

---

# MEADOW VALLEY WASH

## Post-flood Vegetation Assessment

---

**Submitted to:**

U.S. Department of the Interior  
Bureau of Land Management  
Ely Field Office  
702 N. Industrial Way  
Ely, Nevada 89301

**Submitted by:**

BIO-WEST, Inc.  
1063 West 1400 North  
Logan, Utah 84321

**September 2005**





# PREFACE ON MAP AND DATA AVAILABILITY

The Meadow Valley Wash Post-flood Evaluation was funded by the United States Department of Interior, Bureau of Land Management (BLM). As part of the assessment, GIS data sets and maps of post-flood vegetation changes were prepared and submitted to the BLM Ely Field Office, Ely, Nevada. The maps and graphics included the following material, and are available for review at the Ely office.

1. *Three-band Digital Rectified Images, Meadow Valley Wash and Clover Creek.* This is the 3-band imagery captured in June 2005 for both Clover Creek and Meadow Valley Wash.
2. *Two Composite GIS Shapefiles.* These shapefiles cover both Meadow Valley Wash and Clover Creek. One GIS shapefile depicts the overall changes by disturbance type (natural or human) and is delineated into polygons by disturbance type only, without reference to prior vegetation mapping. The second shapefile shows the same information, but polygons are split to depict extent within the original vegetation mapping boundary and the area beyond this boundary.
3. *Post-flood Clover Creek GIS Shapefiles.* One shapefile is the original vegetation delineation (pre flood, dated 2003). The second shapefile is the post-flood delineation of disturbance (by type of disturbance and vegetation type). This is the composite disturbance intersected with the original vegetation. No Southwestern Willow Flycatcher Habitat (SWWFC) data was available for Clover Creek.
4. *Post-flood Meadow Valley Wash GIS Shapefiles.* One shapefile is the original vegetation delineation (pre flood, dated 2003). The second is the post-flood delineation of disturbance (by type of disturbance and vegetation type). This is the composite disturbance intersected with the original vegetation and SWWFC Habitat data.
5. *Atlas of Post-flood Disturbance in Relation to Pre Flood Vegetation and SWWFC Habitat.* This atlas depicts all of the vegetation disturbance by type of disturbance in relation to pre flood vegetation classification and SWWFC habitat. The base map is the June 2005 imagery.

Because of the large size and complexity of the graphics and maps, it was not practicable to include this full array with the current report.

One DVD is included in the back cover of the report containing the *Atlas of Post-flood Disturbance in Relation to Pre Flood Vegetation and SWWFC Habitat*. The DVD contains readable files showing all of the vegetation disturbance by type of disturbance in relation to pre flood vegetation classification and SWWFC habitat. The base map is the June 2005 imagery. The scale is 1:24,000. An index map is included for location reference as well as a legend explaining symbols.

*This page intentionally left blank.*

# TABLE OF CONTENTS

INTRODUCTION .....	1
STUDY AREA .....	2
METHODS .....	4
Aerial Imagery .....	4
Vegetation Community Aggregation .....	5
Vegetation Change Detection .....	5
Aerial Imagery Interpretation .....	5
Field Verification .....	6
Vegetation Change Analysis .....	8
RESULTS .....	9
Post-flood Vegetation Type Changes .....	9
Meadow Valley Wash .....	9
Clover Creek .....	18
Post-flood Southwestern Willow Flycatcher Habitat Changes .....	27
Southwestern Willow Flycatcher Suitable Habitat Loss .....	28
Southwestern Willow Flycatcher Potential Habitat Loss .....	30
REFERENCES .....	32

## LIST OF TABLES

Table 1.	Summary of Post-flood Vegetation Disturbance in Meadow Valley Wash and Clover Creek (July 2005). .....	10
Table 2.	Meadow Valley Wash Summary of Post-flood Disturbance (July 2005). .....	10
Table 3.	Comparison of Post-flood Vegetation – Total Disturbance (July 2005) with Pre-flood Conditions (July 2004) in Meadow Valley Wash. ....	13
Table 4.	Types and Acres of Human Disturbance in Meadow Valley Wash Delineated in July 2005. ....	19
Table 5.	Clover Creek Summary of Post-flood Disturbance (July 2005). ....	21
Table 6.	Comparison of Post-flood Vegetation – Total Disturbance (July 2005) with Pre-flood Conditions (July 2004) in Clover Creek. ....	22
Table 7.	Types and Acres of Human Disturbance in Clover Creek Delineated in July 2005. ....	26

Table 8. Comparison of Post-flood Southwestern Willow Flycatcher Habitat with Pre-flood Conditions (July 2004) in Meadow Valley Wash. . . . . 29

**LIST OF FIGURES**

Figure 1. Meadow Valley Wash Post-flood Evaluation Study Area. . . . . 3

# INTRODUCTION

Within the arid Southwest, the desert riparian ecosystem supports a diverse array of wildlife species, many of which are restricted to the limited habitat components supported by local hydrology. The desert riparian system has historically provided essential habitat components for species, particularly avian species, that have limited distribution or are experiencing population declines across their ranges. The Meadow Valley Wash of southeastern Nevada comprises a variable desert riparian ecosystem punctuated by diverse geologic, hydrologic, and anthropogenic conditions that affect the amount, distribution and structure of the differing riparian vegetation within the system. The vegetation type, distribution, and structural characteristics, subsequently, determine available wildlife habitat within Meadow Valley Wash.

In September 2003 BIO-WEST, Inc. (BIO-WEST), of Logan, Utah, was contracted by Lincoln County and Clark County, Nevada, to prepare the baseline ecological assessment of Meadow Valley Wash. The project was funded through a matching grant from the U.S. Department of Interior (USDI), Fish and Wildlife Service (USFWS) under Section 6 of the Endangered Species Act. The goal of the baseline ecological assessment was to characterize and evaluate riparian communities within the Meadow Valley Wash in order to identify riparian sites that could be protected, enhanced, or restored in compliance with the Multiple Species Habitat Conservation Plans for the Counties (MSHPC) (Clark County 2000, Lincoln County 2003). The baseline ecological assessment focused primarily on the identification of suitable habitat and potentially suitable habitat for covered species, with particular emphasis on the southwestern willow flycatcher (*Empidonax traillii extimus*) (SWWFC). Suitable habitat for covered species was evaluated based on riparian vegetation composition and structure, habitat patch size, presence of surface water, and other elements that appear to affect a covered species' affinity for a habitat patch. Riparian conditions were assessed not only for suitable habitat, but also for habitat patches that could potentially develop suitable conditions for covered species, specifically for the SWWFC.

The baseline ecological assessment defined the condition of riparian communities in the Meadow Valley Wash as of July 2004 and a final report was prepared in early January 2005 (BIO-WEST 2005).

On January 11, 2005 extensive precipitation events in southeastern Nevada culminated with catastrophic flooding of a number of the local drainages, including Meadow Valley Wash and its tributary, Clover Creek. The flood event affected riparian vegetation and floodplain characteristics through Clover Creek and Meadow Valley Wash from Caliente, Nevada, through its confluence with Muddy Creek

In May 2005 the Ely, Nevada, district of the USDI Bureau of Land Management (BLM), contracted with BIO-WEST to conduct a post-flood evaluation of the riparian changes in the Meadow Valley Wash and its major tributary, Clover Creek (Study). The objective of the post-flood Study was to determine the extent of riparian changes caused by winter 2005 flooding and by subsequent human activities to restore and/or protect infrastructure within or adjacent to the floodplain. This report summarizes the results of the post-flood evaluation.

# STUDY AREA

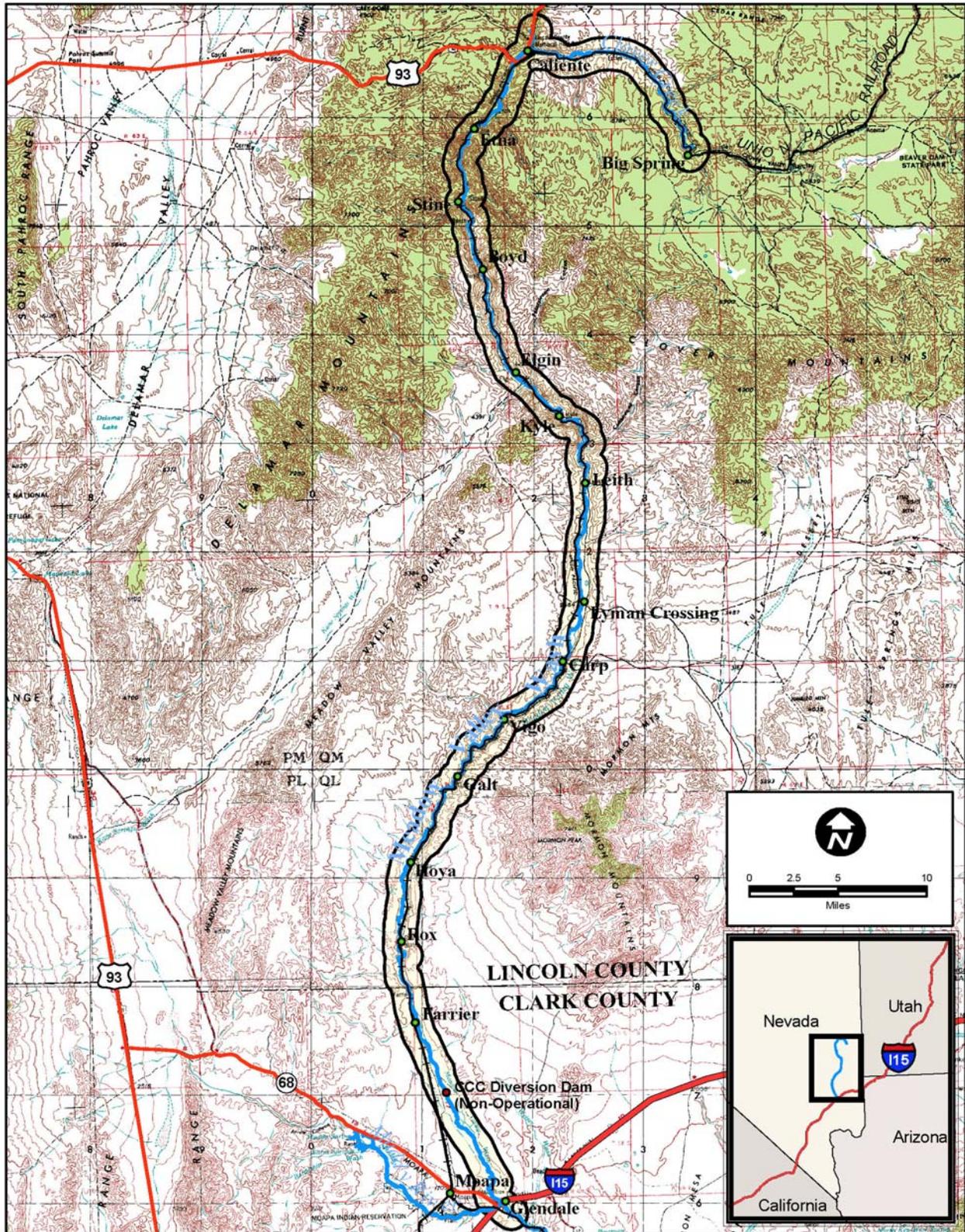
Meadow Valley Wash drains a substantial portion of southeast Nevada, extending about 110 miles in a general north-south direction from a northern origin in the Wilson Creek Range of eastern Lincoln County to a southern confluence with the Muddy River in Clark County. The drainage originates in the Great Basin physiographic region, but after approximately 30 miles it enters the Mojave Desert physiographic region and continues through the Mojave Desert to its confluence with the Muddy River. Provencher et al. (2003) identified the Meadow Valley Wash as ecologically significant because it is the only remaining corridor of bird migration between the Mojave Desert and Great Basin with a large amount of native riparian vegetation.

The Study Area (Figure 1) for the post-flood evaluation comprises approximately 85 miles of the lower-elevation portion of the Meadow Valley Wash main channel, which extends through the area covered by the Southeastern Lincoln County MSHCP and the Clark County MSHCP. Approximately 70 miles of the Study Area is within Lincoln County, and 15 miles is within Clark County. The Study Area includes the general floodplain of the Meadow Valley Wash from about 1 mile north of Caliente (T4S R67E NE 1/4 NW 1/4, Section 5) to the confluence of Meadow Valley Wash and Muddy River immediately east of Glendale, Nevada (T15S R66E NW 1/4 NE 1/4 Section 2). The elevation grades from 4,434 feet above sea level at the northern Study Area terminus to 1,520 feet above sea level at the confluence with the Muddy River at the southern terminus. The Study Area is primarily within the Mojave Desert, although the northern section through the Rainbow Canyon to Caliente is transitional to the Great Basin.

In addition to the area included in the baseline ecological assessment, the Study Area of the post-flood evaluation also includes the lower 14 miles of Clover Creek from its confluence with Meadow Valley Wash at Caliente upstream to approximately 1 mile northeast of Big Springs, Nevada (T5S R68E NW 1/4 NE 1/4 Section 11). Clover Creek is considered an important perennial tributary of Meadow Valley Wash (Provencher et al. 2003).

All of the water in Meadow Valley Wash comes from precipitation in the mountains. On average, the Meadow Valley Wash in the Mojave Desert portion receives 4-6 inches of rain annually, while the northern portion in the Great Basin receives 8-14 inches of rain annually (Provencher et al. 2003). Flash flooding has been frequently reported in the Meadow Valley Wash between Caliente and Rox, Nevada. Catastrophic flood events have also been reported, primarily during the first half of the 1900s (Averett 1995).

Railroad development in the Study Area began near the turn of the 20th Century. The rail line through the Meadow Valley Wash from Moapa, Nevada on the south to Caliente on the north became an integral section of the Union Pacific Railroad transcontinental system during the early 20th Century (Averett 1995). The Union Pacific Railroad continued east from Caliente through Clover Creek, one of the primary tributaries of Meadow Valley Wash, and continued north to Salt Lake City, Utah. The Union Pacific Railroad induced the development of towns in Nevada within the Meadow Valley Wash including Caliente, Elgin, Leith, and Carp (Averett 1995, Provencher et



**Figure 1. Meadow Valley Wash Post-flood Evaluation Study Area.**

al. 2003). The railroad has also had a substantial effect on the geomorphology, hydraulics, and subsequent vegetation communities within the Meadow Valley Wash by disconnecting the floodplain from the river and dredging operations (Provencher et al. 2003).

Within the Study Area, as with the Meadow Valley Wash in general, land ownership is predominantly public, primarily managed by the BLM. The overall Meadow Valley Wash is approximately 97 percent public lands with the remaining 3 percent privately owned, principally along Meadow Valley Wash (Provencher et al. 2003). Within the area between Caliente and Moapa, public land ownership is approximately 92 percent with the remaining 8 percent privately owned, again primarily along Meadow Valley Wash.

## **METHODS**

The methods employed in this study were based on those proposed in the contractor's contractual scope of work. These methods were developed to permit a valid comparison with the ecological baseline evaluation previously conducted by BIO-WEST (BIO-WEST 2005). In summary, the methods were developed (1) to permit identification of changes in vegetation within the general floodplain of the Study Area, (2) to describe the apparent cause of the change, and (3) to identify the type of vegetation changed and the value of the vegetation changed with regard to SWWFC. It is important to note that the identified changes were as of the date that new aerial imagery was acquired: on June 4, 2005, approximately 5 months after the flood event of January 11, 2005.

### **Aerial Imagery**

High-resolution, digital 3-band, multispectral imagery was acquired so that a width of approximately 3,300 feet at approximately 1.6 feet-pixel resolution would cover the entire Meadow Valley Wash floodplain. The imagery was acquired for the complete 85 miles of the Meadow Valley Wash Study Area, as well as the 14 miles of Clover Creek from approximately Big Springs to the confluence with Meadow Valley Wash. The imagery was acquired on June 4, 2005. Sky conditions were clear and cloudless, and images were captured on three narrow spectral bands centered in the green, red, and near-infrared portions of the electromagnetic spectrum. The imagery acquisition was conducted by EMARS of Logan, Utah, the same firm that conducted the imagery acquisition for the baseline ecological assessment of 2004. The methods of acquisition were the same as described for that assessment (BIO-WEST 2005). The individual 3-band images were then rectified through a polynomial method in Erdas Imagine 8.6 to the original rectified imagery from the baseline ecological assessment of 2004 (BIO-WEST 2005) using common control points visible in both sets of imagery. The rectified images were then color-balanced, mosaicked, and clipped to tiles for the reaches of Meadow Valley Wash and Clover Creek.

## **Vegetation Community Aggregation**

The original baseline ecological assessment classified the vegetation and land types (e.g., roads, railroads) within the floodplains of Meadow Valley Wash and Clover Creek (BIO-WEST 2005). This classification permitted the identification and segregation of vegetation communities at a minimum mapping area of 0.25-acre polygons for the Meadow Valley Wash floodplain. The areas of Meadow Valley Wash outside of the floodplain, but within the acquired imagery, were not classified nor delineated to minimum 0.25-acre mapping units during the original study. The baseline ecological evaluation was confined solely to the floodplain/riparian areas. Although an initial imagery classification was performed on the Clover Creek riparian corridor during the baseline ecological assessment, the scope of that assessment did not include a vegetation community delineation or riparian assessment of Clover Creek. As part of the post-flood evaluation, the unprocessed Clover Creek imagery classification from the original study was vectorized as to discrete vegetation communities using an aggregation technique. This technique aggregated the previously classified vegetation into discrete polygons based on the dominant vegetation type. The methods of aggregation are as described in the original baseline ecological assessment (BIO-WEST 2005). However, the aggregation into community types were not field verified or refined as in the original study. Without field refinement, the accuracy of vegetation community typing outside the boundaries evaluated in the original baseline ecological assessment (BIO-WEST 2005) cannot be certified. As such, the classification and aggregation for Clover Creek does provide an understanding of general vegetation community types changed by flood and post-flood events.

Because vegetation classification through reflective signatures was not conducted for boundary areas beyond the floodplains of Clover Creek and for outlying areas of Meadow Valley Wash, 172 acres of post-flood vegetation change in Meadow Valley Wash and 30 acres of post-flood vegetation change in Clover Creek did not have associated vegetation classifications. It was only possible to describe these areas as vegetated or not vegetated in pre-flood conditions. A subsequent field investigation would be needed in these outlying areas to delineate the vegetation type changed under post-flood conditions.

## **Vegetation Change Detection**

### **Aerial Imagery Interpretation**

The original multi-spectral imagery obtained in September 2003 as part of the original baseline ecological assessment was used as the basis for comparison with the new imagery obtained in June 2005. The September 2003 digital imagery was overlain with the new imagery acquired in June 2005 to determine where changes in vegetation occurred. Because the vegetation had been previously classified and segregated to vegetation communities, no interpretation of vegetation types was required. Changes were only delineated where vegetation was identified as missing; that is, bare ground and areas of substantially reduced vegetation density were denoted. The aerial interpretation was conducted by the same geographic information system (GIS) specialists who conducted the original ecological baseline evaluation (BIO-WEST 2005).

Bare ground and areas of substantially reduced vegetation density were identified and delineated at 1:4,800 (1" = 400'). This resultant polygon shape file showed changes from pre-flood to post-flood conditions by delineating areas that were vegetated in the pre-flood imagery and have been replaced by bare soil in the post-flood imagery. A more detailed manual change analysis was then conducted to increase the accuracy of the changed vegetation identification. A swipe analysis was conducted of the entire project area. The manual change analysis ensured all areas with vegetation change were accurately digitized as discrete polygons. In addition, the manual change analysis provided a preliminary determination as to the cause of change – natural flood processes or human alteration. The preliminary identification of human caused alteration was based on the geometrical pattern of the alteration or the identification of new anthropogenic structures (e.g., roads, diversion structures). Polygons with linear or rectilinear configurations were preliminarily described as human alterations. Changed vegetation polygons were preliminarily delineated as follows:

1. Naturally denuded. An area where natural flood processes eliminated pre-flood vegetation.
2. Naturally thinned. An area where natural flood processes substantially reduced the density of pre-flood vegetation.
3. Human Disturbance – Bladed. An area where human activities included substantial mechanical blading and/or grading that eliminated pre-flood vegetation.
4. Human Disturbance – Structure. An area where human activities created new diversion structures, berms, piers, or other structures to protect infrastructure or divert surface water. Such activities resulted in elimination or substantial thinning of pre-flood vegetation.
5. Human Disturbance – Borrow Site. An area where human activities included excavation, which resulted in the elimination of pre-flood vegetation.
6. Human Disturbance – Road. An area where new roads or extensive road widening resulted in the elimination of pre-flood vegetation.
7. New Vegetation Community. An area where human activities resulted in the creation of new vegetation.

## **Field Verification**

Between July 27 and July 31, 2005, an on-site field visit was conducted to review and verify the changed vegetation identified during the change analysis, which was prepared based on the aerial imagery. Prior to the field evaluation, an atlas of preliminary mapped changes in vegetation was overlain on a hard copy of the 2005 imagery at a scale of 1:6000 for field use.

The field investigator was the riparian specialist who conducted the riparian field assessments during the original baseline ecological assessment. The field verification was conducted using a helicopter flying at low elevations. Use of the helicopter permitted hovering and touch downs for detailed

evaluation. The entire Study Area was overflowed during field verification. Each polygon preliminarily identified as changed vegetation was investigated on site. The boundaries were verified and refined in the field, as warranted. In addition, the type of disturbance was verified or changed based on field observations. Additional information describing the disturbance was collected and mapped as appropriate. This included location and description of new structures, evidence of human activities (e.g., mechanical tracks), and areas of natural sediment deposition or scouring. In limited instances, the field investigation identified new areas of disturbance not identified through the imagery interpretation exercise. A total of 453 polygons were originally identified as post-flood changed vegetation.

Upon return from the field, all field revisions were digitized into the GIS database on-screen at 1:2,000, and a final GIS shape file of changed vegetation was compiled. All attributes related to the type of disturbance were changed, as appropriate, and the polygons were refined to 557 discrete areas of post-flood vegetation changes. Attributes for the changed vegetation polygons were refined and expanded to include the following:

1. Naturally denuded. An area where natural flood processes eliminated pre-flood vegetation.
2. Naturally thinned. An area where natural flood processes substantially reduced the density of pre-flood vegetation.
3. Human Disturbance – Bladed or Graded. An area where human activities involved substantial mechanical blading and/or grading that eliminated pre-flood vegetation.
4. Human Disturbance – Borrow Site. An area where soil and/or rock material was excavated resulting in the elimination of pre-flood vegetation.
5. Human Disturbance – Berm. An area where a new berm was created of soil and/or rock to protect infrastructure or contain surface water.
6. Human Disturbance – Bridge. A new bridge structure was emplaced, which, along with other mechanical disturbance adjacent to the bridge, resulted in elimination or substantial thinning of pre-flood vegetation.
7. Human Disturbance – Diversion. A new ditch was constructed to move surface water away from infrastructure.
8. Human Disturbance – Jetty. A new structure created of soil and/or rock material was constructed in association with existing infrastructure to deflect future floods.
9. Human Disturbance – New Channel. A section of the Meadow Valley Wash or Clover Creek channel was mechanically relocated away from human infrastructure to carry base flows.

10. Human Disturbance – New Fence. One new fence was installed that resulted in clearing a corridor through existing riparian vegetation.
11. Human Disturbance – New Road. A new road was bladed and graded through an area of pre-flood vegetation.
12. Human Disturbance – Widened Road. An area where extensive road widening resulted in the elimination of pre-flood vegetation.
13. Human Disturbance – Stream Crossing. An area where channel banks were leveled and the channel bottom stabilized to support equipment and vehicles crossing the stream.
14. New Marsh Community. An area of new marsh created through detention of surface water.

## **Vegetation Change Analysis**

The resultant GIS shape file of changes was used to evaluate the post-flood vegetation changes by intersecting the shape file of changes with the shape file of vegetation type communities and the SWWFC habitat delineated in the original baseline ecological assessment (BIO-WEST 2005). This intersection, performed in ArcGIS 9.1, resulted in a new shape file that depicted the areas of vegetation change, and contained full attributes of change type, vegetation community, and SWWFC habitat information. This shape file was queried to tabulate and sort the following information:

1. Total acres of each vegetation type changed.
2. Acres of each vegetation type denuded or thinned as a result of natural flood events.
3. Acres of each vegetation type where post-flood human activities currently have replaced the vegetation type.
4. Total acres of SWWFC Suitable Habitat changed.
5. Acres of SWWFC Suitable Habitat changed as a result of natural flood events.
6. Acres of SWWFC Suitable Habitat where post-flood human activities currently have replaced the suitable habitat.
7. Total acres of SWWFC Potential Habitat changed.
8. Acres of SWWFC Potential Habitat changed as a result of natural flood events.
9. Acres of SWWFC Potential Habitat where post-flood human activities currently have replaced the suitable habitat.

# RESULTS

## Post-flood Vegetation Type Changes

An evaluation of Meadow Valley Wash and Clover Creek was conducted to determine the extent of vegetation change that has occurred since the catastrophic flood of January 11, 2005. The evaluation was conducted by comparing pre-flood vegetation captured in September 2003 digital imagery and delineated through ground verification in July 2004 to vegetation from post-flood conditions captured in June 2005 digital imagery.

The Meadow Valley Wash portion of the Study included a distance of approximately 85 miles from 1 mile north of Caliente south to the confluence of Meadow Valley Wash and Muddy River. The Clover Creek portion of the Study included a distance of approximately 14 miles from Big Springs west to the confluence with Meadow Valley Wash at Caliente. Based on linear distance, Meadow Valley Wash accounted for approximately 86 percent of the Study Area and Clover Creek accounted for approximately 14 percent.

A total of approximately 2,498 acres of vegetation was delineated as changed from pre-flood conditions (Table 1). Approximately 2,095 acres (84% of total change) were delineated as changed in Meadow Valley Wash, and approximately 403 acres (16% of total change) were delineated as changed in Clover Creek (Table 1). The percent of change within each portion of the Study Area (84% Meadow Valley Wash; 16% Clover Creek) is consistent with the spatial proportions between Study Area portions (86% Meadow Valley Wash; 14% Clover Creek).

Natural flooding appears to have changed approximately 1,641 acres of vegetation in the entire Study Area through denudation and thinning of vegetation (Table 1). This is approximately 66 percent of the delineated change in vegetation. Human disturbance was delineated over approximately 857 acres of pre-flood vegetation (Table 1). This is approximately 34 percent of the delineated change. However, it must be remembered that the changes were identified in July 2005, approximately 6 months after the catastrophic flood event of January 11, 2005. It is possible that some of the areas delineated as disturbed by human activities may have been initially disturbed by natural flood events.

### Meadow Valley Wash

Table 2 presents a summary of the delineated post-flood vegetation disturbance described within Meadow Valley Wash. This table describes the type of disturbance identified in July 2005 and the pre-flood vegetation type affected. As can be interpreted from Table 2, most (68%) of the disturbance resulted from natural flood processes (approximately 1,434 acres).

**Table 1. Summary of Post-flood Vegetation Disturbance in Meadow Valley Wash and Clover Creek (July 2005).**

	NATURAL DENUDATION <sup>a</sup>	NATURAL THINNING <sup>b</sup>	HUMAN DISTURBANCE <sup>c</sup>	TOTAL DISTURBANCE
	Acres	Acres	Acres	Acres
<b>RIPARIAN VEGETATION TYPES</b>				
Meadow Valley Wash	545.14	287.87	133.80	966.81
Clover Creek	128.25	2.40	117.50	248.15
<b>Subtotals</b>	<b>673.39</b>	<b>290.27</b>	<b>251.30</b>	<b>1214.96</b>
<b>UPLAND VEGETATION TYPES</b>				
Meadow Valley Wash	531.60	69.58	527.05	1128.23
Clover Creek	75.20	1.16	78.34	154.70
<b>Subtotals</b>	<b>606.80</b>	<b>70.74</b>	<b>605.39</b>	<b>1282.93</b>
<b>SUMMARY</b>				
Meadow Valley Wash	1076.74	357.45	660.85	2095.04
Clover Creek	203.45	3.56	195.84	402.85
<b>TOTALS</b>	<b>1280.19</b>	<b>361.01</b>	<b>856.69</b>	<b>2497.89</b>

<sup>a</sup> Natural Denudation describes areas where natural flood events appear to have eliminated all or most of the vegetation identified in the October 2003 Aerial Imagery.

<sup>b</sup> Natural Thinning describes areas where natural flood events appear to have substantially reduced the density of the vegetation identified in the October 2003 Aerial Imagery.

<sup>c</sup> Human Disturbance describes areas where mechanical processes or new structures appear to have eliminated all or most of the vegetation identified in the October 2003 Aerial Imagery.

**Table 2. Meadow Valley Wash Summary of Post-flood Disturbance (July 2005).**

VEGETATION TYPE / LAND USE	NATURAL DENUDATION <sup>a</sup>	NATURAL THINNING <sup>b</sup>	HUMAN DISTURBANCE <sup>c</sup>	TOTAL DISTURBANCE
	Acres	Acres	Acres	Acres
<b>RIPARIAN VEGETATION TYPES</b>				
Alluvium	281.38	3.49	31.45	316.32
Arrowweed Shrubland	40.42	6.39	2.35	49.16
Burnt or Dead Tamarisk	10.83	28.76	4.75	44.34
Bush Seepweed Shrubland	8.90	0.92	9.78	19.60
Cattail Marsh	18.17	1.15	2.48	21.80
Coyote Willow Shrubland	3.78	0.00	0.38	4.16
Desert Willow Shrubland	11.78	1.56	3.60	16.94
Fremont Cottonwood Forest	28.09	26.45	17.35	71.89
Mixed Marsh	0.00	0.00	0.62	0.62
Mixed Wet Meadow	2.54	0.21	0.02	2.77
Open Water	1.10	0.00	0.97	2.07
Red Willow Forest	4.38	11.19	0.02	15.59

**Table 2. Meadow Valley Wash Summary of Post-flood Disturbance (July 2005) (cont.).**

VEGETATION TYPE / LAND USE	NATURAL DENUDATION <sup>a</sup>	NATURAL THINNING <sup>b</sup>	HUMAN DISTURBANCE <sup>c</sup>	TOTAL DISTURBANCE
	Acres	Acres	Acres	Acres
Red Willow Shrubland	2.52	0.21	0.05	2.78
Riparian Forest	51.19	77.25	15.13	143.57
Riparian Forest Tamarisk Woodland Mix	15.14	15.95	19.13	50.22
Saltgrass Grassland	0.17	0.94	0.00	1.11
Seepwillow Shrubland	8.35	2.39	2.79	13.53
Tamarisk Woodland	56.40	111.01	22.93	190.34
<b>Subtotals</b>	<b>545.14</b>	<b>287.87</b>	<b>133.80</b>	<b>966.81</b>
<b>UPLAND VEGETATION TYPES</b>				
Creosote Bush Shrubland	34.92	14.71	25.14	74.77
Exposed Soil	0.43	0.00	0.00	0.43
Gambel Oak Shrubland	0.73	0.00	0.00	0.73
Greasewood Shrubland	2.62	0.06	0.05	2.73
Mesquite Shrubland	0.00	0.47	0.74	1.21
Mixed Canyon Shrubland	68.07	6.72	38.52	113.31
Mixed Desert Shrubland	171.44	10.78	175.47	357.69
Mixed Grassland	5.95	0.63	7.70	14.28
Pasture/Agricultural Lands	47.72	1.07	1.91	50.70
Quailbush Shrubland	0.03	0.02	4.73	4.78
Quarry	1.27	0.12	0.19	1.58
Rabbitbrush Shrubland	21.19	2.86	11.83	35.88
Railroad/Road	4.89	0.84	22.57	28.30
Sagebrush Shrubland	3.23	0.31	0.44	3.98
Shadscale Shrubland	7.82	2.06	17.92	27.80
Sparsely Vegetated/ Disturbed Lands	124.15	20.40	88.33	232.88
Upland Forest	0.00	5.32	0.00	5.32
<b>Subtotals</b>	<b>494.46</b>	<b>66.37</b>	<b>395.54</b>	<b>956.37</b>
<b>UNDELINEATED VEGETATION TYPES<sup>d</sup></b>				
Unknown Upland Vegetation	37.14	3.21	131.51	171.86
<b>TOTALS</b>	<b>1076.74</b>	<b>357.45</b>	<b>660.85</b>	<b>2095.04</b>

<sup>a</sup> Natural Denudation describes areas where natural flood events appear to have eliminated all or most of the vegetation identified in the October 2003 Aerial Imagery.

<sup>b</sup> Natural Thinning describes areas where natural flood events appear to have substantially reduced the density of the vegetation identified in the October 2003 Aerial Imagery.

<sup>c</sup> Human Disturbance describes areas where mechanical processes or new structures appear to have eliminated all or most of the vegetation identified in the October 2003 Aerial Imagery.

<sup>d</sup> Undelineated Vegetation Types describes areas of vegetation that were beyond the boundaries of the vegetation classification conducted during the original Meadow Valley Wash Ecological Assessment of 2004 (BIO-WEST 2005). The vegetation was captured in both the original imagery of October 2003 and the subsequent imagery of June 2005. Since no original classification was done in these areas, no specific vegetation typing was possible other than to note all types occur in uplands.

Table 3 delineates the amount of each vegetation type disturbed within Meadow Valley Wash in comparison to the amount of each vegetation type delineated prior to the catastrophic flooding of January 2005. As a result of the catastrophic flood event of January 2005, approximately 19 percent of the pre-flood vegetation has been substantially affected. The riparian communities were most affected with substantial disturbance or loss to approximately 39 percent of the pre-flood vegetation (Table 3). Overall, natural disturbance accounted for approximately 14 percent loss of pre-flood vegetation and human disturbance occurred on approximately 5 percent of what was pre-flood vegetation (Table 3). Human disturbance occurred on approximately 5 percent of both riparian and upland pre-flood vegetation; while natural flood processes affected 34 percent of the pre-flood vegetation in the riparian communities and only 7 percent in the upland communities.

Total acres of seven different vegetation types were reduced by more than 50 percent over pre-flood conditions in Meadow Valley Wash, either by natural flood processes or human disturbance (Table 3). These included Alluvium (316 acres; 60%), Cattail Marsh (22 acres; 61%), Coyote Willow Shrubland (4 acres; 84%), Riparian Forest (144 acres; 70%), Seepwillow Shrubland (14 acres; 81%), Quailbush Shrubland (5 acres; 55%), and Upland Forest (5 acres; 86%). Each of these vegetation types, other than Alluvium and Riparian Forest, are rare within the Meadow Valley Wash and are distinctive dominant communities.

### ***Natural Flooding Changes***

Of the approximate 2,095 acres of vegetation change within the Meadow Valley Wash, approximately 1,434 acres (68% of delineated change in Meadow Valley Wash) were described as resulting from natural flood disturbance. This includes approximately 1,077 acres that were denuded of vegetation and approximately 357 acres that were substantially reduced in vegetation density (Table 1 and Table 2). Although most of the natural flood disturbance resulted in a complete denudation of the pre-flood vegetation (1,075 acres), a substantial proportion (25 percent) of the disturbance maintained the pre-flood vegetation type, but significantly reduced the vegetation density (357 acres) (Table 2).

### **Riparian Vegetation Types**

Approximately 58 percent (833 acres) of the vegetation affected by natural flood processes occurred within riparian vegetation types (Table 2). Approximately 545 acres of the riparian vegetation types were denuded of vegetation, or approximately 65 percent of the riparian vegetation delineated as changed by natural flood processes (Table 2). The remaining 35 percent (288 acres) of riparian vegetation affected by natural flood processes were substantially reduced in vegetative density.

Prior to the flood event of January 2005, approximately 2,452 acres of riparian/wetland vegetation types occurred in Meadow Valley Wash (Table 3). Natural flood processes (denudation and thinning) disturbed approximately 34 percent of this pre-flood riparian vegetation (Table 3).

**Table 3. Comparison of Post-flood Vegetation – Total Disturbance (July 2005) with Pre-flood Conditions (July 2004) in Meadow Valley Wash.**

VEGETATION TYPE / LAND USE	PRE-FLOOD ACRES <sup>a</sup>	NATURAL DISTURBANCE <sup>b</sup>		HUMAN DISTURBANCE <sup>c</sup>		TOTAL DISTURBANCE	
	Acres	Acres Disturbed	Percent Disturbed	Acres Disturbed	Percent Disturbed	Acres Disturbed	Percent Disturbed
<b>RIPARIAN VEGETATION TYPES</b>							
Alluvium	528.43	284.87	53.9%	31.45	6.0%	316.32	59.9%
Arrowweed Shrubland	117.32	46.81	39.9%	2.35	2.0%	49.16	41.9%
Burnt or Dead Tamarisk	251.44	39.59	15.7%	4.75	1.9%	44.34	17.6%
Bush Seepweed Shrubland	45.13	9.82	21.8%	9.78	21.6%	19.60	43.4%
Cattail Marsh	35.49	19.32	54.4%	2.48	7.0%	21.80	61.4%
Coyote Willow Shrubland	4.96	3.78	76.2%	0.38	7.7%	4.16	83.9%
Desert Willow Shrubland	65.71	13.34	20.3%	3.60	5.5%	16.94	25.8%
Fremont Cottonwood Forest	182.29	54.54	29.9%	17.35	9.5%	71.89	39.4%
Mixed Marsh	5.79	0.00	0.0%	0.62	10.7%	0.62	10.7%
Mixed Wet Meadow	119.95	2.75	2.3%	0.02	>0.1%	2.77	2.3%
Open Water	9.86	1.10	11.2%	0.97	9.8%	2.07	21.0%
Red Willow Forest	52.74	15.57	29.5%	0.02	>0.1%	15.59	29.6%
Red Willow Shrubland	7.51	2.73	36.4%	0.05	0.7%	2.78	37.1%
Riparian Forest	204.94	128.44	62.7%	15.13	7.4%	143.57	70.1%
Riparian Forest Tamarisk Woodland Mix	144.05	31.09	21.6%	19.13	13.3%	50.22	34.9%
Saltgrass Grassland	2.43	1.11	45.7%	0.00	0.0%	1.11	45.7%
Seepwillow Shrubland	16.75	10.74	64.1%	2.79	16.7%	13.53	80.8%
Tamarisk Woodland	651.34	167.41	25.7%	22.93	3.5%	190.34	29.2%
<b>Subtotals</b>	<b>2452.14</b>	<b>833.01</b>	<b>34.0%</b>	<b>133.80</b>	<b>5.4%</b>	<b>966.81</b>	<b>39.4%</b>
<b>UPLAND VEGETATION TYPES</b>							
Creosote Bush Shrubland	591.78	49.63	8.4%	25.14	4.2%	74.77	12.6%
Exposed Soil	230.13	0.43	0.2%	0.00	0.0%	0.43	0.2%
Gambel Oak Shrubland	9.33	0.73	7.8%	0.00	0.0%	0.73	7.8%
Greasewood Shrubland	263.44	2.68	1.0%	0.05	>0.1%	2.73	1.0%
Mesquite Shrubland	23.31	0.47	2.0%	0.74	3.2%	1.21	5.2%
Mixed Canyon Shrubland	618.52	74.79	12.1%	38.52	6.2%	113.31	18.3%
Mixed Desert Shrubland	2275.19	182.22	8.0%	175.47	7.7%	357.69	15.7%
Mixed Grassland	211.43	6.58	3.1%	7.70	3.6%	14.28	6.8%

**Table 3. Comparison of Post-flood Vegetation – Total Disturbance (July 2005) with Pre-flood Conditions (July 2004) in Meadow Valley Wash (cont.).**

VEGETATION TYPE / LAND USE	PRE-FLOOD ACRES <sup>a</sup>	NATURAL DISTURBANCE <sup>b</sup>		HUMAN DISTURBANCE <sup>c</sup>		TOTAL DISTURBANCE	
	Acres	Acres Disturbed	Percent Disturbed	Acres Disturbed	Percent Disturbed	Acres Disturbed	Percent Disturbed
Pasture/Agricultural Lands	989.07	48.79	4.9%	1.91	0.2%	50.70	5.1%
Quailbush Shrubland	8.66	0.05	0.6%	4.73	54.6%	4.78	55.2%
Quarry	235.42	1.39	0.6%	0.19	0.1%	1.58	0.7%
Rabbitbrush Shrubland	350.36	24.05	6.9%	11.83	3.4%	35.88	10.2%
Railroad/Road	241.33	5.73	2.3%	22.57	9.4%	28.30	11.7%
Sagebrush Shrubland	87.37	3.54	4.1%	0.44	0.5%	3.98	4.6%
Shadscale Shrubland	590.74	9.88	1.7%	17.92	3.0%	27.80	4.7%
Sparsely Vegetated/ Disturbed Lands	1104.91	144.55	13.1%	88.33	8.0%	232.88	21.1%
Upland Forest	6.19	5.32	85.9%	0.00	0.0%	5.32	85.9%
<b>Subtotals</b>	<b>7837.18</b>	<b>560.83</b>	<b>7.2%</b>	<b>395.54</b>	<b>5.0%</b>	<b>956.37</b>	<b>12.2%</b>
<b>TOTALS</b>	<b>10289.32</b>	<b>1393.84</b>	<b>13.5%</b>	<b>529.34</b>	<b>5.1%</b>	<b>1923.18</b>	<b>18.7%</b>

<sup>a</sup> Pre-flood Acres were the total acres of a vegetation type/land use delineated based on the October 2003 Aerial Imagery and field verified in July 2004 (BIO-WEST 2005).

<sup>b</sup> Natural Disturbance includes areas denuded or substantially thinned. These are areas where natural flood events have appeared to have eliminated vegetation or substantially reduced the density of the vegetation identified in the October 2003 Aerial Imagery.

<sup>c</sup> Human Disturbance are areas where mechanical processes or new structures appeared to eliminate all or most of the vegetation identified in the October 2003 Aerial Imagery.

A substantial amount (approximately 34%; 285 acres) of the natural disturbance in the riparian communities occurred in the Alluvium vegetation type (Table 2), a type that was sparsely vegetated in pre-flood conditions. Natural flood processes disturbed, primarily through denudation, approximately 54 percent of the pre-flood Alluvium vegetation type (Table 3).

Approximately 20 percent (167 acres) of the natural disturbance in the riparian communities occurred in the Tamarisk Woodland vegetation type, most of which (66%) resulted in a substantial decrease in vegetative density as opposed to total vegetation denudation (Table 2). The natural flood processes disturbed approximately 26 percent of the pre-flood Tamarisk Woodland vegetation type (Table 3).

Within the native riparian vegetation types, most of the natural flood disturbances occurred in the Riparian Forest (15 %) and Fremont Cottonwood Forest (6 %) vegetation types (Table 2). The natural flood processes disturbed approximately 15 percent of the pre-flood Riparian Forest and 30 percent of the pre-flood Fremont Cottonwood Forest (Table 3). Natural thinning of vegetation density in the understories of these two vegetation types accounted for 60 percent (77 acres) and 48 percent (26 acres), respectively, of the natural flood disturbance in these two vegetation types (Table 2).

Natural flood processes disturbed a substantial amount of other pre-flood riparian/wetland vegetation communities as depicted in Table 3. Of particular note is the disturbance of approximately 76 percent of the pre-flood Coyote Willow vegetation type, 64 percent of the pre-flood Seepwillow Shrubland, and 36 percent of the Red Willow Shrubland – all woody vegetation types in limited distribution within the Meadow Valley Wash.

### **Upland Vegetation Types**

Approximately 42 percent (601 acres) of the vegetation affected by natural flood processes occurred within upland vegetation types (Table 2). Much of this disturbance occurred within the general flood plain of Meadow Valley Wash, as delineated in the original Meadow Valley Wash Ecological Baseline Assessment (BIO-WEST 2005). Although approximately 40 acres were affected beyond the boundaries originally classified (Table 2). Approximately 532 acres of the upland vegetation types were denuded of vegetation, or approximately 88 percent of the upland vegetation delineated as changed by natural flood processes (Table 2). The remaining 12 percent (70 acres) of upland vegetation affected by natural flood processes were substantially reduced in vegetative density.

Prior to the flood event of January 2005, approximately 7,837 acres of upland vegetation types occurred in Meadow Valley Wash (Table 3). Natural flood processes (denudation and thinning) disturbed approximately 7 percent of this pre-flood upland vegetation, which is substantially less than the 34 percent of pre-flood riparian vegetation disturbed by natural flood processes (Table 3).

A large amount (approximately 30%; 182 acres) of the natural disturbance in upland communities occurred in the Mixed Desert Shrubland vegetation type (Table 2). Natural flood processes disturbed, primarily through denudation, approximately 8 percent of the pre-flood Mixed Desert Shrubland vegetation type (Table 3).

Other upland vegetation types of possible importance to species covered under the Lincoln County and Clark County MSHCPs were also disturbed by natural flood processes, although not in extensive amounts or as a large proportion of pre-flood vegetation availability. Most of the disturbance occurred in Creosote Bush Shrubland, Mixed Canyon Shrubland, Rabbitbrush Shrubland, and Shadscale Shrubland. A total of approximately 341 acres of these upland vegetation types were disturbed by natural flood processes, which is approximately 8 percent of the pre-flood vegetation within these combined vegetation types.

Approximately 8 percent (50 acres) of the natural flood disturbance in upland communities occurred in Creosote Bush Shrubland (Table 2). This disturbed approximately 8 percent of the pre-flood Creosote Bush Shrublands (Table 3).

Approximately 12 percent (75 acres) of the natural flood disturbance in upland communities occurred in Mixed Canyon Shrubland (Table 2), and disturbed approximately 12 percent of the pre-flood Mixed Canyon Shrublands (Table 3).

Approximately 4 percent (24 acres) of the natural flood disturbance in upland communities occurred in Rabbitbrush Shrubland (Table 2), and disturbed approximately 7 percent of the pre-flood Rabbitbrush Shrublands (Table 3).

Approximately 2 percent (10 acres) of the natural flood disturbance in upland communities occurred in Shadscale Shrubland (Table 2), and disturbed approximately 2 percent of the pre-flood Shadscale Shrublands (Table 3).

Approximately 33 percent (201 acres) of the total natural disturbance in upland communities were delineated in the Sparsely Vegetated/Disturbed Lands vegetation type, Pasture/Agricultural Lands, Quarry, or Railroad/Road right of ways (Table 2).

### ***Human Disturbances***

Of the approximate 2,095 acres of vegetation change within the Meadow Valley Wash, human disturbance occurred on approximately 661 acres (32% of delineated change in Meadow Valley Wash) (Table 1 and Table 2). Where human disturbance was delineated, all vegetation was eliminated.

### **Riparian Vegetation Types**

Approximately 20 percent (134 acres) of the total human disturbance occurred within riparian vegetation types (Table 2), and approximately 5 percent of the pre-flood vegetation was eliminated on lands where human disturbance was noted (Table 3). This is in comparison with the approximate 34 percent of pre-flood riparian vegetation disturbed by natural processes.

Human disturbance did not exceed 32 acres of any one vegetation type within the riparian communities. The most human disturbance (approximately 31 acres) was delineated on Alluvium vegetation type (Table 2). Human disturbance was identified on 23 acres of Tamarisk Woodland and 19 acres Riparian Forest Tamarisk Woodland Mix (Table 2), resulting in the loss of 4 percent and 13 percent, respectively, of these pre-flood vegetation types (Table 3). The elimination of the 42 acres of invasive vegetation types provides an opportunity for reestablishment of native vegetation types.

Of the native riparian vegetation types, most of the human disturbance occurred in the Riparian Forest (15 acres) and Fremont Cottonwood Forest (17 acres) (Table 2), which is approximately 2 percent of the pre-flood acreage of each of these two vegetation types (Table 3).

Human disturbance also occurred on riparian/wetland vegetation types with limited distribution in Meadow Valley Wash. Where these disturbances were identified, substantial portions of pre-flood vegetation has been eliminated. These include approximately 22 percent of the pre-flood Bush Seepweed Shrubland, 17 percent of the Seepwillow Shrubland, and 11 percent of the pre-flood Mixed Marsh (Table 3). However, since no records are available immediately after the catastrophic flood, some of these areas could have been initially affected by natural flood processes.

## **Upland Vegetation Types**

Approximately 80 percent (527 acres) of the vegetation on which human disturbance was delineated occurred within upland vegetation types (Table 2). Much of this disturbance occurred within the general flood plain of Meadow Valley Wash, as delineated in the original Meadow Valley Wash Ecological Baseline Assessment (BIO-WEST 2005); although approximately 132 acres were affected beyond the boundaries originally classified, which is substantially more than the 40 acres of natural flood disturbance (Table 2).

Prior to the flood event of January 2005, approximately 7,837 acres of upland vegetation types occurred in Meadow Valley Wash (Table 3). Human disturbance was delineated on approximately 5 percent of this pre-flood upland vegetation (Table 3).

As with natural flood disturbance, a substantial amount (approximately 33%; 175 acres) of the human disturbance delineated in upland communities occurred in the Mixed Desert Shrubland vegetation type (Table 2). Where this human disturbance was identified, approximately 8 percent of the pre-flood Mixed Desert Shrubland vegetation type has been eliminated (Table 3). This is very similar to the resultant loss of Mixed Desert Shrubland vegetation type through natural processes.

Human disturbance was identified on other upland vegetation types of possible importance to species covered under the Lincoln County and Clark County MSHCPs, although not in extensive amounts or as a large proportion of pre-flood vegetation availability. Most of the disturbance occurred in Creosote Bush Shrubland, Mixed Canyon Shrubland, Rabbitbrush Shrubland, and Shadscale Shrubland. A total of approximately 269 acres of human disturbance was identified on these combined upland vegetation types, which is approximately 6 percent of the pre-flood vegetation within these combined vegetation types.

Approximately 5 percent (25 acres) of human disturbance in upland communities occurred in Creosote Bush Shrubland (Table 2). This is approximately 4 percent of the pre-flood Creosote Bush Shrublands (Table 3).

Approximately 7 percent (38 acres) of human disturbance identified in upland communities occurred in Mixed Canyon Shrubland (Table 2), and disturbed approximately 6 percent of the pre-flood Mixed Canyon Shrublands (Table 3).

Approximately 2 percent (12 acres) of human disturbance identified in upland communities occurred in Rabbitbrush Shrubland (Table 2), and disturbed approximately 3 percent of the pre-flood Rabbitbrush Shrublands (Table 3).

Approximately 3 percent (18 acres) of human disturbance identified in upland communities occurred in Shadscale Shrubland (Table 2), and disturbed approximately 3 percent of the pre-flood Shadscale Shrublands (Table 3).

As with natural flood processes, a substantial amount of human disturbance occurred in vegetation types that were previously disturbed. Approximately 21 percent (113 acres) of the human

disturbance delineated occurred in the Sparsely Vegetated/Disturbed Lands vegetation type, Pasture/Agricultural Lands, Quarry, or Railroad/Road right of ways (Table 2 and Table 3).

### **Types of Human Disturbance**

During the site verification, each area with visible human disturbance was described as to the primary type of human disturbance that occurred. Twelve separate types of human disturbance were identified in the field. Table 4 delineates the acres of each type of human disturbance within each vegetation type in Meadow Valley Wash. Mechanical blading and grading occurred over approximately 571 acres. This is approximately 86 percent of the human disturbance in Meadow Valley Wash. The largest extent (154 acres) of the mechanical blading and grading occurred in Mixed Desert Shrubland (Table 4). New road construction was the next most prevalent type of human disturbance (approximately 6%), occurring over approximately 41 acres of previously vegetated land. Widened roads disturbed an additional 15 acres of pre-flood vegetation. New borrow pits occurred on approximately 12 acres of pre-flood vegetation. New stream channels and deflection jetties each occurred on approximately 9 acres of pre-flood vegetation (Table 4). Other noteworthy types of human disturbance include new stream crossings (approximately 2 acres) and new diversion channels (approximately 1 acre) (Table 4).

### **Clover Creek**

Table 5 presents a summary of the delineated post-flood vegetation disturbance described within Clover Creek from Big Springs downstream to the confluence with Meadow Valley Wash. This table describes the type of disturbance identified in July 2005 and the pre-flood vegetation type affected. As can be interpreted from Table 2, current disturbance of pre-flood vegetation appears to be almost equally distributed between natural flood processes (207 acres) and human disturbance (196 acres).

Table 6 delineates the amount of each vegetation type disturbed within Clover Creek in comparison to the amount of each vegetation type delineated prior to the catastrophic flooding of January 2005. As a result of the catastrophic flood event of January 2005, approximately 27 percent of the pre-flood vegetation has been substantially affected, compared with the approximately 19 percent of the pre-flood vegetation substantially affected in Meadow Valley Wash. The riparian communities were most affected with substantial disturbance or loss to approximately 38 percent of the pre-flood vegetation (Table 6), which is similar to the 39 percent of pre-flood riparian vegetation affected in Meadow Valley Wash.

Overall, natural disturbance accounted for approximately 14 percent loss of pre-flood vegetation (Table 6), the same proportion identified in Meadow Valley Wash (Table 3). Human disturbance occurred on approximately 12 percent of what was pre-flood vegetation (Table 6), which is substantially more than the 5 percent of pre-flood vegetation affected by human disturbance in Meadow Valley Wash (Table 3). Both natural flood processes and human activities affected a larger proportion of riparian community types than upland community types in Clover Creek (Table 6).

**Table 4. Types and Acres of Human Disturbance in Meadow Valley Wash Delineated in July 2005.**

VEGETATION TYPE / LAND USE	TYPES OF DISTURBANCE											
	New Berm	Bladed /Graded	New Borrow Pit	New Bridge	New Diversion	New Jetty	New Channel	New Fence	New Road	New Stream Crossing	Widened Road	Total Human Disturbance
<b>RIPARIAN VEGETATION DISTURBANCE</b>												
	Acres											
Alluvium	-	29.49	-	0.03	0.27	1.37	0.22	-	0.07	-	-	31.45
Arrowweed Shrubland	-	2.34	-	-	-	0.01	-	-	-	-	-	2.35
Burnt or Dead Tamarisk	-	4.15	-	-	-	-	-	0.11	0.07	0.06	0.36	4.75
Bush Seepweed Shrubland	-	9.18	-	-	-	0.36	-	-	0.24	-	-	9.78
Cattail Marsh	-	2.48	-	-	-	-	-	-	-	-	-	2.48
Coyote Willow Shrubland	-	0.38	-	-	-	-	-	-	-	-	-	0.38
Desert Willow Shrubland	-	3.11	0.47	0.02	-	-	-	-	-	-	-	3.60
Fremont Cottonwood Forest	0.16	17.09	-	0.01	-	-	-	-	-	0.09	-	17.35
Mixed Marsh	-	0.62	-	-	-	-	-	-	-	-	-	0.62
Mixed Wet Meadow	-	-	-	0.02	-	-	-	-	-	-	-	0.02
Open Water	-	0.97	-	-	-	-	-	-	-	-	-	0.97
Red Willow Forest	-	-	-	0.02	-	-	-	-	-	-	-	0.02
Red Willow Shrubland	0.05	-	-	-	-	-	-	-	-	-	-	0.05
Riparian Forest	-	14.47	-	0.03	0.03	-	-	-	-	0.60	>0.01	15.13
Riparian Forest Tamarisk Woodland Mix	-	18.14	-	-	-	0.36	-	-	0.63	-	-	19.13
Saltgrass Grassland	-	>0.01	-	-	-	-	-	-	-	-	-	>0.01
Seepwillow Shrubland	-	2.79	-	-	-	-	-	-	-	-	-	2.79
Tamarisk Woodland	-	15.98	-	-	>0.01	0.12	1.07	-	4.01	0.02	1.73	22.93
<b>Subtotals</b>	<b>0.21</b>	<b>121.19</b>	<b>0.47</b>	<b>0.13</b>	<b>0.30</b>	<b>2.22</b>	<b>1.29</b>	<b>0.11</b>	<b>5.02</b>	<b>0.77</b>	<b>2.09</b>	<b>133.80</b>

**Table 4. Types and Acres of Human Disturbance in Meadow Valley Wash Delineated in July 2005.**

VEGETATION TYPE / LAND USE	TYPES OF DISTURBANCE											
	New Berm	Bladed /Graded	New Borrow Pit	New Bridge	New Diversion	New Jetty	New Channel	New Fence	New Road	New Stream Crossing	Widened Road	Total Human Disturbance
<b>UPLAND VEGETATION TYPES</b>												
Creosote Bush Shrubland	-	16.67	-	-	0.06	-	1.01	-	6.88	0.36	0.16	25.14
Exposed Soil	-	-	-	-	-	-	-	-	-	-	-	0.00
Gambel Oak Shrubland	-	-	-	-	-	-	-	-	-	-	-	0.00
Greasewood Shrubland	0.05	-	-	-	-	-	-	-	-	-	-	0.05
Mesquite Shrubland	-	0.74	-	-	-	-	-	-	-	-	-	0.74
Mixed Canyon Shrubland	-	35.50	0.06	0.03	0.10	1.22	-	-	-	0.38	1.23	38.52
Mixed Desert Shrubland	-	153.90	-	0.02	0.74	4.00	5.93	-	9.08	-	1.80	175.47
Mixed Grassland	-	7.46	-	-	-	0.15	-	-	-	0.09	-	7.70
Pasture/Agricultural Lands	-	1.23	-	-	-	-	-	0.11	0.57	-	-	1.91
Quailbush Shrubland	-	4.35	-	-	-	0.10	-	-	-	-	0.28	4.73
Quarry	-	-	-	-	0.09	-	0.10	-	-	-	-	0.19
Rabbitbrush Shrubland	-	11.48	>0.01	-	-	-	-	-	0.24	0.11	-	11.83
Railroad/Road	-	20.02	0.06	0.31	-	0.16	0.54	-	1.07	0.03	0.38	22.57
Sagebrush Shrubland	-	0.33	0.08	-	-	-	-	-	-	0.03	-	0.44
Shadscale Shrubland	-	16.52	-	-	-	0.06	-	-	0.62	-	0.72	17.92
Sparsely Vegetated/ Disturbed Lands	-	76.36	3.94	>0.01	-	0.79	0.05	0.12	6.36	0.10	0.61	88.33
Upland Forest	-	-	-	-	-	-	-	-	-	-	-	0.00
<b>Subtotals</b>	<b>0.05</b>	<b>344.56</b>	<b>4.14</b>	<b>0.36</b>	<b>0.99</b>	<b>6.48</b>	<b>7.63</b>	<b>0.23</b>	<b>24.82</b>	<b>1.10</b>	<b>5.18</b>	<b>395.54</b>
<b>UNDELINEATED VEGETATION TYPES</b>												
Unknown Upland Vegetation	0.46	104.72	7.16	-	-	0.09	0.02	-	11.08	0.02	7.96	131.51
<b>TOTALS</b>	<b>0.72</b>	<b>570.47</b>	<b>11.77</b>	<b>0.49</b>	<b>1.29</b>	<b>8.79</b>	<b>8.94</b>	<b>0.34</b>	<b>40.92</b>	<b>1.89</b>	<b>15.23</b>	<b>660.85</b>

**Table 5. Clover Creek Summary of Post-flood Disturbance (July 2005).**

VEGETATION TYPE / LAND USE	NATURAL DENUDATION <sup>a</sup>	NATURAL THINNING <sup>b</sup>	HUMAN DISTURBANCE <sup>c</sup>	TOTAL DISTURBANCE
	Acres	Acres	Acres	Acres
<b>RIPARIAN VEGETATION TYPES</b>				
Alluvium	88.61	0.05	104.57	193.23
Cattail Marsh	1.56	0.00	0.00	1.56
Coyote Willow Shrubland	2.48	0.00	1.29	3.77
Fremont Cottonwood Forest	19.36	0.00	3.82	23.18
Mixed Wet Meadow	7.01	0.00	0.05	7.06
Open Water	3.18	0.00	0.00	3.18
Red Willow Forest	5.55	2.35	7.77	15.67
Water Cress/Duck Weed Marsh	0.50	0.00	0.00	0.50
<b>Subtotals</b>	<b>128.25</b>	<b>2.40</b>	<b>117.50</b>	<b>248.15</b>
<b>UPLAND VEGETATION TYPES</b>				
Mixed Grassland	0.29	0.00	0.00	0.29
Rabbitbrush Shrubland	2.26	0.47	1.73	4.46
Railroad/Road	0.28	0.07	6.09	6.44
Sagebrush Shrubland	22.22	0.55	25.85	48.62
Sparsely Vegetated/ Disturbed Lands	45.60	0.07	19.22	64.89
<b>Subtotals</b>	<b>70.65</b>	<b>1.16</b>	<b>52.89</b>	<b>124.70</b>
<b>UNDELINEATED VEGETATION TYPES<sup>d</sup></b>				
Unknown Upland Vegetation	4.55	0.00	25.45	30.00
<b>TOTALS</b>	<b>203.45</b>	<b>3.56</b>	<b>195.84</b>	<b>402.85</b>

<sup>a</sup> Natural Denudation describes areas where natural flood events appear to have eliminated all or most of the vegetation identified in the October 2003 Aerial Imagery.

<sup>b</sup> Natural Thinning describes areas where natural flood events appear to have substantially reduced the density of the vegetation identified in the October 2003 Aerial Imagery.

<sup>c</sup> Human Disturbance describes areas where mechanical processes or new structures appear to have eliminated all or most of the vegetation identified in the October 2003 Aerial Imagery.

<sup>d</sup> Undelineated Vegetation Types describes areas of vegetation that were beyond the boundaries of the vegetation classification conducted during the original Meadow Valley Wash Ecological Assessment of 2004 (BIO-WEST 2005). The vegetation was captured in both the original imagery of October 2003 and the subsequent imagery of June 2005. Since no original classification was done in these areas, no specific vegetation typing was possible other than to note all types occur in uplands.

**Table 6. Comparison of Post-flood Vegetation – Total Disturbance (July 2005) with Pre-flood Conditions (July 2004) in Clover Creek.**

VEGETATION TYPE / LAND USE	PRE-FLOOD ACRES <sup>a</sup>	NATURAL DISTURBANCE <sup>b</sup>		HUMAN DISTURBANCE <sup>c</sup>		TOTAL DISTURBANCE	
	Acres	Acres Disturbed	Percent Disturbed	Acres Disturbed	Percent Disturbed	Acres Disturbed	Percent Disturbed
<b>RIPARIAN VEGETATION TYPES</b>							
Alluvium	396.80	88.66	22.3%	104.57	26.4%	193.23	48.7%
Cattail Marsh	2.85	1.56	54.7%	0.00	0.0%	1.56	54.7%
Coyote Willow Shrubland	8.40	2.48	29.5%	1.29	15.4%	3.77	44.9%
Fremont Cottonwood Forest	100.08	19.36	19.3%	3.82	3.8%	23.18	23.2%
Mixed Wet Meadow	38.02	7.01	18.4%	0.05	0.1%	7.06	18.6%
Open Water	3.35	3.18	94.9%	0.00	0.0%	3.18	94.9%
Red Willow Forest	95.87	7.90	8.2%	7.77	8.1%	15.67	16.3%
Water Cress/ Duck Weed Marsh	0.72	0.50	69.4%	0.00	0.0%	0.50	69.4%
<b>Subtotals</b>	<b>646.09</b>	<b>130.65</b>	<b>20.2%</b>	<b>117.50</b>	<b>18.2%</b>	<b>248.15</b>	<b>38.4%</b>
<b>UPLAND VEGETATION TYPES</b>							
Gambel Oak Shrubland	0.59	0.00	0.0%	0.00	0.0%	0.00	0.0%
Mixed Grassland	18.41	0.29	1.6%	0.00	0.0%	0.29	1.6%
Rabbitbrush Shrubland	73.13	2.73	3.7%	1.73	2.4%	4.46	6.1%
Railroad/Road	80.81	0.35	0.4%	6.09	7.5%	6.44	8.0%
Sagebrush Shrubland	266.20	22.77	8.6%	25.85	9.7%	48.62	18.3%
Sparsely Vegetated/ Disturbed Lands	318.74	45.67	14.3%	19.22	6.0%	64.89	20.3%
<b>Subtotals</b>	<b>757.88</b>	<b>71.81</b>	<b>9.5%</b>	<b>52.89</b>	<b>7.0%</b>	<b>124.70</b>	<b>16.5%</b>
<b>TOTALS</b>	<b>1403.97</b>	<b>202.46</b>	<b>14.4%</b>	<b>170.39</b>	<b>12.1%</b>	<b>372.85</b>	<b>26.5%</b>

<sup>a</sup> Pre-flood Acres were the total acres of a vegetation type/land use delineated based on the October 2003 Aerial Imagery and field verified in July 2004 (BIO-WEST 2005).

<sup>b</sup> Natural Disturbance includes areas denuded or substantially thinned. These are areas where natural flood events have appeared to have eliminated vegetation or substantially reduced the density of the vegetation identified in the October 2003 Aerial Imagery.

<sup>c</sup> Human Disturbance are areas where mechanical processes or new structures appeared to eliminate all or most of the vegetation identified in the October 2003 Aerial Imagery.

Total acres of three different vegetation types were reduced by more than 50 percent over pre-flood conditions in Clover Creek, either by natural flood processes or human disturbance (Table 6). These included Cattail Marsh (2 acres; 55%), Water Cress/Duck Weed Marsh (0.5 acres; 69%), and Open Water (3 acres; 95%). Open water may be influenced by temporal factors and recent climactic events at the time of imagery acquisition, and may not be a conclusive category for evaluation. The other two vegetation types are very limited in Clover Creek as distinctive dominant communities. Additionally, 45 percent of the approximate 8 acres of pre-flood Coyote Willow Shrubland was

changed by the catastrophic flood (Table 6). As with Meadow Valley Wash, most of the changes (193 acres) occurred in the Alluvium vegetation type – the most common type in Clover Creek.

### **Natural Flooding Changes**

Of the approximate 403 acres of vegetation change within Clover Creek, approximately 207 acres (51% of delineated change in Clover Creek) were described as resulting from natural flood disturbance. The vast majority (98%) of the natural flood disturbance were denuded of vegetation (Table 5). This contrasts to Meadow Valley Wash where a substantial proportion (25 percent) of the natural flood disturbance still maintained the pre-flood vegetation type, although the vegetation density was significantly reduced (Table 2).

### **Riparian Vegetation Types**

Approximately 63 percent (131 acres) of the vegetation affected by natural flood processes (207 acres) occurred within riparian vegetation types (Table 5). Approximately 128 acres of the riparian vegetation types were denuded of vegetation, while only about 2 acres of riparian vegetation were substantially reduced in vegetative density (Table 5).

Prior to the flood event of January 2005, approximately 646 acres of riparian/wetland vegetation types occurred in Clover Creek from Big Creek downstream to the confluence with Meadow Valley Wash at Caliente (Table 6). Natural flood processes (denudation and thinning) disturbed approximately 20 percent of this pre-flood riparian vegetation (Table 6).

Most (68%; 89 acres) of the natural disturbance in the riparian communities occurred in the Alluvium vegetation type (Table 5), a type that was sparsely vegetated in pre-flood conditions. Natural flood processes disturbed, primarily through denudation, approximately 22 percent of the pre-flood Alluvium vegetation type in Clover Creek (Table 6).

Within the native riparian vegetation types, most of the natural flood disturbances occurred in the Fremont Cottonwood Forest (14%; 19 acres) (Table 5). The natural flood processes eliminated approximately 19 percent of the pre-flood Fremont Cottonwood Forest (Table 6). Natural flood processes also eliminated a substantial portion (30%) of the pre-flood Coyote Willow Shrubland, a riparian woody vegetation type with very limited distribution in Clover Creek (Table 6).

### **Upland Vegetation Types**

Approximately 37 percent (76 acres) of the vegetation affected by natural flood processes occurred within upland vegetation types (Table 5). Much of this disturbance occurred within the general flood plain of Clover Creek, although approximately 5 acres were affected beyond the boundaries of image classification conducted in the original vegetation baseline study (BIO-WEST 2005). Approximately 75 acres of the upland vegetation types were denuded of vegetation, while only about 1 acre of upland vegetation was substantially reduced in vegetative density (Table 5).

Prior to the flood event of January 2005, approximately 758 acres of upland vegetation types occurred in Clover Creek (Table 6). Natural flood processes (denudation and thinning) disturbed

approximately 10 percent of this pre-flood upland vegetation (Table 6). None of the vegetation types were substantially reduced by natural flood processes.

Sagebrush Shrubland was the native upland vegetation community most affected by natural flood processes, and only to the extent of 23 acres of disturbance or approximately 9 percent of pre-flood Sagebrush Shrubland in Clover Creek.

Approximately 60 percent (46 acres) of the total natural disturbance in upland communities were delineated in the Sparsely Vegetated/Disturbed Lands vegetation type and Railroad/Road right of ways (Table 5).

### ***Human Disturbances***

Of the approximate 403 acres of vegetation change within Clover Creek, human disturbance occurred on approximately 196 acres (49% of delineated change in Clover Creek) (Table 1 and Table 5). Where human disturbance was delineated, all vegetation was eliminated. The proportionate amount of human disturbance in relation to total disturbance in Clover Creek is substantially higher than in Meadow Valley Wash – 49 percent to 32 percent, respectively.

### ***Riparian Vegetation Types***

Approximately 60 percent (118 acres) of the vegetation on which human disturbance was delineated occurred within riparian vegetation types (Table 5). Human disturbance occurred on approximately 47 percent of all the flood disturbed riparian vegetation in Clover Creek (Table 5). Comparatively, human disturbance only occurred on approximately 14 percent of all the flood disturbed riparian vegetation in Meadow Valley Wash (Table 2). Total acres of riparian vegetation on which human disturbance was delineated in Clover Creek was similar to the total acres of riparian vegetation on which human disturbance was delineated in Meadow Valley Wash (118 acres and 134 acres, respectively). In relation to linear mile of stream corridor, human disturbance occurred on riparian vegetation types in Meadow Valley Wash at 1.6 acres per linear mile, while human disturbance occurred on riparian vegetation types in Clover Creek at 8.4 acres per linear mile. These relationships indicate that, proportionately, more human disturbance was delineated in the riparian vegetation types of Clover Creek than the riparian vegetation types of Meadow Valley Wash.

Approximately 18 percent of the pre-flood riparian vegetation was eliminated on lands where human disturbance was noted (Table 6). This is in comparison with the approximate 20 percent of pre-flood vegetation altered by natural processes. In Meadow Valley Wash, 5 percent of the pre-flood riparian vegetation was eliminated on lands where human disturbance was noted (Table 3).

The most human disturbance (approximately 105 acres) was delineated on Alluvium vegetation type (Table 5). This accounts for approximately 89 percent of all riparian vegetation types on which human disturbance were noted in Clover Creek. Most (about 13 acres) of the remaining human disturbance occurred on native woody riparian vegetation types including Coyote Willow Shrubland (1 acre), Fremont Cottonwood Forest (4 acres), and Red Willow Forest (8 acres) (Table 5). In total, human disturbance occurred on approximately 6 percent of the pre-flood woody riparian vegetation

types in Clover Creek. This is similar to the approximate 5 percent of pre-flood woody riparian vegetation types in Meadow Valley Wash on which human disturbance occurred.

It is interesting to note that approximately 5 acres of new marsh appears to have been created in Clover Creek between the existing railroad bed and the newly graded and built-up access road at approximately 6.8 miles upstream from the confluence of Clover Creek with Meadow Valley Wash (see Sheet 69 of the Atlas). Pre-flood sparsely vegetated lands and shrublands appear to have been inundated and converted to shallow water/emergent wetland vegetation. From the aerial imagery it appears that a spring drainage between the railroad and the road may have been blocked, resulting in ponding within the enclosed area. Subsequent to this inundation, it appears the original drainage was reopened and a diversion channel established to drain this newly inundated area. As such, it is not anticipated that a marsh vegetation type of this extent will be perpetuated at this location.

### **Upland Vegetation Types**

Approximately 40 percent (78 acres) of the vegetation on which human disturbance was delineated in Clover Creek occurred within upland vegetation types (Table 5). Much of this disturbance occurred within the general flood plain of Clover Creek, as delineated in the original Meadow Valley Wash Ecological Baseline Assessment (BIO-WEST 2005). Although approximately 5 acres were affected beyond the boundaries originally classified. In comparison, approximately 66 percent of the vegetation on which human disturbance was delineated in Meadow Valley Wash occurred within upland vegetation types (Table 2).

Prior to the flood event of January 2005, approximately 758 acres of upland vegetation types occurred in Clover Creek (Table 6). Human disturbance was delineated on approximately 7 percent (53 acres) of this pre-flood upland vegetation (Table 6).

As with natural flood disturbance, a substantial amount (approximately 49%; 25 acres) of the human disturbance in upland communities occurred in the Sagebrush Shrubland vegetation type (Table 5). Where this human disturbance was identified, approximately 10 percent of the pre-flood Sagebrush Shrubland vegetation type has been eliminated (Table 3). This is very similar to the resultant loss of Sagebrush Shrubland vegetation type through natural processes (23 acres).

The only other native upland community in Clover Creek affected by human disturbance was approximately 2 acres of Rabbitbrush Shrubland that eliminated approximately 2 percent of the pre-flood community.

A substantial amount of human disturbance occurred in vegetation types that were previously disturbed. Approximately 47 percent (32 acres) of the delineated human disturbance occurred in the Sparsely Vegetated/Disturbed Lands vegetation type and Railroad/Road right of ways (Table 5).

**Table 7. Types and Acres of Human Disturbance in Clover Creek Delineated in July 2005.**

VEGETATION TYPE / LAND USE	TYPES OF DISTURBANCE											
	New Berm	Bladed / Graded	New Borrow Pit	New Bridge	New Diversion	New Jetty	New Channel	New Fence	New Road	New Stream Crossing	Widened Road	Total Human Disturbance
<b>RIPARIAN VEGETATION DISTURBANCE</b>												
	Acres											
Alluvium	2.19	96.80	-	-	0.15	3.06	1.42	-	-	-	0.95	104.57
Coyote Willow Shrubland	0.19	1.01	-	-	0.01	-	0.08	-	-	-	-	1.29
Fremont Cottonwood Forest	-	3.02	-	-	-	>0.01	0.63	-	-	-	0.17	3.82
Mixed Wet Meadow	-	0.05	-	-	-	-	-	-	-	-	-	0.05
Red Willow Forest	-	7.26	-	0.01	-	-	-	-	-	-	0.50	7.77
<b>Subtotals</b>	<b>2.38</b>	<b>108.14</b>	<b>0.00</b>	<b>0.01</b>	<b>0.16</b>	<b>3.06</b>	<b>2.13</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>1.62</b>	<b>117.50</b>
<b>UPLAND VEGETATION TYPES</b>												
Mixed Grassland	-	-	-	-	-	-	-	-	-	-	-	0.00
Rabbitbrush Shrubland	-	1.60	-	-	-	-	-	-	-	-	0.13	1.73
Railroad/Road	-	4.95	-	0.02	>0.01	0.52	-	-	-	-	0.60	6.09
Sagebrush Shrubland	0.45	21.98	-	-	0.01	2.76	0.22	-	-	-	0.43	25.85
Sparsely Vegetated/ Disturbed Lands	-	19.05	-	-	-	0.01	-	-	-	-	0.16	19.22
<b>Subtotals</b>	<b>0.45</b>	<b>47.58</b>	<b>0.00</b>	<b>0.02</b>	<b>0.01</b>	<b>3.29</b>	<b>0.22</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>1.32</b>	<b>52.89</b>
<b>UNDELINEATED VEGETATION TYPES</b>												
Unknown Upland Vegetation	-	24.89	-	-	-	-	-	-	-	-	0.56	25.45
<b>TOTALS</b>	<b>2.83</b>	<b>180.61</b>	<b>0.00</b>	<b>0.03</b>	<b>0.17</b>	<b>6.35</b>	<b>2.35</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>3.50</b>	<b>195.84</b>

## **Types of Human Disturbance**

During the site verification, each area in with visible human disturbance was described as to the primary type of human disturbance that was done. Twelve separate types of human disturbance were identified in the field. Table 7 delineates the acres of each type of human disturbance within each vegetation type in Clover Creek. As with Meadow Valley Wash, mechanical blading and grading accounted for the vast majority of human disturbance. Mechanical blading and grading occurred over approximately 181 acres in Clover Creek. This is approximately 92 percent of the human disturbance in Clover Creek. The largest extent (97 acres) of the mechanical blading and grading occurred in Alluvium (Table 7). New deflection jetty construction was the next most prevalent type of human disturbance (approximately 3%) occurring over approximately 6 acres of previously vegetated land. The deflection jetties occur along one segment of the railroad and appears to have been developed to protect the railroad bed from future flood erosion and scouring. Widened roads disturbed an additional 4 acres of pre-flood vegetation. New berms and newly created stream channels occurred on approximately 3 acres and 2 acres, respectively, of pre-flood vegetation (Table 7).

## **Post-flood Southwestern Willow Flycatcher Habitat Changes**

Southwestern willow flycatcher (SWWFC) habitat was delineated for Meadow Valley Wash as an integral component of the original Meadow Valley Wash Baseline Ecological Assessment conducted in 2004 (BIO-WEST 2005). This delineation is representative of conditions prior to the January 11, 2005, catastrophic flood and is described as pre-flood SWWFC habitat in this current report. A limitation of the baseline ecological evaluation was that no habitat delineations were made for Clover Creek. As such, post-flood changes in SWWFC habitat can only be described for Meadow Valley Wash. SWWFC habitat in Meadow Valley Wash was defined as suitable habitat or potential habitat.

SWWFC Suitable Habitat was defined as woody riparian vegetation stands, either trees or shrubs, that appear to have all the components necessary for SWWFC to establish territories and/or nest. Woody riparian vegetation may be dominated by native vegetation or by exotic tamarisk. The primary components include: (1) a stand, or patch size, of 0.25 acre or greater; (2) a vegetation width of more than about 30 feet; (3) a dense canopy; (4) dense interior vegetation from ground level up to about 15 feet or dense patches interspersed with openings; and (5) surface water or saturated soils present within the stand or within 125 feet of the stand. Suitable habitat may be unoccupied for any of a multitude of reasons (BIO-WEST 2005). This definition is consistent with the suitable habitat definition in the SWWFC Recovery Plan (USFWS 2002).

SWWFC Potential Habitat was defined as woody riparian vegetation stands that do not currently have all the components necessary for SWWFC to establish territories and/or reproduce but do have the vegetation composition, patch size, and the basic vegetation structure to potentially develop into SWWFC Suitable Habitat in the future, especially if management objectives are designed to promote suitable habitat development (BIO-WEST 2005). This definition is consistent with the potential habitat definition in the SWWFC Recovery Plan (USFWS 2002).

Approximately 1,406 acres of SWWFC habitat (suitable and potential combined) occurred in Meadow Valley Wash prior to the January 11, 2005, flood. A total of approximately 507 acres of SWWFC habitat was delineated as changed from pre-flood conditions, which is a loss of approximately 36 percent of the total pre-flood SWWFC habitat in Meadow Valley Wash (Table 8). Natural flooding has caused the loss the vast majority (86%) of the total SWWFC habitat; while human disturbance occurred on only 14 percent (73 acres) of pre-flood SWWFC habitat (Table 8).

### **Southwestern Willow Flycatcher Suitable Habitat Loss**

Most (64%) of the SWWFC habitat that was lost after the January 11, 2005 flood was delineated as suitable habitat. A total of approximately 326 acres of SWWFC Suitable Habitat was changed from pre-flood conditions (Table 8). This is approximately 46 percent of the pre-flood SWWFC Suitable Habitat in Meadow Valley Wash (Table 8).

#### ***Natural Flooding Changes***

Natural flooding has caused the loss of approximately 274 acres of SWWFC Suitable Habitat in Meadow Valley Wash. This is the vast majority (84%) of the total SWWFC Suitable Habitat lost in Meadow Valley Wash (Table 8). Approximately 98 acres were entirely denuded, while 176 acres were substantially reduced in vegetation density, particularly the understory components necessary for SWWFC nesting. Substantial thinning and vegetation density reduction has eliminated the SWWFC Suitable Habitat; however, environmental site conditions may still be conducive to re-establishment of vegetative densities required for SWWFC habitat. An analysis of such re-establishment is beyond the scope of this study.

Natural flooding affected approximately 126 acres of native vegetation types supporting pre-flood SWWFC Suitable Habitat, resulting in the loss of approximately 56 percent of the pre-flood SWWFC Suitable Habitat in native vegetation types. Most of this loss (96 acres) occurred in Riparian Forest where 67 percent of the pre-flood SWWFC Suitable Habitat was lost (Table 8). Approximately 38 acres of the Riparian Forest was denuded and approximately 58 acres were substantially reduced in vegetation density.

Suitable habitat in Fremont Cottonwood Forest was also substantially affected with the loss of 20 acres of habitat, which is approximately 41 percent of the pre-flood SWWFC habitat in Fremont Cottonwood Forest. Approximately 5 acres of the Fremont Cottonwood Forest delineated as SWWFC Suitable Habitat was denuded, while 15 acres were substantially reduced in vegetation density.

Natural flood processes eliminated a substantial amount of other pre-flood SWWFC Suitable Habitat in native vegetation types. Of particular note is the disturbance of approximately 67 percent of the pre-flood suitable habitat in Desert Willow Shrubland, and 93 percent of the pre-flood suitable habitat in Red Willow Shrubland – both woody vegetation types with extremely limited suitable habitat and distribution within the Meadow Valley Wash.

**Table 8. Comparison of Post-flood Southwestern Willow Flycatcher Habitat with Pre-flood Conditions (July 2004) in Meadow Valley Wash.**

VEGETATION TYPE / LAND USE	PRE-FLOOD ACRES <sup>1</sup>	NATURAL DISTURBANCE <sup>2</sup>		HUMAN DISTURBANCE <sup>3</sup>		TOTAL DISTURBANCE	
	Acres	Acres Disturbed	Percent Disturbed	Acres Disturbed	Percent Disturbed	Acres Disturbed	Percent Disturbed
<b>SUITABLE HABITAT FOR SOUTHWESTERN WILLOW FLYCATCHER</b>							
Desert Willow Shrubland	0.56	0.38	67.8%	0.00	0.0%	0.38	67.8%
Fremont Cottonwood Forest	48.29	19.72	40.8%	8.60	17.8%	28.32	58.6%
Red Willow Forest	30.41	8.01	26.3%	0.02	0.1%	8.03	26.4%
Red Willow Shrubland	1.67	1.55	92.8%	0.00	0.0%	1.55	92.8%
Riparian Forest	142.84	96.12	67.3%	11.19	7.8%	107.31	75.1%
Riparian Forest Tamarisk Woodland Mix	133.26	28.62	21.5%	18.66	14.0%	47.28	35.5%
Tamarisk Woodland	355.62	120.08	33.8%	13.07	3.7%	133.15	37.4%
<b>Subtotals</b>	<b>713.65</b>	<b>274.48</b>	<b>38.5%</b>	<b>51.54</b>	<b>7.2%</b>	<b>326.02</b>	<b>45.7%</b>
<b>POTENTIAL HABITAT FOR SOUTHWESTERN WILLOW FLYCATCHER</b>							
Burnt or Dead Tamarisk Woodland	245.72	36.92	15.0%	2.34	1.0%	39.26	16.1%
Coyote Willow Shrubland	4.96	3.78	76.2%	0.38	7.7%	4.16	83.9%
Desert Willow Shrubland	19.83	5.77	29.1%	0.27	1.4%	6.04	30.5%
Freemont Cottonwood Forest	74.54	19.49	26.1%	7.39	9.9%	26.88	36.1%
Red Willow Forest	16.93	7.56	44.7%	0.00	0.0%	7.56	44.7%
Red Willow Shrubland	5.84	1.17	20.0%	0.05	0.9%	1.22	20.9%
Riparian Forest	62.12	32.31	52.0%	3.94	6.3%	36.25	58.3%
Riparian Forest Tamarisk Woodland Mix	10.78	2.46	22.8%	0.46	4.3%	2.92	27.1%
Seep Willow Shrubland	13.51	7.77	57.5%	2.79	20.7%	10.56	78.2%
Tamarisk Woodland	238.05	41.69	17.5%	4.16	1.7%	45.85	19.3%
<b>Subtotals</b>	<b>692.28</b>	<b>158.92</b>	<b>23.0%</b>	<b>21.78</b>	<b>3.1%</b>	<b>180.70</b>	<b>26.1%</b>
<b>TOTALS</b>	<b>1405.93</b>	<b>433.40</b>	<b>30.8%</b>	<b>73.32</b>	<b>5.2%</b>	<b>506.72</b>	<b>36.0%</b>

<sup>a</sup> Pre-flood Acres were the acres of a Southwestern Willow Flycatcher habitat delineated in the original Meadow Valley Wash Baseline Ecological Assessment (BIO-WEST 2005).

<sup>b</sup> Natural Disturbance includes areas denuded or substantially thinned. These are areas where natural flood events have appeared to have eliminated vegetation or substantially reduced the density of the vegetation identified in the October 2003 Aerial Imagery.

<sup>c</sup> Human Disturbance are areas where mechanical processes or new structures appeared to eliminate all or most of the vegetation identified in the October 2003 Aerial Imagery.

Most of the SWWFC Suitable Habitat loss resulting from natural flood events occurred in Tamarisk Woodland. Approximately 120 acres of Tamarisk Woodland suitable habitat were eliminated, which is approximately 34 percent of the pre-flood suitable habitat delineated in Tamarisk Woodland. Again most of the suitable habitat loss in this vegetation type was the result of a substantial reduction in vegetation density (83 acres).

### ***Human Disturbance***

Human disturbance was delineated on approximately 52 acres of pre-flood SWWFC Suitable Habitat in Meadow Valley Wash. This 52 acres comprises approximately 16 percent of the total SWWFC Suitable Habitat lost in Meadow Valley Wash (Table 8). Where the human disturbance was delineated, all vegetation was eliminated and no SWWFC habitat remained.

Most (62%) of the human disturbance delineated on pre-flood SWWFC Suitable Habitat occurred on invasive vegetation types including Tamarisk Woodland (13 acres) and Riparian Forest Tamarisk Woodland Mix vegetation types (19 acres).

Human disturbance was delineated on approximately 20 acres of native vegetation types supporting pre-flood SWWFC Suitable Habitat, resulting in the loss of approximately 9 percent of the pre-flood SWWFC Suitable Habitat. Human disturbance primarily occurred on pre-flood SWWFC Suitable Habitat in Riparian Forest vegetation type (11 acres) and Fremont Cottonwood Forest (9 acres).

### **Southwestern Willow Flycatcher Potential Habitat Loss**

Approximately 36 percent of the SWWFC habitat that was lost after the January 11, 2005 flood was delineated as potential habitat. A total of approximately 181 acres of SWWFC Potential Habitat was changed from pre-flood conditions, which is approximately 26 percent of the pre-flood SWWFC Potential Habitat in Meadow Valley Wash (Table 8).

### ***Natural Flooding Changes***

Natural flooding has caused the loss of approximately 159 acres of SWWFC Potential Habitat in Meadow Valley Wash. Natural flooding comprised the vast majority (88%) of the total SWWFC Potential Habitat lost in Meadow Valley Wash (Table 8). Approximately 68 acres were entirely denuded, while 91 acres were substantially reduced in vegetation density, particularly the understory components necessary for SWWFC nesting. As with SWWF Suitable Habitat, substantial thinning and vegetation density reduction has eliminated the SWWFC Potential Habitat; however, environmental site conditions may still be conducive to re-establishment of vegetative densities required for SWWFC habitat. An analysis of such re-establishment is beyond the scope of this study.

Natural flooding affected approximately 78 acres of native vegetation types supporting pre-flood SWWFC Potential Habitat, resulting in the loss of approximately 39 percent of the pre-flood SWWFC Potential Habitat in native vegetation types. A substantial amount (32 acres) of this loss occurred in Riparian Forest where 52 percent of the pre-flood SWWFC Potential Habitat was lost

(Table 8). Approximately 13 acres of the Riparian Forest was denuded and approximately 19 acres were substantially reduced in vegetation density.

Potential habitat in Fremont Cottonwood Forest was also substantially affected with the loss of approximately 19 acres of habitat, which is approximately 26 percent of the pre-flood SWWFC Potential Habitat in Fremont Cottonwood Forest. Whereas in most instances, SWWFC habitat was lost due to a substantial reduction in vegetation density as opposed to complete loss of vegetation, loss of SWWFC Potential Habitat in Fremont Cottonwood was primarily denudation: approximately 13 acres of the Fremont Cottonwood Forest delineated as SWWFC Potential Habitat was denuded, while about 6 acres were substantially reduced in vegetation density.

Approximately 50 percent (79 acres) of SWWFC Potential Habitat loss resulting from natural flood events occurred in Tamarisk Woodland or Burnt Tamarisk Woodland. The loss of 79 acres of these vegetation types, eliminated approximately 16 percent of the pre-flood potential habitat delineated in Tamarisk Woodland and Burnt Tamarisk Woodland. Most of the potential habitat loss in this vegetation type was the result of a substantial reduction in vegetation density (55 acres).

### ***Human Disturbance***

Human disturbance was delineated on approximately 22 acres of pre-flood SWWFC Potential Habitat in Meadow Valley Wash. This 22 acres comprises approximately 12 percent of the total SWWFC Potential Habitat lost in Meadow Valley Wash (Table 8). Where the human disturbance was delineated, all vegetation was eliminated and no SWWFC habitat remained.

Human disturbance was delineated on approximately 15 acres of native vegetation types supporting pre-flood SWWFC Potential Habitat, resulting in the loss of approximately 8 percent of the pre-flood SWWFC Potential Habitat. Human disturbance primarily occurred on pre-flood SWWFC Potential Habitat in Fremont Cottonwood Forest (7 acres), Riparian Forest (4 acres), and Seep Willow Shrubland (3 acres).

Approximately 7 acres of the human disturbance delineated on pre-flood SWWFC Potential Habitat occurred on invasive vegetation types including Tamarisk Woodland (4 acres) and Burnt Tamarisk Woodland (2 acres).

## REFERENCES

- Averett W.R. 1995. Through the Rainbow Canyon. Grand Junction (CO): Walter R. Averett. 176 p.
- [BIO-WEST] BIO-WEST, Inc. 2005. Meadow Valley Wash final baseline ecological assessment. Pioche (NV): Lincoln County. 105 p. plus appendices.
- Clark County. 2000. Final Clark County multiple species habitat conservation plan and environmental impact statement for issuance of a permit to allow incidental take of 79 species in Clark County, Nevada. Las Vegas: Clark County Department of Comprehensive Planning, and Reno (NV): U.S. Fish and Wildlife Service. 528 p. plus appendices.
- Lincoln County. 2003. Multiple-species habitat conservation plan for Southeastern Lincoln County, Nevada. Pioche (NV): Lincoln County Commission. 109 p. plus appendices.
- Provencher L., Nachlinger J., Forbis T., Morrill W.M. 2003. Antelope and North Springs Valleys, Steptoe Valley and uplands, Newark Valley extended watershed, and Meadow Valley Wash and uplands conservation area assessment executive summary. Revised final draft. Reno: The Nature Conservancy. 79 p.
- USFWS. 2002. Southwestern willow flycatcher recovery plan. Albuquerque (NM): U.S. Fish and Wildlife Service. 210 p. plus appendices.