



Submitted to:
BLM

Submitted by:
AECOM
60285374
5/29/13

WEMO OHV Monitoring Protocol

Final

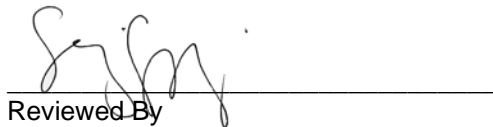


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List of Acronyms

A priori analysis	analysis conducted before monitoring occurs
ATV	all-terrain vehicle
Confidence level	the percentage of all possible samples that can be expected to include the true population parameter
Data dictionary	A list of features and their associated attributes to be collected in the field
FPC	finite population correction
GIS	geographic information system
GPS	global positioning system
Incursion	the location along a designated route (on BLM land only) where visitors have gone off the designated route to use a closed route or develop a new route
MS Excel	Microsoft Excel program
NAIP	National Agriculture Imagery Program
NRCS	Natural Resources Conservation Service
OHV	off-highway vehicle
Post-hoc analysis	analysis conducted after monitoring has occurred
Sampling error	the difference between the sample and population values is considered a sampling error
Stratum/Strata	Non-overlapping statistical subpopulation/s
TMA	Travel Management Area
WEMO	West Mojave (Plan Area)

Table of Contents

1.0	Summary of OHV Monitoring Activities	3
1.1	Monitoring Purpose and Need.....	3
1.2	General Description of OHV Monitoring Activities	3
2.0	Sampling Strategy	5
2.1	Baseline Data	5
2.2	Sampling Strategy.....	8
2.3	Sample Sizes	10
3.0	Field Staff Direction.....	12
3.1	Description of Monitoring Methodology and Goals	12
3.2	Description of How to Select Routes to be Monitored	12
3.2.1	Route Stratification Process	13
3.2.2	Random Sampling of Routes.....	14
3.3	Description of Field Monitoring Methods and Information to be Collected	15
3.4	Monitoring Protocols	18
3.4.1	Check In/Out Procedures/Safety Info.....	18
3.4.2	Data Submittal Procedures.....	18
3.4.3	Converting GPS Data into GIS Data	18
3.4.4	Converting Form Data into GIS Data	20
3.4.5	Converting GIS Data into Excel Data.....	20
3.5	Field Equipment Requirements	20
3.6	Aerial Photography Monitoring Procedures	21
3.7	Monitoring Form	21
4.0	Monitoring Outputs	23
4.1	Year 1 and 2 Memos.....	23
4.2	Year 3 Monitoring Results Report	23
4.3	9-Year Trend Analysis Report	36
4.4	Statistical Analysis for Report Preparation.....	36
4.5	Monitoring Data Analysis for Report Preparation.....	38
5.0	Photo Examples of Monitoring Variables	40
6.0	References.....	45

List of Tables

Table 2.1-1.	Designated Routes, Incursions, and Incursions/Mile by TMA/Subregion.	5
Table 2.1-2.	Designated Routes with and without Incursions by TMA/Subregion.....	7
Table 2.2-1.	Miles of Routes within Monitoring Strata.	9
Table 2.3-1.	Sample Sizes (Miles of Routes to be Monitored) Under Several Sampling Strategies.	10
Table 3.2-1.	Routes with an Average of more than 100 Incursions per Mile.....	13
Table 3.2-2.	Sample Sizes (Route Mileage) for each Monitoring Stratum for a 3-Year Monitoring Period.....	15

1.0 Summary of OHV Monitoring Activities

1.1 Monitoring Purpose and Need

The West Mojave (WEMO) Plan area contains approximately 5,000 miles of designated routes and likely many miles of “unauthorized” routes. BLM will be conducting monitoring of the designated route network to evaluate public compliance with travel management designations established in the West Mojave Plan (2005) or in any subsequent Plan amendments. Specifically, the purpose of monitoring will be to evaluate: (1) public compliance with route closures, and (2) the creation of new illegal routes (referred to herein as incursions). An incursion is defined as the location along a designated route (on BLM land only) where visitors have gone off the designated route to use a closed route or develop a new route. Incursions do not include hiking, mountain biking, or equestrian trails that may intersect designated routes.

The monitoring protocol is the result of a process that included a baseline inventory of all designated routes, development of a monitoring strategy, and a pilot study. A baseline inventory of designated routes in the WEMO Plan Area was completed by the BLM in 2012 to identify all existing incursions (see Section 2.1 for census results). After conducting this baseline inventory, BLM recognized several ongoing monitoring-related needs, including:

- A mechanism to capture consistent data;
- Clear field instructions, training, and data quality controls;
- A way to efficiently capture field information electronically; and
- A streamlined method to monitor incursions (other than a census due to the cost and time commitment involved in completing a census).

Subsequently, the BLM explored and developed a monitoring strategy and a draft monitoring protocol to address these needs. The draft protocol was assessed during a pilot study that allowed BLM to test the monitoring variables and methods, and identified a number of changes needed to the protocol (see Pilot Test Summary document for more information on changes identified as a result of the pilot test). Following the pilot test, the draft protocol was revised – this final protocol document is the outcome of this process.

1.2 General Description of OHV Monitoring Activities

Monitoring of designated routes will occur over a 3-year monitoring cycle with a random sample of routes selected in the first year of monitoring and spread out over three years, sampled sequentially. The population of monitored routes within the WEMO Plan area will be limited to routes that are over 0.01 miles in length and are designated as open or limited. All incursions that exist at the initiation of this monitoring protocol are considered active: following monitoring, an existing incursion may be either active or inactive. Routes will be stratified by whether or not the route includes at least one existing, active incursion. This stratification process results in two strata:

1. Routes with existing, active incursions
2. Routes without existing, active incursions

Field monitoring will be performed annually on approximately 100 miles of designated routes in the ‘routes with existing, active incursions stratum’ (a total of about 300 miles of routes will be monitored over each 3-year monitoring cycle in this stratum). For routes with no existing, active incursions, aerial photography will be used to review a random selection of routes for new incursions. Approximately 50 miles of routes with no existing, active incursions will be reviewed annually for a total of about 150 monitored miles over the 3-year monitoring period.

A 3-year monitoring sample of 300 miles of routes with existing incursions and 150 miles of routes with no existing incursions will provide statistically valid results (estimated 80% confidence level and 10% sampling error). After three monitoring cycles (9 years), the population of routes with existing, active incursions may be adjusted based on aerial photography and field monitoring results. Section 2.0 provides more information regarding the sampling strategy, and Section 3.2 describes the random sampling selection process that will occur every three years.

For field monitoring of routes with existing, active incursions, staff will record GPS coordinates of incursions in addition to recording information on the incursion usage intensity, width, and type, as well as any BLM closure actions taken. Staff will also record the length of each route monitored, record any designated routes not locatable on the ground, and take photos of new incursions and any existing, active incursions where conditions have changed since previous monitoring visits. BLM will record field data electronically through the use of GPS units or other electronic devices. Data will be converted to GIS format and then exported into Excel for use in statistical analysis and report preparation. Section 3.3 provides additional detail on monitoring methods and the information to be collected. Section 3.4 provides further information regarding data submittal procedures and how data will be converted from the GPS unit or paper forms (back-up data collection method) into GIS data and then into Excel format. Section 3.5 provides information on field equipment requirements. Section 3.7 provides a paper copy of the back-up form to be used for recording field monitoring information.

Monitoring of the usage variables listed above (incursion usage intensity, width, type, and any BLM closure actions taken) will provide BLM with the information necessary to determine where illegal route creation is concentrated and how effective different closure methods are at obliterating illegal and closed routes and/or reducing use of illegal or closed routes. In addition, BLM will be able to track whether certain types of OHVs tend to create new incursions or use closed routes more frequently than other types, and if so, in which areas this occurs. Section 4 describes the outputs BLM expects to receive from monitoring efforts – including monitoring reports to be generated for each year of the 3-year monitoring cycle, statistical analyses to be conducted every three years, and trend analysis report to be generated every 9 years. The 9-Year Trend Analysis Report will identify general trends related to compliance with route closures and development of new, illegal routes. The report will be based on data from the 900 miles of routes with existing incursions and 450 miles of routes without existing incursion monitored over the previous 9-year period (3 3-year cycles). The BLM will also use the data in the monitoring reports to evaluate and potentially modify implementation strategies developed as part of the travel management planning process for the WEMO Plan area. At the end of each 3-year monitoring period, including after the 9-Year Trend Analysis Report is generated, the BLM will reassess the protocol to ensure that useful data is being generated in the most effective manner possible. The reporting cycle will be identified in the WEMO Route Network Plan.

The OHV monitoring protocol is intended to provide broad indicators of public compliance with route closures and the creation of new incursions throughout the entire WEMO Plan Area. By sampling a portion of designated routes in the WEMO Plan Area, the BLM will be able to make statistical inferences about the average number of incursions per mile of designated route and the percent of routes with and without incursions for the entire WEMO Plan Area within stated levels of precision (e.g., confidence level, sampling error, etc.). Additionally, the BLM will be able to develop general trends over time regarding compliance with closure methods (as measured through incursion width and estimated use). While the sampling approach to route monitoring will provide statistically significant general indicators that are applicable to the entire WEMO Plan Area, the sampling approach and associated monitoring process is not designed to provide statistically significant results at the TMA, subregion, or route specific levels, nor can statistically significant results be assured for each variable. It should be acknowledged that statistical significance simply means that a statistic is reliable. It does not mean that the finding is important or that it has any decision-making utility. This is not to say that the monitoring protocol will not provide site specific information or significant results, simply that statistically significant results will only be available for the entire Plan Area for the specific variables used to develop the sampling approach (e.g., incursions per mile, percent of routes with/without incursions, etc.).

2.0 Sampling Strategy

In general, properly-constructed samples provide a method to make statistically-valid inferences or descriptions of a larger population by selecting and monitoring a representative subsection of the population (Vaske 2008; Watson et al. 2000; Elzinga, Salzer, and Willoughby 1998). Sampling is especially useful in situations where monitoring the full population (through a census) is labor- and/or cost-prohibitive. For purposes of the WEMO monitoring effort, the population is defined as all designated open or limited routes in the WEMO Plan Area. The intent of the monitoring protocol is to select and use a representative sample of all designated routes to make statistical generalizations about the creation of new illegal routes and public compliance with route closures.

2.1 Baseline Data

In 2012, the BLM performed a census of all designated open and limited routes in the WEMO Plan Area. The intent of this census was to capture the current extent, usage, and locations of all existing incursions in the Plan Area. For monitoring purposes, this 2012 census effort is considered the “baseline” and was used to derive the sampling strategy and approach detailed in this monitoring protocol. According to the baseline data, there are approximately 4,918 miles of designated open and limited routes in the WEMO Plan Area (this total does not include routes under 0.01 miles) and 1,555 existing incursions (all existing incursions are considered active for baseline purposes even if a closure action has been taken)¹. Plan Area-wide there is an average of 0.37 incursions per mile of designated route. However, the existing incursions are not equally distributed throughout the Plan Area, and instead tend to be concentrated in specific areas and/or along specific designated routes. Table 2.1-1 displays the miles of designated routes, existing incursions, and average incursions per mile of designated route by Travel Management Area (TMA) and subregion (note: all information and data in Table 2.1-1 is preliminary and subject to additional revisions to the baseline dataset).

Table 2.1-1. Designated Routes, Incursions, and Incursions/Mile by TMA/Subregion.

Travel Management Area/ Subregion	Miles of Designated Routes	Existing Incursions	Average Incursions/ Mile
<u>TMA 1</u>	311.15	43	0.34
<i>Afton Canyon</i>	115.47	17	0.85
<i>Barstow</i>	0.62	0	0.00
<i>Broadwell Lake</i>	195.05	26	0.07
<u>TMA 2</u>	644.52	36	0.05
<i>Darwin</i>	97.82	5	0.03
<i>North Searles</i>	140.32	10	0.11
<i>Sierra</i>	278.57	7	0.03

¹ These totals do not include 14 outlier routes. These routes are considered outliers because they have an exceptionally high average number of incursions-per-mile. The total length of these 14 routes is 0.14 miles and there are currently 42 incursions on these routes. This results an average incursions-per-mile on these routes of 327.49. Retaining these routes in the general population causes the average incursions-per-mile to rise from 0.37 to 1.7, a substantial increase that unduly influences the descriptive statistics necessary for calculating sample sizes. As such, these outlier routes have been removed from the population for statistical purposes, but may be retained for field monitoring purposes.

Travel Management Area/ Subregion	Miles of Designated Routes	Existing Incursions	Average Incursions/ Mile
<i>South Searles</i>	127.81	14	0.05
<u>TMA 3</u>	628.91	254	0.28
<i>Joshua Tree</i>	137.26	64	0.44
<i>Juniper Flats</i>	102.86	147	0.97
<i>Morongo Valley</i>	10.39	0	0.00
<i>Needles South</i>	72.84	6	0.04
<i>Rattlesnake Canyon</i>	212.86	11	0.05
<i>Wonder Valley</i>	92.72	26	0.23
<u>TMA 4</u>	345.41	106	1.15
<i>Jawbone</i>	256.80	7	0.05
<i>Middle Knob</i>	88.61	99	1.66
<u>TMA 5</u>	1,070.87	459	0.42
<i>Black Mountain</i>	204.82	63	0.13
<i>Calico Mountains</i>	90.69	72	1.04
<i>Coolgardie</i>	181.70	199	0.90
<i>Cronese Lake</i>	184.67	12	0.22
<i>Fremont Peak</i>	236.36	51	0.24
<i>Harper Lake</i>	114.93	48	0.35
<i>Mitchel Mountains</i>	57.70	14	0.20
<u>TMA 6</u>	423.80	69	0.23
<i>El Mirage</i>	103.46	15	0.09
<i>Iron Mountain</i>	72.00	15	0.53
<i>Kramer Hills</i>	248.35	39	0.17
<u>TMA 7</u>	935.33	569	0.58
<i>El Paso</i>	310.49	141	0.44
<i>Rands</i>	139.58	42	0.19
<i>Red Mountain</i>	309.87	135	0.62
<i>Ridgecrest</i>	175.38	251	0.95
<u>TMA 8</u>	558.61	19	0.04
<i>Johnson Valley</i>	27.72	8	0.37
<i>Newberry/Rodman</i>	166.03	5	0.01
<i>Ord Mountains</i>	184.52	3	0.01
<i>Pisgah Crater</i>	42.37	0	0.00

Travel Management Area/ Subregion	Miles of Designated Routes	Existing Incursions	Average Incursions/ Mile
<i>Stoddard Valley</i>	137.97	3	0.03
Total	4,918.60	1,555	0.37

While the geographic summary provided in Table 2.1-1 is informative, it does not capture the variability in numbers of routes with and without incursions within each subregion. Table 2.1-2 displays the number of routes with and without incursions in each TMA and subregion (note: all information and data in Table 2.1-2 is preliminary and subject to additional revisions to the baseline dataset). In nine of the 34 WEMO Plan Area subregions (excluding Victorville and Lancaster), the percent of routes with incursions exceeds 20 percent. In general, most routes (84 percent) in the WEMO Plan Area do not have existing incursions. From a mileage perspective, routes with incursions represent approximately 1,604.44 miles (or 32.6 percent of the total mileage within the Plan Area), and routes without incursions represent approximately 3,314.16 miles (or 67.4 percent of the total mileage within the Plan Area).

Table 2.1-2. Designated Routes with and without Incursions by TMA/Subregion.

Travel Management Area/Subregion	Number of Designated Routes	Number of Designated Routes with Existing Incursions	Percent of Designated Routes with Existing Incursions
<u>TMA 1</u>	126	19	15.1%
<i>Afton Canyon</i>	44	8	18.2%
<i>Barstow</i>	1	0	0.0%
<i>Broadwell Lake</i>	81	11	13.6%
<u>TMA 2</u>	343	23	6.7%
<i>Darwin</i>	50	3	6.0%
<i>North Searles</i>	84	6	7.1%
<i>Sierra</i>	129	5	3.9%
<i>South Searles</i>	80	9	11.3%
<u>TMA 3</u>	561	80	14.3%
<i>Joshua Tree</i>	91	29	31.9%
<i>Juniper Flats</i>	89	30	33.7%
<i>Morongo Valley</i>	13	0	0.0%
<i>Needles South</i>	44	1	2.3%
<i>Rattlesnake Canyon</i>	246	10	4.1%
<i>Wonder Valley</i>	78	10	12.8%
<u>TMA 4</u>	174	42	24.1%
<i>Jawbone</i>	55	4	7.3%
<i>Middle Knob</i>	119	38	31.9%
<u>TMA 5</u>	948	171	18.0%

Travel Management Area/Subregion	Number of Designated Routes	Number of Designated Routes with Existing Incursions	Percent of Designated Routes with Existing Incursions
<i>Black Mountain</i>	163	21	12.9%
<i>Calico Mountains</i>	73	28	38.4%
<i>Coolgardie</i>	197	55	27.9%
<i>Cronese Lake</i>	123	11	8.9%
<i>Fremont Peak</i>	215	27	12.6%
<i>Harper Lake</i>	98	16	16.3%
<i>Mitchel Mountains</i>	79	13	16.5%
TMA 6	286	42	14.7%
<i>El Mirage</i>	89	7	7.9%
<i>Iron Mountain</i>	67	12	17.9%
<i>Kramer Hills</i>	130	23	17.7%
TMA 7	595	149	25.0%
<i>El Paso</i>	224	66	29.5%
<i>Rands</i>	74	17	23.0%
<i>Red Mountain</i>	152	37	24.3%
<i>Ridgecrest</i>	145	29	20.0%
TMA 8	389	15	3.9%
<i>Johnson Valley</i>	28	5	17.9%
<i>Newberry/Rodman</i>	138	5	3.6%
<i>Ord Mountains</i>	71	3	4.2%
<i>Pisgah Crater</i>	31	0	0.0%
<i>Stoddard Valley</i>	121	2	1.7%
Total	3,422	541	15.8%

2.2 Sampling Strategy

Given the uneven distribution of incursions, a sampling strategy that addresses and helps minimize this uneven distribution is warranted. Stratified sampling tends to be more statistically efficient (compared to simple random sampling) when there are large differences between subgroups within the population (Watson et al. 2000), as is the case between routes with and without incursions in the WEMO Plan Area. The use of a stratified sampling approach involves “dividing the population into non-overlapping groups (or strata)” and then selecting a simple random sample from each group (Vaske 2008). This type of sampling approach is helpful because it allows for results that are specific to the designated strata of interest and it reduces sampling error by classifying relatively homogeneous segments within a heterogeneous population (Mitra and Lankford 1999, Vaske 2008).

For WEMO Plan Area route monitoring purposes, all designated open and limited routes will be stratified by the presence or absence of existing, active incursions. This will create two non-overlapping subgroups of routes: 1) those with existing, active incursions, and 2) those currently without active incursions. Each of these subgroups will be addressed through separate sampling and monitoring processes (described in more detail in Section 3.1). This stratification approach may result in routes that no longer meet the stratum definitions over time (either when an incursion is created on a route where previously there were none, or when an incursion is fully rehabilitated along a route [usage is recorded as “none”]). This will require periodic adjustments of the subgroups to properly classify routes and to help ensure that a consistent level of heterogeneity is maintained throughout implementation of the monitoring protocol.

This stratification strategy will allow for more targeted results that specifically address the two goals of the monitoring effort. In particular, compliance with route closures will be limited to those routes with existing, active incursions, while the creation of new routes will be monitored across all routes. Table 2.2-1 indicates the miles of routes currently in each stratum. The mileage of routes in each stratum is considered the population from which a simple random sample will be selected. Again, at present, all existing incursions are considered active.

Table 2.2-1. Miles of Routes within Monitoring Strata.

	Miles of Routes with Existing Incursions	Miles of Routes without Existing Incursions
Plan Area	1,604.44	3,314.16

In research and monitoring efforts, confidence levels and sampling errors are typically defined a priori to determine appropriate sample sizes for each stratum. Sampling error defines the extent to which a sample is limited in its ability to accurately describe a population (since only some elements of the population are sampled). At the beginning of a sampling process, sampling error is commonly communicated in conjunction with a specific confidence level. The confidence level indicates the degree of confidence that the results from the sample approximate the true population. For example, a 95 percent confidence level and 5 percent sampling error would mean that if 100 samples were selected from a larger population, 95 of the samples would result in an estimate that is +/- 5 percent of the true population value (assuming no other types of error). Note: after the monitoring process is complete and all routes have been sampled, the actual sampling error can be calculated and reported.

In addition to confidence levels and sampling error, sample size must also consider tradeoffs between precision and cost. That is, there is an inherent tradeoff in sample-based research and monitoring efforts between sample size or precision and costs (e.g., labor, data collection expenses, etc.). A larger sample size may result in a greater degree of precision, but may be labor- and/or cost-prohibitive; a smaller sample size may cost less, but result in less than ideal precision. The WEMO Plan Area monitoring protocol and associated sampling strategies are intended to balance precision and costs.

Two monitoring and corresponding sampling strategies will be used to sample the routes in the WEMO Plan Area:

1. A simple random sample of routes without existing, active incursions will be selected for monitoring. National Agricultural Imagery Program (NAIP) aerial imagery, which is compiled by the USDA's Farm Service Agency, will be used to review the selected sample routes for the presence of incursions. The use of NAIP imagery to monitor field conditions is an established methodology and has been used on previous BLM route identification and monitoring efforts (see Moab Resource Management Plan [October 2008], and Imperial Sand Dunes Recreation Area Management Plan [May 2003]). New NAIP imagery is released by the USDA's Farm Service

Agency every three years, providing a frequently updated set of images by which to identify potential new incursions. This review will primarily be focused on identifying the presence of incursions on sample routes. The presence of an incursion on a route will be treated as a categorical variable (Yes = incursion on route; No = no incursion on route). This allows for a sample size to be derived based on estimating a population proportion.

- For routes with existing incursions, a simple random sample will be selected for field monitoring. Selected sample routes will be field monitored for new incursions, as well as the conditions of any existing incursions on sample routes. Since this field-based monitoring is focused on reporting averages, the sample size may be determined by using a formula based on estimating a mean.

Once every 9 years (after 3 cycles of monitoring), the groups of routes with and without existing, active incursions will be reviewed and potentially revised. The change in percent of routes with/without incursions provides a broad indicator of the status of new illegal routes in the WEMO Plan Area, as well as a general trend over time.

2.3 Sample Sizes

The sample size formulas for both of the sampling strategies described above are slightly different, but both make use of confidence levels and sampling errors. The sample size formula for the 'routes with existing, active incursions' stratum incorporates the population standard deviation (derived from the 2012 baseline data), while the sample size formula for the 'routes without existing, active incursions' stratum assumes a conservative population proportion of 50 percent. For planning purposes, two confidence levels (90% and 80%) and two sampling errors (10% and 20%) were used as statistical targets to determine preliminary sample sizes. Table 2.3-1 displays the sample sizes (reported as miles of designated routes) that would be needed under each of these different sampling scenarios. Note: the Finite Population Correction (FPC) has been applied, as necessary, to the sample sizes reported in Table 2.3-1. The FPC adjusts the sampling error and associated sample sizes when the target population is finite and the initial sample represents more than 5 percent of the population (Elzinga, Salzer, and Willoughby 1998).

Table 2.3-1. Sample Sizes (Miles of Routes to be Monitored) Under Several Sampling Strategies.

Sampling Strata	Confidence Level Sampling Error			
	90%		80%	
	10%	20%	10%	20%
Routes with Existing, Active Incursions	484.2	156.5	333.5	98.8
Routes without Existing, Active Incursions	66.3	16.8	40.6	10.2

The sample sizes listed in Table 2.3-1 do not acknowledge staffing or budget constraints. Given current and anticipated future financial conditions, the BLM anticipates being able to field monitor about 100 miles of designated routes with incursions on an annual basis in the WEMO Plan Area. A sample of 100 miles should provide for monitoring results that meet the 80 percent confidence level and 20 percent sampling error statistical targets on an annual basis. If a longer monitoring timeframe is assumed (e.g., 3 years), this would allow for larger sample sizes. For example, if annual monitored efforts are aggregated across a 3-year monitoring cycle, the cumulative 300 mile sample size would then provide monitoring results that meet higher confidence levels and/or sampling error targets (assumes the sample is derived once at the start of

the timeframe to ensure individual routes are not selected multiple times). Similarly, if the BLM monitors a sample of 50 miles of routes without existing, active incursions in the WEMO Plan Area (through a review of sample routes using aerial imagery), monitoring results would likely meet 80 percent confidence level and 10 percent sampling error targets on an annual basis, but would achieve higher confidence levels and lower sampling error targets if a longer monitoring timeframe is used.

Ultimately, an annual sample size of 100 miles of field monitored routes (routes with incursions) and 50 miles of aerial photography monitored routes (routes without incursions) will yield sufficient sample sizes to make statistical inferences on an annual basis and may be aggregated over a reasonable time period (3 years) to provide additional statistical precision.

3.0 Field Staff Direction

3.1 Description of Monitoring Methodology and Goals

Field and aerial photography monitoring will be used to determine compliance with route closures and the creation of illegal routes. Staff will drive designated routes over 0.01 miles in length with at least one existing, active incursion and note where incursions are located and some key information regarding each incursion using GPS units or other electronic devices. Routes less than 0.01 miles in length will not be included in sampling. Staff will have access to active incursion locations from previous monitoring visits on the selected routes. If a previously active incursion is no longer being used, staff will note this under incursion usage (none) in order to identify "rehabilitated" (existing, inactive) incursions. An incursion is defined as the location where visitors have gone off the designated route (on BLM land only) to use a closed route or develop a new route. Incursions do not include hiking, mountain biking, or equestrian trails. For routes with no existing, active incursions, aerial photography monitoring of a random sample of routes will be used to confirm that routes still have no incursions.

Monitoring data will allow the BLM to track where illegal route creation is concentrated and how effective different closure methods are at obliterating illegal and closed routes and/or reducing use of illegal or closed routes. The goals of OHV monitoring in the WEMO Plan area are to:

1. Evaluate rate of illegal route creation
2. Determine effectiveness of closure methods
3. Determine where closure methods are most successful
4. Determine areas in need of additional effort to reduce route proliferation
5. Determine whether use of closed or illegal routes is declining
6. Determine whether closed routes are shrinking in size (width)
7. Determine whether certain types of OHVs are creating routes and where

3.2 Description of How to Select Routes to be Monitored

This section describes the process or steps needed to stratify the population of routes in the WEMO Plan Area and select a sample from each corresponding stratum. Underlying this sampling approach is a basic assumption that the baseline data represent the best available route and incursion information at this time. Over time and through implementation of the monitoring protocol, the distribution of routes with and without existing, active incursions may be re-assessed and periodically updated, as needed.

The stratification and sampling processes described below can be performed in Microsoft (MS) Excel. The approaches described below assume that MS Excel will be used, though other spreadsheet programs, databases, and/or statistical packages may be used instead. Prior to implementing the route stratification and sampling processes described below, the BLM would review and make any needed corrections to the list of designated routes in the WEMO Plan Area, paying particular attention to the completeness of the list of routes (so that all designated routes have an equal probability of being selected).

A few specific routes, which meet specific criteria, will be removed from the population of routes to be monitored to reduce data skewness. For example, the 2012 baseline data includes 14 routes with an average incursions per mile of more than 100 (see Table 3.2-1). These routes are all under 0.02 miles in length and have between 1 and 11 existing incursions. Their short length and number of existing incursions result in an extraordinarily high average incursions per mile. Given this high average, these routes will be

removed from the population of routes to be monitored so as to not skew the results (should these routes be selected during the random sampling process).

Table 3.2-1. Routes with an Average of more than 100 Incursions per Mile.

Subregion	Route Number	Route Length	Existing Incursions
Black Mountain	CG7210	0.01	11
Black Mountain	CG7225	0.01	1
Black Mountain	BM6375	0.01	1
Black Mountain	BM6383	0.01	2
Coolgardie	CG7253	0.01	2
El Paso	RC21	0.02	2
Harper Lake	BM7153	0.01	3
Jawbone	EP3	0.01	1
Juniper Flats	JF3381	0.01	6
Rands	EP11	0.01	3
Rands	EP146	0.02	2
Rands	RM0036	0.01	1
Red Mountain	RM0034	0.02	6
Ridgecrest	EP647	0.01	1
Total		0.14	42

3.2.1 Route Stratification Process

The WEMO Plan Area routes may be stratified for sampling purposes by performing the following actions (using MS Excel):

1. Using the 2012 baseline data, select all routes designated as Open or Limited that are greater than or equal to 0.01 miles in length. This will remove all short connector routes and pullouts.
2. Remove outlier routes (the 14 routes listed in Table 3.2-1 and/or other routes that have an average incursions per mile of over 100). Once removed, the remaining routes represent the full route population. At a minimum, the route population should include the designated route ID, route mileage, field office, and number of existing incursions for each route.
3. Filter the route population for routes with incursions (i.e., incursions => 1) and routes without incursions (i.e., incursions = 0). This may be accomplished by using Excel's data filter or formula (e.g., =vlookup) functionality. Copy each subpopulation to a separate worksheet (one for routes with and one for routes without incursions).

The stratification process would be re-run at the beginning of each 3-year cycle of monitoring to account for any corrections (e.g., route length, route numbers, etc.) to the baseline data. However, the adjustments to the baseline data to account for any changes to routes with and/or without incursions should only occur once every 9 years (after three consecutive 3-year monitoring cycles). Any potential changes to the number of routes (and associated route mileage) with and without incursions will be noted in the sample adjustments described in the 9-Year Trend Analysis report, which is detailed in Section 4.

3.2.2 Random Sampling of Routes

Once the full population of routes has been stratified, the next step is to select a random sample from each stratum that will be monitored. The sample selection process described below may be used for each of the strata (i.e., routes with and routes without incursions). A random sample of routes may be selected by performing the following actions (using MS Excel):

1. Assign a random number to each route. This may be accomplished by using Excel's "=RAND" formula. In a separate worksheet column, enter the following formula into the topmost cell: =RAND(). This will generate a random number between 0 and 1. Copy and paste this formula in all column cells such that all routes have an associated random number. Next, select the random number column and format (using the Format Cells functionality) all values so that they are "numbers" and have at least six decimal points. Using six decimal points will help reduce the probability that two routes will have the same random number.
2. Lock the random numbers for each route. Excel's "=RAND" formula is dynamic; this means that the values will refresh every time a change is made to the workbook. To select a random sample that does not change every time a change is made to the workbook, the random numbers need to be locked. To lock the random numbers, select the random number column, copy it, and then use "Paste Special" (select "Values and number formats") to paste the numbers back into their original locations.
3. Sort the routes by the random number column. Using Excel's sort functionality, select all routes and sort (either high to low or low to high) by the random number column. This will re-organize the route information according to the random number and result in a randomized list of routes.
4. Select a random sample of routes. Using the sorted, randomized list of routes and the associated route mileage column, select the first "N" routes whose mileages sum to the desired total mileage for the sample. To account for any routes that may no longer be used and/or shorter route lengths (than in the current baseline data), a slightly larger sample selection is recommended (e.g., select 110 miles of routes instead of the target sample of 100 miles). The additional miles would only be monitored if one or more routes in the primary sample (100 miles) is no longer used and/or shorter than the baseline length.
5. Once the random sample of routes is selected for the entire 3-year monitoring period, the sample for each stratum can be split into annual samples (Year 1, 2, and 3 List of Routes to Monitor). Table 3.2-2 lists the total sample size for each stratum, as well as annual allocation of miles of routes to be monitored.
6. Once the annual lists of routes to monitor are created, the list of routes to be monitored should be reviewed by GIS staff prior to monitoring activities (field or aerial photo monitoring) to identify any possible duplicate or misnumbered routes in GIS. If duplicate or misnumbered routes are identified such that a route must be removed from the annual list of routes to monitor, additional routes can be added from the reserve list to reach the target sample size of route miles to monitor per year.
7. Each annual list of routes to monitor should be updated if issues arise during monitoring and corrections are needed to route numbers or mileages.

The random selection of all sample routes to be monitored through one 3-year cycle should be selected at the beginning of that cycle. This will ensure that the set of annual routes to be monitored does not contain duplicate routes during the 3-year implementation period. All routes should be re-randomized prior to selecting a new sample at the beginning of each subsequent 3-year monitoring cycle. Table 3.2-2 below shows target sample sizes for each stratum for an entire 3-year monitoring period.

Table 3.2-2. Sample Sizes (Route Mileage) for each Monitoring Stratum for a 3-Year Monitoring Period.

Year	Miles of Routes with Existing Incursions	Miles of Routes without Existing Incursions	Total Miles of Routes
Year 1	100	50	150
Year 2	100	50	150
Year 3	100	50	150
Total	300	150	450

3.3 Description of Field Monitoring Methods and Information to be Collected

Monitoring will occur over the course of a year, depending on staff availability and workload. Therefore, there is no set monitoring schedule.

On each day of monitoring, one to two staff members will drive one or more of the designated routes identified for monitoring in the current calendar year (see Section 3.2 for more info). If there are two staff members conducting monitoring, one staff member will drive and the other staff member will either fill out the monitoring form or enter data into a GPS unit or other electronic device. A second GPS unit or electronic device will contain monitoring data from previous years for reference. If additional authorized implementation activities will be conducted in addition to monitoring, if possible, two staff members should be used for monitoring. Prior to leaving the field office, staff will ensure they have paper data forms as back-up in case the GPS unit or other electronic device malfunctions, as well as a map of existing incursions on the routes to be monitored in case the second GPS unit (showing previous monitoring data) or other electronic device also malfunctions. If GPS units are used, the use of Trimble Juno GPS units is encouraged, as these units have photo taking capability, unlike GeoXM and other Trimble units. If a Juno GPS unit is to be used for monitoring, staff must have appropriate training on how to use the device. In addition, ensure that staff will use appropriate vehicles for monitoring use – some routes are accessible via a four-wheel-drive vehicle, while other routes may require use of an ATV or motorcycle.

Staff should start at the beginning of the designated route and drive the entire length of the route, stopping at every incursion point to record data. An incursion point would consist of any location where visitors have gone off the designated route (on BLM land only) to use a closed route or develop a new route. Incursions DO NOT include driveways, other agency roads, routes designated as administrative use only, hike/bike/horse trails, etc. Incursion points can be on either side of the designated route. Staff should use previous monitoring data on a separate, second GPS unit (to ensure the same GPS coordinates and incursion ID number) or other electronic device and stop at all incursions from the previous monitoring visits as well as any new incursions. If any segment of the route being monitored becomes impassable (e.g., via washout), staff should document the location at which the route became impassable, include the reason it has become impassable, and whether the remaining section of the route could be accessed by other means on the GPS unit and with a camera (see Variable 15 below).

Once an incursion point is reached, staff should pull over and data should be entered onto the monitoring form or into the GPS unit or other electronic device. The monitoring form is located in Section 3.7. Below is a description of what to enter into each part of the form/GPS unit (data dictionary). As staff travel the designated route, monitors should also look for previously active incursions on the second GPS unit or other electronic device. If the incursion is still active, they should fill in all information described below. If the incursion is no longer active, they should fill in #1-7 below and select "None" for incursion usage. "No" or "none" should be selected for the remaining required variables in the data dictionary on the GPS unit, or written in if using the paper form.

Required Variables – the following 11 variables are required for all incursions (existing and new). Variable 12 is required for all monitored routes.

1. **GPS Coordinates of Incursion (Start Incursion variable in data dictionary)** – Enter the GPS coordinates of where the incursion begins (i.e., where it branches from the designated route). The GPS unit will automatically enter these coordinates.
2. **Designated Route Number** – Enter the number of the route being monitored. This number should consist of 1-2 letters and at least one number (e.g., R45, AC205, BE4415, etc.)
3. **Staff Name(s)** – Enter the names of the staff conducting monitoring activities.
4. **Monitoring Date** – Enter today's date. The GPS unit will autogenerate the date.
5. **Subregion** – Select the subregion within which the designated route being monitored is located from the list of 33 subregions. The subregion name should match the letter code of the route, i.e., BM274 and Black Mountain subregion.
6. **Incursion ID number** – If the incursion is an existing incursion (i.e., shows up in baseline/previous monitoring data on the second GPS unit), enter the Incursion ID number for the incursion. If the incursion is new (i.e., was not included in previous monitoring), write None. An incursion ID number will be assigned to new incursions by GIS staff following compilation of the GPS data. Incursion IDs need to be unique.
7. **Incursion Usage Intensity** – Select None, Light, Medium, or Heavy. Definitions are below. Numbers of vehicle tracks are totals and can be a combination of vehicle types.
 - None – No visible vehicle tracks and vegetation would be starting to come back, i.e., vegetation within the road width would be visible
 - Light – Light use with some natural revegetation occurring, 1-10 vehicle tracks
 - Medium – Moderate use with 11-25 vehicle tracks
 - Heavy – Route is widening, noticeable ruts, whoop-de-do's present, gully erosion, more than 25 vehicle tracks

See photos in Section 5 for examples of None, Light, Medium and Heavy use.
8. **Incursion Width** – Select the width of the incursion as truck, quad, or motorcycle. For reference, truck width is over 5 feet wide, quad is 3 to 5 feet wide, and motorcycle width is less than 3 feet wide. Select "None" if the incursion is no longer active and "None" was selected for the Incursion Usage variable (#7).
9. **Type of Incursion Use** – Select Single Track, Two Track, Multi-Track, Hiking, MtnBiking, Equestrian, Animal, Camping/Staging or Other based on the tracks seen on the incursion. Select Single Track if only motorcycle tracks are visible. Select Two Track if there are only 4-wheel vehicle tracks (ATV, OHV, truck, jeep, etc.). Select Multi-Track if both 4-wheel vehicle tracks and motorcycle tracks are visible. Select Hiking if only footprints are visible. Select MtnBiking if only bike tracks are visible. Select Equestrian if only horse hoof prints are visible. Select Animal if only animal tracks (other than horses) are visible. Select Camping/Staging if the incursion is used as a camping/staging area. Select Other if there is some other kind of track present. Select "None" if the incursion is no longer active and "None" was selected for the Incursion Usage variable (#7).
10. **BLM Closure Action in Place** – Select Yes or No based on whether BLM has instituted a closure action for the incursion. See #11 for examples of actions that BLM typically uses to close an incursion.

11. **Describe Closure Action** – If there is a Closure Action in place (see #10), select a BLM Closure Action that is currently in place on the incursion: fencing, boulders, vegetation, closed sign, or natural (letting the route revegetate naturally). Select “None” if there is no closure action in place.
12. **Linear Sample** – Record the length of the route being monitored along with the designated route number of the route being monitored.

Discretionary Variables – these variables are not required for every incursion.

13. **Incursion Use Comment** – If staff need to make notes regarding the route or incursion, please do so as part of this variable. The maximum length of this variable in the GPS unit is 25 characters. Inform management of any comments as necessary.
14. **Photo** – Take a photo(s) of each new incursion and existing incursion (i.e., incursion identified in previous monitoring visits) where conditions have changed since previous monitoring efforts (e.g., the incursion has gotten wider, has a new type of use, use has increased, or a closure action has been put in place). If using a Trimble GeoXM GPS unit, under the subvariable Comment, record the photo number(s) of the photo(s) taken of the incursion from a separate camera. The subvariables of Date and Time will be autogenerated. If using a Trimble Juno GPS unit, take a photo directly from the GPS unit.
15. **Route Not Present** – If a designated route to be monitored is not locatable on the ground, take a point under this variable, provide a brief description of the on-site conditions where the route should be and note route not found, and record the designated route number of the route that cannot be located. Before taking a point for this variable, confirm that the route is not locatable at the beginning, end or at any expected intersections with other routes. Relay information regarding routes not locatable on the ground to the BLM manager for evaluation. If a route being monitored becomes impassable, at the point in which the route becomes impassable, take a point under this variable, provide a brief description of the on-site conditions where the route becomes impassable and note route impassable, and record the designated route number of the route.

Example photos of incursion usage intensity levels, widths, and track types (single, two, multi) are located in Section 5.

Variable 12, Linear Sample, is more complicated to enact on the GPS unit and thus requires additional training; make sure staff receive training on how to perform this variable on the GPS unit being used prior to starting field monitoring.

If a designated route to be monitored becomes impassable, follow instructions described under Variable 15, Route Not Present.

If a designated route to be monitored is not locatable on the ground, follow instructions described under Variable 15, Route Not Present. Relay information regarding routes not locatable on the ground to the BLM manager for evaluation and potential redesignation as closed.

If staff run into issues with routes being numbered wrong in the field versus GIS, routes duplicated in GIS, multiple different routes with the same number, or some other baseline GIS data-related issue, make a note of the issue and report it to the lead GIS staff member. If total monitored route mileage is reduced, select additional routes to be monitored from the list generated for the 3-year monitoring period (see Section 3.2 for additional info).

The GPS unit data dictionary for field monitoring is located here:

<\\blm\dfs\ca\ba\pub\gis\image\gis\project\gps\DataDictionary\MonitoringSamplingPilotUpdate>

2012 and 2013 GPS observational reporting data are stored in two geodatabases located here:
<\\blm\dfs\ca\ba\pub\gisimage\gis\project\WEMO Court Remedy\BFO Monitoring 2012> and
<\\blm\dfs\ca\ba\pub\gisimage\gis\project\WEMO Court Remedy\BFO Monitoring 2013>.

3.4 Monitoring Protocols

3.4.1 Check In/Out Procedures/Safety Info

Staff conducting monitoring activities will follow all standard check-in/out and safety procedures for their field office.

3.4.2 Data Submittal Procedures

All monitoring data will be saved to the server. At the end of each monitoring day, download data from the GPS unit or other electronic device to the server. If using paper forms, scan all forms and save them to the server. If a separate camera is used to take photos of incursions, download the photos daily and save to the server.

Save all monitoring data here: <\\blm\dfs\ca\ba\pub\gisimage\gis\project\WEMO Court Remedy> (Barstow)

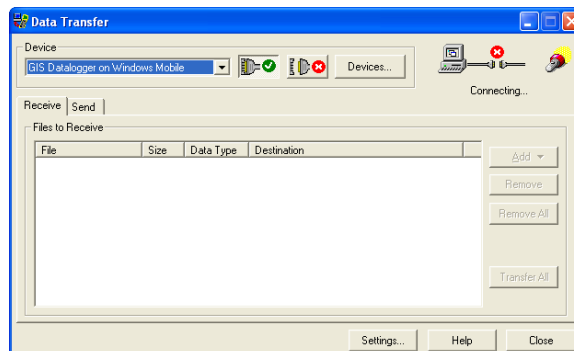
<\\blm\dfs\ca\ri\pub\gisimage\gis\project\WEMO Court Remedy> (Ridgecrest)

3.4.3 Converting GPS Data into GIS Data

Field data for the WEMO OHV Monitoring Protocol will be primarily collected on Trimble Juno and GeoXM series GPS units or other electronic devices. A GPS unit will collect information regarding the positional accuracy of the data, the date and time the incursion was logged and the coordinates of the incursion, in addition to staff input for the variables listed in Section 3.3.

When the GPS units are brought back into the office, use the Trimble Pathfinder Office desktop software to post-process the GPS data. Post-processing increases the positional accuracy of the data by correcting for atmospheric distortions. Pathfinder Office also has the utility to convert the GPS data into an ESRI shapefile for use in GIS.

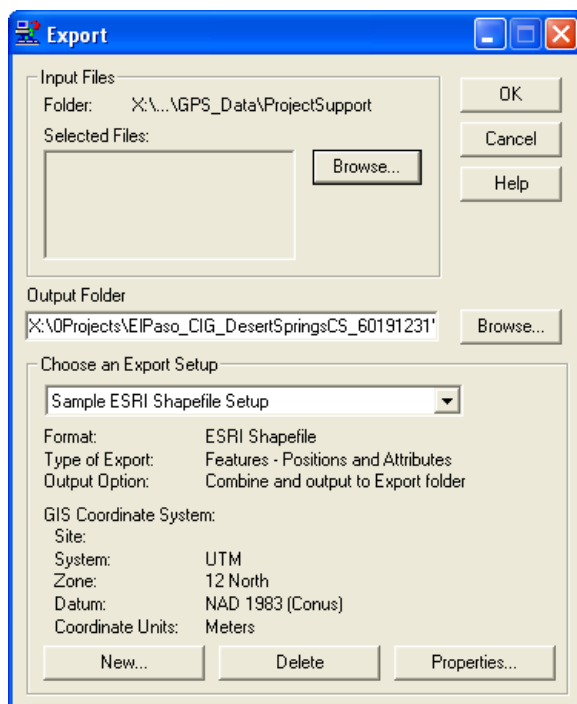
To download data from the GPS unit, using Pathfinder Office, Click Utilities → Data Transfer, and then work through the Transfer Wizard.



To post process the data and do differential corrections to enhance the positional accuracy of the data, Using Pathfinder Office, Click Utilities → Differential Corrections, and then work through the Differential Correction Wizard.



To convert GPS data into GIS data, Using Pathfinder Office, Click Utilities → Export, and then work through the Export Wizard.



After GPS data has been converted to GIS data, review the data for accuracy and update GTLF with any changes that need to be made to route locations (based on linear sample variable), route numbers, mileages, etc.

Data checks to perform on the converted GIS data include:

1. Make sure the subregion for all monitored routes matches the designated route number 2-letter code.
2. For all incursions where usage is "none", make sure that "no" or "none" is filled in for all subsequent variables (width, type, closure action, describe closure).
3. Make sure that for the variable Closure Actions, where the response was "yes", a closure action other than "none" is filled in. Where the response was "no", make sure that Describe Closure is "none."
4. Review any points under the route not present variable and identify which are routes not locatable on the ground and which are impassable route sections.
5. Make sure incursions with the Type of "Single Track" also have a width of "Motorcycle."

New incursions need to be assigned an Incursion ID number. The Incursion ID numbers need to be unique and should be formed with the 2-letter subregion prefix (BM, R, CG, etc.) followed by 4 numeric digits.

3.4.4 Converting Form Data into GIS Data

- a. Enter the form data into excel using the following headings:
 - i. StaffNames, Date, Subregion, Designated, Easting, Northing, Inc_ID, Usage, Width, Type, ClosureAct, DescribeCl, TypeUseCom, PhotoCom, PhotoDate, RNP_Cond
 - ii. All data must be on a single line (i.e., no wrapping text)
- b. Add the tab of the spreadsheet to ArcMap as a table.
- c. Right click on the table and select Display XY Data
 - i. Select the fields that correspond with the X Field (Easting) and Y Field (Northing)
 - ii. Select the coordinate system of the points (most likely UTM Zone 11, NAD 83) and click ok.
 - iii. Right click on the newly created Event Theme, and Export it as a shapefile.

3.4.5 Converting GIS Data into Excel Data

- a. Open the Feature Class Attribute Table in ArcMap.
- b. Export the attribute table as a dBASE table.
- c. Open the dBASE table in Excel and save as an Excel file.

3.5 Field Equipment Requirements

Though all field monitoring will be conducted from an automobile, staff need to be prepared for hot temperatures during certain times of the year and potentially inclement weather during other times of the year, should something happen to the automobile.

Staff should bring the following on every field monitoring day:

- Ample water and food in a cooler

- Sunglasses, sunscreen, etc.
- Extra clothes (layers, jacket)
- Two GPS units (one of which should be a Juno unit if available) or other electronic device to capture field data; one device has previous monitoring data loaded
- Extra batteries for the GPS unit/other electronic device if available
- GPS unit/other electronic device car charger
- Paper monitoring forms (at least 20)
- Paper map of incursions on routes to be monitored
- A few sheets of blank paper for notes
- Copy of this monitoring protocol document
- Pencils/pens
- Cell phone/radio
- Camera (if using GeoXM Trimble unit)

3.6 Aerial Photography Monitoring Procedures

Monitoring of routes without existing, active incursions will occur from a desktop computer and will consist of reviewing routes without existing, active incursions against an aerial photograph and determining if there are any incursions along the route. See Section 3.2 for developing the sample of 'routes without existing, active incursions' to be monitored. The aerial photography used for this monitoring will consist of the latest National Agriculture Imagery Program (NAIP) imagery available from the USDA's Farm Service Agency. For additional information on this imagery, see the NAIP website:

<http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=prog&topic=nai>.

NAIP Imagery can be downloaded from the NRCS Geospatial Data Gateway, or can be accessed directly from ArcGIS via the ArcGIS Server. Instructions for setting up the online server can be found here: http://www.fsa.usda.gov/Internet/FSA_File/arcgisserverwebservicevia_93.pdf. When projecting On-The-Fly, remember to use the NAD_1983_To_WGS_1984_5 transformation (ESRI Article ID: 24159).

Desktop aerial photography monitoring will consist of a GIS specialist zooming in on one end of a route (1:1,200 would be a good scale), and then panning along the route looking for incursions. An incursion point would be created for any incursions identified along the route (and given a new Incursion ID number). When reviewing routes for incursions, keep in mind that an incursion point would consist of any location where visitors have gone off the designated route (on BLM land only) to use a closed route or develop a new route. Incursions DO NOT include driveways, other agency roads, routes designated as administrative use only, hike/bike/horse trails, etc. Incursion points can be on either side of the designated route.

Once the entire route has been reviewed against the aerial photo background and any incursions identified, the route should be attributed as monitored, the date it was monitored, the date of the NAIP imagery used, and the name of the individual(s) that reviewed it. This information would be used to track routes that have been reviewed, particularly if no incursions were identified.

3.7 Monitoring Form

Although a paper monitoring form is provided herein, staff will primarily use GPS units or other electronic devices to record the GPS locations and other monitoring information required and will only use paper copies of the monitoring form as a back-up if the GPS unit or other electronic device is not available or malfunctions.

4.0 Monitoring Outputs

The BLM anticipates providing monitoring status memos in years 1 and 2 of monitoring, with a complete monitoring report produced after monitoring is completed in year 3. The BLM also anticipates discussing results from 3 cycles of monitoring, any identified trends, and any adjustments needed to the population of routes with existing, active incursions in a 9-Year Trend Analysis Report. The following sections outline the contents of each report and the analyses to be conducted for each report. At the end of each 3-year monitoring period, including after the 9-Year Trend Analysis Report is generated, the BLM will reassess the protocol to ensure that useful data is being generated in the most effective manner possible. The data in the monitoring reports will be utilized to evaluate and potentially modify implementation strategies developed as part of the travel management planning process for the WEMO Plan area. The reporting cycle will be identified in the WEMO Route Network Plan.

4.1 Year 1 and 2 Memos

BLM would develop brief memos following monitoring activities conducted in years 1 and 2 of a 3-year monitoring cycle. The memo would state which routes were monitored in the field and via aerial photos (see tables below), contain a map of the routes that were monitored (color coded for field versus aerial photo monitoring), when monitoring occurred (days), any issues encountered (including issues with baseline GIS data), and any deviations from the protocol that were required and/or recommendations for changes to the protocol or variables. No statistical or other analysis would be conducted for these memos.

Table X. Routes Field Monitored in Year 1.

Field Office	Travel Management Area	Designated Route Number	Route Mileage
Barstow	Black Mountain	BM6265	10.45
		BM6285	10.59

Table X. Routes Monitored via Aerial Photos in Year 1.

Field Office	Travel Management Area	Designated Route Number	Route Mileage
Barstow	Iron Mountain	IM5208	4.16
		IM5256	1.01

4.2 Year 3 Monitoring Results Report

Results from one 3-year monitoring cycle would be presented in the Year 3 Monitoring Results Report. The report would summarize the data collected for each variable and aggregate data up to the WEMO Plan area, discuss statistical results of data collection, and progress towards reaching goals in Section 3.1. The report would also discuss any modifications to sampling protocols or monitoring variables that are needed.

The following is an outline of the contents of the Year 3 Monitoring Results Report.

1. Introduction

This section would generally describe the monitoring being conducted and history of monitoring efforts.

2. Monitoring Purpose and Need

This section would describe the purpose and need of monitoring activities and the goals of monitoring (goals are in Section 3.1 of this document).

3. Methodology

a. Sampling Strategy

This section would describe the sampling strategy (summarize Section 2 of this protocol document).

b. Field Monitoring Methodology

This section would describe the field monitoring methodology (summarize Section 3.3 of this protocol document).

c. Aerial Photography Monitoring Methodology

This section would describe the aerial photography monitoring methodology (summarize Section 3.6 of this protocol document).

4. Issues Identified

This section would summarize the issues identified over the course of the 3-year monitoring period, including issues with baseline GIS data, and any deviations from the protocol that were required. Suggestions for protocol changes are included in Section 6, Recommendations.

5. Results

a. Monitoring Sample

This section would summarize the sample of routes that was monitored as part of the 3-year monitoring period and how the sample was generated. The example table below shows how the monitoring sample would be presented – the total miles monitored in each stratum and how many miles were monitored in each stratum in year 1, year 2, and year 3.

Table X. Summary of Monitoring Sample.

Strata	Total Miles Monitored	Miles Monitored in Year 1	Miles Monitored in Year 2	Miles Monitored in Year 3
Routes with Incursions				
Routes without Incursions				

b. Results for Monitoring of Routes with Incursions

This section would present results for field monitoring of routes with at least one existing, active incursion. Results would be presented for each of the monitoring variables. The example tables

within the sections below demonstrate how the data for each monitoring variable could be analyzed and reported; it is assumed that associated report text would describe the analysis and results presented in the tables. The sections below also include a brief description of maps that could be included within the write-up for each variable to help display monitoring results graphically.

i. Number of Incursions

Information presented here would identify the number/percentage of incursions that are existing, active incursions identified in baseline data and the number/percentage of incursions that are new and are not present in the baseline data, along with identifying where the new incursions are located.

Table X. Summary of Existing and New Incursions Monitored.

Total Number of Incursions Monitored	Within Baseline Data		New Incursions	
	# of Incursions	% of Total Incursions Identified	# of Incursions	% of Total Incursions Identified

Table X. Areas with New Incursions.

TMA	# of New Incursions	% of Total of New Incursions	% of Total Route Miles Monitored

Maps –

1. Map of routes monitored with all incursions noted – new in one color and existing in another color. Show Field Office boundaries and TMA boundaries.

ii. Incursion Usage Intensity

Information presented for this variable would describe the number of incursions in each usage category compared to the baseline, the level of increase or decrease in incursion usage compared to the baseline, and where the increases in incursion usage were focused – certain routes or areas.

Table X. Incursion Usage.

Usage Level	Total # of Incursions Monitored	% of Incursions Monitored	% of Incursions Monitored	
			Existing Incursions	New Incursions
None				
Light				
Medium				
Heavy				

The following tables relate to existing incursions and changes to the incursion usage of existing incursions. Because both Field Offices had "None" and "Light" combined into one category for the baseline data, this will need to be noted in the following tables. It is assumed that there would be no routes with "None" as the usage category under the baseline condition and that all "None/Light" usage should be converted to "Light."

Table X. Incursion Usage for Existing Incursions – Baseline versus Monitoring.

Usage Category	% of Incursions	
	Baseline	Monitoring
None	0	
Light		
Medium		
Heavy		

Note - Both Field Offices had "None" and "Light" combined into one category for the baseline data. All "None/Light" usage has been converted to "Light."

Table X. Comparison of Incursion Usage Change.

Usage Category	Number and Percent of Incursions					
	One Level Change ¹		Two Level Change ²		Three Level Change ³	
	Increase	Decrease	Increase	Decrease	Increase	Decrease
None	0	-	0	-	0	-
Light				-	-	-
Medium			-		-	-
Heavy	-		-		-	

Notes

1 – Usage level changed from none to light, light to medium, or medium to heavy (or the reverse).

2 – Usage level changed from none to medium, light to heavy or the reverse.

3 – Usage level changed from none to heavy or the reverse.

AECOM

27

Table X. Existing Incursions No Longer Active.

TMA	# of Incursions with Incursion Usage "None"

The following table relates to new incursions only (i.e., incursions not included in baseline data).

Table X. Incursion Usage for New Incursions Only.

TMA	% of New Incursions			
	None	Light	Medium	Heavy
	-			
	-			
	-			
	-			
	-			

Maps –

1. All monitored incursions color coded by usage level, show existing incursions with a halo or other denotation (compared to new incursions).
2. All existing incursions with 4 color codes – usage level decreased, stayed the same or increased, and usage level "none".

iii. Incursion Width

Information presented for this variable would describe the number of incursions in each width category compared to the baseline, the level of increase or decrease in incursion width compared to the baseline, and where the increases in incursion width were focused – certain routes or areas.

Table X. Incursion Width.

Width Level	Total # of Incursions Monitored	% of Incursions Monitored	% of Incursions Monitored	
			Existing Incursions	New Incursions
Truck				
Quad				
Motorcycle				

The following tables relate to existing incursions and changes to the incursion width of existing incursions. Because the Barstow Field Office measured width in feet as part of baseline conditions, the widths will need to be converted to Truck (greater than 5 feet), Quad (3-5 feet), and Motorcycle (less than 3 feet). This should be noted in the tables below.

Table X. Incursion Width for Existing Incursions – Baseline versus Monitoring.

Width Level	% of Incursions	
	Baseline	Monitoring
Truck		
Quad		
Motorcycle		

Table X. Comparison of Incursion Width Change.

Width Category	Number and Percent of Incursions			
	One Level Change ¹		Two Level Change ²	
	Increase	Decrease	Increase	Decrease
Truck	-		-	
Quad			-	-
Motorcycle		-		-

Notes:

1 – One level change is from motorcycle to quad or quad to truck or the reverse.

2 – Two level change is from motorcycle to truck (increase) or truck to motorcycle (decrease).

Table X. Incursion Width Increases versus Increases in Incursion Use.

	% of Incursions with		
	1 Level Increase in Incursion Use	2 Level Increase in Incursion Use	3 Level Increase in Incursion Use
1 Level Increase in Width			
2 Level Increase in Width			

The following table relates to new incursions only (i.e., incursions not included in baseline data).

Table X. Incursion Width for New Incursions Only.

TMA	% of New Incursions		
	Truck	Quad	Motorcycle

Maps –

1. All monitored incursions color coded by width level, show existing incursions with a halo or other denotation (compared to new incursions).
2. All existing incursions with 3 color codes – width level decreased, stayed the same or increased.

iv. Type of Incursion Use

Information presented for this variable would identify the types of incursion use compared to the baseline, changes in the type of incursion use and where changes in the type of incursion use were focused, in addition to noting type of use for new incursions.

Table X. Type of Incursion Use.

Type of Incursion Use	Total # of Incursions Monitored	% of Incursions Monitored	% of Incursions Monitored	
			Existing Incursions	New Incursions
Single Track				
Two Track				
Multi-Track				
Hiking				

Mountain Biking				
Equestrian				
Animal				
Camping/Staging				
Other				

The following tables relate to existing incursions and changes to the type of incursion use for existing incursions. The Ridgecrest Field Office did not include type of incursion use in the baseline data; thus, there will be no available comparison data until after a few monitoring cycles. The Barstow Field Office did include type of incursion use in the baseline data; however, hiking, mountain biking, equestrian, animal, and camping/staging were included under "Other."

Table X. Type of Incursion Use for Existing Incursions – Baseline versus Monitoring.

Type of Incursion Use	% of Incursions	
	Baseline	Monitoring
Single Track		
Two Track		
Multi-Track		
Hiking		
Mountain Biking		
Equestrian		
Animal		
Camping/Staging		
Other		

Table X. Change in Type of Incursion Use.

Type of Incursion Use	% of Incursions that Changed to								
	Single Track	Two Track	Multi-Track	Hiking	Mtn Biking	Equestrian	Animal	Camping/Staging	Other
Single Track	-								
Two Track		-							
Multi-Track			-						
Hiking				-					
Mountain Biking					-				
Equestrian						-			
Animal							-		
Camping/Staging								-	

Other										-
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Table X. Comparison of Type of Incursion Use and Changes in Incursion Width and Use.

	% of Incursions				
	Increased in Width 1 Level	Increased in Width 2 Levels	Increased In Use 1 Level	Increased in Use 2 Levels	Increased in Use 3 Levels
Incursions that Changed from Single Track to Two Track					
Incursions that Changed from Single Track to Multi-Track					
Incursions that Changed from Two-Track to Multi-Track					

The following table relates to new incursions only (i.e., incursions not included in baseline data).

Table X. Type of Incursion Use for New Incursions Only.

TMA	% of New Incursions								
	Single Track	Two Track	Multi-Track	Hiking	Mountain Biking	Equestrian	Animal	Camping/ Staging	Other

Maps –

1. All monitored incursions color coded by Type of Use, show existing incursions with a halo or other denotation (compared to new incursions).
2. All existing incursions with 3 color codes – single to two track, two track to multi-track, single to multi-track.
3. New incursions only color coded by Type of Use.

v. BLM Closure Actions

Information presented for this variable would identify the number and location of BLM closure actions on incursions, the prevalence of the different types of closure actions within monitored incursions, characteristics of incursions with each type of closure action in place and changes to use levels, incursion widths, and types of incursion use.

Table X. BLM Closure Actions in Place on Incursions.

BLM Closure Action in Place?	Total # of Incursions Monitored	% of Incursions Monitored	% of Incursions Monitored	
			Existing Incursions	New Incursions
Yes				
No				

The following tables relate to existing incursions only and the possible effects of closure actions on incursion usage, width and type of use. The Ridgecrest Field Office did not include closure action variables within baseline data; thus, there will be no available comparison data until after a few monitoring cycles. The Barstow Field Office did include some information on past management within baseline data, though categories of actions were different. This should be noted in the tables below.

Table X. Location of Incursion Closure Actions in Place.

TMA	# of Existing Incursions Monitored	# of Existing Incursions Monitored with Closure Action	% of Existing Incursions Monitored with Closure Action

Table X. Comparison of Closure Actions – Baseline versus Monitoring.

% of Incursions			
Baseline		Monitored	
With Closure	No Closure	With Closure	No Closure

AECOM

33

Table X. Type of Closure Action for Incursions with BLM Closure Action In Place.

BLM Closure Action in Place?	# of Existing Incursions Monitored	% of Existing Incursions Monitored
No		
Yes		
Fencing		
Boulders		
Vegetation		
Closed Sign		
Natural		

The following tables provide information on the other characteristics of incursions that contain closure actions.

Table X. Incursion Usage Level for Incursions with Closure Actions.

Type of BLM Closure Action	% of Incursions with Usage Level			
	None	Light	Medium	Heavy
Fencing				
Boulders				
Vegetation				
Closed Sign				
Natural				

Table X. Incursion Width for Incursions with Closure Actions.

Type of BLM Closure Action	% of Incursions with Width Level		
	Truck	Quad	Motorcycle
Fencing			
Boulders			
Vegetation			
Closed Sign			
Natural			

Table X. Type of Incursion Use for Incursions with Closure Actions.

Type of BLM Closure Action	% of Incursions with Type of Use								
	Single Track	Two Track	Multi-Track	Hiking	Mountain Biking	Equestrian	Animal	Camping/Staging	Other
Fencing									
Boulders									
Vegetation									
Closed Sign									
Natural									

The following tables would show the effectiveness of the different closure types.

Table X. Summary of Change in Incursion Use for Incursions with Closure Actions.

Type of BLM Closure Action	% of Incursions with No Use	% of Incursions with Decrease in Use	% of Incursions with No Change in Use Level	% of Incursions with Increase in Use Level
Fencing				
Boulders				
Vegetation				
Closed Sign				
Natural				

Table X. Summary of Change in Incursion Width for Incursions with Closure Actions.

Type of BLM Closure Action	% of Incursions with Decrease in Width	% of Incursions with No Change in Width Level	% of Incursions with Increase in Width
Fencing			
Boulders			
Vegetation			
Closed Sign			
Natural			

Table X. Summary of Change in Type of Incursion Use for Incursions with Closure Actions.

Type of BLM Closure Action	% of Incursions with Change from Single Track to Two Track	% of Incursions with Change from Single Track to Multi-Track	% of Incursions with Change from Two Track to Multi-Track	% of Incursions with Change from Multi-Track to Single or Two Track
Fencing				
Boulders				
Vegetation				
Closed Sign				
Natural				

Maps –

1. Incursions with and without closure actions.
2. Incursions color coded by type of closure action.
3. Incursions color coded for change in use level for incursions with closure actions.
4. Incursions color coded for change in width level for incursions with closure actions.

c. Results for Monitoring of Routes without Incursions

This section would present results for aerial photograph monitoring of routes without existing, active incursions. Results would identify the number/mileage of routes for which aerial photography monitoring determined there were no new incursions as well as the number/mileage of routes where monitoring was able to identify a new incursion(s). The following tables demonstrate how this information may be presented in the report.

Table X. Results of Aerial Photography Monitoring for Routes without Existing Incursions.

	Number of Routes	Mileage
Routes with No New Incursions Identified		
Routes with at Least One New Incursion Identified		
Total Routes Monitored without Existing Incursions		

Table X. Summary of New Incursions Identified.

Number of New Incursions Identified	# of Routes	% of Monitored Routes without Existing Incursions
1		
2		
3		
4		
5		

Maps –

1. Routes without existing incursions that were monitored, color coded – one color for routes with no new incursions identified, one color for routes with at least one new incursion identified.
2. Map of routes with at least one new incursion identified color coded by the number of new incursions identified (1, 2, 3, 4, 5, 6-10, etc.).

6. Recommendations

This section would describe any modifications needed to the sampling approach, monitoring variables, baseline GIS data, or general protocol based on monitoring results and/or issues identified during monitoring activities.

4.3 9-Year Trend Analysis Report

The 9-Year Trend Analysis Report would compile 3 monitoring cycles' worth of data (9 years of monitoring). Analysis conducted for the report would include aggregating analysis for the monitoring variables from the 9 years of monitoring and reviewing the previous three Year 3 Monitoring Results Reports to identify trends in the issues identified, effectiveness of closure actions, new incursions identified and their location, and results of aerial photography monitoring. In addition, a list of routes that need to change strata would be provided in the report (either routes no longer contain active incursions and should move to the 'routes without existing, active incursions' strata or vice versa). Based on this list, the report would identify the new strata population sizes, any effects on the protocol's sampling approach, and any changes that need to be made to maintain statistical validity at the WEMO Plan Area level, in addition to any protocol changes needed.

4.4 Statistical Analysis for Report Preparation

The WEMO Plan Area monitoring protocol will yield valuable data and information on both the creation of new incursions and public compliance with closure methods for existing incursions. These data can be analyzed and summarized using a variety of software packages, some of which are specifically designed for statistical analyses. These software options include the following, among others:

1. MS Excel – Excel comes preloaded with some statistical analysis functions, while others may be developed (using formulas and/or Visual Basic) or purchased (through online downloads). Excel

tends to be easier to use (given most users' familiarity with the MS Office suite), but does not offer the same level of sophistication as the other statistical packages listed below.

2. Stata, SAS, PASW – These are three of the more common statistical packages that can be purchased. All offer similar analysis capabilities, though the specific interfaces and strengths of each tend to be different. The downside of these packages is that they take time to learn (some more than others) and can be very expensive (between the initial software purchase and additional licenses required for continued use of the software).
3. R – R is a statistical package that can be downloaded for free. The program offers very little of the structure and interface found in the statistical packages above, but does offer nearly unlimited analysis options. Some degree of programming knowledge is needed to write analyses in R, though analysis programs written by other R users are commonly available online for download.

The software package selected to use for analysis of monitoring data will in part depend on staff knowledge of and familiarity with individual programs, as well as overall cost. Any of the software options listed above can be used to derive the statistical analyses described below, as well as the other data summary tables referenced in the protocol report outline.

The WEMO Plan Area monitoring protocol is intended to gather data needed to estimate the following related to the creation of new incursions within the WEMO Plan area:

1. Percentage of routes with incursions,
2. Number of new incursions per route, and
3. The mean number of incursions per mile of designated route.

At a minimum, these descriptive statistics (e.g., counts, means, etc.) provide a preliminary summary and allow for additional exploration of the monitoring data. The descriptive statistics should also include post-hoc estimates of confidence, sampling error, standard deviation, and other statistical measures (e.g., skewness, kurtosis, etc.) and assessments (e.g., Type I and II [Power] error, etc.). They also allow for more sophisticated statistical comparisons (e.g., t-tests, analysis of variance [ANOVA], etc.). These comparisons (which rely on an acceptable significance threshold or p value) can be performed for each of the monitoring variables listed above by comparing the sample monitoring data to the sample baseline data, as well as to the baseline population data. The results of the comparisons enable inferences to be made regarding the statistical significance of the results (e.g., is there a statistical difference between the sample mean number of incursions per mile and the baseline number of incursions per mile for the total population).

The monitoring protocol is also intended to gather data needed to gauge public compliance with route closures. Public compliance will be assessed over time based on an analysis of the following variables:

1. The number and types of closure actions,
2. The mean incursion usage intensity, and
3. The mean incursion width.

Similar to the incursion statistics above, these descriptive statistics related to route compliance (e.g., counts, means, etc.) provide a preliminary summary and allow for additional exploration of the monitoring data. The descriptive statistics should also include post-hoc estimates of confidence, sampling error, standard deviation, and other statistical measures (e.g., skewness, kurtosis, etc.) and assessments (e.g., Type I and II [Power] error, etc.). The compliance-related variables are generally categorical (see Section 3.3), though incursion usage intensity and incursion width may be converted to quantitative variables that lend themselves to the types of comparisons described above. Assessment techniques that account for categorical variables can also be used, in particular in analyzing the relationship between the type of incursion action and corresponding usage intensity and width. Correlation tests (e.g., Pearson's chi-

squared test) can be used to test for statistical relationships and differences between closure methods and incursion usage intensity and/or incursion width. Since the numbers and types of closure action were not captured during the 2012 baseline for the Ridgecrest Field Office, it will take several cycles of monitoring protocol implementation to establish a trend and allow for statistical tests that address closure methods.

Again, it should be stressed that while the monitoring protocol will result in a wealth of data and information that can be statistically analyzed, it is also designed to yield pragmatic information that can be used to manage the WEMO Plan Area route network. This is not to minimize the role of statistical analysis in the monitoring effort, but rather to help focus the post-analysis decision making effort as it relates to prioritizing route management actions.

4.5 Monitoring Data Analysis for Report Preparation

Before GIS data is converted to Excel data, some additional fields need to be added to the geodatabase to assist in report preparation. In addition, some baseline data needs to be re-attributed to be consistent with attributes for the new monitoring variables.

In GIS, a field should be added titled "Origin" and attributed as "baseline" for incursions within the baseline data that were not re-monitored within the monitoring cycle, "baseline/new" for incursions that were in the baseline data that were re-monitored, and "new" for incursions that are new and were not included in the original baseline data.

For the Barstow Field Office, three fields will need to be re-attributed to be consistent with attributes for the new monitoring variables. Avg_Width will need to be converted from feet to Truck, Motorcycle and Quad. Widths of 5 feet or more should be converted to Truck, 0-2 feet widths should be converted to Motorcycle and widths of 3-4 feet should be converted to Quad. The conversions should be done as part of a new field (e.g., Width_Converted). In addition, 3 feet widths for single track routes (under OHV_Use) should be converted to Motorcycle.

The baseline data field of Frequency_ will also need to be re-attributed to be consistent with the 4 classes of use under the new Usage variable. Under Frequency_, "None/Light" should be converted to "Light". The conversion should be done as part of a new field (e.g., Freq Use_Converted). There should be nothing attributed as "None" under the baseline data, only Light, Moderate and Heavy.

The Past_Mgmt variable will also need to be converted to two fields to correspond with the new Closure Action and Describe Closure variables. For the conversion to Closure Action, "No evidence apparent" under Past_Mgmt would be converted to "No" and all other attributes would be converted to "Yes". For the conversion to Describe Closure the table below shows how to convert attributes under Past_Mgmt. The conversions should be done as part of two new fields (e.g., Past_Conv_Action, Past_Conv_Desc).

Past_Mgmt	New Converted Field
Brown Carsonite Sign	Closed Sign
Fencing	Fencing
Horizontal Mulching	Vegetation
No Evidence apparent	None
Other Camouflaging	Natural
Red Carsonite Sign	Closed Sign
Rock Work	Boulders

Vertical Mulching	Vegetation
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Once incursion width and usage fields have been re-attributed, new fields also need to be created that convert the text attributes to numbers. This needs to be done for both baseline data and monitoring data. The table below shows the conversions of text to numbers.

Width Attribute	Number Conversion
Motorcycle	1
Quad	2
Truck	3

Usage Attribute	Number Conversion
None	1
Light	2
Medium (Moderate in baseline data)	3
Heavy	4

Once the fields have been converted to numbers two additional fields can be created that show the difference between baseline and monitoring data by subtracting the value for monitoring data from the baseline value. Resulting numbers can be either positive (i.e., the width got larger or usage increased) or negative (i.e., width got smaller or usage decreased). The number value indicates the level change – a value of 1 means that width or usage increased by 1 level from baseline to monitoring; a value of -2 means that usage or width decreased by two levels. The different fields will be used in report preparation to show level changes of these two variables.

Once these fields have been created and baseline variables re-attributed, the geodatabase is ready for conversion to Excel and pivot tables for analysis and report preparation. The database needs to include the fields for route number, incursion ID, baseline variables (as modified), monitoring variables, new difference fields, subregion, TMA, and field office. This information can be saved from GIS to Excel and then a Pivot table created. The pivot table will be dynamic in order to compare various variables, but generally will use Count of Incursion IDs as the value, Origin as the column label, and variables such as width, usage and type as row labels. Pivot tables should be sufficient for the non-statistical analysis needed to fill in the tables in the Year 3 Monitoring Results Report.

5.0 Photo Examples of Monitoring Variables

Photos of Incursion Usage Intensity



None



Light

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41



Moderate



Heavy

Photos of Incursion Width



Truck & Motorcycle



Quad

Photos of Type of Incursion Use



Single Track



Two-Track

AECOM

44



Multi-Track

6.0 References

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