# 5.0 Uncertainty

The following discussion describes uncertainties related to data, input scores, and land use.

## 5.1. Data Uncertainties

### 5.1.1. Detector Efficiency

All geophysical detection instruments have limitations. The Schonstedt GA-52/Cx limitations include its inability to detect non-ferrous items. Also, the detection capability diminishes with increasing distance from the instrument (e.g., increasing depth below ground surface). The uncertainties with the surveys and removals performed using this instrument detector are that non-ferrous MEC items may potentially remain at the site, as well as the potential for MEC items to remain at depth.

### 5.1.2. Detection Efficiency

The detection efficiency was used to help select the appropriate risk input scores for the depth and density of MEC potentially remaining at Parker Flats MRA. The detection efficiency was determined in a controlled test in which known items were 'seeded' in a test area. The procedures used in the test differed from the procedures used in the field surveys. For that reason, the following discussion elaborates on procedures used in the test versus the field implementation methods, to provide a context for the comparison of the equipment efficiency derived from the ODDS Seeded Test and other seed data, to actual field implementation procedures.

The equipment detection efficiency is based on the ODDS Seeded Test, supplemented by seed data from other sites where sufficient data were not available from the ODDS. In the ODDS, items were seeded to depths deeper than that expected based on the mode of deployment. Each detected anomaly was flagged and the flag locations assessed for accuracy against the known seeded item locations. If the flag was within a specified radius (1.6 feet and 3.2 feet) of the seeded anomaly, the flag was scored as a positive identification of the anomaly. No excavation was conducted as part of this effort.

During field implementation at Parker Flats MRA, anomalies detected using a Schonstedt GA-52/Cx instrument were investigated by excavating using the instrument to guide the excavation, thus refining and improving the effectiveness of pinpointing subsurface items. A contractor Quality Control Officer resurveyed 10% of each grid; and USACE personnel typically resurveyed 10% of each grid. The process used at the Parker Flats MRA during the removal actions should achieve a higher detection efficiency and subsequent removal efficiency because the removals were performed until all anomalies were resolved.

Data from investigations on other sites at Fort Ord were sought to provide a context for assessing the relevance and applicability of the ODDS results. Specifically, an investigation at another Fort Ord site was reviewed to provide insight into the performance of the ferrous-only detecting instruments compared to the non-ferrous detecting instruments. The 33-acre Munitions Response Site, Monterey County Site 2 (MRS MOCO.2) was subjected to a 100% survey and removal using the Schonstedt GA-52/Cx magnetometer from 2003 to 2004, using similar procedures to the Parker Flats study. The results of the Schonstedt surveys are summarized as:

- 551 MEC items removed (including 5 high explosive (HE) items)
- 1493 lbs of munitions debris were removed
- 457 of the 551 MEC items were found in the 20 burial pits discovered
- 32 of 33 seeded QC items were found (97% detection efficiency) and 19 of 20 QA-seeded simulation items were recovered (95% detection efficiency). The Quality Control/Quality Assurance (QC/QA) items were seeded to depths ranging from 1 to 14 inches.

The one QC-seeded item that was not recovered was a MKII practice hand grenade seeded to a depth of 10 inches. The lack of detection is attributed to the low mass of ferrous material in the hand grenade and the depth of the item. It should be noted there were 7 hand grenades seeded at depths of 7 to 12 inches in the QC/QA simulation. Of these, six were detected, including two at depths greater than 10 inches. This contrasts with the 1 in 5 hand grenades detected during the ODDS Seeded Test in the 7- to 12-inch depth interval. The difference in detection efficiency may be partially attributed to procedural differences in the approach for the MOCO.2 QC/QA test compared to the ODDS protocol. The MOCO.2 QC/QA test seeds were placed in the actual site area surveyed, and they were investigated by using the detection instrument to guide excavation, similar to the field procedures used at the Parker Flats MRA. In the ODDS, recovery was not conducted.

Subsequently the MOCO.2 area was surveyed using digital, non-ferrous detection instruments. A combination of individually operated and towed array EM61-MK2 electromagnetic metal detectors and G-858 magnetometers were used. This survey produced 7 MEC items and 43 lbs of munitions debris. (Draft Final Technical Information Paper Non-Time Critical Removal Action MRS-MOCO.2 (Phase 1), Parsons, June 2004.) Based on the total number of items detected, the percent detection efficiency of the Schonstedt survey is 93%, discounting for the items found in pits[3]. It should also be noted that the MOCO.2

[3] There were 94 items detected by the Schonstedt instrument that were not denoted as being in a pit out of the 551 items total detected by Schonstedt instruments. An additional 7 items were detected using the EM61 detector. The detection efficiency calculated using this set of data is 94 items detected out of a total 101 items found, which is 93%.

field survey utilized a 3-foot search lane compared to the 5-foot search lanes used in the Parker Flats MRA surveys.

Several factors increase the variance in the percent detection and MEC density calculations:

- A small sample size was used in determining the detection efficiencies. Because small sample sizes are associated with large variances, the actual detection efficiencies and MEC densities could be far higher or far lower than the estimates.
- The location of MEC items identified in the Parker Flats MRA indicates a heterogeneous distribution of items, which may increase the variability.
- The detection efficiencies were extrapolated from studies performed in several settings at locations outside of the Parker Flats MRA. These locations will have different physical properties than Parker Flats MRA and will increase the variability associated with the detection efficiencies.
- The detection efficiencies for different items from the studies were combined to determine the average detection efficiency for those items not included in the seeded studies.
- The detection efficiencies from some items were extrapolated to other items with similar characteristics; however, the detection efficiencies cannot be considered exact matches for those items.
- As discussed in Section 3.5.2.2 of Volume I: Remedial Investigation, there are limitations in the use of Schonstedt magnetometers. These limitations may increase the uncertainty of the density calculations.

Given these factors, the MEC Density calculations may be higher or lower than the numbers provided in Tables 4-1 and 4-2."

In summary, although the methodology of the ODDS Seeded Test is not identical to the field method used for the geophysical investigation, overall the ODDS Seeded Test and supplementary seed studies used in the RI equipment evaluation are considered conservative in estimating the detection efficiency achieved in the field.

#### 5.1.3. Uncertainties of the Calculation of MEC Density

As discussed earlier, the determination of the MEC Density is an estimate of the items potentially not detected by the detection equipment. The back-calculation of the potential MEC present after the removal using a percent detection value is not a definitive method for precisely determining MEC density. The purpose of calculating a potential residual density is to estimate a MEC Density input factor of high, medium, or low, as it relates to risk of exposure, not to conclude the actual number of items which may or may not be on the site.

The percent detection values were developed from available and relevant equipment performance data. However, the equipment performance data available do not provide a statistically sound basis for determining a Pd. The number of data points is limited, increasing the variance of the data set. Developing a data set sufficient for statistical application would require an extensive study of equipment performance for each type of MEC item found at the site at each depth interval. The value of such a study is questionable given that only two numbers of MEC Density have an affect on the risk score (i.e., less than 0.1 items per acre gives a score of low and greater than 1.0 items per acre gives a score of high). The purpose of the risk score is to characterize and estimate the potential risk sufficiently for the evaluation of feasibility study alternatives, such as the selection of institutional controls. Therefore, although not statistically defensible, the mathematical calculation of potential residual MEC density is considered adequate to provide a theoretical estimate of the number of MEC items for use in assessing exposure and the potential change in exposure.

Also, the estimate of MEC density in deeper intervals after-action is likely overestimated. This is caused by using equipment performance data collected on items seeded at depths exceeding those anticipated for that type of item. For example, the maximum penetration depth anticipated for 60-mm projectiles is 1.2 inches (See RI equipment evaluation table). Four 60-mm projectiles were seeded at depths greater than 12 inches as a conservative test of the equipment performance. None of these items were detected. This equipment performance data was consolidated with the other detection results to produce an aggregate Pd for the greater than 12-inch depth interval. The risk assessment approach currently applies this aggregate Pd to all MEC types for which a unique Pd is unavailable (e.g., 'other' MEC). When used in the back-calculation of MEC, the result is a higher estimate of residual MEC density.

The exclusion of items found in burial pits adds to the uncertainty in the potential residual density. The data used to calculate detection efficiency is not applicable to burial pits in the estimation of potential residual density at Parker Flats because the ability to detect multiple items in a single location is higher than the ability to detect one seeded item. The field procedure was to continue using the detection instruments as excavations proceeded for all detected items, resulting in better performance than demonstrated in the controlled studies for single seeded items. The increased amount of metal items at pit locations would increase detection ability above what was determined from the seeded tests; therefore, potential for residual burial pits is significantly lower than the potential for residual single items. Because of the factors addressed above, the removal of items detected in pits from the calculation of potential residual densities is considered appropriate.

The distribution of MEC and MD at Parker Flats MRA does not exhibit the patterned characteristics of a target range with identifiable and consistently-used targets, due to multiple uses over many years. This lack of a distinct pattern of distribution of MEC increases the uncertainty in calculation of potential residual density.

It should be noted that the theoretical potential after-action MEC Densities in the various reuse areas within the depth intervals of interest, varied from 3.5 items per acre to 0.003 items per acre, with many values an order of magnitude below the lowest number used to determine a MEC Density score (0.1 items per acre). In addition, the potential residual MEC Density in the depth interval closest to the surface has been reduced significantly as evidenced by the volume of items removed coupled with the higher detection efficiencies in the near-surface intervals. According to the RI/FS Section 3.4.3, most of the MEC and MD items should have been located in the top one to two feet of the soil based on the mode of deployment. Therefore, for the receptors intruding deeper than one-foot (e.g., construction workers), the majority of the MEC items would have been removed (from the top 2 feet) and the resulting Overall MEC Risk, based on the potential residual MEC Density, is likely overestimated.

In summary the decrease in risk is not sufficiently reflected in the scoring due to the uncertainty in the data as the Depth Below Ground Surface increases.

## 5.2. Uncertainties for Additional Input Factors

This section discusses the potential uncertainties and the resulting change in the Overall MEC Risk for each of the input factors used to determine the risk at the Parker Flats MRA, except for MEC Density, which is discussed in Section 5.1.

### 5.2.1. Depth Below Ground Surface Uncertainties

In general, the Depth Below Ground Surface of the MEC items found at the site is a simple score for the baseline analysis of the MEC risk. However, for MRS-13B, 82 out of 129 of the findings reported from the survey and removal did not have a depth given in the records. Depths were assumed for this risk assessment by determining the range of depths that MEC and MD items were found at MRS-13B and at comparable MR sites, including MRS-13C, MRS-37, MRS-50, MRS-50EXP, MRS-54, and MRS-55. These sites were chosen based on the types of items found during survey and removal activities and based on similar historical uses and terrain. As discussed in Section 2.2, the number of items found in each depth interval were counted and a percentage was applied to the items in MRS-13B without recorded depths to determine a depth interval. If only one or two items were found in MRS-13B without recorded depth, the depth interval was applied based on the median depth. Table 2-2 gives the depth distribution for specific MEC items used to assume depths for the items in MRS-13B. The depth of burial pits was determined by counting the number of burial pits in each interval of MRS-13B and applying an interval based on the percent distribution. Attachment B shows the range of depths used for the items without a recorded depth below ground surface.

Additional complications arise when attempting to score this input factor for the after-action analysis. This analysis assumed a score of 6 (MEC $\geq$ 1 foot bgs) for all areas where receptors were expected to intrude below the ground surface. Because sufficient data was available to determine whether items were present below the surface in the baseline scenario for MRS-13B, the score of 6 is applicable, and the effect of the missing depth information is negligible. Considering the discussion of data uncertainties in Section 5.1 (MEC Density), the actual depth of any potential MEC items, which may be none, is impossible to determine. This score overestimates the likely depth of any potential MEC items, and therefore, overestimates the Overall MEC Risk.

A MEC Depth score of 6 was chosen for the after action scenario for all of the areas having a receptor with a Level of Intrusion greater than one foot bgs. A MEC Depth score of 6 describes an area where "any MEC items remaining at the site are at a depth of 1 foot or greater." This approach likely overstates the risk because no anomalies were left uninvestigated by USA Environmental within the Parker Flats MRA.

### 5.2.2. Migration/Erosion Potential Uncertainties

The Universal Soil Loss Equation is used to derive the number of inches per year of erosion is expected at the Parker Flats MRA. The uncertainty in using this calculation to determine the level of erosion involves the changes in land surface due to human activities at the site. It is possible that the erosion potential in specific areas of the Parker Flats MRA is higher than this estimate, which could increase the Overall MEC Risk. However, Migration/Erosion Potential was found to be only a modifying factor in the development of the Protocol, so it is assumed that the change in the risk score would be minor.

### 5.2.3. Level of Intrusion Uncertainties

The Level of Intrusion and the Depth Below Ground Surface input factors are closely related in the scoring of the Overall MEC Risk. Specifically, the Accessibility Factor depends on the depth between the level of intrusion and the shallowest MEC item expected on the site. As the interval between the Level of Intrusion and Depth Below Ground Surface decreases less than one foot, the Accessibility Factor score increases. This implicit one-foot buffer may overestimate the actual risk at the site, because in practice, the activities of a receptor may potentially not contact a MEC item even if the buffer is less than one foot. Therefore, if a receptor intrudes more than is assumed in this analysis, the Overall MEC Risk may or may not be underestimated. However, if a receptor does not intrude to the level assumed in this analysis, the Overall MEC Risk is overestimated.

Another consideration in the uncertainty of the Level of Intrusion scoring is the method used for intruding below the ground surface. If a receptor is using mechanical equipment to dig at the site, in some cases, the risk may be greater than if the receptor is using hand tools. This would be because the mechanical equipment would reach a potential MEC item faster than a shovel and the pressure of an impact would be greater.

#### 5.2.4. Frequency of Entry Uncertainties

An individual receptor is more likely to come in contact with a MEC item if they are at the site often than if they rarely go to the site. This factor is a measure of the number of times per year that the receptor will be in an area potentially containing MEC. It is difficult to estimate how often individual receptors will be in the former Parker Flats MRA. The Overall MEC Risk score increases with the Frequency of Entry. Therefore, if a receptor is at the site more times per year than assumed in this risk assessment, that is, if they have a higher Frequency of Entry, then the Overall MEC Risk for that receptor given in Section 4 may underestimate the actual risk. In the same way, if the receptor visits the site fewer times per year than assumed in this analysis, the Overall MEC Risk score may be lower than what is shown in Section 4.

#### 5.2.5. Intensity of Contact with Soil Uncertainties

For an individual receptor to come in contact with a MEC item, they will need to be in contact with the medium where the MEC is located. This factor is a measure of the length of time the receptor will have in contact with the exposure medium. It is difficult to estimate what the activities of the individual receptors will be in the future use of the Parker Flats MRA. The Overall MEC Risk score increases with the Intensity of Contact with Soil. Therefore, if a receptor spends more time in the area than assumed in this risk assessment, that is, if they have a higher Intensity of Contact with Soil, then the Overall MEC Risk for that receptor given in Section 4 may underestimate the actual risk. In the same way, if the receptor spends less time on the site than assumed in this analysis, the Overall MEC Risk score may be lower than what is shown in Section 4.

### 5.3. Overall MEC Risk Score Uncertainties

The uncertainties for the input factors discussed in Sections 5.1 and 5.2 may overestimate or underestimate the Overall MEC Risk score on an individual basis. Inputs to the risk protocol reflect the uncertainty regarding the density of MEC items remaining at the site. The MEC Density inputs are based on the MEC items found and the estimates of equipment detection efficiencies. The estimate of equipment detection efficiency is expected to be lower than the actual field detection efficiencies as described in Section 3.5.2.2 of Volume 1: Remedial Investigation. Page 67 of Volume 1: Remedial Investigation summarizes the reason that the detection efficiency was likely higher than that used in the Risk Assessment: the ODDS used a 1.6 foot search radius, over 163,000 excavations were performed as part of the removal action in Parker Flats MRA, the Schonstedt is capable of detecting 37mm better than the detection efficiency numbers as demonstrated at MOCO.2, and typical depth distribution of the items are shallower than the ordnance depth distribution used in ODDS.

Although all MEC items found during the 100% survey of Parker Flats were removed, the after-action risk results for receptors with a Level of Intrusion greater than one foot below ground surface are the same as the baseline risk in 7 of the 9 reuse areas. In other words, the reduction in risk from removing the MEC items found during the survey of 100% of the area is not reflected in risk score. The fact that the risk reduction provided by the removal action often is not reflected in the risk scores is an indication of the conservative nature of the risk protocol in characterizing the potential remaining MEC risk at the site. Therefore, in the opinion of the Army, the risk results provide a conservative profile of the potential risk remaining at Parker Flats MRA.