2020 Annual Monitoring Results and Maintenance Plan for San Acacia Reach Restoration Sites

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Introduction

This technical memo presents results from effectiveness monitoring completed in 2020 at eight habitat restoration sites located along a 23-mile segment of the San Acacia Reach of the Middle Rio Grande (MRG) between the San Acacia Diversion Dam (River Mile [RM] 116) and the Rhodes property at RM 93; **Figure 1**). Five of the eight projects were designed by the New Mexico Interstate Stream Commission (NMISC), while the other three were designed by the U.S. Bureau of Reclamation's (Reclamation). Reclamation's Socorro Field Division completed construction at all eight project sites in winter 2019 (**Table 1**).

While some restoration design details differed between NMISC and Reclamation projects (see **Table 1**), the overarching project objectives for all eight projects were similar: to physically lower elevated floodplain terraces so they could become inundated during low to moderate river discharges (i.e., begin inundating at approximately 800 cfs and be fully inundated at approximately 2,000 cfs) and provide physical conditions conducive to spawning and rearing for the federally endangered Rio Grande silvery minnow (*Hybognathus amarus*; Caplan & McKenna 2019; Reclamation 2019). None of the sites were revegetated with native riparian species due to concerns of impacts by uncontrolled livestock grazing. Instead, both NMISC and Reclamation adopted an experimental approach to evaluate whether and to what extent native riparian vegetation (mostly cottonwood and willow) would naturally establish, survive, and develop.

GeoSystems Analysis, Inc. (GSA) developed a monitoring plan in 2019 titled *Monitoring and Adaptive Management Plan for New Mexico Interstate Stream Commission Habitat Restoration Projects in the San Acacia Reach of the Middle Rio Grande* (herein Monitoring & AM Plan; Caplan & McKenna 2019). The Monitoring & AM Plan was developed in close coordination with Reclamation so that similar physical and biological response variables can be compared across all eight restoration project sites.

The Monitoring & AM Plan provides tiered linkages between project goals, SMART (**S**pecific, **M**easurable, **A**ttainable, **R**elevant, **T**ime-Bound) objectives (Bjerke & Renger 2017), monitoring methods, and quantitative success criteria. Standard Operating Procedures (SOPs) for each monitoring component are included in the Monitoring & AM Plan (Caplan & McKenna 2019) and describe monitoring methods for:

- Mapping inundation extent at 800 cfs and 2,000 cfs
- Measuring inundation depth, velocity and water temperature at 2,000 cfs
- Monitoring presence, abundance, and reproductive status of adult Rio Grande silvery minnow (RGSM) and presence and abundance of larval RGSM[1]

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[1] SWCA Environmental Consultants is the technical lead on fish monitoring and only summary information is provided regarding RGSM monitoring methods in the GSA monitoring and adaptive management plan. For detailed descriptions of field monitoring procedures see SWCA 2019 in Appendix H.

- Evaluating presence of isolated pools of water (i.e., not draining back to the river channel) and potential to strand silvery minnow
- Presence and distribution of New Mexico state listed noxious weeds
- Presence and distribution of native and non-native woody riparian vegetation
- Post-runoff sediment deposition trends and volumetric estimates

This report focuses on presenting and summarizing results from monitoring completed in 2020 along with adaptive management recommendations for ensuring project sites continue to function as designed.

Table 1. Restoration Project Sites

Project Name*	Acres	Designed by	General Design Features
RM 114	1.7	NMISC	Two backwater channels, inundation initiated at approximately 800 cfs
RM 112	1.5	NMISC	One backwater channel, inundation initiated at approximately 800 cfs
RM 104.5 (Escondida East)	3.2	Reclamation	One backwater channel, inundation initiated at approximately 300 cfs
RM 103 (Escondida West)	10.5	Reclamation	Four backwater channels and one high-flow channel, inundation initiated at approximately 300 cfs
RM 100.5	8.2	NMISC	Two backwater channels, inundation initiated at approximately 800 cfs
RM 100	1.4	NMISC	One backwater channel, inundation initiated at approximately 800 cfs
RM 99.5	3.5	NMISC	Two backwater channels, inundation initiated at approximately 800 cfs
RM 93 (Rhodes)	17.2	Reclamation	Eleven embayments and one high-flow channel, inundation initiated at approximately 300 cfs

*RM = river mile markers from the 2012 USBR centerline, sites named according to the nearest half river mile.

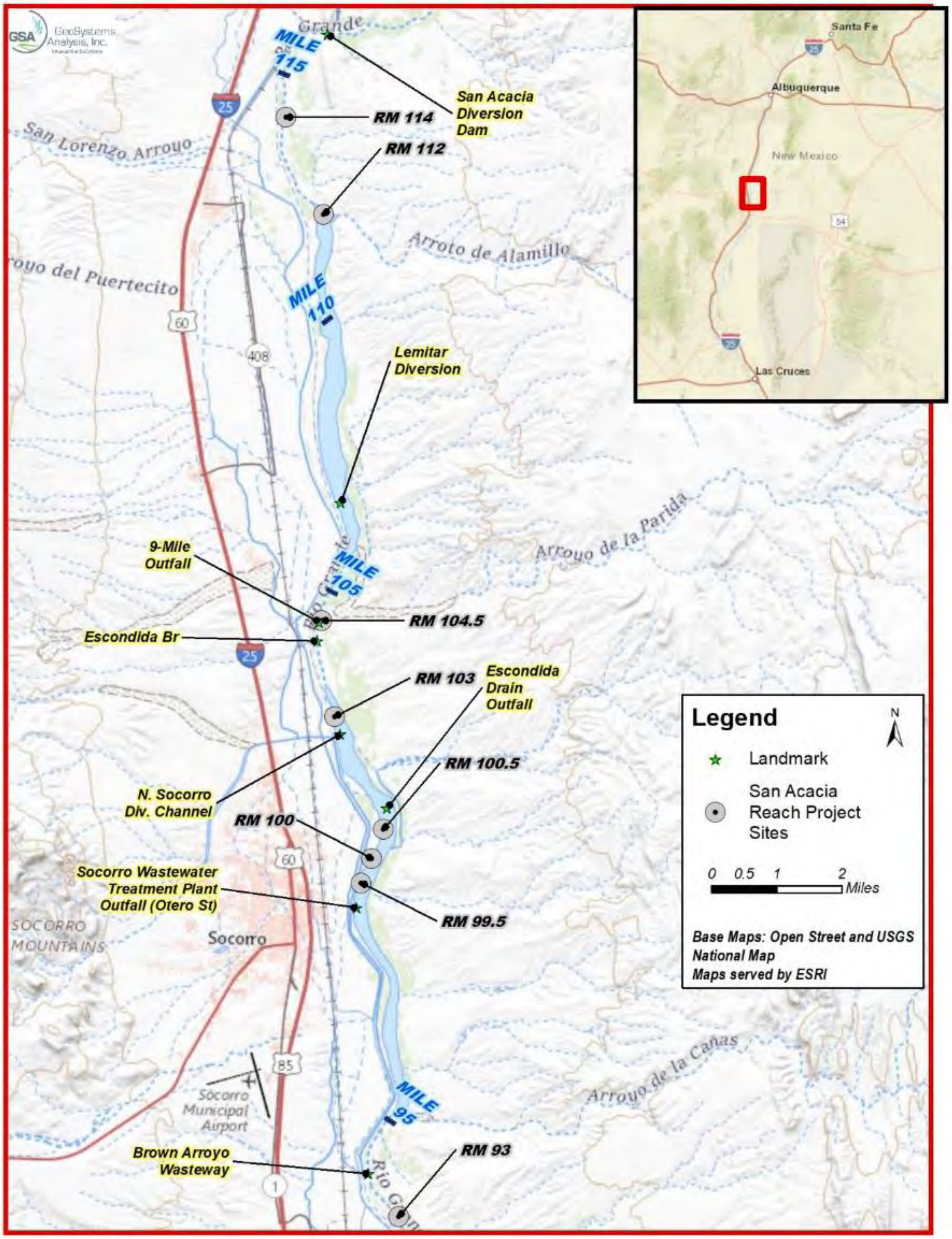

Figure 1. Restoration project site location map

2020 Snowmelt Runoff

Characterizing the snowmelt runoff in 2020 as "below average" understates the severity of hydrologic conditions throughout the spring and summer months in the San Acacia Reach. River discharge was highest in January and February then dropped precipitously between March and July from a "high" of approximately 800 cfs in mid-March to less than 50 cfs by June 1st (**Figure 2, Figure 3).**

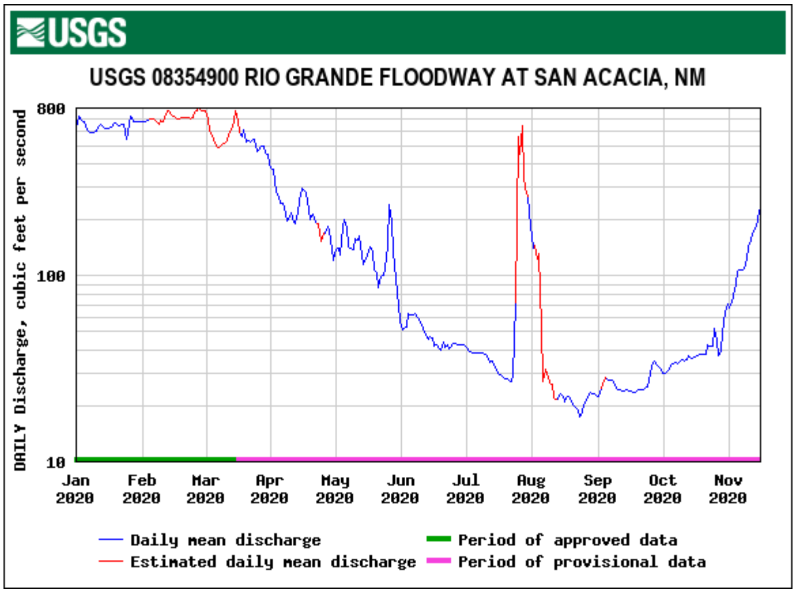

Figure 2. Hydrograph showing mean daily discharge recorded in 2020 at the San Acacia Gage

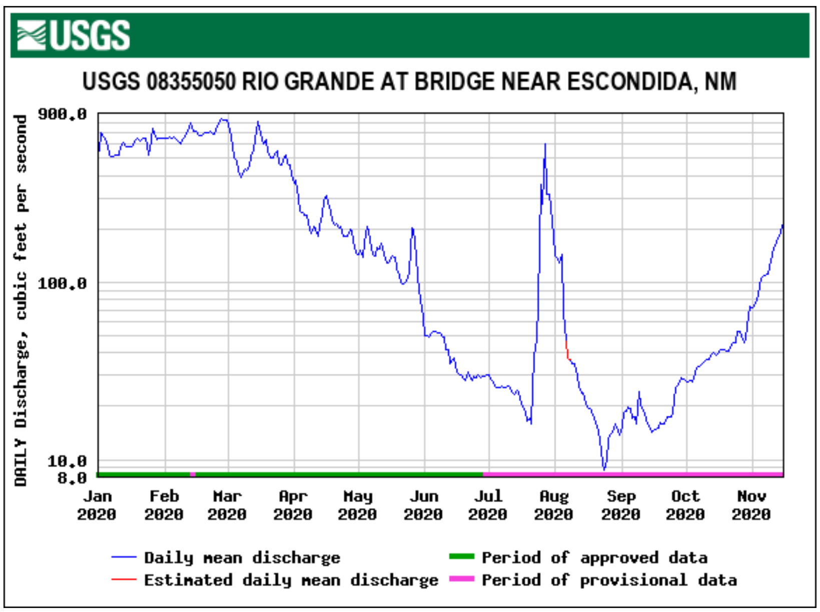

Figure 3. Hydrograph showing mean daily discharge recorded in 2020 at the Escondida Gage

As a result, none of the project sites were inundated (see satellite images in **Appendix G**) and there was no opportunity to monitor condition-dependent hydrologic variables (inundation extent; inundation depth, velocity, temperature; presence of isolated pools; silvery minnow adult and larval fish abundance; sediment deposition volumes). Accordingly, the only data collected at the project sites in 2020 related to presence and spatial distribution of herbaceous noxious weeds and woody native and non-native riparian vegetation.

The following report sections describe the vegetation monitoring methods and results from all eight SA-Reach restoration sites. Adaptive maintenance actions implemented at project sites in 2020, and those proposed for implementation during 2021 are discussed in the *Adaptive Management Actions and Recommendations* section towards the end of the report.

Methods

Noxious Weeds

Noxious weeds can invade and spread rapidly across newly created restoration sites, so early detection and treatment was recommended in the Monitoring & AM Plan (Caplan & McKenna 2019). The SOBTF surveyed for presence and distribution of noxious weeds at project sites between late May and early August (**Table 2**). Surveys were conducted by documenting observed noxious weed populations in the *Fulcrum* EFF in accordance with the *Standard Operation Procedures for Documenting Noxious Weed Occurrences at San Acacia Reach Restoration Sites* (Caplan & McKenna 2019).

Table 2. Noxious weed survey dates by site

Site	93.0	99.5	100	100.5	103	104.5	112	114
Survey Date(s)	Aug 1-14	Aug 3	Aug 3	Aug 3	Aug 4	Aug 4	Aug 4	Aug 5

Woody Vegetation

Woody vegetation monitoring was implemented between September 29 and October 15, 2020 at all eight project sites to evaluate establishment and spatial distribution of both native and non-native woody plants across the project sites. These monitoring data are to be used to determine: 1) if, and to what extent, natural recruitment and development of cottonwood-willow are occurring; 2) if supplement cottonwood-willow plantings would be necessary to mitigate project construction impacts on breeding and foraging habitat for the yellow-billed cuckoo (see USFWS 2016); 3) if non-native woody plant control treatments are recommended, and; 4) if woody plants (native or non-native) need to be removed from channel maintenance zones at any project site (see Table 3, Row 6, in Caplan & McKenna 2019).

Monitoring methods followed the *Standard Operating Procedures for Documenting Presence and Distribution of Native and Non-Native Woody Plant Species at San Acacia Restoration Sites* (Caplan & McKenna 2019).

Results

Noxious Weeds

Noxious weeds were documented in only three of the eight restoration sites during 2020 field surveys, including sites RM 104.5, RM 99.5, and RM 93 (**Table 3;** also see maps in **Appendix A**). By far the greatest number of noxious weeds were documented at RM 93 and were composed primarily of perennial pepperweed and Russian knapweed.

Compared to 2019, the data collected by SOBTF indicates the total number of noxious weeds detected in 2020 dropped approximately 50% for all species except Whitetop, which dropped 100% (**Table 3**). The only exceptions were one Ravenna grass plant detected in 2020 at RM 93, one perennial pepperweed plant population at RM 99.5, and three new Russian knapweed populations recorded at RM 99.5.

Note that the numbers in **Table 3** and location markers on the maps in **Appendix A** refer to populations (one or more plant groupings). Some mapped populations may overlap but were recorded using best professional judgement to depict overall distribution of noxious weed infestations within each site and guide maintenance prioritization and implementation.

Table 3. Number of noxious weed populations documented at each restoration site during 2020. Maps showing location of noxious weed species detections are provided in Appendix A.

Site	Perennial pepperweed		Ravenna grass		Russian knapweed		Whitetop		*Grand Total*	
	2019	2020	2019	2020	2019	2020	2019	2020	2019	2020
RM 114	0	0	0	0	0	0	0	0	0	0
RM 112	0	0	0	0	15	0	0	0	***15***	**0**
RM 104.5	4	2	0	0	0	0	0	0	***4***	**2**
RM 103	4	0	0	0	1	0	0	0	***5***	**0**
RM 100.5	2	0	0	0	0	0	0	0	***2***	**0**
RM 99.5	0	1	12	5	0	3	0	0	***12***	**9**
RM 93	40	23	0	1	24	18	2	0	***66***	**42**
Grand Total	**50**	**26**	**12**	**6**	**40**	**21**	**2**	**0**	**104**	**53**

Woody Vegetation

Cottonwood-Willow Seedling Recruitment

Monitoring for new cottonwood-willow seedlings revealed few survey grid cells containing any seedlings of the three species of interest (**Table 4**). Maps in **Appendix B** highlight the difference in spatial distribution of seedlings between 2019 and 2020 for all three species. Poor seedling recruitment is attributed to fact that none of the sites inundated and soil moisture was predictably low during May-June seed dispersal. This latter point is underscored by the lack of new seedlings in the lower elevation channel maintenance zones (**Table 5** and maps in **Appendix B**).

Table 4. Proportion of survey grid cells containing cottonwood, coyote willow or Goodding's willow seedlings.

Native Riparian Seedling Recruitment Throughout Sites						
	Cottonwood		**Coyote Willow**		**Goodding's Willow**	
Site	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**
RM 114	19%	0%	6%	0%	1%	0%
RM 112	12%	0%	2%	0%	1%	0%
RM 104.5	7%	5%	2%	7%	1%	2%
RM 103	5%	3%	2%	6%	0%	0%
RM 100.5	12%	0%	1%	0%	0%	0%
RM 100	12%	0%	2%	0%	0%	1%
RM 99.5	13%	0%	2%	0%	0%	0%
RM 93	10%	0%	21%	1%	9%	0%

Table 5. Proportion of survey grid cells within channel maintenance zones containing cottonwood, coyote willow or Goodding's willow seedlings.

Native Riparian Seedling Recruitment Within Channel Maintenance Zones						
	Cottonwood		**Coyote Willow**		**Goodding's Willow**	
Site*	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**
RM 114	13%	0%	5%	0%	1%	0%
RM 112	12%	1%	2%	0%	2%	0%
RM 103	5%	3%	2%	6%	0%	0%
RM 100.5	12%	0%	1%	0%	0%	0%
RM 100	10%	0%	1%	0%	0%	1%
RM 99.5	11%	0%	2%	0%	0%	0%
RM 93	8%	0%	16%	1%	7%	0%

Cottonwood-Willow Plants, All Sizes

Although new seedling recruitment was low in 2020, the number of survey grid cells supporting cottonwood and Goodding's willow plants of all sizes (seedlings, saplings, poles, mature trees) remained relatively consistent at most sites between 2019 and 2020 (**Table 6; also see maps in Appendix C**). The exception was site RM 100, where the data indicate a sharp (20%) expansion of cottonwood between monitoring years (**Table 6**). This difference is attributed to 1) mature cottonwood trees along the site perimeter were counted in a higher density of grid cells during the 2020 survey than in 2019, and 2) sapling size cottonwoods observed along the river bankline and along portions of the project site perimeter (see Site 100 map in **Appendix C**).

Unlike cottonwood and Goodding's willow trees, the percentage of grid cells in which coyote willow was recorded increased sharply at most sites (**Table 6)**. Coyote willow expansion is attributed to the fact that this species is rhizomatous, meaning new stems emerge from roots that spread laterally just below the ground surface. The expansion of coyote willow across the sites may be partially due to vegetative reproduction by new seedlings that established in 2019, although we suspect that most of the observed expansion is from older coyote willow root systems that remained viable below ground after the above ground stems were cleared during site construction in winter 2019 (a similar phenomenon has been observed at other MRG restoration project sites). The only exception to this coyote willow plant expansion was the decline observed at the RM 93 site. This decline appears associated with coyote willows growing in channel maintenance zones that were cleared during April 2020 sediment removal activities (see RM 93 map in **Appendix C**).

Table 6. Proportion of survey grid cells containing all size classes of cottonwood, coyote willow and Goodding's willow.

Native Riparian Plants - All Sizes						
	Cottonwood		**Coyote Willow**		**Goodding's Willow**	
Site	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**
RM 114	45%	49%	36%	62%	2%	4%
RM 112	15%	11%	76%	88%	3%	7%
RM 104.5	9%	8%	3%	8%	1%	3%
RM 103	12%	14%	8%	22%	0%	0%
RM 100.5	24%	23%	37%	61%	1%	1%
RM 100	28%	48%	2%	8%	1%	3%
RM 99.5	31%	38%	50%	72%	1%	2%
RM 93	11%	6%	25%	14%	7%	1%

Non-Native Woody Plants

The proportion of survey grid cells with non-native woody vegetation increased between 2019 and 2020, although the increase varied by species and by site (**Table 7**). Spatial distribution of saltcedar and Russian olive increased at all sites, likely from combinations of new seedlings, root sprouts, and adventitious spread through rhizomes (for saltcedar). Siberian elm plants are uncommon at any site, although a few individual plants are beginning to colonize RM 100.5 and RM 99.5 (**Table 7**).

Table 7. Proportion of survey grid cells with non-native woody plant species.

Exotic Woody Vegetation Summary - All Sizes						
	Saltcedar		**Siberian Elm**		**Russian Olive**	
Site	**2019**	**2020**	**2019**	**2020**	**2019**	**2020**
RM 114	29%	42%	0%	0%	13%	30%
RM 112	11%	18%	0%	0%	6%	15%
RM 104.5	40%	70%	0%	0%	0%	2%
RM 103	13%	27%	0%	0%	2%	4%
RM 100.5	24%	46%	1%	1%	10%	11%
RM 100	26%	42%	0%	0%	3%	18%
RM 99.5	19%	36%	0%	1%	9%	17%
RM 93	45%	53%	0%	0%	4%	6%

Maps showing spatial distribution of cells containing non-native woody plants are provided in **Appendix D**

Adaptive Management & Maintenance Actions and Recommendations

Sediment Management within Channel Maintenance Zones

As reported in the *2019 Annual Monitoring Results and Maintenance Plan* (GSA 2020), sediment deposition occurred within the channel inlets at all project sites. Hydrodynamic models developed for the five project sites designed by NMISC predicted that the deposition could reduce or preclude future inundation at the design discharge, particularly at the lower-end discharge of 800 cfs (28 m^3/s; **Figure 4**). The volume of sediment at all inlets within individual project sites was quantified and used by NMISC and SOBTF to obtain cost estimates from qualified contractors to excavate and haul away accumulated sediments from designated channel maintenance zones (see maps in **Appendix D**).

GSA used RTK GPS to establish "cut stakes" at all project site inlets to guide contractors with sediment removal (**Figure 5**). Sediments deposited following 2019 runoff were excavated from channel inlets at project sites in April 2020. The NMISC contracted PG Enterprises LLC (via subcontract through Wilco Marsh Buggies, Inc.) to remove sediments from inlets at sites RM 114, RM 112, RM 100.5, RM 100, and RM 99.5. The SOBTF contracted Lanford Excavation LLC to excavate sediments from channel inlets at RM 93. No sediment was excavated at project sites RM 104.5 or RM 103. The volume (yds^3) of sediment removed from each inlet along with sediment spoil locations for each site are shown on maps in **Appendix D**. Cost per cubic yard and total cost for sediment removal from each project site is presented in **Table 8**.

Given the dry conditions spring and summer months of 2020, no additional sediment removal will be required prior to 2021 snowmelt runoff.

Table 8. Total cubic yards and costs of April 2020 sediment removal from channel maintenance zones at six project sites

Site	Total Cubic Yards	Cost/cubic yard	Cost
RM 114	781	$ 13.38	$ 10,449.78
RM 112	387	$ 13.38	$ 5,178.06
RM 100.5	270	$ 13.38	$ 3,612.60
RM 100	67	$ 13.38	$ 896.46
RM 99.5	438	$ 13.38	$ 5,860.44
RM 93	1,389	$ 16.40	$ 22,278.87
		Total Cost	**$ 48,276.21**

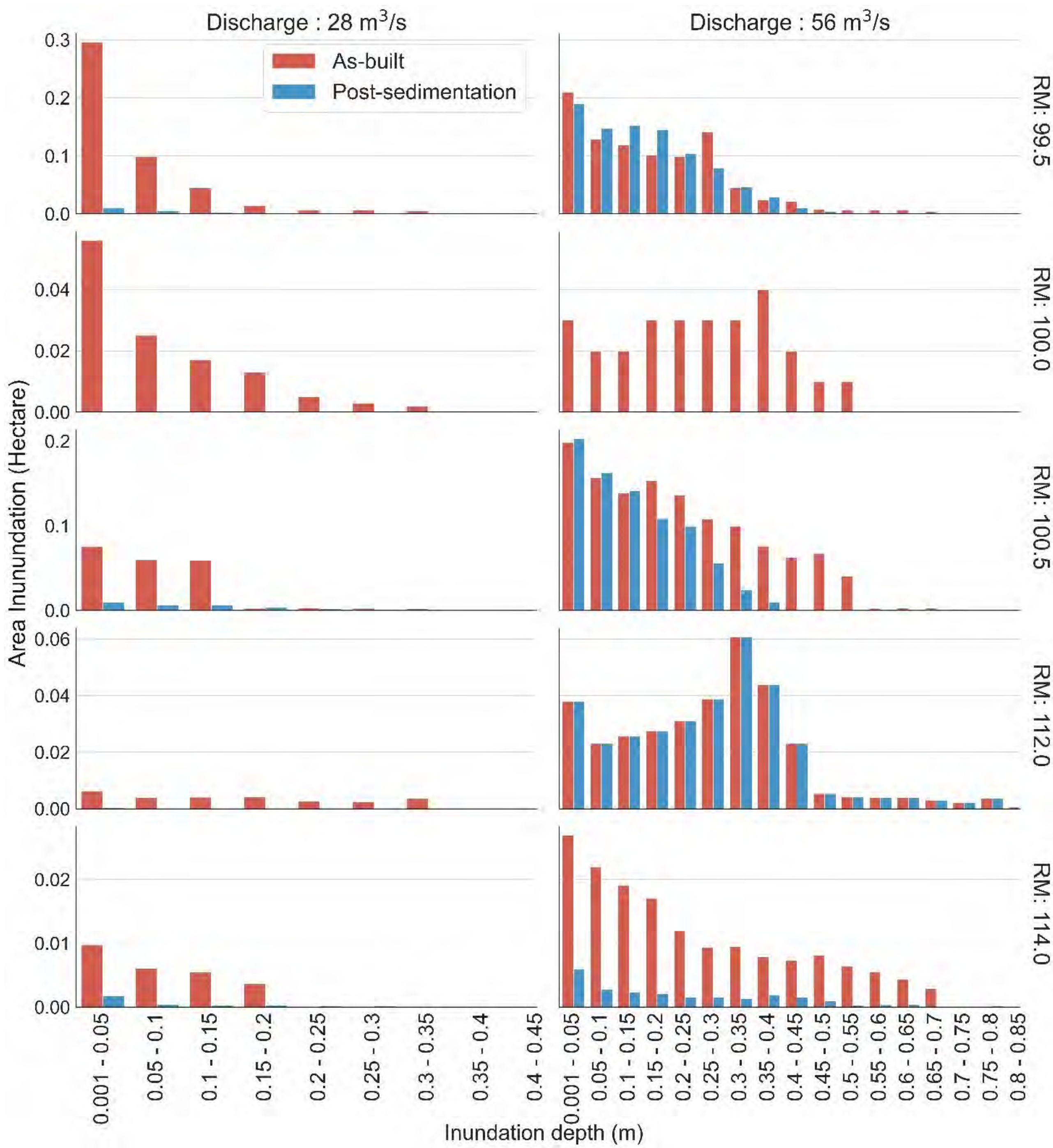

Figure 4. Histogram showing 2-D model predictions of inundation depths at design discharge of 28m³ (800 cfs) and 56 m³ (2,000 cfs), respectively at the five NMISC project sites using as-built and post-runoff topography.

Figure 5. Representative photos of sediment removal within channel maintenance zones. These photographs were taken immediately after sediment removal at RM 100.5

Non-Native Plant Management

The SOBTF led efforts to control herbaceous noxious weeds at all project sites identified during 2019 monitoring. SOBTF hired a contractor in May 2020 to apply Rodeo (aquatic approved formulation of glyphosate) to perennial pepperweed and whitetop plants at project sites RM 93, RM 100.5 and RM 103. Ravenna grass plants at RM 99.5 were removed in late July by SOBTF interns using shovels and hand tools. SOBTF crews revisited these Ravenna grass removal locations later in the summer to dig up any additional plants that may have come up since the first survey/removal. Other noxious weeds identified during summer 2019 and 2020 surveys were also treated by SOBTF interns using shovels and hand tools in June and August 2020 (see **Appendix F**, SOBTF field notes).

Additional herbicide applications are recommended in spring/summer 2021 for treating perennial pepperweed and Russian knapweed. Ravenna grass plants identified at RM 99.5 and RM 93 should be removed using shovels. **Tables 9** summarize treatment approach, timing, and location for noxious weeds. Maps showing location of noxious weed species detections are provided in **Appendix A**.

Table 9. Number of noxious weed populations documented at each restoration site during 2020 monitoring.

Site	Perennial pepperweed	Ravenna grass	Russian knapweed
RM 104.5	2		
RM 99.5	1	5	3
RM 93	23	1	18
Recommended Treatment Method	**2% imazapyr (Habitat) foliar treatment**	**Hand Dig**	**10% glyphosate foliar treatment**
Timing	**1x/year in April-May**	**Prior to seed set**	**2x/year; first in mid-July, second in mid-September**

Herbicide applications will be required for treating Russian olive and saltcedar plants documented at all project sites. All non-native woody plants should be treated using a cut-stump or foliar herbicide treatment of an aquatic approved herbicide such as Habitat (active ingredient imazapyr) or Rodeo, AquaMaster (active ingredient glyphosate). We recommend that cut stump application be used on individuals with greater than one-inch basal stem diameter (bsd) and could be implemented year-round (as allowable per environmental compliance guidelines). A July-September foliar application is recommended for smaller individuals (i.e. seedlings with <1 inch bsd). An SOP for implementing and documenting non-native plant control treatments is provided in **Appendix E.**

Incidental Site Observations and Maintenance Issues

Livestock Browse Impacts

One of the reasons why active planting of cottonwood poles and willow cuttings was not implemented at the project sites was over concerns of uncontrolled livestock grazing. Incidental observations at the project sites indicates considerable browsing pressure on coyote willows, most notably at project site RM 112. While some browsing may be by elk or deer, there is evidence (tracks, cow pies) that livestock are also roaming through the project sites. Ongoing browsing of new cottonwood and willow shoots will prevent those plants from developing canopy heights used by nesting birds.

It may be prudent to develop and implement simple monitoring procedures to document browse pressure on cottonwood and willow plants in the project areas. As part of this monitoring it may be worthwhile to discuss establishing some exclosure fencing in certain locations to demonstrate plant growth impacts by browsing. Accordingly, we recommend the project adaptive management team discuss this topic and document the conversation and decision for the administrative record.

ORV Trespass

Apart from RM 93, off-road four-wheel drive vehicles (to include both trucks and all-terrain vehicles) continue to utilize the inlets at most project sites as river access locations for fishing and recreating. The vehicles are creating varying degrees of ground disturbance that create topographic depressions, alter drainage patterns, and destroy or damage young native vegetation. Most of the inlets (e.g. sites RM 114, 112, 100.5, 100, 99.5) now have well-established two-track roads to the bank of the river. In some locations (e.g., RM 100) the topographic depressions are significant and have potential to promote ponding and fish entrapment following flow recession. We recommend the project adaptive management team discuss potential opportunities to restrict trespass vehicle entry into the various project sites.

Figure 6. Well used two track road through the RM 99.5 site. Most of the features now have similar heavily used roads down to the river.

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APPENDIX A – NOXIOUS WEED POPULATIONS

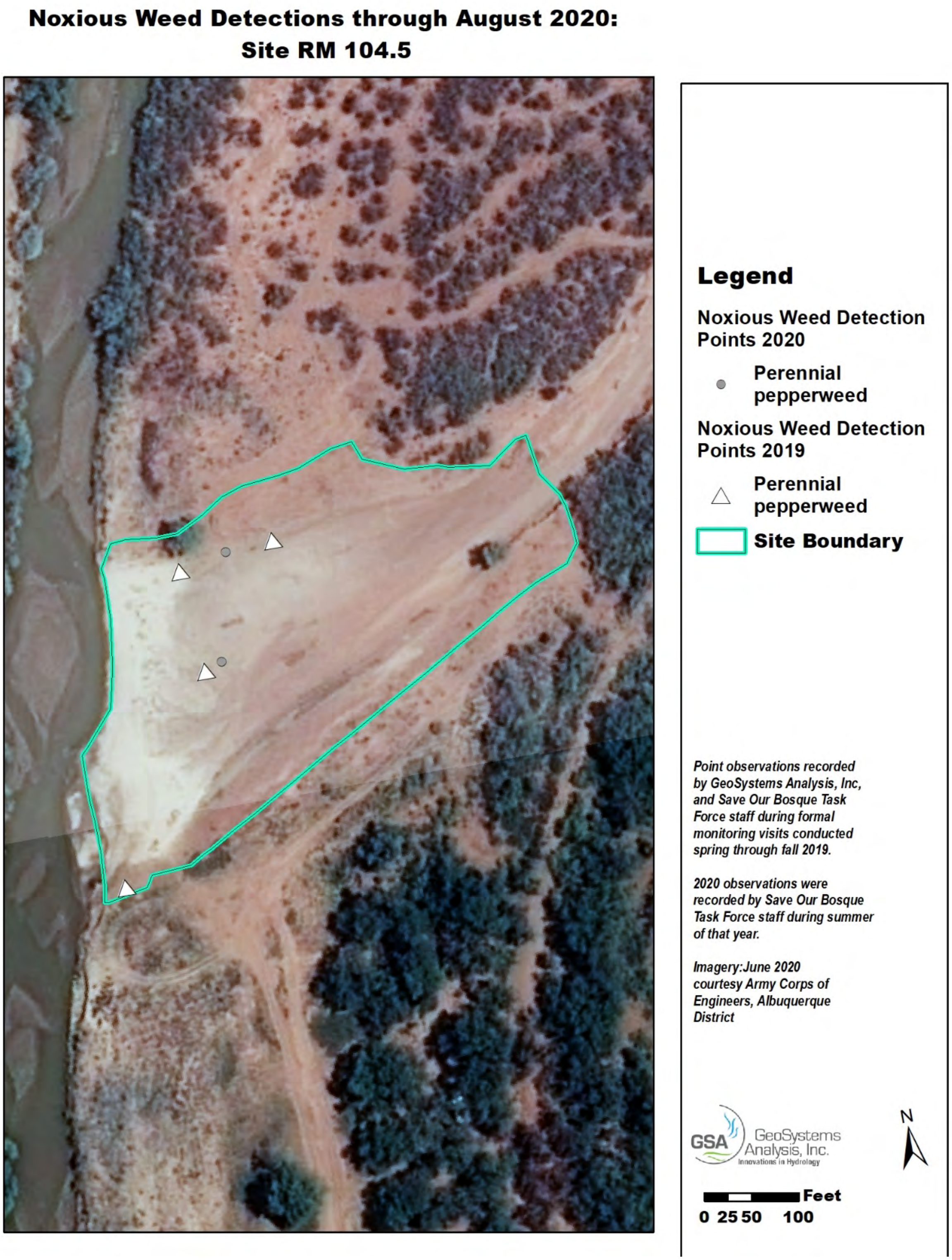

Figure A-1. Noxious weed species populations documented at RM 104.5.

Figure A-2. Noxious weed species populations documented at RM 99.5.

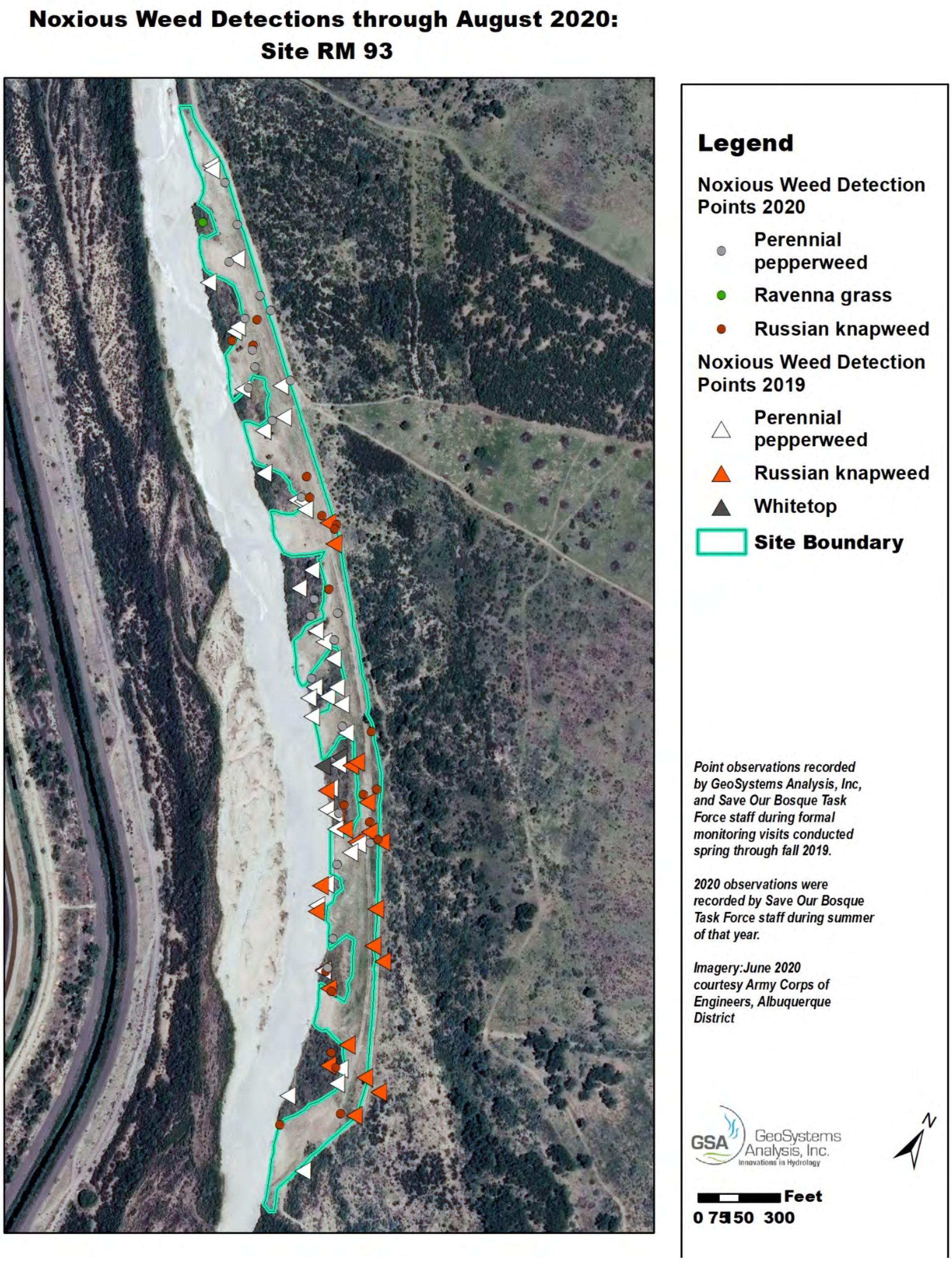

Figure A-3. Noxious weed species populations documented at RM 93.

APPENDIX B – NATIVE WOODY PLANT RECRUITMENT

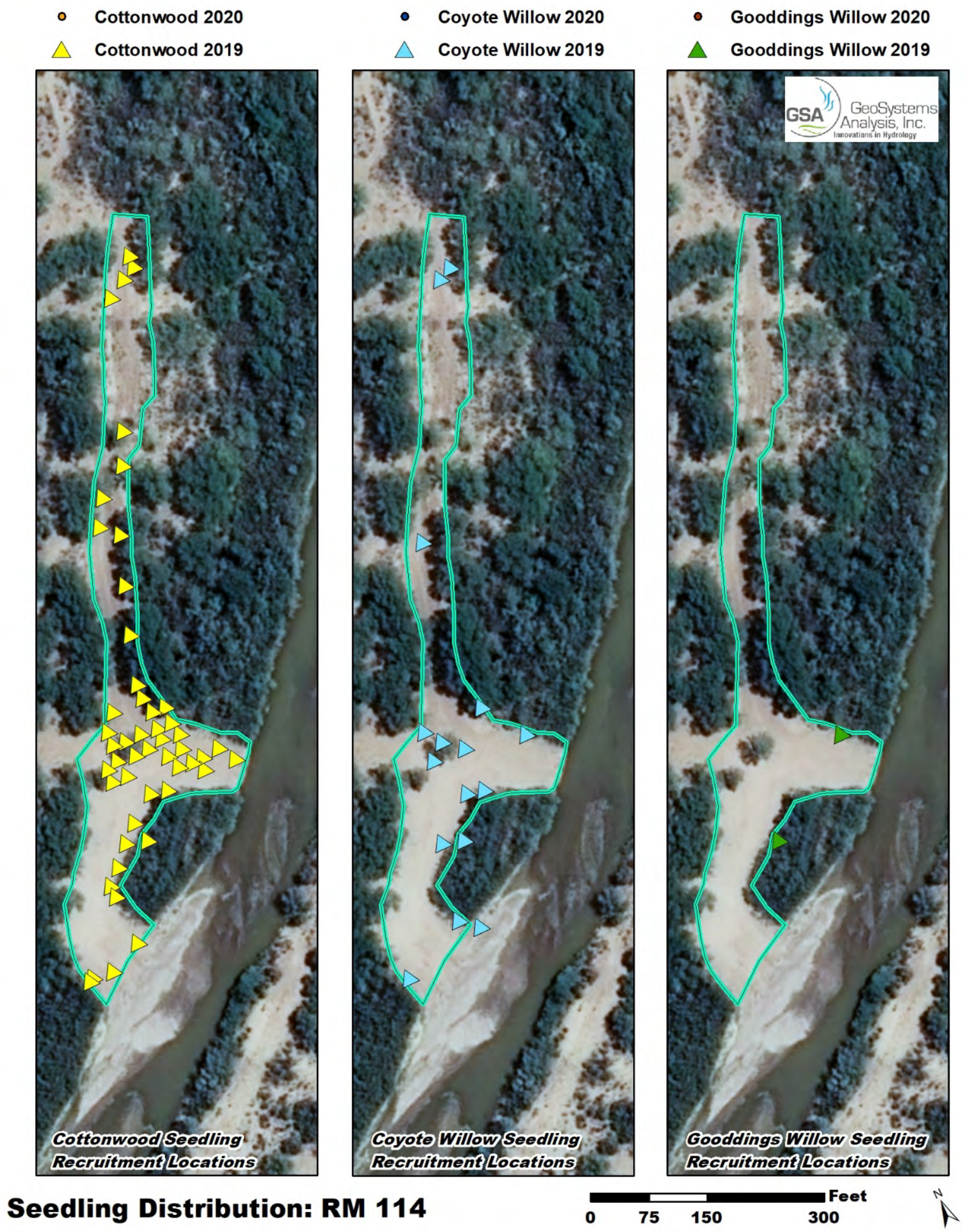

Figure B-1. Distribution of native cottonwood (left), coyote willow (center) and Gooddings willow (right) seedlings recorded in 2019 and 2020 at RM 114.

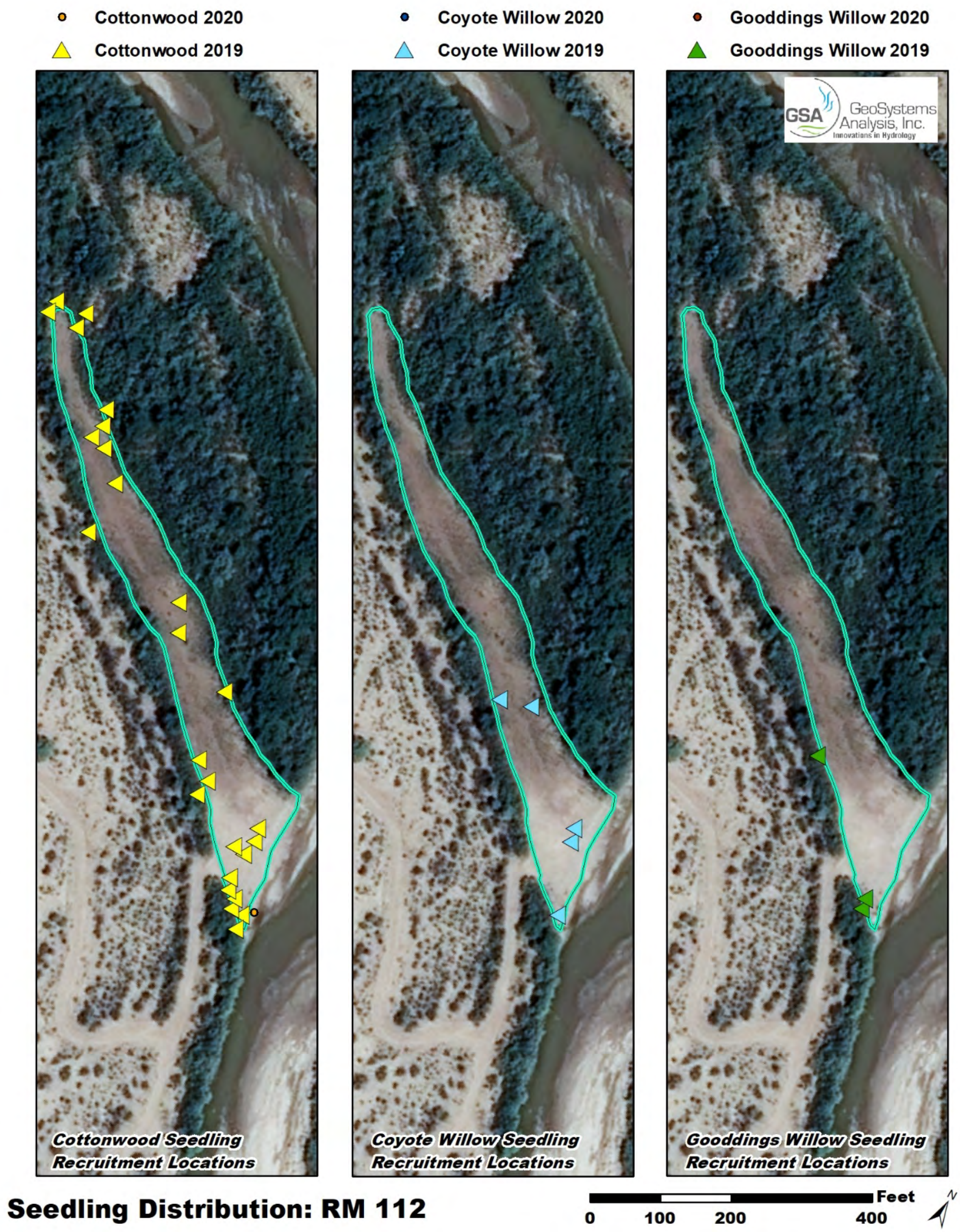

Figure B-2. Distribution of native cottonwood (left), coyote willow (center) and Gooddings willow (right) seedlings recorded in 2019 and 2020 at RM 112.

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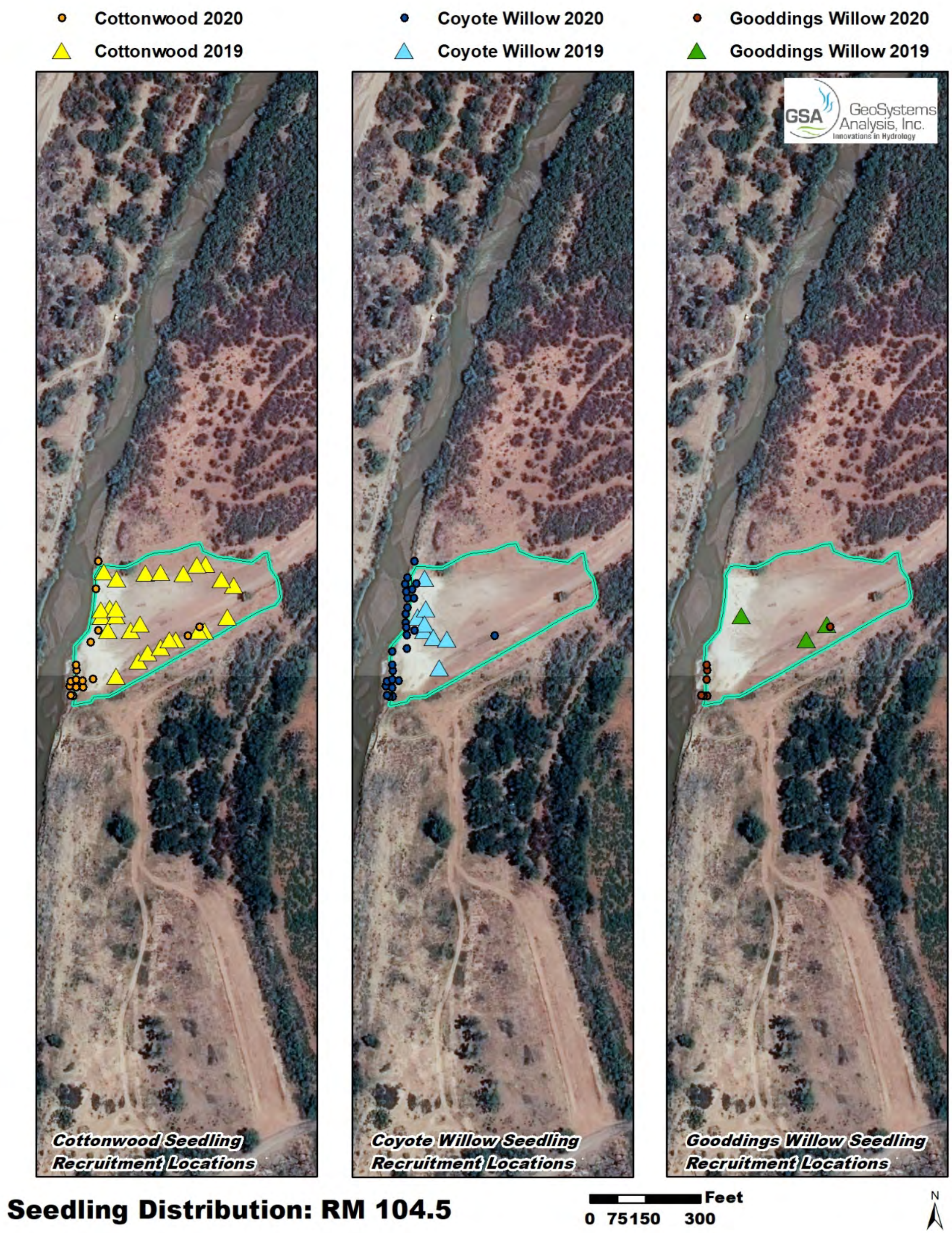


Figure B-3. Distribution of native cottonwood (left), coyote willow (center) and Gooddings willow (right) seedlings recorded in 2019 and 2020 at RM 104.5.

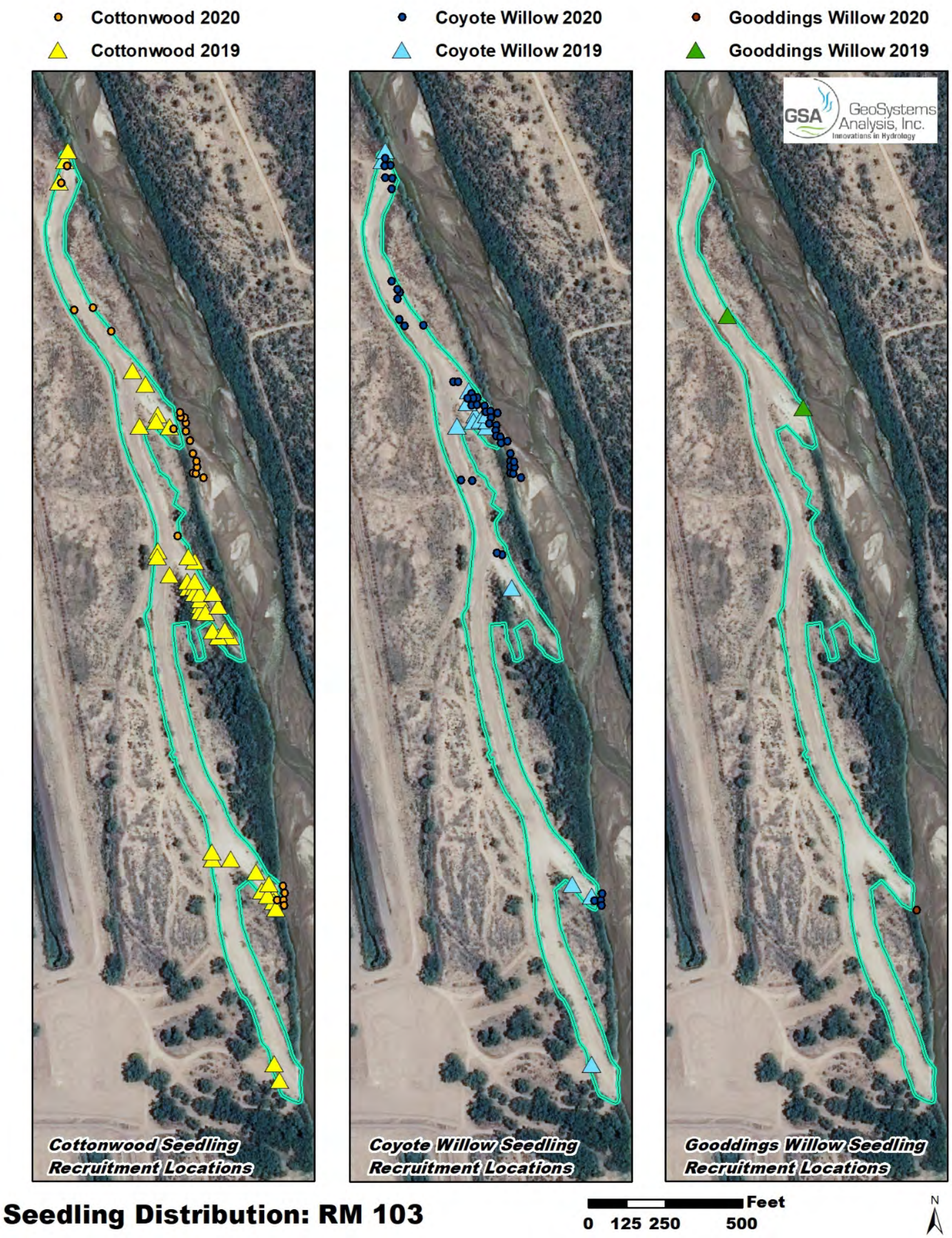


Figure B-4. Distribution of native cottonwood (left), coyote willow (center) and Gooddings willow (right) seedlings recorded in 2019 and 2020 at RM 103.

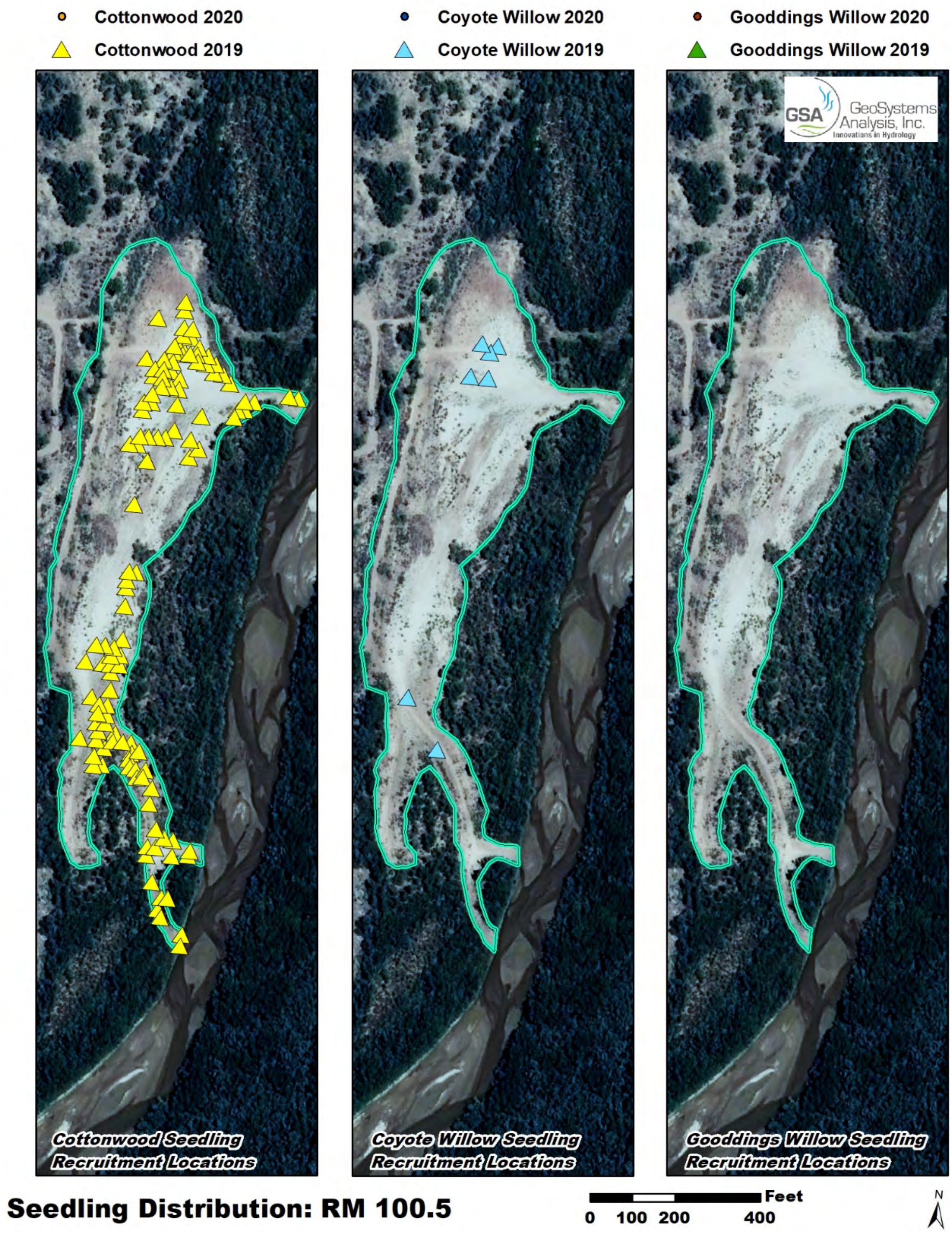


Figure B-5. Distribution of native cottonwood (left), coyote willow (center) and Gooddings willow (right) seedlings recorded in 2019 and 2020 at RM 100.5.

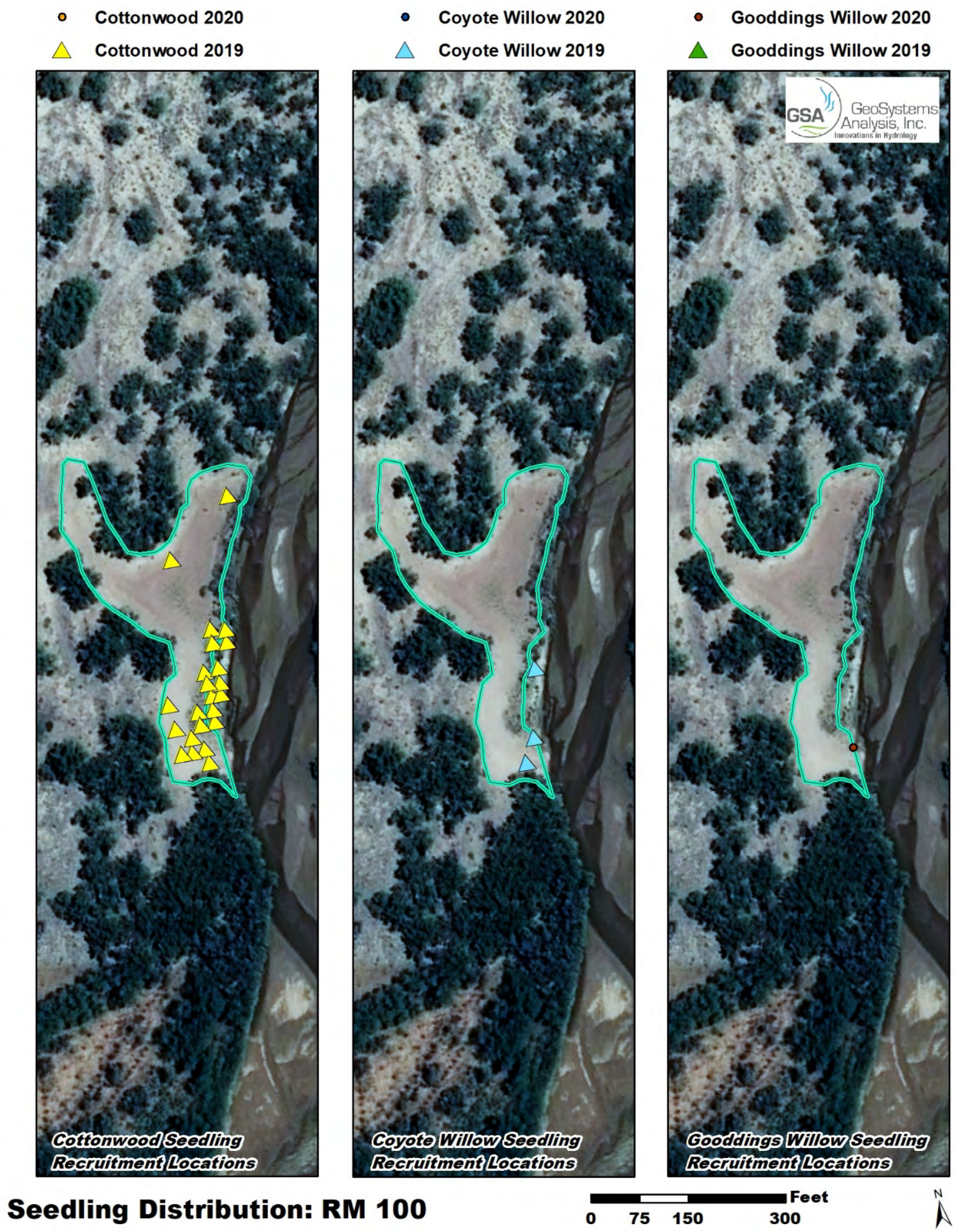


Figure B-6. Distribution of native cottonwood (left), coyote willow (center) and Gooddings willow (right) seedlings recorded in 2019 and 2020 at RM 100.

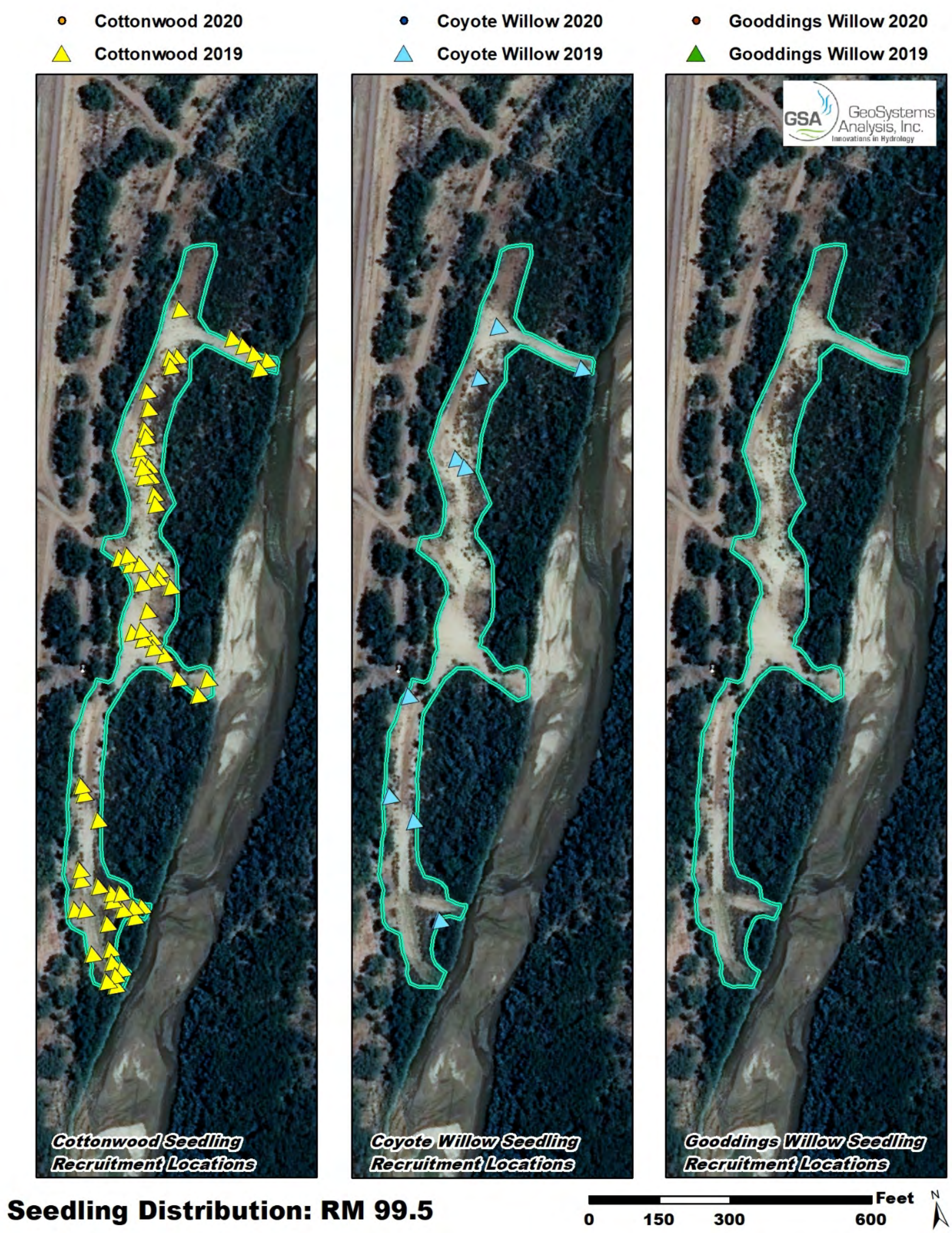


Figure B-7. Distribution of native cottonwood (left), coyote willow (center) and Gooddings willow (right) seedlings recorded in 2019 and 2020 at RM 99.5.

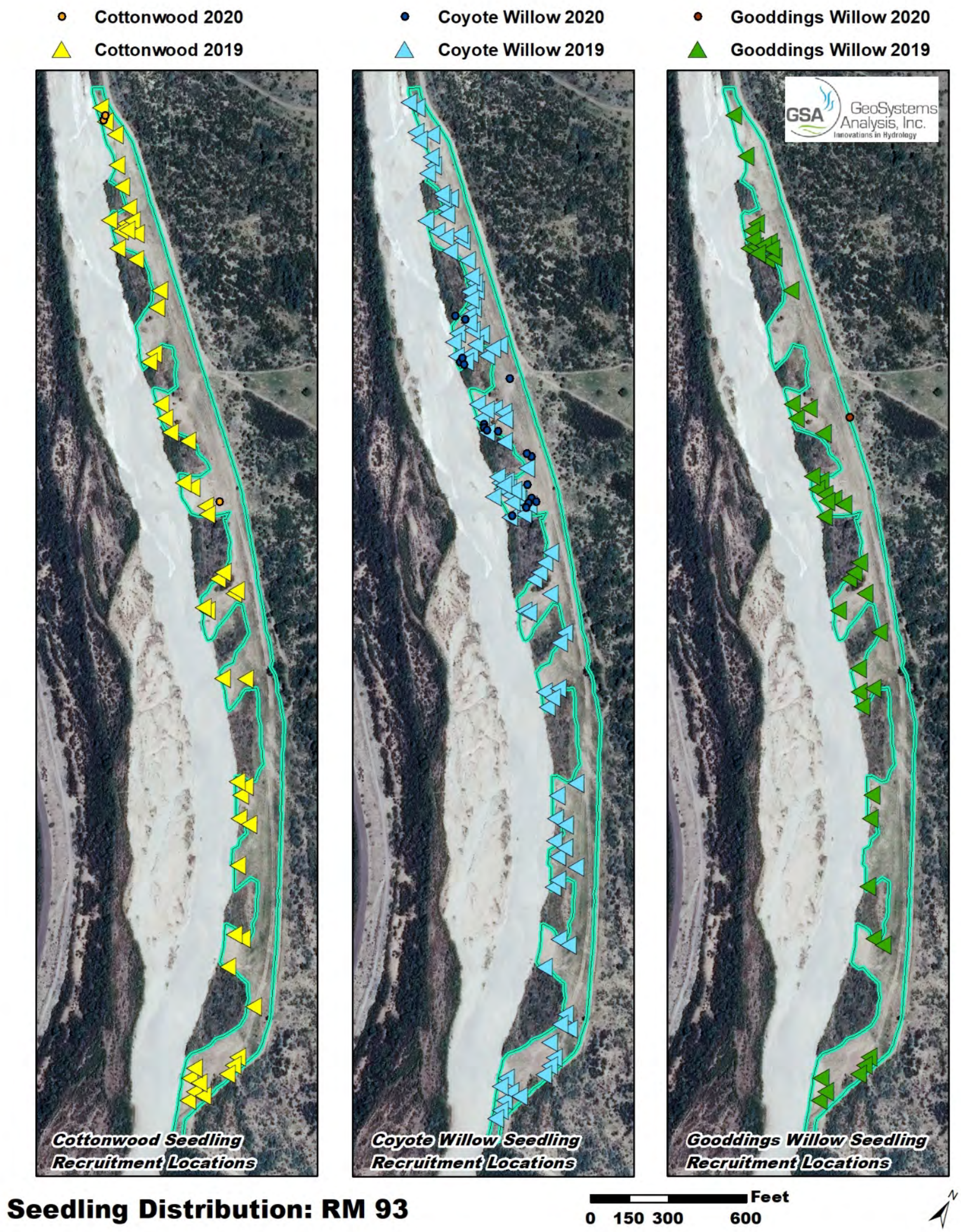


Figure B-8. Distribution of native cottonwood (left), coyote willow (center) and Gooddings willow (right) seedlings recorded in 2019 and 2020 at RM 93.

APPENDIX C –NATIVE WOODY PLANT OCCURRENCES, ALL SIZES

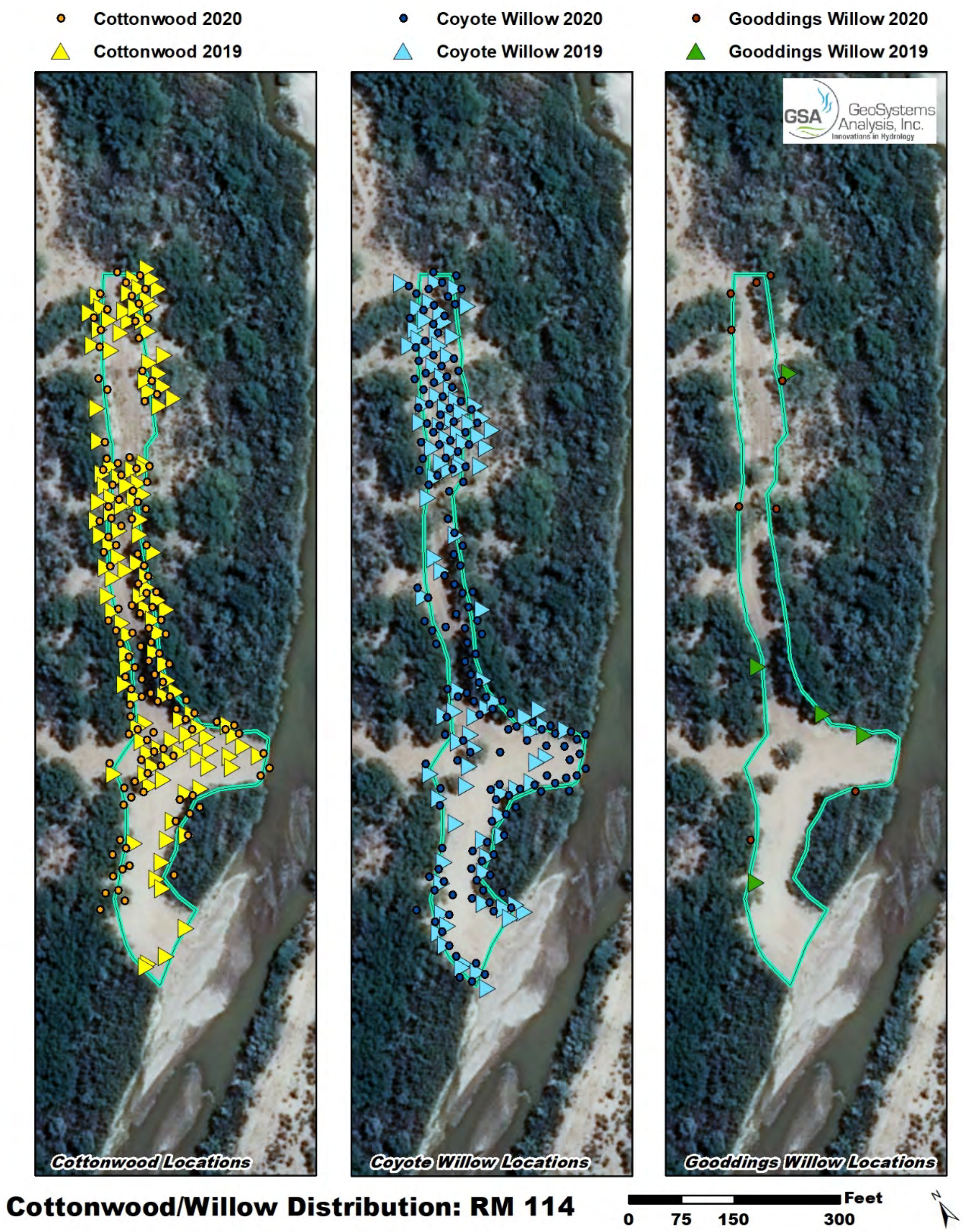


Figure C-1. Distribution of all native cottonwood (left), coyote willow (center) and Gooddings willow (right) plants (seedlings, saplings, poles and mature trees) recorded in 2019 and 2020 at RM 114.

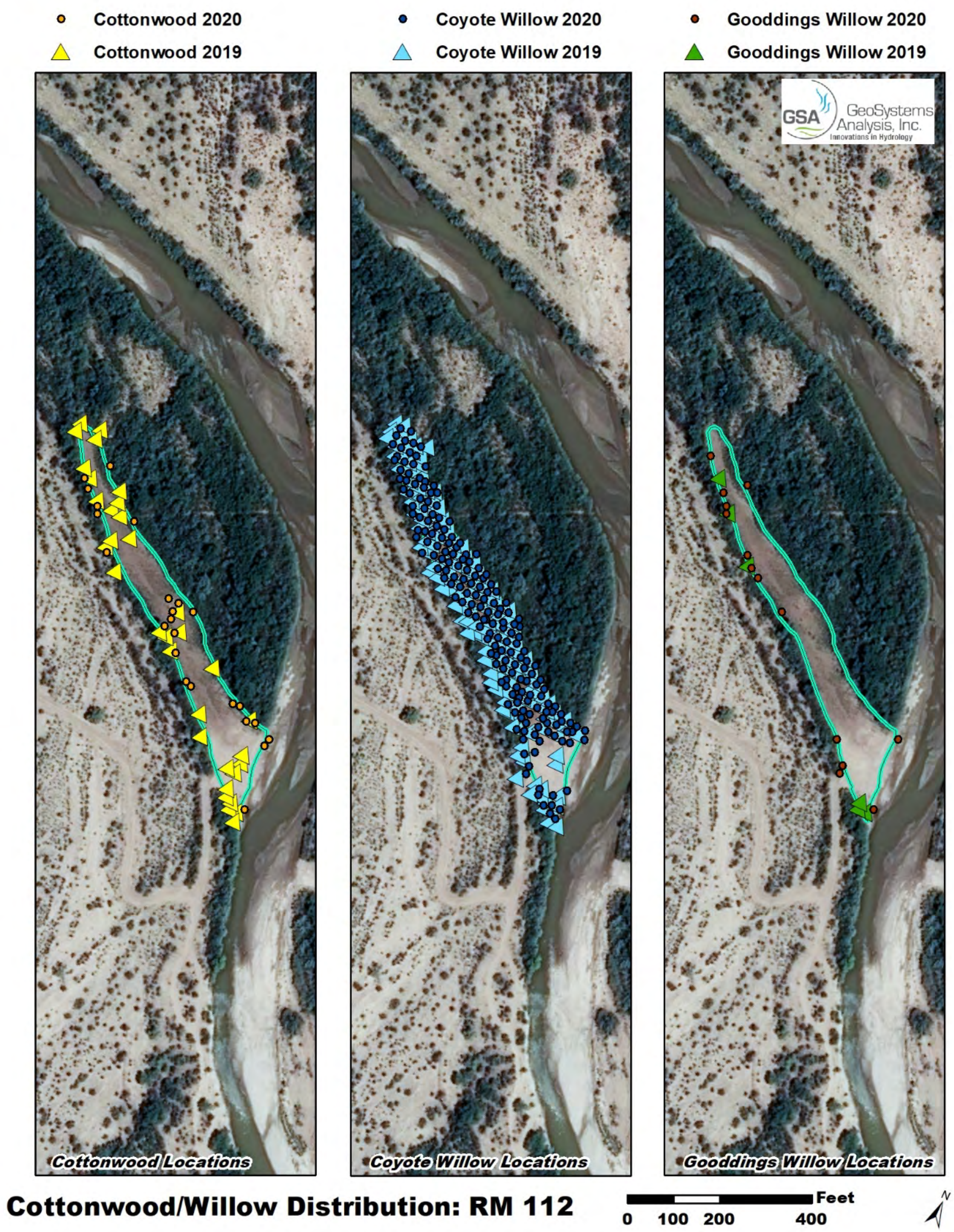


Figure C-2. Distribution of all native cottonwood (left), coyote willow (center) and Gooddings willow (right) plants (seedlings, saplings, poles and mature trees) recorded in 2019 and 2020 at RM 112.

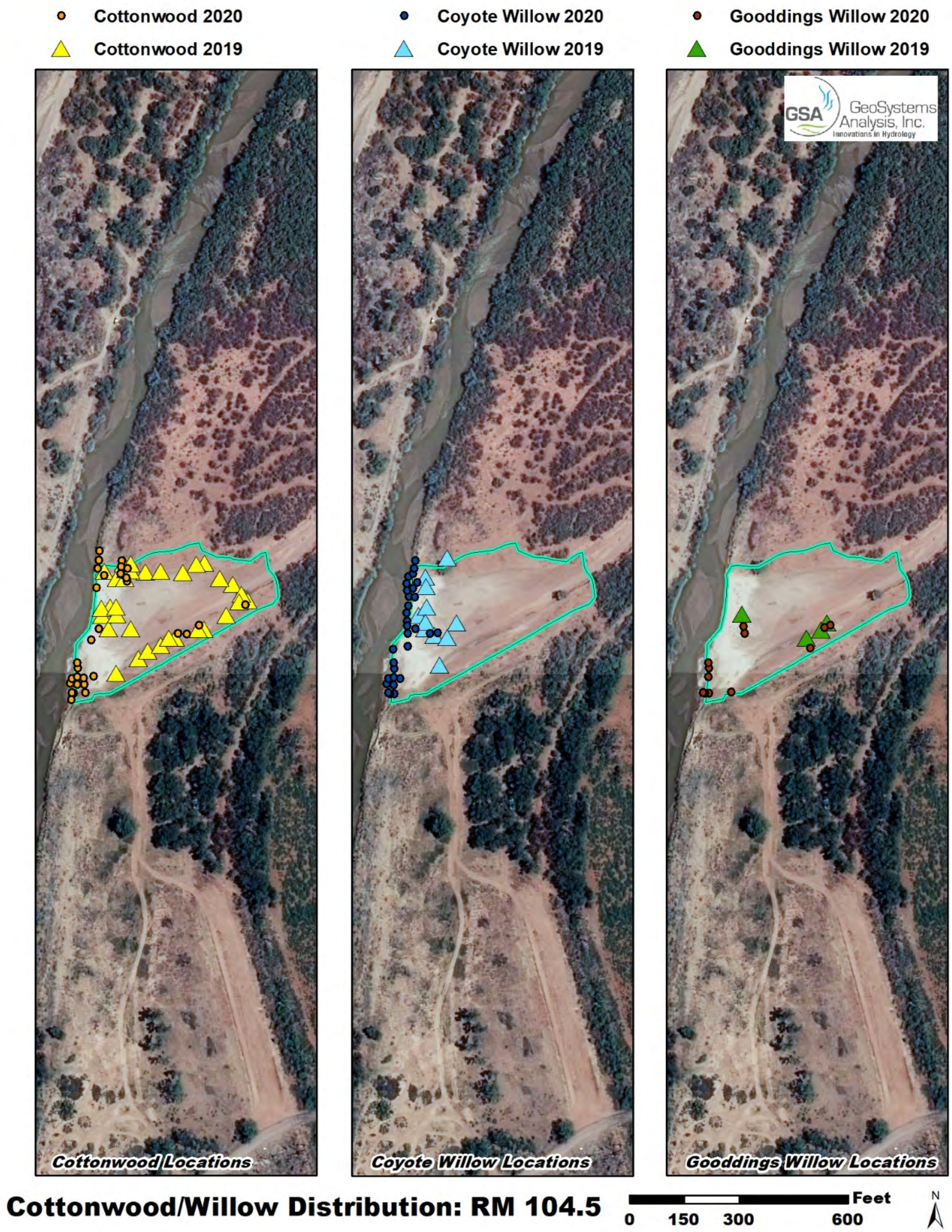


Figure C-3. Distribution of all native cottonwood (left), coyote willow (center) and Gooddings willow (right) plants (seedlings, saplings, poles and mature trees) recorded in 2019 and 2020 at RM 104.5.

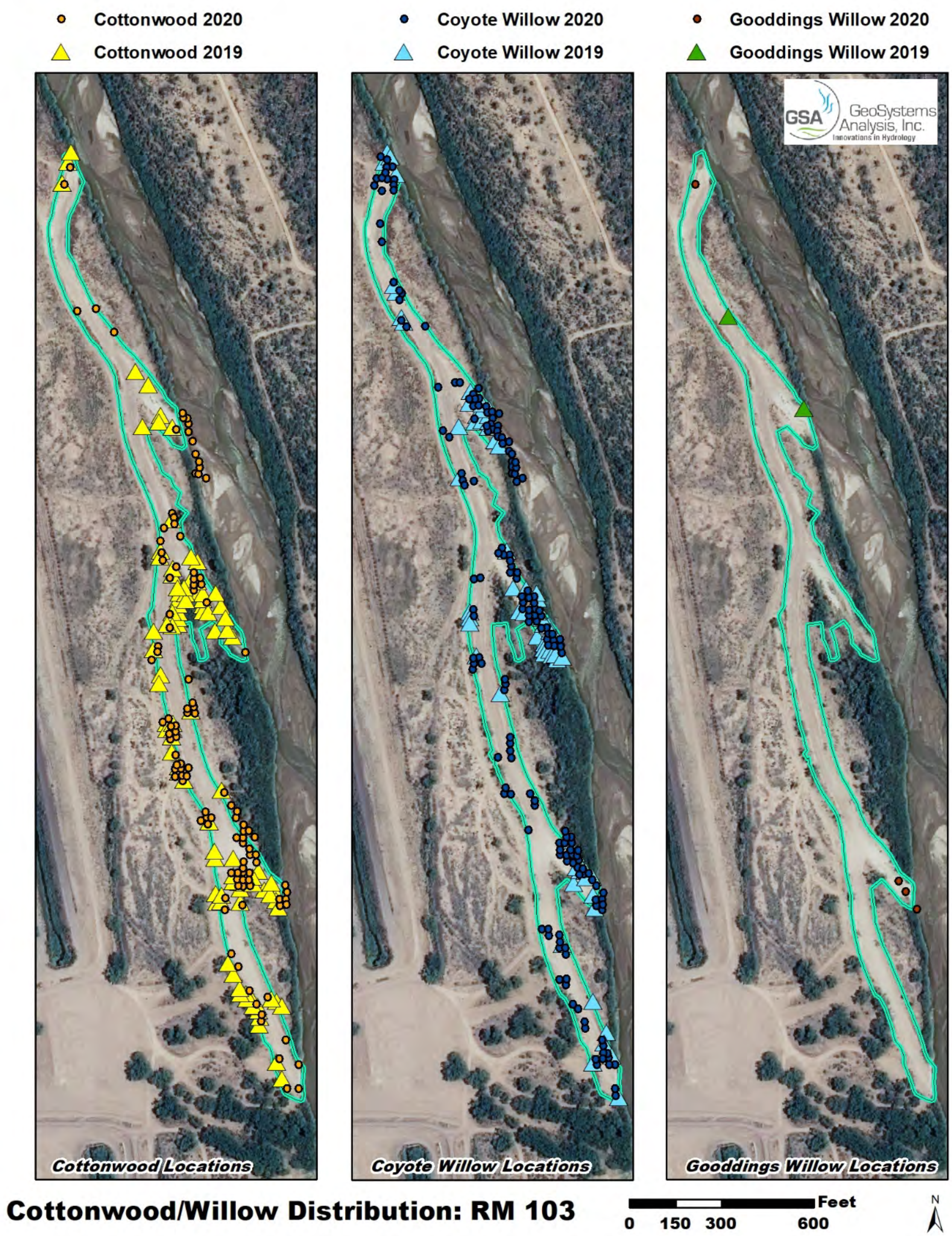


Figure C-4. Distribution of all native cottonwood (left), coyote willow (center) and Gooddings willow (right) plants (seedlings, saplings, poles and mature trees) recorded in 2019 and 2020 at RM 103.

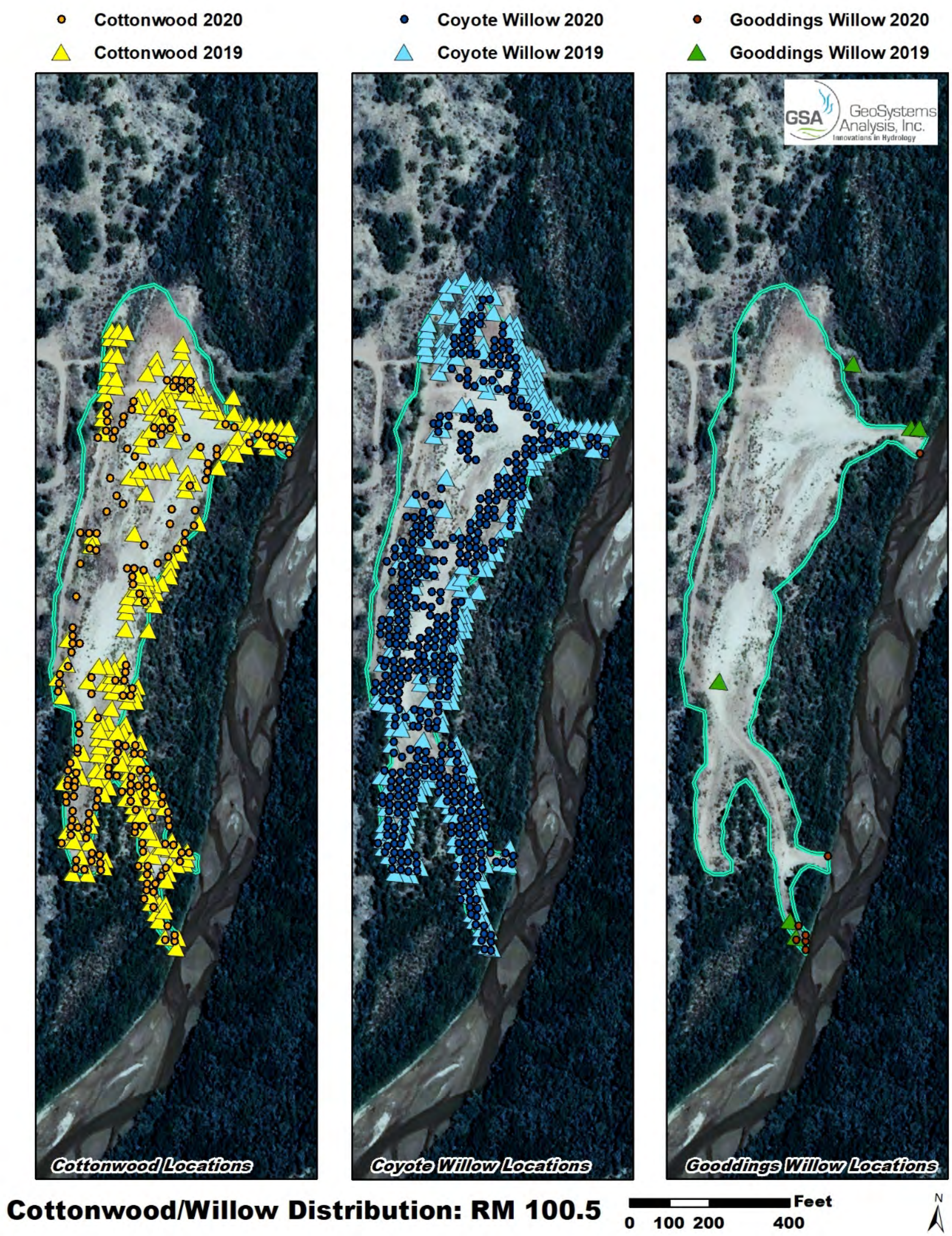


Figure C-5. Distribution of all native cottonwood (left), coyote willow (center) and Gooddings willow (right) plants (seedlings, saplings, poles and mature trees) recorded in 2019 and 2020 at RM 100.5.

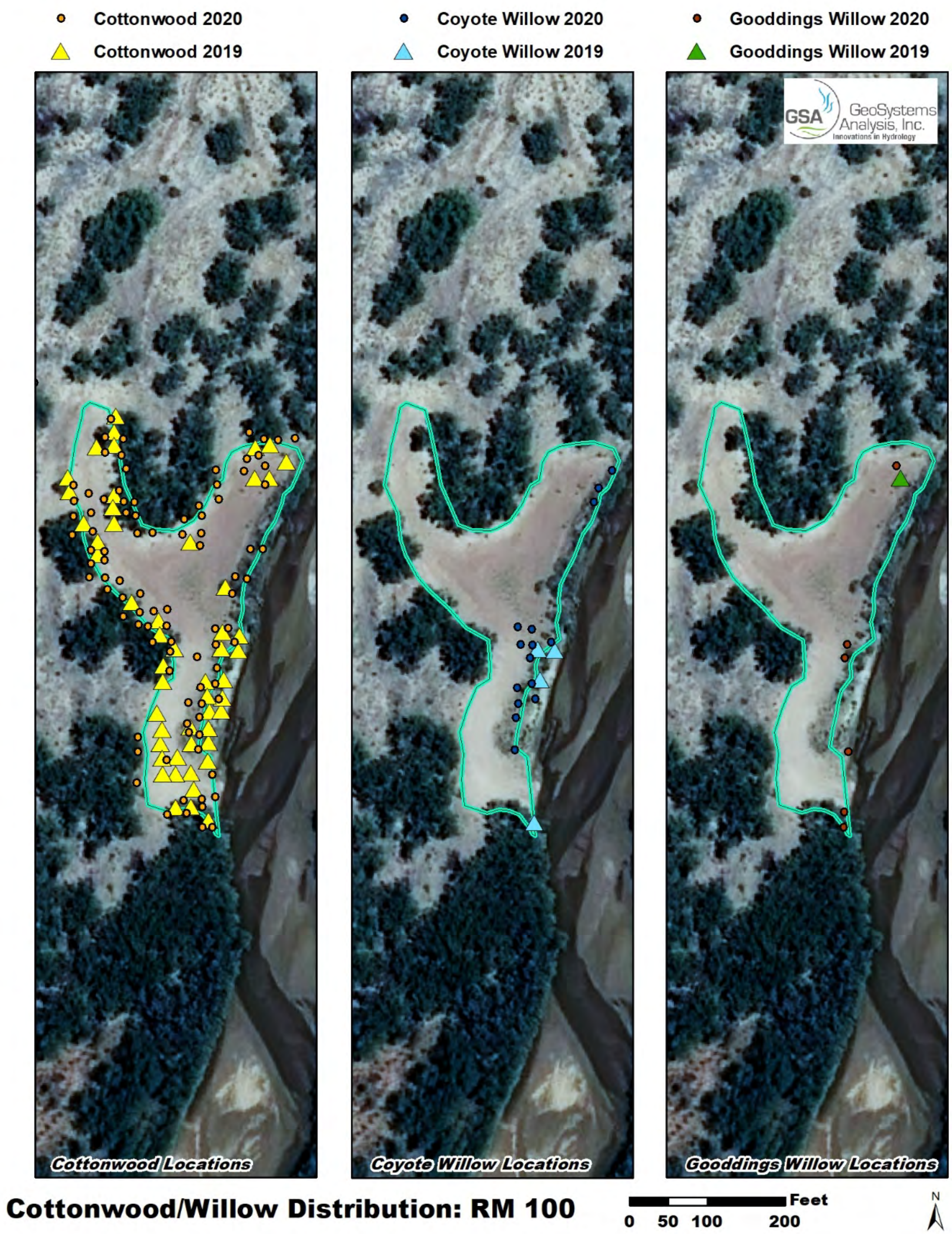


Figure C-6. Distribution of all native cottonwood (left), coyote willow (center) and Gooddings willow (right) plants (seedlings, saplings, poles and mature trees) recorded in 2019 and 2020 at RM 100.

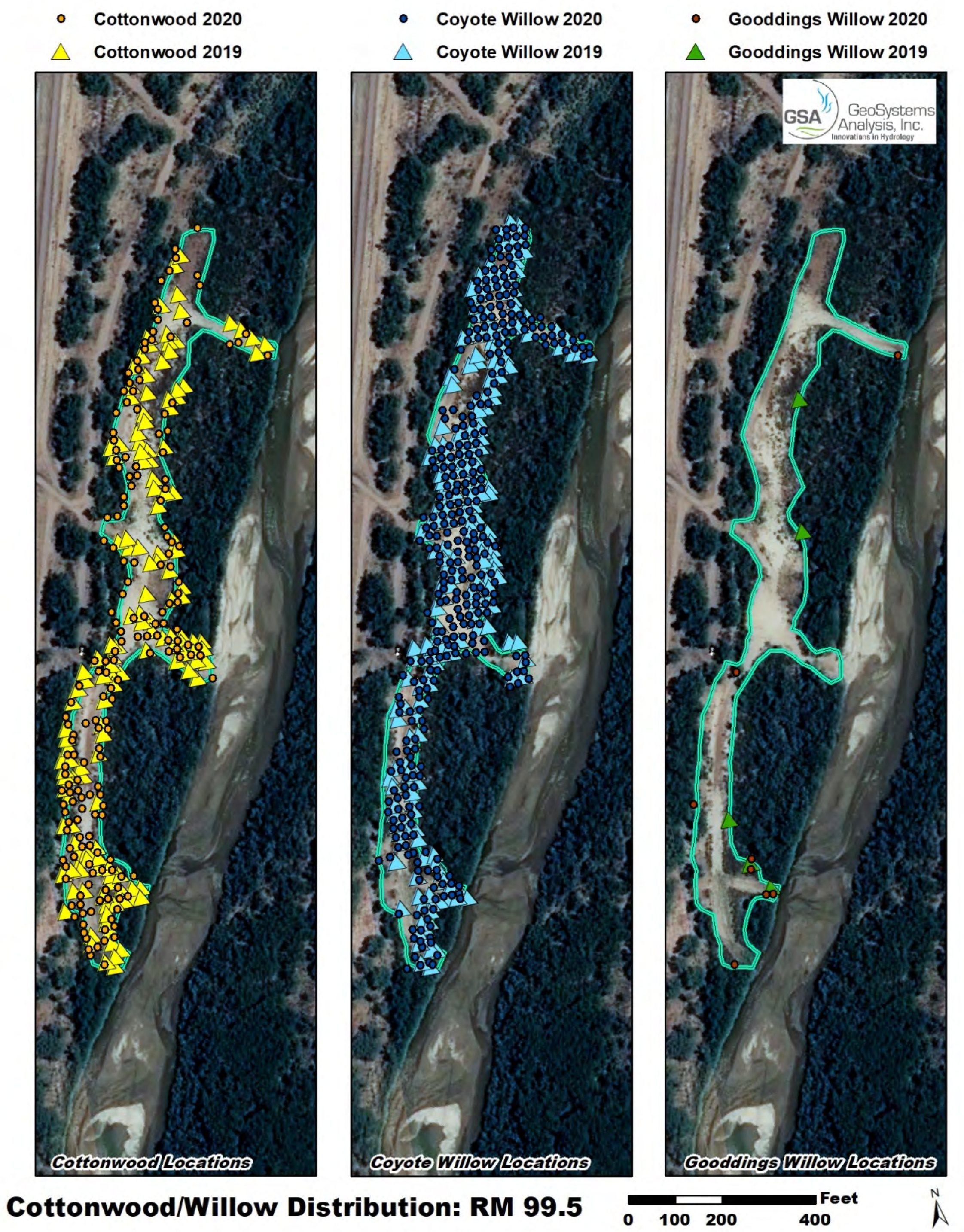


Figure C-7. Distribution of all native cottonwood (left), coyote willow (center) and Gooddings willow (right) plants (seedlings, saplings, poles and mature trees) recorded in 2019 and 2020 at RM 99.5.

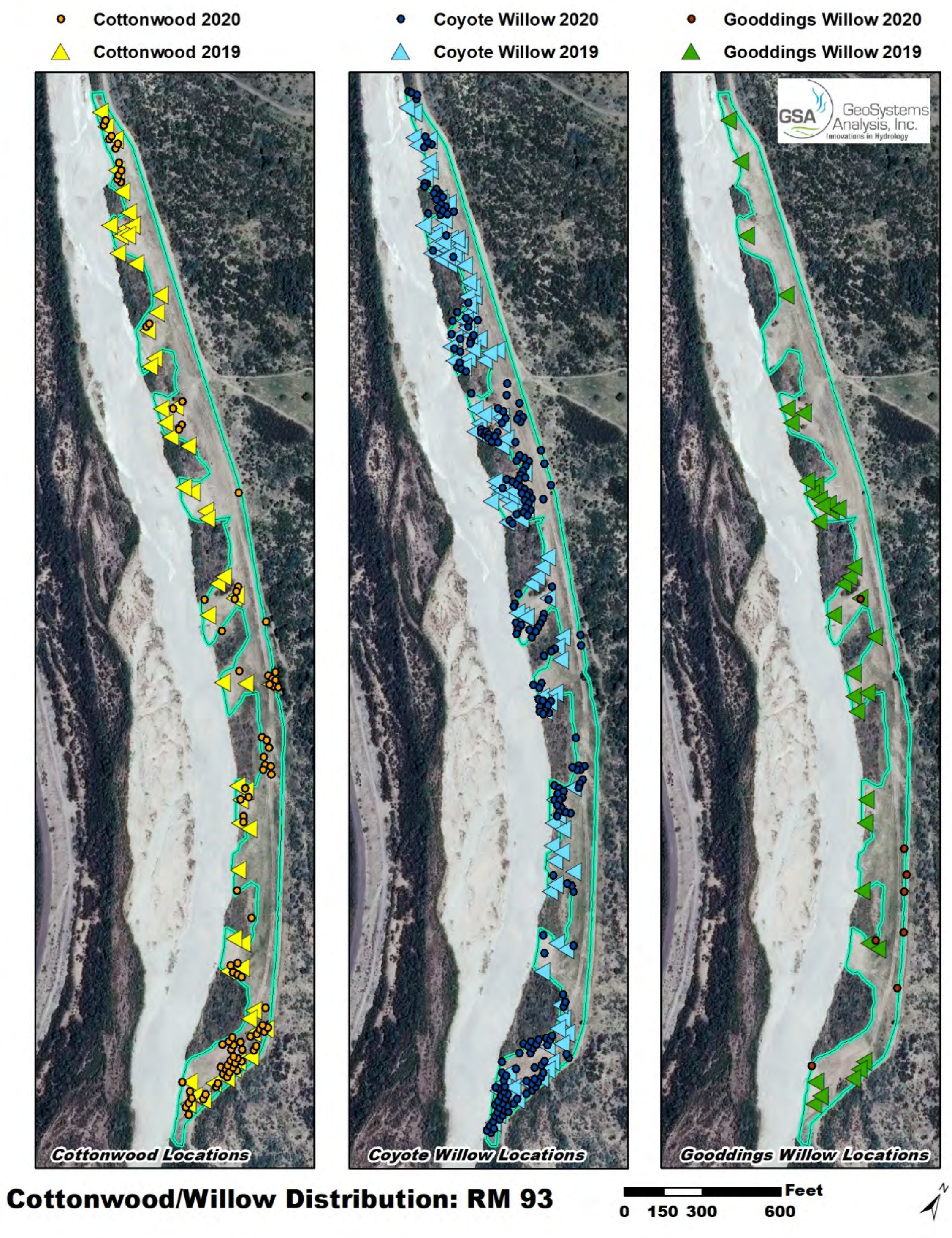


Figure C-8. Distribution of all native cottonwood (left), coyote willow (center) and Gooddings willow (right) plants (seedlings, saplings, poles and mature trees) recorded in 2019 and 2020 at RM 93.

APPENDIX D – NON-NATIVE WOODY PLANT OCCURRENCES

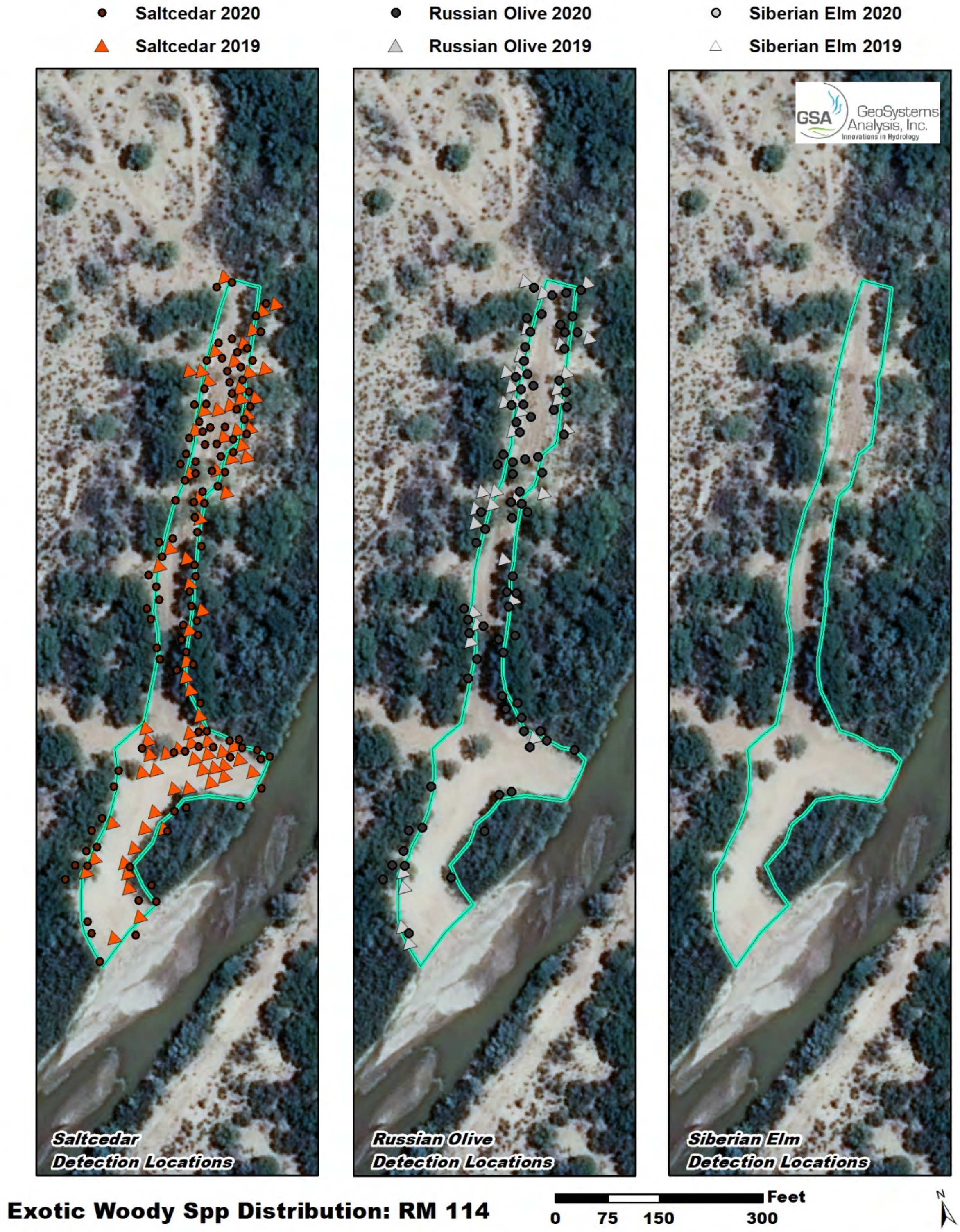


Figure D-1. Distribution of non-native saltcedar (left), Russian olive (center) and Siberian elm (right) plants recorded in 2019 and 2020 at RM 114.

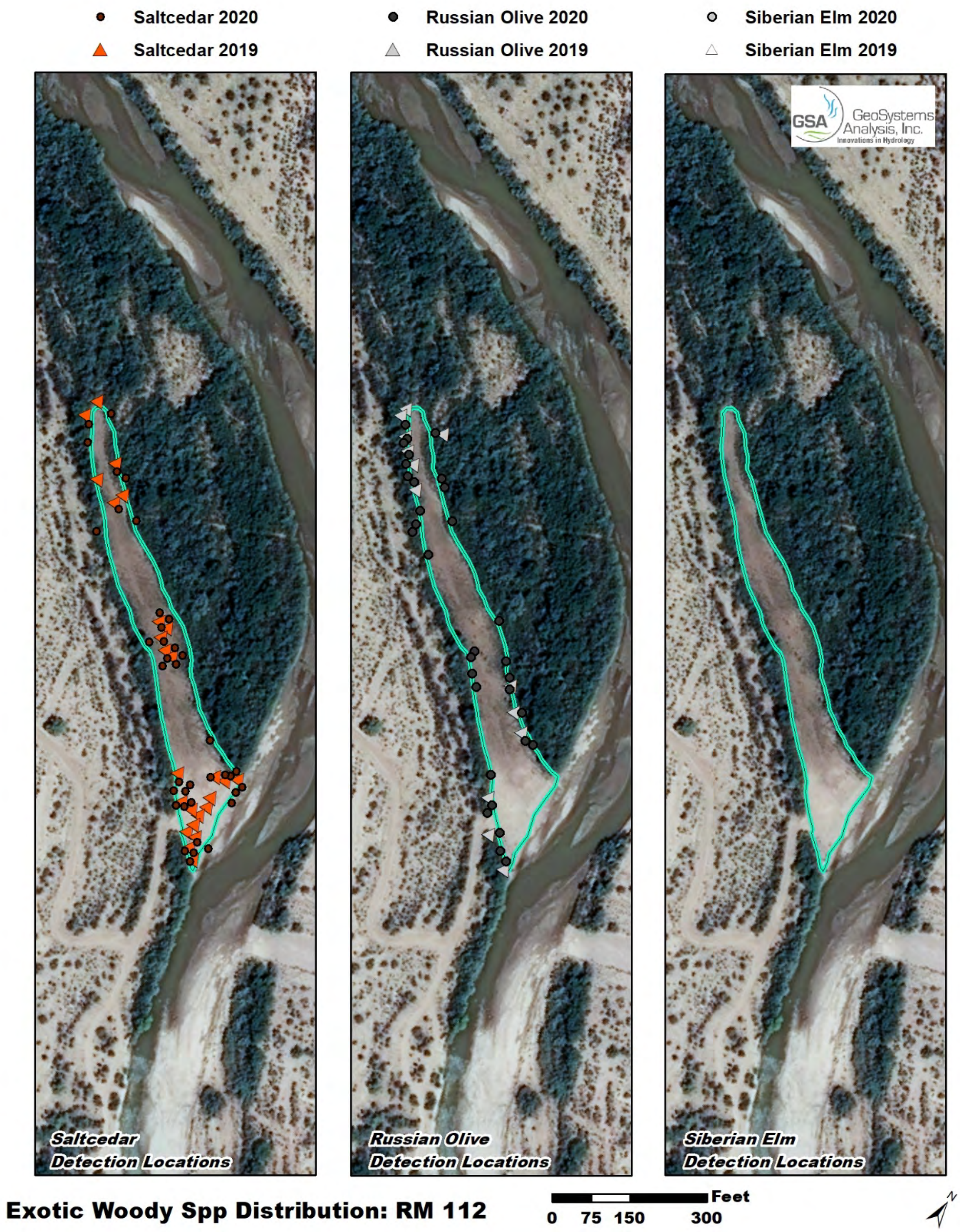


Figure D-2. Distribution of non-native saltcedar (left), Russian olive (center) and Siberian elm (right) plants recorded in 2019 and 2020 at RM 112.

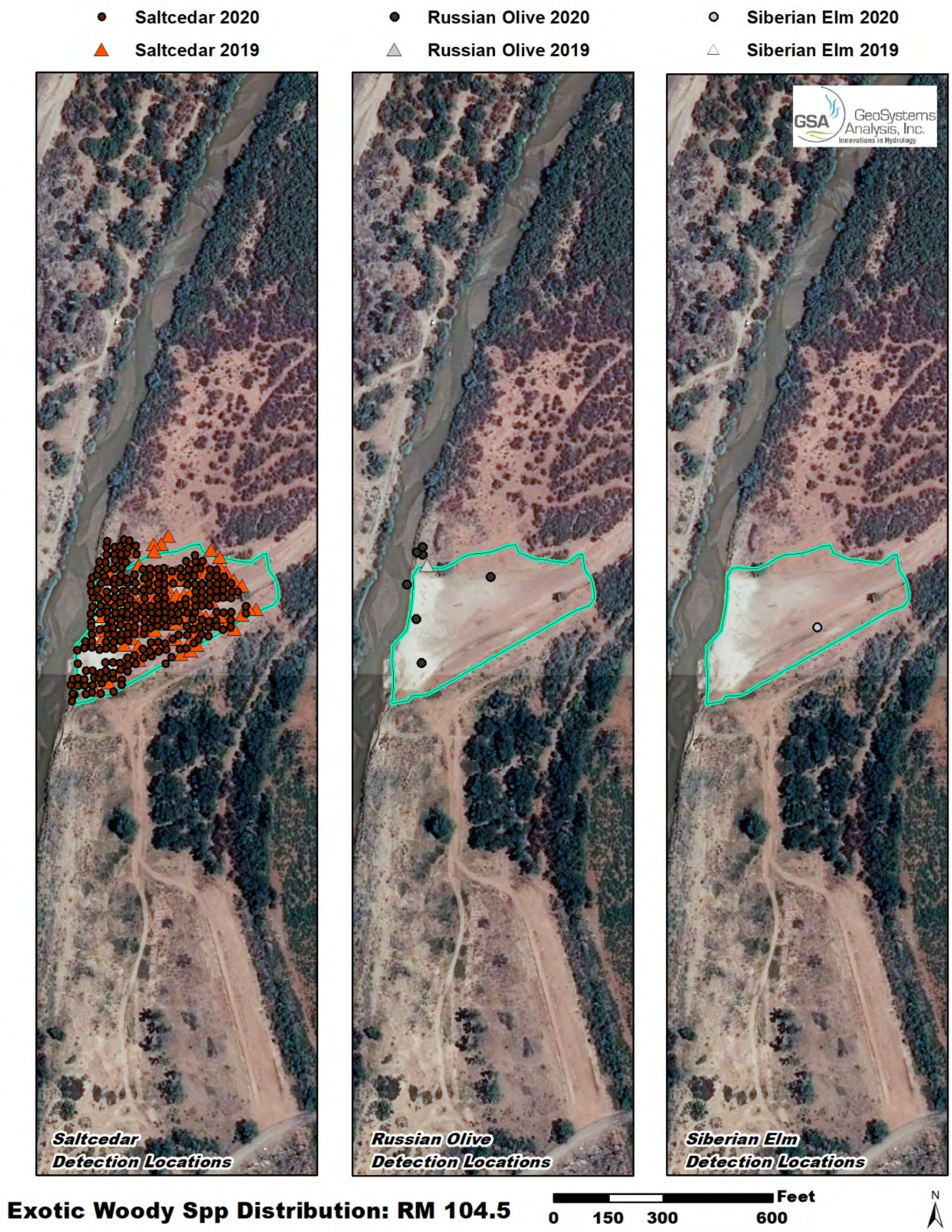


Figure D-3. Distribution of non-native saltcedar (left), Russian olive (center) and Siberian elm (right) plants recorded in 2019 and 2020 at RM 104.5.

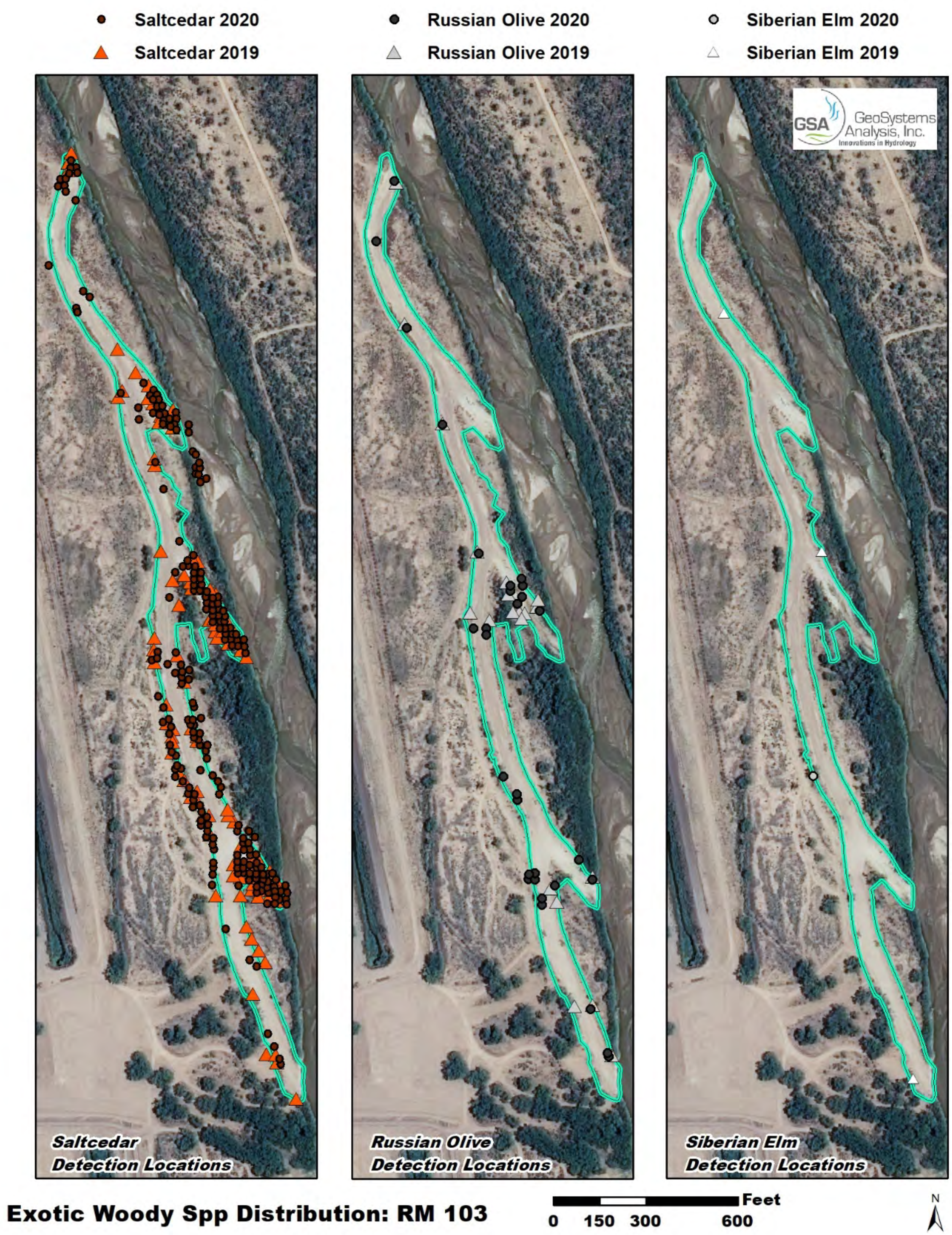


Figure D-4. Distribution of non-native saltcedar (left), Russian olive (center) and Siberian elm (right) plants recorded in 2019 and 2020 at RM 103.

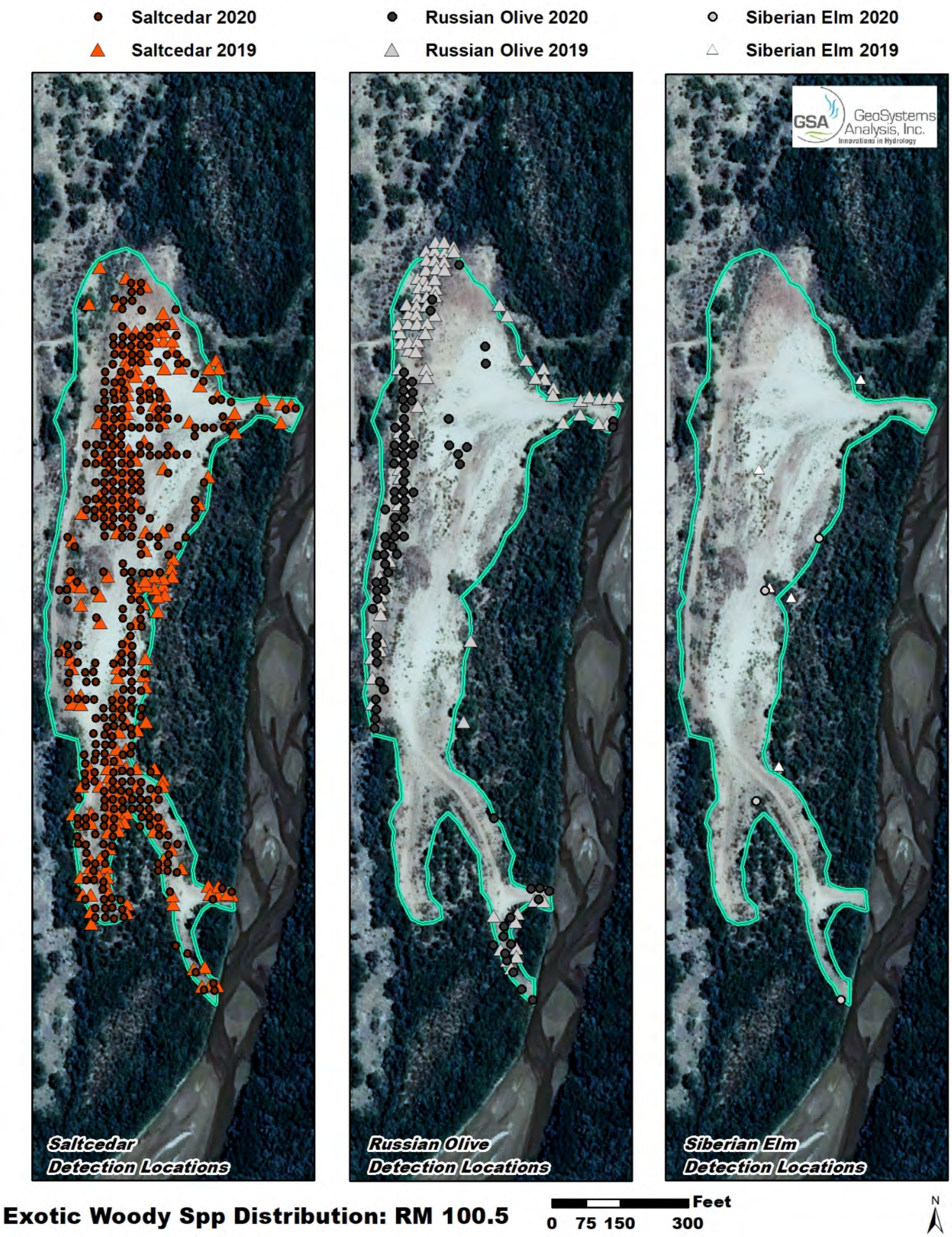


Figure D-5. Distribution of non-native saltcedar (left), Russian olive (center) and Siberian elm (right) plants recorded in 2019 and 2020 at RM 100.5.

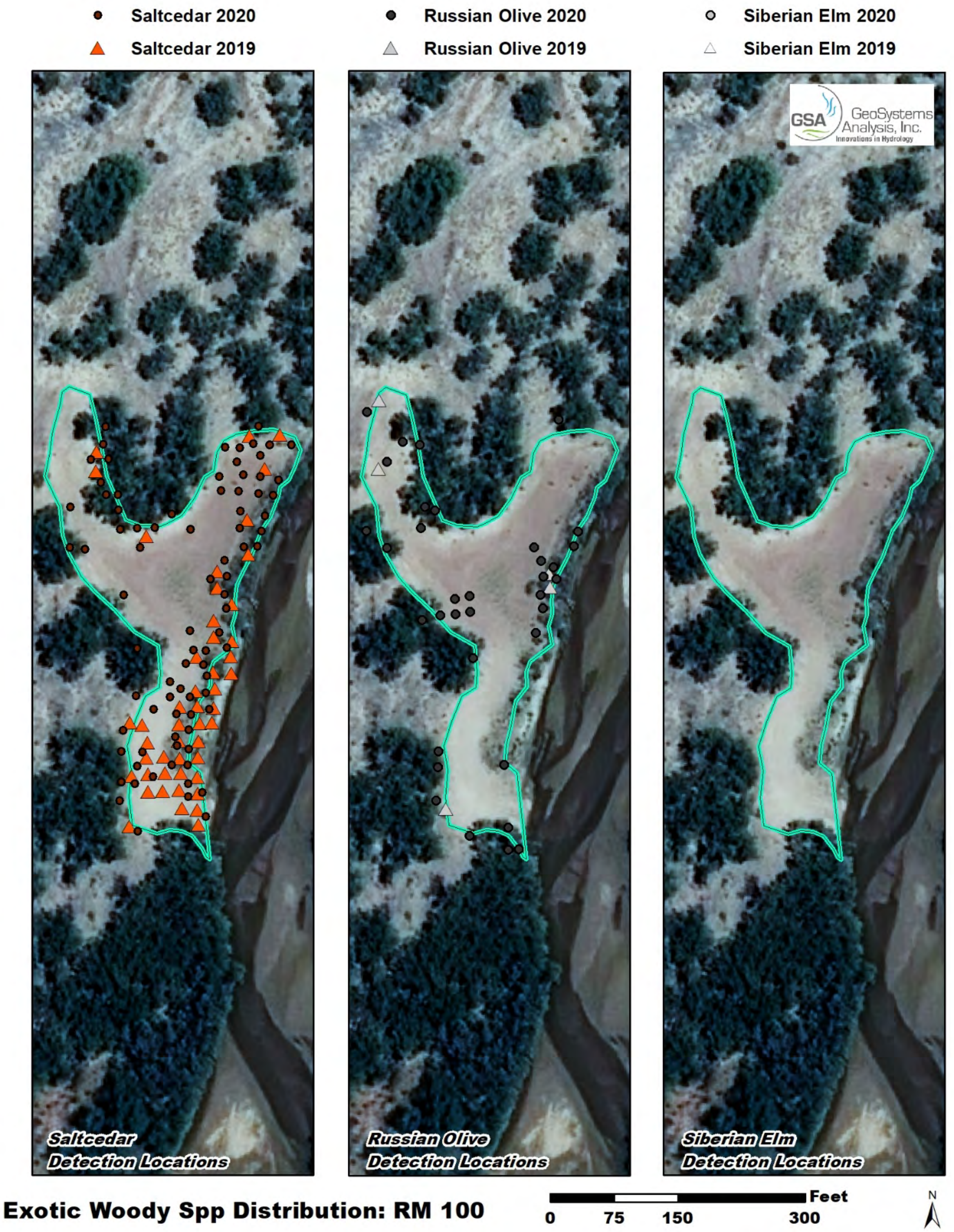


Figure D-6. Distribution of non-native saltcedar (left), Russian olive (center) and Siberian elm (right) plants recorded in 2019 and 2020 at RM 100.

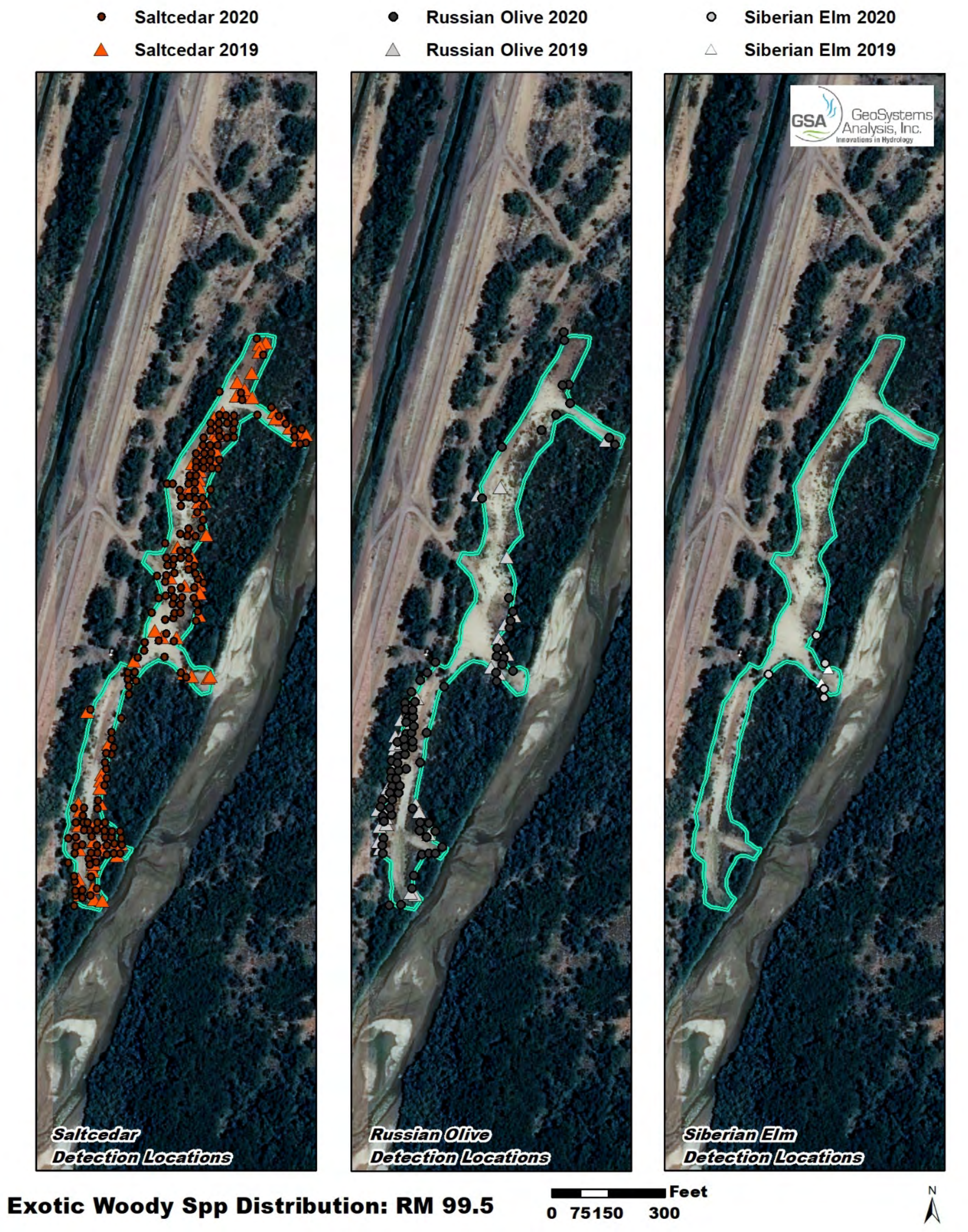


Figure D-7. Distribution of non-native saltcedar (left), Russian olive (center) and Siberian elm (right) plants recorded in 2019 and 2020 at RM 99.5.

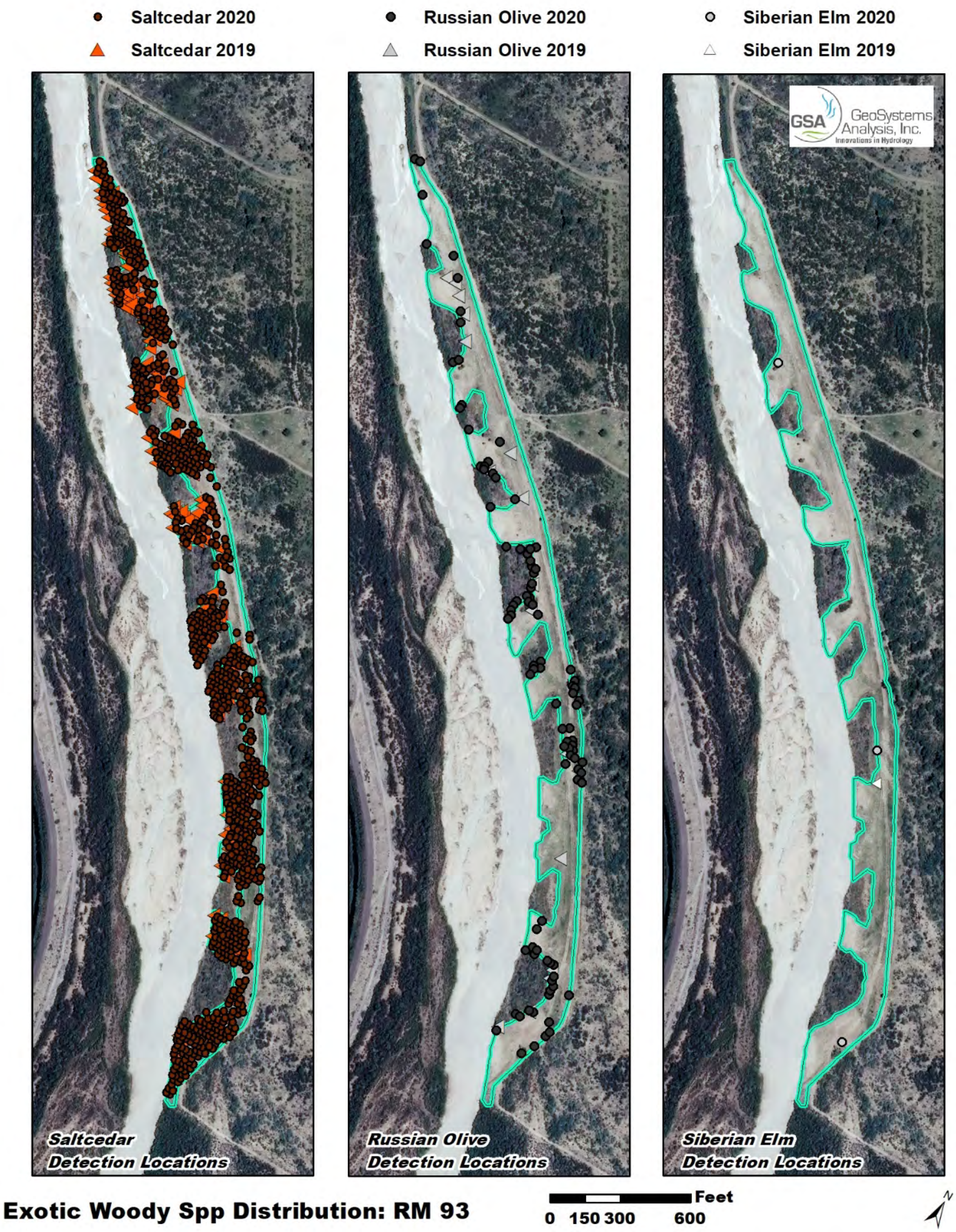


Figure D-8. Distribution of non-native saltcedar (left), Russian olive (center) and Siberian elm (right) plants recorded in 2019 and 2020 at RM 93.

APPENDIX E – 2020 SEDIMENT CLEANOUT AND SPOIL LOCATIONS

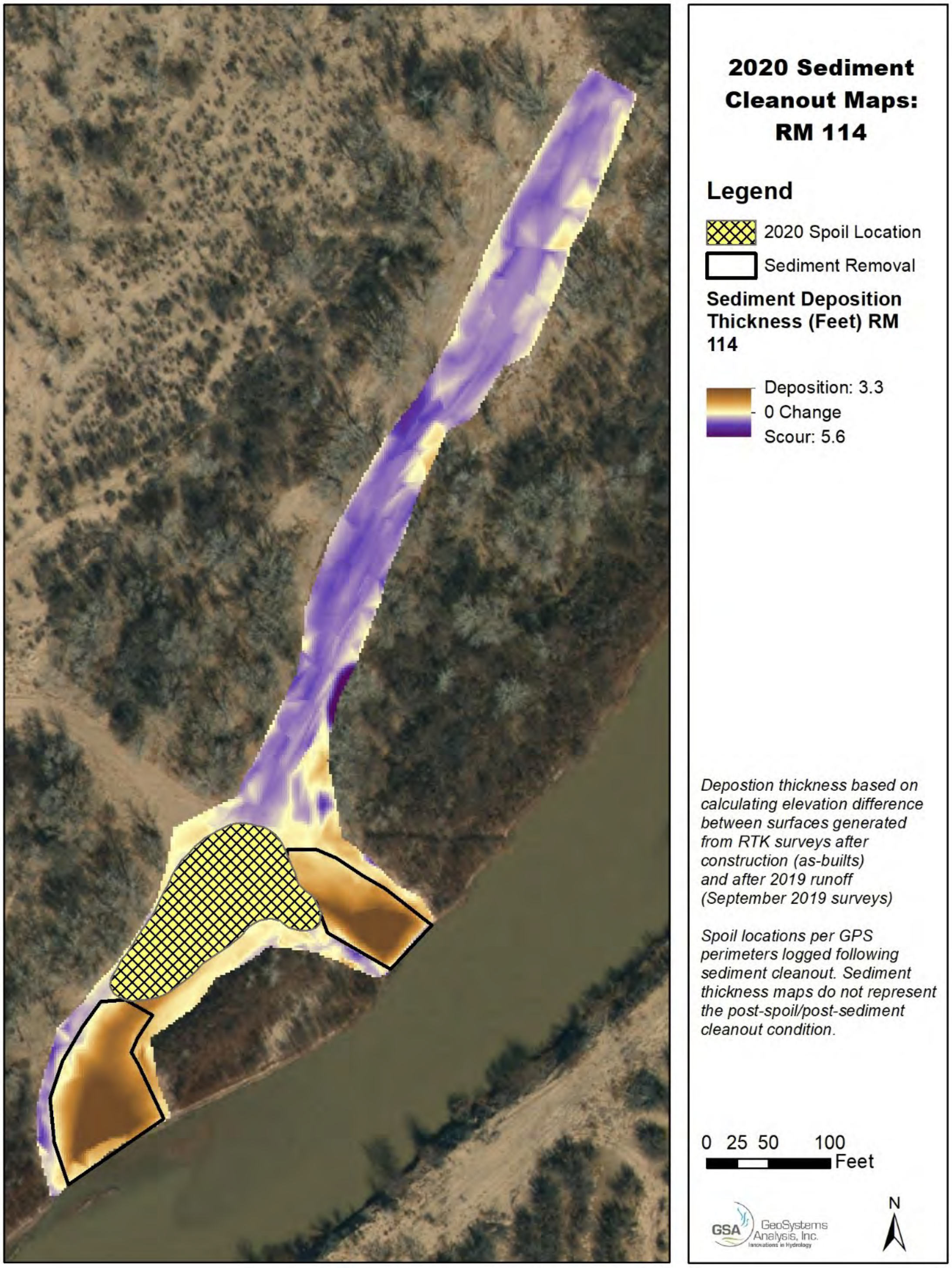


Figure E-1. Map showing locations where sediment cleanout and spoiling occured at the RM 114 site during 2020.

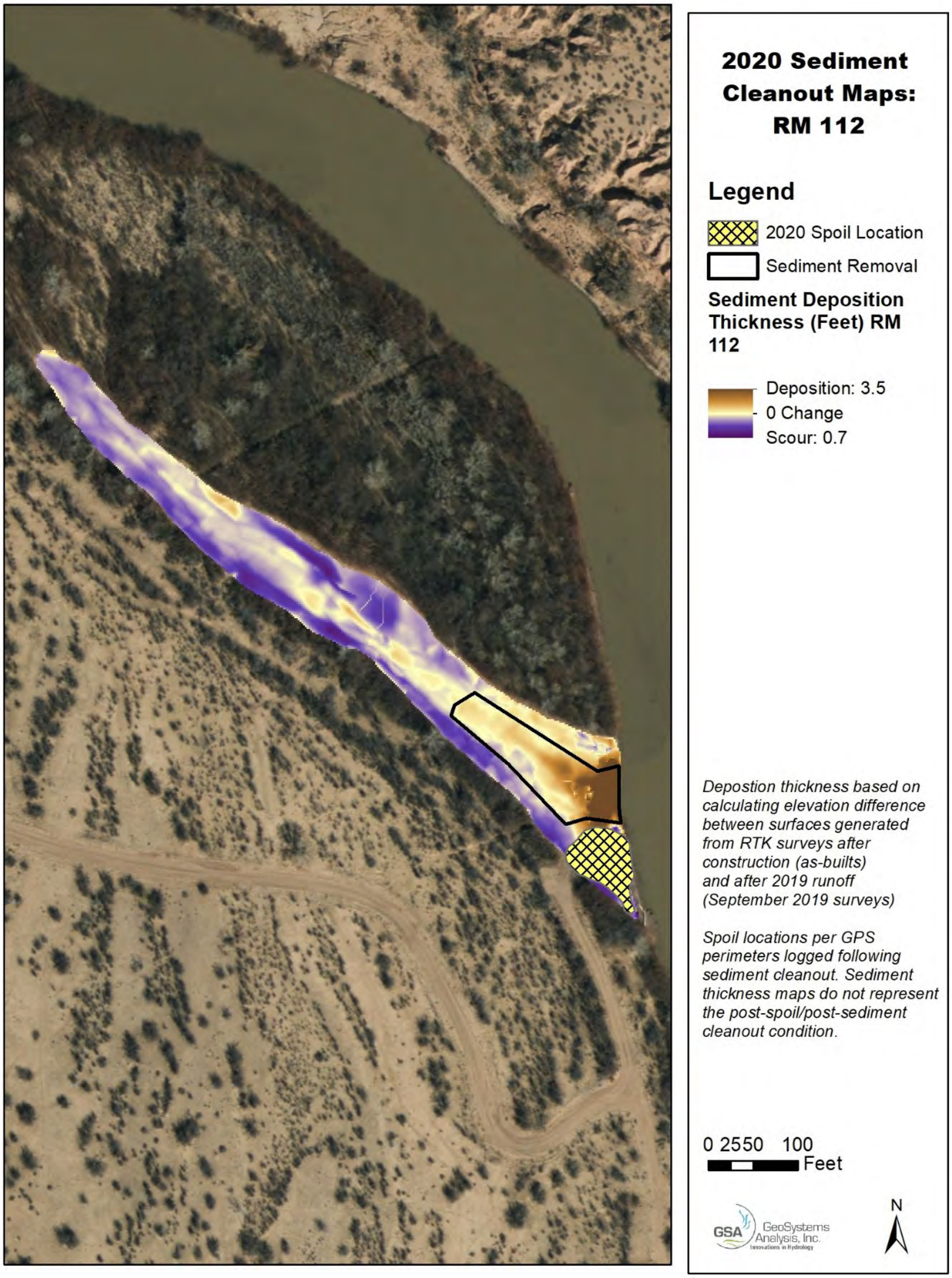


Figure E-2. Map showing locations where sediment cleanout and spoiling occured at the RM 112 site during 2020.

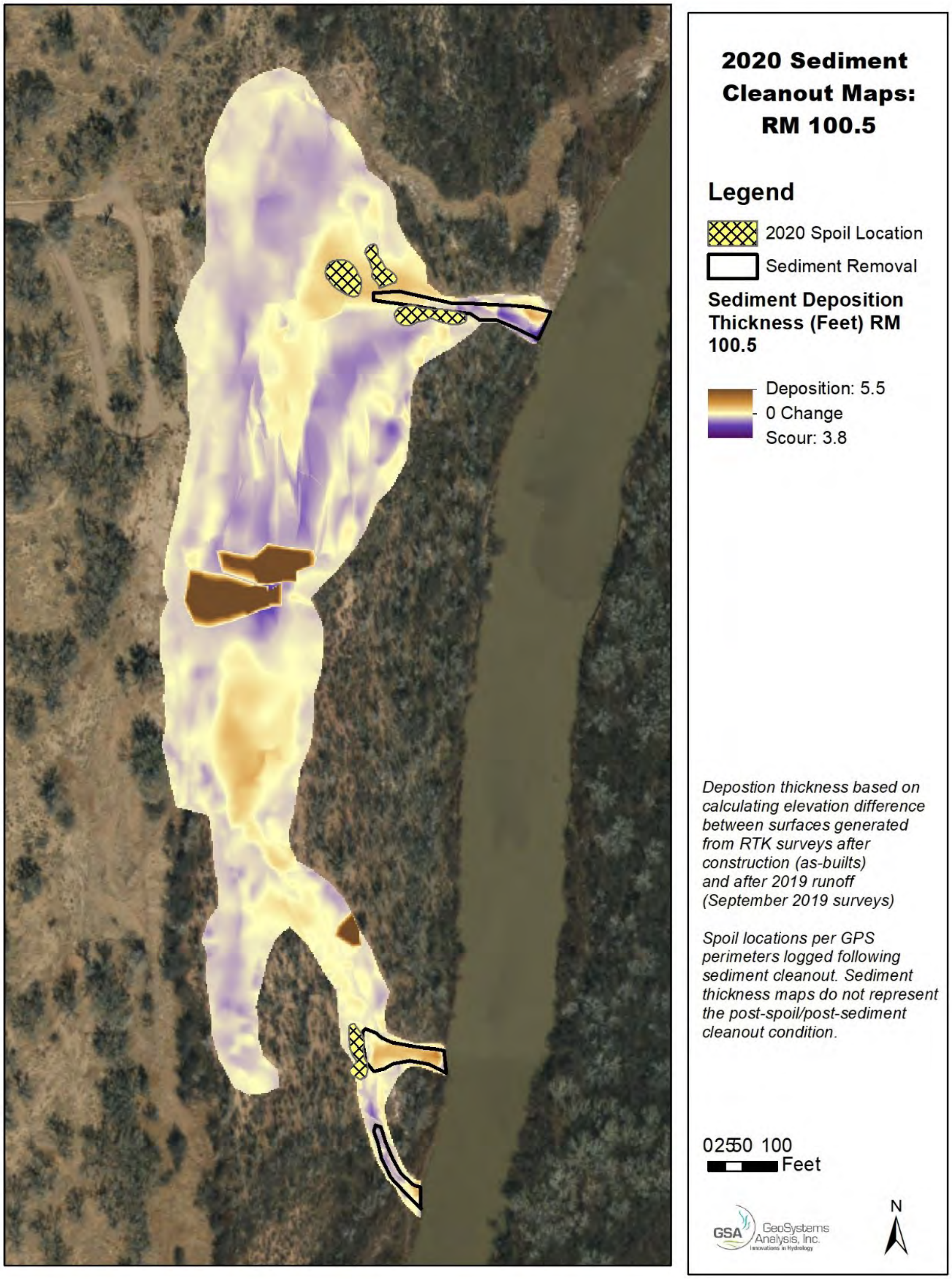


Figure E-3. Map showing locations where sediment cleanout and spoiling occurred at the RM 100.5 site during 2020.

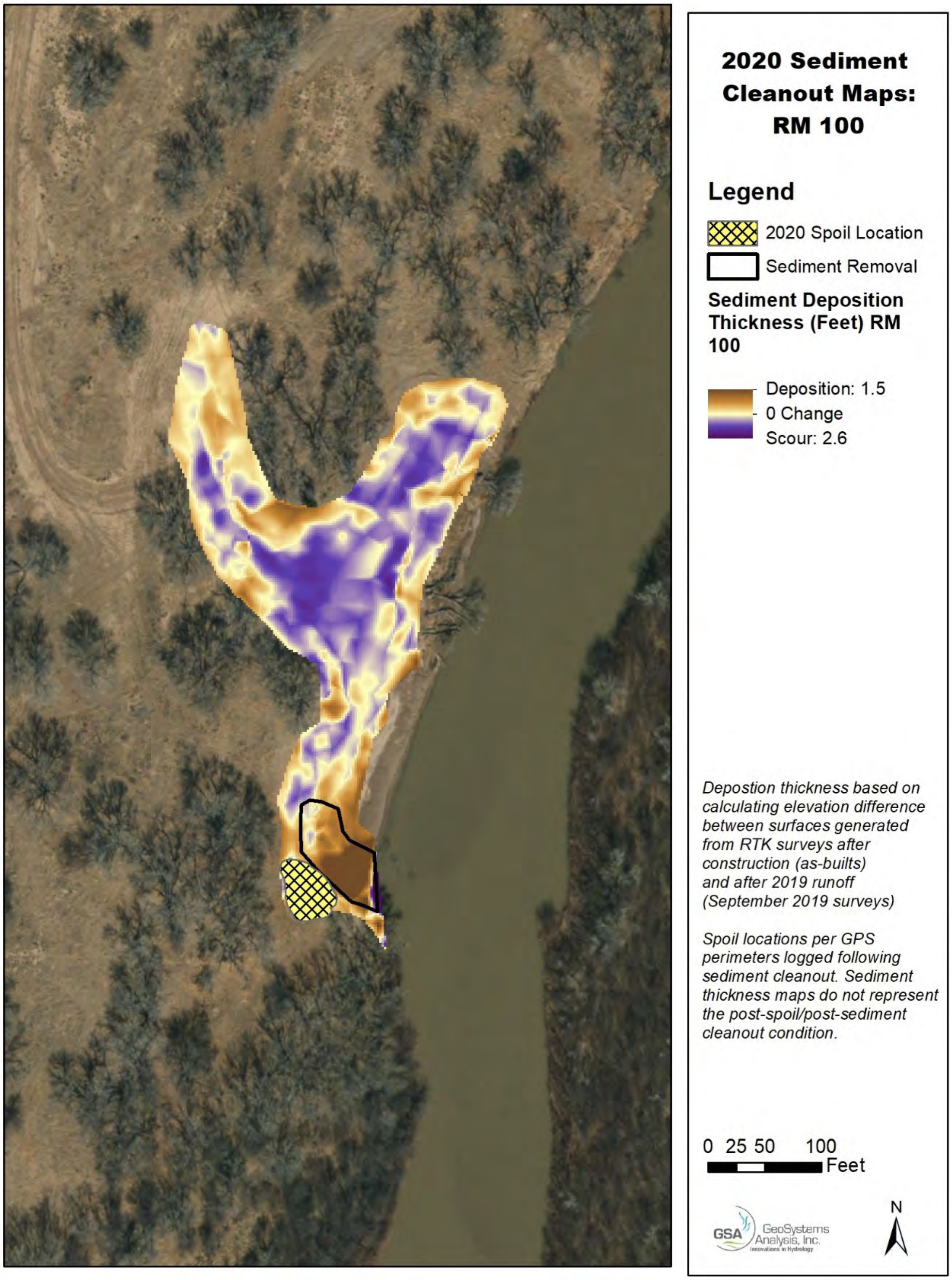


Figure E-4. Map showing locations where sediment cleanout and spoiling occurred at the RM 100 site during 2020.

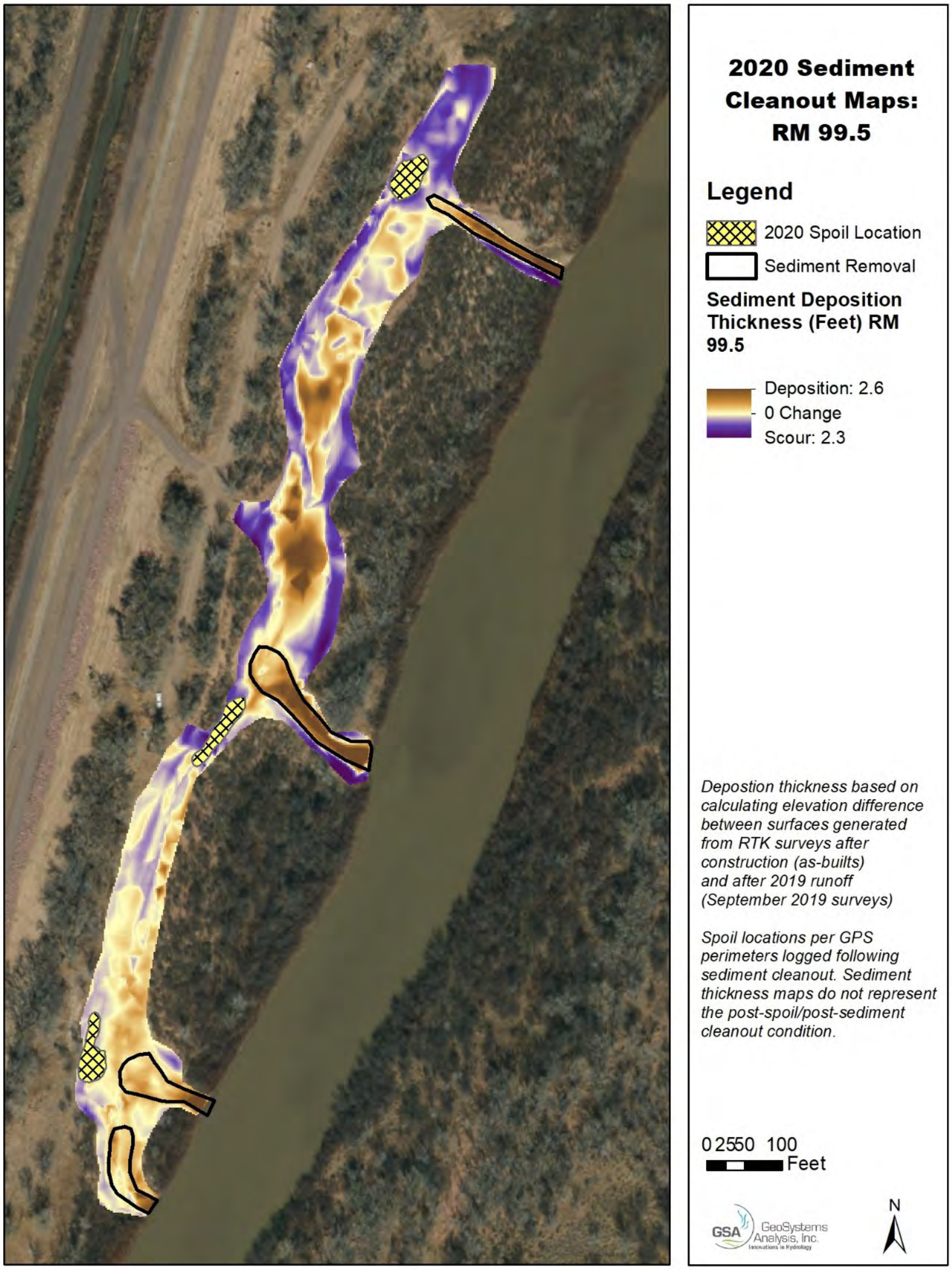
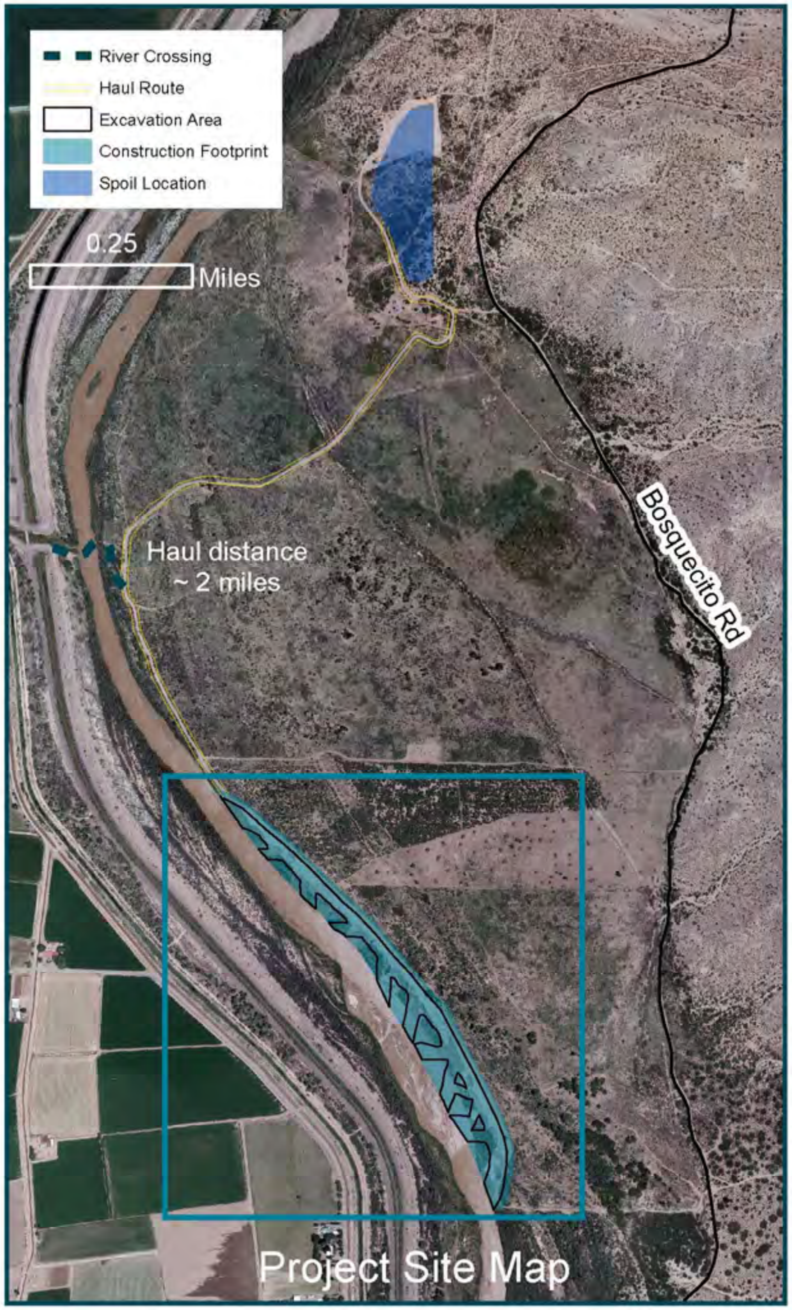
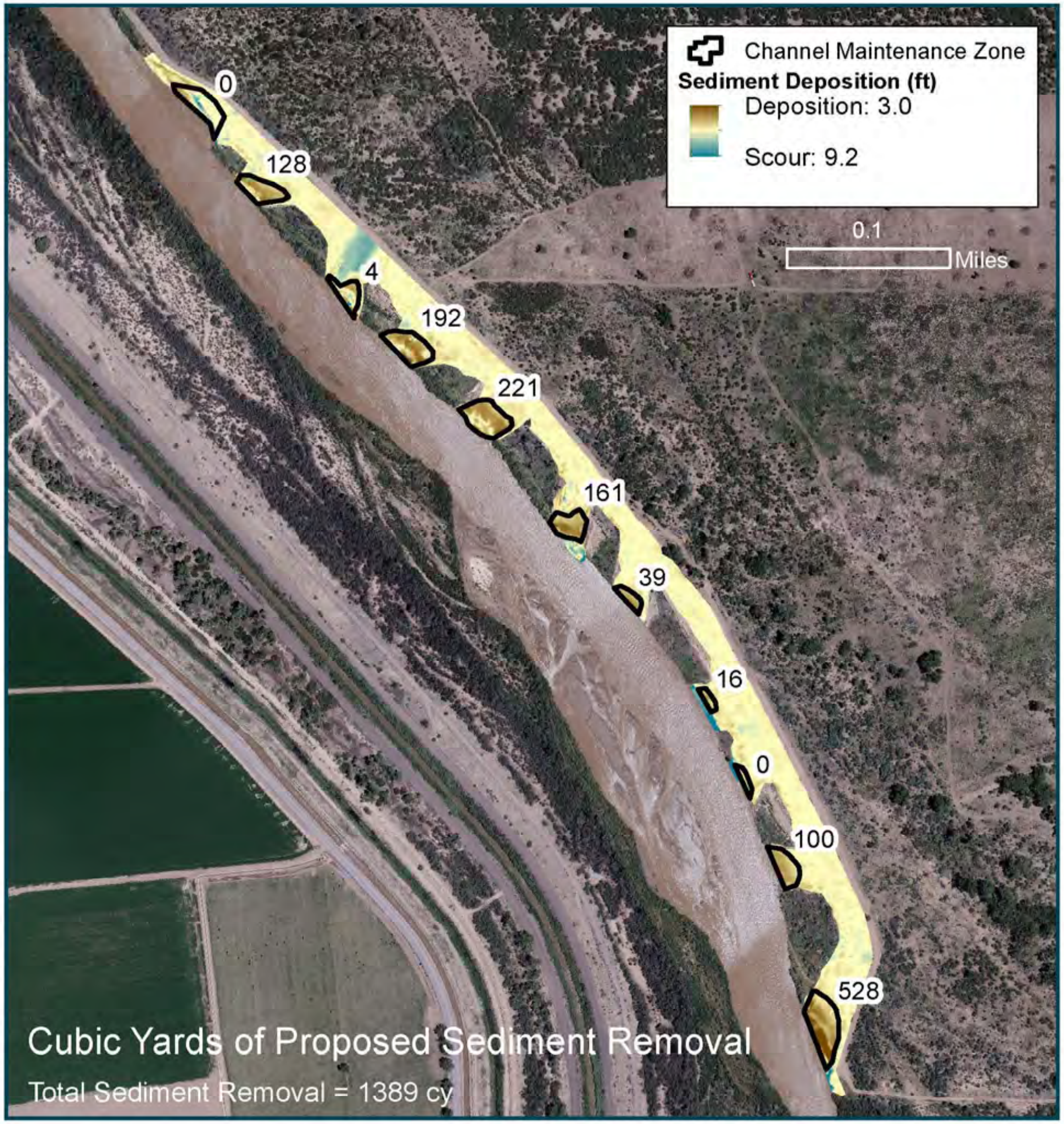


Figure E-5. Map showing locations where sediment cleanout and spoiling occurred at the RM 99.5 site during 2020.





Produced by the Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

Coordinate System:
NAD 1983 UTM Zone 13N

Habitat Restoration Adaptive Management

Rhodes Bank Line Habitat Project (RM 93)
winter 2020

Printed: 20200214
Document Name: 2019_Rhodes_AM

APPENDIX F - STANDARD OPERATING PROCEDURES TO TREATING AND DOCUMENTING NON-NATIVE PLANT TREATMENTS

STANDARD OPERATING PROCEDURES FOR DOCUMENTING NON-NATIVE PLANT SPECIES TREATMENTS AT SAN ACACIA REACH RESTORATION SITES

VERSION 1: MARCH 11, 2020

Below is a step-by-step guide for documenting non-native species treatments performed within restoration sites along the Middle Rio Grande. This information will be maintained in a detailed database that logs maintenance and adaptive management actions implemented during a project's lifespan. The purpose of the SOP is to ensure that treatment implementation is documented with sufficient consistency and detail to enable assessments of treatment effectiveness over time.

Version 1 of this SOP and associated EFF was developed to record non-native species treatments, regardless of patch size, within excavated floodplain features along the Isleta and San Acacia Reaches of the Middle Rio Grande. According to the current *Monitoring and Adaptive Management Plan* (GSA 2019a), a formal vegetation assessment is conducted annually, and the results of the vegetation survey are used to guide the location and necessity of non-native vegetation species treatment. The *Monitoring and Adaptive Management Plan* (GSA 2019a) also specifies adaptive management "triggers" which represent measurable thresholds to guide when specific maintenance treatments should be implemented. In practice, annual monitoring results are published in a *Draft Annual Monitoring Results Report* (e.g. GSA 2019b) and the information in that report is used to facilitate project adaptive management team discussions and prioritize annual maintenance treatments, if necessary. The recommended maintenance treatments are then compiled into a *Final Annual Monitoring Results and Maintenance Plan* (e.g. GSA 2020).

The specific adaptive management trigger (GSA 2019a) varies by non-native species as follows:

- Siberian elm (*Ulmus pumila*) and tree of heaven (*Ailanthus altissima*) treatment initiated when detected at >0% of grid cells.
- Saltcedar (*Tamarix spp*), Russian olive (*Elaeagnus angustifolia*), Mulberry (*Morus spp*) treatment initiated when detected at >5% of grid cells.
- Presence of any noxious herbaceous plant. Species of primary concern include: Bull thistle (*Cirsium vulgare*), Camelthorn (*Alhagi maurorum*), Canada thistle (*Cirsium arvense*), Perennial pepperweed (*Lepidium latifolium*), Ravenna grass (*Saccharum ravennae*), Russian knapweed (*Acroptilon repens*), Whitetop (*Cardaria draba*).

The following step-by-step procedures were developed to document details associated with non-native plant treatments across restoration project sites, including species, treatment method, treatment timing, site name, etc. **We assume that monitoring personnel are walking along-side the treatment crews and using the Avenza Maps to guide them to target plant locations. Thus, monitoring will be implemented at the same time that control treatments are being implemented.** This SOP Version 1 and the associated EFF should be amended as needed to improve efficiency and/or management application.

STEP 1: Review the non-native species distribution maps, recommended treatment methods, and recommended treatment timing described in the *Final Annual Monitoring Results and Maintenance Plan* to plan the treatment and monitoring schedule. Examples of treatment timing and treatment methods tables are shown below along with a sample noxious weed distribution map (examples extracted from GSA 2020).

Table 1. Number of patches of different New Mexico state listed noxious weed species documented at NMISC project sites

Site	Perennial pepperweed	Ravenna grass	Russian knapweed
RM 112			15
RM 100.5	2		
RM 100			
RM 99.5		12	
Treatment Method	2% Imazapyr foliage treatment	Hand dig	10% Glyphosate foliar treatment
Treatment Timing	Once per year, April-May	Before seed-set	Twice per year, first mid-July, secondly mid-September

Table 2. Proportion of monitoring grid cells containing exotic woody plant species

Site	Saltcedar	Siberian Elm	Russian Olive
RM 114	29%	0%	13%
RM 112	11%	0%	6%
RM 100.5	24%	1%	10%
RM 100	26%	0%	3%
RM 99.5	19%	0%	9%
Recommended Treatment Method and Timing	All non-native woody species should be treated using a cut-stump or foliar herbicide treatment with an aquatic approved imazapyr (e.g. Arsenal or Habitat) or glyphosate (Rodeo, AquaMaster) formulation. Cut stump application should be used on individuals with greater than one-inch basal stem diameter (bsd) and could be implemented year-round (as allowable per environmental compliance guidelines). A July-September foliar application is recommended for smaller individuals (i.e. seedlings with <1 inch bsd).		

STEP 2: Gather required gear – pinflags, a site map and tablet (GPS enabled, Fulcrum app, and Avenza Map app installed).

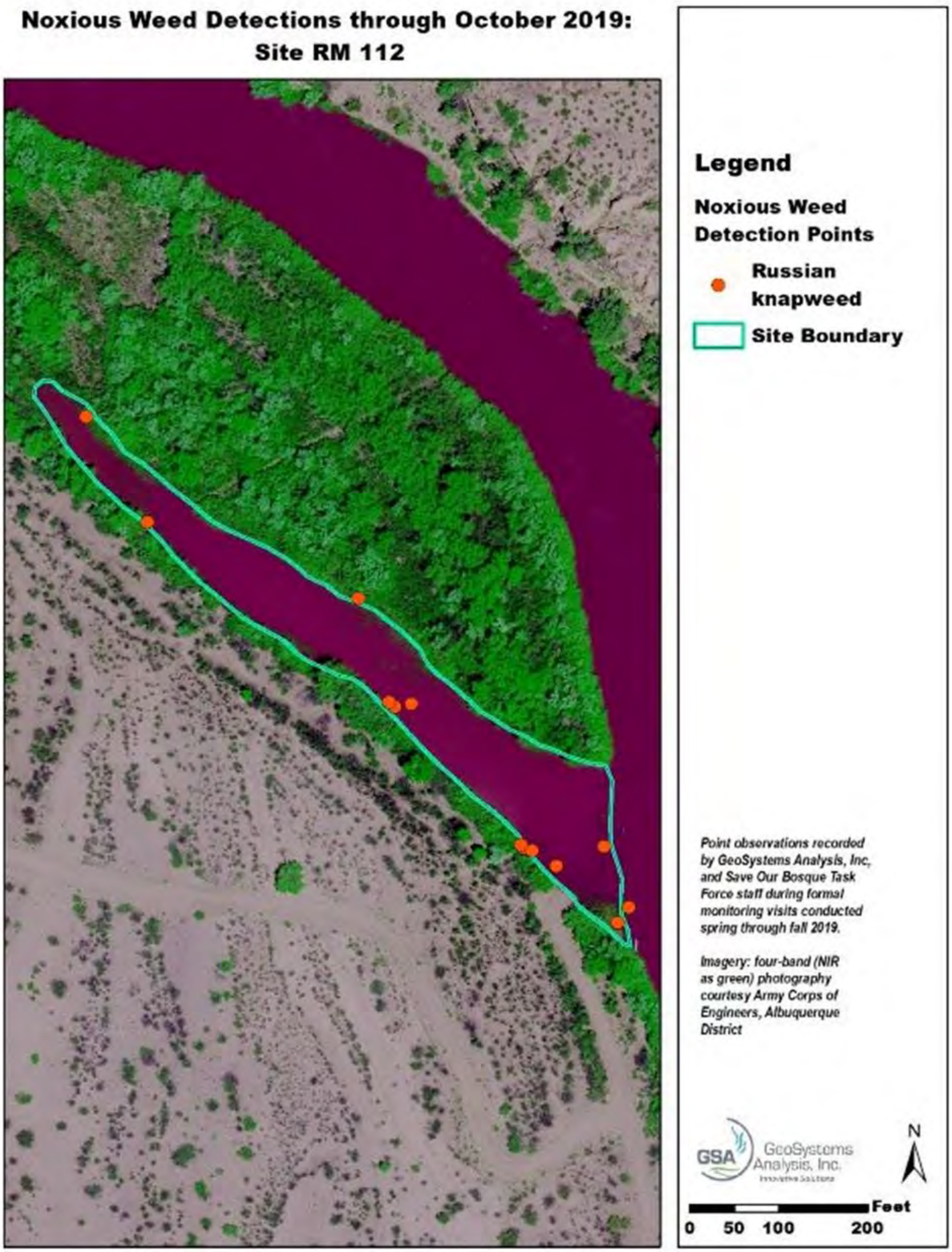


Figure 1. Noxious weed species populations documented at RM 112**.**

STEP 3: Once onsite, open the non-native species distribution map in Avenza Maps. Note that herbaceous noxious weed and non-native woody species detections are shown on separate maps. Avenza Maps will show your current location as a blue dot on the map. In the sample map shown above, monitoring personnel would locate Russian knapweed populations documented at the RM 112 site (shown as red dots on the map) via the Avenza Maps app.

STEP 4: Ensure that crews implementing control treatments follow the species-specific recommended treatment methods and timing described in the *Final Annual Monitoring Results and Maintenance Plan*. When herbicide treatments are recommended, confirm that implementation crews add a blue dye to the specified herbicide formulation so treatment quality can be accurately assessed.

STEP 5: While detection maps are expected to be accurate and representative of current site conditions, also treat additional target species populations that may not be shown on the map, if identified.

STEP 6: After the treatment is applied through the entire site, use Avenza Maps to conduct a quality control inspection of herbicide treatments and ensure blue dye is visible on all individuals within the target population. Use pinflags to mark the location of untreated individuals as identified and return with implementation crews to spray untreated individuals as quickly as possible (ideally within a few hours).

STEP 7: General notes, photos, and other observations will be recorded on an Electronic Field Form (EFF) via the Fulcrum App. This information is critical for documenting treatment implementation and promoting the assessment of treatment effectiveness. Representative field photos should be recorded with each record. Open the Fulcrum App on your mobile device.

STEP 8: Select the App titled *San Acacia HR Maintenance App*. Once open, the App will display the list of existing records logged using this App.

STEP 9: Press the + sign on the App to create a new field record. Begin filling out the EFF. All relevant fields must be completed, or the App will not allow you to save the electronic record. Required fields are specific to the type of treatment logged and indicated by an asterisk (*).

STEP 10: Complete all general fields at the top of the form (site, date, observer(s), entity implementing treatment). Under *Type of Adaptive Management Treatment Implemented*, select ‘Non-Native Species Treatment’ and then press Done to return to the field form.

STEP 11: Select the *General Type of Treatment* (woody or herbaceous) being implemented. A new section automatically becomes visible on the form depending on the type of treatment selected. Fill out all relevant fields.

<u>Save the Record:</u> Click *Save* in the upper right corner of the screen (left screenshot below). The App will not allow you to save the record if any required fields have not been completed. If you

receive this message, follow prompts to complete missing fields and then press *Save*. When the record is successfully saved you will see your record in the list containing all records saved in the *San Acacia HR Maintenance App.*

APPENDIX G – SOBTF FIELD TREATMENT ACTIVITIES TIMELINE AND NOTES

Site	Date	Action	Description	Entity
93	4/6	Sediment Removal	4/6-4/9: Lanford Excavation removed sediment	Contractor
93	5/6	Photopoint Collection	5/6-5/7: Photopoint data collection at all sites	PM
93	5/15	Noxious weed Herbicide	5/15-5/16: Round-up Custom Aquatic applied to Pepperweed and Whitetop	Contractor
93	6/22	Noxious Weed Pulling	Hand pulling of Pepperweed, Whitetop, Knapweed	Interns
93	6/23	Noxious Weed Pulling	Hand pulling of pepperweed, whitetop, knapweed	Interns
93	8/10	Noxious Weed Surveys and Removal	Weed Surveys and Removal: pepperweed, knapweed	Interns/PM
93	8/11	Noxious Weed Surveys and Removal	Weed Surveys and Removal: pepperweed, knapweed	Interns
93	8/12	Noxious Weed Surveys and Removal	Weed Surveys and Removal: pepperweed, knapweed	Interns
93	8/14	Noxious Weed Surveys and Removal	Weed Surveys and Removal: pepperweed, knapweed	Interns
93	10/13	Woody Veg Surveys	Woody Veg Surveys	PM
99.5	4/8	Sediment Removal	4/8-4/9: P.G. Enterprises removed sediment	Contractor
99.5	5/6	Photopoint Collection	5/6-5/7: Photopoint data collection at all sites	PM
99.5	5/26	Ravenna survey	Site imprint was walked to assess the presence of Ravenna grass	Interns/PM
99.5	5/27	Garbage removal	Interns walked the site and removed garbage	Interns
99.5	6/3	Training	Interns and PM were trained in plant identification	Interns/PM
99.5	6/4	Ravenna removal	Interns removed Ravenna grass using shovels	Interns
99.5	6/29	Noxious weed Removal	Hand pulling of any pepperweed, whitetop, knapweed present	Interns
99.5	7/30	Ravenna Removal	Ravenna Survey and hand Digging removal of any found	Interns
99.5	8/3	Noxious Weed Surveys	Weed Surveys	Interns
100	4/7	Sediment Removal	4/7-4/8: P.G. Enterprises removed sediment	Contractor
100	5/6	Photopoint Collection	5/6-5/7: Photopoint data collection at all sites	PM
100	5/27	Garbage removal	Interns walked the site and removed garbage	Interns

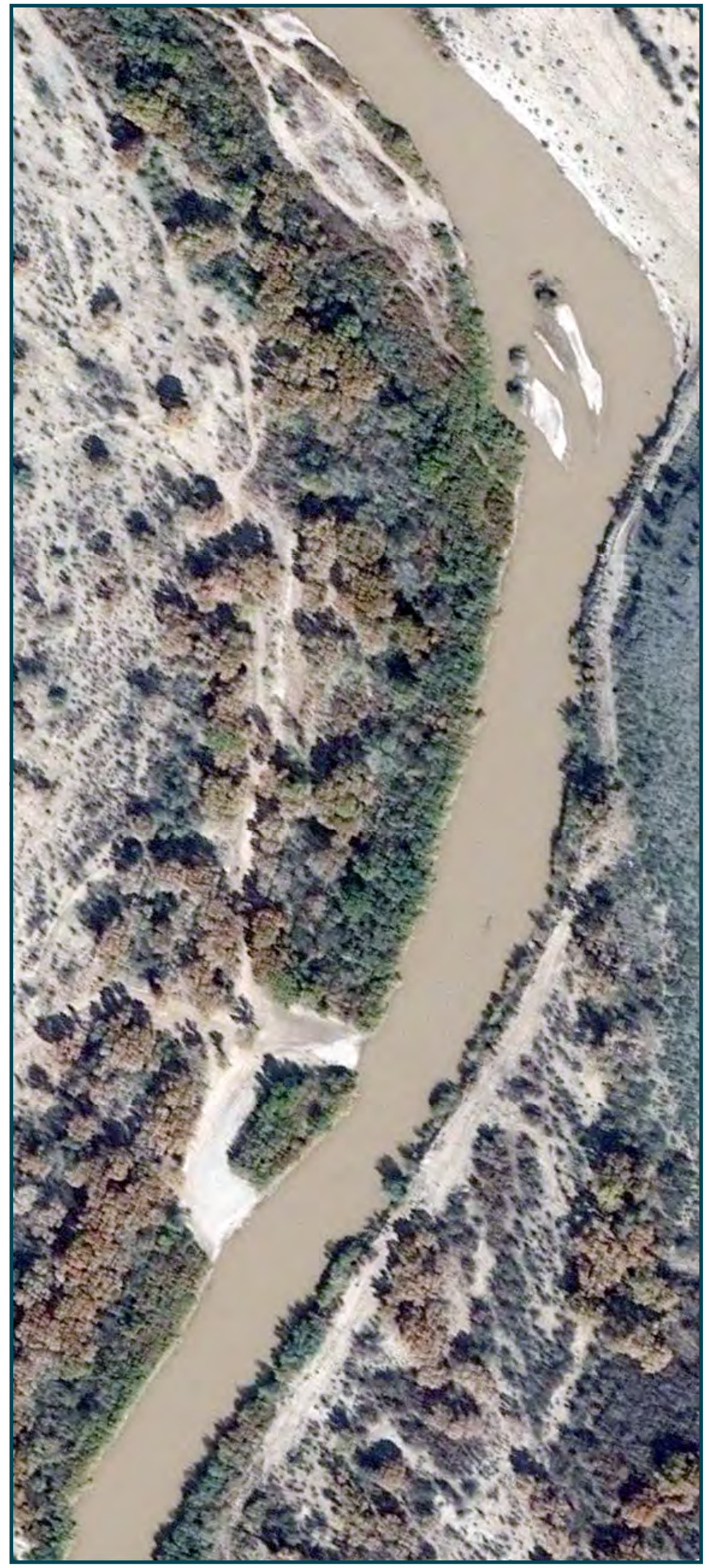
100	7/1	Weed Removal	Hand pulling of any pepperweed, whitetop, knapweed present	Interns
100	8/3	Noxious Weed Surveys	Weed Surveys	Interns
100.5	4/7	Sediment Removal	4/7: P.G. Enterprises removed sediment	Contractor
100.5	5/6	Photopoint Collection	5/6-5/7: Photopoint data collection at all sites	PM
100.5	5/17	Noxious weed Herbicide	Round-up Custom Aquatic applied to Pepperweed and Whitetop	Contractor
100.5	5/28	Garbage removal	Interns walked the site and removed garbage	Interns
100.5	7/1	Noxious weed Removal	Hand Pulling of noxious weeds: Pepperweed, Knapweed	Interns
100.5	8/3	Noxious Weed Surveys	Weed Surveys	Interns
103	5/6	Photopoint Collection	5/6-5/7: Photopoint data collection at all sites	PM
103	5/17	Noxious weed Herbicide	Round-up Custom Aquatic applied to Pepperweed and Whitetop	Contractor
103	5/27	Garbage removal	Interns walked the site and removed garbage	Interns
103	6/3	Training	Interns were trained in plant identification	Interns/PM
103	6/29	Noxious weed Removal	Hand Pulling of noxious weeds: Pepperweed, Knapweed	Interns/PM
103	6/30	Noxious weed Removal	Hand Pulling of noxious weeds: Pepperweed, Knapweed	Interns
103	8/4	Noxious Weed Surveys	Weed Surveys	Interns
103	10/15	Woody Vegetation Surveys	Woody Veg Surveys	PM
104	5/6	Photopoint Collection	5/6-5/7: Photopoint data collection at all sites	PM
104	6/2	Garbage removal	Interns walked the site and removed garbage	Interns
104	6/3	Training	Interns were trained in plant identification	Interns/PM
104	6/30	Noxious weed Removal	Hand Pulling of noxious weeds: Pepperweed, Knapweed	Interns
104	8/6	Weed Surveys	Weed Surveys	Interns
104	10/14	Woody Vegetation Surveys	Woody Vegetation Surveys	PM
112	4/6	Sediment Removal	4/6-4/7 P.G. Enterprises removed sediment	Contractor
112	5/6	Photopoint Collection	5/6-5/7: Photopoint data collection at all sites	PM

112	5/27	Garbage removal	Interns walked the site and removed garbage	Interns
112	6/29	Noxious weed Removal	Hand Pulling of noxious weeds: Pepperweed, Knapweed	Interns
112	8/4	Noxious Weed Surveys	Weed Surveys	Interns
114	4/6	Sediment Removal	4/6: P.G. Enterprises removed sediment	Contractor
114	5/6	Photopoint Collection	5/6-5/7: Photopoint data collection at all sites	PM
114	5/27	Garbage removal	Interns walked the site and removed garbage	Interns
114	6/3	Training	Interns were trained in plant identification	Interns/PM
114	6/29	Noxious weed Removal	Hand Pulling of noxious weeds: Pepperweed, Knapweed	Interns/PM
114	8/5	Noxious Weed Surveys	Weed Surveys	Interns

APPENDIX H – Satellite Images of Project Sites July 2019 – June 2020

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-07-15 12:02 PM MDT
SA gage 1930 cfs

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-11-01 11:47 AM MDT
SA gage 922 cfs



GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-02-17 11:57 MST
SA gage 723 cfs

GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-06-18 12:09 MDT
SA gage 40 cfs

Habitat Restoration Satellite Imagery Monitoring

San Acacia Site River Mile 114
July 2019 through June 2020

Produced by the Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

Coordinate System:
NAD 1983 UTM Zone 13N

0 0.05 0.1 0.2 Miles

Printed: 20201118
Document Name: 2020_114SatImagery

Digital Globe (50 cm, 3-band)
2019-07-15 12:02 PM MDT
SA gage 1930 cfs

Digital Globe (50 cm, 8-band)
2019-11-01 11:47 AM MDT
SA gage 922 cfs

GeoNorth (Corps) Collection
(50 cm, 5-band)
2020-02-17 10:57 AM MST
SA gage 715 cfs

GeoNorth (Corps) Collection
(50cm, 5-band)
2020-06-18 12:09 PM MDT
SA gage 42 cfs

Produced by the Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

Coordinate System:
NAD 1983 UTM Zone 13N

0 0.05 0.1 0.2 Miles

Habitat Restoration Satellite Imagery Monitoring

San Acacia Site River Mile 112
July 2019 through June 2020

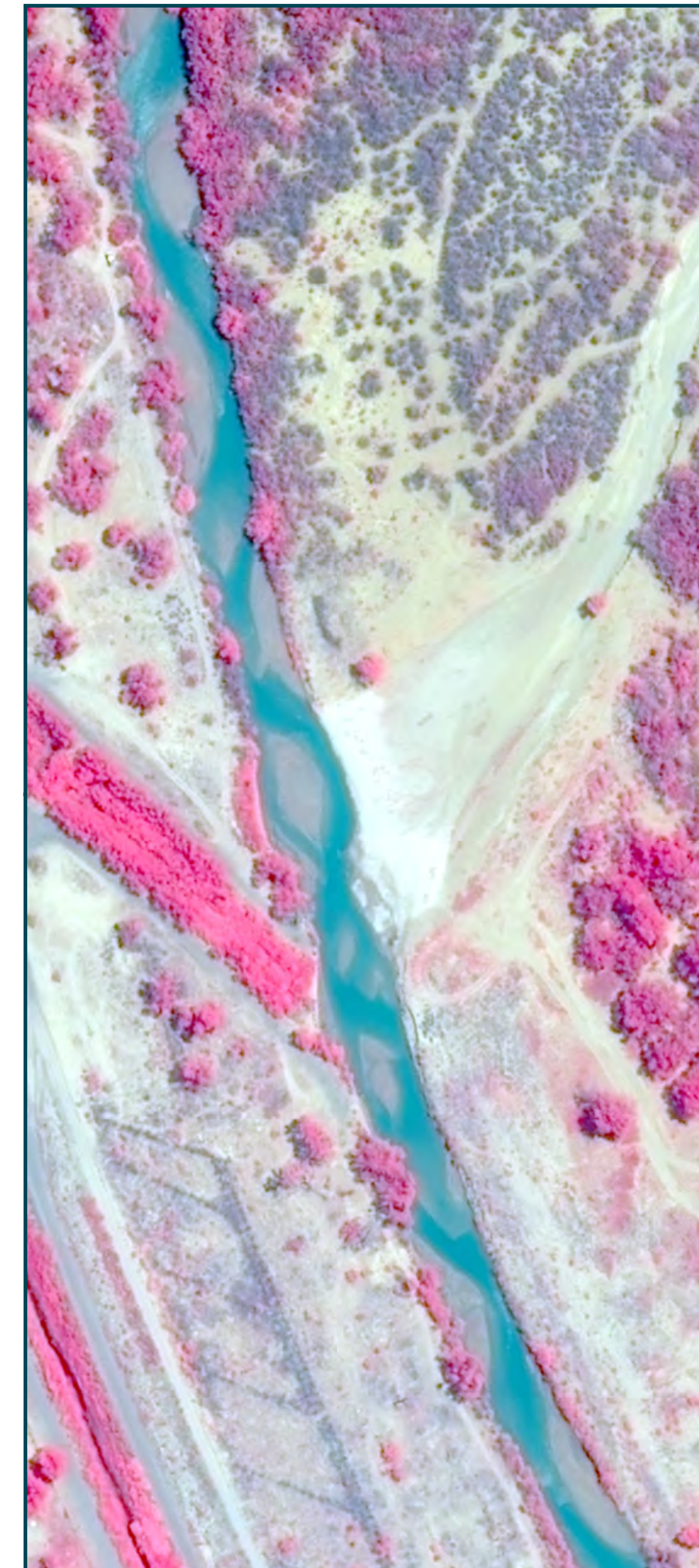
Printed: 20201118
Document Name: 2020_112SatImagery

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-07-15 12:02 PM MDT
SA gage 1930 cfs

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-11-01 11:47 AM MDT
SA gage 922 cfs

GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-02-17 11:57 MST
SA gage 723 cfs

GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-06-18 12:09 MDT
SA gage 40 cfs



Produced by the Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

Coordinate System:
NAD 1983 UTM Zone 13N

0 0.05 0.1 0.2 Miles

Habitat Restoration Satellite Imagery Monitoring

Escondida East Habitat Project (RM 104.5)
July 2019 through June 2020

Printed: 20201118
Document Name: 2020_104_5SatImagery

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-07-15 12:02 PM MDT
SA gage 1930 cfs

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-11-01 11:47 AM MDT
SA gage 922 cfs

GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-02-17 11:57 MST
SA gage 723 cfs

GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-06-18 12:09 MDT
SA gage 40 cfs

Produced by the Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office

Coordinate System:
NAD 1983 UTM Zone 13N

Habitat Restoration Satellite Imagery Monitoring

Escondida Habitat Project (RM 103)
July 2019 through June 2020

Printed: 20201118
Document Name: 2020_103SatImagery

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-07-15 12:02 PM MDT
SA gage 1930 cfs

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-11-01 11:47 AM MDT
SA gage 922 cfs

GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-02-17 11:57 MST
SA gage 723 cfs

GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-06-18 12:09 MDT
SA gage 40 cfs

Produced by the Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office
A. Rudolph

Coordinate System:
NAD 1983 UTM Zone 13N

0 0.05 0.1 0.2 Miles

Habitat Restoration Satellite Imagery Monitoring

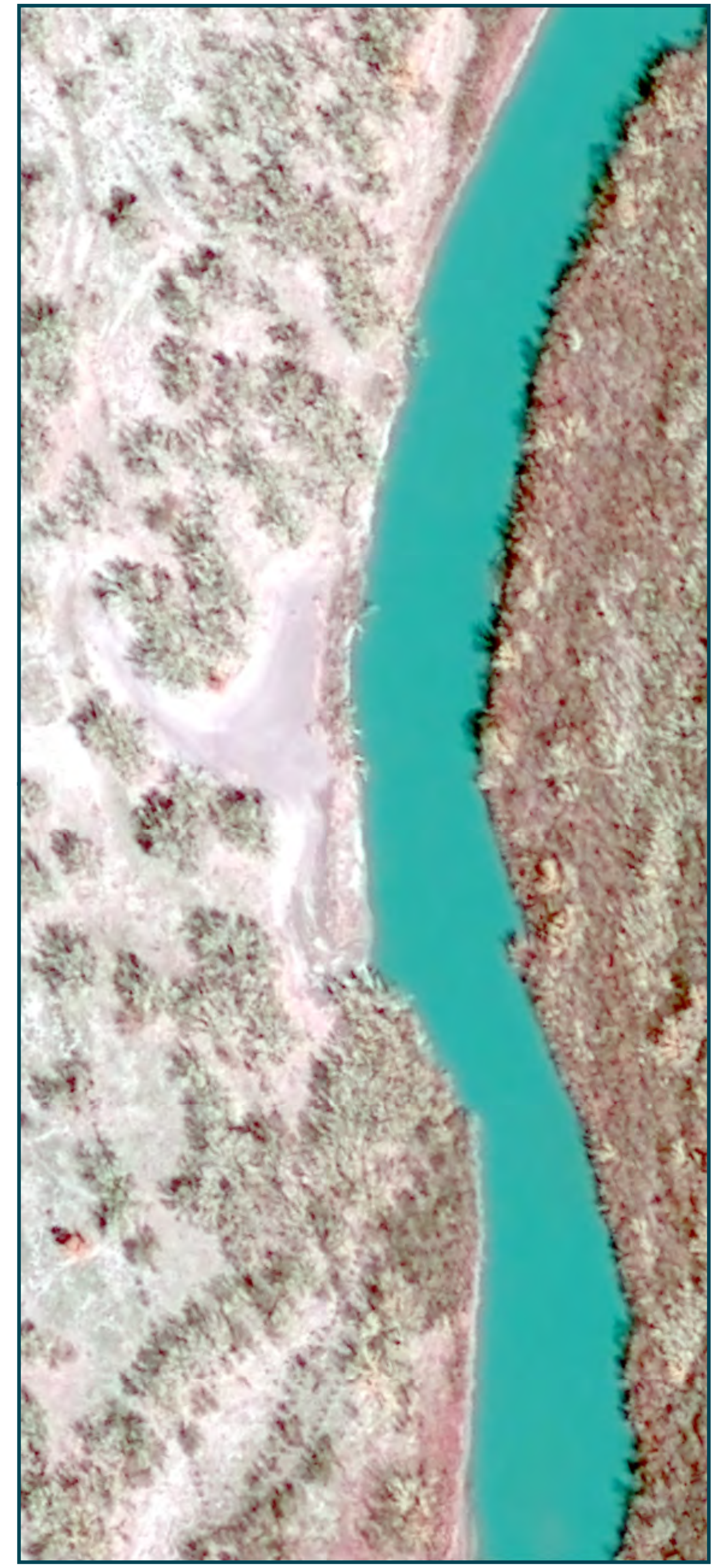
San Acacia Site River Mile 99.5
July 2019 through June 2020

Printed: 20201118
Document Name: 2020_99_5SatImagery

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-07-15 12:02 PM MDT
SA gage 1930 cfs

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-11-01 11:47 AM MDT
SA gage 922 cfs

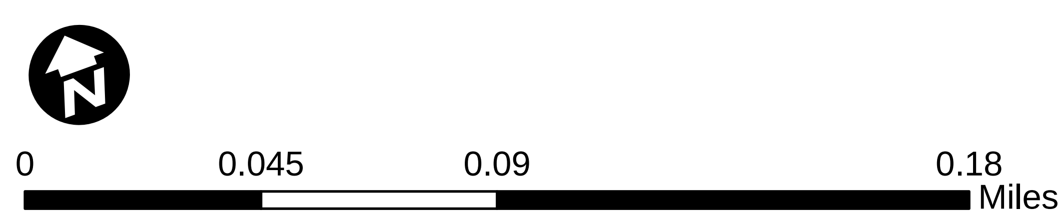
GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-02-17 11:57 MST
SA gage 723 cfs



GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-06-18 12:09 MDT
SA gage 40 cfs

Produced by the Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office
A. Rudolph

Coordinate System:
NAD 1983 UTM Zone 13N



Habitat Restoration Satellite Imagery Monitoring

San Acacia Site River Mile 100
July 2019 through June 2020

Printed: 20201118
Document Name: 2020_100SatImagery

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-07-15 12:02 PM MDT
SA gage 1930 cfs

Digital Globe Unscheduled Collection
(50 cm, 3-band)
2019-11-01 11:47 AM MDT
SA gage 922 cfs

GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-02-17 11:57 MST
SA gage 723 cfs

GeoNorth (Corps) Scheduled Collection
(50 cm, 5-band)
2020-06-18 12:09 MDT
SA gage 40 cfs

Produced by the Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office
A. Rudolph

Coordinate System:
NAD 1983 UTM Zone 13N

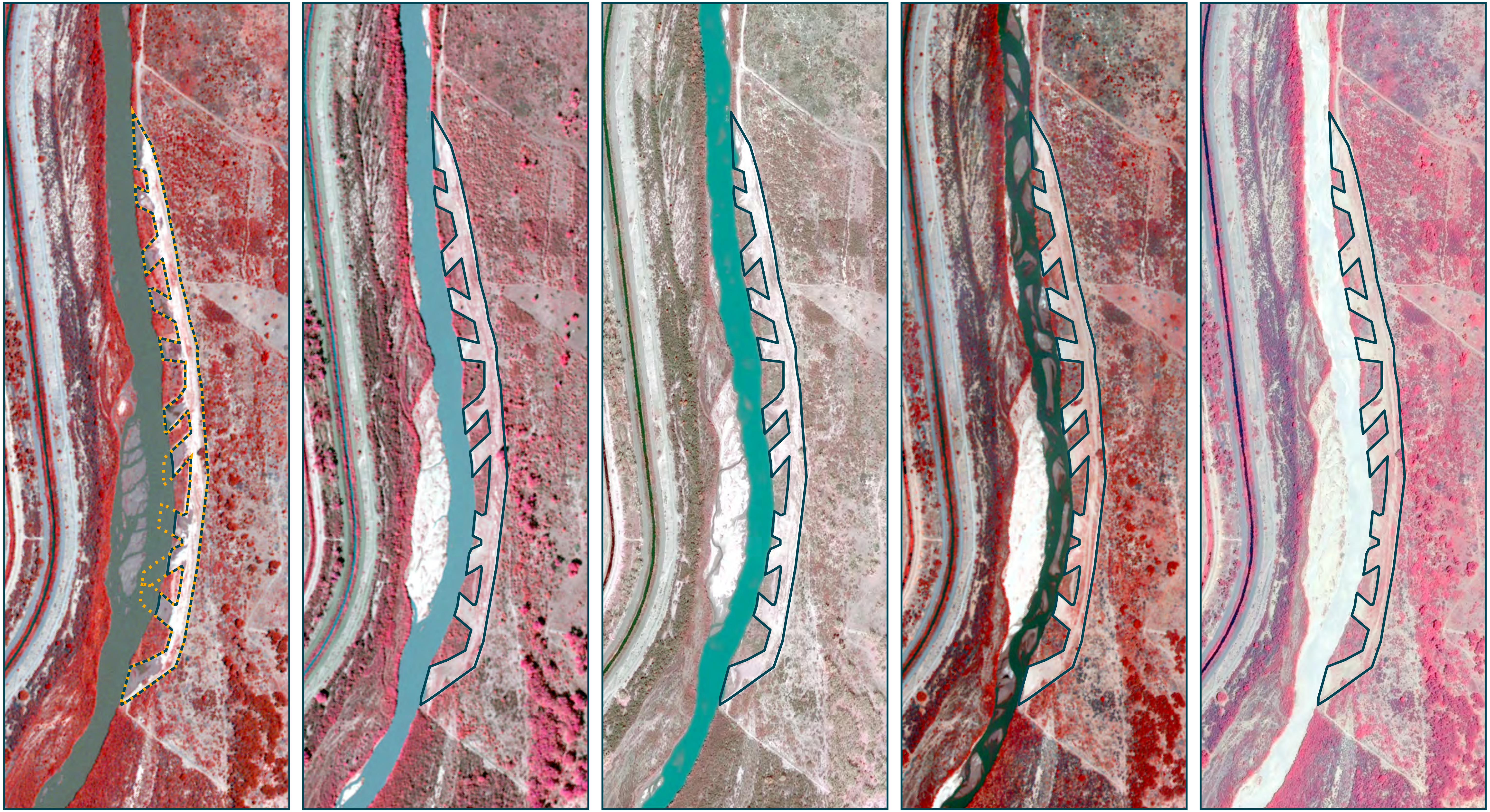
0 0.075 0.15 0.3 Miles

Habitat Restoration Satellite Imagery Monitoring

San Acacia Site River Mile 100.5
July 2019 through June 2020

Printed: 20201118
Document Name: 2020_100_5SatImagery

Digital Globe Unscheduled Collection (2m, 8-band) 2019-07-15 12:02 PM MDT SA gage 1930 cfs	Digital Globe Unscheduled Collection (2m, 8-band) 2019-11-01 11:47 AM MDT SA gage 922 cfs	GeoNorth (Corps) Scheduled Collection (50 cm, 5-band) 2020-02-17 11:57 MST SA gage 723 cfs	Digital Globe Unscheduled Collection (2m, 8-band) 2020-05-09 11:50 AM MDT SA gage 146 cfs	GeoNorth (Corps) Scheduled Collection (50 cm, 5-band) 2020-06-19 12:01 MDT SA gage 38 cfs - no water at RM 93



Rhodes Boundary (As-Built Feb 2019)

Rhodes Boundary (Post 2019 Runoff)

0 0.125 0.25 0.5 Miles

Habitat Restoration Satellite Imagery Monitoring

Rhodes Bank Line Habitat Project (RM 93)
July 2019 through June 2020

Produced by the Bureau of Reclamation
Upper Colorado Region
Albuquerque Area Office
A. Rudolph

Coordinate System:
NAD 1983 UTM Zone 13N

Printed: 20201118
Document Name: 2020_93SatImagery