2.0 Data and Data Usability

The data used to support the risk assessment at the Parker Flats MRA can generally be categorized as site-condition data or future land use data. This section focuses on the site-condition data and Section 3.0 discusses future land use data. To understand the distinction, Table 2-1 identifies the risk protocol input factors and category of data that supports each.

Table 2-1. Category of Data Supporting Each Input Factor

Overarching Factor	Input Factor	Category	
		Site Condition	**Future Land Use**
Accessibility	Depth Below Ground Surface	●	
	Migration/ Erosion Potential	●	
	Level of Intrusion		●
Overall Hazard	MEC Hazard Type	●	
Exposure	Frequency of Entry		●
	MEC Density	●	
	Intensity of Contact with Soil		●

In addition to the information presented in the RI/FS report, sources of information used to support the risk assessment included:

- The Fort Ord database of field survey data, including the MEC items identified and removed during the survey, and the survey coordinates of each MEC item.
- Geographical Information System (GIS) data from the Fort Ord GIS repository, containing general information on the site and base maps.
- The Soil Survey Geographic (SSURGO) data base developed by U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), containing information on soil structure and type.
- United States Geologic Service (USGS) Digital Elevation Model, which provided elevation and slope information used to determine the Migration/Erosion Potential input scores.

The remainder of this section describes the usability of the data and the approach for deriving the information needed to select input scores for the site-condition-related input factors.

2.1. Data Usability

Usable data is defined as data with sufficient quality for use in the project decision-making process. The evaluation of the usability of data collected during the RI is presented in Appendix A of the RI/FS Report, "Evaluation of Previous Work." An evaluation of the equipment performance is presented in RI/FS Report Section 3.5.2.2, Equipment Review (hereinafter referred to as "the RI equipment evaluation"). The RI equipment evaluation and the evaluation of previous work concluded that the survey and removal data are usable to base decisions on considering the constraints of detection. Those constraints are that only a ferrous-detecting instrument (e.g., Schonstedt GA-52/Cx) was used in the field surveys, and that detection efficiency decreases with depth. Further discussion is presented later in this section to elaborate on the type and scope of uncertainties related to the data used and the subsequent risk scores.

2.2. Data Used

2.2.1. MRA Investigations

Field data was collected during the site surveys and removals that were conducted at Fort Ord beginning in 1994. Surface and geophysical surveys were conducted across a portion of the MEC sites of concern and all MEC items found were removed. As discussed in Volume 1, according to the November 30, 2001 *Grid Sampling & OE Removal Inland Range Contract Closure After Action Report – Former Fort Ord* (USA, 2001) prepared by USA Environmental (USA) to document activities conducted between June 1996 and 2000, USA actively pursued the investigation of all anomalies encountered during 4 foot removal operations. If an anomaly was detected below 4 feet, permission from the USACE OE safety specialist was obtained prior to continuing the investigation. The report also states "This statement is made to ensure personnel reading this document do not believe any anomalies detected by the Schonstedt 52Cx magnetometer were left uninvestigated in an OE site that a 4 foot removal was performed".

Based on this statement, no anomalies detected above or below 4 feet were left in place within the Parker Flats MRA in areas where work was completed after June 1996. All removal activities within the Parker Flats MRA were conducted after June 1996 with the exception of a portion of MRS-13B. It should be noted, however that all anomalies detected within MRS-13B were within the top 4 feet (USA, 2001). Based on this information, no anomalies were left uninvestigated by USA Environmental within the Parker Flats MRA.

Throughout the surveys and removals Schonstedt instruments were used to detect MEC and munitions debris (MD). Over the course of these studies, over 14,000 MEC and MD items were discovered and removed including more than 2,800 MEC items.

The field data identifying the MEC items found on the Parker Flats MRA is summarized in Attachment B, Tables B-1 through B-11. This data served as the basis for munition type, density, and depth inputs for the Parker Flats MRA risk assessment. All MEC items found during the survey and removal activities were included in this risk assessment, with the exception of the partial CAIS kits and two additional incidental items found in MRS-13B. The CAIS kits are not included in this assessment because the purpose of the Fort Ord MEC Risk Assessment Protocol is to analyze MEC risks. Chemical materiels were specifically not included in the Protocol. The two incidental items found in MRS-13B that were not include in this analysis were one 20 mm HE incendiary projectile M53A3 and one 40 mm HE projectile M384. As discussed in the RI, Section 3.4.3, these two items do not show a pattern of use (no other MD found from these types of items) in MRS-13B and; therefore, are excluded from consideration in the risk assessment.

Depth information for some items found in MRS-13B were determined based on the depth information for similar items in MRS-13B and from depth information for similar items at other MR sites with the same type of munition use and the same type of terrain. Table 2-2 gives the median and the distribution of depth for each munition type used to apply an assumed depth range to the items in MRS-13B without recorded depths. These distributions were determined by counting the number of items of each munition type found in one foot depth intervals (0-12 inches, 13-24 inches, etc.) and calculating a percentage of items found in each of those intervals. A depth interval was then applied each of the items in MRS-13B without recorded depths by applying the percentage found for each interval to the number of items without recorded depths. If only one or two items were found in MRS-13B without recorded depth, the interval of the median from Table 2-2 was applied. Depths of items found in burial pits were assumed based on the distribution of other burial pits in MRS-13B. That is, all of the burial pits were counted from MRS-13B and a percentage was calculated for each depth interval. These percentages were then applied to the burial pits found without recorded depth information.

In addition to the data from the field surveys and removals, data on the equipment performance were used to assess both the potential depth and density of MEC potentially remaining onsite. The equipment used to detect MEC is evaluated in the RI. The following sections summarize the RI equipment evaluation as it applies to both MEC depth and MEC density.

Table 2-2. Depth Distribution Used to Determine Depth for MRS-13B Items With No Recorded Depth

MM Items	Surface	0-12 inches	13-24 inches	25-36 inches	37-48 inches	49-60 inches	>60 inches	Median (inches)
Flare, surface, trip, M49 series*	10%	50%	40%	0%	0%	0%	0%	6
Fuze, grenade, hand, M204 series*	11%	89%	0%	0%	0%	0%	0%	6
Fuze, grenade, hand, practice, M205 series*	0%	89%	11%	0%	0%	0%	0%	2
Fuze, grenade, hand, practice, M228*	50%	50%	0%	0%	0%	0%	0%	3
Grenade, hand, practice, M30*	0%	62%	38%	0%	0%	0%	0%	8
Grenade, hand, practice, MK II*	0%	75%	25%	0%	0%	0%	0%	8
Grenade, hand, smoke, M18 series*	0%	50%	50%	0%	0%	0%	0%	9
Grenade, rifle, smoke, M22 series*	0%	100%	0%	0%	0%	0%	0%	4
Signal, illumination, ground, M126 series*	0%	69%	31%	0%	0%	0%	0%	6
Signal, Illumination, Ground, Parachute, White Star M127*	0%	100%	0%	0%	0%	0%	0%	3
Cartridge, ignition, M2 series*	0%	71%	29%	0%	0%	0%	0%	6
Cap, blasting, electric, M6**	0%	65%	18.5%	18.5%	0%	0%	0%	6
Cartridge, ignition, M2 series**	4%	69%	4%	4%	0%	19%	0%	6
Firing device, pull, M1**	0%	100%	0%	0%	0%	0%	0%	2
Firing device, release, M5**	0%	100%	0%	0%	0%	0%	0%	1.5
Fuze, grenade, hand, practice, M228**	1%	87%	10%	1%	1%	0%	0%	2
Fuze, mine, antitank, practice, M604**	0%	100%	0%	0%	0%	0%	0%	4
Grenade, hand, Illumination, MK I**	2%	90%	4%	2%	2%	0%	0%	4
Grenade, hand, practice, M69**	0%	86%	7%	0%	7%	0%	0%	5.5
Grenade, hand, smoke, HC, AN-M8**	0%	75%	15%	10%	0%	0%	0%	5
Pot, 2.5llb and 10lb, smoke, HC, screening, M1**	0%	37.5%	37.5%	12.5%	12.5%	0%	0%	14
Pyrotechnic mixture, illumination**	14%	36%	21.5%	7%	21.5%	0%	0%	4
Signal, illumination, ground, M125 series**	6%	92%	2%	0%	0%	0%	0%	2
Signal, smoke, ground, parachute, M128A1 series**	0%	33%	0%	0%	0%	67%	0%	25
Simulator, explosive boobytrap, flash, M117**	0%	33%	67%	0%	0%	0%	0%	9.5

* MD and MEC data from MRS-13B used to determine depth intervals.
** MD and MEC data from MRS 13C, 37, 50, 50 EXP, 54, and 55 used to determine depth intervals.

2.2.2. Detection Efficiency

For the purposes of the risk assessment, the detection efficiency demonstrated with the Schonstedt GA-52/Cx serves as the basis for estimating the potential depth below ground surface (bgs) and density of MEC potentially remaining onsite because this is the instrument that was used during the Parker Flats MRA survey and removal. The detection efficiency for the Schonstedt surveys at Fort Ord was evaluated in an Ordnance Detection and Discrimination Study (ODDS) (Parsons, 2001). In the ODDS Seeded Test, inert ordnance items were seeded in a test area, and the contractor conducted a survey of the area, flagging anomalies detected by the Schonstedt. A flag placed within a specified radius of the item (1.6 foot and 3.2 foot radii) was considered a positive find. The results of the ODDS Seeded Test are further described in the RI equipment evaluation in the RI/FS Report Section 3.5.2.2, and detection efficiencies by depth interval and by type of item are presented in that section. A discussion of the ODDS Seeded Test and a comparison to the procedures used in the field surveys is presented later in this document in Section 5.1.2.

Because the risk assessment is based on the potential hazard remaining at the site, the percent detection (Pd) is used to back-calculate an estimate of MEC potentially remaining at the site. This calculated density estimate is a theoretical number used to determine the score of the MEC Density input factor in the Protocol. This theoretical number is not and should not be interpreted as an actual number of potentially remaining MEC items; it is only used to show a change in the potential density of MEC items before and after a removal action. Because there is no established way to determine the actual number of items that may be at a site (that is, there is no way to know the source term), it is impossible to determine if any items remain at the site, or provide an accurate count of the items remaining.

As presented in RI Section 3.5.2.2, detection efficiencies were calculated for MEC items by combining the information gathered in seeded studies in the ODDS and at Del Rey Oaks and found at the Parker Flats MRA. Detection efficiencies were developed by depth interval to account for differences in detection capability at various depths. For the purposes of the risk assessment, Pds were used for each MEC type and depth interval with seed results. MEC types with no items seeded in a specific depth interval were applied an overall Pd for that depth interval. For MEC types not included in the ODD or Del Rey Oaks studies, the overall Pd was used. A Pd was developed for the 0- to 6-inch, 7- to 12-inch, and greater than 12-inch depth intervals. Because the actual Pd for the removal action at Parker Flats is unknown and the Pd values used to determine density are based on a small number of seeded items, the efficiency used to calculate density could be higher or lower than the actual field efficiency and is considered a best estimate based on available data.

Table 2-3 presents the table from RI Section 3.5.2.2 used as a basis for determining Pd for the risk assessment. The results of consolidating the data from all the seeds (considered in the RI equipment evaluation) are summarized in Table 2-4.

Table 2-3. Percent Detection for Depth Intervals from Section 3.5.2.2 of RI

MEC Type	Max Pen. Depth[4] (in)	Pd for Depth Interval bgs[1]					
		0-6 in	7-12 in	13-24 in	25-36 in	37-48 in	>48 in
Rocket, 2.36-inch	4.8	100% (1)	100% (2)	60% (5)	0% (2)	*NE*	*NE*
Rocket, 35mm Subcaliber	6	100% (5)	100% (5)	75% (4)	0% (1)	*NE*	*NE*
Projectile, 37mm	46.8	100% (3)	50% (2)	17% (6)	0% (2)	*NE*	*NE*
Projectile, 60mm Mortar[3]	*13.2*	*100%*	*50%*	0% (3)	0% (1)	*NE*	*NE*
Projectile, 75mm	*58.8*	*100%*[2]	100% (3)	100% (1)	0% (3)	0% (1)	*NE*
Hand Grenade	*NP*	100% (4)	50% (8)	*NE*	*NE*	*NE*	*NE*
Rifle Grenade	*1.2*	*100%*[2]	100% (2)	33% (3)	0% (1)	*NE*	*NE*
Signal Illumination Flare	*NP*	88% (8)	60% (10)	50% (2)	*NE*	*NE*	*NE*
Projectile, 3-inch Stokes	Unknown	100% (1)	100% (1)	100% (3)	100% (3)	0% (4)	0% (5)

NE = Not Evaluated
NP = Non-Penetrating – Items expected on the surface only.
[1]The number of items seeded in the depth interval is included in parentheses.
[2]100% Pd is assumed in depth intervals with no seed items when the next deeper depth interval has a 100% Pd.
[3]The values for the 60mm Mortar above 12 inches are based on the results of Hand Grenade seeds at the ODDS because the shallowest seeded 60mm Mortar was 18 inches bgs. The 60mm Mortar is approximately the same weight and diameter as the MkII seeded Hand Grenades and both are made from ferrous material.
[4]Maximum penetration depths are from the penetration study conducted as part of the Phase II EECA.

Table 2-4. Percent Detection for Depth Interval (Number of Seeded Items)

MEC Type	Max Pen. Depth[5] (in)	Pd for Depth Interval bgs[1]		
		0-6 in.	7-12 in.	>12 in.
Rocket, 2.36-inch	4.8	100% (1)	100% (2)	43% (7)
Rocket, 35mm Subcaliber	6	100% (5)	100% (5)	60% (5)
Projectile, 37mm	46.8	100% (3)	50% (2)	13% (8)
Projectile, 60mm Mortar[3]	*13.2*	*100% (0)*	*50% (0)*	0% (4)
Projectile, 75mm	*58.8*	*100% (0)* [2]	100% (3)	20% (5)
Hand Grenade	*NP*	100% (4)	50% (8)	*32% (0)* [4]
Rifle Grenade	*1.2*	*100% (0)* [2]	100% (2)	25% (4)
Signal Illumination Flare	*NP*	88% (8)	60% (10)	50% (2)
Projectile, 3-inch Stokes Mortar	Unknown	100% (1)	100% (1)	40% (15)
All Items[4]	Not Applicable	95% (22)	73% (33)	32% (50)

NP = Non-penetrating - Items expected on the surface only.
[1] Number of items seeded is shown in parentheses.
[2] Used Pd in the next deeper interval in lieu of data for this depth interval.
[3] Assumed that 60-mm mortar projectiles had approximately same Pd as hand grenades, based on similar size and ferrous content. See RI Equipment Evaluation.
[4] Used the aggregate value for all items evaluated in lieu of seed results for this item in this depth interval.
[5] Maximum penetration depths are from the penetration study conducted as part of the Phase II Engineering Evaluation/Cost Analysis (EECA).

Following is a discussion of the approach for selecting the MEC Hazard Type, MEC Density, MEC Depth, and Erosion Factors.

2.3. MEC Hazard Type

The MEC Hazard Type was determined by a team of military munitions and MEC qualified specialists, using the definition of the four hazard types:

Score	Description
0	Inert, will cause no injury
1	Will cause an injury, or in extreme cases could cause major injury or death to an individual if functioned by an individual's activities
2	Will cause major injury or in extreme cases could cause death to an individual if functioned by an individual's activities
3	Will kill an individual if detonated by an individual's activities.

The MEC hazard type is not variable and provides reliable input for the Parker Flats MRA risk assessment.

2.4. MEC Density Input Factor

The MEC density input score represents the potential density (items per acre) of MEC potentially remaining on the site in a depth interval that is likely to be accessed by a receptor. The MEC Density scores in the Protocol are high (>1.0 items per acre), medium (between 1.0 and 0.1 MEC items per acre), and low (<0.1 MEC items per acre). Potential MEC density is estimated for both baseline and after-action conditions because it is an input factor used for the purposes of estimating and developing an exposure input score. Because the potential MEC density is estimated by depth interval (surface, 0 to 1 foot, 0 to 2 foot, etc.), the missing depth information in MRS-13B affects the resulting MEC Density scores. If the assumed depth is changed, the potential MEC density would likely change. Depending on the number of items found without depth information, changing the assumed depth could change the resulting MEC Density scores. The following discussion focuses first on the after-action potential MEC density estimate followed by the approach for determining the baseline MEC density estimate.

2.4.1. Selection of Approach for Estimating Potential MEC Density

One hundred percent of the grids within the Parker Flats MRA were surveyed and 100% of the items detected with the Schonstedt were removed to the depth of detection. The removal action was designed to address MEC at a depth of four feet below the ground surface; however, per the RI, approval was given to investigate anomalies at depths greater than four feet. During the survey, all of the items that were found were removed, which corresponds to a score of "1" for the MEC Density input factor, if all data quality objectives (DQOs) are met or if the Base Closure Team (BCT) agrees that it is appropriate. However, the work was performed before it was standard practice to establish DQOs for MEC surveys/removals. Because there were no DQOs in place at the time of the fieldwork, the quality of the data was evaluated using the "Evaluation of Previous Work Checklist" (Appendix A to the RI/FS Report). The Evaluation of Previous Work Checklist, Results of Removal Evaluation question "A" concluded "that the data can be used for performance of the risk assessment. The uncertainties related to instrument detection efficiencies should be considered when performing the risk assessment." Given the limitations on the detection efficiency, it is presumed that there is a potential for MEC items to remain onsite. The number of items remaining onsite is unknown. However, a theoretical estimate can be deduced based on the performance profile of the detection instrument, and the general distribution of items on the site.[1]

The following formula is used to estimate the potential residual density of MEC items by depth interval for use in estimating changes in potential exposure for a receptor. For the risk assessment purposes,

$$\text{Potential Residual Density [number/acre]} = \frac{\left(\frac{1}{\text{Pd}} - 1\right) \times (\text{Number of Items Found - Number of Items Found in Pits})}{\text{Acres surveyed}}$$

Where:

- Potential Residual Density = the potential number of MEC items remaining at the site in number per acre.
- Pd = the detection efficiency of the survey equipment based on the equipment evaluation. Percent detection efficiencies are applied separately for each type of item with a Pd in each of depth interval of interest. The total count of items is then summed by MEC type to provide the density by MEC type.
- Number of items found = the number of MEC items found in the survey area
- Number of items in pits = the number of MEC items found in the survey area and recorded as being in a pit.[2]

[1] Patterns of MEC and MD can be used to predict the pattern of remaining MEC. However, 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. The distribution of MEC and MD appears scattered across the site due to multiple uses over many years. This lack of a distinct pattern of distribution of MEC renders methods that consider a geospatial orientation difficult to apply and increases the uncertainty in calculation of potential residual density.

[2] The pit-related items are removed from the calculation of potentially undetected items to avoid skewing the results. The data used to calculate Pd is not applicable to burial pits in the estimation of potential residual density at Parker Flats MRA because the ability to detect multiple items in a single location is

For example, if 90 items were found in a 100 acre area using an instrument with 90% detection efficiency, the potential residual density would be 10 items per 100 acres or 0.1 items per acre. This assumes that none of the 90 items were found in a pit.

Calculation of the baseline MEC density is similar. The baseline MEC density (i.e., density before the surveys were conducted) includes all of the items detected and removed during the survey plus an estimate of the items that may not have been detected and potentially remain after the survey.

$$\text{Assumed Baseline Density (number/acre)} = \frac{\text{(Number of Items Found)}}{\text{Acres Surveyed}} + \left(\text{Potential Residual Density [items/acre]}\right)$$

In this scenario, using the example above, the potential number of MEC items estimated to be present in the baseline scenario would be 100. The MEC Density Scores are provided in Section 4.

2.5. MEC Depth Input Factor

The input scoring for MEC Depth is provided in Attachment A. MEC Depth scores are in one-foot depth intervals, with “1” being the best removal and “8” representing MEC on the ground surface.

The following facts were considered when selecting the MEC Depth Input Factor for the Parker Flats MRA Risk Assessment:

- Even though a 4 foot removal was carried out at the Parker Flats MRA, a MEC depth score of 6 (any MEC items remaining at the site are at a depth of 1 foot or greater) has been conservatively selected for input to the MEC risk assessment for the after action scenario.
- 95% of MEC items seeded in the 0 to 6-inch depth interval were detected in the RI equipment evaluations.
- 73% of the MEC items seeded in the 6 to 12-inch depth interval were detected in the RI equipment evaluations.
- 32% of the MEC items seeded at depths greater than 12 inches were detected in the RI equipment evaluation.
- The performance of the surveys and removals at the Parker Flats MRA are considered to be more efficient than the RI equipment evaluation indicates because removals were conducted until all of the anomalies were resolved.

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higher than the ability to detect one seeded item. In addition, 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 also 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.

The following MEC Depth Input Scores were selected for the Parker Flats MRA for the after-action scenario:

- A MEC depth score of 6 is selected, representing that no MEC is present on the surface and MEC items may be present at a depth greater than one foot. This score means that the clearance operation is considered to be of a sufficient quality within the top one foot of soil based on the performance. The use of this score is considered valid for the Parker Flats MRA because of the detection efficiencies demonstrated in the top 12 inches. Also the entire site was cleared to the limits of detection of the Schonstedt GA-52/Cx for which the USACE UXO safety specialist was consulted with on a case-by-case basis for approval to investigate all anomalies at depths greater than four feet.
- For scenarios having receptors that have only surface contact with the soil, the MEC Depth score is selected as 1. As mentioned earlier, a score of 1 indicates that the survey and removal of 100% of the items detected over 100% of the area was deemed by the BCT to be of high enough quality to merit a score of 1. This is appropriate because the detection capability was demonstrated at 95% in the top 6 inches. Although the detection efficiency was less than 100%, one hundred percent of the grids within the Parker Flats MRA (except the Army Maintenance Center) were surveyed and all of the items detected with the Schonstedt were removed to the depth of detection. The removal action was designed to address MEC at depth with the USACE UXO safety specialist being consulted with on a case-by-case basis for approval to investigate all anomalies at depths greater than four feet.

The baseline MEC Depth Input Score is 8 for MEC Hazard Types 1 and 2, representing MEC on the surface and MEC below ground surface. The MEC Depth Input Score for MEC Hazard Type 3 is 7, representing no MEC on the surface and MEC below ground surface.

Depths were assumed for the items in MRS-13B without recorded depth information. These assumed depths have minimal effect on the MEC Depth Input Factor. In general, there was enough information regarding depth in MRS-13B to determine whether items were found on the surface. If items were found on the surface, a MEC Depth score of 8 applies for the baseline scenario. In addition, there was sufficient information regarding the depth of items in MRS-13B to show that items were present in most reuse areas below the surface, therefore, a score of 6, as discussed above, would be applicable for the after action scenario.

2.6. Erosion Input Factor

The erosion input factor is based on an estimate of erosion that occurs at the site. Erosion is estimated using the Universal Soil Loss Equation (USLE). The data used to support the erosion estimate is from reference documents and the equation and a step-by-step example calculation are provided as follows:

A = R x K x LS x C x P

Where:

A = the estimation of average annual soil loss in tons per acre caused by sheet and rill erosion
R = rainfall erosivity factor
K = soil erodibility factor
LS = slope length and steepness factor
C = cover and management factor
P = support practice factor

Values for each of the above factors were calculated or taken from references as indicated below:

- R = USDA Soil Conservation Service (now called Natural Resource Conservation Service), Davis, CA. "Guides for Erosion and Sediment Control," Appendix A. August 1983
- K = SSURGO Data Base published by the USDA
- LS = Site-specific information calculated by using digital elevation model (DEM) dataset (published by the USGS), and by applying a GIS tool developed by Robert J. Hickey (May 2002).
- C and P: Frederick R. Troeh and Louis M. Thompson. Soil and Soil Fertility. Oxford Press, 1991.

Fort Ord has three soil types according to the SSURGO Data Base published by the USDA. Following is an example calculation for the Arnold-Santa Ynez Complex (Ar) soil, showing the values identified and the final calculated erosion.

R Factor = 15

Step 1: Determine the 2-year 6-hour precipitation in tenths of an inch by looking at appropriate map in Appendix A of "Guides for Erosion and Sediment Control" (USDA 1983). Fort Ord is within the 10 tenths of an inch isopluvial. Convert to inches (10 tenths of an inch = 1 inch).

Step 2: Refer to Figure A-1 of "Guides for Erosion and Sediment Control" (USDA 1983) to determine the R Factor Zone. Fort Ord is located in R Factor Zone 1.

Step 3: Use Table A-1 (USDA 1983) to look up the Rounded Annual "R" Values for California R Zones. Fort Ord, which is in R Zone 1 and has a 2-year 6-hour precipitation of 1.0 inch, has an R Factor value of 15. (R values in R Zone 1 are based on the equation $R=16.552*P^{2.17}$ where P = the 2 year 6 hour precipitation).

K Factor = 0.49

Look up the soil erodibility or K Factor value for each soil type. The SSURGO Data Base published by the USDA was used to determine the K Factor value. The K Factors for each of the three soil types found at Fort Ord are listed below:

Oceano (OaD); K = 0.1
Arnold-Santa Ynez Complex (Ar), K = 0.49
Baywood Sand (BbC), K = 0.15

For this example we are using the Ar soil and therefore a K Factor of 0.49.

LS Factor = 0.054 (mean)

Step 1: Obtain a data set for slope length and steepness. The DEM dataset, published by the USGS was used to obtain these values for Fort Ord. The DEM data is a grid system of 100 square foot grids.

Step 2: Input data found in Step 1 into a GIS and use a calculation tool to determine the LS Factor value. The tool developed by Robert J. Hickey, was used to calculate the LS factor for Fort Ord. This tool uses the DEM grid system and the calculation shown below to determine the LS Factor:

$$\mathrm{LS} = \left(\frac{\mathrm{I}}{72.6\ \mathrm{m}}\right) \times \left(65.41 \sin 2\beta + 4.56 \sin\beta + 0.065\right)$$

Where:
I is the cumulative slope length in feet
β is the downhill slope angle

C Factor = 0.004

Using a reference and knowledge of the site, the C Factor value is selected for the condition of the site. This factor is determined based on land cover and management practices. According to the textbook Soils and Soil Fertility (Troeh, et.al., 1991), Chapter 19, page 381, the C factor for a good growth of permanent pasture is 0.004. Because most of Fort Ord is covered by native vegetation this value was chosen.

P Factor = 1.0

Using a reference and knowledge of the site, to determine a P Factor value for condition of the site is determined. According to the textbook Soils and Soil Fertility (Troeh, et.al., 1991), Chapter 19, page 381, this factor is assigned a value of 1.0 unless special practices are used to reduce erosion. No special erosion reducing practices are used at Ford Ord so the value of 1.0 was used.

Calculating A (tons per acre)

A = R x K x LS x C x P

$$\text{A (tons per acre)} = 15 \times 0.49 \times 0.054 \times 0.004 \times 1 = 0.0016 \text{ tons per acre}$$

Converting to inches

Conversion factors to use:
1 US ton = 907.2 kilograms (kg)
1 kg = 1000 grams (g)
1 acre = 6,170,256 square inches (in^2)
Average Soil Bulk Density = 1.65 g per centimeter cubed (cm^3) (Assumed bulk density for undisturbed soils [Soils and Soil Fertility, Chapter 3, page 53])

Calculations:

$$\text{A (cubic inches per acre)} = \frac{0.0016 \text{ tons}}{1 \text{ acre}} \times \frac{907.2 \text{ kg}}{1 \text{ ton}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ cm}^3}{1.65 \text{ g}} \times \frac{1 \text{ in}^3}{16.39 \text{ cm}^3} = \frac{53.7 \text{ in}^3}{\text{acre}}$$

$$\text{A (inches)} = \frac{53.7 \text{ in}^3}{\text{acre}} \times \frac{1 \text{ acre}}{6{,}170{,}256 \text{ in}^2} = 0.000009 \text{ inch}$$

The result of the Migration/Erosion input factor score is that the erosion at each of the Parker Flats MRA reuse areas is 1 or “Very stable: MEC will not migrate. Erosion is equal to or less than the site-wide average of 3/100 inch per year.” Erosion may have occurred on the MRA, but it is expected to be associated mostly with roads and trails.