BIO-WEST, Inc.
1812 Central Commerce Court
Round Rock, Texas 78664

MEMORANDUM

TO: Nathan Pence, Chris Abernathy

FROM: Ed Oborny

DATE: December 30, 2013

SUBJECT: **ITEM M ASSESSMENT FOR EAA ITP ANNUAL REPORT**

Requirement M (1a and 2a) of EAA's USFWS threatened and endangered species permit (#TE63663A-0) addresses minimization and mitigation activities associated with the HCP. The requirements for Item M (1a and 2a) are stated below directly from the permit:

1 Comal Springs, Landa Lake, and the Comal River
   a. The Permittees will limit disturbance of the (a) substrate, (b) water quality, (c) plants, and (d) animals of the Comal Springs, Landa Lake, and Comal River to no more than 10% of the occupied habitat on an annual basis when implementing HCP measures such as habitat and riparian restoration efforts that may directly or indirectly affect species considered here;
2 San Marcos Springs, Spring Lake, and the San Marcos River
   a. The Permittees will limit disturbance of the (a) substrate, (b) water quality, (c) plants, and (d) animals of the San Marcos Springs, Spring Lake, and the San Marcos River to no more than 10% of the occupied habitat on an annual basis when implementing HCP measures such as habitat and riparian restoration efforts that may directly or indirectly affect species considered here;

All activities described in this memorandum pertain to the HCP Covered species that are actively authorized (Item H: 1-6) in 2013 for incidental take via EAA's ITP permit. This includes:

- Fountain darter
- Comal Springs riffle beetle
- Comal Springs dryopid beetle
- Peck's Cave amphipod
- Texas Blind salamander
- San Marcos salamander

Although the Texas cave diving beetle, Texas troglobitic water slater, and Comal Spring salamander are listed in the permit, the conditions in the Permit are not active in 2013 as none of these species are presently listed as threatened or endangered with this directly acknowledged (Item H: 7-9) in the permit. Additionally, Item I of the permit acknowledges that only if the San Marcos gambusia is located or found in the study area, will take provisions apply. As this has not occurred in 2013, the San Marcos gambusia is not included in this Item M assessment. Finally, being a plant, Texas wild-rice is not allotted incidental take provisions under this federal permit, so it is not germane to the Item M assessment. However, it is noted that Texas wild-rice is included throughout this memorandum to document restoration activities in the San Marcos River.

Documentation of baseline habitat conditions: For the six actively covered HCP species (listed above) maps of occupied habitat for the Comal and San Marcos Springs/River systems have been prepared in GIS, based on EAA bio-monitoring data (BIO-WEST 2002 - 2013a,b) and other existing sources for the HCP covered species.

Prior to the Item M assessment, specific discussions were held with staff from the USFWS Austin Ecological Services (ES) office to establish the appropriate definition and description of "occupied" habitat. Based on those conversations, "occupied" habitat is defined as 1) areas in the Comal and San Marcos systems where the covered species have been physically collected or visually documented, and 2) aquatic vegetation types specific to the fountain darter that have been routinely sampled over the past decade through bio-monitoring with documented occupancy. Over the course of the Item M assessment, specific meetings and discussions were conducted with staff from the USFWS Aquatic Resources Center (ARC) and Austin ES to evaluate existing data sources and describe occupied habitat for each of the covered species.

Table 1 summarizes the occupied habitat in meters squared (m^2) for each of the covered species pertinent to the Item M assessment. Figures for each species are also presented following the discussion in each respective section.

As per the ITP, the baseline assessment in 2013 is representative of conditions at the issuance of the ITP (March 18, 2013) or as close of a representation to that date as possible.

Comal System

The fountain darter has been extensively sampled throughout the Comal system via the long-term biological monitoring program conducted by EAA. Drop netting has occurred in dominant aquatic vegetation types within representative sampling reaches for over a decade. On a broader scale, dipnetting for fountain darters has occurred throughout the Comal system over time. Finally, sampling via other collection techniques, seining, snorkel, and SCUBA have been conducted in the Comal system as well. For the fountain darter Item M assessment (represented in Table 1 and Figure 1), only known collection locations and aquatic vegetation that has been routinely sampled and documented as supporting darters throughout the system were counted. Although, fountain darters have been physically collected as well as visually documented on bare substrate, this is not common in the Comal system. As such, bare substrate was not counted as occupied habitat for the fountain darter in the Comal system. Figure 1 shows the occupied habitat for the fountain darter throughout the Comal System with the quantification of area presented in Table 1.

TABLE 1 – OCCUPIED HABITAT

ITEM M - SPECIES	OCCUPIED HABITAT (m^2)	NOTES AND ASSUMPTIONS
COMAL SPRINGS / RIVER		
Fountain Darter	73,410	Based on collections and known occurrence in aquatic vegetation types sampled over the course of the HCP bio-monitoring. Sampling included drop netting, dip netting, snorkel, SCUBA, and seining throughout the Comal system. Although fountain darters have been collected on bare substrate on occasion, no bare areas were included in this baseline assessment.
Comal Springs Riffle Beetle	1,383	Based on collection of individuals via cotton lure, drift net, or quadrat sampling over the years. An area of 1 m^2 around each collection point was included but did not include any overlap between collection points.
Peck's Cave Amphipod	1,470	This species is considered subterranean and thus subsurface habitat is the more appropriate calculation. The total area of subsurface habitat for this species is presently unknown. Surface habitat was based on collection of individuals via cotton lure and drift net sampling. An area of 0.5 m^2 around each collection point was included but did not include any overlap between collection points.
Comal Springs Dryopid Beetle	350	This species is considered subterranean and thus subsurface habitat is the more appropriate calculation. The total area of subsurface habitat for this species is presently unknown. Surface habitat was based on collection of individuals via cotton lure and drift net sampling. An area of 0.5 m^2 around each collection point was included but did not include any overlap between collection points.
SAN MARCOS SPRINGS / RIVER		
Fountain Darter	113,179	Based on collections and known occurrence in aquatic vegetation types sampled over the course of HCP bio-monitoring. Sampling included drop netting, dip netting, snorkel, SCUBA, and seining throughout the San Marcos system. Although fountain darters have been collected on bare substrate in the river on occasion, no bare river areas were included in this baseline assessment. In contrast, bare substrate areas in Spring Lake were included for this assessment as fountain darters have frequently been observed inhabiting these areas within Spring Lake. Finally, although fountain darters have been collected further upstream in the slough arm of Spring Lake, those collections are considered seasonal at this time and thus were not included in the overall area calculated.
San Marcos Salamander	2,165	Based on observation or collection of individuals via snorkel / SCUBA over the course of HCP bio-monitoring. Also, based on collections conducted by the USFWS Aquatic Resources Center.
Texas Blind Salamander	n/a	This species is considered subterranean and thus subsurface habitat is the appropriate calculation. As such, no surface habitat was calculated as "occupied habitat" for this species.
Comal Springs Riffle Beetle	11	Based on collection of individuals via cotton lure and drift net sampling. An area of 1 m^2 around each collection point was included but did not include any overlap between collection points.
Texas wild-rice*	4,561	* As a plant, Texas wild-rice is not granted "take" protection rendering the Item M exercise not applicable. However, to assist with a calculation of mitigation and restoration measures net benefit for the City of San Marcos and Texas State University, the Spring 2013 map of Texas wild-rice in the San Marcos River was included as a baseline for this section.

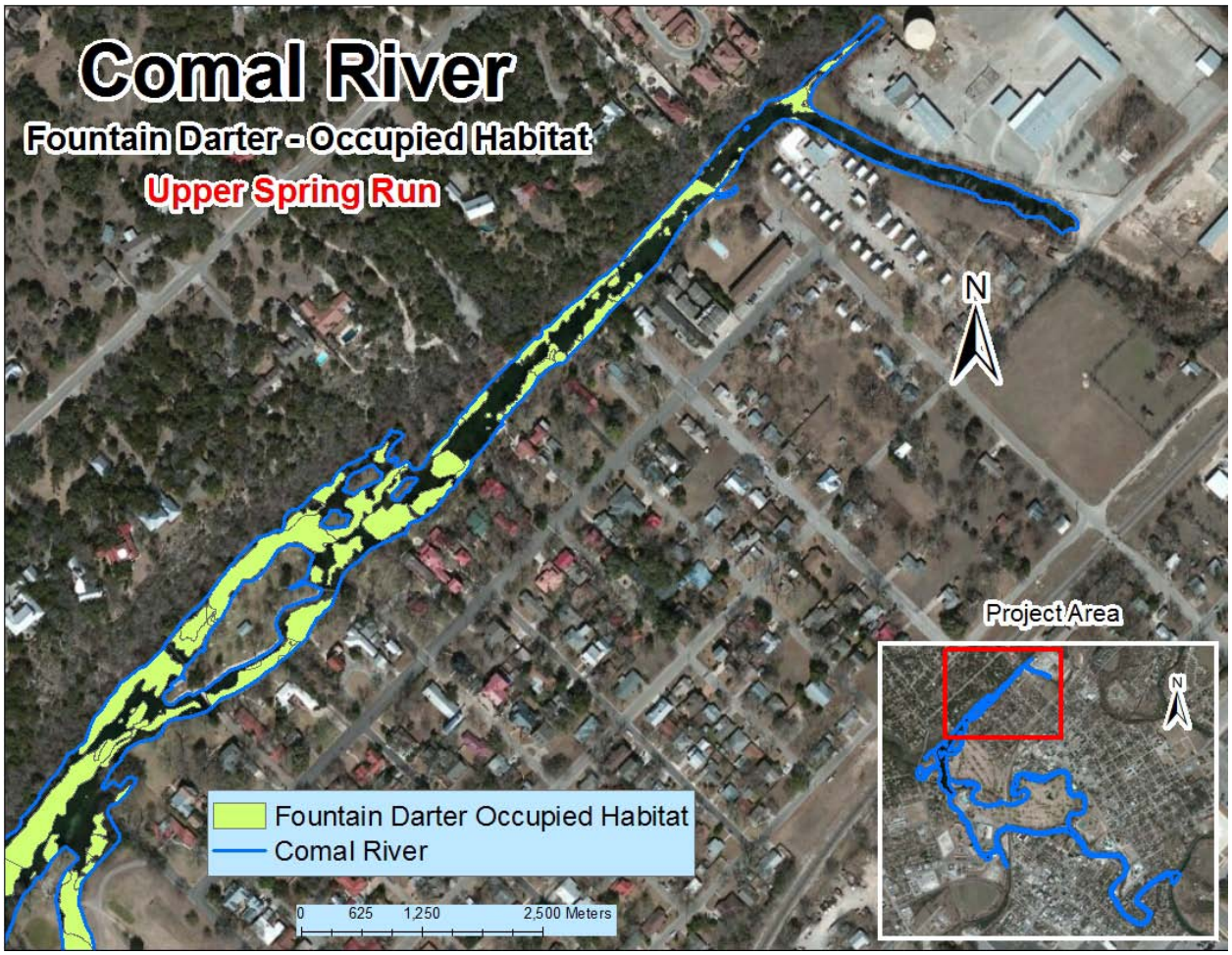

Figure 1: Fountain Darter Occupied Habitat – Upper Spring Run (Comal System)

Although not as extensive as for the fountain darter, routine sampling for the Comal Springs riffle beetle has also occurred. Over the years, sampling has been conducted by quadrats, drift netting, and cotton lures. In the early 1990's extensive sampling in the Spring Runs was conducted by Dr. David Bowles, with that data included in this assessment (Bowles et al. 2003). Additionally, Mr. Randy Gibson (USFWS ARC) has collected Comal invertebrates at locations throughout the system for a number of projects and for refugia purposes over time. Finally, the EAA biological monitoring program has routinely sampled for the Comal Springs riffle beetle within representative reaches in the Comal system. Based on the sample techniques over time and experience and guidance of Mr. Randy Gibson the determination was made to include a 1 m^2 area surrounding each known collection location to quantify overall surface area of occupied habitat for the 2013 baseline. It is anticipated that larger areas of the Comal system are actually occupied than represented in this assessment as the entire Comal system has not been thoroughly sampled. As part of one contracted 2014 HCP applied research study, the distribution and occurrence of the Comal Spring riffle beetle throughout the Comal system will be examined in more detail. It is noted that only surface habitat area was calculated for this assessment, as the extent of subsurface habitat utilization by this species is presently unknown. Figure 2 shows the occupied habitat for the Comal Springs riffle beetle throughout the Comal System with the quantification of area presented in Table 1.

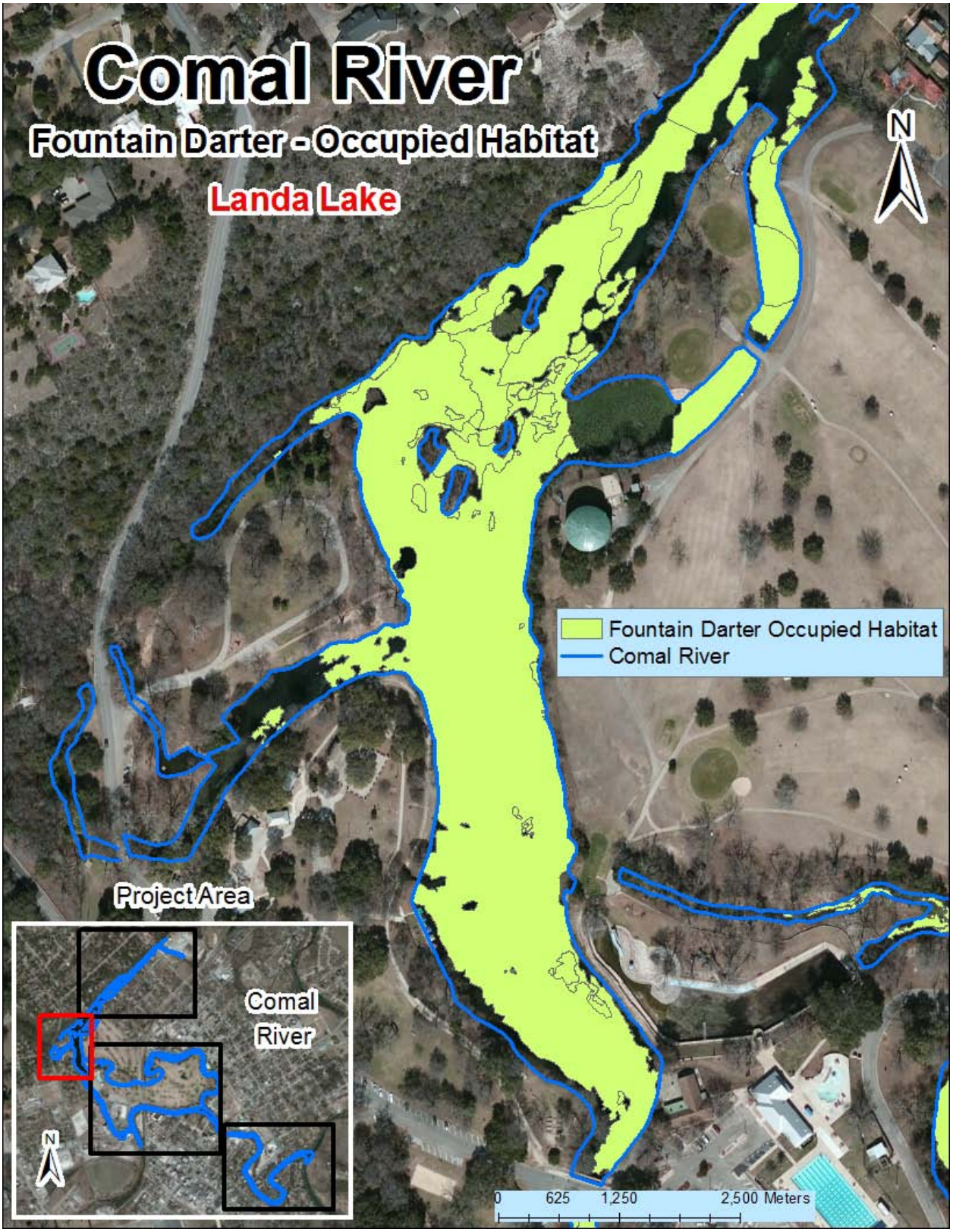

Figure 1 (continued): Fountain Darter Occupied Habitat – Landa Lake (Comal System).

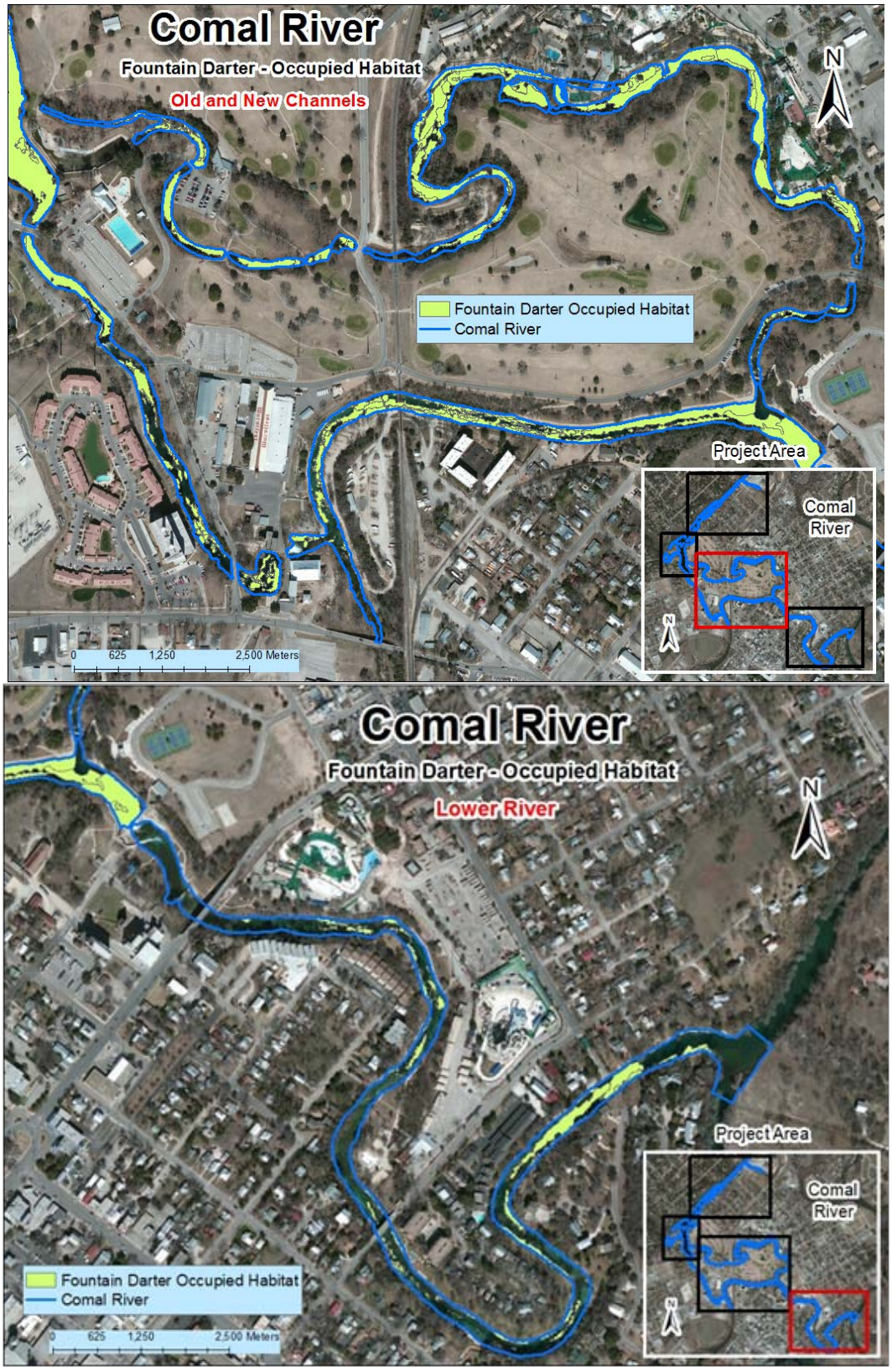

Figure 1 (continued): Fountain Darter Occupied Habitat – Old and New Channels (Top) and Lower Comal River (bottom) - (Comal System).

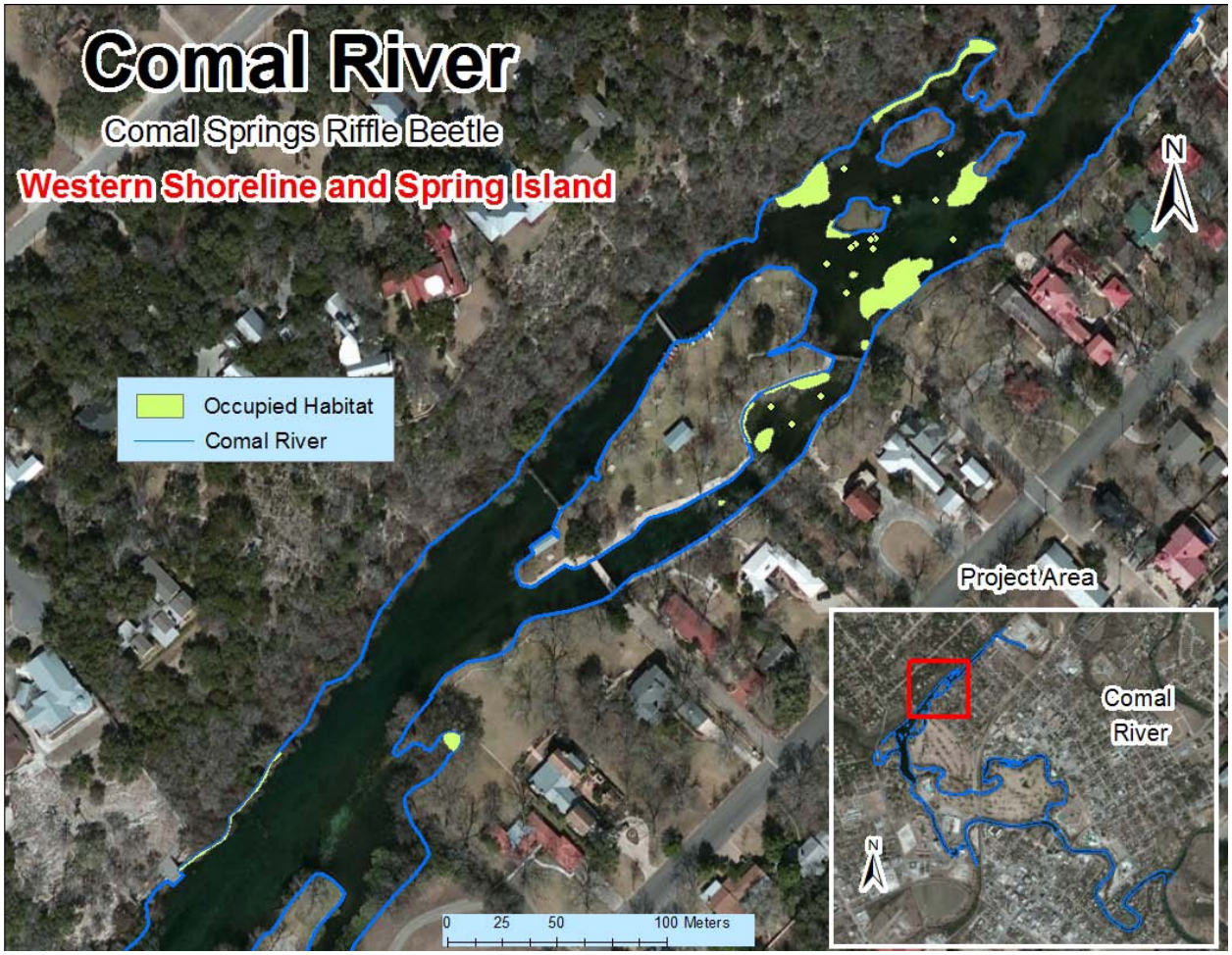

Figure 2: Comal Springs Riffle Beetle Occupied Surface Habitat – Spring Island and Western Shoreline areas (Comal System).

As described in the HCP, both the Peck's cave amphipod and Comal Springs dryopid beetle are subterranean species. Peck's cave amphipods are frequently found at the surface primarily in areas that Comal Springs riffle beetles are collected, whereas the Comal Springs dryopid beetle is less commonly found. As it is presumed that these subterranean invertebrates are not suited for survival in surface conditions, the decision was made to quantify 0.5 m^2 around the orifices that these species have been collected in the Comal system. As for the riffle beetle, sampling for these species over the years has been conducted by quadrats, drift netting, and cotton lures. Dr. Bowles and Mr. Gibson's data were again reviewed in detail as was the EAA biological monitoring database. For these two species, it is presumed that the majority of their occupied habitat is located subsurface. However, it is not possible to quantify the subsurface occupied habitat for these species at this time. Rather, the orifices where they have been collected are documented for further evaluation of potential impacts to these areas later in this memorandum. Figures 3 and 4 show occupied habitat for the Peck's Cave amphipod and Comal Springs dryopid beetle, respectively, throughout the Comal System with the quantification of surface habitat area presented in Table 1.

Figure 2 (continued): Comal Springs Riffle Beetle Occupied Surface Habitat – Spring Runs (Comal System).

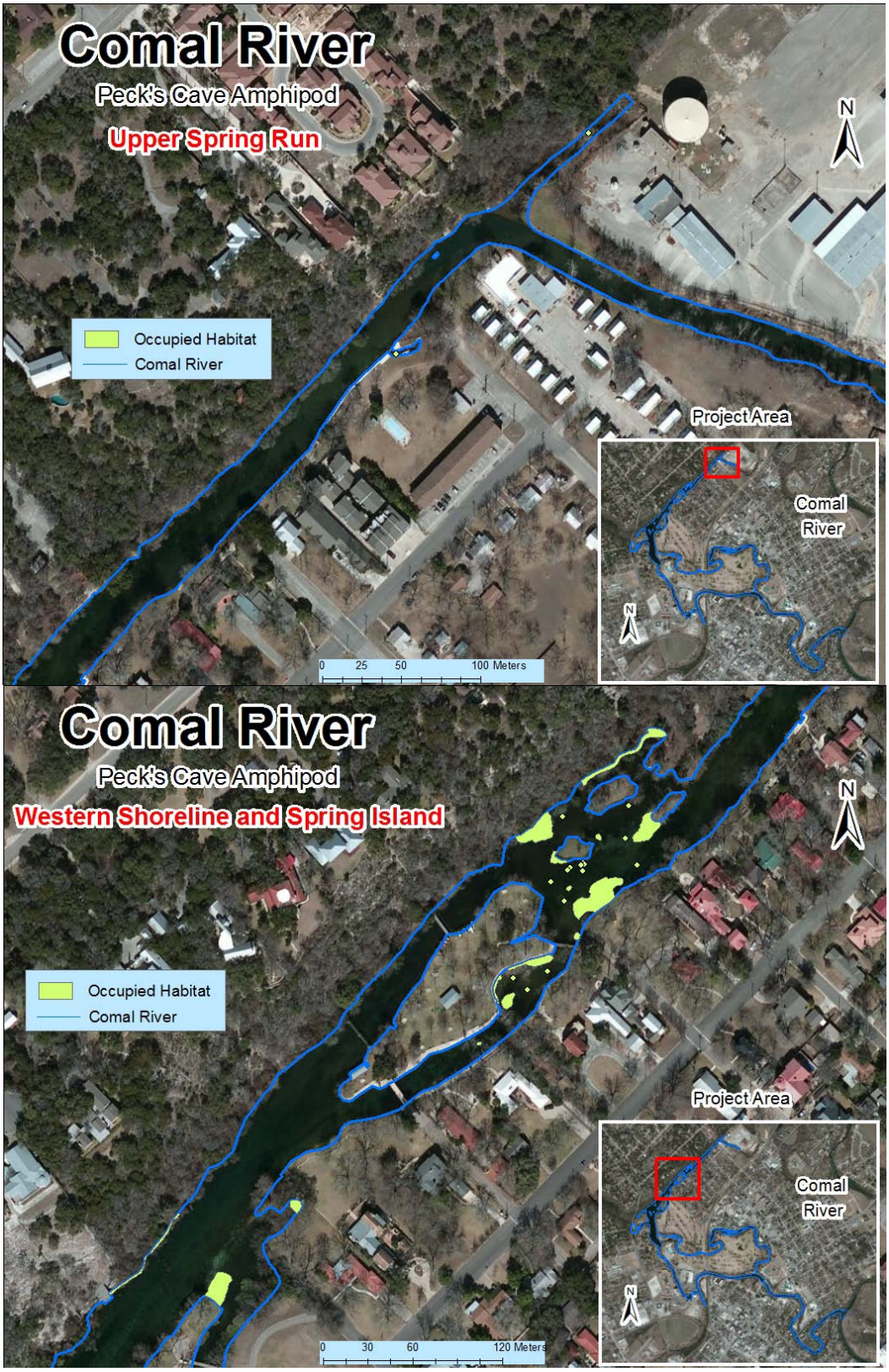

Figure 3: Peck's Cave Amphipod Occupied Surface Habitat – Upper Spring Run (top) and Spring Island and Western Shoreline areas (bottom) - (Comal System).

Figure 3 (continued): Peck's Cave Amphipod Occupied Surface Habitat – Spring Runs (Comal System).

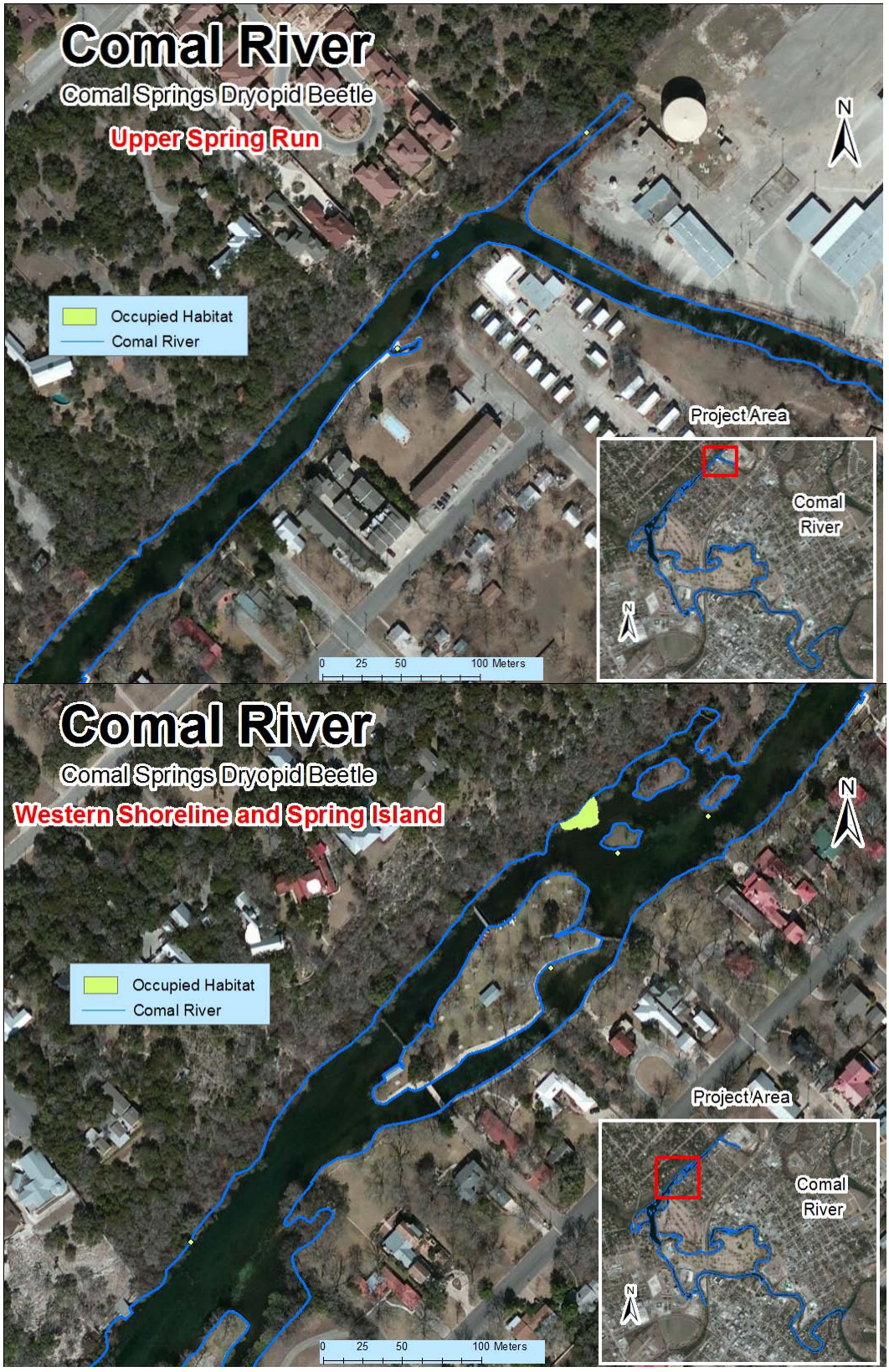

Figure 4: Comal Springs Dryopid Beetle Occupied Surface Habitat – Upper Spring Run (top) and Spring Island and Western Shoreline areas (bottom) - (Comal System).

Figure 4 (continued): Comal Springs Dryopid Beetle Occupied Surface Habitat – Spring Runs (Comal System).

San Marcos System

The fountain darter has been extensively sampled throughout the San Marcos system via the long-term biological monitoring program conducted by EAA as well as activities conducted by Texas State University over the years. For EAA biological monitoring, drop netting has occurred in dominant aquatic vegetation types within representative sampling reaches for over a decade. On a broader scale, dipnetting for fountain darters has occurred throughout the San Marcos system relative to EAA biological monitoring. Finally, sampling via other collection techniques, seining, snorkel, and SCUBA have been conducted in the San Marcos system over time by many researchers. For the fountain darter Item M assessment, only known collection locations and aquatic vegetation that has been routinely sampled with documented occupancy throughout the system were counted. Although fountain darters have been visually documented within Texas wild-rice, this aquatic vegetation type has not been routinely sampled via other methods over time as to not disturb this federally-listed plant. As such, Texas wild-rice area was not included as occupied fountain darter habitat in this assessment. Similar to the Comal system, although fountain darters have been physically collected and visually documented on bare substrate in the San Marcos River, this is not a common occurrence in the river. As such, bare substrate was not counted as occupied habitat for the fountain darter in the San Marcos River. In contrast, bare substrate and algae areas in Spring Lake were included for this assessment as fountain darters have frequently been observed inhabiting these areas within Spring Lake. Finally, although fountain darters have been collected further upstream in the slough arm of Spring Lake, those collections are considered seasonal at this time and thus were not included in the overall area calculated. Figure 5 shows the occupied habitat for the fountain darter throughout the San Marcos system with the quantification of area presented in Table 1.

The San Marcos salamander has been routinely sampled over the years by both the EAA biological monitoring program as well as by the USFWS ARC for refugia collection purposes. Additional efforts relating to master's thesis and other research have been conducted by Texas State University as well as sampling efforts specific to construction projects involving maintenance to Spring Lake Dam (western and eastern spillways). SCUBA and snorkel sampling has been conducted in the eastern spillway below Spring Lake Dam as well as the Big Riverbed and Hotel areas of Spring Lake over the past decade. In addition, the USFWS ARC has sampled nearly all the spring orifices and surrounding areas within Spring Lake. The known collection locations and occupied habitat are depicted in Figure 6 and quantified in Table 1. It is likely that the overall distribution of San Marcos salamanders is a bit larger in Spring Lake as not all bare substrate areas have been sampled to date. However, for this assessment, only documented collection areas were included.

As documented in the HCP, the Texas blind salamander is an aquifer/cave dwelling species. Unlike the subterranean Comal invertebrates which can be found in and around orifices in surface habitat at times, blind salamanders are collected as they are expelled from the aquifer. As such, there is no surface habitat designated for the Texas blind salamander as footnoted in Table 1. Known collection areas are depicted in Figure 7 for later use in the net disturbance assessment.

Although not as extensive as in the Comal systems, sampling for the Comal Springs riffle beetle has occurred in the San Marcos system. Following up on an earlier documentation of this species in the San Marcos system via drift net, Mr. Randy Gibson set cotton lures throughout the upper portion of the San Marcos system with the main focus occurring in Spring Lake. During

those and subsequent efforts, the only documented occupied habitat has been the Hotel Area in the uppermost portion of Spring Lake (Gibson et al. 2008; Gonzales 2008). As for this species in the Comal system, the determination was made to include a 1 m^2 area surrounding each known collection location to quantify overall surface area of occupied habitat for the 2013 baseline. It is noted that only surface habitat area was calculated for this assessment, as the extent of subsurface habitat utilization by this species is presently unknown. Figure 8 shows the occupied habitat for the Comal Springs riffle beetle in the San Marcos system with the quantification of area presented in Table 1.

Although Texas wild-rice is not allotted take projection in the ITP, its 2013 baseline coverage was included (Figure 9 and Table 1) in this assessment for informational purposes regarding restoration and enhancement.

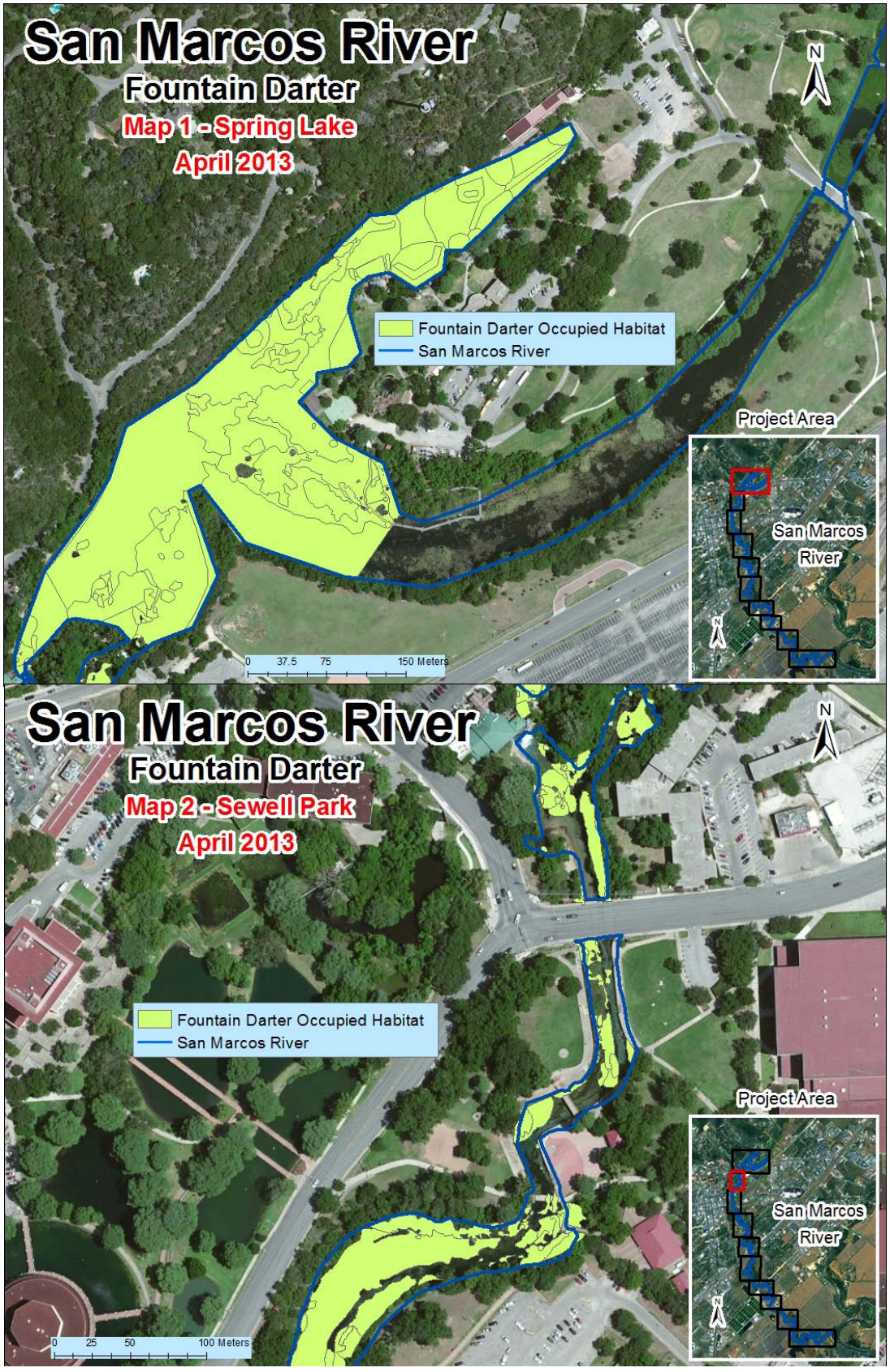

Figure 5: Fountain Darter Occupied Habitat – San Marcos System

Figure 5 (continued): Fountain Darter Occupied Habitat – San Marcos System

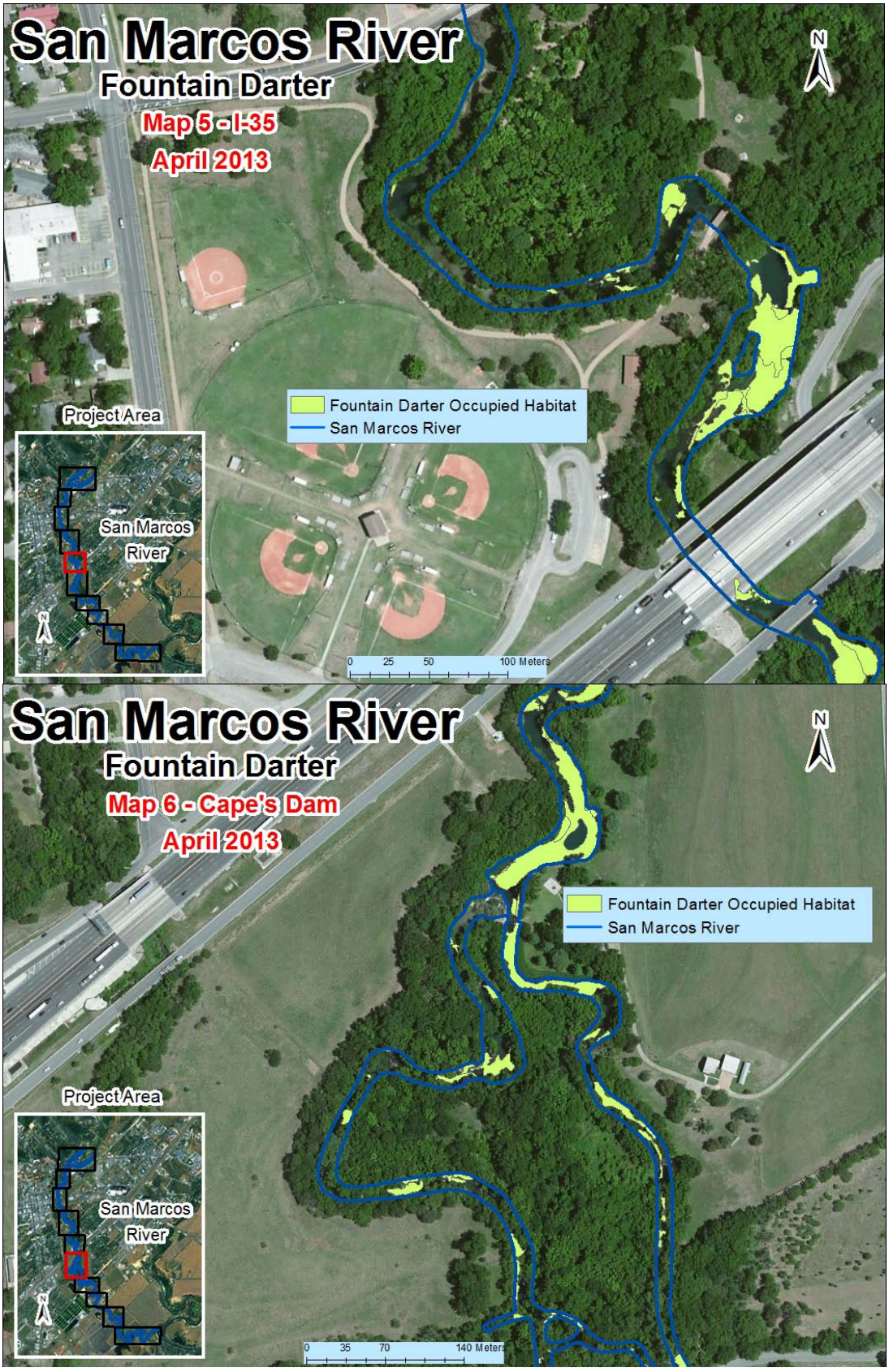

Figure 5 (continued): Fountain Darter Occupied Habitat – San Marcos System

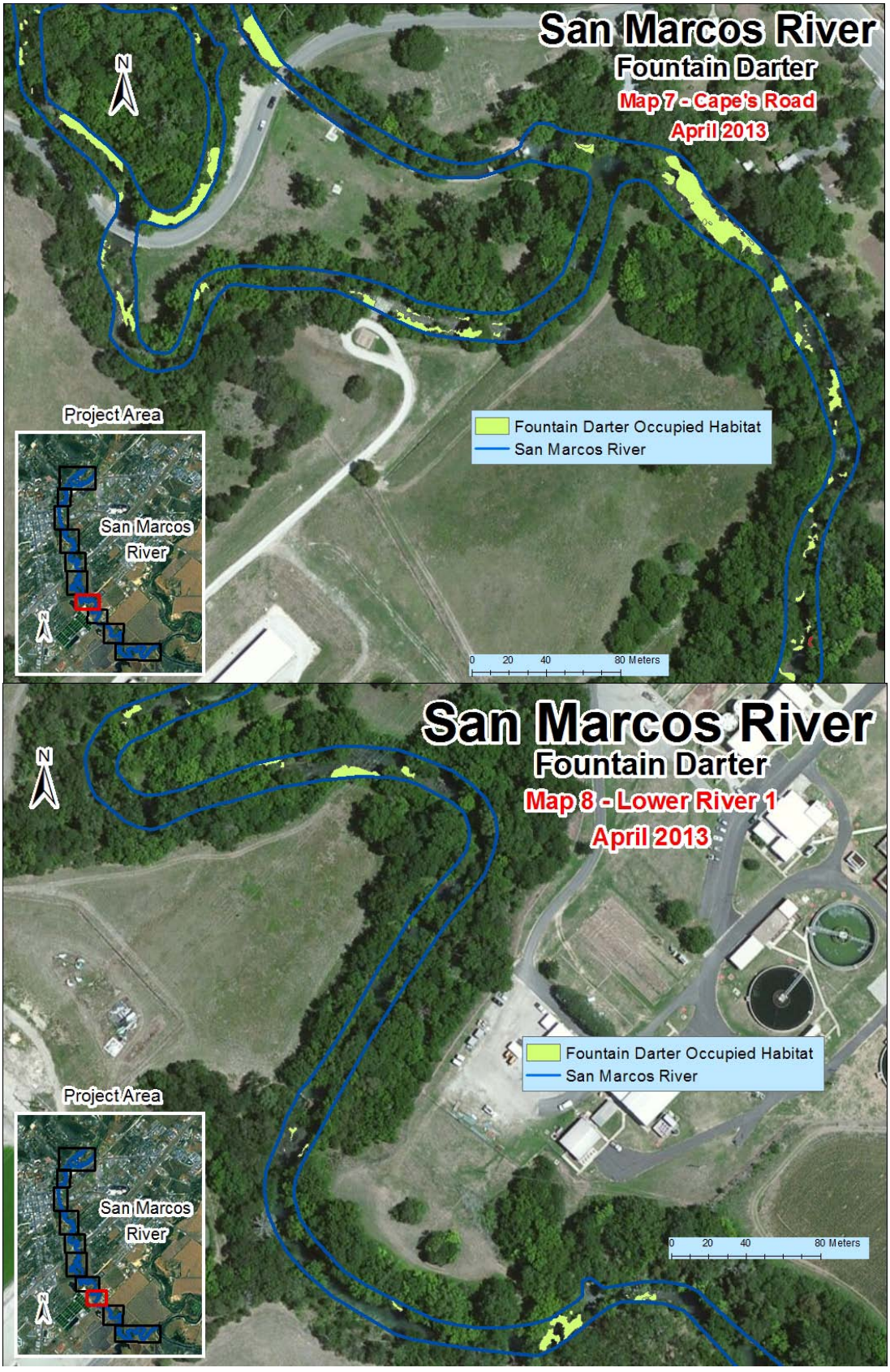

Figure 5 (continued): Fountain Darter Occupied Habitat – San Marcos System

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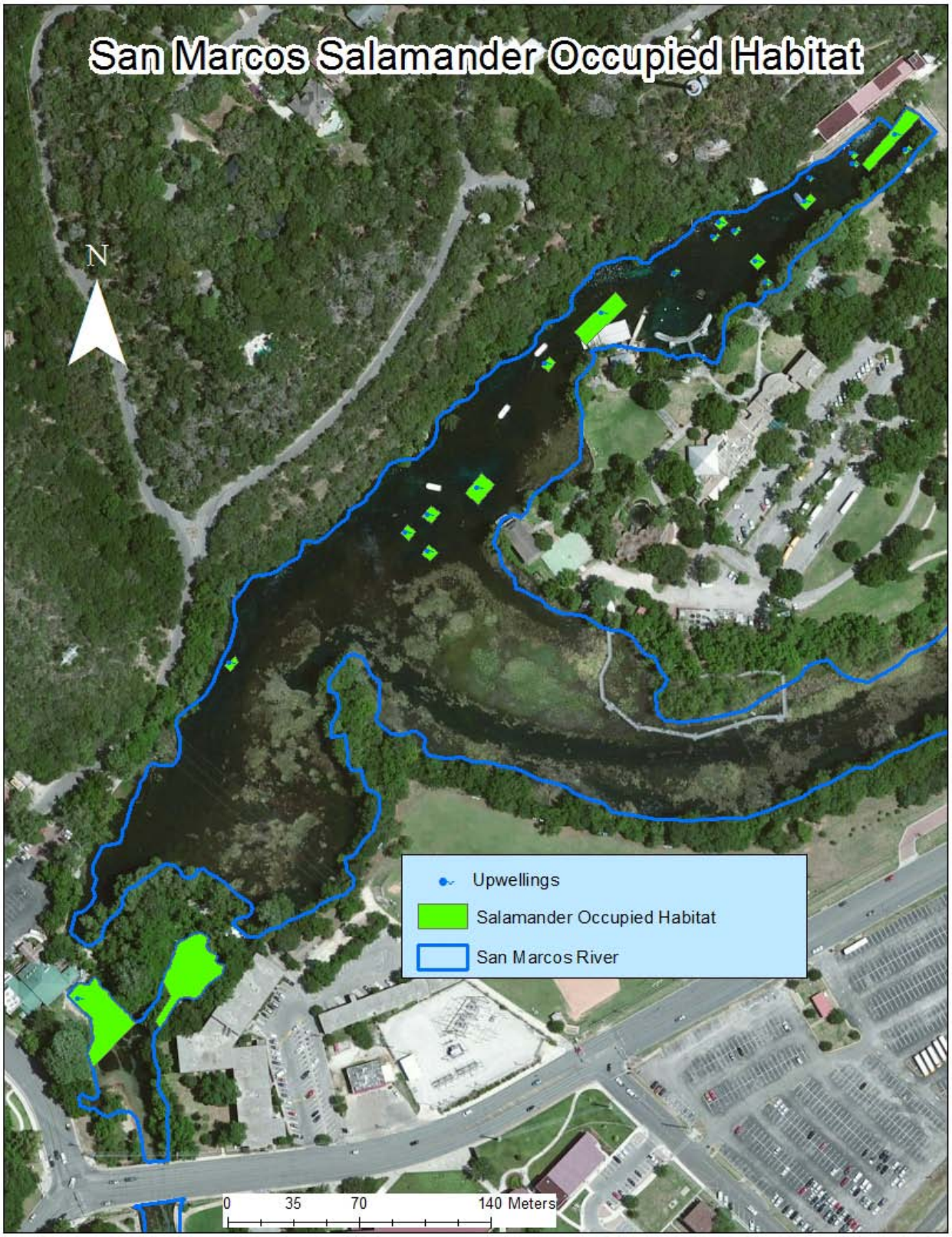

Figure 6: San Marcos Salamander Occupied Habitat – San Marcos System

Figure 7: Texas Blind Salamander Routine Collection Locations – San Marcos System

Figure 8: Comal Springs riffle beetle Surface Occupied Habitat – San Marcos System

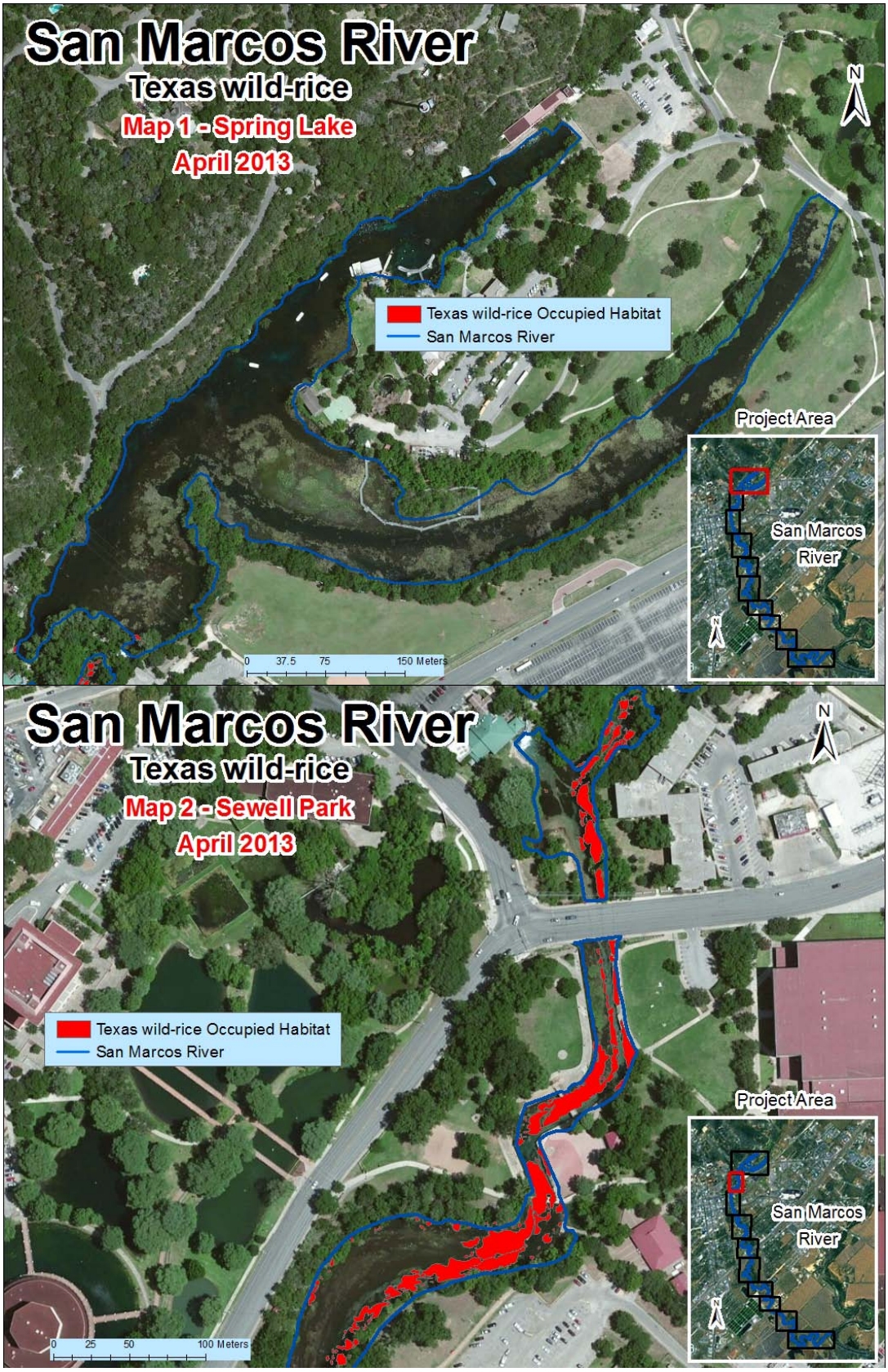

Figure 9: Texas wild-rice – San Marcos System

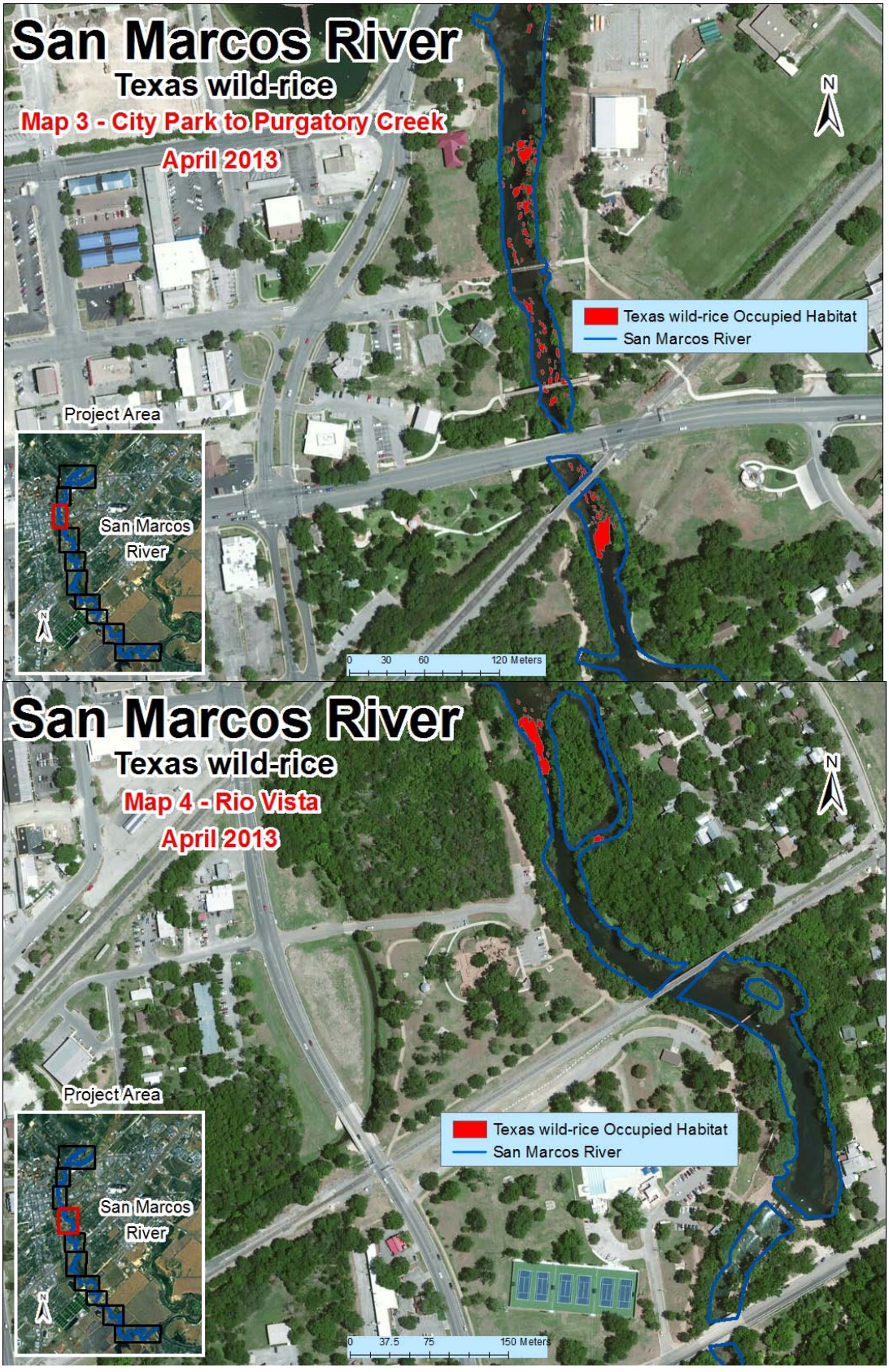

Figure 9 (continued): Texas wild-rice – San Marcos System

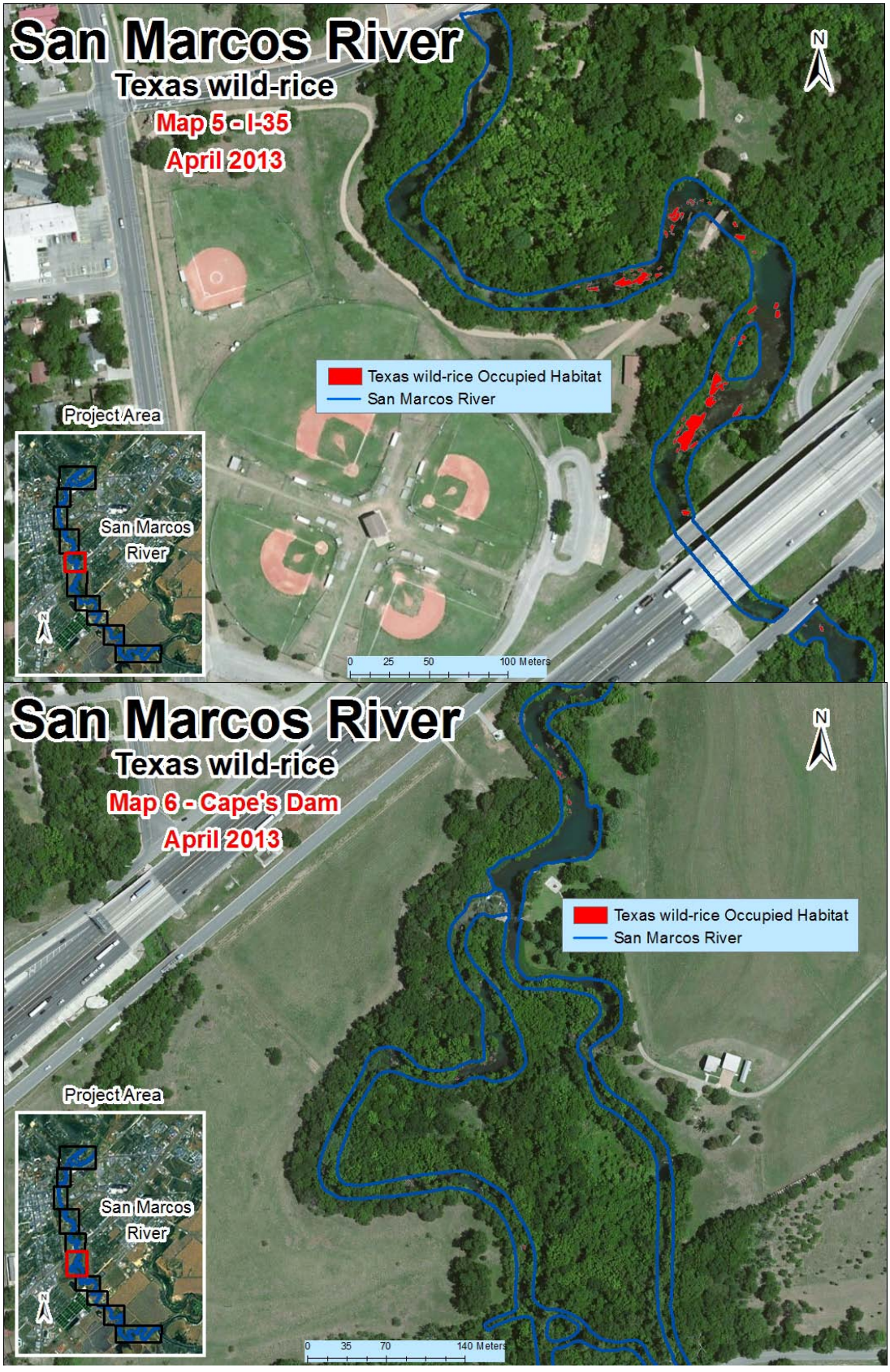

Figure 9 (continued): Texas wild-rice – San Marcos System

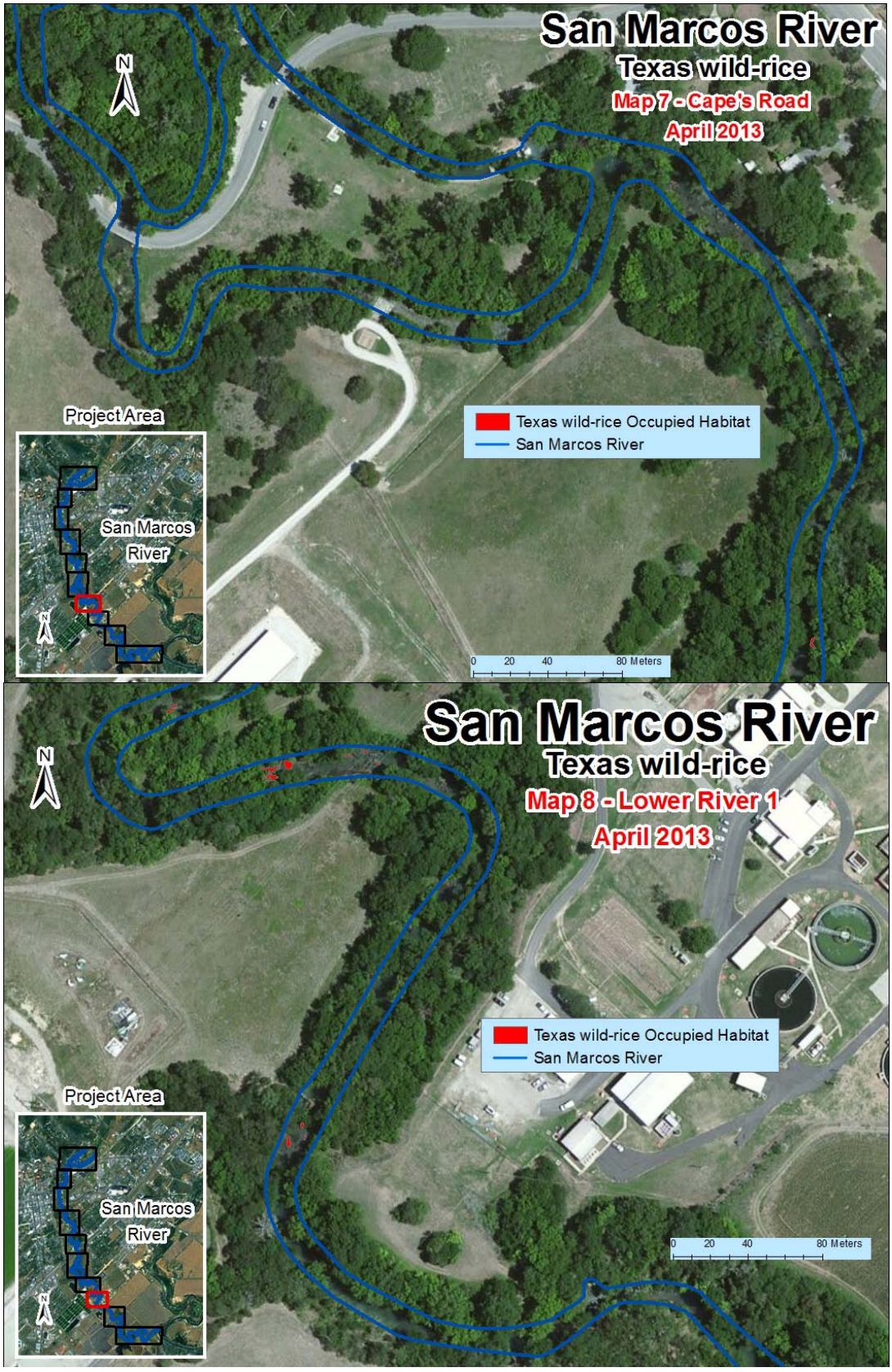

Figure 9 (continued): Texas wild-rice – San Marcos System

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Documentation of HCP mitigation areal extent per project: Descriptions of the HCP minimization and mitigation measures and 2013 activities for the City of New Braunfels, City of San Marcos, and Texas State University are presented in the ITP Annual Report (Sections 3.2, 3.3, and 3.4, respectively) and will not be duplicated in this memorandum.

Item M of the ITP requires an assessment of the direct HCP mitigation and restoration activities conducted each year. The direct HCP mitigation and restoration activities relative to Item M are listed below for the City of New Braunfels, City of San Marcos and Texas State University.

- City of New Braunfels (projects derived from Item 2f in permit)
  - Flow-split management
  - Restoration and maintenance of native aquatic vegetation (Old Channel and Landa Lake)
  - Decaying vegetation removal
  - Aeration and water quality sonde in Landa Lake
  - Gill parasite
  - Riparian restoration and bank stabilization
  - Riffle beetle restoration
  - Non-native species removal
  - Sediment Island removal
- City of San Marcos and Texas State University (projects derived from Item 3d and the second 4e in permit)
  - Enhancement and restoration of Texas wild-rice
  - Management of recreation specific to State Scientific Areas (only)
  - Non-native species removal
  - Restoration and maintenance of native aquatic vegetation
  - Sediment removal
  - Access Points and Bank Stabilization
  - Riparian restoration

For these projects, the areal extent of the project footprint has been quantified in Table 2 and depicted in subsequent figures per project. The project footprints were then overlaid on the occupied habitat maps in GIS and calculations of "Impact" area were performed. The results for each project and covered species are presented in Table 2.

Comal System

Of the projects listed above and presented in Table 2, both the **Flow-split management** and **Riparian restoration and bank stabilization** studies involved project design supplemented with some field survey activities. There were no on the ground construction or field activities that constituted an impacted project footprint for these two activities in 2013. As such, no project area footprint maps are included for these projects. It is anticipated that both projects will have on the ground activities in 2014 and thus will require project area maps next year.

The **restoration and maintenance of native aquatic vegetation** project involved restoration activities in both Landa Lake and the Old Channel of the Comal system. These activities included the removal on non-native aquatic vegetation and subsequent restoration of native aquatic vegetation in its place. The 2013 project footprints for native vegetation restoration are depicted in figures 10 and 11 with areas (m^2) and quantified in Table 2. Additionally, the MUPPT

nursery areas used to propagate native aquatic vegetation for restoration activities are also considered part of the project footprint (Figure 10).

TABLE 2 – Mitigation and Restoration Project Areas and Calculated Impact Area per Covered Species

HCP ACTIVITY	Project Footprint Area (m^2)	"Impact Area" Overlap with Occupied Habitat for Covered Species (m^2)						
		Fountain darter	Comal Springs riffle beetle	Comal Springs dryopid beetle	Peck's Cave amphipod	San Marcos salamander	Texas blind salamander	Texas wild-rice [A]
CITY OF NEW BRAUNFELS								
Flow-split management	B	--	--	--	--			
Restoration and maintenance of native aquatic vegetation	1,793	1,681	0	0	0			
Decaying vegetation removal	C	--	--	--	--			
Aeration, Water Quality Sonde	4.5	4.5	0	0	0			
Gill parasite	3,394	2,485	0	0	0			
Riparian restoration and bank stabilization	B	--	--	--	--			
Riffle beetle restoration	547	0	0	0	0			
Non-native species removal	29.4	10.0	0	0	0			
Sediment Island removal	287.8	D	--	--	--			
TOTAL	6,056	4,180.5	0	0	0			
CITY OF SAN MARCOS / TEXAS STATE UNIVERSITY								
Enhancement and restoration of Texas wild-rice	E	--	--			--	--	--
Management of recreation specific to Exclusion zones (only)	788	39.4	--			14.8	--	--
Non-native species removal	C	--	--			--	--	--
Restoration and maintenance of native aquatic vegetation	5,266	3,065	0			0	0	0
Sediment removal	559	132	0			0	0	0
Access Points and Bank Stabilization	152	0	0			0	0	0
Riparian restoration	7,974	0	0			0	0	0
TOTAL	14,739	3,236.4	0			14.8	0	0

A Texas wild-rice not formally needed for the Item M assessment but included for informational purposes

B Only design work conducted in 2013

C Throughout system – described in qualitative impacts discussion

D Vegetation removal adjacent to the island prior to removal is accounted for under the Native Vegetation Restoration project

E Project footprint is accounted for in Native Aquatic Vegetation restoration project

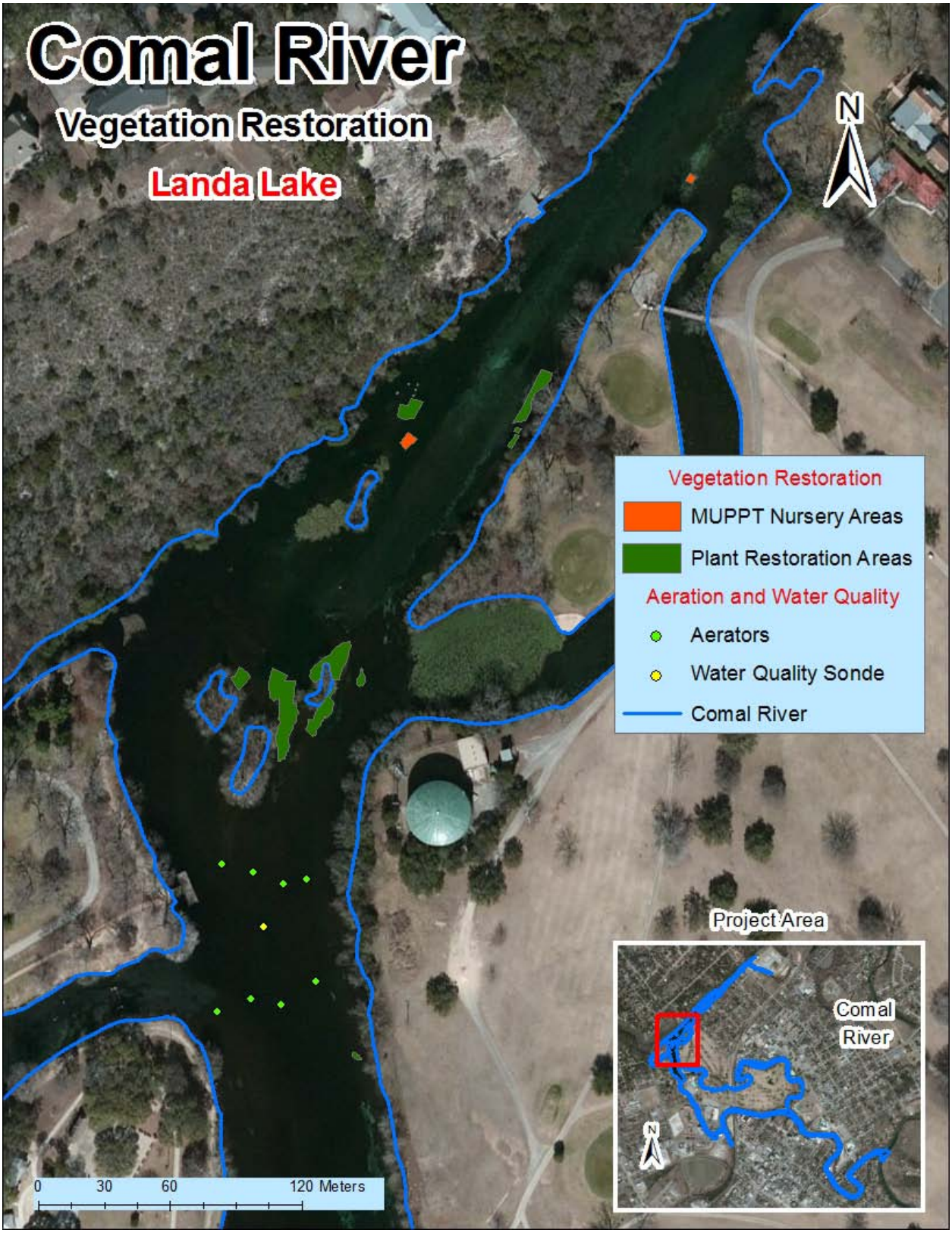

Figure 10: Restoration and Maintenance of Native Aquatic Vegetation project and Aeration and Water quality sonde project – Landa Lake (Comal system)

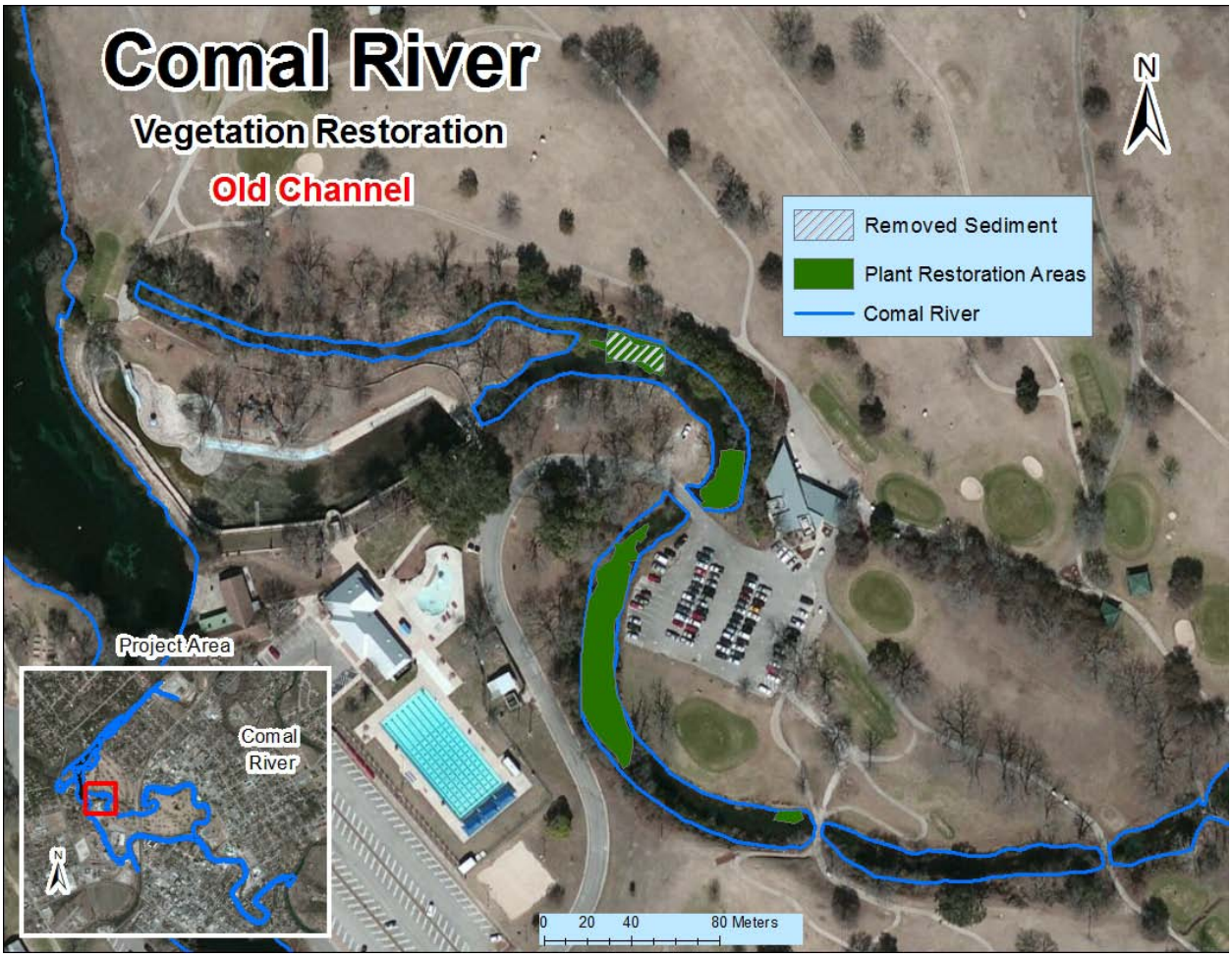

Figure 11: Restoration and Maintenance of Native Aquatic Vegetation project and Sediment Island removal project – Old Channel (Comal River)

As noted in Table 2, the project footprint of the Native Aquatic Vegetation restoration effort in the Comal system encompassed 1,793 m^2 which overlapped with 1,681 m^2 of occupied fountain darter habitat. There was not any overlap with occupied habitat for the endangered Comal invertebrates. Although not quantified for this assessment, disturbance from foot traffic to and from these locations and from slightly elevated turbidity during non-native vegetation removal did temporarily occur.

The **Sediment Island removal** project in the Old Channel involved the removal of a terrestrial island at the upper portion of the Old Channel (Figure 11) and subsequently restoring that area with native aquatic vegetation. Although the project footprint is represented as 287.8 m^2 (Table 2) there was no overlap with fountain darter occupied habitat as the entire island was above the water surface prior to removal. As noted in Table 2, all non-native vegetation removal that occurred adjacent to the sediment island before removal activities took place is accounted for in the native vegetation restoration project footprint. Temporary disturbance to downstream fountain darter occupied habitat did occur relative to slightly elevated turbidity during island removal activities.

There is no project footprint map for the **Decaying Vegetation Removal** project as it was conducted throughout the main portion of Landa Lake and the New Channel on an as needed basis when floating mats of aquatic vegetation had built up. As such, no quantified area of impact was designated for this project in Table 2. Temporary disturbance resulting from foot traffic within fountain darter occupied habitat did occur as well as slightly elevated turbidity downstream from immediate work zone.

The **Aeration and water quality** sonde project consisted of the installation of a series of aerators in Landa Lake as well as the installation of a water quality sonde in the lake for continual real-time measurements. The project footprint for these components was small as represented in Figure 10, Table 2. As the aerators and water quality sonde were placed within native aquatic vegetation, there was a direct overlap with 4.5 m^2 of occupied fountain darter habitat. As noted for other projects, short-term and limited exposure disturbance is experienced from foot traffic when calibrating the water quality sonde or maintenance of the aerators is required.

The **Gill parasite** project involved the placement of snail traps into the substrate, snail density quadrat sampling that disturbed the entire substrate, and the pilot study reach of the New Channel (Figure 12, Table 2). The overall project footprint involved 3,394 m^2 with 2,485 m^2 overlapping with fountain darter occupied habitat. The majority of the project footprint was in the upper portion of the New Channel that was used during the Gill Parasite pilot study. During that study, approximately 86,000 non-native snails were removed via dip netting and hand removal (via snorkel and SCUBA) from that area over the course of several days. For all Gill Parasite project activities (snail trap placement, snail density sampling, pilot study, water sampling cross sections) temporary disturbance from foot traffic in and around the areas/transects as well as slightly elevated turbidity downstream did occur.

The **Riffle beetle restoration** project involved the removal of fine sediment from along three different locations adjacent to the western shoreline of Landa Lake (Figure 13). Additionally, the project footprint was made up of erosion control zones that were constructed along the banks of the western shoreline and Spring Run 3. Although the project footprint consisted of 547 m^2, the majority of this area was out of the water and thus did not overlap with any Covered Species occupied habitat. The fine sediment removal areas were all downstream of occupied Comal Invertebrate habitat, so no impact areas were calculated for Table 2. These areas are considered potential habitat and as such, the restoration of these areas will be assessed further below in the net benefits overview. As noted for all restoration projects, temporary disturbance from foot traffic and slightly elevated turbidity did occur relative to in water activities.

The **Non-native species removal** project involved using four fyke nets during each trapping session. Fyke nets are passive traps that have 50-foot leads that guide fish into a 12-foot long by 3-foot wide hoop net. Additionally, a series of nutria traps were deployed along the banks of the Comal system. The fyke nets and nutria traps are depicted in Figure 14. The footprint of the fyke nets and nutria traps is presented in Table 2 along with the overlap of fountain darter occupied habitat. In addition to these activities, biologists snorkeled early in the morning and late in the afternoon (high times of fish activity) in areas of high fish density and speared non-native fish as well as hand picking giant ramshorn snails. Temporary disturbance resulting from foot traffic within fountain darter occupied habitat did occur around the fyke nets as well as slightly elevated turbidity downstream when nets were being placed, checked, and removed.

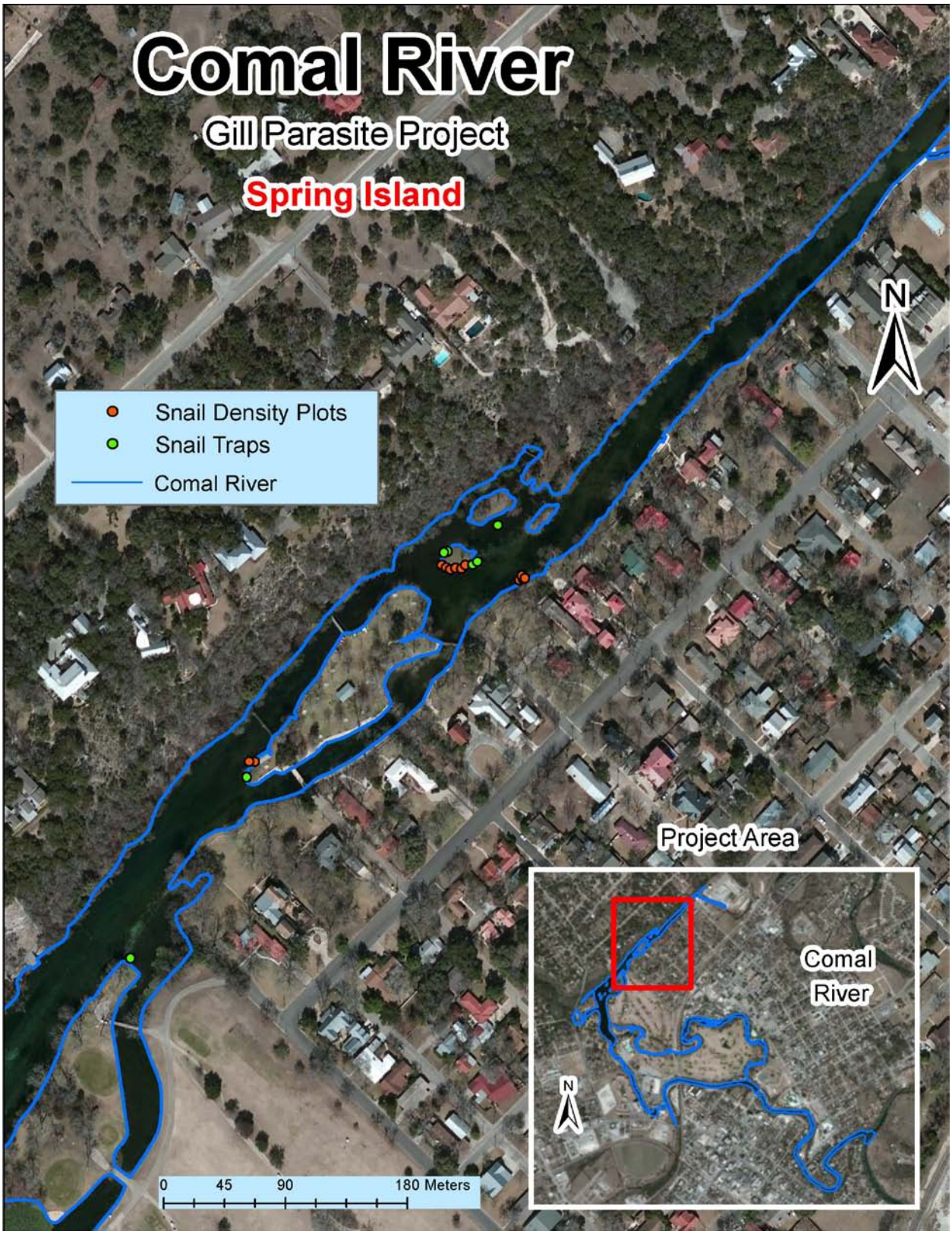

Figure 12: Gill Parasite project – Spring Island Area (Comal System)

Figure 12 (continued): Gill Parasite project – Landa Lake and New Channel (Comal System)

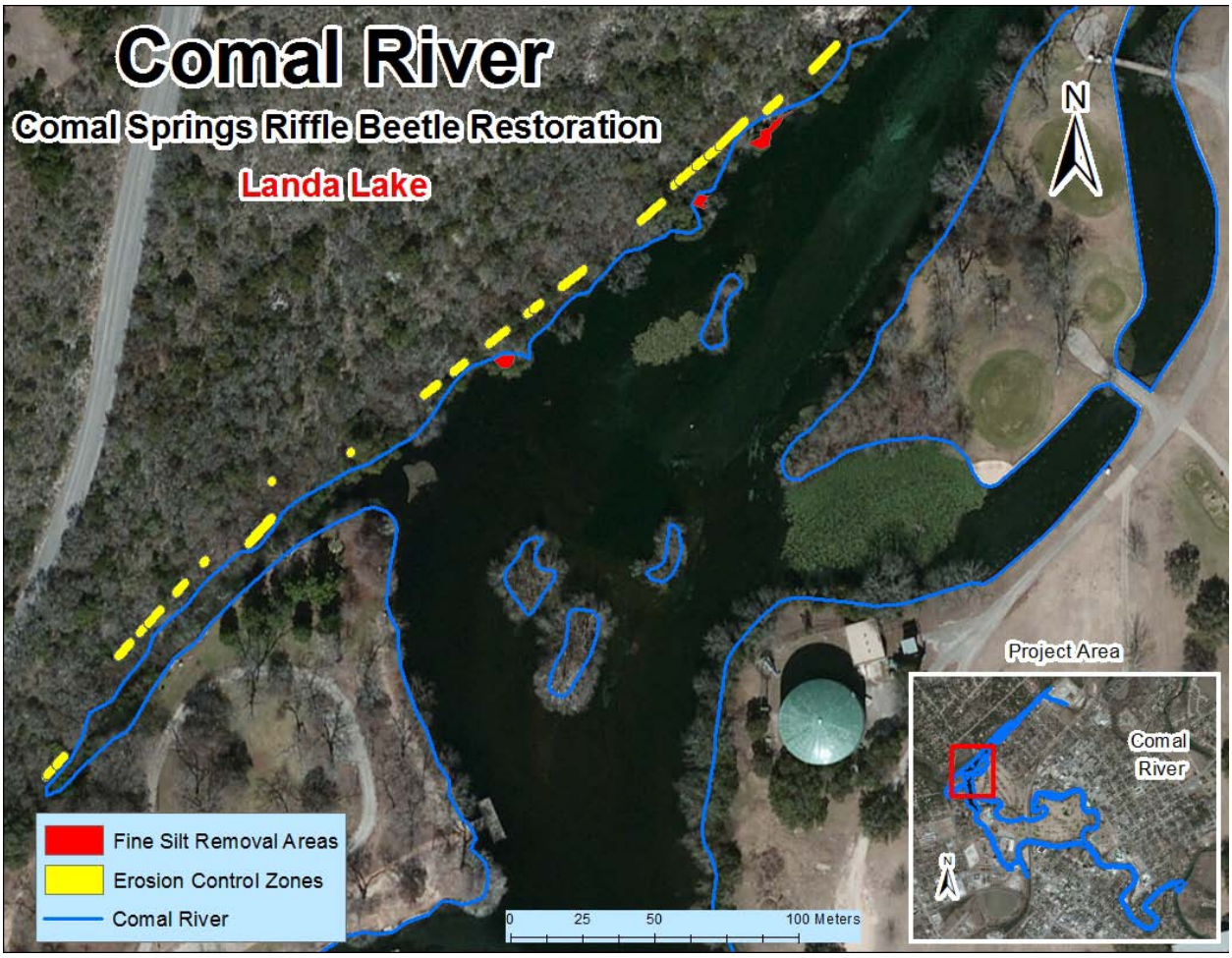

Figure 13: Comal Springs Riffle Beetle Restoration project – Comal System.

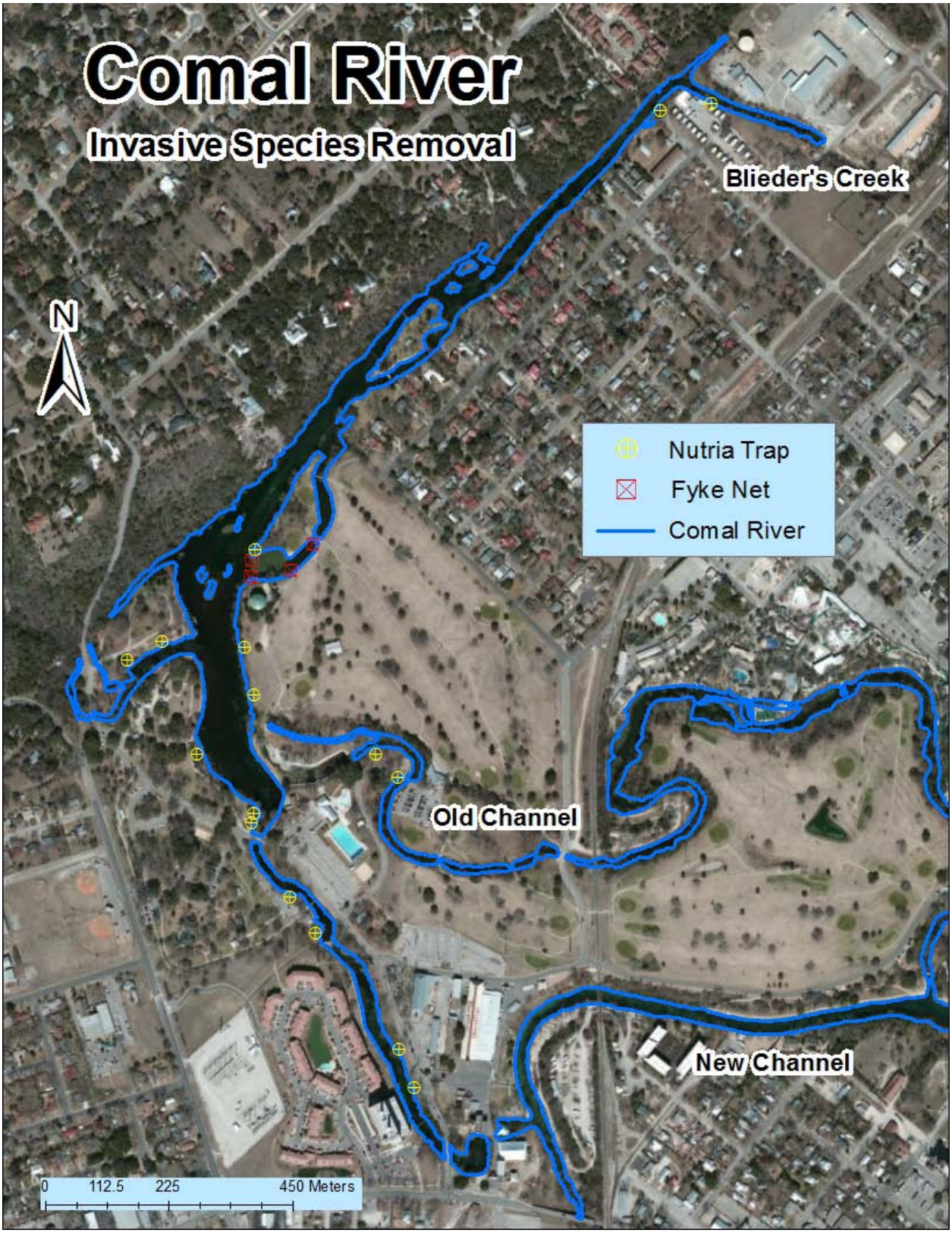

Figure 14: Non-native Animal Species Removal Project – Comal System.

San Marcos System

The **Enhancement and restoration of Texas wild-rice** and **Restoration and maintenance of native aquatic vegetation** project areas are depicted in Figure 15. As described in Section 3.3 and 3.4 of the ITP Annual Report, select non-native aquatic vegetation was removed from these areas allowing native vegetation (including Texas wild-rice) to expand over 2013. Native aquatic vegetation was also planted in cleared areas within these sections to promote restoration activities where practical and appropriate. Additionally, this project included the removal of an emergent sediment island in Sewell Park immediately below University Avenue. As evident in Table 2, the working project area supports a footprint of 5,266 m^2. Of that amount, 1,352 m^2 was existing Texas wild-rice in spring 2013 which was not disturbed. Subtracting the 1,352 m^2 from the 5,266 m^2, leaves 3,914 m^2 of which 3,065 m^2 overlaps with fountain darter occupied habitat (Table 2). Although not quantified for this assessment, disturbance from foot traffic to and from these locations and from slightly elevated turbidity during non-native vegetation and sediment island removal did temporarily occur.

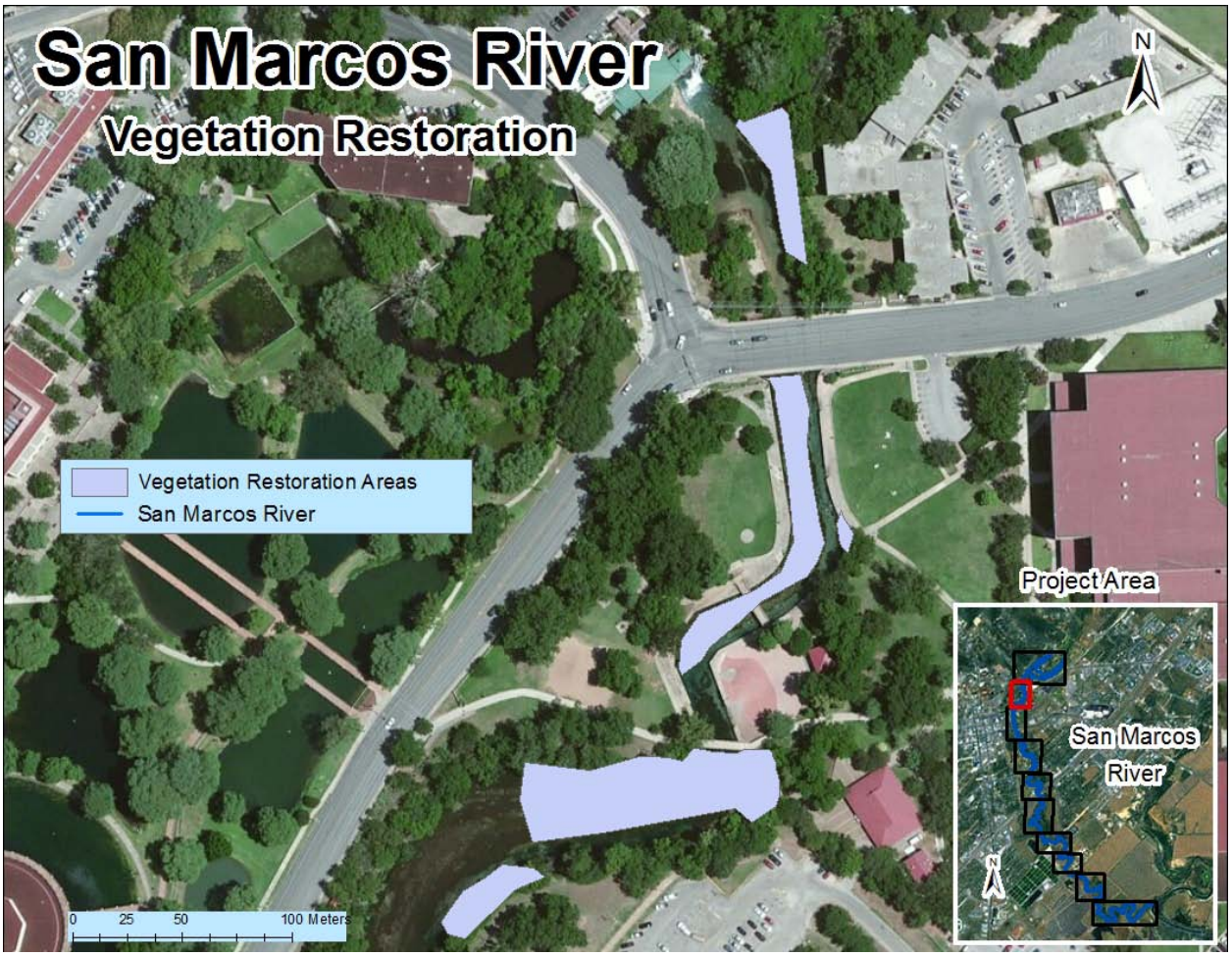

Figure 15: Restoration and Maintenance of Native Aquatic Vegetation and Enhancement of Texas wild-rice projects – San Marcos River.

There were two **Exclusion zones** incorporated within the State Scientific Area in 2013 for the management of recreation (Figure 16) which resulted in the protection of approximately 788 m^2. The upstream exclusion zone in the eastern spillway below Spring Lake Dam was strategically placed over fountain darter and San Marcos salamander occupied habitat as well as Texas wild-rice. Although this area overlaps each of these covered species occupied habitats, the majority of the project footprint is a net benefit from the exclusion of recreation in these areas. The impact area calculated for this upstream zone was 0.5 meters wide by 29.5 meters long (≈15 m^2) for the placement of t-posts and boom surrounding the protection area. The second exclusion zone is just below the confluence of purgatory creek with this area overlapping with fountain darter occupied habitat as well as Texas wild-rice. However, again the majority of this overlap is considered a net benefit. The impact area listed in Table 2 represents the 0.5 m wide by 69.5 meters long (≈35 m^2) area for the placement of the t-posts and booms as well as foot traffic to patrol this area. As such the total disturbance area for the two exclusions zones was 49.5 m^2. Temporary disturbance of slightly elevated turbidity to downstream areas did result from foot traffic to patrol and maintain these areas.

There is no project footprint map for the **Non-native species removal** project as it was conducted throughout Spring Lake and the San Marcos River without permanent or temporary installation of equipment. Most work was conducted via snorkel or SCUBA in areas of high fish density with non-native fish being speared.

The **Sediment Removal** project areas are depicted on Figure 17. Fine sediment was carefully removed from within these boundaries following the protocols described in Section 3.3 of the ITP Annual Report. The overall project footprint was 559 m^2 which overlapped with 132 m^2 of fountain darter occupied habitat in the San Marcos River (Table 2). Temporary disturbance from foot traffic to and from these locations and from slightly elevated turbidity during fine sediment removal did occur. The footprint for the **Bank stabilization** project (152 m^2) is also depicted on Figure 16. As this work took place on land, there was no overlap with occupied habitat for any of the covered species.

The **Riparian restoration** project along the San Marcos River involved the largest project footprint (7,974 m^2) of any HCP restoration project in either spring system to date. The restored areas are depicted on Figure 18 and quantified in Table 2. As with the bank stabilization project, the riparian restoration project took place on the banks and water's edge and did not overlap with any occupied habitat for the covered species.

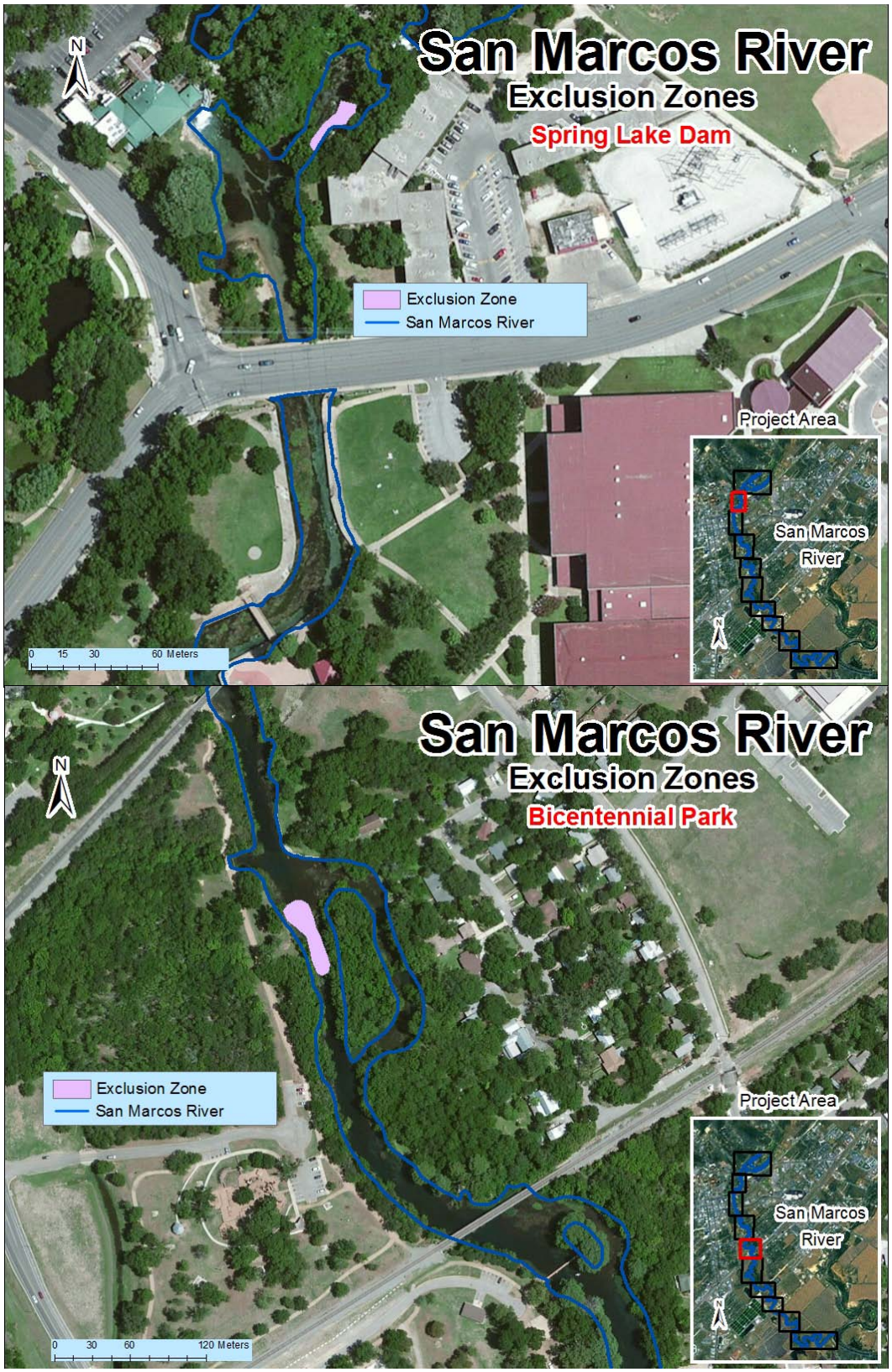

Figure 16: Exclusion Zones within State Scientific Area for Recreation control – San Marcos River.

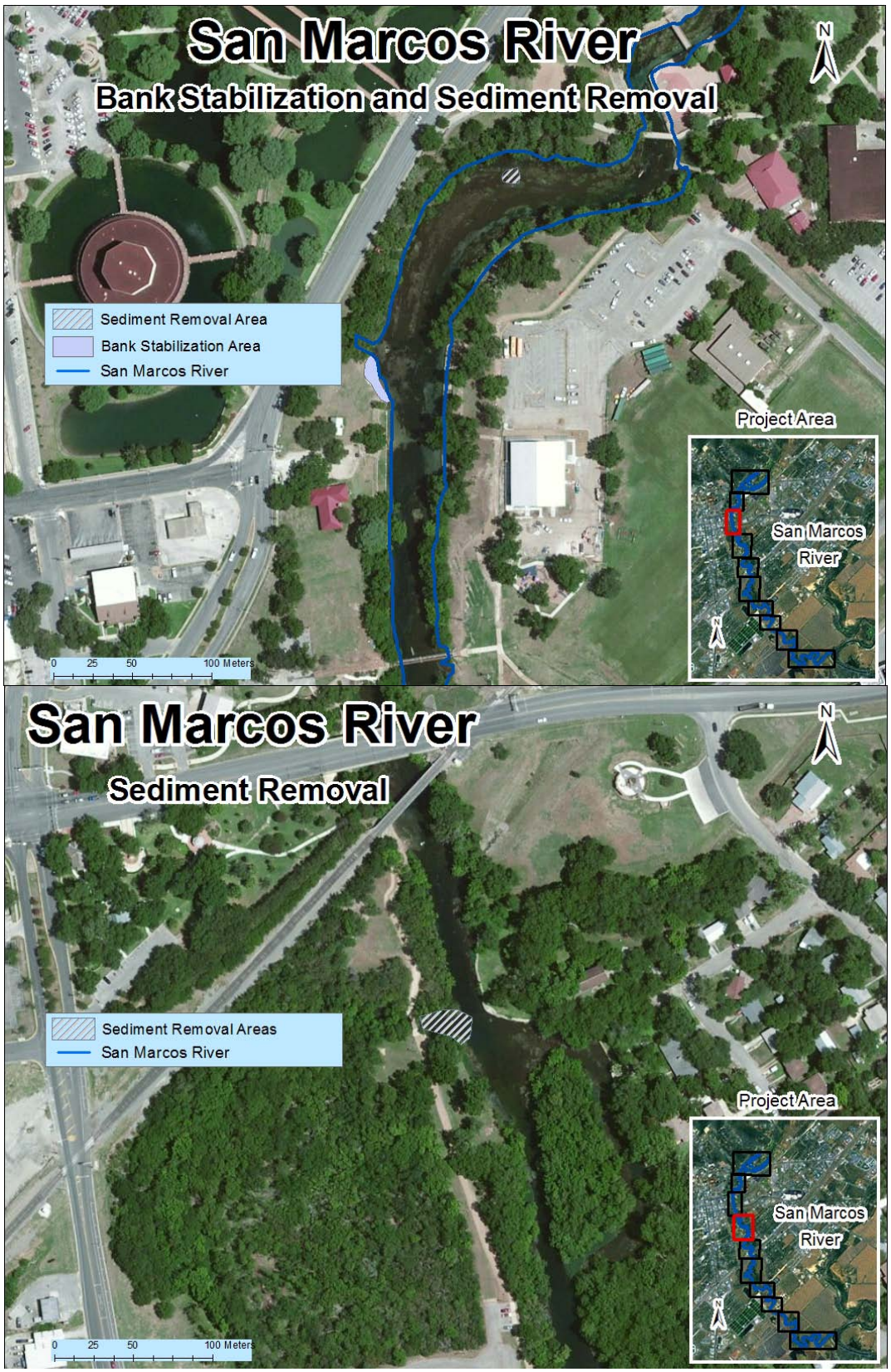

Figure 17: Sediment Removal and Bank Stabilization areas – San Marcos River.

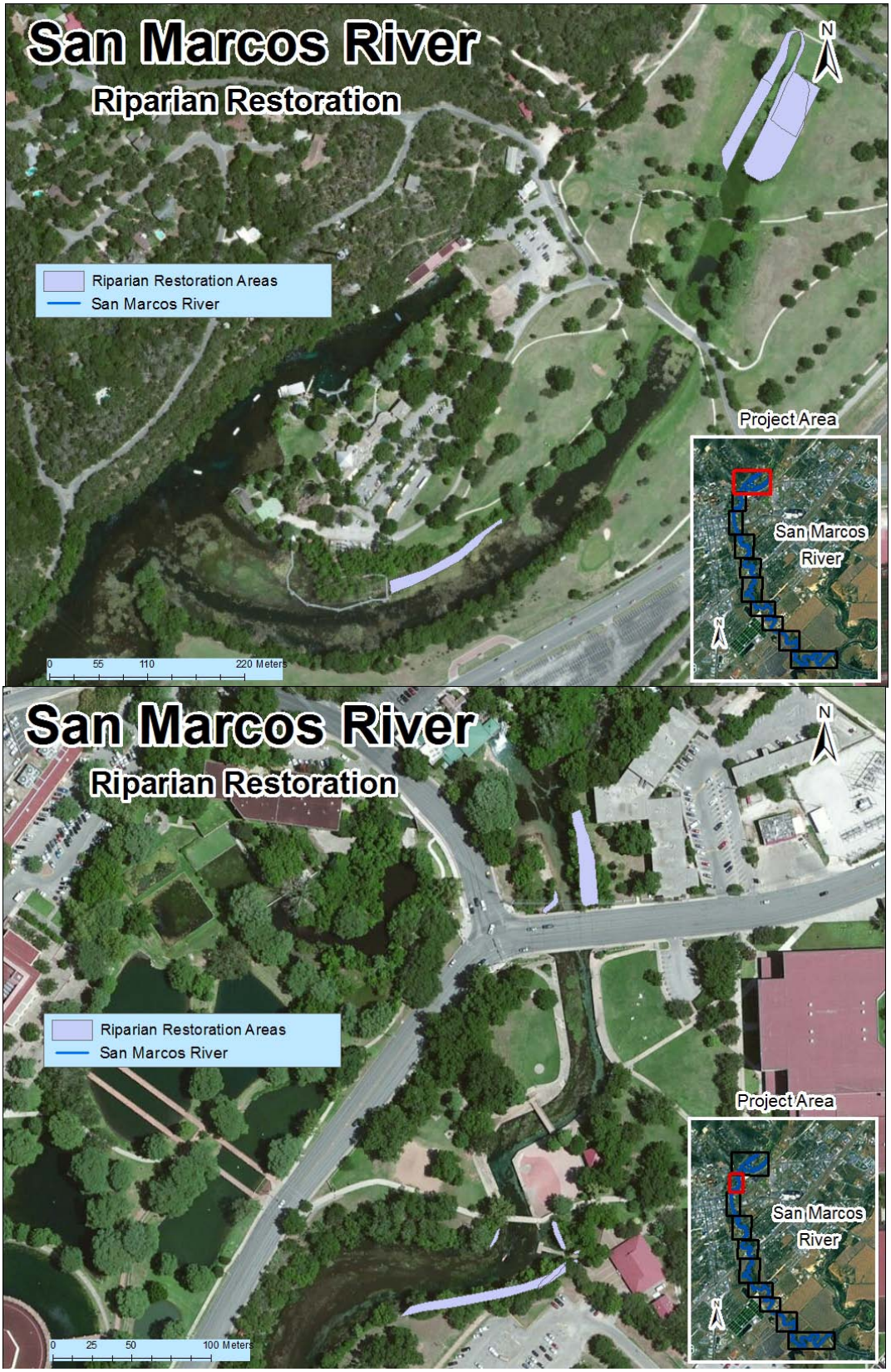

Figure 18: Riparian Restoration areas – San Marcos River.

Net Disturbance Assessment:

As described above, the baseline maps of occupied habitat versus the HCP project footprint maps were examined to quantify the area of potential effects from mitigation and restoration activities as required in Item M (1a and 2a). This included a system-wide assessment of net disturbance and net benefit. The focus was on quantifying the direct impacts (removal of non-native vegetation, removal of sediment, permanent placement of equipment, etc.) via areal coverage of activity, but temporary disturbance from slightly elevated turbidity and increased foot traffic were also described.

Table 3 shows the Net Disturbance calculation which is simply the sum of all project impact area that is overlaying baseline occupied habitat for a given covered species per system.

TABLE 3 - NET DISTURBANCE AREA AND PERCENTAGE OF TOTAL PER SPECIES PER SYSTEM

COVERED SPECIES	Total Occupied Habitat (m^2)	Net Disturbance	
		Impact Area (m^2)	% of Total
CITY OF NEW BRAUNFELS			
Fountain Darter	73,410	4,181	5.7%
Comal Springs riffle beetle	1,383	0	0
Comal Springs dryopid beetle	350 [A]	0	0
Peck's Cave amphipod	1,470 [A]	0	0
CITY OF SAN MARCOS / TEXAS STATE UNIVERSITY			
Fountain Darter	113,179	3,236	2.9%
San Marcos salamander	2,165	14.8	0.7%
Texas blind salamander	[B]		
Comal Springs riffle beetle	11	0	0

[A] Although a minimal amount of surface habitat was documented for the baseline and comparison purposes, this species is subterranean and utilizes subsurface habitat.

[B] No surface habitat documented for this species.

As shown in Table 3, only the fountain darter in the Comal System had a net disturbance when considering the project footprint overlaid on occupied habitat. The net disturbance was 5.7% of the total occupied habitat for this species. As shown in Table 2, there were no project footprints that overlapped with any of the occupied habitat for the endangered Comal invertebrates. Additionally, for the subterranean species, there was no project impacts noted that directly affected spring orifices that could have resulted into changes to subterranean habitat.

In the San Marcos system, both the fountain darter and San Marcos salamander had a net disturbance per this assessment. The fountain darter had 2.9% of its total occupied habitat disturbed whereas the San Marcos salamander amount was lower at 0.7%. For the Texas blind salamander and Comal Springs riffle beetle, there were no activities conducted in 2013 that

directly impacted any of the orifices that collections have routinely been made over the years. As such, no direct impacts to subterranean or aquifer habitat was experienced from 2013 HCP mitigation and restoration measures in the San Marcos system.

All HCP mitigation and restoration activities pertinent to the Item M requirements of the ITP were in compliance in 2013.

Net Benefit Overview:

Although not required in the Item M assessment for the ITP, it is important to put the mitigation and restoration activities discussed above into context with the HCP long-term biological goals. Table 4 provides an overview of some of the net benefits relative to increasing the quality and quantity of covered species habitat in the Comal and San Marcos ecosystems. Continuing to increase and enhance covered species habitat supports the path towards accomplishing the HCP long-term biological goals and objectives.

TABLE 4 – NET BENEFIT AREA AND DESCRIPTION

COVERED SPECIES	Restored Habitat (m^2)	Description of Activity and Benefit
CITY OF NEW BRAUNFELS		
Fountain Darter	1,347	Establishment of native vegetation in the Old Channel and Landa Lake reaches of the Comal system. Increased the quality of fountain darter habitat.
Comal Springs riffle beetle	63.6 --	Fine sediment removal over spring orifices along the western shoreline of Landa Lake. Enhances the potential for additional Comal Springs riffle beetle habitat. Protection from sediment deposition over spring orifices from established erosion control zones.
Comal Springs dryopid beetle	--	Protection from sediment deposition over spring orifices from established erosion control zones.
Peck's Cave amphipod	--	Protection from sediment deposition over spring orifices from established erosion control zones.
CITY OF SAN MARCOS / TEXAS STATE UNIVERSITY		
Fountain Darter	235 352 427	Establishment of native vegetation in the San Marcos River. Increases the quality of fountain darter habitat. Protection of occupied fountain darter habitat from recreation within the recreation exclusion zones. Removal of fine sediment to promote native vegetation restoration. Increases the quality and quantity of fountain darter habitat.

San Marcos salamander	125	Protection of occupied San Marcos salamander habitat from recreation within the exclusion zone.
Texas blind salamander	--	
Texas wild-rice[A]	212	Increased coverage of Texas wild-rice directly from non-native vegetation removal and Texas wild-rice plantings.
	455	Protection of existing Texas wild-rice from recreation in the recreation exclusion zones.

[A] Texas wild-rice not formally needed for the Item M assessment but included for informational purposes

References

BIO-WEST, Inc., 2002-2013a, Comprehensive and critical period monitoring program to evaluate the effects of variable flow on biological resources in the Comal Springs/River aquatic ecosystem: Final Annual Reports (2002 through 2013) submitted to the Edwards Aquifer Authority, San Antonio, Texas, variously paginated.

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