used which looks only at the percentage of ordnance items detected, not the percentage detected and correctly identified. Similarly P_{fp}^{res} is a measure of the percentage of clutter items found. P_{fp}^{disc} is a measure of the number of clutter items detected and misidentified as ordnance (after discrimination has occurred) divided by the total number of clutter items in the GT. Thus, if P_{fp}^{disc} is greater than 0.5, a majority of the clutter items in the field are being detected and misidentified as ordnance.

b. When a demonstrator has no ability to discriminate or identify the anomalies that have been found, that demonstrator will likely err on the side of caution and identify all anomalies as ordnance. Thus, the demonstrator's P_d^{disc} score will be the best possible (= P_d^{res}) but lack of discrimination ability will be manifest by the highest value of P_{fp}^{disc} possible (= P_{fp}^{res}).

c. If a demonstrator is detecting ordnance and clutter at the same level in the response stage, no discrimination ability will be manifest in a ratio of P_d^{disc}/P_{fp}^{disc} that is about equal to one. For example, if a demonstrator detects all of the GT ($P_d^{res} = P_{fp}^{res} = 1$) and randomly rejects half of the GT during discrimination, then the resulting P_d^{disc} and P_{fp}^{disc} values will be approximately 0.5. The ratio of P_d^{disc}/P_{fp}^{disc} will be close to 1.0 indicating no discrimination ability. However, if nearly all the items are discriminated correctly (i.e. high P_d^{disc}, low P_{fp}^{disc}) then the ratio will be substantially larger than 1.

d. P_d versus P_{fp} in the discrimination stage is shown in Figures 2.3.3-1 through 2.3.3-4 for open field and blind grid test areas at both proving grounds using the standard GT. When all four figures are looked at as a whole the community of demonstrators in general are performing near levels of equal probability (i.e., $P_d^{disc} = P_{fp}^{disc}$ or $P_d^{disc}/P_{fp}^{disc} = 1$), indicating little to no ability to discriminate.

e. In the figures, most plotted points trend parallel to the equal probability line. These points are consistently on one side of the line or the other. It is likely these trends are related to how easily clutter is being “detected” relative to ordnance. For example, clutter is harder to find at APG because the smaller items are buried relatively deep, therefore, P_{fp}^{res} scores are usually lower than P_d^{res} scores. If the same percentage of ordnance and clutter are correctly identified by the systems, P_d^{disc}/P_{fp}^{disc} will be greater than one and plotted points will typically fall above the equal probability line for most systems.

f. While P_d^{disc} and the P_{fp}^{disc} indicate a final percentage of items both detected and properly identified, the metrics are not the best way to measure discrimination ability alone. A more accurate way to determine how well a demonstrator is discriminating is by analyzing the shape of his receiver-operating characteristic (ROC) curve in the discrimination stage, as shown in section 2.3.3.3.

g. One of the more obvious results shown in Figures 2.3.3-1 through 2.3.3-4 is that after discriminating, the amount of false positives present is high, especially for those systems with the highest ordnance detection scores.

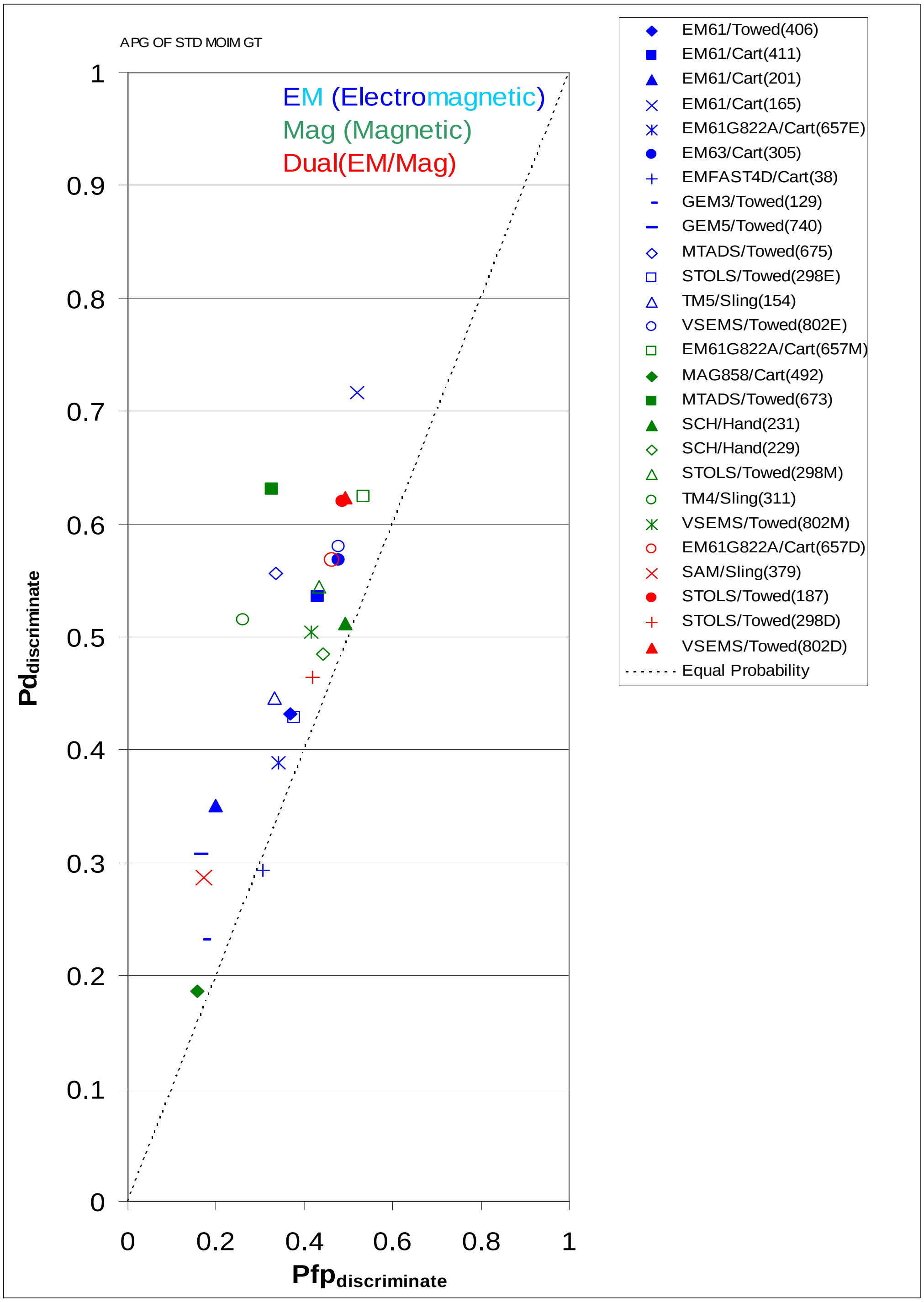

Figure 2.3.3-1. P_d^{disc} versus P_{fp}^{disc}, APG open field.

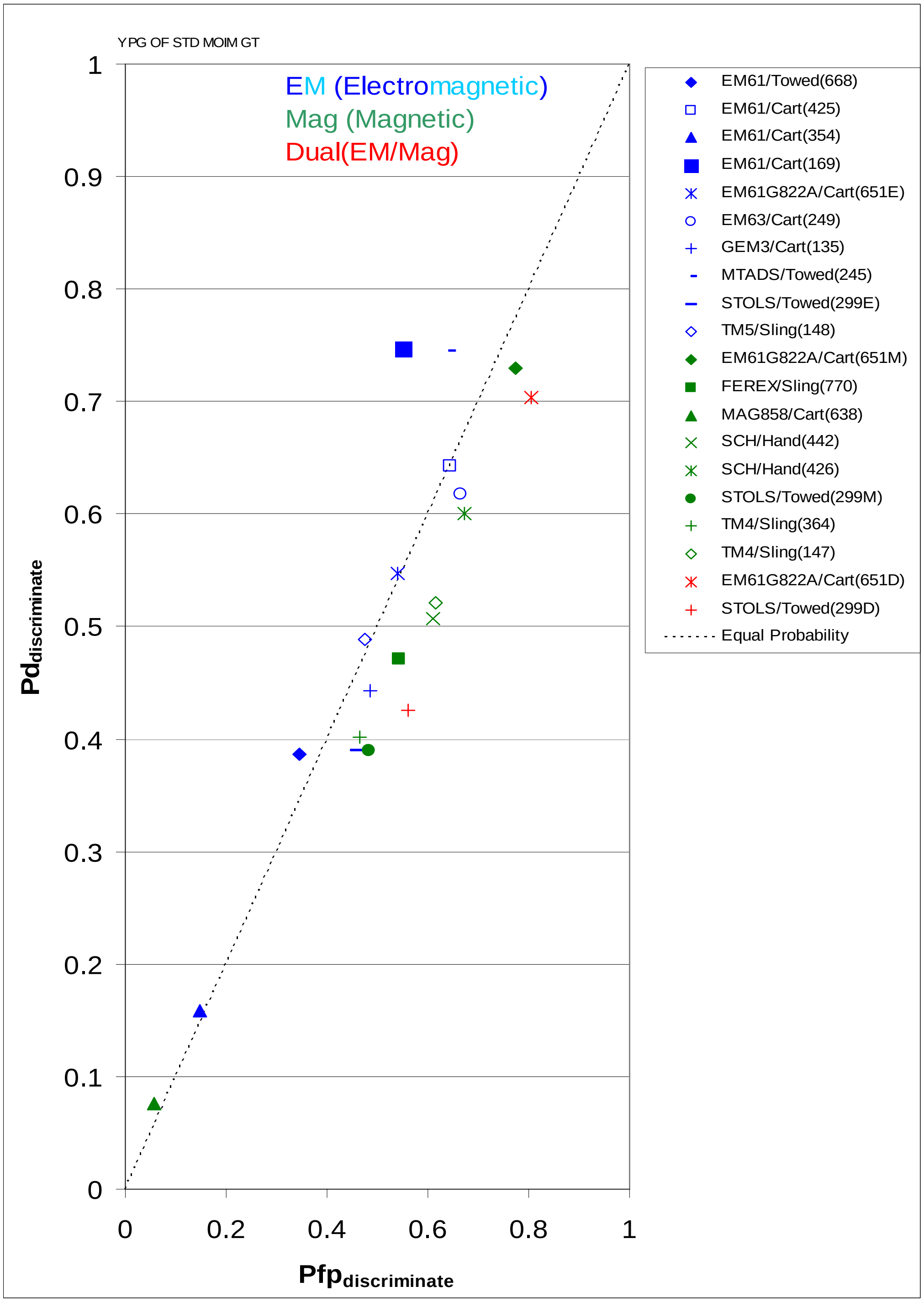

Figure 2.3.3-2. P_d^{disc} versus P_{fp}^{disc}, YPG open field.

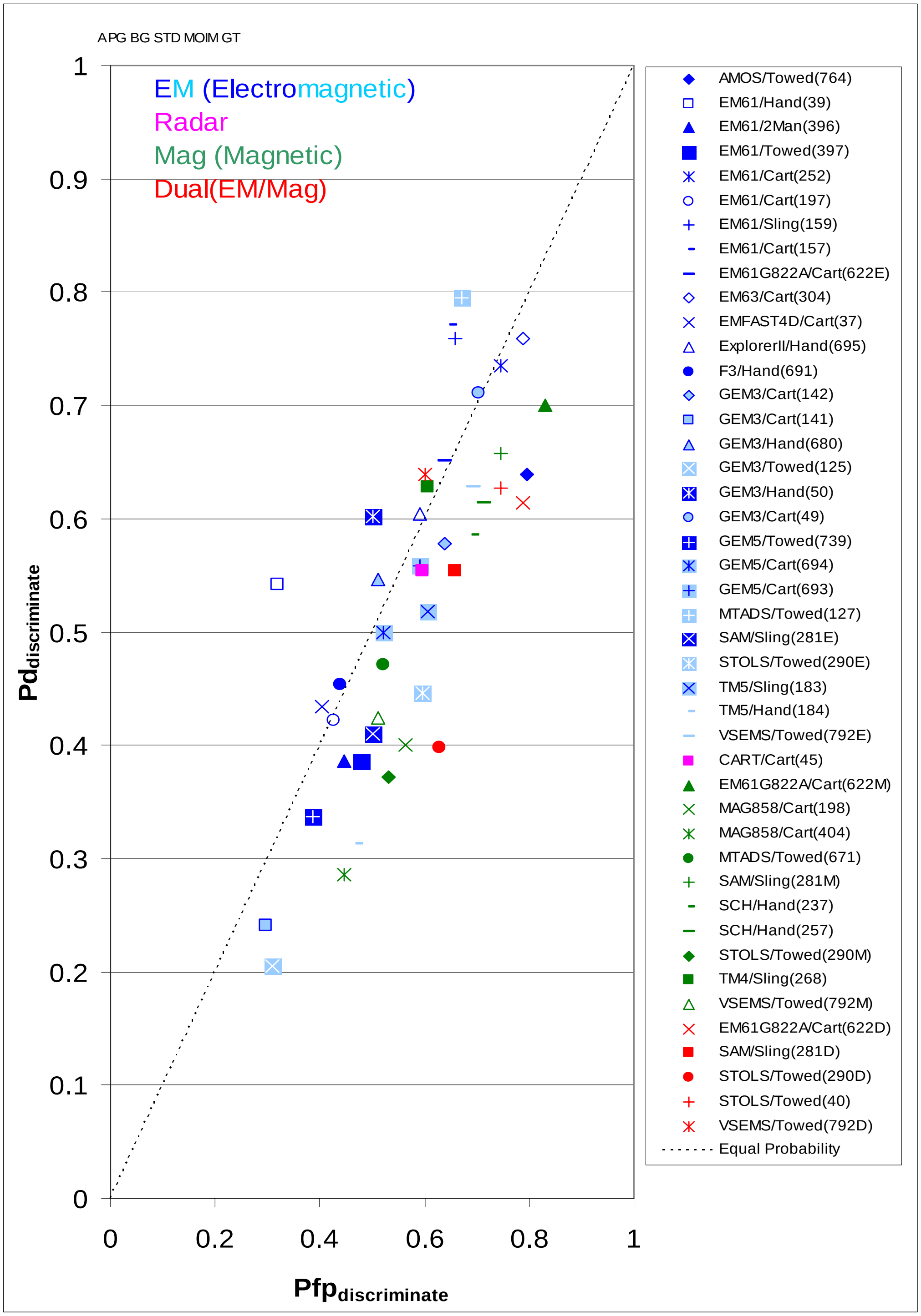

Figure 2.3.3-3. P_d^{disc} versus P_{fp}^{disc}, APG blind grid.

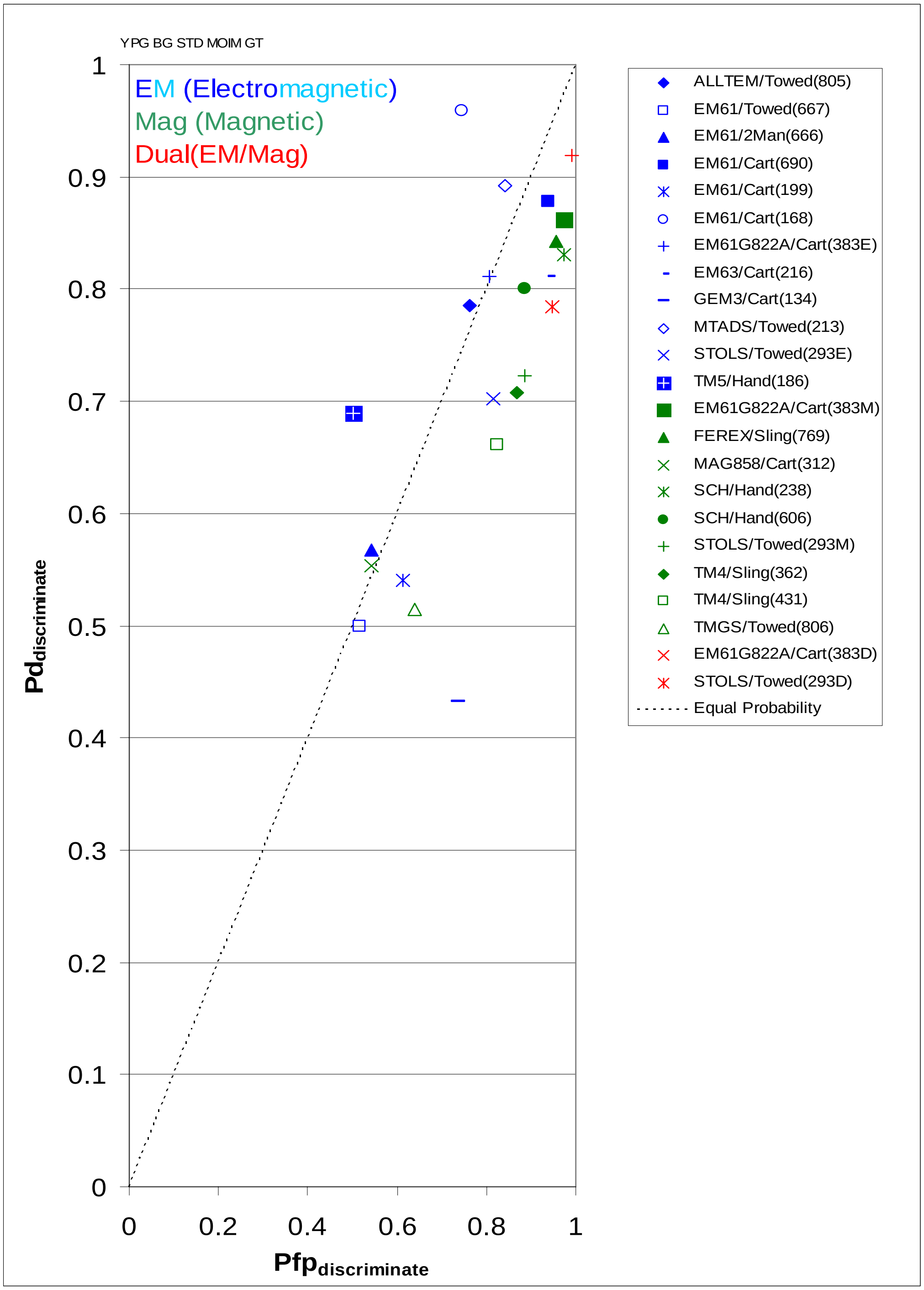

Figure 2.3.3-4. P_d^{disc} versus P_{fp}^{disc}, YPG blind grid.

2.3.3.2 *Efficiency (E), R_{fp}, R_{ba}, and P_d^{res}*

a. Three additional metrics were developed to help evaluate discrimination ability for the Standardized UXO program. These measures are efficiency (E) (the ability to retain ordnance), false positive rejection rate (R_{fp}), and background alarm rejection rate (R_{ba}). In effect, all three values are a measure of how efficiently items are being kept or rejected, where a value of 1.0 indicates optimum performance.

b. A demonstrator creates a list of anomalies believed to be potential ordnance in the response stage. In the discrimination stage the list is taken and reduced in size by rejecting items thought not to be ordnance. If all ordnance items from the response stage list are kept the demonstrator will be given an E score equal to 1.0 (100 percent of ordnance found are kept). If all of the clutter items are rejected and not carried forward into the discrimination stage list the demonstrator will have a R_{fp} of 1.0 (100 percent of clutter items are eliminated). Similarly, if all anomalies from the response stage list that were actually noise are eliminated in the discrimination stage list the demonstrator will have a R_{ba} score of 1.0 (100 percent of background alarms are rejected). Whereas P_d^{disc} and P_{fp}^{disc} relate the number of items properly and improperly identified to the entire amount possible in the GT, the above measures relate the number of items kept and rejected to the number of items of that type identified as anomalies in the response stage.

c. When all of these measures are plotted side-by-side, a better picture of the amount of effort exerted in discriminating is manifest. For example, a demonstrator may not discriminate at all and carry all anomalies over into the discrimination stage list and say they are ordnance. It appears the demonstrator has discriminated because the E (retaining ordnance) score for the effort is 1.0. However, when the percentage of clutter and background alarms rejected is examined by looking at associated rejection rates, these values will be zero.

d. E, R_{fp}, R_{ba}, and P_d^{res} (P_d^{res} showing the initial amount of ordnance detected) scores for systems demonstrated at the APG open field using the standard GT set are shown in Figure 2.3.3-6. The results are sorted on the measure of E, in descending order going from left to right. For the highest E scores on the left, no clutter or background alarms are being rejected as witnessed by the low scores for these measures. This indicates that discrimination was not attempted or was minimal in effort. As rejection rates for clutter and background alarms increase, the E value associated with retaining ordnance decreases (moving right on plot) until all three values meet at about 0.50. This indicates that clutter and anomalous noise currently cannot be discriminated by SOTA systems in the standardized test area configuration without significant ordnance rejection.

e. As shown in Figure 2.3.3-6, demonstrators have more success identifying and rejecting background alarms than they do clutter.

f. Results for the same test area as in Figure 2.3.3-6 but using an easier GT set are shown in Figure 2.3.3-7. The GT variant used is an 11D version where no ordnance depths exceed 11Ds. Further any items with overlapping halos (items within 1 m of another) and items in challenge areas (fence, power line, wet, etc.) are eliminated. This should serve to increase the signal to noise ratio of the GT set and eliminate items from the set that are difficult to access at times. Further, all non-ferrous ordnance are eliminated to allow direct capability comparisons between all sensor types.

g. As shown in Figure 2.3.3-7, the E level changed for various systems so that the sort order has changed. However, the overall trend is about the same as shown in Figure 2.3.3-6, with the exception that the P_d^{res} scores have improved. This indicates that the 11D depth limit and removal of overlaps had little effect on the ability to discriminate.

h. E scores for different ordnance types are addressed in section 2.3.5.6.

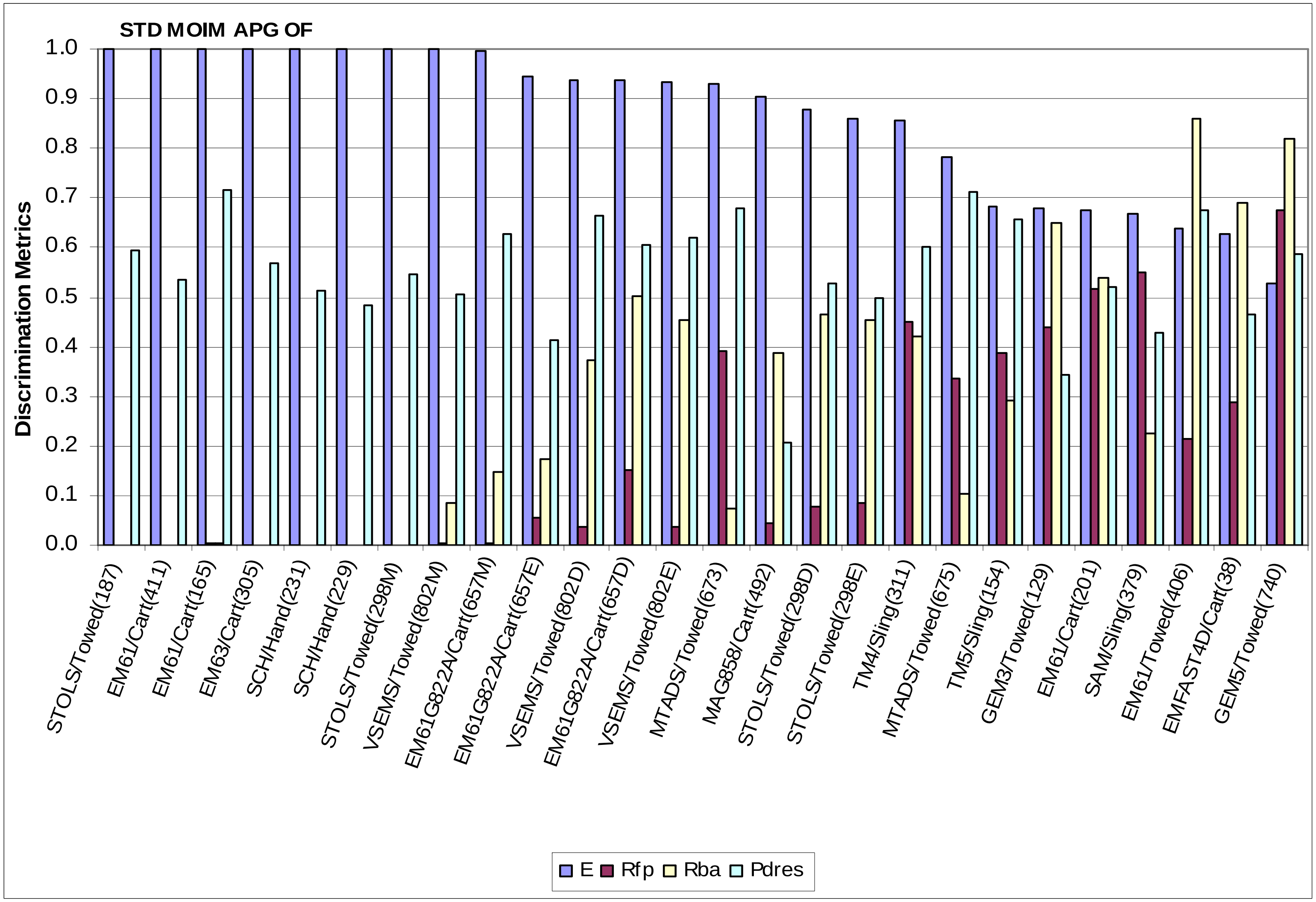

Figure 2.3.3-6. Discrimination metrics, E, R_{fp}, R_{ba}, and P_d^{res}, for various demonstrators at APG open field.

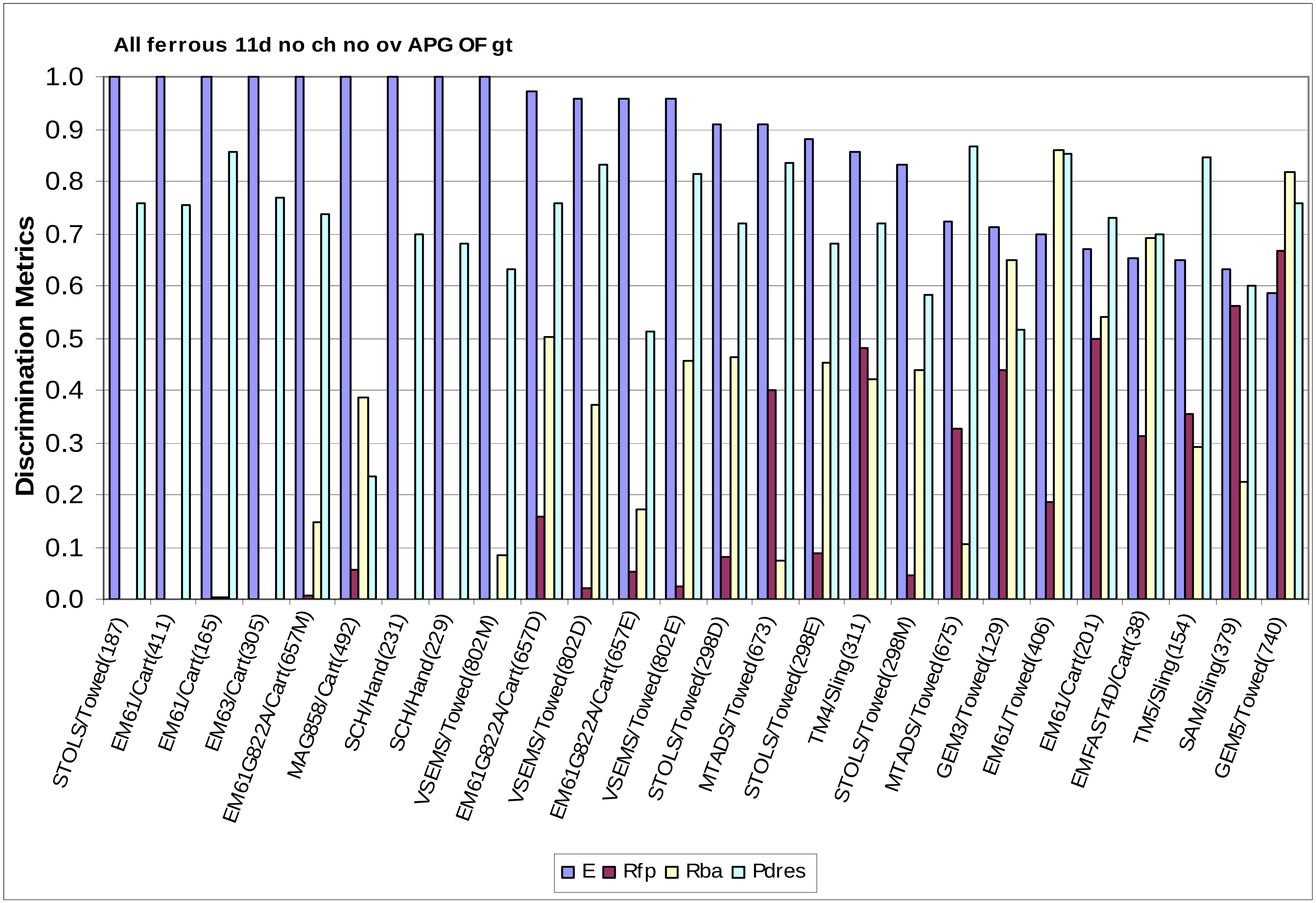

Figure 2.3.3-7. Discrimination metrics, E, R_{fp}, R_{ba}, and P_d^{res}, for various demonstrators at APG open field, all ferrous, 11D depth limit, no challenge area, no overlaps..

2.3.3.3 *ROC Curves*

a. In the discrimination stage, demonstrators are asked to refine their response stage anomaly list so those items likely to be ordnance are identified. The list is to be prioritized in descending order of likelihood that items are ordnance. This order allows the demonstrator to establish a threshold level where items above threshold are considered to be ordnance. All items below the threshold are considered likely to be clutter. The scoring authority will vary this threshold value to see if discrimination metrics improve or not. Results of varying the threshold values are included in published scoring reports and are also included in Figure 2.3.3-8 for APG open field results using the standard GT (report numbers are shown in the legend, refer to Table 2.2-1 to correlate with system types).

b. The metrics used in Figure 2.3.3-8 are P_d^{disc} versus P_{fp}^{disc}. Specifically, the figure shows a curve of how the metrics vary when the discrimination threshold value is varied from maximum to minimum (moving left to right on the plot). The curve is termed a ROC curve. An optimal curve is a vertical line with a P_{fp}^{res} value of 0.0 that peaks at the fraction of ordnance detected and then goes horizontally to the right, ending at the fraction of clutter detected. If demonstrators have mostly ordnance at the top of their list, then a mix of ordnance and clutter for the remainder, the ROC curve will start out near vertical and then project out to the right at an angle. This type of curve shows some discrimination ability. If the demonstrators have a uniform distribution of ordnance and clutter throughout their list, the ROC curve will project out at a slope ~ 1 from the origin (assuming the percentage of ordnance and clutter detected are approximately the same). This type of curve indicates no discrimination was performed or no discrimination ability exists.

c. As shown in Figure 2.3.3-8, a majority of the curves have slopes near 1.0 indicating minimal to no discrimination ability. Two of the curves (reports No. 311 and No. 740) start out with a high slope that diminishes as P_{fp}^{disc} increases. This indicates that most of the items on the top of the discrimination lists, which were most confidently affirmed to be ordnance, were indeed ordnance. Four of the curves start off with a slope near or below 1.0 but finish with a high slope and a respectable P_d^{disc} score. These curves are numbers 675, 165, 406, and 802D. These trends show that confidence rankings were deficient (in reverse order). Curve 673 starts with a slope near 1.0, but with a significant portion of the remaining curve at a characteristically good shape.

d. As indicated by the curves shown in Figure 2.3.3-8, changing the threshold values for most system results will not generally help or hinder the ratio of P_d^{disc}/P_{fp}^{disc}. Thus, feedback from the scoring authority on the effects of varying threshold values has not provided much aid in helping demonstrators refine their discrimination algorithms.

e. In summary, little discrimination ability is exhibited in the ROC curves of the detection system community. The TM-4/sling (report No. 311, G-TEK) and the GEM-3/towed (report No. 740, Geophex) systems were able to discriminate the best. Their ROC curves demonstrated trends somewhat consistent with proper confidence level rankings. The MTADs MAG system (report No. 673, Naval Research Laboratory (NRL)) also demonstrated noticeable discrimination ability. The large variety of ordnance and clutter at the sites, along with highly dense areas of emplacement proved to make discrimination extremely challenging. It is expected that ability improves as the variety of items decrease and spacing increase.

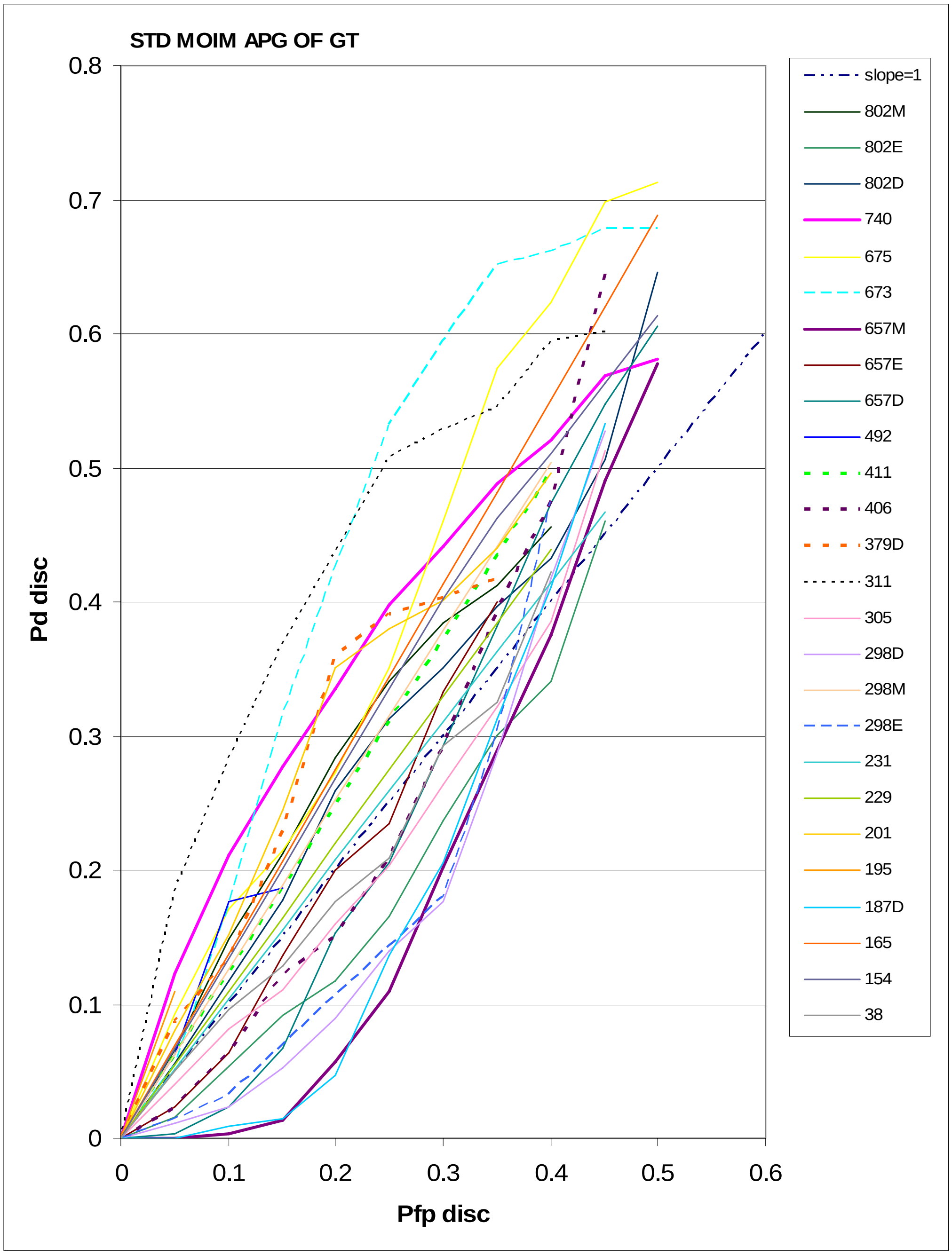

Figure 2.3.3-8. ROC curve, P_d^{disc} vs. P_{fp}^{disc}, for systems demonstrated at APG open field.

2.3.3.4 *R_{fp} and R_{ba} Values at Optimum Efficiency (E)*

a. The prioritized discrimination stage lists, of likely ordnance for each system demonstrated in the open fields, were processed to find the minimum threshold values that allowed all ordnance items from the response stage anomaly list to be retained. The percentage of clutter and background alarms that would be rejected at these threshold values were then calculated. These values, measured as R_{fp} and R_{ba}, are shown in Figures 2.3.3-9 and 2.3.3-10 for the APG and YPG open field. They are denoted as "optimum" values in the sense that no ordnance is rejected when discriminated and the maximum amount of clutter and background alarms below threshold are rejected. The values are shown beside values associated with threshold values chosen by the demonstrators.

b. When examining the optimum values of R_{fp} and R_{ba}, it is found that a very small portion of clutter and background alarms, typically much less than 15 percent, are rejected for a vast majority of the systems. Thus, if optimum thresholds could accurately be determined, it would be currently required that about 85 percent of clutter and background alarms found be dug up for SOTA technologies. This result is specific to the GT configurations at the test sites.

c. As shown in Figure 2.3.3-10, the EM61 MKII/pushcart combination (report No. 169) demonstrated by Tetra Tech Foster Wheeler (TTFW) not only performed best in the optimized list, but also had selected a threshold that was close to the optimum value. This system had the third best P_d^{res} score (= 0.76) at the YPG open field. The other systems that had some of the best rejection rates at optimum threshold did not have the best P_d^{res} scores (see section 2.3.1 results).

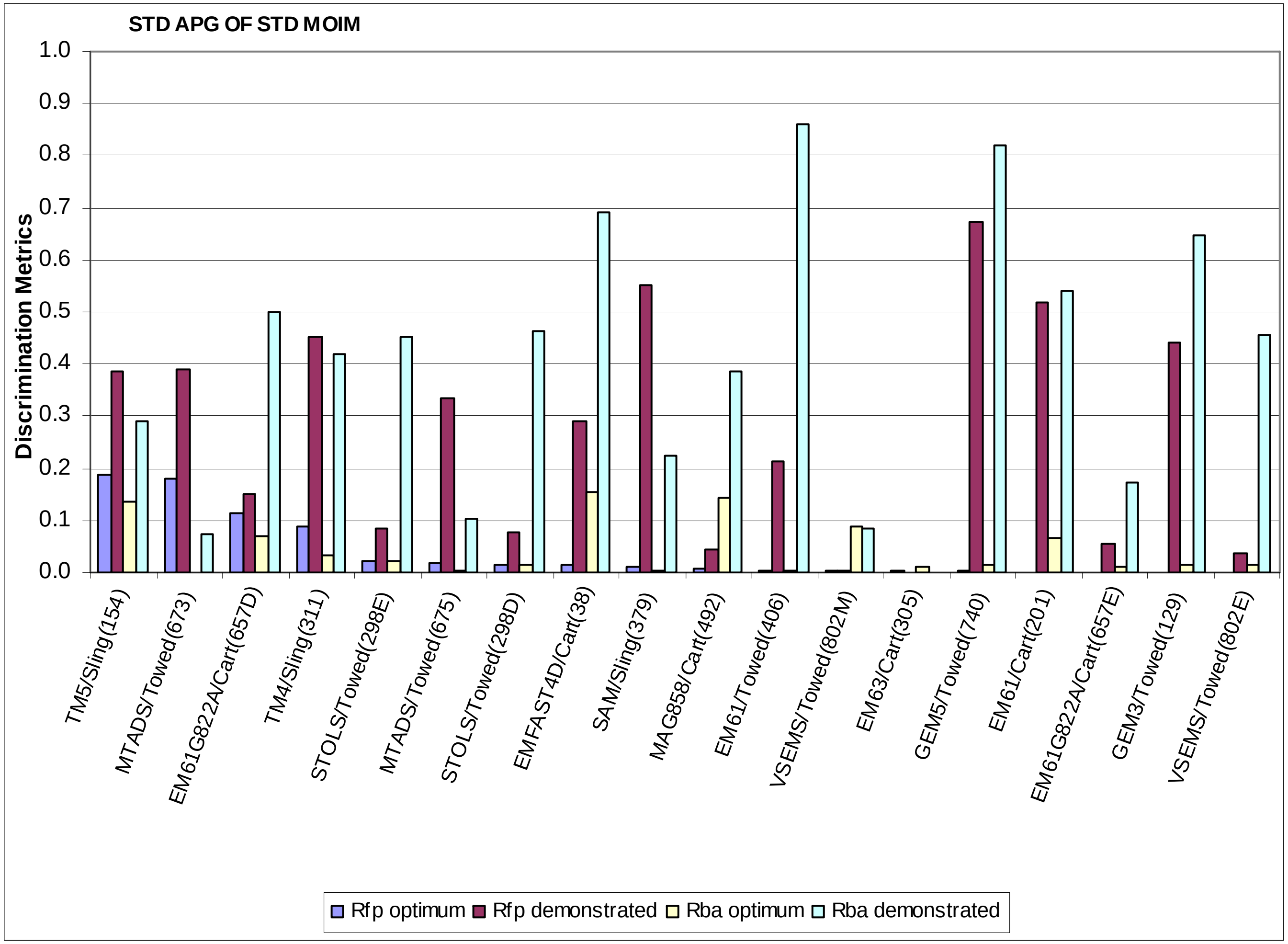

Figure 2.3.3-9. Discrimination metrics, R_{fp} optimum, R_{fp} demonstrated, R_{ba} optimum, and R_{ba} demonstrated, for various demonstrators at APG open field.

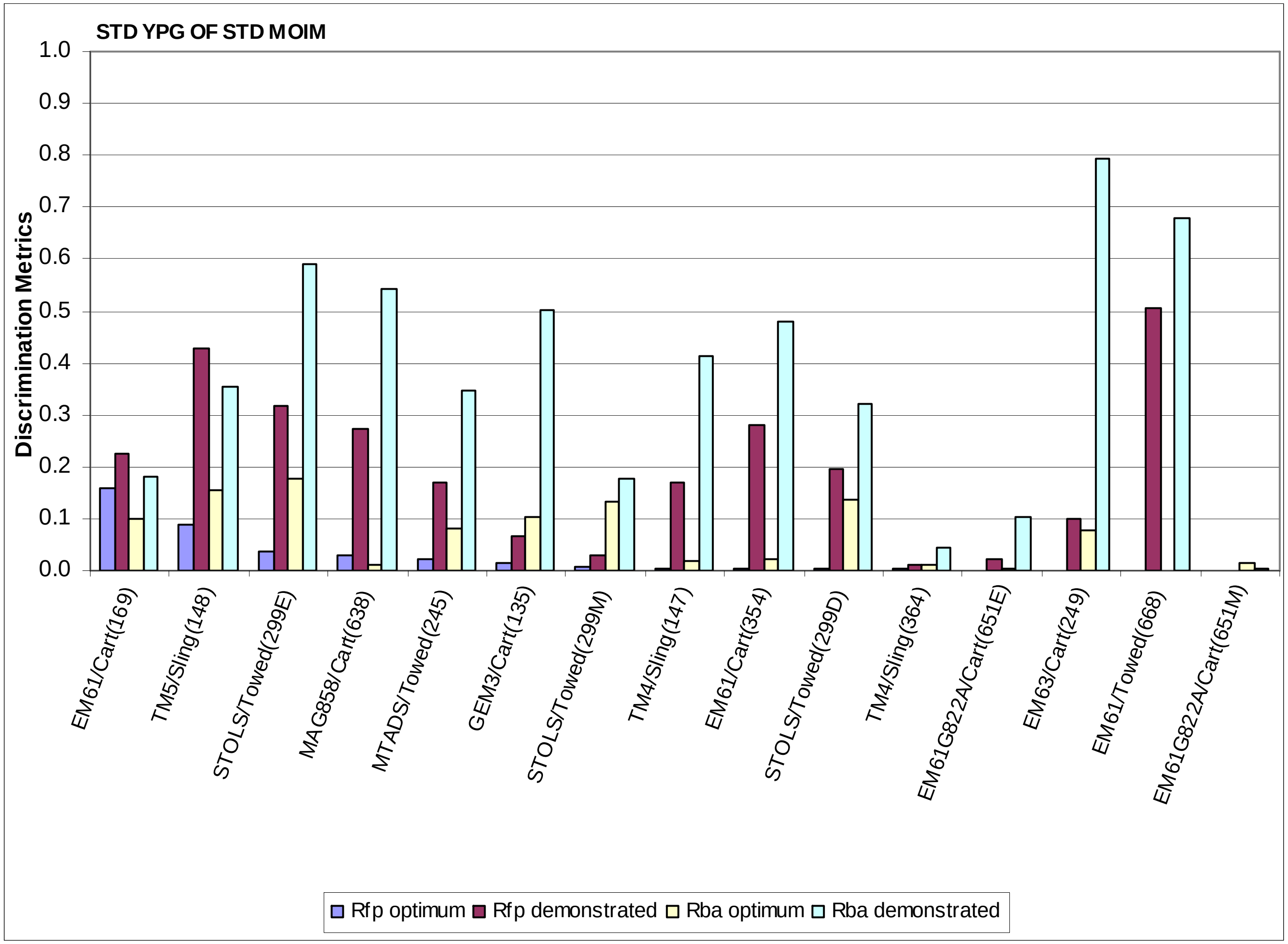

Figure 2.3.3-10. Discrimination metrics, R_{fp} optimum, R_{fp} demonstrated, R_{ba} optimum, and R_{ba} demonstrated, for various demonstrators at YPG open field.

2.3.4 Influence of Platform/Navigation/Location

Inaccuracies in the measurement of the location of the dig list at the sites can lead to lower P_d scores in the response stage. If the error in the determined location of a GT item is greater than 0.5 meter, then the anomaly will be outside of the scoring halo of the GT item and not considered a detection. Errors in navigation (guiding the platform) can lead to parts of the site not being surveyed. This could also lead to a lower P_d^{res}. These location and navigation errors can vary as a function of the platform type that is used, the area that is surveyed and the navigation/positioning system itself. This section analyzes the navigation and location errors of the detection systems demonstrated at the standardized sites.

2.3.4.1 *Improvement in P_d^{res} (When Only Ground Covered is Used)*

a. All demonstrators who survey the standardized UXO test sites are required to supply their minimally processed raw data, if such is available. In most cases the data are in a standard form that can be loaded into a large database so that the data from each vendor can be compared. Typically, the data includes the location where each measurement is taken. In addition to these minimally processed data, the vendor supplies the lane spacing that is used while surveying the site. When vendors survey the sites they typically take data while moving back and forth over the site in relatively straight lines. The lane spacing is the distance between these lines.

b. By comparing the location of the GT with the location where the demonstrator collected each data point, it is possible to measure the minimum distance between the GT item and where data has been collected. If that distance is greater than one half the demonstrator's lane spacing, it is assumed that the vendor did not collect enough data to properly survey the item. So for each vendor who supplied data in a standard format it is possible to tabulate a list of GT items where insufficient data was collected to accurately survey. It is then possible to create a custom GT for which each vendor collected adequate data to properly survey. In this way it is possible to explore the effects of incomplete coverage on the vendor's P_d^{res} score.

c. P_d^{res} results with and without the items that were not (based on lane spacing) properly surveyed as part of the GT are shown in Figures 2.3.4-1a through 2.3.4-1c. In each of these figures, items that were buried deeper than 11 times their diameter, items that are closer than 1.0 meter to another item, and items in challenge areas were eliminated from the GT. The figures show results for the APG open field, woods, and moguls, respectively. Both sets of results are not present for all systems because of insufficient data.

d. In most cases there is an increase in P_d^{res}, typically 0.01 to 0.05, when the items inadequately surveyed are eliminated. If there is no increase in P_d^{res} after these items are removed, then this would indicate that either the vendor surveyed the entire site or that the sensor used was capable of properly surveying beyond the lane spacing used.

e. In addition to incomplete coverage, the terrain of the site could make it impossible for some vendors to survey some parts of the site using a chosen platform. In the open field, areas that were difficult for vendors to survey (i.e., wet and fenced areas) were deemed challenges and were eliminated from the GT when generating Figure 2.3.4-1a. However, much of the woods and moguls are meant to be difficult for vendors to survey. This difficult terrain may lead to the slightly larger increases in P_d^{res} seen in Figures 2.3.4-1b and 2.3.4-1c.

f. The figures below conclude that better quality controls on navigation would benefit the detection rates of many systems.

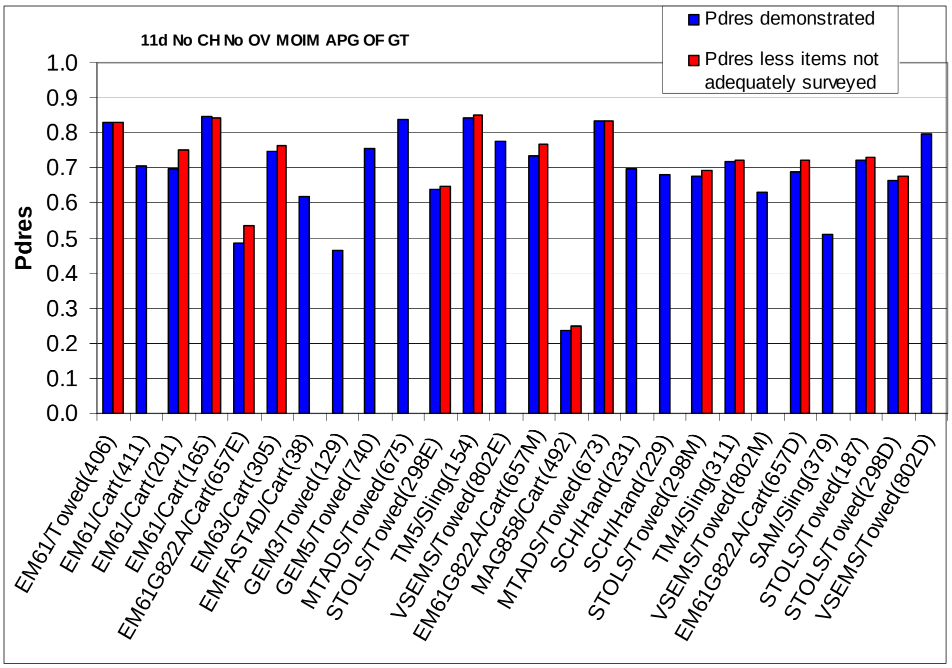

Figure 2.3.4-1a. P_d^{res} with and without items that were not adequately surveyed for each platform type, APG open field, 11D limit, no challenges, no overlaps.

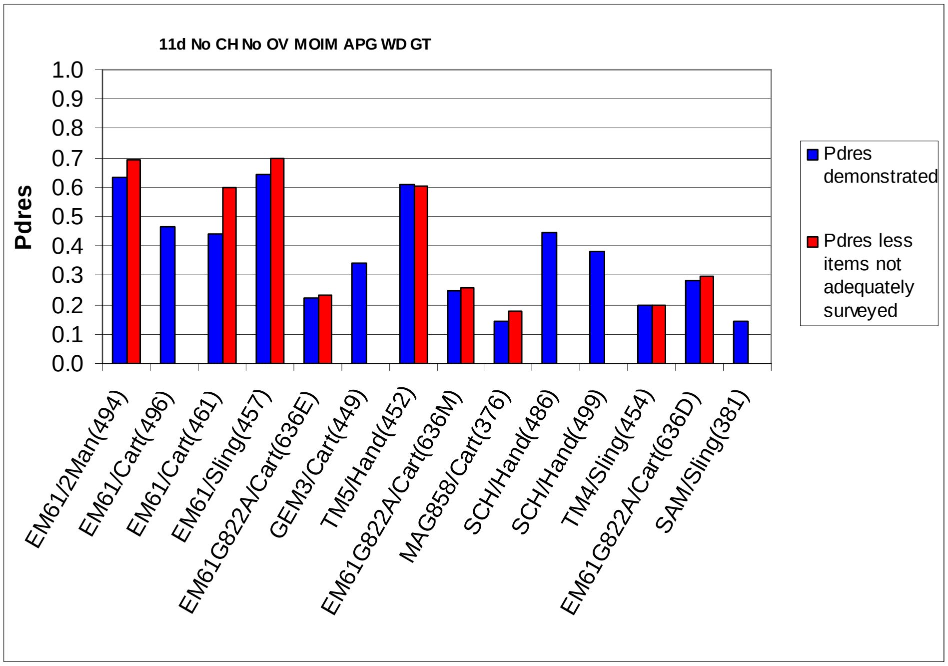

Figure 2.3.4-1b. P_d^{res} with and without items that were not adequately surveyed for each platform type, APG woods, 11D limit, no challenges, no overlaps.

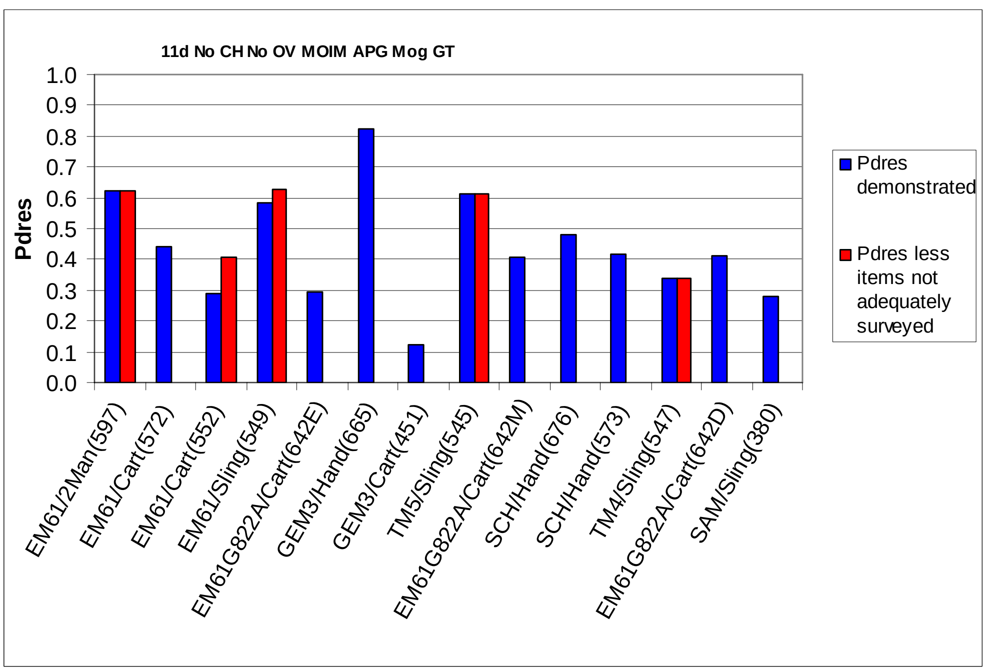

Figure 2.3.4-1c. P_d^{res} with and without items that were not adequately surveyed for each platform type, APG moguls, 11D limit, no challenges, no overlaps.

2.3.4.2 *Location Error for Demonstrators Tested*

a. This section examines the location errors demonstrated by the detection systems at the test sites. By comparing the location of a demonstrator's anomalies to the location of the matching GT items it is possible to study location error. It is difficult to account for location error if the distance between the anomaly and the intended matching GT item is sufficiently large to make the anomaly a background alarm. In this study, an anomaly exceeding a 0.5-meter distance to a GT item will not be counted toward the demonstrator's P_d^{res} but will be assumed a background alarm by virtue of scoring criteria. Therefore, location error will only be calculated for each anomaly that is within 0.5 meter of its intended matching GT item.

b. When the GT items were buried at the UXO sites, great care was taken to accurately record the location of each item. However, some error in measurement of the location of each GT item can still be expected. In addition, once these items are buried, phenomena such as frost heave, or the effect of heavy surface equipment traversing the area, may change the location of the items. Settling may also contribute to GT migration. When the UXO sites were reconfigured from 2004 through 2005, many GT items were extracted from the ground. The locations of the items were measured during this process so that effects of migration and error in measuring location could be bounded after calculating distances from the original burial positions. The mean difference calculated represents inaccuracy of the GT locations. The inaccuracy value represents the minimum location error that the vendors could be expected to obtain when they are surveying the site. The values obtained from the reconfiguration effort were 0.06 meter for inaccuracy and 0.07 meter for the corresponding standard deviation (may be termed uncertainty). These values were obtained from part of the GT in the APG open field.

c. Location error versus the standard deviation in location error between the vendors' anomalies and matching GT items in different test areas is shown in Figures 2.3.4-2 through 2.3.4-7. The inaccuracy and uncertainty in GT location is also shown in Figure 2.3.4-2 for reference.

d. In each figure, the location error and the standard deviation of that error for the systems decrease together toward the inaccuracy and uncertainty in the location of the GT. These trends are indicated by the lines bounding a majority of the points, which trend not toward (0, 0) but some finite value. One laser based system will typically not trend with a majority of systems that are GPS based.

e. Some of the smallest location errors were obtained by vendors using towed arrays or those who were using MAG and Flag or EM and Flag systems. It is likely that the towed array systems are yielding more accurate location measurements because the stability of the platforms makes it easier to produce more accurate GPS measurements. The MAG and Flag vendors are likely producing smaller location errors because when the operator finds an anomaly the vendor can immediately resurvey the area in order to place his flag as accurately as possible. Once the flag is placed the locations of the flags can be accurately measured by a non-moving system.

f. The smallest location error, 0.09 meter, was produced by a towed array system in the YPG open field. Otherwise, minimum location errors were typically about 0.15 meter. This minimum is slightly higher at the APG moguls. If the 0.06-meter inaccuracy in the GT location in the APG open field is taken into account, the best location errors by the systems will be lower in that test area.

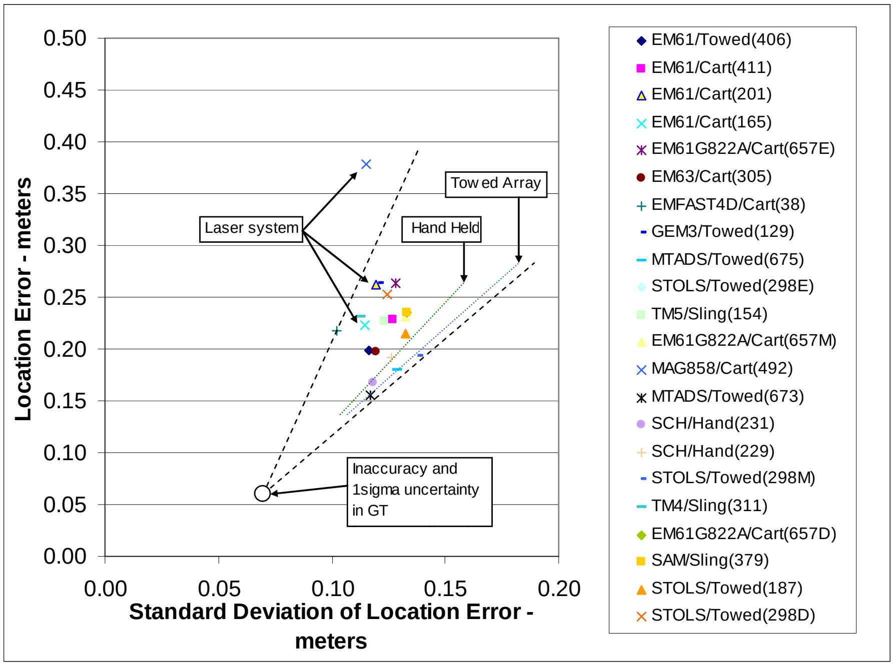

Figure 2.3.4-2. Location error versus standard deviation of location error for all systems, APG open field.

g. Demonstrators were asked to give the location of the center of the anomaly they detected. An element of signal interpretation that plays into the location errors is inevitable. Analysis of this is beyond the scope of this work.

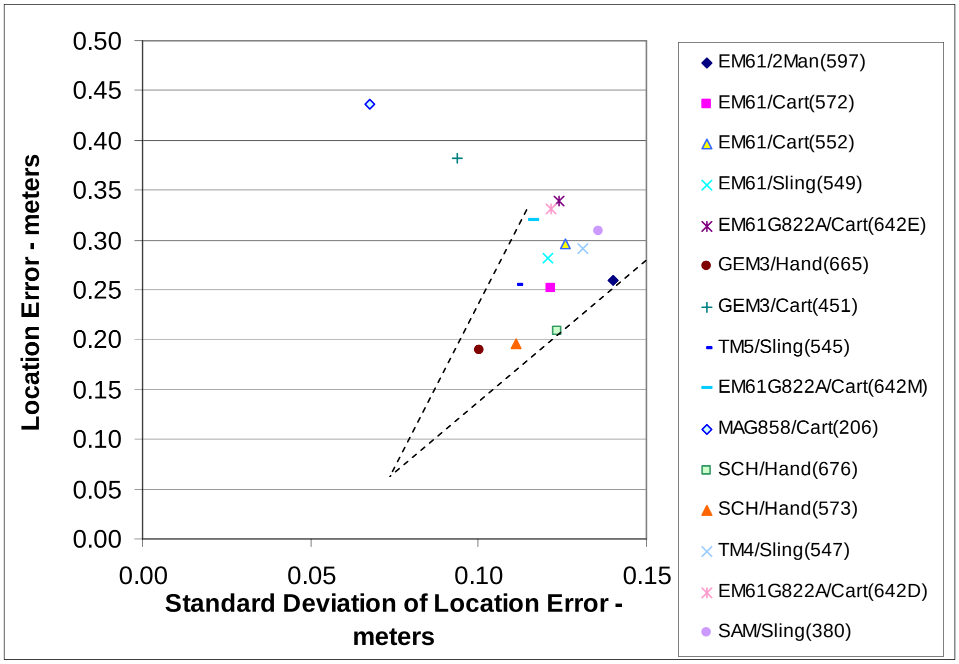

Figure 2.3.4-3. Location error versus standard deviation of location error for all systems, APG moguls.

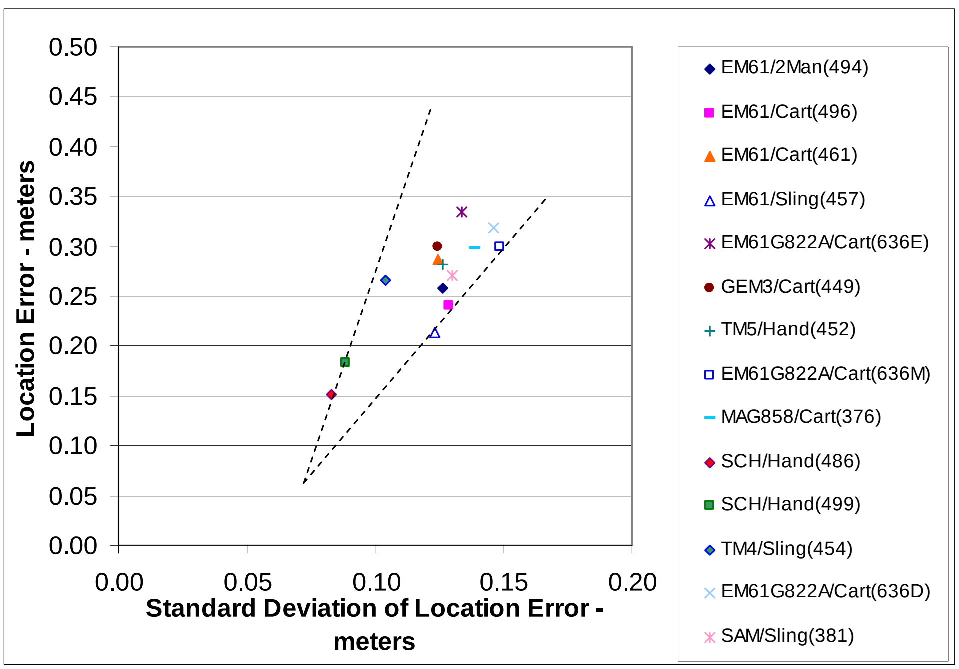

Figure 2.3.4-4. Location error versus standard deviation of location error for all systems, APG woods.

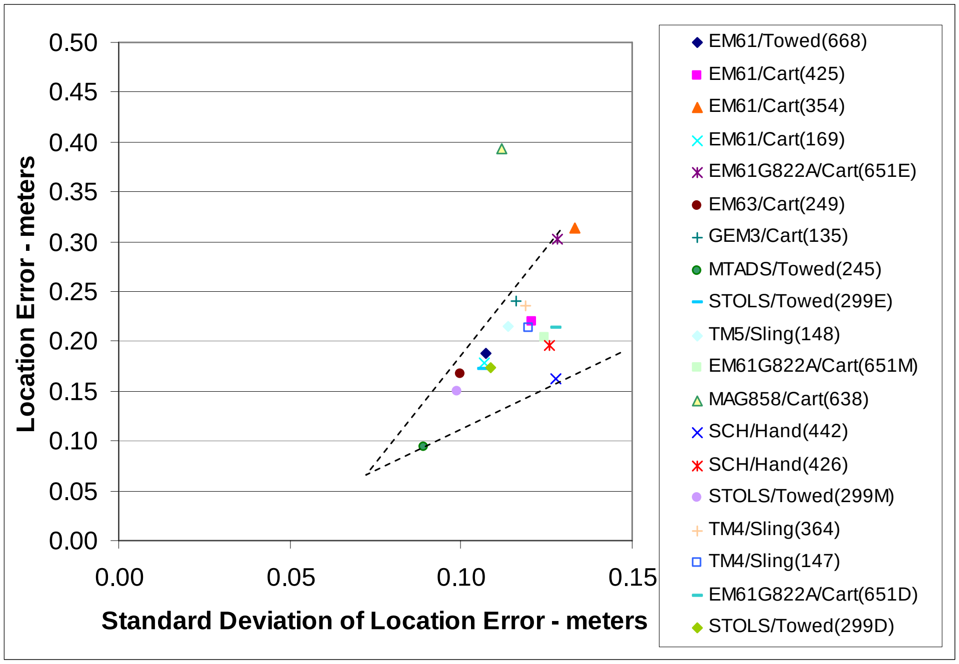

Figure 2.3.4-5. Location error versus standard deviation of location error for all systems, YPG open field.

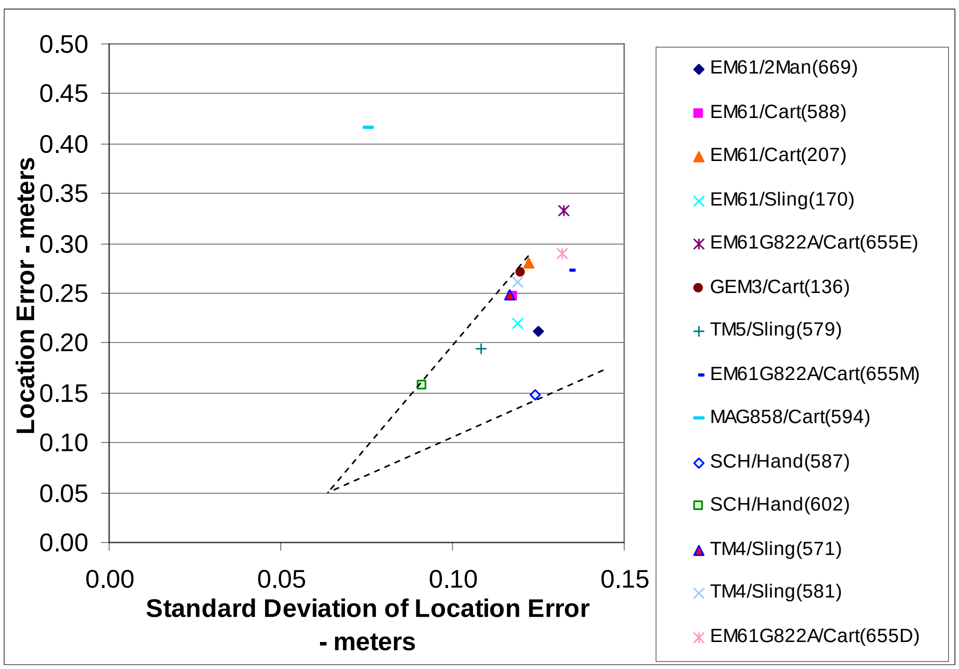

Figure 2.3.4-6. Location error versus standard deviation of location error for all systems, YPG moguls.

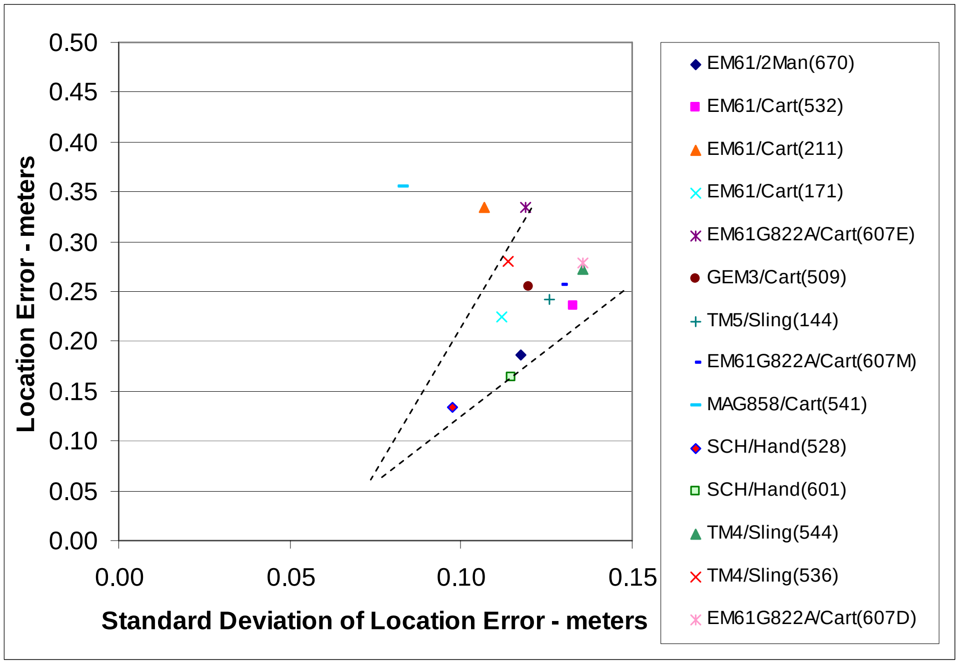

Figure 2.3.4-7. Location error versus standard deviation of location error for all systems, YPG desert.

2.3.4.3 *Comparative Results for Platform and Areas*

a. Once the location error for each vendor that surveyed the UXO sites was analyzed, a comparison of the minimum location error that demonstrators produced as a function of the platform and the site being surveyed was made. A location error scale was created to allow a quick look at relationships.

b. A comparison of the minimum location error for each type of platform in each area at the UXO sites is presented in Table 2.3.4-1. Consistent with section 2.3.4.2, the towed array and hand held systems allow a good or excellent minimum location error for each area that was surveyed. The hand held units accessed all areas whereas the towed array units did not. In the open field, demonstrators produced a lower minimum location error using a pushcart than a sling. This may have been due to the greater stability of the pushcart platform. As terrain becomes more difficult to traverse, as in the YPG desert moguls, the lowest location error was produced using a hand held unit. In the most difficult terrains such as YPG desert extreme, APG moguls, and APG woods, the hand held units still had the best error. As the terrain changed, the ability of systems to accurately determine the location of GT items was largely a function of platform type.

TABLE 2.3.4-1. BEST LOCATION ERROR RESULTS FOR PLATFORM/AREA

Terrain	Site	Towed Array	Pushcart	2 Man	Sling	Hand Held
Wooded	APG	No data Min= N/A N= 0	Marginal Min= 0.24 N= 7	Marginal Min= 0.26 N= 1	Marginal Min= 0.21 N= 3	Good Min= 0.15 N= 3
Moguls - Marsh	APG	No data Min= N/A N= 0	Marginal Min= 0.25 N= 7	Marginal Min= 0.26 N= 1	Marginal Min= 0.25 N= 4	Good Min= 0.19 N= 3
Moguls - Desert	YPG	No data Min= N/A N= 0	Marginal Min= 0.25 N= 7	Marginal Min= 0.21 N= 1	Good Min= 0.19 N= 4	Good Min= 0.15 N= 2
Open Field - Loam	APG	Good Min= 0.16 N= 8	Good Min= 0.20 N= 9	No data Min= N/A N= 0	Marginal Min= 0.23 N= 3	Good Min= 0.17 N= 2
Open Field - Desert	YPG	Excellent Min= 0.09 N= 5	Good Min= 0.17 N= 9	No data Min= N/A N= 0	Marginal Min= 0.21 N= 3	Good Min= 0.16 N= 2
Desert Extreme - Brush/Eroded	YPG	No data Min= N/A N= 0	Marginal Min= 0.22 N= 8	Good Min= 0.19 N= 1	Marginal Min= 0.24 N= 3	Good Min= 0.13 N= 2

← Indicates best error value among systems demonstrated and number of systems tested

Location Error Scale	
Excellent	0-0.1 m
Good	0.1-0.2 m
Marginal	0.2-0.3 m
Poor	0.3-0.4 m

2.3.4.4 *Percentage of Ordnance Possibly Missed Because of Location Error*

a. Many of the systems would have a slightly increased P_d^{res} value if their location error were better. The variation in their existing location error extends beyond 0.5 m and therefore precludes some anomalies from being considered a hit. It is difficult to determine the difference between a true background alarm and a legitimate hit as distance from a GT item increases. An effort to estimate the reduction in P_d^{res} being caused by location error was made so that P_d^{res} increases possible with improving locating methods/technologies might be quantified.

b. To estimate the reduction in P_d^{res} resulting from location error, histograms of location error within the allowable halo radius were plotted. Next, a characteristic distribution that best described the histograms was found. It was determined that a Weibull distribution that is skewed right fitted most system results best. The estimated cumulative probability of location error was then plotted on a Weibull chart. Total population was based upon the fit of the distribution which typically extended beyond 0.5 meter. The cumulative probability at the intersection of the line fitting the distribution and a line denoting a 0.5-meter halo radius was used as an estimate of the ordnance population that will be found at location errors below 0.5 meter. The difference between that value and 100 percent was used as an estimate of the percentage of ordnance likely missed given the 0.5-meter criterion. Populations of items less than 0.6 meter long were used since these items do not require an elliptical halo which can exceed a 0.5-meter radius. These items comprise approximately 84 percent of the APG open field GT (used for study).

c. A typical histogram for one of the systems processed is shown in Figure 2.3.4-8, and the corresponding probability plot is shown in Figure 2.3.4-9. The data are from an NRL system demonstrated at APG open field. Past 0.5 meter, for the distribution of location error shown in the histogram, there is still area under the characteristic curve representing the trend. Further, from the probability plot, the population found at 0.5 meter would be estimated to be 98.9 percent, and the population not found estimated at 100 - 98.9 = 1.1 percent. Since the population used comprises 84 percent of the GT, the percentage missed comprises 1.1 percent x 0.84 = 0.9 percent of the overall ordnance population. The P_d^{res} score could be improved by 0.009 (0.01 when rounded) if location error was sufficiently improved. This is a small percentage for this example. Greater values will be seen for other systems.

d. The vertical axis in the histogram is unlabeled to help preserve GT information related to quantity.

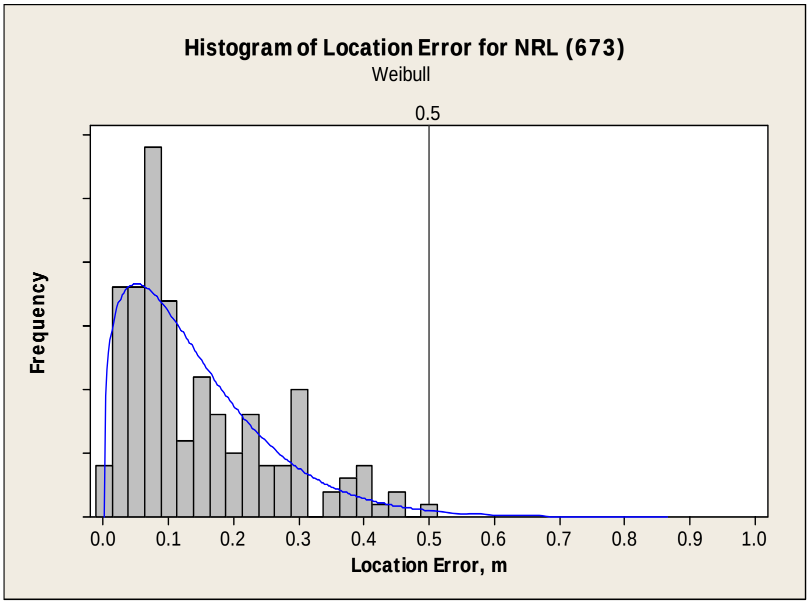

Figure 2.3.4-8. Histogram of location error for NRL towed system (report No. 673) at APG open field.

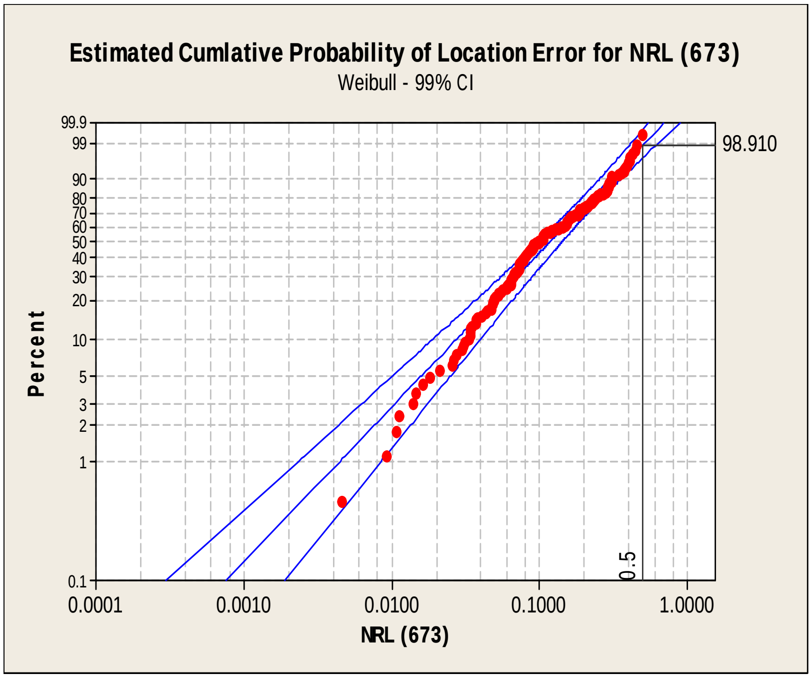

Figure 2.3.4-9. Estimated cumulative probability of location error for NRL towed system (report No. 673) at APG open field.

e. The percentage of the population of ordnance not found because of location error is estimated for all systems at APG open field using the above method, and the results are summarized in Figure 2.3.4-10 (estimates based on general trends). The systems are represented by report numbers in the plots. Most systems may be missing approximately 1 to 3 percent of the ordnance in the ground because of location error and the scoring criteria of 0.5 meter used at the sites. If the inaccuracy of the GT location is factored in, the values may decrease slightly.

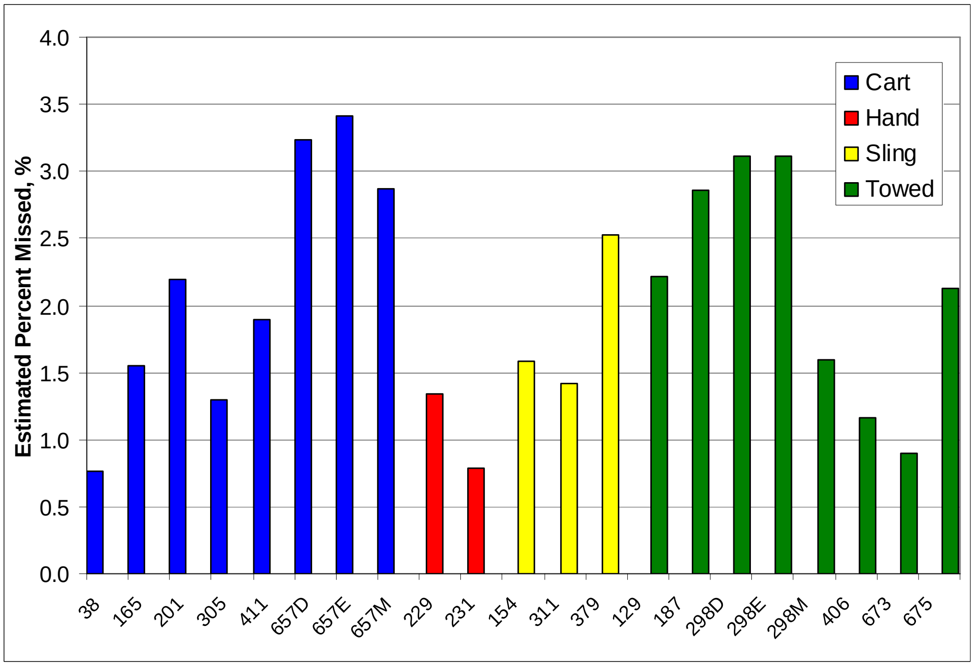

Figure 2.3.4-10. Estimated percentage of ordnance missed because of location error, APG open field.

f. The plot in Figure 2.3.4-9 shows that probabilities can be chosen such as 99.9 or 99.99 percent. These percentages would represent 1 in 1,000 and 1 in 10,000 items being left in the ground, respectively. When these values are correlated with the radius on the horizontal axis, radial dig limits can be estimated. These values for the systems demonstrated at APG open field are shown in Figures 2.3.4-11 and 2.3.4-12 (systems are represented by report numbers). The estimates are for GT items less than 0.6 meter long.

g. As shown in Figures 2.3.4-11 and 2.3.4-12, no well defined trends between platform types are evident. As shown in Figure 2.3.4-12, a 1-meter dig radius encompasses all location error results for a 1 in 10,000 miss. The geophysical prove-outs (GPOs) typically use a 1-meter detection radius for scoring.

h. Histograms and probability plots of location error for all demonstrators at APG open field are presented in Appendixes E and F.

i. See section 2.3.6 for an examination of how BARs may inflate a P_d score as the scoring radius is increased.

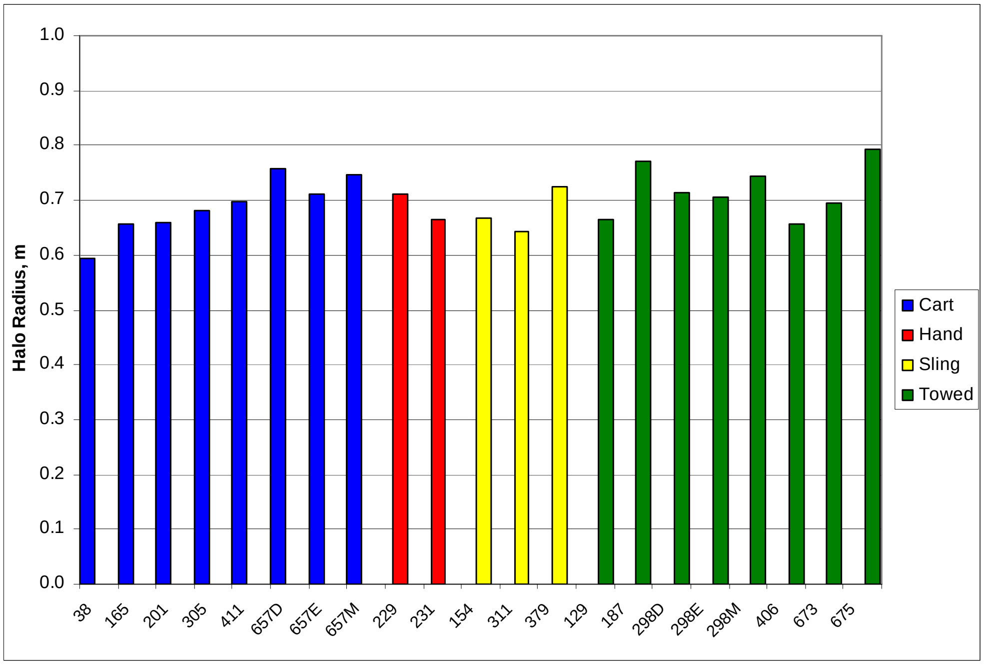

Figure 2.3.4-11. Estimated halo radius at which 1 in 1,000 items would be left in the ground because of location error, APG open field.

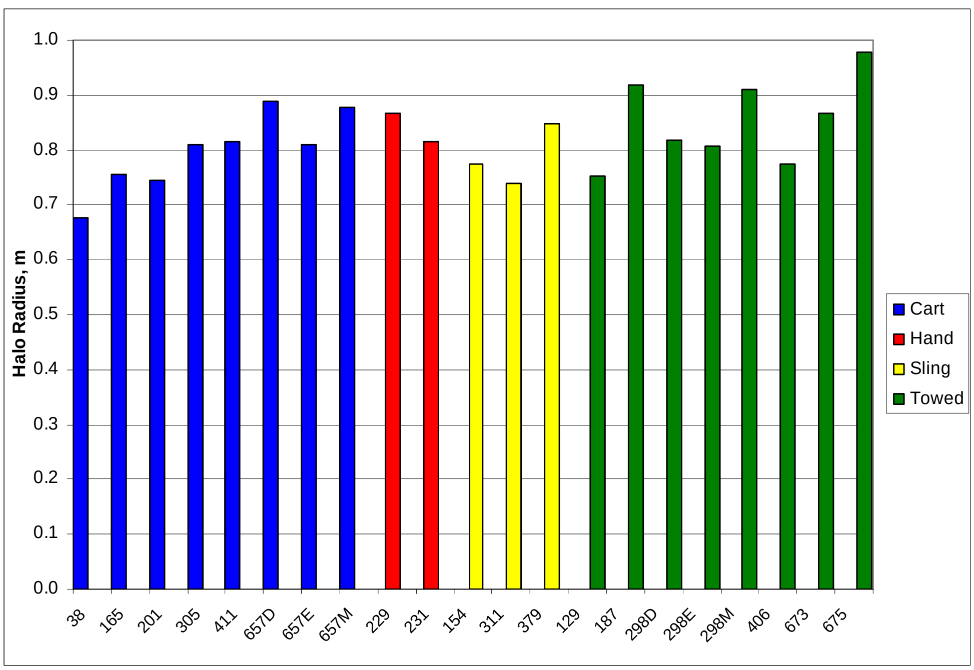

Figure 2.3.4-12. Estimated halo radius at which 1 in 10,000 items would be left in the ground because of location error, APG open field.

2.3.5 Effects of Field Configurations/Item Type

2.3.5.1 *Standard and Non-standard Items*

a. Ordnance items buried at the sites are designed to fit into one of two categories, standard or nonstandard. Standard items are members of a set whose physical properties are identical and that resemble a complete production configuration. Some examples of the physical properties that must conform in order for an item to be categorized as being standard are, caliber, configuration, size, weight, aspect ratio, material filler, and nomenclature. Items whose physical properties do not conform are categorized as being nonstandard. Nonstandard items can have missing parts such as fuses or fins, they could have lost mass from already having been buried in the ground for several years or they could simply be filled with a different filler material. The degree to which nonstandard items do not conform to the standard physical properties varies depending on the particular item.

b. It was originally intended that all standard items be degaussed. In review of records, it was found that both standard and non-standard items had been degaussed to varying degrees. Therefore, this characteristic is variable.

c. Standard and non-standard items comprise the overall standard GT sets used in this report. Standard GT sets examined thus far are not to give the impression that only standard items, as defined above, were used.

d. The P_d^{res} for standard and nonstandard items in the APG open field is shown in Figure 2.3.5-1. The standard and nonstandard GT used in the figure are a duplicate in quantity, round type (whether in part or whole), azimuth, dip, and depth. In addition, the distance to the next closest item is similar for a standard and its nonstandard counterpart in GTs.

e. With the characteristics of depth and orientation being the same, the relative abilities of systems to detect standard versus nonstandard items are shown in Figure 2.3.5-1. For some systems, the standard items may be easier to detect because they are slightly larger or are not missing any parts. In addition, standard items are buried in the calibration lanes and it may be easier to identify the standard items. As shown in Figure 2.3.5-1, no well defined trends exist between standard and nonstandard items for the basic sensor types. This indicates that the detection systems are not thrown off by the absence of part of a round to a noticeable degree in the APG open field environment. It may also simply indicate an insufficient sample size (15 items in this case) to make adequate comparisons.

f. The P_d^{res} for standard and nonstandard items at the YPG open field is shown in Figure 2.3.5-2. Even though the standard and nonstandard GTs shown in Figure 2.3.5-2 are duplicates (in terms of round type, depth, and orientation, etc.), the GTs shown in Figure 2.3.5-2 are not identical to those shown in Figure 2.3.5-1. So the differences between the two figures could be caused by differences in the GTs, such as the basic round types used, population, depth, and orientation. The differences may also be a result of a better test statistic. The population size used for YPG is 38, which is much better for making comparisons (for P_d = 0.95, upper confidence level = 0.99 and lower confidence level = 0.87 at 80% confidence).

g. As shown in Figure 2.3.5-2, most EM systems are finding the standard items at a greater frequency than nonstandard items. The reverse is true for the MAG systems; howbeit the MAG systems are finding less of the standard and nonstandard items as a whole when compared to the EM results. It is likely that the aluminum fuzes and tails present in standard items but not present in non-standard items are causing these trends (MAG systems are not sensitive to these parts). More analysis needs to be done to confirm this. Differences between the GT at both testing sites need to be examined.

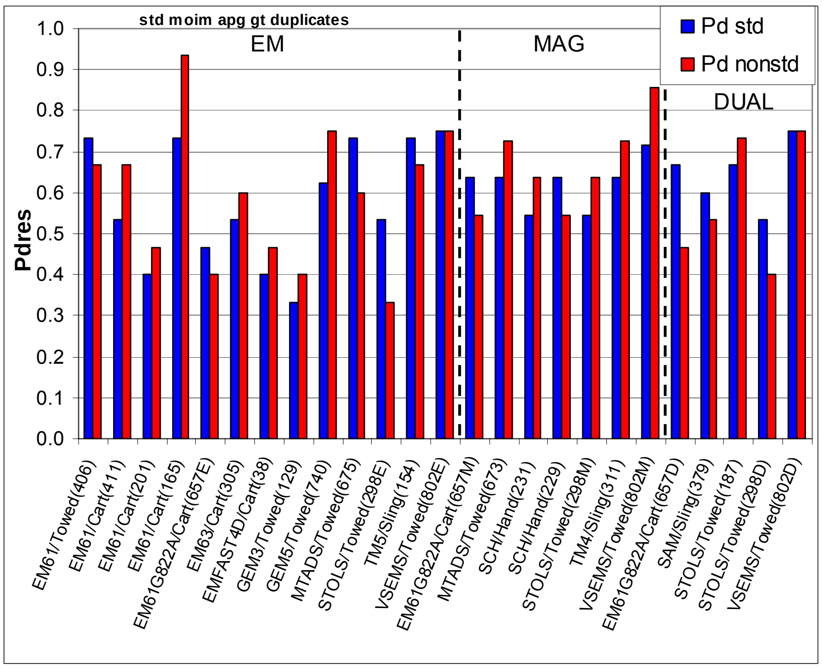

Figure 2.3.5-1. P_d^{res} versus demonstrator for standard and nonstandard GT, APG open field.

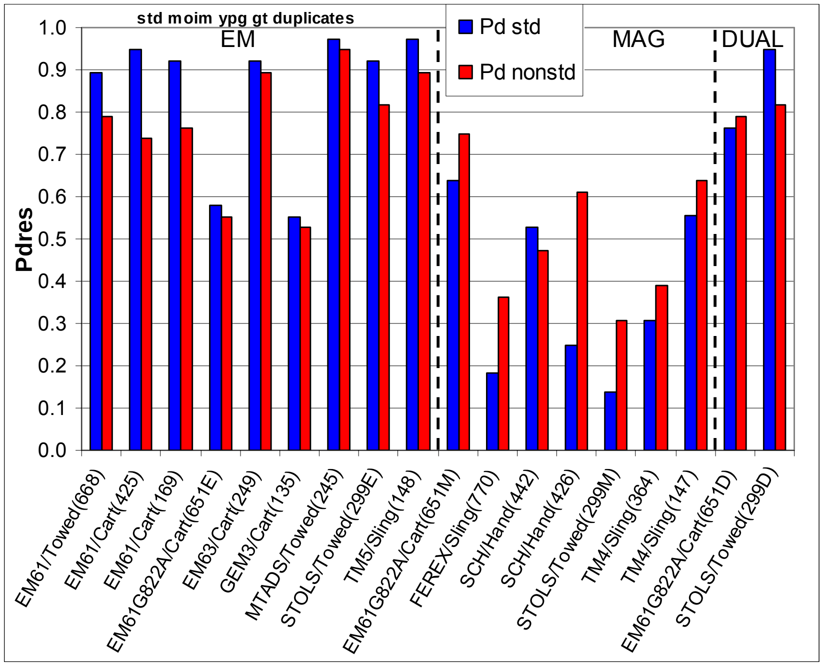

Figure 2.3.5-2. P_d^{res} versus configuration for standard and nonstandard GT, YPG open field.

2.3.5.2 *Depth*

a. Items at the standardized UXO sites are buried at a variety of depths. In general, as items are buried deeper and signal levels decrease, the items become more difficult to detect. The effects of depth on the ability of vendors to detect GT items are shown in Figures 2.3.5-3a, 2.3.5-3b, 2.3.5-4a, and 2.3.5-4b. The first two figures are APG open field results, and the latter two figures are YPG open field results. To achieve a result more representative of the ability to detect individual items, GT items that are closer than 1.0 meter to another item, and items that are in challenge areas (including wet areas), were removed from the GT used to generate results.

b. Depths are separated into ranges that were typically analyzed for published reports in Figures 2.3.5-3a and 2.3.5-4a. The figures show the P_d^{res} as a function of depth. The figures indicate that as the ordnance items are emplaced deeper the items become more difficult to detect. However, the figures do not take into account the size of the item which is typically proportional to signal return. In this respect, Figures 2.3.5-3b and 2.3.5-4b are more useful because they show the P_d^{res} as a function of depth divided by the diameter of an item.

c. The results show that for items greater than 1 meter deep there is a marked decrease in P_d^{res}. While not disclosing critical GT information, typically, with few exceptions, a small amount of only large items are buried at depths greater than 1 meter.

d. Some magnetometers show better detection rates between 0.3 and 1 meter than at 0.0 to 0.3 meter. This is not the case with the Schonstedt.

e. No systems with high P_d^{res} values were able to see across all depth ranges with near equal detection ability. The VSEMS dual system shown in Figure 2.3.5-3a, however, was close.

f. A large drop in P_d^{res} for depths greater than 11D for all systems was demonstrated, as expected.

g. Items buried between 5 and 11D typically had approximately a 0.05 to 0.20 drop in P_d^{res} when compared to 0 to 5D performances for the better systems. This indicates that sensing at this depth range still has room for improvement within the community of systems demonstrated. At YPG open field (fig 2.3.5-4b), the MTADS/towed array system (report No. 245, GEM-3 sensor) had only a ~0.01 decrease in performance going to the 5 to 11D depth range.

h. Finally, the depth distributions at YPG tended to be shallower than at APG because of difficulty burying items in the sand at YPG. This in part explains differences in performance between the two grounds.

i. For the influence of depth on clutter results, see section 2.3.5.8.

j. The Institute for Defense Analysis (IDA) has done extensive work on detection rates as a function of depth at the sites. Their work is reproduced in part in reference 5. An independent report is expected to follow.

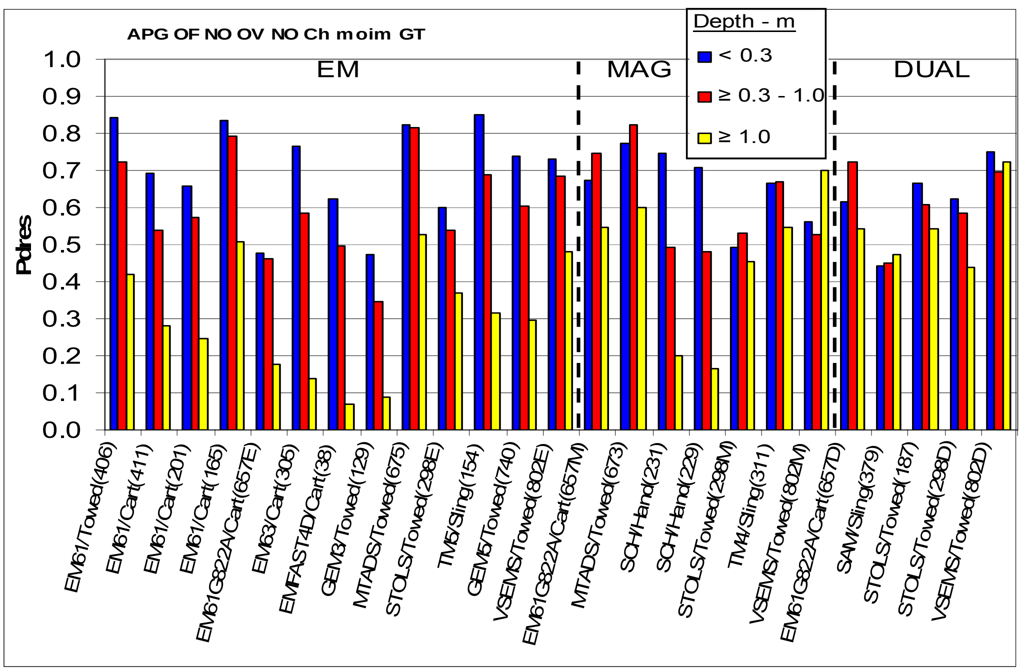

Figure 2.3.5-3a. P_d^{res} versus configurations for different depth ranges (< 0.3 m, ≥ 0.3 m to < 1 m, ≥ 1 m), APG open field, no challenge areas, no overlaps.

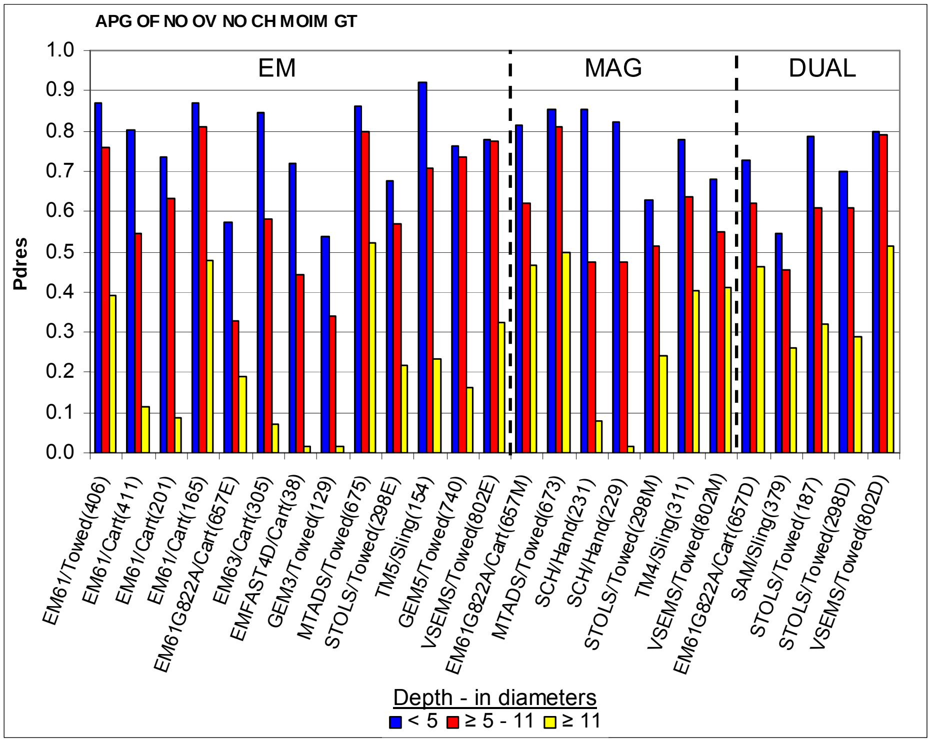

Figure 2.3.5-3b. P_d^{res} versus configurations for different depth ranges (< 5D, ≥ 5D to < 11D, ≥ 11D), APG open field, no challenge area, no overlaps.

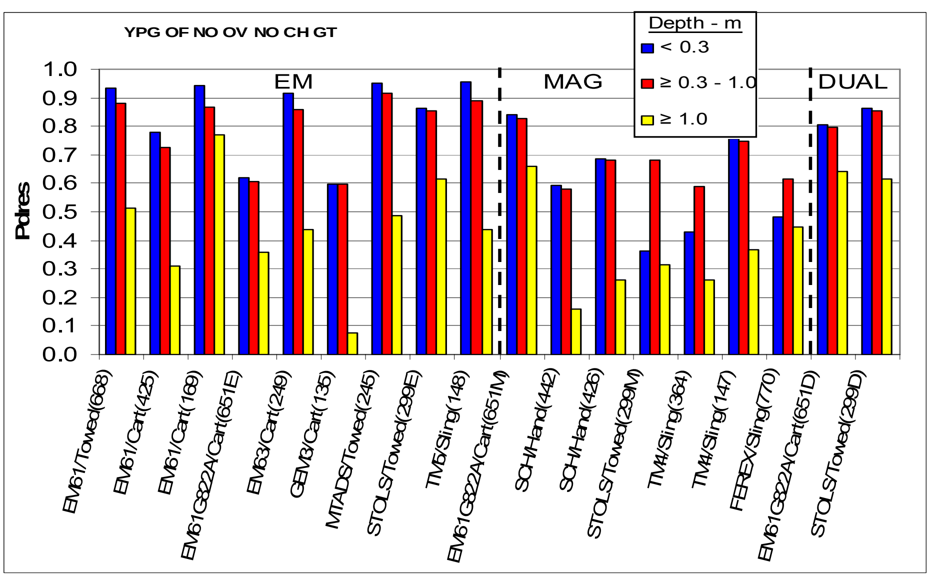

Figure 2.3.5-4a. P_d^{res} versus configurations for different depth ranges (< 0.3 m, ≥ 0.3 m to < 1 m, ≥ 1 m), YPG open field, no challenge area, no overlaps.

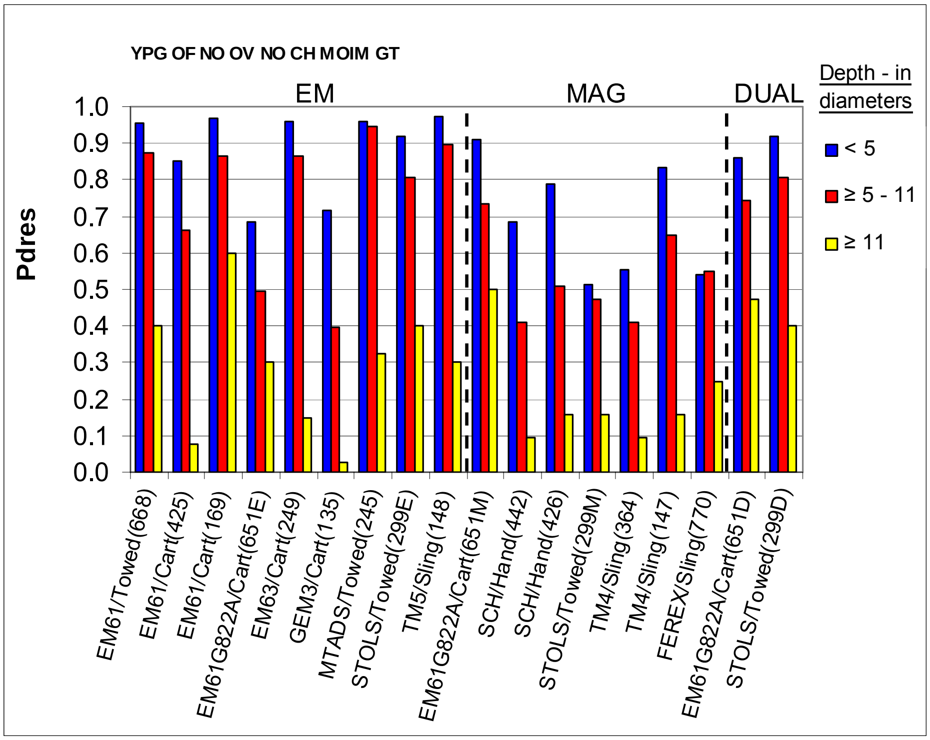

Figure 2.3.5-4b. P_d^{res} versus configurations for different depth ranges (< 5D, ≥ 5D to < 11D, ≥ 11D), YPG open field, no challenge area, no overlaps.

2.3.5.3 *Size*

a. A total of 14 different types of inert ordnance items have been buried at all of the standardized demonstration sites. An additional two types of ordnance can be found at limited test areas. These items have been categorized into small, medium, and large size groups for general analysis. Small items include 20-mm projectiles, 40-mm projectiles, 40-mm grenades, M42 submunitions, BLU-26 submunitions, and BDU-28 submunitions. Medium size ordnance items include 57-mm projectiles, MK118 Rockeye submunitions, 60-mm projectiles, 64-mm M75 submunition (only at YPG), 81-mm projectiles, and 2.75-inch rockets. Large items include 105-mm heat rounds, 105-mm projectiles, 155-mm projectiles, and 500-pound bombs (only in open fields).

b. P_d^{res} as a function of ordnance size for the systems tested at the standardized sites is shown in Figures 2.3.5-5 and 2.3.5-6. To help to remove the influence of extreme depths, overlapping halos, and challenge areas (including wet areas), the figures do not include results from items that are deeper than 11 times their diameter, items that are closer than 1.0 meter to another item, or items in challenge areas. The results for the APG open field are shown in Figure 2.3.5-5; the results for the YPG open field are shown in Figure 2.3.5-6.

c. The figures indicate that, in general, it is easier for most systems to detect large items than it is to detect small and medium sized items, small items being the most difficult. Because the 11D GT was used (i.e., items should be within sensor range), and the GT approximates depths of items at remediated sites, the finding suggests a deficiency exists in detecting small items at <11D for many of the SOTA systems. An examination of which small ordnances in particular are driving the results is discussed in section 2.3.5-6. Some EM systems at YPG found all three size ranges of ordnance with near equal ability: the MTADS/towed array (GEM-3), TM-5/sling, and EM61/cart configurations (EM61 MK11).

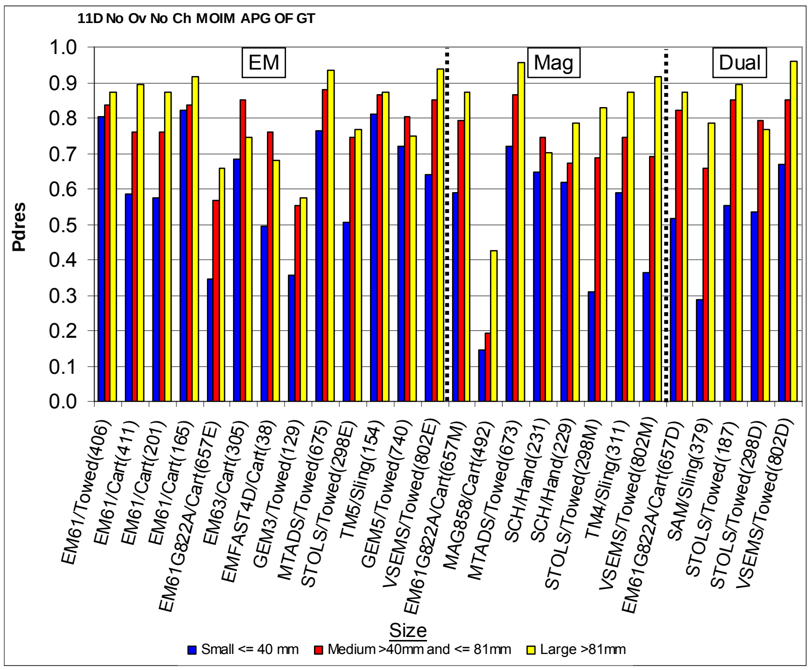

Figure 2.3.5-5. P_d^{res} versus demonstrator for size ranges, APG open field, 11D depth limit, no challenge area, no overlaps.

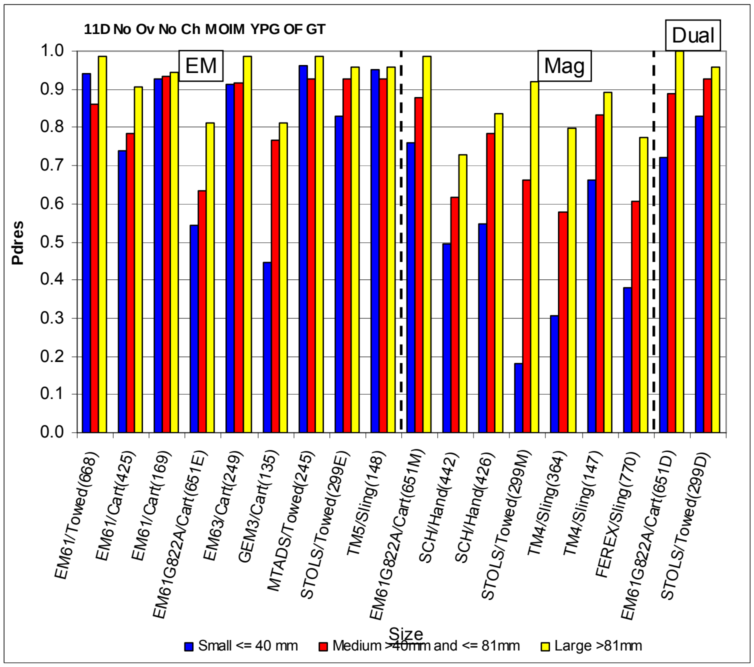

Figure 2.3.5-6. P_d^{res} versus demonstrator for size ranges, YPG open field, 11D depth limit, no challenge area, no overlaps.

2.3.5.4 *Overlap and Items in Proximity*

a. When items are buried close enough to each other, the signal from one item may bleed over into the area of its neighboring item. When bleed-over (may also be referred to as overlapping signal or shadow effect) occurs, it can become difficult to accurately detect all items in that area. To study this effect, both the APG and YPG sites were designed to have areas where several GT items were buried close to other items.

b. To analyze the effects of items in proximity, six GT subsets were broken out of the entire GT for the APG open field test area. Each subset represents ranges of proximity in increments of 0.5 meter. Thus, for the first subset, 0.0 to <0.5 meter, all ordnance in the GT within 0 to <0.5 meter of another item (item includes ordnance or clutter) were grouped together. For the next subset, if ordnance are within ≥0.5 to <1.0 meter of another item they were separated out as a group. This method is repeated up to 2.5 meters at increments of 0.5 meter. The last subset includes all ordnance that have items no closer than 2.5 meters to them.

c. By scoring each subset of ordnance as a GT in itself, a relationship of P_d^{res} versus item proximity or distance to next closest item can be calculated.

d. P_d^{res} and discrimination ability as a function of distance to the next closest item at the APG open field are shown in Figures 2.3.5-7 and 2.3.5-8. The GT subsets used in the figures do not go beyond 11D in depth and do not contain items in challenge areas (including wet areas). This was done to help isolate effects of proximity.

e. As shown in Figure 2.3.5-7, most systems experience a marked decrease in P_d^{res} when a GT item is within 1.5 meters or less of another item.

f. The percentage of demonstrators that experienced a decrease in P_d results after discriminating for the different proximity ranges is shown in Figure 2.3.5-8. Alternately, this is the same as the percentage of demonstrators that did not retain all ordnance in a group when discriminating. The plot indicates that more difficulty exists when discriminating ordnance items with greater distance between them and another item. This seems counterintuitive. A possible explanation is that items very close to one another were more difficult to discriminate and that most demonstrators erred on the side of caution and declared them ordnance. A more in-depth analysis is needed to explain this trend.

g. The sample sizes are small for the groups that were close together. Confidence limits are not shown to preserve GT information from disclosure. Results from the proximity study should be viewed as indicative of general trends.

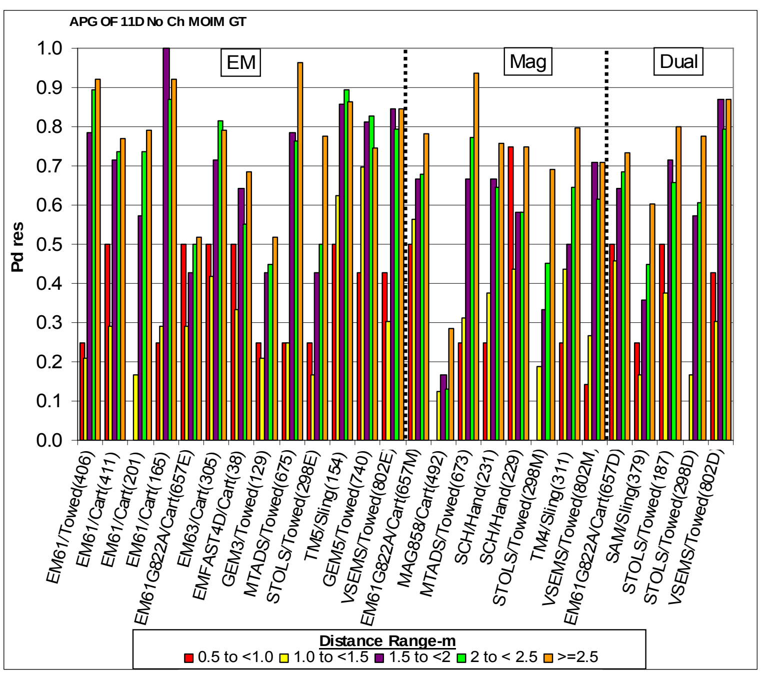

Figure 2.3.5-7. P_d^{res} for various systems versus distance to closest GT item, APG open field, 11D depth limit, no challenge area.

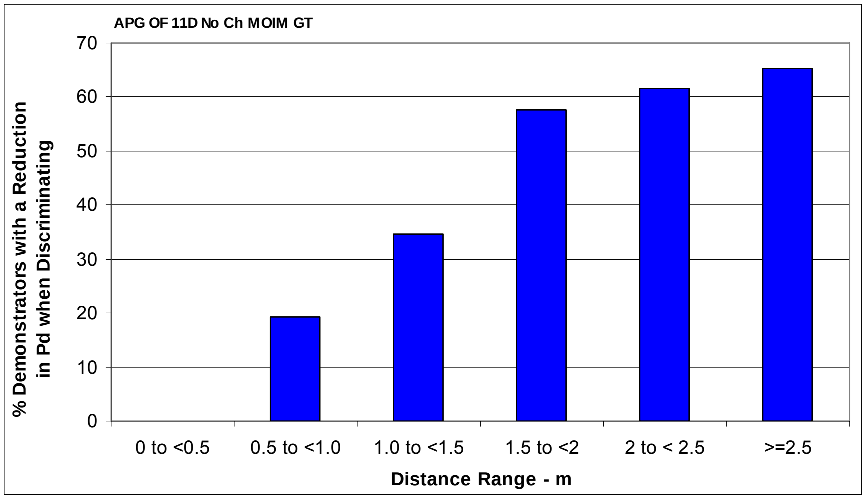

Figure 2.3.5-8. Percentage of demonstrators with a reduction in P_d when discriminating for various distance ranges to next to closest GT item, APG open field, 11D depth limit, no challenge area.

2.3.5.5 *Challenge Areas*

a. To accurately measure the effects that the different challenge areas have on P_d^{res}, it is necessary to have a statistically significant number of items in each challenge area that are identical to other items in the open fields in non-challenge areas for comparison. In addition, these items need to be far enough apart to remove the effects of overlapping halos and depths needs to be well within range of detection. In 2005, a statistically significant number of items did not exist.

b. After the 2004 through 2005 reconfiguration, such groups of items were buried in the open field (control) as well as in all of the challenge areas (test). However, since the reconfiguration, few demonstrators have surveyed the sites.

c. In the fence challenge area, a chain-link fence was installed over an area where a number of GT items were buried. The area will help evaluate how detection abilities are affected by the fence.

d. In the power line area, the same items were buried directly underneath domestic power lines. The magnetic field produced from the 60-Hz alternating current flowing through these 13,000-volt lines may interfere with a system's ability to detect items in this area as well. The lines are about 7 meters off the ground (at the lowest point).

e. P_d^{res} results, for the challenge areas to date are shown in Figures 2.3.5-9 and 2.3.5-10. If it is assumed that the number of ordnance successfully detected is a binomially distributed random variable, it can be said with an 80 percent confidence that results will fall within the intervals displayed in the figures. The results are for two systems, a GEM-5/towed array and a VSEMS dual mode (EM61 MK11/G822A) towed array that surveyed the area after the 2005 reconfiguration. To see if the results are significantly different, a chi-square test was performed. It was found that at a 0.1 significance level (2-sided test), the power line and fence results could not be said to be significantly different from the control results for the GEM-5. For the VSEMS the fence results are significantly different but the power line results are not.

f. As shown in Figure 2.3.5-11, efficiencies (E = fraction of ordnance retained after discrimination) were calculated from the GEM-5 results. The GEM-5 vendor was aggressive in attempting to discriminate and thus provided a good test case to evaluate challenge area effects. An E of 1 means 100 percent of the ordnance were correctly identified or retained. The figure shows that about 90 percent of ordnance items were retained after discriminating the control and power line group. However, only 38 percent of the ordnance items were retained in the fence test area. This is significantly different from the control group. The VSEMS results are not shown because little effort was made in discrimination (i.e., high E, low false positive rejection).

g. Therefore, preliminary results indicate the power lines are not significantly effecting results. However, the fence has significantly affected the performance of a dual mode system in terms of detection and an EM system in terms of discrimination. Further analysis needs to be performed to see what part navigation around the fence played in the reduced scores. More details about the GT will be provided after the challenge areas are reconfigured.

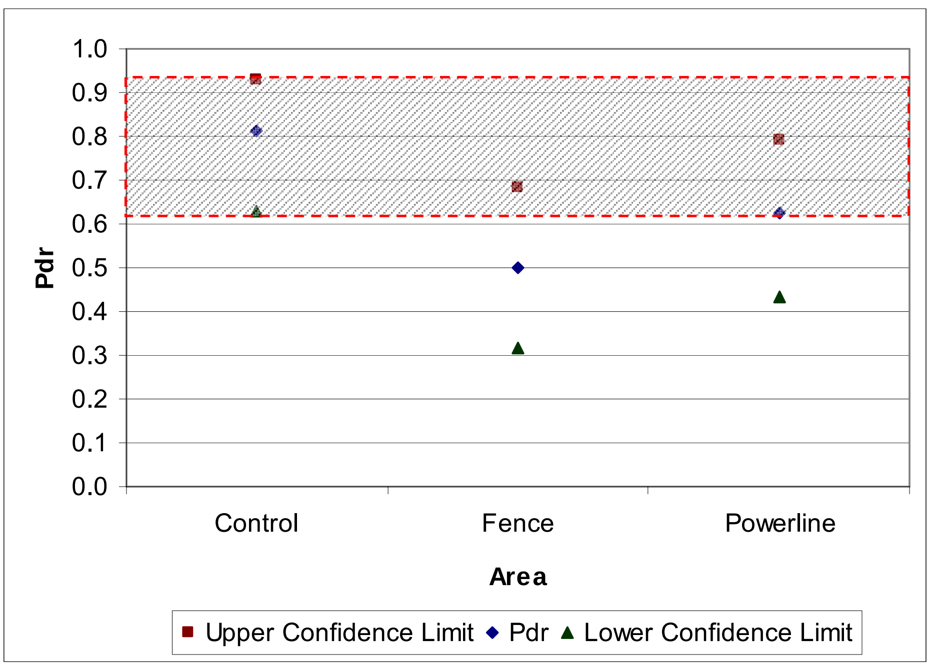

Figure 2.3.5-9. P_d^{res} for different challenge areas, with upper and lower confidence limits for GEM-5 towed array, report No. 740, APG.

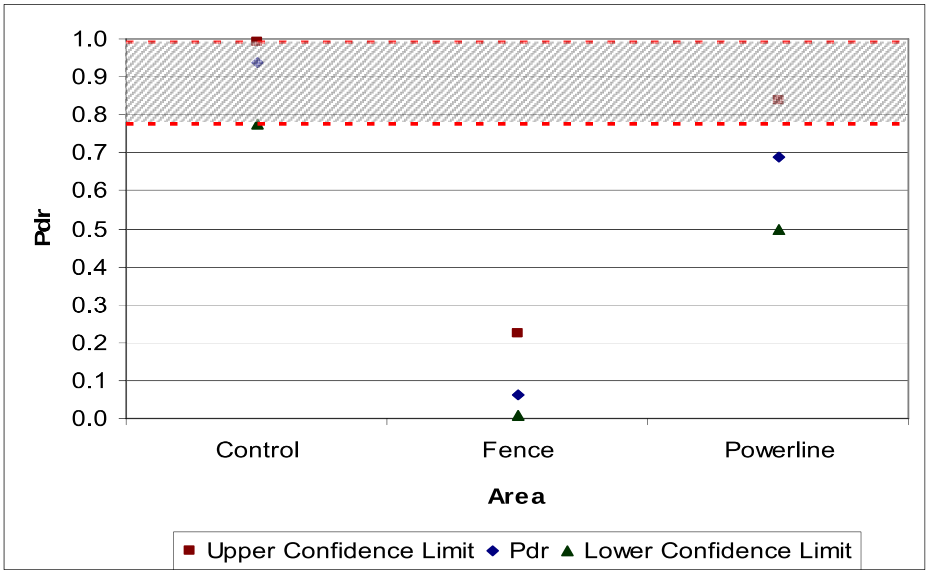

Figure 2.3.5-10. P_d^{res} for different challenge areas, with upper and lower confidence limits for VSEMS towed array, report No. 802D, APG.

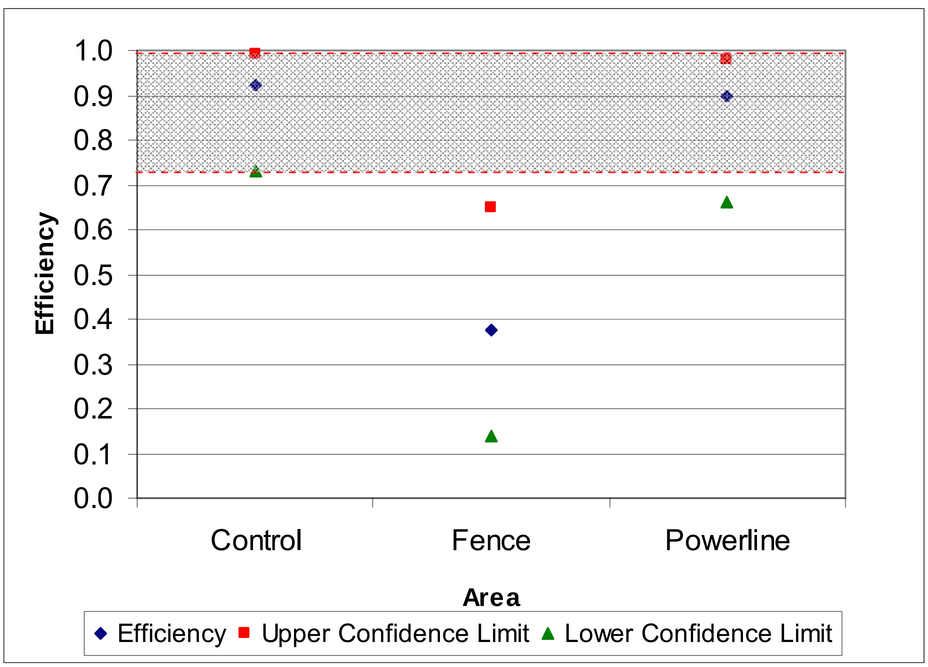

Figure 2.3.5-11. E versus challenge area for GEM-5 towed array, report No. 740, APG.

2.3.5.6 *Ordnance Type*

a. The following section examines how easily the demonstrated detection systems found and identified individual ordnance types at the standardized sites. As indicated in section 2.3.5-3, in general, smaller ordnance were more difficult to detect. By looking at types it will be determined if some or all of the small ordnance types are driving this trend.

b. The Pdres scores for some of the relatively better performing EM and MAG systems at the APG open field are shown (EM blue, MAG green) in Figure 2.3.5-12. The GT used has no items in challenge areas (including wet areas), items closer than 1.0 meter to another item (no overlaps), or items deeper than 11D. BAR values (all ordnance) for the systems are included in the plot as the first group on the horizontal axis.

c. As shown in Figure 2.3.5-12, the magnetometers have no result showing for the 40-mm grenades and MK118 Rockeye submunition. This is because the standard GT for magnetometers does not include non-ferrous items.

d. Of the small ordnance types (which include 20-mm projectiles, 40-mm projectiles, 40-mm grenades, M42 submunitions, BLU-26 submunitions, and BDU 28 submunitions), the 20-mm projectiles are approximately 20 to 30 percent more difficult to detect than other items in this group for EM systems. This margin is even greater for MAG systems. The 20-mm projectiles are driving detection scores for smaller items. The ordnance is the smallest type in the GT configuration. A possible reason for this performance shortfall by the systems is discussed in section 2.3.7.3.

e. One other ordnance type that is relatively difficult to detect is the MK118 Rockeye submunition. It is part of the medium sized ordnance group. This ordnance type does not drive the medium group results like the 20-mm projectiles drive the small group results, as seen in section 2.3.5.3. This is due to the smaller population of the MK118s at the APG open field.

f. The largest ordnance are easiest to find, especially since an 11D limit is in place. However, one small ordnance type, BLU 26 submunition, was also easy to find; it is the only type that is round. It could be that the depths associated with its burial are causing this ease of detection. Further study needs to be done to determine causes.

g. Values of P_d^{res} for each system and ordnance type at APG and YPG open fields using an 11D, no challenge (including wet areas), no overlap GT are included in Appendix G. The tables should provide a quick look at what systems may (some systems might have underachieved for some reason specific to the test instance) be best suited to detect a particular ordnance type. Unfortunately, time prohibited the updating of the tables to show corresponding BAR values. The reader is referred to figures 2.3.1-11 and 2.3.1-12 for this information (a high Pd may not necessarily be good if the corresponding BAR value is high). Scores in the tables are rounded to the nearest 0.05 level to help keep GT quantities from being discovered. The GT used for the tables is the same for both EM and MAG systems and includes non-ferrous items. Therefore, the MAG systems will justifiably have low scores for the 40-mm grenades and MK118 Rockeye submunitions.

h. An E score is shown in Figure 2.3.5-13 for the different ordnance types in the APG open field using the same GT limitations as Figure 2.3.5-12. The same systems are also used with the exception of the EM61/Cart(165) and SCH/Hand(229) which did not discriminate. For the group of systems examined it is seen that the BDU28 and 20mmP ordnance types were most difficult to discriminate. In general the small ordnance types gave the demonstrators the most difficulty.

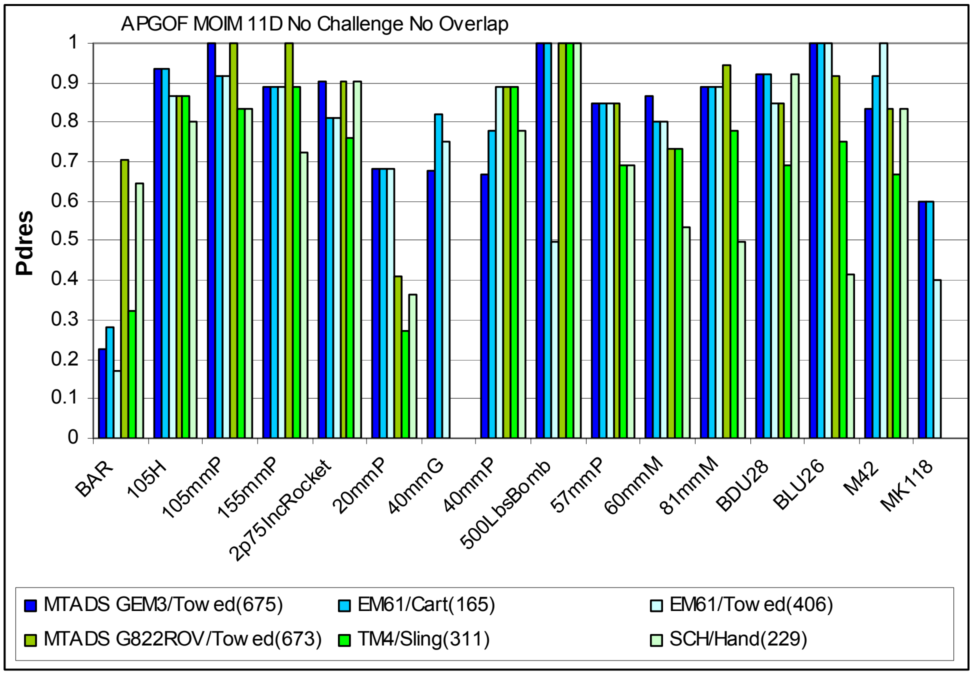

Figure 2.3.5-12. P_d^{res}, per ordnance type and sensor type, APG open field, 11D depth limit, no challenge area, no overlaps.

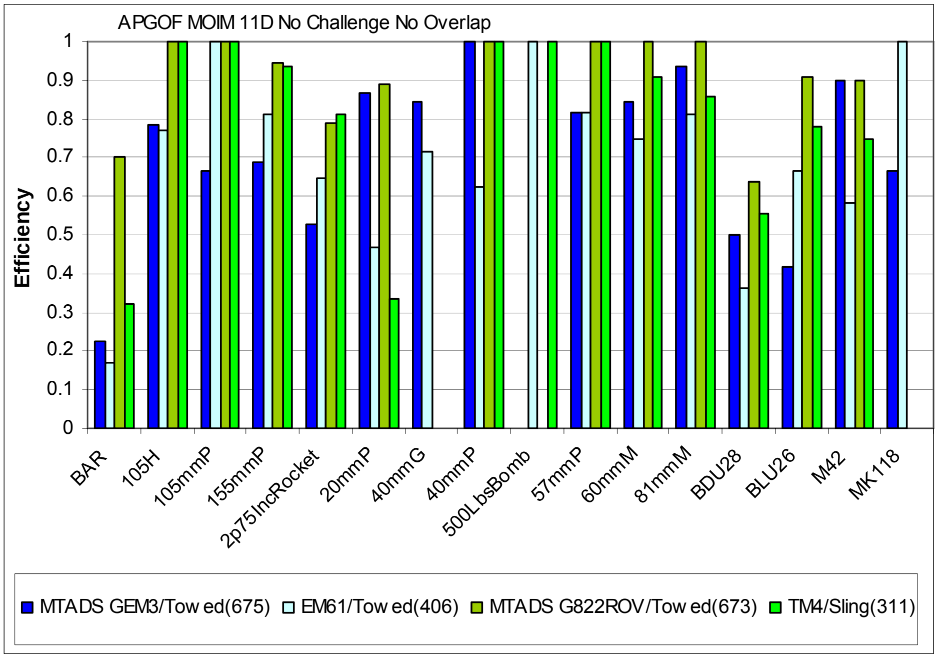

Figure 2.3.5-13. E for systems per ordnance type for APG open field, 11D depth limit, no challenge area, no overlaps.

2.3.5.7 *Combined Effects*

a. Different influences on P_d^{res} have been examined. The following contributors to reduced P_d^{res} values have been identified.

(1) Item depths beyond 11D have been proven to cause significant detection problems. Even depths from 5 to 11D have been problematic for systems.

(2) Small size ordnance and, to a lesser degree, medium size ordnance had lower detection rates. The rates were found to be driven primarily by 20-mm projectiles and to a lesser degree by MK118 submunitions.

(3) Items in proximity to the GT have been found to reduce detection rates. It appears when items are within 1.5 meter or less from a GT item that marked decreases in detection rates typically occur.

(4) Location error may be causing some systems to have potential detections nullified because they are just outside of the allowed 0.5-meter detection radius. Judging from error distribution characteristics, a lower value (typically no more than 3.5% reduction, in most cases not significant) of P_d^{res} occurred for many systems.

(5) It appears that coverage deficiencies may be causing some systems to have a decrease in P_d^{res} rates of up to 0.05.

(6) Metallic ground obstacles such as fences in the challenge areas cause P_d^{res} reduction if GT items are in proximity. More testing is needed to quantify distance, depth, mass, etc., relationships with P_d^{res}.

b. All of the above considerations were taken into account to create an adjusted GT or LIM (limited) GT subset to see how much P_d^{res} scores can be improved.

(1) Items deeper than 11D are eliminated.

(2) 20-mm projectiles and MK118 submunitions are eliminated.

(3) GT items that have a neighboring item within 1.5 meter are eliminated.

(4) Items missed because of lack of sensor coverage are eliminated (varies from demonstrator to demonstrator).

(5) Estimated percentages of missed population due to location error were not added on to detection scores (varies from demonstrator to demonstrator). This is because some of the location error was likely related to coverage and overlapping halo effects, which are accounted for in above items 3 and 4.

(6) Items in challenge areas are eliminated.

c. The new P_d^{res} results for demonstrators in the APG open field, using the LIM GT, are shown in Figure 2.3.5-11 alongside standard results and an LIM version of the blind grid results. Some LIM results are not calculated, because of data formatting issues and time restrictions in processing the data. Nonetheless, all systems are represented on the graph.

d. The LIM GT promotes a drastic increase in P_d^{res} results (30 to 66 percent) for the APG open field. The top four performers using the LIM GT have scores between $P_d^{res} = 0.92$ and 0.94, which are 6 to 8 percent shy of 100 percent detection. Six systems are at or near 100 percent detection for the LIM blind grid results.

e. It is likely that another means of increasing P_d^{res} scores would be to further decrease the maximum depth (into the 5D to 11D range) of the GT.

f. This exercise is not meant to make the detection systems look good or to excuse deficiencies but is meant to try to account for or identify causes of deficiencies to give direction to development efforts and understand current system limitations. Further, this exercise shows the full potential of the systems in detecting individual (not clustered) items within expected (11D depth, accessable environment, etc.) system limits, allowing a more objective means of evaluation. Lastly, comparative analysis should not be done without considering BAR scores for the systems presented earlier in the report.

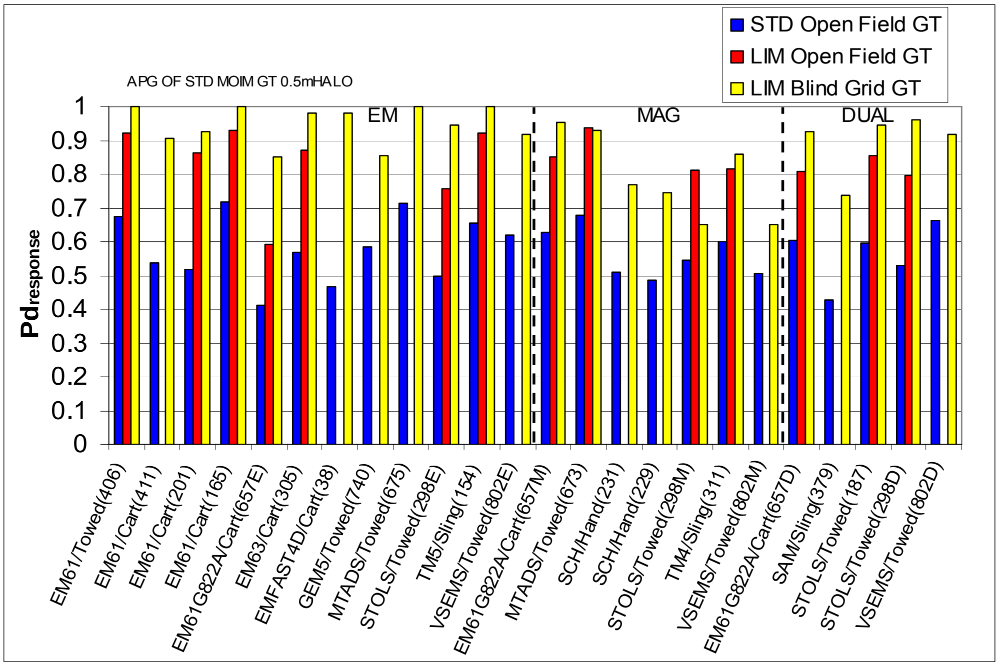

Figure 2.3.5-14. P_d^{res} for all systems in the APG open field using an LIM GT set.

2.3.5.8 *Clutter Type*

a. A large number of ferrous items that were not ordnance were also buried at the standardized UXO sites. These clutter items are categorized based upon their mass. No dimensional details were recorded. This is because of the wide variation in shapes ands sizes of the clutter. At the time of emplacement, greater emphasis was placed on mass than is now as a driver in detectability. The mass categories include, in kilograms, the following ranges: 0.0-0.25, >0.25-0.7, >0.7-1.0, >1.0-4.0, >4.0-10.0, and >10.0.

b. Probability of false positive in the response stage, P_{fp}^{res}, as a function of the average mass of the clutter groups in the APG and YPG open field for all vendors is shown in Figures 2.3.5-15a and 2.3.5-15b. P_{fp}^{res} is in effect a measure of the percentage (where 1.0 = 100 percent) of clutter items detected. The GT used for the plotted results excluded clutter items if they were less than 1.0 meter from another object (no overlaps) and if they were in the challenge areas (including wet areas). Detectability increases up to about 1 kg, then drops off slightly, increasing again as mass increases for APG results. A more consistent increasing trend with mass is seen in P_{fp}^{res} when YPG results are viewed.

c. The average depths of the mass categories are plotted as a dashed line using the scale on the right vertical axis in the figures. This was done to see to what degree mass or depth are driving detectability trends.

d. An interesting trend in the figures is that at APG the groups at the smallest value of mass are more difficult to detect than at YPG. This appears to be driven by depth since the APG items at this mass range are approximately two times deeper than the YPG items.

e. Since the APG P_{fp}^{res} values are so low for the minimal mass group it appears that the limits of the SOTA systems are being manifest. Items less than ~0.5 kg at depths greater than ~0.25 meter are very difficult to detect. Otherwise, in general, the systems performed well when detecting clutter.

f. The average false positive rejection rate (R_{fp}), for all demonstrators, for the same GT used as in Figures 2.3.5-15a and 2.3.5-15b, is shown in Figure 2.3.5-16. R_{fp} x 100 is the percentage of clutter items rejected (i.e., declared not to be ordnance) during discrimination, where 100 percent is optimum. The figure shows that a small percentage of detected clutter items were rejected as clutter (i.e., most clutter items were called ordnance by SOTA systems). On average, for both proving grounds and all clutter masses, ~25 percent of clutter is typically rejected (identified as clutter) during discrimination. The exception to the trend is the larger mass items at APG which had an R_{fp} that averaged around 0.46. This value still indicates an inability to properly discriminate clutter. The more massive items at YPG did not have the higher R_{fp} value even though they were at similar depths. This is likely due to the type clutter items, type systems, or type soil differences between APG and YPG.

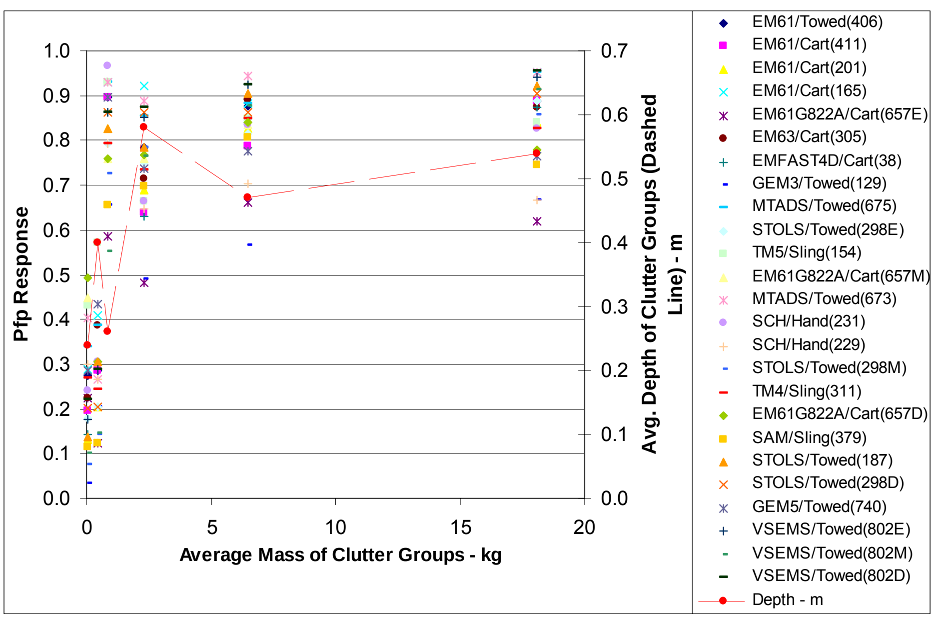

Figure 2.3.5-15a. P_{fp}^{res}, for different groups of clutter mass, APG open field, no challenge area, no overlaps.

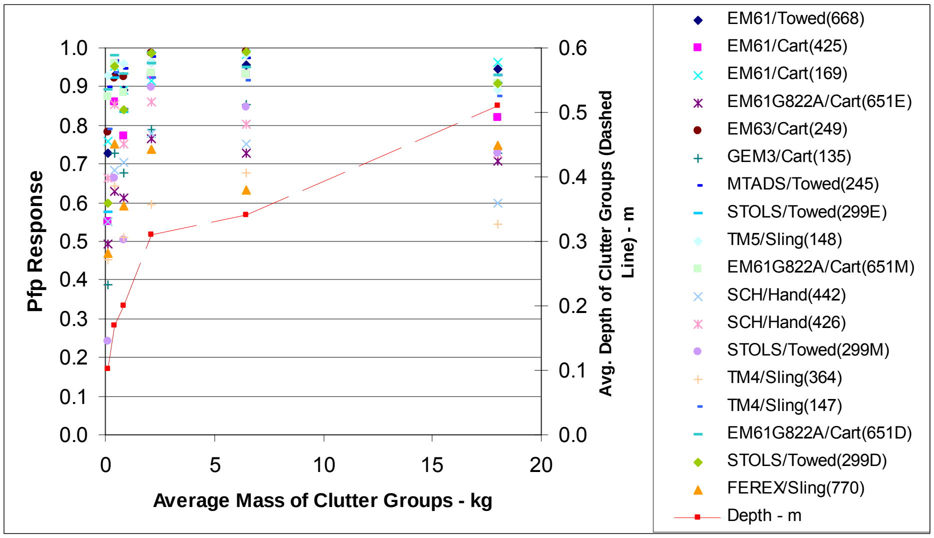

Figure 2.3.5-15b. P_{fp}^{res}, for different groups of clutter mass, YPG open field, no challenge area, no overlaps.

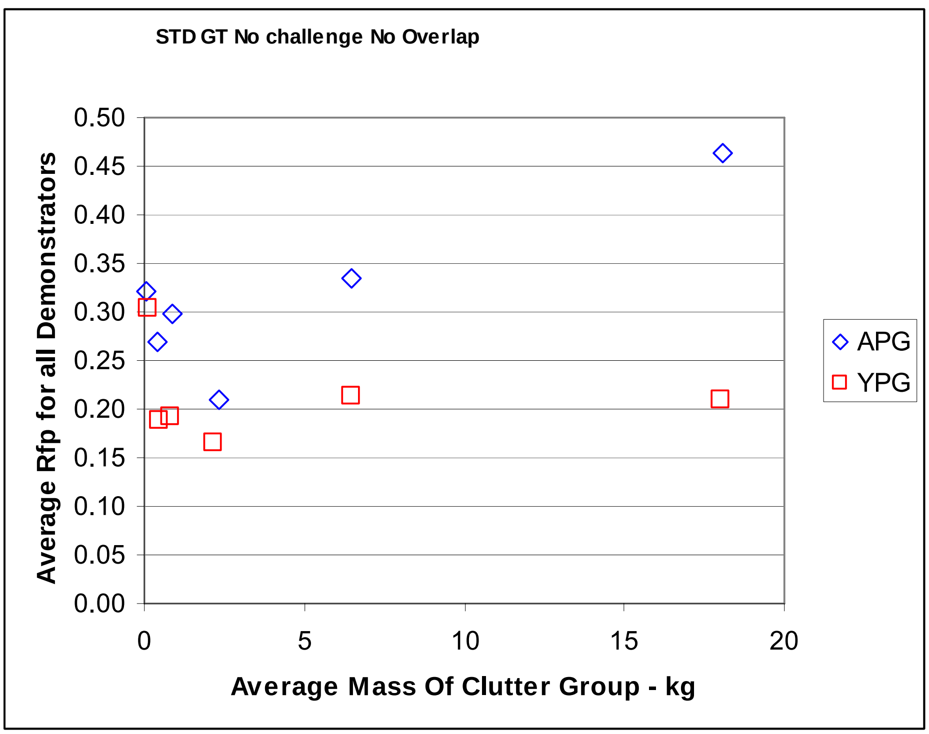

Figure 2.3.5-16. R_{fp} for different groups of clutter mass, APG and YPG open field, no challenge, no overlaps.

2.3.6 Effects of Scoring Methodologies

a. In this section, P_d^{res} versus halo size around GT items will be examined. If the location of an item on a dig list is within 0.5 meter of a GT item, the standardized site rules dictate that the two items be associated and the GT item be considered detected (general case). The 0.5-meter radius around the GT traces out a circle that in standardized site terminology is called a halo. A quick analysis was performed to see what effects varying this halo size would have on scoring.

b. A subset of the GT was created which contained ordnance with no neighboring items within 4 meters. This allowed the halo radius to be increased to 2 meters while limiting interference on detection by neighboring GT. Items no deeper than 11D were selected for the subset used.

c. The trends of P_d^{res} versus halo radius for the GT subset are shown in Figure 2.3.6-1 for a representative number of systems demonstrated in the APG open field.

d. As shown in Figure 2.3.6-1, trends start with a high-sloped-linear region then begin transitioning to a low slope region as halo size increases. The high slope region represents true detections, while the low slope region represents background alarms being counted as detections. As a system experiences a greater location error, the transition between high slope and low slope will shift right (many systems have this characteristic). As discussed in section 2.3.4.4, estimates of P_d^{res} increases that can be afforded by eliminating location error, greater than 0.5 meter, typically run from 1 to 3 percent. Further study is needed to look at the number of anomalies as a function of distance from GT to better understand the transition region of the curves.

e. The best performers (reports No. 673 and 675, both NRL MTADS systems, G822ROV and GEM3 sensors respectively) have a sharp transition between slopes at or below a halo radius of 0.5 meter.

f. The figure indicates that the chosen halo radius of 0.5 meter is a good value to use to show true detection ability. Most system results enter a transition region near this radius. GPOs typically use a 1-meter detection radius. As shown in Figure 2.3.6-1, detection scores at the standardized UXO sites would be inflated using a value of 1-meter due to background alarms becoming legitimate detections. However, as discussed in section 2.3.4.4, from a margin of error standpoint, 1 meter is a good number to use when digging.

g. As shown in Figure 2.3.6-1, P_d^{res} scores are much higher than those from standard GT results. This is a result of the large, 4-meter minimum spacing between GT items that is limiting signal interference from other items and causing the items to stand out better. It may be these items are also larger because they are well spaced in the GT.

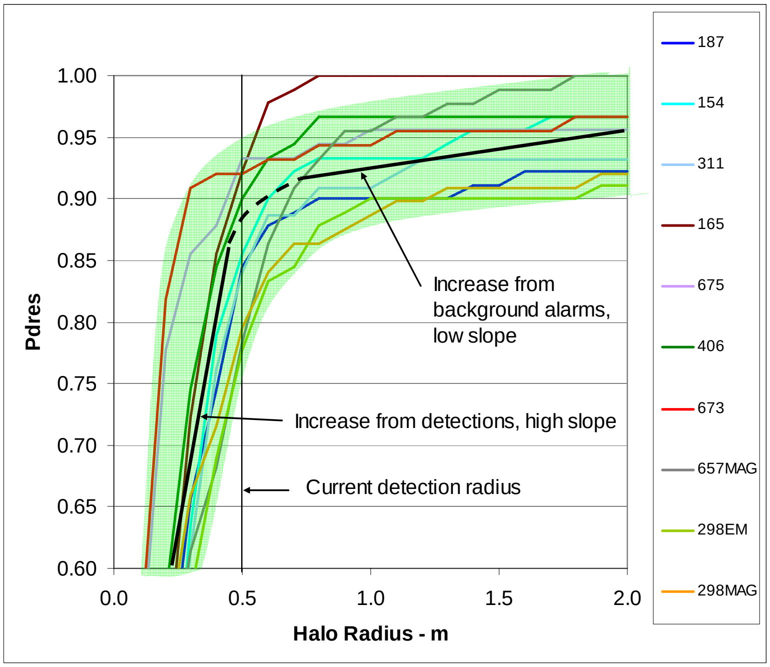

Figure 2.3.6-1. P_d^{res}, versus halo size, 11D depth limit, APG open field, reduced GT size (no items within 4 m).

2.3.7 Environmental Effects

This section will show that system performance was affected by various environments.

2.3.7.1 *Comparing Performance in Different Terrains for Similar GT*

a. The GT for each test area at the UXO test sites is unique. This means that the distributions of ordnance types, orientations and depths are not duplicated as a whole in any other test area. It can be difficult to analyze the effects of a change of terrain by simply looking at the change in P_d using the standard GTs in the different areas. A drop in P_d^{res} from one area to the next could be caused by the change of the terrain in the different areas, or it could be caused by the change in GT distribution for the different areas. To compare the effects of the terrain in the different areas, both the GT distribution in each area and the systems the vendors are using in each area must be identical.

b. By carefully analyzing each GT item in each of the test areas it is possible to select a subset of GT items in one area that have an identical set of GT in another area. Two GT items are defined to be identical if they are of the same type, are both standard or nonstandard, if the closest item to both of them is either greater than or less than 1 meter away, and if the difference between the depth, dip angle, and azimuth angle of the two are within the margin of error for which these quantities can be measured.

c. If a common set of GT were found between all sites this GT set would be very small. So, to maximize the population of items to be compared between terrains, two baseline areas were established: the APG and YPG open fields. Items in each test area identical to items in the baseline areas were selected for analysis at each proving ground. Populations of identical items varied from 55 items to 177 items for the different areas. The blind grids could have been selected as baseline areas but since they are much smaller than the open fields, finding populations of identical items between sites adequate for analysis would be difficult.

d. The percentage change in P_d^{res} going from the open field baselines to other test areas at each proving ground for various systems is shown in Figure 2.3.7-1. Not all systems demonstrated are included in this figure because of time restrictions in analyzing the data, and because not everyone used an identical system at each area.

e. As shown in Figure 2.3.7-1, for the more difficult terrains to navigate (e.g., APG woods, APG moguls, and YPG desert extreme), the detection rates typically drop from 25 to 60 percent when compared to open field performance at the same proving ground. The exception to this rule is the Schonstedt unit at the YPG desert extreme area; that unit’s performance decreased by 3 percent.

f. The performance as measured by percentage change in P_d^{res} at the YPG moguls was not as pronounced as in the APG moguls. This is no doubt due to the lower slope and height of the moguls at YPG. There is much variation in performance degradation between demonstrators at this test area and in general a decrease in performance. The exception to this trend is the Schondstedt whose performance improved in the YPG moguls when compared with open field performance.

g. As expected, performance in the blind grids was typically better than in the open fields. This is driven by the fact that the demonstrators know the potential locations of the GT in this test area.

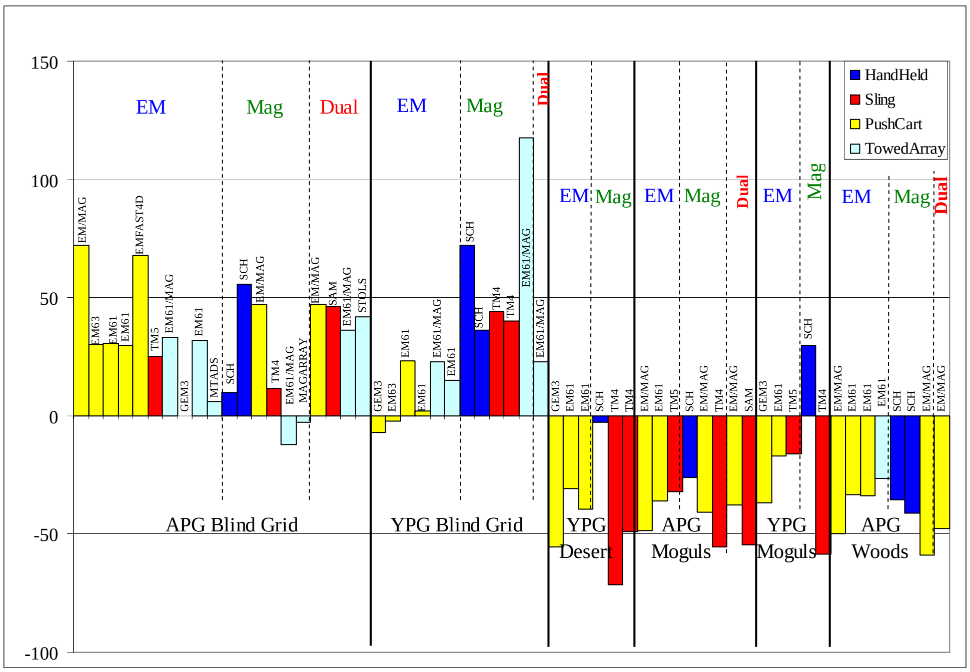

Figure 2.3.7-1. Percentage change in detection rate from open field baselines at APG and YPG for different test terrains and platforms, same comparative GT used.

2.3.7.2 *Power Line and Fence Effects*

See section 2.3.5.5 for discussion.

2.3.7.3 *Noise Level/Bleed-over Effects*

a. This section will examine the effects of background noise (environmental, not system) level on detection rate for 20-mm projectiles. Background noise levels are specific to each test area and are contributed to by natural and man-made items/disturbances. Earlier, it was determined that 20-mm items were more difficult to find, and it is speculated that due to their size/mass they were likely falling within the noise limits of the test areas. Due to time considerations, this will be the only ordnance type used to study this effect.

b. In order to study noise effects, a method was needed to characterize a background noise level. The method used was to map out a test area, in this case the YPG open field, into grid cells 1 x 1 m^2. If no ordnance or clutter were within a grid box, that box would be considered blank. All blank boxes were assigned 0.5-meter halos at their center. Raw signal data were then processed for each system, and all signals within the 0.5-meter halos were selected. Only magnetometers were considered; therefore, magnetic field strength data were used (unprocessed). Absolute values of the signals were sorted through for maximum values occurring in the blank halos. All maximums were then averaged and standard deviations found. The averages represent maximum field levels, in an absolute sense, to expect from background noise in any given halo in the field. All data will be compared relative to the same system since it is not known what processing had been performed with each data set and because system noise levels are not known. Inherent system noise was assumed constant across the field.

c. The same methodology was performed for determining signal levels in the 20-mm projectile halos. Absolute values were found and maximum values averaged.

d. The results of the exercise for the 20-mm projectile round are shown in Figure 2.3.7-2. Signal returns are broken down into groups from two depth regimes:

(1) Less than 0.133-meter depth.

(2) Greater than or equal to 0.133-m depth.

e. All bars represent the average of the absolute maximum signal values for the halos in the labeled groups. The results from three MAG systems are shown. The signal levels from the rounds are indeed close to the background noise level, especially the group at depths greater than 0.133 meter (this is the median depth; items deeper than this value represent 50 percent of the population). The lines in the plot represent 1 standard deviation. When ranges of signal values within 1 standard deviation are compared, it is apparent that a good portion of 20-mm signals fall within the background noise range. As discussed in reference 5, signal-to-noise ratios below 2:1 are typically problematic. The deeper 20-mm population, >0.133 meter, are at this level, on average. As discussed in section 2.3.5.7, the MAG systems were missing more than 60 percent of the 20-mm projectiles at the APG open field. YPG MAG results were similar, except for system 651M, which found 70 percent of the 20-mm items, but with a very high BAR.

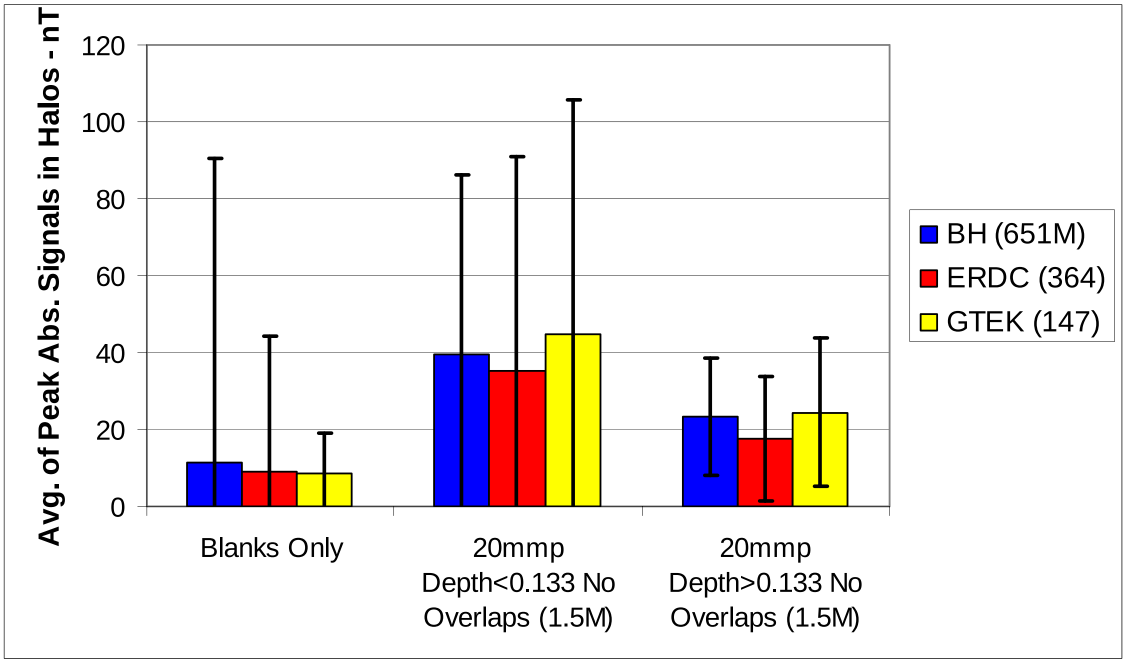

Figure 2.3.7-2. Signal (average peak absolute) to noise comparisons for the 20-mm projectile at YPG open field.

f. The GT used for the above exercise had no items within 1.5 meters to confuse signals. The value of 1.5 meters is borrowed from section 2.3.5.4 and represents where items in proximity begin to affect P_d^{res} scores in general. Initially, the exercise did not use the proximity criteria, and it was found that the average peak absolute signal from the 20-mm halos was approximately 25 times greater or more than the background noise level calculated. This did not make sense until the population of 20-mm items in proximity to other items was examined. A significant portion (actual percentage not given to preserve GT discovery) of the 20-mm population have items within 1.5 meters of them. Therefore, two drivers affect the low 20-mm detection rates: low signal-to-noise ratios and high levels of signal bleed over from items in proximity. If line spacing were decreased for the systems the signal-to-noise ratio may improve (analysis beyond the scope of this report).

g. Round-by-round analysis must be done to complete this study.

2.3.8 Production and Cost Rates

a. The following section will cover measures of time and cost as they relate to detection system performance. During the testing of the systems, a test log of hours spent setting up, calibrating, surveying, and demobilizing was kept as well as the number of personnel involved in the effort. Standard cost rates were applied to an assumed hierarchy of the personnel to generate total production costs. These values, along with acreage and time data, were used to calculate cost per acre and production rates.

b. The data in this section are based on test performance and not an actual production survey. It could be that more or less time and personnel would be used in actual production. Further, downtime due to maintenance and repair are included in the numbers. It is likely this may cause values to be inflated. In short, the potential of some systems may not be realized by the time and cost numbers shown.

c. What the numbers should show are rough order of magnitude cost and time estimates. The lowest values show what "is possible." Also, because of the quantity of systems and test areas, general trends between basic system types and test area should be seen. Cost and time are shown along with P_d^{res} scores from the standard GT (GT exceeds system limits in some cases). It is difficult to show corresponding BAR scores on the plots without making them difficult to read. Therefore it is left to the reader to make finer comparisons using BAR scores and P_d^{res} scores shown in Figures 2.3.3-1 to 2.3.3-6 which use an 11D, no overlap, no challenge area GT. A low cost rate is not significant unless it is accompanied by a relatively low BAR score.

2.3.8.1 *P_d^{res} versus Man-Hours/Acre*

a. The total man-hours spent in setup, calibration, survey, and demobilization for a given test area were found for each system demonstrated. These values were divided by the corresponding test site acreages and plotted against P_d^{res} (fig. 2.3.8-1 through 2.3.8-6). The purpose of the plots is to show how labor intensive it is to operate the various systems.

b. When minimal man-hours per acre to achieve best P_d^{res} scores are compared between all test areas, two levels of effort are manifest. The APG and YPG open fields and YPG moguls show around 10 to 15 man-hours per acre are required. The remaining areas, which include APG woods, APG moguls, and YPG desert extreme, require twice the effort or more with minimal rates of about 25 man-hours per acre. One system defies this generalization which is the GEM-3 hand held system demonstrated at the APG moguls. This system had a good Pd score but a poor BAR score in the area and expended much labor, about 220 man-hours per acre.

c. If man-hours for the systems are compared in the open field areas (figs. 2.3.8-1 and 2.3.8-4), at first glance it will appear that from best to least best the platform trend is towed, sling, cart, and then hand held (symbols are color coded for platform type). Minimal man-hour rates for the towed systems are at approximately 2.5 hours per acre. However, when P_d^{res} values are considered, best scores appear to require 10 to 14 man-hours per acre and differences between towed, sling, and cart platforms are not as great. Hand held units in the open fields typically have lower P_d^{res} and higher man-hour values than other platform types.

d. All figures show an hour per acre annotation for one Schonstedt hand held unit that flagged anomalies but did not locate them in local geographic coordinates. The annotated value represents an estimate of how much more effort was required to locate the positions of the anomalies, via the flags, using surveying equipment. The cost is based on time to perform such tasks by proving ground personnel. This effort was required to give tabulated dig list locations for scoring at the test sites. At actual site surveys, flagging systems do not need to supply this data since the flags mark the dig location. Therefore, if one wants to subtract off the effort it will be in the order of a couple hours per acre.

e. Typically, three systems flagged targets in the test areas. They are indicated by a flag on their symbols in the plots below. In actual site surveys, no reacquisition of targets would be required for the systems that flagged. Rather, the systems that did not flag would incur additional expense to mark (flag) targets for digging. Depending on the number of false positives and BARs, this reacquisition cost/labor would vary. Therefore, when comparing non-flagging systems with flagging systems, time to reacquire targets is not shown for non-flagging systems. It is likely that a few hours or more per acre would be needed to reacquire and mark target positions (based on time to locate Schonstedt flag positions).

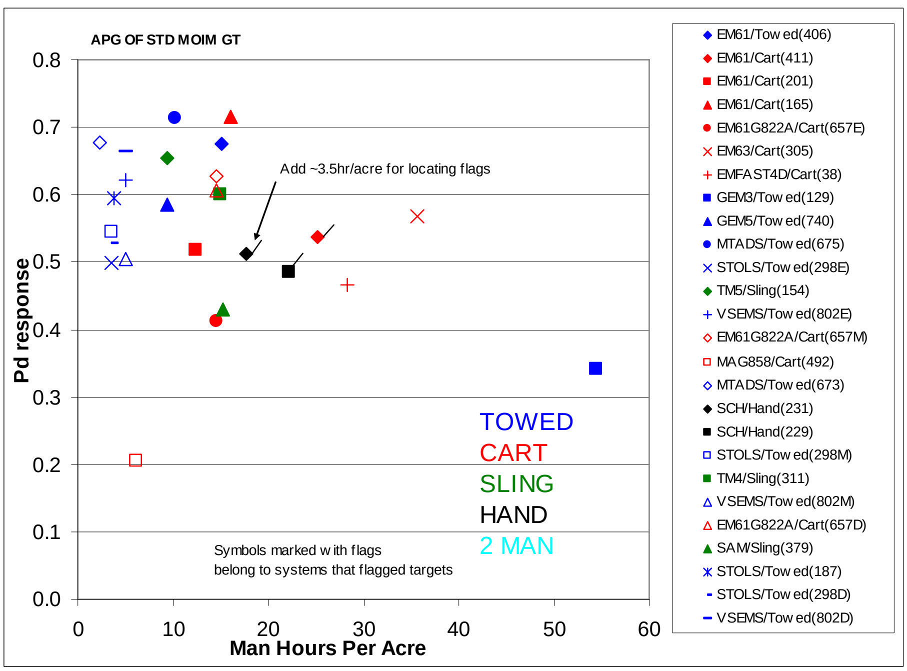

Figure 2.3.8-1. P_d^{res}, versus man-hours per acre, APG open field.

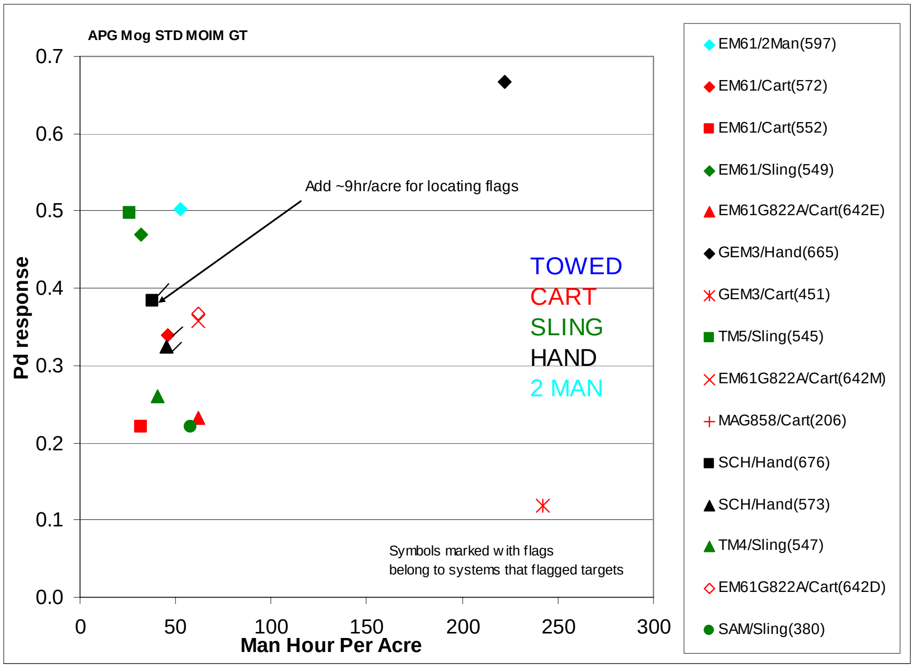

Figure 2.3.8-2. P_d^{res}, versus man-hours per acre, APG moguls.

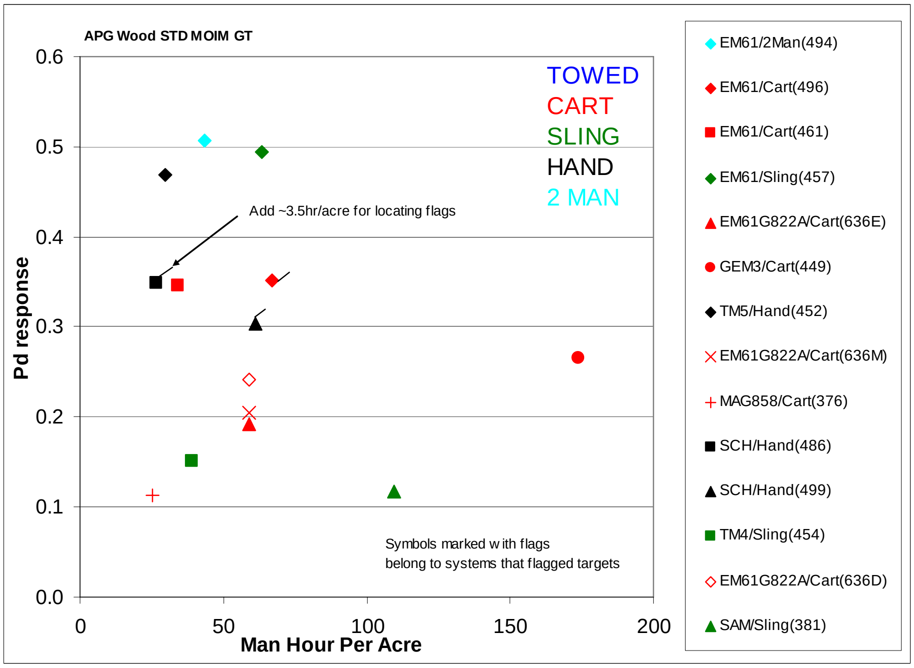

Figure 2.3.8-3. P_d^{res}, versus man-hours per acre, APG woods.

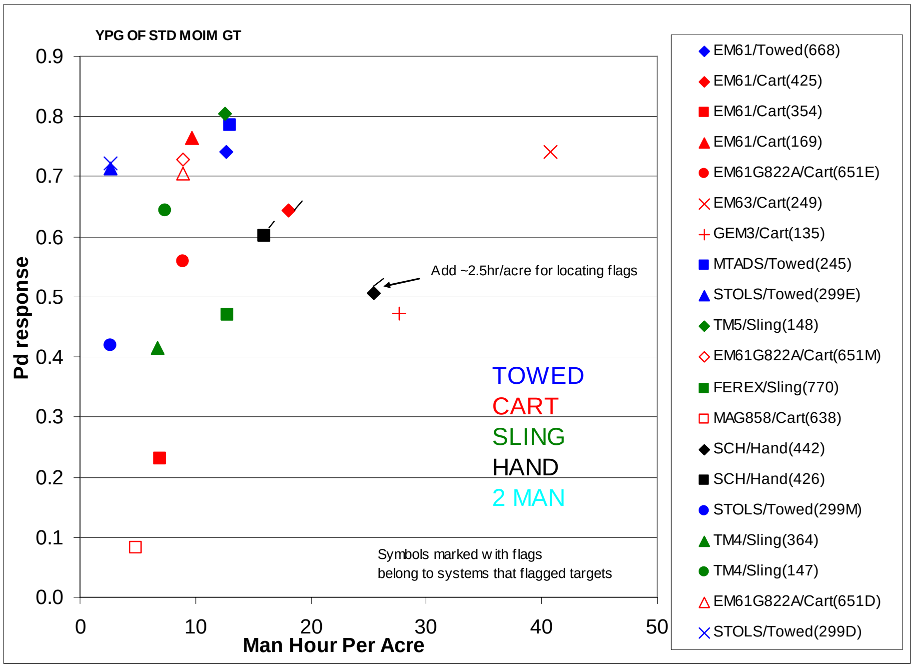

Figure 2.3.8-4. P_d^{res}, versus man-hours per acre, YPG open field.

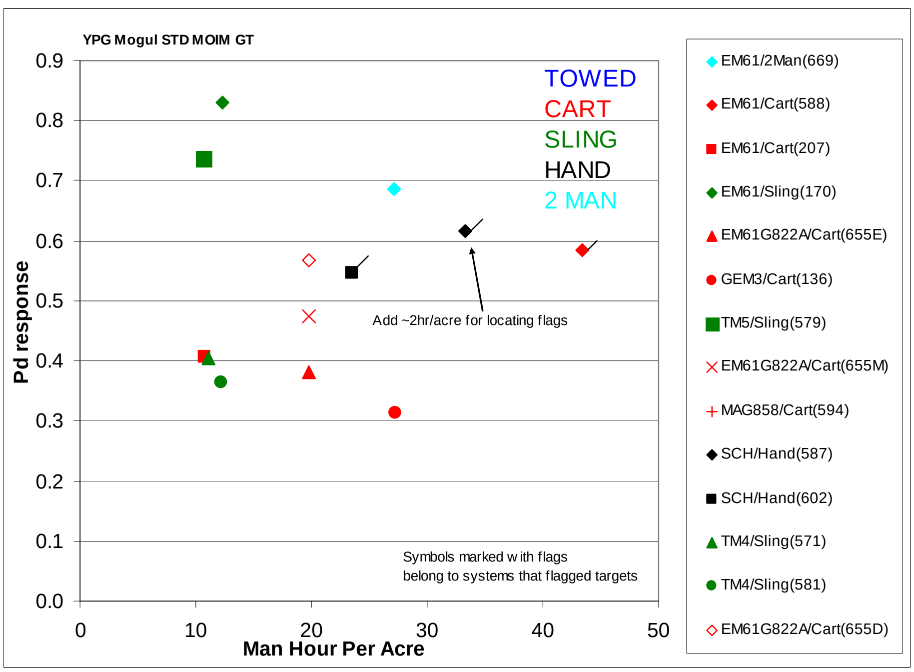

Figure 2.3.8-5. P_d^{res}, versus man-hours per acre, YPG moguls.

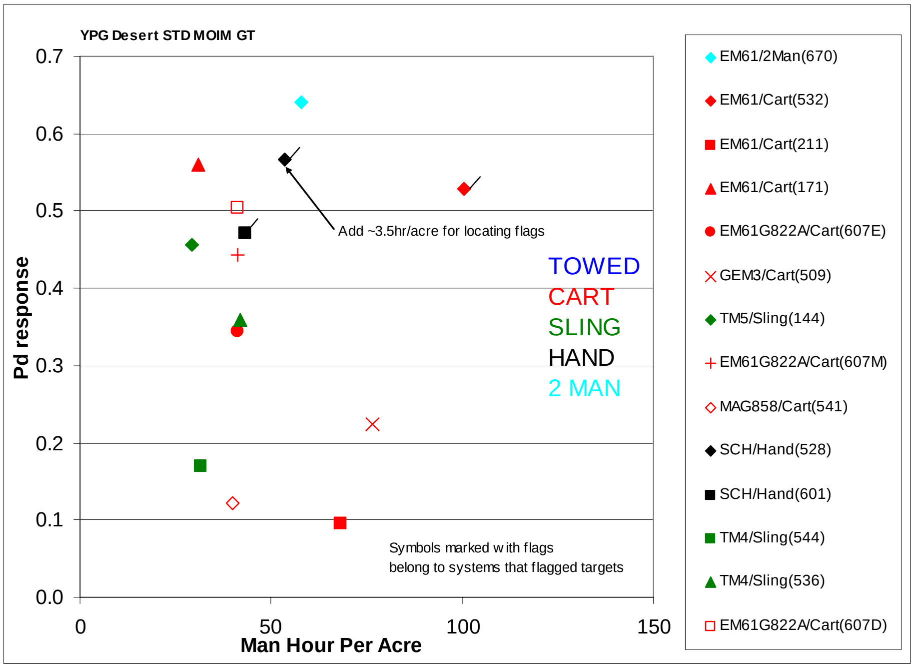

Figure 2.3.8-6. P_d^{res}, versus man-hours per acre, YPG desert extreme.

2.3.8.2 *P_d^{res} versus Cost/Acre*

a. Plots of P_d^{res} versus cost per acre for all demonstrators at the various UXO test areas are shown in Figures 2.3.8-7 through 2.3.8-12. Costs represent total production values for survey (from setup to demobilization). They do not include any type of post processing costs for the data taken, travel expenses, or reacquisition costs (only applicable to systems that did not flag, see section 2.3.8.1e). Cost was calculated using the following labor rates: supervisor = $95.00 per hour, data analyst = $57.00 per hour, and field support = $28.50 per hour. A hierarchy of position was assumed for personnel using the following rules.

(1) There must be only one supervisor.

(2) If more than one person is in the work crew, there must be only one data analyst.

(3) If more than two people are in the work crew, these remaining personnel will be considered field support.

b. Knowing the time spent in each phase (setup, calibration, survey, and demobilization) of testing and the number of personnel working in each phase of testing, total production costs were calculated using the above rules and rates. These costs were in turn divided by the acreage of each corresponding test site to get cost per acre values or operating costs.

c. This cost estimation is the product of the test site organization and does not represent any cost estimate data given by the demonstrators. The costs are rough order of magnitude and should provide a means of comparison of system operating costs between test areas and between system types. If flagging and non-flagging system costs are to be compared in a non-test environment, some adjustments need to be made to the costs shown. In general, a few hundred dollars per acre should be added to non-flagging system costs for reacquisition of target and a similar amount subtracted off of flagging system costs because of the test requirement to provide GPS derived coordinates.

d. The cost-per-acre trends are not necessarily proportional to man-hour-per acre trends since labor rates are not constant for each type of personnel nor are the amount of personnel the same between systems. However, similarities will be observed for both.

e. The best P_d^{res} scores (approximately 0.71 APG and 0.8 YPG) produced in the open fields have operating costs associated with them of about $500 to $700 per acre. These were produced by towed, cart, and sling based systems. Towed systems with performance that is about 3 to 10 percent off of the best P_d^{res} values are yielding costs of about $140 and $200 per acre, respectively. There may be a correlation between the towed platform speeds, cost, sampling rates per area and P_d^{res}. Such analysis will not be made but the reader is referred to section 2.3.11 to view sampling data characteristics versus P_d^{res}.

f. There is greater variation in cost than in man-hours expended from test area to test area. The following are the systems with highest P_d^{res} in each non-open field test area and their associated operating cost.

(1) APG moguls, GEM-3/hand held, P_d^{res} maximum = 0.67, cost/acre = $10,660 (note the GEM3 had a high BAR score, the next best P_d^{res} = 0.50, cost/acre = $1,950, TM-5/sling).

(2) APG woods, EM61/2-man-portable, P_d^{res} maximum = 0.51, cost/acre = $3,250.

(3) YPG moguls, EM61/sling, P_d^{res} maximum = 0.83, cost/acre = $940.

(4) YPG desert extreme, EM61/2-man-portable, P_d^{res} maximum = 0.64, cost/acre = $3,030.

g. From the above costs, it is seen that terrains like the APG moguls, which are not navigable by towed platforms and are difficult even for carts, may very well cost approximately $10,000/acre just to survey.

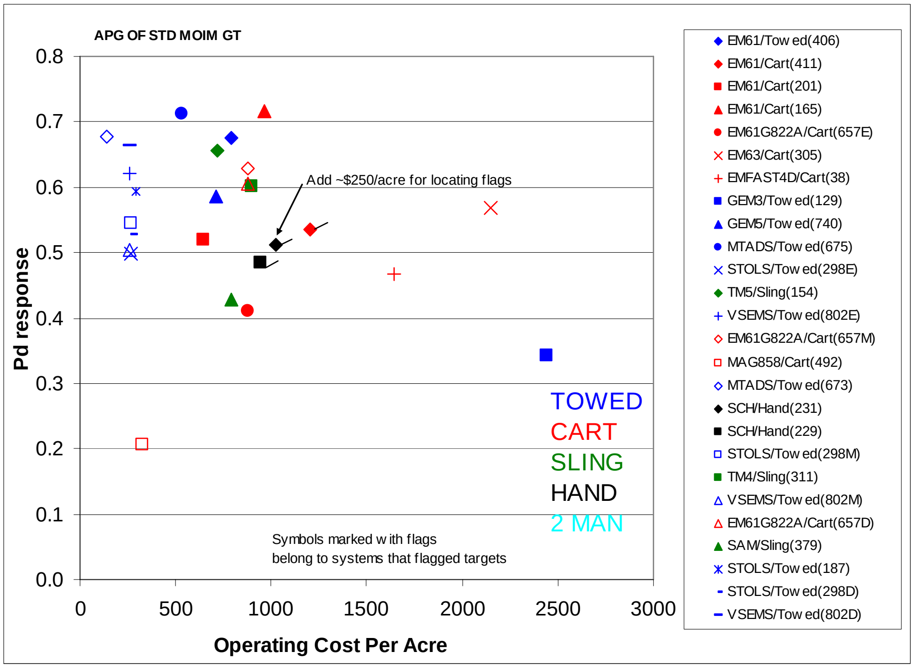

Figure 2.3.8-7. P_d^{res}, versus operating cost per acre, APG open field.

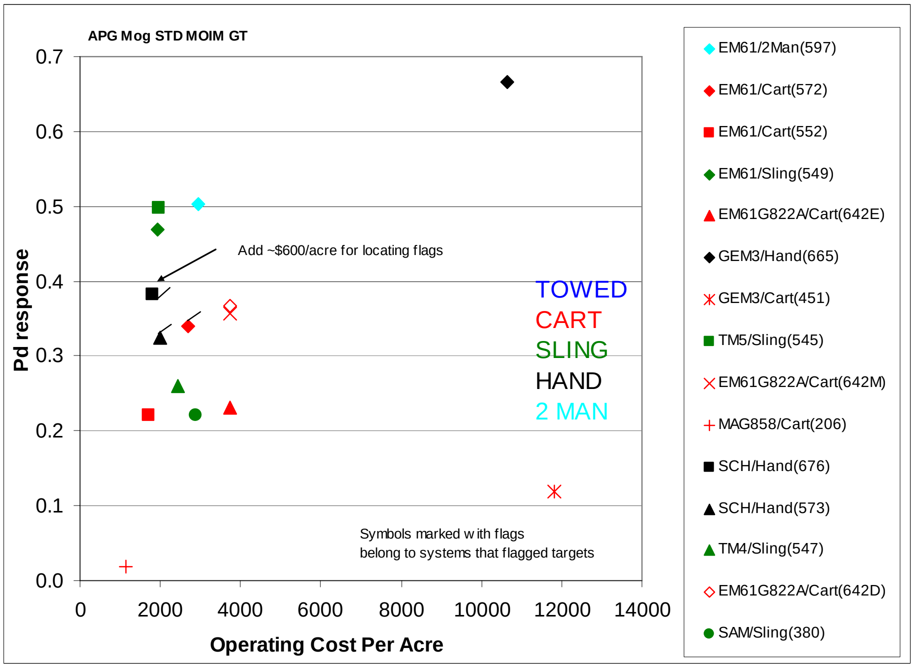

Figure 2.3.8-8. P_d^{res}, versus operating cost per acre, APG moguls.

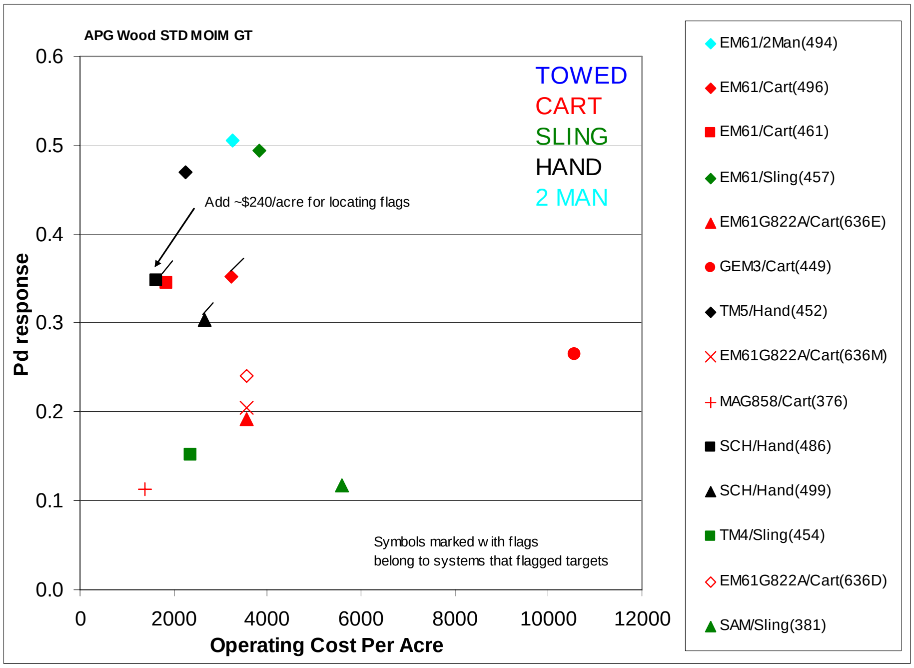

Figure 2.3.8-9. P_d^{res}, versus operating cost per acre, APG woods.

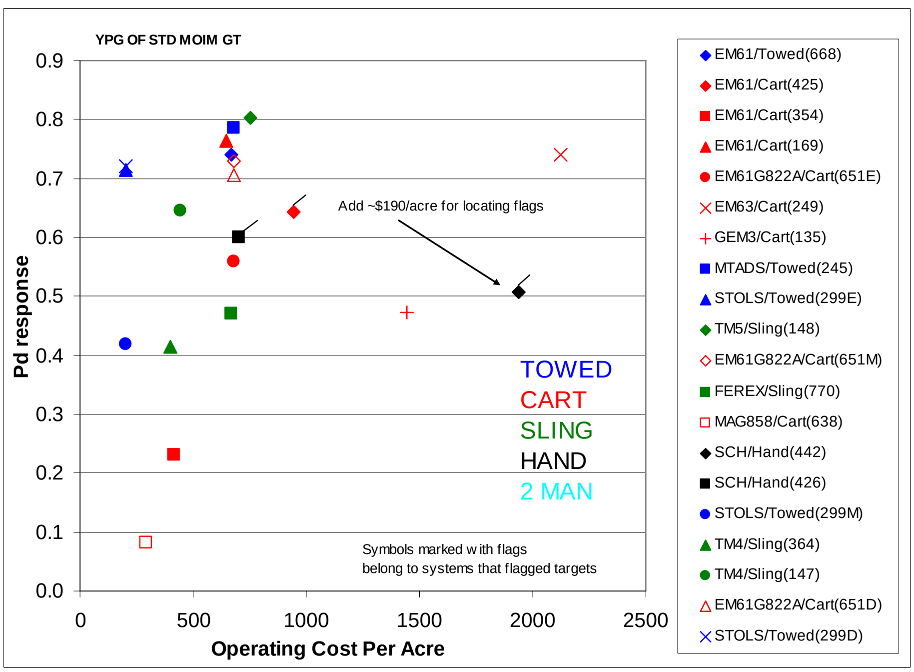

Figure 2.3.8-10. P_d^{res}, versus operating cost per acre, YPG open field.

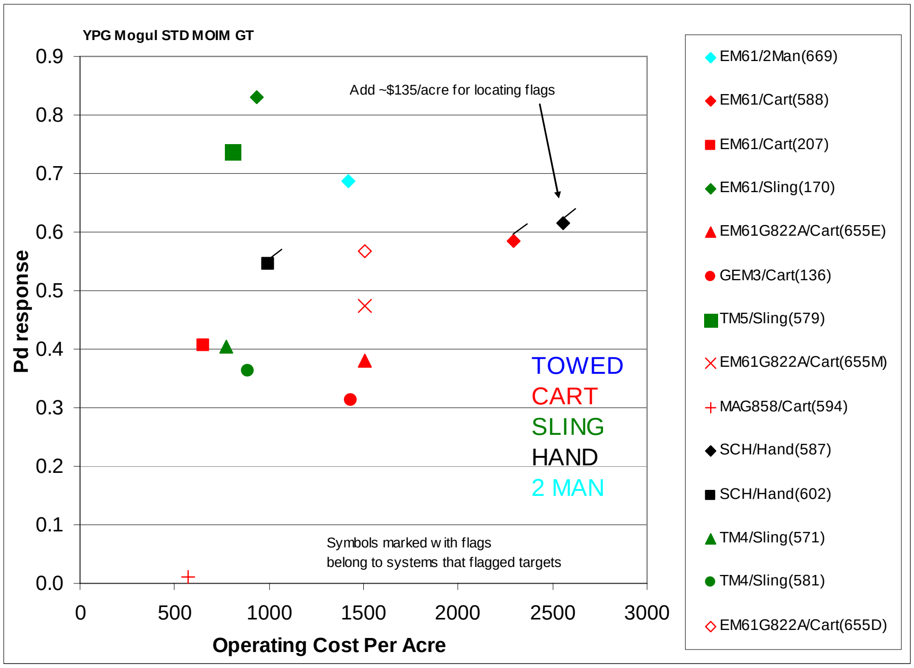

Figure 2.3.8-11. P_d^{res}, versus operating cost per acre, YPG moguls.

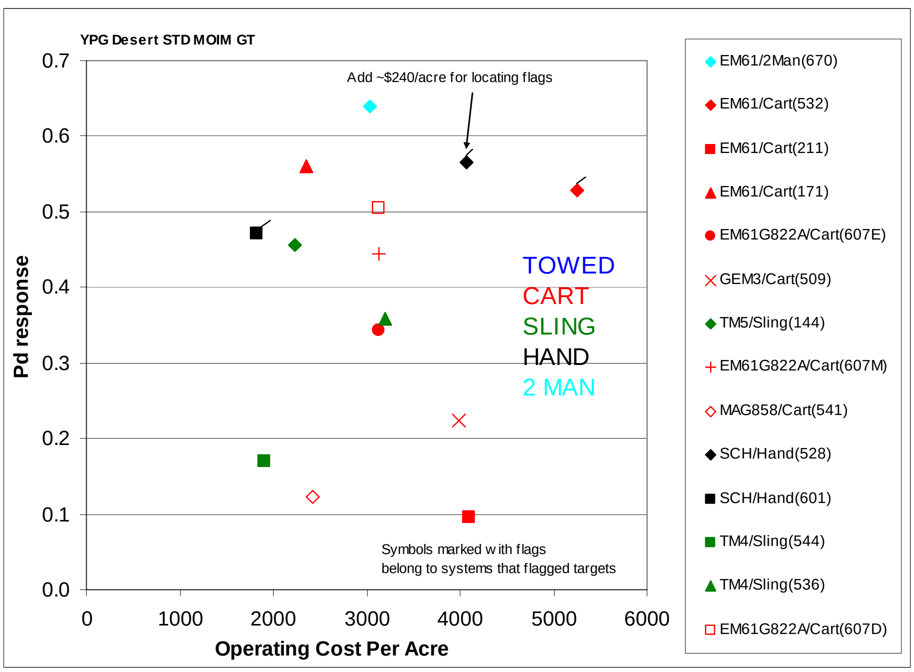

Figure 2.3.8-12. P_d^{res}, versus operating cost per acre, YPG desert extreme.

2.3.8.3 *Total Cost*

a. To show the effect of system performance on total site cleanup costs, a short analysis of these costs was performed for the APG open field. The system considered first is the EM version of MTADS demonstrated by NRL. The towed array system is one of the best performers at APG open field in terms of P_d^{res} and background alarm scores. A total site cleanup cost breakdown using the MTADS results are shown in Figure 2.3.8-13, except that a 100 percent detection rate was assumed for ordnance items. This will increase the dig and detonation costs to reflect a complete site cleanup cost. All costs shown are estimates of the test authority and are based on performance and not on demonstrator input.

b. The site survey cost shown is based upon personnel used and time spent. This survey cost, $7500 (actual rounded to the nearest $500), does not include target reacquisition, travel, or data processing costs. Reacquisition was estimated to cost about $8000 and is based upon reacquiring all targets (ordnance, clutter and background alarms). Response stage targets are used since discrimination ability is insufficient. Travel costs were estimated for four people traveling (by road) 2 half days and surveying 2 days. Meal and hotel expenses were included. The travel costs were estimated at $2,500. Data processing costs were estimated on the low side at $4,000. These costs could be as high $20,000 or more. Thus, the total site survey package was estimated to cost about $22,000.

c. Using time and manpower data from current dig and detonate operations at APG, costs were estimated for removal of ordnance and clutter along with discovery of background alarms. Again, it was assumed that a 100 percent detection of ordnance occurred. It is estimated that it would take approximately $20,000 to unearth all the ordnance in the APG open field and $80,000 to detonate these items. To unearth the clutter items it is estimated that it would cost about $27,500 and to discover the background alarms (false alarms) it is estimated that it would cost $64,500. The amount of clutter assumed is the amount detected by the MTADS system. Further, the number of background alarms that would be discovered to be such upon digging are those coming from the MTADS system.

d. Administrative costs are considered to include planning, documentation, and coordination components. Total cost is estimated at $12,000.

e. When all costs are summed, the total site cleanup cost is estimated to be about $288,000. This cost is likely on the low side but should represent most major costs at a rough order of magnitude. In a real world scenario, one or two additional systems would survey (sweep operation) and hence further increase the total cost (would probably approach ~$400,000).

f. When the total site survey cost is compared to the total site cleanup cost, it is seen that the survey package comprises about 10 percent of the total cost.

g. The ordnance removal costs in total comprise about 45 percent of the total costs and effectively should not change. The administrative costs would also be fixed. Thus, about 50 percent of the total costs cannot be affected by detection technology. The part that is affected is a product of detection technology, namely the number of background alarms followed by the number of non-rejected clutter items. Costs to reacquire and discover these items comprise approximately 40 percent of total cost. Thus, it is seen how important development of discrimination technology is from a cost standpoint.

h. Finally, it should be kept in mind that the cost comparison performed here is site specific and is subject to change for other sites depending on GT composition.

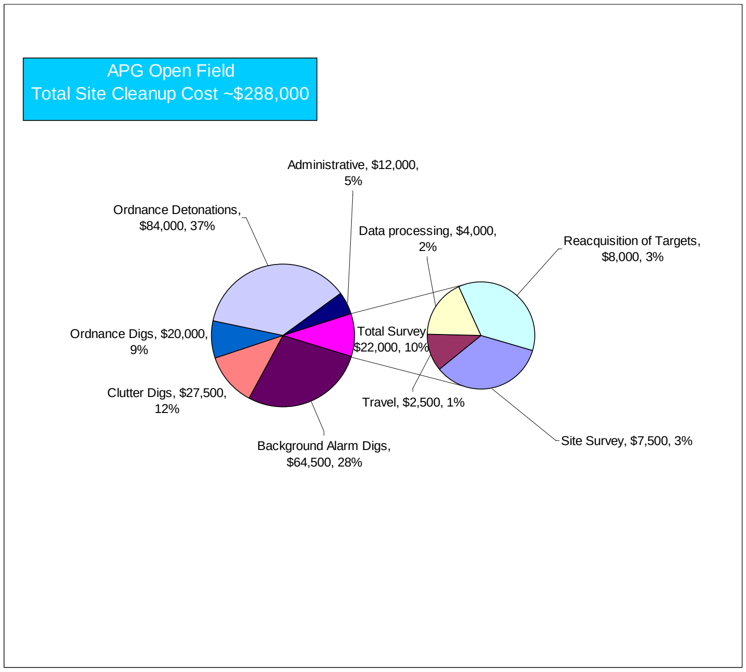

Figure 2.3.8-13. P_d^{res}, versus operating and dig cost per acre, APG open field.

i. The top performing EM and MAG systems in the APG open field are next considered along side the Schonstedt baselines. All non-fixed costs (clutter digs, background alarm digs, travel, data processing, reacquisition, and site survey) will be compared. One hundred percent ordnance detection is assumed to calculate reacquisition costs. Travel costs are estimated for carts and slings to be 60 percent of that for towed platforms and costs for hand held units to be 30 percent of towed platform values. Data processing costs are assumed to be $4000 for all but the Schonstedts, which effectively have none (any that was done would be reflected in survey costs). The total costs are divided by the test area acreage and should approximate rates for a similar sized site with a similar GT configuration. The GT used is an 11D, no challenge area (wet areas eliminated), no overlap (no items closer than 1 meter) version. The cost comparisons are shown in Figure 2.3.8-14.

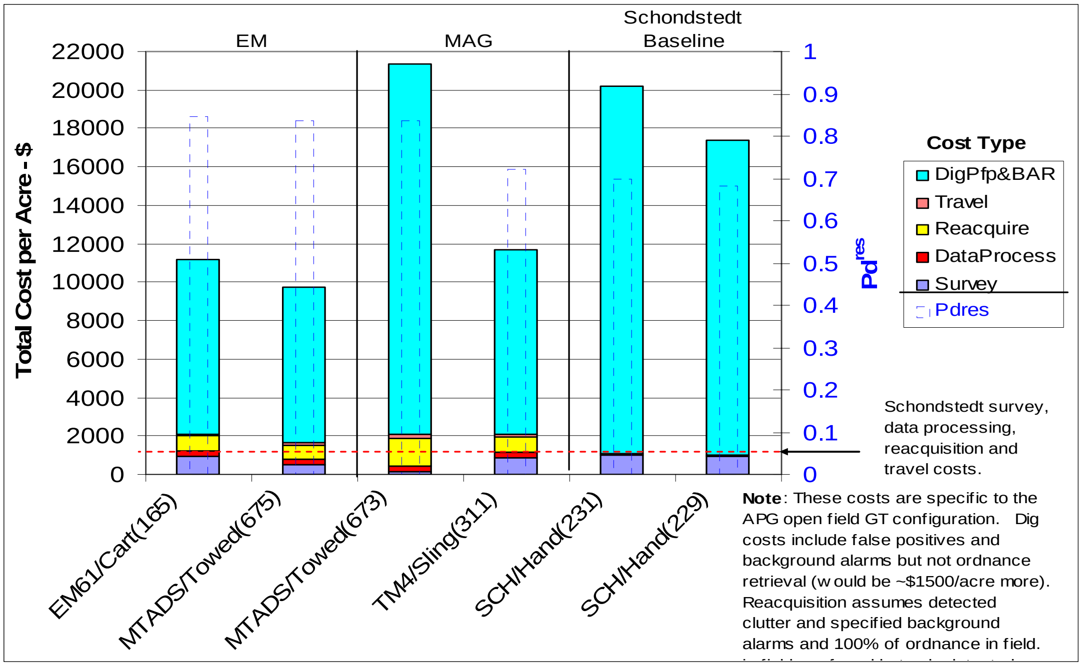

Figure 2.3.8-14. P_d^{res} versus operating and dig cost per acre, APG open field.

j. The systems are separated by basic sensor type in Figure 2.3.8-14. P_d^{res} scores are on the right vertical axis and are represented on the plot by dashed rectangles. It is seen that the best EM and MAG P_d^{res} scores are about 0.85 (85 percent ordnance detection), and the Schonstedt scores are about 0.7 (70 percent ordnance detection). Thus, the best systems have about a 20% greater detection score than the Schonstedts in the open field (Schonstedts do relatively better in rougher terrains and small areas).

k. As shown in Figure 2.3.8-14, when the total of all of the non-dig costs (travel, reacquire, data process, and survey) are compared, the Schonstedts are the least expensive system. However, when the dig costs are factored in for clutter and background alarm discovery, the Schonstedts become among the most expensive systems in overall result.

l. In the APG open field test area, which contains challenging varieties, depths, and densities of ordnance and clutter, the best detection systems find about 20 percent more ordnance than Schonstedt systems at about one-half the overall resulting cost. When deeper and more dense GT are added (as in the standard GT), the relative Schonstedt results become worse. These reults should help the reader to have a greater appreciation for parameters governing overall costs.

2.3.8.4 *Production Rate*

a. The average, maximum, and minimum production rates for all systems in all areas were found and are shown in Figure 2.3.8-15. The values represent the time to survey an area from setup to demobilization, including calibration.

b. As shown in Figure 2.3.8-15, the towed array systems break away from the pack on flat grassy terrains, as in the APG open field. The best rate in that area, by the MAG version of NRL's MTADS system, is about 1.3 acres per hour. The P_d^{res} for this system was 0.68 (third best for area using standard GT) but it had a relatively high BAR score compared to better performing EM systems.

c. Rates of less than 0.2 acre per hour are all that could be achieved in terrains with brush, trees, gulleys, or pronounced moguls.

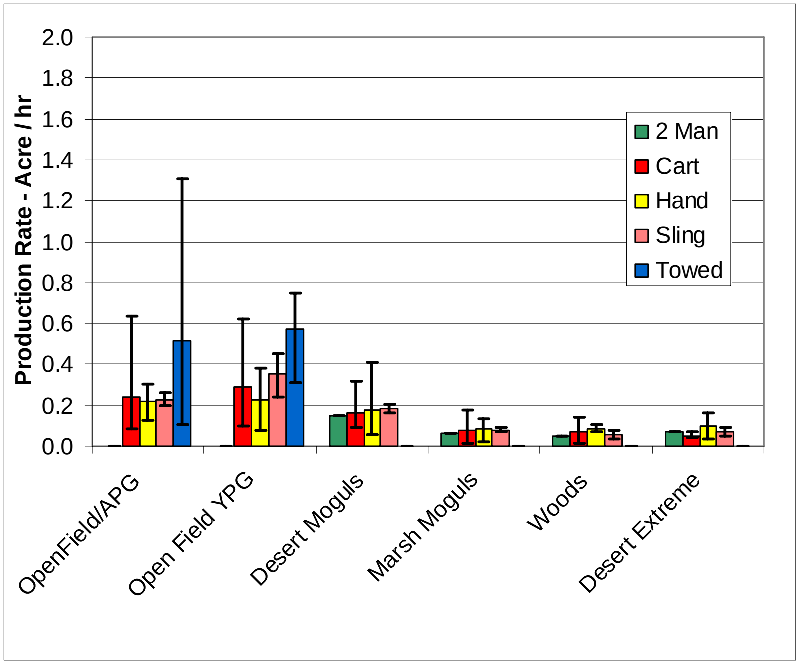

Figure 2.3.8-15. Production rates.

d. A plot of survey rates that exclude calibration, setup, and demobilization time is shown in Figure 2.3.8-16 for all systems. Production rates will likely approach survey rates for larger sites where setup and calibration are a smaller part of total time spent.

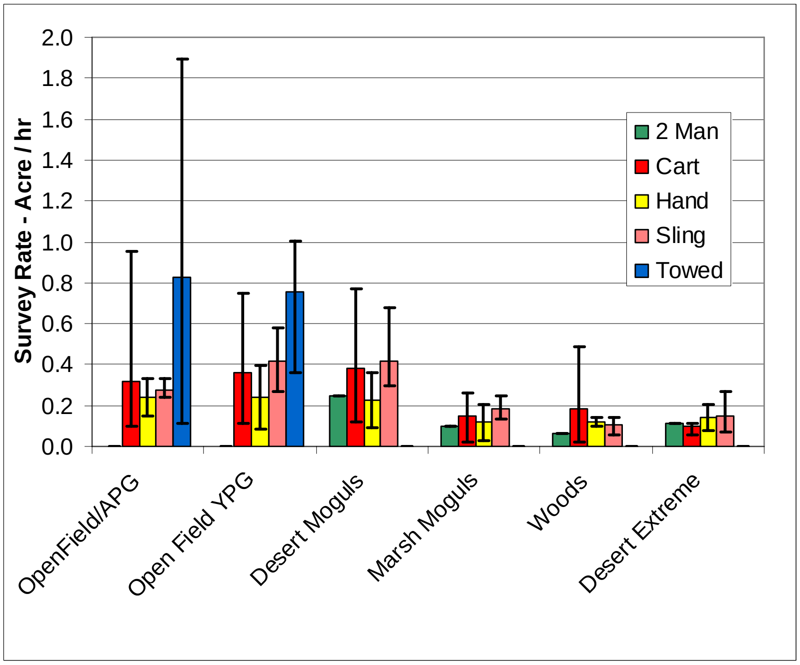

Figure 2.3.8-16. Survey rates.

2.3.9 Technology Comparisons

2.3.9.1 *Dual versus Non-dual Systems*

a. Dual mode systems are composed of two sensor types operating in tandem on the same platform. EM and MAG sensors were typically combined and demonstrated at the standardized sites. The details of how the demonstrators combined or fused their data are beyond the scope of this report. The demonstrators that used dual systems were asked to submit three dig lists, one for each component system and one for the combined system. The purpose of this request was to allow direct comparison of performance between component and combined components of the systems. (It is not known to what extent single components were optimized for dual use.)

b. The probability of detection for the dual systems demonstrated at the APG and YPG open fields in the response stage is shown in Figures 2.3.9-1 and 2.3.9-2. BAR scores are also shown in the figures. Individual and combined sensor performance results are shown. Also shown are the results of all systems (including non-dual) demonstrated at the respective sites, as represented by maximum, median, and average values of P_d^{res}. The GT used contains both ferrous and non-ferrous items; thus, the MAG scores are biased on the low side.

c. The figures show that a 0.01 to 0.05 P_d^{res} increase above the best constituent performance is afforded by combining sensor data in a dual mode. The best P_d^{res} result is from the VSEMS system in the APG open field. It is noted that this system was tested after the open field GT was reconfigured. While clutter and ordnance distributions remained essentially the same as the old configuration, many items contributing to background noise ended up being removed. Therefore BAR scores from the VSEMS can not be compared directly with all other values shown in Figure 2.3.9-1. The BAR score is likely on the low side for the VSEMS and could not increase more than 0.2 if the items were put back in the ground and all flagged as anomalies. It is also noted that system scores for report numbers 675 and 298 are not corrected for wet areas that were not surveyed (Pd and BAR would increase) as is done when the 11D, no overlap, no challenge GT variant is used. The standard GT result is used here because it shows a greater benefit from the dual system combination. The standard GT has items closer together and deeper than the 11D variant.

d. In general, community wide, dual systems perform above average.

e. It is not known to what extent dual system performance benefits are resulting simply from increased data density.

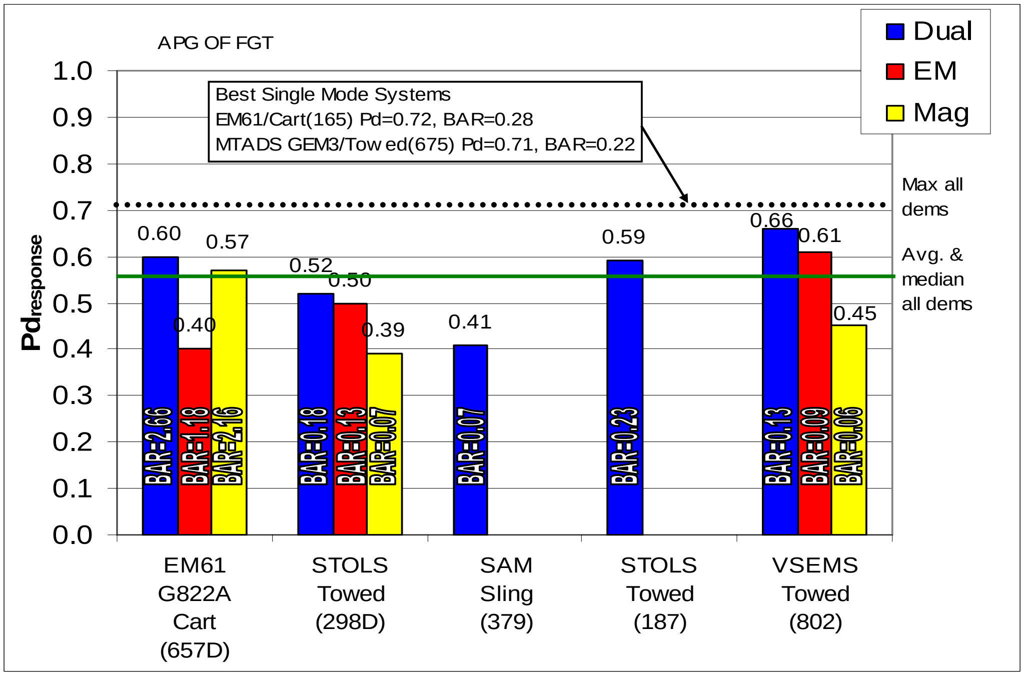

Figure 2.3.9-1. P_d^{res}, for dual and single counterparts in APG open field.

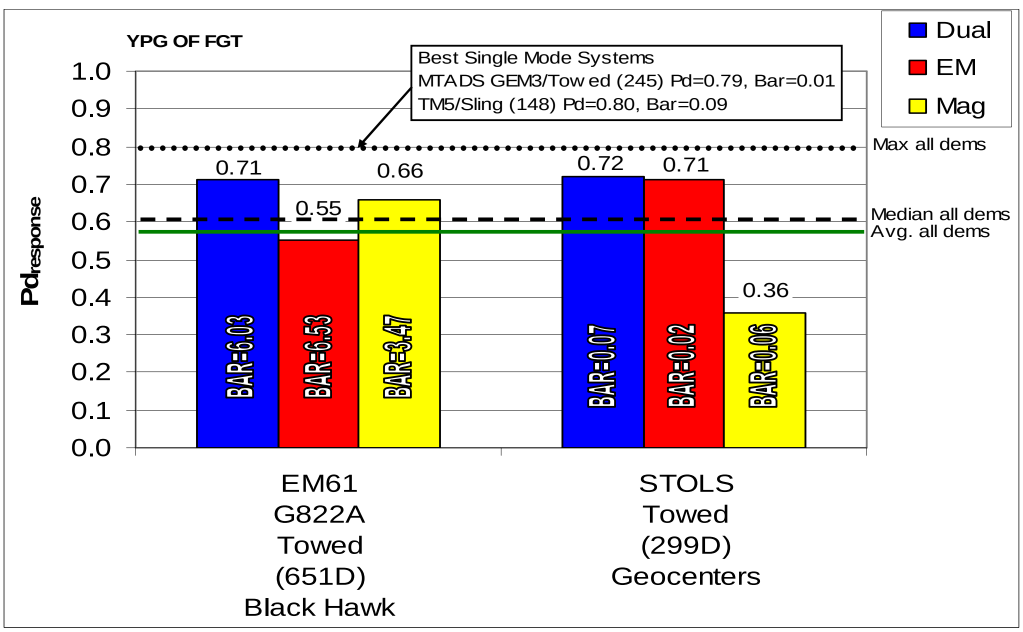

Figure 2.3.9-2. P_d^{res}, for dual and single counterparts in YPG open field.

2.3.9.2 *Digital Geophysical Mapping (DGM) versus Flag*

a. One of the more common ways to detect buried UXO is to use MAG and Flag or EM and flag techniques with a hand held unit. With these flag techniques, typically the operator surveys over the area using an instrument that does not collect and store data. If the instrument detects an object then the instrument informs the operator (usually by emitting an audible signal). Once the instrument alerts the operator to the presence of an object, the operator can immediately resurvey the area to get an accurate fix on the location of the item. Typically, an operator will place a flag into the ground directly over the suspected object. Then the area around the flag can later be excavated in order to find the buried object. If such a system/technique is used at the standardized UXO detection sites, after the operator is finished placing the flags, the flags must be surveyed so that their locations can be tabulated as part of a dig list.

b. One major advantage of this system/technique is that it excels in very difficult terrains. A disadvantage is that large areas can become cumbersome to survey and as a result quality may suffer. Another disadvantage is the extra time/cost it takes to survey the location of the flags if needed. Also, the operator is dependent on his own memory and skill to locate and identify an item.

c. Another technique for surveying an area where UXO is suspected to be buried is the use of DGM. With DGM, an operator will survey the site with an instrument that is continuously collecting signal, location and time data. Location data is typically provided by a GPS system. The data that are collected will typically be sent to a skilled geophysicist to be processed. The geophysicist will apply a variety of algorithms to the data in order to compile a dig list of locations where suspected UXO like items are buried.

d. The advantage of this technique is that it offers a large picture of signal returns to be viewed at one time which permits better interpretation of the sensor data. The disadvantage of this technique is that if additional information is needed a resurvey may not be convenient depending on whether or not real-time processing was performed. Further, for rough terrains, more elaborate instrumentation is required to orient/locate a sensor platform relative to the topography being surveyed. Finally, extra cost is required to mark dig locations after the survey unless real-time processing is used.

e. Up to this point in the report, the results of all system configurations have been compared side-by-side, and it has been seen that often MAG and Flag, and EM and flag, systems are outperformed by systems that geophysically map items in the ground. Some of the performance differences may be due to sensor and platform differences. To better isolate trends, a plot of only hand held platform performance, as measured by P_d^{res} and P_{ba} in the APG blind grid, is shown in Figure 2.3.9-3 (no depth limits are imposed). When EM systems are compared, the systems that used geophysical mapping to locate anomalies typically performed better. To what degree the different system types are contributing to performance differences cannot be established.

f. In terms of location error, the flagging technique used by hand held units works very well, only surpassed by towed platforms using the geophysical technique on flat terrains (see section 2.3.4.2).

g. In summary, it appears that geophysical mapping and processing has proven itself not only a viable technology but a reliable technology for all terrains. This is attested to by all best performers in each test area using the technology. Further the technology consistently, when configured with different sensors, outperforms flagging technology in these terrains.

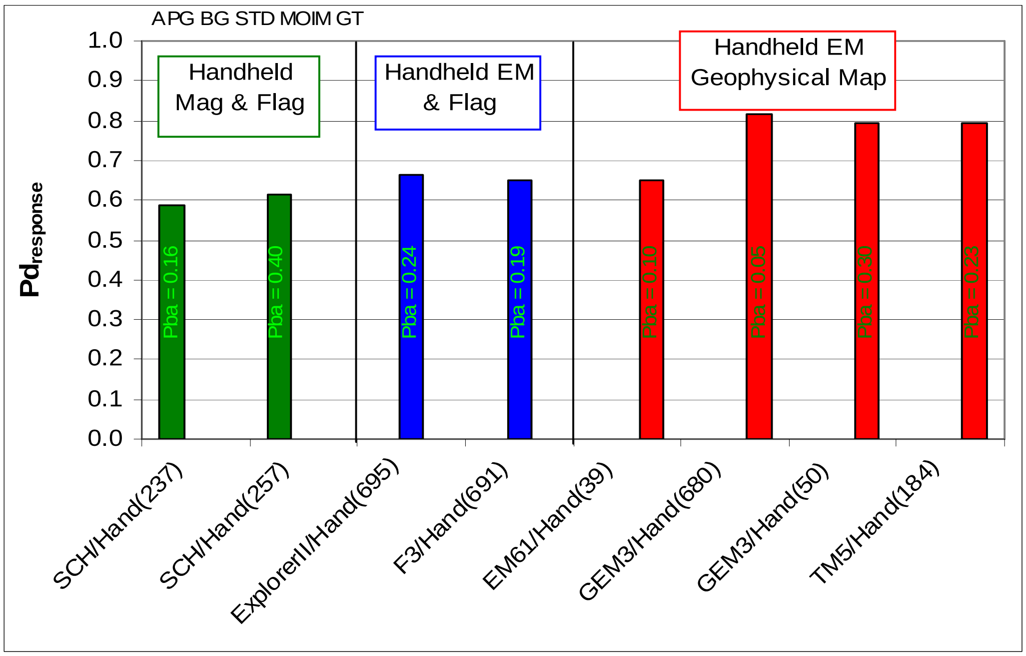

Figure 2.3.9-3. P_d^{res} for systems that Flag and that process geophysical data, APG blind grid.

2.3.10 *Operational Requirements Document (ORD) Evaluation*

a. The U.S. Army, through their Environmental Quality Technology (EQT) Program established an ORD in April 2002 (ref 6). The document gives guidance to the type of systems to be developed and demonstrated at the Standardized UXO Demonstration sites in light of expected operational requirements. The ORD also sets forth threshold and objective requirements for performance that are considered a leap ahead of year 2002 technologic capability and deemed necessary for practical use. The following section will evaluate how the technologies demonstrated at the standardized sites relate to the ORD metrics. Not all requirements will be evaluated since some pertain to the transfer of government developed technology to the contract community. Nonetheless, where applicable, an assessment of how development and performance requirements in the ORD are being met by the demonstrated technologies will be made.

b. In section 4.1.2 of the ORD, a table of "threshold" and "objective" metrics are established in six categories of performance. The threshold values represent acceptable measures of performance while the objective values represent developmental targets. Demonstrated performance at the sites will be compared with these values. Results for one GT variant will be shown from the sites. The variant uses only items less than 11D deep and contains no items in challenge areas (including wet areas) or items within 1 meter of a GT item (i.e., no overlapping halos). Only open field results will be examined, since this area is more common and is the easiest of terrains to detect ordnance.

c. The first performance category evaluated is P_d^{res}. A 0.95 threshold and a 0.98 objective value are specified in the ORD. The P_d^{res} value for each system tested in the open field at APG and YPG using the GT variant discussed above are plotted to see how the demonstrated technologies compare to these values. The plots are shown in Figures 2.3.10-1 through 2.3.10-2.

d. As shown in Figures 2.3.10-1 and 2.3.10-2, the P_d^{res} threshold value of 0.95 is currently being met by SOTA systems at YPG, The threshold value is not being met at APG, however, when the MK118 and 20mm items are eliminated from the GT and better ground coverage quality controls are employed, better systems are within .01 to .02 from the value (see Figure 2.3.5-14). If "individual" ordnance results in a no challenge, no overlap (1 m), <11D depth environment are examined (app G), it will be found that 8 of the 14 ordnance types can be detected at or above threshold value in both open fields. Four ordnance types can be detected at or above objective values at both open fields. Finally, it is noted that a majority of systems meeting the requirements have relatively low BAR scores. Therefore SOTA system designers appear to be on track for the development of needed detection capability.

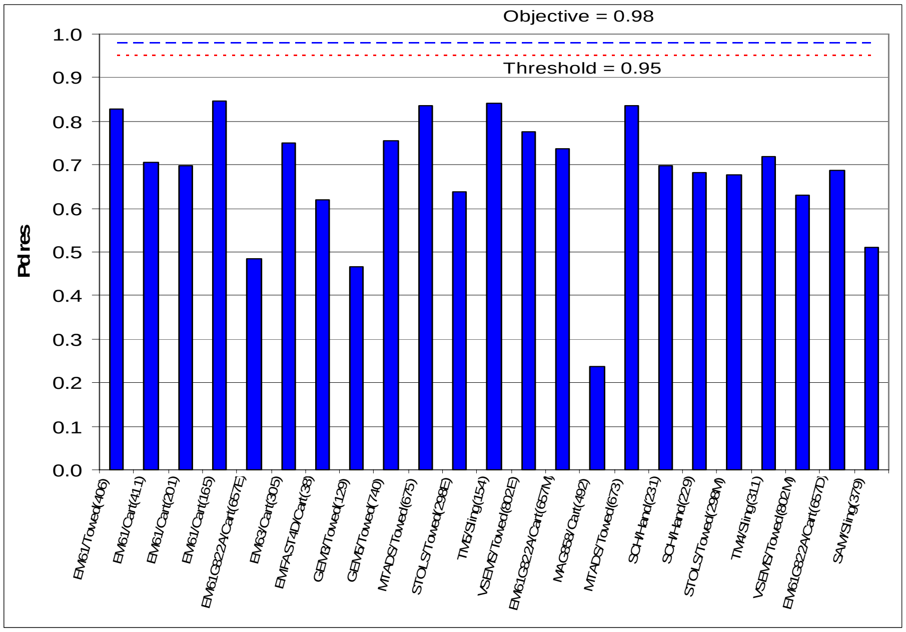

Figure 2.3.10-1. P_d^{res}, for systems demonstrated at APG open field, 11D depth limit, no overlap, no challenge area, all ferrous GT used for MAG systems.

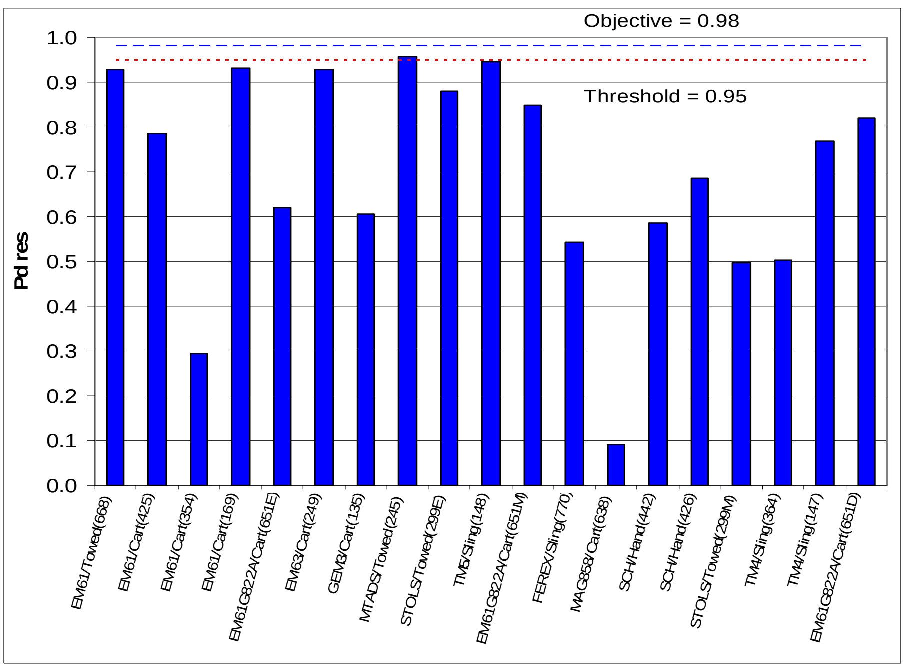

Figure 2.3.10-2. P_d^{res}, for systems demonstrated at YPG open field, 11D depth limit, no overlaps, no challenge area, all ferrous GT used for MAG systems.

e. The second performance category evaluated is discrimination as measured by the clutter rejection rate. Ideally, when a demonstrator discriminates the items in the list of response stage anomalies, the goal is to eliminate or reject 100 percent of the non-ordnance or clutter items. A 75 percent threshold and 90 percent objective value are specified in the ORD. A comparison of these requirements against demonstrated performance at APG and YPG open fields is shown in Figures 2.3.10-3 and 2.3.10-4.

f. Upon examination of Figures 2.3.10-3 and 2.3.10-4, it is seen that the best clutter rejection rates fall about 9 percent below the threshold at APG and about 25 percent below the threshold at YPG. However, the next group of figures show that the clutter rejection rates come at the cost of rejecting significant amounts of ordnance.

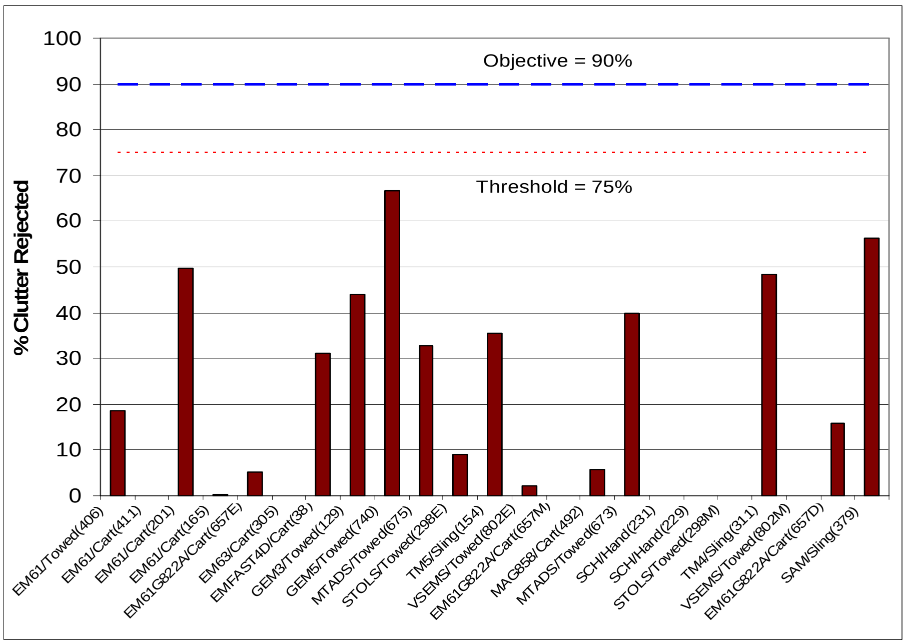

Figure 2.3.10-3. Percentage of clutter rejected, R_{fp}^{disc} x 100, for systems demonstrated at APG open field, 11D, no overlap, no challenge area.

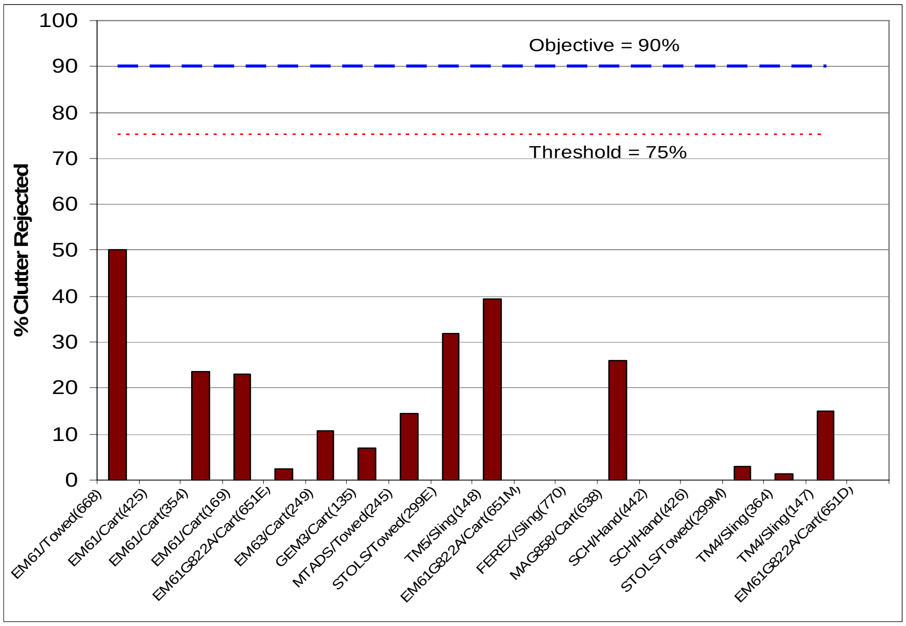

Figure 2.3.10-4. Percentage of clutter rejected, R_{fp}^{disc} x 100, for systems demonstrated at YPG open field, 11D, no overlap, no challenge area.

g. One other measure of discrimination ability, false negative rejection rate (R_{fn}^{disc}), is also evaluated. This rate is the amount of ordnance detected that is called clutter by a demonstrator upon discrimination. A 5 percent threshold and 0.5 percent objective value are specified in the ORD. A comparison of these requirements against demonstrated performance at APG and YPG open fields is shown in Figures 2.3.10-5 and 2.3.10-6.

h. The figures show that the threshold and objective values can be met by systems, but it is known that if a demonstrator makes little effort to discriminate, most anomalies will be called ordnance and the false negative rates will be low. So, the results should be looked at in light of other detection and discrimination metrics for balance. When results are compared with figures 2.3.10-3 and 2.3.10-4, it will be seen that when small amounts of ordnance are misidentified (false negative), large amounts of clutter end up being misidentified. In summary, discrimination ability demonstrated at the sites does not meet threshold requirements for discrimination as a whole as specified in the ORD. Future test sites with a smaller variety of ordnance may reveal a more favorable result for SOTA discrimination ability.

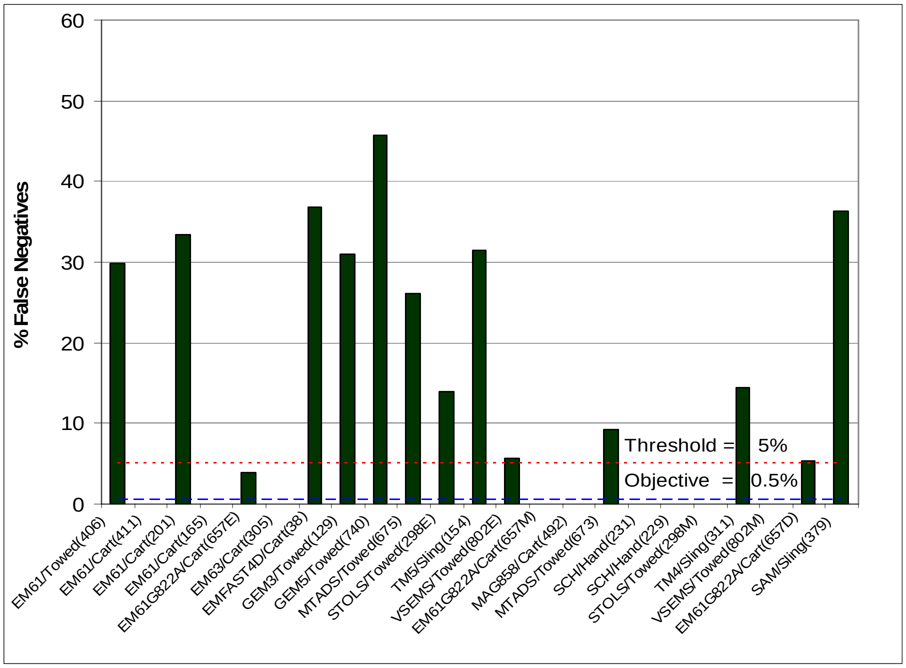

Figure 2.3.10-5. Percentage of R_{fn}^{disc} x 100, for systems demonstrated at APG open field, 11D depth limit, no overlap, no challenge area, all ferrous GT used for MAG systems.

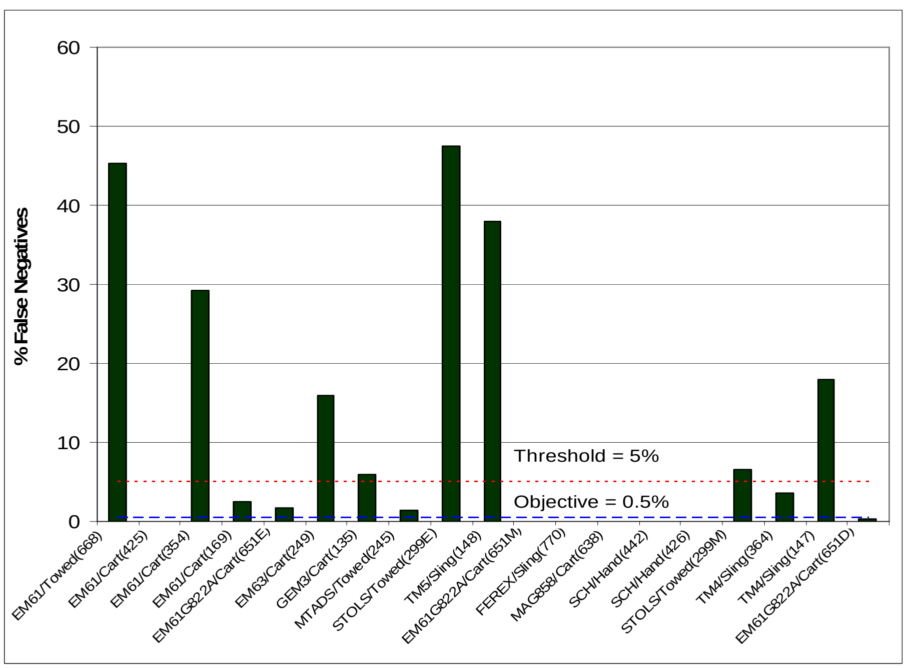

Figure 2.3.10-6. Percentage of R_{fn}^{disc} x 100, for systems demonstrated at YPG open field, 11D, no overlap, no challenge area, all ferrous GT used for MAG systems.

i. The third performance category evaluated is reacquisition error. This error was not truly measured for systems at the sites. The geophysical mapping systems were not made to physically reacquire their target locations once identified, they were only asked to submit calculated locations in a dig list. If ATC personnel had to reacquire the target locations from the systems, location error of surveying equipment would average about 0.01 meter using best surveying practices. This would meet the objective reacquisition error requirement of 0.1 meter. It would also have a negligible impact on the overall location error of the systems. If reacquisition error is meant as overall location error from the GT after reacquisition, then the error is closely approximated by the location error of the systems alone. The best values demonstrated at each test area are shown in Figure 2.3.10-7.

j. As shown in Figure 2.3.10-7, the best location error in each test area falls within the threshold requirement of the ORD for reacquisition. One value, 0.09 meter, falls within the objective value. This value is from the MTADS towed array system (EM, report No. 245).

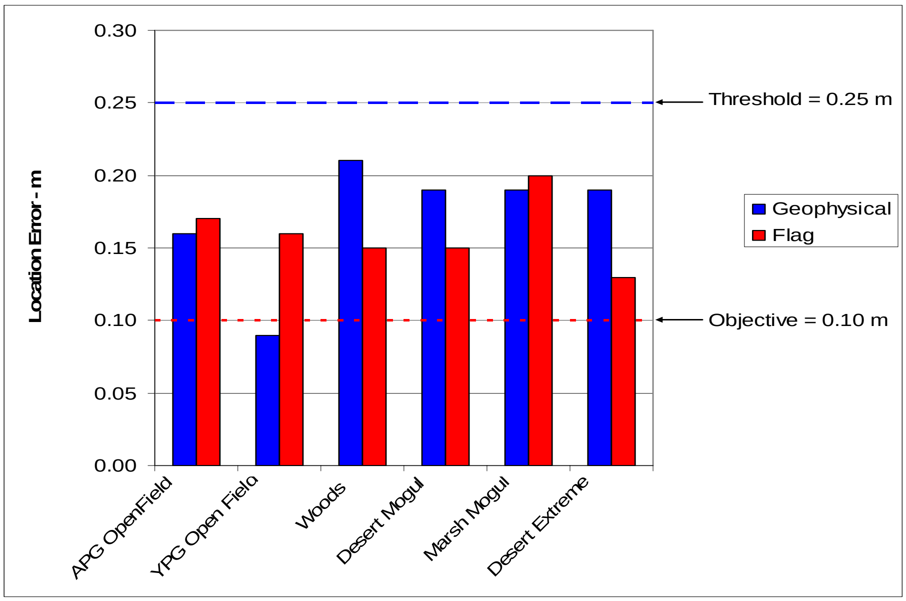

Figure 2.3.10-7. Best location/reacquisition error demonstrated in test areas at the standardized sites.

k. The fourth performance category evaluated is cost rate, which is a measure of production cost, based on time spent (including setup, calibration, and demobilization) in the open field and number/type of personnel working, divided by acreage. A $4000/acre threshold and $400/acre objective value are specified in the ORD. A comparison of these requirements against demonstrated performance at APG and YPG open fields is shown in Figure 2.3.10-8. The costs shown do not include travel, post-processing, and reacquisition costs.

l. The values shown in Figure 2.3.10-8 are average costs for the whole community of systems demonstrated, along with maximum and minimum values. The minimum values for all three basic sensor types at both open fields are within objective values. Further all maximums are within threshold requirements. Reacquisition costs are not a part of the calculated cost values, as stated above. Such costs are estimated to be as high as $600/acre for the better performers at APG open field and will likely bring survey costs above the objective threshold. Further, if data processing costs are included, additional costs of approximately $300 to $2000 per acre are possible. Future tests at the sites should require demonstrators to supply data processing costs.

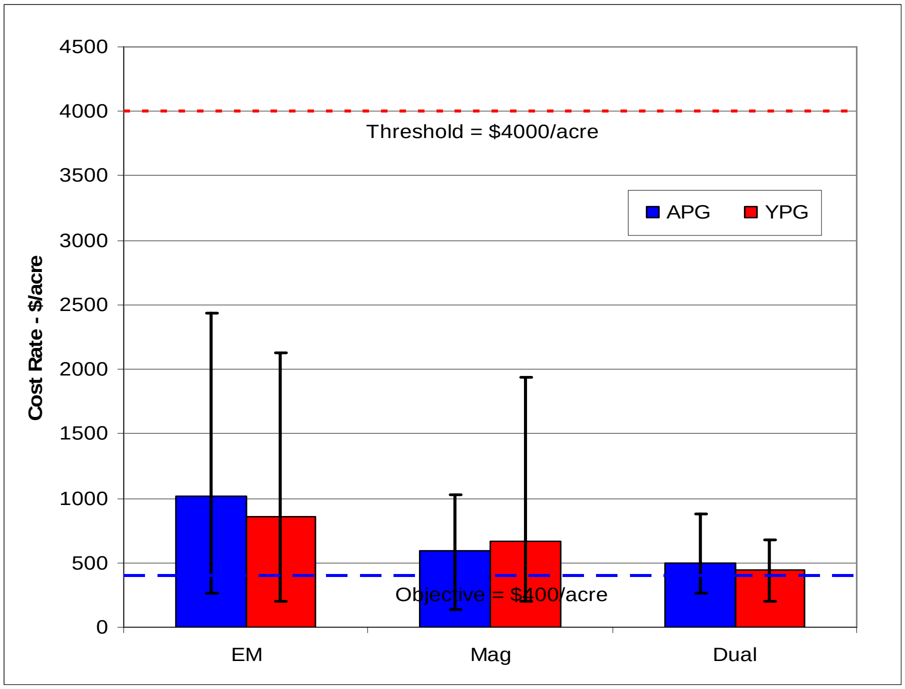

Figure 2.3.10-8. Average cost rates with maximums and minimums, APG and YPG open fields for all demonstrators.

m. The fifth performance category evaluated is the ability of detection technology to operate in all test areas at the standardized sites. The test areas represented at the sites are moguls (desert and marsh), desert terrain, open field (desert and grass), and woods. The threshold metric is simply the ability to operate in the areas, and the objective metric is to have unhindered access to all of the areas. By observation of test site personnel, the former requirement can be met by SOTA technology, but the latter requirement is not being met in desert extreme and wooded areas (the major hindrance being brush).

n. The sixth and final performance category evaluated is production rate. The threshold value required is 5 acres per day (0.625 acre per hour for 8-hr workday), and the objective value targeted is 50 acres per day (6.25 acres per hr). A comparison of these values is made in Figure 2.3.10-9 against average production rates, as well as maximums and minimums, for all systems demonstrated at the various test areas. In the open fields, some systems (towed arrays) meet the threshold requirement; however, no systems meet the objective requirement.

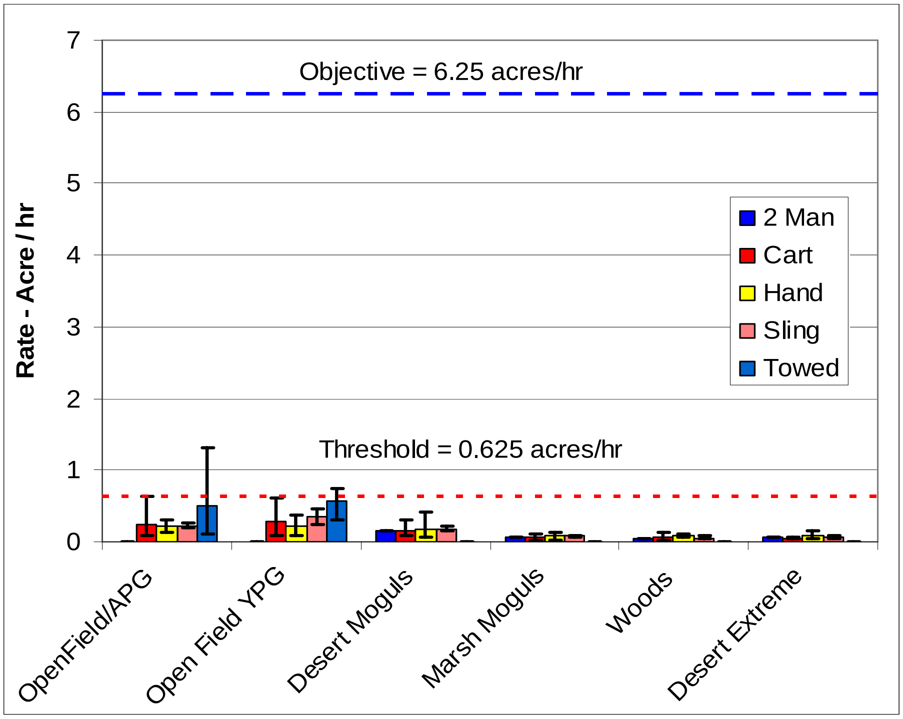

Figure 2.3.10-9. Production rates for all APG demonstrated systems at various test areas.

2.3.11 Optimization

a. Given the data available, efforts have been made to look at different ways system performance might be optimized. From a discrimination standpoint, it was shown that optimizing threshold values in the discrimination stage did not make much difference in results (see section 2.3.3.3). No attempt was made to optimize response stage thresholds to see how much detection rates increase, since most demonstrators supplied no data below threshold values. Optimum halo sizes were examined for digging and scoring (section 2.3.4.4 and 2.3.6). It is suggested in section 2.3.4.1 that if quality controls are optimized to verify coverage, minor gains in P_d^{res} may result. Finally, one area not yet considered is the determination of the minimum number of systems required to survey an area to give optimum detection rates.

b. The practice of having multiple systems come in to survey a site in order to increase the number of detected ordnance is not a new concept. The benefit of this practice primarily results from effectively increasing the sample density (samples per area) of signal returns. However, this is not in a fused sense, for the "results" are being superimposed, not the raw data. This mode of thought brings to light a second means of optimization, namely finding the value of sample density by which systems will achieve maximum or diminishing returns in P_d^{res}.

c. The optimum number of systems to survey an area and possible optimum sample densities will be examined in this section. It is realized that coil size, sample rate, translation speed, and transmitting power (EM), operating modes, etc., will affect sample density considerations. Further, GT characteristics (depth, density, and size) will affect system configurations. Results presented represent general trends at best and apply to "similar" systems.

d. The raw/unprocessed data from the detection systems are required to determine the average number of samples taken per square meter in the ordnance halos. These raw data files are huge and prohibit, because of time considerations, analyzing all systems at all test sites. For this reason, only systems demonstrated at the YPG open field are examined (standard GT). Also, not all systems had raw data in a format that was conducive to processing and therefore not all systems could be analyzed at the YPG open field. All data associated with one time value and one sensor is considered to comprise one sample. The number of samples in each ordnance halo were averaged and divided by the halo area to calculate sample density (samples/square meter).

e. A plot of P_d^{res} versus data samples per m^2 is shown in Figure 2.3.11-1. Results are in blue for EM and in green for MAG. If only the top performers for the EM systems are examined and a trend line fitted (blue solid line), it can be seen that P_d^{res} increases as the number of samples per m^2 increases. Insufficient data exists at very low densities to fit a trend line to, but it is apparent that a high slope line will exist for the EM systems at very low densities and that a sharp transition or "corner" to a low sloped region will occur. It appears that most of the EM systems have "turned the corner" from a high sloped trend to a low sloped trend (at ~ 8 samples per m^2). The low slope region indicates some improvement in Pd may be possible by increasing data density. It is not apparent whether the MAG systems have such a sharp transition. If they have not, a moderate slope may exist and improvement may be possible by increasing their data density. MAG systems with higher sample densities are needed to make this determination.

f. A plot of the detection rate for clutter in the response stage, P_{fp}^{res}, versus sample density is shown in Figure 2.3.11-2. It is seen that the detection trends are similar to those in Figure 2.3.11-1 for the ordnance. BAR scores from Figure 2.3.11-1 apply to Figure 2.3.11-2.

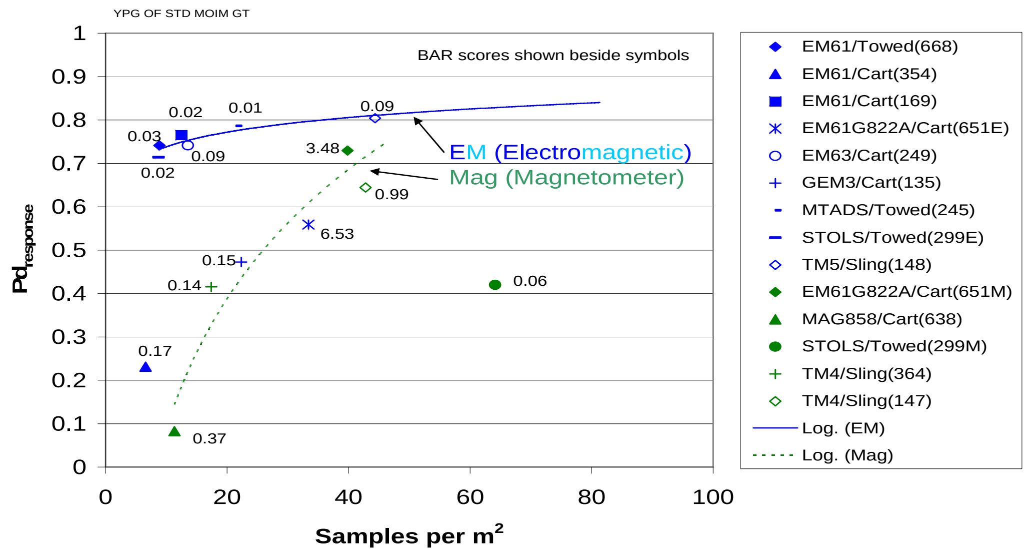

Figure 2.3.11-1. P_d^{res} versus samples per m^2, BAR score labeled, YPG open field.

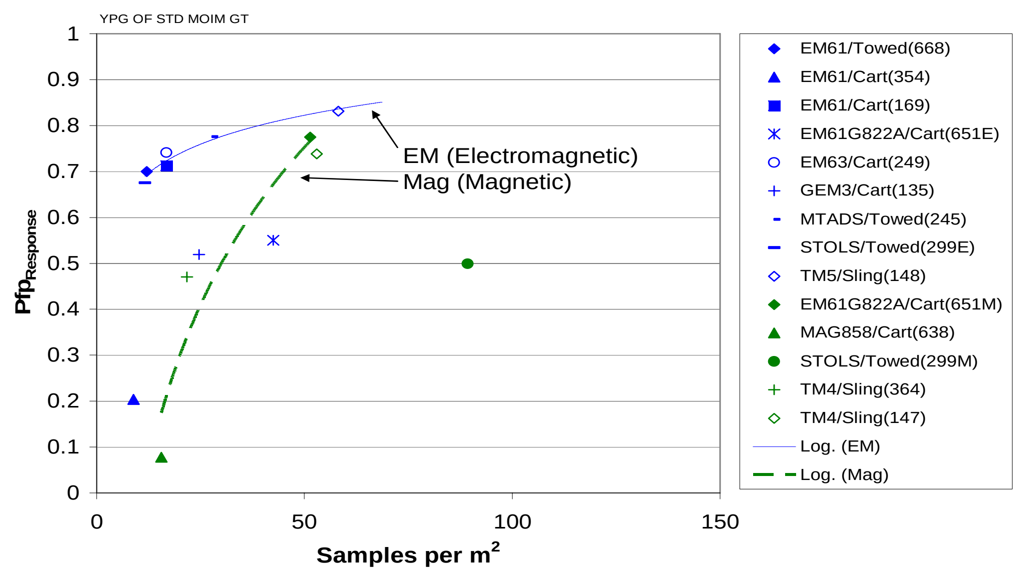

Figure 2.3.11-2. P_{fp}^{res} versus samples per m^2, YPG open field.

g. The results of combining (all combinations, up to three different systems) system dig lists are shown in Figure 2.3.11-3. This should be the same as having multiple demonstrators come in to survey a site. The GT used contains ferrous and non-ferrous items, and both EM and MAG systems are being combined. A trend line has been fitted to the best combination of systems. It is seen that the effects of combining results yields a greater increase in P_d^{res} than is realized by the trends in single system results, given their current design configurations. Further, increases in P_d^{res} diminish at about three systems, or at about 100 samples per square meter. The combined systems are effectively giving better site coverage at a higher sampling density. However, results are improving at the cost of an increased background alarm rate (will not be analyzed here).

h. Combining results is advantageous for P_d results but not for BAR results and cost. It would be interesting to fuse the raw data of multiple systems (multiple platforms) to see if an even greater increase in detection rates will occur after processing and determine what the resulting BAR will be.

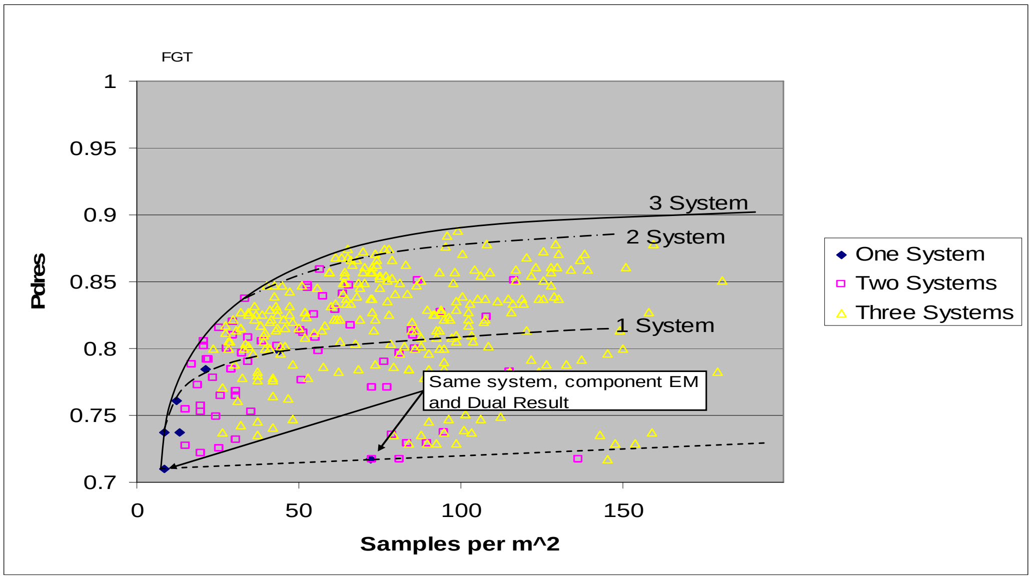

Figure 2.3.11-3. YPG open field, Combined results

i. Combined results, from a GT with items spaced at least 1.5 meters apart from the next closest item, are shown in Figure 2.3.11-4. The P_d^{res} trends turn the corner better in such a GT configuration, with diminishing returns when using approximately two systems at a sample density of about 50 samples per square meter. This indicates that for a field with ordnance/clutter that are less densely packed, spaced greater than 1.5 meters apart, data resolution requirements can be relaxed. Also, for the field with greater spacing, fewer systems are required to achieve optimum detection.

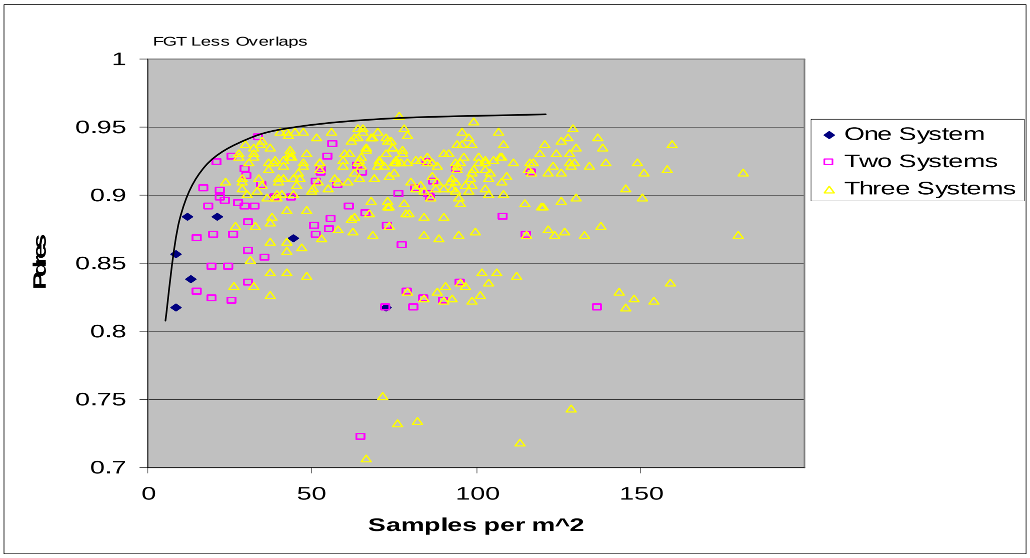

Figure 2.3.11-4. YPG open field ,Combined results for GT spaced at least 1.5 meters apart.

j. The sensor/platform combinations that were most effective when combined are presented in Table 2.3.11-1. The results are for the >1.5-meter spaced GT. It is noted that the 651D, 651M, and 651E systems had very high BAR values.

TABLE 2.3.11-1. COMBINED SYSTEM RESULTS

Single/Single	Pdres	Sample Density	System 1	System 2	
1	0.94	43	MTADS/Towed(245)	EM61/Cart(169)	
2	0.93	33	EM63/Cart(249)	EM61/Cart(169)	
3	0.93	70	TM4/Sling(147) Mag	EM61/Cart(169)	
Single/Dual	**Pdres**	**Sample Density**	**System 1**	**System 2**	
1	0.94	109	EM61/Cart(169)	EM61G822A/Towed(651D)	
2	0.94	105	EM61/Towed(668)	EM61G822A/Towed(651D)	
3	0.94	121	MTADS/Towed(245)	EM61G822A/Towed(651D)	
4	0.94	150	TM5/Sling(148)	EM61G822A/Towed(651D)	
Single/Single/Single	**Pdres**	**Sample Density**	**System 1**	**System 2**	**System 3**
1	0.97	109	EM61/Cart(169)	EM61G822A/Towed(651E)	EM61G822A/Towed(651M)
2	0.97	105	EM61/Towed(668)	EM61G822A/Towed(651E)	EM61G822A/Towed(651M)
3	0.96	113	TM4/Sling(147) Mag	EM61/Cart(169)	EM61G822A/Towed(651E)
Single/Single/Dual	**Pdres**	**Sample Density**	**System 1**	**System 2**	**System 3**
1	0.97	136	MTADS/Towed(245)	EM61/Cart(169)	EM61G822A/Towed(651D)
2	0.97	166	TM5/Sling(148)	EM61/Cart(169)	EM61G822A/Towed(651D)

k. The relationships between P_d^{res} and sample density are plotted for individual EM and MAG sensor types, as shown in Figures 2.3.11-5 and 2.3.11-6, respectively, using the GT spaced at a minimum of 1.5 meters.

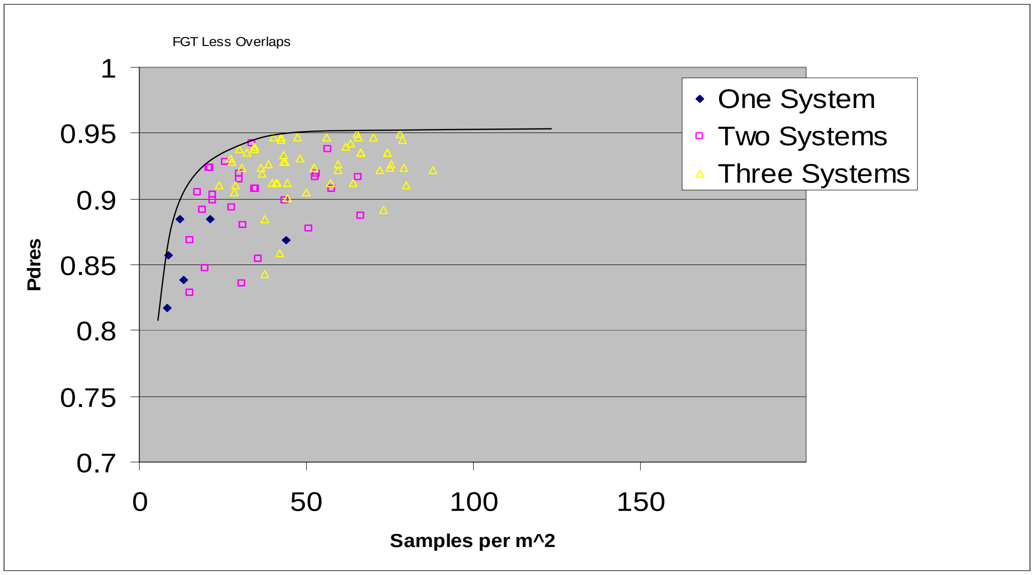

Figure 2.3.11-5. YPG open field, Combined results for GT spaced at least 1.5 meters apart, EM sensors only.

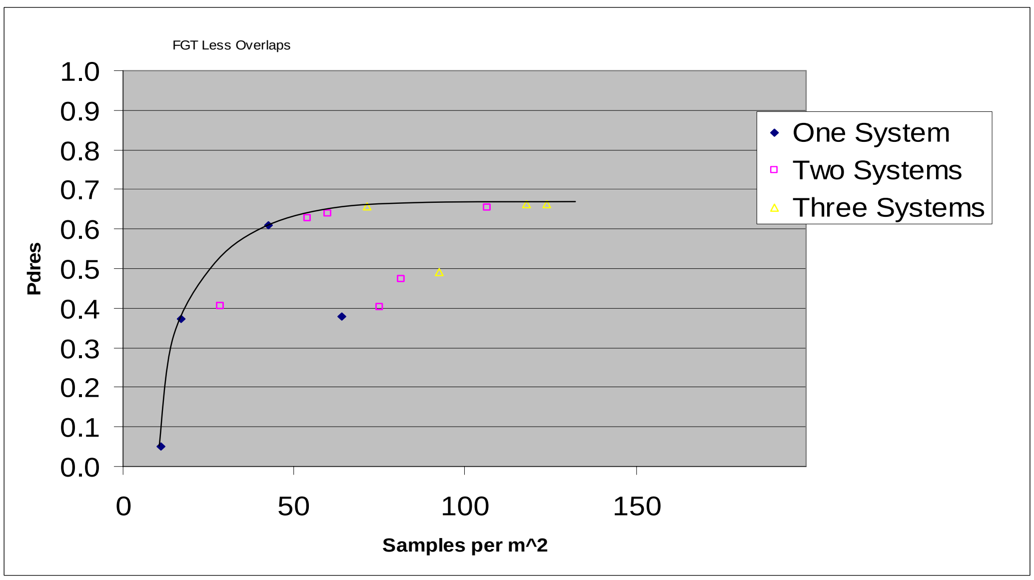

Figure 2.3.11-6. YPG open field, Combined results for GT spaced at least 1.5 meters apart, MAG sensors only.

l. When comparing the EM results shown in Figure 2.3.11-5 against those in Figure 2.3.11-4 (which contains all sensor combinations), the trend line is practically the same. Therefore, the best combinations of sensors are turning out to be combinations of different types of EM sensors, not combinations of EM and MAG sensors. Further, when Figures 2.3.11-5 and 2.3.11-6 are compared, it is seen that greater increases in P_d occur when different EM systems are combined than occur when MAG systems are combined. Also, the number of EM systems and sample density required to optimize P_d are less.

m. Discrimination trends with sampling density could not be discerned in preliminary analysis, so they are not included for consideration.

SECTION 3. APPENDIXES

APPENDIX A. TERMS AND DEFINITIONS

GENERAL DEFINITIONS

Anomaly: Location of a system response deemed to warrant further investigation by the demonstrator for consideration as an emplaced ordnance item.

Detection: An anomaly location that is within R_{halo} of an emplaced ordnance item.

Munitions and Explosives Of Concern (MEC): Specific categories of military munitions that may pose unique explosive safety risks, including UXO as defined in 10 USC 101(e)(5), DMM as defined in 10 USC 2710(e)(2) and/or munitions constituents (e.g. TNT, RDX) as defined in 10 USC 2710(e)(3) that are present in high enough concentrations to pose an explosive hazard.

Emplaced Ordnance: An ordnance item buried by the government at a specified location in the test site.

Emplaced Clutter: A clutter item (i.e., non-ordnance item) buried by the government at a specified location in the test site.

R_{halo}: A pre-determined radius about the periphery of an emplaced item (clutter or ordnance) within which a location identified by the demonstrator as being of interest is considered to be a response from that item. If multiple declarations lie within R_{halo} of any item (clutter or ordnance), the declaration with the highest signal output within the R_{halo} will be utilized. For the purpose of this program, a circular halo 0.5 meters in radius will be placed around the center of the object for all clutter and ordnance items less than 0.6 meters in length. When ordnance items are longer than 0.6 meters, the halo becomes an ellipse where the minor axis remains 1 meter and the major axis is equal to the length of the ordnance plus 1 meter.

Small Ordnance: Caliber of ordnance less than or equal to 40 mm (includes 20-mm projectile, 40-mm projectile, submunitions BLU-26, BLU-63, and M42).

Medium Ordnance: Caliber of ordnance greater than 40 mm and less than or equal to 81 mm (includes 57-mm projectile, 60-mm mortar, 2.75 in. Rocket, MK118 Rockeye, 81-mm mortar).

Large Ordnance: Caliber of ordnance greater than 81 mm (includes 105-mm HEAT, 105-mm projectile, 155-mm projectile, 500-pound bomb).

Shallow: Items buried less than 0.3 meter below ground surface.

Medium: Items buried greater than or equal to 0.3 meter and less than 1 meter below ground surface.

Deep: Items buried greater than or equal to 1 meter below ground surface.

Response Stage Noise Level: The level that represents the point below which anomalies are not considered detectable. Demonstrators are required to provide the recommended noise level for the Blind Grid test area.

Discrimination Stage Threshold: The demonstrator selected threshold level that they believe provides optimum performance of the system by retaining all detectable ordnance and rejecting the maximum amount of clutter. This level defines the subset of anomalies the demonstrator would recommend digging based on discrimination.

Binomially Distributed Random Variable: A random variable of the type which has only two possible outcomes, say success and failure, is repeated for n independent trials with the probability p of success and the probability 1-p of failure being the same for each trial. The number of successes x observed in the n trials is an estimate of p and is considered to be a binomially distributed random variable.

RESPONSE AND DISCRIMINATION STAGE DATA

The scoring of the demonstrator's performance is conducted in two stages. These two stages are termed the RESPONSE STAGE and DISCRIMINATION STAGE. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of false positive (P_{fp}) and those that do not correspond to any known item, termed background alarms.

The RESPONSE STAGE scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate ordnance from other anomalies. For the RESPONSE STAGE, the demonstrator provides the scoring committee with the location and signal strength of all anomalies that the demonstrator has deemed sufficient to warrant further investigation and/or processing as potential emplaced ordnance items. This list is generated with minimal processing (e.g., this list will include all signals above the system noise threshold). As such, it represents the most inclusive list of anomalies.

The DISCRIMINATION STAGE evaluates the demonstrator's ability to correctly identify ordnance as such, and to reject clutter. For the same locations as in the RESPONSE STAGE anomaly list, the DISCRIMINATION STAGE list contains the output of the algorithms applied in the discrimination-stage processing. This list is prioritized based on the demonstrator's determination that an anomaly location is likely to contain ordnance. Thus, higher output values are indicative of higher confidence that an ordnance item is present at the specified location. For electronic signal processing, priority ranking is based on algorithm output. For other systems, priority ranking is based on human judgment. The demonstrator also selects the threshold that the demonstrator believes will provide "optimum" system performance, (i.e., that retains all the detected ordnance and rejects the maximum amount of clutter).

Note: The two lists provided by the demonstrator contain identical numbers of potential target locations. They differ only in the priority ranking of the declarations.

RESPONSE STAGE DEFINITIONS

Response Stage Probability of Detection (P_d^{res}): P_d^{res} = (No. of response-stage detections)/(No. of emplaced ordnance in the test site).

Response Stage False Positive (fp^{res}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Response Stage Probability of False Positive (P_{fp}^{res}): P_{fp}^{res} = (No. of response-stage false positives)/(No. of emplaced clutter items).

Response Stage Background Alarm (ba^{res}): An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Response Stage Probability of Background Alarm (P_{ba}^{res}): Blind Grid only: P_{ba}^{res} = (No. of response-stage background alarms)/(No. of empty grid locations).

Response Stage Background Alarm Rate (BAR^{res}): Open Field only: BAR^{res} = (No. of response-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{res}, P_{fp}^{res}, P_{ba}^{res}, and BAR^{res} are functions of t^{res}, the threshold applied to the response-stage signal strength. These quantities can therefore be written as $P_d^{res}(t^{res})$, $P_{fp}^{res}(t^{res})$, $P_{ba}^{res}(t^{res})$, and $BAR^{res}(t^{res})$.

DISCRIMINATION STAGE DEFINITIONS

Discrimination: The application of a signal processing algorithm or human judgment to response-stage data that discriminates ordnance from clutter. Discrimination should identify anomalies that the demonstrator has high confidence correspond to ordnance, as well as those that the demonstrator has high confidence correspond to non-ordnance or background returns. The former should be ranked with highest priority and the latter with lowest.

Discrimination Stage Probability of Detection (P_d^{disc}): P_d^{disc} = (No. of discrimination-stage detections)/(No. of emplaced ordnance in the test site).

Discrimination Stage False Positive (fp^{disc}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Discrimination Stage Probability of False Positive (P_{fp}^{disc}): P_{fp}^{disc} = (No. of discrimination stage false positives)/(No. of emplaced clutter items).

Discrimination Stage Background Alarm (ba^{disc}): An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Discrimination Stage Probability of Background Alarm (P_{ba}^{disc}): P_{ba}^{disc} = (No. of discrimination-stage background alarms)/(No. of empty grid locations).

Discrimination Stage Background Alarm Rate (BAR^{disc}): BAR^{disc} = (No. of discrimination-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{disc}, P_{fp}^{disc}, P_{ba}^{disc}, and BAR^{disc} are functions of t^{disc}, the threshold applied to the discrimination-stage signal strength. These quantities can therefore be written as $P_d^{disc}(t^{disc})$, $P_{fp}^{disc}(t^{disc})$, $P_{ba}^{disc}(t^{disc})$, and $BAR^{disc}(t^{disc})$.

RECEIVER-OPERATING CHARACERISTIC (ROC) CURVES

ROC curves at both the response and discrimination stages can be constructed based on the above definitions. The ROC curves plot the relationship between P_d versus P_{fp} and P_d versus BAR or P_{ba} as the threshold applied to the signal strength is varied from its minimum (t_{min}) to its maximum (t_{max}) value.[1] Figure A-1 shows how P_d versus P_{fp} and P_d versus BAR are combined into ROC curves. Note that the "res" and "disc" superscripts have been suppressed from all the variables for clarity.

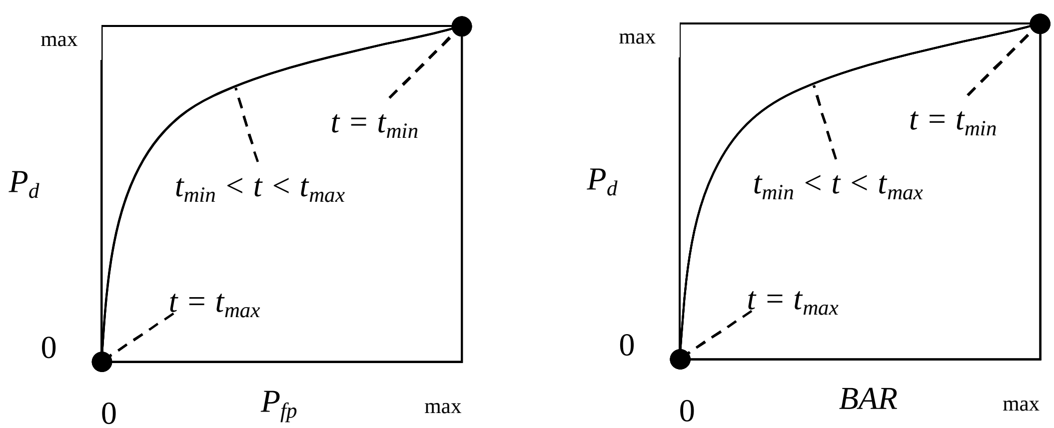

Figure A-1. ROC curves for open field testing. Each curve applies to both the response and discrimination stages.

[1]Strictly speaking, ROC curves plot the P_d versus P_{ba} over a pre-determined and fixed number of detection opportunities (some of the opportunities are located over ordnance and others are located over clutter or blank spots). In an open field scenario, each system suppresses its signal strength reports until some bare-minimum signal response is received by the system. Consequently, the open field ROC curves do not have information from low signal-output locations, and, furthermore, different contractors report their signals over a different set of locations on the ground. These ROC curves are thus not true to the strict definition of ROC curves as defined in textbooks on detection theory. Note, however, that the ROC curves obtained in the Blind Grid test sites are true ROC curves.

METRICS TO CHARACTERIZE THE DISCRIMINATION STAGE

The demonstrator is also scored on efficiency and rejection ratio, which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list, while rejecting the maximum number of anomalies arising from non-ordnance items. The efficiency measures the amount of detected ordnance retained by the discrimination, while the rejection ratio measures the fraction of false alarms rejected. Both measures are defined relative to the entire response list, i.e., the maximum ordnance detectable by the sensor and its accompanying false positive rate or background alarm rate.

Efficiency (E): $E = P_d^{disc}(t^{disc})/P_d^{res}(t_{min}^{res})$; Measures (at a threshold of interest), the degree to which the maximum theoretical detection performance of the sensor system (as determined by the response stage t_{min}) is preserved after application of discrimination techniques. Efficiency is a number between 0 and 1. An efficiency of 1 implies that all of the ordnance initially detected in the response stage was retained at the specified threshold in the discrimination stage, t^{disc}.

False Positive Rejection Rate (R_{fp}): $R_{fp} = 1 - [P_{fp}^{disc}(t^{disc})/P_{fp}^{res}(t_{min}^{res})]$; Measures (at a threshold of interest), the degree to which the sensor system's false positive performance is improved over the maximum false positive performance (as determined by the response stage t_{min}). The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all emplaced clutter initially detected in the response stage were correctly rejected at the specified threshold in the discrimination stage.

Background Alarm Rejection Rate (R_{ba}):

Blind Grid: $R_{ba} = 1 - [P_{ba}^{disc}(t^{disc})/P_{ba}^{res}(t_{min}^{res})]$.
Open Field: $R_{ba} = 1 - [BAR^{disc}(t^{disc})/BAR^{res}(t_{min}^{res})]$).

Measures the degree to which the discrimination stage correctly rejects background alarms initially detected in the response stage. The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all background alarms initially detected in the response stage were rejected at the specified threshold in the discrimination stage.

CHI-SQUARE COMPARISON EXPLANATION:

The Chi-square test for differences in probabilities (or 2 x 2 contingency table) is used to analyze two samples drawn from two different populations to see if both populations have the same or different proportions of elements in a certain category. More specifically, two random samples are drawn, one from each population, to test the null hypothesis that the probability of event A (some specified event) is the same for both populations (ref 3).

A 2 x 2 contingency table is used in the Standardized UXO Technology Demonstration Site Program to determine if there is reason to believe that the proportion of ordnance correctly detected/discriminated by demonstrator X’s system is significantly degraded by the more challenging terrain feature introduced. The test statistic of the 2 x 2 contingency table is the

Chi-square distribution with one degree of freedom. Since an association between the more challenging terrain feature and relatively degraded performance is sought, a one-sided test is performed. A significance level of 0.05 is chosen which sets a critical decision limit of 2.71 from the Chi-square distribution with one degree of freedom. It is a critical decision limit because if the test statistic calculated from the data exceeds this value, the two proportions tested will be considered significantly different. If the test statistic calculated from the data is less than this value, the two proportions tested will be considered not significantly different.

An exception must be applied when either a 0 or 100 percent success rate occurs in the sample data. The Chi-square test cannot be used in these instances. Instead, Fischer's test is used and the critical decision limit for one-sided tests is the chosen significance level, which in this case is 0.05. With Fischer's test, if the test statistic is less than the critical value, the proportions are considered to be significantly different.

Standardized UXO Technology Demonstration Site examples, where blind grid results are compared to those from the open field and open field results are compared to those from one of the scenarios, follow. It should be noted that a significant result does not prove a cause and effect relationship exists between the two populations of interest; however, it does serve as a tool to indicate that one data set has experienced a degradation in system performance at a large enough level than can be accounted for merely by chance or random variation. Note also that a result that is not significant indicates that there is not enough evidence to declare that anything more than chance or random variation within the same population is at work between the two data sets being compared.

Demonstrator X achieves the following overall results after surveying each of the three progressively more difficult areas using the same system (results indicate the number of ordnance detected divided by the number of ordnance emplaced):

	Blind Grid	Open Field	Moguls
P_d^{res}	100/100 = 1.0	8/10 = .80	20/33 = .61
P_d^{disc}	80/100 = 0.80	6/10 = .60	8/33 = .24

P_d^{res}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the response stage, all 100 ordnance out of 100 emplaced ordnance items were detected in the blind grid while 8 ordnance out of 10 emplaced were detected in the open field. Fischer's test must be used since a 100 percent success rate occurs in the data. Fischer's test uses the four input values to calculate a test statistic of 0.0075 that is compared against the critical value of 0.05. Since the test statistic is less than the critical value, the smaller response stage detection rate (0.80) is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists between the change in survey area and degradation in performance, it does indicate that the detection ability of demonstrator X's system seems to have been degraded in the open field relative to results from the blind grid using the same system.

P_d^{disc}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the discrimination stage, 80 out of 100 emplaced ordnance items were correctly discriminated as ordnance in blind grid testing while 6 ordnance out of 10 emplaced were correctly discriminated as such in open field-testing. Those four values are used to calculate a test statistic of 1.12. Since the test statistic is less than the critical value of 2.71, the two discrimination stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{res}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the response stage, 8 out of 10 and 20 out of 33 are used to calculate a test statistic of 0.56. Since the test statistic is less than the critical value of 2.71, the two response stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{disc}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the discrimination stage, 6 out of 10 and 8 out of 33 are used to calculate a test statistic of 2.98. Since the test statistic is greater than the critical value of 2.71, the smaller discrimination stage detection rate is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists between the change in survey area and degradation in performance, it does indicate that the ability of demonstrator X to correctly discriminate seems to have been degraded by the mogul terrain relative to results from the flat open field using the same system.

APPENDIX B. DAILY WEATHER LOGS

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
39	EM	Blind Grid	hand	AETC	21 October	54.2 ˚F	0"
39	EM	Blind Grid	hand	AETC	22 October	51.6 ˚F	0"
39	EM	Blind Grid	hand	AETC	23 October	52.8 ˚F	0"
695	EM	Blind Grid	hand	ARM	4 April	58 ˚F	0"
695	EM	Blind Grid	hand	ARM	5 April	59.63 ˚F	0"
695	EM	Blind Grid	hand	ARM	6 April	68.93 ˚F	0"
695	EM	Blind Grid	hand	ARM	7 April	70.5 ˚F	0"
695	EM	Blind Grid	hand	ARM	14 April	56.02 ˚F	0"
691	EM	Blind Grid	hand	ARM	4 April	58 ˚F	0"
691	EM	Blind Grid	hand	ARM	5 April	59.63 ˚F	0"
691	EM	Blind Grid	hand	ARM	6 April	68.93 ˚F	0"
691	EM	Blind Grid	hand	ARM	7 April	70.5 ˚F	0"
691	EM	Blind Grid	hand	ARM	14 April	56.02 ˚F	0"
622	dual	Blind Grid	cart	BH	24 August	79.06 ˚F	0"
642	dual	Moguls	cart	BH	1 September	78.51 ˚F	0"
657	dual	Open Field	cart	BH	25 August	75.63 ˚F	0"
657	dual	Open Field	cart	BH	26 August	77.89 ˚F	0"
657	dual	Open Field	cart	BH	27 August	81.12 ˚F	0"
657	dual	Open Field	cart	BH	28 August	83.4 ˚F	0"
657	dual	Open Field	cart	BH	30 August	79.17 ˚F	0"
657	dual	Open Field	cart	BH	31 August	79.5 ˚F	0"
657	dual	Open Field	cart	BH	2 September	76.44 ˚F	0"
636	dual	Woods	cart	BH	31August	79.5 ˚F	0"
636	dual	Woods	cart	BH	2 September	76.44 ˚F	0"
304	EM	Blind Grid	cart	ERDC	31 March	46.63 ˚F	0.09"
304	EM	Blind Grid	cart	ERDC	1 April	49.1 ˚F	1.03"
305	EM	Open Field	cart	ERDC	30 March	41.85 ˚F	0.04"
305	EM	Open Field	cart	ERDC	31 March	46.64 ˚F	0.1"
305	EM	Open Field	cart	ERDC	1 April	49.1 ˚F	1.03"
305	EM	Open Field	cart	ERDC	2 April	46.39 ˚F	0.69"
305	EM	Open Field	cart	ERDC	3 April	47.2 ˚F	0.04"
305	EM	Open Field	cart	ERDC	4 April	43.66 ˚F	0.21"
305	EM	Open Field	cart	ERDC	5 April	37.98 ˚F	0"
305	EM	Open Field	cart	ERDC	6 April	48.55 ˚F	0"
305	EM	Open Field	cart	ERDC	7 April	64.87 ˚F	0"
305	EM	Open Field	cart	ERDC	8 April	49.39 ˚F	0.02"
305	EM	Open Field	cart	ERDC	9 April	57.32 ˚F	0.03"
305	EM	Open Field	cart	ERDC	10 April	55.36 ˚F	0"
305	EM	Open Field	cart	ERDC	11 April	46.46 ˚F	0.02"
305	EM	Open Field	cart	ERDC	12 April	47.28 ˚F	1.15"
305	EM	Open Field	cart	ERDC	13 April	49.45 ˚F	0.4"
305	EM	Open Field	cart	ERDC	14 April	51.19 ˚F	0.14"
305	EM	Open Field	cart	ERDC	15 April	55.89 ˚F	0.01"
305	EM	Open Field	cart	ERDC	16April	55.66 ˚F	0"
305	EM	Open Field	cart	ERDC	17 April	65.43 ˚F	0"
305	EM	Open Field	cart	ERDC	18 April	76.4 ˚F	0"
305	EM	Open Field	cart	ERDC	19 April	76.19 ˚F	0"

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
305	EM	Open Field	cart	ERDC	20 April	72.25 ˚F	0"
305	EM	Open Field	cart	ERDC	21 April	63.16 ˚F	0"
305	EM	Open Field	cart	ERDC	22 April	73.65 ˚F	0"
305	EM	Open Field	cart	ERDC	23 April	73.75 ˚F	0.15"
305	EM	Open Field	cart	ERDC	24 April	66.28 ˚F	0"
305	EM	Open Field	cart	ERDC	25 April	57.54 ˚F	0"
305	EM	Open Field	cart	ERDC	26 April	63.65 ˚F	0.72"
305	EM	Open Field	cart	ERDC	27 April	61.05 ˚F	0"
305	EM	Open Field	cart	ERDC	28 April	52.69 ˚F	0"
305	EM	Open Field	cart	ERDC	29 April	61.74 ˚F	0"
142	EM	Blind Grid	cart	ERDC	8 September 8	75.9 ˚F	0"
142	EM	Blind Grid	cart	ERDC	9 September 9	72.3 ˚F	0"
142	EM	Blind Grid	cart	ERDC	10 September	71.7 ˚F	0"
142	EM	Blind Grid	cart	ERDC	11 September	76.1 ˚F	0"
142	EM	Blind Grid	cart	ERDC	12 September	65.1 ˚F	0.55"
141	EM	Blind Grid	cart	ERDC	8 September	75.9 ˚F	0"
141	EM	Blind Grid	cart	ERDC	9 September	72.3 ˚F	0"
141	EM	Blind Grid	cart	ERDC	10 September	71.7 ˚F	0"
141	EM	Blind Grid	cart	ERDC	11 September	76.1 ˚F	0"
141	EM	Blind Grid	cart	ERDC	12 September	65.1 ˚F	0.55"
40	dual	Blind Grid	towed	Geocenters	8 October	57.6 ˚F	0"
40	dual	Blind Grid	towed	Geocenters	9 October	58.9 ˚F	0"
290	dual	Blind Grid	towed	Geocenters	4 October	84.55 ˚F	0.06"
187	dual	Open Field	towed	Geocenters	7 October	72.6 ˚F	0"
187	dual	Open Field	towed	Geocenters	8 October	57.6 ˚F	0"
187	dual	Open Field	towed	Geocenters	9 October	58.9 ˚F	0"
187	dual	Open Field	towed	Geocenters	10 October	63.5 ˚F	0.61"
187	dual	Open Field	towed	Geocenters	11 October	64.9 ˚F	2.59"
298	dual	Open Field	towed	Geocenters	4 August	84.55 ˚F	0.06"
298	dual	Open Field	towed	Geocenters	5 August	72.91 ˚F	0.03"
298	dual	Open Field	towed	Geocenters	6 August	66.7 ˚F	0"
792	dual	Blind Grid	towed	Geocenters	17 April	58.8 ˚F	0"
792	dual	Blind Grid	towed	Geocenters	18 April	59.4 ˚F	0"
802	dual	Open Field	towed	Geocenters	18 April	61.4 ˚F	0"
802	dual	Open Field	towed	Geocenters	19 April	68.5 ˚F	0"
50	EM	Blind Grid	hand	Geophex	29 April	66.65 ˚F	0"
50	EM	Blind Grid	hand	Geophex	30 April	66.81 ˚F	0"
680	EM	Blind Grid	hand	Geophex	26 April	64.94 ˚F	0"
680	EM	Blind Grid	hand	Geophex	27 April	65.79 ˚F	0.02"
125	EM	Blind Grid	towed	Geophex	1 May	67.04 ˚F	0.05"
125	EM	Blind Grid	towed	Geophex	2 May	71.07 ˚F	0"
125	EM	Blind Grid	towed	Geophex	3 May	60.28 ˚F	0"
125	EM	Blind Grid	towed	Geophex	5 May	51.19 ˚F	0.03"
49	EM	Blind Grid	cart	Geophex	28 April	66.74 ˚F	0"
49	EM	Blind Grid	cart	Geophex	29 April	66.65 ˚F	0"
451	EM	Moguls	cart	Geophex	9 December	25.67 ˚F	0"
451	EM	Moguls	cart	Geophex	10 December	27.49 ˚F	0"
451	EM	Moguls	cart	Geophex	11 December	35.5 ˚F	1.5"
451	EM	Moguls	cart	Geophex	12 December	41.55 ˚F	0.03"
451	EM	Moguls	cart	Geophex	13 December	34.4 ˚F	0.67"
665	EM	Moguls	hand	Geophex	18 April	72.39 ˚F	0"

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
665	EM	Moguls	hand	Geophex	19 April	73.97 ˚F	0"
665	EM	Moguls	hand	Geophex	20 April	78.07 ˚F	0"
665	EM	Moguls	hand	Geophex	21 April	60.02 ˚F	0"
665	EM	Moguls	hand	Geophex	22 April	52.29 ˚F	0"
665	EM	Moguls	hand	Geophex	25 April	54.31 ˚F	0"
665	EM	Moguls	hand	Geophex	26 April	64.94 ˚F	0"
665	EM	Moguls	hand	Geophex	27 April	65.79 ˚F	0.02"
129	EM	Open Field	towed	Geophex	28 April	71.55 ˚F	0"
129	EM	Open Field	towed	Geophex	29 April	71.49 ˚F	0"
129	EM	Open Field	towed	Geophex	30 April	67.62 ˚F	0"
129	EM	Open Field	towed	Geophex	1 May	71.11 ˚F	0.05"
129	EM	Open Field	towed	Geophex	2 May	78.35 ˚F	0"
129	EM	Open Field	towed	Geophex	3 May	65.32 ˚F	0"
129	EM	Open Field	towed	Geophex	4 May	62.76 ˚F	0"
129	EM	Open Field	towed	Geophex	5 May	53.09 ˚F	0.03"
129	EM	Open Field	towed	Geophex	6 May	57.36 ˚F	0.02"
129	EM	Open Field	towed	Geophex	7 May	69.85 ˚F	0.56"
449	EM	Woods	cart	Geophex	28 April	66.74 ˚F	0"
449	EM	Woods	cart	Geophex	29 April	66.65 ˚F	0"
449	EM	Woods	cart	Geophex	30 April	66.81 ˚F	0"
449	EM	Woods	cart	Geophex	1 May	67.04 ˚F	0.05"
694	EM	Blind Grid	cart	Geophex	18 April	72.39 ˚F	0"
694	EM	Blind Grid	cart	Geophex	19 April	73.97 ˚F	0"
694	EM	Blind Grid	cart	Geophex	20 April	78.07 ˚F	0"
694	EM	Blind Grid	cart	Geophex	26 April	64.94 ˚F	0"
694	EM	Blind Grid	cart	Geophex	27 April	65.79 ˚F	0.02"
739	EM	Blind Grid	towed	Geophex	5 October	70.2 ˚F	0"
739	EM	Blind Grid	towed	Geophex	6 October	71.6 ˚F	0"
693	EM	Blind Grid	cart	Geophex	18 April	72.39 ˚F	0"
693	EM	Blind Grid	cart	Geophex	19 April	73.97 ˚F	0"
693	EM	Blind Grid	cart	Geophex	20 April	78.07 ˚F	0"
693	EM	Blind Grid	cart	Geophex	26 April	64.94 ˚F	0"
693	EM	Blind Grid	cart	Geophex	27 April	65.79 ˚F	0.02"
740	EM	Open Field	towed	Geophex	7 October	75.1 ˚F	1.21"
740	EM	Open Field	towed	Geophex	17 October	59.2 ˚F	0"
740	EM	Open Field	towed	Geophex	18 October	67.1 ˚F	0"
740	EM	Open Field	towed	Geophex	19 October	61.7 ˚F	0"
740	EM	Open Field	towed	Geophex	20 October	55.1 ˚F	0"
184	EM	Blind Grid	hand	G-TEK	24 October	49.45 ˚F	0"
183	EM	Blind Grid	sling	G-TEK	14 October	62.05 ˚F	1.28"
545	EM	Moguls	sling	G-TEK	22 October	55.09 ˚F	0"
154	EM	Open Field	sling	G-TEK	15 October	61.12 ˚F	0.11"
154	EM	Open Field	sling	G-TEK	16 October	61.73 ˚F	0"
154	EM	Open Field	sling	G-TEK	17 October	55.15 ˚F	0.05"
154	EM	Open Field	sling	G-TEK	18 October	54.36 ˚F	0"
154	EM	Open Field	sling	G-TEK	20 October	55.24 ˚F	0"
154	EM	Open Field	sling	G-TEK	21 October	67.51 ˚F	0"
452	EM	Woods	hand	G-TEK	23 October	44.38 ˚F	0"
452	EM	Woods	hand	G-TEK	24 October	49.45 ˚F	0.01"
268	MAG	Blind Grid	sling	G-TEK	14 October	62 ˚F	0"
268	MAG	Blind Grid	sling	G-TEK	24 October	49.4 ˚F	0"

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
547	MAG	Moguls	sling	G-TEK	23 October	44.38 ˚F	0"
547	MAG	Moguls	sling	G-TEK	24 October	49.45 ˚F	0.01"
311	MAG	Open Field	sling	G-TEK	15 October	61.12 ˚F	0.11"
311	MAG	Open Field	sling	G-TEK	16 October	61.73 ˚F	0"
311	MAG	Open Field	sling	G-TEK	17 October	55.15 ˚F	0.05"
311	MAG	Open Field	sling	G-TEK	18 October	54.36 ˚F	0"
311	MAG	Open Field	sling	G-TEK	20 October	55.24 ˚F	0"
311	MAG	Open Field	sling	G-TEK	21 October	67.51 ˚F	0"
454	MAG	Woods	sling	G-TEK	22 October	55.09 ˚F	0"
281	dual	Blind Grid	sling	G-TEK	24 May	83.75 ˚F	0"
281	dual	Blind Grid	sling	G-TEK	4 June	69.63 ˚F	0"
380	dual	Moguls	sling	G-TEK	3 June	73.6 ˚F	0.01"
379	dual	Open Field	sling	G-TEK	24 May	83.75 ˚F	0"
379	dual	Open Field	sling	G-TEK	25 May	81.02 ˚F	0.07"
379	dual	Open Field	sling	G-TEK	26 May	74.81 ˚F	0.02"
379	dual	Open Field	sling	G-TEK	27 May	75.67 ˚F	0.25"
379	dual	Open Field	sling	G-TEK	1 June	72.01 ˚F	0.19"
379	dual	Open Field	sling	G-TEK	2 June	74.14 ˚F	0.08"
379	dual	Open Field	sling	G-TEK	3 June	73.6 ˚F	0.01"
379	dual	Open Field	sling	G-TEK	4 June	69.63 ˚F	0"
381	dual	Woods	sling	G-TEK	28 May	76.62 ˚F	0.01"
381	dual	Woods	sling	G-TEK	29 May	66.15 ˚F	0"
381	dual	Woods	sling	G-TEK	1 June	72.01 ˚F	0.19"
237	MAG	Blind Grid	hand	HFA	14 June	78.67 ˚F	2.02"
676	MAG	Moguls	hand	HFA	19 July	75.45 ˚F	0"
676	MAG	Moguls	hand	HFA	20 July	80.23 ˚F	0"
231	MAG	Open Field	hand	HFA	15 June	82.61 ˚F	0"
231	MAG	Open Field	hand	HFA	16 June	80.71 ˚F	0"
231	MAG	Open Field	hand	HFA	17 June	82.6 ˚F	0.18"
231	MAG	Open Field	hand	HFA	18 June	84.72 ˚F	0"
231	MAG	Open Field	hand	HFA	28 June	78.6 ˚F	0"
231	MAG	Open Field	hand	HFA	29 June	72.46 ˚F	0.03"
231	MAG	Open Field	hand	HFA	30 June	78.69 ˚F	0"
231	MAG	Open Field	hand	HFA	1 July	79.14 ˚F	0"
231	MAG	Open Field	hand	HFA	2 July	84.18 ˚F	0"
231	MAG	Open Field	hand	HFA	6 July	79.96 ˚F	0"
231	MAG	Open Field	hand	HFA	7 July	81.65 ˚F	0.34"
231	MAG	Open Field	hand	HFA	12 July	76.69 ˚F ˚F	3.56"
231	MAG	Open Field	hand	HFA	13 July	74.89 ˚F	0"
231	MAG	Open Field	hand	HFA	14 July	75.09 ˚F	1.12"
231	MAG	Open Field	hand	HFA	15 July	77.74 ˚F	0"
231	MAG	Open Field	hand	HFA	16 July	78.06 ˚F	0"
486	MAG	Woods	hand	HFA	8 July	82.19 ˚F	0"
486	MAG	Woods	hand	HFA	9 July	79.53 ˚F	0"
647	EM	Mine Grid	towed	NAEVA	12 August	80.04 ˚F	0.74"
396	EM	Blind Grid	2-man	NAEVA	18 August	78.07 ˚F	0.05"
396	EM	Blind Grid	2-man	NAEVA	22 August	71.96 ˚F	0"
397	EM	Blind Grid	towed	NAEVA	10 August	79.22 ˚F	0"
597	EM	Moguls	2-man	NAEVA	19 August	80.65 ˚F	0"
597	EM	Moguls	2-man	NAEVA	20 August	85.59 ˚F	0"
406	EM	Open Field	towed	NAEVA	10 August	79.22 ˚F	0"

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
406	EM	Open Field	towed	NAEVA	11 August	79.94 ˚F	0.02"
406	EM	Open Field	towed	NAEVA	12 August	80.04 ˚F	0.74"
406	EM	Open Field	towed	NAEVA	16 August	77.95 ˚F	0.01"
406	EM	Open Field	towed	NAEVA	17 August	76.25 ˚F	0.02"
406	EM	Open Field	towed	NAEVA	18 August	78.07 ˚F	0.05"
406	EM	Open Field	towed	NAEVA	22 August	71.96 ˚F	0"
494	EM	Woods	2-man	NAEVA	18 August	78.07 ˚F	0.05"
494	EM	Woods	2-man	NAEVA	20 August	85.59 ˚F	0"
494	EM	Woods	2-man	NAEVA	21 August	79.17 ˚F	0.09"
494	EM	Woods	2-man	NAEVA	22 August	71.96 ˚F	0"
127	EM	Blind Grid	towed	NRL	24 September	68.3 ˚F	0"
127	EM	Blind Grid	towed	NRL	25 September	72.6 ˚F	0.04"
127	EM	Blind Grid	towed	NRL	2 October	53.2 ˚F	0"
127	EM	Blind Grid	towed	NRL	6 October	57.3 ˚F	0"
675	EM	Open Field	towed	NRL	7 June	72.68 ˚F	0"
675	EM	Open Field	towed	NRL	8 June	78.2 ˚F	0"
675	EM	Open Field	towed	NRL	9 June	84.74 ˚F	0"
671	MAG	Blind Grid	towed	NRL	21 June	74.14 ˚F	0"
671	MAG	Blind Grid	towed	NRL	22 June	79.78 ˚F	0.24"
673	MAG	Open Field	towed	NRL	21 June	74.14 ˚F	0"
673	MAG	Open Field	towed	NRL	22 June	79.78 ˚F	0.24"
252	EM	Blind Grid	cart	Parsons	14 September	73.41 ˚F	0"
572	EM	Moguls	cart	Parsons	21 September	73.12 ˚F	0"
572	EM	Moguls	cart	Parsons	22 September	77.3 ˚F	0"
411	EM	Open Field	cart	Parsons	15 September	68.05 ˚F	0.05"
411	EM	Open Field	cart	Parsons	16 September	74.77 ˚F	0"
411	EM	Open Field	cart	Parsons	17 September	75.57 ˚F	0.1"
411	EM	Open Field	cart	Parsons	20 September	64.25 ˚F	0"
411	EM	Open Field	cart	Parsons	21 September	73.12 ˚F	0"
496	EM	Woods	cart	Parsons	22 September	77.3 ˚F	0"
496	EM	Woods	cart	Parsons	23 September	79.92 ˚F	0"
257	MAG	Blind Grid	hand	Parsons	21 September	73.12 ˚F	0"
573	MAG	Moguls	hand	Parsons	28 September	73.65 ˚F	2.69"
573	MAG	Moguls	hand	Parsons	29 September	69.37 ˚F	0.01"
229	MAG	Open Field	hand	Parsons	21 September	73.12 ˚F	0"
229	MAG	Open Field	hand	Parsons	22 September	77.3 ˚F	0"
229	MAG	Open Field	hand	Parsons	23 September	79.92 ˚F	0"
229	MAG	Open Field	hand	Parsons	24 September	73.14 ˚F	0"
229	MAG	Open Field	hand	Parsons	27 September	71.18 ˚F	0"
229	MAG	Open Field	hand	Parsons	28 September	73.65 ˚F	2.69"
229	MAG	Open Field	hand	Parsons	29 September	69.37 ˚F	0.01"
499	MAG	Woods	hand	Parsons	September 29	69.37 ˚F	0.01"
499	MAG	Woods	hand	Parsons	September 30	68.96 ˚F	0.02"
197	EM	Blind Grid	cart	Shaw	8 December 8	31.64 ˚F	0"
197	EM	Blind Grid	cart	Shaw	9 December 9	33.68 ˚F	0.12"
552	EM	Moguls	cart	Shaw	18 December	34.33 ˚F	0"
201	EM	Open Field	cart	Shaw	10 December	39.8 ˚F	0.39"
201	EM	Open Field	cart	Shaw	11 December	52.37 ˚F	0.57"
201	EM	Open Field	cart	Shaw	12 December	39.33 ˚F	0"
201	EM	Open Field	cart	Shaw	13 December	32.55 ˚F	0"
201	EM	Open Field	cart	Shaw	15 December	40.5 ˚F	0"

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
461	EM	Woods	cart	Shaw	15 December	40.59 ˚F	0"
461	EM	Woods	cart	Shaw	16 December	40.21 ˚F	0"
198	MAG	Blind Grid	cart	Shaw	8 December	31.64 ˚F	0"
198	MAG	Blind Grid	cart	Shaw	9 December	33.68 ˚F	0.12"
404	MAG	Blind Grid	cart	Shaw	19 December	33.9 ˚F	0"
206	MAG	Moguls	cart	Shaw	19 December	33.94 ˚F	0"
492	MAG	Open Field	cart	Shaw	9 December	33.68 ˚F	0.12"
492	MAG	Open Field	cart	Shaw	16 December	40.21 ˚F	0"
492	MAG	Open Field	cart	Shaw	18 December	34.33 ˚F	0"
492	MAG	Open Field	cart	Shaw	19 December	33.94 ˚F	0"
376	MAG	Woods	cart	Shaw	19 December	33.9 ˚F	0"
157	EM	Blind Grid	cart	TT	3 November	68.7 ˚F	0"
159	EM	Blind Grid	sling	TT	5 November	65.78 ˚F	0.2"
549	EM	Moguls	sling	TT	11 November	51.3 ˚F	0"
549	EM	Moguls	sling	TT	12 November	54.64 ˚F	0.68"
165	EM	Open Field	cart	TT	4 November	67.54 ˚F	0"
165	EM	Open Field	cart	TT	5 November	65.78 ˚F	0.2"
165	EM	Open Field	cart	TT	6 November	63.46 ˚F	0.31"
165	EM	Open Field	cart	TT	7 November	57.17 ˚F	0.03"
165	EM	Open Field	cart	TT	10 November	42.05 ˚F	0"
165	EM	Open Field	cart	TT	11 November	51.3 ˚F	0"
457	EM	Woods	sling	TT	11 November	51.3 ˚F	0"
457	EM	Woods	sling	TT	12 November	54.64 ˚F	0.68"
457	EM	Woods	sling	TT	13 November	48.05 ˚F	0"
764	EM	Blind Grid	towed	VF Warner	23 January	40.7 ˚F	0.89"
764	EM	Blind Grid	towed	VF Warner	24 January	40.7 ˚F	0.08"
764	EM	Blind Grid	towed	VF Warner	25 January	39.4 ˚F	0.02"
45	GPR	Blind Grid	cart	Witten	2 December	38.6 ˚F	0"
45	GPR	Blind Grid	cart	Witten	3 December	25 ˚F	0"
126	GPR	Mine Grid	cart	Witten	2 December	38.6 ˚F	0"
126	GPR	Mine Grid	cart	Witten	3 December	25 ˚F	0"
37	EM	Blind Grid	cart	Zonge	19 August	87 ˚F	0"
37	EM	Blind Grid	cart	Zonge	20 August	84.2 ˚F	0"
38	EM	Open Field	cart	Zonge	19 August	87 ˚F	0"
38	EM	Open Field	cart	Zonge	20 August	84.2 ˚F	0"
38	EM	Open Field	cart	Zonge	21 August	81.6 ˚F	0"
38	EM	Open Field	cart	Zonge	22 August	82.2 ˚F	0"
38	EM	Open Field	cart	Zonge	23 August	80.8 ˚F	0.07"
38	EM	Open Field	cart	Zonge	24 August	78 ˚F	0.84"
38	EM	Open Field	cart	Zonge	25 August	80.2 ˚F	0"
38	EM	Open Field	cart	Zonge	26 August	78.1 ˚F	0"
38	EM	Open Field	cart	Zonge	27 August	79.6 ˚F	0"
38	EM	Open Field	cart	Zonge	28 August	71.2 ˚F	0.64"
38	EM	Open Field	cart	Zonge	29 August	65.2 ˚F	0.2"
38	EM	Open Field	cart	Zonge	30 August	67.5 ˚F	0"
38	EM	Open Field	cart	Zonge	31 August	74.3 ˚F	0"
38	EM	Open Field	cart	Zonge	1 September	64.1 ˚F	0.92"
38	EM	Open Field	cart	Zonge	2 September	70.5 ˚F	0"

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
383	dual	Blind Grid	cart	BH	18 May	30.6 ˚F	0"
607	dual	Desert Ext	cart	BH	26 May	26.9 ˚F	0"
607	dual	Desert Ext	cart	BH	27 May	29.7 ˚F	0"
655	dual	Moguls	cart	BH	25 May	28.5 ˚F	0"
655	dual	Moguls	cart	BH	26 May	26.9 ˚F	0"
655	dual	Moguls	cart	BH	27 May	29.7 ˚F	0"
655	dual	Moguls	cart	BH	28 May	31.5 ˚F	0"
651	dual	Open Field	towed	BH	19 May	30.5 ˚F	0"
651	dual	Open Field	towed	BH	20 May	30.3 ˚F	0"
651	dual	Open Field	towed	BH	21 May	27 ˚F	0"
651	dual	Open Field	towed	BH	22 May	25.8 ˚F	0"
651	dual	Open Field	towed	BH	24 May	28.3 ˚F	0"
651	dual	Open Field	towed	BH	25 May	28.5 ˚F	0"
651	dual	Open Field	towed	BH	26 May	26.9 ˚F	0"
216	EM	Blind Grid	cart	ERDC	6 May	76.5 ˚F	0"
216	EM	Blind Grid	cart	ERDC	7 May	66.1 ˚F	0"
216	EM	Blind Grid	cart	ERDC	8 May	59.4 ˚F	0"
216	EM	Blind Grid	cart	ERDC	10 May	75.25 ˚F	0"
249	EM	Open Field	cart	ERDC	6 May	76.5 ˚F	0"
249	EM	Open Field	cart	ERDC	7 May	66.1 ˚F	0"
249	EM	Open Field	cart	ERDC	8 May	59.4 ˚F	0"
249	EM	Open Field	cart	ERDC	9 May	68.2 ˚F	0"
249	EM	Open Field	cart	ERDC	12 May	87.4 ˚F	0"
249	EM	Open Field	cart	ERDC	14 May	88.9 ˚F	0"
249	EM	Open Field	cart	ERDC	15 May	78.3 ˚F	0"
249	EM	Open Field	cart	ERDC	16 May	91.3 ˚F	0"
249	EM	Open Field	cart	ERDC	19 May	93.2 ˚F	0"
134	EM	Blind Grid	cart	ERDC	6 May	76.5 ˚F	0"
134	EM	Blind Grid	cart	ERDC	7 May	66.1 ˚F	0"
134	EM	Blind Grid	cart	ERDC	8 May	59.4 ˚F	0"
509	EM	Desert Ext	cart	ERDC	20 May	81 ˚F	0"
136	EM	Moguls	cart	ERDC	21 May	81 ˚F	0"
135	EM	Open Field	cart	ERDC	7 May	72.1 ˚F	0"
135	EM	Open Field	cart	ERDC	8 May	70.7 ˚F	0"
135	EM	Open Field	cart	ERDC	9 May	68.2 ˚F	0"
135	EM	Open Field	cart	ERDC	12 May	87.4 ˚F	0"
135	EM	Open Field	cart	ERDC	14 May	88.9 ˚F	0"
135	EM	Open Field	cart	ERDC	15 May	78.3 ˚F	0"
135	EM	Open Field	cart	ERDC	16 May	91.3 ˚F	0"
135	EM	Open Field	cart	ERDC	19 May	93.2 ˚F	0"
362	MAG	Blind Grid	sling	ERDC	12 May	87.2 ˚F	0"
544	MAG	Desert Ext	sling	ERDC	17 May	81 ˚F	0"
571	MAG	Moguls	sling	ERDC	16 May	91.2 ˚F	0"
364	MAG	Open Field	sling	ERDC	14 May	88.96 ˚F	0"
364	MAG	Open Field	sling	ERDC	15 May	78.35 ˚F	0"
364	MAG	Open Field	sling	ERDC	16 May	91.25 ˚F	0"

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
769	MAG	Blind Grid	hand	Forester	30 January	17.4 ˚F	0"
769	MAG	Blind Grid	hand	Forester	6 February	19.7 ˚F	0"
770	MAG	Open Field	hand	Forester	30 January	63.3 ˚F	0"
770	MAG	Open Field	hand	Forester	31 January	64.2 ˚F	0"
770	MAG	Open Field	hand	Forester	1 February	64.6 ˚F	0"
770	MAG	Open Field	hand	Forester	2 February	69.3 ˚F	0"
770	MAG	Open Field	hand	Forester	3 February	65.5 ˚F	0"
770	MAG	Open Field	hand	Forester	6 February	67.5 ˚F	0"
770	MAG	Open Field	hand	Forester	7 February	67.1 ˚F	0"
293	dual	Blind Grid	towed	Geocenters	18 October	75.9 ˚F	0"
293	dual	Blind Grid	towed	Geocenters	19 October	74.93 ˚F	0"
293	dual	Blind Grid	towed	Geocenters	20 October	76.5 ˚F	0"
299	dual	Open Field	towed	Geocenters	18 October	75.9 ˚F	0"
299	dual	Open Field	towed	Geocenters	19 October	74.93 ˚F	0"
299	dual	Open Field	towed	Geocenters	20 October	76.5 ˚F	0"
186	EM	Blind Grid	hand	G-TEK	28 October	73.65 ˚F	0"
144	EM	Desert Ext.	hand	G-TEK	3 November	63.29 ˚F	0"
144	EM	Desert Ext.	hand	G-TEK	5 November	64.97 ˚F	0"
579	EM	Moguls	sling	G-TEK	4 November	62.6 ˚F	0"
148	EM	Open Field	sling	G-TEK	28 October	82.11 ˚F	0"
148	EM	Open Field	sling	G-TEK	29 October	79.61 ˚F	0"
148	EM	Open Field	sling	G-TEK	30 October	73.98 ˚F	0"
148	EM	Open Field	sling	G-TEK	31 October	67.55 ˚F	0"
148	EM	Open Field	sling	G-TEK	3 November	63.3 ˚F	0"
148	EM	Open Field	sling	G-TEK	4 November	62.65 ˚F	0"
148	EM	Open Field	sling	G-TEK	5 November	64.99 ˚F	0"
148	EM	Open Field	sling	G-TEK	6 November	67.03 ˚F	0"
431	MAG	Blind Grid	sling	G-TEK	28 October	73.65 ˚F	0"
431	MAG	Blind Grid	sling	G-TEK	6 November	62.73 ˚F	0"
536	MAG	Desert Ext.	sling	G-TEK	3 November	63.29 ˚F	0"
536	MAG	Desert Ext.	sling	G-TEK	4 November	62.59 ˚F	0"
536	MAG	Desert Ext.	sling	G-TEK	5 November	64.97 ˚F	0"
536	MAG	Desert Ext.	sling	G-TEK	6 November	67.02 ˚F	0"
581	MAG	Moguls	sling	G-TEK	31 October	67.5 ˚F	0"
581	MAG	Moguls	sling	G-TEK	3 November	63.2 ˚F	0"
581	MAG	Moguls	sling	G-TEK	5 November	64.9 ˚F	0"
147	MAG	Open Field	sling	G-TEK	28 October	82.08 ˚F	0"
147	MAG	Open Field	sling	G-TEK	29 October	79.62 ˚F	0"
147	MAG	Open Field	sling	G-TEK	30 October	74 ˚F	0"
147	MAG	Open Field	sling	G-TEK	31 October	67.51 ˚F	0"
147	MAG	Open Field	sling	G-TEK	4 November	62.6 ˚F	0"
147	MAG	Open Field	sling	G-TEK	5 November	64.98 ˚F	0"
238	MAG	Blind Grid	hand	HFA	20 April	24.8 ˚F	0"
238	MAG	Blind Grid	hand	HFA	21 April	27.3 ˚F	0"
528	MAG	Desert Ext.	hand	HFA	7 May	32.6 ˚F	0"
528	MAG	Desert Ext.	hand	HFA	10 May	32 ˚F	0"

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
528	MAG	Desert Ext.	hand	HFA	11 May	28.2 ˚F	0"
587	MAG	Moguls	hand	HFA	11 May	28.2 ˚F	0"
587	MAG	Moguls	hand	HFA	12 May	27.2 ˚F	0"
442	MAG	Open Field	hand	HFA	22 April	25.2 ˚F	0"
442	MAG	Open Field	hand	HFA	23 April	26.3 ˚F	0"
442	MAG	Open Field	hand	HFA	26 April	34.1 ˚F	0"
442	MAG	Open Field	hand	HFA	27 April	33.7 ˚F	0"
442	MAG	Open Field	hand	HFA	28 April	32.6 ˚F	0"
442	MAG	Open Field	hand	HFA	29 April	26.6 ˚F	0"
442	MAG	Open Field	hand	HFA	30 April	26.3 ˚F	0"
442	MAG	Open Field	hand	HFA	3 May	35.4 ˚F	0"
442	MAG	Open Field	hand	HFA	4 May	35.3 ˚F	0"
442	MAG	Open Field	hand	HFA	5 May	33.8 ˚F	0"
442	MAG	Open Field	hand	HFA	6 May	33 ˚F	0"
442	MAG	Open Field	hand	HFA	7 May	37.8 ˚F	0"
667	EM	Blind Grid	towed	NAEVA	6 December	53.78 ˚F	0"
667	EM	Blind Grid	towed	NAEVA	8 December	48.4 ˚F	0"
666	EM	Blind Grid	2-man	NAEVA	15 December	56.7 ˚F	0"
670	EM	Desert Ext.	2-man	NAEVA	14 December	60.42 ˚F	0"
670	EM	Desert Ext.	2-man	NAEVA	15 December	56.7 ˚F	0"
669	EM	Moguls	2-man	NAEVA	13 December	57.83 ˚F	0"
669	EM	Moguls	2-man	NAEVA	14 December	60.42 ˚F	0"
668	EM	Open Field	towed	NAEVA	6 December	53.78 ˚F	0"
668	EM	Open Field	towed	NAEVA	8 December	48.4 ˚F	0"
668	EM	Open Field	towed	NAEVA	9 December	47.61 ˚F	0"
668	EM	Open Field	towed	NAEVA	10 December	58.35 ˚F	0"
668	EM	Open Field	towed	NAEVA	13 December	57.83 ˚F	0"
668	EM	Open Field	towed	NAEVA	14 December	60.42 ˚F	0"
668	EM	Open Field	towed	NAEVA	15 December	56.7 ˚F	0"
213	EM	Blind Grid	towed	NRL	13 November	68.9 ˚F	0"
213	EM	Blind Grid	towed	NRL	14 November	62.9 ˚F	0"
213	EM	Blind Grid	towed	NRL	19 November	72.1 ˚F	0"
245	EM	Open Field	towed	NRL	14 November	17.2 ˚F	0"
245	EM	Open Field	towed	NRL	17 November	17.1 ˚F	0"
245	EM	Open Field	towed	NRL	18 November	19.2 ˚F	0"
245	EM	Open Field	towed	NRL	19 November	18.5 ˚F	0"
690	EM	Blind Grid	cart	Parsons	29 September	26.4 ˚F	0"
532	EM	Desert Ext.	cart	Parsons	29 September	26.4 ˚F	0"
532	EM	Desert Ext.	cart	Parsons	30 September	24.6 ˚F	0"
532	EM	Desert Ext.	cart	Parsons	1 October	28.1 ˚F	0"
532	EM	Desert Ext.	cart	Parsons	4 October	29.8 ˚F	0"
532	EM	Desert Ext.	cart	Parsons	7 October	29.6 ˚F	0"
588	EM	Moguls	cart	Parsons	29 September	26.4 ˚F	0"
588	EM	Moguls	cart	Parsons	30 September	22.7 ˚F	0"
588	EM	Moguls	cart	Parsons	1 October	26.8 ˚F	0"
588	EM	Moguls	cart	Parsons	4 October	29.8 ˚F	0"

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
425	EM	Open Field	cart	Parsons	1 October	28.1 ˚F	0"
425	EM	Open Field	cart	Parsons	4 October	29.8 ˚F	0"
425	EM	Open Field	cart	Parsons	5 October	27.9 ˚F	0"
425	EM	Open Field	cart	Parsons	6 October	30.5 ˚F	0"
425	EM	Open Field	cart	Parsons	7 October	29.6 ˚F	0"
606	MAG	Blind Grid	hand	Parsons	12 October	26.6 ˚F	0"
601	MAG	Desert Ext.	hand	Parsons	19 October	23 ˚F	0"
601	MAG	Desert Ext.	hand	Parsons	20 October	23.9 ˚F	0"
602	MAG	Moguls	hand	Parsons	18 October	23.6 ˚F	0"
602	MAG	Moguls	hand	Parsons	19 October	23 ˚F	0"
426	MAG	Open Field	hand	Parsons	12 October	26.7 ˚F	0"
426	MAG	Open Field	hand	Parsons	13 October	26.6 ˚F	0"
426	MAG	Open Field	hand	Parsons	14 October	30.4 ˚F	0"
426	MAG	Open Field	hand	Parsons	15 October	27.1 ˚F	0"
426	MAG	Open Field	hand	Parsons	18 October	23.6 ˚F	0"
199	EM	Blind Grid	cart	Shaw	12 January	17.9 ˚F	0"
199	EM	Blind Grid	cart	Shaw	13 January	18.5 ˚F	0"
211	EM	Desert Ext.	cart	Shaw	16 January	17.8 ˚F	0"
211	EM	Desert Ext.	cart	Shaw	23 January	14.3 ˚F	0"
211	EM	Desert Ext.	cart	Shaw	26 January	13.7 ˚F	0"
211	EM	Desert Ext.	cart	Shaw	27 January	13.6 ˚F	0"
207	EM	Moguls	cart	Shaw	16 January	17.8 ˚F	0"
354	EM	Open Field	cart	Shaw	12 January	18.2 ˚F	0"
354	EM	Open Field	cart	Shaw	13 January	29.8 ˚F	0"
354	EM	Open Field	cart	Shaw	14 January	21.1 ˚F	0"
354	EM	Open Field	cart	Shaw	15 January	19.2 ˚F	0"
354	EM	Open Field	cart	Shaw	27 January	13.6 ˚F	0"
312	MAG	Blind Grid	cart	Shaw	20 January	15.74 ˚F	0"
312	MAG	Blind Grid	cart	Shaw	22 January	14.55 ˚F	0"
312	MAG	Blind Grid	cart	Shaw	26 January	13.7 ˚F	0"
541	MAG	Desert Ext.	cart	Shaw	23 January	14.3 ˚F	0"
541	MAG	Desert Ext.	cart	Shaw	26 January	13.7 ˚F	0"
594	MAG	Moguls	cart	Shaw	22 January	14.5 ˚F	0"
638	MAG	Open Field	cart	Shaw	20 January	15.7 ˚F	0.1"
638	MAG	Open Field	cart	Shaw	21 January	14.4 ˚F	0.1"
638	MAG	Open Field	cart	Shaw	22 January	14.5 ˚F	0"
638	MAG	Open Field	cart	Shaw	23 January	14.3 ˚F	0"
638	MAG	Open Field	cart	Shaw	26 January	13.7 ˚F	0"
168	EM	Blind Grid	cart	TT	1 December	59.7 ˚F	0"
171	EM	Desert Ext.	cart	TT	4 December	64.1 ˚F	0"
171	EM	Desert Ext.	cart	TT	5 December	63.8 ˚F	0"
171	EM	Desert Ext.	cart	TT	8 December	63.7 ˚F	0"
170	EM	Moguls	sling	TT	4 December	64 ˚F	0"
170	EM	Moguls	sling	TT	5 December	63.8 ˚F	0"
169	EM	Open Field	cart	TT	2 December	64.3 ˚F	0"
169	EM	Open Field	cart	TT	3 December	64.5 ˚F	0"

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Area**	**Platform**	**Vendor**	**Date**	**Temperature**	**Precipitation**
169	EM	Open Field	cart	TT	4 December	64.1 ˚F	0"
169	EM	Open Field	cart	TT	8 December	63.7 ˚F	0"

APPENDIX C. SOIL MOISTURE

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
39	EM	hand	AETC	Open Field	0 to 6	32.78	7.04
39	EM	hand	AETC	Open Field	6 to 12	27.95	9.71
39	EM	hand	AETC	Open Field	12 to 24	11.63	3.86
39	EM	hand	AETC	Open Field	24 to 36	30.93	17.65
39	EM	hand	AETC	Open Field	36 to 48	11.95	8.49
695	EM	hand	ARM	Wet Probe	0 to 6	0	0
695	EM	hand	ARM	Wet Probe	6 to 12	0	0
695	EM	hand	ARM	Wet Probe	12 to 24	0	0
695	EM	hand	ARM	Wet Probe	24 to 36	0	0
695	EM	hand	ARM	Wet Probe	36 to 48	0	0
695	EM	hand	ARM	Woods	0 to 6	0	0
695	EM	hand	ARM	Woods	6 to 12	0	0
695	EM	hand	ARM	Woods	12 to 24	0	0
695	EM	hand	ARM	Woods	24 to 36	0	0
695	EM	hand	ARM	Woods	36 to 48	0	0
695	EM	hand	ARM	Open Field	0 to 6	0	0
695	EM	hand	ARM	Open Field	6 to 12	0	0
695	EM	hand	ARM	Open Field	12 to 24	0	0
695	EM	hand	ARM	Open Field	24 to 36	0	0
695	EM	hand	ARM	Open Field	36 to 48	0	0
695	EM	hand	ARM	Calibration	0 to 6	6.187	0.183
695	EM	hand	ARM	Calibration	6 to 12	37.738	0.581
695	EM	hand	ARM	Calibration	12 to 24	50.55	0.132
695	EM	hand	ARM	Calibration	24 to 36	44.875	0.334
695	EM	hand	ARM	Calibration	36 to 48	40.075	0.399
695	EM	hand	ARM	Blind Grid	0 to 6	3.767	0.137
695	EM	hand	ARM	Blind Grid	6 to 12	24.267	0.262
695	EM	hand	ARM	Blind Grid	12 to 24	38.033	0.149
695	EM	hand	ARM	Blind Grid	24 to 36	35.167	0.189
695	EM	hand	ARM	Blind Grid	36 to 48	39.833	0.229
691	EM	hand	ARM	Wet Probe	0 to 6	0	0
691	EM	hand	ARM	Wet Probe	6 to 12	0	0
691	EM	hand	ARM	Wet Probe	12 to 24	0	0
691	EM	hand	ARM	Wet Probe	24 to 36	0	0
691	EM	hand	ARM	Wet Probe	36 to 48	0	0
691	EM	hand	ARM	Woods	0 to 6	0	0
691	EM	hand	ARM	Woods	6 to 12	0	0
691	EM	hand	ARM	Woods	12 to 24	0	0
691	EM	hand	ARM	Woods	24 to 36	0	0
691	EM	hand	ARM	Woods	36 to 48	0	0
691	EM	hand	ARM	Open Field	0 to 6	0	0
691	EM	hand	ARM	Open Field	6 to 12	0	0
691	EM	hand	ARM	Open Field	12 to 24	0	0
691	EM	hand	ARM	Open Field	24 to 36	0	0
691	EM	hand	ARM	Open Field	36 to 48	0	0
691	EM	hand	ARM	Calibration	0 to 6	6.187	0.183
691	EM	hand	ARM	Calibration	6 to 12	37.738	0.581

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
691	EM	hand	ARM	Calibration	12 to 24	50.55	0.132
691	EM	hand	ARM	Calibration	24 to 36	44.875	0.334
691	EM	hand	ARM	Calibration	36 to 48	40.075	0.399
691	EM	hand	ARM	Blind Grid	0 to 6	3.767	0.137
691	EM	hand	ARM	Blind Grid	6 to 12	24.267	0.262
691	EM	hand	ARM	Blind Grid	12 to 24	38.033	0.149
691	EM	hand	ARM	Blind Grid	24 to 36	35.167	0.189
691	EM	hand	ARM	Blind Grid	36 to 48	39.833	0.229
622	dual	cart	BH	Wet Probe	0 to 6	64.133	0.634
622	dual	cart	BH	Wet Probe	6 to 12	72.947	0.56
622	dual	cart	BH	Wet Probe	12 to 24	77.727	0.742
622	dual	cart	BH	Wet Probe	24 to 36	54.033	0.753
622	dual	cart	BH	Wet Probe	36 to 48	51.373	0.249
622	dual	cart	BH	Woods	0 to 6	13.65	0.357
622	dual	cart	BH	Woods	6 to 12	5.625	0.179
622	dual	cart	BH	Woods	12 to 24	5.8	0.122
622	dual	cart	BH	Woods	24 to 36	55.55	0.112
622	dual	cart	BH	Woods	36 to 48	57.45	0.15
622	dual	cart	BH	Open Field	0 to 6	19.953	0.741
622	dual	cart	BH	Open Field	6 to 12	5.187	0.365
622	dual	cart	BH	Open Field	12 to 24	18.273	0.621
622	dual	cart	BH	Open Field	24 to 36	25.413	0.534
622	dual	cart	BH	Open Field	36 to 48	51.467	0.282
622	dual	cart	BH	Calibration	0 to 6	0.9	0.1
622	dual	cart	BH	Calibration	6 to 12	20.1	0.1
622	dual	cart	BH	Calibration	12 to 24	28.25	0.05
622	dual	cart	BH	Calibration	24 to 36	35.3	0.1
622	dual	cart	BH	Calibration	36 to 48	39	0
622	dual	cart	BH	Blind Grid	0 to 6	3.175	0.286
622	dual	cart	BH	Blind Grid	6 to 12	24.825	0.179
622	dual	cart	BH	Blind Grid	12 to 24	38.925	0.228
622	dual	cart	BH	Blind Grid	24 to 36	35.9	0.158
622	dual	cart	BH	Blind Grid	36 to 48	39.475	0.396
642	dual	cart	BH	Wet Probe	0 to 6	64.133	0.634
642	dual	cart	BH	Wet Probe	6 to 12	72.947	0.56
642	dual	cart	BH	Wet Probe	12 to 24	77.727	0.742
642	dual	cart	BH	Wet Probe	24 to 36	54.033	0.753
642	dual	cart	BH	Wet Probe	36 to 48	51.373	0.249
642	dual	cart	BH	Woods	0 to 6	13.65	0.357
642	dual	cart	BH	Woods	6 to 12	5.625	0.179
642	dual	cart	BH	Woods	12 to 24	5.8	0.122
642	dual	cart	BH	Woods	24 to 36	55.55	0.112
642	dual	cart	BH	Woods	36 to 48	57.45	0.15
642	dual	cart	BH	Open Field	0 to 6	19.953	0.741
642	dual	cart	BH	Open Field	6 to 12	5.187	0.365
642	dual	cart	BH	Open Field	12 to 24	18.273	0.621
642	dual	cart	BH	Open Field	24 to 36	25.413	0.534
642	dual	cart	BH	Open Field	36 to 48	51.467	0.282
642	dual	cart	BH	Calibration	0 to 6	0.9	0.1
642	dual	cart	BH	Calibration	6 to 12	20.1	0.1

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
642	dual	cart	BH	Calibration	12 to 24	28.25	0.05
642	dual	cart	BH	Calibration	24 to 36	35.3	0.1
642	dual	cart	BH	Calibration	36 to 48	39	0
642	dual	cart	BH	Blind Grid	0 to 6	3.175	0.286
642	dual	cart	BH	Blind Grid	6 to 12	24.825	0.179
642	dual	cart	BH	Blind Grid	12 to 24	38.925	0.228
642	dual	cart	BH	Blind Grid	24 to 36	35.9	0.158
642	dual	cart	BH	Blind Grid	36 to 48	39.475	0.396
657	dual	cart	BH	Wet Probe	0 to 6	64.133	0.634
657	dual	cart	BH	Wet Probe	6 to 12	72.947	0.56
657	dual	cart	BH	Wet Probe	12 to 24	77.727	0.742
657	dual	cart	BH	Wet Probe	24 to 36	54.033	0.753
657	dual	cart	BH	Wet Probe	36 to 48	51.373	0.249
657	dual	cart	BH	Woods	0 to 6	13.65	0.357
657	dual	cart	BH	Woods	6 to 12	5.625	0.179
657	dual	cart	BH	Woods	12 to 24	5.8	0.122
657	dual	cart	BH	Woods	24 to 36	55.55	0.112
657	dual	cart	BH	Woods	36 to 48	57.45	0.15
657	dual	cart	BH	Open Field	0 to 6	19.953	0.741
657	dual	cart	BH	Open Field	6 to 12	5.187	0.365
657	dual	cart	BH	Open Field	12 to 24	18.273	0.621
657	dual	cart	BH	Open Field	24 to 36	25.413	0.534
657	dual	cart	BH	Open Field	36 to 48	51.467	0.282
657	dual	cart	BH	Calibration	0 to 6	0.9	0.1
657	dual	cart	BH	Calibration	6 to 12	20.1	0.1
657	dual	cart	BH	Calibration	12 to 24	28.25	0.05
657	dual	cart	BH	Calibration	24 to 36	35.3	0.1
657	dual	cart	BH	Calibration	36 to 48	39	0
657	dual	cart	BH	Blind Grid	0 to 6	3.175	0.286
657	dual	cart	BH	Blind Grid	6 to 12	24.825	0.179
657	dual	cart	BH	Blind Grid	12 to 24	38.925	0.228
657	dual	cart	BH	Blind Grid	24 to 36	35.9	0.158
657	dual	cart	BH	Blind Grid	36 to 48	39.475	0.396
636	dual	cart	BH	Wet Probe	0 to 6	64.133	0.634
636	dual	cart	BH	Wet Probe	6 to 12	72.947	0.56
636	dual	cart	BH	Wet Probe	12 to 24	77.727	0.742
636	dual	cart	BH	Wet Probe	24 to 36	54.033	0.753
636	dual	cart	BH	Wet Probe	36 to 48	51.373	0.249
636	dual	cart	BH	Woods	0 to 6	13.65	0.357
636	dual	cart	BH	Woods	6 to 12	5.625	0.179
636	dual	cart	BH	Woods	12 to 24	5.8	0.122
636	dual	cart	BH	Woods	24 to 36	55.55	0.112
636	dual	cart	BH	Woods	36 to 48	57.45	0.15
636	dual	cart	BH	Open Field	0 to 6	19.953	0.741
636	dual	cart	BH	Open Field	6 to 12	5.187	0.365
636	dual	cart	BH	Open Field	12 to 24	18.273	0.621
636	dual	cart	BH	Open Field	24 to 36	25.413	0.534
636	dual	cart	BH	Open Field	36 to 48	51.467	0.282
636	dual	cart	BH	Calibration	0 to 6	0.9	0.1
636	dual	cart	BH	Calibration	6 to 12	20.1	0.1

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
636	dual	cart	BH	Calibration	12 to 24	28.25	0.05
636	dual	cart	BH	Calibration	24 to 36	35.3	0.1
636	dual	cart	BH	Calibration	36 to 48	39	0
636	dual	cart	BH	Blind Grid	0 to 6	3.175	0.286
636	dual	cart	BH	Blind Grid	6 to 12	24.825	0.179
636	dual	cart	BH	Blind Grid	12 to 24	38.925	0.228
636	dual	cart	BH	Blind Grid	24 to 36	35.9	0.158
636	dual	cart	BH	Blind Grid	36 to 48	39.475	0.396
304	EM	cart	ERDC	Wet Probe	0 to 6	78.479	2.922
304	EM	cart	ERDC	Wet Probe	6 to 12	77.262	1.753
304	EM	cart	ERDC	Wet Probe	12 to 24	69.7	0.726
304	EM	cart	ERDC	Wet Probe	24 to 36	52.641	0.596
304	EM	cart	ERDC	Wet Probe	36 to 48	49.741	0.516
304	EM	cart	ERDC	Woods	0 to 6	0	0
304	EM	cart	ERDC	Woods	6 to 12	0	0
304	EM	cart	ERDC	Woods	12 to 24	0	0
304	EM	cart	ERDC	Woods	24 to 36	0	0
304	EM	cart	ERDC	Woods	36 to 48	0	0
304	EM	cart	ERDC	Open Field	0 to 6	12.772	1.325
304	EM	cart	ERDC	Open Field	6 to 12	2.421	0.697
304	EM	cart	ERDC	Open Field	12 to 24	15.679	1.027
304	EM	cart	ERDC	Open Field	24 to 36	21.548	0.302
304	EM	cart	ERDC	Open Field	36 to 48	27.245	0.964
304	EM	cart	ERDC	Calibration	0 to 6	39.5	0.3
304	EM	cart	ERDC	Calibration	6 to 12	37.6	0.1
304	EM	cart	ERDC	Calibration	12 to 24	0.9	0
304	EM	cart	ERDC	Calibration	24 to 36	4.6	0.1
304	EM	cart	ERDC	Calibration	36 to 48	5.05	0.15
304	EM	cart	ERDC	Blind Grid	0 to 6	4.65	0.25
304	EM	cart	ERDC	Blind Grid	6 to 12	9.65	0.15
304	EM	cart	ERDC	Blind Grid	12 to 24	35.1	0.2
304	EM	cart	ERDC	Blind Grid	24 to 36	36.45	0.25
304	EM	cart	ERDC	Blind Grid	36 to 48	38.8	0.1
305	EM	cart	ERDC	Wet Probe	0 to 6	78.479	2.922
305	EM	cart	ERDC	Wet Probe	6 to 12	77.262	1.753
305	EM	cart	ERDC	Wet Probe	12 to 24	69.7	0.726
305	EM	cart	ERDC	Wet Probe	24 to 36	52.641	0.596
305	EM	cart	ERDC	Wet Probe	36 to 48	49.741	0.516
305	EM	cart	ERDC	Woods	0 to 6	0	0
305	EM	cart	ERDC	Woods	6 to 12	0	0
305	EM	cart	ERDC	Woods	12 to 24	0	0
305	EM	cart	ERDC	Woods	24 to 36	0	0
305	EM	cart	ERDC	Woods	36 to 48	0	0
305	EM	cart	ERDC	Open Field	0 to 6	12.772	1.325
305	EM	cart	ERDC	Open Field	6 to 12	2.421	0.697
305	EM	cart	ERDC	Open Field	12 to 24	15.679	1.027
305	EM	cart	ERDC	Open Field	24 to 36	21.548	0.302
305	EM	cart	ERDC	Open Field	36 to 48	27.245	0.964
305	EM	cart	ERDC	Calibration	0 to 6	39.5	0.3
305	EM	cart	ERDC	Calibration	6 to 12	37.6	0.1

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
305	EM	cart	ERDC	Calibration	12 to 24	0.9	0
305	EM	cart	ERDC	Calibration	24 to 36	4.6	0.1
305	EM	cart	ERDC	Calibration	36 to 48	5.05	0.15
305	EM	cart	ERDC	Blind Grid	0 to 6	4.65	0.25
305	EM	cart	ERDC	Blind Grid	6 to 12	9.65	0.15
305	EM	cart	ERDC	Blind Grid	12 to 24	35.1	0.2
305	EM	cart	ERDC	Blind Grid	24 to 36	36.45	0.25
305	EM	cart	ERDC	Blind Grid	36 to 48	38.8	0.1
142	EM	cart	ERDC	Wet Probe	0 to 6	0	0
142	EM	cart	ERDC	Wet Probe	6 to 12	0	0
142	EM	cart	ERDC	Wet Probe	12 to 24	0	0
142	EM	cart	ERDC	Wet Probe	24 to 36	0	0
142	EM	cart	ERDC	Wet Probe	36 to 48	0	0
142	EM	cart	ERDC	Woods	0 to 6	0	0
142	EM	cart	ERDC	Woods	6 to 12	0	0
142	EM	cart	ERDC	Woods	12 to 24	0	0
142	EM	cart	ERDC	Woods	24 to 36	0	0
142	EM	cart	ERDC	Woods	36 to 48	0	0
142	EM	cart	ERDC	Open Field	0 to 6	39.812	0.276
142	EM	cart	ERDC	Open Field	6 to 12	38.138	0.387
142	EM	cart	ERDC	Open Field	12 to 24	8.462	0.628
142	EM	cart	ERDC	Open Field	24 to 36	5.412	0.713
142	EM	cart	ERDC	Open Field	36 to 48	5.525	1.015
141	EM	cart	ERDC	Wet Probe	0 to 6	0	0
141	EM	cart	ERDC	Wet Probe	6 to 12	0	0
141	EM	cart	ERDC	Wet Probe	12 to 24	0	0
141	EM	cart	ERDC	Wet Probe	24 to 36	0	0
141	EM	cart	ERDC	Wet Probe	36 to 48	0	0
141	EM	cart	ERDC	Woods	0 to 6	0	0
141	EM	cart	ERDC	Woods	6 to 12	0	0
141	EM	cart	ERDC	Woods	12 to 24	0	0
141	EM	cart	ERDC	Woods	24 to 36	0	0
141	EM	cart	ERDC	Woods	36 to 48	0	0
141	EM	cart	ERDC	Open Field	0 to 6	39.812	0.276
141	EM	cart	ERDC	Open Field	6 to 12	38.138	0.387
141	EM	cart	ERDC	Open Field	12 to 24	8.462	0.628
141	EM	cart	ERDC	Open Field	24 to 36	5.412	0.713
141	EM	cart	ERDC	Open Field	36 to 48	5.525	1.015
40	dual	towed	Geocenters	Open Field	0 to 6	17.37	6.83
40	dual	towed	Geocenters	Open Field	6 to 12	10.17	2.03
40	dual	towed	Geocenters	Open Field	12 to 24	0.35	0.1
40	dual	towed	Geocenters	Open Field	24 to 36	26.52	0.34
40	dual	towed	Geocenters	Open Field	36 to 48	9.75	0.17
290	dual	towed	Geocenters	Wet Probe	0 to 6	65.367	0.287
290	dual	towed	Geocenters	Wet Probe	6 to 12	75.3	0.408
290	dual	towed	Geocenters	Wet Probe	12 to 24	79.5	0.327
290	dual	towed	Geocenters	Wet Probe	24 to 36	55.5	0.327
290	dual	towed	Geocenters	Wet Probe	36 to 48	52.4	0.374
290	dual	towed	Geocenters	Woods	0 to 6	0	0
290	dual	towed	Geocenters	Woods	6 to 12	0	0

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
290	dual	towed	Geocenters	Woods	12 to 24	0	0
290	dual	towed	Geocenters	Woods	24 to 36	0	0
290	dual	towed	Geocenters	Woods	36 to 48	0	0
290	dual	towed	Geocenters	Open Field	0 to 6	22.133	0.189
290	dual	towed	Geocenters	Open Field	6 to 12	6.833	0.094
290	dual	towed	Geocenters	Open Field	12 to 24	19.433	0.368
290	dual	towed	Geocenters	Open Field	24 to 36	26.3	0.356
290	dual	towed	Geocenters	Open Field	36 to 48	52.567	0.33
290	dual	towed	Geocenters	Calibration	0 to 6	1.2	0
290	dual	towed	Geocenters	Calibration	6 to 12	20.8	0
290	dual	towed	Geocenters	Calibration	12 to 24	28.9	0
290	dual	towed	Geocenters	Calibration	24 to 36	36.3	0
290	dual	towed	Geocenters	Calibration	36 to 48	39.2	0
290	dual	towed	Geocenters	Blind Grid	0 to 6	2.9	0.1
290	dual	towed	Geocenters	Blind Grid	6 to 12	25.15	0.15
290	dual	towed	Geocenters	Blind Grid	12 to 24	39.1	0.1
290	dual	towed	Geocenters	Blind Grid	24 to 36	34.9	0.1
290	dual	towed	Geocenters	Blind Grid	36 to 48	40.35	0.15
298	dual	towed	Geocenters	Wet Probe	0 to 6	65.367	0.287
298	dual	towed	Geocenters	Wet Probe	6 to 12	75.3	0.408
298	dual	towed	Geocenters	Wet Probe	12 to 24	79.5	0.327
298	dual	towed	Geocenters	Wet Probe	24 to 36	55.5	0.327
298	dual	towed	Geocenters	Wet Probe	36 to 48	52.4	0.374
298	dual	towed	Geocenters	Woods	0 to 6	0	0
298	dual	towed	Geocenters	Woods	6 to 12	0	0
298	dual	towed	Geocenters	Woods	12 to 24	0	0
298	dual	towed	Geocenters	Woods	24 to 36	0	0
298	dual	towed	Geocenters	Woods	36 to 48	0	0
298	dual	towed	Geocenters	Open Field	0 to 6	22.133	0.189
298	dual	towed	Geocenters	Open Field	6 to 12	6.833	0.094
298	dual	towed	Geocenters	Open Field	12 to 24	19.433	0.368
298	dual	towed	Geocenters	Open Field	24 to 36	26.3	0.356
298	dual	towed	Geocenters	Open Field	36 to 48	52.567	0.33
298	dual	towed	Geocenters	Calibration	0 to 6	1.2	0
298	dual	towed	Geocenters	Calibration	6 to 12	20.8	0
298	dual	towed	Geocenters	Calibration	12 to 24	28.9	0
298	dual	towed	Geocenters	Calibration	24 to 36	36.3	0
298	dual	towed	Geocenters	Calibration	36 to 48	39.2	0
298	dual	towed	Geocenters	Blind Grid	0 to 6	2.9	0.1
298	dual	towed	Geocenters	Blind Grid	6 to 12	25.15	0.15
298	dual	towed	Geocenters	Blind Grid	12 to 24	39.1	0.1
298	dual	towed	Geocenters	Blind Grid	24 to 36	34.9	0.1
298	dual	towed	Geocenters	Blind Grid	36 to 48	40.35	0.15
792	dual	towed	Geocenters	Wet Probe	0 to 6	13.45	0
792	dual	towed	Geocenters	Wet Probe	6 to 12	32.6	0
792	dual	towed	Geocenters	Wet Probe	12 to 24	30.675	0
792	dual	towed	Geocenters	Wet Probe	24 to 36	22.575	0
792	dual	towed	Geocenters	Wet Probe	36 to 48	43.6	0
792	dual	towed	Geocenters	Woods	0 to 6	0	0
792	dual	towed	Geocenters	Woods	6 to 12	0	0

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
792	dual	towed	Geocenters	Woods	12 to 24	0	0
792	dual	towed	Geocenters	Woods	24 to 36	0	0
792	dual	towed	Geocenters	Woods	36 to 48	0	0
792	dual	towed	Geocenters	Open Field	0 to 6	1.925	0
792	dual	towed	Geocenters	Open Field	6 to 12	11.25	0
792	dual	towed	Geocenters	Open Field	12 to 24	12.275	0
792	dual	towed	Geocenters	Open Field	24 to 36	15.7	0
792	dual	towed	Geocenters	Open Field	36 to 48	16.575	0
792	dual	towed	Geocenters	Calibration	0 to 6	3.4	0
792	dual	towed	Geocenters	Calibration	6 to 12	18.6	0
792	dual	towed	Geocenters	Calibration	12 to 24	19.4	0
792	dual	towed	Geocenters	Calibration	24 to 36	21.4	0
792	dual	towed	Geocenters	Calibration	36 to 48	18.7	0
792	dual	towed	Geocenters	Blind Grid	0 to 6	3.2	0
792	dual	towed	Geocenters	Blind Grid	6 to 12	14.3	0
792	dual	towed	Geocenters	Blind Grid	12 to 24	15.5	0
792	dual	towed	Geocenters	Blind Grid	24 to 36	12.6	0
792	dual	towed	Geocenters	Blind Grid	36 to 48	18.7	0
802	dual	towed	Geocenters	Wet Probe	0 to 6	13.45	0
802	dual	towed	Geocenters	Wet Probe	6 to 12	32.6	0
802	dual	towed	Geocenters	Wet Probe	12 to 24	30.675	0
802	dual	towed	Geocenters	Wet Probe	24 to 36	22.575	0
802	dual	towed	Geocenters	Wet Probe	36 to 48	43.6	0
802	dual	towed	Geocenters	Woods	0 to 6	0	0
802	dual	towed	Geocenters	Woods	6 to 12	0	0
802	dual	towed	Geocenters	Woods	12 to 24	0	0
802	dual	towed	Geocenters	Woods	24 to 36	0	0
802	dual	towed	Geocenters	Woods	36 to 48	0	0
802	dual	towed	Geocenters	Open Field	0 to 6	1.925	0
802	dual	towed	Geocenters	Open Field	6 to 12	11.25	0
802	dual	towed	Geocenters	Open Field	12 to 24	12.275	0
802	dual	towed	Geocenters	Open Field	24 to 36	15.7	0
802	dual	towed	Geocenters	Open Field	36 to 48	16.575	0
802	dual	towed	Geocenters	Calibration	0 to 6	3.4	0
802	dual	towed	Geocenters	Calibration	6 to 12	18.6	0
802	dual	towed	Geocenters	Calibration	12 to 24	19.4	0
802	dual	towed	Geocenters	Calibration	24 to 36	21.4	0
802	dual	towed	Geocenters	Calibration	36 to 48	18.7	0
802	dual	towed	Geocenters	Blind Grid	0 to 6	3.2	0
802	dual	towed	Geocenters	Blind Grid	6 to 12	14.3	0
802	dual	towed	Geocenters	Blind Grid	12 to 24	15.5	0
802	dual	towed	Geocenters	Blind Grid	24 to 36	12.6	0
802	dual	towed	Geocenters	Blind Grid	36 to 48	18.7	0
50	EM	hand	Geophex	Wet Probe	0 to 6	77.9	0.458
50	EM	hand	Geophex	Wet Probe	6 to 12	65.675	0.936
50	EM	hand	Geophex	Wet Probe	12 to 24	74.525	1.53
50	EM	hand	Geophex	Wet Probe	24 to 36	61.8	0.943
50	EM	hand	Geophex	Wet Probe	36 to 48	51.375	0.545
50	EM	hand	Geophex	Woods	0 to 6	84.6	0.3
50	EM	hand	Geophex	Woods	6 to 12	64.85	0.05

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
50	EM	hand	Geophex	Woods	12 to 24	63.15	0.25
50	EM	hand	Geophex	Woods	24 to 36	88.1	0.2
50	EM	hand	Geophex	Woods	36 to 48	48.5	0.2
50	EM	hand	Geophex	Open Field	0 to 6	15.325	1.295
50	EM	hand	Geophex	Open Field	6 to 12	1.125	0.311
50	EM	hand	Geophex	Open Field	12 to 24	22.6	0.412
50	EM	hand	Geophex	Open Field	24 to 36	29.65	0.45
50	EM	hand	Geophex	Open Field	36 to 48	42.625	0.444
680	EM	hand	Geophex	Wet Probe	0 to 6	0	0
680	EM	hand	Geophex	Wet Probe	6 to 12	0	0
680	EM	hand	Geophex	Wet Probe	12 to 24	0	0
680	EM	hand	Geophex	Wet Probe	24 to 36	0	0
680	EM	hand	Geophex	Wet Probe	36 to 48	0	0
680	EM	hand	Geophex	Woods	0 to 6	0	0
680	EM	hand	Geophex	Woods	6 to 12	0	0
680	EM	hand	Geophex	Woods	12 to 24	0	0
680	EM	hand	Geophex	Woods	24 to 36	0	0
680	EM	hand	Geophex	Woods	36 to 48	0	0
680	EM	hand	Geophex	Open Field	0 to 6	0	0
680	EM	hand	Geophex	Open Field	6 to 12	0	0
680	EM	hand	Geophex	Open Field	12 to 24	0	0
680	EM	hand	Geophex	Open Field	24 to 36	0	0
680	EM	hand	Geophex	Open Field	36 to 48	0	0
680	EM	hand	Geophex	Calibration	0 to 6	5	0.305
680	EM	hand	Geophex	Calibration	6 to 12	36.536	0.199
680	EM	hand	Geophex	Calibration	12 to 24	49.929	0.228
680	EM	hand	Geophex	Calibration	24 to 36	43.457	0.425
680	EM	hand	Geophex	Calibration	36 to 48	38.286	0.307
680	EM	hand	Geophex	Blind Grid	0 to 6	2.707	0.296
680	EM	hand	Geophex	Blind Grid	6 to 12	22.986	0.346
680	EM	hand	Geophex	Blind Grid	12 to 24	36.436	0.381
680	EM	hand	Geophex	Blind Grid	24 to 36	33.714	0.493
680	EM	hand	Geophex	Blind Grid	36 to 48	38.043	0.344
125	EM	towed	Geophex	Wet Probe	0 to 6	77.661	4.526
125	EM	towed	Geophex	Wet Probe	6 to 12	67.856	3.49
125	EM	towed	Geophex	Wet Probe	12 to 24	74.606	1.141
125	EM	towed	Geophex	Wet Probe	24 to 36	61.8	1.197
125	EM	towed	Geophex	Wet Probe	36 to 48	49.561	4.433
125	EM	towed	Geophex	Woods	0 to 6	76.979	7.626
125	EM	towed	Geophex	Woods	6 to 12	66.536	3.353
125	EM	towed	Geophex	Woods	12 to 24	78.307	13.289
125	EM	towed	Geophex	Woods	24 to 36	73.057	12.473
125	EM	towed	Geophex	Woods	36 to 48	49.936	1.25
125	EM	towed	Geophex	Open Field	0 to 6	10.694	3.779
125	EM	towed	Geophex	Open Field	6 to 12	0.665	0.407
125	EM	towed	Geophex	Open Field	12 to 24	19.994	1.682
125	EM	towed	Geophex	Open Field	24 to 36	27.376	1.736
125	EM	towed	Geophex	Open Field	36 to 48	40.159	1.83
49	EM	cart	Geophex	Wet Probe	0 to 6	77.9	0.458
49	EM	cart	Geophex	Wet Probe	6 to 12	65.675	0.936

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
49	EM	cart	Geophex	Wet Probe	12 to 24	74.525	1.53
49	EM	cart	Geophex	Wet Probe	24 to 36	61.8	0.943
49	EM	cart	Geophex	Wet Probe	36 to 48	51.375	0.545
49	EM	cart	Geophex	Woods	0 to 6	84.6	0.3
49	EM	cart	Geophex	Woods	6 to 12	64.85	0.05
49	EM	cart	Geophex	Woods	12 to 24	63.15	0.25
49	EM	cart	Geophex	Woods	24 to 36	88.1	0.2
49	EM	cart	Geophex	Woods	36 to 48	48.5	0.2
49	EM	cart	Geophex	Open Field	0 to 6	15.325	1.295
49	EM	cart	Geophex	Open Field	6 to 12	1.125	0.311
49	EM	cart	Geophex	Open Field	12 to 24	22.6	0.412
49	EM	cart	Geophex	Open Field	24 to 36	29.65	0.45
49	EM	cart	Geophex	Open Field	36 to 48	42.625	0.444
451	EM	cart	Geophex	Wet Probe	0 to 6	76.2	7.063
451	EM	cart	Geophex	Wet Probe	6 to 12	68.1	0.566
451	EM	cart	Geophex	Wet Probe	12 to 24	75.567	0.17
451	EM	cart	Geophex	Wet Probe	24 to 36	63.3	0.283
451	EM	cart	Geophex	Wet Probe	36 to 48	51.967	0.125
451	EM	cart	Geophex	Woods	0 to 6	21.333	0.85
451	EM	cart	Geophex	Woods	6 to 12	21.933	1.621
451	EM	cart	Geophex	Woods	12 to 24	27.533	0.419
451	EM	cart	Geophex	Woods	24 to 36	4.2	0
451	EM	cart	Geophex	Woods	36 to 48	25.767	0.205
451	EM	cart	Geophex	Open Field	0 to 6	43.517	27.513
451	EM	cart	Geophex	Open Field	6 to 12	44.367	42.298
451	EM	cart	Geophex	Open Field	12 to 24	36.133	26.382
451	EM	cart	Geophex	Open Field	24 to 36	39.067	19.048
451	EM	cart	Geophex	Open Field	36 to 48	40.083	20.226
665	EM	hand	Geophex	Wet Probe	0 to 6	0	0
665	EM	hand	Geophex	Wet Probe	6 to 12	0	0
665	EM	hand	Geophex	Wet Probe	12 to 24	0	0
665	EM	hand	Geophex	Wet Probe	24 to 36	0	0
665	EM	hand	Geophex	Wet Probe	36 to 48	0	0
665	EM	hand	Geophex	Woods	0 to 6	0	0
665	EM	hand	Geophex	Woods	6 to 12	0	0
665	EM	hand	Geophex	Woods	12 to 24	0	0
665	EM	hand	Geophex	Woods	24 to 36	0	0
665	EM	hand	Geophex	Woods	36 to 48	0	0
665	EM	hand	Geophex	Open Field	0 to 6	0	0
665	EM	hand	Geophex	Open Field	6 to 12	0	0
665	EM	hand	Geophex	Open Field	12 to 24	0	0
665	EM	hand	Geophex	Open Field	24 to 36	0	0
665	EM	hand	Geophex	Open Field	36 to 48	0	0
665	EM	hand	Geophex	Calibration	0 to 6	5	0.305
665	EM	hand	Geophex	Calibration	6 to 12	36.536	0.199
665	EM	hand	Geophex	Calibration	12 to 24	49.929	0.228
665	EM	hand	Geophex	Calibration	24 to 36	43.457	0.425
665	EM	hand	Geophex	Calibration	36 to 48	38.286	0.307
665	EM	hand	Geophex	Blind Grid	0 to 6	2.707	0.296
665	EM	hand	Geophex	Blind Grid	6 to 12	22.986	0.346

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
665	EM	hand	Geophex	Blind Grid	12 to 24	36.436	0.381
665	EM	hand	Geophex	Blind Grid	24 to 36	33.714	0.493
665	EM	hand	Geophex	Blind Grid	36 to 48	38.043	0.344
129	EM	towed	Geophex	Wet Probe	0 to 6	77.661	4.526
129	EM	towed	Geophex	Wet Probe	6 to 12	67.856	3.49
129	EM	towed	Geophex	Wet Probe	12 to 24	74.606	1.141
129	EM	towed	Geophex	Wet Probe	24 to 36	61.8	1.197
129	EM	towed	Geophex	Wet Probe	36 to 48	49.561	4.433
129	EM	towed	Geophex	Woods	0 to 6	76.979	7.626
129	EM	towed	Geophex	Woods	6 to 12	66.536	3.353
129	EM	towed	Geophex	Woods	12 to 24	78.307	13.289
129	EM	towed	Geophex	Woods	24 to 36	73.057	12.473
129	EM	towed	Geophex	Woods	36 to 48	49.936	1.25
129	EM	towed	Geophex	Open Field	0 to 6	10.694	3.779
129	EM	towed	Geophex	Open Field	6 to 12	0.665	0.407
129	EM	towed	Geophex	Open Field	12 to 24	19.994	1.682
129	EM	towed	Geophex	Open Field	24 to 36	27.376	1.736
129	EM	towed	Geophex	Open Field	36 to 48	40.053	1.922
449	EM	cart	Geophex	Wet Probe	0 to 6	77.661	4.526
449	EM	cart	Geophex	Wet Probe	6 to 12	67.856	3.49
449	EM	cart	Geophex	Wet Probe	12 to 24	74.606	1.141
449	EM	cart	Geophex	Wet Probe	24 to 36	61.8	1.197
449	EM	cart	Geophex	Wet Probe	36 to 48	49.561	4.433
449	EM	cart	Geophex	Woods	0 to 6	76.979	7.626
449	EM	cart	Geophex	Woods	6 to 12	66.536	3.353
449	EM	cart	Geophex	Woods	12 to 24	78.307	13.289
449	EM	cart	Geophex	Woods	24 to 36	73.057	12.473
449	EM	cart	Geophex	Woods	36 to 48	49.936	1.25
449	EM	cart	Geophex	Open Field	0 to 6	10.694	3.779
449	EM	cart	Geophex	Open Field	6 to 12	0.665	0.407
449	EM	cart	Geophex	Open Field	12 to 24	19.994	1.682
449	EM	cart	Geophex	Open Field	24 to 36	27.376	1.736
449	EM	cart	Geophex	Open Field	36 to 48	40.159	1.83
694	EM	cart	Geophex	Wet Probe	0 to 6	0	0
694	EM	cart	Geophex	Wet Probe	6 to 12	0	0
694	EM	cart	Geophex	Wet Probe	12 to 24	0	0
694	EM	cart	Geophex	Wet Probe	24 to 36	0	0
694	EM	cart	Geophex	Wet Probe	36 to 48	0	0
694	EM	cart	Geophex	Woods	0 to 6	0	0
694	EM	cart	Geophex	Woods	6 to 12	0	0
694	EM	cart	Geophex	Woods	12 to 24	0	0
694	EM	cart	Geophex	Woods	24 to 36	0	0
694	EM	cart	Geophex	Woods	36 to 48	0	0
694	EM	cart	Geophex	Open Field	0 to 6	0	0
694	EM	cart	Geophex	Open Field	6 to 12	0	0
694	EM	cart	Geophex	Open Field	12 to 24	0	0
694	EM	cart	Geophex	Open Field	24 to 36	0	0
694	EM	cart	Geophex	Open Field	36 to 48	0	0
694	EM	cart	Geophex	Calibration	0 to 6	5.125	0.323
694	EM	cart	Geophex	Calibration	6 to 12	36.525	0.233

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
694	EM	cart	Geophex	Calibration	12 to 24	49.963	0.245
694	EM	cart	Geophex	Calibration	24 to 36	43.588	0.457
694	EM	cart	Geophex	Calibration	36 to 48	38.425	0.338
694	EM	cart	Geophex	Blind Grid	0 to 6	2.812	0.344
694	EM	cart	Geophex	Blind Grid	6 to 12	23.125	0.367
694	EM	cart	Geophex	Blind Grid	12 to 24	36.625	0.402
694	EM	cart	Geophex	Blind Grid	24 to 36	33.95	0.48
694	EM	cart	Geophex	Blind Grid	36 to 48	38.137	0.409
739	EM	towed	Geophex	Wet Probe	0 to 6	4.317	1.025
739	EM	towed	Geophex	Wet Probe	6 to 12	7.708	1.787
739	EM	towed	Geophex	Wet Probe	12 to 24	14.808	3.109
739	EM	towed	Geophex	Wet Probe	24 to 36	4.242	1.096
739	EM	towed	Geophex	Wet Probe	36 to 48	4.367	1.091
739	EM	towed	Geophex	Woods	0 to 6	0	0
739	EM	towed	Geophex	Woods	6 to 12	0	0
739	EM	towed	Geophex	Woods	12 to 24	0	0
739	EM	towed	Geophex	Woods	24 to 36	0	0
739	EM	towed	Geophex	Woods	36 to 48	0	0
739	EM	towed	Geophex	Open Field	0 to 6	5.092	1.107
739	EM	towed	Geophex	Open Field	6 to 12	5.975	1.461
739	EM	towed	Geophex	Open Field	12 to 24	3.792	0.866
739	EM	towed	Geophex	Open Field	24 to 36	11.767	2.491
739	EM	towed	Geophex	Open Field	36 to 48	20.9	4.365
739	EM	towed	Geophex	Calibration	0 to 6	0.35	0.05
739	EM	towed	Geophex	Calibration	6 to 12	14.05	0.112
739	EM	towed	Geophex	Calibration	12 to 24	21.625	0.349
739	EM	towed	Geophex	Calibration	24 to 36	26.275	0.164
739	EM	towed	Geophex	Calibration	36 to 48	27.15	0.087
739	EM	towed	Geophex	Blind Grid	0 to 6	1.95	0.05
739	EM	towed	Geophex	Blind Grid	6 to 12	4.075	0.083
739	EM	towed	Geophex	Blind Grid	12 to 24	22.25	0.112
739	EM	towed	Geophex	Blind Grid	24 to 36	2.925	0.13
739	EM	towed	Geophex	Blind Grid	36 to 48	2.275	0.083
693	EM	cart	Geophex	Wet Probe	0 to 6	0	0
693	EM	cart	Geophex	Wet Probe	6 to 12	0	0
693	EM	cart	Geophex	Wet Probe	12 to 24	0	0
693	EM	cart	Geophex	Wet Probe	24 to 36	0	0
693	EM	cart	Geophex	Wet Probe	36 to 48	0	0
693	EM	cart	Geophex	Woods	0 to 6	0	0
693	EM	cart	Geophex	Woods	6 to 12	0	0
693	EM	cart	Geophex	Woods	12 to 24	0	0
693	EM	cart	Geophex	Woods	24 to 36	0	0
693	EM	cart	Geophex	Woods	36 to 48	0	0
693	EM	cart	Geophex	Open Field	0 to 6	0	0
693	EM	cart	Geophex	Open Field	6 to 12	0	0
693	EM	cart	Geophex	Open Field	12 to 24	0	0
693	EM	cart	Geophex	Open Field	24 to 36	0	0
693	EM	cart	Geophex	Open Field	36 to 48	0	0
693	EM	cart	Geophex	Calibration	0 to 6	5.125	0.323
693	EM	cart	Geophex	Calibration	6 to 12	36.525	0.233

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
693	EM	cart	Geophex	Calibration	12 to 24	49.963	0.245
693	EM	cart	Geophex	Calibration	24 to 36	43.588	0.457
693	EM	cart	Geophex	Calibration	36 to 48	38.425	0.338
693	EM	cart	Geophex	Blind Grid	0 to 6	2.812	0.344
693	EM	cart	Geophex	Blind Grid	6 to 12	23.125	0.367
693	EM	cart	Geophex	Blind Grid	12 to 24	36.625	0.402
693	EM	cart	Geophex	Blind Grid	24 to 36	33.95	0.48
693	EM	cart	Geophex	Blind Grid	36 to 48	38.137	0.409
740	EM	towed	Geophex	Wet Probe	0 to 6	4.317	1.025
740	EM	towed	Geophex	Wet Probe	6 to 12	7.708	1.787
740	EM	towed	Geophex	Wet Probe	12 to 24	14.808	3.109
740	EM	towed	Geophex	Wet Probe	24 to 36	4.242	1.096
740	EM	towed	Geophex	Wet Probe	36 to 48	4.367	1.091
740	EM	towed	Geophex	Woods	0 to 6	0	0
740	EM	towed	Geophex	Woods	6 to 12	0	0
740	EM	towed	Geophex	Woods	12 to 24	0	0
740	EM	towed	Geophex	Woods	24 to 36	0	0
740	EM	towed	Geophex	Woods	36 to 48	0	0
740	EM	towed	Geophex	Open Field	0 to 6	5.092	1.107
740	EM	towed	Geophex	Open Field	6 to 12	5.975	1.461
740	EM	towed	Geophex	Open Field	12 to 24	3.792	0.866
740	EM	towed	Geophex	Open Field	24 to 36	11.767	2.491
740	EM	towed	Geophex	Open Field	36 to 48	20.9	4.365
740	EM	towed	Geophex	Calibration	0 to 6	0.35	0.05
740	EM	towed	Geophex	Calibration	6 to 12	14.05	0.112
740	EM	towed	Geophex	Calibration	12 to 24	21.625	0.349
740	EM	towed	Geophex	Calibration	24 to 36	26.275	0.164
740	EM	towed	Geophex	Calibration	36 to 48	27.15	0.087
740	EM	towed	Geophex	Blind Grid	0 to 6	1.95	0.05
740	EM	towed	Geophex	Blind Grid	6 to 12	4.075	0.083
740	EM	towed	Geophex	Blind Grid	12 to 24	22.25	0.112
740	EM	towed	Geophex	Blind Grid	24 to 36	2.925	0.13
740	EM	towed	Geophex	Blind Grid	36 to 48	2.275	0.083
184	EM	hand	G-TEK	Wet Probe	0 to 6	70.858	6.235
184	EM	hand	G-TEK	Wet Probe	6 to 12	73.775	1.371
184	EM	hand	G-TEK	Wet Probe	12 to 24	71.592	2.525
184	EM	hand	G-TEK	Wet Probe	24 to 36	53.083	0.906
184	EM	hand	G-TEK	Wet Probe	36 to 48	49.192	0.671
184	EM	hand	G-TEK	Woods	0 to 6	12.033	0.149
184	EM	hand	G-TEK	Woods	6 to 12	6	0.516
184	EM	hand	G-TEK	Woods	12 to 24	4.583	0.227
184	EM	hand	G-TEK	Woods	24 to 36	52.1	0.424
184	EM	hand	G-TEK	Woods	36 to 48	54.483	0.414
184	EM	hand	G-TEK	Open Field	0 to 6	15.9	3.209
184	EM	hand	G-TEK	Open Field	6 to 12	1.908	2.029
184	EM	hand	G-TEK	Open Field	12 to 24	17.1	1.922
184	EM	hand	G-TEK	Open Field	24 to 36	22.3	1.888
184	EM	hand	G-TEK	Open Field	36 to 48	31.8	8.579
184	EM	hand	G-TEK	Calibration	0 to 6	39.35	0.15
184	EM	hand	G-TEK	Calibration	6 to 12	36.95	0.75

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
184	EM	hand	G-TEK	Calibration	12 to 24	0.65	0.15
184	EM	hand	G-TEK	Calibration	24 to 36	4.3	0.2
184	EM	hand	G-TEK	Calibration	36 to 48	4.2	0.4
184	EM	hand	G-TEK	Blind Grid	0 to 6	4.071	0.587
184	EM	hand	G-TEK	Blind Grid	6 to 12	11.514	4.854
184	EM	hand	G-TEK	Blind Grid	12 to 24	35.071	0.641
184	EM	hand	G-TEK	Blind Grid	24 to 36	36.3	0.293
184	EM	hand	G-TEK	Blind Grid	36 to 48	38.314	0.36
183	EM	sling	G-TEK	Wet Probe	0 to 6	70.858	6.235
183	EM	sling	G-TEK	Wet Probe	6 to 12	73.775	1.371
183	EM	sling	G-TEK	Wet Probe	12 to 24	71.592	2.525
183	EM	sling	G-TEK	Wet Probe	24 to 36	53.083	0.906
183	EM	sling	G-TEK	Wet Probe	36 to 48	49.192	0.671
183	EM	sling	G-TEK	Woods	0 to 6	12.033	0.149
183	EM	sling	G-TEK	Woods	6 to 12	6	0.516
183	EM	sling	G-TEK	Woods	12 to 24	4.583	0.227
183	EM	sling	G-TEK	Woods	24 to 36	52.1	0.424
183	EM	sling	G-TEK	Woods	36 to 48	54.483	0.414
183	EM	sling	G-TEK	Open Field	0 to 6	15.9	3.209
183	EM	sling	G-TEK	Open Field	6 to 12	1.908	2.029
183	EM	sling	G-TEK	Open Field	12 to 24	17.1	1.922
183	EM	sling	G-TEK	Open Field	24 to 36	22.3	1.888
183	EM	sling	G-TEK	Open Field	36 to 48	31.8	8.579
183	EM	sling	G-TEK	Calibration	0 to 6	39.35	0.15
183	EM	sling	G-TEK	Calibration	6 to 12	36.95	0.75
183	EM	sling	G-TEK	Calibration	12 to 24	0.65	0.15
183	EM	sling	G-TEK	Calibration	24 to 36	4.3	0.2
183	EM	sling	G-TEK	Calibration	36 to 48	4.2	0.4
183	EM	sling	G-TEK	Blind Grid	0 to 6	4.071	0.587
183	EM	sling	G-TEK	Blind Grid	6 to 12	11.514	4.854
183	EM	sling	G-TEK	Blind Grid	12 to 24	35.071	0.641
183	EM	sling	G-TEK	Blind Grid	24 to 36	36.3	0.293
183	EM	sling	G-TEK	Blind Grid	36 to 48	38.314	0.36
545	EM	sling	G-TEK	Wet Probe	0 to 6	70.858	6.235
545	EM	sling	G-TEK	Wet Probe	6 to 12	73.775	1.371
545	EM	sling	G-TEK	Wet Probe	12 to 24	71.592	2.525
545	EM	sling	G-TEK	Wet Probe	24 to 36	53.083	0.906
545	EM	sling	G-TEK	Wet Probe	36 to 48	49.192	0.671
545	EM	sling	G-TEK	Woods	0 to 6	12.033	0.149
545	EM	sling	G-TEK	Woods	6 to 12	6	0.516
545	EM	sling	G-TEK	Woods	12 to 24	4.583	0.227
545	EM	sling	G-TEK	Woods	24 to 36	52.1	0.424
545	EM	sling	G-TEK	Woods	36 to 48	54.483	0.414
545	EM	sling	G-TEK	Open Field	0 to 6	15.9	3.209
545	EM	sling	G-TEK	Open Field	6 to 12	1.908	2.029
545	EM	sling	G-TEK	Open Field	12 to 24	17.1	1.922
545	EM	sling	G-TEK	Open Field	24 to 36	22.3	1.888
545	EM	sling	G-TEK	Open Field	36 to 48	31.8	8.579
545	EM	sling	G-TEK	Calibration	0 to 6	39.35	0.15
545	EM	sling	G-TEK	Calibration	6 to 12	36.95	0.75

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
545	EM	sling	G-TEK	Calibration	12 to 24	0.65	0.15
545	EM	sling	G-TEK	Calibration	24 to 36	4.3	0.2
545	EM	sling	G-TEK	Calibration	36 to 48	4.2	0.4
545	EM	sling	G-TEK	Blind Grid	0 to 6	4.071	0.587
545	EM	sling	G-TEK	Blind Grid	6 to 12	11.514	4.854
545	EM	sling	G-TEK	Blind Grid	12 to 24	35.071	0.641
545	EM	sling	G-TEK	Blind Grid	24 to 36	36.3	0.293
545	EM	sling	G-TEK	Blind Grid	36 to 48	38.314	0.36
154	EM	sling	G-TEK	Wet Probe	0 to 6	70.858	6.235
154	EM	sling	G-TEK	Wet Probe	6 to 12	73.775	1.371
154	EM	sling	G-TEK	Wet Probe	12 to 24	71.592	2.525
154	EM	sling	G-TEK	Wet Probe	24 to 36	53.083	0.906
154	EM	sling	G-TEK	Wet Probe	36 to 48	49.192	0.671
154	EM	sling	G-TEK	Woods	0 to 6	12.033	0.149
154	EM	sling	G-TEK	Woods	6 to 12	6	0.516
154	EM	sling	G-TEK	Woods	12 to 24	4.583	0.227
154	EM	sling	G-TEK	Woods	24 to 36	52.1	0.424
154	EM	sling	G-TEK	Woods	36 to 48	54.483	0.414
154	EM	sling	G-TEK	Open Field	0 to 6	15.9	3.209
154	EM	sling	G-TEK	Open Field	6 to 12	1.908	2.029
154	EM	sling	G-TEK	Open Field	12 to 24	17.1	1.922
154	EM	sling	G-TEK	Open Field	24 to 36	22.3	1.888
154	EM	sling	G-TEK	Open Field	36 to 48	31.8	8.579
154	EM	sling	G-TEK	Calibration	0 to 6	39.35	0.15
154	EM	sling	G-TEK	Calibration	6 to 12	36.95	0.75
154	EM	sling	G-TEK	Calibration	12 to 24	0.65	0.15
154	EM	sling	G-TEK	Calibration	24 to 36	4.3	0.2
154	EM	sling	G-TEK	Calibration	36 to 48	4.2	0.4
154	EM	sling	G-TEK	Blind Grid	0 to 6	4.071	0.587
154	EM	sling	G-TEK	Blind Grid	6 to 12	11.514	4.854
154	EM	sling	G-TEK	Blind Grid	12 to 24	35.071	0.641
154	EM	sling	G-TEK	Blind Grid	24 to 36	36.3	0.293
154	EM	sling	G-TEK	Blind Grid	36 to 48	38.314	0.36
452	EM	hand	G-TEK	Wet Probe	0 to 6	70.858	6.235
452	EM	hand	G-TEK	Wet Probe	6 to 12	73.775	1.371
452	EM	hand	G-TEK	Wet Probe	12 to 24	71.592	2.525
452	EM	hand	G-TEK	Wet Probe	24 to 36	53.083	0.906
452	EM	hand	G-TEK	Wet Probe	36 to 48	49.192	0.671
452	EM	hand	G-TEK	Woods	0 to 6	12.033	0.149
452	EM	hand	G-TEK	Woods	6 to 12	6	0.516
452	EM	hand	G-TEK	Woods	12 to 24	4.583	0.227
452	EM	hand	G-TEK	Woods	24 to 36	52.1	0.424
452	EM	hand	G-TEK	Woods	36 to 48	54.483	0.414
452	EM	hand	G-TEK	Open Field	0 to 6	15.9	3.209
452	EM	hand	G-TEK	Open Field	6 to 12	1.908	2.029
452	EM	hand	G-TEK	Open Field	12 to 24	17.1	1.922
452	EM	hand	G-TEK	Open Field	24 to 36	22.3	1.888
452	EM	hand	G-TEK	Open Field	36 to 48	31.8	8.579
452	EM	hand	G-TEK	Calibration	0 to 6	39.35	0.15
452	EM	hand	G-TEK	Calibration	6 to 12	36.95	0.75

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
452	EM	hand	G-TEK	Calibration	12 to 24	0.65	0.15
452	EM	hand	G-TEK	Calibration	24 to 36	4.3	0.2
452	EM	hand	G-TEK	Calibration	36 to 48	4.2	0.4
452	EM	hand	G-TEK	Blind Grid	0 to 6	4.071	0.587
452	EM	hand	G-TEK	Blind Grid	6 to 12	11.514	4.854
452	EM	hand	G-TEK	Blind Grid	12 to 24	35.071	0.641
452	EM	hand	G-TEK	Blind Grid	24 to 36	36.3	0.293
452	EM	hand	G-TEK	Blind Grid	36 to 48	38.314	0.36
268	MAG	sling	G-TEK	Wet Probe	0 to 6	70.858	6.235
268	MAG	sling	G-TEK	Wet Probe	6 to 12	73.775	1.371
268	MAG	sling	G-TEK	Wet Probe	12 to 24	71.592	2.525
268	MAG	sling	G-TEK	Wet Probe	24 to 36	53.083	0.906
268	MAG	sling	G-TEK	Wet Probe	36 to 48	49.192	0.671
268	MAG	sling	G-TEK	Woods	0 to 6	12.033	0.149
268	MAG	sling	G-TEK	Woods	6 to 12	6	0.516
268	MAG	sling	G-TEK	Woods	12 to 24	4.583	0.227
268	MAG	sling	G-TEK	Woods	24 to 36	52.1	0.424
268	MAG	sling	G-TEK	Woods	36 to 48	54.483	0.414
268	MAG	sling	G-TEK	Open Field	0 to 6	15.9	3.209
268	MAG	sling	G-TEK	Open Field	6 to 12	1.908	2.029
268	MAG	sling	G-TEK	Open Field	12 to 24	17.1	1.922
268	MAG	sling	G-TEK	Open Field	24 to 36	22.3	1.888
268	MAG	sling	G-TEK	Open Field	36 to 48	31.8	8.579
268	MAG	sling	G-TEK	Calibration	0 to 6	39.35	0.15
268	MAG	sling	G-TEK	Calibration	6 to 12	36.95	0.75
268	MAG	sling	G-TEK	Calibration	12 to 24	0.65	0.15
268	MAG	sling	G-TEK	Calibration	24 to 36	4.3	0.2
268	MAG	sling	G-TEK	Calibration	36 to 48	4.2	0.4
268	MAG	sling	G-TEK	Blind Grid	0 to 6	4.071	0.587
268	MAG	sling	G-TEK	Blind Grid	6 to 12	11.514	4.854
268	MAG	sling	G-TEK	Blind Grid	12 to 24	35.071	0.641
268	MAG	sling	G-TEK	Blind Grid	24 to 36	36.3	0.293
268	MAG	sling	G-TEK	Blind Grid	36 to 48	38.314	0.36
547	MAG	sling	G-TEK	Wet Probe	0 to 6	70.858	6.235
547	MAG	sling	G-TEK	Wet Probe	6 to 12	73.775	1.371
547	MAG	sling	G-TEK	Wet Probe	12 to 24	71.592	2.525
547	MAG	sling	G-TEK	Wet Probe	24 to 36	53.083	0.906
547	MAG	sling	G-TEK	Wet Probe	36 to 48	49.192	0.671
547	MAG	sling	G-TEK	Woods	0 to 6	12.033	0.149
547	MAG	sling	G-TEK	Woods	6 to 12	6	0.516
547	MAG	sling	G-TEK	Woods	12 to 24	4.583	0.227
547	MAG	sling	G-TEK	Woods	24 to 36	52.1	0.424
547	MAG	sling	G-TEK	Woods	36 to 48	54.483	0.414
547	MAG	sling	G-TEK	Open Field	0 to 6	15.9	3.209
547	MAG	sling	G-TEK	Open Field	6 to 12	1.908	2.029
547	MAG	sling	G-TEK	Open Field	12 to 24	17.1	1.922
547	MAG	sling	G-TEK	Open Field	24 to 36	22.3	1.888
547	MAG	sling	G-TEK	Open Field	36 to 48	31.8	8.579
547	MAG	sling	G-TEK	Calibration	0 to 6	39.35	0.15
547	MAG	sling	G-TEK	Calibration	6 to 12	36.95	0.75

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
547	MAG	sling	G-TEK	Calibration	12 to 24	0.65	0.15
547	MAG	sling	G-TEK	Calibration	24 to 36	4.3	0.2
547	MAG	sling	G-TEK	Calibration	36 to 48	4.2	0.4
547	MAG	sling	G-TEK	Blind Grid	0 to 6	4.071	0.587
547	MAG	sling	G-TEK	Blind Grid	6 to 12	11.514	4.854
547	MAG	sling	G-TEK	Blind Grid	12 to 24	35.071	0.641
547	MAG	sling	G-TEK	Blind Grid	24 to 36	36.3	0.293
547	MAG	sling	G-TEK	Blind Grid	36 to 48	38.314	0.36
311	MAG	sling	G-TEK	Wet Probe	0 to 6	70.858	6.235
311	MAG	sling	G-TEK	Wet Probe	6 to 12	73.775	1.371
311	MAG	sling	G-TEK	Wet Probe	12 to 24	71.592	2.525
311	MAG	sling	G-TEK	Wet Probe	24 to 36	53.083	0.906
311	MAG	sling	G-TEK	Wet Probe	36 to 48	49.192	0.671
311	MAG	sling	G-TEK	Woods	0 to 6	12.033	0.149
311	MAG	sling	G-TEK	Woods	6 to 12	6	0.516
311	MAG	sling	G-TEK	Woods	12 to 24	4.583	0.227
311	MAG	sling	G-TEK	Woods	24 to 36	52.1	0.424
311	MAG	sling	G-TEK	Woods	36 to 48	54.483	0.414
311	MAG	sling	G-TEK	Open Field	0 to 6	15.9	3.209
311	MAG	sling	G-TEK	Open Field	6 to 12	1.908	2.029
311	MAG	sling	G-TEK	Open Field	12 to 24	17.1	1.922
311	MAG	sling	G-TEK	Open Field	24 to 36	22.3	1.888
311	MAG	sling	G-TEK	Open Field	36 to 48	31.8	8.579
311	MAG	sling	G-TEK	Calibration	0 to 6	39.35	0.15
311	MAG	sling	G-TEK	Calibration	6 to 12	36.95	0.75
311	MAG	sling	G-TEK	Calibration	12 to 24	0.65	0.15
311	MAG	sling	G-TEK	Calibration	24 to 36	4.3	0.2
311	MAG	sling	G-TEK	Calibration	36 to 48	4.2	0.4
311	MAG	sling	G-TEK	Blind Grid	0 to 6	4.071	0.587
311	MAG	sling	G-TEK	Blind Grid	6 to 12	11.514	4.854
311	MAG	sling	G-TEK	Blind Grid	12 to 24	35.071	0.641
311	MAG	sling	G-TEK	Blind Grid	24 to 36	36.3	0.293
311	MAG	sling	G-TEK	Blind Grid	36 to 48	38.314	0.36
454	MAG	sling	G-TEK	Wet Probe	0 to 6	70.858	6.235
454	MAG	sling	G-TEK	Wet Probe	6 to 12	73.775	1.371
454	MAG	sling	G-TEK	Wet Probe	12 to 24	71.592	2.525
454	MAG	sling	G-TEK	Wet Probe	24 to 36	53.083	0.906
454	MAG	sling	G-TEK	Wet Probe	36 to 48	49.192	0.671
454	MAG	sling	G-TEK	Woods	0 to 6	12.033	0.149
454	MAG	sling	G-TEK	Woods	6 to 12	6	0.516
454	MAG	sling	G-TEK	Woods	12 to 24	4.583	0.227
454	MAG	sling	G-TEK	Woods	24 to 36	52.1	0.424
454	MAG	sling	G-TEK	Woods	36 to 48	54.483	0.414
454	MAG	sling	G-TEK	Open Field	0 to 6	15.9	3.209
454	MAG	sling	G-TEK	Open Field	6 to 12	1.908	2.029
454	MAG	sling	G-TEK	Open Field	12 to 24	17.1	1.922
454	MAG	sling	G-TEK	Open Field	24 to 36	22.3	1.888
454	MAG	sling	G-TEK	Open Field	36 to 48	31.8	8.579
454	MAG	sling	G-TEK	Calibration	0 to 6	39.35	0.15
454	MAG	sling	G-TEK	Calibration	6 to 12	36.95	0.75

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
454	MAG	sling	G-TEK	Calibration	12 to 24	0.65	0.15
454	MAG	sling	G-TEK	Calibration	24 to 36	4.3	0.2
454	MAG	sling	G-TEK	Calibration	36 to 48	4.2	0.4
454	MAG	sling	G-TEK	Blind Grid	0 to 6	4.071	0.587
454	MAG	sling	G-TEK	Blind Grid	6 to 12	11.514	4.854
454	MAG	sling	G-TEK	Blind Grid	12 to 24	35.071	0.641
454	MAG	sling	G-TEK	Blind Grid	24 to 36	36.3	0.293
454	MAG	sling	G-TEK	Blind Grid	36 to 48	38.314	0.36
281	dual	sling	G-TEK	Wet Probe	0 to 6	58.99	2.85
281	dual	sling	G-TEK	Wet Probe	6 to 12	74.65	4.932
281	dual	sling	G-TEK	Wet Probe	12 to 24	76.88	0.807
281	dual	sling	G-TEK	Wet Probe	24 to 36	58.6	6.273
281	dual	sling	G-TEK	Wet Probe	36 to 48	51.06	1.589
281	dual	sling	G-TEK	Woods	0 to 6	15.233	0.125
281	dual	sling	G-TEK	Woods	6 to 12	6.233	0.249
281	dual	sling	G-TEK	Woods	12 to 24	4.817	0.241
281	dual	sling	G-TEK	Woods	24 to 36	52.933	0.461
281	dual	sling	G-TEK	Woods	36 to 48	55.35	0.594
281	dual	sling	G-TEK	Open Field	0 to 6	21.29	0.277
281	dual	sling	G-TEK	Open Field	6 to 12	5.97	0.287
281	dual	sling	G-TEK	Open Field	12 to 24	19.35	0.766
281	dual	sling	G-TEK	Open Field	24 to 36	27.98	0.584
281	dual	sling	G-TEK	Open Field	36 to 48	52.59	0.375
281	dual	sling	G-TEK	Calibration	0 to 6	39.1	0.1
281	dual	sling	G-TEK	Calibration	6 to 12	37.75	0.25
281	dual	sling	G-TEK	Calibration	12 to 24	1.55	0.05
281	dual	sling	G-TEK	Calibration	24 to 36	4.15	0.05
281	dual	sling	G-TEK	Calibration	36 to 48	5.4	0.1
281	dual	sling	G-TEK	Blind Grid	0 to 6	3.283	0.203
281	dual	sling	G-TEK	Blind Grid	6 to 12	23.75	0.275
281	dual	sling	G-TEK	Blind Grid	12 to 24	37.65	0.754
281	dual	sling	G-TEK	Blind Grid	24 to 36	35.983	0.811
281	dual	sling	G-TEK	Blind Grid	36 to 48	38.317	0.241
380	dual	sling	G-TEK	Wet Probe	0 to 6	58.99	2.85
380	dual	sling	G-TEK	Wet Probe	6 to 12	74.65	4.932
380	dual	sling	G-TEK	Wet Probe	12 to 24	76.88	0.807
380	dual	sling	G-TEK	Wet Probe	24 to 36	58.6	6.273
380	dual	sling	G-TEK	Wet Probe	36 to 48	51.06	1.589
380	dual	sling	G-TEK	Woods	0 to 6	15.233	0.125
380	dual	sling	G-TEK	Woods	6 to 12	6.233	0.249
380	dual	sling	G-TEK	Woods	12 to 24	4.817	0.241
380	dual	sling	G-TEK	Woods	24 to 36	52.933	0.461
380	dual	sling	G-TEK	Woods	36 to 48	55.35	0.594
380	dual	sling	G-TEK	Open Field	0 to 6	21.29	0.277
380	dual	sling	G-TEK	Open Field	6 to 12	5.97	0.287
380	dual	sling	G-TEK	Open Field	12 to 24	19.35	0.766
380	dual	sling	G-TEK	Open Field	24 to 36	27.98	0.584
380	dual	sling	G-TEK	Open Field	36 to 48	52.59	0.375
380	dual	sling	G-TEK	Calibration	0 to 6	39.1	0.1
380	dual	sling	G-TEK	Calibration	6 to 12	37.75	0.25

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
380	dual	sling	G-TEK	Calibration	12 to 24	1.55	0.05
380	dual	sling	G-TEK	Calibration	24 to 36	4.15	0.05
380	dual	sling	G-TEK	Calibration	36 to 48	5.4	0.1
380	dual	sling	G-TEK	Blind Grid	0 to 6	3.283	0.203
380	dual	sling	G-TEK	Blind Grid	6 to 12	23.75	0.275
380	dual	sling	G-TEK	Blind Grid	12 to 24	37.65	0.754
380	dual	sling	G-TEK	Blind Grid	24 to 36	35.983	0.811
380	dual	sling	G-TEK	Blind Grid	36 to 48	38.317	0.241
379	dual	sling	G-TEK	Wet Probe	0 to 6	58.99	2.85
379	dual	sling	G-TEK	Wet Probe	6 to 12	74.65	4.932
379	dual	sling	G-TEK	Wet Probe	12 to 24	76.88	0.807
379	dual	sling	G-TEK	Wet Probe	24 to 36	58.6	6.273
379	dual	sling	G-TEK	Wet Probe	36 to 48	51.06	1.589
379	dual	sling	G-TEK	Woods	0 to 6	15.233	0.125
379	dual	sling	G-TEK	Woods	6 to 12	6.233	0.249
379	dual	sling	G-TEK	Woods	12 to 24	4.817	0.241
379	dual	sling	G-TEK	Woods	24 to 36	52.933	0.461
379	dual	sling	G-TEK	Woods	36 to 48	55.35	0.594
379	dual	sling	G-TEK	Open Field	0 to 6	21.29	0.277
379	dual	sling	G-TEK	Open Field	6 to 12	5.97	0.287
379	dual	sling	G-TEK	Open Field	12 to 24	19.35	0.766
379	dual	sling	G-TEK	Open Field	24 to 36	27.98	0.584
379	dual	sling	G-TEK	Open Field	36 to 48	52.59	0.375
379	dual	sling	G-TEK	Calibration	0 to 6	39.1	0.1
379	dual	sling	G-TEK	Calibration	6 to 12	37.75	0.25
379	dual	sling	G-TEK	Calibration	12 to 24	1.55	0.05
379	dual	sling	G-TEK	Calibration	24 to 36	4.15	0.05
379	dual	sling	G-TEK	Calibration	36 to 48	5.4	0.1
379	dual	sling	G-TEK	Blind Grid	0 to 6	3.283	0.203
379	dual	sling	G-TEK	Blind Grid	6 to 12	23.75	0.275
379	dual	sling	G-TEK	Blind Grid	12 to 24	37.65	0.754
379	dual	sling	G-TEK	Blind Grid	24 to 36	35.983	0.811
379	dual	sling	G-TEK	Blind Grid	36 to 48	38.317	0.241
381	dual	sling	G-TEK	Wet Probe	0 to 6	58.99	2.85
381	dual	sling	G-TEK	Wet Probe	6 to 12	74.65	4.932
381	dual	sling	G-TEK	Wet Probe	12 to 24	76.88	0.807
381	dual	sling	G-TEK	Wet Probe	24 to 36	58.6	6.273
381	dual	sling	G-TEK	Wet Probe	36 to 48	51.06	1.589
381	dual	sling	G-TEK	Woods	0 to 6	15.233	0.125
381	dual	sling	G-TEK	Woods	6 to 12	6.233	0.249
381	dual	sling	G-TEK	Woods	12 to 24	4.817	0.241
381	dual	sling	G-TEK	Woods	24 to 36	52.933	0.461
381	dual	sling	G-TEK	Woods	36 to 48	55.35	0.594
381	dual	sling	G-TEK	Open Field	0 to 6	21.29	0.277
381	dual	sling	G-TEK	Open Field	6 to 12	5.97	0.287
381	dual	sling	G-TEK	Open Field	12 to 24	19.35	0.766
381	dual	sling	G-TEK	Open Field	24 to 36	27.98	0.584
381	dual	sling	G-TEK	Open Field	36 to 48	52.59	0.375
381	dual	sling	G-TEK	Calibration	0 to 6	39.1	0.1
381	dual	sling	G-TEK	Calibration	6 to 12	37.75	0.25

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
381	dual	sling	G-TEK	Calibration	12 to 24	1.55	0.05
381	dual	sling	G-TEK	Calibration	24 to 36	4.15	0.05
381	dual	sling	G-TEK	Calibration	36 to 48	5.4	0.1
381	dual	sling	G-TEK	Blind Grid	0 to 6	3.283	0.203
381	dual	sling	G-TEK	Blind Grid	6 to 12	23.75	0.275
381	dual	sling	G-TEK	Blind Grid	12 to 24	37.65	0.754
381	dual	sling	G-TEK	Blind Grid	24 to 36	35.983	0.811
381	dual	sling	G-TEK	Blind Grid	36 to 48	38.317	0.241
237	MAG	hand	HFA	Wet Probe	0 to 6	64.138	1.283
237	MAG	hand	HFA	Wet Probe	6 to 12	75.121	1.556
237	MAG	hand	HFA	Wet Probe	12 to 24	79.214	0.827
237	MAG	hand	HFA	Wet Probe	24 to 36	59.666	2.15
237	MAG	hand	HFA	Wet Probe	36 to 48	52.931	2.22
237	MAG	hand	HFA	Woods	0 to 6	14.7	0.255
237	MAG	hand	HFA	Woods	6 to 12	6.1	0.122
237	MAG	hand	HFA	Woods	12 to 24	5.875	0.043
237	MAG	hand	HFA	Woods	24 to 36	54.5	0.274
237	MAG	hand	HFA	Woods	36 to 48	57.225	0.217
237	MAG	hand	HFA	Open Field	0 to 6	21.352	1.172
237	MAG	hand	HFA	Open Field	6 to 12	7.431	1.139
237	MAG	hand	HFA	Open Field	12 to 24	22.11	2.682
237	MAG	hand	HFA	Open Field	24 to 36	26.597	0.965
237	MAG	hand	HFA	Open Field	36 to 48	56.855	2.603
237	MAG	hand	HFA	Calibration	0 to 6	0	0
237	MAG	hand	HFA	Calibration	6 to 12	0	0
237	MAG	hand	HFA	Calibration	12 to 24	0	0
237	MAG	hand	HFA	Calibration	24 to 36	0	0
237	MAG	hand	HFA	Calibration	36 to 48	0	0
237	MAG	hand	HFA	Blind Grid	0 to 6	4.16	0.602
237	MAG	hand	HFA	Blind Grid	6 to 12	12.64	10.012
237	MAG	hand	HFA	Blind Grid	12 to 24	20.18	15.613
237	MAG	hand	HFA	Blind Grid	24 to 36	36.76	0.692
237	MAG	hand	HFA	Blind Grid	36 to 48	39.76	0.185
676	MAG	hand	HFA	Wet Probe	0 to 6	64.138	1.283
676	MAG	hand	HFA	Wet Probe	6 to 12	75.121	1.556
676	MAG	hand	HFA	Wet Probe	12 to 24	79.214	0.827
676	MAG	hand	HFA	Wet Probe	24 to 36	59.666	2.15
676	MAG	hand	HFA	Wet Probe	36 to 48	52.931	2.22
676	MAG	hand	HFA	Woods	0 to 6	14.7	0.255
676	MAG	hand	HFA	Woods	6 to 12	6.1	0.122
676	MAG	hand	HFA	Woods	12 to 24	5.875	0.043
676	MAG	hand	HFA	Woods	24 to 36	54.5	0.274
676	MAG	hand	HFA	Woods	36 to 48	57.225	0.217
676	MAG	hand	HFA	Open Field	0 to 6	21.352	1.172
676	MAG	hand	HFA	Open Field	6 to 12	7.431	1.139
676	MAG	hand	HFA	Open Field	12 to 24	22.11	2.682
676	MAG	hand	HFA	Open Field	24 to 36	26.597	0.965
676	MAG	hand	HFA	Open Field	36 to 48	56.855	2.603
676	MAG	hand	HFA	Calibration	0 to 6	0	0
676	MAG	hand	HFA	Calibration	6 to 12	0	0

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
676	MAG	hand	HFA	Calibration	12 to 24	0	0
676	MAG	hand	HFA	Calibration	24 to 36	0	0
676	MAG	hand	HFA	Calibration	36 to 48	0	0
676	MAG	hand	HFA	Blind Grid	0 to 6	4.16	0.602
676	MAG	hand	HFA	Blind Grid	6 to 12	12.64	10.012
676	MAG	hand	HFA	Blind Grid	12 to 24	20.18	15.613
676	MAG	hand	HFA	Blind Grid	24 to 36	36.76	0.692
676	MAG	hand	HFA	Blind Grid	36 to 48	39.76	0.185
231	MAG	hand	HFA	Wet Probe	0 to 6	64.138	1.283
231	MAG	hand	HFA	Wet Probe	6 to 12	75.121	1.556
231	MAG	hand	HFA	Wet Probe	12 to 24	79.214	0.827
231	MAG	hand	HFA	Wet Probe	24 to 36	59.666	2.15
231	MAG	hand	HFA	Wet Probe	36 to 48	52.931	2.22
231	MAG	hand	HFA	Woods	0 to 6	14.7	0.255
231	MAG	hand	HFA	Woods	6 to 12	6.1	0.122
231	MAG	hand	HFA	Woods	12 to 24	5.875	0.043
231	MAG	hand	HFA	Woods	24 to 36	54.5	0.274
231	MAG	hand	HFA	Woods	36 to 48	57.225	0.217
231	MAG	hand	HFA	Open Field	0 to 6	20.569	3.994
231	MAG	hand	HFA	Open Field	6 to 12	7.436	1.159
231	MAG	hand	HFA	Open Field	12 to 24	22.218	2.667
231	MAG	hand	HFA	Open Field	24 to 36	26.593	0.982
231	MAG	hand	HFA	Open Field	36 to 48	56.979	2.564
231	MAG	hand	HFA	Calibration	0 to 6	0	0
231	MAG	hand	HFA	Calibration	6 to 12	0	0
231	MAG	hand	HFA	Calibration	12 to 24	0	0
231	MAG	hand	HFA	Calibration	24 to 36	0	0
231	MAG	hand	HFA	Calibration	36 to 48	0	0
231	MAG	hand	HFA	Blind Grid	0 to 6	4.16	0.602
231	MAG	hand	HFA	Blind Grid	6 to 12	12.64	10.012
231	MAG	hand	HFA	Blind Grid	12 to 24	20.18	15.613
231	MAG	hand	HFA	Blind Grid	24 to 36	36.76	0.692
231	MAG	hand	HFA	Blind Grid	36 to 48	39.76	0.185
486	MAG	hand	HFA	Wet Probe	0 to 6	64.138	1.283
486	MAG	hand	HFA	Wet Probe	6 to 12	75.121	1.556
486	MAG	hand	HFA	Wet Probe	12 to 24	79.214	0.827
486	MAG	hand	HFA	Wet Probe	24 to 36	59.666	2.15
486	MAG	hand	HFA	Wet Probe	36 to 48	52.931	2.22
486	MAG	hand	HFA	Woods	0 to 6	14.7	0.255
486	MAG	hand	HFA	Woods	6 to 12	6.1	0.122
486	MAG	hand	HFA	Woods	12 to 24	5.875	0.043
486	MAG	hand	HFA	Woods	24 to 36	54.5	0.274
486	MAG	hand	HFA	Woods	36 to 48	57.225	0.217
486	MAG	hand	HFA	Open Field	0 to 6	21.352	1.172
486	MAG	hand	HFA	Open Field	6 to 12	7.431	1.139
486	MAG	hand	HFA	Open Field	12 to 24	22.11	2.682
486	MAG	hand	HFA	Open Field	24 to 36	26.597	0.965
486	MAG	hand	HFA	Open Field	36 to 48	56.855	2.603
486	MAG	hand	HFA	Calibration	0 to 6	0	0
486	MAG	hand	HFA	Calibration	6 to 12	0	0

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
486	MAG	hand	HFA	Calibration	12 to 24	0	0
486	MAG	hand	HFA	Calibration	24 to 36	0	0
486	MAG	hand	HFA	Calibration	36 to 48	0	0
486	MAG	hand	HFA	Blind Grid	0 to 6	4.16	0.602
486	MAG	hand	HFA	Blind Grid	6 to 12	12.64	10.012
486	MAG	hand	HFA	Blind Grid	12 to 24	20.18	15.613
486	MAG	hand	HFA	Blind Grid	24 to 36	36.76	0.692
486	MAG	hand	HFA	Blind Grid	36 to 48	39.76	0.185
647	EM	towed	NAEVA	Wet Probe	0 to 6	66.909	0.761
647	EM	towed	NAEVA	Wet Probe	6 to 12	75.791	0.723
647	EM	towed	NAEVA	Wet Probe	12 to 24	79.373	0.277
647	EM	towed	NAEVA	Wet Probe	24 to 36	55.273	0.305
647	EM	towed	NAEVA	Wet Probe	36 to 48	53.264	0.503
647	EM	towed	NAEVA	Woods	0 to 6	14.45	0.206
647	EM	towed	NAEVA	Woods	6 to 12	5.425	0.192
647	EM	towed	NAEVA	Woods	12 to 24	5.55	0.166
647	EM	towed	NAEVA	Woods	24 to 36	55.5	0.316
647	EM	towed	NAEVA	Woods	36 to 48	57.675	0.179
647	EM	towed	NAEVA	Open Field	0 to 6	23.436	1.077
647	EM	towed	NAEVA	Open Field	6 to 12	6.473	0.289
647	EM	towed	NAEVA	Open Field	12 to 24	19.473	0.2
647	EM	towed	NAEVA	Open Field	24 to 36	27.091	0.557
647	EM	towed	NAEVA	Open Field	36 to 48	52.445	0.227
647	EM	towed	NAEVA	Calibration	0 to 6	1.2	0.163
647	EM	towed	NAEVA	Calibration	6 to 12	20.5	0.245
647	EM	towed	NAEVA	Calibration	12 to 24	28.667	0.205
647	EM	towed	NAEVA	Calibration	24 to 36	36.2	0.141
647	EM	towed	NAEVA	Calibration	36 to 48	38.867	0.34
647	EM	towed	NAEVA	Blind Grid	0 to 6	3.3	0.551
647	EM	towed	NAEVA	Blind Grid	6 to 12	24.9	0.306
647	EM	towed	NAEVA	Blind Grid	12 to 24	39	0.529
647	EM	towed	NAEVA	Blind Grid	24 to 36	36.183	0.43
647	EM	towed	NAEVA	Blind Grid	36 to 48	39.533	0.499
396	EM	2-man	NAEVA	Wet Probe	0 to 6	66.909	0.761
396	EM	2-man	NAEVA	Wet Probe	6 to 12	75.791	0.723
396	EM	2-man	NAEVA	Wet Probe	12 to 24	79.373	0.277
396	EM	2-man	NAEVA	Wet Probe	24 to 36	55.273	0.305
396	EM	2-man	NAEVA	Wet Probe	36 to 48	53.264	0.503
396	EM	2-man	NAEVA	Woods	0 to 6	14.45	0.206
396	EM	2-man	NAEVA	Woods	6 to 12	5.425	0.192
396	EM	2-man	NAEVA	Woods	12 to 24	5.55	0.166
396	EM	2-man	NAEVA	Woods	24 to 36	55.5	0.316
396	EM	2-man	NAEVA	Woods	36 to 48	57.675	0.179
396	EM	2-man	NAEVA	Open Field	0 to 6	23.436	1.077
396	EM	2-man	NAEVA	Open Field	6 to 12	6.473	0.289
396	EM	2-man	NAEVA	Open Field	12 to 24	19.473	0.2
396	EM	2-man	NAEVA	Open Field	24 to 36	27.091	0.557
396	EM	2-man	NAEVA	Open Field	36 to 48	52.445	0.227
396	EM	2-man	NAEVA	Calibration	0 to 6	1.2	0.163
396	EM	2-man	NAEVA	Calibration	6 to 12	20.5	0.245

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
396	EM	2-man	NAEVA	Calibration	12 to 24	28.667	0.205
396	EM	2-man	NAEVA	Calibration	24 to 36	36.2	0.141
396	EM	2-man	NAEVA	Calibration	36 to 48	38.867	0.34
396	EM	2-man	NAEVA	Blind Grid	0 to 6	3.3	0.551
396	EM	2-man	NAEVA	Blind Grid	6 to 12	24.9	0.306
396	EM	2-man	NAEVA	Blind Grid	12 to 24	39	0.529
396	EM	2-man	NAEVA	Blind Grid	24 to 36	36.183	0.43
396	EM	2-man	NAEVA	Blind Grid	36 to 48	39.533	0.499
397	EM	towed	NAEVA	Wet Probe	0 to 6	66.909	0.761
397	EM	towed	NAEVA	Wet Probe	6 to 12	75.791	0.723
397	EM	towed	NAEVA	Wet Probe	12 to 24	79.373	0.277
397	EM	towed	NAEVA	Wet Probe	24 to 36	55.273	0.305
397	EM	towed	NAEVA	Wet Probe	36 to 48	53.264	0.503
397	EM	towed	NAEVA	Woods	0 to 6	14.45	0.206
397	EM	towed	NAEVA	Woods	6 to 12	5.425	0.192
397	EM	towed	NAEVA	Woods	12 to 24	5.55	0.166
397	EM	towed	NAEVA	Woods	24 to 36	55.5	0.316
397	EM	towed	NAEVA	Woods	36 to 48	57.675	0.179
397	EM	towed	NAEVA	Open Field	0 to 6	23.436	1.077
397	EM	towed	NAEVA	Open Field	6 to 12	6.473	0.289
397	EM	towed	NAEVA	Open Field	12 to 24	19.473	0.2
397	EM	towed	NAEVA	Open Field	24 to 36	27.091	0.557
397	EM	towed	NAEVA	Open Field	36 to 48	52.445	0.227
397	EM	towed	NAEVA	Calibration	0 to 6	1.2	0.163
397	EM	towed	NAEVA	Calibration	6 to 12	20.5	0.245
397	EM	towed	NAEVA	Calibration	12 to 24	28.667	0.205
397	EM	towed	NAEVA	Calibration	24 to 36	36.2	0.141
397	EM	towed	NAEVA	Calibration	36 to 48	38.867	0.34
397	EM	towed	NAEVA	Blind Grid	0 to 6	3.3	0.551
397	EM	towed	NAEVA	Blind Grid	6 to 12	24.9	0.306
397	EM	towed	NAEVA	Blind Grid	12 to 24	39	0.529
397	EM	towed	NAEVA	Blind Grid	24 to 36	36.183	0.43
397	EM	towed	NAEVA	Blind Grid	36 to 48	39.533	0.499
597	EM	2-man	NAEVA	Wet Probe	0 to 6	66.909	0.761
597	EM	2-man	NAEVA	Wet Probe	6 to 12	75.791	0.723
597	EM	2-man	NAEVA	Wet Probe	12 to 24	79.373	0.277
597	EM	2-man	NAEVA	Wet Probe	24 to 36	55.273	0.305
597	EM	2-man	NAEVA	Wet Probe	36 to 48	53.264	0.503
597	EM	2-man	NAEVA	Woods	0 to 6	14.45	0.206
597	EM	2-man	NAEVA	Woods	6 to 12	5.425	0.192
597	EM	2-man	NAEVA	Woods	12 to 24	5.55	0.166
597	EM	2-man	NAEVA	Woods	24 to 36	55.5	0.316
597	EM	2-man	NAEVA	Woods	36 to 48	57.675	0.179
597	EM	2-man	NAEVA	Open Field	0 to 6	23.436	1.077
597	EM	2-man	NAEVA	Open Field	6 to 12	6.473	0.289
597	EM	2-man	NAEVA	Open Field	12 to 24	19.473	0.2
597	EM	2-man	NAEVA	Open Field	24 to 36	27.091	0.557
597	EM	2-man	NAEVA	Open Field	36 to 48	52.445	0.227
597	EM	2-man	NAEVA	Calibration	0 to 6	1.2	0.163
597	EM	2-man	NAEVA	Calibration	6 to 12	20.5	0.245

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
597	EM	2-man	NAEVA	Calibration	12 to 24	28.667	0.205
597	EM	2-man	NAEVA	Calibration	24 to 36	36.2	0.141
597	EM	2-man	NAEVA	Calibration	36 to 48	38.867	0.34
597	EM	2-man	NAEVA	Blind Grid	0 to 6	3.3	0.551
597	EM	2-man	NAEVA	Blind Grid	6 to 12	24.9	0.306
597	EM	2-man	NAEVA	Blind Grid	12 to 24	39	0.529
597	EM	2-man	NAEVA	Blind Grid	24 to 36	36.183	0.43
597	EM	2-man	NAEVA	Blind Grid	36 to 48	39.533	0.499
406	EM	towed	NAEVA	Wet Probe	0 to 6	66.909	0.761
406	EM	towed	NAEVA	Wet Probe	6 to 12	75.791	0.723
406	EM	towed	NAEVA	Wet Probe	12 to 24	79.373	0.277
406	EM	towed	NAEVA	Wet Probe	24 to 36	55.273	0.305
406	EM	towed	NAEVA	Wet Probe	36 to 48	53.264	0.503
406	EM	towed	NAEVA	Woods	0 to 6	14.45	0.206
406	EM	towed	NAEVA	Woods	6 to 12	5.425	0.192
406	EM	towed	NAEVA	Woods	12 to 24	5.55	0.166
406	EM	towed	NAEVA	Woods	24 to 36	55.5	0.316
406	EM	towed	NAEVA	Woods	36 to 48	57.675	0.179
406	EM	towed	NAEVA	Open Field	0 to 6	23.436	1.077
406	EM	towed	NAEVA	Open Field	6 to 12	6.473	0.289
406	EM	towed	NAEVA	Open Field	12 to 24	19.473	0.2
406	EM	towed	NAEVA	Open Field	24 to 36	27.091	0.557
406	EM	towed	NAEVA	Open Field	36 to 48	52.445	0.227
406	EM	towed	NAEVA	Calibration	0 to 6	1.2	0.163
406	EM	towed	NAEVA	Calibration	6 to 12	20.5	0.245
406	EM	towed	NAEVA	Calibration	12 to 24	28.667	0.205
406	EM	towed	NAEVA	Calibration	24 to 36	36.2	0.141
406	EM	towed	NAEVA	Calibration	36 to 48	38.867	0.34
406	EM	towed	NAEVA	Blind Grid	0 to 6	3.3	0.551
406	EM	towed	NAEVA	Blind Grid	6 to 12	24.9	0.306
406	EM	towed	NAEVA	Blind Grid	12 to 24	39	0.529
406	EM	towed	NAEVA	Blind Grid	24 to 36	36.183	0.43
406	EM	towed	NAEVA	Blind Grid	36 to 48	39.533	0.499
494	EM	2-man	NAEVA	Wet Probe	0 to 6	66.909	0.761
494	EM	2-man	NAEVA	Wet Probe	6 to 12	75.791	0.723
494	EM	2-man	NAEVA	Wet Probe	12 to 24	79.373	0.277
494	EM	2-man	NAEVA	Wet Probe	24 to 36	55.273	0.305
494	EM	2-man	NAEVA	Wet Probe	36 to 48	53.264	0.503
494	EM	2-man	NAEVA	Woods	0 to 6	14.45	0.206
494	EM	2-man	NAEVA	Woods	6 to 12	5.425	0.192
494	EM	2-man	NAEVA	Woods	12 to 24	5.55	0.166
494	EM	2-man	NAEVA	Woods	24 to 36	55.5	0.316
494	EM	2-man	NAEVA	Woods	36 to 48	57.675	0.179
494	EM	2-man	NAEVA	Open Field	0 to 6	23.436	1.077
494	EM	2-man	NAEVA	Open Field	6 to 12	6.473	0.289
494	EM	2-man	NAEVA	Open Field	12 to 24	19.473	0.2
494	EM	2-man	NAEVA	Open Field	24 to 36	27.091	0.557
494	EM	2-man	NAEVA	Open Field	36 to 48	52.445	0.227
494	EM	2-man	NAEVA	Calibration	0 to 6	1.2	0.163
494	EM	2-man	NAEVA	Calibration	6 to 12	20.5	0.245

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
494	EM	2-man	NAEVA	Calibration	12 to 24	28.667	0.205
494	EM	2-man	NAEVA	Calibration	24 to 36	36.2	0.141
494	EM	2-man	NAEVA	Calibration	36 to 48	38.867	0.34
494	EM	2-man	NAEVA	Blind Grid	0 to 6	3.3	0.551
494	EM	2-man	NAEVA	Blind Grid	6 to 12	24.9	0.306
494	EM	2-man	NAEVA	Blind Grid	12 to 24	39	0.529
494	EM	2-man	NAEVA	Blind Grid	24 to 36	36.183	0.43
494	EM	2-man	NAEVA	Blind Grid	36 to 48	39.533	0.499
127	EM	towed	NRL	Wet Probe	0 to 6	0	0
127	EM	towed	NRL	Wet Probe	6 to 12	0	0
127	EM	towed	NRL	Wet Probe	12 to 24	0	0
127	EM	towed	NRL	Wet Probe	24 to 36	0	0
127	EM	towed	NRL	Wet Probe	36 to 48	0	0
127	EM	towed	NRL	Woods	0 to 6	0	0
127	EM	towed	NRL	Woods	6 to 12	0	0
127	EM	towed	NRL	Woods	12 to 24	0	0
127	EM	towed	NRL	Woods	24 to 36	0	0
127	EM	towed	NRL	Woods	36 to 48	0	0
127	EM	towed	NRL	Open Field	0 to 6	28.95	0.18
127	EM	towed	NRL	Open Field	6 to 12	0.55	0.112
127	EM	towed	NRL	Open Field	12 to 24	24.925	0.192
127	EM	towed	NRL	Open Field	24 to 36	33.7	0.274
127	EM	towed	NRL	Open Field	36 to 48	52.675	0.148
127	EM	towed	NRL	Calibration	0 to 6	38.733	1.084
127	EM	towed	NRL	Calibration	6 to 12	37.767	0.094
127	EM	towed	NRL	Calibration	12 to 24	7.9	0.216
127	EM	towed	NRL	Calibration	24 to 36	4.733	0.262
127	EM	towed	NRL	Calibration	36 to 48	4.733	0.189
127	EM	towed	NRL	Blind Grid	0 to 6	3.4	0.432
127	EM	towed	NRL	Blind Grid	6 to 12	17.667	0.403
127	EM	towed	NRL	Blind Grid	12 to 24	36.2	1.558
127	EM	towed	NRL	Blind Grid	24 to 36	36.567	1.793
127	EM	towed	NRL	Blind Grid	36 to 48	37.8	1.705
675	EM	towed	NRL	Wet Probe	0 to 6	63.183	0.418
675	EM	towed	NRL	Wet Probe	6 to 12	75.033	0.83
675	EM	towed	NRL	Wet Probe	12 to 24	77.917	0.555
675	EM	towed	NRL	Wet Probe	24 to 36	55.533	0.534
675	EM	towed	NRL	Wet Probe	36 to 48	50.517	1.218
675	EM	towed	NRL	Woods	0 to 6	0	0
675	EM	towed	NRL	Woods	6 to 12	0	0
675	EM	towed	NRL	Woods	12 to 24	0	0
675	EM	towed	NRL	Woods	24 to 36	0	0
675	EM	towed	NRL	Woods	36 to 48	0	0
675	EM	towed	NRL	Open Field	0 to 6	24.57	3.586
675	EM	towed	NRL	Open Field	6 to 12	3.76	2.63
675	EM	towed	NRL	Open Field	12 to 24	21	3.217
675	EM	towed	NRL	Open Field	24 to 36	29.17	3.743
675	EM	towed	NRL	Open Field	36 to 48	52.36	0.673
675	EM	towed	NRL	Calibration	0 to 6	38.733	1.084
675	EM	towed	NRL	Calibration	6 to 12	37.767	0.094

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
675	EM	towed	NRL	Calibration	12 to 24	7.9	0.216
675	EM	towed	NRL	Calibration	24 to 36	4.733	0.262
675	EM	towed	NRL	Calibration	36 to 48	4.733	0.189
675	EM	towed	NRL	Blind Grid	0 to 6	3.157	0.358
675	EM	towed	NRL	Blind Grid	6 to 12	21.529	3.36
675	EM	towed	NRL	Blind Grid	12 to 24	37.057	1.404
675	EM	towed	NRL	Blind Grid	24 to 36	35.771	1.405
675	EM	towed	NRL	Blind Grid	36 to 48	38.471	1.269
671	MAG	towed	NRL	Wet Probe	0 to 6	60.2	0.082
671	MAG	towed	NRL	Wet Probe	6 to 12	75.633	0.249
671	MAG	towed	NRL	Wet Probe	12 to 24	78.1	0.216
671	MAG	towed	NRL	Wet Probe	24 to 36	55.4	0.216
671	MAG	towed	NRL	Wet Probe	36 to 48	48.433	0.189
671	MAG	towed	NRL	Woods	0 to 6	0	0
671	MAG	towed	NRL	Woods	6 to 12	0	0
671	MAG	towed	NRL	Woods	12 to 24	0	0
671	MAG	towed	NRL	Woods	24 to 36	0	0
671	MAG	towed	NRL	Woods	36 to 48	0	0
671	MAG	towed	NRL	Open Field	0 to 6	21.2	0.082
671	MAG	towed	NRL	Open Field	6 to 12	6.533	0.205
671	MAG	towed	NRL	Open Field	12 to 24	18.267	0.17
671	MAG	towed	NRL	Open Field	24 to 36	26.3	0.163
671	MAG	towed	NRL	Open Field	36 to 48	54.1	0.163
671	MAG	towed	NRL	Calibration	0 to 6	40.25	0.05
671	MAG	towed	NRL	Calibration	6 to 12	38.45	0.05
671	MAG	towed	NRL	Calibration	12 to 24	1.65	0.15
671	MAG	towed	NRL	Calibration	24 to 36	4.1	0.1
671	MAG	towed	NRL	Calibration	36 to 48	4.4	0.1
671	MAG	towed	NRL	Blind Grid	0 to 6	3.95	0.05
671	MAG	towed	NRL	Blind Grid	6 to 12	25.9	0.2
671	MAG	towed	NRL	Blind Grid	12 to 24	36.1	0.2
671	MAG	towed	NRL	Blind Grid	24 to 36	37.65	0.15
671	MAG	towed	NRL	Blind Grid	36 to 48	38.45	0.05
673	MAG	towed	NRL	Wet Probe	0 to 6	60.2	0.082
673	MAG	towed	NRL	Wet Probe	6 to 12	75.633	0.249
673	MAG	towed	NRL	Wet Probe	12 to 24	78.1	0.216
673	MAG	towed	NRL	Wet Probe	24 to 36	55.4	0.216
673	MAG	towed	NRL	Wet Probe	36 to 48	48.433	0.189
673	MAG	towed	NRL	Woods	0 to 6	0	0
673	MAG	towed	NRL	Woods	6 to 12	0	0
673	MAG	towed	NRL	Woods	12 to 24	0	0
673	MAG	towed	NRL	Woods	24 to 36	0	0
673	MAG	towed	NRL	Woods	36 to 48	0	0
673	MAG	towed	NRL	Open Field	0 to 6	21.2	0.082
673	MAG	towed	NRL	Open Field	6 to 12	6.533	0.205
673	MAG	towed	NRL	Open Field	12 to 24	18.267	0.17
673	MAG	towed	NRL	Open Field	24 to 36	26.3	0.163
673	MAG	towed	NRL	Open Field	36 to 48	54.1	0.163
673	MAG	towed	NRL	Calibration	0 to 6	40.25	0.05
673	MAG	towed	NRL	Calibration	6 to 12	38.45	0.05

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
673	MAG	towed	NRL	Calibration	12 to 24	1.65	0.15
673	MAG	towed	NRL	Calibration	24 to 36	4.1	0.1
673	MAG	towed	NRL	Calibration	36 to 48	4.4	0.1
673	MAG	towed	NRL	Blind Grid	0 to 6	3.95	0.05
673	MAG	towed	NRL	Blind Grid	6 to 12	25.9	0.2
673	MAG	towed	NRL	Blind Grid	12 to 24	36.1	0.2
673	MAG	towed	NRL	Blind Grid	24 to 36	37.65	0.15
673	MAG	towed	NRL	Blind Grid	36 to 48	38.45	0.05
252	EM	cart	Parsons	Wet Probe	0 to 6	64.585	0.549
252	EM	cart	Parsons	Wet Probe	6 to 12	73.3	0.522
252	EM	cart	Parsons	Wet Probe	12 to 24	77.1	0.621
252	EM	cart	Parsons	Wet Probe	24 to 36	54.235	0.662
252	EM	cart	Parsons	Wet Probe	36 to 48	53.355	0.466
252	EM	cart	Parsons	Woods	0 to 6	13.3	0.818
252	EM	cart	Parsons	Woods	6 to 12	6.3	0.46
252	EM	cart	Parsons	Woods	12 to 24	6.771	0.198
252	EM	cart	Parsons	Woods	24 to 36	57.786	0.264
252	EM	cart	Parsons	Woods	36 to 48	59.371	0.377
252	EM	cart	Parsons	Open Field	0 to 6	20.37	0.603
252	EM	cart	Parsons	Open Field	6 to 12	7.535	0.338
252	EM	cart	Parsons	Open Field	12 to 24	21.445	0.264
252	EM	cart	Parsons	Open Field	24 to 36	28.25	0.398
252	EM	cart	Parsons	Open Field	36 to 48	54.56	0.365
252	EM	cart	Parsons	Calibration	0 to 6	2.05	0.75
252	EM	cart	Parsons	Calibration	6 to 12	14.95	0.65
252	EM	cart	Parsons	Calibration	12 to 24	25.05	0.65
252	EM	cart	Parsons	Calibration	24 to 36	32.2	1.3
252	EM	cart	Parsons	Calibration	36 to 48	38.1	1
252	EM	cart	Parsons	Blind Grid	0 to 6	5.162	0.908
252	EM	cart	Parsons	Blind Grid	6 to 12	1.675	0.614
252	EM	cart	Parsons	Blind Grid	12 to 24	25.938	0.831
252	EM	cart	Parsons	Blind Grid	24 to 36	35.937	0.394
252	EM	cart	Parsons	Blind Grid	36 to 48	40.838	0.817
572	EM	cart	Parsons	Wet Probe	0 to 6	64.585	0.549
572	EM	cart	Parsons	Wet Probe	6 to 12	73.3	0.522
572	EM	cart	Parsons	Wet Probe	12 to 24	77.1	0.621
572	EM	cart	Parsons	Wet Probe	24 to 36	54.235	0.662
572	EM	cart	Parsons	Wet Probe	36 to 48	53.355	0.466
572	EM	cart	Parsons	Woods	0 to 6	13.3	0.818
572	EM	cart	Parsons	Woods	6 to 12	6.3	0.46
572	EM	cart	Parsons	Woods	12 to 24	6.771	0.198
572	EM	cart	Parsons	Woods	24 to 36	57.786	0.264
572	EM	cart	Parsons	Woods	36 to 48	59.371	0.377
572	EM	cart	Parsons	Open Field	0 to 6	20.37	0.603
572	EM	cart	Parsons	Open Field	6 to 12	7.535	0.338
572	EM	cart	Parsons	Open Field	12 to 24	21.445	0.264
572	EM	cart	Parsons	Open Field	24 to 36	28.25	0.398
572	EM	cart	Parsons	Open Field	36 to 48	54.56	0.365
572	EM	cart	Parsons	Calibration	0 to 6	2.05	0.75
572	EM	cart	Parsons	Calibration	6 to 12	14.95	0.65

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
572	EM	cart	Parsons	Calibration	12 to 24	25.05	0.65
572	EM	cart	Parsons	Calibration	24 to 36	32.2	1.3
572	EM	cart	Parsons	Calibration	36 to 48	38.1	1
572	EM	cart	Parsons	Blind Grid	0 to 6	5.162	0.908
572	EM	cart	Parsons	Blind Grid	6 to 12	1.675	0.614
572	EM	cart	Parsons	Blind Grid	12 to 24	25.938	0.831
572	EM	cart	Parsons	Blind Grid	24 to 36	35.937	0.394
572	EM	cart	Parsons	Blind Grid	36 to 48	40.838	0.817
411	EM	cart	Parsons	Wet Probe	0 to 6	64.585	0.549
411	EM	cart	Parsons	Wet Probe	6 to 12	73.3	0.522
411	EM	cart	Parsons	Wet Probe	12 to 24	77.1	0.621
411	EM	cart	Parsons	Wet Probe	24 to 36	54.235	0.662
411	EM	cart	Parsons	Wet Probe	36 to 48	53.355	0.466
411	EM	cart	Parsons	Woods	0 to 6	13.3	0.818
411	EM	cart	Parsons	Woods	6 to 12	6.3	0.46
411	EM	cart	Parsons	Woods	12 to 24	6.771	0.198
411	EM	cart	Parsons	Woods	24 to 36	57.786	0.264
411	EM	cart	Parsons	Woods	36 to 48	59.371	0.377
411	EM	cart	Parsons	Open Field	0 to 6	20.37	0.603
411	EM	cart	Parsons	Open Field	6 to 12	7.535	0.338
411	EM	cart	Parsons	Open Field	12 to 24	21.445	0.264
411	EM	cart	Parsons	Open Field	24 to 36	28.25	0.398
411	EM	cart	Parsons	Open Field	36 to 48	54.56	0.365
411	EM	cart	Parsons	Calibration	0 to 6	2.05	0.75
411	EM	cart	Parsons	Calibration	6 to 12	14.95	0.65
411	EM	cart	Parsons	Calibration	12 to 24	25.05	0.65
411	EM	cart	Parsons	Calibration	24 to 36	32.2	1.3
411	EM	cart	Parsons	Calibration	36 to 48	38.1	1
411	EM	cart	Parsons	Blind Grid	0 to 6	5.162	0.908
411	EM	cart	Parsons	Blind Grid	6 to 12	1.675	0.614
411	EM	cart	Parsons	Blind Grid	12 to 24	25.938	0.831
411	EM	cart	Parsons	Blind Grid	24 to 36	35.937	0.394
411	EM	cart	Parsons	Blind Grid	36 to 48	40.838	0.817
496	EM	cart	Parsons	Wet Probe	0 to 6	64.585	0.549
496	EM	cart	Parsons	Wet Probe	6 to 12	73.3	0.522
496	EM	cart	Parsons	Wet Probe	12 to 24	77.1	0.621
496	EM	cart	Parsons	Wet Probe	24 to 36	54.235	0.662
496	EM	cart	Parsons	Wet Probe	36 to 48	53.355	0.466
496	EM	cart	Parsons	Woods	0 to 6	13.3	0.818
496	EM	cart	Parsons	Woods	6 to 12	6.3	0.46
496	EM	cart	Parsons	Woods	12 to 24	6.771	0.198
496	EM	cart	Parsons	Woods	24 to 36	57.786	0.264
496	EM	cart	Parsons	Woods	36 to 48	59.371	0.377
496	EM	cart	Parsons	Open Field	0 to 6	20.37	0.603
496	EM	cart	Parsons	Open Field	6 to 12	7.535	0.338
496	EM	cart	Parsons	Open Field	12 to 24	21.445	0.264
496	EM	cart	Parsons	Open Field	24 to 36	28.25	0.398
496	EM	cart	Parsons	Open Field	36 to 48	54.56	0.365
496	EM	cart	Parsons	Calibration	0 to 6	2.05	0.75
496	EM	cart	Parsons	Calibration	6 to 12	14.95	0.65

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
496	EM	cart	Parsons	Calibration	12 to 24	25.05	0.65
496	EM	cart	Parsons	Calibration	24 to 36	32.2	1.3
496	EM	cart	Parsons	Calibration	36 to 48	38.1	1
496	EM	cart	Parsons	Blind Grid	0 to 6	5.162	0.908
496	EM	cart	Parsons	Blind Grid	6 to 12	1.675	0.614
496	EM	cart	Parsons	Blind Grid	12 to 24	25.938	0.831
496	EM	cart	Parsons	Blind Grid	24 to 36	35.937	0.394
496	EM	cart	Parsons	Blind Grid	36 to 48	40.838	0.817
257	MAG	hand	Parsons	Wet Probe	0 to 6	64.585	0.549
257	MAG	hand	Parsons	Wet Probe	6 to 12	73.3	0.522
257	MAG	hand	Parsons	Wet Probe	12 to 24	77.1	0.621
257	MAG	hand	Parsons	Wet Probe	24 to 36	54.235	0.662
257	MAG	hand	Parsons	Wet Probe	36 to 48	53.355	0.466
257	MAG	hand	Parsons	Woods	0 to 6	13.3	0.818
257	MAG	hand	Parsons	Woods	6 to 12	6.3	0.46
257	MAG	hand	Parsons	Woods	12 to 24	6.771	0.198
257	MAG	hand	Parsons	Woods	24 to 36	57.786	0.264
257	MAG	hand	Parsons	Woods	36 to 48	59.371	0.377
257	MAG	hand	Parsons	Open Field	0 to 6	20.37	0.603
257	MAG	hand	Parsons	Open Field	6 to 12	7.535	0.338
257	MAG	hand	Parsons	Open Field	12 to 24	21.445	0.264
257	MAG	hand	Parsons	Open Field	24 to 36	28.25	0.398
257	MAG	hand	Parsons	Open Field	36 to 48	54.56	0.365
257	MAG	hand	Parsons	Calibration	0 to 6	2.05	0.75
257	MAG	hand	Parsons	Calibration	6 to 12	14.95	0.65
257	MAG	hand	Parsons	Calibration	12 to 24	25.05	0.65
257	MAG	hand	Parsons	Calibration	24 to 36	32.2	1.3
257	MAG	hand	Parsons	Calibration	36 to 48	38.1	1
257	MAG	hand	Parsons	Blind Grid	0 to 6	5.162	0.908
257	MAG	hand	Parsons	Blind Grid	6 to 12	1.675	0.614
257	MAG	hand	Parsons	Blind Grid	12 to 24	25.938	0.831
257	MAG	hand	Parsons	Blind Grid	24 to 36	35.937	0.394
257	MAG	hand	Parsons	Blind Grid	36 to 48	40.838	0.817
573	MAG	hand	Parsons	Wet Probe	0 to 6	64.585	0.549
573	MAG	hand	Parsons	Wet Probe	6 to 12	73.3	0.522
573	MAG	hand	Parsons	Wet Probe	12 to 24	77.1	0.621
573	MAG	hand	Parsons	Wet Probe	24 to 36	54.235	0.662
573	MAG	hand	Parsons	Wet Probe	36 to 48	53.355	0.466
573	MAG	hand	Parsons	Woods	0 to 6	13.3	0.818
573	MAG	hand	Parsons	Woods	6 to 12	6.3	0.46
573	MAG	hand	Parsons	Woods	12 to 24	6.771	0.198
573	MAG	hand	Parsons	Woods	24 to 36	57.786	0.264
573	MAG	hand	Parsons	Woods	36 to 48	59.371	0.377
573	MAG	hand	Parsons	Open Field	0 to 6	20.37	0.603
573	MAG	hand	Parsons	Open Field	6 to 12	7.535	0.338
573	MAG	hand	Parsons	Open Field	12 to 24	21.445	0.264
573	MAG	hand	Parsons	Open Field	24 to 36	28.25	0.398
573	MAG	hand	Parsons	Open Field	36 to 48	54.56	0.365
573	MAG	hand	Parsons	Calibration	0 to 6	2.05	0.75
573	MAG	hand	Parsons	Calibration	6 to 12	14.95	0.65

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
573	MAG	hand	Parsons	Calibration	12 to 24	25.05	0.65
573	MAG	hand	Parsons	Calibration	24 to 36	32.2	1.3
573	MAG	hand	Parsons	Calibration	36 to 48	38.1	1
573	MAG	hand	Parsons	Blind Grid	0 to 6	5.162	0.908
573	MAG	hand	Parsons	Blind Grid	6 to 12	1.675	0.614
573	MAG	hand	Parsons	Blind Grid	12 to 24	25.938	0.831
573	MAG	hand	Parsons	Blind Grid	24 to 36	35.937	0.394
573	MAG	hand	Parsons	Blind Grid	36 to 48	40.838	0.817
229	MAG	hand	Parsons	Wet Probe	0 to 6	64.585	0.549
229	MAG	hand	Parsons	Wet Probe	6 to 12	73.3	0.522
229	MAG	hand	Parsons	Wet Probe	12 to 24	77.1	0.621
229	MAG	hand	Parsons	Wet Probe	24 to 36	54.235	0.662
229	MAG	hand	Parsons	Wet Probe	36 to 48	53.355	0.466
229	MAG	hand	Parsons	Woods	0 to 6	13.3	0.818
229	MAG	hand	Parsons	Woods	6 to 12	6.3	0.46
229	MAG	hand	Parsons	Woods	12 to 24	6.771	0.198
229	MAG	hand	Parsons	Woods	24 to 36	57.786	0.264
229	MAG	hand	Parsons	Woods	36 to 48	59.371	0.377
229	MAG	hand	Parsons	Open Field	0 to 6	20.37	0.603
229	MAG	hand	Parsons	Open Field	6 to 12	7.535	0.338
229	MAG	hand	Parsons	Open Field	12 to 24	21.445	0.264
229	MAG	hand	Parsons	Open Field	24 to 36	28.25	0.398
229	MAG	hand	Parsons	Open Field	36 to 48	54.56	0.365
229	MAG	hand	Parsons	Calibration	0 to 6	2.05	0.75
229	MAG	hand	Parsons	Calibration	6 to 12	14.95	0.65
229	MAG	hand	Parsons	Calibration	12 to 24	25.05	0.65
229	MAG	hand	Parsons	Calibration	24 to 36	32.2	1.3
229	MAG	hand	Parsons	Calibration	36 to 48	38.1	1
229	MAG	hand	Parsons	Blind Grid	0 to 6	5.162	0.908
229	MAG	hand	Parsons	Blind Grid	6 to 12	1.675	0.614
229	MAG	hand	Parsons	Blind Grid	12 to 24	25.938	0.831
229	MAG	hand	Parsons	Blind Grid	24 to 36	35.937	0.394
229	MAG	hand	Parsons	Blind Grid	36 to 48	40.838	0.817
499	MAG	hand	Parsons	Wet Probe	0 to 6	64.585	0.549
499	MAG	hand	Parsons	Wet Probe	6 to 12	73.3	0.522
499	MAG	hand	Parsons	Wet Probe	12 to 24	77.1	0.621
499	MAG	hand	Parsons	Wet Probe	24 to 36	54.235	0.662
499	MAG	hand	Parsons	Wet Probe	36 to 48	53.355	0.466
499	MAG	hand	Parsons	Woods	0 to 6	13.3	0.818
499	MAG	hand	Parsons	Woods	6 to 12	6.3	0.46
499	MAG	hand	Parsons	Woods	12 to 24	6.771	0.198
499	MAG	hand	Parsons	Woods	24 to 36	57.786	0.264
499	MAG	hand	Parsons	Woods	36 to 48	59.371	0.377
499	MAG	hand	Parsons	Open Field	0 to 6	20.37	0.603
499	MAG	hand	Parsons	Open Field	6 to 12	7.535	0.338
499	MAG	hand	Parsons	Open Field	12 to 24	21.445	0.264
499	MAG	hand	Parsons	Open Field	24 to 36	28.25	0.398
499	MAG	hand	Parsons	Open Field	36 to 48	54.56	0.365
499	MAG	hand	Parsons	Calibration	0 to 6	2.05	0.75
499	MAG	hand	Parsons	Calibration	6 to 12	14.95	0.65

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
499	MAG	hand	Parsons	Calibration	12 to 24	25.05	0.65
499	MAG	hand	Parsons	Calibration	24 to 36	32.2	1.3
499	MAG	hand	Parsons	Calibration	36 to 48	38.1	1
499	MAG	hand	Parsons	Blind Grid	0 to 6	5.162	0.908
499	MAG	hand	Parsons	Blind Grid	6 to 12	1.675	0.614
499	MAG	hand	Parsons	Blind Grid	12 to 24	25.938	0.831
499	MAG	hand	Parsons	Blind Grid	24 to 36	35.937	0.394
499	MAG	hand	Parsons	Blind Grid	36 to 48	40.838	0.817
197	EM	cart	Shaw	Wet Probe	0 to 6	88.072	0.881
197	EM	cart	Shaw	Wet Probe	6 to 12	79.1	0.399
197	EM	cart	Shaw	Wet Probe	12 to 24	70.056	0.679
197	EM	cart	Shaw	Wet Probe	24 to 36	54.706	1.397
197	EM	cart	Shaw	Wet Probe	36 to 48	51.606	1.306
197	EM	cart	Shaw	Woods	0 to 6	79.883	0.318
197	EM	cart	Shaw	Woods	6 to 12	69.75	0.678
197	EM	cart	Shaw	Woods	12 to 24	94.017	0.414
197	EM	cart	Shaw	Woods	24 to 36	68.517	0.515
197	EM	cart	Shaw	Woods	36 to 48	58.867	0.309
197	EM	cart	Shaw	Open Field	0 to 6	23.111	0.401
197	EM	cart	Shaw	Open Field	6 to 12	3.461	0.73
197	EM	cart	Shaw	Open Field	12 to 24	39.472	0.323
197	EM	cart	Shaw	Open Field	24 to 36	60.911	0.683
197	EM	cart	Shaw	Open Field	36 to 48	57.644	0.905
197	EM	cart	Shaw	Calibration	0 to 6	39.5	0
197	EM	cart	Shaw	Calibration	6 to 12	36.3	0
197	EM	cart	Shaw	Calibration	12 to 24	7.7	0
197	EM	cart	Shaw	Calibration	24 to 36	5.6	0
197	EM	cart	Shaw	Calibration	36 to 48	5.8	0
197	EM	cart	Shaw	Blind Grid	0 to 6	3.95	0.112
197	EM	cart	Shaw	Blind Grid	6 to 12	17.075	0.164
197	EM	cart	Shaw	Blind Grid	12 to 24	39.4	0.235
197	EM	cart	Shaw	Blind Grid	24 to 36	41.05	0.572
197	EM	cart	Shaw	Blind Grid	36 to 48	42	0.158
552	EM	cart	Shaw	Wet Probe	0 to 6	88.072	0.881
552	EM	cart	Shaw	Wet Probe	6 to 12	79.1	0.399
552	EM	cart	Shaw	Wet Probe	12 to 24	70.056	0.679
552	EM	cart	Shaw	Wet Probe	24 to 36	54.706	1.397
552	EM	cart	Shaw	Wet Probe	36 to 48	51.606	1.306
552	EM	cart	Shaw	Woods	0 to 6	79.883	0.318
552	EM	cart	Shaw	Woods	6 to 12	69.75	0.678
552	EM	cart	Shaw	Woods	12 to 24	94.017	0.414
552	EM	cart	Shaw	Woods	24 to 36	68.517	0.515
552	EM	cart	Shaw	Woods	36 to 48	58.867	0.309
552	EM	cart	Shaw	Open Field	0 to 6	23.111	0.401
552	EM	cart	Shaw	Open Field	6 to 12	3.461	0.73
552	EM	cart	Shaw	Open Field	12 to 24	39.472	0.323
552	EM	cart	Shaw	Open Field	24 to 36	60.911	0.683
552	EM	cart	Shaw	Open Field	36 to 48	57.644	0.905
552	EM	cart	Shaw	Calibration	0 to 6	39.5	0
552	EM	cart	Shaw	Calibration	6 to 12	36.3	0

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
552	EM	cart	Shaw	Calibration	12 to 24	7.7	0
552	EM	cart	Shaw	Calibration	24 to 36	5.6	0
552	EM	cart	Shaw	Calibration	36 to 48	5.8	0
552	EM	cart	Shaw	Blind Grid	0 to 6	3.95	0.112
552	EM	cart	Shaw	Blind Grid	6 to 12	17.075	0.164
552	EM	cart	Shaw	Blind Grid	12 to 24	39.4	0.235
552	EM	cart	Shaw	Blind Grid	24 to 36	41.05	0.572
552	EM	cart	Shaw	Blind Grid	36 to 48	42	0.158
201	EM	cart	Shaw	Wet Probe	0 to 6	88.072	0.881
201	EM	cart	Shaw	Wet Probe	6 to 12	79.1	0.399
201	EM	cart	Shaw	Wet Probe	12 to 24	70.056	0.679
201	EM	cart	Shaw	Wet Probe	24 to 36	54.706	1.397
201	EM	cart	Shaw	Wet Probe	36 to 48	51.606	1.306
201	EM	cart	Shaw	Woods	0 to 6	79.883	0.318
201	EM	cart	Shaw	Woods	6 to 12	69.75	0.678
201	EM	cart	Shaw	Woods	12 to 24	94.017	0.414
201	EM	cart	Shaw	Woods	24 to 36	68.517	0.515
201	EM	cart	Shaw	Woods	36 to 48	58.867	0.309
201	EM	cart	Shaw	Open Field	0 to 6	23.111	0.401
201	EM	cart	Shaw	Open Field	6 to 12	3.461	0.73
201	EM	cart	Shaw	Open Field	12 to 24	39.472	0.323
201	EM	cart	Shaw	Open Field	24 to 36	60.911	0.683
201	EM	cart	Shaw	Open Field	36 to 48	57.644	0.905
201	EM	cart	Shaw	Calibration	0 to 6	39.5	0
201	EM	cart	Shaw	Calibration	6 to 12	36.3	0
201	EM	cart	Shaw	Calibration	12 to 24	7.7	0
201	EM	cart	Shaw	Calibration	24 to 36	5.6	0
201	EM	cart	Shaw	Calibration	36 to 48	5.8	0
201	EM	cart	Shaw	Blind Grid	0 to 6	3.95	0.112
201	EM	cart	Shaw	Blind Grid	6 to 12	17.075	0.164
201	EM	cart	Shaw	Blind Grid	12 to 24	39.4	0.235
201	EM	cart	Shaw	Blind Grid	24 to 36	41.05	0.572
201	EM	cart	Shaw	Blind Grid	36 to 48	42	0.158
461	EM	cart	Shaw	Wet Probe	0 to 6	88.072	0.881
461	EM	cart	Shaw	Wet Probe	6 to 12	79.1	0.399
461	EM	cart	Shaw	Wet Probe	12 to 24	70.056	0.679
461	EM	cart	Shaw	Wet Probe	24 to 36	54.706	1.397
461	EM	cart	Shaw	Wet Probe	36 to 48	51.606	1.306
461	EM	cart	Shaw	Woods	0 to 6	79.883	0.318
461	EM	cart	Shaw	Woods	6 to 12	69.75	0.678
461	EM	cart	Shaw	Woods	12 to 24	94.017	0.414
461	EM	cart	Shaw	Woods	24 to 36	68.517	0.515
461	EM	cart	Shaw	Woods	36 to 48	58.867	0.309
461	EM	cart	Shaw	Open Field	0 to 6	23.111	0.401
461	EM	cart	Shaw	Open Field	6 to 12	3.461	0.73
461	EM	cart	Shaw	Open Field	12 to 24	39.472	0.323
461	EM	cart	Shaw	Open Field	24 to 36	60.911	0.683
461	EM	cart	Shaw	Open Field	36 to 48	57.644	0.905
461	EM	cart	Shaw	Calibration	0 to 6	39.5	0
461	EM	cart	Shaw	Calibration	6 to 12	36.3	0

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
461	EM	cart	Shaw	Calibration	12 to 24	7.7	0
461	EM	cart	Shaw	Calibration	24 to 36	5.6	0
461	EM	cart	Shaw	Calibration	36 to 48	5.8	0
461	EM	cart	Shaw	Blind Grid	0 to 6	3.95	0.112
461	EM	cart	Shaw	Blind Grid	6 to 12	17.075	0.164
461	EM	cart	Shaw	Blind Grid	12 to 24	39.4	0.235
461	EM	cart	Shaw	Blind Grid	24 to 36	41.05	0.572
461	EM	cart	Shaw	Blind Grid	36 to 48	42	0.158
198	MAG	cart	Shaw	Wet Probe	0 to 6	88.072	0.881
198	MAG	cart	Shaw	Wet Probe	6 to 12	79.1	0.399
198	MAG	cart	Shaw	Wet Probe	12 to 24	70.056	0.679
198	MAG	cart	Shaw	Wet Probe	24 to 36	54.706	1.397
198	MAG	cart	Shaw	Wet Probe	36 to 48	51.606	1.306
198	MAG	cart	Shaw	Woods	0 to 6	79.883	0.318
198	MAG	cart	Shaw	Woods	6 to 12	69.75	0.678
198	MAG	cart	Shaw	Woods	12 to 24	94.017	0.414
198	MAG	cart	Shaw	Woods	24 to 36	68.517	0.515
198	MAG	cart	Shaw	Woods	36 to 48	58.867	0.309
198	MAG	cart	Shaw	Open Field	0 to 6	23.111	0.401
198	MAG	cart	Shaw	Open Field	6 to 12	3.461	0.73
198	MAG	cart	Shaw	Open Field	12 to 24	39.472	0.323
198	MAG	cart	Shaw	Open Field	24 to 36	60.911	0.683
198	MAG	cart	Shaw	Open Field	36 to 48	57.644	0.905
198	MAG	cart	Shaw	Calibration	0 to 6	39.5	0
198	MAG	cart	Shaw	Calibration	6 to 12	36.3	0
198	MAG	cart	Shaw	Calibration	12 to 24	7.7	0
198	MAG	cart	Shaw	Calibration	24 to 36	5.6	0
198	MAG	cart	Shaw	Calibration	36 to 48	5.8	0
198	MAG	cart	Shaw	Blind Grid	0 to 6	3.95	0.112
198	MAG	cart	Shaw	Blind Grid	6 to 12	17.075	0.164
198	MAG	cart	Shaw	Blind Grid	12 to 24	39.4	0.235
198	MAG	cart	Shaw	Blind Grid	24 to 36	41.05	0.572
198	MAG	cart	Shaw	Blind Grid	36 to 48	42	0.158
404	MAG	cart	Shaw	Wet Probe	0 to 6	88.072	0.881
404	MAG	cart	Shaw	Wet Probe	6 to 12	79.1	0.399
404	MAG	cart	Shaw	Wet Probe	12 to 24	70.056	0.679
404	MAG	cart	Shaw	Wet Probe	24 to 36	54.706	1.397
404	MAG	cart	Shaw	Wet Probe	36 to 48	51.606	1.306
404	MAG	cart	Shaw	Woods	0 to 6	79.883	0.318
404	MAG	cart	Shaw	Woods	6 to 12	69.75	0.678
404	MAG	cart	Shaw	Woods	12 to 24	94.017	0.414
404	MAG	cart	Shaw	Woods	24 to 36	68.517	0.515
404	MAG	cart	Shaw	Woods	36 to 48	58.867	0.309
404	MAG	cart	Shaw	Open Field	0 to 6	23.111	0.401
404	MAG	cart	Shaw	Open Field	6 to 12	3.461	0.73
404	MAG	cart	Shaw	Open Field	12 to 24	39.472	0.323
404	MAG	cart	Shaw	Open Field	24 to 36	60.911	0.683
404	MAG	cart	Shaw	Open Field	36 to 48	57.644	0.905
404	MAG	cart	Shaw	Calibration	0 to 6	39.5	0
404	MAG	cart	Shaw	Calibration	6 to 12	36.3	0

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
404	MAG	cart	Shaw	Calibration	12 to 24	7.7	0
404	MAG	cart	Shaw	Calibration	24 to 36	5.6	0
404	MAG	cart	Shaw	Calibration	36 to 48	5.8	0
404	MAG	cart	Shaw	Blind Grid	0 to 6	3.95	0.112
404	MAG	cart	Shaw	Blind Grid	6 to 12	17.075	0.164
404	MAG	cart	Shaw	Blind Grid	12 to 24	39.4	0.235
404	MAG	cart	Shaw	Blind Grid	24 to 36	41.05	0.572
404	MAG	cart	Shaw	Blind Grid	36 to 48	42	0.158
206	MAG	cart	Shaw	Wet Probe	0 to 6	88.072	0.881
206	MAG	cart	Shaw	Wet Probe	6 to 12	79.1	0.399
206	MAG	cart	Shaw	Wet Probe	12 to 24	70.056	0.679
206	MAG	cart	Shaw	Wet Probe	24 to 36	54.706	1.397
206	MAG	cart	Shaw	Wet Probe	36 to 48	51.606	1.306
206	MAG	cart	Shaw	Woods	0 to 6	79.883	0.318
206	MAG	cart	Shaw	Woods	6 to 12	69.75	0.678
206	MAG	cart	Shaw	Woods	12 to 24	94.017	0.414
206	MAG	cart	Shaw	Woods	24 to 36	68.517	0.515
206	MAG	cart	Shaw	Woods	36 to 48	58.867	0.309
206	MAG	cart	Shaw	Open Field	0 to 6	23.111	0.401
206	MAG	cart	Shaw	Open Field	6 to 12	3.461	0.73
206	MAG	cart	Shaw	Open Field	12 to 24	39.472	0.323
206	MAG	cart	Shaw	Open Field	24 to 36	60.911	0.683
206	MAG	cart	Shaw	Open Field	36 to 48	57.644	0.905
206	MAG	cart	Shaw	Calibration	0 to 6	39.5	0
206	MAG	cart	Shaw	Calibration	6 to 12	36.3	0
206	MAG	cart	Shaw	Calibration	12 to 24	7.7	0
206	MAG	cart	Shaw	Calibration	24 to 36	5.6	0
206	MAG	cart	Shaw	Calibration	36 to 48	5.8	0
206	MAG	cart	Shaw	Blind Grid	0 to 6	3.95	0.112
206	MAG	cart	Shaw	Blind Grid	6 to 12	17.075	0.164
206	MAG	cart	Shaw	Blind Grid	12 to 24	39.4	0.235
206	MAG	cart	Shaw	Blind Grid	24 to 36	41.05	0.572
206	MAG	cart	Shaw	Blind Grid	36 to 48	42	0.158
492	MAG	cart	Shaw	Wet Probe	0 to 6	88.072	0.881
492	MAG	cart	Shaw	Wet Probe	6 to 12	79.1	0.399
492	MAG	cart	Shaw	Wet Probe	12 to 24	70.056	0.679
492	MAG	cart	Shaw	Wet Probe	24 to 36	54.706	1.397
492	MAG	cart	Shaw	Wet Probe	36 to 48	51.606	1.306
492	MAG	cart	Shaw	Woods	0 to 6	79.883	0.318
492	MAG	cart	Shaw	Woods	6 to 12	69.75	0.678
492	MAG	cart	Shaw	Woods	12 to 24	94.017	0.414
492	MAG	cart	Shaw	Woods	24 to 36	68.517	0.515
492	MAG	cart	Shaw	Woods	36 to 48	58.867	0.309
492	MAG	cart	Shaw	Open Field	0 to 6	23.111	0.401
492	MAG	cart	Shaw	Open Field	6 to 12	3.461	0.73
492	MAG	cart	Shaw	Open Field	12 to 24	39.472	0.323
492	MAG	cart	Shaw	Open Field	24 to 36	60.911	0.683
492	MAG	cart	Shaw	Open Field	36 to 48	57.644	0.905
492	MAG	cart	Shaw	Calibration	0 to 6	39.5	0
492	MAG	cart	Shaw	Calibration	6 to 12	36.3	0

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
492	MAG	cart	Shaw	Calibration	12 to 24	7.7	0
492	MAG	cart	Shaw	Calibration	24 to 36	5.6	0
492	MAG	cart	Shaw	Calibration	36 to 48	5.8	0
492	MAG	cart	Shaw	Blind Grid	0 to 6	3.95	0.112
492	MAG	cart	Shaw	Blind Grid	6 to 12	17.075	0.164
492	MAG	cart	Shaw	Blind Grid	12 to 24	39.4	0.235
492	MAG	cart	Shaw	Blind Grid	24 to 36	41.05	0.572
492	MAG	cart	Shaw	Blind Grid	36 to 48	42	0.158
376	MAG	cart	Shaw	Wet Probe	0 to 6	88.072	0.881
376	MAG	cart	Shaw	Wet Probe	6 to 12	79.1	0.399
376	MAG	cart	Shaw	Wet Probe	12 to 24	70.056	0.679
376	MAG	cart	Shaw	Wet Probe	24 to 36	54.706	1.397
376	MAG	cart	Shaw	Wet Probe	36 to 48	51.606	1.306
376	MAG	cart	Shaw	Woods	0 to 6	79.883	0.318
376	MAG	cart	Shaw	Woods	6 to 12	69.75	0.678
376	MAG	cart	Shaw	Woods	12 to 24	94.017	0.414
376	MAG	cart	Shaw	Woods	24 to 36	68.517	0.515
376	MAG	cart	Shaw	Woods	36 to 48	58.867	0.309
376	MAG	cart	Shaw	Open Field	0 to 6	23.111	0.401
376	MAG	cart	Shaw	Open Field	6 to 12	3.461	0.73
376	MAG	cart	Shaw	Open Field	12 to 24	39.472	0.323
376	MAG	cart	Shaw	Open Field	24 to 36	60.911	0.683
376	MAG	cart	Shaw	Open Field	36 to 48	57.644	0.905
376	MAG	cart	Shaw	Calibration	0 to 6	39.5	0
376	MAG	cart	Shaw	Calibration	6 to 12	36.3	0
376	MAG	cart	Shaw	Calibration	12 to 24	7.7	0
376	MAG	cart	Shaw	Calibration	24 to 36	5.6	0
376	MAG	cart	Shaw	Calibration	36 to 48	5.8	0
376	MAG	cart	Shaw	Blind Grid	0 to 6	3.95	0.112
376	MAG	cart	Shaw	Blind Grid	6 to 12	17.075	0.164
376	MAG	cart	Shaw	Blind Grid	12 to 24	39.4	0.235
376	MAG	cart	Shaw	Blind Grid	24 to 36	41.05	0.572
376	MAG	cart	Shaw	Blind Grid	36 to 48	42	0.158
157	EM	cart	TTF	Wet Probe	0 to 6	85.875	3.549
157	EM	cart	TTF	Wet Probe	6 to 12	79.7	2.765
157	EM	cart	TTF	Wet Probe	12 to 24	72.625	2.24
157	EM	cart	TTF	Wet Probe	24 to 36	54.012	1.161
157	EM	cart	TTF	Wet Probe	36 to 48	50.213	0.878
157	EM	cart	TTF	Woods	0 to 6	82.65	7.577
157	EM	cart	TTF	Woods	6 to 12	68.55	5.752
157	EM	cart	TTF	Woods	12 to 24	92.8	1.002
157	EM	cart	TTF	Woods	24 to 36	66.35	1.404
157	EM	cart	TTF	Woods	36 to 48	60.775	3.031
157	EM	cart	TTF	Open Field	0 to 6	19.855	3.09
157	EM	cart	TTF	Open Field	6 to 12	1.964	0.808
157	EM	cart	TTF	Open Field	12 to 24	25.118	10.59
157	EM	cart	TTF	Open Field	24 to 36	33.291	19.37
157	EM	cart	TTF	Open Field	36 to 48	41.018	10.798
157	EM	cart	TTF	Calibration	0 to 6	24.9	13.8
157	EM	cart	TTF	Calibration	6 to 12	37.3	0.4

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
157	EM	cart	TTF	Calibration	12 to 24	8.1	0.3
157	EM	cart	TTF	Calibration	24 to 36	4.8	0.3
157	EM	cart	TTF	Calibration	36 to 48	4.95	0.35
157	EM	cart	TTF	Blind Grid	0 to 6	2.35	0.112
157	EM	cart	TTF	Blind Grid	6 to 12	24.55	9.711
157	EM	cart	TTF	Blind Grid	12 to 24	36.65	0.594
157	EM	cart	TTF	Blind Grid	24 to 36	36.425	0.303
157	EM	cart	TTF	Blind Grid	36 to 48	38.275	0.179
159	EM	sling	TTF	Wet Probe	0 to 6	85.875	3.549
159	EM	sling	TTF	Wet Probe	6 to 12	79.7	2.765
159	EM	sling	TTF	Wet Probe	12 to 24	72.625	2.24
159	EM	sling	TTF	Wet Probe	24 to 36	54.012	1.161
159	EM	sling	TTF	Wet Probe	36 to 48	50.213	0.878
159	EM	sling	TTF	Woods	0 to 6	82.65	7.577
159	EM	sling	TTF	Woods	6 to 12	68.55	5.752
159	EM	sling	TTF	Woods	12 to 24	92.8	1.002
159	EM	sling	TTF	Woods	24 to 36	66.35	1.404
159	EM	sling	TTF	Woods	36 to 48	60.775	3.031
159	EM	sling	TTF	Open Field	0 to 6	19.855	3.09
159	EM	sling	TTF	Open Field	6 to 12	1.964	0.808
159	EM	sling	TTF	Open Field	12 to 24	25.118	10.59
159	EM	sling	TTF	Open Field	24 to 36	33.291	19.37
159	EM	sling	TTF	Open Field	36 to 48	41.018	10.798
159	EM	sling	TTF	Calibration	0 to 6	24.9	13.8
159	EM	sling	TTF	Calibration	6 to 12	37.3	0.4
159	EM	sling	TTF	Calibration	12 to 24	8.1	0.3
159	EM	sling	TTF	Calibration	24 to 36	4.8	0.3
159	EM	sling	TTF	Calibration	36 to 48	4.95	0.35
159	EM	sling	TTF	Blind Grid	0 to 6	2.35	0.112
159	EM	sling	TTF	Blind Grid	6 to 12	24.55	9.711
159	EM	sling	TTF	Blind Grid	12 to 24	36.65	0.594
159	EM	sling	TTF	Blind Grid	24 to 36	36.425	0.303
159	EM	sling	TTF	Blind Grid	36 to 48	38.275	0.179
549	EM	sling	TTF	Wet Probe	0 to 6	85.875	3.549
549	EM	sling	TTF	Wet Probe	6 to 12	79.7	2.765
549	EM	sling	TTF	Wet Probe	12 to 24	72.625	2.24
549	EM	sling	TTF	Wet Probe	24 to 36	54.012	1.161
549	EM	sling	TTF	Wet Probe	36 to 48	50.213	0.878
549	EM	sling	TTF	Woods	0 to 6	82.65	7.577
549	EM	sling	TTF	Woods	6 to 12	68.55	5.752
549	EM	sling	TTF	Woods	12 to 24	92.8	1.002
549	EM	sling	TTF	Woods	24 to 36	66.35	1.404
549	EM	sling	TTF	Woods	36 to 48	60.775	3.031
549	EM	sling	TTF	Open Field	0 to 6	19.855	3.09
549	EM	sling	TTF	Open Field	6 to 12	1.964	0.808
549	EM	sling	TTF	Open Field	12 to 24	25.118	10.59
549	EM	sling	TTF	Open Field	24 to 36	33.291	19.37
549	EM	sling	TTF	Open Field	36 to 48	41.018	10.798
549	EM	sling	TTF	Calibration	0 to 6	24.9	13.8
549	EM	sling	TTF	Calibration	6 to 12	37.3	0.4

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
549	EM	sling	TTF	Calibration	12 to 24	8.1	0.3
549	EM	sling	TTF	Calibration	24 to 36	4.8	0.3
549	EM	sling	TTF	Calibration	36 to 48	4.95	0.35
549	EM	sling	TTF	Blind Grid	0 to 6	2.35	0.112
549	EM	sling	TTF	Blind Grid	6 to 12	24.55	9.711
549	EM	sling	TTF	Blind Grid	12 to 24	36.65	0.594
549	EM	sling	TTF	Blind Grid	24 to 36	36.425	0.303
549	EM	sling	TTF	Blind Grid	36 to 48	38.275	0.179
165	EM	cart	TTF	Wet Probe	0 to 6	85.875	3.549
165	EM	cart	TTF	Wet Probe	6 to 12	79.7	2.765
165	EM	cart	TTF	Wet Probe	12 to 24	72.625	2.24
165	EM	cart	TTF	Wet Probe	24 to 36	54.012	1.161
165	EM	cart	TTF	Wet Probe	36 to 48	50.213	0.878
165	EM	cart	TTF	Woods	0 to 6	82.65	7.577
165	EM	cart	TTF	Woods	6 to 12	68.55	5.752
165	EM	cart	TTF	Woods	12 to 24	92.8	1.002
165	EM	cart	TTF	Woods	24 to 36	66.35	1.404
165	EM	cart	TTF	Woods	36 to 48	60.775	3.031
165	EM	cart	TTF	Open Field	0 to 6	19.855	3.09
165	EM	cart	TTF	Open Field	6 to 12	1.964	0.808
165	EM	cart	TTF	Open Field	12 to 24	25.118	10.59
165	EM	cart	TTF	Open Field	24 to 36	33.291	19.37
165	EM	cart	TTF	Open Field	36 to 48	41.018	10.798
165	EM	cart	TTF	Calibration	0 to 6	24.9	13.8
165	EM	cart	TTF	Calibration	6 to 12	37.3	0.4
165	EM	cart	TTF	Calibration	12 to 24	8.1	0.3
165	EM	cart	TTF	Calibration	24 to 36	4.8	0.3
165	EM	cart	TTF	Calibration	36 to 48	4.95	0.35
165	EM	cart	TTF	Blind Grid	0 to 6	2.35	0.112
165	EM	cart	TTF	Blind Grid	6 to 12	24.55	9.711
165	EM	cart	TTF	Blind Grid	12 to 24	36.65	0.594
165	EM	cart	TTF	Blind Grid	24 to 36	36.425	0.303
165	EM	cart	TTF	Blind Grid	36 to 48	38.275	0.179
457	EM	sling	TTF	Wet Probe	0 to 6	85.875	3.549
457	EM	sling	TTF	Wet Probe	6 to 12	79.7	2.765
457	EM	sling	TTF	Wet Probe	12 to 24	72.625	2.24
457	EM	sling	TTF	Wet Probe	24 to 36	54.012	1.161
457	EM	sling	TTF	Wet Probe	36 to 48	50.213	0.878
457	EM	sling	TTF	Woods	0 to 6	82.65	7.577
457	EM	sling	TTF	Woods	6 to 12	68.55	5.752
457	EM	sling	TTF	Woods	12 to 24	92.8	1.002
457	EM	sling	TTF	Woods	24 to 36	66.35	1.404
457	EM	sling	TTF	Woods	36 to 48	60.775	3.031
457	EM	sling	TTF	Open Field	0 to 6	19.855	3.09
457	EM	sling	TTF	Open Field	6 to 12	1.964	0.808
457	EM	sling	TTF	Open Field	12 to 24	25.118	10.59
457	EM	sling	TTF	Open Field	24 to 36	33.291	19.37
457	EM	sling	TTF	Open Field	36 to 48	41.018	10.798
457	EM	sling	TTF	Calibration	0 to 6	24.9	13.8
457	EM	sling	TTF	Calibration	6 to 12	37.3	0.4

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Area Measured	Layer, in.	Average Moisture Content, %	Standard Deviation
457	EM	sling	TTF	Calibration	12 to 24	8.1	0.3
457	EM	sling	TTF	Calibration	24 to 36	4.8	0.3
457	EM	sling	TTF	Calibration	36 to 48	4.95	0.35
457	EM	sling	TTF	Blind Grid	0 to 6	2.35	0.112
457	EM	sling	TTF	Blind Grid	6 to 12	24.55	9.711
457	EM	sling	TTF	Blind Grid	12 to 24	36.65	0.594
457	EM	sling	TTF	Blind Grid	24 to 36	36.425	0.303
457	EM	sling	TTF	Blind Grid	36 to 48	38.275	0.179
764	EM	towed	VF Warner	Wet Probe	0 to 6	0	0
764	EM	towed	VF Warner	Wet Probe	6 to 12	0	0
764	EM	towed	VF Warner	Wet Probe	12 to 24	0	0
764	EM	towed	VF Warner	Wet Probe	24 to 36	0	0
764	EM	towed	VF Warner	Wet Probe	36 to 48	0	0
764	EM	towed	VF Warner	Woods	0 to 6	0	0
764	EM	towed	VF Warner	Woods	6 to 12	0	0
764	EM	towed	VF Warner	Woods	12 to 24	0	0
764	EM	towed	VF Warner	Woods	24 to 36	0	0
764	EM	towed	VF Warner	Woods	36 to 48	0	0
764	EM	towed	VF Warner	Open Field	0 to 6	0	0
764	EM	towed	VF Warner	Open Field	6 to 12	0	0
764	EM	towed	VF Warner	Open Field	12 to 24	0	0
764	EM	towed	VF Warner	Open Field	24 to 36	0	0
764	EM	towed	VF Warner	Open Field	36 to 48	0	0
764	EM	towed	VF Warner	Calibration	0 to 6	2.9	0
764	EM	towed	VF Warner	Calibration	6 to 12	15.8	0
764	EM	towed	VF Warner	Calibration	12 to 24	24.8	0
764	EM	towed	VF Warner	Calibration	24 to 36	28.85	0
764	EM	towed	VF Warner	Blind Grid	0 to 6	3.55	0
764	EM	towed	VF Warner	Blind Grid	6 to 12	5.85	0
764	EM	towed	VF Warner	Blind Grid	12 to 24	1251.4	0
764	EM	towed	VF Warner	Blind Grid	24 to 36	5.05	0
764	EM	towed	VF Warner	Blind Grid	36 to 48	4.55	0
45	GPR	cart	Witten	Open Field	0 to 6	12.4	2.45
45	GPR	cart	Witten	Open Field	6 to 12	4.43	5.08
45	GPR	cart	Witten	Open Field	12 to 24	6.87	3.71
45	GPR	cart	Witten	Open Field	24 to 36	20.8	2.38
45	GPR	cart	Witten	Open Field	36 to 48	28.3	2.95
126	GPR	cart	Witten	Open Field	0 to 6	12.4	2.45
126	GPR	cart	Witten	Open Field	6 to 12	4.43	5.08
126	GPR	cart	Witten	Open Field	12 to 24	6.87	3.71
126	GPR	cart	Witten	Open Field	24 to 36	20.8	2.38
126	GPR	cart	Witten	Open Field	36 to 48	28.3	2.95
37	EM	cart	Zonge	Open Field	0 to 6	13.71	10.15
37	EM	cart	Zonge	Open Field	6 to 12	6.85	4.45
37	EM	cart	Zonge	Open Field	12 to 24	1.8	0.23
37	EM	cart	Zonge	Open Field	24 to 36	4.4	1.25
37	EM	cart	Zonge	Open Field	36 to 48	0.18	0.15
37	EM	cart	Zonge	Wet Probe	0 to 6	20.11	9.31
37	EM	cart	Zonge	Wet Probe	6 to 12	12.25	3.68
37	EM	cart	Zonge	Wet Probe	12 to 24	12.53	1.8

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
37	EM	cart	Zonge	Wet Probe	24 to 36	30.61	2.98
37	EM	cart	Zonge	Wet Probe	36 to 48	36.4	1.68
38	EM	cart	Zonge	Open Field	0 to 6	13.5	9.79
38	EM	cart	Zonge	Open Field	6 to 12	9.6	4.33
38	EM	cart	Zonge	Open Field	12 to 24	1.87	0.23
38	EM	cart	Zonge	Open Field	24 to 36	4.43	1.21
38	EM	cart	Zonge	Open Field	36 to 48	0.17	0.15
38	EM	cart	Zonge	Wet Probe	0 to 6	19.88	8.98
38	EM	cart	Zonge	Wet Probe	6 to 12	12.15	3.55
38	EM	cart	Zonge	Wet Probe	12 to 24	12.47	1.75
38	EM	cart	Zonge	Wet Probe	24 to 36	31.79	9.9
38	EM	cart	Zonge	Wet Probe	36 to 48	35.2	6.33

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
383	dual	cart	BH	Calibration	0 to 6	1.57	0.046
383	dual	cart	BH	Calibration	6 to 12	2.225	0.07
383	dual	cart	BH	Calibration	12 to 24	3.88	0.04
383	dual	cart	BH	Calibration	24 to 36	3.6	0
383	dual	cart	BH	Calibration	36 to 48	4	0
383	dual	cart	BH	Moguls	0 to 6	1.61	0.083
383	dual	cart	BH	Moguls	6 to 12	2.07	0.064
383	dual	cart	BH	Moguls	12 to 24	3.68	0.04
383	dual	cart	BH	Moguls	24 to 36	4	0
383	dual	cart	BH	Moguls	36 to 48	4	0
383	dual	cart	BH	Desert Ext.	0 to 6	1.63	0.09
383	dual	cart	BH	Desert Ext.	6 to 12	2.1	0.045
383	dual	cart	BH	Desert Ext.	12 to 24	3.5	0
383	dual	cart	BH	Desert Ext.	24 to 36	4	0
383	dual	cart	BH	Desert Ext.	36 to 48	4.095	0.022
607	dual	cart	BH	Calibration	0 to 6	1.57	0.046
607	dual	cart	BH	Calibration	6 to 12	2.235	0.073
607	dual	cart	BH	Calibration	12 to 24	3.88	0.04
607	dual	cart	BH	Calibration	24 to 36	3.6	0
607	dual	cart	BH	Calibration	36 to 48	4	0
607	dual	cart	BH	Moguls	0 to 6	1.6	0.077
607	dual	cart	BH	Moguls	6 to 12	2.08	0.06
607	dual	cart	BH	Moguls	12 to 24	3.68	0.04
607	dual	cart	BH	Moguls	24 to 36	4	0
607	dual	cart	BH	Moguls	36 to 48	4	0
607	dual	cart	BH	Desert Ext.	0 to 6	1.63	0.09
607	dual	cart	BH	Desert Ext.	6 to 12	2.095	0.038
607	dual	cart	BH	Desert Ext.	12 to 24	3.5	0
607	dual	cart	BH	Desert Ext.	24 to 36	4	0
607	dual	cart	BH	Desert Ext.	36 to 48	4.095	0.022
655	dual	cart	BH	Calibration	0 to 6	1.57	0.046
655	dual	cart	BH	Calibration	6 to 12	2.235	0.073
655	dual	cart	BH	Calibration	12 to 24	3.88	0.04
655	dual	cart	BH	Calibration	24 to 36	3.6	0

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
655	dual	cart	BH	Calibration	36 to 48	4	0
655	dual	cart	BH	Moguls	0 to 6	1.6	0.077
655	dual	cart	BH	Moguls	6 to 12	2.08	0.06
655	dual	cart	BH	Moguls	12 to 24	3.68	0.04
655	dual	cart	BH	Moguls	24 to 36	4	0
655	dual	cart	BH	Moguls	36 to 48	4	0
655	dual	cart	BH	Desert Ext.	0 to 6	1.63	0.09
655	dual	cart	BH	Desert Ext.	6 to 12	2.095	0.038
655	dual	cart	BH	Desert Ext.	12 to 24	3.5	0
655	dual	cart	BH	Desert Ext.	24 to 36	4	0
655	dual	cart	BH	Desert Ext.	36 to 48	4.095	0.022
651	dual	towed	BH	Calibration	0 to 6	1.57	0.046
651	dual	towed	BH	Calibration	6 to 12	2.235	0.073
651	dual	towed	BH	Calibration	12 to 24	3.88	0.04
651	dual	towed	BH	Calibration	24 to 36	3.6	0
651	dual	towed	BH	Calibration	36 to 48	4	0
651	dual	towed	BH	Moguls	0 to 6	1.6	0.077
651	dual	towed	BH	Moguls	6 to 12	2.08	0.06
651	dual	towed	BH	Moguls	12 to 24	3.68	0.04
651	dual	towed	BH	Moguls	24 to 36	4	0
651	dual	towed	BH	Moguls	36 to 48	4	0
651	dual	towed	BH	Desert Ext.	0 to 6	1.63	0.09
651	dual	towed	BH	Desert Ext.	6 to 12	2.095	0.038
651	dual	towed	BH	Desert Ext.	12 to 24	3.5	0
651	dual	towed	BH	Desert Ext.	24 to 36	4	0
651	dual	towed	BH	Desert Ext.	36 to 48	4.095	0.022
769	MAG	hand	Forester	Calibration	0 to 6	1.731	0
769	MAG	hand	Forester	Calibration	6 to 12	2.169	0
769	MAG	hand	Forester	Calibration	12 to 24	3.592	0
769	MAG	hand	Forester	Calibration	24 to 36	3.715	0
769	MAG	hand	Forester	Calibration	36 to 48	4.1	0
769	MAG	hand	Forester	Mogul Area	0 to 6	1.685	0
769	MAG	hand	Forester	Mogul Area	6 to 12	4.223	0
769	MAG	hand	Forester	Mogul Area	12 to 24	3.808	0
769	MAG	hand	Forester	Mogul Area	24 to 36	4.7	0
769	MAG	hand	Forester	Mogul Area	36 to 48	4.854	0
769	MAG	hand	Forester	Desert Ext.	0 to 6	2.25	0
769	MAG	hand	Forester	Desert Ext.	6 to 12	2.133	0
769	MAG	hand	Forester	Desert Ext.	12 to 24	3.217	0
769	MAG	hand	Forester	Desert Ext.	24 to 36	4	0
769	MAG	hand	Forester	Desert Ext.	36 to 48	4	0
769	MAG	hand	Forester	Desert Ext.	0 to 6	1.7	0
769	MAG	hand	Forester	Desert Ext.	6 to 12	1.8	0
769	MAG	hand	Forester	Desert Ext.	12 to 24	3.3	0
769	MAG	hand	Forester	Desert Ext.	24 to 36	4	0
769	MAG	hand	Forester	Desert Ext.	36 to 48	4	0

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
769	MAG	hand	Forester	Calibration	0 to 6	1.731	0
769	MAG	hand	Forester	Calibration	6 to 12	2.169	0
769	MAG	hand	Forester	Calibration	12 to 24	3.592	0
769	MAG	hand	Forester	Calibration	24 to 36	3.715	0
769	MAG	hand	Forester	Calibration	36 to 48	4.1	0
769	MAG	hand	Forester	Mogul Area	0 to 6	1.685	0
769	MAG	hand	Forester	Mogul Area	6 to 12	4.223	0
769	MAG	hand	Forester	Mogul Area	12 to 24	3.808	0
769	MAG	hand	Forester	Mogul Area	24 to 36	4.7	0
769	MAG	hand	Forester	Mogul Area	36 to 48	4.854	0
769	MAG	hand	Forester	Desert Ext.	0 to 6	2.25	0
769	MAG	hand	Forester	Desert Ext.	6 to 12	2.133	0
769	MAG	hand	Forester	Desert Ext.	12 to 24	3.217	0
769	MAG	hand	Forester	Desert Ext.	24 to 36	4	0
769	MAG	hand	Forester	Desert Ext.	36 to 48	4	0
769	MAG	hand	Forester	Desert Ext.	0 to 6	1.7	0
769	MAG	hand	Forester	Desert Ext.	6 to 12	1.8	0
769	MAG	hand	Forester	Desert Ext.	12 to 24	3.3	0
769	MAG	hand	Forester	Desert Ext.	24 to 36	4	0
769	MAG	hand	Forester	Desert Ext.	36 to 48	4	0
293	dual	towed	Geocenters	Calibration	0 to 6	1.76	0.08
293	dual	towed	Geocenters	Calibration	6 to 12	2.2	0
293	dual	towed	Geocenters	Calibration	12 to 24	3.7	0
293	dual	towed	Geocenters	Calibration	24 to 36	3.6	0
293	dual	towed	Geocenters	Calibration	36 to 48	4.1	0
293	dual	towed	Geocenters	Moguls	0 to 6	1.6	0
293	dual	towed	Geocenters	Moguls	6 to 12	2.04	0.049
293	dual	towed	Geocenters	Moguls	12 to 24	3.44	0.08
293	dual	towed	Geocenters	Moguls	24 to 36	3.92	0.04
293	dual	towed	Geocenters	Moguls	36 to 48	4	0
293	dual	towed	Geocenters	Desert Ext.	0 to 6	1.64	0.049
293	dual	towed	Geocenters	Desert Ext.	6 to 12	1.98	0.183
293	dual	towed	Geocenters	Desert Ext.	12 to 24	3.28	0.098
293	dual	towed	Geocenters	Desert Ext.	24 to 36	3.9	0
293	dual	towed	Geocenters	Desert Ext.	36 to 48	4.033	0.047
299	dual	towed	Geocenters	Calibration	0 to 6	1.76	0.08
299	dual	towed	Geocenters	Calibration	6 to 12	2.2	0
299	dual	towed	Geocenters	Calibration	12 to 24	3.7	0
299	dual	towed	Geocenters	Calibration	24 to 36	3.6	0
299	dual	towed	Geocenters	Calibration	36 to 48	4.1	0
299	dual	towed	Geocenters	Moguls	0 to 6	1.6	0
299	dual	towed	Geocenters	Moguls	6 to 12	2.04	0.049
299	dual	towed	Geocenters	Moguls	12 to 24	3.44	0.08
299	dual	towed	Geocenters	Moguls	24 to 36	3.92	0.04
299	dual	towed	Geocenters	Moguls	36 to 48	4	0
299	dual	towed	Geocenters	Desert Ext.	0 to 6	1.64	0.049

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
299	dual	towed	Geocenters	Desert Ext.	6 to 12	1.98	0.183
299	dual	towed	Geocenters	Desert Ext.	12 to 24	3.28	0.098
299	dual	towed	Geocenters	Desert Ext.	24 to 36	3.9	0
299	dual	towed	Geocenters	Desert Ext.	36 to 48	4.033	0.047
238	MAG	hand	HFA	Calibration	0 to 6	1.759	0.072
238	MAG	hand	HFA	Calibration	6 to 12	2.278	0.047
238	MAG	hand	HFA	Calibration	12 to 24	3.824	0.043
238	MAG	hand	HFA	Calibration	24 to 36	3.6	0
238	MAG	hand	HFA	Calibration	36 to 48	4	0
238	MAG	hand	HFA	Moguls	0 to 6	1.595	0.061
238	MAG	hand	HFA	Moguls	6 to 12	2.089	0.045
238	MAG	hand	HFA	Moguls	12 to 24	3.689	0.031
238	MAG	hand	HFA	Moguls	24 to 36	4	0
238	MAG	hand	HFA	Moguls	36 to 48	4	0
238	MAG	hand	HFA	Desert Ext.	0 to 6	1.684	0.049
238	MAG	hand	HFA	Desert Ext.	6 to 12	2.092	0.036
238	MAG	hand	HFA	Desert Ext.	12 to 24	3.5	0
238	MAG	hand	HFA	Desert Ext.	24 to 36	3.995	0.023
238	MAG	hand	HFA	Desert Ext.	36 to 48	4.097	0.016
528	MAG	hand	HFA	Calibration	0 to 6	1.759	0.072
528	MAG	hand	HFA	Calibration	6 to 12	2.278	0.047
528	MAG	hand	HFA	Calibration	12 to 24	3.824	0.043
528	MAG	hand	HFA	Calibration	24 to 36	3.6	0
528	MAG	hand	HFA	Calibration	36 to 48	4	0
528	MAG	hand	HFA	Moguls	0 to 6	1.595	0.061
528	MAG	hand	HFA	Moguls	6 to 12	2.089	0.045
528	MAG	hand	HFA	Moguls	12 to 24	3.689	0.031
528	MAG	hand	HFA	Moguls	24 to 36	4	0
528	MAG	hand	HFA	Moguls	36 to 48	4	0
528	MAG	hand	HFA	Desert Ext.	0 to 6	1.684	0.049
528	MAG	hand	HFA	Desert Ext.	6 to 12	2.092	0.036
528	MAG	hand	HFA	Desert Ext.	12 to 24	3.5	0
528	MAG	hand	HFA	Desert Ext.	24 to 36	3.995	0.023
528	MAG	hand	HFA	Desert Ext.	36 to 48	4.097	0.016
587	MAG	hand	HFA	Calibration	0 to 6	1.759	0.072
587	MAG	hand	HFA	Calibration	6 to 12	2.278	0.047
587	MAG	hand	HFA	Calibration	12 to 24	3.824	0.043
587	MAG	hand	HFA	Calibration	24 to 36	3.6	0
587	MAG	hand	HFA	Calibration	36 to 48	4	0
587	MAG	hand	HFA	Moguls	0 to 6	1.595	0.061
587	MAG	hand	HFA	Moguls	6 to 12	2.089	0.045
587	MAG	hand	HFA	Moguls	12 to 24	3.689	0.031
587	MAG	hand	HFA	Moguls	24 to 36	4	0
587	MAG	hand	HFA	Moguls	36 to 48	4	0
587	MAG	hand	HFA	Desert Ext.	0 to 6	1.684	0.049
587	MAG	hand	HFA	Desert Ext.	6 to 12	2.092	0.036

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
587	MAG	hand	HFA	Desert Ext.	12 to 24	3.5	0
587	MAG	hand	HFA	Desert Ext.	24 to 36	3.995	0.023
587	MAG	hand	HFA	Desert Ext.	36 to 48	4.097	0.016
442	MAG	hand	HFA	Calibration	0 to 6	1.759	0.072
442	MAG	hand	HFA	Calibration	6 to 12	2.278	0.047
442	MAG	hand	HFA	Calibration	12 to 24	3.824	0.043
442	MAG	hand	HFA	Calibration	24 to 36	3.6	0
442	MAG	hand	HFA	Calibration	36 to 48	4	0
442	MAG	hand	HFA	Moguls	0 to 6	1.595	0.061
442	MAG	hand	HFA	Moguls	6 to 12	2.089	0.045
442	MAG	hand	HFA	Moguls	12 to 24	3.689	0.031
442	MAG	hand	HFA	Moguls	24 to 36	4	0
442	MAG	hand	HFA	Moguls	36 to 48	4	0
442	MAG	hand	HFA	Desert Ext.	0 to 6	1.684	0.049
442	MAG	hand	HFA	Desert Ext.	6 to 12	2.092	0.036
442	MAG	hand	HFA	Desert Ext.	12 to 24	3.5	0
442	MAG	hand	HFA	Desert Ext.	24 to 36	3.876	0.497
442	MAG	hand	HFA	Desert Ext.	36 to 48	3.995	0.429
667	EM	towed	NAEVA	Calibration	0 to 6	1.853	0.062
667	EM	towed	NAEVA	Calibration	6 to 12	2.787	0.088
667	EM	towed	NAEVA	Calibration	12 to 24	4.587	0.096
667	EM	towed	NAEVA	Calibration	24 to 36	3.7	0
667	EM	towed	NAEVA	Calibration	36 to 48	4.033	0.047
667	EM	towed	NAEVA	Moguls	0 to 6	1.713	0.034
667	EM	towed	NAEVA	Moguls	6 to 12	2.773	0.044
667	EM	towed	NAEVA	Moguls	12 to 24	4.487	0.034
667	EM	towed	NAEVA	Moguls	24 to 36	3.8	0
667	EM	towed	NAEVA	Moguls	36 to 48	3.9	0
667	EM	towed	NAEVA	Desert Ext.	0 to 6	1.513	0.034
667	EM	towed	NAEVA	Desert Ext.	6 to 12	2.087	0.034
667	EM	towed	NAEVA	Desert Ext.	12 to 24	3.633	0.249
667	EM	towed	NAEVA	Desert Ext.	24 to 36	3.7	0
667	EM	towed	NAEVA	Desert Ext.	36 to 48	3.9	0
666	EM	2-man	NAEVA	Calibration	0 to 6	1.853	0.062
666	EM	2-man	NAEVA	Calibration	6 to 12	2.787	0.088
666	EM	2-man	NAEVA	Calibration	12 to 24	4.587	0.096
666	EM	2-man	NAEVA	Calibration	24 to 36	3.7	0
666	EM	2-man	NAEVA	Calibration	36 to 48	4.033	0.047
666	EM	2-man	NAEVA	Moguls	0 to 6	1.713	0.034
666	EM	2-man	NAEVA	Moguls	6 to 12	2.773	0.044
666	EM	2-man	NAEVA	Moguls	12 to 24	4.487	0.034
666	EM	2-man	NAEVA	Moguls	24 to 36	3.8	0
666	EM	2-man	NAEVA	Moguls	36 to 48	3.9	0
666	EM	2-man	NAEVA	Desert Ext.	0 to 6	1.513	0.034
666	EM	2-man	NAEVA	Desert Ext.	6 to 12	2.087	0.034
666	EM	2-man	NAEVA	Desert Ext.	12 to 24	3.633	0.249

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
666	EM	2-man	NAEVA	Desert Ext.	24 to 36	3.7	0
666	EM	2-man	NAEVA	Desert Ext.	36 to 48	3.9	0
670	EM	2-man	NAEVA	Calibration	0 to 6	1.853	0.062
670	EM	2-man	NAEVA	Calibration	6 to 12	2.787	0.088
670	EM	2-man	NAEVA	Calibration	12 to 24	4.587	0.096
670	EM	2-man	NAEVA	Calibration	24 to 36	3.7	0
670	EM	2-man	NAEVA	Calibration	36 to 48	4.033	0.047
670	EM	2-man	NAEVA	Moguls	0 to 6	1.713	0.034
670	EM	2-man	NAEVA	Moguls	6 to 12	2.773	0.044
670	EM	2-man	NAEVA	Moguls	12 to 24	4.487	0.034
670	EM	2-man	NAEVA	Moguls	24 to 36	3.8	0
670	EM	2-man	NAEVA	Moguls	36 to 48	3.9	0
670	EM	2-man	NAEVA	Desert Ext.	0 to 6	1.513	0.034
670	EM	2-man	NAEVA	Desert Ext.	6 to 12	2.087	0.034
670	EM	2-man	NAEVA	Desert Ext.	12 to 24	3.633	0.249
670	EM	2-man	NAEVA	Desert Ext.	24 to 36	3.7	0
670	EM	2-man	NAEVA	Desert Ext.	36 to 48	3.9	0
669	EM	2-man	NAEVA	Calibration	0 to 6	1.853	0.062
669	EM	2-man	NAEVA	Calibration	6 to 12	2.787	0.088
669	EM	2-man	NAEVA	Calibration	12 to 24	4.587	0.096
669	EM	2-man	NAEVA	Calibration	24 to 36	3.7	0
669	EM	2-man	NAEVA	Calibration	36 to 48	4.033	0.047
669	EM	2-man	NAEVA	Moguls	0 to 6	1.713	0.034
669	EM	2-man	NAEVA	Moguls	6 to 12	2.773	0.044
669	EM	2-man	NAEVA	Moguls	12 to 24	4.487	0.034
669	EM	2-man	NAEVA	Moguls	24 to 36	3.8	0
669	EM	2-man	NAEVA	Moguls	36 to 48	3.9	0
669	EM	2-man	NAEVA	Desert Ext.	0 to 6	1.513	0.034
669	EM	2-man	NAEVA	Desert Ext.	6 to 12	2.087	0.034
669	EM	2-man	NAEVA	Desert Ext.	12 to 24	3.633	0.249
669	EM	2-man	NAEVA	Desert Ext.	24 to 36	3.7	0
669	EM	2-man	NAEVA	Desert Ext.	36 to 48	3.9	0
668	EM	towed	NAEVA	Calibration	0 to 6	1.853	0.062
668	EM	towed	NAEVA	Calibration	6 to 12	2.787	0.088
668	EM	towed	NAEVA	Calibration	12 to 24	4.587	0.096
668	EM	towed	NAEVA	Calibration	24 to 36	3.7	0
668	EM	towed	NAEVA	Calibration	36 to 48	4.033	0.047
668	EM	towed	NAEVA	Moguls	0 to 6	1.713	0.034
668	EM	towed	NAEVA	Moguls	6 to 12	2.773	0.044
668	EM	towed	NAEVA	Moguls	12 to 24	4.487	0.034
668	EM	towed	NAEVA	Moguls	24 to 36	3.8	0
668	EM	towed	NAEVA	Moguls	36 to 48	3.9	0
668	EM	towed	NAEVA	Desert Ext.	0 to 6	1.513	0.034
668	EM	towed	NAEVA	Desert Ext.	6 to 12	2.087	0.034
668	EM	towed	NAEVA	Desert Ext.	12 to 24	3.633	0.249
668	EM	towed	NAEVA	Desert Ext.	24 to 36	3.7	0

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
668	EM	towed	NAEVA	Desert Ext.	36 to 48	3.9	0
213	EM	towed	NRL	Calibration	0 to 6	1.85	0.05
213	EM	towed	NRL	Calibration	6 to 12	2.588	0.105
213	EM	towed	NRL	Calibration	12 to 24	3.7	0
213	EM	towed	NRL	Calibration	24 to 36	3.6	0
213	EM	towed	NRL	Calibration	36 to 48	4	0
213	EM	towed	NRL	Moguls	0 to 6	1.6	0
213	EM	towed	NRL	Moguls	6 to 12	2.413	0.145
213	EM	towed	NRL	Moguls	12 to 24	3.5	0
213	EM	towed	NRL	Moguls	24 to 36	3.925	0.043
213	EM	towed	NRL	Moguls	36 to 48	3.975	0.043
213	EM	towed	NRL	Desert Ext.	0 to 6	1.675	0.083
213	EM	towed	NRL	Desert Ext.	6 to 12	2.387	0.06
213	EM	towed	NRL	Desert Ext.	12 to 24	3.3	0
213	EM	towed	NRL	Desert Ext.	24 to 36	3.9	0
213	EM	towed	NRL	Desert Ext.	36 to 48	4.1	0
245	EM	towed	NRL	Calibration	0 to 6	1.85	0.05
245	EM	towed	NRL	Calibration	6 to 12	2.588	0.105
245	EM	towed	NRL	Calibration	12 to 24	3.7	0
245	EM	towed	NRL	Calibration	24 to 36	3.6	0
245	EM	towed	NRL	Calibration	36 to 48	4	0
245	EM	towed	NRL	Moguls	0 to 6	1.6	0
245	EM	towed	NRL	Moguls	6 to 12	2.413	0.145
245	EM	towed	NRL	Moguls	12 to 24	3.5	0
245	EM	towed	NRL	Moguls	24 to 36	3.925	0.043
245	EM	towed	NRL	Moguls	36 to 48	3.975	0.043
245	EM	towed	NRL	Desert Ext.	0 to 6	1.675	0.083
245	EM	towed	NRL	Desert Ext.	6 to 12	2.387	0.06
245	EM	towed	NRL	Desert Ext.	12 to 24	3.3	0
245	EM	towed	NRL	Desert Ext.	24 to 36	3.9	0
245	EM	towed	NRL	Desert Ext.	36 to 48	4.1	0
690	EM	cart	Parsons	Calibration	0 to 6	1.786	0.035
690	EM	cart	Parsons	Calibration	6 to 12	2.286	0.035
690	EM	cart	Parsons	Calibration	12 to 24	3.7	0
690	EM	cart	Parsons	Calibration	24 to 36	3.65	0.05
690	EM	cart	Parsons	Calibration	36 to 48	4.1	0
690	EM	cart	Parsons	Moguls	0 to 6	1.7	0
690	EM	cart	Parsons	Moguls	6 to 12	2	0
690	EM	cart	Parsons	Moguls	12 to 24	3.6	0
690	EM	cart	Parsons	Moguls	24 to 36	3.9	0
690	EM	cart	Parsons	Moguls	36 to 48	4	0
690	EM	cart	Parsons	Desert Ext.	0 to 6	1.6	0
690	EM	cart	Parsons	Desert Ext.	6 to 12	2	0
690	EM	cart	Parsons	Desert Ext.	12 to 24	3.4	0
690	EM	cart	Parsons	Desert Ext.	24 to 36	3.9	0
690	EM	cart	Parsons	Desert Ext.	36 to 48	4.1	0

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
532	EM	cart	Parsons	Calibration	0 to 6	1.786	0.035
532	EM	cart	Parsons	Calibration	6 to 12	2.286	0.035
532	EM	cart	Parsons	Calibration	12 to 24	3.7	0
532	EM	cart	Parsons	Calibration	24 to 36	3.65	0.05
532	EM	cart	Parsons	Calibration	36 to 48	4.1	0
532	EM	cart	Parsons	Moguls	0 to 6	1.7	0
532	EM	cart	Parsons	Moguls	6 to 12	2	0
532	EM	cart	Parsons	Moguls	12 to 24	3.6	0
532	EM	cart	Parsons	Moguls	24 to 36	3.9	0
532	EM	cart	Parsons	Moguls	36 to 48	4	0
532	EM	cart	Parsons	Desert Ext.	0 to 6	1.6	0
532	EM	cart	Parsons	Desert Ext.	6 to 12	2	0
532	EM	cart	Parsons	Desert Ext.	12 to 24	3.4	0
532	EM	cart	Parsons	Desert Ext.	24 to 36	3.9	0
532	EM	cart	Parsons	Desert Ext.	36 to 48	3.771	0.805
588	EM	cart	Parsons	Calibration	0 to 6	1.786	0.035
588	EM	cart	Parsons	Calibration	6 to 12	2.286	0.035
588	EM	cart	Parsons	Calibration	12 to 24	3.7	0
588	EM	cart	Parsons	Calibration	24 to 36	3.657	0.049
588	EM	cart	Parsons	Calibration	36 to 48	4.1	0
588	EM	cart	Parsons	Moguls	0 to 6	1.7	0
588	EM	cart	Parsons	Moguls	6 to 12	2	0
588	EM	cart	Parsons	Moguls	12 to 24	3.6	0
588	EM	cart	Parsons	Moguls	24 to 36	3.9	0
588	EM	cart	Parsons	Moguls	36 to 48	4	0
588	EM	cart	Parsons	Desert Ext.	0 to 6	1.6	0
588	EM	cart	Parsons	Desert Ext.	6 to 12	2	0
588	EM	cart	Parsons	Desert Ext.	12 to 24	3.4	0
588	EM	cart	Parsons	Desert Ext.	24 to 36	3.9	0
588	EM	cart	Parsons	Desert Ext.	36 to 48	4.1	0
425	EM	cart	Parsons	Calibration	0 to 6	1.786	0.035
425	EM	cart	Parsons	Calibration	6 to 12	2.286	0.035
425	EM	cart	Parsons	Calibration	12 to 24	3.7	0
425	EM	cart	Parsons	Calibration	24 to 36	3.65	0.05
425	EM	cart	Parsons	Calibration	36 to 48	4.1	0
425	EM	cart	Parsons	Moguls	0 to 6	1.7	0
425	EM	cart	Parsons	Moguls	6 to 12	2	0
425	EM	cart	Parsons	Moguls	12 to 24	3.6	0
425	EM	cart	Parsons	Moguls	24 to 36	3.9	0
425	EM	cart	Parsons	Moguls	36 to 48	4	0
425	EM	cart	Parsons	Desert Ext.	0 to 6	1.6	0
425	EM	cart	Parsons	Desert Ext.	6 to 12	2	0
425	EM	cart	Parsons	Desert Ext.	12 to 24	3.4	0
425	EM	cart	Parsons	Desert Ext.	24 to 36	3.9	0
425	EM	cart	Parsons	Desert Ext.	36 to 48	4.1	0
606	MAG	hand	Parsons	Calibration	0 to 6	1.677	0.119

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
606	MAG	hand	Parsons	Calibration	6 to 12	2.2	0
606	MAG	hand	Parsons	Calibration	12 to 24	3.7	0
606	MAG	hand	Parsons	Calibration	24 to 36	3.6	0
606	MAG	hand	Parsons	Calibration	36 to 48	4.1	0
606	MAG	hand	Parsons	Moguls	0 to 6	1.654	0.05
606	MAG	hand	Parsons	Moguls	6 to 12	2.015	0.036
606	MAG	hand	Parsons	Moguls	12 to 24	3.6	0.13
606	MAG	hand	Parsons	Moguls	24 to 36	3.923	0.042
606	MAG	hand	Parsons	Moguls	36 to 48	4	0
606	MAG	hand	Parsons	Desert Ext.	0 to 6	1.623	0.042
606	MAG	hand	Parsons	Desert Ext.	6 to 12	2.008	0.1
606	MAG	hand	Parsons	Desert Ext.	12 to 24	3.354	0.075
606	MAG	hand	Parsons	Desert Ext.	24 to 36	3.869	0.072
606	MAG	hand	Parsons	Desert Ext.	36 to 48	4.054	0.075
601	MAG	hand	Parsons	Calibration	0 to 6	1.677	0.119
601	MAG	hand	Parsons	Calibration	6 to 12	2.2	0
601	MAG	hand	Parsons	Calibration	12 to 24	3.7	0
601	MAG	hand	Parsons	Calibration	24 to 36	3.6	0
601	MAG	hand	Parsons	Calibration	36 to 48	4.1	0
601	MAG	hand	Parsons	Moguls	0 to 6	1.654	0.05
601	MAG	hand	Parsons	Moguls	6 to 12	2.015	0.036
601	MAG	hand	Parsons	Moguls	12 to 24	3.6	0.13
601	MAG	hand	Parsons	Moguls	24 to 36	3.923	0.042
601	MAG	hand	Parsons	Moguls	36 to 48	4	0
601	MAG	hand	Parsons	Desert Ext.	0 to 6	1.623	0.042
601	MAG	hand	Parsons	Desert Ext.	6 to 12	2.008	0.1
601	MAG	hand	Parsons	Desert Ext.	12 to 24	3.354	0.075
601	MAG	hand	Parsons	Desert Ext.	24 to 36	3.869	0.072
601	MAG	hand	Parsons	Desert Ext.	36 to 48	4.054	0.075
602	MAG	hand	Parsons	Calibration	0 to 6	1.677	0.119
602	MAG	hand	Parsons	Calibration	6 to 12	2.2	0
602	MAG	hand	Parsons	Calibration	12 to 24	3.7	0
602	MAG	hand	Parsons	Calibration	24 to 36	3.6	0
602	MAG	hand	Parsons	Calibration	36 to 48	4.1	0
602	MAG	hand	Parsons	Moguls	0 to 6	1.654	0.05
602	MAG	hand	Parsons	Moguls	6 to 12	2.015	0.036
602	MAG	hand	Parsons	Moguls	12 to 24	3.6	0.13
602	MAG	hand	Parsons	Moguls	24 to 36	3.923	0.042
602	MAG	hand	Parsons	Moguls	36 to 48	4	0
602	MAG	hand	Parsons	Desert Ext.	0 to 6	1.623	0.042
602	MAG	hand	Parsons	Desert Ext.	6 to 12	2.008	0.1
602	MAG	hand	Parsons	Desert Ext.	12 to 24	3.354	0.075
602	MAG	hand	Parsons	Desert Ext.	24 to 36	3.869	0.072
602	MAG	hand	Parsons	Desert Ext.	36 to 48	4.054	0.075
426	MAG	hand	Parsons	Calibration	0 to 6	1.677	0.119
426	MAG	hand	Parsons	Calibration	6 to 12	2.2	0

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
426	MAG	hand	Parsons	Calibration	12 to 24	3.7	0
426	MAG	hand	Parsons	Calibration	24 to 36	3.6	0
426	MAG	hand	Parsons	Calibration	36 to 48	4.1	0
426	MAG	hand	Parsons	Moguls	0 to 6	1.654	0.05
426	MAG	hand	Parsons	Moguls	6 to 12	2.015	0.036
426	MAG	hand	Parsons	Moguls	12 to 24	3.6	0.13
426	MAG	hand	Parsons	Moguls	24 to 36	3.923	0.042
426	MAG	hand	Parsons	Moguls	36 to 48	4	0
426	MAG	hand	Parsons	Desert Ext.	0 to 6	1.623	0.042
426	MAG	hand	Parsons	Desert Ext.	6 to 12	2.008	0.1
426	MAG	hand	Parsons	Desert Ext.	12 to 24	3.354	0.075
426	MAG	hand	Parsons	Desert Ext.	24 to 36	3.869	0.072
426	MAG	hand	Parsons	Desert Ext.	36 to 48	3.708	0.817
199	EM	cart	Shaw	Calibration	0 to 6	1.73	0.09
199	EM	cart	Shaw	Calibration	6 to 12	2.32	0.04
199	EM	cart	Shaw	Calibration	12 to 24	3.7	0
199	EM	cart	Shaw	Calibration	24 to 36	3.6	0
199	EM	cart	Shaw	Calibration	36 to 48	3.93	0.046
199	EM	cart	Shaw	Moguls	0 to 6	1.61	0.03
199	EM	cart	Shaw	Moguls	6 to 12	2.04	0.08
199	EM	cart	Shaw	Moguls	12 to 24	3.58	0.04
199	EM	cart	Shaw	Moguls	24 to 36	3.9	0
199	EM	cart	Shaw	Moguls	36 to 48	3.9	0
199	EM	cart	Shaw	Desert Ext.	0 to 6	1.6	0
199	EM	cart	Shaw	Desert Ext.	6 to 12	2.2	0.077
199	EM	cart	Shaw	Desert Ext.	12 to 24	3.38	0.04
199	EM	cart	Shaw	Desert Ext.	24 to 36	3.9	0
199	EM	cart	Shaw	Desert Ext.	36 to 48	4.01	0.03
211	EM	cart	Shaw	Calibration	0 to 6	1.713	0.093
211	EM	cart	Shaw	Calibration	6 to 12	2.325	0.043
211	EM	cart	Shaw	Calibration	12 to 24	3.7	0
211	EM	cart	Shaw	Calibration	24 to 36	3.6	0
211	EM	cart	Shaw	Calibration	36 to 48	3.925	0.043
211	EM	cart	Shaw	Moguls	0 to 6	1.612	0.033
211	EM	cart	Shaw	Moguls	6 to 12	2.05	0.087
211	EM	cart	Shaw	Moguls	12 to 24	3.575	0.043
211	EM	cart	Shaw	Moguls	24 to 36	3.9	0
211	EM	cart	Shaw	Moguls	36 to 48	3.9	0
211	EM	cart	Shaw	Desert Ext.	0 to 6	1.6	0
211	EM	cart	Shaw	Desert Ext.	6 to 12	2.2	0.087
211	EM	cart	Shaw	Desert Ext.	12 to 24	3.375	0.043
211	EM	cart	Shaw	Desert Ext.	24 to 36	3.9	0
211	EM	cart	Shaw	Desert Ext.	36 to 48	4.012	0.033
207	EM	cart	Shaw	Calibration	0 to 6	1.713	0.093
207	EM	cart	Shaw	Calibration	6 to 12	2.325	0.043
207	EM	cart	Shaw	Calibration	12 to 24	3.7	0

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
207	EM	cart	Shaw	Calibration	24 to 36	3.6	0
207	EM	cart	Shaw	Calibration	36 to 48	3.925	0.043
207	EM	cart	Shaw	Moguls	0 to 6	1.612	0.033
207	EM	cart	Shaw	Moguls	6 to 12	2.05	0.087
207	EM	cart	Shaw	Moguls	12 to 24	3.575	0.043
207	EM	cart	Shaw	Moguls	24 to 36	3.9	0
207	EM	cart	Shaw	Moguls	36 to 48	3.9	0
207	EM	cart	Shaw	Desert Ext.	0 to 6	1.6	0
207	EM	cart	Shaw	Desert Ext.	6 to 12	2.2	0.087
207	EM	cart	Shaw	Desert Ext.	12 to 24	3.375	0.043
207	EM	cart	Shaw	Desert Ext.	24 to 36	3.9	0
207	EM	cart	Shaw	Desert Ext.	36 to 48	4.012	0.033
354	EM	cart	Shaw	Calibration	0 to 6	1.713	0.093
354	EM	cart	Shaw	Calibration	6 to 12	2.325	0.043
354	EM	cart	Shaw	Calibration	12 to 24	3.7	0
354	EM	cart	Shaw	Calibration	24 to 36	3.6	0
354	EM	cart	Shaw	Calibration	36 to 48	3.925	0.043
354	EM	cart	Shaw	Moguls	0 to 6	1.612	0.033
354	EM	cart	Shaw	Moguls	6 to 12	2.05	0.087
354	EM	cart	Shaw	Moguls	12 to 24	3.575	0.043
354	EM	cart	Shaw	Moguls	24 to 36	3.9	0
354	EM	cart	Shaw	Moguls	36 to 48	3.9	0
354	EM	cart	Shaw	Desert Ext.	0 to 6	1.6	0
354	EM	cart	Shaw	Desert Ext.	6 to 12	2.2	0.087
354	EM	cart	Shaw	Desert Ext.	12 to 24	3.375	0.043
354	EM	cart	Shaw	Desert Ext.	24 to 36	3.9	0
354	EM	cart	Shaw	Desert Ext.	36 to 48	4.012	0.033
312	MAG	cart	Shaw	Calibration	0 to 6	1.74	0.092
312	MAG	cart	Shaw	Calibration	6 to 12	2.4	0.089
312	MAG	cart	Shaw	Calibration	12 to 24	3.69	0.03
312	MAG	cart	Shaw	Calibration	24 to 36	3.6	0
312	MAG	cart	Shaw	Calibration	36 to 48	3.94	0.049
312	MAG	cart	Shaw	Moguls	0 to 6	1.64	0.049
312	MAG	cart	Shaw	Moguls	6 to 12	2.27	0.215
312	MAG	cart	Shaw	Moguls	12 to 24	3.5	0
312	MAG	cart	Shaw	Moguls	24 to 36	3.9	0
312	MAG	cart	Shaw	Moguls	36 to 48	3.9	0
312	MAG	cart	Shaw	Desert Ext.	0 to 6	1.64	0.08
312	MAG	cart	Shaw	Desert Ext.	6 to 12	2.26	0.136
312	MAG	cart	Shaw	Desert Ext.	12 to 24	3.3	0
312	MAG	cart	Shaw	Desert Ext.	24 to 36	3.9	0
312	MAG	cart	Shaw	Desert Ext.	36 to 48	4	0
541	MAG	cart	Shaw	Calibration	0 to 6	1.74	0.092
541	MAG	cart	Shaw	Calibration	6 to 12	2.4	0.089
541	MAG	cart	Shaw	Calibration	12 to 24	3.69	0.03
541	MAG	cart	Shaw	Calibration	24 to 36	3.6	0

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
541	MAG	cart	Shaw	Calibration	36 to 48	3.94	0.049
541	MAG	cart	Shaw	Moguls	0 to 6	1.64	0.049
541	MAG	cart	Shaw	Moguls	6 to 12	2.27	0.215
541	MAG	cart	Shaw	Moguls	12 to 24	3.5	0
541	MAG	cart	Shaw	Moguls	24 to 36	3.9	0
541	MAG	cart	Shaw	Moguls	36 to 48	3.9	0
541	MAG	cart	Shaw	Desert Ext.	0 to 6	1.64	0.08
541	MAG	cart	Shaw	Desert Ext.	6 to 12	2.26	0.136
541	MAG	cart	Shaw	Desert Ext.	12 to 24	3.3	0
541	MAG	cart	Shaw	Desert Ext.	24 to 36	3.9	0
541	MAG	cart	Shaw	Desert Ext.	36 to 48	4	0
594	MAG	cart	Shaw	Calibration	0 to 6	1.74	0.092
594	MAG	cart	Shaw	Calibration	6 to 12	2.4	0.089
594	MAG	cart	Shaw	Calibration	12 to 24	3.69	0.03
594	MAG	cart	Shaw	Calibration	24 to 36	3.6	0
594	MAG	cart	Shaw	Calibration	36 to 48	3.94	0.049
594	MAG	cart	Shaw	Moguls	0 to 6	1.64	0.049
594	MAG	cart	Shaw	Moguls	6 to 12	2.27	0.215
594	MAG	cart	Shaw	Moguls	12 to 24	3.5	0
594	MAG	cart	Shaw	Moguls	24 to 36	3.9	0
594	MAG	cart	Shaw	Moguls	36 to 48	3.9	0
594	MAG	cart	Shaw	Desert Ext.	0 to 6	1.64	0.08
594	MAG	cart	Shaw	Desert Ext.	6 to 12	2.26	0.136
594	MAG	cart	Shaw	Desert Ext.	12 to 24	3.3	0
594	MAG	cart	Shaw	Desert Ext.	24 to 36	3.9	0
594	MAG	cart	Shaw	Desert Ext.	36 to 48	4	0
638	MAG	cart	Shaw	Calibration	0 to 6	1.74	0.092
638	MAG	cart	Shaw	Calibration	6 to 12	2.4	0.089
638	MAG	cart	Shaw	Calibration	12 to 24	3.69	0.03
638	MAG	cart	Shaw	Calibration	24 to 36	3.6	0
638	MAG	cart	Shaw	Calibration	36 to 48	3.94	0.049
638	MAG	cart	Shaw	Moguls	0 to 6	1.64	0.049
638	MAG	cart	Shaw	Moguls	6 to 12	2.27	0.215
638	MAG	cart	Shaw	Moguls	12 to 24	3.5	0
638	MAG	cart	Shaw	Moguls	24 to 36	3.9	0
638	MAG	cart	Shaw	Moguls	36 to 48	3.9	0
638	MAG	cart	Shaw	Desert Ext.	0 to 6	1.64	0.08
638	MAG	cart	Shaw	Desert Ext.	6 to 12	2.26	0.136
638	MAG	cart	Shaw	Desert Ext.	12 to 24	3.3	0
638	MAG	cart	Shaw	Desert Ext.	24 to 36	3.9	0
638	MAG	cart	Shaw	Desert Ext.	36 to 48	4	0
168	EM	cart	TTF	Calibration	0 to 6	1.8	0
168	EM	cart	TTF	Calibration	6 to 12	2.4	0
168	EM	cart	TTF	Calibration	12 to 24	3.7	0
168	EM	cart	TTF	Calibration	24 to 36	3.6	0
168	EM	cart	TTF	Calibration	36 to 48	3.983	0.037

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
168	EM	cart	TTF	Moguls	0 to 6	1.65	0.05
168	EM	cart	TTF	Moguls	6 to 12	2.167	0.047
168	EM	cart	TTF	Moguls	12 to 24	3.517	0.037
168	EM	cart	TTF	Moguls	24 to 36	3.9	0
168	EM	cart	TTF	Moguls	36 to 48	3.9	0
168	EM	cart	TTF	Desert Ext.	0 to 6	1.6	0
168	EM	cart	TTF	Desert Ext.	6 to 12	2.217	0.055
168	EM	cart	TTF	Desert Ext.	12 to 24	3.358	0.049
168	EM	cart	TTF	Desert Ext.	24 to 36	3.9	0
168	EM	cart	TTF	Desert Ext.	36 to 48	4.083	0.055
171	EM	cart	TTF	Calibration	0 to 6	1.8	0
171	EM	cart	TTF	Calibration	6 to 12	2.4	0
171	EM	cart	TTF	Calibration	12 to 24	3.7	0
171	EM	cart	TTF	Calibration	24 to 36	3.6	0
171	EM	cart	TTF	Calibration	36 to 48	3.983	0.037
171	EM	cart	TTF	Moguls	0 to 6	1.65	0.05
171	EM	cart	TTF	Moguls	6 to 12	2.167	0.047
171	EM	cart	TTF	Moguls	12 to 24	3.517	0.037
171	EM	cart	TTF	Moguls	24 to 36	3.9	0
171	EM	cart	TTF	Moguls	36 to 48	3.9	0
171	EM	cart	TTF	Desert Ext.	0 to 6	1.6	0
171	EM	cart	TTF	Desert Ext.	6 to 12	2.217	0.055
171	EM	cart	TTF	Desert Ext.	12 to 24	3.358	0.049
171	EM	cart	TTF	Desert Ext.	24 to 36	3.9	0
171	EM	cart	TTF	Desert Ext.	36 to 48	4.083	0.055
170	EM	sling	TTF	Calibration	0 to 6	1.8	0
170	EM	sling	TTF	Calibration	6 to 12	2.4	0
170	EM	sling	TTF	Calibration	12 to 24	3.7	0
170	EM	sling	TTF	Calibration	24 to 36	3.6	0
170	EM	sling	TTF	Calibration	36 to 48	3.983	0.037
170	EM	sling	TTF	Moguls	0 to 6	1.65	0.05
170	EM	sling	TTF	Moguls	6 to 12	2.167	0.047
170	EM	sling	TTF	Moguls	12 to 24	3.517	0.037
170	EM	sling	TTF	Moguls	24 to 36	3.9	0
170	EM	sling	TTF	Moguls	36 to 48	3.9	0
170	EM	sling	TTF	Desert Ext.	0 to 6	1.6	0
170	EM	sling	TTF	Desert Ext.	6 to 12	2.217	0.055
170	EM	sling	TTF	Desert Ext.	12 to 24	3.358	0.049
170	EM	sling	TTF	Desert Ext.	24 to 36	3.9	0
170	EM	sling	TTF	Desert Ext.	36 to 48	4.083	0.055
169	EM	cart	TTF	Calibration	0 to 6	1.8	0
169	EM	cart	TTF	Calibration	6 to 12	2.4	0
169	EM	cart	TTF	Calibration	12 to 24	3.7	0
169	EM	cart	TTF	Calibration	24 to 36	3.6	0
169	EM	cart	TTF	Calibration	36 to 48	3.983	0.037
169	EM	cart	TTF	Moguls	0 to 6	1.65	0.05

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Area Measured**	**Layer, in.**	**Average Moisture Content, %**	**Standard Deviation**
169	EM	cart	TTF	Moguls	6 to 12	2.167	0.047
169	EM	cart	TTF	Moguls	12 to 24	3.517	0.037
169	EM	cart	TTF	Moguls	24 to 36	3.9	0
169	EM	cart	TTF	Moguls	36 to 48	3.9	0
169	EM	cart	TTF	Desert Ext.	0 to 6	1.6	0
169	EM	cart	TTF	Desert Ext.	6 to 12	2.217	0.055
169	EM	cart	TTF	Desert Ext.	12 to 24	3.358	0.049
169	EM	cart	TTF	Desert Ext.	24 to 36	3.9	0
169	EM	cart	TTF	Desert Ext.	36 to 48	4.083	0.055

APPENDIX D. DAILY ACTIVITY LOGS

Note: The cost column is represented in dollars.

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
39	EM	hand	AETC	Initial Setup	Supervisor	0.5	47.5
39	EM	hand	AETC	Initial Setup	Data Analyst	0	0
39	EM	hand	AETC	Initial Setup	Field Support	0	0
39	EM	hand	AETC	Initial Setup	Subtotal	0	47.5
39	EM	hand	AETC	Calibration	Supervisor	8.75	831.25
39	EM	hand	AETC	Calibration	Data Analyst	0	0
39	EM	hand	AETC	Calibration	Field Support	0	0
39	EM	hand	AETC	Calibration	Subtotal	0	831.25
39	EM	hand	AETC	Site Survey	Supervisor	18.33	1741.35
39	EM	hand	AETC	Site Survey	Data Analyst	0	0
39	EM	hand	AETC	Site Survey	Field Support	0	0
39	EM	hand	AETC	Site Survey	Subtotal	0	1741.35
39	EM	hand	AETC	Demobilization	Supervisor	0.25	23.75
39	EM	hand	AETC	Demobilization	Data Analyst	0	0
39	EM	hand	AETC	Demobilization	Field Support	0	0
39	EM	hand	AETC	Demobilization	Subtotal	0	23.75
39	EM	hand	AETC	Total	Total	0	2643.85
695	EM	hand	ARM	Initial Setup	Supervisor	1.58	150.1
695	EM	hand	ARM	Initial Setup	Data Analyst	1.58	90.06
695	EM	hand	ARM	Initial Setup	Field Support	1.58	0
695	EM	hand	ARM	Initial Setup	Subtotal	0	240.16
695	EM	hand	ARM	Calibration	Supervisor	11.66	1107.7
695	EM	hand	ARM	Calibration	Data Analyst	11.66	664.62
695	EM	hand	ARM	Calibration	Field Support	11.66	0
695	EM	hand	ARM	Calibration	Subtotal	0	1772.32
695	EM	hand	ARM	Site Survey	Supervisor	15.58	1480.1
695	EM	hand	ARM	Site Survey	Data Analyst	15.58	888.06
695	EM	hand	ARM	Site Survey	Field Support	15.58	0
695	EM	hand	ARM	Site Survey	Subtotal	0	2368.16
695	EM	hand	ARM	Demobilization	Supervisor	0.5	47.5
695	EM	hand	ARM	Demobilization	Data Analyst	0.5	28.5
695	EM	hand	ARM	Demobilization	Field Support	0.5	0
695	EM	hand	ARM	Demobilization	Subtotal	0	76
695	EM	hand	ARM	Total	Total	0	4456.64
691	EM	hand	ARM	Initial Setup	Supervisor	1.08	102.6
691	EM	hand	ARM	Initial Setup	Data Analyst	1.08	61.56
691	EM	hand	ARM	Initial Setup	Field Support	1.08	0
691	EM	hand	ARM	Initial Setup	Subtotal	0	164.16
691	EM	hand	ARM	Calibration	Supervisor	12.16	1155.2
691	EM	hand	ARM	Calibration	Data Analyst	12.16	693.12
691	EM	hand	ARM	Calibration	Field Support	12.16	0
691	EM	hand	ARM	Calibration	Subtotal	0	1848.32
691	EM	hand	ARM	Site Survey	Supervisor	17.25	1638.75
691	EM	hand	ARM	Site Survey	Data Analyst	17.25	983.25
691	EM	hand	ARM	Site Survey	Field Support	17.25	0
691	EM	hand	ARM	Site Survey	Subtotal	0	2622

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
691	EM	hand	ARM	Demobilization	Supervisor	0.5	47.5
691	EM	hand	ARM	Demobilization	Data Analyst	0.5	28.5
691	EM	hand	ARM	Demobilization	Field Support	0.5	0
691	EM	hand	ARM	Demobilization	Subtotal	0	76
691	EM	hand	ARM	Total	Total	0	4710.48
622	dual	cart	BH	Initial Setup	Supervisor	13.25	1258.75
622	dual	cart	BH	Initial Setup	Data Analyst	13.25	755.25
622	dual	cart	BH	Initial Setup	Field Support	13.25	377.63
622	dual	cart	BH	Initial Setup	Subtotal	0	2391.63
622	dual	cart	BH	Calibration	Supervisor	3.33	316.35
622	dual	cart	BH	Calibration	Data Analyst	3.33	189.81
622	dual	cart	BH	Calibration	Field Support	3.33	94.91
622	dual	cart	BH	Calibration	Subtotal	0	601.07
622	dual	cart	BH	Site Survey	Supervisor	1.75	166.25
622	dual	cart	BH	Site Survey	Data Analyst	1.75	99.75
622	dual	cart	BH	Site Survey	Field Support	1.75	49.88
622	dual	cart	BH	Site Survey	Subtotal	0	315.88
622	dual	cart	BH	Demobilization	Supervisor	1.58	150.1
622	dual	cart	BH	Demobilization	Data Analyst	1.58	90.06
622	dual	cart	BH	Demobilization	Field Support	1.58	45.03
622	dual	cart	BH	Demobilization	Subtotal	0	285.19
622	dual	cart	BH	Total	Total	0	3593.77
642	dual	cart	BH	Initial Setup	Supervisor	13.25	1258.75
642	dual	cart	BH	Initial Setup	Data Analyst	13.25	755.25
642	dual	cart	BH	Initial Setup	Field Support	13.25	377.63
642	dual	cart	BH	Initial Setup	Subtotal	0	2391.63
642	dual	cart	BH	Calibration	Supervisor	4.27	405.65
642	dual	cart	BH	Calibration	Data Analyst	4.27	243.39
642	dual	cart	BH	Calibration	Field Support	4.27	121.7
642	dual	cart	BH	Calibration	Subtotal	0	770.74
642	dual	cart	BH	Site Survey	Supervisor	7.72	733.4
642	dual	cart	BH	Site Survey	Data Analyst	7.72	440.04
642	dual	cart	BH	Site Survey	Field Support	7.72	220.02
642	dual	cart	BH	Site Survey	Subtotal	0	1393.46
642	dual	cart	BH	Demobilization	Supervisor	1.58	150.1
642	dual	cart	BH	Demobilization	Data Analyst	1.58	90.06
642	dual	cart	BH	Demobilization	Field Support	1.58	45.03
642	dual	cart	BH	Demobilization	Subtotal	0	285.19
642	dual	cart	BH	Total	Total	0	4841.02
657	dual	cart	BH	Initial Setup	Supervisor	13.25	1258.75
657	dual	cart	BH	Initial Setup	Data Analyst	13.25	755.25
657	dual	cart	BH	Initial Setup	Field Support	13.25	377.63
657	dual	cart	BH	Initial Setup	Subtotal	0	2391.63
657	dual	cart	BH	Calibration	Supervisor	6.15	584.25
657	dual	cart	BH	Calibration	Data Analyst	6.15	350.55
657	dual	cart	BH	Calibration	Field Support	6.15	175.28
657	dual	cart	BH	Calibration	Subtotal	0	1110.08
657	dual	cart	BH	Site Survey	Supervisor	45.5	4322.5
657	dual	cart	BH	Site Survey	Data Analyst	45.5	2593.5

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
657	dual	cart	BH	Site Survey	Field Support	45.5	1296.75
657	dual	cart	BH	Site Survey	Subtotal	0	8212.75
657	dual	cart	BH	Demobilization	Supervisor	1.58	150.1
657	dual	cart	BH	Demobilization	Data Analyst	1.58	90.06
657	dual	cart	BH	Demobilization	Field Support	1.58	45.03
657	dual	cart	BH	Demobilization	Subtotal	0	285.19
657	dual	cart	BH	Total	Total	0	11999.65
636	dual	cart	BH	Initial Setup	Supervisor	13.25	1258.75
636	dual	cart	BH	Initial Setup	Data Analyst	13.25	755.25
636	dual	cart	BH	Initial Setup	Field Support	13.25	377.63
636	dual	cart	BH	Initial Setup	Subtotal	0	2391.63
636	dual	cart	BH	Calibration	Supervisor	3.25	308.75
636	dual	cart	BH	Calibration	Data Analyst	3.25	185.25
636	dual	cart	BH	Calibration	Field Support	3.25	92.63
636	dual	cart	BH	Calibration	Subtotal	0	586.63
636	dual	cart	BH	Site Survey	Supervisor	8.5	807.5
636	dual	cart	BH	Site Survey	Data Analyst	8.5	484.5
636	dual	cart	BH	Site Survey	Field Support	8.5	242.25
636	dual	cart	BH	Site Survey	Subtotal	0	1534.25
636	dual	cart	BH	Demobilization	Supervisor	1.58	150.1
636	dual	cart	BH	Demobilization	Data Analyst	1.58	90.06
636	dual	cart	BH	Demobilization	Field Support	1.58	45.03
636	dual	cart	BH	Demobilization	Subtotal	0	285.19
636	dual	cart	BH	Total	Total	0	4797.7
304	EM	cart	ERDC	Initial Setup	Supervisor	2.66	252.7
304	EM	cart	ERDC	Initial Setup	Data Analyst	2.66	151.62
304	EM	cart	ERDC	Initial Setup	Field Support	2.66	0
304	EM	cart	ERDC	Initial Setup	Subtotal	0	404.32
304	EM	cart	ERDC	Calibration	Supervisor	8.42	799.9
304	EM	cart	ERDC	Calibration	Data Analyst	8.42	479.94
304	EM	cart	ERDC	Calibration	Field Support	8.42	239.97
304	EM	cart	ERDC	Calibration	Subtotal	0	1519.81
304	EM	cart	ERDC	Site Survey	Supervisor	5.42	514.9
304	EM	cart	ERDC	Site Survey	Data Analyst	5.42	308.94
304	EM	cart	ERDC	Site Survey	Field Support	5.42	154.47
304	EM	cart	ERDC	Site Survey	Subtotal	0	978.31
304	EM	cart	ERDC	Demobilization	Supervisor	2.75	261.25
304	EM	cart	ERDC	Demobilization	Data Analyst	2.75	156.75
304	EM	cart	ERDC	Demobilization	Field Support	2.75	78.38
304	EM	cart	ERDC	Demobilization	Subtotal	0	496.38
304	EM	cart	ERDC	Total	Total	0	3398.82
305	EM	cart	ERDC	Initial Setup	Supervisor	2.66	252.7
305	EM	cart	ERDC	Initial Setup	Data Analyst	2.66	151.62
305	EM	cart	ERDC	Initial Setup	Field Support	2.66	0
305	EM	cart	ERDC	Initial Setup	Subtotal	0	404.32
305	EM	cart	ERDC	Calibration	Supervisor	17.33	1646.35
305	EM	cart	ERDC	Calibration	Data Analyst	17.33	987.81
305	EM	cart	ERDC	Calibration	Field Support	17.33	493.91
305	EM	cart	ERDC	Calibration	Subtotal	0	3128.07

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
305	EM	cart	ERDC	Site Survey	Supervisor	140.66	13362.7
305	EM	cart	ERDC	Site Survey	Data Analyst	140.66	8017.62
305	EM	cart	ERDC	Site Survey	Field Support	140.66	4008.81
305	EM	cart	ERDC	Site Survey	Subtotal	0	25389.13
305	EM	cart	ERDC	Demobilization	Supervisor	2.75	261.25
305	EM	cart	ERDC	Demobilization	Data Analyst	2.75	156.75
305	EM	cart	ERDC	Demobilization	Field Support	2.75	78.38
305	EM	cart	ERDC	Demobilization	Subtotal	0	496.38
305	EM	cart	ERDC	Total	Total	0	29417.9
142	EM	cart	ERDC	Initial Setup	Supervisor	4.75	451.25
142	EM	cart	ERDC	Initial Setup	Data Analyst	4.75	270.75
142	EM	cart	ERDC	Initial Setup	Field Support	4.75	270.75
142	EM	cart	ERDC	Initial Setup	Subtotal	0	992.75
142	EM	cart	ERDC	Calibration	Supervisor	4.25	403.75
142	EM	cart	ERDC	Calibration	Data Analyst	4.25	242.25
142	EM	cart	ERDC	Calibration	Field Support	4.25	242.25
142	EM	cart	ERDC	Calibration	Subtotal	0	888.25
142	EM	cart	ERDC	Site Survey	Supervisor	3.83	363.85
142	EM	cart	ERDC	Site Survey	Data Analyst	3.83	218.31
142	EM	cart	ERDC	Site Survey	Field Support	3.83	218.31
142	EM	cart	ERDC	Site Survey	Subtotal	0	800.47
142	EM	cart	ERDC	Demobilization	Supervisor	1	95
142	EM	cart	ERDC	Demobilization	Data Analyst	1	57
142	EM	cart	ERDC	Demobilization	Field Support	1	57
142	EM	cart	ERDC	Demobilization	Subtotal	0	209
142	EM	cart	ERDC	Total	Total	0	2890.47
141	EM	cart	ERDC	Initial Setup	Supervisor	3.25	308.75
141	EM	cart	ERDC	Initial Setup	Data Analyst	3.25	185.25
141	EM	cart	ERDC	Initial Setup	Field Support	3.25	185.25
141	EM	cart	ERDC	Initial Setup	Subtotal	0	679.25
141	EM	cart	ERDC	Calibration	Supervisor	8.41	798.95
141	EM	cart	ERDC	Calibration	Data Analyst	8.41	479.37
141	EM	cart	ERDC	Calibration	Field Support	8.41	479.37
141	EM	cart	ERDC	Calibration	Subtotal	0	1757.59
141	EM	cart	ERDC	Site Survey	Supervisor	12.33	1171.35
141	EM	cart	ERDC	Site Survey	Data Analyst	12.33	702.81
141	EM	cart	ERDC	Site Survey	Field Support	12.33	702.81
141	EM	cart	ERDC	Site Survey	Subtotal	0	2576.97
141	EM	cart	ERDC	Demobilization	Supervisor	1	95
141	EM	cart	ERDC	Demobilization	Data Analyst	1	57
141	EM	cart	ERDC	Demobilization	Field Support	1	57
141	EM	cart	ERDC	Demobilization	Subtotal	0	209
141	EM	cart	ERDC	Total	Total	0	5222.81
40	dual	towed	Geocenters	Initial Setup	Supervisor	1.83	173.85
40	dual	towed	Geocenters	Initial Setup	Data Analyst	1.83	104.31
40	dual	towed	Geocenters	Initial Setup	Field Support	0	0
40	dual	towed	Geocenters	Initial Setup	Subtotal	0	278.16
40	dual	towed	Geocenters	Calibration	Supervisor	5.17	491.15
40	dual	towed	Geocenters	Calibration	Data Analyst	5.17	294.69

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Task	Personnel	Hours	Cost
40	dual	towed	Geocenters	Calibration	Field Support	0	0
40	dual	towed	Geocenters	Calibration	Subtotal	0	785.84
40	dual	towed	Geocenters	Site Survey	Supervisor	11.25	1068.75
40	dual	towed	Geocenters	Site Survey	Data Analyst	11.25	641.25
40	dual	towed	Geocenters	Site Survey	Field Support	0	0
40	dual	towed	Geocenters	Site Survey	Subtotal	0	1710
40	dual	towed	Geocenters	Demobilization	Supervisor	2	190
40	dual	towed	Geocenters	Demobilization	Data Analyst	2	114
40	dual	towed	Geocenters	Demobilization	Field Support	0	0
40	dual	towed	Geocenters	Demobilization	Subtotal	0	304
40	dual	towed	Geocenters	Total	Total	0	3078
290	dual	towed	Geocenters	Initial Setup	Supervisor	6.25	593.75
290	dual	towed	Geocenters	Initial Setup	Data Analyst	6.25	356.25
290	dual	towed	Geocenters	Initial Setup	Field Support	6.25	0
290	dual	towed	Geocenters	Initial Setup	Subtotal	0	950
290	dual	towed	Geocenters	Calibration	Supervisor	0.75	71.25
290	dual	towed	Geocenters	Calibration	Data Analyst	0.75	42.75
290	dual	towed	Geocenters	Calibration	Field Support	0.75	0
290	dual	towed	Geocenters	Calibration	Subtotal	0	114
290	dual	towed	Geocenters	Site Survey	Supervisor	2.5	237.5
290	dual	towed	Geocenters	Site Survey	Data Analyst	2.5	142.5
290	dual	towed	Geocenters	Site Survey	Field Support	2.5	0
290	dual	towed	Geocenters	Site Survey	Subtotal	0	380
290	dual	towed	Geocenters	Demobilization	Supervisor	3.75	356.25
290	dual	towed	Geocenters	Demobilization	Data Analyst	3.75	213.75
290	dual	towed	Geocenters	Demobilization	Field Support	3.75	0
290	dual	towed	Geocenters	Demobilization	Subtotal	0	570
290	dual	towed	Geocenters	Total	Total	0	2014
187	dual	towed	Geocenters	Initial Setup	Supervisor	1.83	173.85
187	dual	towed	Geocenters	Initial Setup	Data Analyst	1.83	104.31
187	dual	towed	Geocenters	Initial Setup	Field Support	1.83	0
187	dual	towed	Geocenters	Initial Setup	Subtotal	0	278.16
187	dual	towed	Geocenters	Calibration	Supervisor	5.17	491.15
187	dual	towed	Geocenters	Calibration	Data Analyst	5.17	294.69
187	dual	towed	Geocenters	Calibration	Field Support	5.17	0
187	dual	towed	Geocenters	Calibration	Subtotal	0	785.84
187	dual	towed	Geocenters	Site Survey	Supervisor	17.33	1646.35
187	dual	towed	Geocenters	Site Survey	Data Analyst	17.33	987.81
187	dual	towed	Geocenters	Site Survey	Field Support	17.33	0
187	dual	towed	Geocenters	Site Survey	Subtotal	0	2634.16
187	dual	towed	Geocenters	Demobilization	Supervisor	2	190
187	dual	towed	Geocenters	Demobilization	Data Analyst	2	114
187	dual	towed	Geocenters	Demobilization	Field Support	2	0
187	dual	towed	Geocenters	Demobilization	Subtotal	0	304
187	dual	towed	Geocenters	Total	Total	0	4002.16
298	dual	towed	Geocenters	Initial Setup	Supervisor	6.25	593.75
298	dual	towed	Geocenters	Initial Setup	Data Analyst	6.25	356.25
298	dual	towed	Geocenters	Initial Setup	Field Support	6.25	0
298	dual	towed	Geocenters	Initial Setup	Subtotal	0	950

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Task	Personnel	Hours	Cost
298	dual	towed	Geocenters	Calibration	Supervisor	0.75	71.25
298	dual	towed	Geocenters	Calibration	Data Analyst	0.75	42.75
298	dual	towed	Geocenters	Calibration	Field Support	0.75	0
298	dual	towed	Geocenters	Calibration	Subtotal	0	114
298	dual	towed	Geocenters	Site Survey	Supervisor	13.33	1266.35
298	dual	towed	Geocenters	Site Survey	Data Analyst	13.33	759.81
298	dual	towed	Geocenters	Site Survey	Field Support	13.33	0
298	dual	towed	Geocenters	Site Survey	Subtotal	0	2026.16
298	dual	towed	Geocenters	Demobilization	Supervisor	3.75	356.25
298	dual	towed	Geocenters	Demobilization	Data Analyst	3.75	213.75
298	dual	towed	Geocenters	Demobilization	Field Support	3.75	0
298	dual	towed	Geocenters	Demobilization	Subtotal	0	570
298	dual	towed	Geocenters	Total	Total	0	3660.16
792	dual	towed	Geocenters	Initial Setup	Supervisor	6	570
792	dual	towed	Geocenters	Initial Setup	Data Analyst	6	0
792	dual	towed	Geocenters	Initial Setup	Field Support	6	171
792	dual	towed	Geocenters	Initial Setup	Subtotal	0	741
792	dual	towed	Geocenters	Calibration	Supervisor	1.66	157.7
792	dual	towed	Geocenters	Calibration	Data Analyst	1.66	0
792	dual	towed	Geocenters	Calibration	Field Support	1.66	94.62
792	dual	towed	Geocenters	Calibration	Subtotal	0	252.32
792	dual	towed	Geocenters	Site Survey	Supervisor	2.42	229.9
792	dual	towed	Geocenters	Site Survey	Data Analyst	2.42	0
792	dual	towed	Geocenters	Site Survey	Field Support	2.42	137.94
792	dual	towed	Geocenters	Site Survey	Subtotal	0	367.84
792	dual	towed	Geocenters	Demobilization	Supervisor	2.58	245.1
792	dual	towed	Geocenters	Demobilization	Data Analyst	2.58	0
792	dual	towed	Geocenters	Demobilization	Field Support	2.58	147.06
792	dual	towed	Geocenters	Demobilization	Subtotal	0	392.16
792	dual	towed	Geocenters	Total	Total	0	1753.32
802	dual	towed	Geocenters	Calibration	Data Analyst	1.66	0
802	dual	towed	Geocenters	Calibration	Field Support	1.66	94.62
802	dual	towed	Geocenters	Calibration	Subtotal	0	252.32
802	dual	towed	Geocenters	Site Survey	Supervisor	14.5	1377.5
802	dual	towed	Geocenters	Site Survey	Data Analyst	14.5	0
802	dual	towed	Geocenters	Site Survey	Field Support	14.5	826.5
802	dual	towed	Geocenters	Site Survey	Subtotal	0	2204
802	dual	towed	Geocenters	Demobilization	Supervisor	2.58	245.1
802	dual	towed	Geocenters	Demobilization	Data Analyst	2.58	0
802	dual	towed	Geocenters	Demobilization	Field Support	2.58	147.06
802	dual	towed	Geocenters	Demobilization	Subtotal	0	392.16
802	dual	towed	Geocenters	Total	Total	0	3589.48
802	dual	towed	Geocenters	Initial Setup	Supervisor	6	570
802	dual	towed	Geocenters	Initial Setup	Data Analyst	6	0
802	dual	towed	Geocenters	Initial Setup	Field Support	6	171
802	dual	towed	Geocenters	Initial Setup	Subtotal	0	741
802	dual	towed	Geocenters	Calibration	Supervisor	1.66	157.7
50	EM	hand	Geophex	Initial Setup	Field Support	0.33	9.41
50	EM	hand	Geophex	Initial Setup	Subtotal	0	59.57

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
50	EM	hand	Geophex	Calibration	Supervisor	3.5	332.5
50	EM	hand	Geophex	Calibration	Data Analyst	3.5	199.5
50	EM	hand	Geophex	Calibration	Field Support	3.5	99.75
50	EM	hand	Geophex	Calibration	Subtotal	0	631.75
50	EM	hand	Geophex	Site Survey	Supervisor	3.65	346.75
50	EM	hand	Geophex	Site Survey	Data Analyst	3.65	208.05
50	EM	hand	Geophex	Site Survey	Field Support	3.65	104.03
50	EM	hand	Geophex	Site Survey	Subtotal	0	658.83
50	EM	hand	Geophex	Demobilization	Supervisor	0.16	15.2
50	EM	hand	Geophex	Demobilization	Data Analyst	0.16	9.12
50	EM	hand	Geophex	Demobilization	Field Support	0.16	4.56
50	EM	hand	Geophex	Demobilization	Subtotal	0	28.88
50	EM	hand	Geophex	Total	Total	0	1379.03
50	EM	hand	Geophex	Initial Setup	Supervisor	0.33	31.35
50	EM	hand	Geophex	Initial Setup	Data Analyst	0.33	18.81
680	EM	hand	Geophex	Initial Setup	Supervisor	4.83	458.85
680	EM	hand	Geophex	Initial Setup	Data Analyst	4.83	275.31
680	EM	hand	Geophex	Initial Setup	Field Support	4.83	412.97
680	EM	hand	Geophex	Initial Setup	Subtotal	0	1147.13
680	EM	hand	Geophex	Calibration	Supervisor	2.5	237.5
680	EM	hand	Geophex	Calibration	Data Analyst	2.5	142.5
680	EM	hand	Geophex	Calibration	Field Support	2.5	0
680	EM	hand	Geophex	Calibration	Subtotal	0	380
680	EM	hand	Geophex	Site Survey	Supervisor	4.66	442.7
680	EM	hand	Geophex	Site Survey	Data Analyst	4.66	265.62
680	EM	hand	Geophex	Site Survey	Field Support	4.66	398.43
680	EM	hand	Geophex	Site Survey	Subtotal	0	1106.75
680	EM	hand	Geophex	Demobilization	Supervisor	0.83	78.85
680	EM	hand	Geophex	Demobilization	Data Analyst	0.83	47.31
680	EM	hand	Geophex	Demobilization	Field Support	0.83	70.97
680	EM	hand	Geophex	Demobilization	Subtotal	0	197.13
680	EM	hand	Geophex	Total	Total	0	2831.01
125	EM	towed	Geophex	Initial Setup	Supervisor	4.6	437
125	EM	towed	Geophex	Initial Setup	Data Analyst	4.6	262.2
125	EM	towed	Geophex	Initial Setup	Field Support	4.6	131.1
125	EM	towed	Geophex	Initial Setup	Subtotal	0	830.3
125	EM	towed	Geophex	Calibration	Supervisor	6.6	627
125	EM	towed	Geophex	Calibration	Data Analyst	6.6	376.2
125	EM	towed	Geophex	Calibration	Field Support	6.6	188.1
125	EM	towed	Geophex	Calibration	Subtotal	0	1191.3
125	EM	towed	Geophex	Site Survey	Supervisor	0.9	85.5
125	EM	towed	Geophex	Site Survey	Data Analyst	0.9	51.3
125	EM	towed	Geophex	Site Survey	Field Support	0.9	25.65
125	EM	towed	Geophex	Site Survey	Subtotal	0	162.45
125	EM	towed	Geophex	Demobilization	Supervisor	1.12	106.4
125	EM	towed	Geophex	Demobilization	Data Analyst	1.12	63.84
125	EM	towed	Geophex	Demobilization	Field Support	1.12	0
125	EM	towed	Geophex	Demobilization	Subtotal	0	170.24
125	EM	towed	Geophex	Total	Total	0	2354.29

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
49	EM	cart	Geophex	Initial Setup	Supervisor	3.6	342
49	EM	cart	Geophex	Initial Setup	Data Analyst	3.6	205.2
49	EM	cart	Geophex	Initial Setup	Field Support	3.6	102.6
49	EM	cart	Geophex	Initial Setup	Subtotal	0	649.8
49	EM	cart	Geophex	Calibration	Supervisor	6.6	627
49	EM	cart	Geophex	Calibration	Data Analyst	6.6	376.2
49	EM	cart	Geophex	Calibration	Field Support	6.6	188.1
49	EM	cart	Geophex	Calibration	Subtotal	0	1191.3
49	EM	cart	Geophex	Site Survey	Supervisor	9.9	940.5
49	EM	cart	Geophex	Site Survey	Data Analyst	9.9	564.3
49	EM	cart	Geophex	Site Survey	Field Support	9.9	282.15
49	EM	cart	Geophex	Site Survey	Subtotal	0	1786.95
49	EM	cart	Geophex	Demobilization	Supervisor	1.12	106.4
49	EM	cart	Geophex	Demobilization	Data Analyst	1.12	63.84
49	EM	cart	Geophex	Demobilization	Field Support	1.12	0
49	EM	cart	Geophex	Demobilization	Subtotal	0	170.24
49	EM	cart	Geophex	Total	Total	0	3798.29
451	EM	cart	Geophex	Initial Setup	Supervisor	3.33	632.7
451	EM	cart	Geophex	Initial Setup	Data Analyst	3.33	189.81
451	EM	cart	Geophex	Initial Setup	Field Support	3.33	474.53
451	EM	cart	Geophex	Initial Setup	Subtotal	0	1297.04
451	EM	cart	Geophex	Calibration	Supervisor	3.52	668.8
451	EM	cart	Geophex	Calibration	Data Analyst	3.52	200.64
451	EM	cart	Geophex	Calibration	Field Support	3.52	501.6
451	EM	cart	Geophex	Calibration	Subtotal	0	1371.04
451	EM	cart	Geophex	Site Survey	Supervisor	30.53	5800.7
451	EM	cart	Geophex	Site Survey	Data Analyst	30.53	1740.21
451	EM	cart	Geophex	Site Survey	Field Support	30.53	4350.53
451	EM	cart	Geophex	Site Survey	Subtotal	0	11891.44
451	EM	cart	Geophex	Demobilization	Supervisor	2	380
451	EM	cart	Geophex	Demobilization	Data Analyst	2	114
451	EM	cart	Geophex	Demobilization	Field Support	2	285
451	EM	cart	Geophex	Demobilization	Subtotal	0	779
451	EM	cart	Geophex	Total	Total	0	15338.52
665	EM	hand	Geophex	Initial Setup	Supervisor	4.83	458.85
665	EM	hand	Geophex	Initial Setup	Data Analyst	4.83	275.31
665	EM	hand	Geophex	Initial Setup	Field Support	4.83	412.97
665	EM	hand	Geophex	Initial Setup	Subtotal	0	1147.13
665	EM	hand	Geophex	Calibration	Supervisor	2.5	237.5
665	EM	hand	Geophex	Calibration	Data Analyst	2.5	142.5
665	EM	hand	Geophex	Calibration	Field Support	2.5	0
665	EM	hand	Geophex	Calibration	Subtotal	0	380
665	EM	hand	Geophex	Site Survey	Supervisor	51.08	4852.6
665	EM	hand	Geophex	Site Survey	Data Analyst	51.08	2911.56
665	EM	hand	Geophex	Site Survey	Field Support	51.08	4367.34
665	EM	hand	Geophex	Site Survey	Subtotal	0	12131.5
665	EM	hand	Geophex	Demobilization	Supervisor	0.83	78.85
665	EM	hand	Geophex	Demobilization	Data Analyst	0.83	47.31
665	EM	hand	Geophex	Demobilization	Field Support	0.83	70.97

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
665	EM	hand	Geophex	Demobilization	Subtotal	0	197.13
665	EM	hand	Geophex	Total	Total	0	13855.76
129	EM	towed	Geophex	Initial Setup	Supervisor	3.58	340.1
129	EM	towed	Geophex	Initial Setup	Data Analyst	3.58	204.06
129	EM	towed	Geophex	Initial Setup	Field Support	3.58	204.06
129	EM	towed	Geophex	Initial Setup	Subtotal	0	748.22
129	EM	towed	Geophex	Calibration	Supervisor	2.93	278.35
129	EM	towed	Geophex	Calibration	Data Analyst	0	0
129	EM	towed	Geophex	Calibration	Field Support	0	0
129	EM	towed	Geophex	Calibration	Subtotal	0	278.35
129	EM	towed	Geophex	Site Survey	Supervisor	120.88	11483.6
129	EM	towed	Geophex	Site Survey	Data Analyst	120.88	6890.16
129	EM	towed	Geophex	Site Survey	Field Support	120.88	13780.32
129	EM	towed	Geophex	Site Survey	Subtotal	0	32154.08
129	EM	towed	Geophex	Demobilization	Supervisor	1.12	106.4
129	EM	towed	Geophex	Demobilization	Data Analyst	1.12	63.84
129	EM	towed	Geophex	Demobilization	Field Support	0	0
129	EM	towed	Geophex	Demobilization	Subtotal	0	170.24
129	EM	towed	Geophex	Total	Total	0	33350.89
449	EM	cart	Geophex	Initial Setup	Supervisor	3.58	340.1
449	EM	cart	Geophex	Initial Setup	Data Analyst	3.58	204.06
449	EM	cart	Geophex	Initial Setup	Field Support	3.58	102.03
449	EM	cart	Geophex	Initial Setup	Subtotal	0	646.19
449	EM	cart	Geophex	Calibration	Supervisor	3.52	334.4
449	EM	cart	Geophex	Calibration	Data Analyst	3.52	200.64
449	EM	cart	Geophex	Calibration	Field Support	0	0
449	EM	cart	Geophex	Calibration	Subtotal	0	535.04
449	EM	cart	Geophex	Site Survey	Supervisor	71.55	6797.25
449	EM	cart	Geophex	Site Survey	Data Analyst	71.55	4078.35
449	EM	cart	Geophex	Site Survey	Field Support	71.55	2039.18
449	EM	cart	Geophex	Site Survey	Subtotal	0	12914.78
449	EM	cart	Geophex	Demobilization	Supervisor	1.12	106.4
449	EM	cart	Geophex	Demobilization	Data Analyst	1.12	63.84
449	EM	cart	Geophex	Demobilization	Field Support	0	0
449	EM	cart	Geophex	Demobilization	Subtotal	0	170.24
449	EM	cart	Geophex	Total	Total	0	14266.25
694	EM	cart	Geophex	Initial Setup	Supervisor	11.25	1068.75
694	EM	cart	Geophex	Initial Setup	Data Analyst	11.25	641.25
694	EM	cart	Geophex	Initial Setup	Field Support	11.25	961.88
694	EM	cart	Geophex	Initial Setup	Subtotal	0	2671.88
694	EM	cart	Geophex	Calibration	Supervisor	1.75	166.25
694	EM	cart	Geophex	Calibration	Data Analyst	1.75	99.75
694	EM	cart	Geophex	Calibration	Field Support	1.75	0
694	EM	cart	Geophex	Calibration	Subtotal	0	266
694	EM	cart	Geophex	Site Survey	Supervisor	4.25	403.75
694	EM	cart	Geophex	Site Survey	Data Analyst	4.25	242.25
694	EM	cart	Geophex	Site Survey	Field Support	4.25	0
694	EM	cart	Geophex	Site Survey	Subtotal	0	646
694	EM	cart	Geophex	Demobilization	Supervisor	0.83	78.85

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
694	EM	cart	Geophex	Demobilization	Data Analyst	0.83	47.31
694	EM	cart	Geophex	Demobilization	Field Support	0.83	70.97
694	EM	cart	Geophex	Demobilization	Subtotal	0	197.13
694	EM	cart	Geophex	Total	Total	0	3781.01
739	EM	towed	Geophex	Initial Setup	Supervisor	13.5	1282.5
739	EM	towed	Geophex	Initial Setup	Data Analyst	13.5	769.5
739	EM	towed	Geophex	Initial Setup	Field Support	13.5	0
739	EM	towed	Geophex	Initial Setup	Subtotal	0	2052
739	EM	towed	Geophex	Calibration	Supervisor	1.16	110.2
739	EM	towed	Geophex	Calibration	Data Analyst	1.16	66.12
739	EM	towed	Geophex	Calibration	Field Support	1.16	0
739	EM	towed	Geophex	Calibration	Subtotal	0	176.32
739	EM	towed	Geophex	Site Survey	Supervisor	1.16	110.2
739	EM	towed	Geophex	Site Survey	Data Analyst	1.16	66.12
739	EM	towed	Geophex	Site Survey	Field Support	1.16	0
739	EM	towed	Geophex	Site Survey	Subtotal	0	176.32
739	EM	towed	Geophex	Demobilization	Supervisor	2.08	197.6
739	EM	towed	Geophex	Demobilization	Data Analyst	2.08	118.56
739	EM	towed	Geophex	Demobilization	Field Support	2.08	0
739	EM	towed	Geophex	Demobilization	Subtotal	0	316.16
739	EM	towed	Geophex	Total	Total	0	2720.8
693	EM	cart	Geophex	Initial Setup	Supervisor	11.25	1068.75
693	EM	cart	Geophex	Initial Setup	Data Analyst	11.25	641.25
693	EM	cart	Geophex	Initial Setup	Field Support	11.25	961.88
693	EM	cart	Geophex	Initial Setup	Subtotal	0	2671.88
693	EM	cart	Geophex	Calibration	Supervisor	1.75	166.25
693	EM	cart	Geophex	Calibration	Data Analyst	1.75	99.75
693	EM	cart	Geophex	Calibration	Field Support	1.75	0
693	EM	cart	Geophex	Calibration	Subtotal	0	266
693	EM	cart	Geophex	Site Survey	Supervisor	4.25	403.75
693	EM	cart	Geophex	Site Survey	Data Analyst	4.25	242.25
693	EM	cart	Geophex	Site Survey	Field Support	4.25	0
693	EM	cart	Geophex	Site Survey	Subtotal	0	646
693	EM	cart	Geophex	Demobilization	Supervisor	0.83	78.85
693	EM	cart	Geophex	Demobilization	Data Analyst	0.83	47.31
693	EM	cart	Geophex	Demobilization	Field Support	0.83	70.97
693	EM	cart	Geophex	Demobilization	Subtotal	0	197.13
693	EM	cart	Geophex	Total	Total	0	3781.01
740	EM	towed	Geophex	Initial Setup	Supervisor	13.5	1282.5
740	EM	towed	Geophex	Initial Setup	Data Analyst	13.5	769.5
740	EM	towed	Geophex	Initial Setup	Field Support	13.5	0
740	EM	towed	Geophex	Initial Setup	Subtotal	0	2052
740	EM	towed	Geophex	Calibration	Supervisor	1.16	110.2
740	EM	towed	Geophex	Calibration	Data Analyst	1.16	66.12
740	EM	towed	Geophex	Calibration	Field Support	1.16	0
740	EM	towed	Geophex	Calibration	Subtotal	0	176.32
740	EM	towed	Geophex	Site Survey	Supervisor	47.5	4512.5
740	EM	towed	Geophex	Site Survey	Data Analyst	47.5	2707.5
740	EM	towed	Geophex	Site Survey	Field Support	47.5	0

Aberdeen Proving Ground Demonstrations							
Report	Sensor	Platform	Vendor	Task	Personnel	Hours	Cost
740	EM	towed	Geophex	Site Survey	Subtotal	0	7220
740	EM	towed	Geophex	Demobilization	Supervisor	2.08	197.6
740	EM	towed	Geophex	Demobilization	Data Analyst	2.08	118.56
740	EM	towed	Geophex	Demobilization	Field Support	2.08	0
740	EM	towed	Geophex	Demobilization	Subtotal	0	316.16
740	EM	towed	Geophex	Total	Total	0	9764.48
184	EM	hand	G-TEK	Initial Setup	Supervisor	0	0
184	EM	hand	G-TEK	Initial Setup	Data Analyst	0	0
184	EM	hand	G-TEK	Initial Setup	Field Support	0	0
184	EM	hand	G-TEK	Initial Setup	Subtotal	0	0
184	EM	hand	G-TEK	Calibration	Supervisor	2.83	268.85
184	EM	hand	G-TEK	Calibration	Data Analyst	2.83	161.31
184	EM	hand	G-TEK	Calibration	Field Support	0	0
184	EM	hand	G-TEK	Calibration	Subtotal	0	430.16
184	EM	hand	G-TEK	Site Survey	Supervisor	0.42	39.9
184	EM	hand	G-TEK	Site Survey	Data Analyst	0.42	23.94
184	EM	hand	G-TEK	Site Survey	Field Support	0	0
184	EM	hand	G-TEK	Site Survey	Subtotal	0	63.84
184	EM	hand	G-TEK	Demobilization	Supervisor	2.33	221.35
184	EM	hand	G-TEK	Demobilization	Data Analyst	2.33	132.81
184	EM	hand	G-TEK	Demobilization	Field Support	0	0
184	EM	hand	G-TEK	Demobilization	Subtotal	0	354.16
184	EM	hand	G-TEK	Total	Total	0	848.16
183	EM	sling	G-TEK	Initial Setup	Supervisor	2.75	261.25
183	EM	sling	G-TEK	Initial Setup	Data Analyst	2.75	156.75
183	EM	sling	G-TEK	Initial Setup	Field Support	0	0
183	EM	sling	G-TEK	Initial Setup	Subtotal	0	418
183	EM	sling	G-TEK	Calibration	Supervisor	1.67	158.65
183	EM	sling	G-TEK	Calibration	Data Analyst	1.67	95.19
183	EM	sling	G-TEK	Calibration	Field Support	0	0
183	EM	sling	G-TEK	Calibration	Subtotal	0	253.84
183	EM	sling	G-TEK	Site Survey	Supervisor	3.58	340.1
183	EM	sling	G-TEK	Site Survey	Data Analyst	3.58	204.06
183	EM	sling	G-TEK	Site Survey	Field Support	0	0
183	EM	sling	G-TEK	Site Survey	Subtotal	0	544.16
183	EM	sling	G-TEK	Demobilization	Supervisor	3.08	292.6
183	EM	sling	G-TEK	Demobilization	Data Analyst	3.08	175.56
183	EM	sling	G-TEK	Demobilization	Field Support	0	0
183	EM	sling	G-TEK	Demobilization	Subtotal	0	468.16
183	EM	sling	G-TEK	Total	Total	0	1684.16
545	EM	sling	G-TEK	Initial Setup	Supervisor	2.75	261.25
545	EM	sling	G-TEK	Initial Setup	Data Analyst	2.75	156.75
545	EM	sling	G-TEK	Initial Setup	Field Support	0	0
545	EM	sling	G-TEK	Initial Setup	Subtotal	0	418
545	EM	sling	G-TEK	Calibration	Supervisor	1.92	182.4
545	EM	sling	G-TEK	Calibration	Data Analyst	1.92	109.44
545	EM	sling	G-TEK	Calibration	Field Support	0	0
545	EM	sling	G-TEK	Calibration	Subtotal	0	291.84
545	EM	sling	G-TEK	Site Survey	Supervisor	9.67	918.65

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
545	EM	sling	G-TEK	Site Survey	Data Analyst	9.67	551.19
545	EM	sling	G-TEK	Site Survey	Field Support	0	0
545	EM	sling	G-TEK	Site Survey	Subtotal	0	1469.84
545	EM	sling	G-TEK	Demobilization	Supervisor	2.33	221.35
545	EM	sling	G-TEK	Demobilization	Data Analyst	2.33	132.81
545	EM	sling	G-TEK	Demobilization	Field Support	0	0
545	EM	sling	G-TEK	Demobilization	Subtotal	0	354.16
545	EM	sling	G-TEK	Total	Total	0	2533.84
154	EM	sling	G-TEK	Initial Setup	Supervisor	2.75	261.25
154	EM	sling	G-TEK	Initial Setup	Data Analyst	2.75	156.75
154	EM	sling	G-TEK	Initial Setup	Field Support	0	0
154	EM	sling	G-TEK	Initial Setup	Subtotal	0	418
154	EM	sling	G-TEK	Calibration	Supervisor	3.5	332.5
154	EM	sling	G-TEK	Calibration	Data Analyst	3.5	199.5
154	EM	sling	G-TEK	Calibration	Field Support	0	0
154	EM	sling	G-TEK	Calibration	Subtotal	0	532
154	EM	sling	G-TEK	Site Survey	Supervisor	55.25	5248.75
154	EM	sling	G-TEK	Site Survey	Data Analyst	55.25	3149.25
154	EM	sling	G-TEK	Site Survey	Field Support	0	0
154	EM	sling	G-TEK	Site Survey	Subtotal	0	8398
154	EM	sling	G-TEK	Demobilization	Supervisor	3.08	292.6
154	EM	sling	G-TEK	Demobilization	Data Analyst	3.08	175.56
154	EM	sling	G-TEK	Demobilization	Field Support	0	0
154	EM	sling	G-TEK	Demobilization	Subtotal	0	468.16
154	EM	sling	G-TEK	Total	Total	0	9816.16
452	EM	hand	G-TEK	Initial Setup	Supervisor	2.75	261.25
452	EM	hand	G-TEK	Initial Setup	Data Analyst	2.75	156.75
452	EM	hand	G-TEK	Initial Setup	Field Support	0	0
452	EM	hand	G-TEK	Initial Setup	Subtotal	0	418
452	EM	hand	G-TEK	Calibration	Supervisor	4.08	387.6
452	EM	hand	G-TEK	Calibration	Data Analyst	4.08	232.56
452	EM	hand	G-TEK	Calibration	Field Support	0	0
452	EM	hand	G-TEK	Calibration	Subtotal	0	620.16
452	EM	hand	G-TEK	Site Survey	Supervisor	10.17	966.15
452	EM	hand	G-TEK	Site Survey	Data Analyst	10.17	579.69
452	EM	hand	G-TEK	Site Survey	Field Support	0	0
452	EM	hand	G-TEK	Site Survey	Subtotal	0	1545.84
452	EM	hand	G-TEK	Demobilization	Supervisor	3.08	292.6
452	EM	hand	G-TEK	Demobilization	Data Analyst	3.08	175.56
452	EM	hand	G-TEK	Demobilization	Field Support	0	0
452	EM	hand	G-TEK	Demobilization	Subtotal	0	468.16
452	EM	hand	G-TEK	Total	Total	0	3052.16
268	MAG	sling	G-TEK	Initial Setup	Supervisor	5.16	490.2
268	MAG	sling	G-TEK	Initial Setup	Data Analyst	5.16	294.12
268	MAG	sling	G-TEK	Initial Setup	Field Support	5.16	147.06
268	MAG	sling	G-TEK	Initial Setup	Subtotal	0	931.38
268	MAG	sling	G-TEK	Calibration	Supervisor	0.97	92.15
268	MAG	sling	G-TEK	Calibration	Data Analyst	0.97	55.29
268	MAG	sling	G-TEK	Calibration	Field Support	0.97	27.65

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
268	MAG	sling	G-TEK	Calibration	Subtotal	0	175.09
268	MAG	sling	G-TEK	Site Survey	Supervisor	1.97	187.15
268	MAG	sling	G-TEK	Site Survey	Data Analyst	1.97	112.29
268	MAG	sling	G-TEK	Site Survey	Field Support	1.97	56.15
268	MAG	sling	G-TEK	Site Survey	Subtotal	0	355.59
268	MAG	sling	G-TEK	Demobilization	Supervisor	1.58	150.1
268	MAG	sling	G-TEK	Demobilization	Data Analyst	1.58	90.06
268	MAG	sling	G-TEK	Demobilization	Field Support	1.58	45.03
268	MAG	sling	G-TEK	Demobilization	Subtotal	0	285.19
268	MAG	sling	G-TEK	Total	Total	0	1747.24
547	MAG	sling	G-TEK	Initial Setup	Supervisor	5.16	490.2
547	MAG	sling	G-TEK	Initial Setup	Data Analyst	5.16	294.12
547	MAG	sling	G-TEK	Initial Setup	Field Support	5.16	147.06
547	MAG	sling	G-TEK	Initial Setup	Subtotal	0	931.38
547	MAG	sling	G-TEK	Calibration	Supervisor	1.17	111.15
547	MAG	sling	G-TEK	Calibration	Data Analyst	1.17	66.69
547	MAG	sling	G-TEK	Calibration	Field Support	1.17	33.35
547	MAG	sling	G-TEK	Calibration	Subtotal	0	211.19
547	MAG	sling	G-TEK	Site Survey	Supervisor	9.75	926.25
547	MAG	sling	G-TEK	Site Survey	Data Analyst	9.75	555.75
547	MAG	sling	G-TEK	Site Survey	Field Support	9.75	277.88
547	MAG	sling	G-TEK	Site Survey	Subtotal	0	1759.88
547	MAG	sling	G-TEK	Demobilization	Supervisor	1.58	150.1
547	MAG	sling	G-TEK	Demobilization	Data Analyst	1.58	90.06
547	MAG	sling	G-TEK	Demobilization	Field Support	1.58	45.03
547	MAG	sling	G-TEK	Demobilization	Subtotal	0	285.19
547	MAG	sling	G-TEK	Total	Total	0	3187.64
311	MAG	sling	G-TEK	Initial Setup	Supervisor	5.16	490.2
311	MAG	sling	G-TEK	Initial Setup	Data Analyst	5.16	294.12
311	MAG	sling	G-TEK	Initial Setup	Field Support	5.16	147.06
311	MAG	sling	G-TEK	Initial Setup	Subtotal	0	931.38
311	MAG	sling	G-TEK	Calibration	Supervisor	4	380
311	MAG	sling	G-TEK	Calibration	Data Analyst	4	228
311	MAG	sling	G-TEK	Calibration	Field Support	4	114
311	MAG	sling	G-TEK	Calibration	Subtotal	0	722
311	MAG	sling	G-TEK	Site Survey	Supervisor	57.25	5438.75
311	MAG	sling	G-TEK	Site Survey	Data Analyst	57.25	3263.25
311	MAG	sling	G-TEK	Site Survey	Field Support	57.25	1631.63
311	MAG	sling	G-TEK	Site Survey	Subtotal	0	10333.63
311	MAG	sling	G-TEK	Demobilization	Supervisor	1.58	150.1
311	MAG	sling	G-TEK	Demobilization	Data Analyst	1.58	90.06
311	MAG	sling	G-TEK	Demobilization	Field Support	1.58	45.03
311	MAG	sling	G-TEK	Demobilization	Subtotal	0	285.19
311	MAG	sling	G-TEK	Total	Total	0	12272.2
454	MAG	sling	G-TEK	Initial Setup	Supervisor	5.16	490.2
454	MAG	sling	G-TEK	Initial Setup	Data Analyst	5.16	294.12
454	MAG	sling	G-TEK	Initial Setup	Field Support	5.16	147.06
454	MAG	sling	G-TEK	Initial Setup	Subtotal	0	931.38
454	MAG	sling	G-TEK	Calibration	Supervisor	1.33	126.35

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
454	MAG	sling	G-TEK	Calibration	Data Analyst	1.33	75.81
454	MAG	sling	G-TEK	Calibration	Field Support	1.33	37.91
454	MAG	sling	G-TEK	Calibration	Subtotal	0	240.07
454	MAG	sling	G-TEK	Site Survey	Supervisor	9.5	902.5
454	MAG	sling	G-TEK	Site Survey	Data Analyst	9.5	541.5
454	MAG	sling	G-TEK	Site Survey	Field Support	9.5	270.75
454	MAG	sling	G-TEK	Site Survey	Subtotal	0	1714.75
454	MAG	sling	G-TEK	Demobilization	Supervisor	1.58	150.1
454	MAG	sling	G-TEK	Demobilization	Data Analyst	1.58	90.06
454	MAG	sling	G-TEK	Demobilization	Field Support	1.58	45.03
454	MAG	sling	G-TEK	Demobilization	Subtotal	0	285.19
454	MAG	sling	G-TEK	Total	Total	0	3171.39
281	dual	sling	G-TEK	Initial Setup	Supervisor	5	475
281	dual	sling	G-TEK	Initial Setup	Data Analyst	5	285
281	dual	sling	G-TEK	Initial Setup	Field Support	5	285
281	dual	sling	G-TEK	Initial Setup	Subtotal	0	1045
281	dual	sling	G-TEK	Calibration	Supervisor	2.66	252.7
281	dual	sling	G-TEK	Calibration	Data Analyst	2.66	151.62
281	dual	sling	G-TEK	Calibration	Field Support	2.66	151.62
281	dual	sling	G-TEK	Calibration	Subtotal	0	555.94
281	dual	sling	G-TEK	Site Survey	Supervisor	3.92	372.4
281	dual	sling	G-TEK	Site Survey	Data Analyst	3.92	223.44
281	dual	sling	G-TEK	Site Survey	Field Support	3.92	223.44
281	dual	sling	G-TEK	Site Survey	Subtotal	0	819.28
281	dual	sling	G-TEK	Demobilization	Supervisor	3.5	332.5
281	dual	sling	G-TEK	Demobilization	Data Analyst	3.5	199.5
281	dual	sling	G-TEK	Demobilization	Field Support	3.5	199.5
281	dual	sling	G-TEK	Demobilization	Subtotal	0	731.5
281	dual	sling	G-TEK	Total	Total	0	3151.72
380	dual	sling	G-TEK	Initial Setup	Supervisor	5	475
380	dual	sling	G-TEK	Initial Setup	Data Analyst	5	285
380	dual	sling	G-TEK	Initial Setup	Field Support	5	427.5
380	dual	sling	G-TEK	Initial Setup	Subtotal	0	1187.5
380	dual	sling	G-TEK	Calibration	Supervisor	2.66	252.7
380	dual	sling	G-TEK	Calibration	Data Analyst	2.66	151.62
380	dual	sling	G-TEK	Calibration	Field Support	2.66	227.43
380	dual	sling	G-TEK	Calibration	Subtotal	0	631.75
380	dual	sling	G-TEK	Site Survey	Supervisor	5.75	546.25
380	dual	sling	G-TEK	Site Survey	Data Analyst	5.75	327.75
380	dual	sling	G-TEK	Site Survey	Field Support	5.75	327.75
380	dual	sling	G-TEK	Site Survey	Subtotal	0	1201.75
380	dual	sling	G-TEK	Demobilization	Supervisor	3.5	332.5
380	dual	sling	G-TEK	Demobilization	Data Analyst	3.5	199.5
380	dual	sling	G-TEK	Demobilization	Field Support	3.5	199.5
380	dual	sling	G-TEK	Demobilization	Subtotal	0	731.5
380	dual	sling	G-TEK	Total	Total	0	3752.5
379	dual	sling	G-TEK	Initial Setup	Supervisor	5	475
379	dual	sling	G-TEK	Initial Setup	Data Analyst	5	285
379	dual	sling	G-TEK	Initial Setup	Field Support	5	285

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
379	dual	sling	G-TEK	Initial Setup	Subtotal	0	1045
379	dual	sling	G-TEK	Calibration	Supervisor	2.66	252.7
379	dual	sling	G-TEK	Calibration	Data Analyst	2.66	151.62
379	dual	sling	G-TEK	Calibration	Field Support	2.66	151.62
379	dual	sling	G-TEK	Calibration	Subtotal	0	555.94
379	dual	sling	G-TEK	Site Survey	Supervisor	40.83	3878.85
379	dual	sling	G-TEK	Site Survey	Data Analyst	40.83	2327.31
379	dual	sling	G-TEK	Site Survey	Field Support	40.83	2327.31
379	dual	sling	G-TEK	Site Survey	Subtotal	0	8533.47
379	dual	sling	G-TEK	Demobilization	Supervisor	3.5	332.5
379	dual	sling	G-TEK	Demobilization	Data Analyst	3.5	199.5
379	dual	sling	G-TEK	Demobilization	Field Support	3.5	199.5
379	dual	sling	G-TEK	Demobilization	Subtotal	0	731.5
379	dual	sling	G-TEK	Total	Total	0	10865.91
381	dual	sling	G-TEK	Initial Setup	Supervisor	5	475
381	dual	sling	G-TEK	Initial Setup	Data Analyst	5	285
381	dual	sling	G-TEK	Initial Setup	Field Support	5	427.5
381	dual	sling	G-TEK	Initial Setup	Subtotal	0	1187.5
381	dual	sling	G-TEK	Calibration	Supervisor	2.66	252.7
381	dual	sling	G-TEK	Calibration	Data Analyst	2.66	151.62
381	dual	sling	G-TEK	Calibration	Field Support	2.66	227.43
381	dual	sling	G-TEK	Calibration	Subtotal	0	631.75
381	dual	sling	G-TEK	Site Survey	Supervisor	23.92	2272.4
381	dual	sling	G-TEK	Site Survey	Data Analyst	23.92	1363.44
381	dual	sling	G-TEK	Site Survey	Field Support	23.92	1363.44
381	dual	sling	G-TEK	Site Survey	Subtotal	0	4999.28
381	dual	sling	G-TEK	Demobilization	Supervisor	3.5	332.5
381	dual	sling	G-TEK	Demobilization	Data Analyst	3.5	199.5
381	dual	sling	G-TEK	Demobilization	Field Support	3.5	199.5
381	dual	sling	G-TEK	Demobilization	Subtotal	0	731.5
381	dual	sling	G-TEK	Total	Total	0	7550.03
237	MAG	hand	HFA	Initial Setup	Supervisor	0.25	23.75
237	MAG	hand	HFA	Initial Setup	Data Analyst	0.25	0
237	MAG	hand	HFA	Initial Setup	Field Support	0.25	7.13
237	MAG	hand	HFA	Initial Setup	Subtotal	0	30.88
237	MAG	hand	HFA	Calibration	Supervisor	3.33	316.35
237	MAG	hand	HFA	Calibration	Data Analyst	3.33	0
237	MAG	hand	HFA	Calibration	Field Support	3.33	94.91
237	MAG	hand	HFA	Calibration	Subtotal	0	411.26
237	MAG	hand	HFA	Site Survey	Supervisor	2.33	221.35
237	MAG	hand	HFA	Site Survey	Data Analyst	2.33	0
237	MAG	hand	HFA	Site Survey	Field Support	2.33	66.41
237	MAG	hand	HFA	Site Survey	Subtotal	0	287.76
237	MAG	hand	HFA	Demobilization	Supervisor	0.17	16.15
237	MAG	hand	HFA	Demobilization	Data Analyst	0.17	0
237	MAG	hand	HFA	Demobilization	Field Support	0.17	4.85
237	MAG	hand	HFA	Demobilization	Subtotal	0	21
237	MAG	hand	HFA	Total	Total	0	750.9
676	MAG	hand	HFA	Initial Setup	Supervisor	0.25	23.75

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
676	MAG	hand	HFA	Initial Setup	Data Analyst	0.25	0
676	MAG	hand	HFA	Initial Setup	Field Support	0.25	7.13
676	MAG	hand	HFA	Initial Setup	Subtotal	0	30.88
676	MAG	hand	HFA	Calibration	Supervisor	3.33	316.35
676	MAG	hand	HFA	Calibration	Data Analyst	3.33	0
676	MAG	hand	HFA	Calibration	Field Support	3.33	94.91
676	MAG	hand	HFA	Calibration	Subtotal	0	411.26
676	MAG	hand	HFA	Site Survey	Supervisor	10.33	981.35
676	MAG	hand	HFA	Site Survey	Data Analyst	10.33	0
676	MAG	hand	HFA	Site Survey	Field Support	10.33	883.22
676	MAG	hand	HFA	Site Survey	Subtotal	0	1864.57
676	MAG	hand	HFA	Demobilization	Supervisor	0.17	16.15
676	MAG	hand	HFA	Demobilization	Data Analyst	0.17	0
676	MAG	hand	HFA	Demobilization	Field Support	0.17	14.54
676	MAG	hand	HFA	Demobilization	Subtotal	0	30.69
676	MAG	hand	HFA	Total	Total	0	2337.4
231	MAG	hand	HFA	Initial Setup	Supervisor	0.25	23.75
231	MAG	hand	HFA	Initial Setup	Data Analyst	0.25	0
231	MAG	hand	HFA	Initial Setup	Field Support	0.25	7.13
231	MAG	hand	HFA	Initial Setup	Subtotal	0	30.88
231	MAG	hand	HFA	Calibration	Supervisor	3.33	316.35
231	MAG	hand	HFA	Calibration	Data Analyst	3.33	0
231	MAG	hand	HFA	Calibration	Field Support	3.33	94.91
231	MAG	hand	HFA	Calibration	Subtotal	0	411.26
231	MAG	hand	HFA	Site Survey	Supervisor	90.25	8573.75
231	MAG	hand	HFA	Site Survey	Data Analyst	90.25	0
231	MAG	hand	HFA	Site Survey	Field Support	90.25	2572.13
231	MAG	hand	HFA	Site Survey	Subtotal	0	11145.88
231	MAG	hand	HFA	Demobilization	Supervisor	13.5	1282.5
231	MAG	hand	HFA	Demobilization	Data Analyst	13.5	0
231	MAG	hand	HFA	Demobilization	Field Support	13.5	1154.25
231	MAG	hand	HFA	Demobilization	Subtotal	0	2436.75
231	MAG	hand	HFA	Total	Total	0	14024.77
486	MAG	hand	HFA	Initial Setup	Supervisor	0.25	23.75
486	MAG	hand	HFA	Initial Setup	Data Analyst	0.25	0
486	MAG	hand	HFA	Initial Setup	Field Support	0.25	7.13
486	MAG	hand	HFA	Initial Setup	Subtotal	0	30.88
486	MAG	hand	HFA	Calibration	Supervisor	3.33	316.35
486	MAG	hand	HFA	Calibration	Data Analyst	3.33	0
486	MAG	hand	HFA	Calibration	Field Support	3.33	94.91
486	MAG	hand	HFA	Calibration	Subtotal	0	411.26
486	MAG	hand	HFA	Site Survey	Supervisor	13.92	1322.4
486	MAG	hand	HFA	Site Survey	Data Analyst	13.92	0
486	MAG	hand	HFA	Site Survey	Field Support	13.92	396.72
486	MAG	hand	HFA	Site Survey	Subtotal	0	1719.12
486	MAG	hand	HFA	Demobilization	Supervisor	0.17	16.15
486	MAG	hand	HFA	Demobilization	Data Analyst	0.17	0
486	MAG	hand	HFA	Demobilization	Field Support	0.17	14.54
486	MAG	hand	HFA	Demobilization	Subtotal	0	30.69

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
486	MAG	hand	HFA	Total	Total	0	2191.95
647	EM	towed	NAEVA	Initial Setup	Supervisor	1.83	173.85
647	EM	towed	NAEVA	Initial Setup	Data Analyst	1.83	104.31
647	EM	towed	NAEVA	Initial Setup	Field Support	1.83	104.31
647	EM	towed	NAEVA	Initial Setup	Subtotal	0	382.47
647	EM	towed	NAEVA	Calibration	Supervisor	4	380
647	EM	towed	NAEVA	Calibration	Data Analyst	4	228
647	EM	towed	NAEVA	Calibration	Field Support	4	228
647	EM	towed	NAEVA	Calibration	Subtotal	0	836
647	EM	towed	NAEVA	Site Survey	Supervisor	1.83	173.85
647	EM	towed	NAEVA	Site Survey	Data Analyst	1.83	104.31
647	EM	towed	NAEVA	Site Survey	Field Support	1.83	104.31
647	EM	towed	NAEVA	Site Survey	Subtotal	0	382.47
647	EM	towed	NAEVA	Demobilization	Supervisor	1.58	150.1
647	EM	towed	NAEVA	Demobilization	Data Analyst	1.58	90.06
647	EM	towed	NAEVA	Demobilization	Field Support	1.58	0
647	EM	towed	NAEVA	Demobilization	Subtotal	0	240.16
647	EM	towed	NAEVA	Total	Total	0	1841.1
396	EM	2-man	NAEVA	Initial Setup	Supervisor	0.75	71.25
396	EM	2-man	NAEVA	Initial Setup	Data Analyst	0.75	42.75
396	EM	2-man	NAEVA	Initial Setup	Field Support	0.75	42.75
396	EM	2-man	NAEVA	Initial Setup	Subtotal	0	156.75
396	EM	2-man	NAEVA	Calibration	Supervisor	3.25	308.75
396	EM	2-man	NAEVA	Calibration	Data Analyst	3.25	185.25
396	EM	2-man	NAEVA	Calibration	Field Support	3.25	0
396	EM	2-man	NAEVA	Calibration	Subtotal	0	494
396	EM	2-man	NAEVA	Site Survey	Supervisor	2.75	261.25
396	EM	2-man	NAEVA	Site Survey	Data Analyst	2.75	156.75
396	EM	2-man	NAEVA	Site Survey	Field Support	2.75	0
396	EM	2-man	NAEVA	Site Survey	Subtotal	0	418
396	EM	2-man	NAEVA	Demobilization	Supervisor	1.58	150.1
396	EM	2-man	NAEVA	Demobilization	Data Analyst	1.58	90.06
396	EM	2-man	NAEVA	Demobilization	Field Support	1.58	0
396	EM	2-man	NAEVA	Demobilization	Subtotal	0	240.16
396	EM	2-man	NAEVA	Total	Total	0	1308.91
397	EM	towed	NAEVA	Initial Setup	Supervisor	1.83	173.85
397	EM	towed	NAEVA	Initial Setup	Data Analyst	1.83	104.31
397	EM	towed	NAEVA	Initial Setup	Field Support	1.83	104.31
397	EM	towed	NAEVA	Initial Setup	Subtotal	0	382.47
397	EM	towed	NAEVA	Calibration	Supervisor	4.5	427.5
397	EM	towed	NAEVA	Calibration	Data Analyst	4.5	256.5
397	EM	towed	NAEVA	Calibration	Field Support	4.5	256.5
397	EM	towed	NAEVA	Calibration	Subtotal	0	940.5
397	EM	towed	NAEVA	Site Survey	Supervisor	5.25	498.75
397	EM	towed	NAEVA	Site Survey	Data Analyst	5.25	299.25
397	EM	towed	NAEVA	Site Survey	Field Support	5.25	299.25
397	EM	towed	NAEVA	Site Survey	Subtotal	0	1097.25
397	EM	towed	NAEVA	Demobilization	Supervisor	1.58	150.1
397	EM	towed	NAEVA	Demobilization	Data Analyst	1.58	90.06

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
397	EM	towed	NAEVA	Demobilization	Field Support	1.58	0
397	EM	towed	NAEVA	Demobilization	Subtotal	0	240.16
397	EM	towed	NAEVA	Total	Total	0	2660.38
597	EM	2-man	NAEVA	Initial Setup	Supervisor	0.75	71.25
597	EM	2-man	NAEVA	Initial Setup	Data Analyst	0.75	42.75
597	EM	2-man	NAEVA	Initial Setup	Field Support	0.75	42.75
597	EM	2-man	NAEVA	Initial Setup	Subtotal	0	156.75
597	EM	2-man	NAEVA	Calibration	Supervisor	4.08	387.6
597	EM	2-man	NAEVA	Calibration	Data Analyst	4.08	232.56
597	EM	2-man	NAEVA	Calibration	Field Support	4.08	0
597	EM	2-man	NAEVA	Calibration	Subtotal	0	620.16
597	EM	2-man	NAEVA	Site Survey	Supervisor	13.5	1282.5
597	EM	2-man	NAEVA	Site Survey	Data Analyst	13.5	769.5
597	EM	2-man	NAEVA	Site Survey	Field Support	13.5	769.5
597	EM	2-man	NAEVA	Site Survey	Subtotal	0	2821.5
597	EM	2-man	NAEVA	Demobilization	Supervisor	1.58	150.1
597	EM	2-man	NAEVA	Demobilization	Data Analyst	1.58	90.06
597	EM	2-man	NAEVA	Demobilization	Field Support	1.58	0
597	EM	2-man	NAEVA	Demobilization	Subtotal	0	240.16
597	EM	2-man	NAEVA	Total	Total	0	3838.57
406	EM	towed	NAEVA	Initial Setup	Supervisor	1.83	173.85
406	EM	towed	NAEVA	Initial Setup	Data Analyst	1.83	104.31
406	EM	towed	NAEVA	Initial Setup	Field Support	1.83	104.31
406	EM	towed	NAEVA	Initial Setup	Subtotal	0	382.47
406	EM	towed	NAEVA	Calibration	Supervisor	7.25	688.75
406	EM	towed	NAEVA	Calibration	Data Analyst	7.25	413.25
406	EM	towed	NAEVA	Calibration	Field Support	7.25	413.25
406	EM	towed	NAEVA	Calibration	Subtotal	0	1515.25
406	EM	towed	NAEVA	Site Survey	Supervisor	41.58	3950.1
406	EM	towed	NAEVA	Site Survey	Data Analyst	41.58	2370.06
406	EM	towed	NAEVA	Site Survey	Field Support	41.58	2370.06
406	EM	towed	NAEVA	Site Survey	Subtotal	0	8690.22
406	EM	towed	NAEVA	Demobilization	Supervisor	1.58	150.1
406	EM	towed	NAEVA	Demobilization	Data Analyst	1.58	90.06
406	EM	towed	NAEVA	Demobilization	Field Support	1.58	0
406	EM	towed	NAEVA	Demobilization	Subtotal	0	240.16
406	EM	towed	NAEVA	Total	Total	0	10828.1
494	EM	2-man	NAEVA	Initial Setup	Supervisor	0.75	71.25
494	EM	2-man	NAEVA	Initial Setup	Data Analyst	0.75	42.75
494	EM	2-man	NAEVA	Initial Setup	Field Support	0.75	42.75
494	EM	2-man	NAEVA	Initial Setup	Subtotal	0	156.75
494	EM	2-man	NAEVA	Calibration	Supervisor	4.08	387.6
494	EM	2-man	NAEVA	Calibration	Data Analyst	4.08	232.56
494	EM	2-man	NAEVA	Calibration	Field Support	4.08	0
494	EM	2-man	NAEVA	Calibration	Subtotal	0	620.16
494	EM	2-man	NAEVA	Site Survey	Supervisor	22.17	2106.15
494	EM	2-man	NAEVA	Site Survey	Data Analyst	22.17	1263.69
494	EM	2-man	NAEVA	Site Survey	Field Support	22.17	0
494	EM	2-man	NAEVA	Site Survey	Subtotal	0	3369.84

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
494	EM	2-man	NAEVA	Demobilization	Supervisor	1.58	150.1
494	EM	2-man	NAEVA	Demobilization	Data Analyst	1.58	90.06
494	EM	2-man	NAEVA	Demobilization	Field Support	1.58	0
494	EM	2-man	NAEVA	Demobilization	Subtotal	0	240.16
494	EM	2-man	NAEVA	Total	Total	0	4386.91
127	EM	towed	NRL	Initial Setup	Supervisor	3.33	316.35
127	EM	towed	NRL	Initial Setup	Data Analyst	3.33	189.81
127	EM	towed	NRL	Initial Setup	Field Support	6.66	379.62
127	EM	towed	NRL	Initial Setup	Subtotal	0	885.78
127	EM	towed	NRL	Calibration	Supervisor	1.9	180.5
127	EM	towed	NRL	Calibration	Data Analyst	1.9	108.3
127	EM	towed	NRL	Calibration	Field Support	3.8	216.6
127	EM	towed	NRL	Calibration	Subtotal	0	505.4
127	EM	towed	NRL	Site Survey	Supervisor	1.62	153.9
127	EM	towed	NRL	Site Survey	Data Analyst	1.62	92.34
127	EM	towed	NRL	Site Survey	Field Support	3.24	184.68
127	EM	towed	NRL	Site Survey	Subtotal	0	430.92
127	EM	towed	NRL	Demobilization	Supervisor	1	95
127	EM	towed	NRL	Demobilization	Data Analyst	1	57
127	EM	towed	NRL	Demobilization	Field Support	2	114
127	EM	towed	NRL	Demobilization	Subtotal	0	266
127	EM	towed	NRL	Total	Total	0	2088.1
675	EM	towed	NRL	Initial Setup	Supervisor	3.58	340.1
675	EM	towed	NRL	Initial Setup	Data Analyst	3.58	204.06
675	EM	towed	NRL	Initial Setup	Field Support	3.58	204.06
675	EM	towed	NRL	Initial Setup	Subtotal	0	748.22
675	EM	towed	NRL	Calibration	Supervisor	7.72	733.4
675	EM	towed	NRL	Calibration	Data Analyst	7.72	440.04
675	EM	towed	NRL	Calibration	Field Support	7.72	440.04
675	EM	towed	NRL	Calibration	Subtotal	0	1613.48
675	EM	towed	NRL	Site Survey	Supervisor	22.5	2137.5
675	EM	towed	NRL	Site Survey	Data Analyst	22.5	1282.5
675	EM	towed	NRL	Site Survey	Field Support	22.5	1282.5
675	EM	towed	NRL	Site Survey	Subtotal	0	4702.5
675	EM	towed	NRL	Demobilization	Supervisor	1	95
675	EM	towed	NRL	Demobilization	Data Analyst	1	57
675	EM	towed	NRL	Demobilization	Field Support	1	57
675	EM	towed	NRL	Demobilization	Subtotal	0	209
675	EM	towed	NRL	Total	Total	0	7273.2
671	MAG	towed	NRL	Initial Setup	Supervisor	1.5	142.5
671	MAG	towed	NRL	Initial Setup	Data Analyst	1.5	85.5
671	MAG	towed	NRL	Initial Setup	Field Support	1.5	42.75
671	MAG	towed	NRL	Initial Setup	Subtotal	0	270.75
671	MAG	towed	NRL	Calibration	Supervisor	1.62	153.9
671	MAG	towed	NRL	Calibration	Data Analyst	1.62	92.34
671	MAG	towed	NRL	Calibration	Field Support	1.62	46.17
671	MAG	towed	NRL	Calibration	Subtotal	0	292.41
671	MAG	towed	NRL	Site Survey	Supervisor	2.03	192.85
671	MAG	towed	NRL	Site Survey	Data Analyst	2.03	115.71

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
671	MAG	towed	NRL	Site Survey	Field Support	2.03	57.86
671	MAG	towed	NRL	Site Survey	Subtotal	0	366.42
671	MAG	towed	NRL	Demobilization	Supervisor	1	95
671	MAG	towed	NRL	Demobilization	Data Analyst	1	57
671	MAG	towed	NRL	Demobilization	Field Support	1	28.5
671	MAG	towed	NRL	Demobilization	Subtotal	0	180.5
671	MAG	towed	NRL	Total	Total	0	1110.08
673	MAG	towed	NRL	Initial Setup	Supervisor	1.5	142.5
673	MAG	towed	NRL	Initial Setup	Data Analyst	1.5	85.5
673	MAG	towed	NRL	Initial Setup	Field Support	1.5	42.75
673	MAG	towed	NRL	Initial Setup	Subtotal	0	270.75
673	MAG	towed	NRL	Calibration	Supervisor	0.75	71.25
673	MAG	towed	NRL	Calibration	Data Analyst	0.75	42.75
673	MAG	towed	NRL	Calibration	Field Support	0.75	21.38
673	MAG	towed	NRL	Calibration	Subtotal	0	135.38
673	MAG	towed	NRL	Site Survey	Supervisor	7.23	686.85
673	MAG	towed	NRL	Site Survey	Data Analyst	7.23	412.11
673	MAG	towed	NRL	Site Survey	Field Support	7.23	206.06
673	MAG	towed	NRL	Site Survey	Subtotal	0	1305.02
673	MAG	towed	NRL	Demobilization	Supervisor	1	95
673	MAG	towed	NRL	Demobilization	Data Analyst	1	57
673	MAG	towed	NRL	Demobilization	Field Support	1	28.5
673	MAG	towed	NRL	Demobilization	Subtotal	0	180.5
673	MAG	towed	NRL	Total	Total	0	1891.65
252	EM	cart	Parsons	Initial Setup	Supervisor	1.66	157.7
252	EM	cart	Parsons	Initial Setup	Data Analyst	1.66	94.62
252	EM	cart	Parsons	Initial Setup	Field Support	1.66	47.31
252	EM	cart	Parsons	Initial Setup	Subtotal	0	299.63
252	EM	cart	Parsons	Calibration	Supervisor	1.33	126.35
252	EM	cart	Parsons	Calibration	Data Analyst	1.33	75.81
252	EM	cart	Parsons	Calibration	Field Support	1.33	37.91
252	EM	cart	Parsons	Calibration	Subtotal	0	240.07
252	EM	cart	Parsons	Site Survey	Supervisor	4	380
252	EM	cart	Parsons	Site Survey	Data Analyst	4	228
252	EM	cart	Parsons	Site Survey	Field Support	4	114
252	EM	cart	Parsons	Site Survey	Subtotal	0	722
252	EM	cart	Parsons	Demobilization	Supervisor	0.92	87.4
252	EM	cart	Parsons	Demobilization	Data Analyst	0.92	52.44
252	EM	cart	Parsons	Demobilization	Field Support	0.92	78.66
252	EM	cart	Parsons	Demobilization	Subtotal	0	218.5
252	EM	cart	Parsons	Total	Total	0	1480.2
572	EM	cart	Parsons	Initial Setup	Supervisor	1.66	157.7
572	EM	cart	Parsons	Initial Setup	Data Analyst	1.66	94.62
572	EM	cart	Parsons	Initial Setup	Field Support	1.66	47.31
572	EM	cart	Parsons	Initial Setup	Subtotal	0	299.63
572	EM	cart	Parsons	Calibration	Supervisor	1.58	150.1
572	EM	cart	Parsons	Calibration	Data Analyst	1.58	90.06
572	EM	cart	Parsons	Calibration	Field Support	1.58	45.03
572	EM	cart	Parsons	Calibration	Subtotal	0	285.19

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
572	EM	cart	Parsons	Site Survey	Supervisor	15	1425
572	EM	cart	Parsons	Site Survey	Data Analyst	15	855
572	EM	cart	Parsons	Site Survey	Field Support	15	427.5
572	EM	cart	Parsons	Site Survey	Subtotal	0	2707.5
572	EM	cart	Parsons	Demobilization	Supervisor	0.92	87.4
572	EM	cart	Parsons	Demobilization	Data Analyst	0.92	52.44
572	EM	cart	Parsons	Demobilization	Field Support	0.92	78.66
572	EM	cart	Parsons	Demobilization	Subtotal	0	218.5
572	EM	cart	Parsons	Total	Total	0	3510.82
411	EM	cart	Parsons	Initial Setup	Supervisor	1.66	157.7
411	EM	cart	Parsons	Initial Setup	Data Analyst	1.66	94.62
411	EM	cart	Parsons	Initial Setup	Field Support	1.66	47.31
411	EM	cart	Parsons	Initial Setup	Subtotal	0	299.63
411	EM	cart	Parsons	Calibration	Supervisor	3.16	300.2
411	EM	cart	Parsons	Calibration	Data Analyst	3.16	180.12
411	EM	cart	Parsons	Calibration	Field Support	3.16	270.18
411	EM	cart	Parsons	Calibration	Subtotal	0	750.5
411	EM	cart	Parsons	Site Survey	Supervisor	64.08	6087.6
411	EM	cart	Parsons	Site Survey	Data Analyst	64.08	3652.56
411	EM	cart	Parsons	Site Survey	Field Support	64.08	5478.84
411	EM	cart	Parsons	Site Survey	Subtotal	0	15219
411	EM	cart	Parsons	Demobilization	Supervisor	0.92	87.4
411	EM	cart	Parsons	Demobilization	Data Analyst	0.92	52.44
411	EM	cart	Parsons	Demobilization	Field Support	0.92	26.22
411	EM	cart	Parsons	Demobilization	Subtotal	0	166.06
411	EM	cart	Parsons	Total	Total	0	16435.19
496	EM	cart	Parsons	Initial Setup	Supervisor	1.66	157.7
496	EM	cart	Parsons	Initial Setup	Data Analyst	1.66	94.62
496	EM	cart	Parsons	Initial Setup	Field Support	1.66	47.31
496	EM	cart	Parsons	Initial Setup	Subtotal	0	299.63
496	EM	cart	Parsons	Calibration	Supervisor	1.92	182.4
496	EM	cart	Parsons	Calibration	Data Analyst	1.92	109.44
496	EM	cart	Parsons	Calibration	Field Support	1.92	164.16
496	EM	cart	Parsons	Calibration	Subtotal	0	456
496	EM	cart	Parsons	Site Survey	Supervisor	14.25	1353.75
496	EM	cart	Parsons	Site Survey	Data Analyst	14.25	812.25
496	EM	cart	Parsons	Site Survey	Field Support	14.25	1218.38
496	EM	cart	Parsons	Site Survey	Subtotal	0	3384.38
496	EM	cart	Parsons	Demobilization	Supervisor	0.92	87.4
496	EM	cart	Parsons	Demobilization	Data Analyst	0.92	52.44
496	EM	cart	Parsons	Demobilization	Field Support	0.92	78.66
496	EM	cart	Parsons	Demobilization	Subtotal	0	218.5
496	EM	cart	Parsons	Total	Total	0	4358.51
257	MAG	hand	Parsons	Initial Setup	Supervisor	0.25	23.75
257	MAG	hand	Parsons	Initial Setup	Data Analyst	0.25	14.25
257	MAG	hand	Parsons	Initial Setup	Field Support	0.25	21.38
257	MAG	hand	Parsons	Initial Setup	Subtotal	0	59.38
257	MAG	hand	Parsons	Calibration	Supervisor	1.42	134.9
257	MAG	hand	Parsons	Calibration	Data Analyst	1.42	80.94

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
257	MAG	hand	Parsons	Calibration	Field Support	1.42	121.41
257	MAG	hand	Parsons	Calibration	Subtotal	0	337.25
257	MAG	hand	Parsons	Site Survey	Supervisor	1.5	142.5
257	MAG	hand	Parsons	Site Survey	Data Analyst	1.5	85.5
257	MAG	hand	Parsons	Site Survey	Field Support	1.5	128.25
257	MAG	hand	Parsons	Site Survey	Subtotal	0	356.25
257	MAG	hand	Parsons	Demobilization	Supervisor	0.75	71.25
257	MAG	hand	Parsons	Demobilization	Data Analyst	0.75	42.75
257	MAG	hand	Parsons	Demobilization	Field Support	0.75	64.13
257	MAG	hand	Parsons	Demobilization	Subtotal	0	178.13
257	MAG	hand	Parsons	Total	Total	0	931.01
573	MAG	hand	Parsons	Initial Setup	Supervisor	0.25	23.75
573	MAG	hand	Parsons	Initial Setup	Data Analyst	0.25	14.25
573	MAG	hand	Parsons	Initial Setup	Field Support	0.25	21.38
573	MAG	hand	Parsons	Initial Setup	Subtotal	0	59.38
573	MAG	hand	Parsons	Calibration	Supervisor	1.42	134.9
573	MAG	hand	Parsons	Calibration	Data Analyst	1.42	80.94
573	MAG	hand	Parsons	Calibration	Field Support	1.42	121.41
573	MAG	hand	Parsons	Calibration	Subtotal	0	337.25
573	MAG	hand	Parsons	Site Survey	Supervisor	6.25	593.75
573	MAG	hand	Parsons	Site Survey	Data Analyst	6.25	356.25
573	MAG	hand	Parsons	Site Survey	Field Support	6.25	890.63
573	MAG	hand	Parsons	Site Survey	Subtotal	0	1840.63
573	MAG	hand	Parsons	Demobilization	Supervisor	1.75	166.25
573	MAG	hand	Parsons	Demobilization	Data Analyst	1.75	99.75
573	MAG	hand	Parsons	Demobilization	Field Support	1.75	99.75
573	MAG	hand	Parsons	Demobilization	Subtotal	0	365.75
573	MAG	hand	Parsons	Total	Total	0	2603.01
229	MAG	hand	Parsons	Initial Setup	Supervisor	0.25	23.75
229	MAG	hand	Parsons	Initial Setup	Data Analyst	0.25	14.25
229	MAG	hand	Parsons	Initial Setup	Field Support	0.25	21.38
229	MAG	hand	Parsons	Initial Setup	Subtotal	0	59.38
229	MAG	hand	Parsons	Calibration	Supervisor	1.42	134.9
229	MAG	hand	Parsons	Calibration	Data Analyst	1.42	80.94
229	MAG	hand	Parsons	Calibration	Field Support	1.42	121.41
229	MAG	hand	Parsons	Calibration	Subtotal	0	337.25
229	MAG	hand	Parsons	Site Survey	Supervisor	41.25	3918.75
229	MAG	hand	Parsons	Site Survey	Data Analyst	41.25	2351.25
229	MAG	hand	Parsons	Site Survey	Field Support	41.25	5878.13
229	MAG	hand	Parsons	Site Survey	Subtotal	0	12148.13
229	MAG	hand	Parsons	Demobilization	Supervisor	1.75	166.25
229	MAG	hand	Parsons	Demobilization	Data Analyst	1.75	99.75
229	MAG	hand	Parsons	Demobilization	Field Support	1.75	99.75
229	MAG	hand	Parsons	Demobilization	Subtotal	0	365.75
229	MAG	hand	Parsons	Total	Total	0	12910.51
499	MAG	hand	Parsons	Initial Setup	Supervisor	0.25	23.75
499	MAG	hand	Parsons	Initial Setup	Data Analyst	0.25	14.25
499	MAG	hand	Parsons	Initial Setup	Field Support	0.25	21.38
499	MAG	hand	Parsons	Initial Setup	Subtotal	0	59.38

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
499	MAG	hand	Parsons	Calibration	Supervisor	1.42	134.9
499	MAG	hand	Parsons	Calibration	Data Analyst	1.42	80.94
499	MAG	hand	Parsons	Calibration	Field Support	1.42	121.41
499	MAG	hand	Parsons	Calibration	Subtotal	0	337.25
499	MAG	hand	Parsons	Site Survey	Supervisor	9.58	910.1
499	MAG	hand	Parsons	Site Survey	Data Analyst	9.58	546.06
499	MAG	hand	Parsons	Site Survey	Field Support	9.58	1365.15
499	MAG	hand	Parsons	Site Survey	Subtotal	0	2821.31
499	MAG	hand	Parsons	Demobilization	Supervisor	1.75	166.25
499	MAG	hand	Parsons	Demobilization	Data Analyst	1.75	99.75
499	MAG	hand	Parsons	Demobilization	Field Support	1.75	99.75
499	MAG	hand	Parsons	Demobilization	Subtotal	0	365.75
499	MAG	hand	Parsons	Total	Total	0	3583.69
197	EM	cart	Shaw	Initial Setup	Supervisor	2.07	196.65
197	EM	cart	Shaw	Initial Setup	Data Analyst	2.07	117.99
197	EM	cart	Shaw	Initial Setup	Field Support	2.07	59
197	EM	cart	Shaw	Initial Setup	Subtotal	0	373.64
197	EM	cart	Shaw	Calibration	Supervisor	1.43	135.85
197	EM	cart	Shaw	Calibration	Data Analyst	1.43	81.51
197	EM	cart	Shaw	Calibration	Field Support	1.43	40.76
197	EM	cart	Shaw	Calibration	Subtotal	0	258.12
197	EM	cart	Shaw	Site Survey	Supervisor	2.58	245.1
197	EM	cart	Shaw	Site Survey	Data Analyst	2.58	147.06
197	EM	cart	Shaw	Site Survey	Field Support	2.58	73.53
197	EM	cart	Shaw	Site Survey	Subtotal	0	465.69
197	EM	cart	Shaw	Demobilization	Supervisor	2.66	252.7
197	EM	cart	Shaw	Demobilization	Data Analyst	2.66	151.62
197	EM	cart	Shaw	Demobilization	Field Support	2.66	151.62
197	EM	cart	Shaw	Demobilization	Subtotal	0	555.94
197	EM	cart	Shaw	Total	Total	0	1653.39
552	EM	cart	Shaw	Initial Setup	Supervisor	2.07	196.65
552	EM	cart	Shaw	Initial Setup	Data Analyst	2.07	117.99
552	EM	cart	Shaw	Initial Setup	Field Support	2.07	58.99
552	EM	cart	Shaw	Initial Setup	Subtotal	0	373.63
552	EM	cart	Shaw	Calibration	Supervisor	1.52	144.4
552	EM	cart	Shaw	Calibration	Data Analyst	1.52	86.64
552	EM	cart	Shaw	Calibration	Field Support	1.52	43.32
552	EM	cart	Shaw	Calibration	Subtotal	0	274.36
552	EM	cart	Shaw	Site Survey	Supervisor	4.92	467.4
552	EM	cart	Shaw	Site Survey	Data Analyst	4.92	280.44
552	EM	cart	Shaw	Site Survey	Field Support	4.92	280.44
552	EM	cart	Shaw	Site Survey	Subtotal	0	1028.28
552	EM	cart	Shaw	Demobilization	Supervisor	2.66	252.7
552	EM	cart	Shaw	Demobilization	Data Analyst	2.66	151.62
552	EM	cart	Shaw	Demobilization	Field Support	2.66	151.62
552	EM	cart	Shaw	Demobilization	Subtotal	0	555.94
552	EM	cart	Shaw	Total	Total	0	2232.21
201	EM	cart	Shaw	Initial Setup	Supervisor	2.07	196.65
201	EM	cart	Shaw	Initial Setup	Data Analyst	2.07	117.99

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
201	EM	cart	Shaw	Initial Setup	Field Support	2.07	117.99
201	EM	cart	Shaw	Initial Setup	Subtotal	0	432.63
201	EM	cart	Shaw	Calibration	Supervisor	2.01	190.95
201	EM	cart	Shaw	Calibration	Data Analyst	2.01	114.57
201	EM	cart	Shaw	Calibration	Field Support	2.01	114.57
201	EM	cart	Shaw	Calibration	Subtotal	0	420.09
201	EM	cart	Shaw	Site Survey	Supervisor	35.5	3372.5
201	EM	cart	Shaw	Site Survey	Data Analyst	35.5	2023.5
201	EM	cart	Shaw	Site Survey	Field Support	35.5	2023.5
201	EM	cart	Shaw	Site Survey	Subtotal	0	7419.5
201	EM	cart	Shaw	Demobilization	Supervisor	2.66	252.7
201	EM	cart	Shaw	Demobilization	Data Analyst	2.66	151.62
201	EM	cart	Shaw	Demobilization	Field Support	2.66	151.62
201	EM	cart	Shaw	Demobilization	Subtotal	0	555.94
201	EM	cart	Shaw	Total	Total	0	8828.16
461	EM	cart	Shaw	Initial Setup	Supervisor	2.07	196.65
461	EM	cart	Shaw	Initial Setup	Data Analyst	2.07	117.99
461	EM	cart	Shaw	Initial Setup	Field Support	2.07	58.99
461	EM	cart	Shaw	Initial Setup	Subtotal	0	373.63
461	EM	cart	Shaw	Calibration	Supervisor	1.43	135.85
461	EM	cart	Shaw	Calibration	Data Analyst	1.43	81.51
461	EM	cart	Shaw	Calibration	Field Support	1.43	40.76
461	EM	cart	Shaw	Calibration	Subtotal	0	258.12
461	EM	cart	Shaw	Site Survey	Supervisor	6.25	593.75
461	EM	cart	Shaw	Site Survey	Data Analyst	6.25	356.25
461	EM	cart	Shaw	Site Survey	Field Support	6.25	356.25
461	EM	cart	Shaw	Site Survey	Subtotal	0	1306.25
461	EM	cart	Shaw	Demobilization	Supervisor	2.66	252.7
461	EM	cart	Shaw	Demobilization	Data Analyst	2.66	151.62
461	EM	cart	Shaw	Demobilization	Field Support	2.66	151.62
461	EM	cart	Shaw	Demobilization	Subtotal	0	555.94
461	EM	cart	Shaw	Total	Total	0	2493.94
198	MAG	cart	Shaw	Initial Setup	Supervisor	2.07	196.65
198	MAG	cart	Shaw	Initial Setup	Data Analyst	2.07	117.99
198	MAG	cart	Shaw	Initial Setup	Field Support	2.07	59
198	MAG	cart	Shaw	Initial Setup	Subtotal	0	373.64
198	MAG	cart	Shaw	Calibration	Supervisor	2	190
198	MAG	cart	Shaw	Calibration	Data Analyst	2	114
198	MAG	cart	Shaw	Calibration	Field Support	2	57
198	MAG	cart	Shaw	Calibration	Subtotal	0	361
198	MAG	cart	Shaw	Site Survey	Supervisor	1.33	126.35
198	MAG	cart	Shaw	Site Survey	Data Analyst	1.33	75.81
198	MAG	cart	Shaw	Site Survey	Field Support	1.33	37.91
198	MAG	cart	Shaw	Site Survey	Subtotal	0	240.07
198	MAG	cart	Shaw	Demobilization	Supervisor	2.66	252.7
198	MAG	cart	Shaw	Demobilization	Data Analyst	2.66	151.62
198	MAG	cart	Shaw	Demobilization	Field Support	2.66	151.62
198	MAG	cart	Shaw	Demobilization	Subtotal	0	555.94
198	MAG	cart	Shaw	Total	Total	0	1530.65

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
404	MAG	cart	Shaw	Initial Setup	Supervisor	1.42	134.9
404	MAG	cart	Shaw	Initial Setup	Data Analyst	1.42	80.94
404	MAG	cart	Shaw	Initial Setup	Field Support	1.42	80.94
404	MAG	cart	Shaw	Initial Setup	Subtotal	0	296.78
404	MAG	cart	Shaw	Calibration	Supervisor	0.08	7.6
404	MAG	cart	Shaw	Calibration	Data Analyst	0.08	4.56
404	MAG	cart	Shaw	Calibration	Field Support	0.08	4.56
404	MAG	cart	Shaw	Calibration	Subtotal	0	16.72
404	MAG	cart	Shaw	Site Survey	Supervisor	0.25	23.75
404	MAG	cart	Shaw	Site Survey	Data Analyst	0.25	14.25
404	MAG	cart	Shaw	Site Survey	Field Support	0.25	14.25
404	MAG	cart	Shaw	Site Survey	Subtotal	0	52.25
404	MAG	cart	Shaw	Demobilization	Supervisor	2.67	253.65
404	MAG	cart	Shaw	Demobilization	Data Analyst	2.67	152.19
404	MAG	cart	Shaw	Demobilization	Field Support	2.67	152.19
404	MAG	cart	Shaw	Demobilization	Subtotal	0	558.03
404	MAG	cart	Shaw	Total	Total	0	923.78
206	MAG	cart	Shaw	Demobilization	Supervisor	2.66	252.7
206	MAG	cart	Shaw	Demobilization	Data Analyst	2.66	151.62
206	MAG	cart	Shaw	Demobilization	Field Support	2.66	151.62
206	MAG	cart	Shaw	Demobilization	Subtotal	0	555.94
206	MAG	cart	Shaw	Total	Total	0	1485.51
206	MAG	cart	Shaw	Initial Setup	Supervisor	2.07	196.65
206	MAG	cart	Shaw	Initial Setup	Data Analyst	2.07	117.99
206	MAG	cart	Shaw	Initial Setup	Field Support	2.07	58.99
206	MAG	cart	Shaw	Initial Setup	Subtotal	0	373.63
206	MAG	cart	Shaw	Calibration	Supervisor	2	190
206	MAG	cart	Shaw	Calibration	Data Analyst	2	114
206	MAG	cart	Shaw	Calibration	Field Support	2	114
206	MAG	cart	Shaw	Calibration	Subtotal	0	418
206	MAG	cart	Shaw	Site Survey	Supervisor	0.66	62.7
206	MAG	cart	Shaw	Site Survey	Data Analyst	0.66	37.62
206	MAG	cart	Shaw	Site Survey	Field Support	0.66	37.62
206	MAG	cart	Shaw	Site Survey	Subtotal	0	137.94
492	MAG	cart	Shaw	Initial Setup	Supervisor	2.07	196.65
492	MAG	cart	Shaw	Initial Setup	Data Analyst	2.07	117.98
492	MAG	cart	Shaw	Initial Setup	Field Support	2.07	58.99
492	MAG	cart	Shaw	Initial Setup	Subtotal	0	373.62
492	MAG	cart	Shaw	Calibration	Supervisor	2.5	237.5
492	MAG	cart	Shaw	Calibration	Data Analyst	2.5	142.5
492	MAG	cart	Shaw	Calibration	Field Support	2.5	142.5
492	MAG	cart	Shaw	Calibration	Subtotal	0	522.5
492	MAG	cart	Shaw	Site Survey	Supervisor	14.33	1361.35
492	MAG	cart	Shaw	Site Survey	Data Analyst	14.33	816.81
492	MAG	cart	Shaw	Site Survey	Field Support	14.33	816.81
492	MAG	cart	Shaw	Site Survey	Subtotal	0	2994.97
492	MAG	cart	Shaw	Demobilization	Supervisor	2.66	252.7
492	MAG	cart	Shaw	Demobilization	Data Analyst	2.66	151.62
492	MAG	cart	Shaw	Demobilization	Field Support	2.66	151.62

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
492	MAG	cart	Shaw	Demobilization	Subtotal	0	555.94
492	MAG	cart	Shaw	Total	Total	0	4447.03
376	MAG	cart	Shaw	Initial Setup	Supervisor	2.07	196.65
376	MAG	cart	Shaw	Initial Setup	Data Analyst	2.07	117.99
376	MAG	cart	Shaw	Initial Setup	Field Support	2.07	58.99
376	MAG	cart	Shaw	Initial Setup	Subtotal	0	373.63
376	MAG	cart	Shaw	Calibration	Supervisor	2.08	197.6
376	MAG	cart	Shaw	Calibration	Data Analyst	2.08	118.56
376	MAG	cart	Shaw	Calibration	Field Support	2.08	59.28
376	MAG	cart	Shaw	Calibration	Subtotal	0	375.44
376	MAG	cart	Shaw	Site Survey	Supervisor	2.75	261.25
376	MAG	cart	Shaw	Site Survey	Data Analyst	2.75	156.75
376	MAG	cart	Shaw	Site Survey	Field Support	2.75	156.75
376	MAG	cart	Shaw	Site Survey	Subtotal	0	574.75
376	MAG	cart	Shaw	Demobilization	Supervisor	2.66	252.7
376	MAG	cart	Shaw	Demobilization	Data Analyst	2.66	151.62
376	MAG	cart	Shaw	Demobilization	Field Support	2.66	151.62
376	MAG	cart	Shaw	Demobilization	Subtotal	0	555.94
376	MAG	cart	Shaw	Total	Total	0	1879.76
157	EM	cart	TTF	Initial Setup	Supervisor	4.25	403.75
157	EM	cart	TTF	Initial Setup	Data Analyst	4.25	242.25
157	EM	cart	TTF	Initial Setup	Field Support	4.25	121.13
157	EM	cart	TTF	Initial Setup	Subtotal	0	767.13
157	EM	cart	TTF	Calibration	Supervisor	1.72	163.4
157	EM	cart	TTF	Calibration	Data Analyst	1.72	98.04
157	EM	cart	TTF	Calibration	Field Support	1.72	49.02
157	EM	cart	TTF	Calibration	Subtotal	0	310.46
157	EM	cart	TTF	Site Survey	Supervisor	1.37	130.15
157	EM	cart	TTF	Site Survey	Data Analyst	1.37	78.09
157	EM	cart	TTF	Site Survey	Field Support	1.37	39.05
157	EM	cart	TTF	Site Survey	Subtotal	0	247.29
157	EM	cart	TTF	Demobilization	Supervisor	2.58	245.1
157	EM	cart	TTF	Demobilization	Data Analyst	2.58	147.06
157	EM	cart	TTF	Demobilization	Field Support	2.58	73.53
157	EM	cart	TTF	Demobilization	Subtotal	0	465.69
157	EM	cart	TTF	Total	Total	0	1790.57
159	EM	sling	TTF	Initial Setup	Supervisor	4.25	403.75
159	EM	sling	TTF	Initial Setup	Data Analyst	4.25	242.25
159	EM	sling	TTF	Initial Setup	Field Support	4.25	121.13
159	EM	sling	TTF	Initial Setup	Subtotal	0	767.13
159	EM	sling	TTF	Calibration	Supervisor	7.58	720.1
159	EM	sling	TTF	Calibration	Data Analyst	7.58	432.06
159	EM	sling	TTF	Calibration	Field Support	0	0
159	EM	sling	TTF	Calibration	Subtotal	0	1152.16
159	EM	sling	TTF	Site Survey	Supervisor	3.75	356.25
159	EM	sling	TTF	Site Survey	Data Analyst	3.75	213.75
159	EM	sling	TTF	Site Survey	Field Support	0	0
159	EM	sling	TTF	Site Survey	Subtotal	0	570
159	EM	sling	TTF	Demobilization	Supervisor	2.58	245.1

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
159	EM	sling	TTF	Demobilization	Data Analyst	2.58	147.06
159	EM	sling	TTF	Demobilization	Field Support	2.58	73.53
159	EM	sling	TTF	Demobilization	Subtotal	0	465.69
159	EM	sling	TTF	Total	Total	0	2954.98
549	EM	sling	TTF	Initial Setup	Supervisor	4.25	403.75
549	EM	sling	TTF	Initial Setup	Data Analyst	4.25	242.25
549	EM	sling	TTF	Initial Setup	Field Support	4.25	121.13
549	EM	sling	TTF	Initial Setup	Subtotal	0	767.13
549	EM	sling	TTF	Calibration	Supervisor	1.78	169.1
549	EM	sling	TTF	Calibration	Data Analyst	1.78	101.46
549	EM	sling	TTF	Calibration	Field Support	1.78	50.73
549	EM	sling	TTF	Calibration	Subtotal	0	321.29
549	EM	sling	TTF	Site Survey	Supervisor	5.33	506.35
549	EM	sling	TTF	Site Survey	Data Analyst	5.33	303.81
549	EM	sling	TTF	Site Survey	Field Support	5.33	151.91
549	EM	sling	TTF	Site Survey	Subtotal	0	962.07
549	EM	sling	TTF	Demobilization	Supervisor	2.58	245.1
549	EM	sling	TTF	Demobilization	Data Analyst	2.58	147.06
549	EM	sling	TTF	Demobilization	Field Support	2.58	73.53
549	EM	sling	TTF	Demobilization	Subtotal	0	465.69
549	EM	sling	TTF	Total	Total	0	2516.18
165	EM	cart	TTF	Initial Setup	Supervisor	4.25	403.75
165	EM	cart	TTF	Initial Setup	Data Analyst	4.25	242.25
165	EM	cart	TTF	Initial Setup	Field Support	4.25	121.13
165	EM	cart	TTF	Initial Setup	Subtotal	0	767.13
165	EM	cart	TTF	Calibration	Supervisor	2.35	223.25
165	EM	cart	TTF	Calibration	Data Analyst	2.35	133.95
165	EM	cart	TTF	Calibration	Field Support	2.35	66.98
165	EM	cart	TTF	Calibration	Subtotal	0	424.18
165	EM	cart	TTF	Site Survey	Supervisor	63.78	6059.1
165	EM	cart	TTF	Site Survey	Data Analyst	63.78	3635.46
165	EM	cart	TTF	Site Survey	Field Support	63.78	1817.73
165	EM	cart	TTF	Site Survey	Subtotal	0	11512.29
165	EM	cart	TTF	Demobilization	Supervisor	2.58	245.1
165	EM	cart	TTF	Demobilization	Data Analyst	2.58	147.06
165	EM	cart	TTF	Demobilization	Field Support	2.58	73.53
165	EM	cart	TTF	Demobilization	Subtotal	0	465.69
165	EM	cart	TTF	Total	Total	0	13169.28
457	EM	sling	TTF	Initial Setup	Supervisor	4.25	403.75
457	EM	sling	TTF	Initial Setup	Data Analyst	4.25	242.25
457	EM	sling	TTF	Initial Setup	Field Support	4.25	121.13
457	EM	sling	TTF	Initial Setup	Subtotal	0	767.13
457	EM	sling	TTF	Calibration	Supervisor	9.48	900.6
457	EM	sling	TTF	Calibration	Data Analyst	9.48	540.36
457	EM	sling	TTF	Calibration	Field Support	9.48	270.18
457	EM	sling	TTF	Calibration	Subtotal	0	1711.14
457	EM	sling	TTF	Site Survey	Supervisor	12.22	1160.9
457	EM	sling	TTF	Site Survey	Data Analyst	12.22	696.54
457	EM	sling	TTF	Site Survey	Field Support	12.22	348.27

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
457	EM	sling	TTF	Site Survey	Subtotal	0	2205.71
457	EM	sling	TTF	Demobilization	Supervisor	2.58	245.1
457	EM	sling	TTF	Demobilization	Data Analyst	2.58	147.06
457	EM	sling	TTF	Demobilization	Field Support	2.58	73.53
457	EM	sling	TTF	Demobilization	Subtotal	0	465.69
457	EM	sling	TTF	Total	Total	0	5149.67
764	EM	towed	VF WARNER	Initial Setup	Supervisor	3.75	356.25
764	EM	towed	VF WARNER	Initial Setup	Data Analyst	3.75	213.75
764	EM	towed	VF WARNER	Initial Setup	Field Support	0	0
764	EM	towed	VF WARNER	Initial Setup	Subtotal	0	570
764	EM	towed	VF WARNER	Calibration	Supervisor	0.96	91.2
764	EM	towed	VF WARNER	Calibration	Data Analyst	0.96	54.72
764	EM	towed	VF WARNER	Calibration	Field Support	0	0
764	EM	towed	VF WARNER	Calibration	Subtotal	0	145.92
764	EM	towed	VF WARNER	Site Survey	Supervisor	0.96	91.2
764	EM	towed	VF WARNER	Site Survey	Data Analyst	0.96	54.72
764	EM	towed	VF WARNER	Site Survey	Field Support	0	0
764	EM	towed	VF WARNER	Site Survey	Subtotal	0	145.92
764	EM	towed	VF WARNER	Demobilization	Supervisor	4.25	403.75
764	EM	towed	VF WARNER	Demobilization	Data Analyst	4.25	242.25
764	EM	towed	VF WARNER	Demobilization	Field Support	0	0
764	EM	towed	VF WARNER	Demobilization	Subtotal	0	646
764	EM	towed	VF WARNER	Total	Total	0	1507.84
45	GPR	cart	Witten	Initial Setup	Supervisor	1.56	148.2
45	GPR	cart	Witten	Initial Setup	Data Analyst	1.56	88.92
45	GPR	cart	Witten	Initial Setup	Field Support	1.56	44.46
45	GPR	cart	Witten	Initial Setup	Subtotal	0	281.58
45	GPR	cart	Witten	Calibration	Supervisor	1.96	186.2
45	GPR	cart	Witten	Calibration	Data Analyst	1.96	111.72
45	GPR	cart	Witten	Calibration	Field Support	1.96	55.86
45	GPR	cart	Witten	Calibration	Subtotal	0	353.78
45	GPR	cart	Witten	Site Survey	Supervisor	5.43	515.85
45	GPR	cart	Witten	Site Survey	Data Analyst	5.43	309.51
45	GPR	cart	Witten	Site Survey	Field Support	5.43	154.76
45	GPR	cart	Witten	Site Survey	Subtotal	0	980.12
45	GPR	cart	Witten	Demobilization	Supervisor	1	95
45	GPR	cart	Witten	Demobilization	Data Analyst	1	57
45	GPR	cart	Witten	Demobilization	Field Support	1	28.5
45	GPR	cart	Witten	Demobilization	Subtotal	0	180.5
45	GPR	cart	Witten	Total	Total	0	1795.98
126	GPR	cart	Witten	Initial Setup	Supervisor	1.56	148.2
126	GPR	cart	Witten	Initial Setup	Data Analyst	1.56	88.92
126	GPR	cart	Witten	Initial Setup	Field Support	1.56	44.46
126	GPR	cart	Witten	Initial Setup	Subtotal	0	281.58
126	GPR	cart	Witten	Calibration	Supervisor	1.96	186.2
126	GPR	cart	Witten	Calibration	Data Analyst	1.96	111.72
126	GPR	cart	Witten	Calibration	Field Support	1.96	55.86
126	GPR	cart	Witten	Calibration	Subtotal	0	353.78
126	GPR	cart	Witten	Site Survey	Supervisor	0.72	68.4

Aberdeen Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
126	GPR	cart	Witten	Site Survey	Data Analyst	0.72	41.04
126	GPR	cart	Witten	Site Survey	Field Support	0.72	20.52
126	GPR	cart	Witten	Site Survey	Subtotal	0	129.96
126	GPR	cart	Witten	Demobilization	Supervisor	1	95
126	GPR	cart	Witten	Demobilization	Data Analyst	1	57
126	GPR	cart	Witten	Demobilization	Field Support	1	28.5
126	GPR	cart	Witten	Demobilization	Subtotal	0	180.5
126	GPR	cart	Witten	Total	Total	0	945.82
37	EM	cart	Zonge	Initial Setup	Supervisor	4.83	458.85
37	EM	cart	Zonge	Initial Setup	Data Analyst	4.83	275.31
37	EM	cart	Zonge	Initial Setup	Field Support	4.83	137.66
37	EM	cart	Zonge	Initial Setup	Subtotal	0	871.82
37	EM	cart	Zonge	Calibration	Supervisor	4.53	430.35
37	EM	cart	Zonge	Calibration	Data Analyst	4.53	258.21
37	EM	cart	Zonge	Calibration	Field Support	4.53	129.1
37	EM	cart	Zonge	Calibration	Subtotal	0	817.67
37	EM	cart	Zonge	Site Survey	Supervisor	3.23	306.85
37	EM	cart	Zonge	Site Survey	Data Analyst	3.23	184.11
37	EM	cart	Zonge	Site Survey	Field Support	3.23	92.06
37	EM	cart	Zonge	Site Survey	Subtotal	0	583.02
37	EM	cart	Zonge	Demobilization	Supervisor	1.75	166.25
37	EM	cart	Zonge	Demobilization	Data Analyst	1.75	99.75
37	EM	cart	Zonge	Demobilization	Field Support	0	0
37	EM	cart	Zonge	Demobilization	Subtotal	0	266
37	EM	cart	Zonge	Total	Total	0	2538.51
38	EM	cart	Zonge	Initial Setup	Supervisor	4.83	458.85
38	EM	cart	Zonge	Initial Setup	Data Analyst	4.83	275.31
38	EM	cart	Zonge	Initial Setup	Field Support	4.83	137.66
38	EM	cart	Zonge	Initial Setup	Subtotal	0	871.82
38	EM	cart	Zonge	Calibration	Supervisor	5	475
38	EM	cart	Zonge	Calibration	Data Analyst	5	285
38	EM	cart	Zonge	Calibration	Field Support	5	142.5
38	EM	cart	Zonge	Calibration	Subtotal	0	902.5
38	EM	cart	Zonge	Site Survey	Supervisor	108.7	10326.5
38	EM	cart	Zonge	Site Survey	Data Analyst	108.7	6195.9
38	EM	cart	Zonge	Site Survey	Field Support	108.7	3872.44
38	EM	cart	Zonge	Site Survey	Subtotal	0	20394.84
38	EM	cart	Zonge	Demobilization	Supervisor	1.75	166.25
38	EM	cart	Zonge	Demobilization	Data Analyst	1.75	99.75
38	EM	cart	Zonge	Demobilization	Field Support	0	0
38	EM	cart	Zonge	Demobilization	Subtotal	0	266
38	EM	cart	Zonge	Total	Total	0	22435.16
Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
383	dual	cart	BH	Initial Setup	Supervisor	7.83	743.85
383	dual	cart	BH	Initial Setup	Data Analyst	7.83	446.31
383	dual	cart	BH	Initial Setup	Field Support	7.83	0
383	dual	cart	BH	Initial Setup	Subtotal	0	1190.16
383	dual	cart	BH	Calibration	Supervisor	4.2	399

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
383	dual	cart	BH	Calibration	Data Analyst	4.2	239.4
383	dual	cart	BH	Calibration	Field Support	4.2	0
383	dual	cart	BH	Calibration	Subtotal	0	638.4
383	dual	cart	BH	Site Survey	Supervisor	2	190
383	dual	cart	BH	Site Survey	Data Analyst	2	114
383	dual	cart	BH	Site Survey	Field Support	2	0
383	dual	cart	BH	Site Survey	Subtotal	0	304
383	dual	cart	BH	Demobilization	Supervisor	1.72	163.4
383	dual	cart	BH	Demobilization	Data Analyst	1.72	98.04
383	dual	cart	BH	Demobilization	Field Support	1.72	0
383	dual	cart	BH	Demobilization	Subtotal	0	261.44
383	dual	cart	BH	Total	Total	0	2394
607	dual	cart	BH	Initial Setup	Supervisor	7.83	743.85
607	dual	cart	BH	Initial Setup	Data Analyst	7.83	446.31
607	dual	cart	BH	Initial Setup	Field Support	7.83	0
607	dual	cart	BH	Initial Setup	Subtotal	0	1190.16
607	dual	cart	BH	Calibration	Supervisor	4.45	422.75
607	dual	cart	BH	Calibration	Data Analyst	4.45	253.65
607	dual	cart	BH	Calibration	Field Support	4.45	0
607	dual	cart	BH	Calibration	Subtotal	0	676.4
607	dual	cart	BH	Site Survey	Supervisor	11.28	1071.6
607	dual	cart	BH	Site Survey	Data Analyst	11.28	642.96
607	dual	cart	BH	Site Survey	Field Support	11.28	0
607	dual	cart	BH	Site Survey	Subtotal	0	1714.56
607	dual	cart	BH	Demobilization	Supervisor	1.72	163.4
607	dual	cart	BH	Demobilization	Data Analyst	1.72	98.04
607	dual	cart	BH	Demobilization	Field Support	1.72	0
607	dual	cart	BH	Demobilization	Subtotal	0	261.44
607	dual	cart	BH	Total	Total	0	3842.56
655	dual	cart	BH	Initial Setup	Supervisor	7.83	743.85
655	dual	cart	BH	Initial Setup	Data Analyst	7.83	446.31
655	dual	cart	BH	Initial Setup	Field Support	7.83	0
655	dual	cart	BH	Initial Setup	Subtotal	0	1190.16
655	dual	cart	BH	Calibration	Supervisor	5.15	489.25
655	dual	cart	BH	Calibration	Data Analyst	5.15	293.55
655	dual	cart	BH	Calibration	Field Support	5.15	0
655	dual	cart	BH	Calibration	Subtotal	0	782.8
655	dual	cart	BH	Site Survey	Supervisor	11.46	1088.7
655	dual	cart	BH	Site Survey	Data Analyst	11.46	653.22
655	dual	cart	BH	Site Survey	Field Support	11.46	0
655	dual	cart	BH	Site Survey	Subtotal	0	1741.92
655	dual	cart	BH	Demobilization	Supervisor	1.72	163.4
655	dual	cart	BH	Demobilization	Data Analyst	1.72	98.04
655	dual	cart	BH	Demobilization	Field Support	1.72	0
655	dual	cart	BH	Demobilization	Subtotal	0	261.44
655	dual	cart	BH	Total	Total	0	3976.32
651	dual	towed	BH	Initial Setup	Supervisor	7.83	743.85
651	dual	towed	BH	Initial Setup	Data Analyst	7.83	446.31
651	dual	towed	BH	Initial Setup	Field Support	7.83	0

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
651	dual	towed	BH	Initial Setup	Subtotal	0	1190.16
651	dual	towed	BH	Calibration	Supervisor	10.92	1037.4
651	dual	towed	BH	Calibration	Data Analyst	10.92	622.44
651	dual	towed	BH	Calibration	Field Support	10.92	0
651	dual	towed	BH	Calibration	Subtotal	0	1659.84
651	dual	towed	BH	Site Survey	Supervisor	48.1	4569.5
651	dual	towed	BH	Site Survey	Data Analyst	48.1	2741.7
651	dual	towed	BH	Site Survey	Field Support	48.1	0
651	dual	towed	BH	Site Survey	Subtotal	0	7311.2
651	dual	towed	BH	Demobilization	Supervisor	1.72	163.4
651	dual	towed	BH	Demobilization	Data Analyst	1.72	98.04
651	dual	towed	BH	Demobilization	Field Support	1.72	0
651	dual	towed	BH	Demobilization	Subtotal	0	261.44
651	dual	towed	BH	Total	Total	0	10422.64
216	EM	cart	ERDC	Initial Setup	Supervisor	3.17	301.15
216	EM	cart	ERDC	Initial Setup	Data Analyst	3.17	180.69
216	EM	cart	ERDC	Initial Setup	Field Support	3.17	271.05
216	EM	cart	ERDC	Initial Setup	Subtotal	0	752.89
216	EM	cart	ERDC	Calibration	Supervisor	9.45	897.75
216	EM	cart	ERDC	Calibration	Data Analyst	9.45	538.65
216	EM	cart	ERDC	Calibration	Field Support	9.45	807.98
216	EM	cart	ERDC	Calibration	Subtotal	0	2244.38
216	EM	cart	ERDC	Site Survey	Supervisor	10.5	997.5
216	EM	cart	ERDC	Site Survey	Data Analyst	10.5	598.5
216	EM	cart	ERDC	Site Survey	Field Support	10.5	897.75
216	EM	cart	ERDC	Site Survey	Subtotal	0	2493.75
216	EM	cart	ERDC	Demobilization	Supervisor	0.6	57
216	EM	cart	ERDC	Demobilization	Data Analyst	0.6	34.2
216	EM	cart	ERDC	Demobilization	Field Support	0.6	51.3
216	EM	cart	ERDC	Demobilization	Subtotal	0	142.5
216	EM	cart	ERDC	Total	Total	0	5633.52
249	EM	cart	ERDC	Initial Setup	Supervisor	1.08	102.6
249	EM	cart	ERDC	Initial Setup	Data Analyst	1.08	61.56
249	EM	cart	ERDC	Initial Setup	Field Support	1.08	61.56
249	EM	cart	ERDC	Initial Setup	Subtotal	0	225.72
249	EM	cart	ERDC	Calibration	Supervisor	17.35	1648.25
249	EM	cart	ERDC	Calibration	Data Analyst	17.35	988.95
249	EM	cart	ERDC	Calibration	Field Support	17.35	988.95
249	EM	cart	ERDC	Calibration	Subtotal	0	3626.15
249	EM	cart	ERDC	Site Survey	Supervisor	135.88	12908.6
249	EM	cart	ERDC	Site Survey	Data Analyst	135.88	7745.16
249	EM	cart	ERDC	Site Survey	Field Support	135.88	7745.16
249	EM	cart	ERDC	Site Survey	Subtotal	0	28398.92
249	EM	cart	ERDC	Demobilization	Supervisor	2.16	205.2
249	EM	cart	ERDC	Demobilization	Data Analyst	2.16	122.55
249	EM	cart	ERDC	Demobilization	Field Support	2.16	122.55
249	EM	cart	ERDC	Demobilization	Subtotal	0	450.3
249	EM	cart	ERDC	Total	Total	0	32701.09
134	EM	cart	ERDC	Initial Setup	Supervisor	6.25	593.75

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
134	EM	cart	ERDC	Initial Setup	Data Analyst	6.25	356.25
134	EM	cart	ERDC	Initial Setup	Field Support	6.25	534.38
134	EM	cart	ERDC	Initial Setup	Subtotal	0	1484.38
134	EM	cart	ERDC	Calibration	Supervisor	7.5	712.5
134	EM	cart	ERDC	Calibration	Data Analyst	7.5	427.5
134	EM	cart	ERDC	Calibration	Field Support	7.5	641.25
134	EM	cart	ERDC	Calibration	Subtotal	0	1781.25
134	EM	cart	ERDC	Site Survey	Supervisor	3.75	356.25
134	EM	cart	ERDC	Site Survey	Data Analyst	3.75	213.75
134	EM	cart	ERDC	Site Survey	Field Support	3.75	320.63
134	EM	cart	ERDC	Site Survey	Subtotal	0	890.63
134	EM	cart	ERDC	Demobilization	Supervisor	0.6	57
134	EM	cart	ERDC	Demobilization	Data Analyst	0.6	34.2
134	EM	cart	ERDC	Demobilization	Field Support	0.6	51.3
134	EM	cart	ERDC	Demobilization	Subtotal	0	142.5
134	EM	cart	ERDC	Total	Total	0	4298.76
509	EM	cart	ERDC	Initial Setup	Supervisor	6.5	617.5
509	EM	cart	ERDC	Initial Setup	Data Analyst	6.5	370.5
509	EM	cart	ERDC	Initial Setup	Field Support	6.5	555.75
509	EM	cart	ERDC	Initial Setup	Subtotal	0	1543.75
509	EM	cart	ERDC	Calibration	Supervisor	5.55	527.25
509	EM	cart	ERDC	Calibration	Data Analyst	5.55	316.35
509	EM	cart	ERDC	Calibration	Field Support	5.55	474.53
509	EM	cart	ERDC	Calibration	Subtotal	0	1318.13
509	EM	cart	ERDC	Site Survey	Supervisor	10.55	1002.25
509	EM	cart	ERDC	Site Survey	Data Analyst	10.55	601.35
509	EM	cart	ERDC	Site Survey	Field Support	10.55	300.68
509	EM	cart	ERDC	Site Survey	Subtotal	0	1904.28
509	EM	cart	ERDC	Demobilization	Supervisor	0.77	73.15
509	EM	cart	ERDC	Demobilization	Data Analyst	0.77	43.89
509	EM	cart	ERDC	Demobilization	Field Support	0.77	21.95
509	EM	cart	ERDC	Demobilization	Subtotal	0	138.99
509	EM	cart	ERDC	Total	Total	0	4905.15
136	EM	cart	ERDC	Initial Setup	Supervisor	6.5	617.5
136	EM	cart	ERDC	Initial Setup	Data Analyst	6.5	370.5
136	EM	cart	ERDC	Initial Setup	Field Support	6.5	370.5
136	EM	cart	ERDC	Initial Setup	Subtotal	0	1358.5
136	EM	cart	ERDC	Calibration	Supervisor	5.37	510.15
136	EM	cart	ERDC	Calibration	Data Analyst	5.37	306.09
136	EM	cart	ERDC	Calibration	Field Support	5.37	459.14
136	EM	cart	ERDC	Calibration	Subtotal	0	1275.38
136	EM	cart	ERDC	Site Survey	Supervisor	5.55	527.25
136	EM	cart	ERDC	Site Survey	Data Analyst	5.55	316.35
136	EM	cart	ERDC	Site Survey	Field Support	5.55	158.18
136	EM	cart	ERDC	Site Survey	Subtotal	0	1001.78
136	EM	cart	ERDC	Demobilization	Supervisor	0.77	73.15
136	EM	cart	ERDC	Demobilization	Data Analyst	0.77	43.89
136	EM	cart	ERDC	Demobilization	Field Support	0.77	21.95
136	EM	cart	ERDC	Demobilization	Subtotal	0	138.99

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
136	EM	cart	ERDC	Total	Total	0	3774.65
135	EM	cart	ERDC	Initial Setup	Supervisor	5.5	522.5
135	EM	cart	ERDC	Initial Setup	Data Analyst	5.5	313.5
135	EM	cart	ERDC	Initial Setup	Field Support	5.5	313.5
135	EM	cart	ERDC	Initial Setup	Subtotal	0	1149.5
135	EM	cart	ERDC	Calibration	Supervisor	7.08	672.6
135	EM	cart	ERDC	Calibration	Data Analyst	7.08	403.56
135	EM	cart	ERDC	Calibration	Field Support	7.08	403.56
135	EM	cart	ERDC	Calibration	Subtotal	0	1479.72
135	EM	cart	ERDC	Site Survey	Supervisor	92.95	8830.25
135	EM	cart	ERDC	Site Survey	Data Analyst	92.95	5298.15
135	EM	cart	ERDC	Site Survey	Field Support	92.95	5298.15
135	EM	cart	ERDC	Site Survey	Subtotal	0	19426.55
135	EM	cart	ERDC	Demobilization	Supervisor	0.76	72.2
135	EM	cart	ERDC	Demobilization	Data Analyst	0.76	43.32
135	EM	cart	ERDC	Demobilization	Field Support	0.76	43.32
135	EM	cart	ERDC	Demobilization	Subtotal	0	158.84
135	EM	cart	ERDC	Total	Total	0	22214.61
362	MAG	sling	ERDC	Initial Setup	Supervisor	0.42	39.9
362	MAG	sling	ERDC	Initial Setup	Data Analyst	0.42	23.94
362	MAG	sling	ERDC	Initial Setup	Field Support	0.42	11.97
362	MAG	sling	ERDC	Initial Setup	Subtotal	0	75.81
362	MAG	sling	ERDC	Calibration	Supervisor	4.25	403.75
362	MAG	sling	ERDC	Calibration	Data Analyst	4.25	242.25
362	MAG	sling	ERDC	Calibration	Field Support	4.25	121.13
362	MAG	sling	ERDC	Calibration	Subtotal	0	767.13
362	MAG	sling	ERDC	Site Survey	Supervisor	7.75	736.25
362	MAG	sling	ERDC	Site Survey	Data Analyst	7.75	441.75
362	MAG	sling	ERDC	Site Survey	Field Support	7.75	220.88
362	MAG	sling	ERDC	Site Survey	Subtotal	0	1398.88
362	MAG	sling	ERDC	Demobilization	Supervisor	0.25	23.75
362	MAG	sling	ERDC	Demobilization	Data Analyst	0.25	14.25
362	MAG	sling	ERDC	Demobilization	Field Support	0.25	7.13
362	MAG	sling	ERDC	Demobilization	Subtotal	0	45.13
362	MAG	sling	ERDC	Total	Total	0	2286.95
544	MAG	sling	ERDC	Initial Setup	Supervisor	3.33	316.35
544	MAG	sling	ERDC	Initial Setup	Data Analyst	3.33	189.81
544	MAG	sling	ERDC	Initial Setup	Field Support	3.33	94.91
544	MAG	sling	ERDC	Initial Setup	Subtotal	0	601.07
544	MAG	sling	ERDC	Calibration	Supervisor	4.92	467.4
544	MAG	sling	ERDC	Calibration	Data Analyst	4.92	280.44
544	MAG	sling	ERDC	Calibration	Field Support	4.92	140.22
544	MAG	sling	ERDC	Calibration	Subtotal	0	888.06
544	MAG	sling	ERDC	Site Survey	Supervisor	4.53	430.35
544	MAG	sling	ERDC	Site Survey	Data Analyst	4.53	258.21
544	MAG	sling	ERDC	Site Survey	Field Support	4.53	129.11
544	MAG	sling	ERDC	Site Survey	Subtotal	0	817.67
544	MAG	sling	ERDC	Demobilization	Supervisor	0.25	23.75
544	MAG	sling	ERDC	Demobilization	Data Analyst	0.25	14.25

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
544	MAG	sling	ERDC	Demobilization	Field Support	0.25	0
544	MAG	sling	ERDC	Demobilization	Subtotal	0	38
544	MAG	sling	ERDC	Total	Total	0	2344.8
571	MAG	sling	ERDC	Demobilization	Subtotal	0	38
571	MAG	sling	ERDC	Total	Total	0	2041.55
571	MAG	sling	ERDC	Initial Setup	Supervisor	3.33	316.35
571	MAG	sling	ERDC	Initial Setup	Data Analyst	3.33	189.81
571	MAG	sling	ERDC	Initial Setup	Field Support	3.33	0
571	MAG	sling	ERDC	Initial Setup	Subtotal	0	506.16
571	MAG	sling	ERDC	Calibration	Supervisor	5.22	495.9
571	MAG	sling	ERDC	Calibration	Data Analyst	5.22	297.54
571	MAG	sling	ERDC	Calibration	Field Support	5.22	0
571	MAG	sling	ERDC	Calibration	Subtotal	0	793.44
571	MAG	sling	ERDC	Site Survey	Supervisor	3.9	370.5
571	MAG	sling	ERDC	Site Survey	Data Analyst	3.9	222.3
571	MAG	sling	ERDC	Site Survey	Field Support	3.9	111.15
571	MAG	sling	ERDC	Site Survey	Subtotal	0	703.95
571	MAG	sling	ERDC	Demobilization	Supervisor	0.25	23.75
571	MAG	sling	ERDC	Demobilization	Data Analyst	0.25	14.25
571	MAG	sling	ERDC	Demobilization	Field Support	0.25	0
364	MAG	sling	ERDC	Initial Setup	Supervisor	3.33	316.35
364	MAG	sling	ERDC	Initial Setup	Data Analyst	3.33	189.81
364	MAG	sling	ERDC	Initial Setup	Field Support	3.33	94.91
364	MAG	sling	ERDC	Initial Setup	Subtotal	0	601.07
364	MAG	sling	ERDC	Calibration	Supervisor	3.92	372.4
364	MAG	sling	ERDC	Calibration	Data Analyst	3.92	223.44
364	MAG	sling	ERDC	Calibration	Field Support	3.92	111.72
364	MAG	sling	ERDC	Calibration	Subtotal	0	707.56
364	MAG	sling	ERDC	Site Survey	Supervisor	26.68	2534.6
364	MAG	sling	ERDC	Site Survey	Data Analyst	26.68	1520.76
364	MAG	sling	ERDC	Site Survey	Field Support	26.68	760.38
364	MAG	sling	ERDC	Site Survey	Subtotal	0	4815.74
364	MAG	sling	ERDC	Demobilization	Supervisor	0.25	23.75
364	MAG	sling	ERDC	Demobilization	Data Analyst	0.25	14.25
364	MAG	sling	ERDC	Demobilization	Field Support	0.25	7.13
364	MAG	sling	ERDC	Demobilization	Subtotal	0	45.13
364	MAG	sling	ERDC	Total	Total	0	6169.5
769	MAG	hand	Forester	Calibration	Supervisor	1.83	173.85
769	MAG	hand	Forester	Calibration	Data Analyst	1.83	104.31
769	MAG	hand	Forester	Calibration	Field Support	1.83	104.31
769	MAG	hand	Forester	Calibration	Subtotal	0	382.47
769	MAG	hand	Forester	Site Survey	Supervisor	2.4	228
769	MAG	hand	Forester	Site Survey	Data Analyst	2.4	136.8
769	MAG	hand	Forester	Site Survey	Field Support	2.4	136.8
769	MAG	hand	Forester	Site Survey	Subtotal	0	501.6
769	MAG	hand	Forester	Demobilization	Supervisor	1.08	102.6
769	MAG	hand	Forester	Demobilization	Data Analyst	1.08	61.56
769	MAG	hand	Forester	Demobilization	Field Support	1.08	61.56
769	MAG	hand	Forester	Demobilization	Subtotal	0	225.72

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
769	MAG	hand	Forester	Total	Total	0	1214.29
769	MAG	hand	Forester	Initial Setup	Supervisor	0.5	47.5
769	MAG	hand	Forester	Initial Setup	Data Analyst	0.5	28.5
769	MAG	hand	Forester	Initial Setup	Field Support	0.5	28.5
769	MAG	hand	Forester	Initial Setup	Subtotal	0	104.5
770	MAG	hand	Forester	Initial Setup	Supervisor	0.5	47.5
770	MAG	hand	Forester	Initial Setup	Data Analyst	0.5	28.5
770	MAG	hand	Forester	Initial Setup	Field Support	0.5	28.5
770	MAG	hand	Forester	Initial Setup	Subtotal	0	104.5
770	MAG	hand	Forester	Calibration	Supervisor	2.03	192.85
770	MAG	hand	Forester	Calibration	Data Analyst	2.03	115.71
770	MAG	hand	Forester	Calibration	Field Support	2.03	115.71
770	MAG	hand	Forester	Calibration	Subtotal	0	424.27
770	MAG	hand	Forester	Site Survey	Supervisor	45.55	4327.25
770	MAG	hand	Forester	Site Survey	Data Analyst	45.55	2596.35
770	MAG	hand	Forester	Site Survey	Field Support	45.55	2596.35
770	MAG	hand	Forester	Site Survey	Subtotal	0	9519.95
770	MAG	hand	Forester	Demobilization	Supervisor	1.08	102.6
770	MAG	hand	Forester	Demobilization	Data Analyst	1.08	61.56
770	MAG	hand	Forester	Demobilization	Field Support	1.08	61.56
770	MAG	hand	Forester	Demobilization	Subtotal	0	225.72
770	MAG	hand	Forester	Total	Total	0	10274.44
293	dual	towed	Geocenters	Initial Setup	Supervisor	2.9	275.5
293	dual	towed	Geocenters	Initial Setup	Data Analyst	2.9	165.3
293	dual	towed	Geocenters	Initial Setup	Field Support	2.9	0
293	dual	towed	Geocenters	Initial Setup	Subtotal	0	440.8
293	dual	towed	Geocenters	Calibration	Supervisor	0.43	40.85
293	dual	towed	Geocenters	Calibration	Data Analyst	0.43	24.51
293	dual	towed	Geocenters	Calibration	Field Support	0.43	0
293	dual	towed	Geocenters	Calibration	Subtotal	0	65.36
293	dual	towed	Geocenters	Site Survey	Supervisor	2.57	244.15
293	dual	towed	Geocenters	Site Survey	Data Analyst	2.57	146.49
293	dual	towed	Geocenters	Site Survey	Field Support	2.57	0
293	dual	towed	Geocenters	Site Survey	Subtotal	0	390.64
293	dual	towed	Geocenters	Demobilization	Supervisor	1.88	178.6
293	dual	towed	Geocenters	Demobilization	Data Analyst	1.88	107.16
293	dual	towed	Geocenters	Demobilization	Field Support	1.88	0
293	dual	towed	Geocenters	Demobilization	Subtotal	0	285.76
293	dual	towed	Geocenters	Total	Total	0	1182.56
299	dual	towed	Geocenters	Initial Setup	Supervisor	2.9	275.5
299	dual	towed	Geocenters	Initial Setup	Data Analyst	2.9	165.3
299	dual	towed	Geocenters	Initial Setup	Field Support	2.9	0
299	dual	towed	Geocenters	Initial Setup	Subtotal	0	440.8
299	dual	towed	Geocenters	Calibration	Supervisor	0.43	40.85
299	dual	towed	Geocenters	Calibration	Data Analyst	0.43	24.51
299	dual	towed	Geocenters	Calibration	Field Support	0.43	0
299	dual	towed	Geocenters	Calibration	Subtotal	0	65.36
299	dual	towed	Geocenters	Site Survey	Supervisor	15.32	1455.4
299	dual	towed	Geocenters	Site Survey	Data Analyst	15.32	873.24

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
299	dual	towed	Geocenters	Site Survey	Field Support	15.32	0
299	dual	towed	Geocenters	Site Survey	Subtotal	0	2328.64
299	dual	towed	Geocenters	Demobilization	Supervisor	1.88	178.6
299	dual	towed	Geocenters	Demobilization	Data Analyst	1.88	107.16
299	dual	towed	Geocenters	Demobilization	Field Support	1.88	0
299	dual	towed	Geocenters	Demobilization	Subtotal	0	285.76
299	dual	towed	Geocenters	Total	Total	0	3120.56
186	EM	hand	G-TEK	Initial Setup	Supervisor	1.67	158.65
186	EM	hand	G-TEK	Initial Setup	Data Analyst	1.67	95.19
186	EM	hand	G-TEK	Initial Setup	Field Support	1.67	0
186	EM	hand	G-TEK	Initial Setup	Subtotal	0	253.84
186	EM	hand	G-TEK	Calibration	Supervisor	1.25	118.75
186	EM	hand	G-TEK	Calibration	Data Analyst	1.25	71.25
186	EM	hand	G-TEK	Calibration	Field Support	1.25	0
186	EM	hand	G-TEK	Calibration	Subtotal	0	190
186	EM	hand	G-TEK	Site Survey	Supervisor	1.17	111.15
186	EM	hand	G-TEK	Site Survey	Data Analyst	1.17	66.69
186	EM	hand	G-TEK	Site Survey	Field Support	1.17	0
186	EM	hand	G-TEK	Site Survey	Subtotal	0	177.84
186	EM	hand	G-TEK	Demobilization	Supervisor	1.28	121.6
186	EM	hand	G-TEK	Demobilization	Data Analyst	1.28	72.96
186	EM	hand	G-TEK	Demobilization	Field Support	1.28	0
186	EM	hand	G-TEK	Demobilization	Subtotal	0	194.56
186	EM	hand	G-TEK	Total	Total	0	816.24
144	EM	hand	G-TEK	Initial Setup	Supervisor	1.66	157.7
144	EM	hand	G-TEK	Initial Setup	Data Analyst	1.66	94.62
144	EM	hand	G-TEK	Initial Setup	Field Support	1.66	0
144	EM	hand	G-TEK	Initial Setup	Subtotal	0	252.32
144	EM	hand	G-TEK	Calibration	Supervisor	3.8	361
144	EM	hand	G-TEK	Calibration	Data Analyst	3.8	216.6
144	EM	hand	G-TEK	Calibration	Field Support	3.8	0
144	EM	hand	G-TEK	Calibration	Subtotal	0	577.6
144	EM	hand	G-TEK	Site Survey	Supervisor	11.28	1071.6
144	EM	hand	G-TEK	Site Survey	Data Analyst	11.28	642.96
144	EM	hand	G-TEK	Site Survey	Field Support	11.28	0
144	EM	hand	G-TEK	Site Survey	Subtotal	0	1714.56
144	EM	hand	G-TEK	Demobilization	Supervisor	1.28	121.6
144	EM	hand	G-TEK	Demobilization	Data Analyst	1.28	72.96
144	EM	hand	G-TEK	Demobilization	Field Support	1.28	0
144	EM	hand	G-TEK	Demobilization	Subtotal	0	194.56
144	EM	hand	G-TEK	Total	Total	0	2739.04
579	EM	sling	G-TEK	Initial Setup	Supervisor	1.66	157.7
579	EM	sling	G-TEK	Initial Setup	Data Analyst	1.66	94.62
579	EM	sling	G-TEK	Initial Setup	Field Support	1.66	0
579	EM	sling	G-TEK	Initial Setup	Subtotal	0	252.32
579	EM	sling	G-TEK	Calibration	Supervisor	3.7	351.5
579	EM	sling	G-TEK	Calibration	Data Analyst	3.7	210.9
579	EM	sling	G-TEK	Calibration	Field Support	3.7	0
579	EM	sling	G-TEK	Calibration	Subtotal	0	562.4

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
579	EM	sling	G-TEK	Site Survey	Supervisor	7.38	701.1
579	EM	sling	G-TEK	Site Survey	Data Analyst	7.38	420.66
579	EM	sling	G-TEK	Site Survey	Field Support	7.38	0
579	EM	sling	G-TEK	Site Survey	Subtotal	0	1121.76
579	EM	sling	G-TEK	Demobilization	Supervisor	1.28	121.6
579	EM	sling	G-TEK	Demobilization	Data Analyst	1.28	72.96
579	EM	sling	G-TEK	Demobilization	Field Support	1.28	0
579	EM	sling	G-TEK	Demobilization	Subtotal	0	194.56
579	EM	sling	G-TEK	Total	Total	0	2131.04
148	EM	sling	G-TEK	Initial Setup	Supervisor	1.67	158.65
148	EM	sling	G-TEK	Initial Setup	Data Analyst	1.67	95.19
148	EM	sling	G-TEK	Initial Setup	Field Support	1.67	47.6
148	EM	sling	G-TEK	Initial Setup	Subtotal	0	301.44
148	EM	sling	G-TEK	Calibration	Supervisor	3.58	340.1
148	EM	sling	G-TEK	Calibration	Data Analyst	3.58	204.06
148	EM	sling	G-TEK	Calibration	Field Support	3.58	102.03
148	EM	sling	G-TEK	Calibration	Subtotal	0	646.19
148	EM	sling	G-TEK	Site Survey	Supervisor	57.82	5492.9
148	EM	sling	G-TEK	Site Survey	Data Analyst	57.82	3295.74
148	EM	sling	G-TEK	Site Survey	Field Support	57.82	1647.87
148	EM	sling	G-TEK	Site Survey	Subtotal	0	10436.51
148	EM	sling	G-TEK	Demobilization	Supervisor	1.28	121.6
148	EM	sling	G-TEK	Demobilization	Data Analyst	1.28	72.96
148	EM	sling	G-TEK	Demobilization	Field Support	1.28	36.48
148	EM	sling	G-TEK	Demobilization	Subtotal	0	231.04
148	EM	sling	G-TEK	Total	Total	0	11615.18
431	MAG	sling	G-TEK	Initial Setup	Supervisor	2.17	206.15
431	MAG	sling	G-TEK	Initial Setup	Data Analyst	2.17	123.69
431	MAG	sling	G-TEK	Initial Setup	Field Support	2.17	61.85
431	MAG	sling	G-TEK	Initial Setup	Subtotal	0	391.69
431	MAG	sling	G-TEK	Calibration	Supervisor	0.9	85.5
431	MAG	sling	G-TEK	Calibration	Data Analyst	0.9	51.3
431	MAG	sling	G-TEK	Calibration	Field Support	0.9	25.65
431	MAG	sling	G-TEK	Calibration	Subtotal	0	162.45
431	MAG	sling	G-TEK	Site Survey	Supervisor	0.77	73.15
431	MAG	sling	G-TEK	Site Survey	Data Analyst	0.77	43.89
431	MAG	sling	G-TEK	Site Survey	Field Support	0.77	21.95
431	MAG	sling	G-TEK	Site Survey	Subtotal	0	138.99
431	MAG	sling	G-TEK	Demobilization	Supervisor	2.67	253.65
431	MAG	sling	G-TEK	Demobilization	Data Analyst	2.67	152.19
431	MAG	sling	G-TEK	Demobilization	Field Support	2.67	0
431	MAG	sling	G-TEK	Demobilization	Subtotal	0	405.84
431	MAG	sling	G-TEK	Total	Total	0	1098.97
536	MAG	sling	G-TEK	Initial Setup	Supervisor	2.16	205.2
536	MAG	sling	G-TEK	Initial Setup	Data Analyst	2.16	123.12
536	MAG	sling	G-TEK	Initial Setup	Field Support	2.16	0
536	MAG	sling	G-TEK	Initial Setup	Subtotal	0	328.32
536	MAG	sling	G-TEK	Calibration	Supervisor	2.78	264.1
536	MAG	sling	G-TEK	Calibration	Data Analyst	2.78	158.46

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
536	MAG	sling	G-TEK	Calibration	Field Support	2.78	0
536	MAG	sling	G-TEK	Calibration	Subtotal	0	422.56
536	MAG	sling	G-TEK	Site Survey	Supervisor	18.23	1731.85
536	MAG	sling	G-TEK	Site Survey	Data Analyst	18.23	1039.11
536	MAG	sling	G-TEK	Site Survey	Field Support	18.23	0
536	MAG	sling	G-TEK	Site Survey	Subtotal	0	2770.96
536	MAG	sling	G-TEK	Demobilization	Supervisor	2.66	252.7
536	MAG	sling	G-TEK	Demobilization	Data Analyst	2.66	151.62
536	MAG	sling	G-TEK	Demobilization	Field Support	2.66	0
536	MAG	sling	G-TEK	Demobilization	Subtotal	0	404.32
536	MAG	sling	G-TEK	Total	Total	0	3926.16
581	MAG	sling	G-TEK	Initial Setup	Supervisor	2.17	206.15
581	MAG	sling	G-TEK	Initial Setup	Data Analyst	2.17	123.69
581	MAG	sling	G-TEK	Initial Setup	Field Support	2.17	61.85
581	MAG	sling	G-TEK	Initial Setup	Subtotal	0	391.69
581	MAG	sling	G-TEK	Calibration	Supervisor	2.35	223.25
581	MAG	sling	G-TEK	Calibration	Data Analyst	2.35	133.95
581	MAG	sling	G-TEK	Calibration	Field Support	2.35	0
581	MAG	sling	G-TEK	Calibration	Subtotal	0	357.2
581	MAG	sling	G-TEK	Site Survey	Supervisor	7.85	745.75
581	MAG	sling	G-TEK	Site Survey	Data Analyst	7.85	447.45
581	MAG	sling	G-TEK	Site Survey	Field Support	7.85	0
581	MAG	sling	G-TEK	Site Survey	Subtotal	0	1193.2
581	MAG	sling	G-TEK	Demobilization	Supervisor	2.66	252.7
581	MAG	sling	G-TEK	Demobilization	Data Analyst	2.66	151.62
581	MAG	sling	G-TEK	Demobilization	Field Support	2.66	0
581	MAG	sling	G-TEK	Demobilization	Subtotal	0	404.32
581	MAG	sling	G-TEK	Total	Total	0	2346.41
147	MAG	sling	G-TEK	Initial Setup	Supervisor	2.17	206.15
147	MAG	sling	G-TEK	Initial Setup	Data Analyst	2.17	123.69
147	MAG	sling	G-TEK	Initial Setup	Field Support	2.17	61.85
147	MAG	sling	G-TEK	Initial Setup	Subtotal	0	391.69
147	MAG	sling	G-TEK	Calibration	Supervisor	0.9	85.5
147	MAG	sling	G-TEK	Calibration	Data Analyst	0.9	51.3
147	MAG	sling	G-TEK	Calibration	Field Support	0.9	25.65
147	MAG	sling	G-TEK	Calibration	Subtotal	0	162.45
147	MAG	sling	G-TEK	Site Survey	Supervisor	32.12	3051.4
147	MAG	sling	G-TEK	Site Survey	Data Analyst	32.12	1830.84
147	MAG	sling	G-TEK	Site Survey	Field Support	32.12	915.42
147	MAG	sling	G-TEK	Site Survey	Subtotal	0	5797.66
147	MAG	sling	G-TEK	Demobilization	Supervisor	2.67	253.65
147	MAG	sling	G-TEK	Demobilization	Data Analyst	2.67	152.19
147	MAG	sling	G-TEK	Demobilization	Field Support	2.67	76.1
147	MAG	sling	G-TEK	Demobilization	Subtotal	0	481.94
147	MAG	sling	G-TEK	Total	Total	0	6833.74
238	MAG	hand	HFA	Initial Setup	Supervisor	1.33	126.35
238	MAG	hand	HFA	Initial Setup	Data Analyst	1.33	0
238	MAG	hand	HFA	Initial Setup	Field Support	1.33	37.91
238	MAG	hand	HFA	Initial Setup	Subtotal	0	164.26

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
238	MAG	hand	HFA	Calibration	Supervisor	14.08	1337.6
238	MAG	hand	HFA	Calibration	Data Analyst	14.08	0
238	MAG	hand	HFA	Calibration	Field Support	14.08	401.28
238	MAG	hand	HFA	Calibration	Subtotal	0	1738.88
238	MAG	hand	HFA	Site Survey	Supervisor	8.58	815.1
238	MAG	hand	HFA	Site Survey	Data Analyst	8.58	0
238	MAG	hand	HFA	Site Survey	Field Support	8.58	244.53
238	MAG	hand	HFA	Site Survey	Subtotal	0	1059.63
238	MAG	hand	HFA	Demobilization	Supervisor	4	380
238	MAG	hand	HFA	Demobilization	Data Analyst	4	0
238	MAG	hand	HFA	Demobilization	Field Support	4	114
238	MAG	hand	HFA	Demobilization	Subtotal	0	494
238	MAG	hand	HFA	Total	Total	0	3456.77
528	MAG	hand	HFA	Initial Setup	Supervisor	1.33	126.35
528	MAG	hand	HFA	Initial Setup	Data Analyst	1.33	75.81
528	MAG	hand	HFA	Initial Setup	Field Support	0	0
528	MAG	hand	HFA	Initial Setup	Subtotal	0	202.16
528	MAG	hand	HFA	Calibration	Supervisor	12.08	1147.6
528	MAG	hand	HFA	Calibration	Data Analyst	12.08	688.56
528	MAG	hand	HFA	Calibration	Field Support	0	0
528	MAG	hand	HFA	Calibration	Subtotal	0	1836.16
528	MAG	hand	HFA	Site Survey	Supervisor	15.55	1477.25
528	MAG	hand	HFA	Site Survey	Data Analyst	15.55	886.35
528	MAG	hand	HFA	Site Survey	Field Support	0	0
528	MAG	hand	HFA	Site Survey	Subtotal	0	2363.6
528	MAG	hand	HFA	Demobilization	Supervisor	4	380
528	MAG	hand	HFA	Demobilization	Data Analyst	4	228
528	MAG	hand	HFA	Demobilization	Field Support	0	0
528	MAG	hand	HFA	Demobilization	Subtotal	0	608
528	MAG	hand	HFA	Total	Total	0	5009.92
587	MAG	hand	HFA	Initial Setup	Supervisor	1.33	126.35
587	MAG	hand	HFA	Initial Setup	Data Analyst	1.33	75.81
587	MAG	hand	HFA	Initial Setup	Field Support	1.33	0
587	MAG	hand	HFA	Initial Setup	Subtotal	0	202.16
587	MAG	hand	HFA	Calibration	Supervisor	12.75	1211.25
587	MAG	hand	HFA	Calibration	Data Analyst	12.75	726.75
587	MAG	hand	HFA	Calibration	Field Support	12.75	0
587	MAG	hand	HFA	Calibration	Subtotal	0	1938
587	MAG	hand	HFA	Site Survey	Supervisor	27.83	2643.85
587	MAG	hand	HFA	Site Survey	Data Analyst	27.83	1586.31
587	MAG	hand	HFA	Site Survey	Field Support	27.83	0
587	MAG	hand	HFA	Site Survey	Subtotal	0	4230.16
587	MAG	hand	HFA	Demobilization	Supervisor	4	380
587	MAG	hand	HFA	Demobilization	Data Analyst	4	0
587	MAG	hand	HFA	Demobilization	Field Support	4	0
587	MAG	hand	HFA	Demobilization	Subtotal	0	380
587	MAG	hand	HFA	Total	Total	0	6750.32
442	MAG	hand	HFA	Initial Setup	Supervisor	1.33	126.35
442	MAG	hand	HFA	Initial Setup	Data Analyst	1.33	75.81

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
442	MAG	hand	HFA	Initial Setup	Field Support	1.33	0
442	MAG	hand	HFA	Initial Setup	Subtotal	0	202.16
442	MAG	hand	HFA	Calibration	Supervisor	12.75	1211.25
442	MAG	hand	HFA	Calibration	Data Analyst	12.75	726.75
442	MAG	hand	HFA	Calibration	Field Support	12.75	0
442	MAG	hand	HFA	Calibration	Subtotal	0	1938
442	MAG	hand	HFA	Site Survey	Supervisor	179.32	17035.4
442	MAG	hand	HFA	Site Survey	Data Analyst	179.32	10221.24
442	MAG	hand	HFA	Site Survey	Field Support	179.32	0
442	MAG	hand	HFA	Site Survey	Subtotal	0	27256.64
442	MAG	hand	HFA	Demobilization	Supervisor	4	380
442	MAG	hand	HFA	Demobilization	Data Analyst	4	0
442	MAG	hand	HFA	Demobilization	Field Support	4	0
442	MAG	hand	HFA	Demobilization	Subtotal	0	380
442	MAG	hand	HFA	Total	Total	0	29776.8
667	EM	towed	NAEVA	Initial Setup	Supervisor	1.83	173.85
667	EM	towed	NAEVA	Initial Setup	Data Analyst	1.83	104.31
667	EM	towed	NAEVA	Initial Setup	Field Support	1.83	104.31
667	EM	towed	NAEVA	Initial Setup	Subtotal	0	382.47
667	EM	towed	NAEVA	Calibration	Supervisor	4.58	435.1
667	EM	towed	NAEVA	Calibration	Data Analyst	4.58	261.06
667	EM	towed	NAEVA	Calibration	Field Support	4.58	261.06
667	EM	towed	NAEVA	Calibration	Subtotal	0	957.22
667	EM	towed	NAEVA	Site Survey	Supervisor	1.58	150.1
667	EM	towed	NAEVA	Site Survey	Data Analyst	1.58	90.06
667	EM	towed	NAEVA	Site Survey	Field Support	1.58	90.06
667	EM	towed	NAEVA	Site Survey	Subtotal	0	330.22
667	EM	towed	NAEVA	Demobilization	Supervisor	2.16	205.2
667	EM	towed	NAEVA	Demobilization	Data Analyst	2.16	123.12
667	EM	towed	NAEVA	Demobilization	Field Support	2.16	123.12
667	EM	towed	NAEVA	Demobilization	Subtotal	0	451.44
667	EM	towed	NAEVA	Total	Total	0	2121.35
666	EM	2-man	NAEVA	Initial Setup	Supervisor	0.92	87.4
666	EM	2-man	NAEVA	Initial Setup	Data Analyst	0.92	52.44
666	EM	2-man	NAEVA	Initial Setup	Field Support	0.92	52.44
666	EM	2-man	NAEVA	Initial Setup	Subtotal	0	192.28
666	EM	2-man	NAEVA	Calibration	Supervisor	3.5	332.5
666	EM	2-man	NAEVA	Calibration	Data Analyst	3.5	199.5
666	EM	2-man	NAEVA	Calibration	Field Support	3.5	199.5
666	EM	2-man	NAEVA	Calibration	Subtotal	0	731.5
666	EM	2-man	NAEVA	Site Survey	Supervisor	2.42	229.9
666	EM	2-man	NAEVA	Site Survey	Data Analyst	2.42	137.94
666	EM	2-man	NAEVA	Site Survey	Field Support	2.42	137.94
666	EM	2-man	NAEVA	Site Survey	Subtotal	0	505.78
666	EM	2-man	NAEVA	Demobilization	Supervisor	2.16	205.2
666	EM	2-man	NAEVA	Demobilization	Data Analyst	2.16	123.12
666	EM	2-man	NAEVA	Demobilization	Field Support	2.16	123.12
666	EM	2-man	NAEVA	Demobilization	Subtotal	0	451.44
666	EM	2-man	NAEVA	Total	Total	0	1881

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
670	EM	2-man	NAEVA	Initial Setup	Supervisor	0.92	87.4
670	EM	2-man	NAEVA	Initial Setup	Data Analyst	0.92	52.44
670	EM	2-man	NAEVA	Initial Setup	Field Support	0.92	52.44
670	EM	2-man	NAEVA	Initial Setup	Subtotal	0	192.28
670	EM	2-man	NAEVA	Calibration	Supervisor	3.83	363.85
670	EM	2-man	NAEVA	Calibration	Data Analyst	3.83	218.31
670	EM	2-man	NAEVA	Calibration	Field Support	3.83	218.31
670	EM	2-man	NAEVA	Calibration	Subtotal	0	800.47
670	EM	2-man	NAEVA	Site Survey	Supervisor	10.92	1037.4
670	EM	2-man	NAEVA	Site Survey	Data Analyst	10.92	622.44
670	EM	2-man	NAEVA	Site Survey	Field Support	10.92	622.44
670	EM	2-man	NAEVA	Site Survey	Subtotal	0	2282.28
670	EM	2-man	NAEVA	Demobilization	Supervisor	2.16	205.2
670	EM	2-man	NAEVA	Demobilization	Data Analyst	2.16	123.12
670	EM	2-man	NAEVA	Demobilization	Field Support	2.16	123.12
670	EM	2-man	NAEVA	Demobilization	Subtotal	0	451.44
670	EM	2-man	NAEVA	Total	Total	0	3726.47
669	EM	2-man	NAEVA	Initial Setup	Supervisor	0.92	87.4
669	EM	2-man	NAEVA	Initial Setup	Data Analyst	0.92	52.44
669	EM	2-man	NAEVA	Initial Setup	Field Support	0.92	52.44
669	EM	2-man	NAEVA	Initial Setup	Subtotal	0	192.28
669	EM	2-man	NAEVA	Calibration	Supervisor	4.16	395.2
669	EM	2-man	NAEVA	Calibration	Data Analyst	4.16	237.12
669	EM	2-man	NAEVA	Calibration	Field Support	4.16	237.12
669	EM	2-man	NAEVA	Calibration	Subtotal	0	869.44
669	EM	2-man	NAEVA	Site Survey	Supervisor	10.66	1012.7
669	EM	2-man	NAEVA	Site Survey	Data Analyst	10.66	607.62
669	EM	2-man	NAEVA	Site Survey	Field Support	10.66	607.62
669	EM	2-man	NAEVA	Site Survey	Subtotal	0	2227.94
669	EM	2-man	NAEVA	Demobilization	Supervisor	2.16	205.2
669	EM	2-man	NAEVA	Demobilization	Data Analyst	2.16	123.12
669	EM	2-man	NAEVA	Demobilization	Field Support	2.16	123.12
669	EM	2-man	NAEVA	Demobilization	Subtotal	0	451.44
669	EM	2-man	NAEVA	Total	Total	0	3741.1
668	EM	towed	NAEVA	Initial Setup	Supervisor	1.83	173.85
668	EM	towed	NAEVA	Initial Setup	Data Analyst	1.83	104.31
668	EM	towed	NAEVA	Initial Setup	Field Support	1.83	104.31
668	EM	towed	NAEVA	Initial Setup	Subtotal	0	382.47
668	EM	towed	NAEVA	Calibration	Supervisor	6.92	657.4
668	EM	towed	NAEVA	Calibration	Data Analyst	6.92	394.44
668	EM	towed	NAEVA	Calibration	Field Support	6.92	394.44
668	EM	towed	NAEVA	Calibration	Subtotal	0	1446.28
668	EM	towed	NAEVA	Site Survey	Supervisor	38.92	3697.4
668	EM	towed	NAEVA	Site Survey	Data Analyst	38.92	2218.44
668	EM	towed	NAEVA	Site Survey	Field Support	38.92	2218.44
668	EM	towed	NAEVA	Site Survey	Subtotal	0	8134.28
668	EM	towed	NAEVA	Demobilization	Supervisor	2.16	205.2
668	EM	towed	NAEVA	Demobilization	Data Analyst	2.16	123.12
668	EM	towed	NAEVA	Demobilization	Field Support	2.16	0

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
668	EM	towed	NAEVA	Demobilization	Subtotal	0	328.32
668	EM	towed	NAEVA	Total	Total	0	10291.35
213	EM	towed	NRL	Initial Setup	Supervisor	3	285
213	EM	towed	NRL	Initial Setup	Data Analyst	3	171
213	EM	towed	NRL	Initial Setup	Field Support	3	171
213	EM	towed	NRL	Initial Setup	Subtotal	0	627
213	EM	towed	NRL	Calibration	Supervisor	1.93	183.35
213	EM	towed	NRL	Calibration	Data Analyst	1.93	110.01
213	EM	towed	NRL	Calibration	Field Support	1.93	110.01
213	EM	towed	NRL	Calibration	Subtotal	0	403.37
213	EM	towed	NRL	Site Survey	Supervisor	3.17	301.15
213	EM	towed	NRL	Site Survey	Data Analyst	3.17	180.69
213	EM	towed	NRL	Site Survey	Field Support	3.17	180.69
213	EM	towed	NRL	Site Survey	Subtotal	0	662.53
213	EM	towed	NRL	Demobilization	Supervisor	2.3	218.5
213	EM	towed	NRL	Demobilization	Data Analyst	2.3	131.1
213	EM	towed	NRL	Demobilization	Field Support	0	0
213	EM	towed	NRL	Demobilization	Subtotal	0	349.6
213	EM	towed	NRL	Total	Total	0	2042.5
245	EM	towed	NRL	Initial Setup	Supervisor	2.5	237.5
245	EM	towed	NRL	Initial Setup	Data Analyst	2.5	142.5
245	EM	towed	NRL	Initial Setup	Field Support	2.5	142.5
245	EM	towed	NRL	Initial Setup	Subtotal	0	522.5
245	EM	towed	NRL	Calibration	Supervisor	2.43	230.85
245	EM	towed	NRL	Calibration	Data Analyst	2.43	138.51
245	EM	towed	NRL	Calibration	Field Support	2.43	138.51
245	EM	towed	NRL	Calibration	Subtotal	0	507.87
245	EM	towed	NRL	Site Survey	Supervisor	42.77	4063.15
245	EM	towed	NRL	Site Survey	Data Analyst	42.77	2437.89
245	EM	towed	NRL	Site Survey	Field Support	42.77	2437.89
245	EM	towed	NRL	Site Survey	Subtotal	0	8938.93
245	EM	towed	NRL	Demobilization	Supervisor	2.3	218.5
245	EM	towed	NRL	Demobilization	Data Analyst	2.3	131.1
245	EM	towed	NRL	Demobilization	Field Support	2.3	131.1
245	EM	towed	NRL	Demobilization	Subtotal	0	480.7
245	EM	towed	NRL	Total	Total	0	10450
690	EM	cart	Parsons	Initial Setup	Supervisor	1.33	126.35
690	EM	cart	Parsons	Initial Setup	Data Analyst	1.33	75.81
690	EM	cart	Parsons	Initial Setup	Field Support	1.33	0
690	EM	cart	Parsons	Initial Setup	Subtotal	0	202.16
690	EM	cart	Parsons	Calibration	Supervisor	1.42	134.9
690	EM	cart	Parsons	Calibration	Data Analyst	1.42	80.94
690	EM	cart	Parsons	Calibration	Field Support	1.42	0
690	EM	cart	Parsons	Calibration	Subtotal	0	215.84
690	EM	cart	Parsons	Site Survey	Supervisor	2.58	245.1
690	EM	cart	Parsons	Site Survey	Data Analyst	2.58	147.06
690	EM	cart	Parsons	Site Survey	Field Support	2.58	0
690	EM	cart	Parsons	Site Survey	Subtotal	0	392.16
690	EM	cart	Parsons	Demobilization	Supervisor	0.66	62.7

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
690	EM	cart	Parsons	Demobilization	Data Analyst	0.66	37.62
690	EM	cart	Parsons	Demobilization	Field Support	0.66	0
690	EM	cart	Parsons	Demobilization	Subtotal	0	100.32
690	EM	cart	Parsons	Total	Total	0	910.48
532	EM	cart	Parsons	Initial Setup	Supervisor	2	190
532	EM	cart	Parsons	Initial Setup	Data Analyst	2	114
532	EM	cart	Parsons	Initial Setup	Field Support	2	114
532	EM	cart	Parsons	Initial Setup	Subtotal	0	418
532	EM	cart	Parsons	Calibration	Supervisor	4.75	451.25
532	EM	cart	Parsons	Calibration	Data Analyst	4.75	270.75
532	EM	cart	Parsons	Calibration	Field Support	4.75	270.75
532	EM	cart	Parsons	Calibration	Subtotal	0	992.75
532	EM	cart	Parsons	Site Survey	Supervisor	22.17	2106.15
532	EM	cart	Parsons	Site Survey	Data Analyst	22.17	1263.69
532	EM	cart	Parsons	Site Survey	Field Support	22.17	1263.69
532	EM	cart	Parsons	Site Survey	Subtotal	0	4633.53
532	EM	cart	Parsons	Demobilization	Supervisor	2	190
532	EM	cart	Parsons	Demobilization	Data Analyst	2	114
532	EM	cart	Parsons	Demobilization	Field Support	2	114
532	EM	cart	Parsons	Demobilization	Subtotal	0	418
532	EM	cart	Parsons	Total	Total	0	6462.28
588	EM	cart	Parsons	Initial Setup	Supervisor	1.33	126.35
588	EM	cart	Parsons	Initial Setup	Data Analyst	1.33	75.81
588	EM	cart	Parsons	Initial Setup	Field Support	1.33	0
588	EM	cart	Parsons	Initial Setup	Subtotal	0	202.16
588	EM	cart	Parsons	Calibration	Supervisor	3.92	372.4
588	EM	cart	Parsons	Calibration	Data Analyst	3.92	223.44
588	EM	cart	Parsons	Calibration	Field Support	3.92	223.44
588	EM	cart	Parsons	Calibration	Subtotal	0	819.28
588	EM	cart	Parsons	Site Survey	Supervisor	22.08	2097.6
588	EM	cart	Parsons	Site Survey	Data Analyst	22.08	1258.56
588	EM	cart	Parsons	Site Survey	Field Support	22.08	1258.56
588	EM	cart	Parsons	Site Survey	Subtotal	0	4614.72
588	EM	cart	Parsons	Demobilization	Supervisor	2	190
588	EM	cart	Parsons	Demobilization	Data Analyst	2	114
588	EM	cart	Parsons	Demobilization	Field Support	2	114
588	EM	cart	Parsons	Demobilization	Subtotal	0	418
588	EM	cart	Parsons	Total	Total	0	6054.16
425	EM	cart	Parsons	Initial Setup	Supervisor	2	190
425	EM	cart	Parsons	Initial Setup	Data Analyst	2	114
425	EM	cart	Parsons	Initial Setup	Field Support	2	114
425	EM	cart	Parsons	Initial Setup	Subtotal	0	418
425	EM	cart	Parsons	Calibration	Supervisor	2.42	229.9
425	EM	cart	Parsons	Calibration	Data Analyst	2.42	137.94
425	EM	cart	Parsons	Calibration	Field Support	2.42	137.94
425	EM	cart	Parsons	Calibration	Subtotal	0	505.78
425	EM	cart	Parsons	Site Survey	Supervisor	63.17	6001.15
425	EM	cart	Parsons	Site Survey	Data Analyst	63.17	3600.69
425	EM	cart	Parsons	Site Survey	Field Support	63.17	3600.69

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
425	EM	cart	Parsons	Site Survey	Subtotal	0	13202.53
425	EM	cart	Parsons	Demobilization	Supervisor	2	190
425	EM	cart	Parsons	Demobilization	Data Analyst	2	114
425	EM	cart	Parsons	Demobilization	Field Support	2	114
425	EM	cart	Parsons	Demobilization	Subtotal	0	418
425	EM	cart	Parsons	Total	Total	0	14544.31
606	MAG	hand	Parsons	Initial Setup	Supervisor	0.5	47.5
606	MAG	hand	Parsons	Initial Setup	Data Analyst	0.5	28.5
606	MAG	hand	Parsons	Initial Setup	Field Support	0.5	57
606	MAG	hand	Parsons	Initial Setup	Subtotal	0	133
606	MAG	hand	Parsons	Calibration	Supervisor	0.33	31.35
606	MAG	hand	Parsons	Calibration	Data Analyst	0.33	18.81
606	MAG	hand	Parsons	Calibration	Field Support	0.33	37.62
606	MAG	hand	Parsons	Calibration	Subtotal	0	87.78
606	MAG	hand	Parsons	Site Survey	Supervisor	0.75	71.25
606	MAG	hand	Parsons	Site Survey	Data Analyst	0.75	42.75
606	MAG	hand	Parsons	Site Survey	Field Support	0.75	85.5
606	MAG	hand	Parsons	Site Survey	Subtotal	0	199.5
606	MAG	hand	Parsons	Demobilization	Supervisor	0.83	78.85
606	MAG	hand	Parsons	Demobilization	Data Analyst	0.83	47.31
606	MAG	hand	Parsons	Demobilization	Field Support	0.83	118.28
606	MAG	hand	Parsons	Demobilization	Subtotal	0	244.44
606	MAG	hand	Parsons	Total	Total	0	664.72
601	MAG	hand	Parsons	Initial Setup	Supervisor	0.5	47.5
601	MAG	hand	Parsons	Initial Setup	Data Analyst	0.5	28.5
601	MAG	hand	Parsons	Initial Setup	Field Support	0.5	57
601	MAG	hand	Parsons	Initial Setup	Subtotal	0	133
601	MAG	hand	Parsons	Calibration	Supervisor	0.33	31.35
601	MAG	hand	Parsons	Calibration	Data Analyst	0.33	18.81
601	MAG	hand	Parsons	Calibration	Field Support	0.33	37.62
601	MAG	hand	Parsons	Calibration	Subtotal	0	87.78
601	MAG	hand	Parsons	Site Survey	Supervisor	6.05	574.75
601	MAG	hand	Parsons	Site Survey	Data Analyst	6.05	344.85
601	MAG	hand	Parsons	Site Survey	Field Support	6.05	862.13
601	MAG	hand	Parsons	Site Survey	Subtotal	0	1781.73
601	MAG	hand	Parsons	Demobilization	Supervisor	0.83	78.85
601	MAG	hand	Parsons	Demobilization	Data Analyst	0.83	47.31
601	MAG	hand	Parsons	Demobilization	Field Support	0.83	118.28
601	MAG	hand	Parsons	Demobilization	Subtotal	0	244.44
601	MAG	hand	Parsons	Total	Total	0	2246.95
602	MAG	hand	Parsons	Initial Setup	Supervisor	0.5	47.5
602	MAG	hand	Parsons	Initial Setup	Data Analyst	0.5	28.5
602	MAG	hand	Parsons	Initial Setup	Field Support	0.5	57
602	MAG	hand	Parsons	Initial Setup	Subtotal	0	133
602	MAG	hand	Parsons	Calibration	Supervisor	0.33	31.35
602	MAG	hand	Parsons	Calibration	Data Analyst	0.33	18.81
602	MAG	hand	Parsons	Calibration	Field Support	0.33	37.62
602	MAG	hand	Parsons	Calibration	Subtotal	0	87.78
602	MAG	hand	Parsons	Site Survey	Supervisor	7.33	696.35

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
602	MAG	hand	Parsons	Site Survey	Data Analyst	7.33	417.81
602	MAG	hand	Parsons	Site Survey	Field Support	7.33	1044.53
602	MAG	hand	Parsons	Site Survey	Subtotal	0	2158.69
602	MAG	hand	Parsons	Demobilization	Supervisor	0.83	78.85
602	MAG	hand	Parsons	Demobilization	Data Analyst	0.83	47.31
602	MAG	hand	Parsons	Demobilization	Field Support	0.83	118.28
602	MAG	hand	Parsons	Demobilization	Subtotal	0	244.44
602	MAG	hand	Parsons	Total	Total	0	2623.91
426	MAG	hand	Parsons	Initial Setup	Supervisor	0.5	47.5
426	MAG	hand	Parsons	Initial Setup	Data Analyst	0.5	28.5
426	MAG	hand	Parsons	Initial Setup	Field Support	0.5	57
426	MAG	hand	Parsons	Initial Setup	Subtotal	0	133
426	MAG	hand	Parsons	Calibration	Supervisor	0.33	31.35
426	MAG	hand	Parsons	Calibration	Data Analyst	0.33	18.81
426	MAG	hand	Parsons	Calibration	Field Support	0.33	37.62
426	MAG	hand	Parsons	Calibration	Subtotal	0	87.78
426	MAG	hand	Parsons	Site Survey	Supervisor	39	3705
426	MAG	hand	Parsons	Site Survey	Data Analyst	39	2223
426	MAG	hand	Parsons	Site Survey	Field Support	39	4446
426	MAG	hand	Parsons	Site Survey	Subtotal	0	10374
426	MAG	hand	Parsons	Demobilization	Supervisor	0.83	78.85
426	MAG	hand	Parsons	Demobilization	Data Analyst	0.83	47.31
426	MAG	hand	Parsons	Demobilization	Field Support	0.83	118.28
426	MAG	hand	Parsons	Demobilization	Subtotal	0	244.44
426	MAG	hand	Parsons	Total	Total	0	10839.22
199	EM	cart	Shaw	Initial Setup	Supervisor	2.41	228.95
199	EM	cart	Shaw	Initial Setup	Data Analyst	2.41	137.37
199	EM	cart	Shaw	Initial Setup	Field Support	2.41	68.69
199	EM	cart	Shaw	Initial Setup	Subtotal	0	435.01
199	EM	cart	Shaw	Calibration	Supervisor	6	570
199	EM	cart	Shaw	Calibration	Data Analyst	6	342
199	EM	cart	Shaw	Calibration	Field Support	6	171
199	EM	cart	Shaw	Calibration	Subtotal	0	1083
199	EM	cart	Shaw	Site Survey	Supervisor	1.11	105.45
199	EM	cart	Shaw	Site Survey	Data Analyst	1.11	63.27
199	EM	cart	Shaw	Site Survey	Field Support	1.11	31.64
199	EM	cart	Shaw	Site Survey	Subtotal	0	200.36
199	EM	cart	Shaw	Demobilization	Supervisor	1.08	102.6
199	EM	cart	Shaw	Demobilization	Data Analyst	1.08	61.56
199	EM	cart	Shaw	Demobilization	Field Support	1.08	30.78
199	EM	cart	Shaw	Demobilization	Subtotal	0	194.95
199	EM	cart	Shaw	Total	Total	0	1913.32
211	EM	cart	Shaw	Initial Setup	Supervisor	2.42	229.9
211	EM	cart	Shaw	Initial Setup	Data Analyst	2.42	137.94
211	EM	cart	Shaw	Initial Setup	Field Support	2.42	68.97
211	EM	cart	Shaw	Initial Setup	Subtotal	0	436.81
211	EM	cart	Shaw	Calibration	Supervisor	2.92	277.4
211	EM	cart	Shaw	Calibration	Data Analyst	2.92	166.44
211	EM	cart	Shaw	Calibration	Field Support	2.92	83.22

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
211	EM	cart	Shaw	Calibration	Subtotal	0	527.06
211	EM	cart	Shaw	Site Survey	Supervisor	21.47	2039.65
211	EM	cart	Shaw	Site Survey	Data Analyst	21.47	1223.79
211	EM	cart	Shaw	Site Survey	Field Support	21.47	611.9
211	EM	cart	Shaw	Site Survey	Subtotal	0	3875.34
211	EM	cart	Shaw	Demobilization	Supervisor	1.08	102.6
211	EM	cart	Shaw	Demobilization	Data Analyst	1.08	61.56
211	EM	cart	Shaw	Demobilization	Field Support	1.08	30.78
211	EM	cart	Shaw	Demobilization	Subtotal	0	194.94
211	EM	cart	Shaw	Total	Total	0	5034.15
207	EM	cart	Shaw	Initial Setup	Supervisor	2.42	229.9
207	EM	cart	Shaw	Initial Setup	Data Analyst	2.42	137.94
207	EM	cart	Shaw	Initial Setup	Field Support	2.42	68.97
207	EM	cart	Shaw	Initial Setup	Subtotal	0	436.81
207	EM	cart	Shaw	Calibration	Supervisor	2.58	245.1
207	EM	cart	Shaw	Calibration	Data Analyst	2.58	147.06
207	EM	cart	Shaw	Calibration	Field Support	2.58	73.53
207	EM	cart	Shaw	Calibration	Subtotal	0	465.69
207	EM	cart	Shaw	Site Survey	Supervisor	3.42	324.9
207	EM	cart	Shaw	Site Survey	Data Analyst	3.42	194.94
207	EM	cart	Shaw	Site Survey	Field Support	3.42	97.47
207	EM	cart	Shaw	Site Survey	Subtotal	0	617.31
207	EM	cart	Shaw	Demobilization	Supervisor	1.08	102.6
207	EM	cart	Shaw	Demobilization	Data Analyst	1.08	61.56
207	EM	cart	Shaw	Demobilization	Field Support	1.08	30.78
207	EM	cart	Shaw	Demobilization	Subtotal	0	194.94
207	EM	cart	Shaw	Total	Total	0	1714.75
354	EM	cart	Shaw	Initial Setup	Supervisor	2.42	229.9
354	EM	cart	Shaw	Initial Setup	Data Analyst	2.42	137.94
354	EM	cart	Shaw	Initial Setup	Field Support	2.42	68.97
354	EM	cart	Shaw	Initial Setup	Subtotal	0	436.81
354	EM	cart	Shaw	Calibration	Supervisor	2.58	245.1
354	EM	cart	Shaw	Calibration	Data Analyst	2.58	147.06
354	EM	cart	Shaw	Calibration	Field Support	2.58	73.53
354	EM	cart	Shaw	Calibration	Subtotal	0	465.69
354	EM	cart	Shaw	Site Survey	Supervisor	29.57	2809.15
354	EM	cart	Shaw	Site Survey	Data Analyst	29.57	1685.49
354	EM	cart	Shaw	Site Survey	Field Support	29.57	842.74
354	EM	cart	Shaw	Site Survey	Subtotal	0	5337.38
354	EM	cart	Shaw	Demobilization	Supervisor	1.08	102.6
354	EM	cart	Shaw	Demobilization	Data Analyst	1.08	61.56
354	EM	cart	Shaw	Demobilization	Field Support	1.08	30.78
354	EM	cart	Shaw	Demobilization	Subtotal	0	194.94
354	EM	cart	Shaw	Total	Total	0	6434.82
312	MAG	cart	Shaw	Initial Setup	Supervisor	3.25	308.75
312	MAG	cart	Shaw	Initial Setup	Data Analyst	3.25	185.25
312	MAG	cart	Shaw	Initial Setup	Field Support	3.25	92.63
312	MAG	cart	Shaw	Initial Setup	Subtotal	0	586.63
312	MAG	cart	Shaw	Calibration	Supervisor	0.16	15.2

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
312	MAG	cart	Shaw	Calibration	Data Analyst	0.16	9.12
312	MAG	cart	Shaw	Calibration	Field Support	0.16	4.56
312	MAG	cart	Shaw	Calibration	Subtotal	0	28.88
312	MAG	cart	Shaw	Site Survey	Supervisor	2.32	220.4
312	MAG	cart	Shaw	Site Survey	Data Analyst	2.32	132.24
312	MAG	cart	Shaw	Site Survey	Field Support	2.32	66.12
312	MAG	cart	Shaw	Site Survey	Subtotal	0	418.76
312	MAG	cart	Shaw	Demobilization	Supervisor	0.75	71.25
312	MAG	cart	Shaw	Demobilization	Data Analyst	0.75	42.75
312	MAG	cart	Shaw	Demobilization	Field Support	0.75	21.38
312	MAG	cart	Shaw	Demobilization	Subtotal	0	135.38
312	MAG	cart	Shaw	Total	Total	0	1169.65
541	MAG	cart	Shaw	Initial Setup	Supervisor	3.25	308.75
541	MAG	cart	Shaw	Initial Setup	Data Analyst	3.25	185.25
541	MAG	cart	Shaw	Initial Setup	Field Support	3.25	92.63
541	MAG	cart	Shaw	Initial Setup	Subtotal	0	586.63
541	MAG	cart	Shaw	Calibration	Supervisor	0.16	15.2
541	MAG	cart	Shaw	Calibration	Data Analyst	0.16	9.12
541	MAG	cart	Shaw	Calibration	Field Support	0.16	4.56
541	MAG	cart	Shaw	Calibration	Subtotal	0	28.88
541	MAG	cart	Shaw	Site Survey	Supervisor	12.5	1187.5
541	MAG	cart	Shaw	Site Survey	Data Analyst	12.5	712.5
541	MAG	cart	Shaw	Site Survey	Field Support	12.5	356.25
541	MAG	cart	Shaw	Site Survey	Subtotal	0	2256.25
541	MAG	cart	Shaw	Demobilization	Supervisor	0.75	71.25
541	MAG	cart	Shaw	Demobilization	Data Analyst	0.75	42.75
541	MAG	cart	Shaw	Demobilization	Field Support	0.75	0
541	MAG	cart	Shaw	Demobilization	Subtotal	0	114
541	MAG	cart	Shaw	Total	Total	0	2985.76
594	MAG	cart	Shaw	Initial Setup	Supervisor	3.25	308.75
594	MAG	cart	Shaw	Initial Setup	Data Analyst	3.25	185.25
594	MAG	cart	Shaw	Initial Setup	Field Support	3.25	92.63
594	MAG	cart	Shaw	Initial Setup	Subtotal	0	586.63
594	MAG	cart	Shaw	Calibration	Supervisor	0.17	16.15
594	MAG	cart	Shaw	Calibration	Data Analyst	0.17	9.69
594	MAG	cart	Shaw	Calibration	Field Support	0.17	4.85
594	MAG	cart	Shaw	Calibration	Subtotal	0	30.69
594	MAG	cart	Shaw	Site Survey	Supervisor	4.21	399.95
594	MAG	cart	Shaw	Site Survey	Data Analyst	4.21	239.97
594	MAG	cart	Shaw	Site Survey	Field Support	4.21	119.98
594	MAG	cart	Shaw	Site Survey	Subtotal	0	759.9
594	MAG	cart	Shaw	Demobilization	Supervisor	0.75	71.25
594	MAG	cart	Shaw	Demobilization	Data Analyst	0.75	42.75
594	MAG	cart	Shaw	Demobilization	Field Support	0.75	21
594	MAG	cart	Shaw	Demobilization	Subtotal	0	135
594	MAG	cart	Shaw	Total	Total	0	1512.22
638	MAG	cart	Shaw	Initial Setup	Supervisor	3.25	308.75
638	MAG	cart	Shaw	Initial Setup	Data Analyst	3.25	185.25
638	MAG	cart	Shaw	Initial Setup	Field Support	3.25	92.63

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
638	MAG	cart	Shaw	Initial Setup	Subtotal	0	586.63
638	MAG	cart	Shaw	Calibration	Supervisor	0.17	16.15
638	MAG	cart	Shaw	Calibration	Data Analyst	0.17	9.69
638	MAG	cart	Shaw	Calibration	Field Support	0.17	4.85
638	MAG	cart	Shaw	Calibration	Subtotal	0	30.69
638	MAG	cart	Shaw	Site Survey	Supervisor	20.55	1952.25
638	MAG	cart	Shaw	Site Survey	Data Analyst	20.55	1171.35
638	MAG	cart	Shaw	Site Survey	Field Support	20.55	585.68
638	MAG	cart	Shaw	Site Survey	Subtotal	0	3709.28
638	MAG	cart	Shaw	Demobilization	Supervisor	0.75	71.25
638	MAG	cart	Shaw	Demobilization	Data Analyst	0.75	42.75
638	MAG	cart	Shaw	Demobilization	Field Support	0.75	21.38
638	MAG	cart	Shaw	Demobilization	Subtotal	0	135.38
638	MAG	cart	Shaw	Total	Total	0	4461.98
168	EM	cart	TTF	Initial Setup	Supervisor	1.92	182.4
168	EM	cart	TTF	Initial Setup	Data Analyst	1.92	328.32
168	EM	cart	TTF	Initial Setup	Field Support	1.92	0
168	EM	cart	TTF	Initial Setup	Subtotal	0	510.72
168	EM	cart	TTF	Calibration	Supervisor	2.08	197.6
168	EM	cart	TTF	Calibration	Data Analyst	2.08	355.68
168	EM	cart	TTF	Calibration	Field Support	2.08	0
168	EM	cart	TTF	Calibration	Subtotal	0	553.28
168	EM	cart	TTF	Site Survey	Supervisor	1.05	99.75
168	EM	cart	TTF	Site Survey	Data Analyst	1.05	179.55
168	EM	cart	TTF	Site Survey	Field Support	1.05	0
168	EM	cart	TTF	Site Survey	Subtotal	0	279.3
168	EM	cart	TTF	Demobilization	Supervisor	0.3	28.5
168	EM	cart	TTF	Demobilization	Data Analyst	0.3	51.3
168	EM	cart	TTF	Demobilization	Field Support	0.3	0
168	EM	cart	TTF	Demobilization	Subtotal	0	79.8
168	EM	cart	TTF	Total	Total	0	1423.1
171	EM	cart	TTF	Initial Setup	Supervisor	1.92	182.4
171	EM	cart	TTF	Initial Setup	Data Analyst	1.92	109.44
171	EM	cart	TTF	Initial Setup	Field Support	1.92	0
171	EM	cart	TTF	Initial Setup	Subtotal	0	291.84
171	EM	cart	TTF	Calibration	Supervisor	3.45	327.75
171	EM	cart	TTF	Calibration	Data Analyst	3.45	196.65
171	EM	cart	TTF	Calibration	Field Support	3.45	0
171	EM	cart	TTF	Calibration	Subtotal	0	524.4
171	EM	cart	TTF	Site Survey	Supervisor	11.35	1078.25
171	EM	cart	TTF	Site Survey	Data Analyst	11.35	646.95
171	EM	cart	TTF	Site Survey	Field Support	11.35	0
171	EM	cart	TTF	Site Survey	Subtotal	0	1725.2
171	EM	cart	TTF	Demobilization	Supervisor	2.33	221.35
171	EM	cart	TTF	Demobilization	Data Analyst	2.33	132.81
171	EM	cart	TTF	Demobilization	Field Support	2.33	0
171	EM	cart	TTF	Demobilization	Subtotal	0	354.16
171	EM	cart	TTF	Total	Total	0	2895.6
170	EM	sling	TTF	Initial Setup	Supervisor	1.92	182.4

Yuma Proving Ground Demonstrations							
Report	**Sensor**	**Platform**	**Vendor**	**Task**	**Personnel**	**Hours**	**Cost**
170	EM	sling	TTF	Initial Setup	Data Analyst	1.92	109.44
170	EM	sling	TTF	Initial Setup	Field Support	1.92	0
170	EM	sling	TTF	Initial Setup	Subtotal	0	291.84
170	EM	sling	TTF	Calibration	Supervisor	3.73	354.35
170	EM	sling	TTF	Calibration	Data Analyst	3.73	212.61
170	EM	sling	TTF	Calibration	Field Support	3.73	0
170	EM	sling	TTF	Calibration	Subtotal	0	566.96
170	EM	sling	TTF	Site Survey	Supervisor	8.97	852.15
170	EM	sling	TTF	Site Survey	Data Analyst	8.97	511.29
170	EM	sling	TTF	Site Survey	Field Support	8.97	0
170	EM	sling	TTF	Site Survey	Subtotal	0	1363.44
170	EM	sling	TTF	Demobilization	Supervisor	1.66	157.7
170	EM	sling	TTF	Demobilization	Data Analyst	1.66	94.62
170	EM	sling	TTF	Demobilization	Field Support	1.66	0
170	EM	sling	TTF	Demobilization	Subtotal	0	252.32
170	EM	sling	TTF	Total	Total	0	2474.56
169	EM	cart	TTF	Initial Setup	Supervisor	1.92	182.4
169	EM	cart	TTF	Initial Setup	Data Analyst	1.92	328.32
169	EM	cart	TTF	Initial Setup	Field Support	1.92	0
169	EM	cart	TTF	Initial Setup	Subtotal	0	510.72
169	EM	cart	TTF	Calibration	Supervisor	2.7	256.5
169	EM	cart	TTF	Calibration	Data Analyst	2.7	461.7
169	EM	cart	TTF	Calibration	Field Support	2.7	0
169	EM	cart	TTF	Calibration	Subtotal	0	718.2
169	EM	cart	TTF	Site Survey	Supervisor	32.17	3056.15
169	EM	cart	TTF	Site Survey	Data Analyst	32.17	5501.07
169	EM	cart	TTF	Site Survey	Field Support	32.17	0
169	EM	cart	TTF	Site Survey	Subtotal	0	8557.22
169	EM	cart	TTF	Demobilization	Supervisor	0.67	63.65
169	EM	cart	TTF	Demobilization	Data Analyst	0.67	114.57
169	EM	cart	TTF	Demobilization	Field Support	0.67	0
169	EM	cart	TTF	Demobilization	Subtotal	0	178.22
169	EM	cart	TTF	Total	Total	0	9964.36

APPENDIX E. LOCATION ERROR HISTOGRAMS

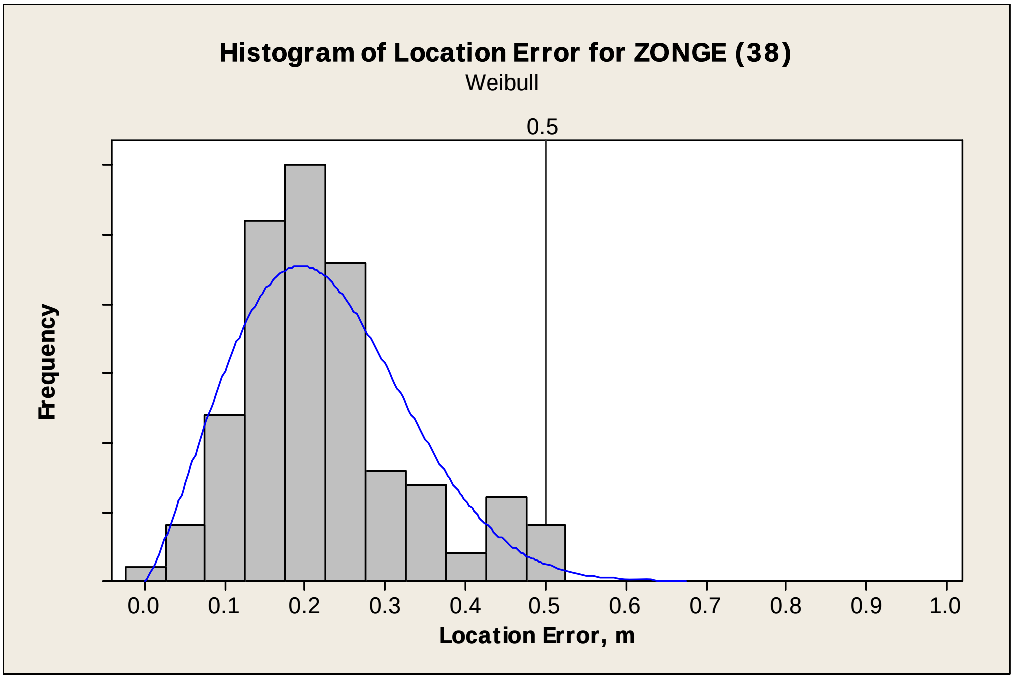

Figure E-1. Location Error Histogram for Zonge, SR #38.

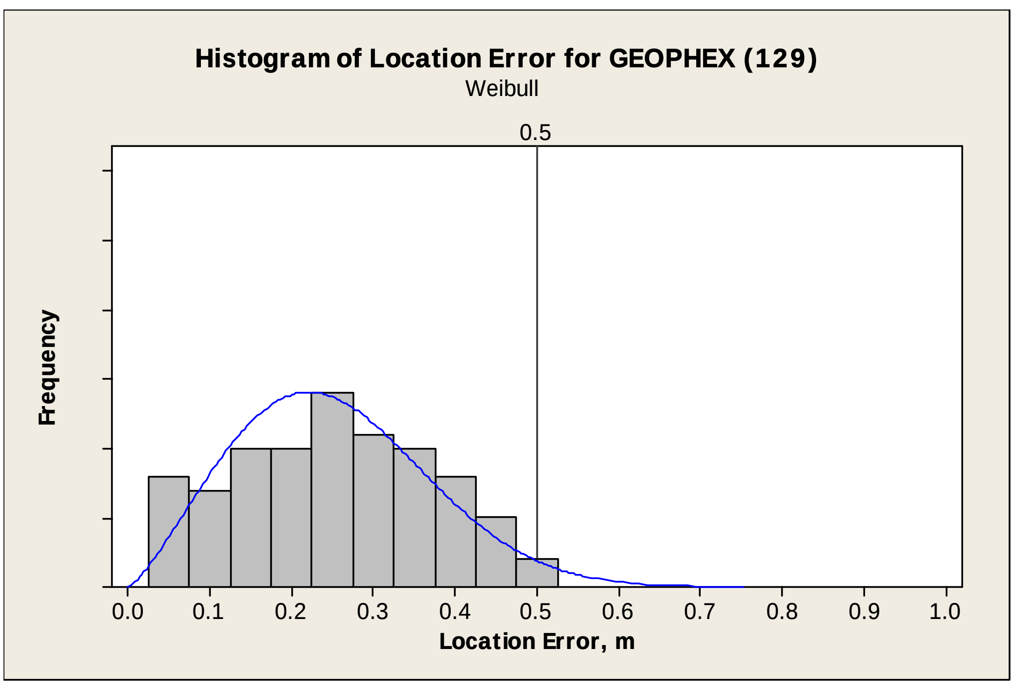

Figure E-2. Location Error Histogram for Geophex, SR #129.

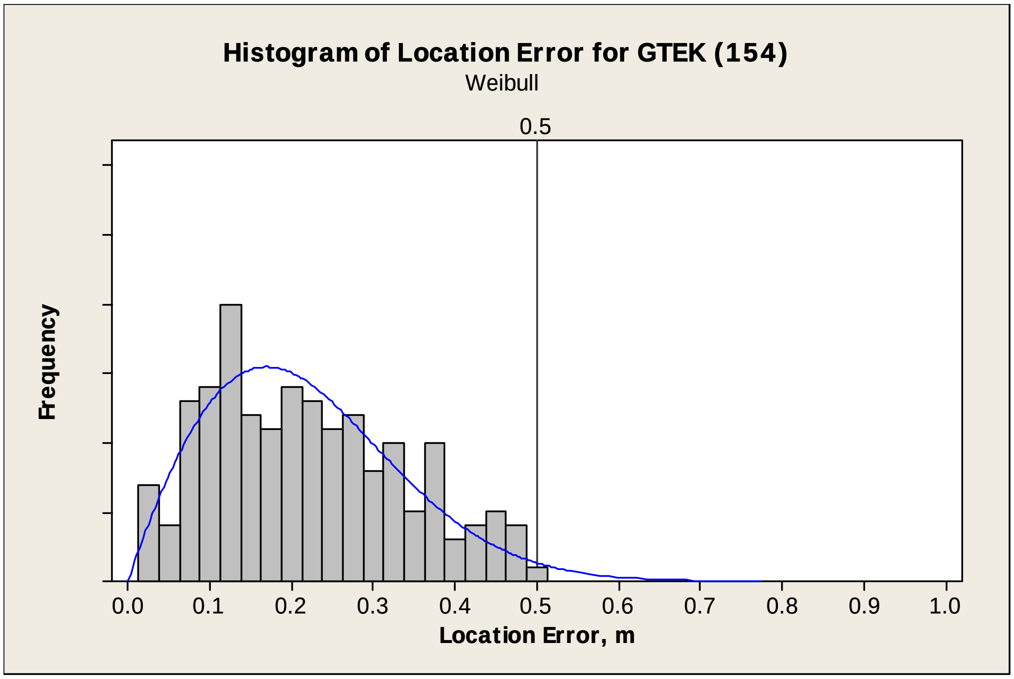

Figure E-3. Location Error Histogram for G-TEK, SR #154.

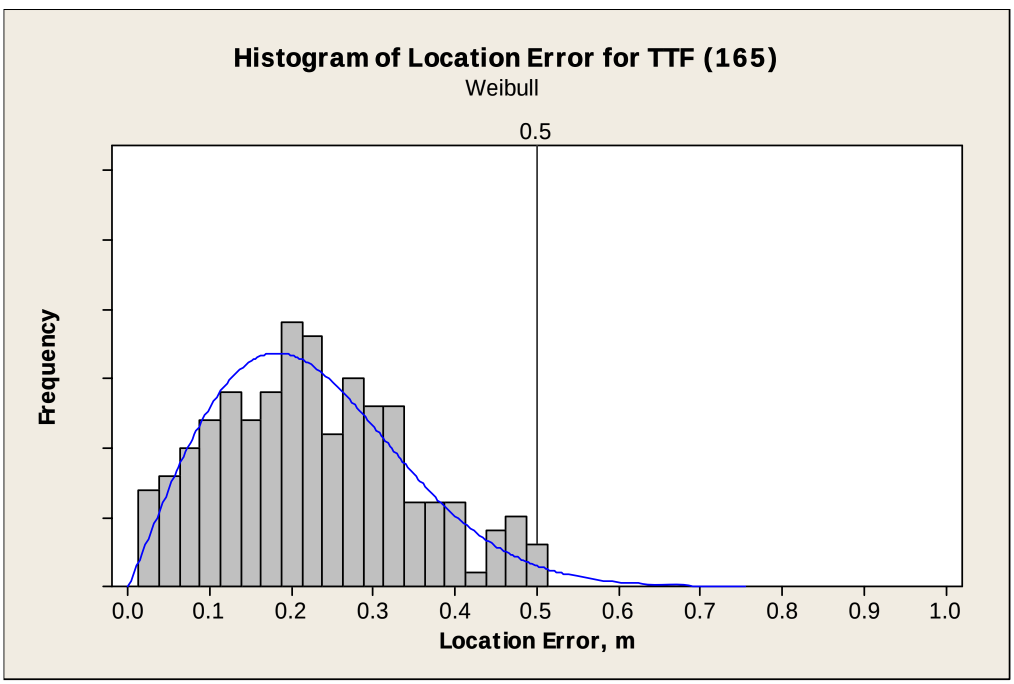

Figure E-4. Location Error Histogram for TTF, SR 165.

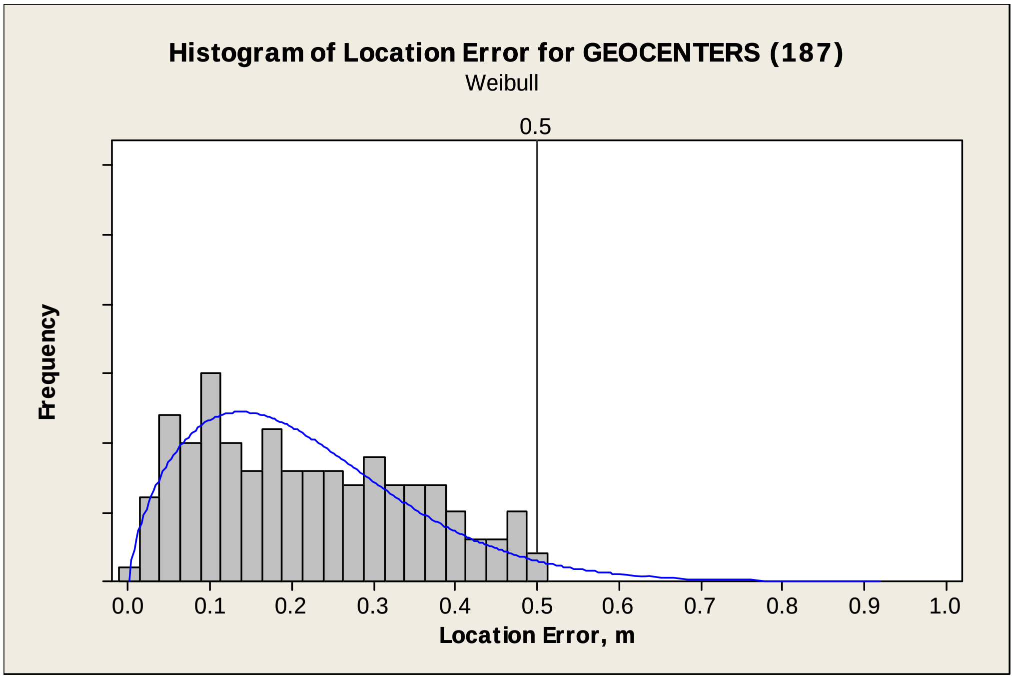

Figure E-5. Location Error Histogram for Geocenters, SR #187.

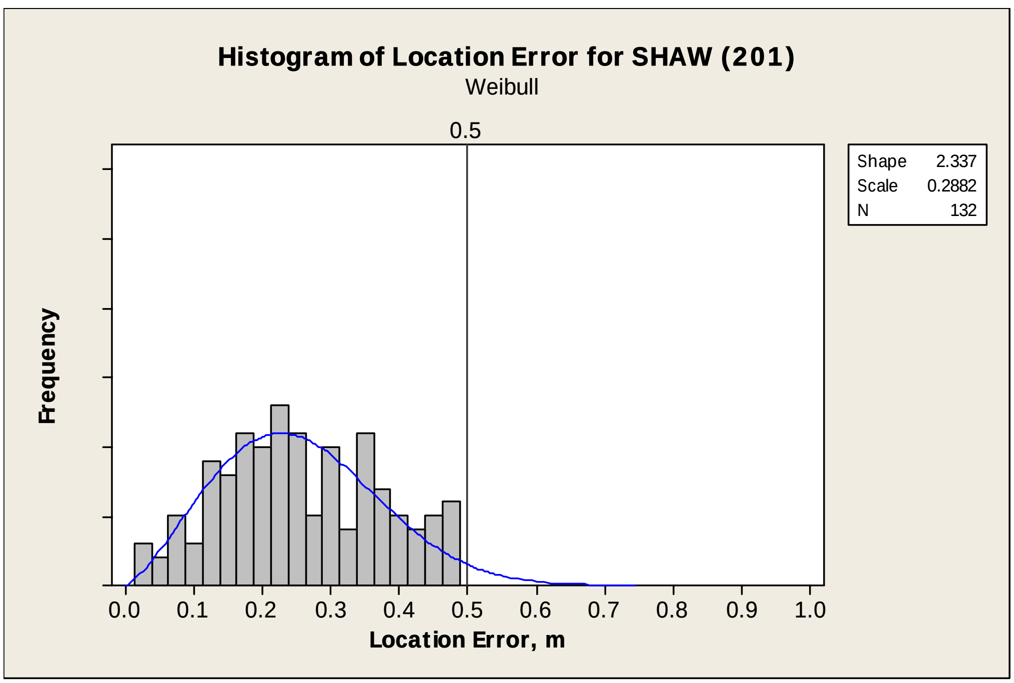

Figure E-6. Location Error Histogram for Shaw, SR #201.

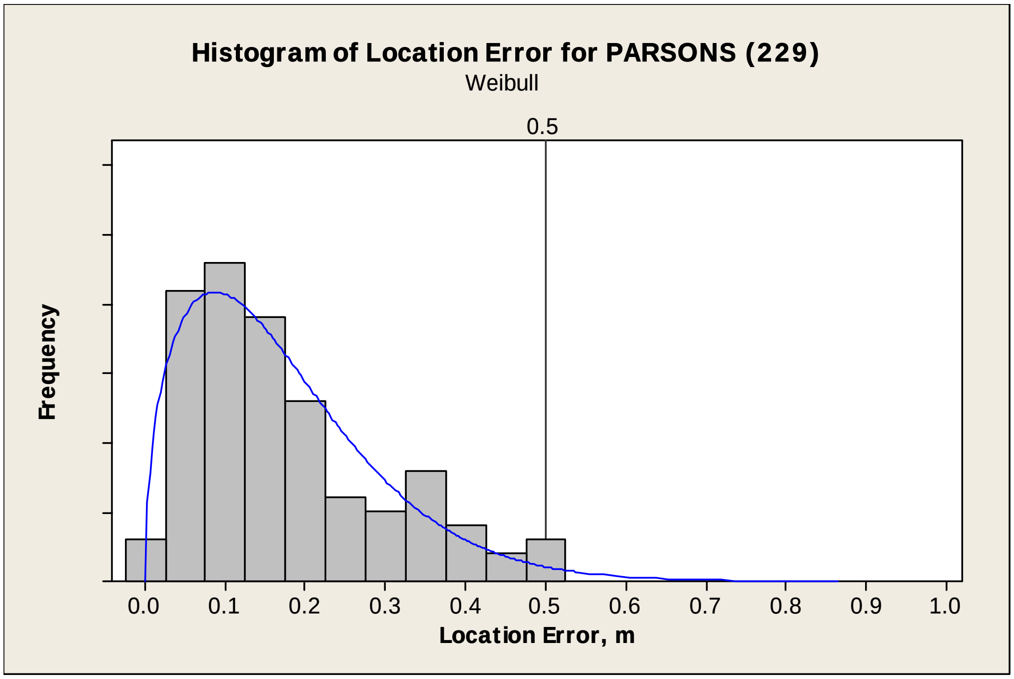

Figure E-7. Location Error Histogram for Parsons, SR #229.

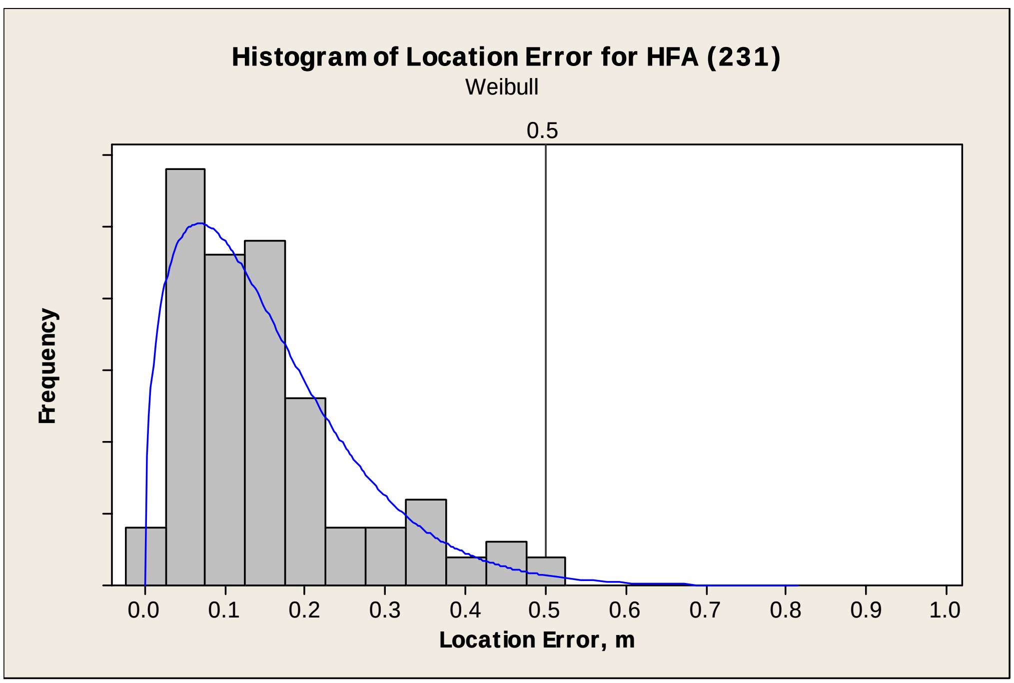

Figure E-8. Location Error Histogram for HFA, SR #231.

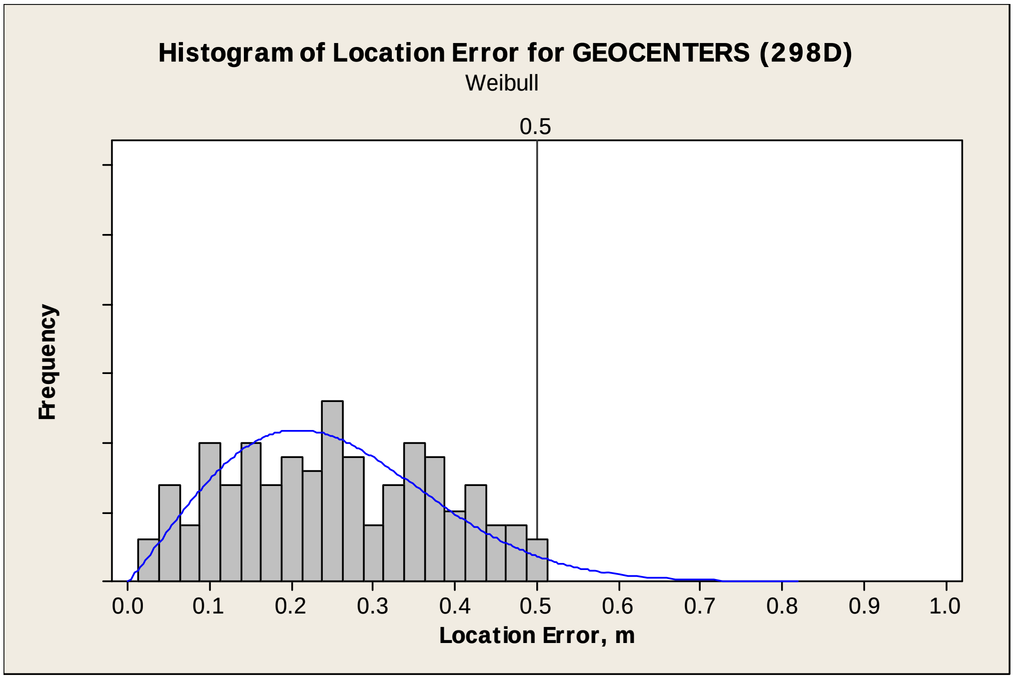

Figure E-9. Location Error Histogram for Geocenters, SR #298.

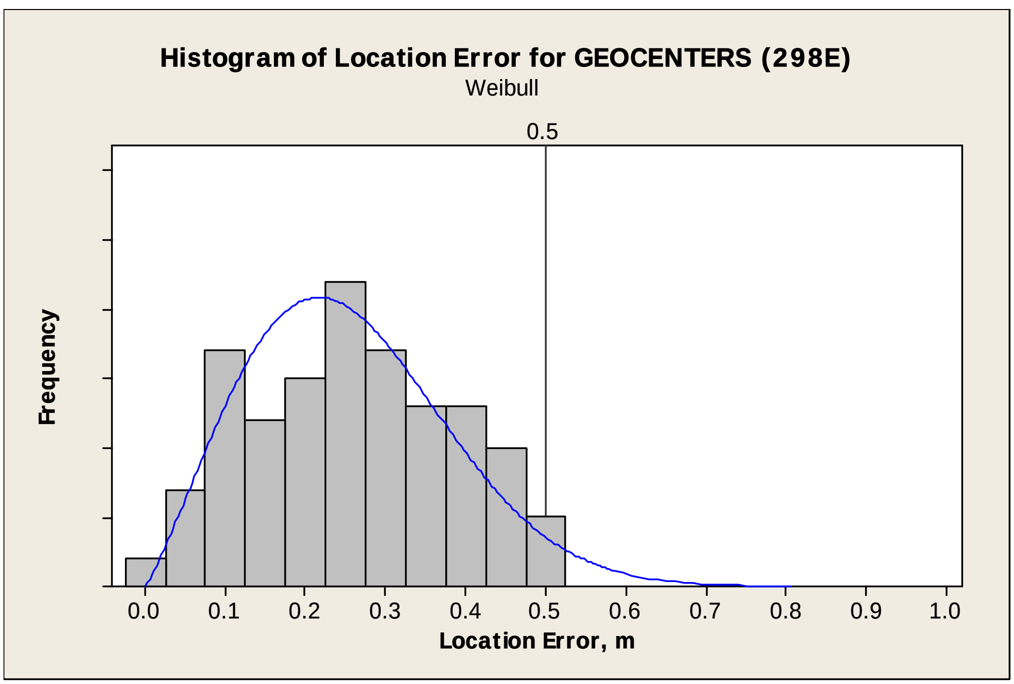

Figure E-10. Location Error Histogram for Geocenters, SR #298.

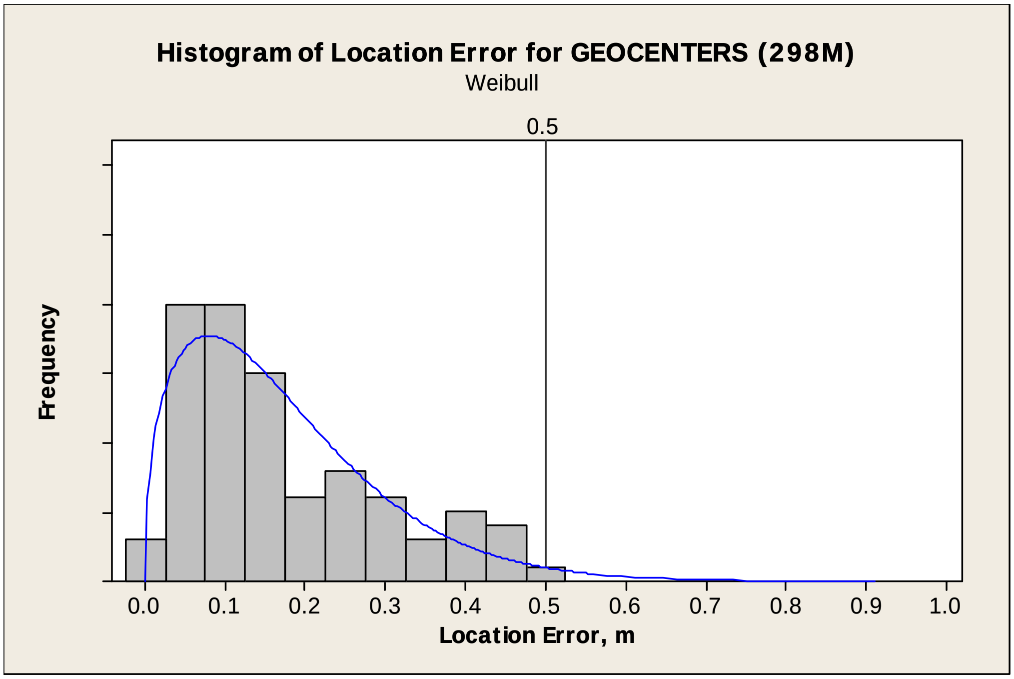

Figure E-11. Location Error Histogram for Geocenters, SR #298.

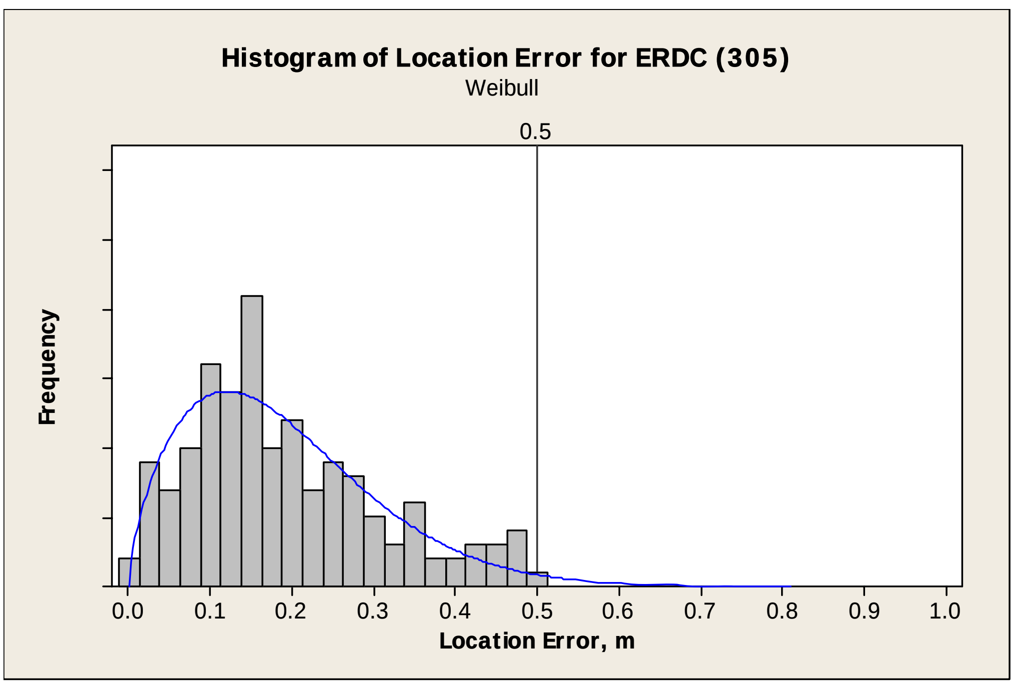

Figure E-12. Location Error Histogram for ERDC, SR #305.

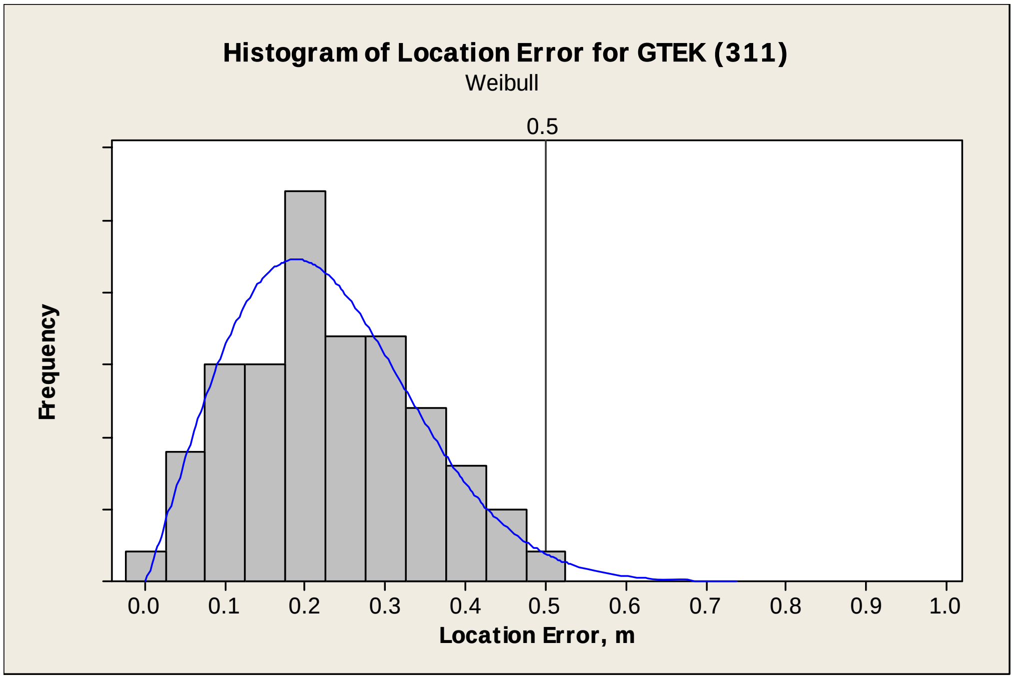

Figure E-13. Location Error Histogram for G-TEK SR #311.

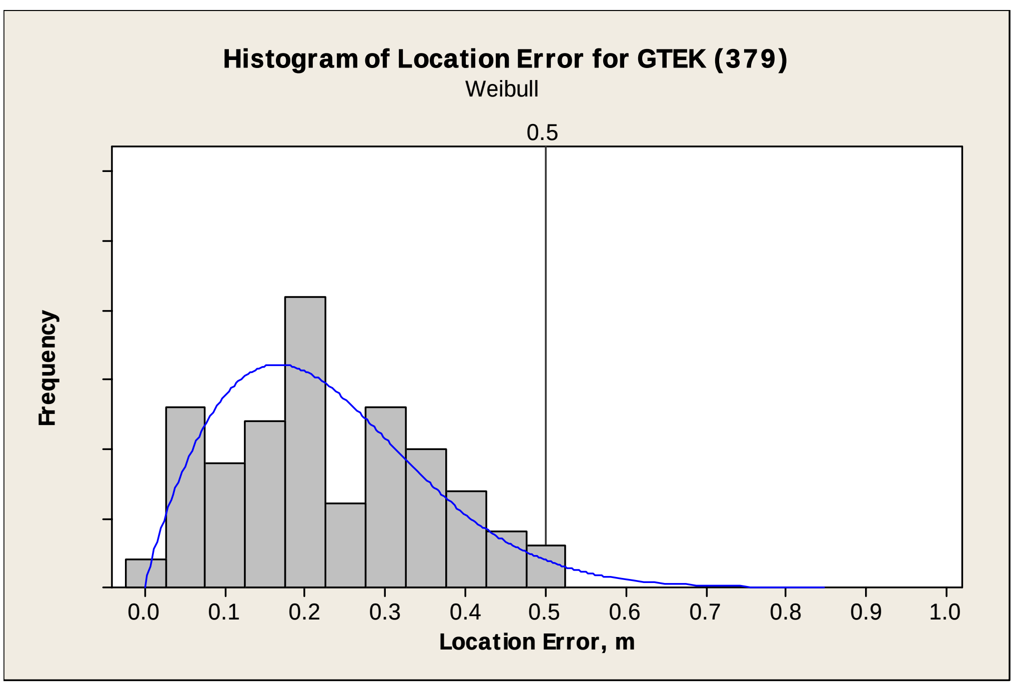

Figure E-14. Location Error Histogram for G-TEK, SR #379.

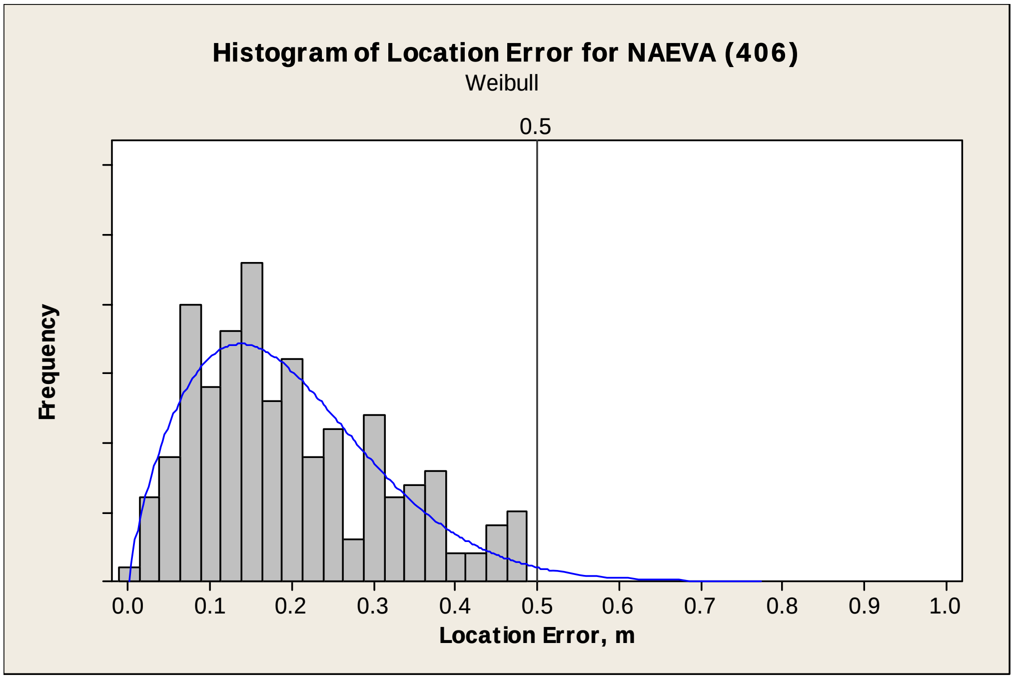

Figure E-15. Location Error Histogram for NAEVA, SR #406.

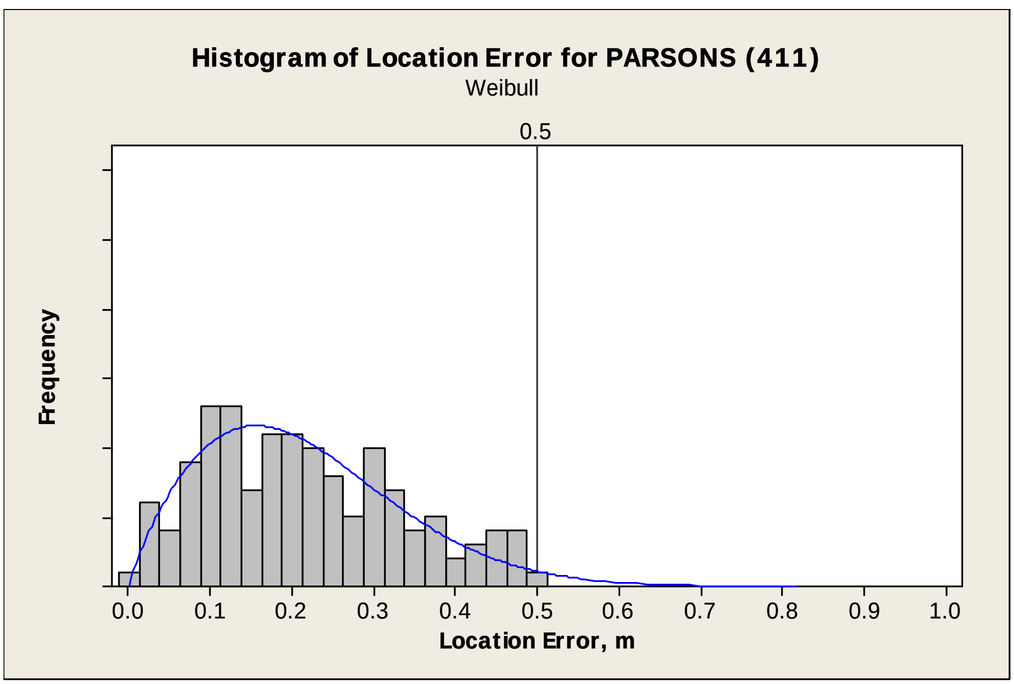

Figure E-16. Location Error Histogram for Parsons, SR #411.

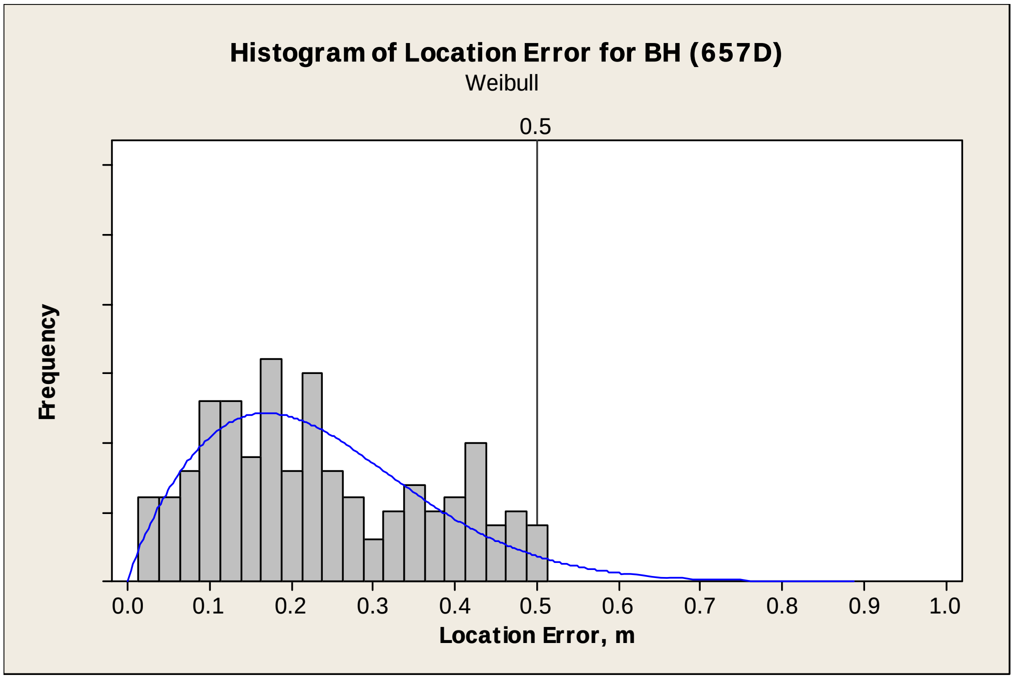

Figure E-17. Location Error Histogram for BH, SR #657.

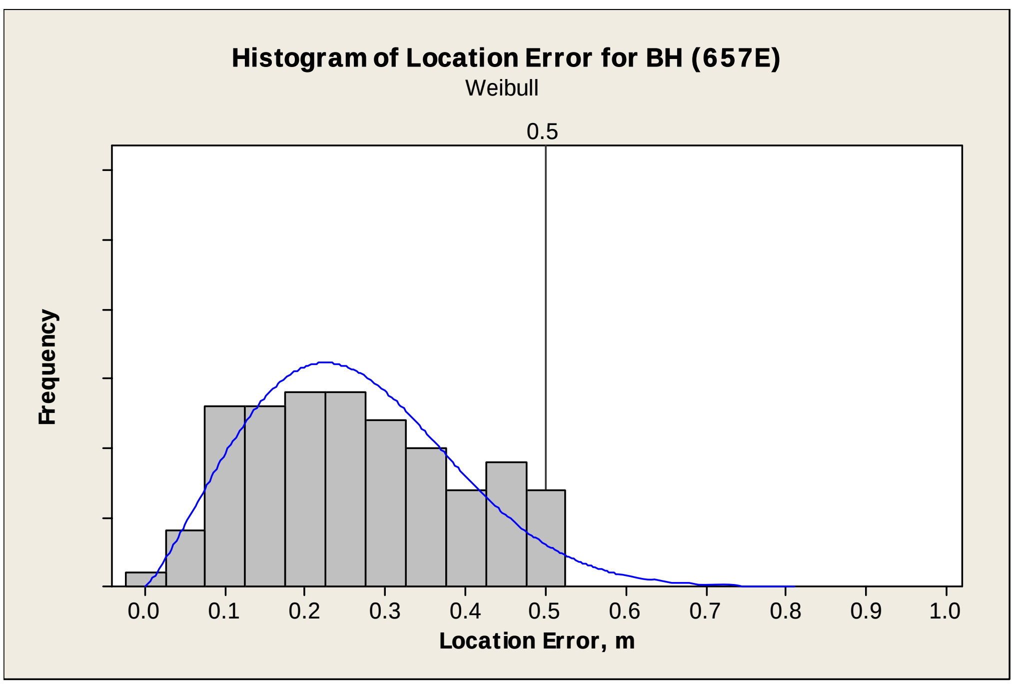

Figure E-18. Location Error Histogram for BH, SR #657.

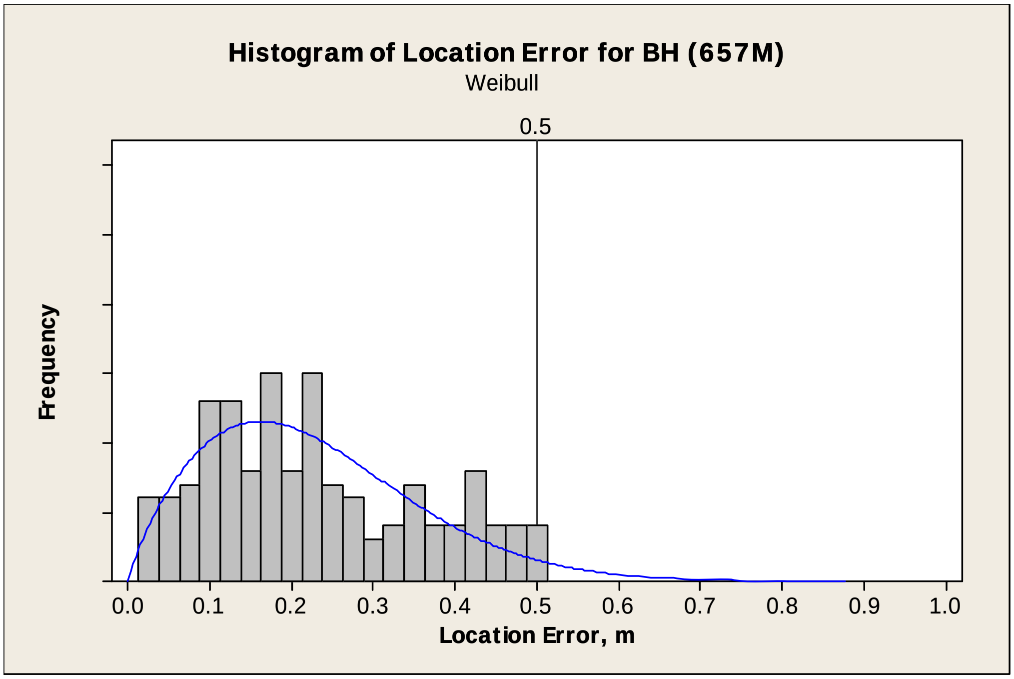

Figure E-19. Location Error Histogram for BH, SR #657.

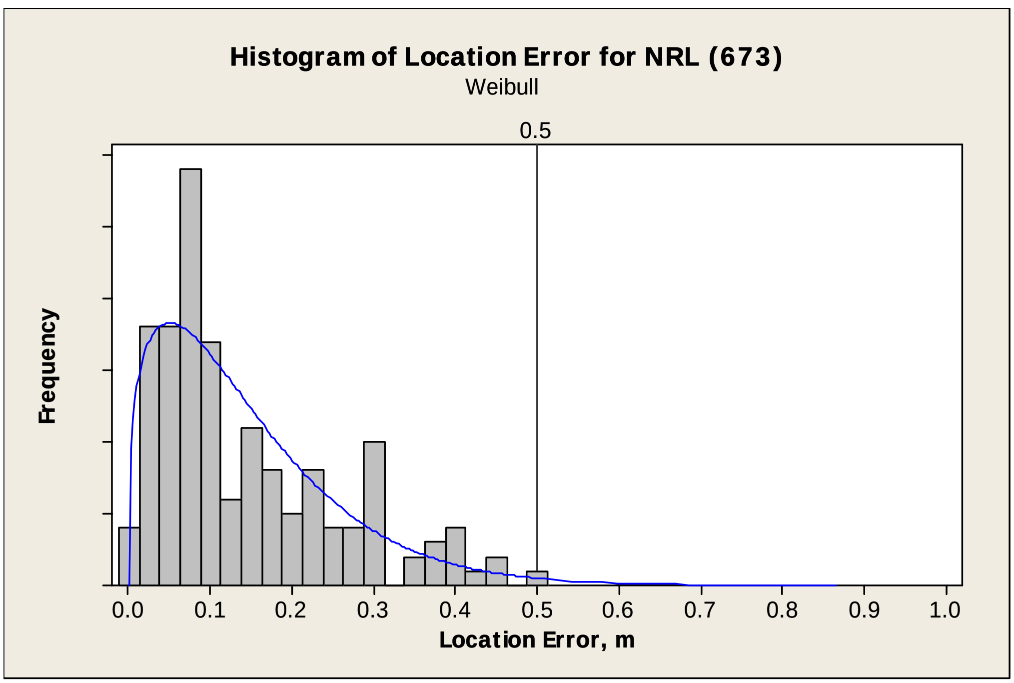

Figure E-20. Location Error Histogram for NRL, SR #673.

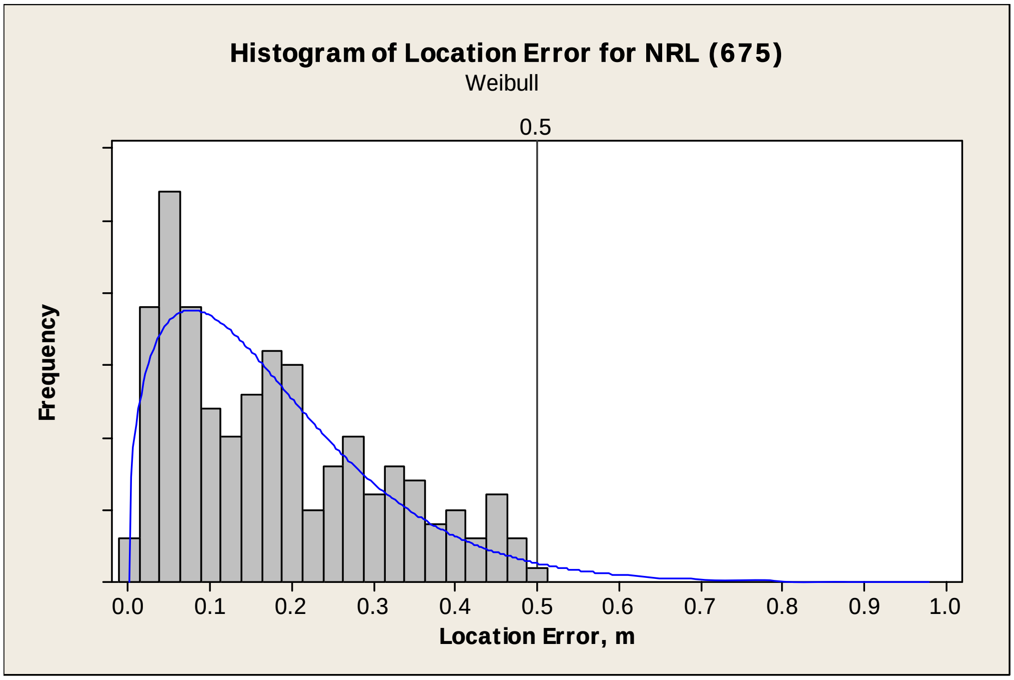

Figure E-21. Location Error Histogram for NRL, SR #675.

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APPENDIX F.   ESTIMATED CUMULATIVE PROBABILITY OF LOCATION ERROR

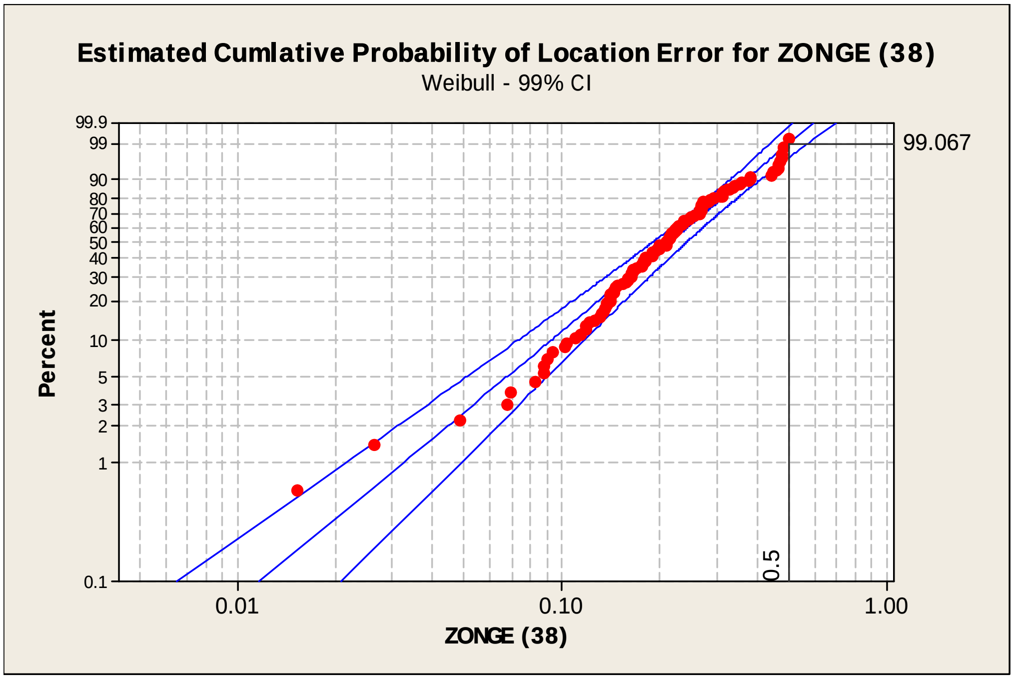

Figure F-1.   Estimated Cumulative Probability of Location Error, Zonge, SR #38.

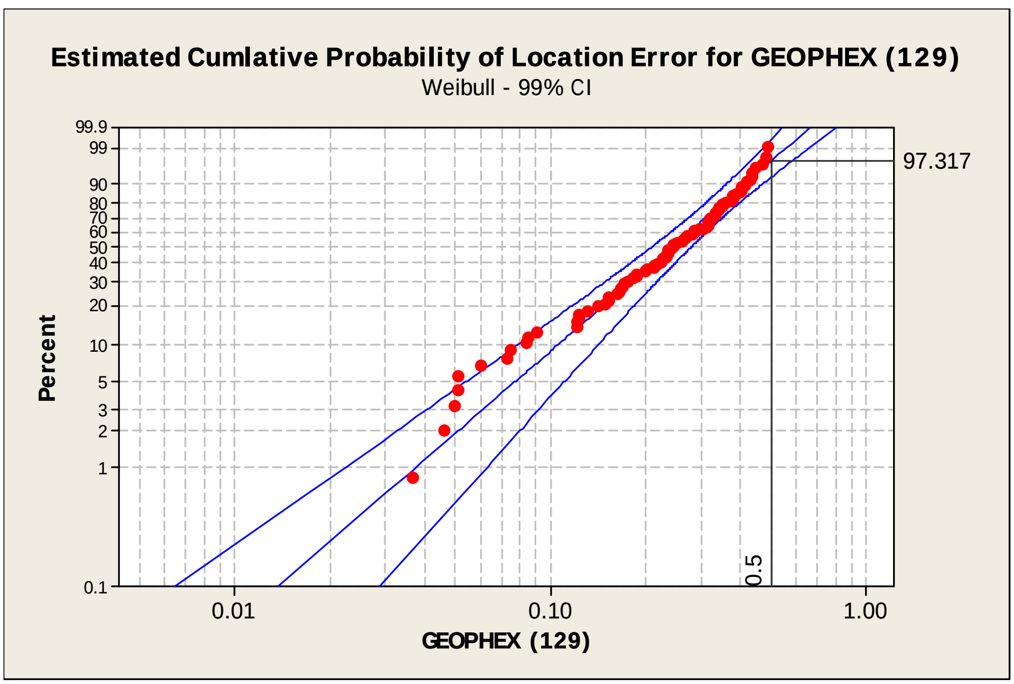

Figure F-2.   Estimated Cumulative Probability of Location Error, Geophex, SR #129.

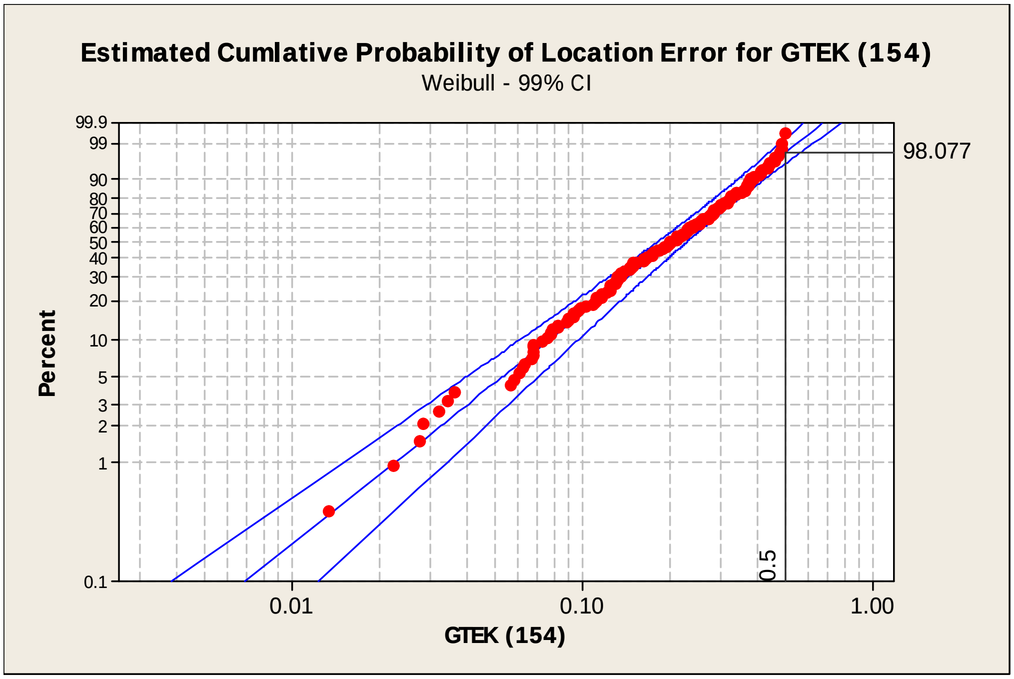

Figure F-3. Estimated Cumulative Probability of Location Error, G-TEK, SR #154.

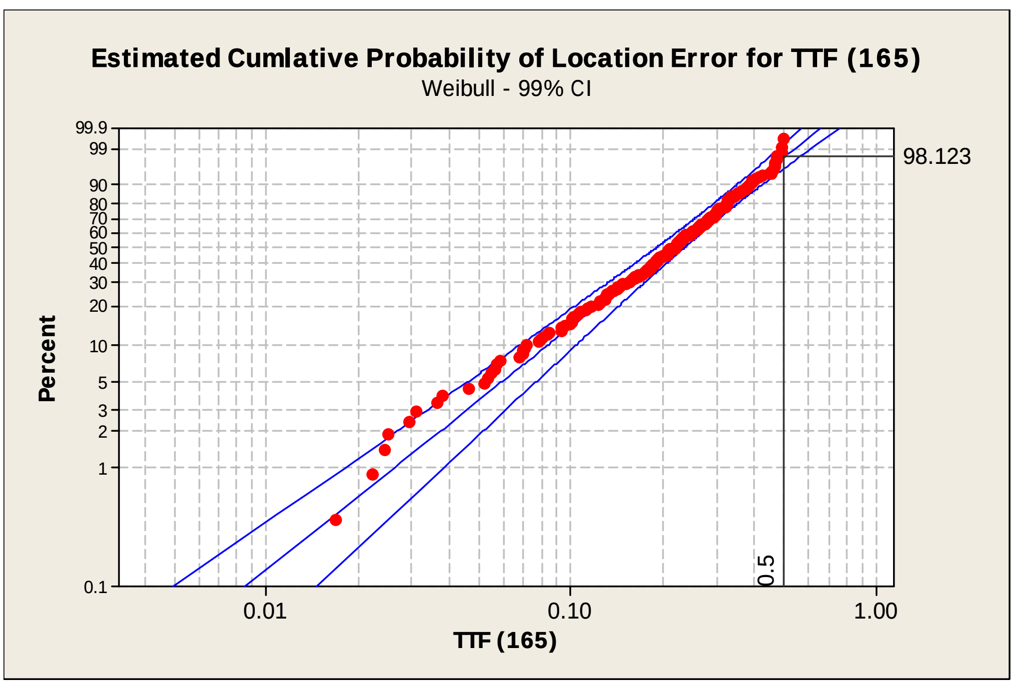

Figure F-4. Estimated Cumulative Probability of Location Error, TTF, SR #165.

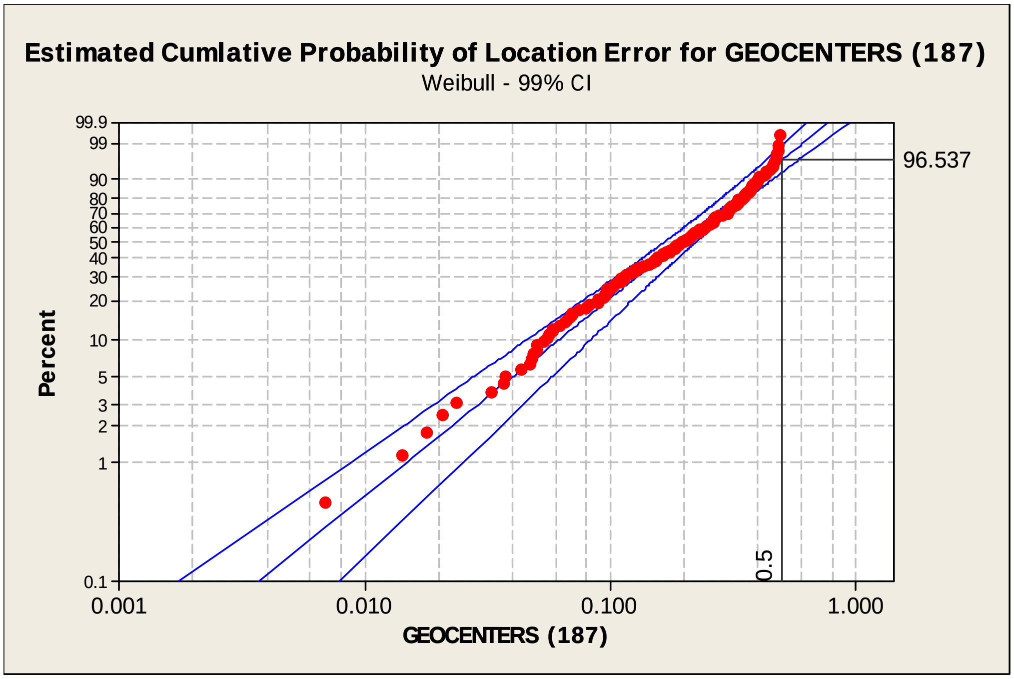

Figure F-5. Estimated Cumulative Probability of Location Error, Geocenters, SR #187.

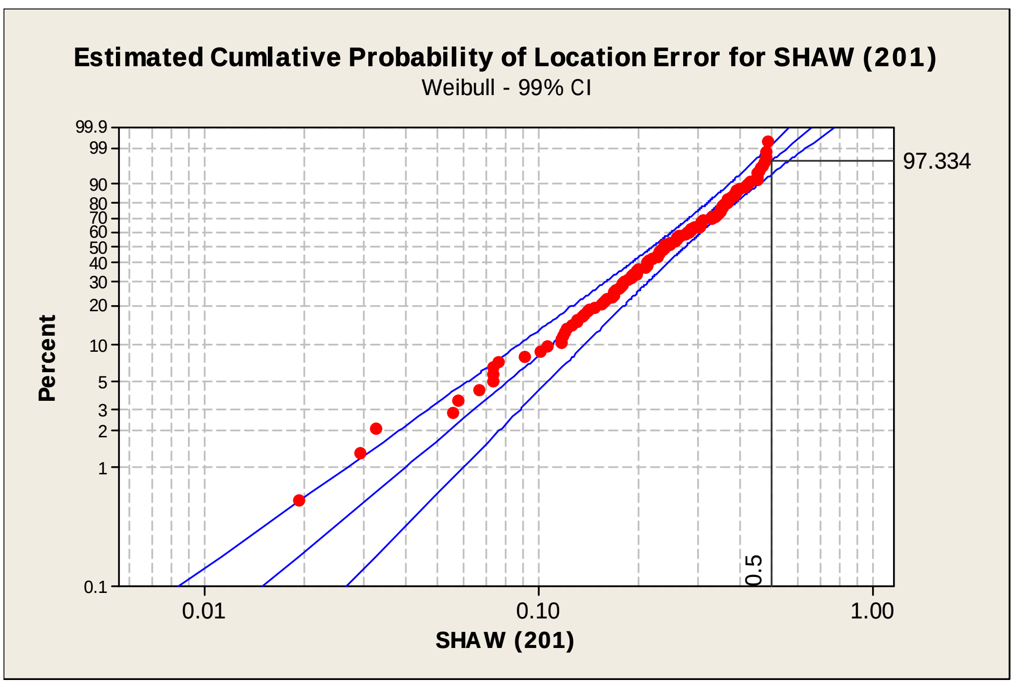

Figure F-6. Estimated Cumulative Probability of Location Error, Shaw, SR #201.

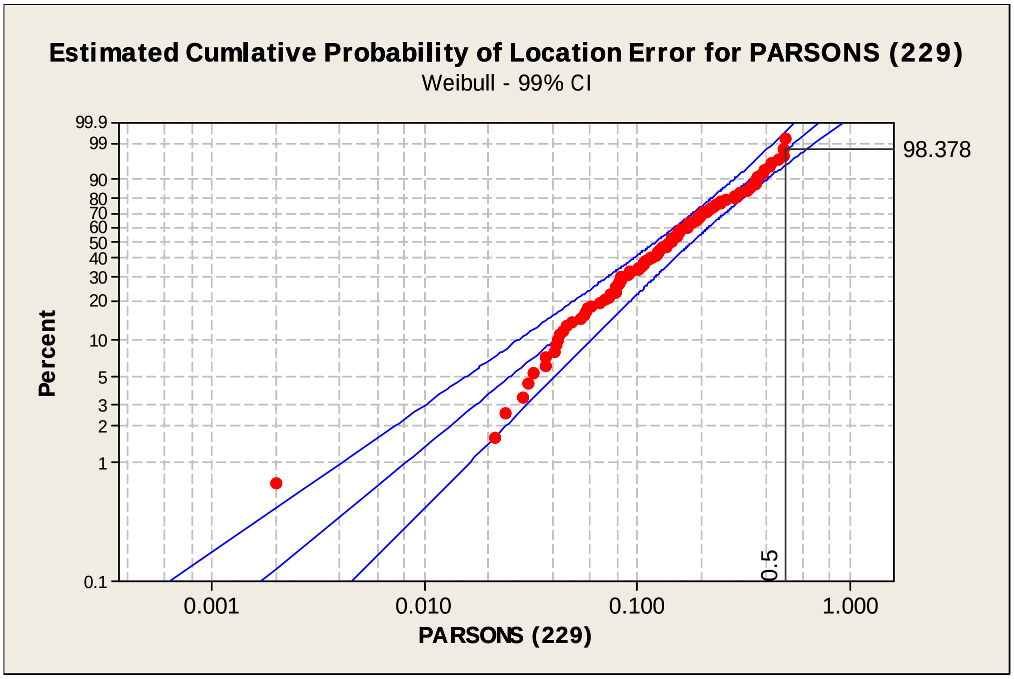

Figure F-7. Estimated Cumulative Probability of Location Error, Parsons, SR #229.

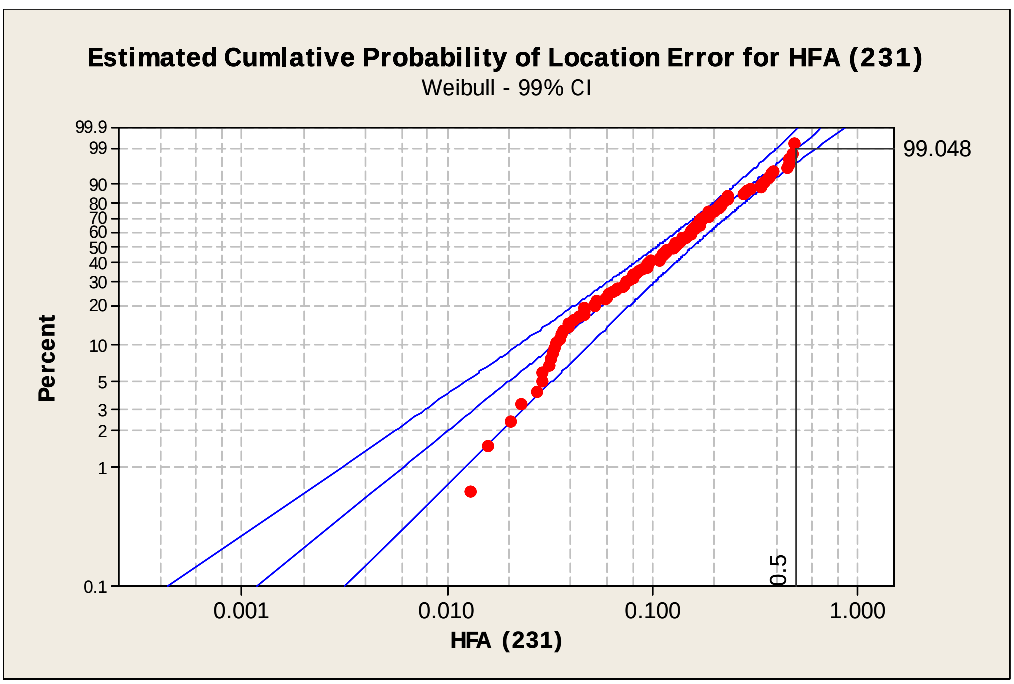

Figure F-8. Estimated Cumulative Probability of Location Error, HFA, SR #231.

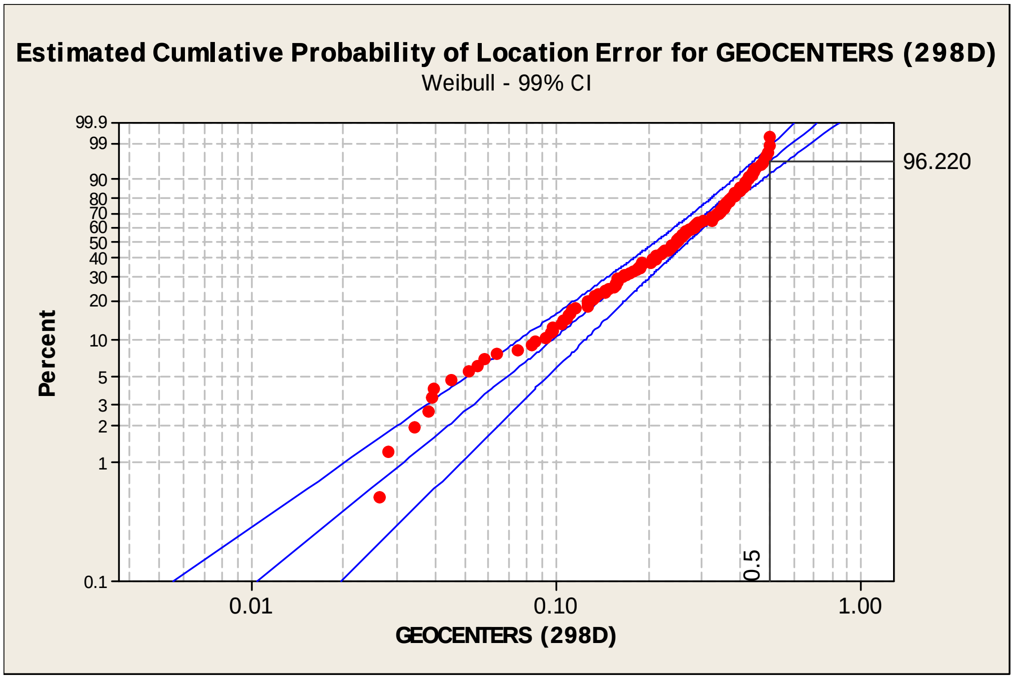

Figure F-9. Estimated Cumulative Probability of Location Error, Geocenters, SR #298.

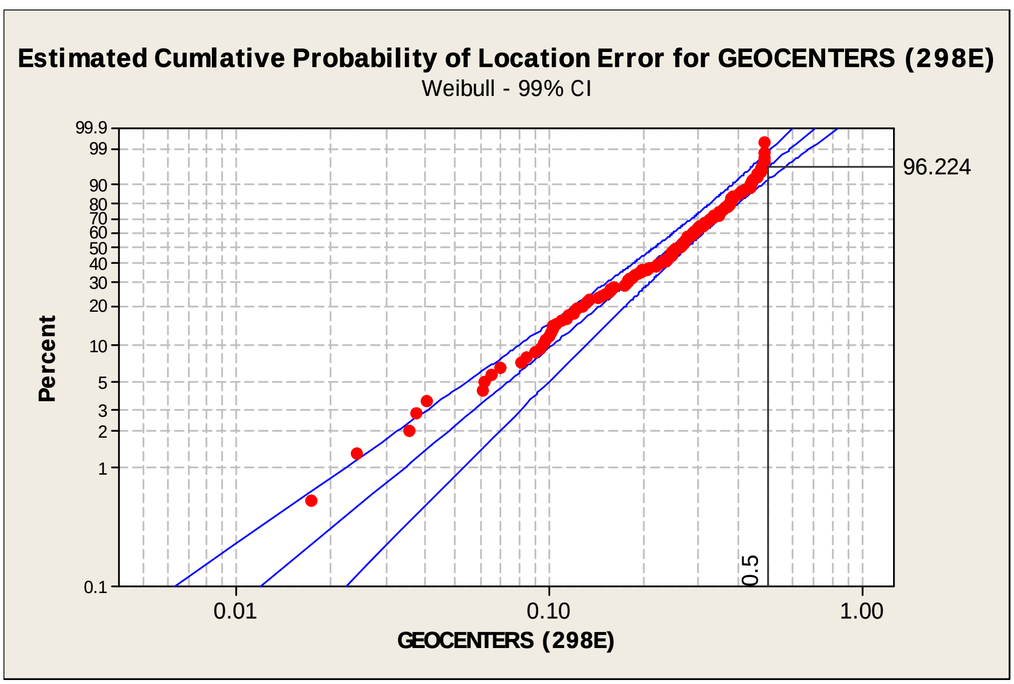

Figure F-10. Estimated Cumulative Probability of Location Error, Geocenters, SR #298.

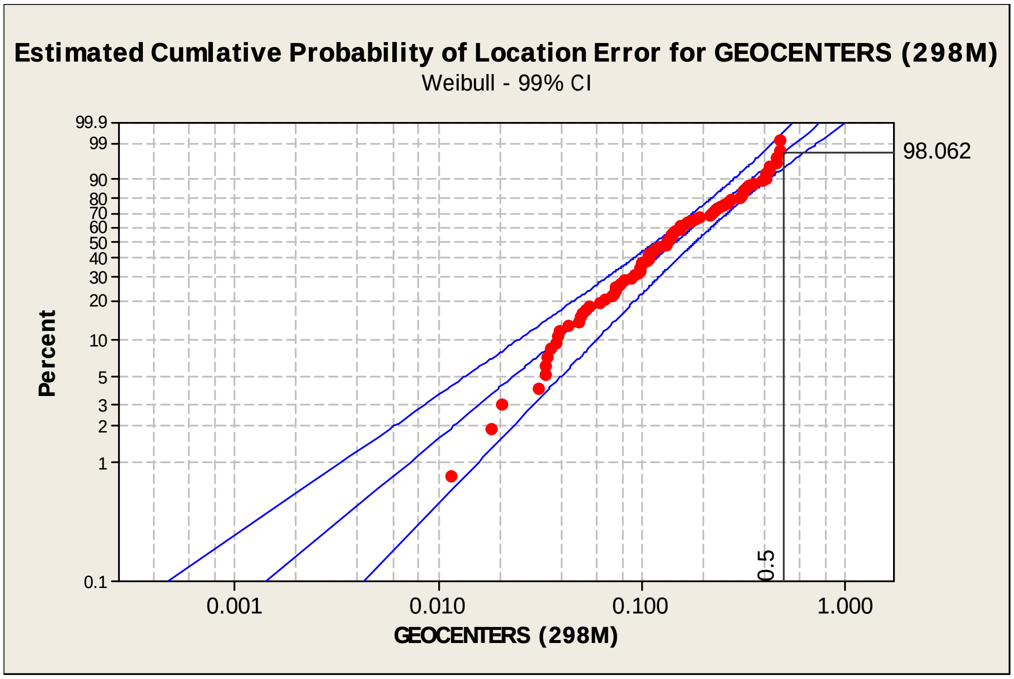

Figure F-11. Estimated Cumulative Probability of Location Error, Geocenters, SR #298.

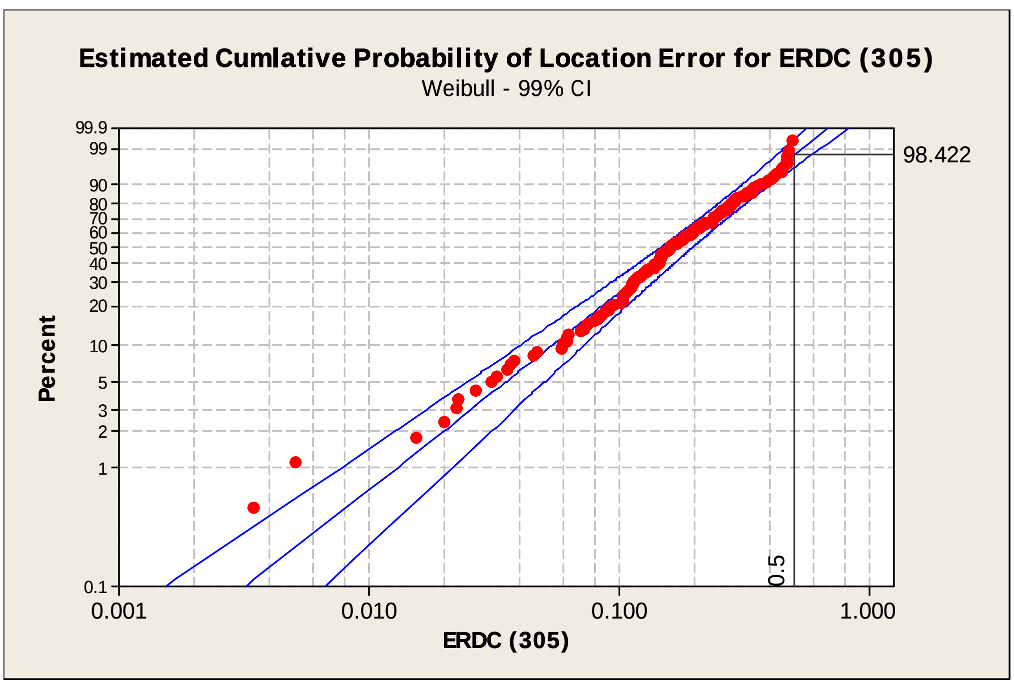

Figure F-12. Estimated Cumulative Probability of Location Error, ERDC, SR #305.

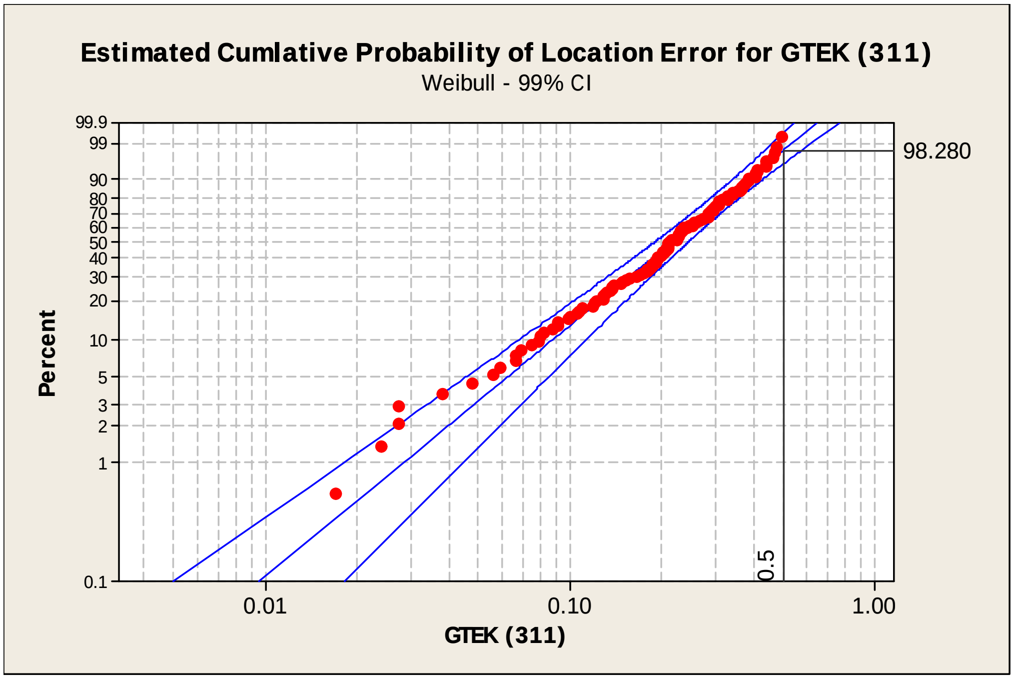

Figure F-13. Estimated Cumulative Probability of Location Error, G-TEK, SR #311.

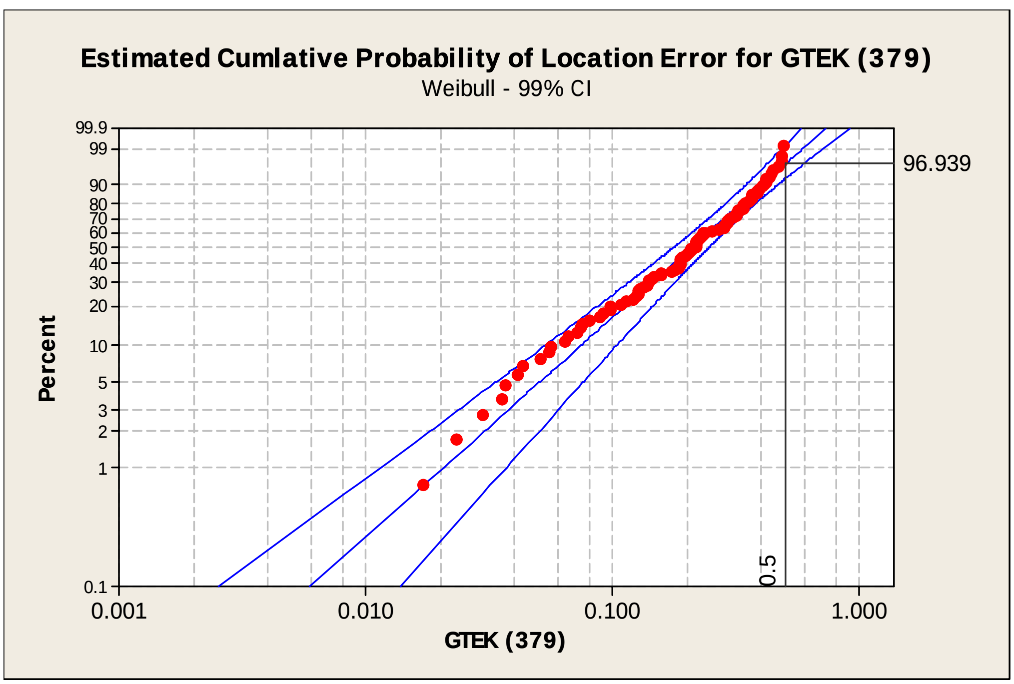

Figure F-14. Estimated Cumulative Probability of Location Error, G-TEK, SR #379.

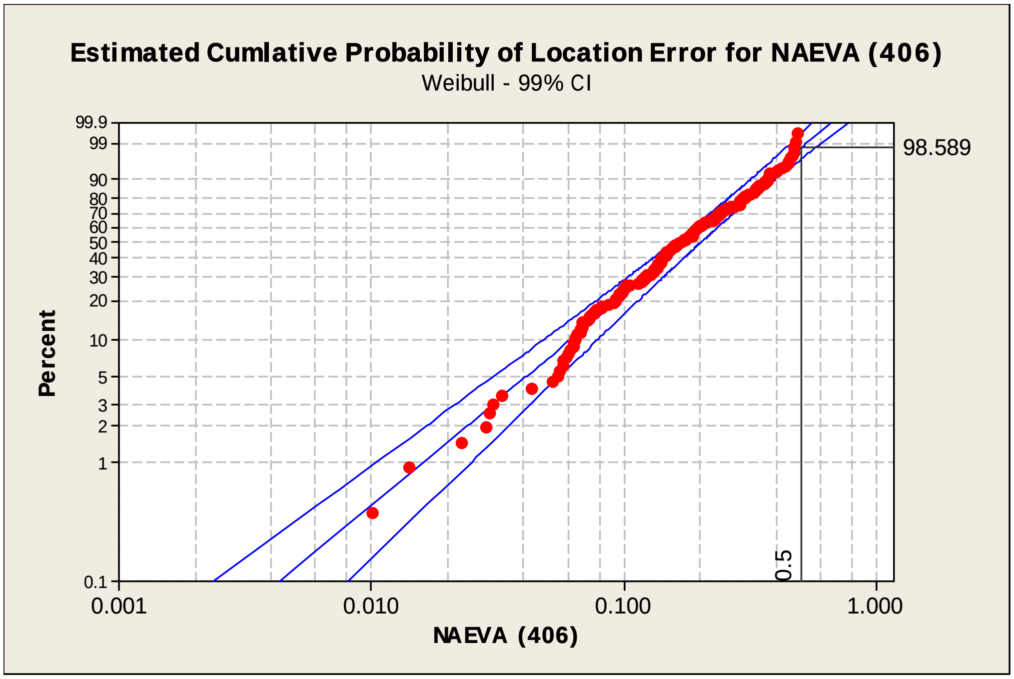

Figure F-15. Estimated Cumulative Probability of Location Error, NAEVA SR #406.

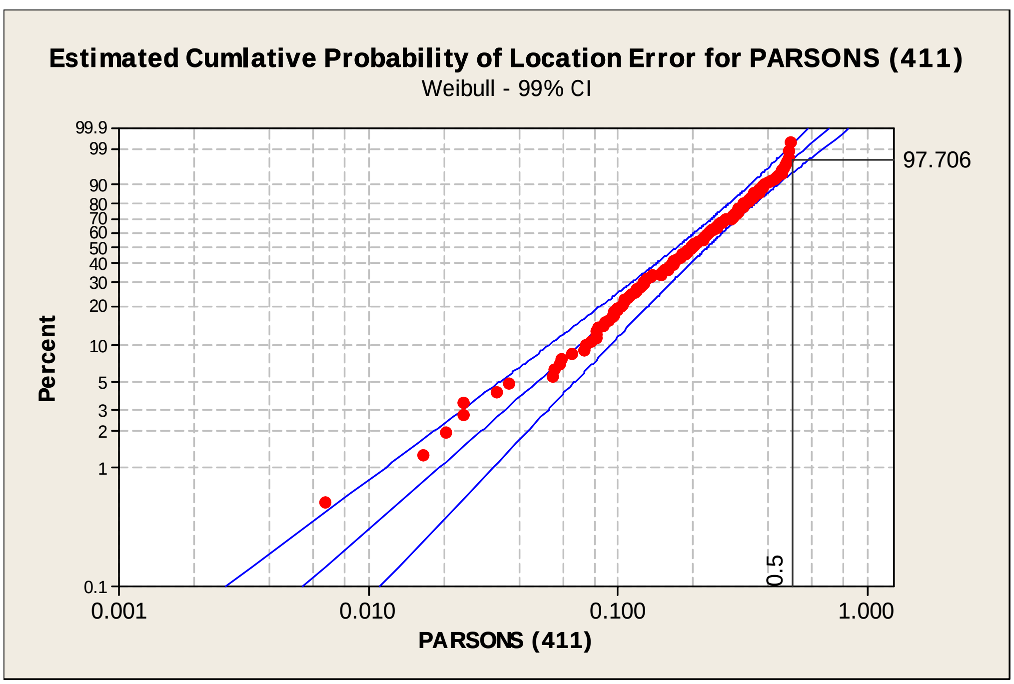

Figure F-16. Estimated Cumulative Probability of Location Error, Parsons, SR #411.

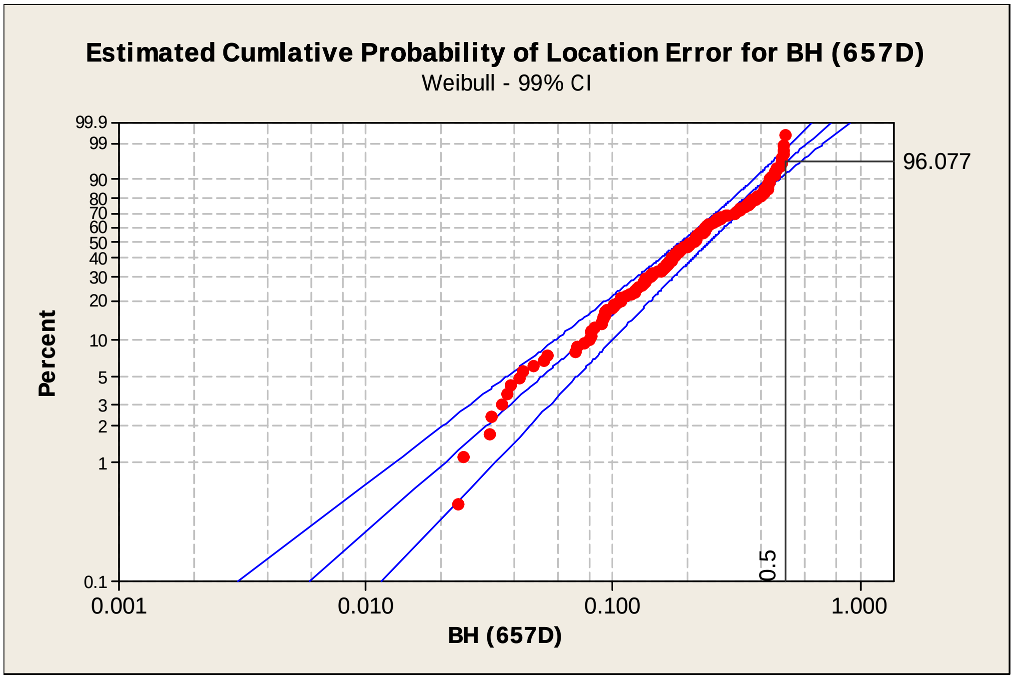

Figure F-17. Estimated Cumulative Probability of Location Error, BH, SR #657.

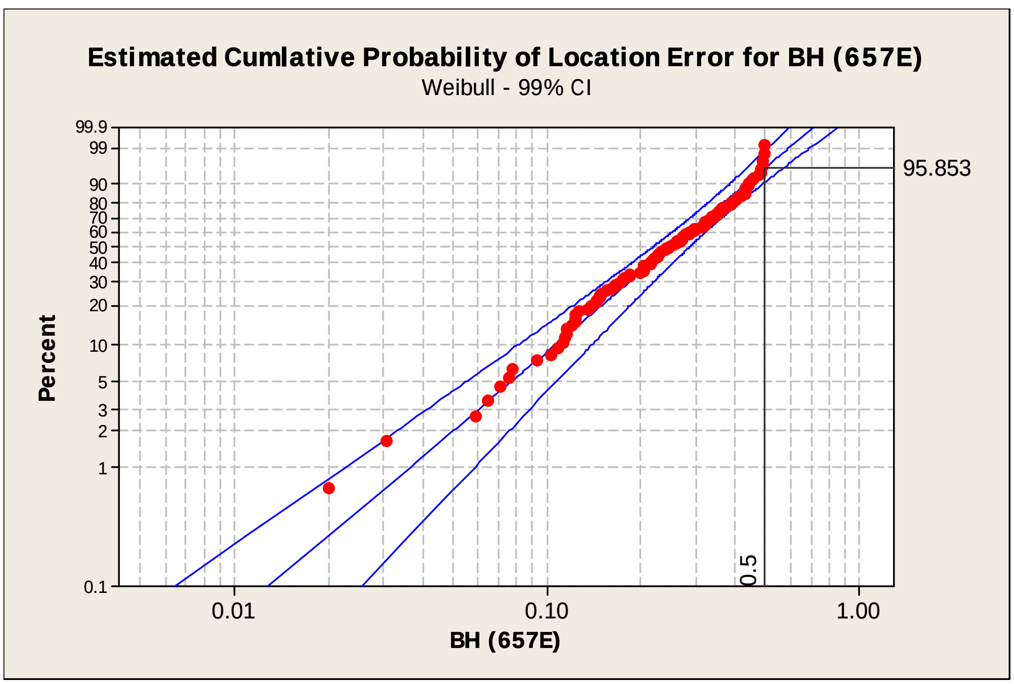

Figure F-18. Estimated Cumulative Probability of Location Error, BH, SR #657.

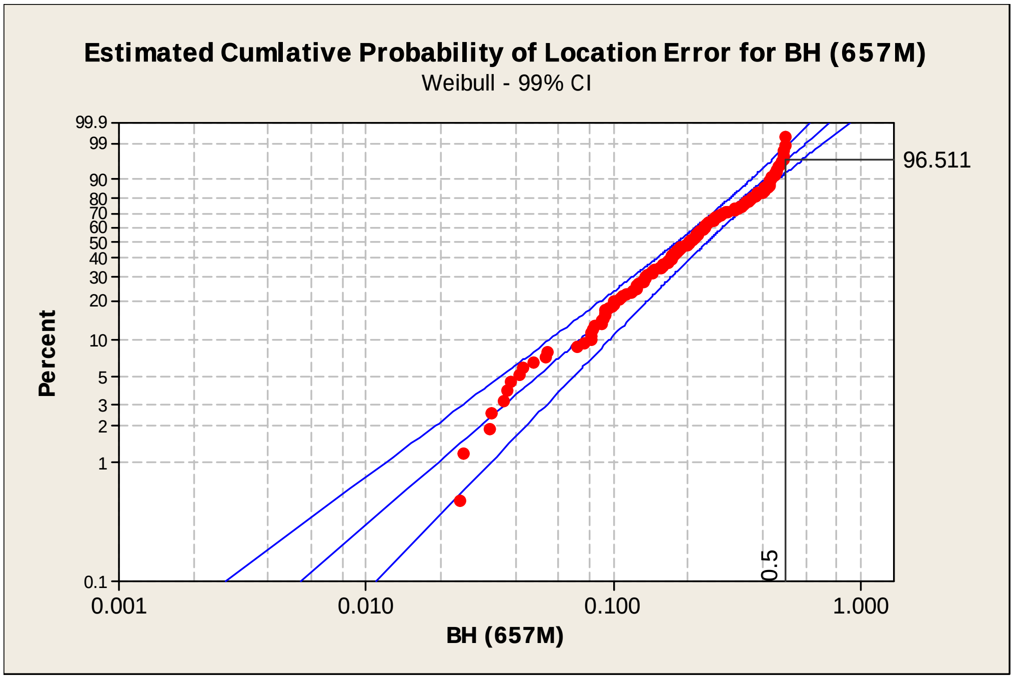

Figure F-19. Estimated Cumulative Probability of Location Error, BH, SR #657.

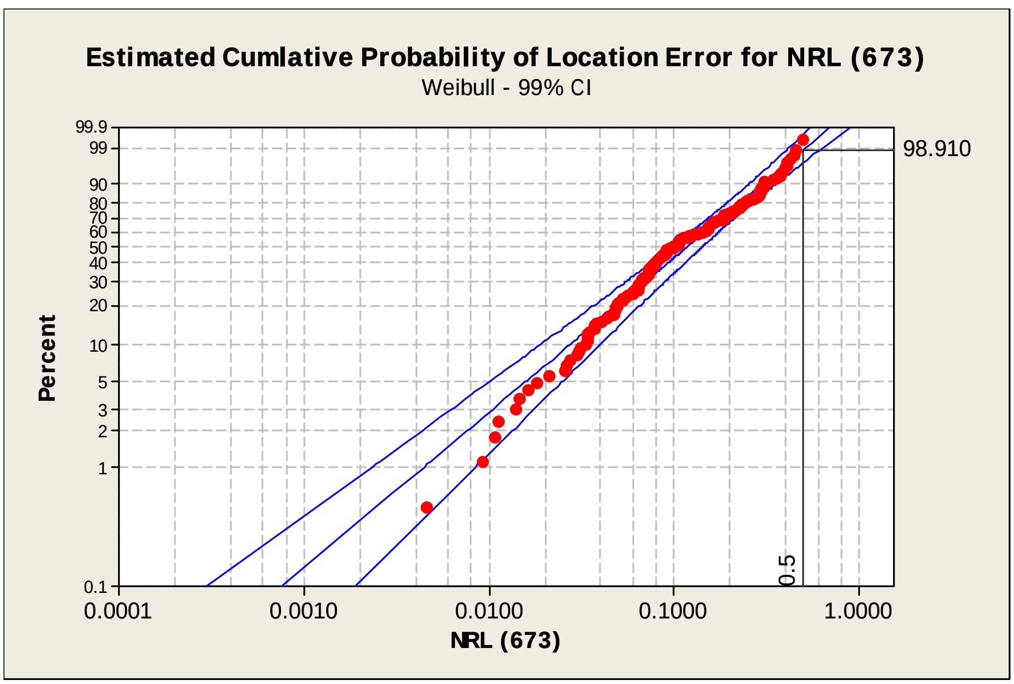

Figure F-20. Estimated Cumulative Probability of Location Error, NRL, SR #673.

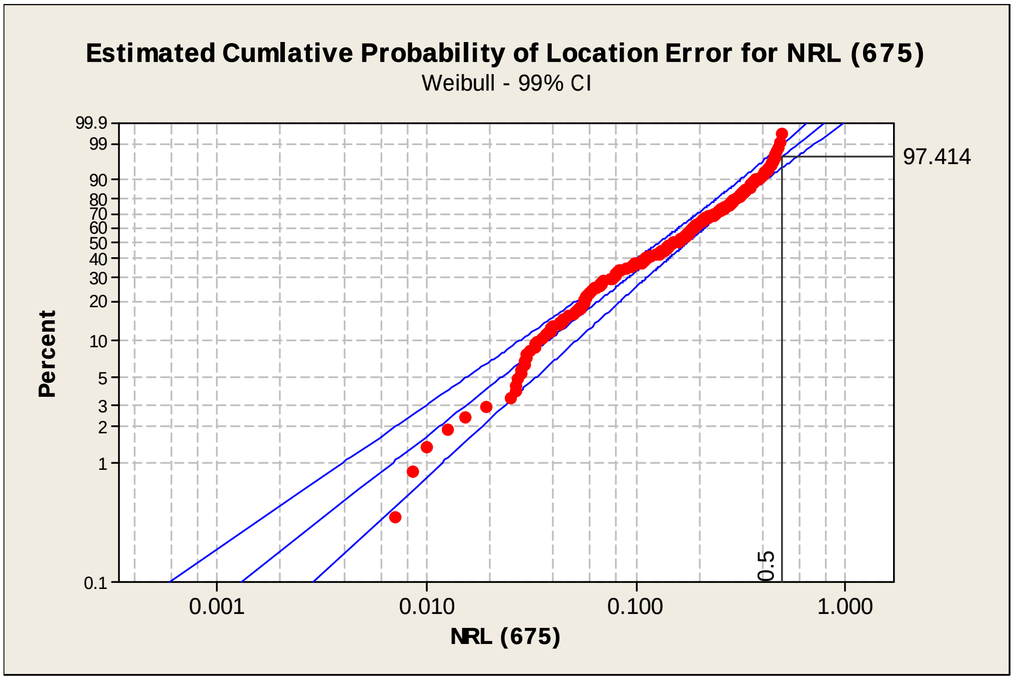

Figure F-21. Estimated Cumulative Probability of Location Error, NRL, SR #675.

APPENDIX G. P_d RESULTS PER ORDNANCE TYPE

Note: The GT has been limited to 11D depth. Challenge area and/or overlapping items have been excluded. Results have been rounded to the nearest 0.05 increment of P_d.

105H Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap 105H Ordnance			
APG		**YPG**	
System	**Pdres**	**System**	**Pdres**
EM61/Cart(411)	0.95	EM63/Cart(249)	1.00
EM61/Cart(201)	0.95	MTADS/Towed(245)	1.00
EM61/Cart(165)	0.95	EM61G822A/Towed(651M)	1.00
MTADS/Towed(675)	0.95	TM4/Sling(147)	1.00
SAM/Sling(379)	0.95	EM61G822A/Towed(651D)	1.00
STOLS/Towed(298E)	0.85	EM61/Towed(668)	0.95
TM5/Sling(154)	0.85	EM61/Cart(425)	0.95
EM61G822A/Cart(657M)	0.85	GEM3/Cart(135)	0.95
MTADS/Towed(673)	0.85	STOLS/Towed(299E)	0.95
EM61G822A/Cart(657D)	0.85	TM5/Sling(148)	0.95
STOLS/Towed(187)	0.85	SCH/Hand(426)	0.95
STOLS/Towed(298D)	0.85	STOLS/Towed(299D)	0.95
EM61/Towed(406)	0.80	EM61/Cart(169)	0.90
SCH/Hand(229)	0.80	EM61G822A/Towed(651E)	0.85
STOLS/Towed(298M)	0.80	STOLS/Towed(299M)	0.85
TM4/Sling(311)	0.75	TM4/Sling(364)	0.85
EM61G822A/Cart(657E)	0.65	SCH/Hand(442)	0.70
EM63/Cart(305)	0.65	EM61/Cart(354)	0.50
EMFAST4D/Cart(38)	0.65	MAG858/Cart(638)	0.10
SCH/Hand(231)	0.60		
GEM3/Towed(129)	0.45		
MAG858/Cart(492)	0.45		

Figure G-1. 105H Ordnance.

105mmP Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		**YPG**	
System	**Pdres**	**System**	**Pdres**
MTADS/Towed(675)	1.00	EM61/Towed(668)	1.00
TM5/Sling(154)	1.00	EM61/Cart(169)	1.00
MTADS/Towed(673)	1.00	EM63/Cart(249)	1.00
EM61/Towed(406)	0.90	MTADS/Towed(245)	1.00
EM61/Cart(411)	0.90	STOLS/Towed(299E)	1.00
EM61/Cart(165)	0.90	EM61G822A/Towed(651M)	1.00
STOLS/Towed(298M)	0.90	STOLS/Towed(299M)	1.00
EM61/Cart(201)	0.85	EM61G822A/Towed(651D)	1.00
EM61G822A/Cart(657E)	0.85	STOLS/Towed(299D)	1.00
EM63/Cart(305)	0.85	TM5/Sling(148)	0.95
EMFAST4D/Cart(38)	0.85	EM61/Cart(425)	0.90
GEM3/Towed(129)	0.85	GEM3/Cart(135)	0.85
STOLS/Towed(298E)	0.85	TM4/Sling(364)	0.85
EM61G822A/Cart(657M)	0.85	TM4/Sling(147)	0.85
SCH/Hand(231)	0.85	SCH/Hand(426)	0.75
SCH/Hand(229)	0.85	EM61G822A/Towed(651E)	0.70
TM4/Sling(311)	0.85	SCH/Hand(442)	0.70
EM61G822A/Cart(657D)	0.85	EM61/Cart(354)	0.40
STOLS/Towed(187)	0.85	MAG858/Cart(638)	0.05
STOLS/Towed(298D)	0.85		
SAM/Sling(379)	0.65		
MAG858/Cart(492)	0.35		

Figure G-2. 105mmP Ordnance.

155mmP Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
System	Pdres	System	Pdres
MTADS/Towed(673)	1.00	EM61G822A/Towed(651D)	1.00
EM61/Cart(165)	0.95	EM61/Towed(668)	0.95
STOLS/Towed(187)	0.95	EM63/Cart(249)	0.95
MTADS/Towed(675)	0.90	MTADS/Towed(245)	0.95
EM61/Towed(406)	0.85	TM5/Sling(148)	0.95
TM5/Sling(154)	0.85	EM61G822A/Towed(651M)	0.95
TM4/Sling(311)	0.85	EM61/Cart(425)	0.90
EM61/Cart(411)	0.80	EM61/Cart(169)	0.90
EM61/Cart(201)	0.80	STOLS/Towed(299E)	0.90
EM61G822A/Cart(657M)	0.80	STOLS/Towed(299M)	0.90
STOLS/Towed(298M)	0.80	TM4/Sling(147)	0.90
EM61G822A/Cart(657D)	0.80	STOLS/Towed(299D)	0.90
SCH/Hand(229)	0.70	SCH/Hand(426)	0.80
SCH/Hand(231)	0.65	EM61G822A/Towed(651E)	0.75
EM63/Cart(305)	0.60	GEM3/Cart(135)	0.75
STOLS/Towed(298E)	0.60	SCH/Hand(442)	0.70
SAM/Sling(379)	0.60	TM4/Sling(364)	0.70
STOLS/Towed(298D)	0.60	EM61/Cart(354)	0.40
EM61G822A/Cart(657E)	0.55	MAG858/Cart(638)	0.05
EMFAST4D/Cart(38)	0.55		
GEM3/Towed(129)	0.50		
MAG858/Cart(492)	0.40		

Figure G-3. 155mmP Ordnance.

2.75 inch Rocket Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
System	Pdres	System	Pdres
STOLS/Towed(187)	0.95	STOLS/Towed(299E)	0.95
MTADS/Towed(675)	0.90	STOLS/Towed(299D)	0.95
MTADS/Towed(673)	0.90	EM61/Cart(169)	0.90
SCH/Hand(231)	0.90	EM63/Cart(249)	0.90
SCH/Hand(229)	0.90	MTADS/Towed(245)	0.90
EM61/Cart(411)	0.85	TM5/Sling(148)	0.90
EM63/Cart(305)	0.85	TM4/Sling(147)	0.90
EMFAST4D/Cart(38)	0.85	GEM3/Cart(135)	0.80
TM5/Sling(154)	0.85	SCH/Hand(426)	0.80
EM61G822A/Cart(657M)	0.85	STOLS/Towed(299M)	0.80
STOLS/Towed(298M)	0.85	EM61G822A/Towed(651D)	0.80
EM61G822A/Cart(657D)	0.85	EM61G822A/Towed(651M)	0.75
EM61/Cart(165)	0.75	EM61/Towed(668)	0.70
TM4/Sling(311)	0.75	EM61/Cart(425)	0.70
SAM/Sling(379)	0.75	SCH/Hand(442)	0.70
EM61/Towed(406)	0.65	TM4/Sling(364)	0.55
EM61/Cart(201)	0.65	EM61G822A/Towed(651E)	0.50
STOLS/Towed(298E)	0.60	EM61/Cart(354)	0.25
STOLS/Towed(298D)	0.60	MAG858/Cart(638)	0.10
EM61G822A/Cart(657E)	0.55		
GEM3/Towed(129)	0.55		
MAG858/Cart(492)	0.25		

Figure G-4. 2.75 inch Rocket Ordnance.

20mmP Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
System	Pdres	System	Pdres
EM61/Towed(406)	0.70	EM61/Towed(668)	0.90
EM61/Cart(165)	0.70	MTADS/Towed(245)	0.90
MTADS/Towed(675)	0.70	EM61/Cart(169)	0.85
TM5/Sling(154)	0.50	TM5/Sling(148)	0.85
MTADS/Towed(673)	0.40	EM61G822A/Towed(651D)	0.80
SCH/Hand(231)	0.40	EM63/Cart(249)	0.75
SCH/Hand(229)	0.35	EM61G822A/Towed(651M)	0.70
EM61/Cart(201)	0.30	EM61/Cart(425)	0.50
EM63/Cart(305)	0.30	TM4/Sling(147)	0.45
EMFAST4D/Cart(38)	0.25	STOLS/Towed(299E)	0.40
GEM3/Towed(129)	0.25	STOLS/Towed(299D)	0.40
STOLS/Towed(298E)	0.25	EM61G822A/Towed(651E)	0.35
TM4/Sling(311)	0.25	SCH/Hand(442)	0.30
STOLS/Towed(298D)	0.25	SCH/Hand(426)	0.30
EM61/Cart(411)	0.20	EM61/Cart(354)	0.10
EM61G822A/Cart(657M)	0.20	GEM3/Cart(135)	0.05
EM61G822A/Cart(657D)	0.20	MAG858/Cart(638)	0.05
EM61G822A/Cart(657E)	0.15	STOLS/Towed(299M)	0.00
STOLS/Towed(187)	0.15	TM4/Sling(364)	0.00
MAG858/Cart(492)	0.10		
STOLS/Towed(298M)	0.00		
SAM/Sling(379)	0.00		

Figure G-5. 20mmP Ordnance.

40mmG Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
System	Pdres	System	Pdres
TM5/Sling(154)	0.90	EM61/Towed(668)	0.95
EM61/Cart(165)	0.80	EM61/Cart(169)	0.95
EM61/Towed(406)	0.75	EM63/Cart(249)	0.95
EM63/Cart(305)	0.70	MTADS/Towed(245)	0.95
MTADS/Towed(675)	0.70	TM5/Sling(148)	0.95
EM61/Cart(201)	0.55	STOLS/Towed(299E)	0.85
STOLS/Towed(187)	0.55	STOLS/Towed(299D)	0.85
EM61/Cart(411)	0.50	EM61/Cart(425)	0.65
STOLS/Towed(298E)	0.40	EM61G822A/Towed(651E)	0.55
STOLS/Towed(298D)	0.40	EM61G822A/Towed(651D)	0.40
EM61G822A/Cart(657E)	0.35	GEM3/Cart(135)	0.35
EM61G822A/Cart(657D)	0.35	EM61/Cart(354)	0.25
EMFAST4D/Cart(38)	0.20	EM61G822A/Towed(651M)	0.00
GEM3/Towed(129)	0.20	MAG858/Cart(638)	0.00
SAM/Sling(379)	0.05	SCH/Hand(442)	0.00
EM61G822A/Cart(657M)	0.00	SCH/Hand(426)	0.00
MAG858/Cart(492)	0.00	STOLS/Towed(299M)	0.00
MTADS/Towed(673)	0.00	TM4/Sling(364)	0.00
SCH/Hand(231)	0.00	TM4/Sling(147)	0.00
SCH/Hand(229)	0.00		
STOLS/Towed(298M)	0.00		
TM4/Sling(311)	0.00		

Figure G-6. 40mmG Ordnance.

40mmP Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
System	Pdres	System	Pdres
EM61/Towed(406)	0.90	MTADS/Towed(245)	1.00
TM5/Sling(154)	0.90	TM5/Sling(148)	1.00
MTADS/Towed(673)	0.90	EM61/Towed(668)	0.90
TM4/Sling(311)	0.90	EM61/Cart(169)	0.90
EM61G822A/Cart(657D)	0.90	EM63/Cart(249)	0.90
SAM/Sling(379)	0.90	STOLS/Towed(299E)	0.90
EM61/Cart(201)	0.80	STOLS/Towed(299D)	0.90
EM61/Cart(165)	0.80	EM61G822A/Towed(651E)	0.85
EM61G822A/Cart(657E)	0.80	EM61G822A/Towed(651M)	0.85
EM61G822A/Cart(657M)	0.80	EM61G822A/Towed(651D)	0.85
SCH/Hand(229)	0.80	EM61/Cart(425)	0.75
STOLS/Towed(187)	0.80	SCH/Hand(426)	0.75
EM61/Cart(411)	0.65	GEM3/Cart(135)	0.60
EM63/Cart(305)	0.65	SCH/Hand(442)	0.60
EMFAST4D/Cart(38)	0.65	TM4/Sling(147)	0.60
GEM3/Towed(129)	0.65	TM4/Sling(364)	0.35
MTADS/Towed(675)	0.65	EM61/Cart(354)	0.25
STOLS/Towed(298E)	0.65	STOLS/Towed(299M)	0.15
SCH/Hand(231)	0.65	MAG858/Cart(638)	0.10
STOLS/Towed(298D)	0.65		
STOLS/Towed(298M)	0.55		
MAG858/Cart(492)	0.45		

Figure G-7. 40mmP Ordnance.

57mmP Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
TotalInformation	57mmP	TotalInformation	57mmP
TM5/Sling(154)	1.00	MTADS/Towed(245)	1.00
EM61/Towed(406)	0.85	EM61G822A/Towed(651M)	1.00
EM61/Cart(201)	0.85	EM61G822A/Towed(651D)	1.00
EM61/Cart(165)	0.85	EM61/Towed(668)	0.95
EM63/Cart(305)	0.85	EM61/Cart(425)	0.95
MTADS/Towed(675)	0.85	EM61/Cart(169)	0.95
STOLS/Towed(298E)	0.85	EM63/Cart(249)	0.95
MTADS/Towed(673)	0.85	STOLS/Towed(299E)	0.95
STOLS/Towed(187)	0.85	TM5/Sling(148)	0.95
STOLS/Towed(298D)	0.85	STOLS/Towed(299D)	0.95
EM61/Cart(411)	0.75	GEM3/Cart(135)	0.85
EMFAST4D/Cart(38)	0.75	TM4/Sling(147)	0.85
EM61G822A/Cart(657M)	0.70	SCH/Hand(442)	0.80
SCH/Hand(229)	0.70	SCH/Hand(426)	0.75
TM4/Sling(311)	0.70	TM4/Sling(364)	0.75
EM61G822A/Cart(657D)	0.70	EM61G822A/Towed(651E)	0.65
SAM/Sling(379)	0.70	STOLS/Towed(299M)	0.45
SCH/Hand(231)	0.60	EM61/Cart(354)	0.40
EM61G822A/Cart(657E)	0.45	MAG858/Cart(638)	0.05
GEM3/Towed(129)	0.45		
STOLS/Towed(298M)	0.45		
MAG858/Cart(492)	0.10		

Figure G-8. 57mmP Ordnance.

60mmM Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
TotalInformation	60mmM	TotalInformation	60mmM
MTADS/Towed(675)	0.85	MTADS/Towed(245)	0.95
EM61/Towed(406)	0.80	TM5/Sling(148)	0.95
EM61/Cart(165)	0.80	EM61/Cart(169)	0.90
EM63/Cart(305)	0.80	EM63/Cart(249)	0.90
STOLS/Towed(298D)	0.80	STOLS/Towed(299E)	0.90
EM61/Cart(201)	0.75	STOLS/Towed(299D)	0.90
MTADS/Towed(673)	0.75	EM61/Towed(668)	0.85
TM4/Sling(311)	0.75	EM61G822A/Towed(651M)	0.85
EM61G822A/Cart(657D)	0.75	EM61G822A/Towed(651D)	0.85
EM61/Cart(411)	0.65	SCH/Hand(426)	0.75
EMFAST4D/Cart(38)	0.65	TM4/Sling(147)	0.75
STOLS/Towed(298E)	0.65	EM61/Cart(425)	0.70
TM5/Sling(154)	0.65	EM61G822A/Towed(651E)	0.60
EM61G822A/Cart(657M)	0.65	GEM3/Cart(135)	0.60
STOLS/Towed(187)	0.65	STOLS/Towed(299M)	0.55
EM61G822A/Cart(657E)	0.60	SCH/Hand(442)	0.45
SCH/Hand(231)	0.60	TM4/Sling(364)	0.45
STOLS/Towed(298M)	0.60	EM61/Cart(354)	0.20
SCH/Hand(229)	0.55	MAG858/Cart(638)	0.20
GEM3/Towed(129)	0.45		
SAM/Sling(379)	0.40		
MAG858/Cart(492)	0.20		

Figure G-9. 60mmM Ordnance.

81mmM Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
TotalInformation	81mmM	TotalInformation	81mmM
MTADS/Towed(673)	0.95	EM61/Cart(169)	0.95
EM61/Towed(406)	0.90	EM61/Towed(668)	0.90
EM61/Cart(165)	0.90	EM63/Cart(249)	0.90
MTADS/Towed(675)	0.90	MTADS/Towed(245)	0.90
TM5/Sling(154)	0.90	STOLS/Towed(299E)	0.90
EM61G822A/Cart(657D)	0.90	TM5/Sling(148)	0.90
STOLS/Towed(187)	0.90	EM61G822A/Towed(651M)	0.90
EM61/Cart(201)	0.85	EM61G822A/Towed(651D)	0.90
EM63/Cart(305)	0.85	STOLS/Towed(299D)	0.90
EM61G822A/Cart(657M)	0.85	EM61/Cart(425)	0.85
STOLS/Towed(298D)	0.85	SCH/Hand(426)	0.85
STOLS/Towed(298E)	0.80	TM4/Sling(147)	0.85
SCH/Hand(231)	0.80	GEM3/Cart(135)	0.80
TM4/Sling(311)	0.80	STOLS/Towed(299M)	0.75
EM61/Cart(411)	0.70	EM61G822A/Towed(651E)	0.70
STOLS/Towed(298M)	0.70	SCH/Hand(442)	0.65
EMFAST4D/Cart(38)	0.65	TM4/Sling(364)	0.65
SAM/Sling(379)	0.65	EM61/Cart(354)	0.40
GEM3/Towed(129)	0.55	MAG858/Cart(638)	0.15
EM61G822A/Cart(657E)	0.50		
SCH/Hand(229)	0.50		
MAG858/Cart(492)	0.20		

Figure G-10. 81mmM Ordnance.

BDU28 Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
TotalInformation	BDU28	TotalInformation	BDU28
EM61/Cart(411)	0.90	EM61/Towed(668)	0.95
EM61/Cart(201)	0.90	EM61/Cart(169)	0.95
EM61/Cart(165)	0.90	MTADS/Towed(245)	0.95
MTADS/Towed(675)	0.90	STOLS/Towed(299E)	0.95
TM5/Sling(154)	0.90	TM5/Sling(148)	0.95
SCH/Hand(229)	0.90	EM61G822A/Towed(651M)	0.95
EM61/Towed(406)	0.85	EM61G822A/Towed(651D)	0.95
EM63/Cart(305)	0.85	STOLS/Towed(299D)	0.95
MTADS/Towed(673)	0.85	EM63/Cart(249)	0.90
SCH/Hand(231)	0.85	SCH/Hand(426)	0.90
STOLS/Towed(187)	0.85	EM61/Cart(425)	0.85
EM61G822A/Cart(657M)	0.75	TM4/Sling(147)	0.85
EM61G822A/Cart(657D)	0.75	GEM3/Cart(135)	0.60
STOLS/Towed(298D)	0.75	SCH/Hand(442)	0.60
EMFAST4D/Cart(38)	0.70	TM4/Sling(364)	0.60
TM4/Sling(311)	0.70	EM61G822A/Towed(651E)	0.55
STOLS/Towed(298E)	0.60	STOLS/Towed(299M)	0.50
EM61G822A/Cart(657E)	0.55	EM61/Cart(354)	0.40
STOLS/Towed(298M)	0.55	MAG858/Cart(638)	0.15
SAM/Sling(379)	0.55		
GEM3/Towed(129)	0.45		
MAG858/Cart(492)	0.10		

Figure G-11. BDU28 Ordnance.

BLU26 Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		YPG	
TotalInformation	BLU26	TotalInformation	BLU26
EM61/Towed(406)	1.00	EM61/Towed(668)	0.95
EM61/Cart(411)	1.00	EM61/Cart(425)	0.95
EM61/Cart(165)	1.00	EM63/Cart(249)	0.95
EM63/Cart(305)	1.00	MTADS/Towed(245)	0.95
EMFAST4D/Cart(38)	1.00	STOLS/Towed(299E)	0.95
MTADS/Towed(675)	1.00	TM5/Sling(148)	0.95
TM5/Sling(154)	1.00	STOLS/Towed(299D)	0.95
STOLS/Towed(187)	1.00	EM61/Cart(169)	0.90
MTADS/Towed(673)	0.90	EM61G822A/Towed(651D)	0.85
EM61/Cart(201)	0.85	EM61G822A/Towed(651M)	0.75
STOLS/Towed(298E)	0.85	EM61G822A/Towed(651E)	0.70
EM61G822A/Cart(657M)	0.85	GEM3/Cart(135)	0.65
EM61G822A/Cart(657D)	0.85	TM4/Sling(147)	0.65
STOLS/Towed(298D)	0.85	SCH/Hand(442)	0.45
TM4/Sling(311)	0.75	SCH/Hand(426)	0.40
GEM3/Towed(129)	0.65	EM61/Cart(354)	0.30
SCH/Hand(231)	0.65	TM4/Sling(364)	0.25
SAM/Sling(379)	0.50	MAG858/Cart(638)	0.05
EM61G822A/Cart(657E)	0.40	STOLS/Towed(299M)	0.05
SCH/Hand(229)	0.40		
STOLS/Towed(298M)	0.25		
MAG858/Cart(492)	0.15		

Figure G-12. BDU26 Ordnance.

M42 Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		**YPG**	
TotalInformation	**M42**	**TotalInformation**	**M42**
EM61/Towed(406)	1.00	MTADS/Towed(245)	1.00
EM63/Cart(305)	1.00	EM61/Cart(169)	0.95
TM5/Sling(154)	1.00	EM63/Cart(249)	0.95
EM61/Cart(165)	0.90	TM5/Sling(148)	0.95
EMFAST4D/Cart(38)	0.90	EM61/Towed(668)	0.90
EM61/Cart(411)	0.85	STOLS/Towed(299E)	0.85
MTADS/Towed(675)	0.85	STOLS/Towed(299D)	0.85
MTADS/Towed(673)	0.85	EM61G822A/Towed(651D)	0.75
SCH/Hand(231)	0.85	TM4/Sling(147)	0.70
SCH/Hand(229)	0.85	EM61/Cart(425)	0.65
EM61G822A/Cart(657D)	0.85	EM61G822A/Towed(651M)	0.65
STOLS/Towed(298D)	0.85	EM61G822A/Towed(651E)	0.55
STOLS/Towed(298E)	0.75	SCH/Hand(442)	0.45
EM61G822A/Cart(657M)	0.75	SCH/Hand(426)	0.45
TM4/Sling(311)	0.65	GEM3/Cart(135)	0.40
SAM/Sling(379)	0.60	TM4/Sling(364)	0.35
STOLS/Towed(298M)	0.50	STOLS/Towed(299M)	0.20
STOLS/Towed(187)	0.50	EM61/Cart(354)	0.10
EM61/Cart(201)	0.40	MAG858/Cart(638)	0.05
GEM3/Towed(129)	0.35		
EM61G822A/Cart(657E)	0.15		
MAG858/Cart(492)	0.10		

Figure G-13. M42 Ordnance.

M75 Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		**YPG**	
TotalInformation	**M75**	**TotalInformation**	**M75**
EM61/Towed(406)	0.00	TM5/Sling(148)	1.00
EM61/Cart(411)	0.00	EM61/Towed(668)	0.95
EM61/Cart(201)	0.00	EM63/Cart(249)	0.95
EM61/Cart(165)	0.00	EM61/Cart(425)	0.90
EM61G822A/Cart(657E)	0.00	EM61/Cart(169)	0.90
EM63/Cart(305)	0.00	MTADS/Towed(245)	0.90
EMFAST4D/Cart(38)	0.00	STOLS/Towed(299E)	0.90
GEM3/Towed(129)	0.00	STOLS/Towed(299D)	0.90
MTADS/Towed(675)	0.00	EM61G822A/Towed(651M)	0.85
STOLS/Towed(298E)	0.00	EM61G822A/Towed(651D)	0.85
TM5/Sling(154)	0.00	GEM3/Cart(135)	0.80
EM61G822A/Cart(657M)	0.00	SCH/Hand(442)	0.75
MAG858/Cart(492)	0.00	SCH/Hand(426)	0.75
MTADS/Towed(673)	0.00	TM4/Sling(147)	0.70
SCH/Hand(231)	0.00	EM61G822A/Towed(651E)	0.55
SCH/Hand(229)	0.00	EM61/Cart(354)	0.40
STOLS/Towed(298M)	0.00	TM4/Sling(364)	0.35
TM4/Sling(311)	0.00	STOLS/Towed(299M)	0.25
EM61G822A/Cart(657D)	0.00	MAG858/Cart(638)	0.00
SAM/Sling(379)	0.00		
STOLS/Towed(187)	0.00		
STOLS/Towed(298D)	0.00		

Figure G-14. M75 Ordnance. No M75 ordnance were emplaced at APG.

MK118 Ordnance Ground Truth Limited to 11 Diameters, No Challenge Area, No Overlap			
APG		**YPG**	
TotalInformation	**MK118**	**TotalInformation**	**MK118**
EM61/Cart(165)	0.60	EM61/Towed(668)	1.00
MTADS/Towed(675)	0.60	EM61/Cart(169)	1.00
EM61/Towed(406)	0.40	MTADS/Towed(245)	1.00
EM61/Cart(201)	0.40	TM5/Sling(148)	1.00
STOLS/Towed(298E)	0.40	EM63/Cart(249)	0.85
TM5/Sling(154)	0.40	STOLS/Towed(299E)	0.85
STOLS/Towed(187)	0.40	STOLS/Towed(299D)	0.85
EM61/Cart(411)	0.20	EM61/Cart(425)	0.70
EM61G822A/Cart(657E)	0.20	EM61G822A/Towed(651D)	0.45
EM63/Cart(305)	0.20	EM61G822A/Towed(651E)	0.35
EMFAST4D/Cart(38)	0.20	GEM3/Cart(135)	0.20
STOLS/Towed(298D)	0.20	EM61/Cart(354)	0.15
GEM3/Towed(129)	0.00	EM61G822A/Towed(651M)	0.00
EM61G822A/Cart(657M)	0.00	MAG858/Cart(638)	0.00
MAG858/Cart(492)	0.00	SCH/Hand(442)	0.00
MTADS/Towed(673)	0.00	SCH/Hand(426)	0.00
SCH/Hand(231)	0.00	STOLS/Towed(299M)	0.00
SCH/Hand(229)	0.00	TM4/Sling(364)	0.00
STOLS/Towed(298M)	0.00	TM4/Sling(147)	0.00
TM4/Sling(311)	0.00		
EM61G822A/Cart(657D)	0.00		
SAM/Sling(379)	0.00		

Figure G-15. MK118 Ordnance.

APPENDIX H. REFERENCES

1. Standardized UXO Technology Demonstration Site Handbook, DTC Project No. 8-CO-160-000-473, Report No. ATC-8349, March 2002.

2. Aberdeen Proving Ground Soil Survey Report, October 1998.

3. Data Summary, UXO Standardized Test Site: APG Soils Description, May 2002.

4. Yuma Proving Ground Soil Survey Report, May 2003.

5. Survey of Munition Response Technologies, ESTCP, ITRC and SERDP, June 2006.

6. The Army Environmental Quality Technology Program A(1.6.a) UXO Screening, Detection, and Discrimination EQT-ORD, Office of the Assistant Secretary of the Army (ALT, I&E), April 2002.

APPENDIX I. ABBREVIATIONS

AC	=	alternating current
APG	=	Aberdeen Proving Ground
ASCII	=	American Standard Code for Information Interchange
ATC	=	U.S. Army Aberdeen Test Center
DMM	=	discarded military munitions
EM	=	electromagnetic
EMI	=	electromagnetic induction
EMIS	=	Electromagnetic Induction Spectroscopy
ESTCP	=	Environmental Security Technology Certification Program
EQT	=	Army Environmental Quality Technology Program
ERDC	=	U.S. Army Corps of Engineers Engineering Research and Development Center
EZ	=	easy
GPO	=	geophysical prove-out
GPR	=	ground-penetrating radar
GPS	=	Global Positioning System
GT	=	Ground Truth
IDA	=	Institute for Defense Analysis
JPG	=	Jefferson Proving Ground
MAG	=	magnetometer
MEC	=	munitions and explosives of concern
MTADS	=	multi-sensor towed array detection system
NRL	=	Naval Research Laboratory
POC	=	point of contact
QA	=	quality assurance
QC	=	quality control
ROC	=	receiver-operating characteristic
RTK	=	real time kinematic
RTS	=	Robotic Total Station
SERDP	=	Strategic Environmental Research and Development Program
SOTA	=	state-of-the-art
TTFW	=	Tetro Tech Foster Wheeler
USAEC	=	U.S. Army Environmental Command
UXO	=	unexploded ordnance
YPG	=	U.S. Army Yuma Proving Ground

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