

Substances Pollution Contingency Plan (NCP) criteria that must be considered with respect to each sector in order to

determine the best response for that sector. These criteria are implementability, effectiveness, and cost. There is no specific requirement for evaluation of statistics in the NCP criteria.

a. The UXO statistics are used to determine the nature and extent of UXO in a sector so that an intelligent decision concerning response action can be made. There are no standards, however, which define an acceptable level of precision for the statistic or at what level of sector UXO a given decision is appropriate (e.g., there is no standard that states that a removal response action must occur when density is "x").

b. The amount of sampling required to support the decision-making process is highly variable. At some sites, very little sampling is needed to determine what the appropriate response action should be. At others, much more sampling is required. The amount of sampling that should be performed at a site depends on the estimate precision required for each sector, the budget available to perform the sampling, alternatives that are to be considered for each sector, and many other variables. It is the responsibility of the OE team to determine what sampling must be done and whether or not the EE/CA budget can meet the sampling requirement.

4. When Not to Use the USAESCH Statistics. The USAESCH-developed statistics should not be used to search for pits, to search for random burials, and in dynamic environments (i.e., environments in which the amount of UXO is changing, such as a beach area). The statistics assume that the sample is representative of the population, and this may not be true for those cases cited, and possibly others. The OE team should make the determination that the statistics are proper to use for the particular site in question. If there are questions concerning the appropriate statistic to use for a site, then the team should contact the USAESCH OE MCX for advice.

5. When Should a Sample be Taken? The USAESCH-developed statistics assume that there is a probability of finding UXO. If there is no proof that OE has ever been fired into the area under investigation, a statistical approach may not be necessary. Sampling is expensive and should be used only when the results are likely to justify the expense. The team should determine if there should be some exploratory sampling (sampling that is not statistically sufficient but is logically sufficient) if it is determined that sampling is required in an area where there are no historical indicators of OE. The team may choose to randomly sample 0.5 to 1 percent on the surface to see if there are any indications of OE scrap. If there are no such indications, there may be no need to perform statistical sampling for the sector at all.

6. UXO Statistical Process. Following is the current process used by USAESCH to determine the appropriate UXO statistics for OE sectors.

a. Predefine Sectors. The first step in the UXO statistical process is to break the site into statistical sectors. A statistical sector is an area that contains similar UXO items due to historical operations within its boundaries, plus a buffer zone. The team should review the Archives Search Report (ASR), look at site maps, and perhaps visit the site to aid them in drawing these sectors. The team should develop a large site map and show the sectors on that map. Each sector should be given a unique identifier for tracking throughout the process. The size of each sector must be known. The buffer zone should constitute approximately 2 percent of the area and should be uniform around the sector.

b. Determine Statistical Method to be Used. The team should determine what statistical method will be used for each sector of the site. This determination will be based on the results of sector predefinition as discussed in paragraph a above, the technology to be used, the size of the sector, the ultimate goal of the statistic, and the budget available for sampling. For instance, if there are areas identified in the ASR as having potential or confirmed UXO, then some thought should be given to performing a statistical sampling to determine if there is UXO in the sectors in question. If the ASR does not show potential or confirmed UXO, then the sectors in question should be excluded from the statistical survey unless there are other reasons for sampling. There are two methods currently used by USAESCH to determine the statistics at an OE site - the UXO Calculator method and the Site/Grid Statistical Sampling Based Methodology (SiteStats/ GridStats) method. The team should decide which method is appropriate for its use. If the primary purpose is to prove that there is little or no UXO in a sector, then the UXO Calculator method should be used. If the primary purpose is to determine the amount of UXO in a sector known to be contaminated, then either method is appropriate. If a geophysicist is selecting anomalies of interest, then the UXO Calculator method should be used unless approval is given by the USAESCH OE MCX to use another method. (The standing operating procedure (SOP) for statistical estimation of UXO at OE sites is presented as appendix C. The SOP for SiteStats/ GridStats is too voluminous for inclusion as an appendix to this document. Contact Mr. James Manthey (256-895-1588) to obtain copies of the SiteStats/GridStats SOP.)

(1) UXO Calculator Method. The UXO Calculator method consists of the following:

(a) Establish a target value. A target value is determined for the sector. This value is dependent upon the future land use and site requirements. The recommended target values are (90-percent confidence that there are less than):

1 0.1 UXO per acre - public usage of the land is significant (more than 20 people a day will be on the land on average).

2 0.5 UXO per acre - public usage of the land is moderate (between 5 and 19 people a day will be on the land on average).

3 1.0 UXO per acre - public usage of the land is minor (fewer than 5 people a day will be on the land on average).

The purpose of the target value is to show that there is not a significant amount of UXO in the sector. The target values differ because we must be more certain of the statistical values as the number of people who could be exposed to the UXO increases. Module 6 of UXO Calculator can be used to determine this value for a given sector size. The statistical statement being made is that given this target value, there is less than a 90-percent chance that there is this amount of

UXO in the sector or a UXO item would have been found. If a UXO item is found, the target value is not necessarily incorrect; however, the intent (to show that there is no UXO) has been defeated.

(b) Determine the amount of sampling required to meet the target value. The team should use module 6 of UXO Calculator to determine the sector-specific sampling requirement. (Appendix D provides examples of sampling requirements for UXO Calculator and SiteStats/GridStats given various sector sizes and target values.) UXO Calculator is not a linear statistic, so one should not interpolate, but, rather, use the computer program or call USAESCH for assistance if the sector size required is not shown.

(c) Determine budget constraints. If there are budget constraints, a decision must be made as to whether or not to pursue more funds or to accept a lesser assurance.

(d) Determine other stopping requirements. The sampling process is sequential (i.e., whether or not a subsequent sample is taken depends on the results of the current sample). If no UXO is expected but UXO is encountered, then other stopping criteria should be invoked. For instance, assume that one has a 100-acre sector and a 0.1 UXO per acre target value. This scenario would require sampling of 20.6 acres to show that there is no UXO in the sector. If our first sample is a 100- by 100-foot grid and a UXO item is found, then our initial purpose is no longer valid. There is UXO in the sector, and our purpose now is to determine how much. When this scenario develops, USAESCH recommends:

- 1 Sampling of 5 percent when sectors are between 0 and 50 acres.
- 2 Sampling of 2 percent for sectors of 50-100 acres.
- 3 Sampling of 1.5 percent for sectors of 100-150 acres.
- 4 Sampling of 1 percent for sectors of 150-1,000 acres.
- 5 Sampling of 0.5 percent for sectors greater than 1,000 acres.

Identifying the sector-by-sector requirements will indicate the maximum sampling. As some sectors may require maximum sampling and others much less than maximum sampling, the OE team may want to establish a base amount of sampling (using, for example, 2 percent as an estimate) and then have options for additional sampling as required. Sampling should begin with the largest sectors and proceed to the smaller ones. Large sectors require fewer samples (per unit) than do small sectors, and when the stopping criteria are met, the sampling not utilized will be available for use elsewhere on the site.

(e) Determine where the samples will be taken. The team should determine where the samples will be taken. A map showing areas to be sampled should be developed and updated as progress continues on the site. The map should show what areas are to be investigated, what areas have been investigated, where UXO has been found, and where OE-related scrap has been found.

(f) Determine homogeneity. The team should use the hopkins statistic (see appendix A) to determine if the sector is homogeneous. Further, the team should use engineering judgment to support the hypothesis. If the sector is determined to be non-homogeneous, it should be broken down into two or more subsectors. These subsectors will be treated as individual sectors and have to meet all the requirements for individual sectors discussed above. If the hopkins statistic has not yet determined that a site is homogeneous or nonhomogeneous but the target value sampling has been completed (very seldom should this happen, but it is a possibility), contact the USAESCH OE MCX for assistance.

(g) Develop confidence interval. The team should develop a 90-percent confidence interval, showing the results of the sample. See appendix B to determine how to perform a hand calculation, or use UXO Calculator to determine the interval.

(2) SiteStats/GridStats Method. The SiteStats/GridStats method consists of the following:

(a) Determine the amount of sampling required to establish a SiteStats homogeneity conclusion (see the SiteStats/GridStats SOP) for each sector.

(b) Select the areas that will be sampled.

(c) Use the SiteStats/GridStats program to terminate sampling or terminate based on other criteria in the field.

(d) Write a statistical report. The report should use the negative binomial distribution to determine the confidence limits for the sector density estimate. Further, the report must state whether the sector is or is not homogeneous and what criteria were used to make that determination.