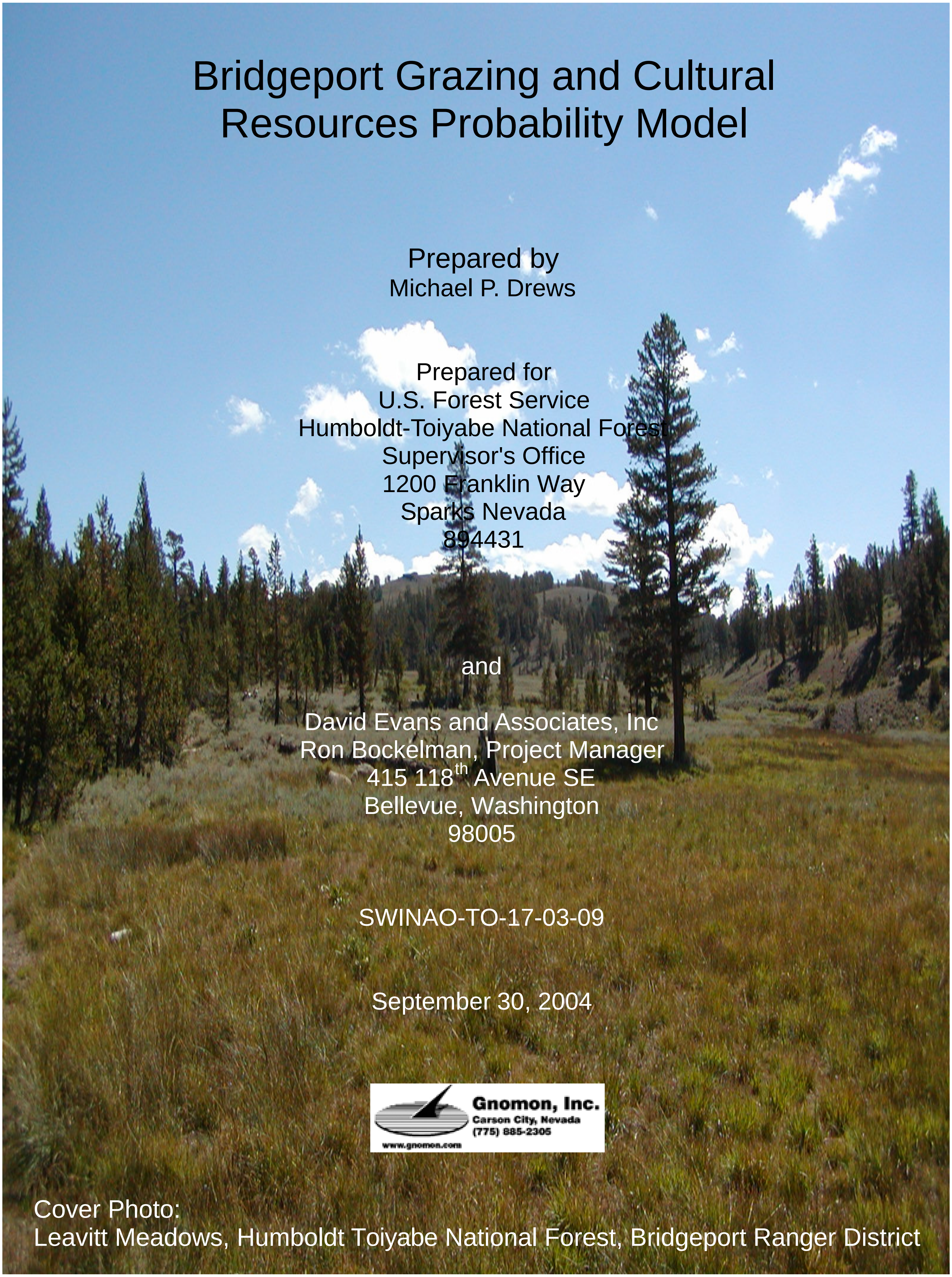

Bridgeport Grazing and Cultural Resources Probability Model

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Prepared for
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SWINAO-TO-17-03-09

September 30, 2004

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Cover Photo:
Leavitt Meadows, Humboldt Toiyabe National Forest, Bridgeport Ranger District

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ACKNOWLEDGEMENTS

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I. INTRODUCTION

The Humboldt-Toiyabe National Forest (USDA Forest Service) has entered into a Memorandum of Understanding (MOU) with the Nevada and California State Historic Preservation Offices that clarifies compliance with Section 106 of the National Historic Preservation Act (NHPA) for rangeland management. In this MOU, the Forest Service agreed to place known sites and all inventories on GIS maps, then to develop predictive models forecasting site locations. A sampling strategy, taking into account livestock utilization and forecasted site sensitivity was also to be developed.

The Bridgeport Grazing Model develops the spatial model and provides a sampling strategy in compliance with the MOU. The model uses available environmental layers to forecast the location of cultural resources and to assess the potential effects due to livestock utilization. An archaeological sampling strategy is developed from the integrated model results. Areas with high archaeological sensitivity and the high potential forage utilization are given highest priority for sampling. This approach provides forest managers with a tool that efficiently accomplishes cultural resource assessments in compliance with Section 106 by focusing survey efforts in areas where sites are likely to occur and importantly, identifying where the risk of site destruction from grazing is highest.

Within the last 10 years, cultural resource sensitivity models developed within the Great Basin (Zeanah et al. 1995, 1999; Drews et al. 2001, Drews et al. 2004a; 2004b) have produced satisfactory forecasting results. These models use a deductive anthropological framework based on optimal foraging theory. Deductive models rely upon fine-grained environmental information and are thus costly to create and limited in areal extent. Inductive models, which seek correlations between cultural resources and other factors are an alternative, complementary approach. Broader, more inductive modeling has recently been compiled for a large portion of the eastern Great Basin (Drews et al. 2004a). Inductive modeling originates from a statistical analysis of site location against relatively coarse landscape datasets.

Grazing effects

The Bridgeport Grazing probability model is an inductive model. It identifies statistically- based spatial relationships between archaeological sites and readily discernable environmental attributes. Those relationships are combined to create a sensitivity or likelihood framework. The model is not an explanatory anthropological model; it is to be used as a management tool that identifies areas where the likelihood of encountering prehistoric cultural resources may increase costs associated with a proposed activity.

The project area covers approximately 1,120,000 acres comprising the entire Bridgeport Ranger District. It includes portions of Douglas, Lyon, and Mineral Counties in western Nevada and extends into portions of Mono County in eastern California. (Figure 1.1).

Topography and environment vary widely across the project area landscape. The extreme western boundary follows the crest of the Sierra Nevada Range across the northern half of Mono County. Elevations generally exceed 11,000 feet and the topography is characterized by steep slopes and moraines formed by a sequence of glacial events. The western region is well watered, forming the headwaters of the West Walker drainage. Sub-alpine vegetation, conifers and alpine meadows dominate the floral community.

Vegetation and topography are more characteristic of the Great Basin province from the Walker River drainage east across the project area. Ranges within the district include portions of the Huntoon Mountains, Excelsior Mountains, Anchorite Hills, Bodie Hills, the Sweetwater Mountains, Pine Grove Hills, Wellington Hills and the Desert Creek Mountains. While not as dramatically sculpted as the Sierra Nevada Range, the eastern mountains average between 8000 and 10,000 feet in elevation. Each of the ranges support a number of perennial and intermittent drainages, all of which drain into the east or west

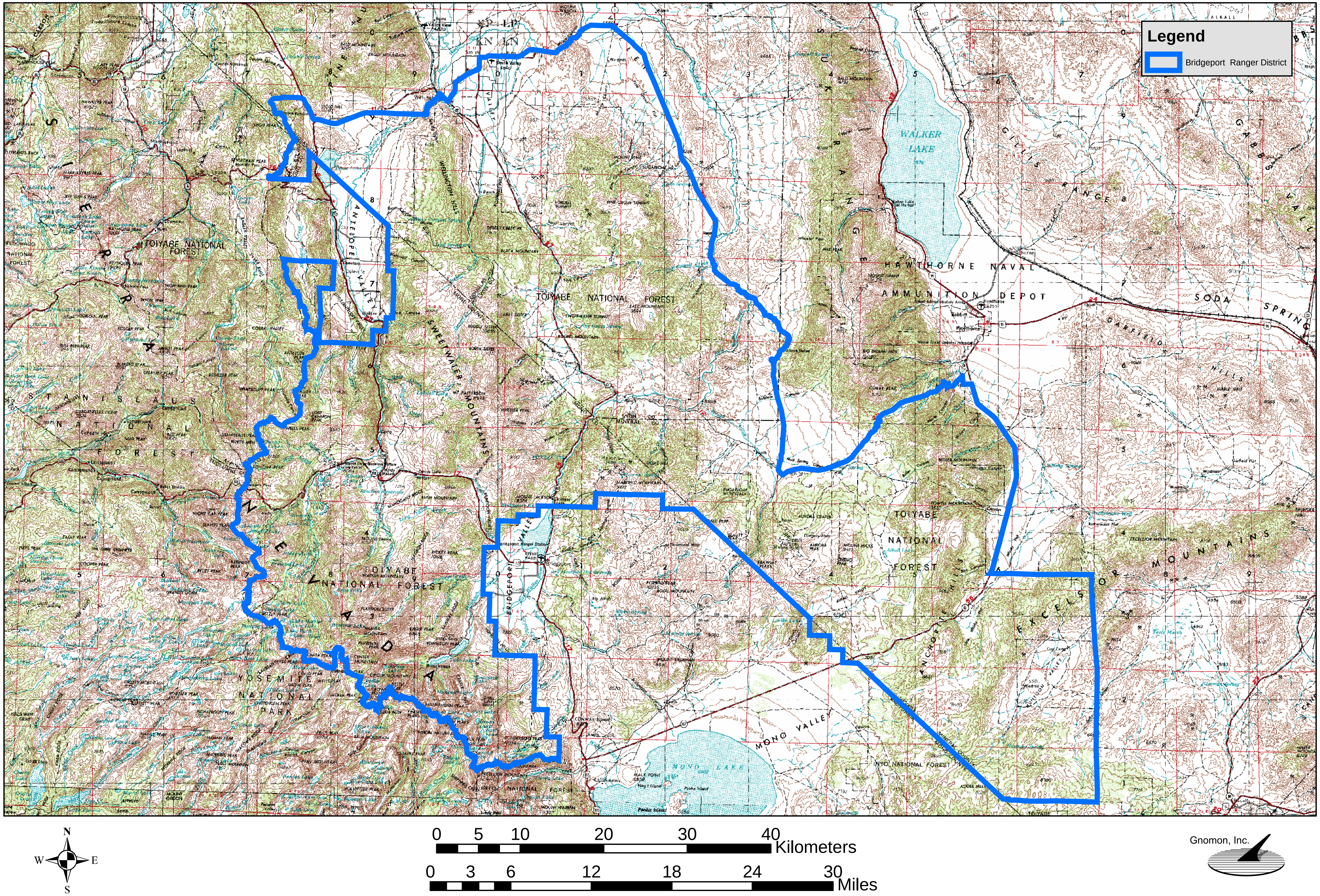

Figure 1.1. Project Area

forks of the Walker River. Shrub cover in the eastern part of the project area is typical of sagebrush steppe. Pinon/juniper woodland dominates the more protected upland slopes. Sagebrush is the typical shrub cover. Riparian zones are confined to well watered drainages.

II. METHODS AND PROCEEDURES

Predictive cultural resource models are "a simplified set of testable hypotheses, based either on behavioral assumptions or on empirical correlations, which at a minimum attempts to predict the loci of past human activities resulting in the deposition of artifacts or alteration of the landscape" (Kohler 1988:33). Based upon their accumulated experience, most archaeologists could, on cursory review of a topographic map, accurately predict with 50% to 80% accuracy where archaeological sites would most likely occur. Predictive capacity alone, however, fails to meet the explanatory capacity of scientific inquiry. Predicting where sites occur does not explain why they occur where they do. Also, sites that fall anomalously outside of an expected pattern are often of great interest to archaeologists (Heidelberg (2001:6).

A number of approaches have been employed as a means to identify patterns within probability layers: *inductive, deductive, intersecting*, and *weighted*. An *inductive* approach establishes conclusions based upon recognition of statistical patterns within existing datasets. The approach is widely used because it draws upon readily available accumulated survey information. Biases are inherent due to variable inventory strategies, sampling criteria and vagaries in data collection methods. Indeed, the extent and methods employed for most archaeological inventories are driven by regulatory compliance issues rather than by scientific inquiry. There is no single research driven sampling protocol. Nonetheless, given the cost of fieldwork, use of observations derived from regulatory work is the only feasible means to create or examine large area models.

Deductive patterns are derived from data specifically collected to test an hypothesis. Theoretical models are proposed, their consequences forecast, and then assessed through primary studies. For example, if we think that campsites will be located within the proximity of particular environmental or resource locations, we first identify those areas, then test our assumptions through a random fieldwork design. Sampling strategies are created to eliminate bias so findings can be more accurately assessed. Variance from model expectations may lead to re-formulation of the original hypothesis, followed by re-testing. that data collected from specific settings within the model environment are consistent. This consistency allows for negative findings to be more readily assessed. Additional background layers consisting of regionally specific data on vegetation, elevation, slope, aspect, soils, hydrology, and climate can be used to test deductive hypotheses.

An *intersecting* approach compares archaeological data explicitly chosen independent variables. The combination of observed archaeological data as they overlap with independent variables define higher or lower probabilities depending on accumulated intersections or lack thereof. When several independent probability strata overlap, their intersection defines an area of high sensitivity.

A significant problem with the *intersecting* approach is that independent variables, environmental strata in this model, are considered equally. To counter that shortcoming, independent variables can be *weighted* so that positive or negative relationships within a stratum, are assigned relative values based upon expert opinion or theoretical direction. For example, slope, might be assigned a lower relative value than distance to water. A scalar variable may also distinguish relative strength of classes within a stratum. For example, areas between 500 and 1000 meters of water might be weighted higher than those lying at greater distances, but lower than those falling within the 0-500 meter range. Combining both *intersecting* and *weighting* methods creates an even more robust approach.

Selecting environmental and cultural attributes, converting them systematically to variables, then determining how the variables should be analyzed were major considerations for the development of the planning model. Fine-grained environmental datasets contain a wealth of information but require very specific manipulation to return a desired analytical layer. For example, soils data can be manipulated to estimate potential density of rice grass per acre in a given area. Depending upon algorithms used, results may hard to duplicate. Modeling based upon fine grained datasets are difficult to maintain or to modify without considerable technical expertise. Finely defined variables are also more difficult to observe or quantify during field testing.

For the analysis presented here, a simplified framework was sought; one that incorporates easily observable environmental and cultural resource layers with a straightforward and maintainable modeling process. Four landscape attributes were considered as environmental variables or layers for prehistoric probability models: elevation, slope, distance to water, and vegetation. The layers are drawn from readily available sources and are easily duplicated. Lithic sources are broadly identified, but lack good spatial context. They are considered in discussions of site density, but could not be utilized as an environmental variable.

The historic probability model considered roads and distance to water as an environmental layer. Cultural resource and inventory layers were collected from various archival sources and added to the dataset. Soil erodibility was considered as a component of the grazing potential and cultural resource probability integration. Datasets and the modeling process are described in the following section

Environmental Layers

Landscape level analysis required the compilation of a number of environmental datasets or evidential themes that could be used with the site data to construct a probability model. Datasets compiled for the project area included elevation and slope, vegetation, distance to water, roads, and soils.

Elevation and Slope

Elevation and slope were derived from a combination of the USGS National Elevation Dataset (NED) and 10 meter digital elevational models (DEM) compiled by the United States Geological Survey (USGS) and provided to us by the Humboldt-Toiyabe National Forest. Slope and elevation were calculated for each cell, and then converted to elevation or slope grids. Elevation grids were grouped into 500 meter bands. For analytical purposes, slope was divided into five classes: 0-5 degrees, 5-11 degrees, and greater than 11 degrees. Again elevation and slope were used to evaluate inventory coverage and site distribution. Slope served as a genera proxy for landform. The NED was also used to create shaded relief maps for use as background graphics in each of the analytic units. Metadata for NED conforms to National Standards for Geospatial Metadata

Vegetation

Vegetation layers, derived from the USGS Gap Analysis Program (GAP), were provided by the Humboldt-Toiyabe National Forest. Land cover maps of GAP data are produced from 30 meter, digital satellite imagery, and depict dominant vegetation types. Since GAP data is compiled on a small scale, vegetation extent is somewhat generalized and oriented toward regional rather than local vegetation regimes. For Nevada, the Biologic Resources Research Center at the University of Nevada, Reno, provides GAP data and metadata.

Distance to Water

A hydrologic layer consisting of springs and streams was compiled for each of the analytic units. Source data was derived from USGS 1:100,000 National Hydrography Dataset (NHD*)* clipped to the project area then buffered at 500 meter intervals. Buffered shapes were then converted into grids for each analytic unit. Both intermittent and perennial stream classes are included in the dataset, since water features currently identified as intermittent may have been more productive prehistorically. Metadata for the NHD data can be found at the USGS National Hydrography Dataset website.

Roads

The roads layer was extracted from U.S. Census Bureau 2000 Tiger/line files. Road centerlines were derived from a generalized 1:100,000 base layer. Line data was then buffered to 200, 400, 600 and 800 meter widths for analytic purposes.

Soils

Soils data were used to assess erodibility of surface material. Data was derived from the United States Department of Agriculture State Soil Geographic Data Base (STATSGO) which is compiled at a 1:250,000 scale. Elements used in the analysis include susceptibility of soil particles by movement of water (*kfact*) and Wind Erodibility Groups (*weg*). *Kfact* indices range from 0-64. A high *kfact* index indicates high susceptibility to water erosion. The *weg* codes range from 1 to 8, with lower numbers assigned to groups with higher wind erodibility.

Lithic Sources

The Bodie Hills and Mount Hicks obsidian localities are known lithic sources within the project area. (Mount Hicks is a dominant topographic feature within the Bodie Hills). The full spatial extent of either source has not been systematically determined, but are instead derived from scattered inventories within the general proximity. Lithic source localities pose a problem inherent in cultural resource modeling, since the source itself is a focal point of utilization. Site densities are often very high within a lithic source locale and thus bias site probability based upon more generalized environmental factors. Without detailed anthro-geologic mapping of source localities, the extent of a lithic terrain layer becomes problematic. A very general layer was compiled by placing three, 10 kilometer buffers extending from the center of Mount Hicks. Within 3 kilometers, the concentric buffers also include most of Bodie Hills.

Potential Forage Utilization

The Humboldt-Toiyabe National Forest Supervisor's office supplied a coverage of potential forage utilization for the entire Bridgeport Ranger District. The coverage depicts potential forage as 30 meter cells classified within four categories: 0-15%, 15-30%, 30-45% and 45-55%. Higher potential forage percentages relate to higher expected utilization.

Cultural Resources and Inventories

The project area encompasses 49 quadrangles lying south of Topaz Lake and north of Bridgeport, California. Twenty-two quadrangles lie wholly within Nevada, sixteen within California, and eleven straddle the state line (Figure 2.1). The California-Nevada state line crosses diagonally through the project area including part of Mono County, California, and portions of Douglas, Lyon, and Mineral counties in Nevada. NVCRIS data was used to compare site and report data archived at the Humboldt-Toiyabe National Forest, Bridgeport Ranger

District office. All 7.5 minute quad overlays at that office were copied then those maps were registered on a large format digitizing tablet. Any data not already entered into NVCRIS was digitized and integrated into the model database. That updated dataset was then used for comparison with archival data maintained at the Eastern Information Center in Riverside, California, and in a like manner, any missing data was added.

Cultural resource layers compiled for the analysis were derived from a number of different sources. Varying amounts of manipulation were needed to make them useful. The goal was to assemble a comprehensive set of spatial and database records for sites and inventories. These are used in modeling and will be useful for management. The Nevada State Historic Preservation Office (SHPO) is implementing the Nevada Cultural Resources Information System (NVCRIS), an information system for cultural resources that consists of spatial data and database records for sites and inventories. Most of the NVCRIS data was compiled from records at the Nevada State Museum. The majority of data for the Nevada study areas were derived from NVCRIS.

The Humboldt-Toiyabe National Forest maintains a relatively complete site database, compatible with NVCRIS, along with 7.5 minute map plots of cultural resources and inventories on Forest Service lands. Depending upon relative size of the feature, site and inventory locations were digitized as point, line or polygon shapes. Generally, any sites or inventories less than 2.5 acres in area were plotted as a points, linear inventories and linear

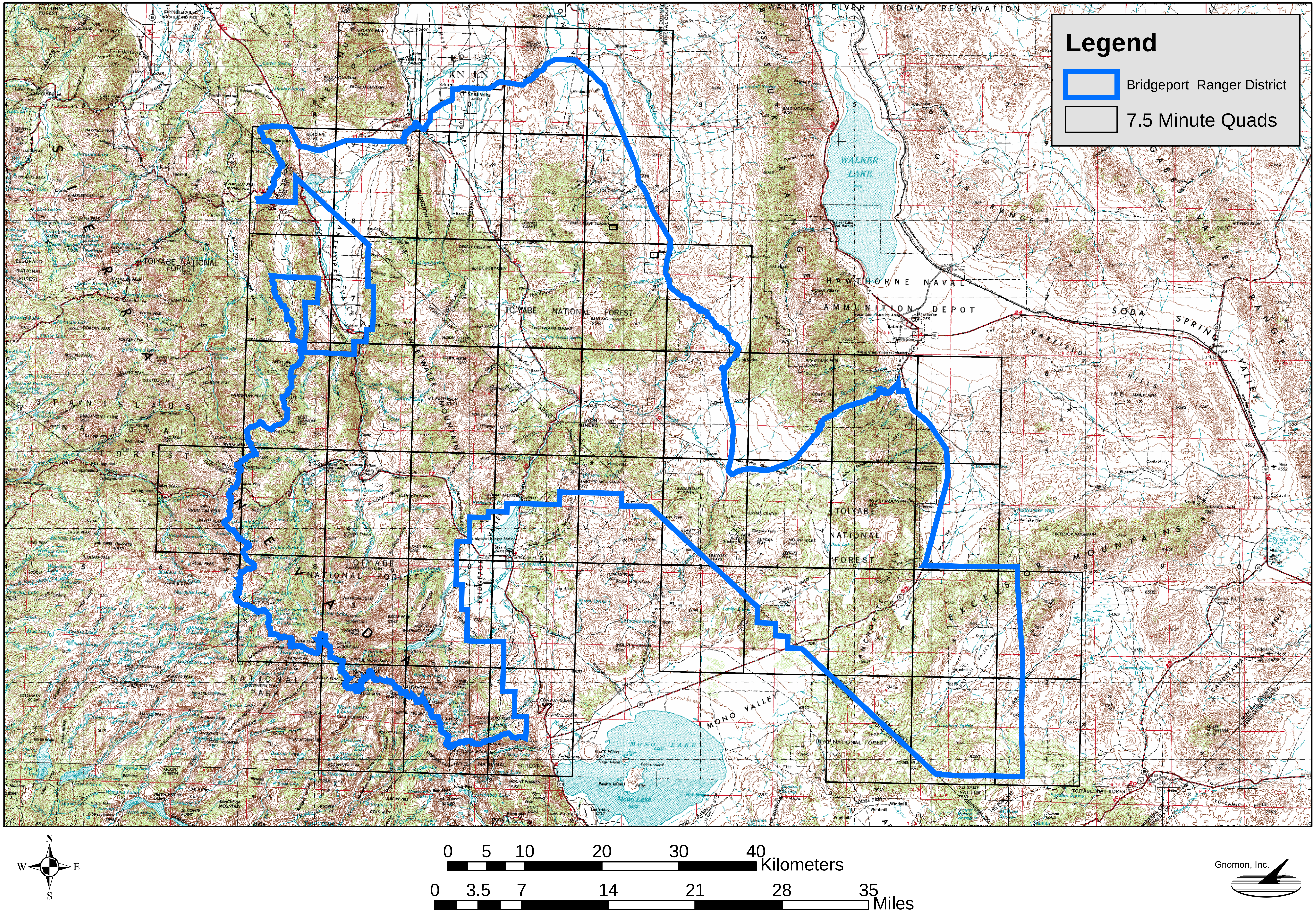

Figure 2.1. Project Area Quad Extent.

Sites were plotted as lines, and larger polygonal inventories and sites were digitized to their full extent. For analytical purposes, points and lines were buffered to create polygons then merged with the appropriate (site or inventory) polygon layers to create single polygonal site or inventory layers. Per contract requirements, all shapefiles were converted to *ArcInfo*® regions. All GIS datasets were converted from their default projections to UTM Zone 11, NAD 1927 projection. In most cases, rather than confine cultural resource data to the more restrictive project boundaries, the archive search was expanded to include entire quadrangles touched by the project extent.

NVCRIS site and inventory databases and the Humboldt-Toiyabe National Forest site database are compiled in a *Microsoft Access*® format. Each contain identical fields. The site database integrates IMACS (Intermountain Antiquities Computer System) coded data into a comprehensive functioning database. Forest Service and NVCRIS datasets were joined into a single file. Data from archival sources, not present in the combined database, was added as necessary. Site records link to the GIS site attribute tables on a common field, usually site number.

The inventory database, also in *Microsoft Access*® contains bibliographic and management data, consisting of report title, associated numeric identifiers, submittal date and survey type at a minimum. To provide comprehensive inventory data for the project area, the title page, management summaries, methods and results sections of any inventory report not already in the NVCRIS database were copied from Forest Service or Information Center archives and added to the existing base file.

Site data from records predating IMACS (1982) proved to be somewhat inconsistent. Likewise, early investigations are generally less complete than more recent ones and survey methods used at the time varied considerably.

Supplemental data pertaining to historic sites and hunting features was complied from datasets given to the Nevada State Historic Preservation Office (SHPO) and the Bridgeport Ranger District. Since both bodies of data consist of point specific information, non-site inferences could not be drawn and thus their spatial patterns were not included as part of the sensitivity forecast. They may however, be considered sensitivity zones themselves, and their locations are considered within the field sampling and sensitivity framework.

The SHPO dataset consists of Nevada ghost towns and constructed features each mapped and photographed by an avocational historic archaeologist. Locations of each feature are attributed with latitude and longitude, and a short description. In order to display their extent as part of the sensitivity layer, geographic coordinates were plotted using ArcMap.

A similar dataset consisting of both historic and prehistoric features was complied over the course of several summers by a volunteer working with the Bridgeport Ranger District. Using a GPS (Global Positioning System) several historic mining camps, prehistoric game drives, hunting blinds and rock art sites were mapped and briefly described. Photographs were also taken of most features. Differentially corrected GPS rover files were provided with this dataset, and appropriate points, lines and polygons were projected into NAD 27, UTM zone 11 coordinates and exported to GIS shapefiles using Trimble Pathfinder Office software.

Analytic Methods

The comprehensive archaeological datasets allowed multiple modeling attempts. Initial analysis consisted of evaluating inventory areas for sampling adequacy of classes identified within each stratum. Environmental and cultural resource layers were gridded into 30 by 30 meter grids then analyzed using *ArcGrid 8.3*®, a cell-based spatial analysis tool that supports per cell, neighborhood, zonal, continuous, and overlay GIS analyses. Resulting cross tabulations produced tables that related frequency of inventory within each zone. Areas with little or no inventory were excluded from consideration as being predictive and were identified as areas of high priority for field testing.

Example Analysis

Table 2.1 shows a sample assessment of inventory against elevation classes in the Study Area. In total, 6.44 % of the study area has been inventoried. Relative percent of survey within each class is generally high, exceeding a 1% sample in all but the 3001-3500 meter range. That elevation class appears to be under sampled, and would be considered as a stratum requiring further examination.

The first run of the cultural resources model considered inventoried sites within the model area contrasted against environmental layers. In a normal distribution one would expect site density to conform generally to areal density within each class.

Table 2.1 Assessment of Inventory Against Elevation within Study Area

ELEVATION

	Elevation in Meters						
Sum of COUNT	STUDY_ELEV						
STUDY_INV	1001 - 1500	1501 - 2000	2001 - 2500	2501 - 3000	3001 - 3500	3501 - 4000	Grand Total
No Inventory	154001	1605933	2397837	1029170	397301	9950	5594192
Inventory	5021	69273	245189	63885	1878	130	385376
Grand Total	159022	1675206	2643026	1093055	399179	10080	5979568
	Number of 30x30 meter cells						
Total Area	159022	1675206	2643026	1093055	399179	10080	5979568
Area %	2.66%	28.02%	44.20%	18.28%	6.68%	0.17%	100.00%
Inventory %	1.30%	17.98%	63.62%	16.58%	0.49%	0.03%	100.00%
Relative Class Inventory%	3.16%	4.14%	9.28%	5.84%	0.47%	1.29%	
% Total Area Inventoried	0.08%	1.16%	4.10%	1.07%	0.03%	0.00%	6.44%

An environmental zone comprising 50% of a layer should contain roughly 50% of the overall site area. Based upon summary comparison of inventoried site area to study area inventories, zones with proportionally greater ratios were considered to be of higher sensitivity (eg.,Table 2.2).

The chi-square test is another means to assess differences between observed and expected values. To populate the chi-square table 30 by 30 meter grids within inventoried areas were identified as site or non site cells and the observed frequencies were tabulated. Expected frequencies, those appropriate for a normal distribution of sites within a specific environmental stratum were then calculated. The chi-square test evaluates variance between observed and expected values (Figure 2.2). Calculated results identify whether the data represent a significant departure from expectations, or are likely by chance alone.

Table 2.2 Table Depicting Inventory Area and Inventoried Site Proportions.

ELEVATION

	Elevation in Meters						
Sum of COUNT	STUDY_ELEV						
STUDY_INV	1001 - 1500	1501 - 2000	2001 - 2500	2501 - 3000	3001 - 3500	3501 - 4000	Grand Total
No Inventory	154001	1605933	2397837	1029170	397301	9950	5594192
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Grand Total	159022	1675206	2643026	1093055	399179	10080	5979568
	Number of 30x30 meter cells						
Total Area	159022	1675206	2643026	1093055	399179	10080	5979568
Area %	2.66%	28.02%	44.20%	18.28%	6.68%	0.17%	100.00%
Inventory %	1.30%	17.98%	63.62%	16.58%	0.49%	0.03%	100.00%
Relative Class Inventory%	3.16%	4.14%	9.28%	5.84%	0.47%	1.29%	
% Total Area Inventoried	0.08%	1.16%	4.10%	1.07%	0.03%	0.00%	6.44%
Sites	41	13037	47950	2877	0	0	63905
Site %	0.06%	20.40%	75.03%	4.50%	0.00%	0.00%	100.00%
Inventoried Areas							
No Sites	4980	66766	226038	63457	1878	130	363249
Sites	41	2507	19151	428	0	0	22127
Site %	0.19%	11.33%	86.55%	1.93%	0.00%	0.00%	100.00%
Weight	0	0	1	0	0	0	

Adjusted standardized residuals are useful in the interpretation of chi-square results (Table 2.3). They are interpreted as a standard score and provide information about which cells contribute to a significant chi-square. The mean of the adjusted standardized residual is 0 and the standard deviation is 1.0. If the standardized residual is greater than an absolute value of 2.0, then that cell is can be considered to be a major contributor to the chi-square value.

When tabulated data and chi-square tests identify that a specific environmental class exhibits a higher than expected probability for sites, that class is given a weight higher than others within the stratum. The proposed model is a composite of sensitivity within each environmental layer. For example, if areas with low slope, near water, and in sagebrush are determined to be sensitive within their distinct environmental zone, composite sensitivity would be highest for cells meeting all three criteria, moderate if only a single criterion were met, and low if no sensitivity masks were present.

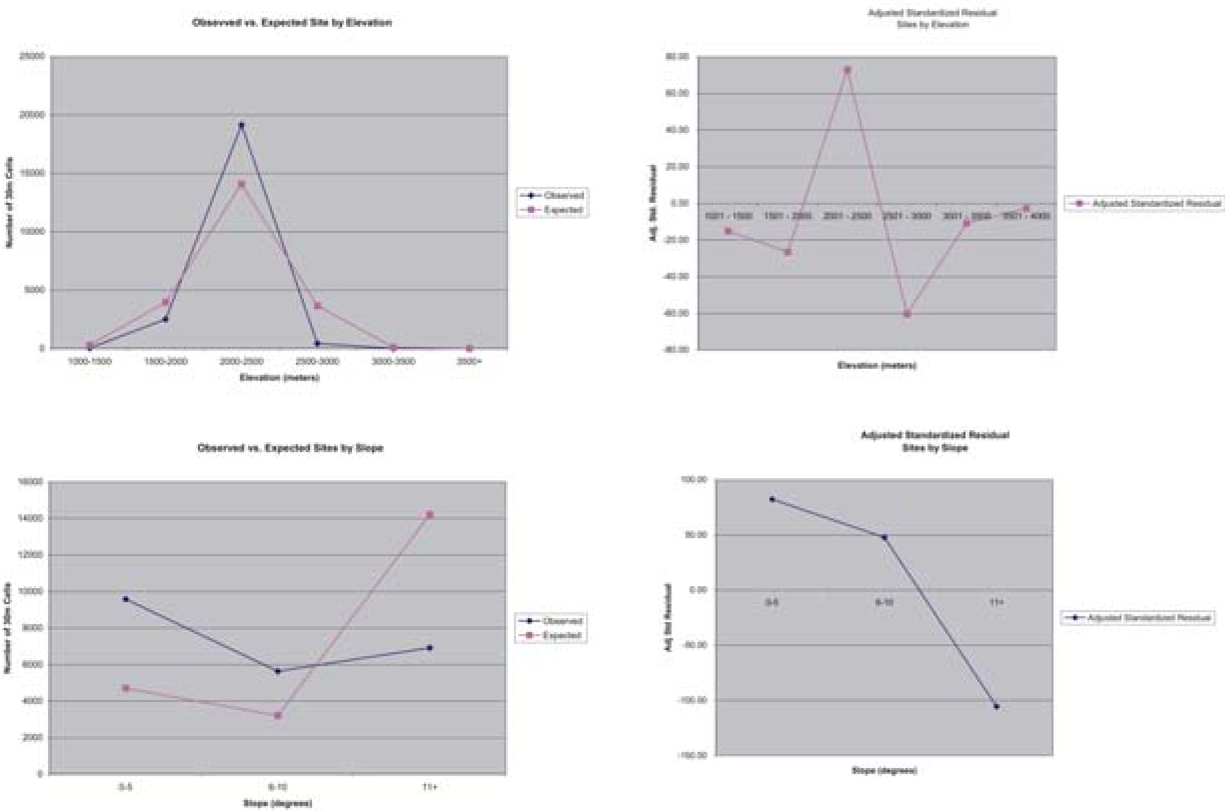


Figure 2.2. Sample Chi-square Analysis

Overall Model Formulation

Summary sensitivity forecasts were compiled for the study area by calculating weighted environmental variables. For prehistoric sites, elevation, slope distance to water, and vegetation were used as environmental layers. Distance to roads and distance to water were used for historic properties. A spatial intersect of derived sensitivity against site area was then calculated to assess the model's goodness of fit. If the site sensitivity forecast model is working correctly, then the highest sensitivity zones should contain proportionally higher densities of site area than those with lower sensitivity. Analysis of inventories against sensitivity area serves to support model results especially when minimal survey area correlates with maximum site density.

One of the goals of this project is to integrate the archaeological site sensitivity forecast with a Forest Service management plan for grazing. In order to evaluate the potential effect of grazing

Table 2.3 Chi-square Analysis of Site and Non-Site distribution by Elevation.

Bridgeport Elevation

Cells on a 30 m grid

	Site	Not Site	ROW
1000-1500	41	4980	5021
1500-2000	2507	66766	69273
2000-2500	19151	226038	245189
2500-3000	428	63457	63885
3000-3500	0	1878	1878
3500+	0	130	130
COL	22127	363249	385376

Cell std. resid.

	Site	Not Site
1000-1500	-14.56	3.59
1500-2000	-23.32	5.75
2000-2500	42.76	-10.55
2500-3000	-53.50	13.20
3000-3500	-10.38	2.56
3500+	-2.73	0.67

Expected values

	Site	Not Site
1000-1500	288	4733
1500-2000	3977	65296
2000-2500	14078	231111
2500-3000	3668	60217
3000-3500	108	1770
3500+	7	123

Cell variance

	Site	Not Site
1000-1500	0.93	0.06
1500-2000	0.77	0.05
2000-2500	0.34	0.02
2500-3000	0.79	0.05
3000-3500	0.94	0.06
3500+	0.94	0.06

Cell chi values

	Site	Not Site	
1000-1500	-247.29	247.29	
1500-2000	-1470.42	1470.42	
2000-2500	5073.07	-5073.07	
2500-3000	-3240.06	3240.06	
3000-3500	-107.83	107.83	
3500+	-7.46	7.46	
chi-square for table			5899.88

adj. std. residuals

	Site	Not Site
1000-1500	-15.10	15.10
1500-2000	-26.52	26.52
2000-2500	73.02	-73.02
2500-3000	-60.33	60.33
3000-3500	-10.72	10.72
3500+	-2.81	2.81

within the site sensitivity matrix, grazing utilization grids provided by the Humboldt-Toiyabe National Forest were overlain with the site sensitivity forecast model. Hypothetically, grazing impacts incrementally degrade vegetative cover exposing soils to erodibility from wind and water. Since erosion or subsequent deposition may effect archaeological site condition, soil erodibility grids derived from the STATSGO soils data base were overlain with grazing and site sensitivity grids. As sensitivity cells overlap, an overall sensitivity matrix is developed and from that, an archaeological sampling plan is developed.

III. ANALYSIS

The following section describes the results of analysis and modeling efforts within the project area.

Project Area

The project area consists of the entire Bridgeport Ranger District. It is located in east-central California and west-central Nevada, extending south from Topaz Lake to near Bridgeport, and from the crest of the Sierra Nevada Range east across the Sweetwater Mountains and Wellington Hills to the Pine Grove Hills (Figure 3.1). The Bridgeport Ranger District as a management unit covers approximately 1,118,477 acres (452,633 hectares). The potential forage coverage provided by the Humboldt-Toiyabe National Forest includes a 1mile buffer around the district boundary. For analytical purposes, archaeological site and erodibility grids conform to the potential grazing extent. Using the analytical buffer, the study area covers 1,329,616 acres (538,088 hectares).

Elevations in the project area range from near 11,000 feet (3350 meters) in the Sweetwater Mountains and Sierra Nevada Range to 5000 feet (1525 meters) in Antelope Valley near Topaz Lake. Bridgeport lies at an elevation of approximately 6500 feet (1980 meters). The crest and upper slopes of the Sierra Nevada retain extensive glacial features in contrast with evidence of volcanism in the Bodie and Pine Grove Hills. The Walker River and its tributaries comprise the major hydrographic feature of the study area, effectively dividing the project area into three distinct zones, the Sierra Nevada, Sweetwater Mountains and Pine Grove Hills, and Bodie Hills.

Summary Cultural Resource Data

Of the 1.3 million acres within the study area, approximately 6.4% has been inventoried for cultural resources. Appendix I provides summary tables of the cultural resource data. Figure 3.2 shows the relative percent of inventory within each of the environmental zones. In general, curves for percent of total area and percent of inventory area should be similar. Divergent values are a preliminary indication of either over or under sampling

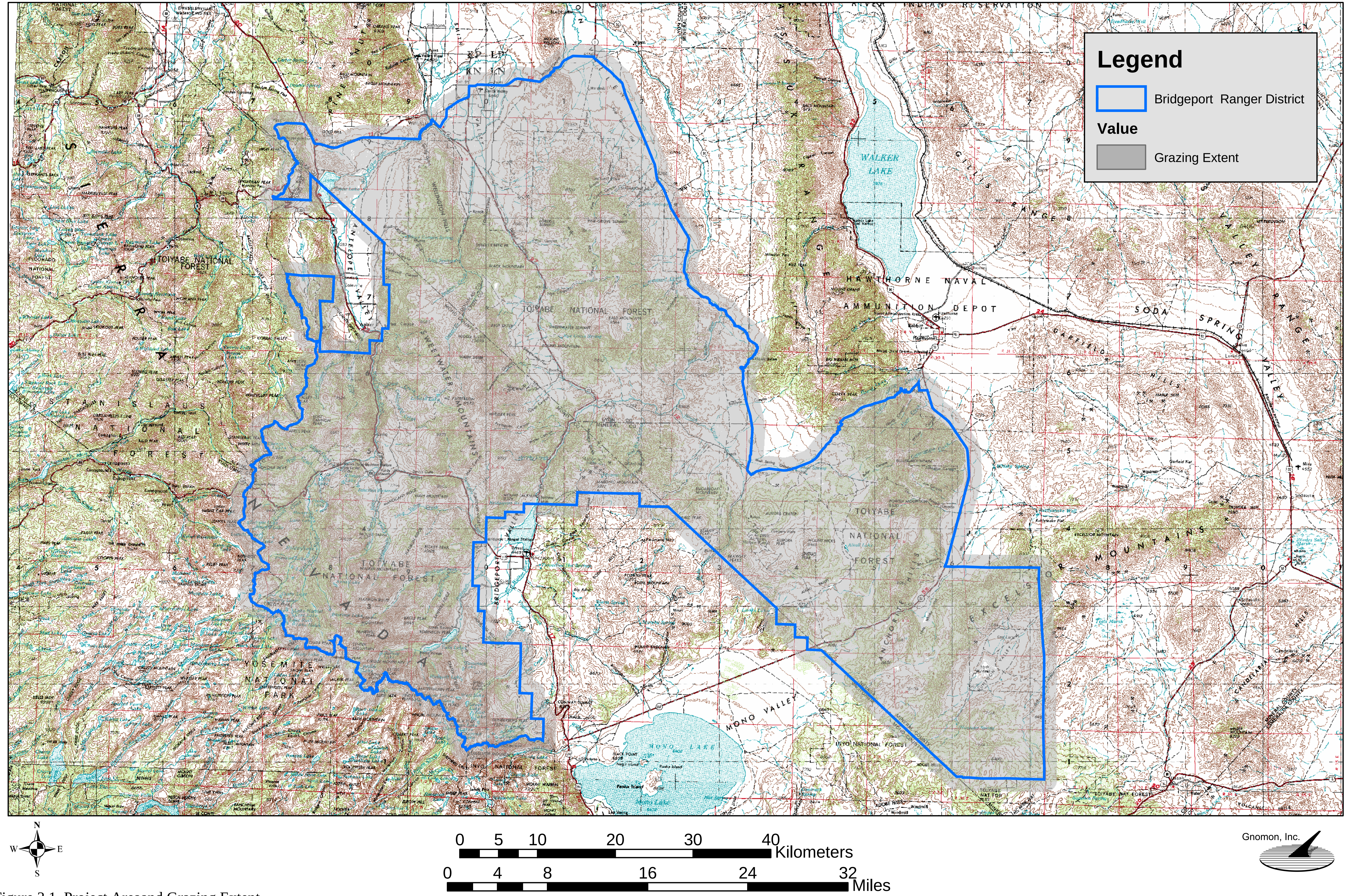


Figure 3.1. Project Areaand Grazing Extent

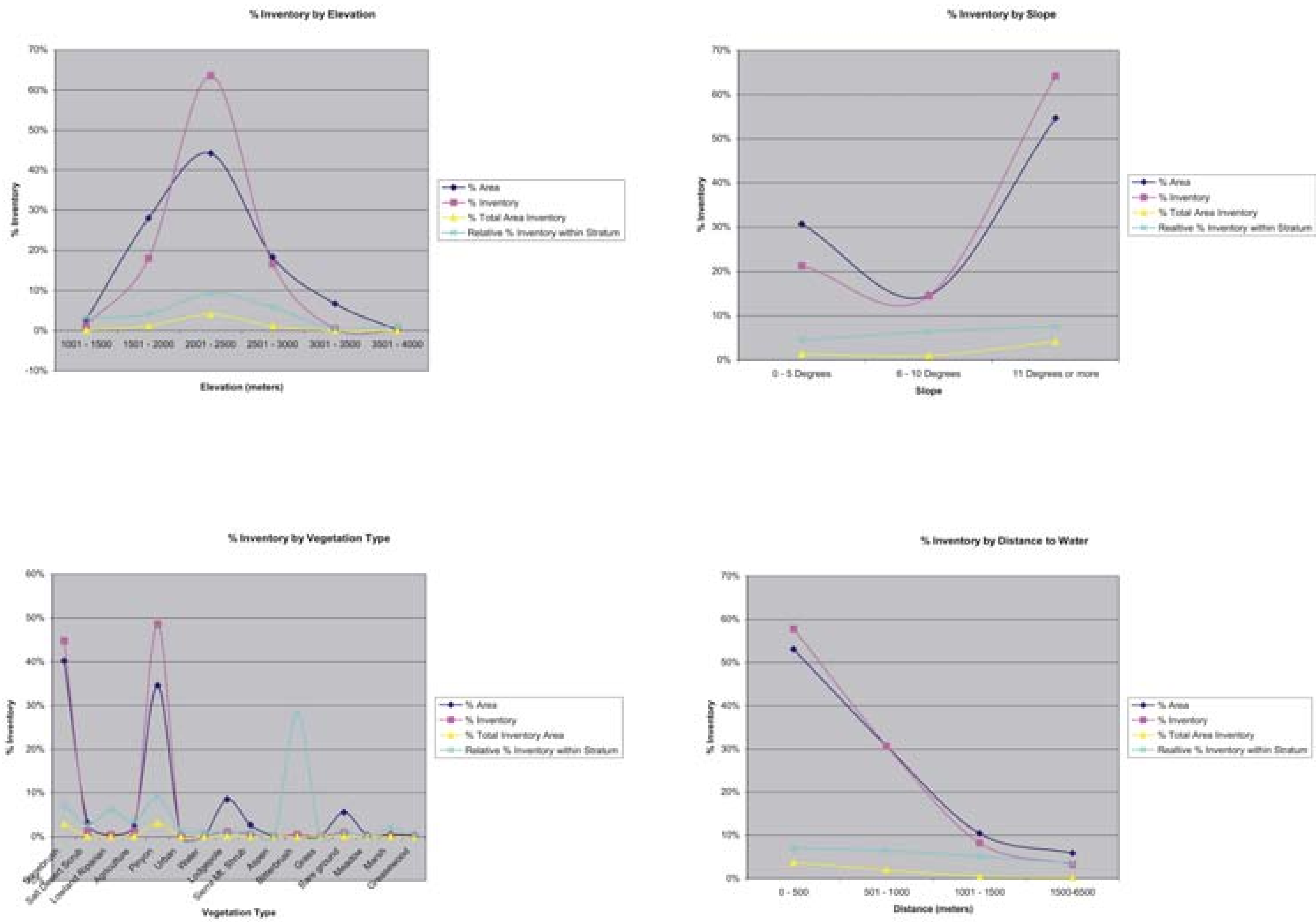


Figure 3.2. Relative Percent of Inventory within Prehistoric Environmental Stratum.

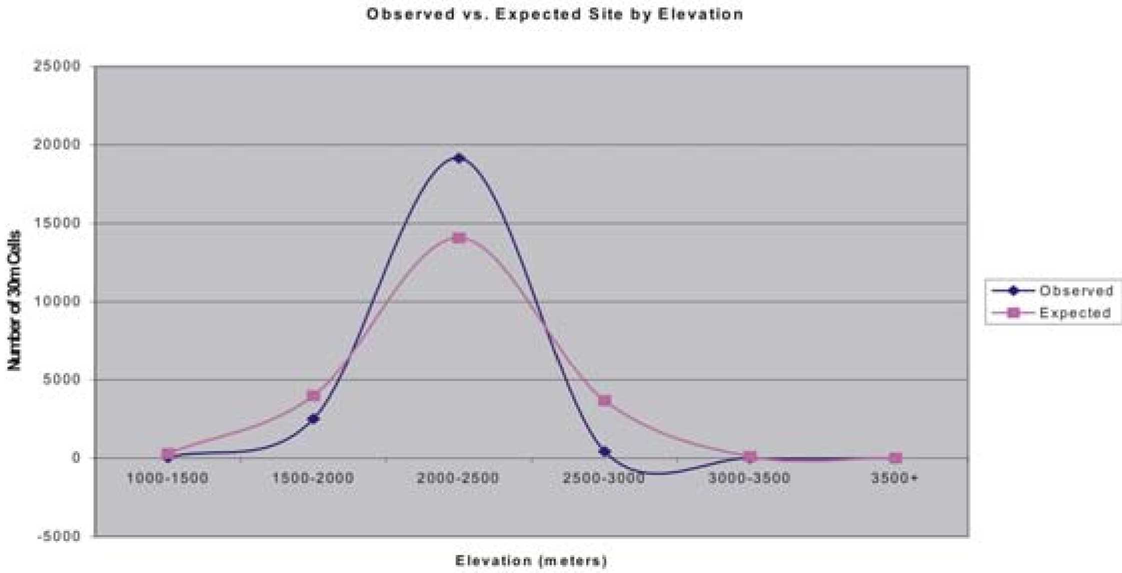
bias. Relative percent of inventory, that is the percent of inventory relative to a specific environmental stratum, is a reliable indicator of inventory bias since it directly relates to the area inventoried within a particular stratum. As long as the relative percentage of inventory lies above or near the total inventoried area, the inventoried sample should provide an adequate assessment of that stratum. In all cases, sampling within environmental stratum appears adequate.

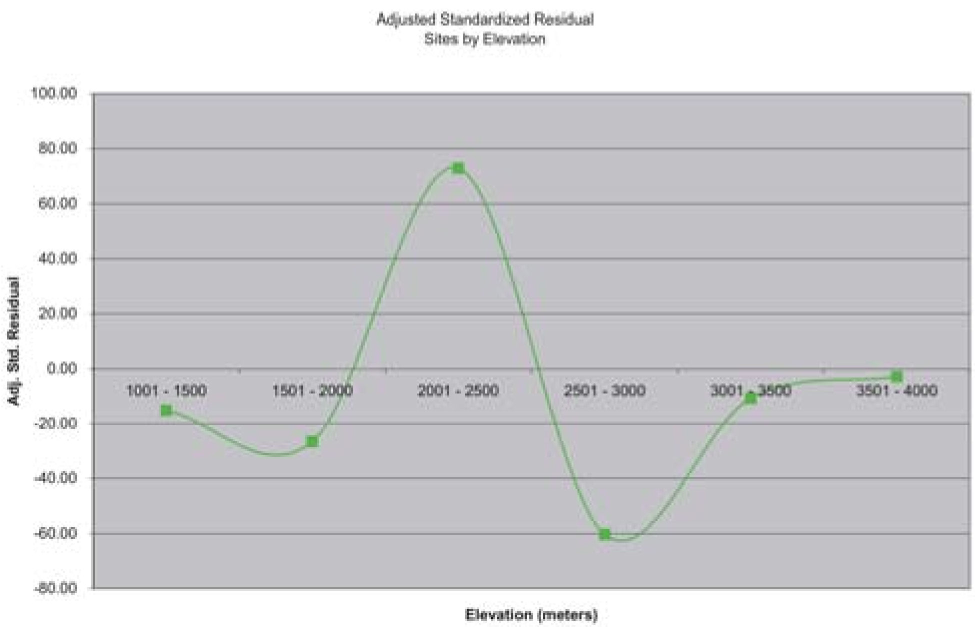
Chi-squares were calculated for each of the environmental variables. All environmental classes exceed the critical chi-square value at the .05 significance level, suggesting non-random associations (Appendix I). The strongest indication of an environmentally predictive stratum occurs when observed values exceed expected values, and when -adjusted standardized residuals range support a similar variance.

Prehistoric Sites

Figure 3.3 depicts selected chi-square data for prehistoric sites by elevation within the project area. There were 1271 prehistoric sites covering approximately 13,377 acres (5413 hectares) considered for analysis. Observed site frequencies and adjusted standardized residuals strongly suggest that elevational stratum between 2000 and 2500 meters are predictive for sites. The converse is true for elevations on either side of that stratum. Figures 3.4, 3.5, and 3.6 summarize chi-square results for the remaining environmental classes. Based upon the chi-square evaluation, slopes between 0 to 5 degrees and 6 to 10 degrees, sagebrush vegetation, and areas within 500 meters of water are predictive for prehistoric sites.

For each environmental layer, weighted values were assigned to the appropriate predictive strata. All grids were then combined and an overlapping sensitivity matrix was created for the project area. Since each predictive stratum was weighted 1, and non-predictive strata 0, sensitivity scores range from 0 (no predictive strata within a grid cell) to 4 (all four predictive strata are present within a grid cell). Figure 3.7 shows the distribution of prehistoric sensitivity stratum and sensitivity scores for the project area.

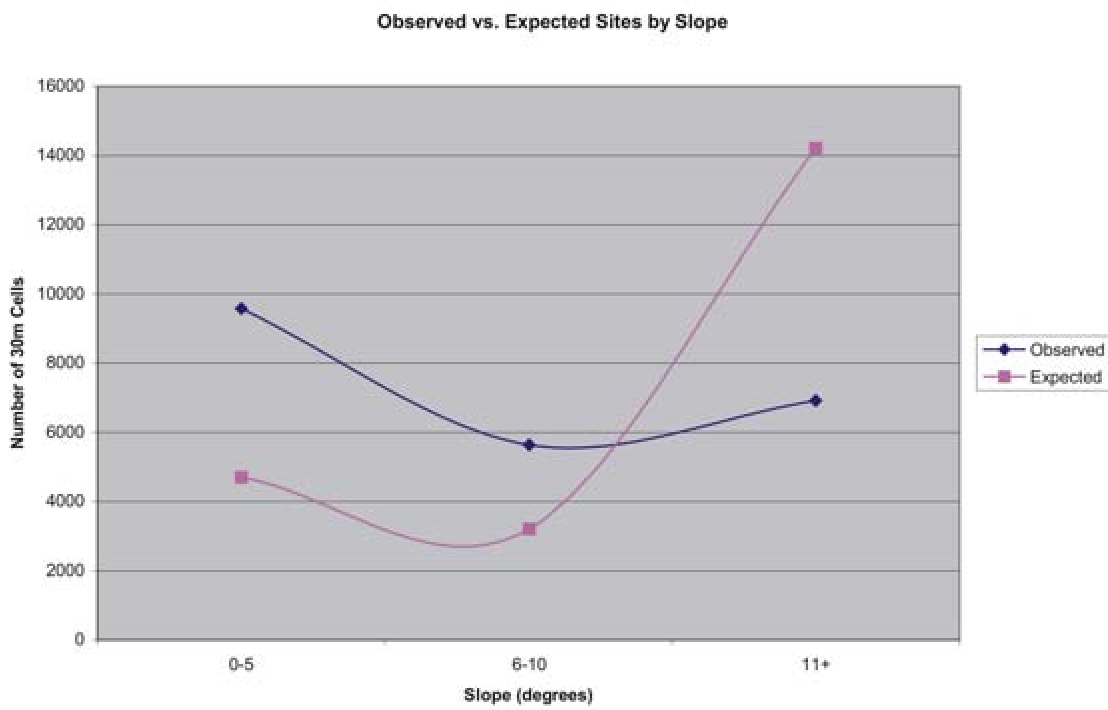


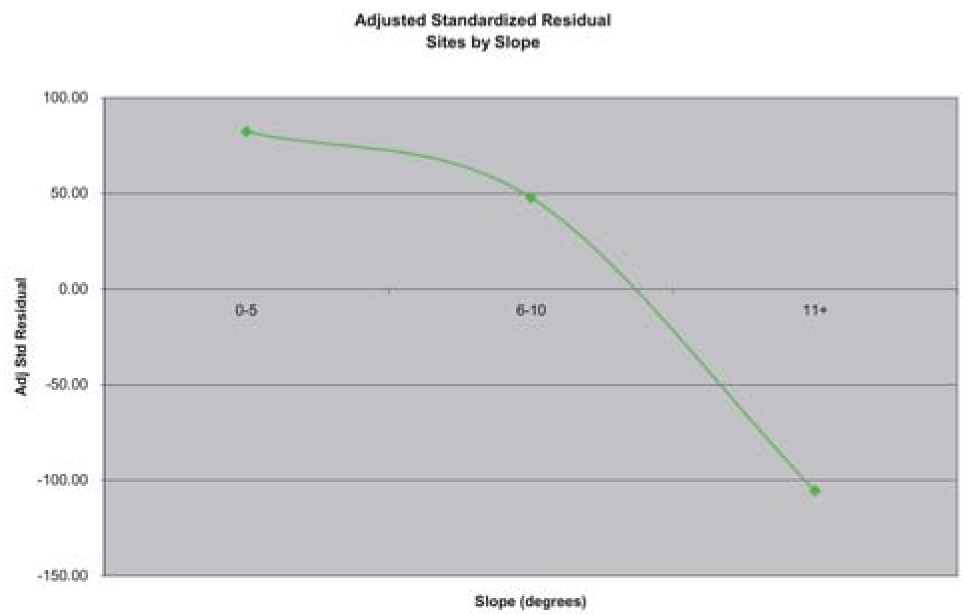


Chi-Square for table 5899.88

Critical Value of $X^2_{0.05}$ at 5 degrees of freedom = 11.0705

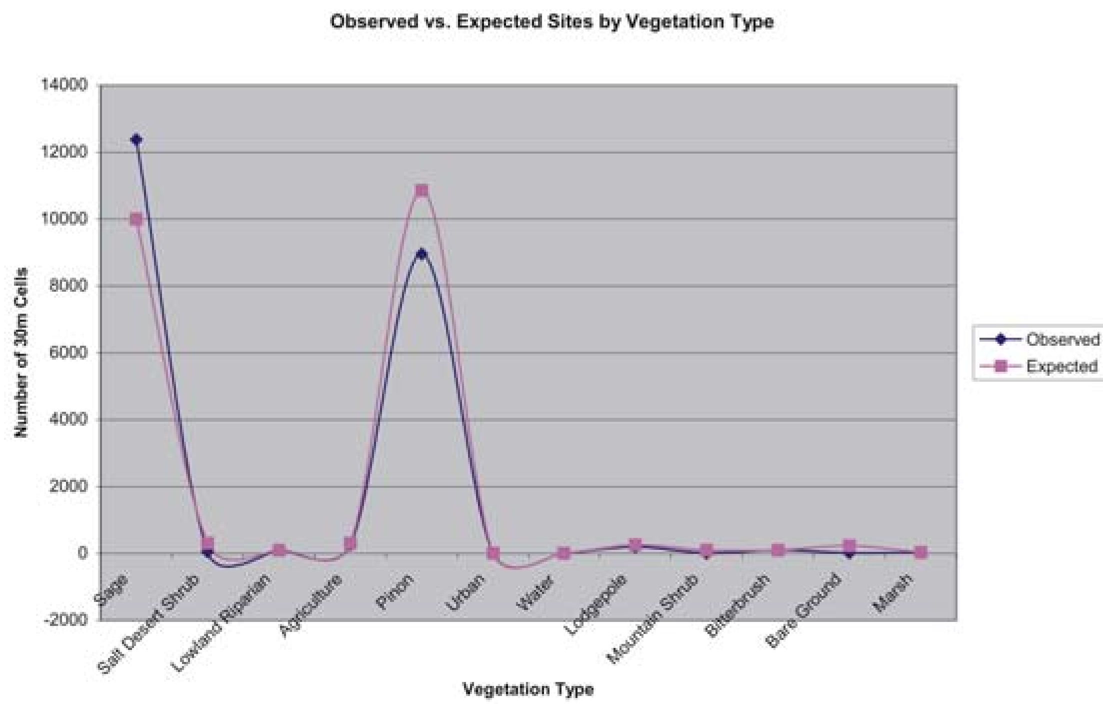
Figure 3.3. Chi-square for Sites by Elevation.

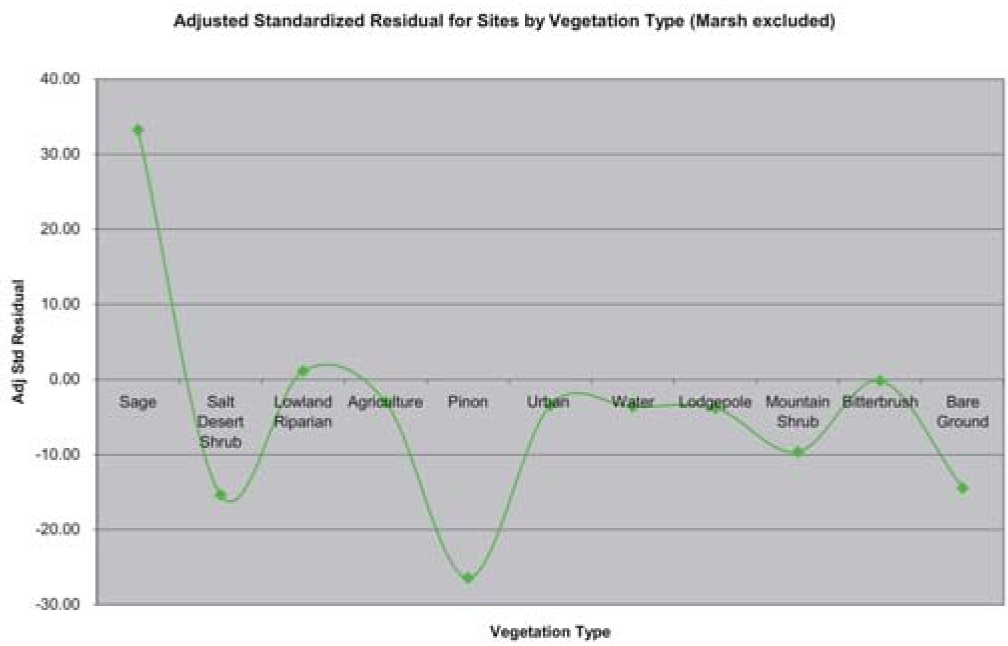




Chi-Square for table 11275.80
Critical Value of $X^2_{0.05}$ at 2 degrees of freedom = 5.99147

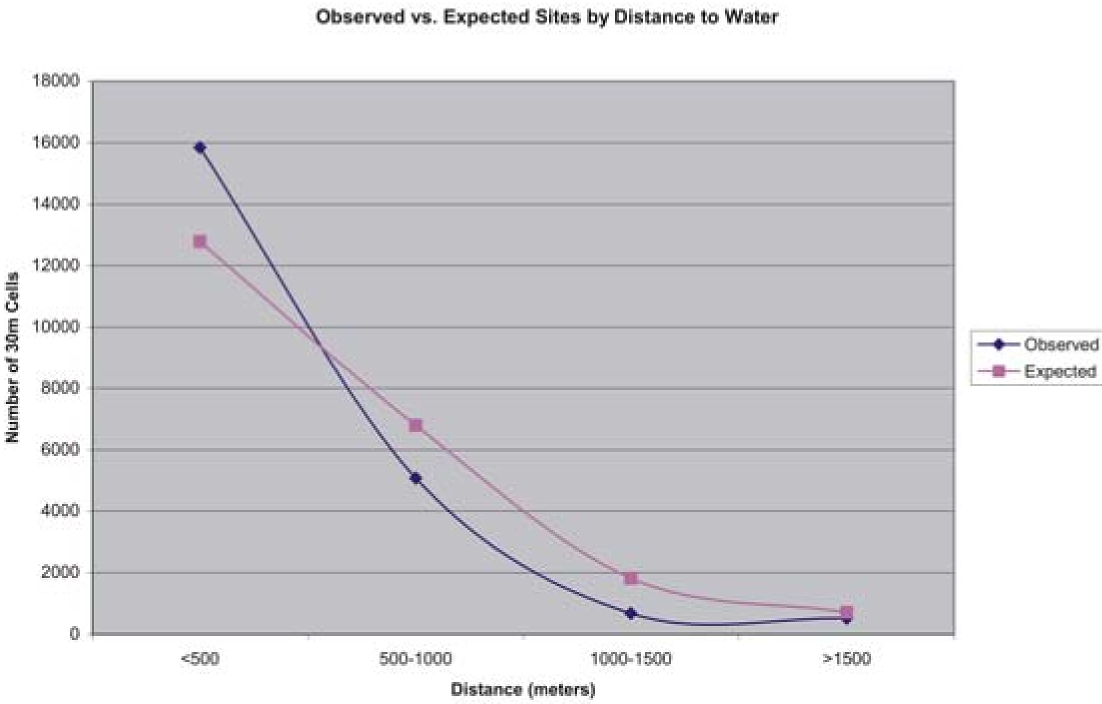
Figure 3.4. Chi-square for Sites by Slope.

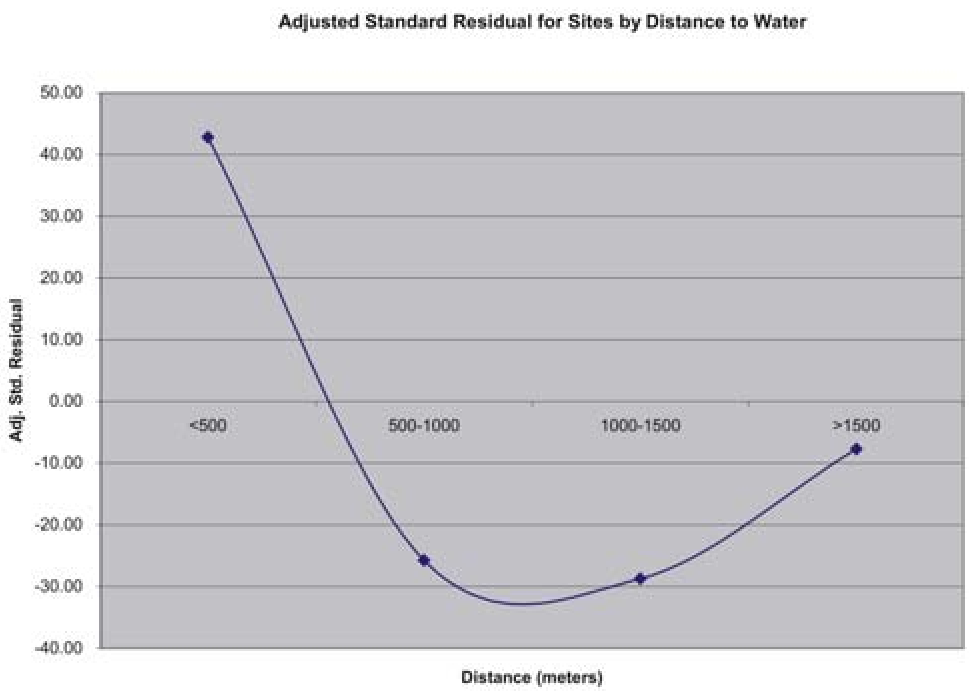




Chi-Square for table 1328.99
Critical Value of $X^2_{0.05}$ at 11 degrees of freedom = 19.6751

Figure 3.5. Chi-square for Sites by Vegetation Type.





Chi-Square for table 2048.19
Critical Value of $X^2_{0.05}$ at 3 degrees of freedom = 7.81473

Figure 3.6. Chi-square for Sites by Distance to Water.

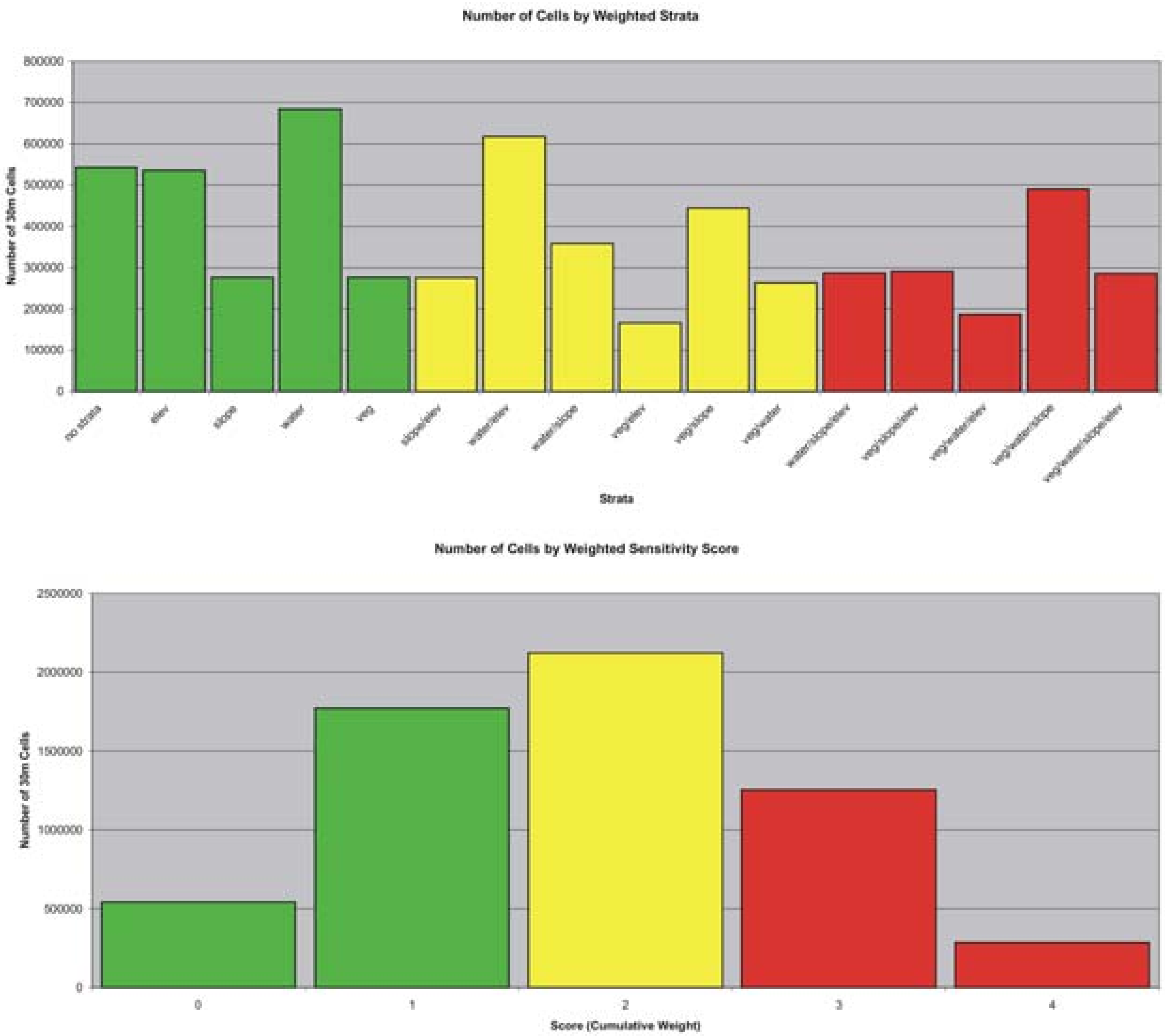


Figure 3.7. Number of Cells by Weighted Prehistoric Strata.

Cells with no predictive environmental strata or with single predictive strata comprise the highest cumulative frequencies, followed by those with combinations of two predictive strata. Lowest cumulative frequencies are associated with cells containing three or more predictive variables. Composite sensitivity rankings for prehistoric sites (Appendix II) were developed from the cross-tabulated environmental data. Prehistoric sensitivity is classified as low (0-1 predictive overlap), moderate (2 overlaps), high (3-4 overlaps).

Figure 3.8 shows prehistoric sensitivity across the study area landscape. High sensitivity areas are generally confined to valley floors and gentle slopes along stream courses. Lowest sensitivity occurs on steep slopes at high elevation. The distribution of sites and inventories within each sensitivity zone supports the predictive pattern of higher site frequencies within areas of highest sensitivity. Site frequencies Figure 3.9 shows the proportions of inventoried areas, inventoried prehistoric sites, and all prehistoric sites within sensitivity zones. While 31% of the inventoried areas fall within low sensitivity zones, they account for slightly more than 7% of all inventoried site cells within the Bridgeport Ranger District. In contrast, a similar percentage of high inventory areas (30.9%) fall within high sensitivity zones, yet 69% of the inventoried sites cells fall within those areas. The proportion of inventories to inventoried sites within moderate sensitivity zones is not as pronounced. Thirty-eight percent of the inventoried areas fall within the moderate sensitivity zone, and 23% of the inventoried sites area falls within that zone. When all sites are considered, proportions of sites within low and moderate sensitivity zones increases slightly to 9% and 26% respectively. A slight decrease is evident in the proportion of all sites within high sensitivity zones where 65% of the sites are concentrated.

Table 3.1 summarizes prehistoric site densities for the study area. When the entire model area and all sites are considered, sites are predicted in high sensitivity areas at a ratio of approximately one site unit per 40 units of inventory. Site density increases to almost one site unit per 425 inventory units within low sensitivity zones. Those numbers are misleading, however, since slightly more than 6% of the study area has been inventoried. When only inventory areas are considered, ratios of all inventory units to units containing

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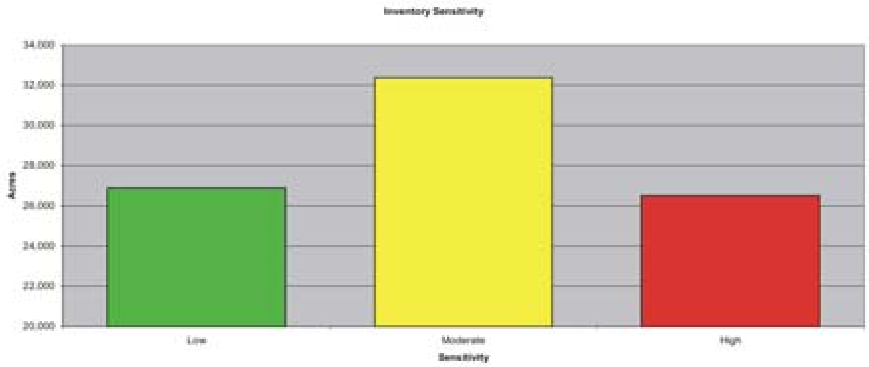
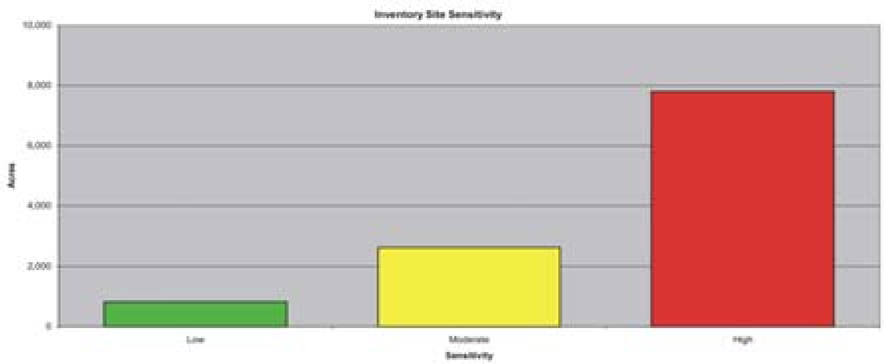
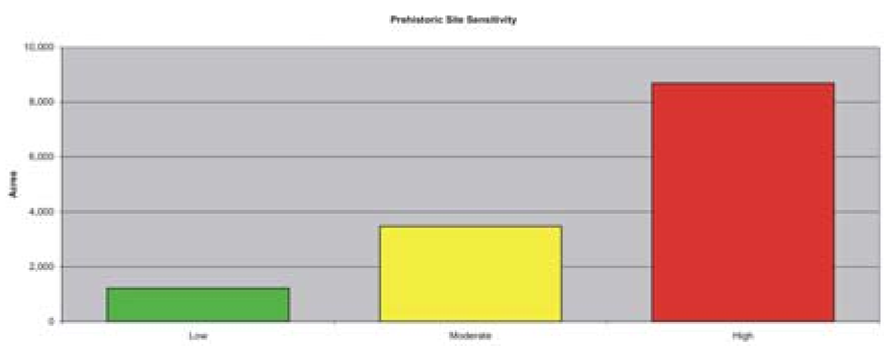
Figure 3.8. Prehistoric Site Sensitivity.



Sensitivity	30m Cells	Area (sq. meters)	Acres	Hectares	% Inventoried
Low	120,921	108,828,900	26,892	10,883	31.3%
Moderate	145,594	131,034,600	32,379	13,103	37.7%
High	119,211	107,289,900	26,511	10,729	30.9%
Total Area	385,726	347,153,400	85,782	34,715	100.0%



Sensitivity	30m Cells	Area (sq. meters)	Acres	Hectares	% Inventoried
Low	3,700	3,330,000	823	333	7.3%
Moderate	11,733	10,559,700	2,609	1,056	23.2%
High	35,073	31,565,700	7,800	3,157	69.4%
Total Area	50,506	45,455,400	11,232	4,546	100.0%



Sensitivity	30m Cells	Area (sq. meters)	Acres	Hectares	% Inventoried
Low	5,450	4,905,000	1,212	491	9.1%
Moderate	15,620	14,058,000	3,474	1,406	26.0%
High	39,079	35,171,100	8,691	3,517	65.0%
Total	60,149	54,134,100	13,377	5,413	100.0%

Figure 3.9. Prehistoric Sensitivity Distribution.

sites range from 3.4 units of inventory per unit of site in high sensitivity zones, to 32.7 units of inventory per unit of site in low sensitivity areas. From a management perspective, if 40 acres were inventoried in a low sensitivity area, one might expect around 1 acre of site to be identified. The same investigation within a high sensitivity zone might yield 12 acres of site. Note that this forecast makes no distinction between 12, one acre sites or a single 12 acre site.

Table 3.1 Prehistoric Site Densities in Study Area.

Model Area	**High**	**Moderate**	**Low**	**Total**
Model Area (m^2)	1,387,074,560	1,910,650,496	2,083,155,328	5,380,880,384
Model Area (ha)	138,707	191,065	208,316	538,088
Model Area (acres)	342,746	472,122	514,748	1,329,616
% Model Area	26%	36%	39%	100%
All Sites				
All Sites Area (m^2)	35,171,100	14,058,000	4,905,000	54,134,100
All Sites Area (ha)	3,517	1,406	491	5,413
All Site Area (acres)	8,691	3,474	1,212	13,377
% Site Area	65%	26%	9%	100%
Site Area: Model Area	0.0254	0.0074	0.0024	0.0101
Model Area: Site Area	***39.44***	***135.91***	***424.70***	***99.40***
Inventory Area				
Inventory Area (m^2)	107,289,900	131,034,600	108,828,900	347,153,400
Inventory Area (ha)	10,729	13,103	10,883	34,715
Inventory Area (acres)	26,511	32,379	26,892	85,782
% Inventory Area	30.91%	37.75%	31.35%	100.00%
% Total Area Inventoried	7.73%	6.86%	5.22%	6.45%
Inventoried Site				
Inventoried Site Area (m^2)	31,565,700	10,559,700	3,330,000	45,455,400
Inventory Site Area (ha)	3157	1056	333	4546
Inventory Site Area (acres)	7800	2609	823	11232
% Inventory Site Area	69.44%	23.23%	7.33%	100.00%
Inventoried Site: Inventory	0.2942	0.0806	0.0306	0.1309
Inventory: Inventoried Site	***3.40***	***12.41***	***32.68***	***7.64***

Due to extensive mining activities, the area within 20 kilometers of Mt. Hicks has been intensively inventoried, and a number of large prehistoric sites have been recorded (Figure 3.10). Forty percent of the inventoried space within the study area lies within the 20 kilometer buffer around Mt. Hicks (Table 3.2). The Mt. Hicks locale also represents a significant prehistoric lithic source within the study area. Over one-third (67.4%) of the inventoried site area falls within the Mt. Hicks buffer. Inventory to site ratios calculated for the 20 kilometer Mt. Hicks buffer reflect site density. Within high sensitivity zones the ratio of inventoried area to site area is very close to 2:1. In a 40 acre survey about 18 acres of site are expected. Even in low sensitivity zones, a 40 acre survey would yield approximately 2 acres of site.

Without inclusion of the Mt. Hicks area, inventory to site area ratios dramatically increase for the study area. Inventory area to site area density ranges from 6.5 units of inventory per unit of site area in high sensitivity zones to 57.4 units of inventory per unit of site area in low sensitivity zones. In moderate sensitivity zones the ratio of inventory area to site area stands at 15.9 to 1. A forty acre survey in the low sensitivity zone might yield 0.7 acres of site. In the moderate sensitivity zone 2.5 acres of site might occur over a 40 acre survey, and about 6 acres of site are predicted to occur within high sensitivity zones.

Table 3.2. Prehistoric Site Densities Including and Excluding Mt. Hicks

Area within 20km of Mt. Hicks

Inventory Area				
Inventory Area (m2)	51,187,500	51,710,400	36,594,000	139,491,900
Inventory Area (ha)	5,119	5,171	3,659	13,949
Inventory Area (acres)	12,648	12,778	9,042	34,468
% Inventory Area	36.70%	37.07%	26.23%	100.00%
Study Area Inventory (Acres)	26,511	32,379	26,892	85,782
% Area Inventoried	47.71%	39.46%	33.63%	40.18%
Inventoried Site				
Inventoried Site Area (m2)	22,978,800	5,583,600	2,071,800	30,634,200
Inventory Site Area (ha)	2,298	558	207	3,063
Inventory Site Area (acres)	5,678	1,380	512	7,570
% Inventory Site Area	75.01%	18.23%	6.76%	100.00%
Study Area Site Acreage	7,800	2,609	823	11,232
% Study Area Site	72.80%	52.88%	62.22%	67.39%
Inventoried Site : Inventory	0.4489	0.1080	0.0566	0.2196
Inventory : Inventoried Site	***2.23***	***9.26***	***17.66***	***4.55***

Study Area Outside of Mt. Hicks Exclusion

Inventory Area				
Inventory Area (m2)	56,102,400	79,324,200	72,234,900	207,661,500
Inventory Area (ha)	5,610	7,932	7,223	20,766
Inventory Area (acres)	13,863	19,601	17,849	51,313
% Inventory Area	27.02%	38.20%	34.78%	100.00%
Study Area Inventory (Acres)	26,511	32,379	26,892	85,782
% Area Inventoried	52.29%	60.54%	66.37%	59.82%
Inventoried Site				
Inventoried Site Area (m2)	8,586,900	4,976,100	1,258,200	14,821,200
Inventory Site Area (ha)	859	498	126	1,482
Inventory Site Area (acres)	2,122	1,230	311	3,662
% Inventory Site Area	57.94%	33.57%	8.49%	100.00%
Study Area Site Acreage	7,800	2,609	823	11,232
% Study Area Site	27.20%	47.12%	37.78%	32.61%
Inventoried Site : Inventory	0.1531	0.0627	0.0174	0.0714
Inventory : Inventoried Site	***6.53***	***15.94***	***57.41***	***14.01***

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Figure 3.10. Sites within 20 kilometers of Mt. Hicks.

III-16

Historic Sites

Figure 3.11 shows the relative percent of inventory within each environmental zone associated with historic sites. Percent area and percent of inventory curves appear similar for both distance to water and distance to roads. As well, relative percent of inventory is consistently above the percent of total inventory area. Sampling within environmental strata appears to be adequate.
Chi-square values for historic sites are depicted in Figure 3.12. Two hundred eighty-nine historic sites covering approximately 3639 acres (1473 hectares) were considered for analysis. Observed versus expected frequencies as well as adjusted standardized residuals suggest that proximity to water as well as proximity to roads may be predictive for historic sites. In both cases, the smallest incremental buffer appears to be most predictive. Weighted values of 1 were assigned to cells within 500 meters of water and to cells within 200 meters of roads. When combined, scores range from 0 to 3. Historic sensitivity is classified as low (0), moderate (1), or high (2 and 3) (Appendix II)..

Figure 3.13 shows the distribution of cells within each of the weighted environmental strata as well as sensitivity by inventory area. Cells containing no weighted strata (low sensitivity) and those within 500 meters of water (moderate sensitivity) dominate the study area. Cells within 200 meters of roads or cells near roads and water are significantly infrequent, but are considered highly sensitive. Moderate sensitivity areas have been most intensively inventoried. They account for 40% of the inventoried area. Thirty-five percent of the inventoried area falls within low sensitivity zones and 24% of the inventories fall in high sensitivity areas. Figure 3.14 depicts the distribution of historic sensitivity zones across the study area.

A cross-tabulation of inventoried sites by sensitivity zone (Figure 3.15) shows that greatest site frequencies (60%) occur within the high sensitivity zones. Twenty-nine percent of the site area falls within moderate sensitivity zones while slightly less than 12% of site area falls in low sensitivity zones. When all historic sites within the study area are considered, a similar distribution is observed. Less than 7% of all site area falls

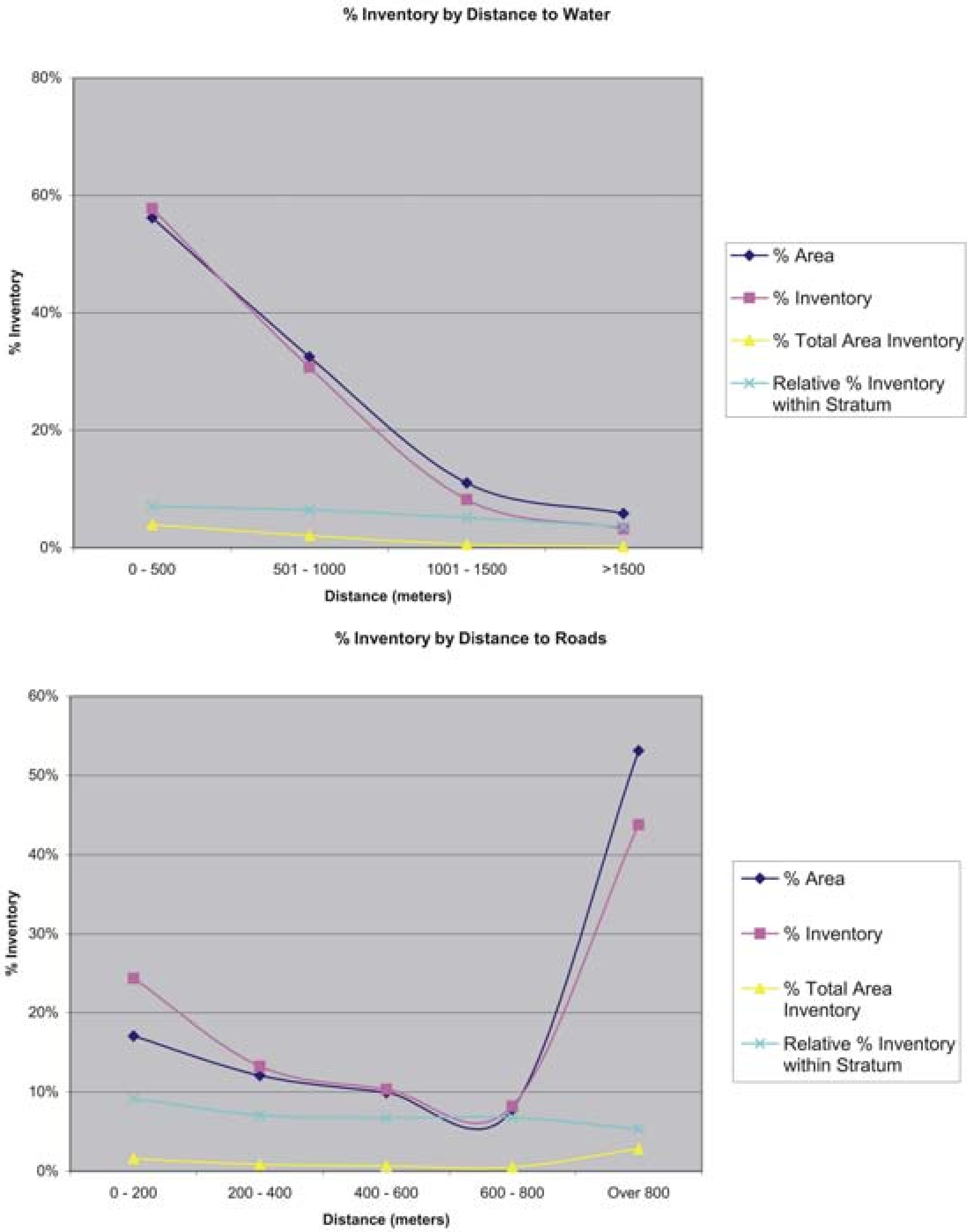
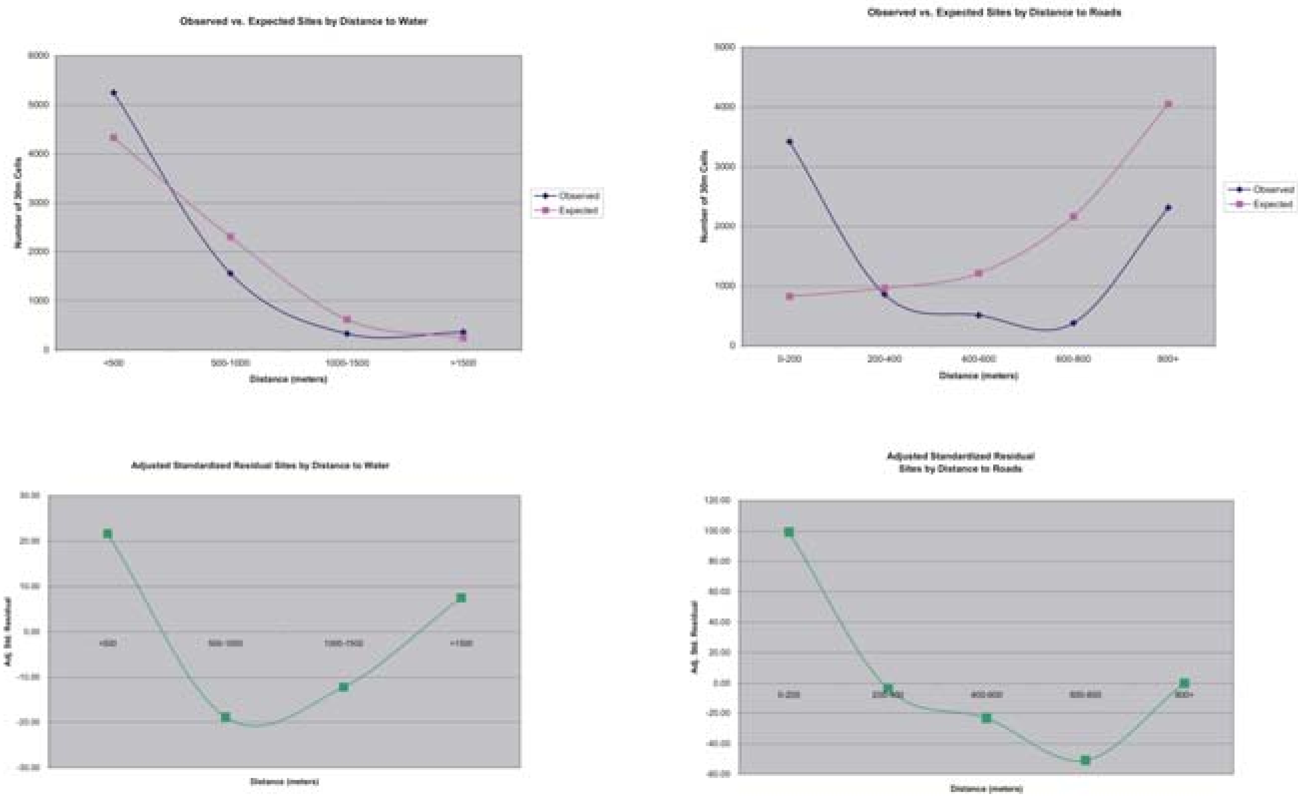


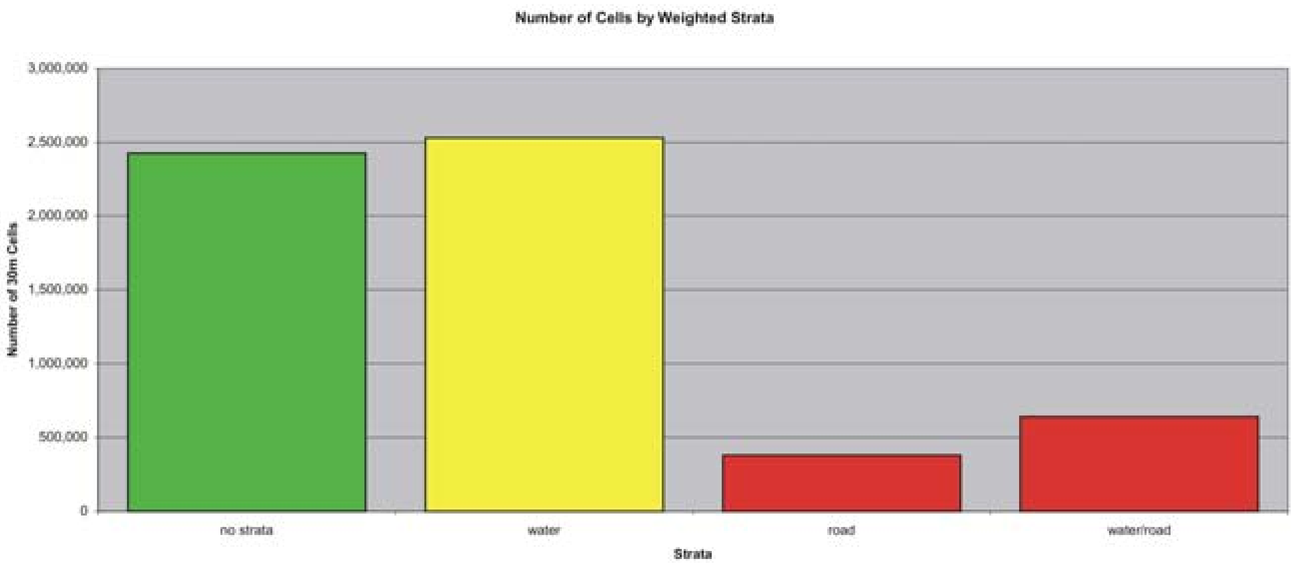
Figure 3.11. Relative Percent of Inventory within Historic Environmental Stratum.

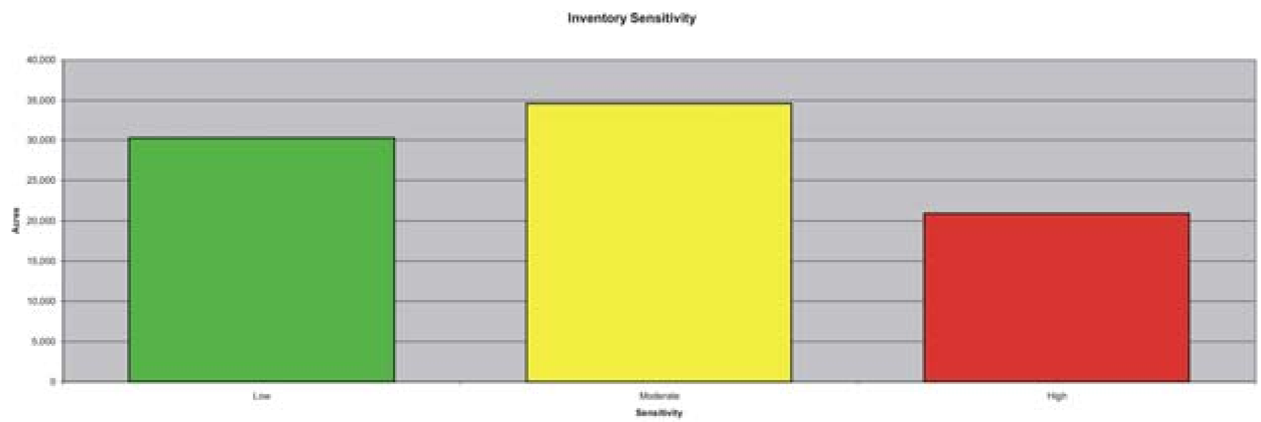


Chi-Square for table 635.56
Critical Value of $X^2_{0.05}$ at 3 degrees of freedom = 7.81473

Chi-Square for table 10217.22
Critical Value of $X^2_{0.05}$ at 4 degrees of freedom = 9.48773

Figure 3.12. Chi-square for Sites by Distance to Water and Roads.





Sensitivity	30m Cells	Area (sq. meters)	Acres	Hectares	% Inventoried
Low	136,174.00	122,556,600	30,284	12,256	35.30%
Moderate	155,613.00	140,051,696	34,607	14,005	40.34%
High	93,939.00	84,545,104	20,891	8,455	24.35%
Total	385,726.00	347153400	85,782	34,715	100.00%

Figure 3.13. Number of Cells by Weighted Historic Strata.

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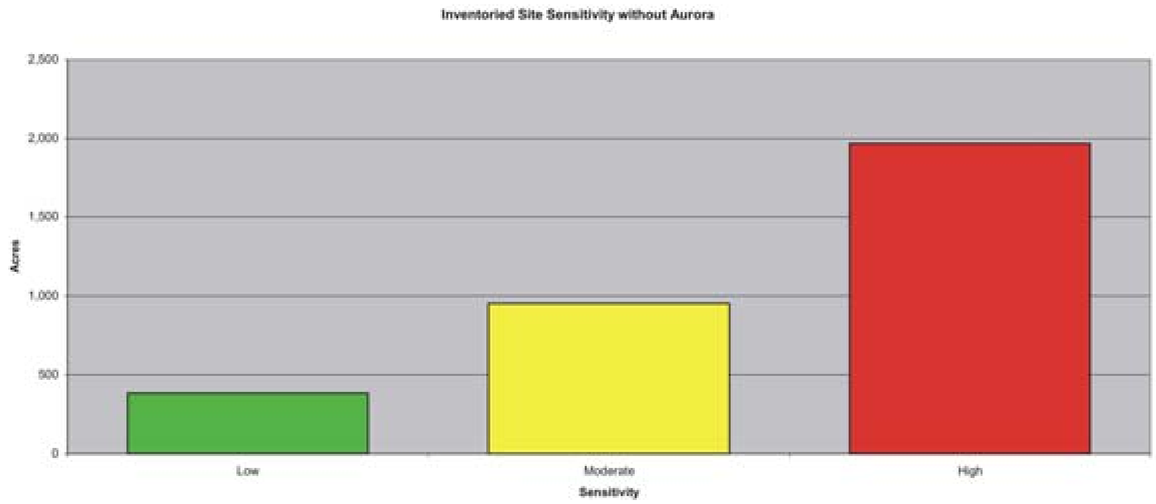
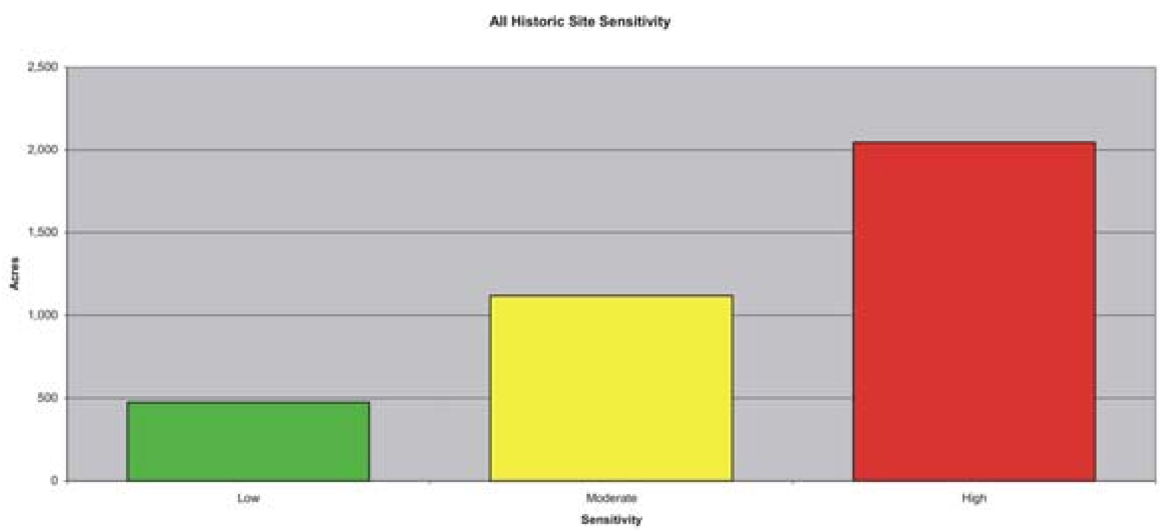
Figure 3.14. Historic Site Sensitivity.



Sensitivity	30m Cells	Area (sq. meters)	Acres	Hectares	% Inventoried
Low	1,726	1,553,400	384	155	11.62%
Moderate	4,280	3,852,000	952	385	28.81%
High	8,851	7,965,900	1,968	797	59.57%
Total	14,857	13,371,300	3,304	1,337	100.00%



Sensitivity	30m Cells	Area (sq. meters)	Acres	Hectares	% Inventoried
Low	2,134	1,920,600	475	192	6.67%
Moderate	5,026	4,523,400	1,118	452	35.32%
High	9,202	8,281,800	2,046	828	64.68%
Total	14,228	12,805,200	3,164	1,281	100.00%

Figure 3.15. Distribution of Historic Sites by Sensitivity Zone.

within low sensitivity zones, with 35% in moderate and 65% occurring in high sensitivity areas.

Historic site and inventory densities are summarized in Table 3.3. When all historic sites are considered over the study area, model area to site area ratios increase steadily from high to low sensitivity zones. Historic sites account for less than 0.3% of the total study area extent and thus ratios are exceedingly high. When only inventory areas are

Table 3.3 Historic Site Density within Study Area

Model Area	**High**	**Moderate**	**Low**	**Total**
Model Area (m^2)	918,516,600	2,278,567,800	2,183,822,100	5,380,906,500
Model Area (ha)	91,852	227,857	218,382	538,091
Model Area (acres)	226,965	563,034	539,622	1,329,622
% Model Area	17%	42%	41%	100%
All Sites				
All Sites Area (m2)	8,281,800	4,523,400	1,920,600	14,725,800
All Sites Area (ha)	828	452	192	1,473
All Site Area (acres)	2,046	1,118	475	3,639
% Site Area	56%	31%	13%	100%
Site Area : Model Area	0.0090	0.0020	0.0009	0.0027
Model Area : Site Area	***110.91***	***503.73***	***1137.05***	***365.41***
Inventory Area				
Inventory Area (m2)	84,545,104	140,051,696	122,556,600	347,153,400
Inventory Area (ha)	8,455	14,005	12,256	34,715
Inventory Area (acres)	20,891	34,607	30,284	85,782
% Inventory Area	24.35%	40.34%	35.30%	100.00%
% Area Inventoried	9.20%	6.15%	5.61%	6.45%
Inventoried Sites				
Inventoried Site Area (m2)	7,965,900	3,852,000	1,553,400	13,371,300
Inventory Site Area (ha)	797	385	155	1,337
Inventory Site Area (acres)	1,968	952	384	3,304
% Inventory Site Area	59.57%	28.81%	11.62%	100.00%
Inventoried Site : Inventory	0.0942	0.0275	0.0127	0.0385
Inventory : Inventoried Site	***10.61***	***36.36***	***78.90***	***25.96***

considered however, inventory to inventoried site ratios are more reasonable. Again ratios increase from high to low sensitivity zones. A 40 acre inventory within a high sensitivity zone should yield approximately 4 acres of historic site. Conversely that same inventory area within a low sensitivity area would reveal 0.5 acres of site and about 1 acre of site in a moderate sensitivity zone.

Analysis Summary

Probability calculations and analysis show a strong affinity for sites to occur within high sensitivity zones. When all prehistoric sites within inventories are considered, ratios of inventories to inventoried sites are extremely low within predictive high sensitivity zones then rapidly increase within moderate and low sensitivity areas. When adjusted for the presence of lithic materials associated with the Mt. Hicks obsidian source, ratios rise slightly but the overall trend remains the same. The likelihood of encountering sites within high probability zones is roughly 10 times that of low probability areas. When historic properties are considered, the overall predictive pattern is the same as that described for prehistoric sites. Densities are approximately 8 times greater in high sensitivity zones.

Table 3.4 shows the combined inventory to site ratios calculated for all inventoried sites (prehistoric and historic) within the project area. On average, site density is 10 times greater within high sensitivity zones, and the density from high to low sensitivity areas shows a consistent decreasing trend. If a 40 acre inventory were conducted within a low sensitivity zone less than 1 (0.84) acre of site might be expected, while more than 8 acres of site might be expected within the high sensitivity zone. Slightly more than 2 acres of site are calculated for moderate sensitivity zones.

Table 3.4 Combined Site Density within Study Area.

Prehistoric and Historic Site Density

Model Area (m2)	1,387,074,560	1,910,650,496	2,083,155,328	5,380,880,384
Hectares	138,707	191,065	208,316	538,088
Acres	342,746	472,122	514,748	1,329,616
Inventory Area	**High**	**Moderate**	**Low**	**Total**
Inventory Area (m2)	191,835,004	271,086,296	231,385,500	694,306,800
Inventory Area (ha)	19,184	27,109	23,139	69,431
Inventory Area (acres)	47,402	66,985	57,175	171,563
% Inventory Area	27.63%	39.04%	33.33%	100.00%
% Total Area Inventoried	13.83%	14.19%	11.11%	12.90%
Inventoried Sites				
Inventoried Site Area (m2)	39,531,600.00	14,411,700.00	4,883,400.00	58,826,700.00
Inventory Site Area (ha)	3,953.16	1,441.17	488.34	5,882.67
Inventory Site Area (acres)	9,768.26	3,561.13	1,206.69	14,536.08
% Inventory Site Area	67.20%	24.50%	8.30%	100.00%
Inventoried Site : Inventory	0.2061	0.0532	0.0211	0.0847
Inventory : Inventoried Site	***4.85***	***18.81***	***47.38***	***11.80***

IV. IMPACT ANALYSIS AND SAMPLE UNIT SELECTION

The potential impact of grazing to cultural resources can be most simply measured by evaluating where existing grazing potential is heaviest, where cultural resources are most likely, and then determining where those areas intersect. In order to evaluate potential grazing impacts within areas of high cultural resource sensitivity, potential forage utilization grids were overlain with the grids derived from site sensitivity and potential erosion analysis. The Humboldt-Toiyabe National Forest provided potential forage utilization grids. Forage utilization is classified into four categories that range from 0%-15% to a maximum between 45%-55%. Prehistoric and historic site sensitivity grids were combined into a single coverage and are likewise classified into four values reflecting composite sensitivity (Table 4.1).

Figure 4.1 shows the sensitivity and foraging grids for the project area. The autocorrelation of environmental variables comprising composite site and potential forage utilization is evident especially along flat slopes adjacent to streams. Soils within the northern, central, and southeastern portion of the project area have the highest erosional sensitivity and appear to correlate with areas of highest potential forage. Greatest potential for adverse effects to cultural resources site destruction occur where the highest values for site sensitivity, erosion, and potential forage utilization overlap.

Table 4.1. Composite Site Sensitivity.

Prehistoric Sensitivity	Historic Sensitivity	Composite Sensitivity	Composite Value
1	1	Low	1
1	2	Moderate	2
1	3	High	3
2	1	Moderate	2
2	2	Moderate	2
2	3	High	3
3	1	High	3
3	2	High	3
3	3	Very High	4

Redacted - Contains Sensitive Information

Figure 4.1 Composite Site, Potential Foraging, and Potential Erosion Grids.

Using the ESRI Spatial Analyst calculator, the three matrices were combined to derive a overlapped and a composite score. Table 4.2 shows the score tables used to compile the composite grid. The composite sensitivity table summarizes the grid overlap Figure 4.2. When combined, overlapping cells create a composite grid that ranges from low to very high. Values can be associated with sensitivity relating to propensity for disturbance to cultural resources due to grazing, then translated to survey priority as related in the project scope.

The scope of work requires a field sampling plan for areas of highest cultural resource sensitivity and grazing overlap.To facilitate field inventory, the survey priority grids were re-sampled into 100 by 100 meter (1 hectare) grids, and the grid extent expanded to the next relative 500 meter interval. The resulting grid can easily be aligned with 1000 meter UTM ticks on a 7.5 minute USGS quadrangle and 100 meter wide cells can be joined to create rectangular transects of manageable length and width.

Three priority zones were identified to stratify inventory over the project area. Each zone is confined to relatively distinct geographic zones (Figure 4.3). Table 4.3 provides summary data for each zone. While the extent of each priority zone is comparable, the acreage of very high and high sampling priority in the Sierra zone is almost half that of the other two areas.

A 2% sample of high and very high priority areas equates to approximately 7500 acres of inventory. As an initial test of the model per the project scope, a 2% sample should be adequate. Even though the Sierra priority zone contains fewer high and very high priority sampling areas, the sample space should be evenly divided, with each priority zone receiving 2500 acres of inventory. This keeps the sampling percentage consistent throughout each priority zone and allows for a preliminary assessment of moderate and low priority zones within the Sierra priority zone.

Table 4.2. Composite Site and Grazing Sensitivity.

Potential Grazing Utilization

Value	Number of cells	Acres	Potential Forage
1	1,727,999	384,292	0-15%
2	2,320,751	516,120	15-30%
3	835,531	185,817	30-45%
4	1,057,881	235,266	45-55%

Composite Site

Value	Number of cells	Acres	Sensitivity
1	1,473,632	327,727	Low
2	2,362,584	525,424	Moderate
3	1,723,319	383,256	High
4	419,221	93,232	Very High

Composite Site and Grazing

Site Value	Grazing Value	Sensitivity	Value
1	1	Low	1
1	2	Low	1
1	3	Low	1
1	4	Moderate	2
2	1	Low	1
2	2	Low	1
2	3	Moderate	2
2	4	High	3
3	1	Moderate	2
3	2	Moderate	2
3	3	High	3
3	4	Very High	4
4	1	High	3
4	2	Very High	4
4	3	Very High	4
4	4	Very High	4

Value	Number of cells	Acres	Site/Grazing Sensitivity
1	3,172,400	705,522	Low
2	532,069	118,328	Moderate
3	1,321,128	293,810	High
4	911,123	202,628	Very High

Potential Erodibility

Value	Number of cells	Acres	Sensitivity
1	3,624,268	806,015	Low
2	1,074,883	239,047	Moderate
3	1,157,335	257,384	High
4	84,816	18,863	Very High

Composite Site/Grazing and Erodibility

Site Value	Grazing Value	Sensitivity	Value
1	1	Low	1
1	2	Low	1
1	3	Low	1
1	4	Moderate	2
2	1	Low	1
2	2	Low	1
2	3	Moderate	2
2	4	High	3
3	1	Moderate	2
3	2	Moderate	2
3	3	High	3
3	4	Very High	4
4	1	High	3
4	2	Very High	4
4	3	Very High	4
4	4	Very High	4

Final Composite Sensitivity

Value	Number of Cells	Acres	Composite Priority
1	3,545,266	788,446	Low
2	823,072	184,158	Moderate
3	927,826	206,343	High
4	639,696	142,265	Very High

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Text

Figure 4.2. Composite Inventory Priority

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Figure 4.3. Priority Zones and Inventory Priority

Figure 4.4 shows selected sample units within each priority zone. The sample units are 300 meters in width and 1000 meters in length. The 300 meter width allows for an even number of 30 meter transects, an important consideration for field logistics.

Table 4.3. Summary Cell Distribution by Priority Zone.

Sierra

Priority	Count	Acres	% Zone	%Total Area
Low	158,253	391,043	76.0%	29.6%
Moderate	21,223	52,442	10.2%	4.0%
High	20,811	51,424	10.0%	3.9%
Very High	7,811	19,301	3.8%	1.5%
Total	208,098	514,210	100.0%	39.0%

Pine Grove Hills

Priority	Count	Acres	% Zone	%Total Area
Low	80,301	198,424	51.2%	15.0%
Moderate	18,740	46,307	11.9%	3.5%
High	30,447	75,235	19.4%	5.7%
Very High	27,349	67,579	17.4%	5.1%
Total	156,837	387,544	100.0%	29.4%

Mt. Hicks

Priority	Count	Acres	% Zone	%Total Area
Low	80,507	198,933	47.6%	15.1%
Moderate	33,994	83,999	20.1%	6.4%
High	32,258	79,710	19.1%	6.0%
Very High	22,509	55,620	13.3%	4.2%
Total	169,268	418,261	100.0%	31.7%

Grand Total	364,935	1,320,016		

In selecting the sample units, care was taken to avoid areas of previous inventory. Very high and high priority areas were the primary focus of sample unit placement, but if adjoining cells of low and moderate priority could easily be included within the sample unit, they were included. Expert knowledge also directed sample unit placement. For example, if an area of very high priority included a playa and shoreline, the sample unit was placed in a location that maximized coverage of the shoreline, where sites are more likely to occur. Likewise, if a mining claim or cultural feature was apparent within one of the high priority areas, the sample unit was oriented to include that feature. Distance to

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Figure 4.4 Selected Sample Units.

roads was considered to be a predictive factor for historic site location. Road proximity is already integrated into the priority area selection. If all other criteria for sample unit placement were met, then proximity to roads was considered for sample unit placement, simply to facilitate access.

Thirty-three sample units are in the Sierra and Pine Grove Hills zone and thirty-four are within the Mt Hicks area. An attribute table attached to the study unit GIS shapefile includes consecutive sample unit numbers. A unique prefix associates a sample unit with the appropriate priority zone.

The sampling plan serves as a guideline for field study. Survey quadrat orientation may be re-positioned to facilitate access. Likewise their extent may also be adjusted. If adjustments are made, care should be taken to assure that aggregate sample size and overall priority orientation remain consistent. Priority inventory can be phased so that all sampling within all priority zones do not have to be completed before a final evaluation. As each priority zone is sampled, field data can be evaluated against the model and modifications to the grazing plan can be amended. If desired, the overall approach can be modified to evaluate sensitivity areas within each grazing allotment. In that case, sample units should be re-distributed as necessary within each allotment.

V. IMPLEMENTATION AND MANAGEMENT DIRECTION

The preceding sections outline both the cultural resources probability model and the integrated grazing and cultural resources model in the Bridgeport Ranger District. These models provide an efficient means for the assessing potential grazing impacts. This chapter discusses implementation of the sampling plan and future management direction for the integrated grazing model.

Project Implementation

The sampling plan, described in Chapter IV, tests the cultural resource model in areas of high grazing potential. As surveys are completed, tabulations should be run to assess site densities within the very high and high priority areas. If densities are similar to those calculated in the cultural resources probability model, then site protection stipulations should be added to grazing permits in areas where high site probability and high potential forage utilization overlap.

Field testing to validate the cultural resources probability model itself, or a sampling design to do so, was not considered as part of the project scope but should be addressed. The sample survey results should be compared to the cultural resources probability model as an initial test of the model's validity. Some additional inventory may be required if the integrated grazing model does not adequately sample the cultural resource sensitivity zones. If the cultural resource model's accuracy falls below expectations, then the utility of the integrated model may be diminished significantly. Neither model should be static, and both must be reevaluated as new cultural resource information is added, or new independent information, such as environmental variables, are considered.

Management Direction

After the integrated grazing model is tested and shown to be reliable, it has value as a planning tool and a means to assess potential effects from grazing on cultural resources.

Upon verification of the model, the following process be used to identify the level of effort necessary to comply with Section 106 of the National Historic Preservation Act. The general procedure follows seven steps:

1. Overlay the inventory priority coverage to assess extent of area with potential for cultural resource and grazing sensitivity.
2. Determine extent of previous inventories and sites within grazing unit.
3. Evaluate results of neighboring inventories.
4. Evaluate effectiveness of GIS in placing predictive variables over landscape. Due to the scale of the digital dataset, not all predictive landforms, vegetation or water sources may be identified in the coverage.
5. Determine need for additional testing/sampling in light of previous field work.
6. Attach appropriate protection stipulations or inventory requirements in areas of high or very high Inventory Priority.
7. Develop a sampling plan for low and moderate priority zones as appropriate.

Figure 5.1 depicts the process using the East Walker Grazing Unit as an example.

The East Walker Grazing Unit has had a considerable amount of inventory within its extent. Extensive inventories occur in the western and northern portion of the grazing unit and fall within all four, inventory priority zones. Existing sites appear frequently in the low inventory priority areas. A large inventory just north of the sample grazing unit identifies numerous sites in low and moderate priority zones. Upon closer inspection, all sites appear to fall on low, flat ridgelines, one of the predictive variables that may not be well defined by slope characterization alone.

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Figure 5.1. Sample Unit Selection.

Additional inventory could clarify the possible ridgeline predictive factor and verify site densities in selected areas of high and very high inventory priority. Based upon results of the inventory, protective stipulations can be formulated for areas of highest cultural resource probability and potential forage utilization. If the forest manager wishes to be more specific in protection stipulations, then an alternate method would be to conduct inventory within all high and very high inventory priority zones.

Based upon composite site and grazing analysis, the final high and very high composite priority zones (348,608 acres) cover 72,475 fewer acres than the highest potential forage utilization areas and 127,880 fewer acres than the high and very high site sensitivity zone in the composite site model (Table 5.1). Using an average cost of $35/acre, a class III, 30 meter interval, inventory of the highest potential grazing utilization zones (30%-45% and 45%-55%) would cost approximately $14.7 million. A similar intensive inventory of the highest final composite priority zones reduces that cost to $12.2 million, a substantial savings of $2.5 million. By developing the probability model, then applying a sampling procedure to test its validity, initial inventory costs are reduced significantly. Even at an inflated rate of $65/acre, the 7500 acre sample would cost less than $500,000.

Table 5.1. Acreage Reduction Utilizing Inventory Priority Area.

Potential Grazing Utilization	
Potential Forage	Acres
0-15%	384,292
15-30%	516,120
30-45%	185,817
45-55%	235,266
Sum High/Very High	421,083
Acreage Reduction	72,475
Savings	-17%

Composite Site	
Sensitivity	Acres
Low	327,727
Moderate	525,424
High	383,256
Very High	93,232
	476,488
	127,880
	-27%

Final Composite Priority	
Sensitivity	Acres
Low	788,446
Moderate	184,158
High	206,343
Very High	142,265
	348,608

In Chapter II the benefit of the deductive approach to model building is discussed. By controlling environmental constraints within the sampling framework patterns can be more easily recognized and a more reliable model constructed. As shown above, modeling as a planning tool can significantly reduce costs related to the traditional cultural resource identification and clearance approach.

Grazing, fire, and timber management have produced various effects upon cultural resources. This projects attempt at developing a cultural resource probability model that specifically addresses potential foraging utilization, appears promising. in developing a more effect approach to management of those resources. Cultural resource probability could be refined and applied to any number of management concerns, for a fraction of the cost savings derived from implementation of the grazing model. To be effective, the models should constantly be refreshed with new data, tested against expectations and adjusted as necessary. The scope of this project does not evaluate or address cultural resources in the low or moderate priority areas defined by the integrated model. Those areas should be sampled at a later date. Since the model is not static new inventory results should be integrated and the model reevaluated on a regular, preferably annual basis. Model revisions should be implemented as needed. Resource managers should be cautioned that the model does not preclude inventory and evaluation requirements under Section 106 of the National Historic Preservation Act. It does provide a management framework to evaluate potential costs associated with the Section 106 process. As the model is proven, less intensive inventory strategies may be applied in areas of low site probability, or in areas of high probability provided that adequate site protection measures are in place. The model is a substantial milestone for the completion of directives set aside in the MOU between the State Historic Preservation Offices and the Humboldt-Toiyabe National Forest as it pertains to rangeland management.

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APPENDIX I
Summary Site Tables and Chi Square Tables

ELEVATION (Number of 30m Cells)

	Elevation in Meters						
	1001 - 1500	1501 - 2000	2001 - 2500	2501 - 3000	3001 - 3500	3501 - 4000	Grand Total
No Inventory	154001	1605933	2397837	1029170	397301	9950	5594192
Inventory	5021	69273	245189	63885	1878	130	385376
Grand Total	159022	1675206	2643026	1093055	399179	10080	5979568

Total Area	5021	69273	245189	63885	1878	130	385376
Area %	1.30%	17.98%	63.62%	16.58%	0.49%	0.03%	100.00%
Inventory %	2.75%	28.71%	42.86%	18.40%	7.10%	0.18%	100.00%
Relative Class Inventory%	3067.14%	2318.27%	977.95%	1610.97%	21155.54%	7653.85%	
% Total Area Inventoried	39.96%	416.72%	622.21%	267.06%	103.09%	2.58%	1451.62%

Sites	41	13037	47950	2877	0	0	63905
Site %	0.06%	20.40%	75.03%	4.50%	0.00%	0.00%	100.00%

Inventoried Areas

No Sites	4980	66766	226038	63457	1878	130	363249
Sites	41	2507	19151	428	0	0	22127
Site %	0.19%	11.33%	86.55%	1.93%	0.00%	0.00%	100.00%

Weight	**0**	**0**	**1**	**0**	**0**	**0**

Bridgeport Elevation

Cells on a 30 m grid

	Site	Not Site	ROW
1000-1500	41	4980	5021
1500-2000	2507	66766	69273
2000-2500	19151	226038	245189
2500-3000	428	63457	63885
3000-3500	0	1878	1878
3500+	0	130	130
COL	22127	363249	385376

Chi-squares

	Site	Not Site
1000-1500	212.12	12.92
1500-2000	543.60	33.11
2000-2500	1828.11	111.36
2500-3000	2862.00	174.34
3000-3500	107.83	6.57
3500+	7.46	0.45

Chi-square for table 5899.88

adj. std. residuals

	Site	Not Site
1000-1500	-15.10	15.10
1500-2000	-26.52	26.52
2000-2500	73.02	-73.02
2500-3000	-60.33	60.33
3000-3500	-10.72	10.72
3500+	-2.81	2.81

Expected values

	Site	Not Site
1000-1500	288	4733
1500-2000	3977	65296
2000-2500	14078	231111
2500-3000	3668	60217
3000-3500	108	1770
3500+	7	123

Cell std. resid.

	Site	Not Site
1000-1500	-14.56	3.59
1500-2000	-23.32	5.75
2000-2500	42.76	-10.55
2500-3000	-53.50	13.20
3000-3500	-10.38	2.56
3500+	-2.73	0.67

Cell chi values

	Site	Not Site
1000-1500	-247.29	247.29
1500-2000	-1470.42	1470.42
2000-2500	5073.07	-5073.07
2500-3000	-3240.06	3240.06
3000-3500	-107.83	107.83
3500+	-7.46	7.46

Cell variance

	Site	Not Site
1000-1500	0.93	0.06
1500-2000	0.77	0.05
2000-2500	0.34	0.02
2500-3000	0.79	0.05
3000-3500	0.94	0.06
3500+	0.94	0.06

Landform (Number of 30m Cells)

	0 - 5 Degrees	6 - 10 Degrees	11 Degrees or more	Grand Total
No Inventory	1753544	816341	3024307	5594192
Inventory	81952	55876	247548	385376
Grand Total	1835496	872217	3271855	5979568

Total Area	81952	55876	247548	385376
Area %	21.27%	14.50%	64.24%	100.00%
Inventory %	31.35%	14.59%	54.06%	100.00%
Relative Class Inventory%	2139.72%	1460.99%	1221.71%	
% Total Area Inventoried	455.02%	211.83%	784.77%	1451.62%

Sites	36009	11428	16468	63905
Site %	56.35%	17.88%	25.77%	100.00%

Inventoried Areas

No Sites	72377	50238	240634	363249
Sites	9575	5638	6914	22127
Site %	43.27%	25.48%	31.25%	100.00%

Weight	**2**	**1**	**0**

Bridgeport Landform

Cells on a 30 m grid

	Site	Not Site	ROW
0-5	9575	72377	81952
6-10	5638	50238	55876
11+	6914	240634	247548
COL	22127	363249	385376

Chi-squares

	Site	Not Site
0-5	5039.50	306.98
6-10	1840.23	112.10
11+	3748.65	228.35

Chi-square for table 11275.80

adj. std. residuals

	Site	Not Site
0-5	82.40	-82.40
6-10	47.78	-47.78
11+	-105.45	105.45

Expected values

	Site	Not Site
0-5	4705	77247
6-10	3208	52668
11+	14213	233335

Cell std. resid.

	Site	Not Site
0-5	70.99	-17.52
6-10	42.90	-10.59
11+	-61.23	15.11

Cell chi values

	Site	Not Site
0-5	4869.59	-4869.59
6-10	2429.79	-2429.79
11+	-7299.38	7299.38

Cell variance

	Site	Not Site
0-5	0.74	0.05
6-10	0.81	0.05
11+	0.34	0.02

Vegetation (Number of 30m Cells)

	Sagebrush	Salt Desert Scrub	Lowland Riparian	Agriculture	Pinyon	Urban	Water	Lodgepole	Sierra Mt. Shrub	Aspen
No Inv	2231443	187402	24622	157430	1881336	12860	17709	504744	158875	10995
Inv	172483	5334	1614	5397	187319	191	221	4453	1830	13
Grand Total	2403926	192736	26236	162827	2068655	13051	17930	509197	160705	11008
Total Area	2403926	192736	26236	162827	2068655	13051	17930	509197	160705	11008
Area %	40.20%	3.22%	0.44%	2.72%	34.60%	0.22%	0.30%	8.52%	2.69%	0.18%
Inventory %	44.76%	1.38%	0.42%	1.40%	48.61%	0.05%	0.06%	1.16%	0.47%	0.00%
Relative Class Inventory%	7.18%	2.77%	6.15%	3.31%	9.06%	1.46%	1.23%	0.87%	1.14%	0.12%
% Total Area Inventoried	2.88%	0.09%	0.03%	0.09%	3.13%	0.00%	0.00%	0.07%	0.03%	0.00%
Sites	40235	788	613	1107	19629	0	15	499	25	3
Site %	62.96%	1.23%	0.96%	1.73%	30.72%	0.00%	0.02%	0.78%	0.04%	0.00%
Inventoried Areas										
No Sites	160103	5285	1510	5135	178360	191	216	4254	1820	0
Sites	12380	49	104	262	8959	0	0	199	10	0
Site %	55.98%	0.22%	0.47%	1.18%	40.51%	0.00%	0.00%	0.90%	0.05%	0.00%
Weight	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

	Bitterbrush	Grass	Bare ground	Meadow	Marsh	Greasewood	Grand Total
No Inv	4644	8347	327512	19060	30367	16817	5594163
Inv	1822	0	4023	0	627	49	385376
Grand Total	6466	8347	331535	19060	30994	16866	5979539
Total Area	6466	8347	331535	19060	30994	16866	5979539
Area %	0.11%	0.14%	5.54%	0.32%	0.52%	0.28%	100.00%
Inventory %	0.47%	0.00%	1.04%	0.00%	0.16%	0.01%	100.00%
Relative Class Inventory%	28.18%	0.00%	1.21%	0.00%	2.02%	0.29%	
% Total Area Inventoried	0.03%	0.00%	0.07%	0.00%	0.01%	0.00%	6.44%
Sites	104	0	847	0	30	10	63905
Site %	0.16%	0.00%	1.33%	0.00%	0.05%	0.02%	100.00%
Inventoried Areas							
No Sites	1718	0	4004	0	599	0	363195
Sites	104	0	19	0	28	0	22114
Site %	0.47%	0.00%	0.09%	0.00%	0.13%	0.00%	100.00%
Weight	**0**	**0**	**0**	**0**	**0**	**0**	

Bridgeport Gap

Cells on a 30 m grid

	Site	Not Site	ROW
Sage	12380	160103	172483
Salt Desert Shrub	49	5285	5334
Lowland Riparian	104	1510	1614
Agriculture	262	5135	5397
Pinon	8959	178360	187319
Urban	0	191	191
Water	0	216	216
Lodgepole	199	4254	4453
Mountain Shrub	10	1820	1830
Bitterbrush	104	1718	1822
Bare Ground	19	4004	4023
Marsh	28	599	627
COL	21963	356874	378837

Chi-squares

	Site	Not Site
Sage	566.62	34.87
Salt Desert Shrub	219.00	13.48
Lowland Riparian	1.16	0.07
Agriculture	8.28	0.51
Pinon	332.69	20.47
Urban	11.07	0.68
Water	12.52	0.77
Lodgepole	13.56	0.83
Mountain Shrub	87.04	5.36
Bitterbrush	0.03	0.00
Bare Ground	196.78	12.11
Marsh	1.92	0.12

Chi-square for table 1328.99

adj. std. residuals

	Site	Not Site
Sage	33.23	-33.23
Salt Desert Shrub	-15.36	15.36
Lowland Riparian	1.11	-1.11
Agriculture	-2.99	2.99
Pinon	-26.43	26.43
Urban	-3.43	3.43
Water	-3.67	3.65
Lodgepole	-3.80	3.82
Mountain Shrub	-9.64	9.64
Bitterbrush	-0.16	0.16
Bare Ground	-14.47	14.53
Marsh	-131443282.08	1.43

Expected values

	Site	Not Site
Sage	10000	162483
Salt Desert Shrub	309	5025
Lowland Riparian	94	1520
Agriculture	313	5084
Pinon	10860	176459
Urban	11	180
Water	13	203
Lodgepole	258	4195
Mountain Shrub	106	1724
Bitterbrush	106	1716
Bare Ground	233	3790
Marsh	36	591

Cell std. resid.

	Site	Not Site
Sage	23.80	-5.91
Salt Desert Shrub	-14.80	3.67
Lowland Riparian	1.08	-0.27
Agriculture	-2.88	0.71
Pinon	-18.24	4.52
Urban	-3.33	0.83
Water	-3.54	0.88
Lodgepole	-3.68	0.91
Mountain Shrub	-9.33	2.31
Bitterbrush	-0.16	0.04
Bare Ground	-14.03	3.48
Marsh	-1.38	0.34

Cell chi values

	Site	Not Site
Sage	2380.33	-2380.33
Salt Desert Shrub	-260.24	260.24
Lowland Riparian	10.43	-10.43
Agriculture	-50.89	50.89
Pinon	-1900.78	1900.78
Urban	-11.07	11.07
Water	-12.52	12.52
Lodgepole	-59.16	59.16
Mountain Shrub	-96.09	96.09
Bitterbrush	-1.63	1.63
Bare Ground	-214.23	214.23
Marsh	-8.35	8.35

Cell variance

	Site	Not Site
Sage	0.51	0.03
Salt Desert Shrub	0.93	0.06
Lowland Riparian	0.94	0.06
Agriculture	0.93	0.06
Pinon	0.48	0.03
Urban	0.94	0.06
Water	0.93	0.06
Lodgepole	0.94	0.06
Mountain Shrub	0.94	0.06
Bitterbrush	0.93	0.06
Bare Ground	0.94	0.06
Marsh	0.00	0.06

WATER (Number of 30m Cells)

	0 - 500	501 - 1000	1001 - 1500	1500-6500	Grand Total
No Inv	2949507	1715619	591669	336619	5593414
Inv	222746	118384	31747	12494	385371
Grand Total	3172253	1834003	623416	349113	5978785

Total Area	3172253	1834003	623416	349113	5978785
Area %	53.06%	30.68%	10.43%	5.84%	100.00%
Inventory %	57.80%	30.72%	8.24%	3.24%	100.00%
Relative Class Inventory%	7.02%	6.45%	5.09%	3.58%	
% Total Area Inventoried	3.73%	1.98%	0.53%	0.21%	6.45%

Prehistoric

Sites	40865	14925	4015	4100	63905
Site %	63.95%	23.35%	6.28%	6.42%	100.00%

Historic

Sites	12293	3040	1672	6016	23021
Site %	53.40%	13.21%	7.26%	26.13%	100.00%

Inventoried Areas

Prehistoric

No Sites	206903	113303	31065	11978	363249
Sites	15843	5081	682	521	22127
Site %	71.60%	22.96%	3.08%	2.35%	100.00%
Weight	2	0	0	0	0

Historic

No Sites	217282	116815	31459	12321	377877
Sites	5250	1559	331	362	7502
Site %	69.98%	20.78%	4.41%	4.83%	100.00%

Weight	**1**	**0**	**0**	**0**	**0**

Bridgeport H2O Prehistoric

Cells on a 30 m grid

	Site	Not Site	ROW
<500	15843	206903	222746
500-1000	5081	113303	118384
1000-1500	682	31065	31747
>1500	521	11987	12508
COL	22127	363258	385385

Chi-squares

	Site	Not Site
<500	729.28	44.42
500-1000	433.25	26.39
1000-1500	713.94	43.49
>1500	54.12	3.30

Chi-square for table 2048.19

adj. std. residuals

	Site	Not Site
<500	42.82	-42.82
500-1000	-25.76	25.76
1000-1500	-28.73	28.73
>1500	-7.70	7.70

Expected values

	Site	Not Site
<500	12789	209957
500-1000	6797	111587
1000-1500	1823	29924
>1500	718	11790

Cell std. resid.

	Site	Not Site
<500	27.01	-6.66
500-1000	-20.81	5.14
1000-1500	-26.72	6.59
>1500	-7.36	1.82

Cell chi values

	Site	Not Site
<500	3053.97	-3053.97
500-1000	-1716.05	1716.05
1000-1500	-1140.76	1140.76
>1500	-197.15	197.15

Cell variance

	Site	Not Site
<500	0.40	0.02
500-1000	0.65	0.04
1000-1500	0.86	0.05
>1500	0.91	0.06

Bridgeport H2O Historic

Cells on a 30 m grid

	Site	Not Site	ROW
<500	5250	217282	222532
500-1000	1559	116815	118374
1000-1500	331	31459	31790
>1500	362	12321	12683
COL	7502	377877	385379

Chi-squares

	Site	Not Site
<500	194.57	3.86
500-1000	241.08	4.79
1000-1500	133.88	2.66
>1500	53.66	1.07

Chi-square for table 635.56

adj. std. residuals

	Site	Not Site
<500	21.67	-21.67
500-1000	-18.84	18.84
1000-1500	-12.20	12.20
>1500	7.52	-7.52

Expected values

	Site	Not Site
<500	4331.93	218200.07
500-1000	2304.33	116069.67
1000-1500	618.84	31171.16
>1500	246.89	12436.11

Cell std. resid.

	Site	Not Site
<500	13.95	-1.97
500-1000	-15.53	2.19
1000-1500	-11.57	1.63
>1500	7.33	-1.03

Cell chi values

	Site	Not Site
<500	918.07	-918.07
500-1000	-745.33	745.33
1000-1500	-287.84	287.84
>1500	115.11	-115.11

Cell variance

	Site	Not Site
<500	0.41	0.01
500-1000	0.68	0.01
1000-1500	0.90	0.02
>1500	0.95	0.02

Roads (Number of 30m Cells)

	0 - 200	200 - 400	400 - 600	600 - 800	Over 800	Grand Total
No Inv	926657	671327	553641	434903	3006881	5593409
Inv	93917	51109	39887	31658	168805	385376
Grand Total	1020574	722436	593528	466561	3175686	5978785
Total Area	1020574	722436	593528	466561	3175686	5978785
Area %	17.07%	12.08%	9.93%	7.80%	53.12%	100.00%
Inventory %	24.37%	13.26%	10.35%	8.21%	43.80%	100.00%
Relative Class Inventory%	9.20%	7.07%	6.72%	6.79%	5.32%	
% Total Area Inventoried	1.57%	0.85%	0.67%	0.53%	2.82%	6.45%
Historic						
Sites	9146	1592	1126	828	10329	23021
Site %	39.73%	6.92%	4.89%	3.60%	44.87%	100.00%
Historic						
Inventoried Areas						
No Sites	90253	50261	39424	31261	166678	377877
Sites	3422	863	513	384	2320	7502
Site %	45.61%	11.50%	6.84%	5.12%	30.93%	100.00%
Weight	**1**	**0**	**0**	**0**	**0**	

Bridgeport Roads

Cells on a 30 m grid

	Site	Not Site	ROW
0-200	3422	31261	34683
200-400	863	39424	40287
400-600	513	50261	50774
600-800	384	90253	90637
800+	2320	166678	168998
COL	5182	211199	216381

Expected values

	Site	Not Site
0-200	831	33852
200-400	965	39322
400-600	1216	49558
600-800	2171	88466
800+	4047	164951

Cell chi values

	Site	Not Site
0-200	2591.39	-2591.39
200-400	-101.81	101.81
400-600	-702.96	702.96
600-800	-1786.62	1786.62
800+	-1786.62	1786.62

Chi-squares

	Site	Not Site
0-200	8084.85	198.37
200-400	10.74	0.26
400-600	406.39	9.97
600-800	1470.55	36.08
800+	0.00	0.00

Chi-square for table 10217.22

Cell std. Resid.

	Site	Not Site
0-200	89.915801	-14.084414
200-400	-3.2777986	0.5134345
400-600	-20.159114	3.1577243
600-800	-38.347786	6.0067986
800+	0	0

Cell variance		
	Site	Not Site
0-200	0.8196034	0.0201099
200-400	0.7943249	0.0194896
400-600	0.7470201	0.018329
600-800	0.5672061	0.013917
800+	0.2137353	0.0052442

adj. std. residuals

	Site	Not Site
0-200	99.319412	-99.319412
200-400	-3.6777583	3.6777583
400-600	-23.324121	23.324121
600-800	-50.917826	50.917826
800+	0	0

APPENDIX II

Weighted Stratum Scores

Weighted Stratum Scores

Prehistoric Cell Score

Value	Cell Count	Stratum	Score
0	543,080.00	no strata	0
1	535,872.00	elev	1
10	275,978.00	slope	1
100	684,115.00	water	1
1000	275,572.00	veg	1
11	274,560.00	slope/elev	2
101	616,805.00	water/elev	2
110	357,843.00	water/slope	2
1001	165,534.00	veg/elev	2
1010	445,024.00	veg/slope	2
1100	263,179.00	veg/water	2
111	286,577.00	water/slope/elev	3
1011	290,895.00	veg/slope/elev	3
1101	186,901.00	veg/water/elev	3
1110	490,949.00	veg/water/slope	3
1111	285,872.00	veg/water/slope/elev	4

543,080.00	Total no strata	0
1,771,537.00	Total 1 strata	1
2,122,945.00	Total 2 Strata	2
1,255,322.00	Total 3 strata	3
285,872.00	Total 4 strata	4

Historic Cell Score

Value	Cell Count	Stratum	Score
0	2,426,469	no strata	0
1	2,531,742	water	1
10	380,063	road	2
11	640,511	road/water	3

2,426,469	Total 1 strata	0
2,531,742	Total 10 strata	1
380,063	Total 3 strata	2
640,511	Total 4 strata	3