MIDDLE RIO GRANDE
ISLETA REACH PHASE II
RIVERINE HABITAT RESTORATION PROJECT
BIOLOGICAL ASSESSMENT

Prepared for

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 BACKGROUND

The U.S. Bureau of Reclamation (Reclamation) is implementing the Isleta Reach Phase II Riverine Habitat Restoration Project (project), a river restoration project in portions of the Isleta Reach of the Middle Rio Grande (MRG) from the southern Isleta Pueblo border to the San Acacia Dam (Figure 1.1). The project will provide benefit for the federally listed Rio Grande silvery minnow (*Hybognathus amarus*; silvery minnow), the southwestern willow flycatcher (*Empidonax traillii extimus*; flycatcher), and the Rio Grande ecosystem as a whole. The project, when implemented, will contribute to the Middle Rio Grande Endangered Species Collaborative Program's (Collaborative Program's) goal of meeting the habitat restoration requirements as stated in Element S of the Reasonable and Prudent Alternatives (RPA) in the March 2003 Biological Opinion (U.S. Fish and Wildlife Service [USFWS] 2003).

The project will build upon the previously completed habitat restoration work in the MRG between Angostura Dam and I-25 Bridge in the Albuquerque Reach and the recently completed work in the Isleta Reach in the Peralta and Lower Peralta #1 Riverside Drain (LP1DR) subreaches. The habitat restoration goals for the Isleta Reach Phase II project include 1) diversifying mesohabitat types, focusing on spawning, egg retention, larval fish, and young-of-year habitat; 2) creating refugial habitat for the silvery minnow during prolonged dewatering/no-flow periods in locations that are adjacent to perennial water sources; 3) designing strategic inundation of disconnected bosque habitat to encourage and increase the extent of overbank inundation; and 4) encouraging fluvial processes and river dynamics (SWCA Environmental Consultants [SWCA] 2008a). The project will complement any existing or planned projects in the Isleta Reach through the application and modification of existing habitat restoration techniques identified in the *Habitat Restoration Plan for the Middle Rio Grande* (Tetra Tech 2004) to create suitable habitat for the silvery minnow in the Isleta Reach. Lessons learned from the monitoring of previous projects in the Albuquerque and Isleta reaches (SWCA 2007; 2008b, 2008c) has been applied to the site selection and final design of specific habitat restoration projects proposed here. One important lesson applied to this project includes the finding that bankline benches, backwater embayments, and island modifications have been found to provide good potential habitat at a variety of flows for egg retention and possible spawning and nursery habitat for the silvery minnow. The disturbance of vegetation that occurs during habitat restoration has also been found to be short term, and monitoring has indicated an increase in native vegetation after restoration activities are completed (SWCA 2008c). Other lessons and recommendations include:

- Conduct monitoring of all features for effectiveness based on 2003 Biological Opinion (USFWS 2003) requirements and/or based on year-to-year results until can ascertain whether feature functions and is or is not effective.
- Ensure removal of at least the upper 6 to 12 inches (15–30.5 cm) of soil/root system to encourage island destabilization.
- Continue to terrace islands/bars for silvery minnow habitat.
- Modify flows by enlarging width or increasing sinuosity of high flow channels to improve conditions for silvery minnow habitat. Possible entrapment issues require monitoring and adaptive management.

- Continue to construct backwaters, monitor for entrapment, and manage as needed.
- Continue to conduct bank lowering and removal of lateral confinement, monitor effectiveness, and manage as needed.
- Monitor entrapment and effectiveness of scallops and created terraces.
- Continue to add large woody debris and monitor effectiveness.

A summary report on lessons learned from the New Mexico Interstate Stream Commission (NMISC) Albuquerque Reach Phase I, Phase II, and Phase IIa restoration projects is found in Appendix A.

This Biological Assessment (BA), completed in accordance with provisions of the Endangered Species Act (ESA), evaluates and analyzes potential impacts of the project on listed threatened, endangered, or other special-status species that may occur within the project area during implementation, which will take place between September 1, 2010, and April 15, 2011.

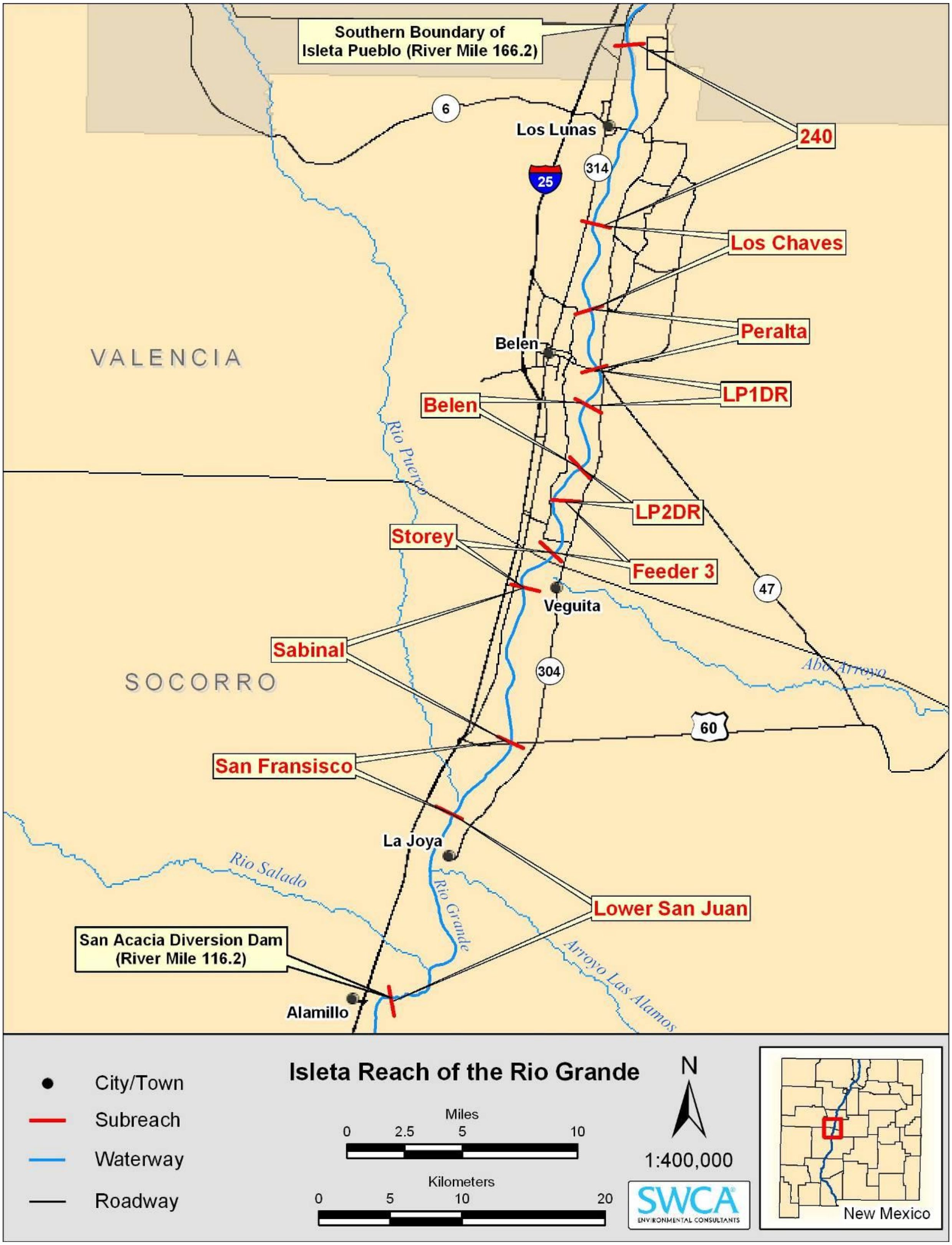

Figure 1.1. Isleta Reach of the MRG.

1.1 PROJECT LOCATIONS

1.1.1 ISLETA REACH

The Isleta Reach of the MRG stretches from the Isleta Diversion Dam south of Albuquerque to the San Acacia Diversion Dam (see Figure 1.1). Here, the Rio Grande is a predominantly sand-bedded channel that has experienced significant channel degradation since the closure of Cochiti Dam. Flood control activities have caused the river to be significantly channelized through the Isleta Reach. The reduced magnitude of peak flows and the presence of non-native phreatophytes have resulted in stabilization of the river planform and disconnection of the channel from its historic floodplain (Mussetter Engineering, Inc. [MEI] 2008). Channel degradation has resulted in a reduced frequency and duration of inundation of bosque lands outside the floodway and the bank-attached and mid-channel bars within the floodway. The resulting changes have caused a loss of habitat required to meet the life stages of the silvery minnow.

A detailed understanding of the specific responses of the river to these changes at each of the identified sites is necessary for successful implementation of habitat restoration measures. Site-specific information on river conditions is developed from a number of investigations of the Rio Grande performed over the past several years, including:

- The NMISC's study of MRG bar morphology and dynamics (MEI 2005a).
- *Geomorphic and Sedimentologic Investigation of the Middle Rio Grande between Cochiti Dam and Elephant Butte Reservoir* (MEI 2002).
- Sediment continuity analysis of the MRG funded by the NMISC and the Upper Rio Grande Basin Water Operations (URGWOPS) Review (MEI 2004).
- U.S. Army Corps of Engineers (USACE) *Spring 2005 Inundation Mapping of the Middle Rio Grande* (USACE 2007).
- USACE FLO-2D modeling (calibrated to the 2005 peak flows) of the MRG (MEI 2005b).
- NMISC *Riparian Groundwater Modeling of the Middle Rio Grande Corridor* (S.S. Papadopulos and Associates [SSPA] 2003).
- NMISC river flow monitoring in support of fish rescue and biological flow requirements (River Eyes) (SSPA 2005).
- Characterization of silvery minnow egg and larval drift and retention study (Widmer et al. 2007)
- Reclamation experimental activities on the MRG (Hatch et al. 2008)
- *Technical Memorandum: Isleta Reach Riverine Restoration Hydrological Analysis and Hydraulic Modeling Recommendations* (MEI 2008)
- *Restoration Analysis and Recommendations for the Isleta Reach of the Middle Rio Grande, NM* (Parametrix et al. 2008)
- *Middle Rio Grande Isleta Reach (Phase I) Habitat Restoration Project Biological Assessment* (Reclamation 2008).

Designs based on updated hydrological analysis and hydraulic modeling have been developed for each site restoration treatment (MEI 2008). Hydrological analysis has included mean daily flow analysis using gage records from the Rio Grande Floodway near Bernardo (U.S. Geological Survey [USGS] Gage No. 08330010) and flood-frequency analysis using flood-frequency values developed by the USACE (2007). HEC-RAS modeling has been used to determine the water surface profiles over a range of steady state discharges and inundation discharge for islands and bank-attached bars. The model uses topographic data, a digital elevation model (DEM), and contour shapefiles obtained from Light Detection and Ranging (LiDAR) topographic data acquired in March 2008.

As shown in Figure 1.2 through Figure 1.4, the four subreaches of the Isleta Reach proposed for restoration/rehabilitation techniques are the Belen, Lower Peralta #2 Riverside Drain (LP2DR), Feeder 3, and Storey subreaches. These subreaches lie within the Los Lunas Subreach and the Belen Subreach as defined in the *Restoration Analysis and Recommendations for the Isleta Reach of the Middle Rio Grande, NM* (Parametrix et al. 2008). Brief descriptions of the existing conditions in the Belen, LP2DR, Feeder 3, and Storey subreaches are contained in Sections 1.1.2 through 1.1.4.

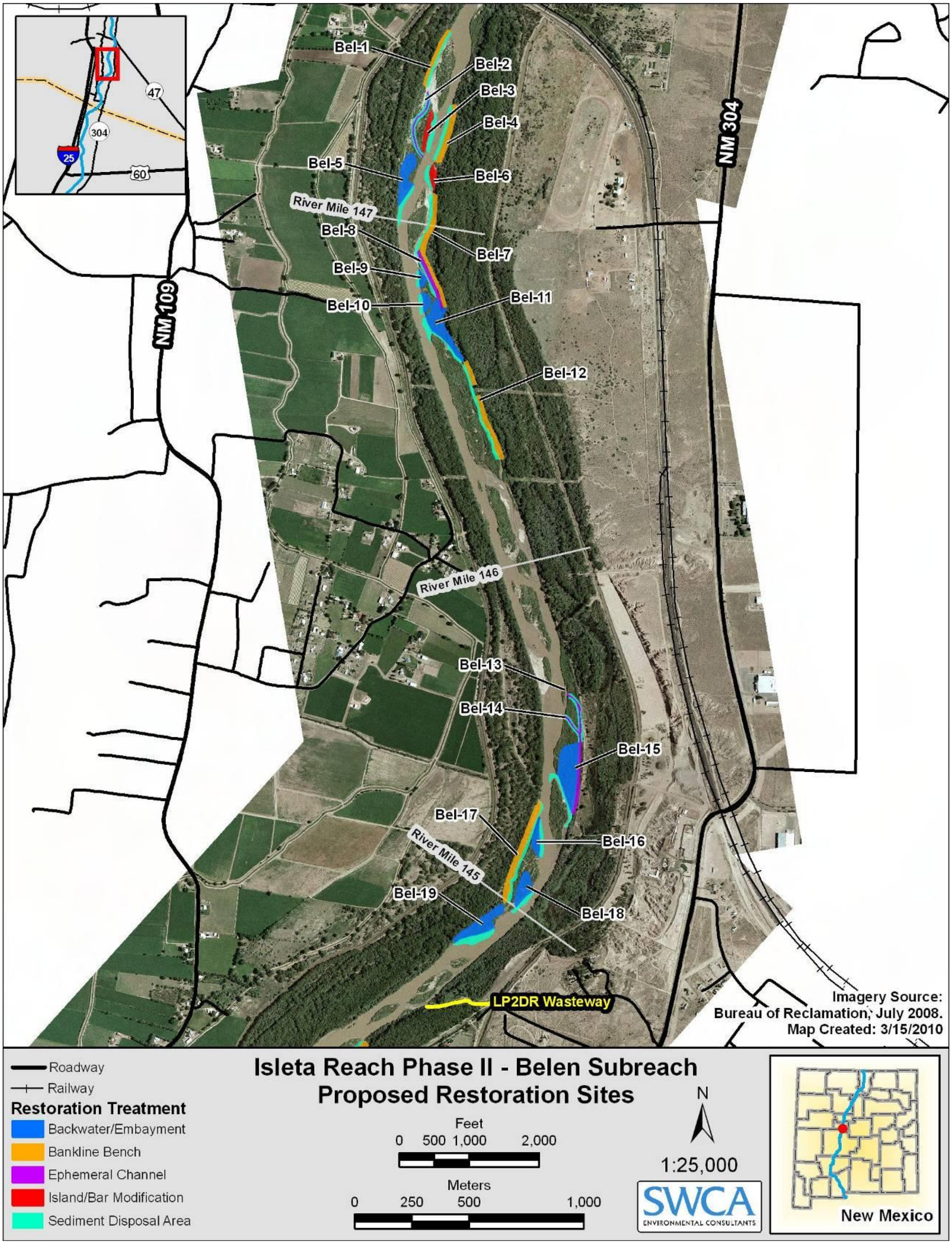

Figure 1.2. Belen Subreach restoration sites.

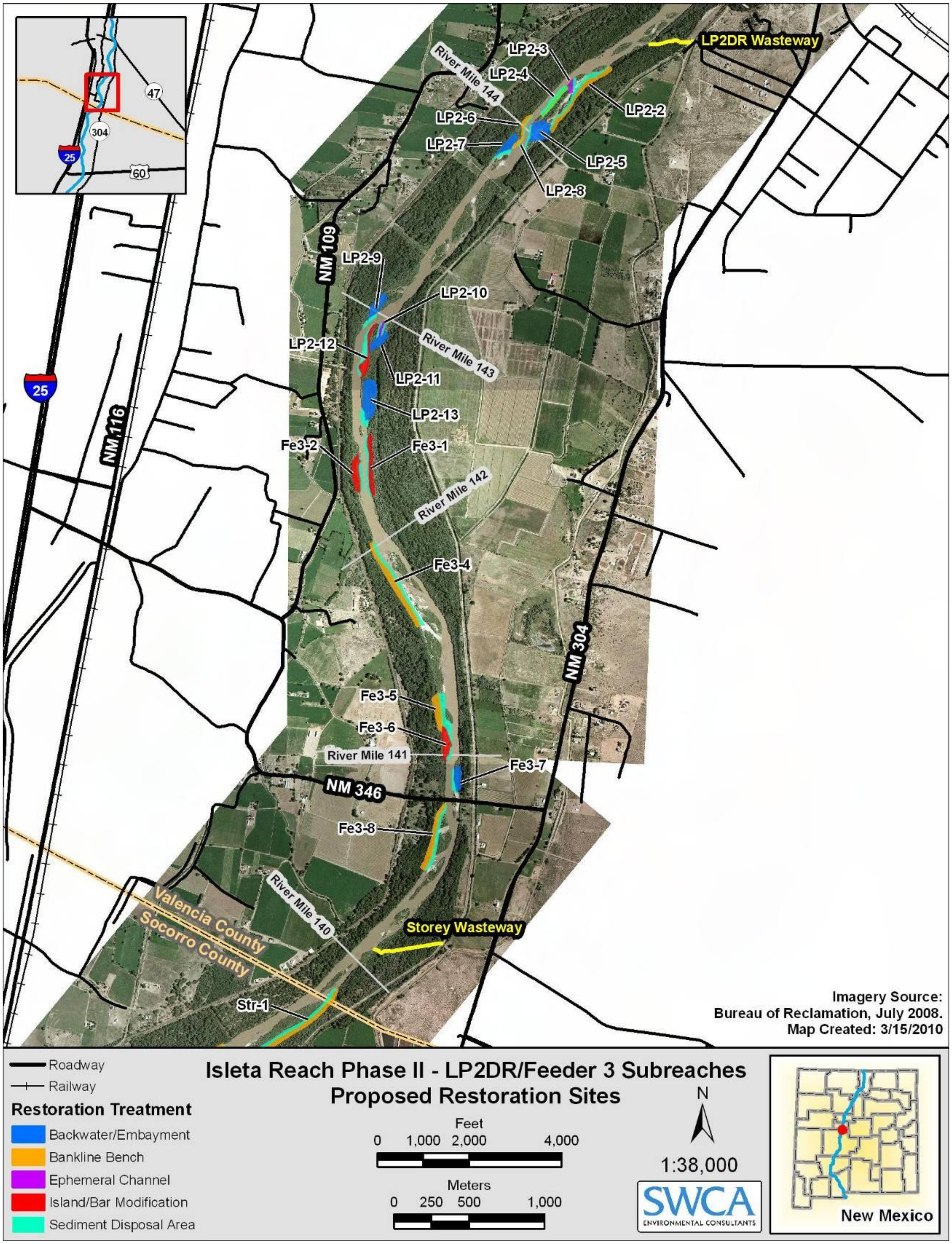

Figure 1.3. LP2DR and Feeder 3 Subreach restoration sites.

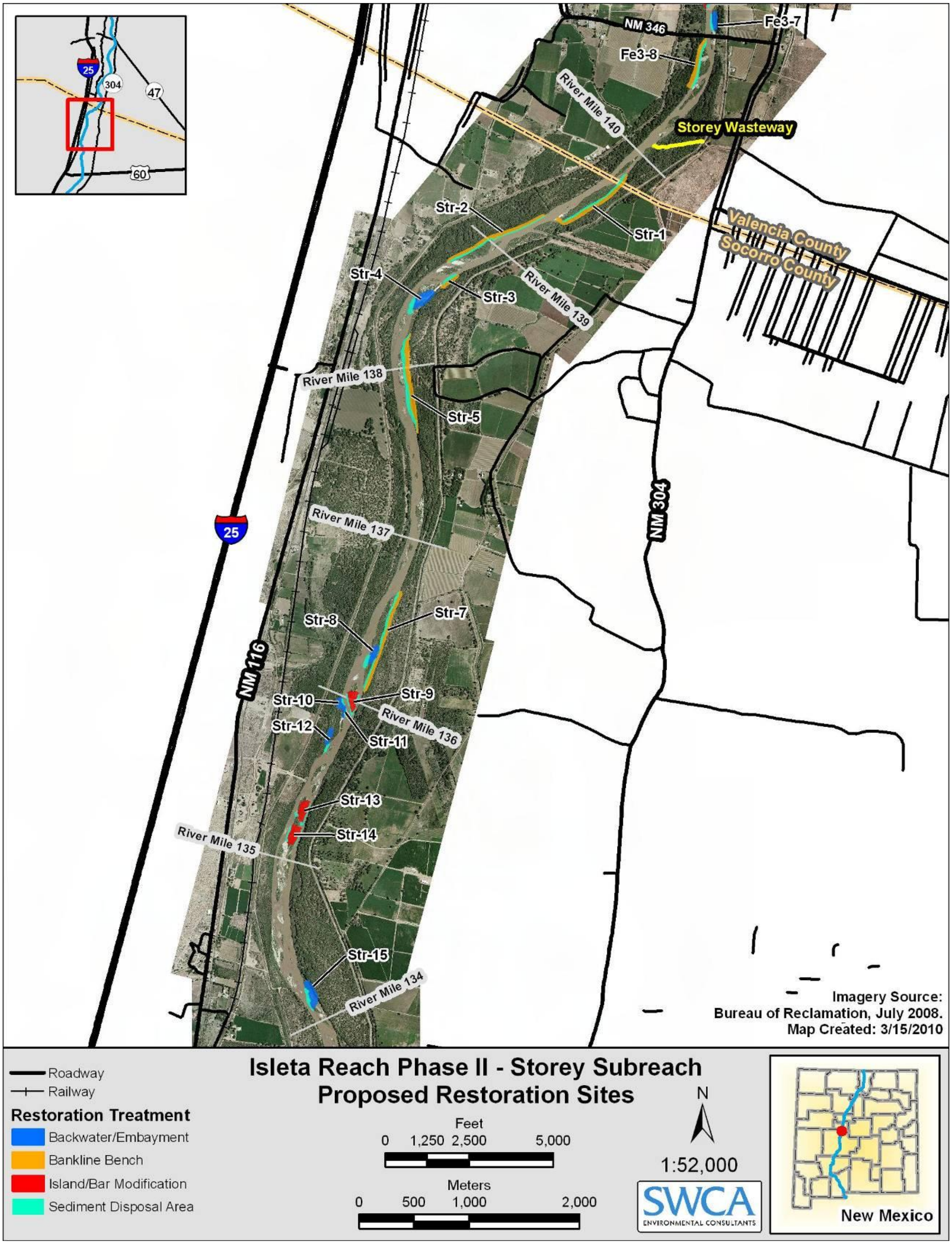

Figure 1.4. Storey Subreach restoration sites.

1.1.2 Belen Subreach

The Belen Subreach (see Figure 1.2) is demarcated by the Burlington Northern Santa Fe Railway Bridge at River Mile 147.7 (River Kilometer 237.7) to the north and the LP2DR wasteway outfall at River Mile 144.7 (River Kilometer 232.9) to the south. The approximate subreach length is 2.97 miles (4.78 km). Bank-attached bars give the appearance of a meandering, single-thread river within a well-defined channel during low-flow periods. Islands appear to be primarily braid bars with a few stabilized mid-channel bars and have become stabilized due to vegetative growth. The river channel throughout this subreach has narrowed substantially from its nominal 600-foot (183-m) channel width as designed under Reclamation's Middle Rio Grande Project (MEI 2002). Within this subreach, the following modifications are being proposed:

- Increase mesohabitat diversity, focusing on egg retention, larval fish, and young-of-year (e.g., backwater, embayments, and bankline terrace creation).
- Encourage overbank inundation through bankline terraces.
- Encourage fluvial processes and sediment redistribution through destabilizing vegetated bars to encourage sediment redistribution and island and bar terracing.
- Restore riparian habitat for the benefit of the flycatcher.

1.1.3 LP2DR and Feeder 3 Subreaches

The LP2DR Subreach (see Figure 1.3) is demarcated by the LP2DR outfall at River Mile 144.7 (River Kilometer 232.9) to the north and the Feeder #3 outfall at River Mile 142.8 (River Kilometer 229.8) to the south. The approximate subreach length is 1.9 miles (3.1 km). The Feeder 3 Subreach is demarcated by the Feeder #3 outfall at River Mile 142.8 (River Kilometer 229.8) to the north and the Storey outfall at River Mile 140.1 (River Kilometer 225.5) to the south. The subreach is 2.7 miles (4.3 km) long.

These subreaches are generally wide with a braided channel at flows less than about 300 to 400 cubic feet per second (cfs) and experience overbank inundation at approximately 5,000 cfs. Level-1 and Level-2 bank-attached bars give the appearance of a meandering, single-thread river within a well-defined channel. Islands appear to be primarily Level-1 braid bars through stabilized Level-2 mid-channel bars. A major characteristic of the LP2DR Subreach is the presence of two large natural gas pipelines crossing the river channel approximately 0.8 and 1.2 miles (1.3 and 1.9 km) downstream of the LP2DR wasteway outfall. The LP2DR and Feeder 3 subreaches have narrowed slightly from the Middle Rio Grande Project design width of 600 feet (183 m), especially adjacent to and downstream of the two pipeline crossings (MEI 2002). Much of the narrowing has manifested itself in the establishment of narrow wedges of sparse immature cottonwood (*Populus* sp.) trees within a framework of dense stands of non-native saltcedar (*Tamarix ramosissima*) and Russian olive (*Elaeagnus angustifolia*). Both subreaches are characterized as "may have intermittent flow" in the project area (SSPA 2005). Additionally, the bosque area just north of the wasteway outfall on the east side of the river experienced a significant fire in 2003, burning much of the vegetation northeast of the subreaches. Much of the regrowth after the fire has been by non-native vegetation, an issue that this project could address. Within these subreaches, the following modifications are being considered:

- Increase mesohabitat diversity, focusing on egg retention, larval fish, and young-of-year (e.g., backwater, embayments, and bankline terrace creation).
- Encourage overbank inundation through bankline terraces.
- Encourage fluvial processes and sediment redistribution through destabilizing vegetated bars to encourage sediment redistribution and island and bar terracing.
- Restore riparian habitat for the benefit of the flycatcher.

1.1.4 STOREY SUBREACH

The Storey Subreach (see Figure 1.4) is demarcated by the Storey wasteway outfall at River Mile 140.1 (River Kilometer 225.5) to the north and the Sabinal wasteway outfall at River Mile 137.9 (River Kilometer 221.9) to the south. The approximate subreach length is 2.2 miles (3.5 km). This subreach is generally a braided channel at flows less than about 300 to 400 cfs and experiences overbank inundation at flows approaching 5,000 cfs. At extremely low flows, the channel appears as a meandering, single thread with few braid or mid-channel bars. Bank-attached Level-1 and Level-2 bars are stabilized, often with dense vegetation. One of the main characteristics of this subreach is the confluence of the Rio Grande and Abo Arroyo, which drains a large alluvial area from the western flank of the Manzano Mountains. This subreach has experienced significant river channel narrowing over time, likely the result of the geomorphic and hydrologic influences of Abo Arroyo. Above Abo Arroyo, the Storey Subreach is characterized as “likely to have intermittent flow” (SSPA 2005). Wildfires have affected this subreach in the past, but no burns have occurred in the last five to 10 years. Vegetation on the bank-attached bars is sometimes well developed and potentially suitable flycatcher habitat.

Within the Storey Subreach, the following modifications are being considered:

- Increase mesohabitat diversity, focusing on egg retention, larval fish, and young-of-year (e.g., backwater, embayments, and bankline terrace creation).
- Encourage overbank inundation through bankline terraces.
- Encourage fluvial processes and sediment redistribution through destabilizing vegetated bars to encourage sediment redistribution and island and bar terracing.
- Restore riparian habitat for the benefit of the flycatcher.

2.0 PROPOSED ACTION

2.1 PROJECT DESCRIPTION

The project consists of the application of several alternative restoration/rehabilitation techniques designed to create aquatic habitat in the four subreaches: Belen, LP2DR, Feeder 3, and Storey (see Figure 1.2–Figure 1.4). The goal of the project is to enhance the availability and condition of spawning and egg retention, larval rearing, young-of-year, and over-wintering habitat for the silvery minnow in support of Element S of the RPA in the March 2003 Biological Opinion (USFWS 2003). The objective of the restoration process is to increase measurable habitat complexity in support of various life stages of the silvery minnow by providing slackwater habitat and facilitating lateral migration of the river across bars and riverbanks during various mid-level and high-flow stages. The project will be implemented with construction from September 1, 2010, through April 15, 2011. Specific restoration treatments will be implemented, monitored, and evaluated to inform the restoration plans of future phases. Phase I of the NMISC Isleta Reach Riverine Habitat Restoration Project was implemented in the Peralta and LP1DR subreaches during spring 2009 (Reclamation 2008).

Empirical evidence derived from habitat remediation work conducted by the NMISC in the Albuquerque Reach of the MRG suggests that silvery minnow habitat goals can be met by 25 days of inundation based on conservative estimates for egg and larval maturation (MEI 2006). Accomplishing these goals will require 1) the creation of backwaters and embayments to create slackwater areas; 2) the reduction in height of banklines, bank-attached bars, and islands; and 3) the creation of ephemeral high-flow channels to carry water into hydrologically disconnected overbank areas and bank-attached bars and islands. These actions will result in redistribution of river sediments into geomorphic units (mesohabitats) that are in balance with the existing sediment supply and hydrology at the sites. Further, the jetty jack lines that are so predominant throughout the project area have contributed to the disconnection of overbank areas from the active channel. Natural levees have built up around the jetty jack lines as the river drops sediment during the receding limb of the hydrograph. Natural levees result from overbank flood sedimentation and develop where there is an abrupt reduction in flow velocity, such as around jetty jacks, resulting in immediate deposition of coarser sand and silt (Hudson 2005). These natural levees reduce the connectivity between the river channel and the floodplain. The deposition of nutrient-rich sediments around the jetty jacks, as well as the accretion of similar sediments on the river banks adjacent to the jetty jacks, provide ideal conditions for the colonization of these areas by non-native vegetation, particularly Russian olive. The colonization of these areas by dense vegetation causes additional decreases in flow velocities, further increasing the deposition of sediment along the channel margins. This positive loop relationship further decreases the connectivity between the channel and adjacent floodplain. Therefore, it is unlikely that flows alone will be able to remove vegetation and permit lateral reworking of the existing in-channel and channel-margin bars and islands. Mechanical intervention is required to initially form and maintain desirable silvery minnow spawning and refugia habitat.

2.2 RESTORATION TREATMENTS

The *Habitat Restoration Plan for the Middle Rio Grande* (Tetra Tech 2004) contains a toolbox of habitat restoration treatments that may be selectively applied to site-specific restoration plans. Conditions at a specific site, combined with the ever-evolving understanding of the silvery minnow, require the restoration practitioner to be creative and adapt techniques appropriate to the goals of the project. Table 2.1 summarizes the specific restoration treatments that will be applied to restoring silvery minnow habitat in the Isleta Reach. In addition, expected benefits to native riverine vegetation will potentially increase habitat for the flycatcher.

Table 2.1. Restoration Treatments and Potential Benefits of Proposed Treatment

Treatment	Description	Benefits of Treatment
Creation of backwaters and embayments	Areas cut into banks and bars to allow water to enter to create slackwater habitat, primarily during mid- to high-flow events including spring runoff and floods.	Increases habitat diversity by increasing backwaters, pools, and eddies at various depths and velocities. Intended to retain drifting silvery minnow eggs and provide rearing habitat and enhance food supplies for developing silvery minnow larvae.
Creation of bankline benches	Removal of vegetation and excavation of soils adjacent to the main channel to create benches that will be inundated at a range of discharges.	Provides shallow water habitat at a range of discharges that could provide spawning habitat and increased retention of silvery minnow eggs and larvae. Increased inundation will benefit native vegetation, potentially increasing habitat for the flycatcher.
High-flow ephemeral channels	Construction of ephemeral channels on islands to carry flow from the main river channel during high-flow events.	Normally dry but creates shallow, ephemeral, low-velocity aquatic habitats important for silvery minnow egg and larval development during medium and high-flow events.
Island/Bar modification	Creation of shelves on islands and bars to increase inundation frequency. This technique is targeted for islands and bars that have an overtopping discharge greater than 3,500 cfs and exceedance days per year less than 21 days.	Increases habitat availability by increasing the inundated area at lower flows. May also destabilize bars and islands, slowing the rate of vegetation stabilization and/or armoring.

Information adapted from Tetra Tech (2004).

Approximately 148 acres (60 ha) of islands and riverbank will be modified to create slackwater mesohabitat features to increase the spawning and larval fish habitat within the Belen, LP2DR, Feeder 3, and Storey subreaches of the Isleta Reach. Table 2.2 provides a summary of the number of sites and the area affected for each restoration technique by subreach. The areas provided in Table 2.2 also include sediment disposal locations. Maps indicating the location of proposed restoration sites are found in Figure 1.2 through Figure 1.4 above.

Table 2.2. Isleta Restoration Technique Treatment Areas by Subreach

Restoration Treatment Type	Isleta Phase II								Total Acres by Restoration Treatment*
	Belen Subreach		LP2DR Subreach		Feeder 3 Subreach		Storey Subreach		
	Area (acres)	# Sites	Area (acres)	# Sites	Area (acres)	# Sites	Area (acres)	# Sites	
Backwater/Embayments	20.72	8	16.15	5	1.97	1	16.20	6	55.05
Bankline Benches	13.50	5	6.05	3	16.04	3	37.87	5	73.47
Ephemeral Channels	4.94	4	1.67	2	0.00	0	0.00	0	6.61
Island/Bar Modification	2.52	2	4.50	2	10.89	3	12.02	3	29.93
Estimated Total Riverine**	**41.69**	**19**	**28.38**	**12**	**28.90**	**7**	**66.09**	**14**	**165.06**

* Total acres include treatment footprint plus sediment disposal area.
** Percentages and totals may not sum exactly due to rounding.

2.2.1 RIVERINE RESTORATION

Islands and bars, with their ability to constantly reshape, expand, contract, and mobilize, are common features in braided river systems that have an ample supply of sediment, which is historically (pre-regulated flow) characteristic of the MRG. The vegetated islands within the MRG have historically been transient and temporary features and have been commonly altered, displaced, or moved during high seasonal flows. The amount of established vegetation increases the likelihood that islands will become permanent, as they become more difficult to move once vegetation is established and mature (Fluder 2004). Reclamation and other entities have physically removed vegetated islands in the MRG for the purpose of maintaining river channel capacity. Bars are transient, unvegetated features of the river that may form into vegetated islands or become part of the riverbank over time. Under current river and climate conditions, where high sustained seasonal flows have been absent for the most part, many of the bars and islands with a higher elevation are tending towards becoming permanent vegetated features that will restrict channel width and river migration through portions of the Isleta Reach, requiring mechanical intervention to redistribute sediment and create mesohabitats that are inundated at a range of elevations (MEI 2008).

Initial site selection was based on the *Restoration Analysis and Recommendations for the Isleta Reach of the Middle Rio Grande, NM* (Parametrix et al. 2008). All six subreaches within the Isleta Reach were considered as part of the site-selection process: Belen, LP2DR, Feeder 3, Storey, Sabinal, and San Francisco. A comparative analysis was then conducted between the 2005 inundation mapping (USACE 2007) and hydraulic modeling results obtained through a steady-state HEC-RAS study conducted in 2008. The purpose of the comparison was to cross-validate both data sets in terms of the mapped and predicted areas of inundation. The results of the comparison showed a close correlation between the mapped and modeled areas of inundation.

In order to narrow down the set of potential restoration sites, bounded flows of existing inundation were selected for each category (bank-attached bars and islands). These are defined as follows: bank-attached bars that currently inundate from between 2,500 and 3,500 cfs and islands that currently inundate from between 4,000 and 5,500 cfs. These criteria were then used to query and extract the features that the HEC-RAS model predicted to inundate at those bounded flows. This produced a subset of potential restoration sites totaling approximately 152 acres (61.5 ha). HEC-RAS modeling output is presented in Appendix B, Figure B.1 through Figure B.3.

A DEM derived from LiDAR data was then used to evaluate each potential site in terms of the range of existing elevations and with respect to the representative elevation used for the hydraulic model. This provided necessary insight for the conceptual design; that is, a given feature (selected bank-attached bar or island) has elevated regions within it that, when treated, will foster a diversity of habitats throughout the considered range of bounded flows. This allows for a more pointed and economical approach to construction, as extensive treatment of the feature is precluded in favor of focusing on the higher elevations and tying these into the lower areas.

Finally, each potential site was evaluated to specifically define the potential treatment areas and how those areas could be incorporated into the natural inundation and flow patterns of the larger site. In addition, areas of bankline bench lowering were refined and incorporated into the conceptual site design. These bankline benched areas will be lowered to foster additional high-flow habitat within the nominal reach of an excavator. Through this process, draft final site selection identified approximately 94 acres (38 ha) of potential restoration (not including sediment disposal locations).

These sites were then reviewed by Reclamation for potential unintended impacts to levees and other river infrastructure. Two sites were deleted from the list of potential restoration sites, and one site was revised to accommodate comments received from Reclamation. The NMISC and Tetra Tech then completed the restoration design and specifications and finalized the treatment footprint and identified sediment disposal areas for the restoration sites. Reclamation conducted a value engineering study. As a result, the final proposed restoration sites treatment footprint totals approximately 101 acres (41 ha) in the Belen, LP2DR, Feeder 3, and Storey subreaches. The total identified sediment disposal area is approximately 64 acres (26 ha)

Selected sites have the following characteristics:

- Are adjacent to wasteway outfalls or perennially wetted or frequently wetted sections of otherwise dry subreaches.
- Are likely to increase inundation frequency or expand inundation areas.
- Provide the potential to provide mesohabitat features currently lacking in the subreach.
- Are in areas of channel morphology that could take advantage of passive restoration techniques.
- Are unlikely to adversely affect or will improve suitable flycatcher habitat.
- Do not increase net depletions.

Riverine restoration techniques in the Isleta Reach are focused on restoring or creating the following mesohabitat features that will be inundated at a range of discharge flows representing dry, medium-flow, and high-flow years:

- Backwaters and embayments
- High-flow ephemeral channels
- Bankline benches and terraces
- Island and bar modification

3.0 RIVERINE RESTORATION TREATMENTS

Habitat restoration in the Isleta Reach will involve a combination of passive and active restoration practices. Passive restoration results when key ecological and geomorphological processes are restored. Active restoration practices are engineered approaches to artificially replace some aspect of lost ecosystem structure or function. Active restoration techniques depend more on human intervention and less on natural riverine processes to repair habitat function (Tetra Tech 2004). Though active restoration strategies rely on mechanical means to achieve the desired habitat restoration results, most of these techniques will also incorporate components of passive restoration. Active restoration will be implemented both in the channel and along the river's banks.

Each active restoration method presented involves the physical manipulation of a predetermined portion of the surface area of selected features with an amphibious excavator or land-based equipment such as a dozer, belly scraper, excavator, or backhoe. Treatments may involve the removal of vegetation, excavation to desired cut-depths, and distribution of sediment spoils. These treatments will generate woody debris and sediments that must be used on site or disposed of in accordance with the 404 permit. Deposition of sediment and vegetation spoils within the riparian areas, but specifically on islands and bank-attached bars, is not desirable because it will further disturb vegetation and raise the elevation of the island or bank-attached bar, which will reduce opportunities for saturation and inundation and create sites for non-native, weedy, herbaceous species establishment (such as Russian thistle [*Salsosa kali*], field bindweed [*Convolvulus arvensis*], Canada thistle [*Cirsium arvense*], etc). Therefore, new low-elevation habitat will be created adjacent to the islands and bank-attached bars within the active river channel using evenly distributed excess sediment and woody debris. Sediments and removed vegetation will be placed within silt barriers to prevent any sediments from falling into the channel. Vegetation is first placed along the inside of the silt barrier to slow the flow of water. Then, sediment is placed on top and adjacent to the sediment to fill the remaining space within the silt fence. Sediment spoils on bankline features will be spread evenly over the land surface to an uncompacted depth not to exceed 2 feet (0.6 m) and seeded with native grasses and forbs.

All treatment and control areas will be monitored for two years to determine the effectiveness of the methods implemented and identify any project-related hydrologic and geomorphic alterations. Reclamation has coordinated with the NMISC and plans to incorporate the NMISC's monitoring plan (Appendix C). Long-term monitoring (up to 10 years) and adaptive management will be coordinated with the Collaborative Program and will incorporate interagency objectives. After monitoring and natural reshaping, any restoration areas that remain void of native vegetation may be replanted with appropriate native species to stabilize the contours to the extent possible. Following restoration, the treated features are expected to have a surface elevation suitable for inundation at a range of river flows, representing dry, moderate, and high water years. Revegetation, whether natural or planted, will also provide suitable roughness to decrease flow velocities and increase egg and larvae retention.

A summary of the proposed techniques, their acreage impacted by each restoration technique (including sediment disposal locations), and the target flows for the inundation of the area after construction can be found in Table 3.1 through Table 3.4. Table 3.5 summarizes the treatment acres in each subreach. Refer to Figure 1.2 through Figure 1.4 for site locations. The restoration impacts analysis for each site, which takes into account the restoration treatment footprint, sediment disposal area, plus a 10% buffer area, can be found in Appendix D. Brief descriptions of the proposed techniques follow.

Table 3.1. Belen Subreach Proposed Sites and Treatment

ID	Sub-reach	Existing Inundation Discharge*	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)**
Bel-05	Belen	2,521	Backwater/Embayment	1,500	2.06	0.74
Bel-09	Belen	2,672	Backwater/Embayment	2,000	0.30	0.23
Bel-10	Belen	2,672	Backwater/Embayment	2,000	0.49	0.40
Bel-11	Belen	2,672	Backwater/Embayment	1,500	2.74	0.96
Bel-15	Belen	2,670	Backwater/Embayment	2,000	4.77	0.79
Bel-16	Belen	2,711	Backwater/Embayment	2,000	0.83	0.62
Bel-18	Belen	2,711	Backwater/Embayment	2,000	1.49	0.53
Bel-19	Belen	2,711	Backwater/Embayment	2,000	2.51	1.26
Backwater/Embayment Total					**15.19**	**5.53**
Bel-01	Belen	NA	Bankline Bench	2,200	0.80	0.71
Bel-04	Belen	NA	Bankline Bench	3,000	1.30	0.93
Bel-07	Belen	NA	Bankline Bench	3,000	2.25	0.71
Bel-12	Belen	NA	Bankline Bench	2,200	1.66	1.41
Bel-17	Belen	NA	Bankline Bench	3,000	2.39	1.34
Bankline Bench Total					**8.40**	**5.10**
Bel-02	Belen	2,521	Ephemeral Channel	1,500	0.46	1.07
Bel-08	Belen	NA	Ephemeral Channel	2,000	0.77	0.71
Bel-13 & 14	Belen	2,670	Ephemeral Channel	2,000	0.86	1.07
Ephemeral Channel Total					**2.09**	**2.85**
Bel-03	Belen	2,521	Island/Bar Modification	1,500	0.68	0.84
Bel-06	Belen	3,324	Island/Bar Modification	2,200	0.52	0.48
Island/Bar Modification Total					**1.20**	**1.32**
BELEN SUBREACH GRAND TOTAL					**26.88**	**14.81**

*** Existing inundation discharge, as defined by the HEC-RAS model, is not available for all sites.**

** Totals may not sum due to rounding.

Table 3.2. LP2DR Subreach Proposed Sites and Treatment

ID	Sub-reach	Existing Inundation Discharge*	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)**
LP2-05	LP2DR	NA	Backwater/Embayment	1,500	3.21	0.64
LP2-07	LP2DR	3,093	Backwater/Embayment	2,200	1.39	0.66
LP2-09	LP2DR	2,899	Backwater/Embayment	2,000	1.69	0.71
LP2-11	LP2DR	3,078	Backwater/Embayment	2,200	1.44	1.00
LP2-13	LP2DR	3,078	Backwater/Embayment	2,200	4.41	1.00
				Backwater/Embayment Total	**12.14**	**4.01**
LP2-02	LP2DR	NA	Bankline Bench	3,500	2.28	2.60
LP2-06	LP2DR	NA	Bankline Bench	3,000	0.51	0.31
LP2-08	LP2DR	3,093	Bankline Bench	2,200	0.25	0.10
				Bankline Bench Total	**3.04**	**3.01**
LP2-03	LP2DR	2,820	Ephemeral Channel	2,000	0.33	0.37
LP2-10	LP2DR	3,078	Ephemeral Channel	2,500	0.34	0.63
				Ephemeral Channel Total	**0.67**	**1.00**
LP2-04	LP2DR	2,820	Island/Bar Modification	2,000	1.10	0.72
LP2-12	LP2DR	3,078	Island/Bar Modification	1,500	1.68	1.00
				Island/Bar Modification Total	**2.78**	**1.72**
				LP2DR GRAND TOTAL	**18.63**	**9.75**

*** Existing inundation discharge, as defined by the HEC-RAS model, is not available for all sites.**
** Totals may not sum due to rounding.

Table 3.3. Feeder 3 Subreach Proposed Sites and Treatment

ID	Sub-reach	Existing Inundation Discharge*	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)**
Fe3-07	Feeder 3	2,504	Backwater/Embayment	1,500	1.27	0.70
				Backwater/Embayment Total	**1.27**	**0.70**
Fe3-04	Feeder 3	NA	Bankline Bench	3,500	3.99	3.17
Fe3-05	Feeder 3	NA	Bankline Bench	3,000	2.12	1.68
Fe3-08	Feeder 3	NA	Bankline Bench	3,000	2.78	2.30
				Bankline Bench Total	**8.89**	**7.15**
Fe3-01	Feeder 3	NA	Island/Bar Modification	2,500	2.17	1.85
Fe3-02	Feeder 3	2,960	Island/Bar Modification	2,200	2.24	1.06
Fe3-06	Feeder 3	3,034	Island/Bar Modification	1,500	1.89	1.68
				Island/Bar Modification Total	**6.30**	**4.59**
				FEEDER 3 SUBREACH GRAND TOTAL	**16.46**	**12.44**

*** Existing inundation discharge, as defined by the HEC-RAS model, is not available for all sites.**
** Totals may not sum due to rounding.

Table 3.4. Storey Subreach Proposed Sites and Treatment

ID	Sub-reach	Existing Inundation Discharge*	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)**
Str-04	Storey	2,252	Backwater/Embayment	1,500	3.63	1.50
Str-08	Storey	2,034	Backwater/Embayment	1,500	1.89	1.09
Str-10	Storey	2,497	Backwater/Embayment	1,500	1.04	0.24
Str-11	Storey	2,497	Backwater/Embayment	1,500	0.30	0.25
Str-12	Storey	2,497	Backwater/Embayment	1,500	1.04	0.53
Str-15	Storey	3,420	Backwater/Embayment	2,200	3.22	1.46
Backwater/Embayment Total					**11.12**	**5.08**
Str-01	Storey	NA	Bankline Bench	2,500	4.08	3.54
Str-02	Storey	NA	Bankline Bench	2,500	4.41	3.51
Str-03	Storey	NA	Bankline Bench	3,000	0.91	1.01
Str-05	Storey	NA	Bankline Bench	3,000	5.87	6.14
Str-07	Storey	NA	Bankline Bench	3,000	4.37	4.03
Bankline Bench Total					**19.64**	**18.23**
Str-09	Storey	4,234	Island/Bar Modification	1,500	2.53	1.44
Str-13	Storey	3,097	Island/Bar Modification	2,200	2.61	1.04
Str-14	Storey	3,097	Island/Bar Modification	2,200	3.19	1.21
Island/Bar Modification Total					**8.33**	**3.69**
STOREY SUBREACH GRAND TOTAL					**39.09**	**27.00**

*** Existing inundation discharge, as defined by the HEC-RAS model, is not available for all sites.**
** Totals may not sum due to rounding.

Table 3.5. Subreach Summary – Proposed Sites and Treatment

Subreach	Backwater/ Embayment (acres)	Bankline Benches (acres)	Ephemeral Channels (acres)	Island/Bar Modification (acres	Total* (acres)
Belen	20.72	13.50	4.94	2.52	**41.69**
LP2DR	16.15	6.05	1.67	4.50	**28.38**
Feeder 3	1.97	16.04	0.00	10.89	**28.90**
Storey	16.20	37.87	0.00	12.02	**66.09**
Total	**55.05**	**73.47**	**6.61**	**29.93**	**165.06**

* Total area includes treatment footprint and sediment disposal areas.
Note: Totals may not sum due to rounding.

3.1 Treatment 1: Backwater/Embayment

The creation of moderate- to high-flow backwater and embayment areas will involve the removal of riverbank and island vegetation and the excavation of soils to prescribed depths. Backwater areas (e.g., no upstream inlet) will be constructed on the downstream end of large point bars, already low-velocity areas, at a range of elevations. This allows for inundation at a range of river flows (Figure 3.1 and Figure 3.2). Backwater areas will slope slightly, with the downstream end lower in elevation than the upstream end, increasing the amount of habitat opportunities at a range of river flows. Backwaters can also be terraced to create two distinct target inundation discharges.

This treatment is being used to increase the amount of shallow, low-velocity habitat. The creation of backwaters and embayments are intended to retain drifting silvery minnow eggs and provide habitat for developing silvery minnow larvae.

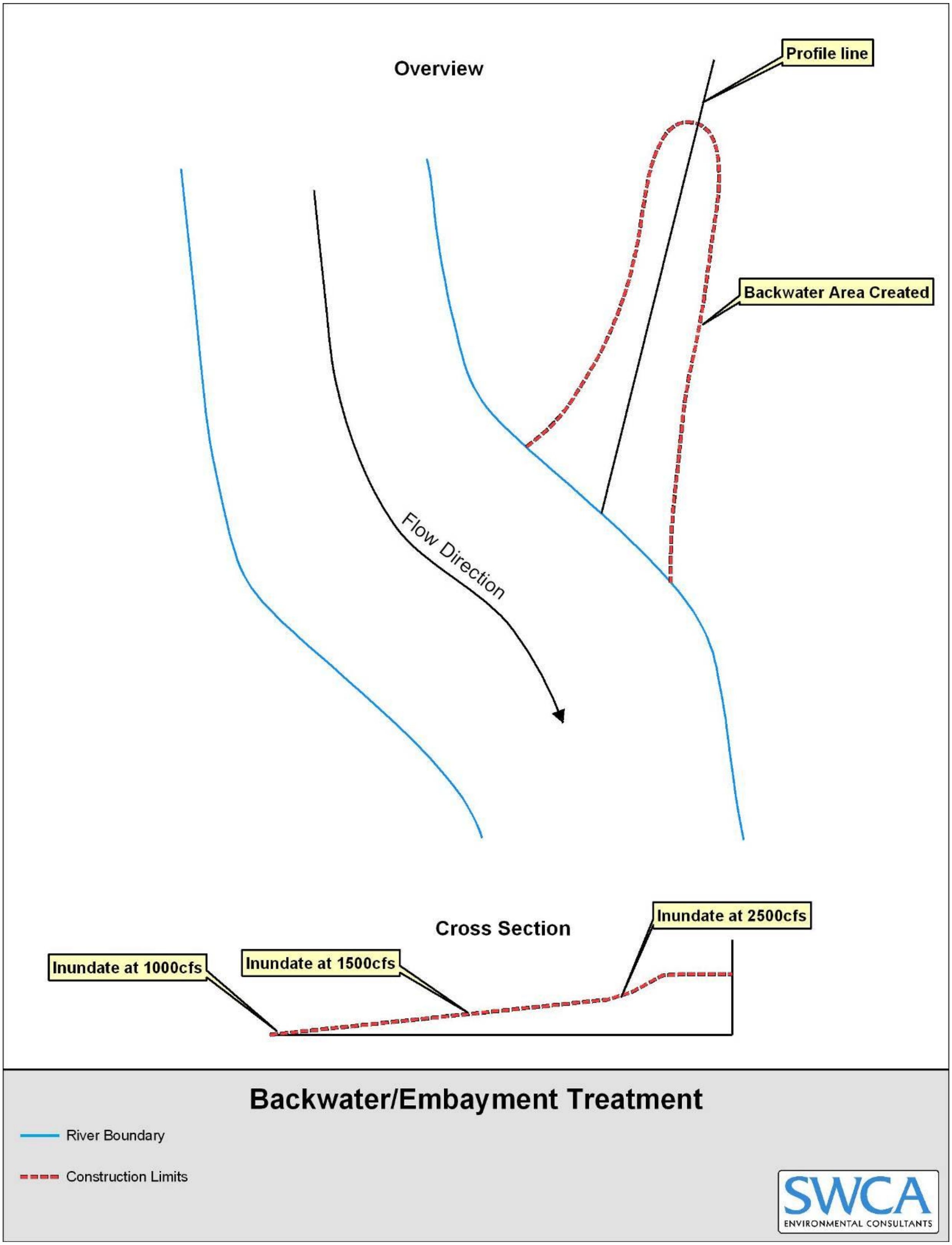

Figure 3.1. Backwater/Embayment schematic design.

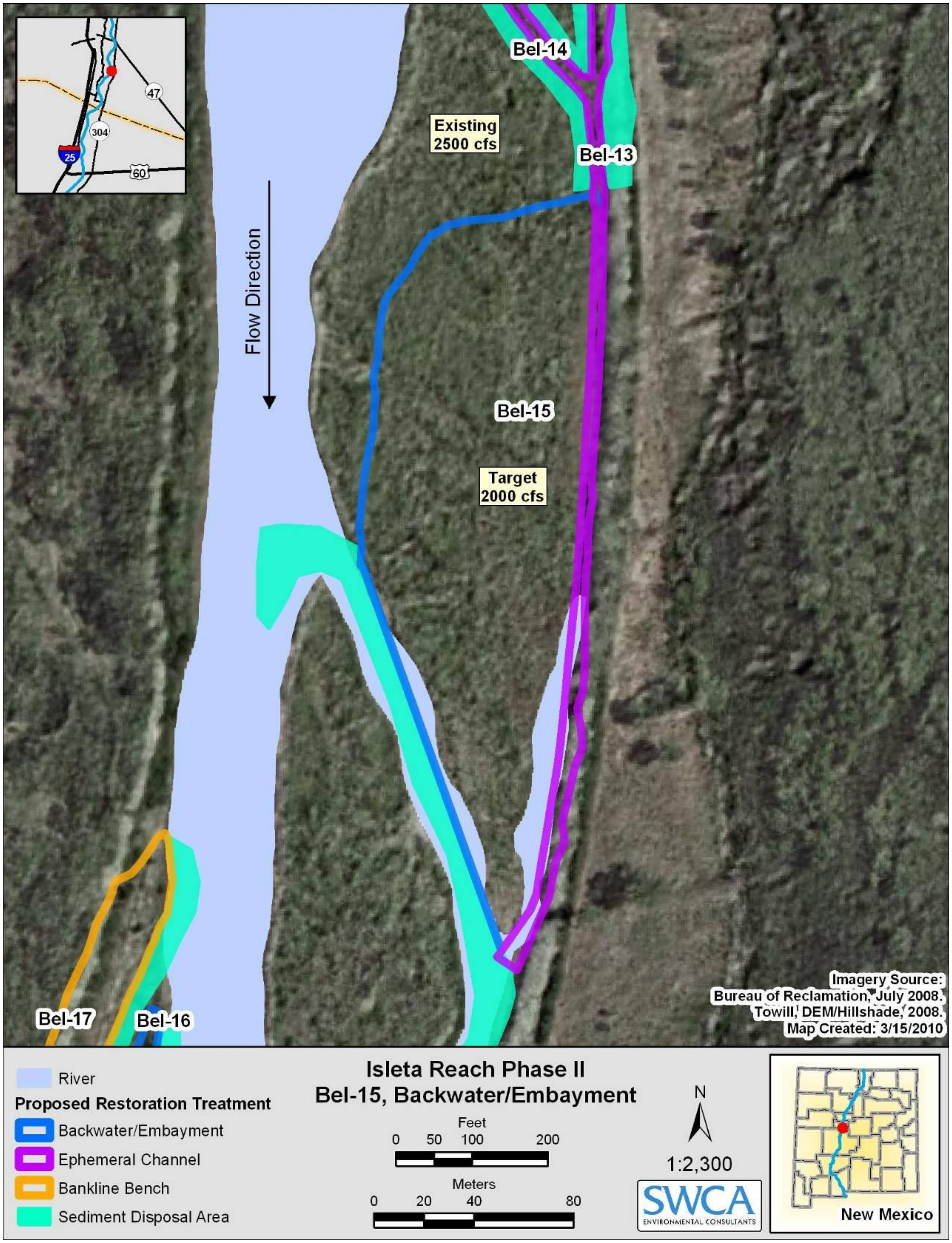

Figure 3.2. Backwater/Embayment example.

3.2 TREATMENT 2: BANKLINE BENCHES

The creation of bankline benches involves lowering the bank through the removal of bankline vegetation and the excavation of soils to increase the potential for overbank flooding (Figure 3.3 and Figure 3.4). The target elevation for excavated and terraced banks varies depending on the height of the bank, the bank-full level, and the target inundation discharge frequency and duration. Bankline benches will be created in areas where the removal of the naturally formed berms that often exist along the banks could increase inundation in the overbank areas.

Bankline benches will be inundated during different stages of moderate to high flows (non-annual events) and will increase the frequency and duration of inundation. However, the overbank areas will not remain flooded for significant periods of time and will not be intended to provide mesohabitat for adult silvery minnow. Conversely, bankline benches are expected to provide additional low-velocity habitat, resulting in improved egg retention and larval fish development during periods of high river flow.

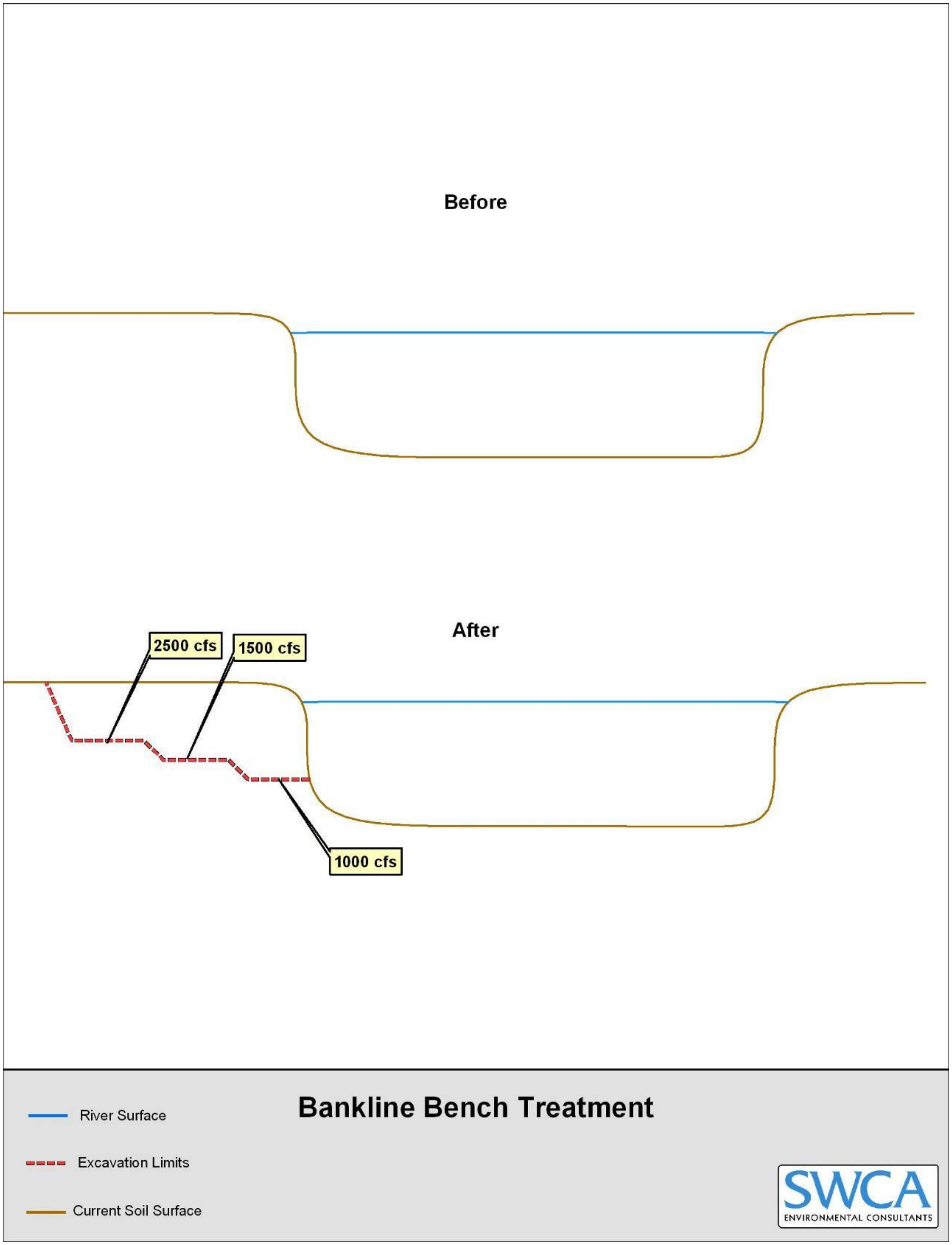

Figure 3.3. Bankline bench schematic design.

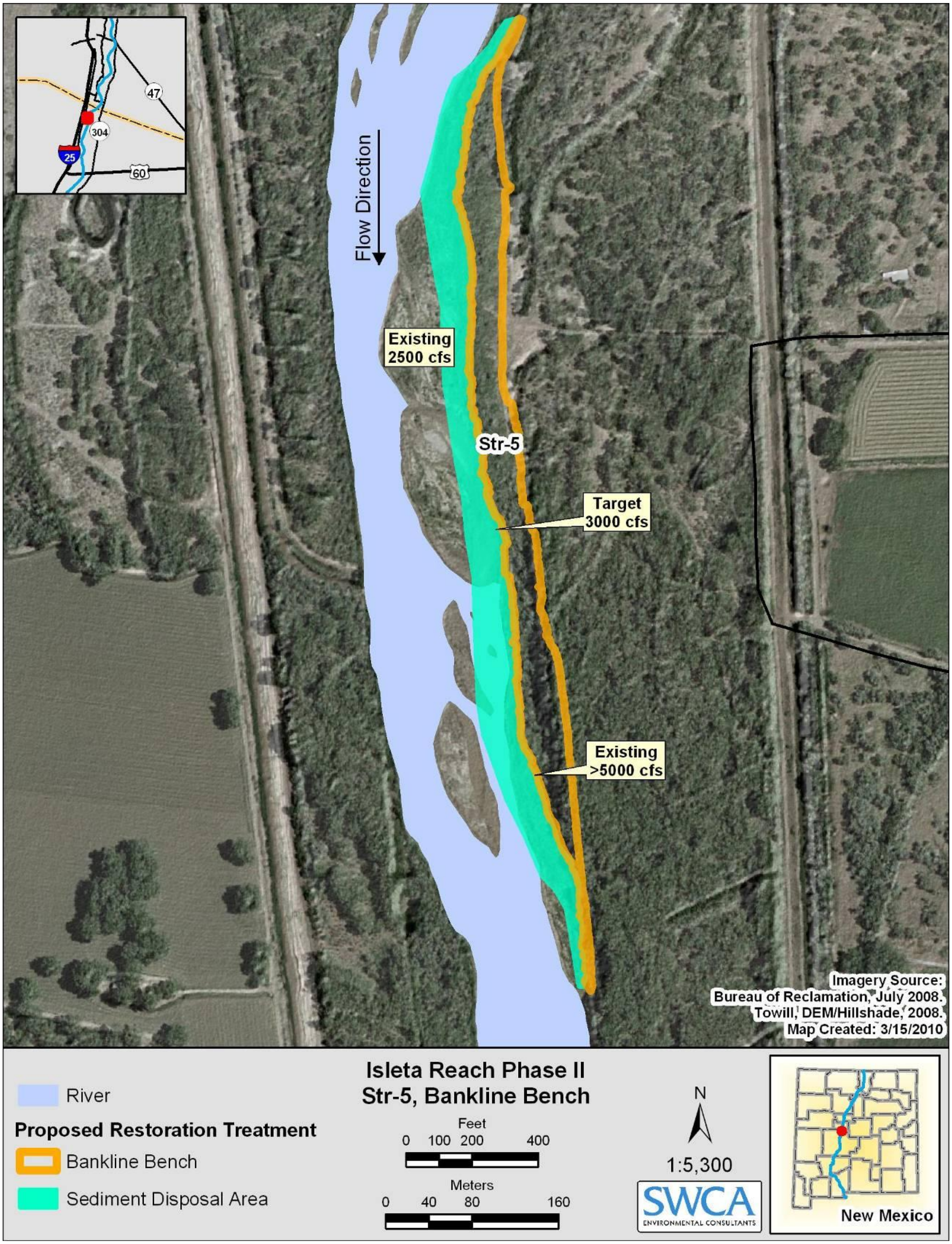

Figure 3.4. Bankline bench example.

3.3 Treatment 3: Ephemeral Channels

Ephemeral channels are low-velocity, flow-through channels that are connected to the main river channel across bars and islands. These channels are normally dry but carry high-discharge flow from the main channel during spring snowmelt and summer monsoon events. The channels carry water at lower velocities than the main channel and may include mesohabitats, such as pools and backwaters with little to no flow. Ephemeral channels are not intended to provide for overbank flooding. Construction of an ephemeral channel requires removal of existing vegetation and will cause the disturbance of some sediment or soil. The channels will be cut through islands, banks, and bars to a depth that will allow water to flow at moderate to high river flows (Figure 3.5 and Figure 3.6). The design of the ephemeral channels will consider the river height and velocity at which water enters the channel and water retention times.

Ephemeral channels create aquatic habitat beneficial to the silvery minnow. The target inundation elevations will accommodate flows to encourage silvery minnow recruitment each year. Ephemeral channels could provide sufficient periods of inundation for larval development and refugia for young silvery minnow. These side channels will dry during lower flows and will not be designed to provide habitat for adult silvery minnow. While channels of this kind are proposed primarily to enhance silvery minnow habitat, they also promote riparian functionality and interconnectedness.

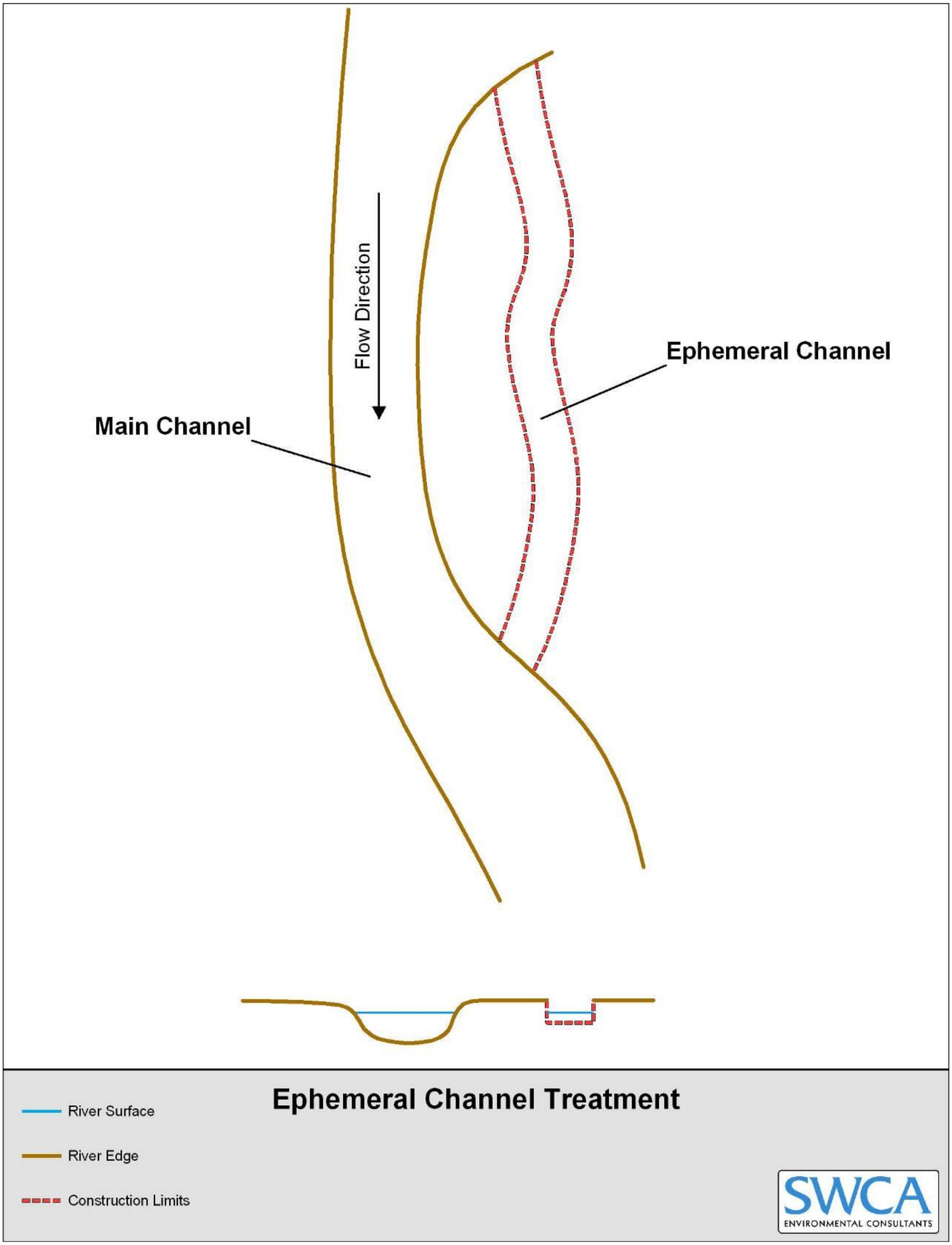

Figure 3.5. Ephemeral channel schematic design.

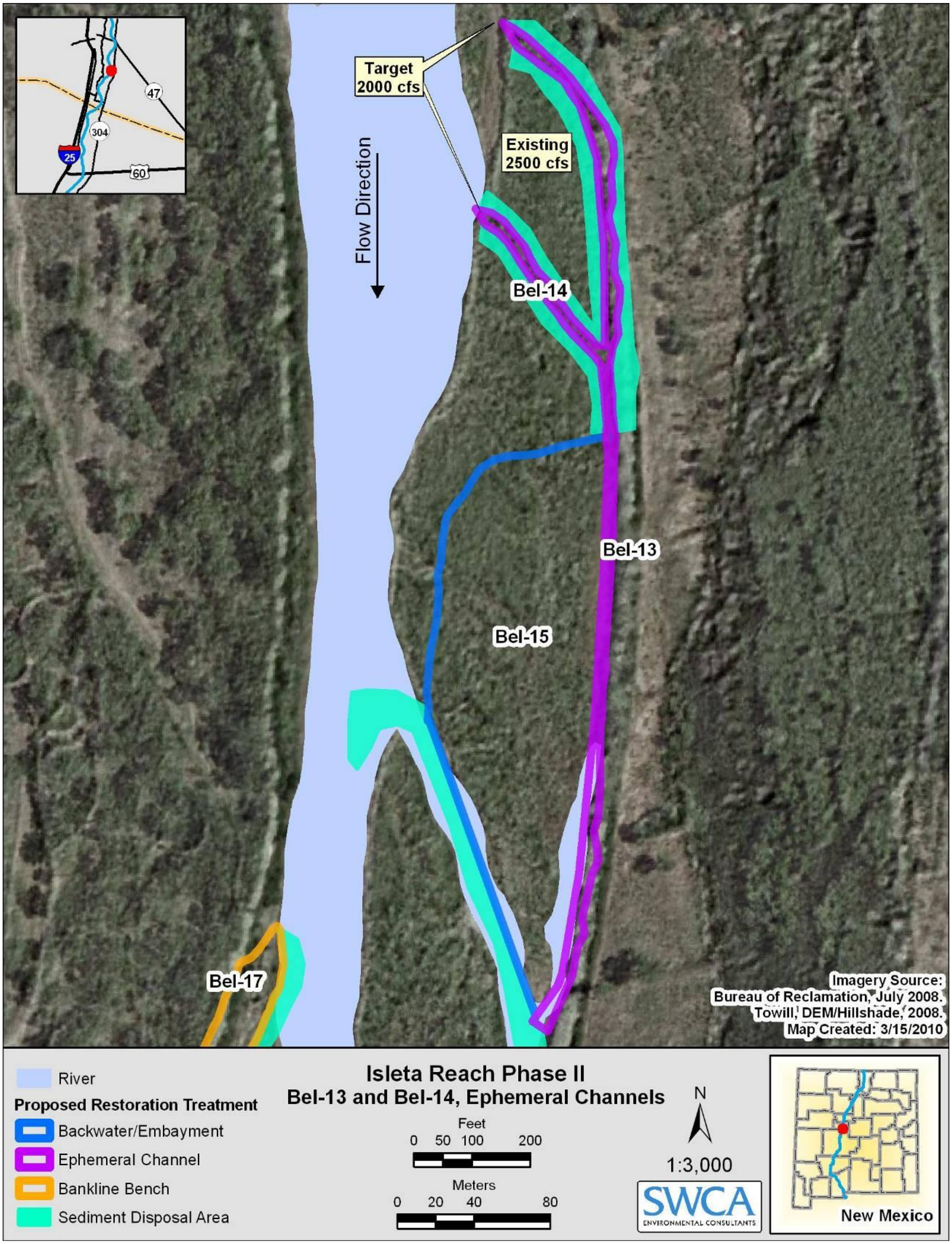

Figure 3.6. Ephemeral channel example.

3.4 Treatment 4: Island/Bar Modification

The island/bar modification technique will be targeted to those features that are infrequently inundated, are stabilized by vegetation, or otherwise are armoring and thus are resistant to sediment mobilization. These bank-attached bars and islands have the potential to become or have already become permanent channel features. Modifying these features may assist in alleviating adverse changes to silvery minnow critical habitat and improving the quality and quantity of available habitat (USFWS 2003). Islands will be modified by planned physical disturbance, such as removing vegetation (including the root mass) and destabilizing soil (Tetra Tech 2004) or through creating shelves that are inundated at a lower discharge. Treated islands will be allowed to naturally expand or contract in response to flows and available sediment load. Island/bar modification will also increase the potential for redeposition of sediment in downstream subreaches of the Rio Grande. Sediment removed as a result of the modification may be placed in the river behind silt fences (Figure 3.7 and Figure 3.8). Reclamation will collaborate with the USACE for island modifications to ensure all 401 and 404 permits are obtained and the proposed actions comply with all elements of the Clean Water Act (CWA).

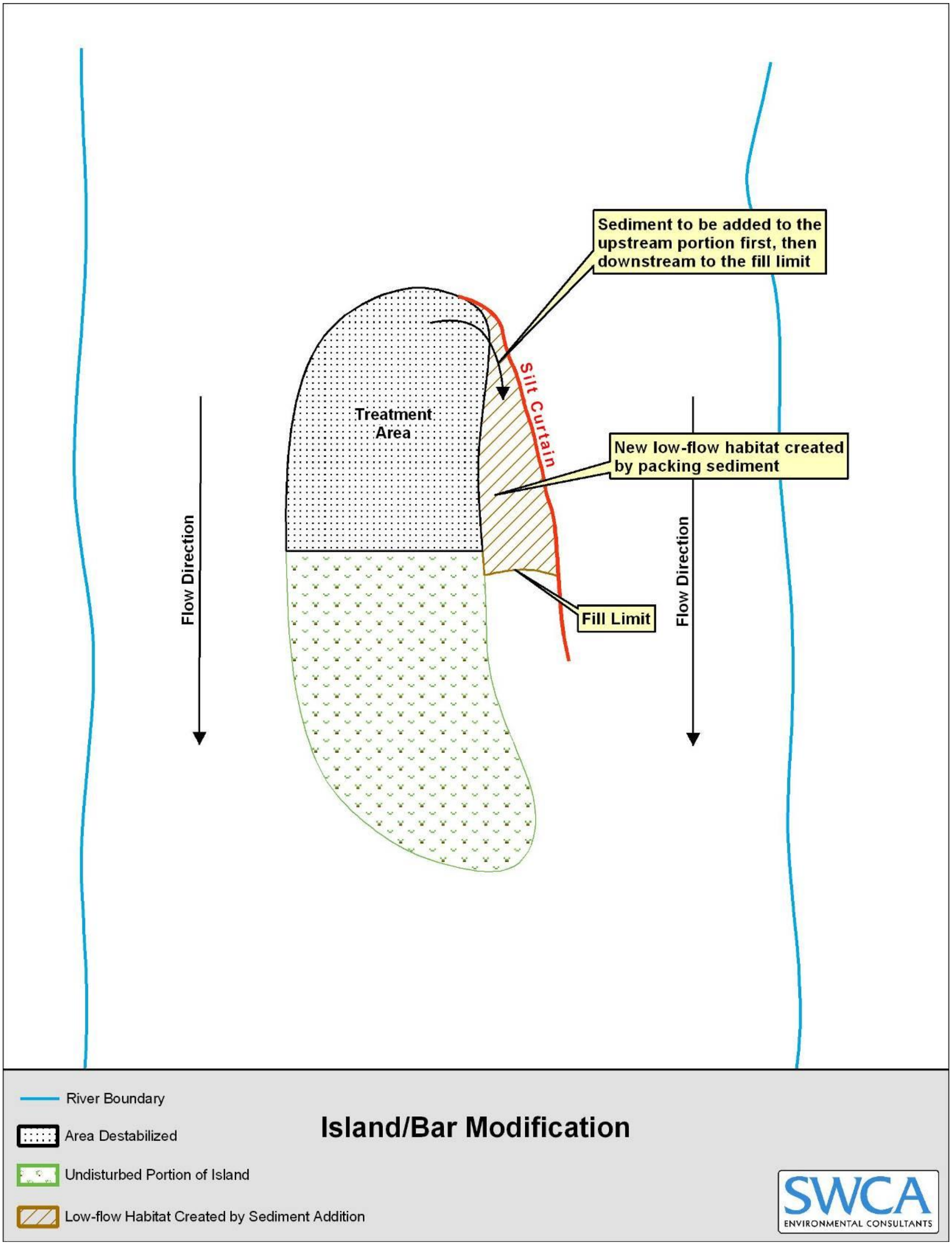

Figure 3.7. Island/Bar modification schematic design. Schematic illustrates sediment dispersal contained within silt curtains installed into the channel.

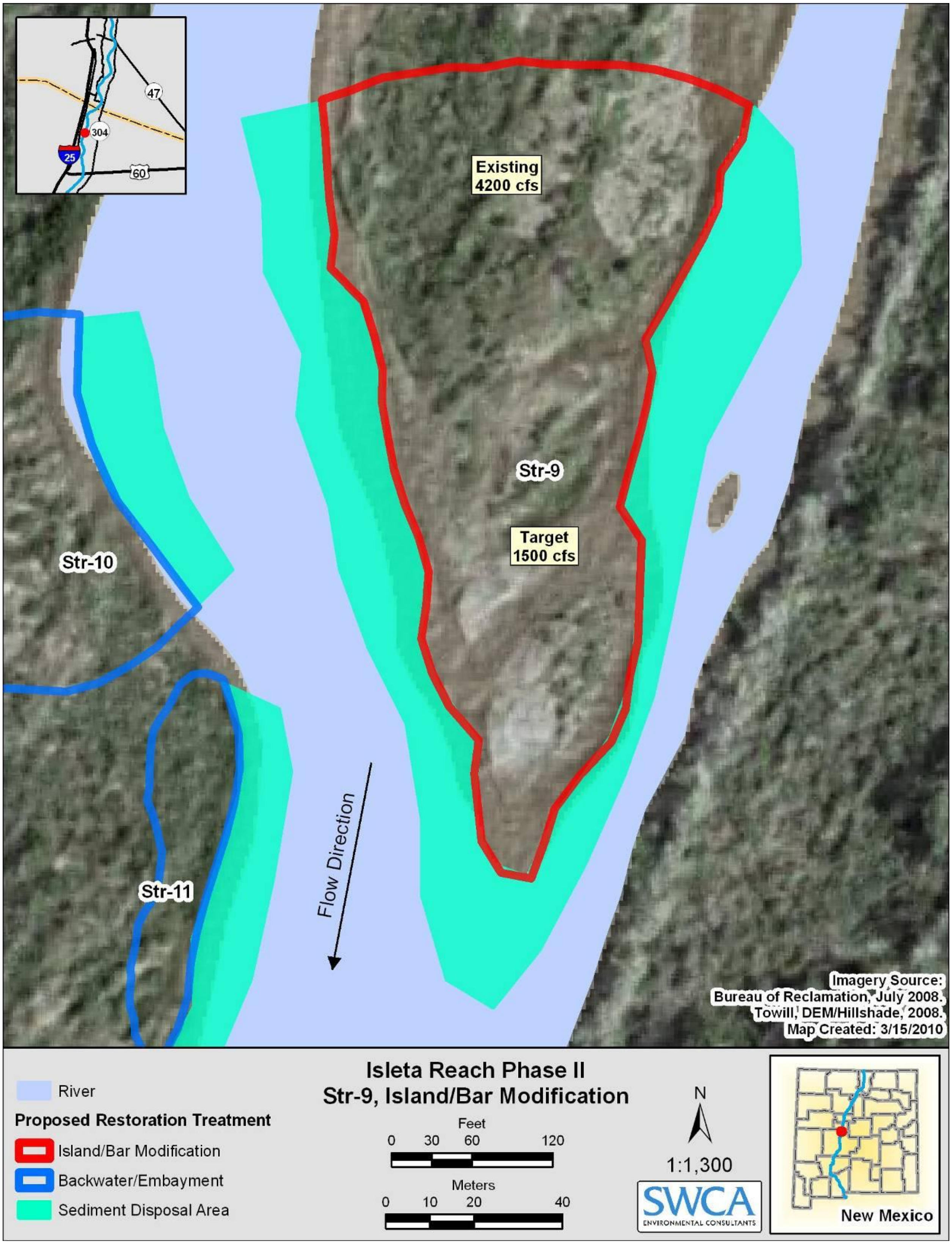

Figure 3.8. Island/Bar modification example.

4.0 EQUIPMENT, STAGING, AND ACCESS

4.1 STAGING AND ACCESS

Equipment and personnel staging and access locations for the four subreaches are shown in Figure 4.1 through Figure 4.3. Designated access routes will be over existing roads and trails; no new roads will be constructed. No mature native vegetation will be removed and construction will occur outside the flycatcher breeding season. All wetlands will be avoided by construction equipment. Work will be scheduled to minimize crossing the river channel. To prevent the mixing of sediments with surface pools and runoff in each of the subreaches, access paths that minimize travel distances in wetted pools or flowing water will be predetermined. Water quality parameters, primarily turbidity, will be measured prior to and after river crossing.

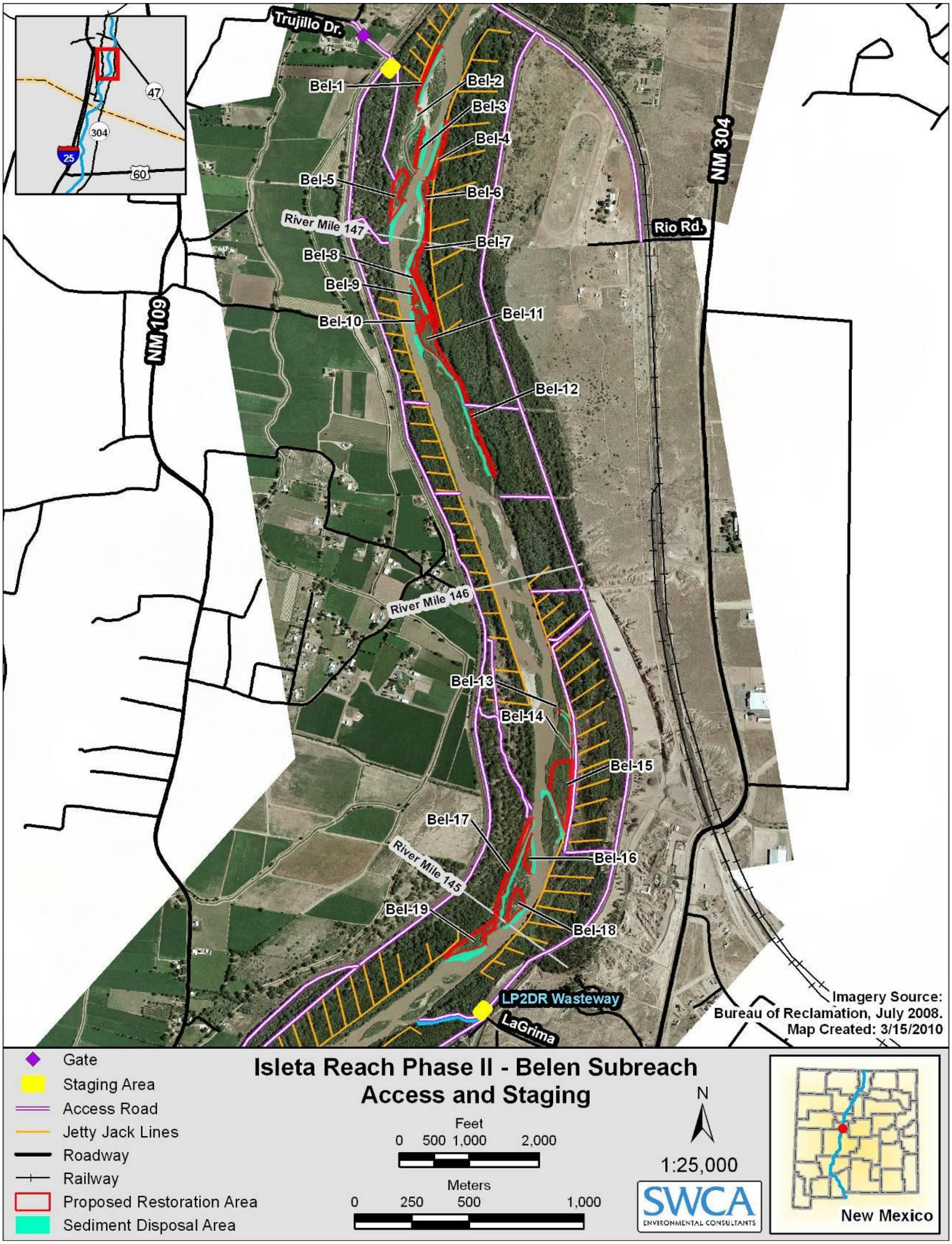

Figure 4.1. Belen Subreach access and staging.

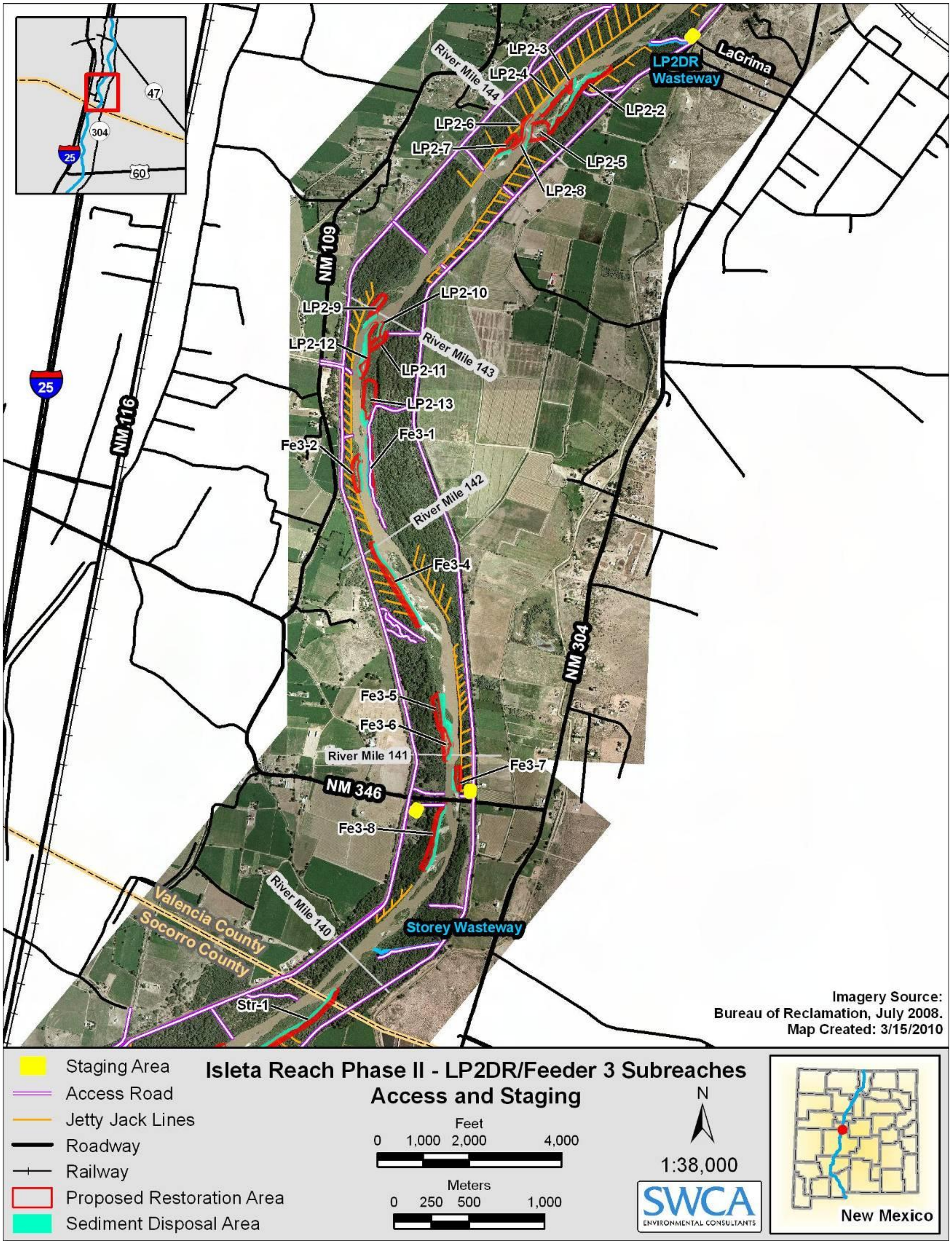

Figure 4.2. LP2DR and Feeder 3 Subreach access and staging.

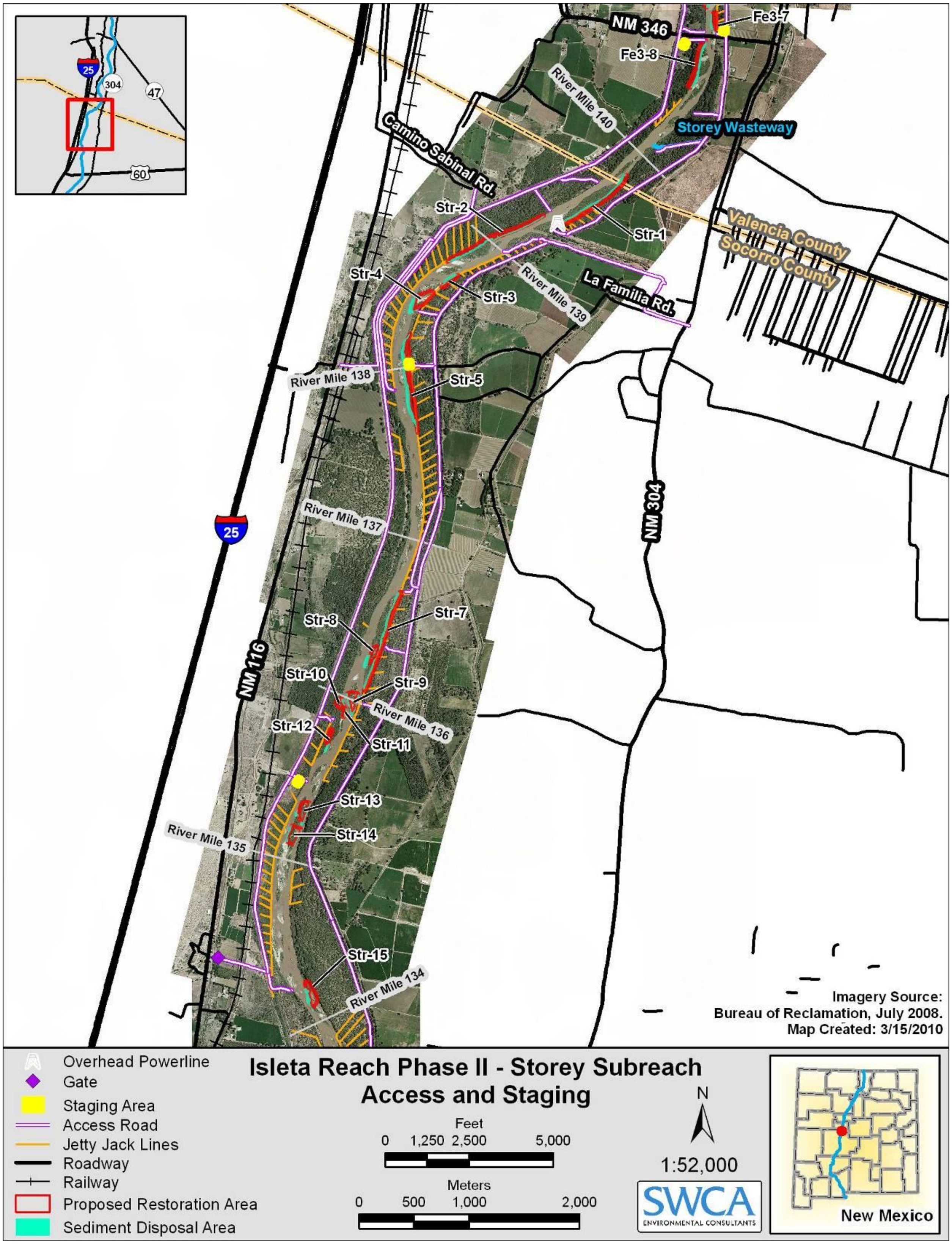

Figure 4.3. Storey Subreach access and staging.

4.2 EQUIPMENT

Equipment proposed for construction on point bars and banks accessible from the shore may include a dozer, an excavator, or a backhoe. For islands and less accessible banks and bars, an amphibious-type excavator capable of crossing the river at low flows will be used (Figure 4.4). Personnel and other equipment may be transported using air boats (Figure 4.5). It is preferable to use low-impact amphibious equipment for work in the river, wetlands, and other sensitive aquatic sites where ecological disturbance, including disturbance to the silvery minnow, must be kept to a minimum. The preferred amphibious equipment is designed to disperse weight and minimize impact of the treads when operating in water. The amphibious excavator is about 18 feet (5.5 m) wide and 34 feet (10 m) long, and is equipped with a 60-foot (18-m) boom, allowing the machine to perform extensive work with a minimal footprint. The gross pressure of the excavator is 1.7 pounds per square inch (psi) and the maximum speed of the machine is 1.2 miles per hour (mph) (1.9 km per hour) on level ground and 1 mph (1.6 km per hour) in water.

To successfully and safely implement all habitat restoration activities, the construction contractor will be held to the following safety precautions and construction specifications:

- All equipment will be steam-cleaned before arriving and departing the job site.
- Prior to leaving contractor facilities, all equipment will be thoroughly inspected, and any leaky or damaged hydraulic hoses will be replaced.
- To avoid any potential impacts to silvery minnow or flycatcher critical habitat, all fuels, hydraulic fluids, and other hazardous materials will be stored outside the normal floodplain and refueling will take place on dry ground with a spill kit ready. Extra precautions will be taken when refueling because of the environmentally sensitive location.
- A spill kit will be maintained on every rig in the river, with spill pans, containment diapers, oil booms, absorbent pads, oil mats, plastic bags, gloves, and goggles. Equipment operators will be trained to use the spill kits.
- Steel-mesh guards will cover all external hydraulic lines.
- Each individual operator will be briefed and will sign off on local environmental considerations specific to the project tasks, including specific Stormwater Pollution Prevention Plans (SWPPPs).
- Water quality testing will be conducted prior to entering the water and periodically during the operating day to ensure that standards are being maintained. Water quality parameters to be tested include pH, temperature, dissolved oxygen, and turbidity, both upstream and downstream of the work area. Responses to changes in water quality measures exceeding the applicable standards will include reporting the measurements to the New Mexico Environment Department Surface Water Quality Bureau and returning equipment to shore.
- Equipment operation will minimize sediment displacement by river flow.

Figure 4.4. Example of amphibious-type excavation equipment.

Figure 4.5. Air boat.

5.0 AFFECTED SPECIES INFORMATION

5.1 RIO GRANDE SILVERY MINNOW (*HYBOGNATHUS AMARUS*)

The silvery minnow was federally listed as endangered under the ESA on July 20, 1994 (Federal Register [FR] 1994), and is listed as endangered by the State of New Mexico. The final recovery plan for the silvery minnow was released in July 1999 (USFWS 1999). The primary objectives of the decision are to increase numbers of silvery minnow, enhance its habitat in the MRG valley, and expand its current range by re-establishing the species in at least three other areas in its historic range (USFWS 2003).

Critical habitat was designated on February 19, 2003 (FR 2003). The critical habitat designation extends from Cochiti Dam downstream to the utility line crossing the Rio Grande upstream of the Elephant Butte Reservoir delta in Socorro County, excluding all pueblo lands. Thus, the project area lies entirely within the critical habitat designation.

The silvery minnow is a moderate-sized, stout minnow that reaches 3.5 inches (9 cm) in total length and spawns in the late spring and early summer, coinciding with high spring snowmelt flows (Sublette et al. 1990). The silvery minnow is omnivorous, feeding primarily on diatoms (Shirey 2004; Magaña 2007). These fish travel in schools and tolerate a wide range of habitats (Sublette et al. 1990), but generally prefer low-velocity areas (<0.33 feet per second [10 cm/second]) over silt or sand substrate that are associated with shallow (<15.8 inches [40 cm]) braided runs, backwaters, or pools (Dudley and Platania 1997). Adults are most commonly found in backwaters, pools, and habitats associated with debris piles, whereas young-of-year occupy shallow, low-velocity backwaters with silt substrates (Dudley and Platania 1997). Habitat includes stream margins, side channels, and off-channel pools where water velocities are low or reduced from main channel velocities. Stream reaches dominated by straight, narrow, incised channels with rapid flows are not typically occupied by silvery minnow (Bestgen and Platania 1991).

The species is a pelagic spawner that produces 3,000 to 6,000 semi-buoyant, non-adhesive eggs during a spawning event (Platania 1995; Platania and Altenbach 1998). There may be more than one spawning peak during spring runoff and increased summer monsoon flows (USFWS 2003). Eggs and larvae may drift for three to five days and be transported from 134 to 223 miles (216–359 km) downstream (Platania 1995). Recent data from augmentation and relocation projects suggest that dispersal of eggs, larvae, and older age classes is usually less than 10 miles (15 km) (Remshardt and Davenport 2003; Porter and Massong 2004; Dudley et al. 2005). Silvery minnow larvae can be found in low-velocity habitats where food (mainly phytoplankton and zooplankton) is abundant and predators are scarce.

Platania (1995) suggests that historically the downstream transport of eggs and larvae of the silvery minnow over long distances was likely beneficial to the survival of species populations. The spawning strategy of releasing floating eggs allows recolonization of reaches impacted during periods of natural drought (Platania 1995). The results of two egg drift studies (Widmer et al. 2007) suggest that egg retention in the Isleta Reach is higher than in the Albuquerque Reach, with bead retention rates during the high-flow ascending limb and the constant high-flow experiments. It is thought the greater egg retention rates in the Isleta Reach may be a result of differences in channel geomorphology and the size and numbers of inundated areas; the Isleta Reach shows a greater area of inundated vegetated surface areas. These results are consistent with Porter and Massong (2006), who have found that bead retention is generally highest in flooded shoreline areas (e.g., benches and shelves) and on flooded island and sand bar surfaces.

Results from an SWCA (Hatch and Gonzales 2008) fisheries monitoring study at the Los Lunas Habitat Restoration Project site suggests that floodplain inundation provides important spawning habitat. To be effective, floodplain inundation must be sustained to exceed a threshold that provides adequate time for parental stock to occupy the floodplain, for embryos to develop and hatch, and for young-of-year to develop at least to the juvenile stage to enable fish evacuation when the floodplain drains (Hatch and Gonzales 2008). The conclusions of this study support a working hypothesis that silvery minnow adaptively and preferentially spawn in low water exchange habitats and that restoration of inundated floodplains is a plausible strategy, along with the creation of backwater and other hydrologic retentive floodplain habitats, to minimize the downstream displacement of eggs and larvae (Hatch and Gonzales 2008).

Swimming studies demonstrate that the silvery minnow can traverse distances equivalent to 30 miles (50 km) in 72 hours (Bestgen et al. 2003). Bestgen et al. (2003) have also recorded silvery minnow speed bursts up to 100 to 120 cm/second (60.0–72.0 m/minute) for periods of 5 to 15 seconds.

The 2003 Biological Opinion (USFWS 2003) lists the following primary constituent elements of silvery minnow critical habitat:

1. Throughout silvery minnow life history, a hydrologic regime that provides sufficient flowing water with low to moderate currents capable of forming and maintaining a diversity of aquatic habitats, such as backwaters, shallow side channels, pools, eddies, and runs of varying depth and velocity. These characteristics are necessary for silvery minnow life-history stages in given seasons (e.g., habitat with sufficient flows from early spring [March] to early summer [June] to trigger spawning; flows in the summer [June] and fall [October] that do not increase prolonged periods of low or no flow; and relatively constant winter flow [November through February]).
2. The presence of eddies created by debris piles, pools, or backwaters, or other refuge habitat within unimpounded stretches of flowing water of sufficient length (river miles) to provide a variety of habitats with a wide range of depths and velocities.
3. Substrates predominantly of sand or silt.
4. Water of sufficient quality to maintain natural, daily, and seasonally variable water temperatures in the approximate range of more than 1 degree Celsius (ºC) (35 degrees Fahrenheit [ºF]) and less than 30ºC (85ºF) and to mitigate degraded conditions (e.g., decreased dissolved oxygen, increased pH).

Silvery minnow populations have been surveyed in the Isleta Reach since 1994 on an ongoing basis by the American Southwest Ichthyological Research Foundation (Dudley et al. 2006; Dudley and Platania 2007a, 2007b, 2008, 2009), Reclamation, the NMISC, and the USFWS. In 2004, an increased abundance of silvery minnow was observed (Dudley et al. 2005). This observed increase shows that population data vary temporally and geographically. Monitoring early in 2005 revealed low silvery minnow numbers (Dudley et al. 2006); however, numbers rose drastically in June 2005 and remained high into 2006. High spring flows in 2007 and 2008 appeared to stimulate spawning, which resulted in relatively high silvery minnow numbers (Dudley and Platania 2007a, 2008). In these years, the Isleta Reach consistently records greater numbers and proportions of silvery minnow collected (Dudley and Platania 2007a, 2007b, 2008). Most specimens were collected in low-velocity habitats, such as shoreline and backwater areas (Dudley and Platania 2007a, 2007b, 2008). The 2009 October sampling results indicate that the Isleta Reach continues to support silvery minnow populations (N = 327) in the MRG during the fall monitoring period (Dudley and Platania 2009). A recent study (Hatch et al. 2008) monitored silvery minnow densities and water quality parameters daily in the channel, as well as in any isolated pools during periods of dewatering, in both the Isleta and San Acacia reaches. Isolated pools were seined daily to monitor silvery minnow populations in relation to other species. Silvery minnow were found in some of the pools in the Isleta Reach.

5.2 SOUTHWESTERN WILLOW FLYCATCHER (*EMPIDONAX TRAILLII EXTIMUS*)

The flycatcher was listed as endangered without critical habitat designation on February 27, 1995 (FR 1995). Critical habitat was designated on July 22, 1997 (FR 1997) but was later withdrawn. In October 2004, the USFWS proposed a new extent of critical habitat, which was finalized in October 2005 (FR 2004). The historic range of the flycatcher includes riparian areas throughout Arizona, California, Colorado, New Mexico, Texas, Utah, and Mexico (FR 1993). The flycatcher is an insectivore that forages in dense shrub and tree vegetation along rivers, streams, and other wetlands (USFWS 2003) and prefers dense riparian thickets, typically willows (*Salix* sp.) with a scattered cottonwood overstory. Dense riparian woodlands are particularly important as breeding habitat.

The extent of critical habitat within Valencia and Socorro counties extends from the southern Isleta Pueblo boundary for 44.2 miles (71.1 km) to the northern boundary of Sevilleta National Wildlife Refuge (FR 2005). Thus, the project area lies entirely within the critical habitat designation. As described in the 2003 Biological Opinion, declining flycatcher numbers have been attributed to loss, modification, and fragmentation of riparian breeding habitat; loss of wintering habitat; and brood parasitism by the brown-headed cowbird (*Molothrus ater*) (USFWS 2003). Habitat loss and degradation are caused by a variety of factors, including urban, recreational, and agricultural development; water diversion and groundwater pumping; and channelization, dams, and livestock grazing.

In 2005, three flycatchers were detected at the Los Lunas Restoration Project site close to the proposed project area, and six flycatchers were detected at areas within the Isleta Reach between the Los Lunas and Belen bridges. All these detections occurred in late May and early June 2005; however, since no detections were made in subsequent surveys, it is believed that the flycatchers were probably migrants (Siegle 2005). During surveys by Reclamation, 30 flycatchers were observed between the Los Lunas and Belen bridges in 2005, 28 in 2006, and 44 in 2007 (Moore and Ahlers 2006a, 2006b). However, no flycatchers were fledged from nests in this subreach in 2005 or 2006 (Moore and Ahlers 2006a, 2006b). During the Reclamation surveys in 2008, 77 flycatchers were detected in the Isleta Reach from the Belen Bridge to the U.S. 60 Bridge. All of these observed flycatchers were migrants except for two lone males. Surveys conducted in 2009 in the same area from the Belen Bridge to U.S. 60 Bridge yielded 26 flycatchers, all of which were migrants. The closest known breeding populations observed in 2008 and 2009 that could serve as sources for flycatcher dispersal into the proposed sites are 6.5 miles (10.5 km) south of the last restoration site in the Storey Subreach (Reclamation 2010).

5.3 PECOS SUNFLOWER (*HELIANTHUS PARADOXUS*)

The Pecos sunflower (*Helianthus paradoxus*) was afforded threatened species status under the ESA, as amended, on October 20, 1999 (FR 1999). The Pecos sunflower is the only sunflower capable of growing directly in the saturated soils of spring-fed, saline desert wetlands. These wetlands are most commonly desert springs and seeps that form wet meadows called cienegas. These are rare wetland habitats in the arid Southwest region (Hendrickson and Minckley 1984). The soils of these desert wetlands are typically saline or alkaline because the waters are high in dissolved solids and high rates of evaporation leave deposits of salts, including carbonates, at the soil's surface. Soils in these habitats are predominantly silty clays or fine sands with high organic matter content. Studies by Van Auken and Bush (1997, 1998) show that Pecos sunflower grows in saline soils, but seeds germinate and establish best when precipitation and high water tables reduce salinity near the soil's surface. Like all sunflowers, this species requires open areas that are not shaded by taller vegetation (USFWS 2005).

Incompatible land uses, habitat degradation and loss, and groundwater withdrawals are historic and current threats to the survival of Pecos sunflower. The loss or alteration of wetland habitat is the main threat. The lowering of water tables through aquifer withdrawals for irrigated agriculture and municipal use, diversion of water from wetlands for agriculture and recreational uses, and wetland filling for conversion to dry land uses destroyed or degraded desert wetlands before the Pecos sunflower was listed as threatened.

The Pecos sunflower was not observed on the restoration sites during field investigations conducted in July 2009. No further analysis will be conducted.

6.0 ANALYSIS OF THE EFFECTS OF THE ACTION

The analysis of effects is conducted for the Isleta Reach Phase II Riverine Habitat Restoration Project. Effects analysis for the silvery minnow and the flycatcher are discussed below and are presented in Table 6.1. To assist the USFWS in its analysis of incidental take, an impacts analysis matrix containing site-specific information, including area (acres), buffer area (acres), construction time (days), and total area impact estimate (acre-days), is presented in Appendix D.

Table 6.1. Effects Determination

Restoration Treatment	Effect	Silvery Minnow	Flycatcher
Backwater/ Embayment	Direct	Harassment, temporary critical habitat disturbance, and vegetation removal during construction; long-term critical habitat benefit	No direct impacts to the flycatcher are expected because construction will take place outside April 15 to August 15
	Indirect	Temporary water quality impairment during construction	Short-term disturbance to the area during construction of existing riparian vegetation
Bankline Benches	Direct	Harassment, temporary critical habitat disturbance, and vegetation removal during construction; long-term critical habitat benefit	No direct impacts to the flycatcher are expected because construction will take place outside April 15 to August 15
	Indirect	Temporary water quality impairment during construction	Short-term disturbance to the area during construction of existing riparian vegetation
Ephemeral Channels	Direct	Harassment, temporary critical habitat disturbance, and vegetation removal during construction; long-term critical habitat benefit	No direct impacts to the flycatcher are expected because construction will take place outside April 15 to August 15
	Indirect	Temporary water quality impairment during construction	Short-term disturbance to the area during construction of existing riparian vegetation
Island/Bar Modification	Direct	Harassment, temporary critical habitat disturbance, and vegetation removal during construction; long-term critical habitat benefit	No direct impacts to the flycatcher are expected because construction will take place outside April 15 to August 15
	Indirect	Temporary water quality impairment during construction	Short-term disturbance to the area during construction of existing riparian vegetation

6.1 RIO GRANDE SILVERY MINNOW (*HYBOGNATHUS AMARUS*)

Silvery minnow critical habitat encompasses the entire project area (FR 2003). The species has declined as a result of impacts from dewatering, channelization, and flow regulation; diminished water quality; and competition/predation by non-native species (FR 1994). The primary objective of the Proposed Action is to improve habitat for the silvery minnow based on the best available information. The project will provide long-term direct and indirect beneficial effects on the silvery minnow and its critical habitat in the Isleta Reach. Beneficial effects of the Proposed Action supporting different life stages of the species include egg and larval retention, potential increased recruitment rates, and increased survival of both young-of-year and adults. The described techniques will be implemented in phases and monitored for achievement of restoration goals. This BA covers the effects implementation in the Belen, LP2DR, Feeder 3, and Storey subreaches only.

6.1.1 DIRECT EFFECTS

Direct effects to the silvery minnow and its critical habitat may occur during the construction phase from the disturbance and removal of vegetation or the possibility of harm from the associated equipment operation. Although the risk of direct effects on silvery minnow in the vicinity of the restoration sites is very low, as described below, such risk cannot be ruled out entirely. A conservative interpretation indicates the possibility for harassment to occur as a result of implementation of the proposed restoration treatments.

The creation of the in-channel low-flow habitats, such as backwaters and embayments, bankline benches, and ephemeral channels, will be accomplished through excavating to desired cut depths to enable inundation at the target inundation discharge. Sediment spoils and debris will be placed in the river behind silt curtains to contain the sediments while they are being put in place and compacted. Work will proceed by filling and compacting the upstream portion of the contained area first and allowing displaced water and fish to move out of a downstream opening.

The anticipated wetted disturbance area for calculating incidental take during construction is presented in Table 6.2. The disturbance area for riverine restoration treatments includes the footprint of the proposed feature plus a 10% buffer. The buffer is intended to include the wetted area affected by the excavator bucket and the estimated area occupied by the silt curtains. The construction time was estimated for each proposed restoration feature. The total area impact is the impact area multiplied by the construction time. The wetted area construction impacts for each subreach are summarized in Appendix D, Table D.1 through Table D.4

Table 6.2. Total Wetted Disturbance Area (to be used for calculating incidental take)

Activity	Belen Subreach (acres)	LP2DR Subreach (acres)	Feeder 3 Subreach (acres)	Storey Subreach (acres)	Total* (acres)
Riverine Habitat Restoration	110.38	90.02	89.89	297.52	587.80
River Channel Crossing	0.92	0.73	0.40	1.13	3.19

*Total disturbance area = (treatment area + sediment disposal area + 10% disturbance area) x number of construction days. Refer to Appendix D for details.

While accessing the islands, the amphibious excavator will be in partial contact with the river bottom. In water more than 3 feet (1 m) deep, the amphibious excavator will be in full flotation, and fish movement will not be impeded. In shallower water, the equipment will move along the riverbed surface. The average speed of the amphibious excavator is approximately 1 mph (1.6 km per hour), or 85 feet (26 m) per minute. In comparison, the silvery minnow is capable of swimming up to 232.3 feet (70.8 m) per minute (118 cm/second) (Bestgen et al. 2003) and can readily avoid the equipment as it moves through the river channel. The slow speed, vibrations, and noise of the amphibious equipment, combined with the silvery minnow's high swimming speed and access to the water column around the equipment, make it unlikely that any silvery minnow will be physically harmed by the equipment. Wherever possible, equipment will operate on the riverbanks, bars, and islands to avoid contact with silvery minnow habitats. A work schedule to efficiently move equipment will be implemented to minimize crossings of the river.

The effects analysis is based on an estimate of the number of river crossings required for each subreach, the width of an amphibious excavator, and the average wetted channel width at low flow conditions. Table 6.3 summarizes the estimated impacted area due to river crossings.

Table 6.3. River Crossing Impact Analysis

Subreach	# Crossings	Excavator Width	Wetted Channel Width (feet)	Impact Area per Crossing (square feet)	Total Impact Area (square feet)	Total Impact Area (acre)*
Belen	10	18	223	4,014	40,140	0.92
LP2DR	7	18	253	4,554	31,878	0.73
Feeder 3	4	18	245	4,410	17,640	0.40
Storey	9	18	304	5,472	49,248	1.13
				Total	**138,906**	**3.19**

* Totals may not sum due to rounding.

6.1.2 WATER QUALITY EFFECTS

Indirect harm or mortality from reduced water quality in the critical habitat of the silvery minnow may occur from accidental introduction of hydrocarbon contaminants from fuel and fluids used by the proposed equipment. Protection of hydraulic lines will prevent punctures during operation. All fueling activities will take place outside the active floodplain, and all equipment will undergo thorough cleaning and inspection prior to daily operation. Excavator personnel are trained and equipped for emergency spill prevention and cleanup, with detailed specifications to prevent any accidental introduction of hazardous materials into the river channel. Equipment will be parked at predetermined locations on high ground overnight. Upstream gages will be monitored during the days prior to and during operation in the channel, and equipment will be removed from the channel in the event of high storm surges detected at the upstream gages. No effects on silvery minnow are expected to result from contamination related to equipment fueling and leakage or accidental spills.

Disturbance of contaminated sediments may occur when equipment is crossing wetted portions of the river channel to access in-channel treatment areas. The general commitment to take the shortest path in crossing the wetted portion of the channels, to avoid crossing during high flows, and to install silt fences to prevent the downstream dispersal of disturbed sediments and allow sediments to resettle before the curtains are removed will avoid any unintended water quality effects. Water quality parameters, including dissolved oxygen, will be monitored before the silt fences are installed and equipment crosses the river. The silt fencing will be removed only after the water quality returns to within 10% of original levels. Since direct access into the channel will be off of dry banks, transfer of any contaminated sediments on the equipment tracks will be minimized.

Some disturbance of the subsurface sediments in the river channel will occur as the equipment travels to the in-channel treatment areas. The temporary suspension of sediments by amphibious caterpillars at operational flows (<1,000 cfs) is less than normal suspended sediment levels at higher flows (>3,000 cfs). When moving in shallow water, the low-psi tracks of the equipment may disturb the water-sediment interface slightly. When traveling in deep water (>3 feet [1 m]), the equipment will float and use its boom with an attached bucket to propel itself forward. Sediment has the potential to be transported when the excavator's bucket secures itself to the riverbed to pull itself forward. The bucket is about 4 feet (1.2 m) wide, and disturbances may increase local turbidity within the water column in deep water. The suspended sediments should settle quickly at projected flows. Water quality will be monitored before, during, and after equipment operation in the channel. The dispersed effects of and limited increase in turbidity will be negligible and unlikely to affect the silvery minnow, since individuals can move to avoid short-term water quality effects. Effects to turbidity and dissolved oxygen will be monitored at both locations. No effects to the silvery minnow are anticipated.

6.2 SOUTHWESTERN WILLOW FLYCATCHER (*EMPIDONAX TRAILLII EXTIMUS*)

6.2.1 DIRECT EFFECTS

Although the project area is within designated critical habitat, there are no known flycatcher nesting territories within the project area. The closest known breeding populations observed in the 2008 and 2009 surveys that could serve as sources for flycatcher dispersal into the proposed sites are 6.5 miles (10.5 km) south of the last restoration site in the Storey Subreach (Hector Garcia, Reclamation, personal communication, SWCA, October 29, 2009). Vegetation data and mapping (Appendix E) were also used in a USFWS Resource Category analysis to determine the potential impacts on the flycatcher (Appendix F).

Short-term potential effects on the flycatcher during construction will be related to temporary noise and disturbance during the migratory and nesting season. Project construction is proposed to take place outside the migratory and breeding season and will therefore not directly affect the species. To minimize impacts to this and other riparian species, clearing and grubbing of woody vegetation will take place between August 15 and April 15. Because there may be annual variation in breeding cycles, Reclamation will consult with the USFWS if work will be planned within two weeks before April 15 or after August 15 and will conduct additional surveys if warranted to determine the presence of breeding flycatchers or other breeding birds. Riparian vegetation will be removed along bank-attached bars and islands. No potential losses to critical habitat will occur because dense willow-dominated riparian vegetation that is at the appropriate height and sufficient area to support flycatcher nesting sites will be avoided.

6.2.2 INDIRECT EFFECTS

Indirect effects to the flycatcher may occur from riparian vegetation removal; however, dense willow-dominated riparian vegetation sufficient to support flycatchers will not be disturbed. In the MRG, flycatchers are known to form territories and nest in very dense riparian vegetation ranging in height from about 12 to 29 feet (3.7–8.8 m) (Moore and Ahlers 2004) with a very dense twig structure in proximity to water. These habitats are most frequently dominated by willow but may also contain cottonwood, Russian olive, and/or saltcedar.

Vegetation modification on the riverine restoration sites will total approximately 87 acres (35 ha), mostly consisting of mixed native and exotic riparian species less than 15 feet (4.6 m) tall, dominated by coyote willow (*Salix exigua*), cottonwood, and Russian olive.

6.3 Cumulative Effects

Cumulative effects include those of ongoing and future state, tribal, local, or private actions that are reasonably certain to occur in the action area. In the Isleta Reach there are many state, local, and private entities and landowners, as well as the Isleta Pueblo, that are participating with the federal agencies in the Collaborative Program and implementing projects outside the Collaborative Program to improve the riparian and riverine conditions along the MRG. The Collaborative Program will continue to fund habitat restoration projects and conduct research that will benefit the silvery minnow and the flycatcher. Activities in the project area include the Isleta Reach Phase I Riverine Habitat Restoration Project (USFWS 2009) to increase recruitment habitat in the floodplain and the Middle Rio Grande Conservancy District (MRGCD) Post-fire Bosque Restoration in the Middle Rio Grande: a Landscape-Scale Approach Towards Revitalization of an Ecosystem project near the former Willie Chavez State Park in Belen (MRGCD 2008). The actions proposed for the current project will complement previous habitat restoration in the Isleta Reach and are consistent with planning recommendations (Tetra Tech 2004; Parametrix et al. 2008) developed by the Collaborative Program. The result will be to expand the area of quality habitat.

Other activities that affect silvery minnow and flycatcher habitat conditions and water quality along the MRG include:

- Municipal wastewater discharges;
- Urban and agricultural runoff;
- Chemical use for vegetation control and crops;
- Recreation along and in the riparian zone, which can be compounded by urban growth;
- Stocking of exotic and predator fish;
- Industrial growth along the river; and
- Riparian clearing without a revegetation plan that could affect both the silvery minnow and the flycatcher and their habitat.

7.0 EFFECT DETERMINATIONS: AFFECTED SPECIES

7.1 RIO GRANDE SILVERY MINNOW (*HYBOGNATHUS AMARUS*)

The direct effects of the riverine restoration treatments are limited to small, isolated areas and a short disturbance time period. The use of a silt curtain when constructing shallow water habitats along the perimeter of islands will minimize any possibility of trapping, injuring, or causing mortality to the silvery minnow. An opening in the silt curtain on the downstream end of the shallow habitat creation areas and placement and packing of fill (sediment and debris) from the upstream end (against the silt curtain) to the downstream end will allow the silvery minnow to escape the treatment area. As a result, no direct or indirect adverse effects to designated critical habitat of the silvery minnow are expected to occur. Implementation of the Proposed Action is expected to provide long-term benefits to the silvery minnow through increasing the amount and diversity of mesohabitats within the project subreaches.

There is risk of harm or harassment to silvery minnow in the immediate area during construction due to the heavy equipment moving and operating in the river channel near silvery minnow populations, which have been identified in the project area in sustained numbers. Surveys conducted in September 2009 in the Isleta Reach resulted in a catch of 284 silvery minnows from a sampling effort of 3,053.8 m^2 (32,870.8 square feet) (9.3 silvery minnows per 100 m^2). Surveys conducted in October 2009 resulted in a catch of 327 silvery minnows within 4,031.4 m^2 (43,393.6 square feet), which is estimated to be equivalent to 8.1 silvery minnows per 100 m^2 (Dudley and Platania 2009). Although silvery minnow present near the work area will be able to move freely in the water column to avoid direct contact, uncertainty regarding silvery minnow behavior in the presence of heavy equipment operating in the channel must be acknowledged. Guidelines discussed in Section 8.0, Environmental Commitments, will be employed to minimize the potential for any short-term effects during the implementation of this project.

The Proposed Action may affect but is not likely to adversely affect critical habitat for the silvery minnow. A risk of harming silvery minnow cannot be ruled out during construction. The project may affect and is likely to adversely affect the silvery minnow. Therefore, Incidental Take is requested.

7.2 SOUTHWESTERN WILLOW FLYCATCHER (*EMPIDONAX TRAILLII EXTIMUS*)

The Proposed Action may affect but is not likely to adversely affect the flycatcher and its critical habitat. Potential short-term effects may result from vegetation removal within the project area. In addition, the short-term disturbance of vegetation that occurs during habitat restoration activities has been found to promote an increase in native vegetation after restoration activities are completed (SWCA 2008c). Best Management Practices (BMPs) discussed in Section 8.0 will be implemented to avoid or minimize any potential effects to the flycatcher or its critical habitat. Frequent flooding on bars and islands disturbs young or newly established vegetation through scouring and deposition processes. Since the project proposes to restore native willow-dominated communities in disturbed areas, no long-term adverse effects should be experienced.

8.0 ENVIRONMENTAL COMMITMENTS

Silvery minnow and flycatcher critical habitat designations encompass the entire project area (FR 1997, 2003). BMPs will be enforced by Reclamation to minimize potential direct impacts to the silvery minnow and the flycatcher and potential short-term impacts to critical habitat. All necessary permits for access points, staging areas, and study sites will be acquired by Reclamation prior to any construction activity. Access coordination has begun with the MRGCD. Reclamation shall have responsibilities for complying with the following environmental commitments.

1. Impacts to terrestrial habitats will be minimized by using existing roads and cleared staging areas. In general, equipment operation will take place in the most open area available, and all efforts will be made to minimize damage to native vegetation and wetlands.
2. Construction and clearing of dense woody vegetation and vegetated islands will be scheduled between August 15 and April 15 to avoid direct impacts protected by the Migratory Bird Treaty Act and to avoid potential short-term impacts to the flycatcher. This construction period is outside the normal breeding season for the flycatcher and most avian species. Because there may be annual variation in breeding cycles, Reclamation will consult with the USFWS if work will be planned within two weeks before April 15 or after August 15 and will conduct additional surveys if warranted to determine the presence of breeding flycatchers or other breeding birds.
3. Silt fencing will be installed downstream of any site where equipment crossings take place, such as in canals, arroyos, or drains. Water quality will be monitored by Reclamation before silt fencing is installed, and the fencing will not be removed until water quality has returned to within 10% of the original measures.
4. Stormwater discharges under the Proposed Action will be limited to ground-disturbing activities outside the mean high water mark. All such activities will be evaluated for compliance with National Pollutant Discharge Elimination System (NPDES) guidance, an NPDES permit, or an SWPPP.
5. All work will be conducted within the active channel; therefore net depletions are not expected. Additional evaluation of the net depletion effects of each proposed technique will be included in the monitoring of project elements. Restoration techniques that are determined to increase net depletion to the surface waters of the Rio Grande will have appropriate depletions offset as determined by the New Mexico Office of the State Engineer.
6. As-built plan and profile maps will be developed after treatment but before high flows.
7. All treatment and control areas will be monitored for two years to determine the effectiveness of the methods implemented and identify any project-related hydrologic and geomorphic alterations. Long-term monitoring (up to 10 years) and adaptive management will be coordinated with the Collaborative Program.

9.0 LITERATURE CITED

Bestgen, K.R., and S.P. Platania. 1991. Status and conservation of the Rio Grande silvery minnow *Hybognathus amarus*. Southwestern Naturalist 36: 225–232.

Bestgen, K.R., B. Mefford, J. Bundy, C. Walford, B. Compton, S. Seal, and T. Sorensen. 2003. Swimming Performance of Rio Grande Silvery Minnow. Final Report to U.S. Bureau of Reclamation, Albuquerque Area Office, New Mexico. Colorado State University, Larval Fish Laboratory Contribution 132.

Dudley, R.K., and S.P. Platania. 1997. Habitat Use of the Rio Grande Silvery Minnow. Report to U.S. Bureau of Reclamation, Albuquerque.

———. 2007a. Summary of Rio Grande Silvery Minnow Monitoring and Program Results from July 2007. Report to the U.S. Bureau of Reclamation, Albuquerque.

——— 2007b. Summary of Rio Grande Silvery Minnow Monitoring and Program Results from October 2007. Report to the U.S. Bureau of Reclamation, Albuquerque.

——— 2008. Summary of the Rio Grande Silvery Minnow Monitoring and Program Results from July 2008. Report to the U.S. Bureau of Reclamation, Albuquerque.

——— 2009. Summary of the Rio Grande Silvery Minnow Population Estimation Program Results from October 2009. Report to the U.S. Bureau of Reclamation, Albuquerque.

Dudley, R.K., S.J. Gottlieb, and S.P. Platania. 2005. 2004 Population Monitoring of Rio Grande Silvery Minnow, *Hybognathus amarus*. Final Report for the U.S. Bureau of Reclamation. American Ichthyological Research Foundation, Albuquerque.

Dudley, R.K., S.P. Platania, and S.J. Gottleib. 2006. Summary of the Rio Grande Silvery Minnow Population Monitoring Program Results from December 2005 (12-16 December 2005). Report to the Middle Rio Grande Endangered Species Collaborative Program, Albuquerque.

Federal Register (FR) 1981. U.S. Fish and Wildlife Service Mitigation Policy. January 23, 1981. Vol. 46, No. 15. pp. 7656–7663. U.S. Fish and Wildlife Service.

———. 1993. Endangered and Threatened Wildlife and Plants: Proposed Rule to List the Southwestern Willow Flycatcher as Endangered with Critical Habitat. Vol. 58, No. 140/Wednesday, June 23, 1993/Proposed Rule. pp. 39495–39522.

———. 1994. Endangered and Threatened Wildlife and Plants: Final Rule to List the Rio Grande Silvery Minnow as an Endangered Species. Vol. 59, No. 138 / Wednesday, July 20, 1994 / Final Rule. pp. 36988–36995.

———. 1995. Endangered and Threatened Wildlife and Plants; Final Rule Determining Endangered Status for the Southwestern Willow Flycatcher. Volume 60, No. 38 / Monday, February 27, 1995 / Final Rule. pp. 10694–10715.

———. 1997. Endangered and Threatened Wildlife and Plants: Final Determination of Critical Habitat for the Southwestern Willow Flycatcher. Vol. 62, No. 140 / Tuesday, July 22, 1997 / Final Rule. pp. 39129–39147.

———. 1999. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Plant *Helianthus paradoxus* (Pecos Sunflower). Volume 64, No. 202 / Wednesday, October 20, 1999 / Final Rule. pp. 56581–56590.

———. 2003. Endangered and Threatened Wildlife and Plants: Designation of Critical Habitat for the Rio Grande Silvery Minnow. Vol. 68, No. 33 / Wednesday, February 19, 2003 / Final Rule. pp. 8087–8135.

———. 2004. Endangered and Threatened Wildlife and Plants: Proposed Designation of Critical Habitat for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*); Proposed Rule. Vol. 69, No. 196 / Tuesday, October 12, 2004. pp. 60706–60786.

———. 2005. Endangered and Threatened Wildlife and Plants: Designation of Critical Habitat for the Southwestern Willow Flycatcher (*Empidonax traillii extimus*); Final Rule. Vol. 69, No. 201/Wednesday, October 19, 2005. pp. 60886–61009.

Fluder, J.J. 2004. Human Modification of the Upper Middle Rio Grande: Using GIT Techniques to Measure Change between Albuquerque and Cochiti Dam, New Mexico. Arizona-Nevada Academy of Science – Hydrology and Water Resources in Arizona and the Southwest, Proceedings of the 2003 Meetings of the Hydrology Section, Flagstaff.

Hatch, M.D., and E. Gonzales. 2008. Los Lunas Habitat Restoration Fisheries Monitoring. Prepared for the U.S. Bureau of Reclamation, Albuquerque.

Hatch, M.D., E. Gonzales, J.J. Fluder, and J. Welch. 2008. 2007 Bureau of Reclamation Experimental Activities on the Middle Rio Grande. Project Summary Report. Prepared for the U.S. Bureau of Reclamation, Albuquerque.

Hendrickson, D.A., and W.L. Minckley. 1984. Cienegas - vanishing climax communities of the American southwest. Desert Plants 6(3):131–175.

Hink, V.C., and R.D. Ohmart. 1984. Middle Rio Grande Biological Survey. U.S. Army Corps of Engineers, Albuquerque District, New Mexico. Contract No. DACW47-81-C-0015, Arizona State University, Tempe.

Hudson, P.F. 2005. Natural levees. Encyclopedia of Water Science DOI: 10.1081/E-EWS-120038052. Taylor and Francis

Magaña, H.A. 2007. A Case for Classifying the Rio Grande Silvery Minnow (*Hybognathus amarus*) as an Omnivore. University of New Mexico Dissertation.

Middle Rio Grande Conservancy District (MRGCD). 2008. Post-fire Bosque Restoration in the Middle Rio Grande: a Landscape-Scale Approach Towards Revitalization of an

Ecosystem. Proposal to the Collaborative Forest Restoration Program, U.S. Forest Service, Albuquerque.

Milford, E., E. Muldavin, and Mann, K. 2006. Vegetation Sampling for the Middle Rio Grande: Re-sampling the 1984 Hink and Ohmart Transects. Progress Report to the U.S. Army Corps of Engineers. Natural Heritage New Mexico Report- 06-GTR-294.

Milford, E., E. Muldavin, and T. Neville. 2008. Middle Rio Grande River Bar Vegetation Map III: Belen to San Acacia. Natural Heritage New Mexico Report- 08-GTR-334.

Moore, D., and D. Ahlers. 2004. 2003 Southwestern Willow Flycatcher Study Results: Selected Sites along the Rio Grande from Highway 60 to Elephant Butte Reservoir. U.S. Department of the Interior, Bureau of Reclamation. Technical Service Center. Ecological Planning and Assessment, Denver.

———. 2006a. 2005 Southwestern Willow Flycatcher Study Results: Selected Sites along the Rio Grande from Velarde, New Mexico, to the headwaters of Elephant Butte Reservoir. Report to the U.S. Bureau of Reclamation, Albuquerque.

———. 2006b. 2006 Southwestern Willow Flycatcher Study Results: Selected Sites along the Rio Grande from Velarde, New Mexico to the headwaters of Elephant Butte Reservoir. Report to the U.S. Bureau of Reclamation, Albuquerque.

Mussetter Engineering, Inc. (MEI). 2002. Geomorphic and Sedimentologic Investigations of the Middle Rio Grande between Cochiti Dam and Elephant Butte Reservoir. Prepared for New Mexico Interstate Stream Commission, MEI Project Number 00-10 T659, June.

———. 2004. Sediment-continuity Analysis of the Rio Grande between Cochiti Dam and Elephant Butte Reservoir. Prepared for New Mexico Interstate Stream Commission, MEI Project Number 00-10 T657, June.

———. 2005a. Evaluation of Bar Morphology, Distribution and Dynamics as Indices of Fluvial Processes in the Middle Rio Grande, New Mexico. Prepared for New Mexico Interstate Stream Commission and Middle Rio Grande Endangered Species Collaborative Program, November.

———. 2005b. FLO-2D Model Development, Albuquerque Reach, Middle Rio Grande. Prepared for U.S. Army Corps of Engineers, Albuquerque District.

———. 2006. Middle Rio Grande Restoration, Phase II, Site Selection and Development of Decision Analysis Tool to Estimate Cut and Fill Volumes and Distribution of Habitat. Technical Memorandum for New Mexico Interstate Stream Commission, Albuquerque.

———. 2008. Isleta Reach Riverine Restoration: Hydrological Analysis and Hydraulic Modeling. Technical Memorandum for New Mexico Interstate Stream Commission, Albuquerque.

Parametrix, Riada Engineering, Tetra Tech, William J. Miller Engineers, and Wolf Engineering. 2008. Restoration Analysis and Recommendations for the Isleta Reach of the Middle Rio Grande, NM. Prepared for the Middle Rio Grande Endangered Species Collaborative Program, Albuquerque.

Platania, S.P. 1995. Reproductive Biology and Early Life-history of the Rio Grande Silvery Minnow, *Hybognathus amarus*. Albuquerque District, U.S. Army Corps of Engineers, Albuquerque.

Platania, S.P., and C. Altenbach. 1998. Reproductive strategies and egg types of seven Rio Grande basin cyprinids. Copeia 1998(3):559–569.

Porter, M.D., and T. Massong. 2004. Contributions to Delisting Rio Grande Silvery Minnow Egg Habitat Study: Egg Habitat Identification. U.S. Bureau of Reclamation, Science and Technology Program.

———. 2006. Progress Report 2005, Contributions to Delisting the Rio Grande Silvery Minnow: Egg Habitat Identification. U.S. Bureau of Reclamation, Albuquerque.

Remshardt, W.J., and S.R. Davenport. 2003. Experimental Augmentation and Monitoring of Rio Grande Silvery Minnow in the Middle Rio Grande, New Mexico. Annual Report June 2002 through May 2003. Submitted to Middle Rio Grande Endangered Species Collaborative Program, Albuquerque.

S.S. Papadopulos and Associates (SSPA). 2003. Riparian Groundwater Modeling of the MRG Corridor. Draft Report submitted to the New Mexico Interstate Stream Commission. Albuquerque.

———. 2005. River Flow Monitoring and Observation for Silvery Minnow Rescue, “River Eyes.” Final project deliverable: SSPA Work Order SSPA2-RG16. Report submitted to the New Mexico Interstate Stream Commission, Albuquerque.

Shirey, P.D. 2004. Foraging Habits and Habitat Utilization of Rio Grande Silvery Minnow (*Hybognathus amarus*) as Inferred by Diatom Frustules. M.S. Thesis. New Mexico State University Las Cruces, New Mexico.

Siegle, R. 2005. Monitoring Report for the Los Lunas Habitat Restoration Site. Prepared for the U.S. Department of Defense, Army Corps of Engineers. Prepared by U.S. Department of Interior, Bureau of Reclamation.

Sublette, J.E., M.D. Hatch, and M. Sublette. 1990. The Fishes of New Mexico. University of New Mexico Press, Albuquerque.

SWCA Environmental Consultants (SWCA). 2007. New Mexico Interstate Stream Commission Middle Rio Grande Riverine Restoration Project Phase I Annual Report. Submitted to the New Mexico Interstate Stream Commission, Albuquerque.

———. 2008a. Isleta Reach Habitat Restoration Conceptual Plan. Prepared for the New Mexico Interstate Stream Commission, Albuquerque.

———. 2008b. New Mexico Interstate Stream Commission Middle Rio Grande Riverine Restoration Project Phase I Annual Report (2007). Submitted to the NMISC. Albuquerque, New Mexico.

———. 2008c. New Mexico Interstate Stream Commission Monitoring for the Phase II Habitat Improvement Monitoring and Riverine Restoration. 2007 Annual Report. Submitted to the New Mexico Interstate Stream Commission, Albuquerque.

Tetra Tech, Inc. 2004. Habitat Restoration Plan for the Middle Rio Grande. Prepared for Middle Rio Grande Endangered Species Collaborative Program, Habitat Restoration Subcommittee, Albuquerque.

U.S. Army Corps of Engineers (USACE). 2007. Spring 2005 Inundation Mapping of the Middle Rio Grande. Report submitted to the Middle Rio Grande Endangered Species Collaborative Program, Albuquerque.

U.S. Bureau of Reclamation (Reclamation). 2008. Middle Rio Grande Isleta Reach (Phase I) Habitat Restoration Project Biological Assessment. Albuquerque: U.S. Bureau of Reclamation on behalf of the New Mexico Interstate Stream Commission.

2010. Unpublished flycatcher monitoring results for 2008 and 2009 monitoring seasons. U.S. Bureau of Reclamation, Albuquerque Area Office, Albuquerque.

U.S. Fish and Wildlife Service (USFWS). 1999. Rio Grande Silvery Minnow (*Hybognathus amarus*) Recovery Plan. Region 2 U.S. Fish and Wildlife Service, Albuquerque, July 1999.

———. 2003. Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, Albuquerque, New Mexico. Consultation Number 2-22-03-F-0129. March 17. U.S. Fish and Wildlife Service, Albuquerque.

———. 2005. Final Pecos Sunflower Recovery Plan. Available at: http://www.fws.gov/southwest/es/Documents/R2ES/Pecos_Sunflower_FINAL_Recovery_Plan.pdf. Accessed October 29, 2009.

———. 2009. Biological Opinion on the Effects of the Middle Rio Grande Isleta Reach Riverine Habitat Restoration Project. Consultation Number 22420-2009-F-0002. U.S. Fish and Wildlife Service, Albuquerque.

Van Auken, O.W., and J.R. Bush. 1997. Flowering phenology and fertilization of *Helianthus paradoxus* (Compositae), an inland salt marsh species. Abstract of oral presentation to Texas Academy of Science at Huntsville, Texas.

———. 1998. Spatial relationships of *Helianthus paradoxus* (Compositae) and associated salt marsh plants. Southwestern Naturalist 43(3):313–320.

Widmer, A.E., J.W. Kehmeier, and J.J. Fluder. 2007. Characterization of Rio Grande Silvery Minnow Egg and Larval Drift and Retention in the Middle Rio Grande. Report submitted to the New Mexico Interstate Stream Commission, Albuquerque.

APPENDIX A
NMISC HABITAT RESTORATION TECHNIQUES SUMMARY AND LESSONS LEARNED

Grant 06-FG-40-2549

New Mexico Interstate Stream Commission

Habitat Restoration Techniques

Summary and Lessons Learned

This summary of lessons learned pertains to Phase I and Phase II New Mexico Interstate Stream Commission's habitat restoration sites for the Rio Grande in the Albuquerque area (Angostura Reach). Following two years of effectiveness monitoring, all habitat restoration sites are still functioning per their design. Most of these restoration sites are designed for spring runoff conditions to entrain eggs, serve as inundated floodplain, and/or nursery habitats at a range of expected runoff conditions. It is difficult to ascertain that a specific technique has been a success or a failure following only two full years of monitoring. Techniques implemented in phases I and II included variations of island and bar modification, ephemeral and backwater channels, bank lowering, scallops and terraces, and placement of large woody debris (LWD). Select restoration sites were monitored between 2006 and 2008. Monitoring included wetlands, vegetation, geomorphology, and fisheries data collection.

Summary of Outcomes by Treatment Technique

1) Island destabilization: results indicate that island destabilization is not effective in the hydrologic conditions that followed the root plowing and vegetation removal. It is believed that the root structure is very difficult to destroy to the level that creates instability and movement of the island. Island destabilization may work effectively if the work is timed such that very high flows immediately follows the island destabilization work.

2) Terracing islands and bank-attached bars: This has provided good potential habitat at a variety of flows for egg retention and possible for spawning and nursery habitat. The treatment types could provide good mid-channel habitat, especially with emergent vegetation under the appropriate hydrologic regime. Flow measurements of islands that have emergent vegetation show very low velocities. Depending on river flows, emergent vegetation such as willows will slow the velocity of the water and provide decent mesohabitat and food resources for fish. Terraced islands experienced some deposition at lower inundation levels with almost no erosion, except at the outside edges of the islands. The terraced islands could function during various runoff years.

3) Ephemeral channels: Monitoring indicates that flows generally may be too high in high flow channels to be acceptable habitat for silvery minnow. They may allow detritus to enter the river, create some high groundwater levels around the channel for plant growth. Maintenance of the channel mouths may be important elements of keeping the channels functioning. Sediment deposition is consistent at upstream inflow locations of channels, especially ephemeral channels. Sediment lips may form at the inlet locations of the ephemeral channels, requiring higher discharge for the channel to flow. Pockets of erosion typically form along the lateral extent of the channels, creating pools or ponds that could become isolated as flows recede. These channels may function best at runoff

flows that are below average to average and with herbaceous vegetation or willows lining the channels.

4) Backwater and downstream embayments to ephemeral channels: Backwater channels appear to provide better habitat due to shallow and low velocity water. Although natural lips or sediment ridges often form in front of the backwater, monitoring indicates that flow out from the backwater as river levels recede carves out the sediment ridge so that entrapment is not a problem. The environment in a backwater matches well with expected desirable habitat for the minnow.

5) Bank lowering: This technique is meant to produce a wider river by creating a bench along the high banklines. Also this will produce a low velocity, vegetated shelf for egg retention and possible for spawning habitat. As with the treatment described below, removal of vegetation can result in erosion of the bankline shelf. This in itself is not considered detrimental as it produces the same result, a wider river channel. Deposition may also occur, as noted, as emergent vegetation occurs.

6) Removal of lateral confinements: Removal of armoring vegetation or jetty jacks has been done at a number of locations in ABQ with a variety of results. After removal of armoring, bankline erosion is expected to occur. This is a very positive passive restoration that promotes river movement and allows the river to widen itself and to move bank-bound sediment. We have found that the amount of bankline erosion is dependent on the flow vectors hitting the bank, intensity of flows, and duration. With only one average runoff since many of the bankline cuts have been in place, assessing the effectiveness requires more monitoring. We feel this is an essential technique to continue wherever possible.

7) Scallops and terraces: These techniques have experienced considerable sediment deposition even within one year of construction. Scallops can be used in conjunction with larger features such as backwater channels or shelves. When first constructed, scallops, embayments, and terraces show a presence of silvery minnow during runoff. Design of the shape of the scallops and terraces may influence how quickly these features become filled.

8) Large woody debris: One study was completed with LWD. LWD is cited in literature as an important component of most river ecologies. In the MRG, supply of LWD has been severely curtailed as bank lines have been stabilized. A conclusion from that study is that there is significant movement of the materials placed in the river. Most of the LWD was fairly small and was not anchored. LWD continues to be scarce in the river channel and addition of LWD should be included in habitat restoration planning so that a new supply of material is added to the system as a regular process.

Recommendations and Lessons Learned

1) Conduct monitoring of all features for effectiveness based on ‘03 Biological Opinion requirements and/or based on year to year results until can ascertain whether feature functions and is or is not effective.

2) Ensure removal of at least the upper 6”-12” of soil/root system to encourage island destabilization.

3) Continue to terrace islands/bars for minnow habitat.

4) Modify the flow by enlarging width or increasing sinuosity of high flow channels to improve conditions for minnow habitat. Possible entrapment issue requires monitoring and adaptive management.

5) Continue to construct backwaters, monitor for entrapment and manage as needed.

6) Continue to conduct bank lowering and removal of lateral confinement, monitor effectiveness, and manage as needed.

7) Monitor entrapment and effectiveness of scallops and created terraces.

8) Continue to add LWD and monitor effectiveness.

APPENDIX B
HYDRAULIC MODELING OUTPUT

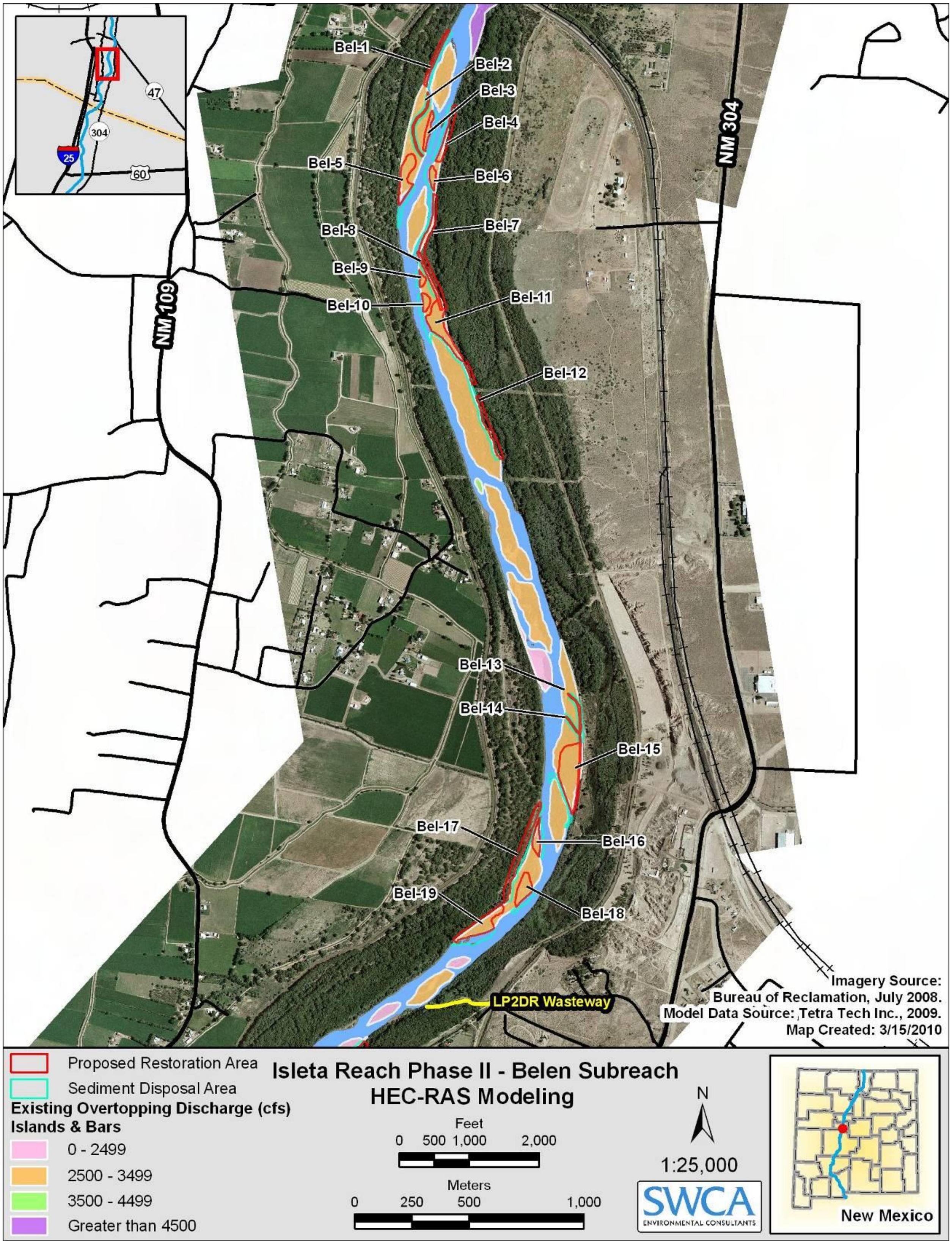

Figure B.1. Belen Subreach HEC-RAS modeling with island/bar and restoration site delineation.

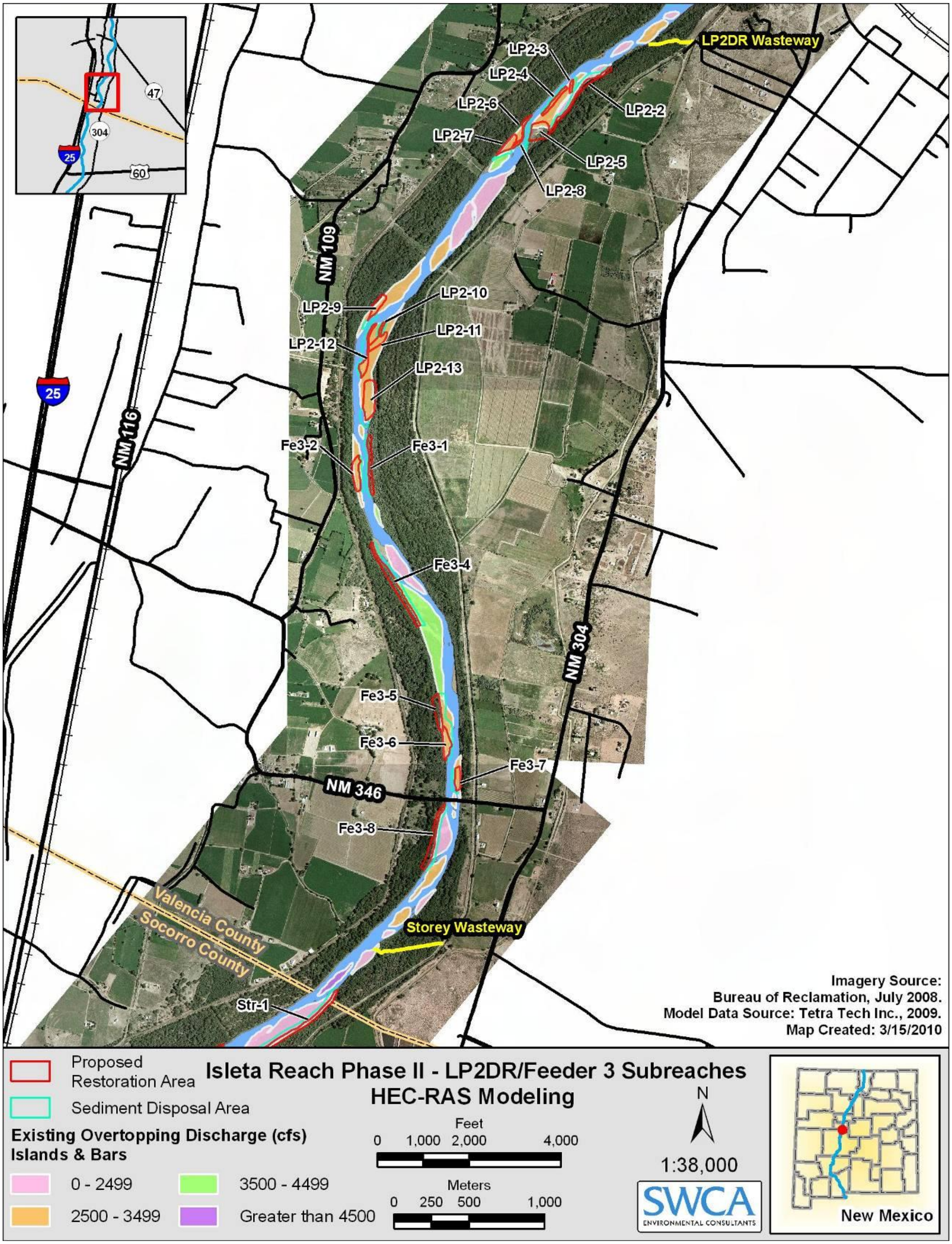

Figure B.2. LP2DR and Feeder 3 Subreaches HEC-RAS modeling with island/bar and restoration site delineation.

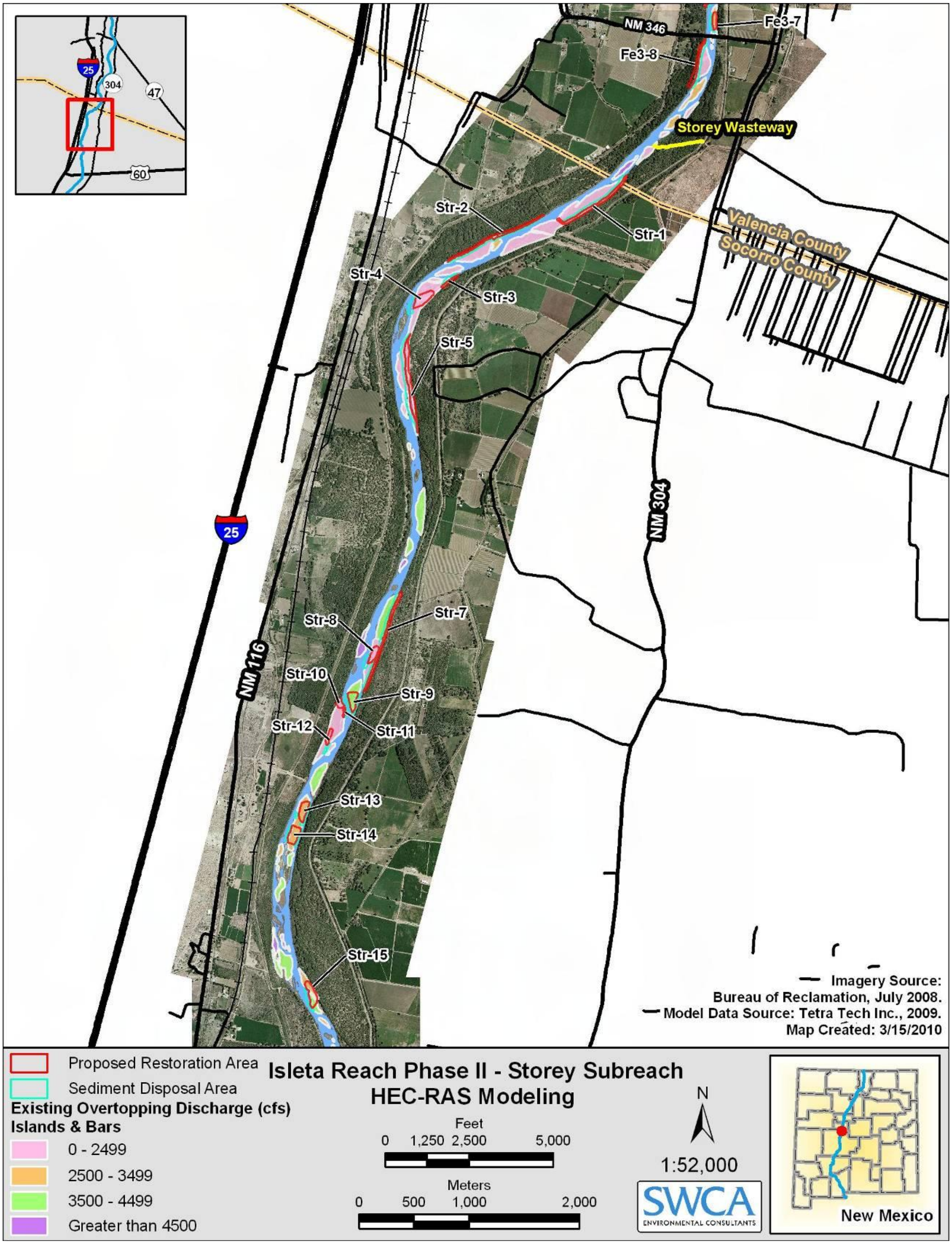

Figure B.3. Storey Subreach HEC-RAS modeling with island/bar and restoration site delineation.

APPENDIX C
NMISC MONITORING PLAN

Monitoring Plan NMISC Isleta Reach Habitat Restoration Phase I

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TABLE OF CONTENTS

INTRODUCTION

This document provides a monitoring plan for monitoring the Phase I restoration sites within the Isleta Reach. Restoration sites are located from the Peralta Wasteway to the Belen Riverside Drain outfall (Figure 1). While the Middle Rio Grande ESA Collaborative Program is formulating a region-wide monitoring plan, monitoring at the Isleta sites constructed by the NMISC remains critical to achieve compliance and to evaluate the effectiveness of the restoration.

This plan is specific for the NMISC's monitoring project in Isleta. A number of techniques are being used within the reach in an effort to evaluate what techniques were most effective and what affects the performance of the technique. Monitoring on Phase I and II sites in the Albuquerque Reach, thus far, have consisted of collecting vegetation, geomorphic, and biological data. The results of these monitoring efforts are documented in monitoring reports provided to the Program (SWCA, 2007; SWCA October 2008). Previous years results have been used to propose a monitoring approach that will provide a representative and cost effective evaluation of the many sites that have been constructed by the NMISC since 2006 and those that are slated to be constructed.

This monitoring plan provides an outline of the monitoring proposed by the NMISC for calendar year 2009 in the Isleta Reach of the Middle Rio Grande (MRG). Monitoring will consist of vegetation, biological, geomorphic, and hydrological surveys when and where applicable. A full suite of monitoring will occur on representative sites while select surveys will occur on all sites. Monitoring will be reported within 3 months of the final monitoring event.

As a reminder, Table 1 provides a description of the habitat restoration techniques that have been employed by the NMISC in the Isleta Reach Phase I project.

Table 1. Habitat Restoration Techniques

Treatment	Description	Benefits of Treatment
Creation of backwaters and embayments	Areas cut into banks and bars to allow water to enter to create slackwater habitat, primarily during mid- to high-flow events including spring runoff and floods.	Increases habitat diversity by increasing backwaters, pools, and eddies at various depths and velocities. Intended to retain drifting silvery minnow eggs and provide rearing habitat and enhance food supplies for developing silvery minnow larvae.
Creation of bankline benches	Removal of vegetation and excavation of soils adjacent to the main channel to create benches that would be inundated at a range of discharges.	Provides shallow water habitat at a range of discharges that could provide spawning habitat and increase retention of silvery minnow eggs and larvae. Increased inundation would benefit native vegetation, potentially increasing habitat for the flycatcher.
High-flow ephemeral channels	Construction of ephemeral channels on islands to carry flow from the main river channel during high-flow events.	Normally dry but creates shallow, ephemeral, low-velocity aquatic habitats important for silvery minnow egg and larval development during medium and high-flow events.
Island/Bar modification	Creation of shelves on islands and bars to increase inundation frequency. This technique is targeted for islands and bars that have an overtopping discharge greater than 3,500 cfs and exceedance days per year less than 21 days.	Increases habitat availability by increasing the inundated area at lower flows. May also destabilize bars and islands, slowing the rate of vegetation stabilization and/or armoring.
Large woody debris (LWD)	Placement of trees, root wads, stumps, or branches in the main river channel or along its banks to create pools.	Creates low-flow refugial habitat (pools and slow-water habitats), provides shelter from predators and winter habitat, and provides structure for periphyton growth to improve food availability for silvery minnow.
Removal of lateral confinements	Elimination or reduction of structural features and maintenance practices that decrease bank erosion potential	Could increase floodplain width with more diverse channel and floodplain features, resulting in increased net-zero and low-velocity habitat for silvery minnow
Floodplain vegetation management	Managing vegetation within the floodplain through actively planting desired native vegetation and controlling non-native vegetation to restore riparian habitat.	Increases habitat availability and diversifies habitat structure for the flycatcher in heavily disturbed sites. Combined with passive restoration techniques to promote natural revegetation, actively planting has the potential to increase flycatcher habitat availability.
Bosque inundation channels	Construction of ephemeral channels in the floodplain to carry flow from the main river channel during high-flow events.	Creates shallow, ephemeral, low-velocity aquatic habitats in the bosque during high-flow events. Provides silvery minnow egg retention and larval habitat associated with silvery minnow spawning. Enhances hydrologic connectivity with the floodplain. Could improve flycatcher habitat.
Passive restoration	Allows for higher magnitude peak flows to accelerate natural channel-forming process and improve floodplain habitat.	Increases sinuosity and allows for development of complex and diverse habitat, including bars, islands, side channels, sloughs, and braided channels.

PROJECT OBJECTIVES

The primary objective of monitoring is to evaluate the success of Phase I habitat restoration activities in the Isleta Reach. This will determine if constructed projects improve silvery minnow habitat and determine the level of maintenance required to maintain an acceptable level of benefit from the project.

A second objective of monitoring is to characterize the community structure of fish at habitat restoration sites, continuing and expanding the fisheries surveys conducted throughout the Isleta Reach of the MRG.

The third objective of monitoring is to note the re-colonization of vegetative communities and any geomorphic changes that may occur. During construction, vegetative communities were disturbed, and it is important to understand species composition and community types following disturbance.

PROJECT PLAN AND STUDY DESIGN

Site Locations and Summary of Monitoring Activities

Monitoring proposed for 2009 and 2010 will include monitoring of selected sites from Phases I of the Isleta Reach Project (See Project EA, 2009). The monitoring will consist of four field activities (Tables 2):

- Vegetation monitoring by Hink and Ohmart method and by quantitative belt transect surveys. Hink and Ohmart will provide the general assessment of how the species composition and community types are responding to disturbance and whether native riparian habitats are successfully regenerating. The belt transects will be done to evaluate how vegetation regrowth on bars and islands, which have been lowered to allow inundation during spring runoff, are contributing and affecting minnow egg retention and nursery habitat conditions.
- Monitoring of the fish community on restored sites when these sites are inundated during spring runoff will be used to determine how well different types of restoration sites perform to attract adult silvery minnow and to retain eggs. This monitoring will be performed by experienced contractors with an up to date ESA permit.
- Geomorphic monitoring to determine how flows have recontoured the sites to create varied features and to evaluate site longevity. This monitoring could be accomplished through the use of aerial LiDAR, ground based LiDAR, traditional survey techniques, or erosion pins.
- Hydrologic monitoring to assess inundated habitat characteristics for suitability for silvery minnow. This monitoring will take place concurrent to fisheries monitoring to determine hydrologic conditions on the sites.

Table 2. Monitoring activities summary.

Monitoring Element	# of Sites	Schedule
Vegetation (H&O)	?	Summer/fall
Vegetation (Belt)	?	Summer/fall
Fish	?	Spring
Geomorphology	?	Summer/fall
Hydrology	?	Spring

All field monitoring activities will include taking photo point documentation of HR project sites (Figure 1). When applicable, digital photos will be taken at established photo point locations for each monitoring site. Typically individual photos are recorded in the four cardinal directions for each established photo point. The exact photo point protocol will be tailored to the specific goal of each monitoring activity. This provides visual evidence of changes in vegetation, geomorphology and hydrology for each site over time and allows for the NMISC to convey those changes to people not intimately involved in the project.

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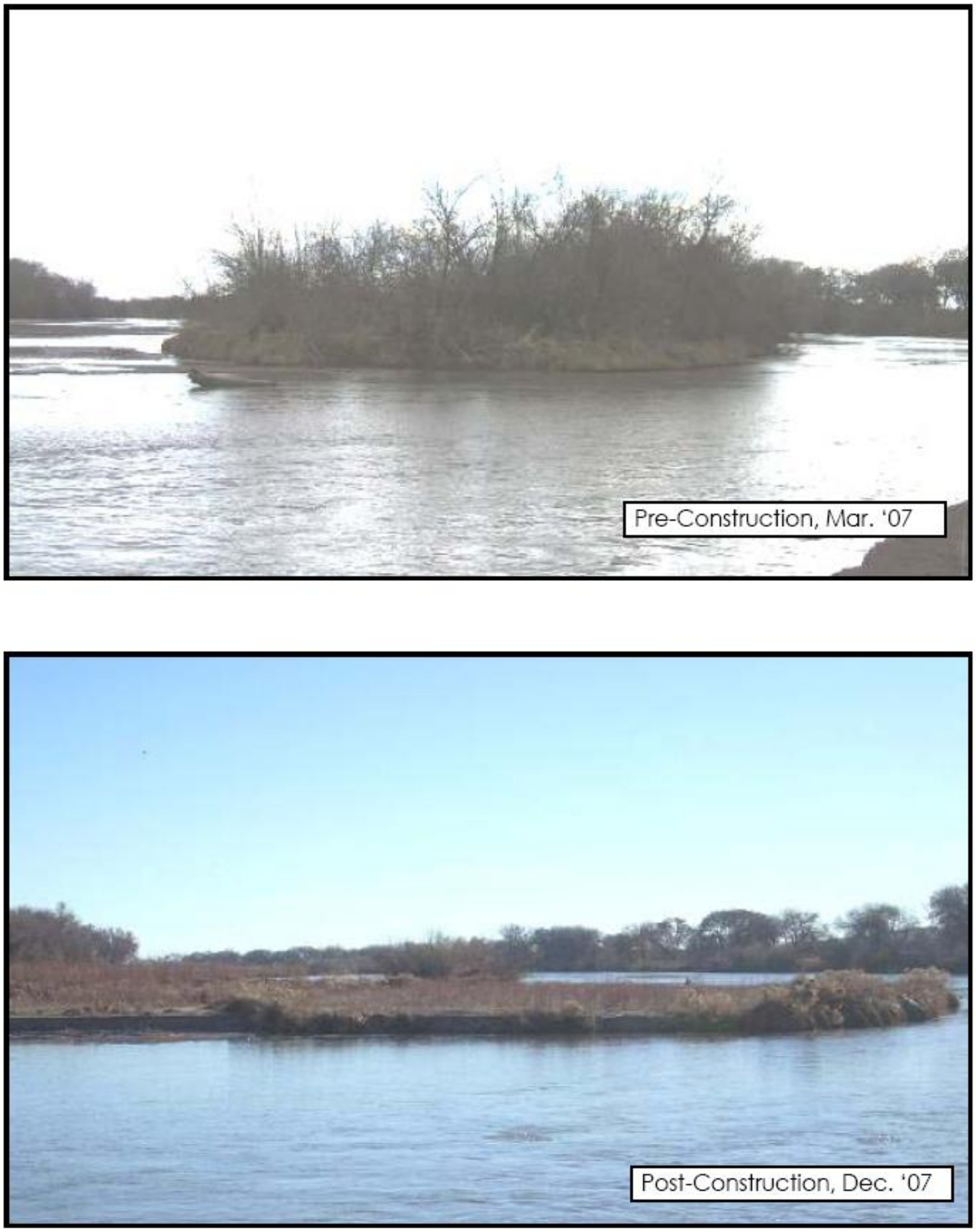

Figure 1. Photo point example for SDC_1i, SSW aspect.

7

Vegetation Monitoring

Vegetation monitoring will be used to assess responses of several vegetative components within treatment areas. The vegetation monitoring will be conducted in a manner that enables accurate, yet efficient characterization of riparian species composition and community types, the density of living trees and snags, percent of overstory canopy cover, understory cover, areas of bare ground and/or litter, wetland delineation and plant species composition, structural classification and quantitative terrestrial vegetation sampling method. The vegetation monitoring may be used in the future to provide information needed to conduct numerous quantitative analyses related to the following topics:

- The rate of naturally regenerating native riparian vegetation
- Changes in habitat structure and species over time, such as those resulting from fire, browse utilization, or regeneration
- The effectiveness of invasive species removal techniques
- The rate of successful establishment following pole and whip planting activities
- Whether habitat restoration design goals are being achieved
- The identification of continuous maintenance activities or adaptive management strategies, if any, that need to be put into place to achieve the desired results

The NMISC proposes to monitor vegetation changes once in 2009 and once 2010. Vegetation monitoring would characterize species composition and community types, including grasses, shrubs, and trees. The Hink and Ohmart (1984) classification system would be used to classify structure (Figure 2). Wetlands and associated species would be identified and mapped to assess overall vegetation changes due to the project as well as for 404 Clean Water Act (CWA) permit compliance. GPS units would collect points and polygons of vegetation at project sites. Any evidence of disturbance, natural or anthropogenic, would be recorded. All data compiled would be stored and analyzed in Excel format and would be submitted to the Collaborative Program.

Vegetation monitoring within the LP1DR subreach is expected to be performed by Natural Heritage New Mexico and Bosque Ecosystem Monitoring Program as part of a cooperative habitat restoration project in this subreach. As partners in a Community Forest Restoration Program (CFRP) grant through the Middle Rio Grande Conservancy District (MRGCD), these entities are establishing vegetation transects and other vegetation monitoring activities to assess the changes in the area due to the NMISC project. Use of the protocols used by these entities could be expanded to include monitoring in the Peralta Subreach. Some logistical and budgetary constraints would first need to be overcome in order for this to happen.

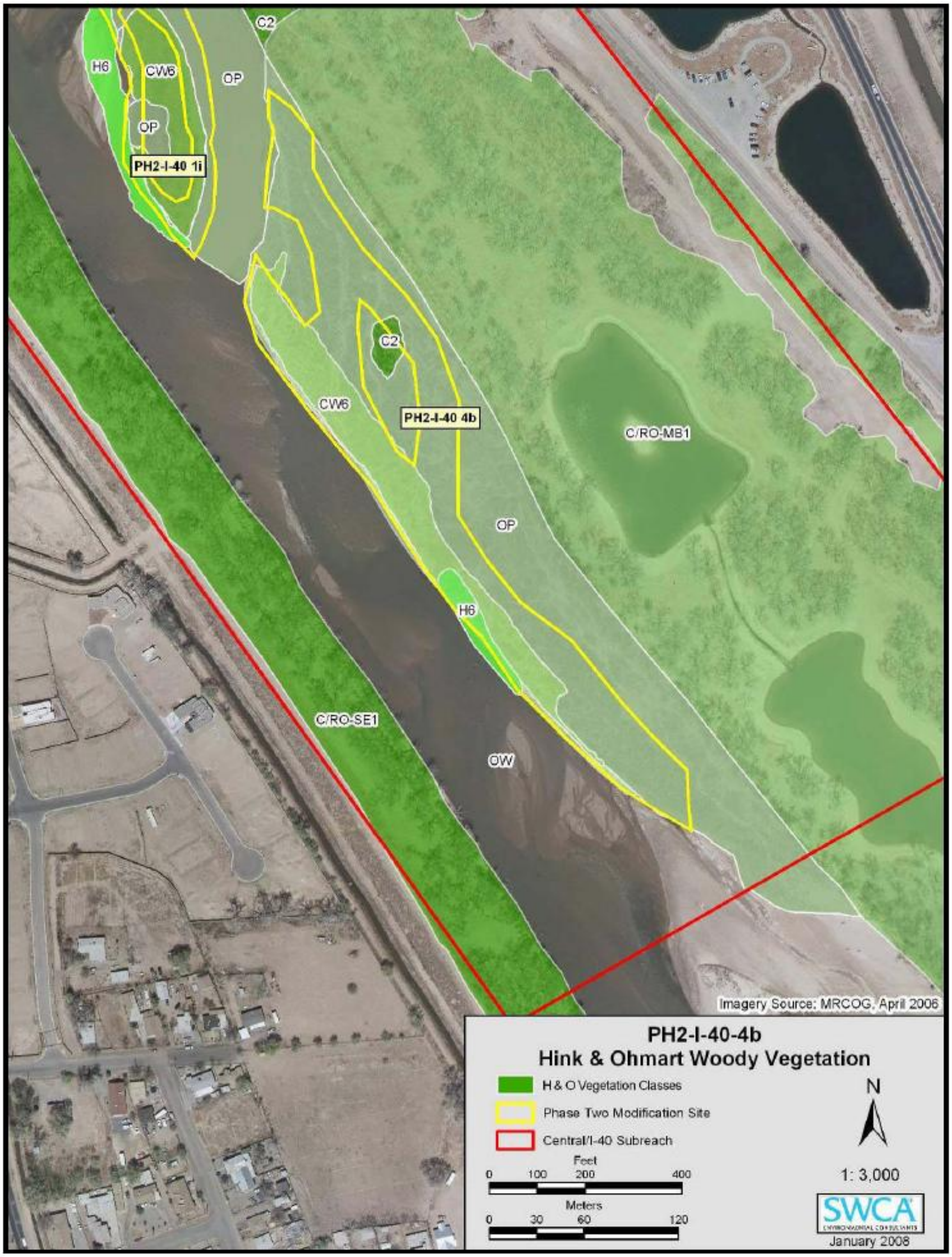

Figure 2. Hink and Ohmart Vegetation Classes for I-40_4b.

9

Fisheries Monitoring

NMISC has been executing a number of river enhancement techniques in the MRG in order to reconnect portions of the immediate floodplain with the main channel during periods of moderate and high flows to benefit the federally endangered silvery minnow. The 2007 and 2008 spring fisheries monitoring was conducted in the Albuquerque Reach to assess the effectiveness of specific techniques used for the creation of silvery minnow habitat and to observe silvery minnow presence in naturally occurring features and HR project sites. Information collected during this monitoring effort documented the occupancy of reproductively mature silvery minnow and the presence of their eggs on both naturally occurring and HR floodplain habitats.

We will monitor Isleta Reach HR sites in the spring of 2009 to determine if adult silvery minnow utilize the sites during the spring runoff. We will also monitor the sites to determine if eggs and/or larvae are present.

Specific project goals/objectives for the spring 2009 fisheries monitoring will include:

Objective 1. Assess if adult silvery minnow are present on HR-created floodplain sites;

Objective 2. Assess if silvery minnow spawn on inundated floodplain habitat adjacent to the main river channel during spring runoff;

Objective 3. Assess if eggs are being entrained on island HR sites as they move downstream.

Through enumeration and documentation of gravid silvery minnow entering and exiting the enclosures and paired fyke nets, through egg monitoring within and outside of the enclosure and above and below the paired fyke nets, it is believed that inference regarding occupancy and the magnitude of silvery minnow spawning on the sites can be made.

To determine when silvery minnow begin spawning and/or occupying the floodplain, crews will monitor for eggs and fish. Crews will use Moore Egg Collectors (MEC), kick nets, and individual fyke nets. Numbers of silvery minnow and eggs captured at each site, along with river stage height, discharge, water temperature, air temperature, water electrical conductivity, dissolved oxygen, and turbidity will be recorded daily. The information collected during pre-monitoring will be plotted and distributed to the project science team daily. When catch rates of either fish or eggs are deemed to be sufficient by the science team, or the anticipated peak in discharge for the season is reached, crews will install and monitor fyke nets, quadrats and other approved monitoring equipment. Monitoring will occur for a period of 14–21 days during the peak spring runoff after the initial or peak detection of silvery minnow and eggs.

Fyke nets will be deployed at multiple locations within the sites in an effort to document floodplain occupancy and spawning of silvery minnow (Figure 3). Depending on the site and topography, individual fyke nets, paired fyke nets (stretched across a narrow channel), one of which will be orientated with the flow and one against the flow, and fyke nets arranged as an enclosure will be set up.

Figure 3. Fyke net installation at NMISC habitat restoration site.

Fyke nets will be monitored when flood waters begin to inundate the site. Fish that are captured will be identified by species and enumerated. Silvery minnow will be classified by spawning category: gravid female; gravid male; spent female; and unknown. Length (mm), weight (+\- 0.1g) will be recorded from a sub-sample of captured silvery minnow.

D-frame invertebrate sampling kick nets will be used at the sites to detect the presence of eggs and larvae. Quadrat egg sampling devices will be set at the upstream and downstream edges of islands to monitor egg entrainment from the river channel. MEC will be utilized to document main channel spawning. Water parameters described above and air temperature will be collected from all sites during the monitoring period in order to assess if the measured parameters are correlated with the initiation and peak of observed silvery minnow occupancy and egg collection.

Geomorphic Monitoring

Fluvial geomorphology (cross-sectional and longitudinal) at Project locations will be monitored to determine physical changes in response to flow (discharge). The NMISC intends on monitoring representative HR sites for geomorphology by conducting topographic surveys. On 2 -4 HR sites the NMISC intends on utilizing emerging technology in the form of Light Detection and Ranging (LiDAR) equipment to produce high resolution Digital Elevation Models (DEM) for geomorphic analysis. The work with LiDAR is intended to produce a more accurate and detailed understanding of changes in geomorphology as well as to gauge the ability of the technology to accomplish monitoring goals. This LiDAR imaging will be directly comparable to a pre-project DEM created for the Isleta Reach by the ISC through the acquisition of aerial LiDAR date. The ISC does not rule out future aerial LiDAR acquisitions if the cost benefit ratio dictates such an action.

The NMISC and their contractors will conduct the geomorphology surveys during summer, following expected peak Rio Grande flows. Initial pre–habitat restoration geomorphic surveys of the Project area were completed by NMISC through the acquisition of aerial LiDAR in order to create a digital elevation model. As-built surveys will be conducted following construction to assess changes in site conditions due to construction. Local geomorphology will be monitored once during 2009; during low flows of late summer or early fall, to determine physical changes in response to flow (discharge) since the last surveys were completed. Absent additional LiDAR surveys, a Leica Series 1200 RTK-GPS unit in the NAVD88 and New Mexico State Plane Central NAD83 coordinate systems will be used for the topographic survey and a field fitted grid pattern will be utilized to accommodate variable site conditions.

Survey results will be compared through time to determine the changes in elevation at the project sites (see Figure 4). The NMISC is interested in site wide aggradation and degradation to determine the sustainability and longevity of the project techniques. The NMISC is also interested in creating and maintaining a diversity of habitat characteristics across individual sites. Determining the isolated scouring and deposition of sediments within a site using the topographic surveys will help characterize that diversity.

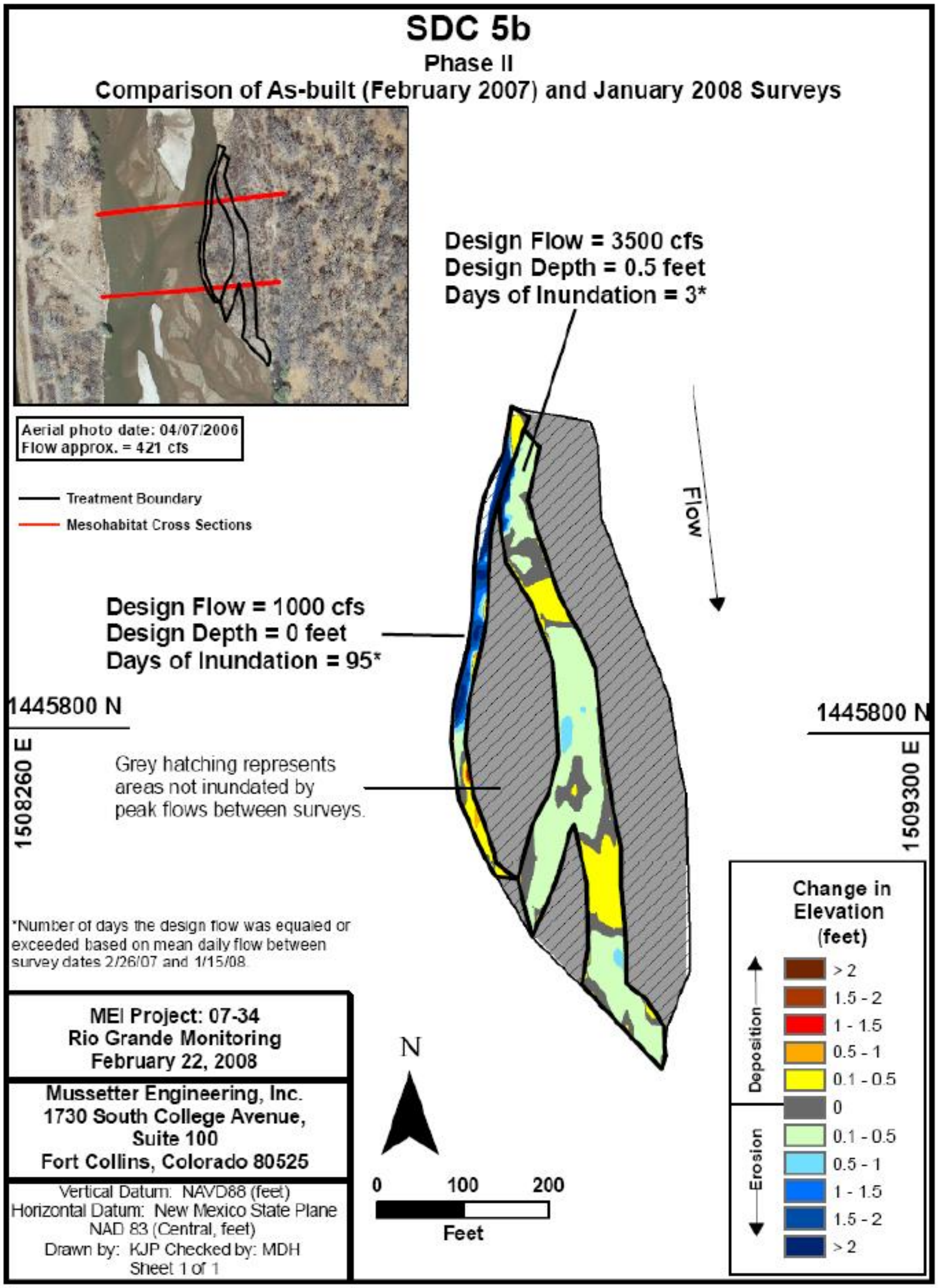

Figure 4. Visual output product for topographic survey comparison of NMISC habitat restoration site.

13

Additionally, the NMISC will utilize the University of New Mexico LiDAR Lab to produce DEMs of at least 2-4 HR sites to provide higher resolution analysis of the changes in geomorphology. The LiDAR lab has imaged and cataloged point in time DEMs for the Phase I I40-1ch bankline cut in January 2008 and July 2008 (see Figure 5). The initial analysis of bankline retreat at this site indicates that over this time period, the bankline has retreated on the order of 10 meters in some locations. The use of LiDAR based DEMs allow for cubic centimeter scale mass balance analysis, Although it is not realistically feasible to perform such analysis for every HR site, results from this type of analysis performed on a representative subset of sites can be correlated to sites not monitored this intensively. Given conditions on the ground, the NMISC would like to use LiDAR to conduct geomorphic monitoring at sites that represent each of the HR modification techniques.

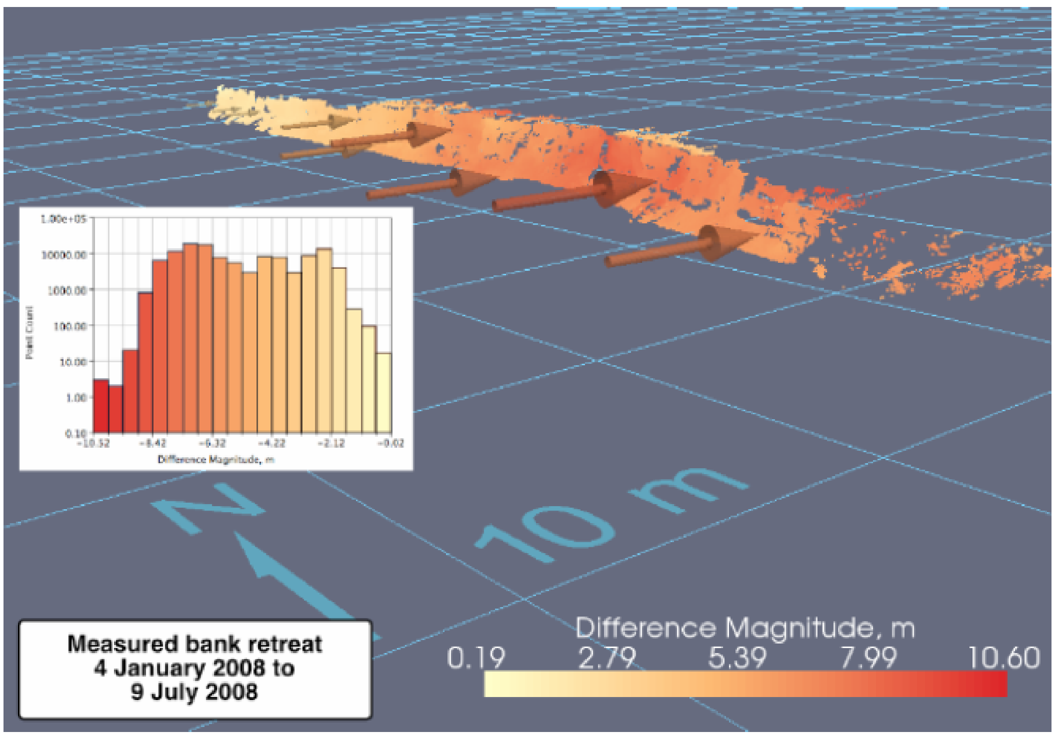

Figure 5. Visual output of changes in geomorphology between pre and post-2008 spring runoff for HR site PH1-I40-1b.

Hydrologic Monitoring

Hydrological monitoring of inundated HR features will by conducted to quantify the hydrologically related habitat characteristics of each site. The NMISC intends on monitoring Isleta Reach HR sites during the 2009 spring runoff. The ISC intends to monitor all Isleta HR sites during the 2009 spring runoff, but if this proves infeasible then sites for this effort will be chosen as representative of the project techniques implemented by the NMISC and to represent the range of technique target discharges. Depth and velocity are two variables that are used by fisheries biologists to categorize what is suitable habitat for the minnow (USFWS, 2003). Using accepted habitat characteristic ranges, the NMISC will be able to make defensible arguments as to the success of the project in terms of the amount of suitable habitat that was created. Temperature is another variable that affects biological productivity of aquatic habitat and thus will be measured during hydrologic monitoring. In particular the NMISC is interested in distinguishing the hydrologic characteristics of existing in-channel habitat versus created effective floodplain habitats (see Figure 6).

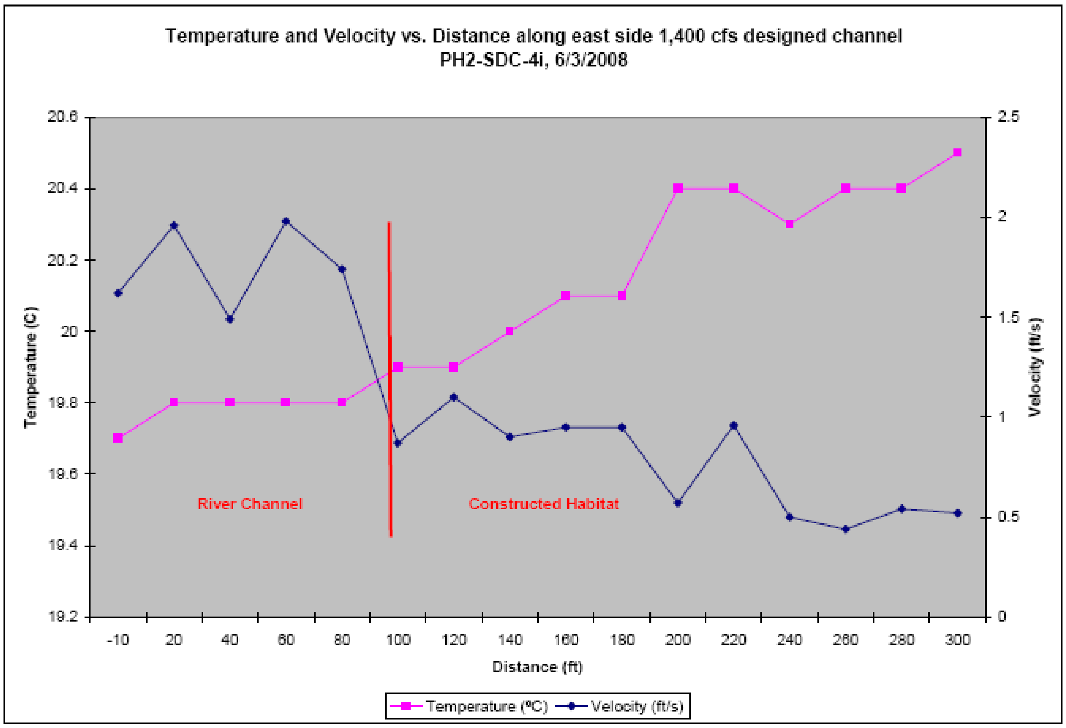

Figure 6. Graphed data results from 2008 hydrological monitoring of NMISC HR sites, notice the values and trends of the data between the river channel and the constructed habitat.

Hydrological monitoring of the project areas will include cross sections and point measurements of water depth, velocity and temperature. Depths will be measured using a standard 4ft wading rod to the nearest hundredth of a foot, velocities will be measured using a Marsh-McBirney Flow Mate 2000 velocity meter, and temperature will be measured using a YSI-556 water quality meter.

REPORTING

The NMISC is responsible for managing, analyzing, and reporting all data collected from the project. All data will be recorded in a Microsoft Excel spreadsheet platform. If necessary, statistical analysis will be performed in SYSTAT, SPSS, or comparable statistical software.

Reporting and evaluation of the results from this project will include data acquisition summary reports, a draft project completion report, and a final project completion report. A draft project completion report for review will be submitted for comments. The final project report will be submitted 30 days after all comments on the draft report are received. In addition, the biological database and all data from statistical analyses will be publicly available upon completion of this work.

QUALITY ASSURANCE/QUALITY CONTROL

QA/QC reviews are an integral component of Project activities. They are conducted to verify that the deliverables and supporting documents are complete and understandable, conform to reasonable standards and meet NMISC's and the client's expectations. QA/QC review activities may include verifying one or more of the following: information; assumptions and data used in developing a document; use of proper format; compliance with regulatory and code requirements; and calculation methods and/or numerical accuracy. Management, implementation, and communication plans will be created.

In general, QA/QC reviews will be led by the NMISC Project Manager and will be conducted in phases throughout the Project, including at Project initiation, preliminary and intermediate stages, and completion of significant elements, phases, or segments of the Project. QA/QC reviews will be conducted and documented for all correspondence, reports, studies, drawings, specifications, calculations, procurement documents, requisitions, and any other documents that either directly or indirectly constitutes the deliverable(s). All QA/QC reviews will be completed in a timely manner to avoid disrupting the scheduled completion of Project documents. Adequate time will be scheduled for the QA/QC reviews and subsequent corrections.

SCHEDULE

LITERATURE REVIEWED

Hink, V.C., and R.D. Ohmart. 1984. Middle Rio Grande biological survey. Final report under Contract No. DACW47- 81-C-0015 with the U.S. Army Corps of Engineers, Albuquerque District. Center for Environmental Studies, Arizona State University, Tempe. 193 pp. + appendices.

Milford, E. E. Muldavin, Y. Chavin, A. Kennedy, and S. Wood. 2002. Vegetation monitoring of riparian restoration sites at Santa Ana Pueblo. Final Report. New Mexico Natural Heritage Program (Natural Heritage New Mexico), University of New Mexico, Albuquerque, NM.

SWCA, ISLETA EA

SWCA Environmental Consultants (SWCA). 2007. New Mexico Interstate Stream Commission Middle Rio Grande Riverine Restoration Project Phase I Annual Report. June 2007.

SWCA Environmental Consultants (SWCA). 2008. Monitoring Report for Phase II Albuquerque Reach Riverine Restoration and Habitat Improvement for the Rio Grande Silvery Minnow. October 2008.

USFWS. 2003. Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamation's Water and River Maintenance Operations, Army Corps of Engineers' Flood Control Operation, and Related Non-Federal Actions on the Middle Rio Grande, Albuquerque, New Mexico. Consultation Number 2-22-03-F-0129. March 17, 2003.

APPENDIX D
RESTORATION IMPACT ANALYSIS

Table D.1. Belen Subreach Riverine Restoration Impact Analysis

ID	Sub-reach	Existing Inundation Discharge	Mean Elevation	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)	Impact Area Buffer (10%)	Const Time (days)	Total Area Impact Estimate (acres)*	Description
Bel-05	Belen	2,521	4,791.41	Backwater/Embayment	1,500	2.06	0.74	0.28	2	6.16	Backwater on downstream end of bar, connected to ephemeral channels
Bel-09	Belen	2,672	4,792.11	Backwater/Embayment	2,000	0.30	0.23	0.05	1	0.59	Embayment on bank-attached bar
Bel-10	Belen	2,672	4,791.10	Backwater/Embayment	2,000	0.49	0.40	0.09	1	0.97	Embayment on bank-attached bar
Bel-11	Belen	2,672	4,790.43	Backwater/Embayment	1,500	2.74	0.96	0.37	3	12.20	Embayment on bank-attached bar
Bel-15	Belen	2,670	4,785.19	Backwater/Embayment	2,000	4.77	0.79	0.56	5	30.57	Backwater on downstream end of bank-attached bar; may need to remove bankline (parallel) jetty jacks, leaving the tie-back jetty jacks
Bel-16	Belen	2,711	4,785.40	Backwater/Embayment	2,000	0.83	0.62	0.15	1	1.60	Embayment on upstream end of bank-attached bar
Bel-18	Belen	2,711	4,784.37	Backwater/Embayment	2,000	1.49	0.53	0.20	1	2.22	Embayment on bank-attached bar
Bel-19	Belen	2,711	4,782.98	Backwater/Embayment	2,000	2.51	1.26	0.38	3	12.45	Backwater on downstream end of bank-attached bar
				Backwater/Embayment Total		**15.19**	**5.53**	**2.07**	**17**	**66.76**	
Bel-01	Belen	NA	4,794.40	Bankline Bench	2,200	0.80	0.71	0.15	1	1.66	Bankline bench on vegetated bankline with jetty jacks on part of feature; remove bankline jetty jacks
Bel-04	Belen	NA	4,795.72	Bankline Bench	3,000	1.30	0.93	0.22	2	4.90	Bankline bench on vegetated bankline with jetty jacks; remove bankline jetty jacks
Bel-07	Belen	NA	4,792.94	Bankline Bench	3,000	2.25	0.71	0.30	3	9.77	Bankline bench on vegetated bankline with jetty jacks; remove bankline jetty jacks
Bel-12	Belen	NA	4,790.80	Bankline Bench	2,200	1.66	1.41	0.31	2	6.76	Bankline bench on vegetated bankline
Bel-17	Belen	NA	4,787.21	Bankline Bench	3,000	2.39	1.34	0.37	3	12.32	Bankline bench on vegetated bankline
				Bankline Bench Total		**8.40**	**5.10**	**1.35**	**11**	**35.41**	

*Totals may not sum due to rounding.

Table D.1. Belen Subreach Riverine Restoration Impact Analysis, continued

ID	Sub-reach	Existing Inundation Discharge	Mean Elevation	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)	Impact Area Buffer (10%)	Const Time (days)	Total Area Impact Estimate (acres)	Description
Bel-02	Belen	2,521	4,792.96	Ephemeral Channel	1,500	0.46	1.07	0.15	1	1.68	Ephemeral channels on bank-attached bar to increase inundation; utilize existing channels to minimize excavation
Bel-08	Belen	NA	4,792.21	Ephemeral Channel	2,000	0.77	0.71	0.15	1	1.63	Ephemeral channels on bank-attached bar to increase inundation; utilize existing channels to minimize excavation
Bel-13 & 14	Belen	2,670	4,786.31	Ephemeral Channel	2,000	0.86	1.07	0.19	1	2.12	Ephemeral channels on bank-attached bar to increase inundation; connect to existing channels to increase habitat heterogeneity
Ephemeral Channel Total						**2.09**	**2.85**	**0.49**	**3**	**5.43**	
Bel-03	Belen	2,521	4,793.14	Island/Bar Modification	1,500	0.68	0.84	0.15	1	1.67	Terrace on edge of bar to increase inundation frequency
Bel-06	Belen	3,324	4,792.33	Island/Bar Modification	2,200	0.52	0.48	0.10	1	1.10	Terrace bank-attached bar to increase inundation frequency
Island/Bar Modification Total						**1.20**	**1.32**	**0.25**	**2**	**2.77**	
BELEN SUBREACH GRAND TOTAL						**26.88**	**14.81**	**4.17**	**33**	**110.38**	

*Totals may not sum due to rounding

Table D.2. LP2DR Subreach Riverine Restoration Impact Analysis

ID	Sub-reach	Existing Inundation Discharge	Mean Elevation	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)	Impact Area Buffer (10%)	Const Time (days)	Total Area Impact Estimate (acres)	Description
LP2-05	LP2DR	NA	4,780.15	Backwater/Embayment	1,500	3.21	0.64	0.39	4	16.95	Backwater on downstream end of bank-attached bar
LP2-07	LP2DR	3,093	4,779.51	Backwater/Embayment	2,200	1.39	0.66	0.14	2	4.39	Backwater on downstream end of bank-attached bar
LP2-09	LP2DR	2,899	4,775.86	Backwater/Embayment	2,000	1.69	0.71	0.17	2	5.13	Backwater on downstream end of bank-attached bar
LP2-11	LP2DR	3,078	4,775.44	Backwater/Embayment	2,200	1.44	1.00	0.14	2	5.17	Embayment on bank-attached bar
LP2-13	LP2DR	3,078	4,774.42	Backwater/Embayment	2,200	4.41	1.00	0.44	5	29.25	Backwater on downstream end of bank-attached bar
					Backwater/Embayment Total	**12.14**	**4.01**	**1.28**	**15**	**60.89**	
LP2-02	LP2DR	NA	4,782.44	Bankline Bench	3,500	2.28	2.60	0.49	3	16.11	Bankline bench on vegetated bankline with jetty jacks on part of feature; remove bankline jetty jacks
LP2-06	LP2DR	NA	4,781.52	Bankline Bench	3,000	0.51	0.31	0.08	1	0.90	Bankline bench on vegetated bankline
LP2-08	LP2DR	3,093	4,779.93	Bankline Bench	2,200	0.25	0.10	0.03	1	0.38	Bankline bench on vegetated bankline
					Bankline Bench Total	**3.04**	**3.01**	**0.59**	**5**	**17.39**	
LP2-03	LP2DR	2,820	4,781.93	Ephemeral Channel	2,000	0.33	0.37	0.07	1	0.77	Ephemeral channel on bank-attached bar to increase inundation; connect to existing channels to increase habitat heterogeneity
LP2-10	LP2DR	3,078	4,776.36	Ephemeral Channel	2,500	0.34	0.63	0.10	1	1.07	Ephemeral channel on bank-attached bar to increase inundation; connect to existing channels to increase habitat heterogeneity
					Ephemeral Channel Total	**0.67**	**1.00**	**0.17**	**2**	**1.84**	

*Totals may not sum due to rounding

Table D.2. LP2DR Subreach Riverine Restoration Impact Analysis, continued

ID	Sub-reach	Existing Inundation Discharge	Mean Elevation	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)	Impact Area Buffer (10%)	Const Time (days)	Total Area Impact Estimate (acres)	Description
LP2-04	LP2DR	2,820	4,780.90	Island/Bar Modification	2,000	1.10	0.72	0.18	2	4.01	Terrace on edge of bar to increase inundation frequency
LP2-12	LP2DR	3,078	4,775.37	Island/Bar Modification	1,500	1.68	1.00	0.27	2	5.90	Terrace on edge of bar to increase inundation frequency
Island/Bar Modification Total						**2.78**	**1.72**	**0.45**	**4**	**9.90**	
LP2DR GRAND TOTAL						**18.63**	**9.75**	**2.49**	**26**	**90.02**	

*Totals may not sum due to rounding

Table D.3. Feeder 3 Subreach Riverine Restoration Impact Analysis

ID	Sub-reach	Existing Inundation Discharge	Mean Elevation	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)	Impact Area Buffer (10%)	Const Time (days)	Total Area Impact Estimate (acres)	Description
Fe3-07	Feeder 3	2,504	4,768.20	Backwater/Embayment	1,500	1.27	0.70	0.20	2	4.34	Backwater on downstream end of bank-attached bar.
Backwater/Embayment Total						**1.27**	**0.70**	**0.20**	**2**	**4.34**	
Fe3-04	Feeder 3	NA	4,773.64	Bankline Bench	3,500	3.99	3.17	0.72	4	31.50	Bankline bench on vegetated bankline with jetty jacks on part of feature; remove bankline jetty jacks
Fe3-05	Feeder 3	NA	4,771.07	Bankline Bench	3,000	2.12	1.68	0.38	3	12.54	Bankline bench on vegetated bankline
Fe3-08	Feeder 3	NA	4,768.87	Bankline Bench	3,000	2.78	2.30	0.51	3	16.76	Bankline bench on vegetated bankline
Bankline Bench Total						**8.89**	**7.15**	**1.60**	**10**	**60.81**	
Fe3-01	Feeder 3	NA	4,774.54	Island/Bar Modification	2,500	2.17	1.85	0.40	3	13.26	Terrace on edge of bar to increase inundation frequency
Fe3-02	Feeder 3	2,960	4,773.45	Island/Bar Modification	2,200	2.24	1.06	0.33	1	3.63	Excavate terrace on edge of bar to increase inundation frequency
Fe3-06	Feeder 3	3,034	4,768.67	Island/Bar Modification	1,500	1.89	1.68	0.36	2	7.85	Terrace on edge of bar to increase inundation frequency
Island/Bar Modification Total						**6.30**	**4.59**	**1.09**	**6**	**24.74**	
FEEDER 3 SUBREACH GRAND TOTAL						**16.46**	**12.44**	**2.89**	**18**	**89.89**	

***Totals may not sum due to rounding**

Table D.4. Storey Subreach Riverine Restoration Impact Analysis

ID	Sub-reach	Existing Inundation Discharge	Mean Elevation	Restoration Treatment	Target Inundation Discharge (cfs)	Treat Area (acres)	Sediment Disposal Area (acres)	Impact Area Buffer (10%)	Const Time (days)	Total Area Impact Estimate (acres)	Description
Str-04	Storey	2,252	4,759.72	Backwater/Embayment	1,500	3.63	1.50	0.51	4	22.59	Backwater on downstream end of bank-attached bar.
Str-08	Storey	2,034	4,750.17	Backwater/Embayment	1,500	1.89	1.09	0.30	2	6.57	Embayment on bank-attached bar
Str-10	Storey	2,497	4,749.83	Backwater/Embayment	1,500	1.04	0.24	0.13	1	1.41	Embayment on bank-attached bar
Str-11	Storey	2,497	4,749.75	Backwater/Embayment	1,500	0.30	0.25	0.06	1	0.61	Embayment on bank-attached bar
Str-12	Storey	2,497	4,749.04	Backwater/Embayment	1,500	1.04	0.53	0.16	1	1.73	Backwater on downstream end of bank-attached bar.
Str-15	Storey	3,420	4,743.34	Backwater/Embayment	2,200	3.22	1.46	0.47	3	15.44	Embayment on bank-attached bar
Backwater/Embayment Total						**11.12**	**5.08**	**1.62**	**12**	**48.34**	
Str-01	Storey	NA	4,764.33	Bankline Bench	2,500	4.08	3.54	0.76	4	33.52	Bankline bench on vegetated bankline.
Str-02	Storey	NA	4,763.76	Bankline Bench	2,500	4.41	3.51	0.79	5	43.59	Bankline bench on vegetated bankline.
Str-03	Storey	NA	4,761.66	Bankline Bench	3,000	0.91	1.01	0.19	1	2.11	Bankline bench on vegetated bankline.
Str-05	Storey	NA	4,757.24	Bankline Bench	3,000	5.87	6.14	1.20	6	79.24	Bankline bench on vegetated bankline.
Str-07	Storey	NA	4,751.95	Bankline Bench	3,000	4.37	4.03	0.84	5	46.22	Bankline bench on vegetated bankline.
Bankline Bench Total						**19.64**	**18.23**	**3.79**	**21**	**204.67**	
Str-09	Storey	4,234	4,749.52	Island/Bar Modification	1,500	2.53	1.44	0.40	3	13.11	Terrace island to increase inundation frequency
Str-13	Storey	3,097	4,746.89	Island/Bar Modification	2,200	2.61	1.04	0.37	3	12.05	Terrace island to increase inundation frequency
Str-14	Storey	3,097	4,746.71	Island/Bar Modification	2,200	3.19	1.21	0.44	4	19.36	Terrace island to increase inundation frequency
Island/Bar Modification Total						**8.33**	**3.69**	**1.20**	**10**	**44.51**	
STOREY SUBREACH GRAND TOTAL						**39.09**	**27.00**	**6.61**	**43**	**297.52**	

*Totals may not sum due to rounding

APPENDIX E
VEGETATION MAPPING

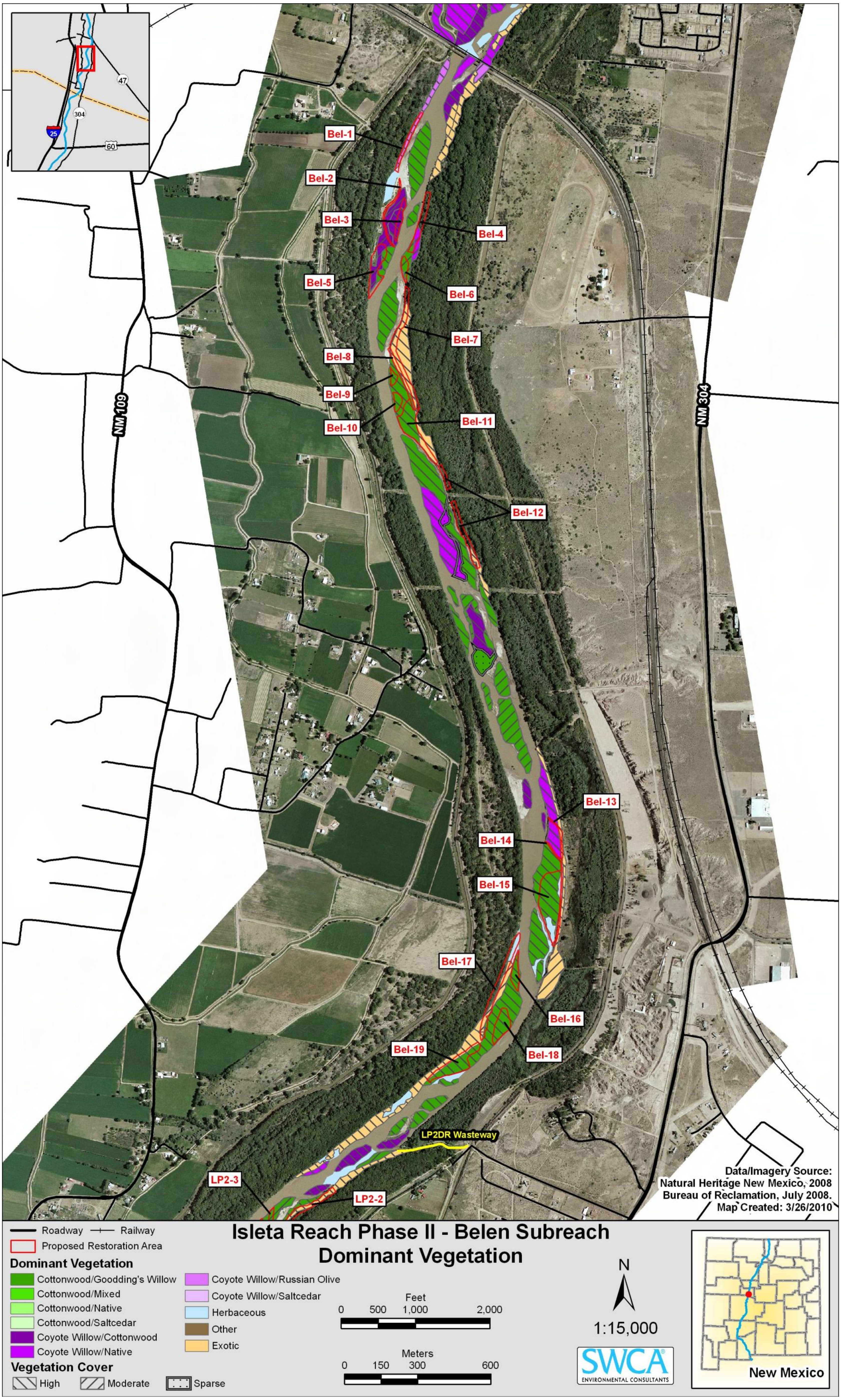

Figure E.1. Belen Subreach dominant vegetation.

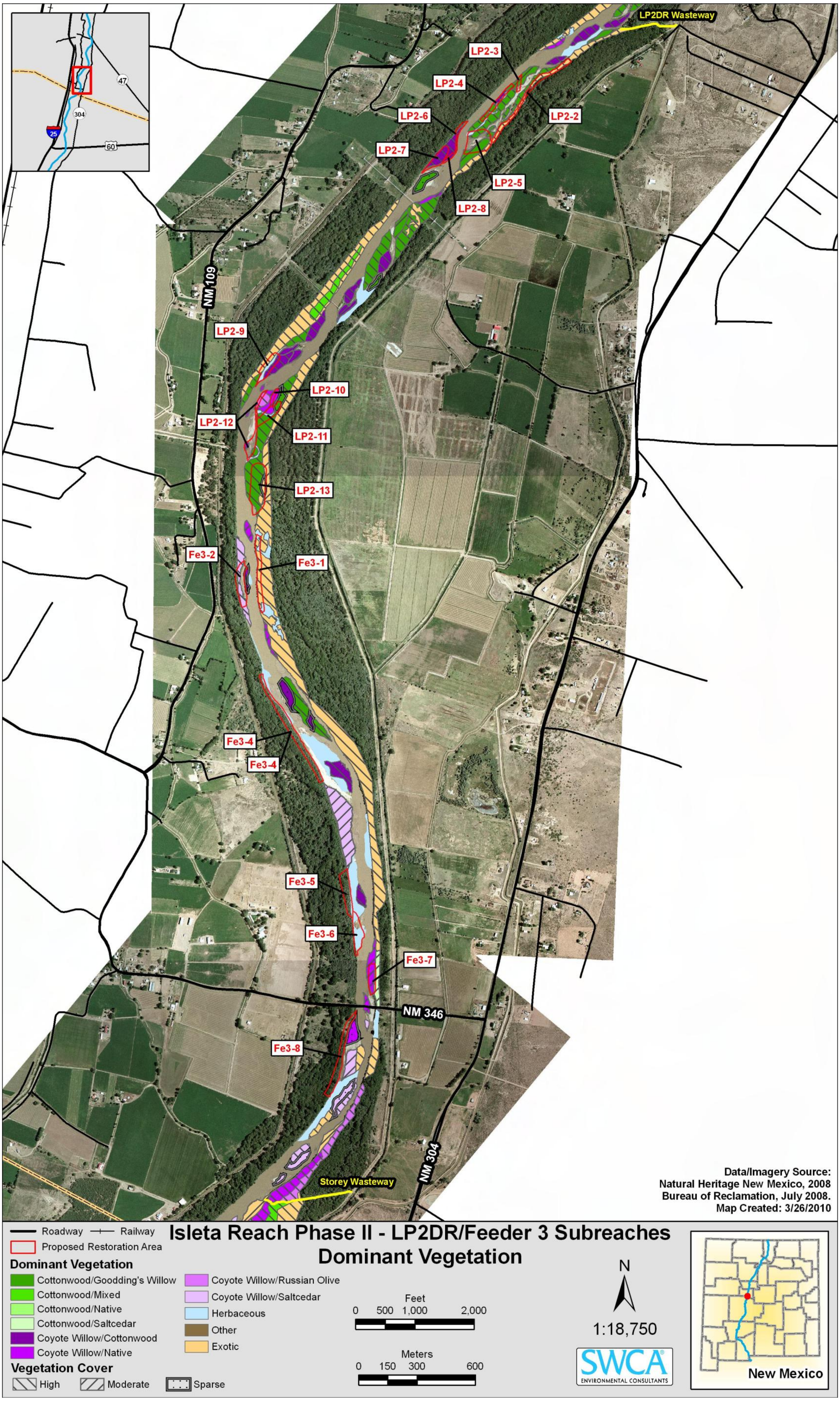

Figure E.2. LP2DR/Feeder 3 Subreach dominant vegetation.

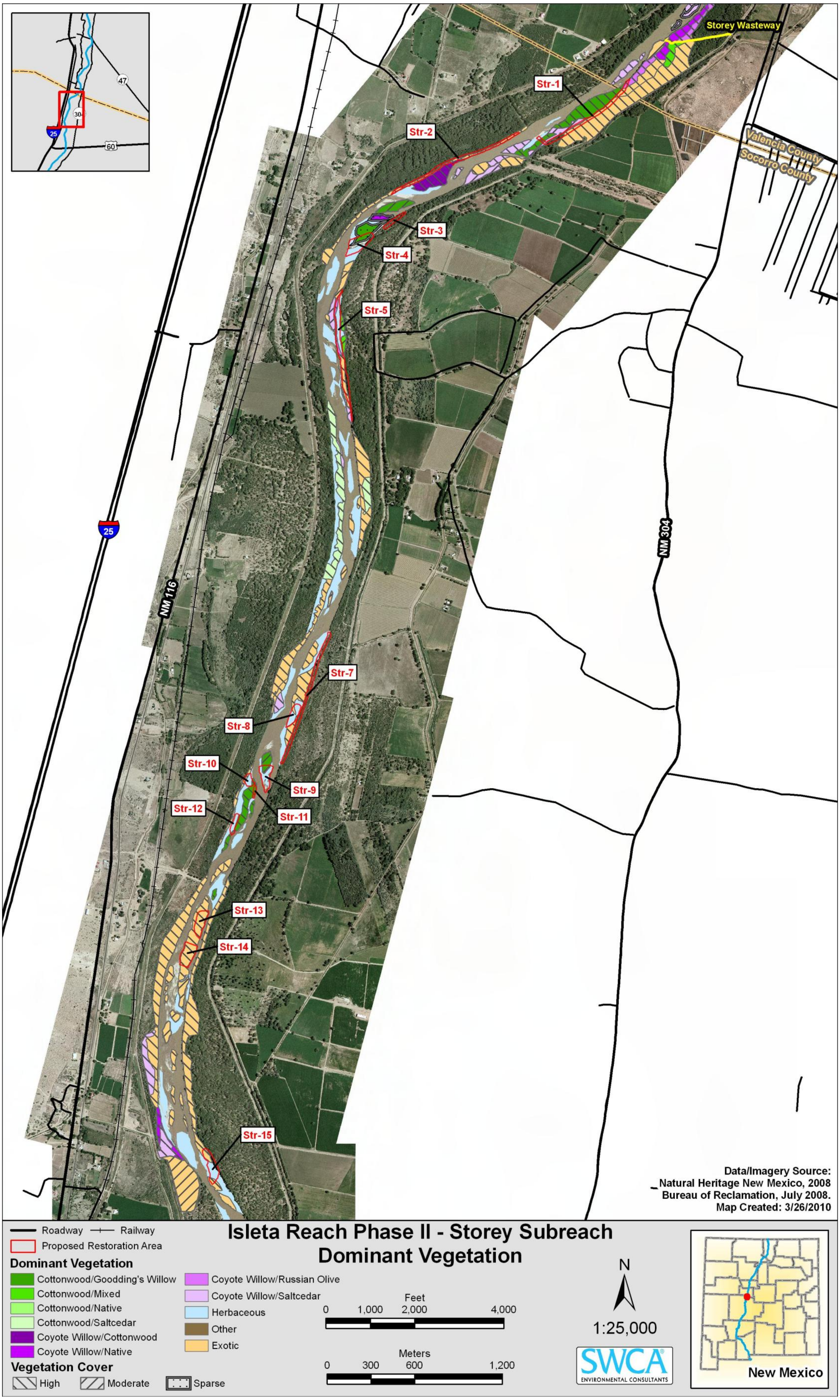

Figure E.3. Storey Subreach dominant vegetation.

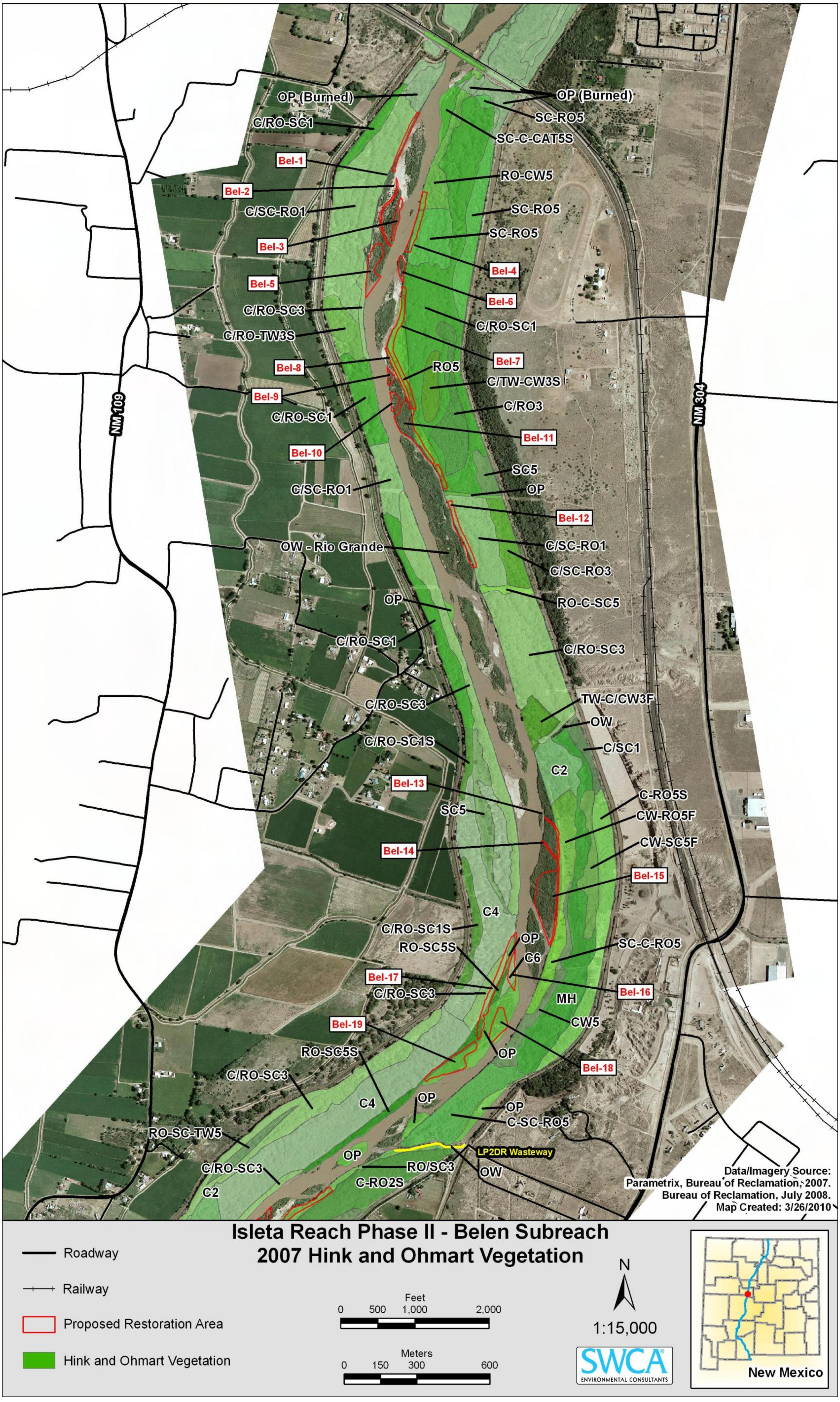

Figure E.4. Hink and Ohmart classifications for the Belen Subreach.

Figure E.5. Hink and Ohmart classifications for the LP2DR/Feeder 3 subreaches.

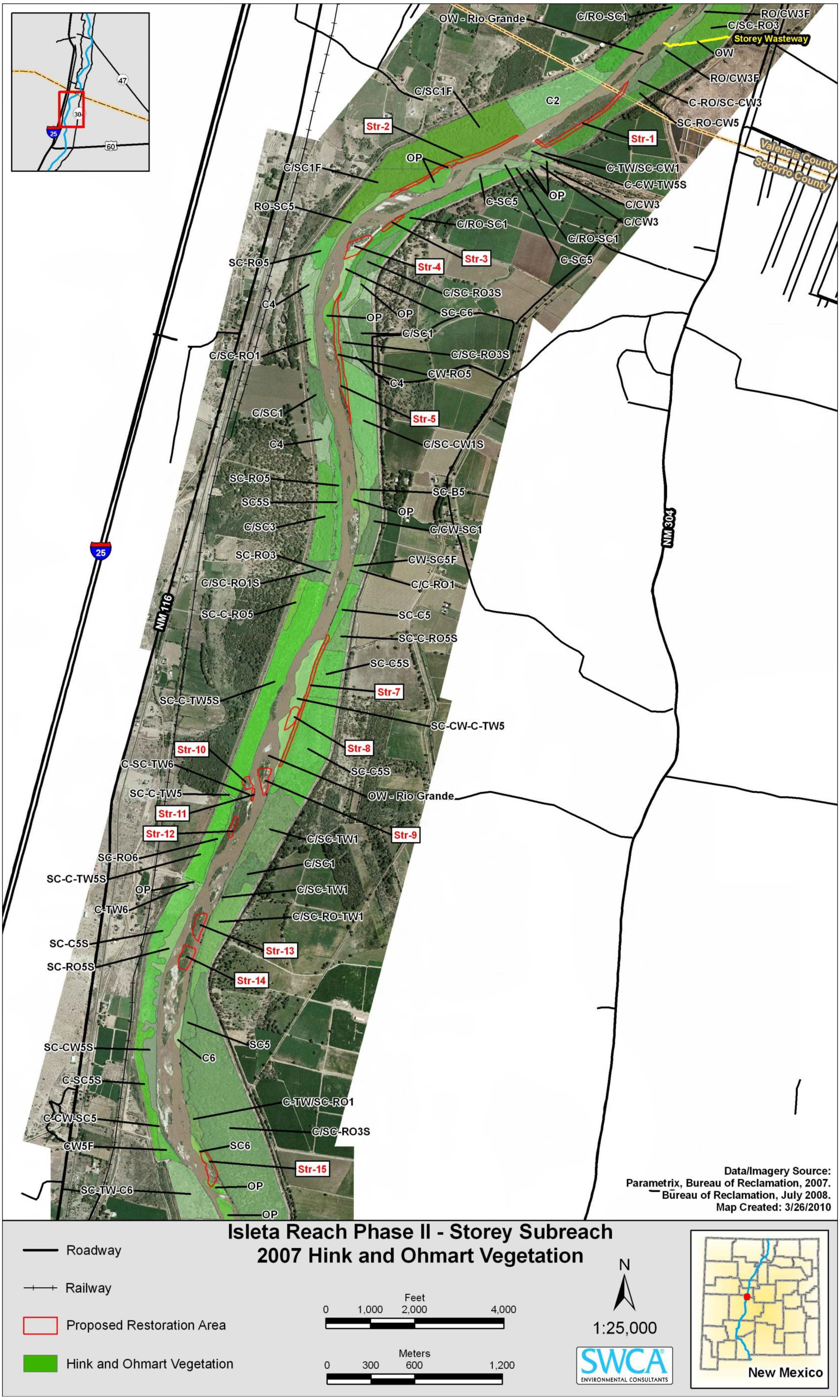

Figure E.6. Hink and Ohmart classifications for the Storey Subreach.

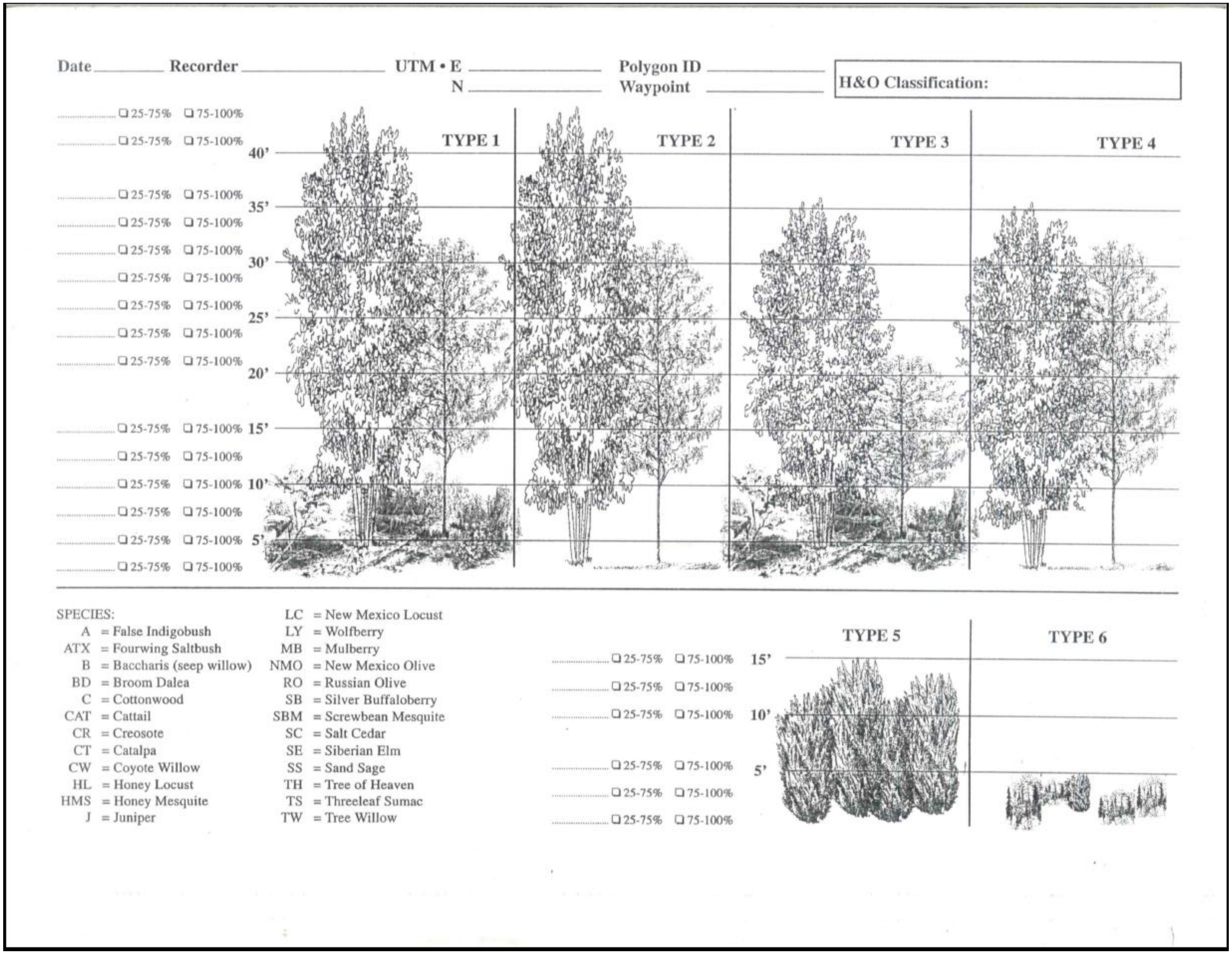

Figure E.7. Hink and Ohmart structural classifications.

Structural Type 1: Mature and mid-aged trees with shrubby vegetation at all heights.

Structural Type 2: Mature and mid-aged trees with little or no shrubby vegetation.

Structural Type 3: Intermediate-aged trees with dense shrubby vegetation.

Structural Type 4: Intermediate-aged trees with little or no shrubby vegetation.

Structural Type 5: Young stands with dense shrubby vegetation.

Structural Type 6: Very young, low, and/or sparse vegetation.

Structural Type OW: Open water.

APPENDIX F
USFWS RESOURCE CATEGORY ANALYSIS

An analysis of the Middle Rio Grande River Bar Vegetation Map III: Belen to San Acacia (Milford et al. 2008) and the Hink and Ohmart (1984) classifications of floodplain vegetation presented in the Isleta Reach Analysis and Recommendations Study (Parametrix et al. 2008) was conducted to assess the effects of vegetation disturbance on suitable habitat for the flycatcher. Vegetation data and mapping were then used in an U.S. Fish and Wildlife Service (USFWS) Resource Category analysis to determine the potential impacts on the species of concern.

Milford et al. (2008) classified and mapped the vegetation of the bank-attached bars using aerial photo interpretation and extensive ground surveys. Map units focus on vegetation structure and density, dominant species composition, and level of exotic encroachment. Figure E.1 through Figure E.3 in Appendix E illustrate the dominant vegetation on the bank-attached bars and islands. Parametrix et al. (2008) quantified and mapped the vegetation composition and structure in the floodplain using the Hink and Ohmart classification system that has been used in earlier vegetation classification studies of the Middle Rio Grande (MRG) (Hink and Ohmart 1984; Milford et al. 2006). Hink and Ohmart vegetation mapping is presented in Appendix E, Figure E.4 through Figure E.6.

Using the USFWS Resource Categories defined in the USFWS Mitigation Policy (Federal Register 1981), habitat areas were assessed in the restoration areas. The Mitigation Policy was designed to assist USFWS personnel in the development of consistent and effective recommendations for the protection and conservation of valuable fish and wildlife resources. Of particular interest to this Biological Assessment are those portions of the Mitigation Policy that address habitat issues and the criteria that define specific habitat types and potential mitigation measures. Each of the habitat types defined by the Mitigation Policy's Resource Categories supports diverse species but of descending biological value. The Resource Categories are as follows:

1. *Resource Category 1:* Habitat is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. The mitigation goal for habitat in Resource Category 1 is "no loss of existing habitat value."
2. *Resource Category 2:* Habitat is of high quality for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat in Resource Category 2 is "no net loss of in-kind habitat value."
3. *Resource Category 3:* Habitat is of high to medium value for evaluation species. The mitigation goal for habitat in Resource Category 3 is "no net loss of habitat value while minimizing loss of in-kind habitat value."
4. *Resource Category 4:* Habitat is of medium to low value for evaluation species. The mitigation goal for habitat in Resource Category 4 is "minimize loss of habitat value."

Proposed restoration sites were evaluated and categorized based on the quality of habitat for the flycatcher using the dominant species, dominant vegetative strata class, and dominant vegetation cover metrics; cover descriptions; and community type descriptions as described by Milford et al. (2008). Sites dominated by willow species that were characterized as shrub-dominated communities and had high to moderate cover were classified as being more important for the flycatcher (e.g., Resource Category 2). These habitats generally are of intermediate height and structure but do not currently support breeding flycatchers, although they have the potential to develop into suitable breeding habitat in the absence of disturbance. Sites with an abundance of non-native species were classified as Resource Category 3, as were sites dominated by herbaceous wetland and herbaceous mesic vegetation and sites characterized with sparse cover. Bare ground areas and areas dominated by herbaceous upland vegetation were categorized as Resource Category 4. No sites were classified as Resource Category 1 due to the absence of any indication of breeding flycatchers and field observations that these sites generally lack the requisite structure to attract breeding flycatchers.

Throughout the project reach Resource Category 2 habitats occupied 42.76% of the mapped areas, Resource Category 3 habitats occupied 21.73% of the mapped areas, and Resource Category 4 habitats occupied 8.87% of the mapped areas. The remaining areas (26.64%) included open water habitats or were classified as active floodplain (Milford et al. 2008). These areas were not assigned to a Resource Category. Resource Category analysis and mapping are presented in Appendix F. Table F.1 through Table F.4 summarize the Resource Categories in each subreach of the project area. Figure F.1 through Figure F.3 illustrate the Resource Category for bank-attached bars and islands.

Disturbance of these in-channel habitats will be temporary. It is anticipated that natural revegetation will occur quickly following excavation of the habitat features. Dynamic succession characterizes riparian habitats, and since the proposed restoration will increase inundation and bring the island and bar ground levels closer to groundwater in the bosque inundation site and on bank-attached and mid-channel bars, the future potential for dense stands of native trees to develop will be improved in these areas, providing better support for the flycatcher in the future. Vegetation will be monitored as it re-establishes in the disturbed island and bar restoration areas. If necessary, revegetation with native willow (coyote willow and Goodding's willow [*Salix gooddingii*]) may be implemented to supplement the natural regeneration process. No recommendation is made for loss of herbaceous vegetation.

Potential disturbance in the floodplain will be limited to access and staging areas and the narrow strip along the banklines associated with excavation of the bankline benches. Staging and access areas will utilize existing roads and disturbance areas; therefore, disturbance to vegetation is not anticipated. Disturbance to vegetation in the bankline bench treatment areas will largely be limited to Russian olive and saltcedar. Native species that may be impacted include cottonwood and willow.

Table F.1. Belen Subreach USFWS Resource Category Site Analysis

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Bel-1	Bankline Benches	BR	B	b	bare	Bare	Sum of Area_sq_m	200.57	4	OTH
							Sum of Acres	0.05		
		HM	H	h	high	Herbaceous Mesic	Sum of Area_sq_m	817.69	3	6
							Sum of Acres	0.20		
		Wi	S	h	high / moderate	Coyote Willow / Russian Olive	Sum of Area_sq_m	1,881.67	2	3
							Sum of Acres	0.46		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	7,726.27		OTH
							Sum of Acres	1.91		
							Bel-1 Sum of Area_sq_m	**10,626.20**		
							Bel-1 Sum of Acres	**2.63**		
Bel-2	Ephemeral Channel	BR	B	b	bare	Bare	Sum of Area_sq_m	3,154.78	4	OTH
							Sum of Acres	0.78		
		HM	H	h	high	Herbaceous Mesic	Sum of Area_sq_m	367.80	3	6
							Sum of Acres	0.09		
		Wi	S	m	moderate / moderate	Coyote Willow / Cottonwood	Sum of Area_sq_m	419.85	2	4
							Sum of Acres	0.10		
							Bel-2 Sum of Area_sq_m	**3,942.44**		
							Bel-2 Sum of Acres	**0.97**		

Table F.1. Belen Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Bel-3	Island/Bar Modification	Wi	S	h	high / high	Coyote Willow / Cottonwood	Sum of Area_sq_m	2,186.65	2	3
							Sum of Acres	0.54		
				m	moderate / moderate	Coyote Willow / Cottonwood	Sum of Area_sq_m	568.52	2	4
							Sum of Acres	0.14		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	30.94		OTH
							Sum of Acres	0.01		
							Bel-3 Sum of Area_sq_m	**2,786.10**		
							Bel-3 Sum of Acres	**0.69**		
Bel-4	Bankline Benches	Cw	S	h	moderate / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	8.78	2	4
							Sum of Acres	0.00		
		Wi	S	h	moderate / moderate	Coyote Willow / Native	Sum of Area_sq_m	2,265.51	2	4
							Sum of Acres	0.56		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	1,366.15		OTH
							Sum of Acres	0.34		
							Bel-4 Sum of Area_sq_m	**3,640.44**		
							Bel-4 Sum of Acres	**0.90**		

Table F.1. Belen Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Bel-5	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	804.47	4	OTH
							Sum of Acres	0.20		
		Cw	S	h	high / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	1,190.85	2	3
							Sum of Acres	0.29		
		Wi	S	m	moderate / moderate	Coyote Willow / Cottonwood	Sum of Area_sq_m	4,319.92	2	4
							Sum of Acres	1.07		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	161.47		OTH
							Sum of Acres	0.04		
						Floodplain	Sum of Area_sq_m	294.83		
							Sum of Acres	0.07		
							Bel-5 Sum of Area_sq_m	**6,771.54**		
							Bel-5 Sum of Acres	**1.67**		
Bel-6	Island/Bar Modification	BR	B	b	bare	Bare	Sum of Area_sq_m	674.81	4	OTH
							Sum of Acres	0.17		
		Cw	S	h	moderate / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	3,003.50	2	3
							Sum of Acres	0.74		
		Wi	S	h	moderate / moderate	Coyote Willow / Native	Sum of Area_sq_m	5.88	2	4
							Sum of Acres	0.00		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	148.52		OTH
							Sum of Acres	0.04		
							Bel-6 Sum of Area_sq_m	**3,832.71**		
							Bel-6 Sum of Acres	**0.95**		

Table F.1. Belen Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Bel-7	Bankline Benches	BR	B	b	bare	Bare	Sum of Area_sq_m	472.72	4	OTH
							Sum of Acres	0.12		
		Ro	S	h	high / high	Russian Olive / Coyote Willow	Sum of Area_sq_m	5,673.46	2	3
							Sum of Acres	1.40		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	2,892.71		OTH
							Sum of Acres	0.71		
							Bel-7 Sum of Area_sq_m	**9,038.89**		
							Bel-7 Sum of Acres	**2.23**		
Bel-8	Ephemeral Channel	BR	B	b	bare	Bare	Sum of Area_sq_m	94.11	4	OTH
							Sum of Acres	0.02		
		Cw	S	h	high / high	Cottonwood / Goodding's Willow	Sum of Area_sq_m	872.08	2	3
							Sum of Acres	0.22		
		Ro	S	h	high / high	Russian Olive / Coyote Willow	Sum of Area_sq_m	2,028.76	2	3
							Sum of Acres	0.50		
							Bel-8 Sum of Area_sq_m	**2,994.96**		
							Bel-8 Sum of Acres	**0.74**		
Bel-9	Backwater / Embayment	Cw	S	h	high / high	Cottonwood / Goodding's Willow	Sum of Area_sq_m	1,135.30	2	3
							Sum of Acres	0.28		
							Bel-9 Sum of Area_sq_m	**1,135.30**		
							Bel-9 Sum of Acres	**0.28**		

Table F.1. Belen Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Bel-10	Backwater / Embayment	Cw	S	h	high / high	Cottonwood / Goodding's Willow	Sum of Area_sq_m	718.59	2	3
							Sum of Acres	0.18		
							Bel-10 Sum of Area_sq_m	**718.59**		
							Bel-10 Sum of Acres	**0.18**		
Bel-11	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	170.86	4	OTH
							Sum of Acres	0.04		
		Cw	S	h	high / high	Cottonwood / Goodding's Willow	Sum of Area_sq_m	7,751.05	2	3
							Sum of Acres	1.92		
		Ro	S	h	high / high	Russian Olive / Coyote Willow	Sum of Area_sq_m	1,849.31	2	3
							Sum of Acres	0.46		
							Bel-11 Sum of Area_sq_m	**9,771.23**		
							Bel-11 Sum of Acres	**2.41**		
Bel-12	Bankline Benches	BR	B	b	bare	Bare	Sum of Area_sq_m	1188.76	4	OTH
							Sum of Acres	0.29		
		Ro	S	h	high / high	Russian Olive / Coyote Willow	Sum of Area_sq_m	108.69	2	3
							Sum of Acres	0.03		
						Russian Olive / Exotic	Sum of Area_sq_m	731.60	3	3
							Sum of Acres	0.18		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	5,896.89		OTH
							Sum of Acres	1.46		
							Bel-12 Sum of Area_sq_m	**7,925.94**		
							Bel-12 Sum of Acres	**1.96**		

Table F.1. Belen Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Bel-13	Ephemeral Channel	BR	B	b	bare	Bare	Sum of Area_sq_m	318.45	4	OTH
							Sum of Acres	0.08		
		Wi	S	h	high / moderate	Coyote Willow / Cottonwood	Sum of Area_sq_m	53.14	2	3
							Sum of Acres	0.01		
						Coyote Willow / Native	Sum of Area_sq_m	718.19	2	3
							Sum of Acres	0.18		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	0.40		OTH
							Sum of Acres	0.00		
							Bel-13 Sum of Area_sq_m	**1,090.18**		
							Bel-13 Sum of Acres	**0.27**		
Bel-14	Ephemeral Channel	BR	B	b	bare	Bare	Sum of Area_sq_m	3.49	4	OTH
							Sum of Acres	0.00		
		Cw	S	h	high / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	717.32	2	3
							Sum of Acres	0.18		
		Wi	S	h	high / moderate	Coyote Willow / Native	Sum of Area_sq_m	440.14	2	3
							Sum of Acres	0.11		
							Bel-14 Sum of Area_sq_m	**1,160.95**		
							Bel-14 Sum of Acres	**0.29**		

Table F.1. Belen Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Bel-15	Backwater / Embayment	Cw	S	h	high / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	12,230.32	2	3
							Sum of Acres	3.02		
		HM	H	m	high	Herbaceous Mesic	Sum of Area_sq_m	3.46	3	6
							Sum of Acres	0.00		
					moderate	Herbaceous Mesic	Sum of Area_sq_m	2,163.13	3	6
							Sum of Acres	0.53		
		HW	H	h	high	Herbaceous Wetland	Sum of Area_sq_m	1,973.99	3	6
							Sum of Acres	0.49		
		Ro	F	h	high / moderate	Russian Olive / Coyote Willow	Sum of Area_sq_m	1,393.69	3	1
							Sum of Acres	0.34		
			S	m	moderate / moderate	Russian Olive / Coyote Willow	Sum of Area_sq_m	468.92	2	4
							Sum of Acres	0.12		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	1,562.09		OTH
							Sum of Acres	0.39		
						Floodplain	Sum of Area_sq_m	10.65		
							Sum of Acres	0.00		
							Bel-15 Sum of Area_sq_m	**19,806.25**		
							Bel-15 Sum of Acres	**4.89**		

Table F.1. Belen Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Bel-16	Backwater / Embayment	Cw	S	h	high / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	2,478.32	2	3
							Sum of Acres	0.61		
		HU	H	h	high	Herbaceous Upland	Sum of Area_sq_m	139.17	4	6
							Sum of Acres	0.03		
		Ro	S	m	moderate / high	Russian Olive / Exotic	Sum of Area_sq_m	35.75	3	4
							Sum of Acres	0.01		
							Bel-16 Sum of Area_sq_m	**2,653.24**		
							Bel-16 Sum of Acres	**0.66**		
Bel-17	Bankline Benches	HU	H	h	high	Herbaceous Upland	Sum of Area_sq_m	9.11	4	6
							Sum of Acres	0.00		
		Ro	F	h	high / high	Russian Olive / Exotic	Sum of Area_sq_m	839.92	3	1
							Sum of Acres	0.21		
			S	m	moderate / high	Russian Olive / Exotic	Sum of Area_sq_m	419.33	3	4
							Sum of Acres	0.10		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	6,563.61		OTH
							Sum of Acres	1.62		
							Bel-17 Sum of Area_sq_m	**7,831.97**		
							Bel-17 Sum of Acres	**1.94**		

Table F.1. Belen Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Bel-18	Backwater / Embayment	Cw	S	h	high / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	4,186.73	2	3
							Sum of Acres	1.03		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	25.44		OTH
							Sum of Acres	0.01		
							Bel-18 Sum of Area_sq_m	**4,212.17**		
							Bel-18 Sum of Acres	**1.04**		
Bel-19	Backwater / Embayment	Cw	S	h	high / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	8,143.82	2	3
							Sum of Acres	2.01		
		HM	H	h	moderate	Herbaceous Mesic	Sum of Area_sq_m	56.28	3	6
							Sum of Acres	0.01		
		Ro	F	h	high / high	Russian Olive / Exotic	Sum of Area_sq_m	571.74	3	1
							Sum of Acres	0.14		
							Bel-19 Sum of Area_sq_m	**8,771.85**		
							Bel-19 Sum of Acres	**2.17**		

Note: Totals may not sum exactly due to rounding.

Dominant Species Code: Cs = cottonwood, Wi = coyote willow, Ro = Russian olive, Sc = saltcedar, HW = herbaceous wetland; HM = herbaceous mesic, HU = herbaceous upland, BR = bare ground.

Dominant Strata Class Code: F = forest, S = Shrub, B = bare.

Dominant Vegetation Cover Code: h = high, m = moderate, s = sparse, b = bare.

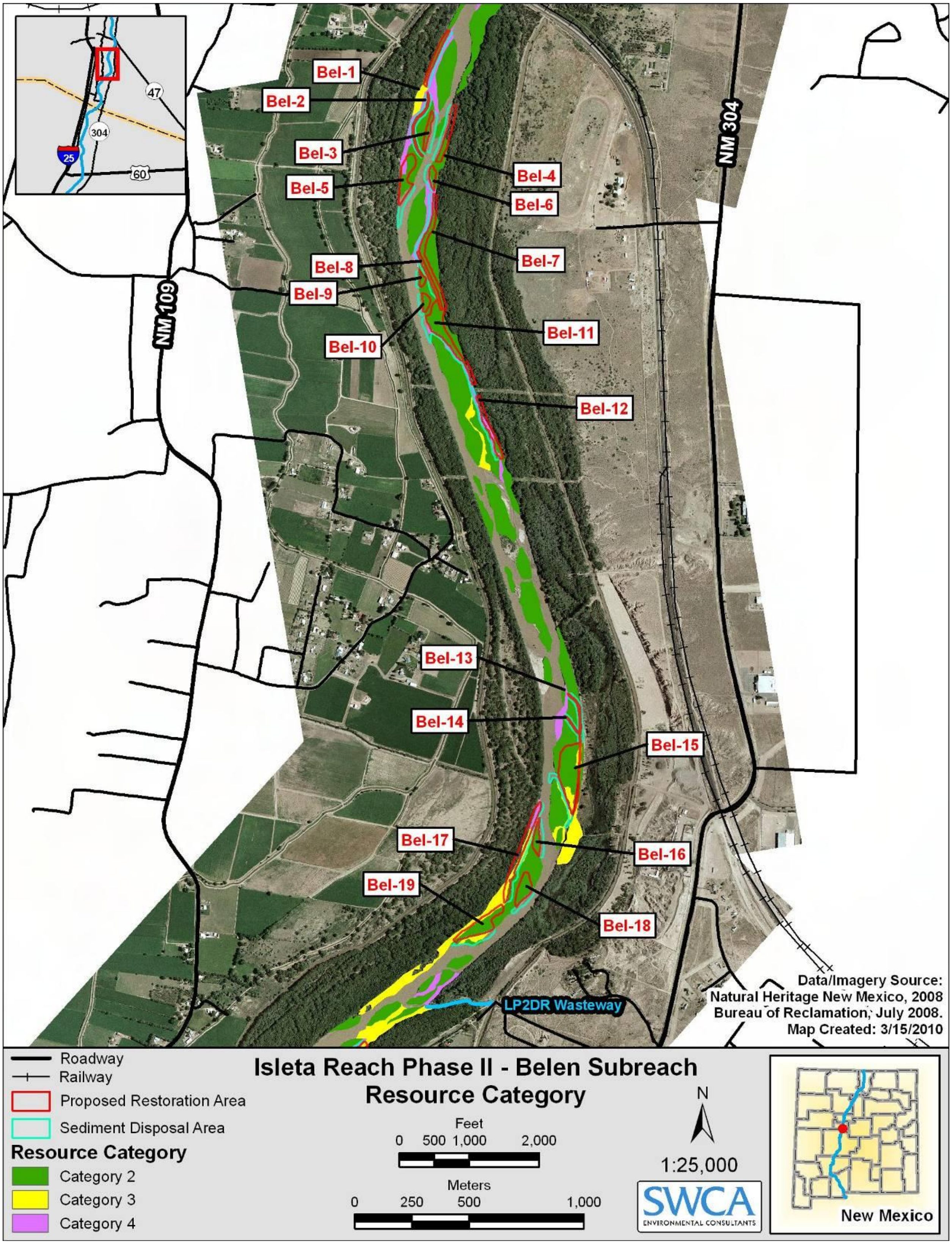

Figure F.1. Belen Subreach Resource Categories.

Table F.2. LP2DR Subreach USFWS Resource Category Site Analysis

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
LP2-2	Bankline Benches	BR	B	b	bare	Bare	Sum of Area_sq_m	118.03	4	OTH
							Sum of Acres	0.03		
		Ro	F	h	high / high	Russian Olive / Exotic	Sum of Area_sq_m	8,614.11	3	1
							Sum of Acres	2.13		
		Sg	S	h	high / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	1,368.40	2	3
							Sum of Acres	0.34		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	3,911.79		OTH
							Sum of Acres	0.97		
							LP2-2 Sum of Area_sq_m	**14,012.34**		
							LP2-2 Sum of Acres	**3.46**		
LP2-3	Ephemeral Channel	BR	B	b	bare	Bare	Sum of Area_sq_m	162.56	4	OTH
							Sum of Acres	0.04		
		Cw	S	m	moderate / sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	446.78	2	4
							Sum of Acres	0.11		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	7.06		OTH
							Sum of Acres	0.00		
							LP2-3 Sum of Area_sq_m	**616.40**		
							LP2-3 Sum of Acres	**0.15**		

Table F.2. LP2DR Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
LP2-4	Island/Bar Destabilization	Cw	S	h	high/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	779.18	2	4
							Sum of Acres	0.19		
				m	moderate / sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	806.79	2	4
							Sum of Acres	0.20		
		HW	H	m	sparse	Herbaceous Wetland	Sum of Area_sq_m	241.75	3	6
							Sum of Acres	0.06		
		Wi	S	h	high/sparse	Coyote Willow / Cottonwood	Sum of Area_sq_m	857.29	2	4
							Sum of Acres	0.21		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	73.82		OTH
							Sum of Acres	0.02		
							LP2-4 Sum of Area_sq_m	**2,758.83**		
							LP2-4 Sum of Acres	**0.68**		

Table F.2. LP2DR Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
LP2-5	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	4795.73	4	OTH
							Sum of Acres	1.19		
		Cw	S	h	high/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	588.94	2	4
							Sum of Acres	0.15		
		HW	H	m	sparse	Herbaceous Wetland	Sum of Area_sq_m	120.75	3	6
							Sum of Acres	0.03		
		Ro	F	h	high / high	Russian Olive / Exotic	Sum of Area_sq_m	222.31	3	1
							Sum of Acres	0.05		
		Sg	S	m	moderate / sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	3,104.49	2	4
							Sum of Acres	0.77		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	2.79		OTH
							Sum of Acres	0.00		
							LP2-5 Sum of Area_sq_m	**8,835.01**		
							LP2-5 Sum of Acres	**2.18**		
LP2-6	Bankline Benches	Wi	S	h	high/sparse	Coyote Willow / Cottonwood	Sum of Area_sq_m	612.65	2	4
							Sum of Acres	0.15		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	23.22		OTH
							Sum of Acres	0.01		
						Floodplain	Sum of Area_sq_m	1,963.85		
							Sum of Acres	0.49		
							LP2-6 Sum of Area_sq_m	**2,599.71**		
							LP2-6 Sum of Acres	**0.64**		

Table F.2. LP2DR Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
LP2-7	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	674.66	4	OTH
							Sum of Acres	0.17		
		Wi	S	h	high/sparse	Coyote Willow / Cottonwood	Sum of Area_sq_m	3,911.63	2	4
							Sum of Acres	0.97		
							LP2-7 Sum of Area_sq_m	**4,586.29**		
							LP2-7 Sum of Acres	**1.13**		
LP2-8	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	87.70	4	OTH
							Sum of Acres	0.02		
		Wi	S	h	high/sparse	Coyote Willow / Cottonwood	Sum of Area_sq_m	967.07	2	4
							Sum of Acres	0.24		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	41.11		OTH
							Sum of Acres	0.01		
							LP2-8 Sum of Area_sq_m	**1,095.87**		
							LP2-8 Sum of Acres	**0.27**		

Table F.2. LP2DR Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
LP2-9	Backwater / Embayment	Cw	S	h	high/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	47.42	2	4
							Sum of Acres	0.01		
		HW	H	m	moderate	Herbaceous Wetland	Sum of Area_sq_m	2,289.53	3	6
							Sum of Acres	0.57		
		Ro	F	h	high / high	Russian Olive / Exotic	Sum of Area_sq_m	17.88	3	1
							Sum of Acres	0.00		
		Wi	S	h	high / moderate	Coyote Willow / Cottonwood	Sum of Area_sq_m	3,819.47	2	4
							Sum of Acres	0.94		
				m	moderate / sparse	Coyote Willow / Cottonwood	Sum of Area_sq_m	4.01	2	4
							Sum of Acres	0.00		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	225.10		OTH
							Sum of Acres	0.06		
							LP2-9 Sum of Area_sq_m	**6,403.42**		
							LP2-9 Sum of Acres	**1.58**		

Table F.2. LP2DR Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
LP2-10	Ephemeral Channel	Cw	S	s	sparse/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	79.41	3	4
							Sum of Acres	0.02		
		Sg	S	h	high/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	44.29	2	3
							Sum of Acres	0.01		
		Wi	S	m	moderate / moderate	Coyote Willow / Native	Sum of Area_sq_m	1,239.44	2	3
							Sum of Acres	0.31		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	228.69		OTH
							Sum of Acres	0.06		
							LP2-10 Sum of Area_sq_m	**1,591.83**		
							LP2-10 Sum of Acres	**0.39**		
LP2-11	Backwater / Embayment	Cw	S	h	high/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	1129.57	2	4
							Sum of Acres	0.28		
				s	sparse/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	544.39	3	5
							Sum of Acres	0.13		
		HM	H	h	high	Herbaceous Mesic	Sum of Area_sq_m	527.63	3	6
							Sum of Acres	0.13		
		Wi	S	m	moderate / moderate	Coyote Willow / Native	Sum of Area_sq_m	825.94	2	4
							Sum of Acres	0.20		
							LP2-11 Sum of Area_sq_m	**3,027.54**		
							LP2-11 Sum of Acres	**0.75**		

Table F.2. LP2DR Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
LP2-12	Island/Bar Modification	BR	B	b	bare	Bare	Sum of Area_sq_m	1,244.60	4	OTH
							Sum of Acres	0.31		
		Cw	S	h	high/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	1,509.93	2	4
							Sum of Acres	0.37		
		HM	H	h	high	Herbaceous Mesic	Sum of Area_sq_m	148.52	3	6
							Sum of Acres	0.04		
		HW	HW	h	high	Herbaceous Wetland	Sum of Area_sq_m	143.11	3	6
							Sum of Acres	0.04		
		Wi	S	h	high / moderate	Coyote Willow / Russian Olive	Sum of Area_sq_m	25.06	2	3
							Sum of Acres	0.01		
				m	moderate / moderate	Coyote Willow / Native	Sum of Area_sq_m	144.51	3	4
							Sum of Acres	0.04		
							LP2-12 Sum of Area_sq_m	**3,215.73**		
							LP2-12 Sum of Acres	**0.79**		

Table F.2. LP2DR Subreach USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
LP2-13	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	253.73	4	OTH
							Sum of Acres	0.06		
		Cw	S	h	high/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	11,483.61	2	4
							Sum of Acres	2.84		
		Ro	S	h	high / high	Russian Olive / Coyote Willow	Sum of Area_sq_m	79.01	2	4
							Sum of Acres	0.02		
					high / moderate	Russian Olive / Coyote Willow	Sum of Area_sq_m	1,183.99	3	4
							Sum of Acres	0.29		
				m	moderate / high	Russian Olive / Coyote Willow	Sum of Area_sq_m	288.70	3	4
							Sum of Acres	0.07		
		Sc	S	s	sparse/sparse	Saltcedar / Mixed	Sum of Area_sq_m	1711.30	4	4
							Sum of Acres	0.42		
							LP2-13 Sum of Area_sq_m	**15,000.34**		
							LP2-13 Sum of Acres	**3.71**		

Note: Totals may not sum exactly due to rounding.

Dominant Species Code: Cs = cottonwood, Wi = coyote willow, Ro = Russian olive, Sc = saltcedar, HW = herbaceous wetland; HM = herbaceous mesic, HU = herbaceous upland, BR = bare ground.

Dominant Strata Class Code: F = forest, S = Shrub, B = bare.

Dominant Vegetation Cover Code: h = high, m = moderate, s = sparse, b = bare.

Table F.3. Feeder 3 USFWS Resource Category Site Analysis

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Fe3-1	Island/Bar Modification	BR	B	b	bare	Bare	Sum of Area_sq_m	176.59	4	OTH
							Sum of Acres	0.04		
		HU	H	h	high	Herbaceous Upland	Sum of Area_sq_m	586.24	4	6
							Sum of Acres	0.14		
		Ro	S	h	high / high	Russian Olive / Coyote Willow	Sum of Area_sq_m	5,256.23	2	3
							Sum of Acres	1.30		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	823.94		OTH
							Sum of Acres	0.20		
							Fe3-1 Sum of Area_sq_m	**6,842.99**		
							Fe3-1 Sum of Acres	**1.69**		
Fe3-2	Island/Bar Modification	BR	B	b	bare	Bare	Sum of Area_sq_m	1,767.13	4	OTH
							Sum of Acres	0.44		
		Wi	S	h	high / moderate	Coyote Willow / Saltcedar	Sum of Area_sq_m	2,278.63	2	3
							Sum of Acres	0.56		
				s	sparse/sparse	Coyote Willow / Native	Sum of Area_sq_m	6.58	3	4
							Sum of Acres	0.00		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	47.71		OTH
							Sum of Acres	0.01		
						Floodplain	Sum of Area_sq_m	287.23		
							Sum of Acres	0.07		
Fe3-2 Sum of Area_sq_m								**4,387.28**		
Fe3-2 Sum of Acres								**1.08**		

Table F.3. Feeder 3 USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Fe3-4	Bankline Benches	BR	B	b	bare	Bare	Sum of Area_sq_m	17.43	4	OTH
							Sum of Acres	0.00		
		HM	H	m	moderate	Herbaceous Mesic	Sum of Area_sq_m	1,437.46	3	6
							Sum of Acres	0.36		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	11,602.78		OTH
							Sum of Acres	2.87		
							Fe3-4 Sum of Area_sq_m	**13,057.67**		
							Fe3-4 Sum of Acres	**3.23**		

Table F.3. Feeder 3 USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Fe3-5	Bankline Benches	HM	H	m	moderate	Herbaceous Mesic	Sum of Area_sq_m	693.32	3	6
							Sum of Acres	0.17		
		Wi	S	m	moderate / moderate	Coyote Willow / Saltcedar	Sum of Area_sq_m	8.55	2	4
							Sum of Acres	0.00		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	7,064.76		OTH
							Sum of Acres	1.75		
							Fe3-5 Sum of Area_sq_m	**7,766.62**		
							Fe3-5 Sum of Acres	**1.92**		
Fe3-6	Island/Bar Modification	BR	B	b	bare	Bare	Sum of Area_sq_m	1,010.28	4	OTH
							Sum of Acres	0.25		
		HM	H	m	moderate	Herbaceous Mesic	Sum of Area_sq_m	4,551.86	3	6
							Sum of Acres	1.12		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	87.23		OTH
							Sum of Acres	0.02		
						Floodplain	Sum of Area_sq_m	212.97		
							Sum of Acres	0.05		
Fe3-6 Sum of Area_sq_m								**5,862.34**		
Fe3-6 Sum of Acres								**1.45**		

Table F.3. Feeder 3 USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Fe3-07	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	210.63	4	OTH
							Sum of Acres	0.05		
		Cw	F	m	moderate / moderate	Cottonwood/Saltcedar	Sum of Area_sq_m	635.88	3	2
							Sum of Acres	0.16		
		Wi	S	m	moderate / moderate	Coyote Willow / Native	Sum of Area_sq_m	2,504.85	2	4
							Sum of Acres	0.62		
							Fe3-07 Sum of Area_sq_m	**3,351.35**		
							Fe3-07 Sum of Acres	**0.83**		
Fe3-8	Bankline Benches	BR	B	b	bare	Bare	Sum of Area_sq_m	135.78	4	OTH
							Sum of Acres	0.03		
		HM	H	s	sparse	Herbaceous Mesic	Sum of Area_sq_m	102.80	3	6
							Sum of Acres	0.03		
		Wi	S	s	sparse/moderate	Coyote Willow / Native	Sum of Area_sq_m	19.25	3	4
							Sum of Acres	0.00		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	9,883.39		OTH
							Sum of Acres	2.44		
							Fe3-8 Sum of Area_sq_m	**10,141.23**		
							Fe3-8 Sum of Acres	**2.51**		

Note: Totals may not sum exactly due to rounding.

Dominant Species Code: Cs = cottonwood, Wi = coyote willow, Ro = Russian olive, Sc = saltcedar, HW = herbaceous wetland; HM = herbaceous mesic, HU = herbaceous upland, BR = bare ground.

Dominant Strata Class Code: F = forest, S = Shrub, B = bare.

Dominant Vegetation Cover Code: h = high, m = moderate, s = sparse, b = bare.

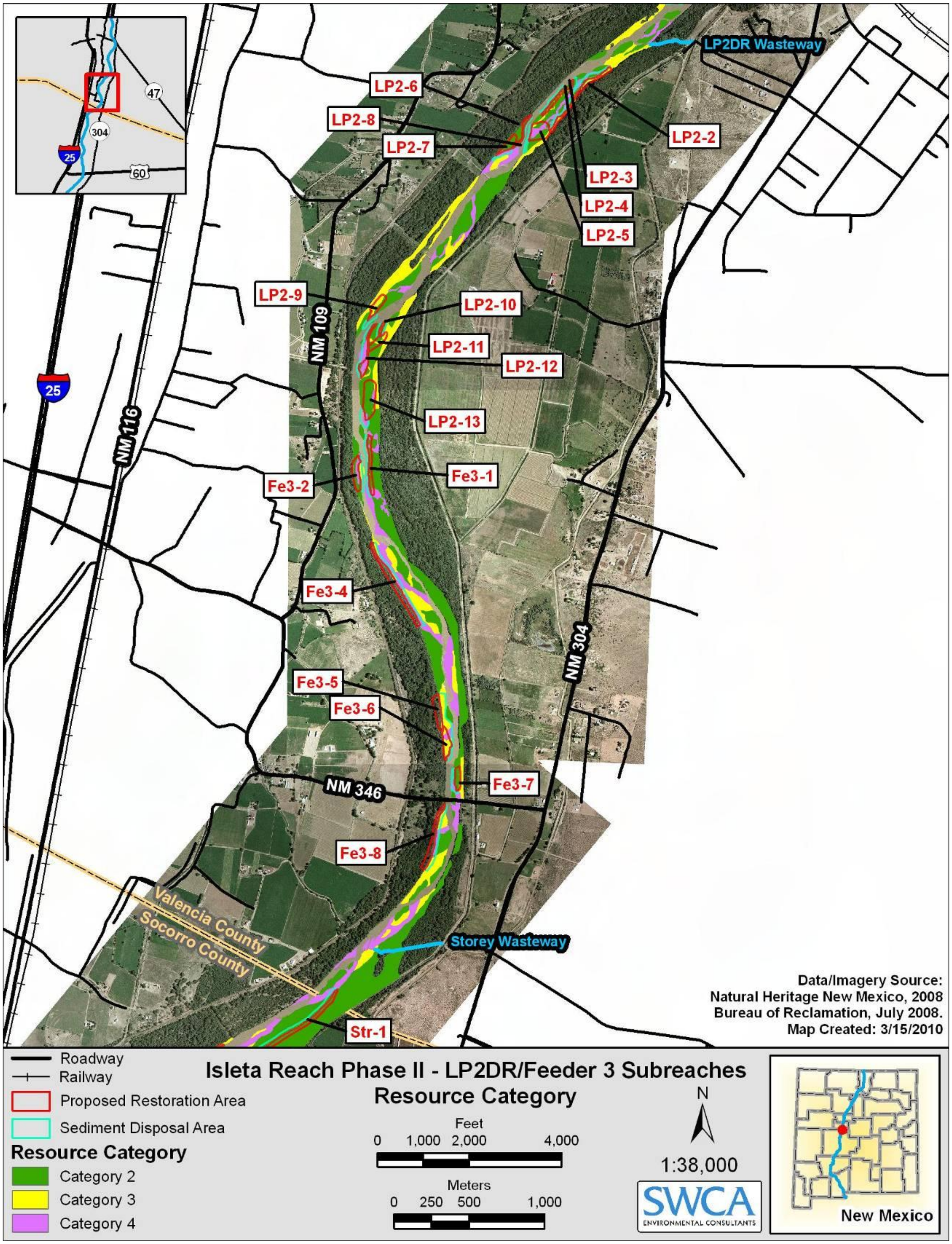

Figure F.2. LP2DR/Feeder 3 Subreach Resource Categories.

Table F.4. Storey USFWS Resource Category Site Analysis

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Str-1	Bankline Benches	BR	B	b	bare	Bare	Sum of Area_sq_m	47.52	4	OTH
							Sum of Acres	0.01		
		Sc	S	h	high / moderate	Saltcedar / Coyote Willow	Sum of Area_sq_m	6,800.15	2	3
							Sum of Acres	1.68		
						Saltcedar / Mixed	Sum of Area_sq_m	1,547.15	3	3
							Sum of Acres	0.38		
		Wi	S	h	high / moderate	Cottonwood / Goodding's Willow	Sum of Area_sq_m	1,070.34	2	3
							Sum of Acres	0.26		
						Coyote Willow / Russian Olive	Sum of Area_sq_m	836.35	2	3
							Sum of Acres	0.21		
				m	moderate / moderate	Coyote Willow / Saltcedar	Sum of Area_sq_m	1,856.82	2	3
							Sum of Acres	0.46		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	2,598.30		OTH
							Sum of Acres	0.64		
							Str-1 Sum of Area_sq_m	**14,756.63**		
							Str-1 Sum of Acres	**3.65**		

Table F.4. Storey USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Str-2	Bankline Benches	HM	H	h	high	Herbaceous Mesic	Sum of Area_sq_m	39.57	3	6
							Sum of Acres	0.01		
		Sc	F	h	high / high	Saltcedar / Mixed	Sum of Area_sq_m	10,199.57	3	1
							Sum of Acres	2.52		
		Wi	S	h	high / moderate	Coyote Willow / Cottonwood	Sum of Area_sq_m	770.71	2	3
							Sum of Acres	0.19		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	45.76		OTH
							Sum of Acres	0.01		
						Floodplain	Sum of Area_sq_m	5,960.46		
							Sum of Acres	1.47		
							Str-2 Sum of Area_sq_m	**17,016.06**		
							Str-2 Sum of Acres	**4.20**		
Str-3	Bankline Benches	BR	B	b	bare	Bare	Sum of Area_sq_m	1,132.13	4	OTH
							Sum of Acres	0.28		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	2,838.91		OTH
							Sum of Acres	0.70		
							Str-3 Sum of Area_sq_m	**3,971.04**		
							Str-3 Sum of Acres	**0.98**		

Table F.4. Storey USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Str-4	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	3,532.41	4	OTH
							Sum of Acres	0.87		
		Cw	S	s	sparse/sparse	Cottonwood / Goodding's Willow	Sum of Area_sq_m	3,922.18	3	5
							Sum of Acres	0.97		
		HM	H	m	moderate	Herbaceous Mesic	Sum of Area_sq_m	4,401.07	3	6
							Sum of Acres	1.09		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	149.48		OTH
							Sum of Acres	0.04		
							Str-4 Sum of Area_sq_m	**12,005.15**		
							Str-4 Sum of Acres	**2.97**		

Table F.4. Storey USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Str-5	Bankline Benches	BR	B	b	bare	Bare	Sum of Area_sq_m	1,588.76	4	OTH
							Sum of Acres	0.39		
		HM	H	m	moderate	Herbaceous Mesic	Sum of Area_sq_m	491.14	3	6
							Sum of Acres	0.12		
		HU	H	h	high	Herbaceous Upland	Sum of Area_sq_m	1,693.26	4	6
							Sum of Acres	0.42		
		HW	H	m	moderate	Herbaceous Wetland	Sum of Area_sq_m	952.30	3	6
							Sum of Acres	0.24		
		Ro	S	h	high / moderate	Russian Olive / Coyote Willow	Sum of Area_sq_m	5,406.04	2	3
							Sum of Acres	1.34		
		Sc	S	m	moderate / sparse	Saltcedar / Mixed	Sum of Area_sq_m	125.91	3	4
							Sum of Acres	0.03		
		Wi	S	h	high / moderate	Coyote Willow / Russian Olive	Sum of Area_sq_m	5,077.23	2	3
							Sum of Acres	1.25		
				m	moderate / sparse	Coyote Willow / Saltcedar	Sum of Area_sq_m	3,321.61	3	4
							Sum of Acres	0.82		
							Str-5 Sum of Area_sq_m	**18,656.27**		
							Str-5 Sum of Acres	**4.61**		

Table F.4. Storey USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Str-7	Bankline Benches	HM	H	h	high	Herbaceous Mesic	Sum of Area_sq_m	2,985.37	3	6
							Sum of Acres	0.74		
		Sc	S	h	high / moderate	Saltcedar / Coyote Willow	Sum of Area_sq_m	3,427.46	2	3
							Sum of Acres	0.85		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	8,982.51		OTH
							Sum of Acres	2.22		
							Str-7 Sum of Area_sq_m	**15,395.34**		
							Str-7 Sum of Acres	**3.80**		
Str-8	Backwater / Embayment	HM	H	h	high	Herbaceous Mesic	Sum of Area_sq_m	2,276.46	3	6
							Sum of Acres	0.56		
		HW	H	h	high	Herbaceous Wetland	Sum of Area_sq_m	1,133.17	3	6
							Sum of Acres	0.28		
		Sc	S	h	high / moderate	Saltcedar / Coyote Willow	Sum of Area_sq_m	514.46	2	3
							Sum of Acres	0.13		
							Str-8 Sum of Area_sq_m	**3,924.09**		
							Str-8 Sum of Acres	**0.97**		

Table F.4. Storey USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Str-9	Island/Bar Modification	BR	B	b	bare	Bare	Sum of Area_sq_m	2,401.62	4	OTH
							Sum of Acres	0.59		
		HM	H	h	high	Herbaceous Mesic	Sum of Area_sq_m	3,822.94	3	6
							Sum of Acres	0.94		
		Sg	S	m	moderate / sparse	Cottonwood / Gooding's Willow	Sum of Area_sq_m	133.25	2	5
							Sum of Acres	0.03		
							Str-9 Sum of Area_sq_m	**6,357.81**		
							Str-9 Sum of Acres	**1.57**		
Str-10	Backwater / Embayment	HM	H	m	moderate	Herbaceous Mesic	Sum of Area_sq_m	2,139.48	3	6
							Sum of Acres	0.53		
		HW	H	m	moderate	Herbaceous Wetland	Sum of Area_sq_m	276.83	3	6
							Sum of Acres	0.07		
		Sg	S	h	high/sparse	Cottonwood / Gooding's Willow	Sum of Area_sq_m	160.75	2	4
							Sum of Acres	0.04		
							Str-10 Sum of Area_sq_m	**2,577.05**		
							Str-10 Sum of Acres	**0.64**		
Str-11	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	23.39	4	OTH
							Sum of Acres	0.01		
		Sg	S	h	high/sparse	Cottonwood / Gooding's Willow	Sum of Area_sq_m	855.40	2	4
							Sum of Acres	0.21		
							Str-11 Sum of Area_sq_m	**878.79**		
							Str-11 Sum of Acres	**0.22**		

Table F.4. Storey USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Str-12	Backwater / Embayment	BR	B	b	bare	Bare	Sum of Area_sq_m	194.69	4	OTH
							Sum of Acres	0.05		
		HM	H	h	high	Herbaceous Mesic	Sum of Area_sq_m	1,775.43	3	6
							Sum of Acres	0.44		
		Sg	S	h	high/sparse	Cottonwood / Gooding's Willow	Sum of Area_sq_m	913.97	2	4
							Sum of Acres	0.23		
							Str-12 Sum of Area_sq_m	**2,884.08**		
							Str-12 Sum of Acres	**0.71**		
Str-13	Island/Bar Modification	BR	B	b	bare	Bare	Sum of Area_sq_m	27.40	4	OTH
							Sum of Acres	0.01		
		Sc	S	h	high / moderate	Saltcedar / Gooding's Willow	Sum of Area_sq_m	4,302.23	2	3
							Sum of Acres	1.06		
							Str-13 Sum of Area_sq_m	**4,329.63**		
							Str-13 Sum of Acres	**1.07**		
Str-14	Island/Bar Modification	Sc	S	h	high / moderate	Saltcedar / Gooding's Willow	Sum of Area_sq_m	7,903.44	2	3
							Sum of Acres	1.95		
		(blank)	(blank)	(blank)	(blank)	Active Channel	Sum of Area_sq_m	85.21		OTH
							Sum of Acres	0.02		
							Str-14 Sum of Area_sq_m	**7,988.65**		
							Str-14 Sum of Acres	**1.97**		

Table F.4. Storey USFWS Resource Category Site Analysis, continued

Tmt Id	Restoration Treatment	Dominant Species	Dominant Veg Strata Class	Dominant Veg Cover	Cover Map Unit	Community Type	Data	Total	Resource Category	H&O Class
Str-15	Backwater / Embayment	HM	H	m	moderate	Herbaceous Mesic	Sum of Area_sq_m	460.50	3	6
							Sum of Acres	0.11		
		Sc	S	h	high / high	Saltcedar / Herbaceous Mesic	Sum of Area_sq_m	2,441.21	3	5
							Sum of Acres	0.60		
		(blank)	(blank)	(blank)	(blank)	Floodplain	Sum of Area_sq_m	3,666.79		OTH
							Sum of Acres	0.91		
							Str-15 Sum of Area_sq_m	**6,568.50**		
							Str-15 Sum of Acres	**1.62**		

Note: Totals may not sum exactly due to rounding.

Dominant Species Code: Cs = cottonwood, Wi = coyote willow, Ro = Russian olive, Sc = saltcedar, HW = herbaceous wetland; HM = herbaceous mesic, HU = herbaceous upland, BR = bare ground.

Dominant Strata Class Code: F = forest, S = Shrub, B = bare.

Dominant Vegetation Cover Code: h = high, m = moderate, s = sparse, b = bare.

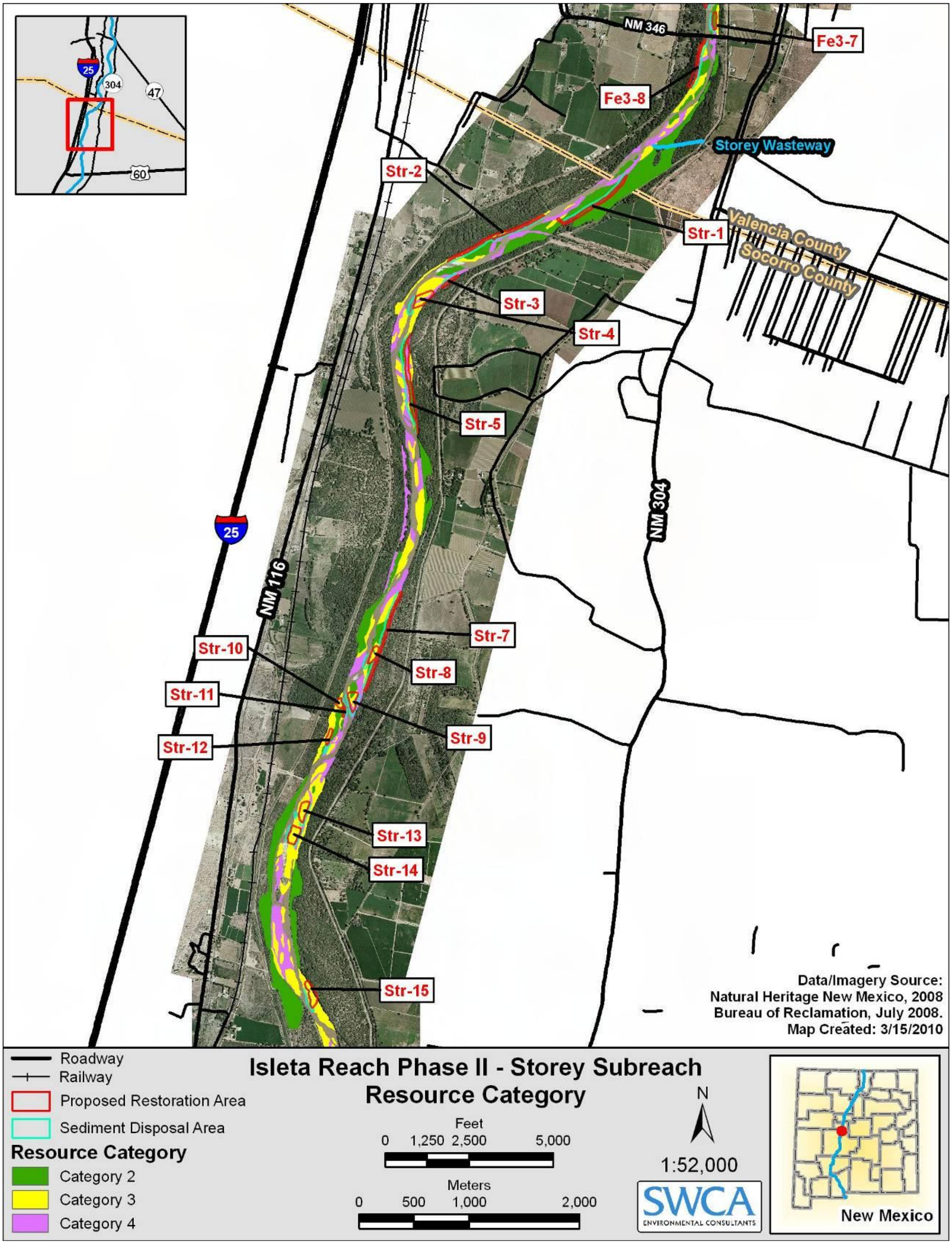

Figure F.3. Storey Subreach Resource Categories.