Appendix G

Meso-Habitat Surveys

DRAFT
Annual Technical Report

Draft
March 2010

1.0 Introduction

The following appendix includes a report provided by the California Department of Fish and Game, Summary of Pilot Study for Reach 1A Meso-Habitat Monitoring during the fall Interim Flow Period for the San Joaquin Restoration Program. This report details monitoring methodology and results from monitoring surveys conducted during the fall Water Year 2010 Interim Flows period.

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Summary of Pilot Study for Reach 1A Meso-Habitat Monitoring during the fall Interim Flow Period

Eric Guzman, California Department of Fish and Game, San Joaquin River Restoration Fisheries Management Work Group

Introduction.- This report summarizes the San Joaquin River (SJR) Meso-Habitat Monitoring Pilot Study related to the 2009 Interim Flow Period (IFP) for the San Joaquin River Restoration Program (SJRRP). The IFP started October 1, 2009 and ended November 20, 2009. See Table 1 for time periods of flow release magnitudes and volumes. Meso-habitat monitoring consisted of mapping and characterizing SJR Habitat Units (HU) from Friant Dam to the end of Reach 1A (Highway 99). Meso-habitat mapping began on October 1, 2009 and ended October 31, 2009. Recent aerial photographs were used to refine and expand GPS data points into map polygons in GIS depicting habitat units. The aerial photographs were estimated to be taken at 150 – 250 cfs (cubic feet per second) releases from Friant Dam (Appendix A: SJR Habitat Maps). This report summarizes the data collection methods, periods of data collection, San Joaquin River (SJR) conditions. The purpose of this habitat monitoring is to document the longitudinal distribution of HU in an effort to plan for other studies (microhabitat, holding, and spawning) HU are relatively homogenous areas and are coarse in scale. Data collected for this Pilot Study will be used to refine and inform design and data collection activities and will be used to determine sampling locations for subsequent microhabitat measurements. All data contained within this report and appendices are preliminary and subject to revision.

Table 1: IFP Flow Release Magnitudes and Volumes

Time window	Riparian Release	Interim Flow Release	Total Friant Dam Release
Oct 1-31, 2009	160 cfs	190 cfs	350 cfs
Nov 1-10, 2009	130 cfs	570 cfs	700 cfs
Nov 11-20, 2009	120 cfs	230 cfs	350 cfs
Total Release Volume:	14,800 ac-ft	27,500 ac-ft	42,300 ac-ft

Methods.- Crews of 2-6 individuals from the Department of Fish and Game floated the river in kayaks or waded in shallow habitats while taking measurements at each habitat unit. HU were identified utilizing a classification system based upon those developed by Flosi and Reynolds (1998) and P.A. Bisson, et al. (1982). A main HU was identified when its length was equal to or greater than the width of the river. A

side-channel HU (sub-habitat adjacent to the main channel HU) was identified when its length was equal to or greater than half the width of the river. If the area being sampled appeared to have some features that were not entirely consistent with the dominant HU but did not meet the above criteria (i.e. its channel length was less than the width), that area was lumped in with the dominant mid-channel HU. Table 2 displays all of the potential habitat types that were considered likely to be present in the study area.

Table 2: Potential Habitat Unit Types Within The SJR Restoration Area

RIFFLE	
Low Gradient Riffle	(LGR)
High Gradient Riffle	(HGR)
CASCADE	
Cascade	(CAS)
Bedrock Sheet	(BRS)
FLATWATER	
Pocket Water	(POW)
Glide	(GLD)
Run	(RUN)
Step Run	(SRN)
Edgewater	(EDW)*
MAIN CHANNEL POOL	
Trench Pool	(TRP)
Mid-Channel Pool	(MCP)
Channel Confluence Pool	(CCP)
Step Pool	(STP)
SCOUR POOL	
Corner Pool	(CRP)*
L. Scour Pool - Log Enhanced	(LSL)*
L. Scour Pool - Root Wad Enhanced	(LSR)*

L. Scour Pool - Bedrock Formed (LSBk) *

L. Scour Pool - Boulder Formed (LSBo)*

Plunge Pool (PLP)

BACKWATER POOLS

Secondary Channel Pool (SCP)*

Backwater Pool - Boulder Formed (BPB)*

Backwater Pool - Root Wad Formed (BPR)*

Backwater Pool - Log Formed (BPL)*

Dammed Pool (DPL)

ADDITIONAL UNIT DESIGNATIONS

Dry (DRY)

Culvert (CUL)

Not Surveyed (NS)

Not Surveyed due to a marsh (MAR)

In Channel Mine Pit (ICMP)

Captured Mine Pit (CMP)

* indicate side HU type

Visual estimation of flow, depth, and substrate were criteria used to identify and delineate a HU. HU are discrete characterizations for relative estimations of continuous conditions and therefore difficult to quantify using qualitative criteria. It is common for smaller habitat patches to be present, especially in reaches with more complex channel features (riffle, run, pools complex), therefore, it was difficult to be objective and accurate when delineating HU boundary points. The complex transitional nature of channel features does not easily accommodate subjective decisions made by a group of surveyors. When a defined HU was encountered, average wetted width, length, mean depth, and HU type were recorded. The boundaries of each HU were recorded using a Garmin E-Trex Global Positioning System (GPS) and a range finder. A range finder was used to measure wetted widths and shorter HU lengths (typically runs, riffles, and pools). GPS points were used to measure longer HU lengths (typically long glides and large mine pits). GPS points were recorded at three equidistant points (top, middle, and bottom) throughout the length of the HU when the length of the unit was shorter than 8 times the average wetted width of the river. When habitat units were longer than 8 times the average wetted width of the river, points were recorded at five equidistant points (top, top/middle, middle, middle/bottom, and bottom) throughout the length of the HU. To better capture the variation in widths, GPS points were taken at more locations (top/middle, middle, and middle/bottom) when bends were

located within a HU sampled. Depth was measured using several methods, but a meter stick was found to be more effective in shallower units and a SpeedTech SM-5 Depthmate Portable Sounder and Depth Meter was more effective in deeper water. Discharge was recorded based upon the CDEC station records closest to the survey point (i.e. upstream of Hwy 41 bridge sites recorded **Mil** station data). Polygons were created on aerial photographs taken in the summer of 2009 (Appendix A: SJR Habitat Maps). Width measurements were averaged and used to "ground truth" GIS polygon to obtain a more accurate measure of HU area. The starting and ending GPS points from the survey provided the upstream and down stream boundary. The polygon was connected by following the wetted edge of the river on either the left or right bank and connecting the upstream to the downstream boundary. The area from each HU was calculated from the GIS polygons.

Reach 1A was divided into 18 sub-reaches. Sub-reach 1A.1 was the first ten HU encountered in Reach 1A, the next ten were 1A.2. This system continued through the entire Reach and ended at sub-reach 1A.18. Each HU (including main- and side-channel) within each sub-reach were identified and recorded. A photograph was also taken, looking downstream and is recorded on the data sheet as the corresponding photo number displayed on the camera and the camera ID. Side-habitats (such as edgewater, backwater, etc.) were determined to be distinct HU, and were recorded as distinct features associated within the HU. Likewise, if a secondary channel HU had side channel habitat, then the side channel habitat would be recorded similarly. If the river was divided into two or more channels (braided channels), the dominant channel (the one with the highest discharge) was assigned the main HU number. Each secondary channel habitat was given a separate HU identifier (provided it met the minimum length criteria for side- and main-channel HU). Additionally, some secondary channels contained multiple HU before reconnecting with the main channel and were recorded as well.

Mine pits that have the river flowing directly through them were classified as in-channel mine pits and were included in the survey. Mine pits that have connectivity to the river but the main channel does not flow through them were classified as off-channel mine pits and were not included in the survey. A GPS point was taken at the entrance point of off-channel mine pits. Mine pits that may be adjacent to the SJR but do not have connectivity were not identified in this study.

Results.- Results from this SJR Meso-Habitat Monitoring Pilot Study indicate that in Reach 1A [Friant Dam (RM 267) to Highway 99 Bridge (RM 243)] 378 distinct habitat units were encountered (see Table 3: Reach 1A Habitat Units). There were 21 different habitat types that include 179 main channel habitat units, 93 side habitat units, and 108 secondary channel habitat units (see Table 4: Habitat Units by Sub-Reach). Pools were the most frequently encountered habitat type (27.8%), whereas glides consume most (54.0%) of the area of the river that was surveyed. A bar graph showing distribution of habitat types is provided in Figure 1.

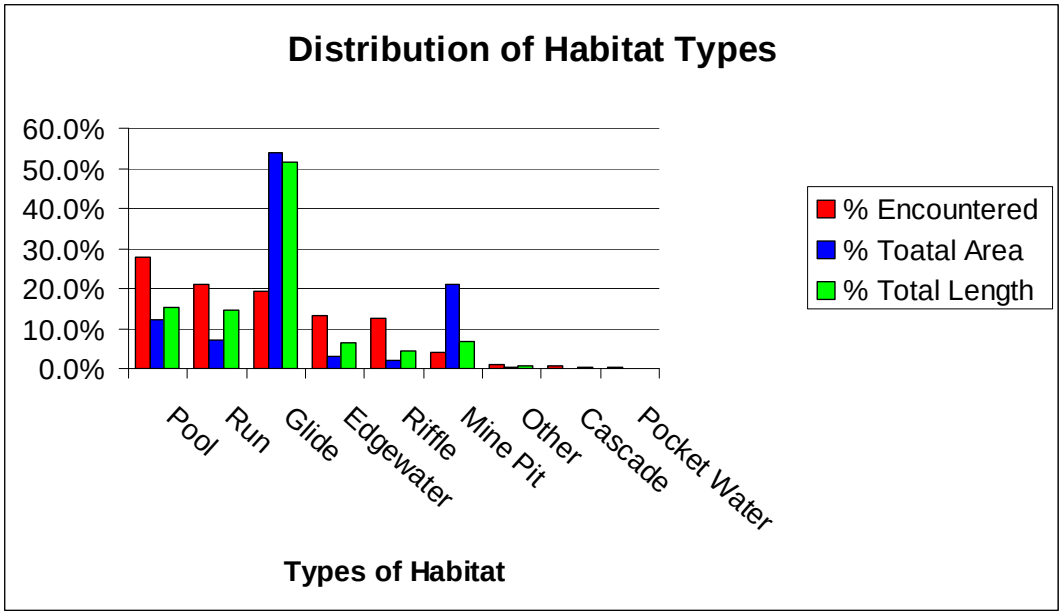
Table 3: Reach 1A Habitat Units

Type of Habitat	Quantity	% Encountered	Total Area (sq m)	% Total Area	Total Length (m)	% Total Length
Pool	105	27.8%	222,434.8	12.2%	8,525.2	15.3%
Run	80	21.2%	132,389.7	7.2%	8,112.1	14.6%
Glide	73	19.3%	988,494.9	54.0%	28,674.3	51.6%
Edgewater	50	13.2%	54,546.0	3.0%	3,558.9	6.4%
Riffle	47	12.4%	37,140.0	2.0%	2,473.8	4.5%
Mine Pit	15	4.0%	386,707.4	21.1%	3,746.8	6.7%
Other	4	1.1%	5,211.3	0.3%	302.7	0.5%
Cascade	3	0.8%	2,419.9	0.1%	127.4	0.2%
Pocket Water	1	0.3%	342.9	0.02%	20.7	0.04%
Total	378		1,829,687.0		55,541.9	

Table 4: Habitat Units by Sub-Reach

Reach	Number of Main Channel Habitat Units	Number of Side Habitat Units	Number of Secondary Channel Habitat Units	Combined Total of Habitat Units
1A.1	10	4	7	21
1A.2	10	5	7	22
1A.3	10	8	2	20
1A.4	10	4	4	18
1A.5	10	10	24	44
1A.6	10	5	4	19
1A.7	10	7	8	25
1A.8	10	10	19	39
1A.9	10	8	3	21
1A.10	10	5	3	18
1A.11	10	5	7	22
1A.12	10	2	0	12
1A.13	10	3	11	24
1A.14	10	3	3	15
1A.15	10	3	3	16
1A.16	10	4	0	14
1A.17	10	4	3	17
1A.18	9	1	0	10
TOTAL	179	91	108	378

Figure 1: Distribution of Habitat Types



Literature Cited

Bisson, P.A., J.L. Nielsen, R.A. Palmson, and L.E. Grove. 1982. A system of naming habitat types in small streams with examples of habitat utilization by salmonids during low stream flow. Symposium on acquisition and utilization of aquatic habitat inventory information. Western Division, American Fisheries Society. Bethesda, Maryland.

Flosi, G., and F.L. Reynolds. 1998. California Salmonid Stream Habitat Restoration Manual. California Department of Fish and Game, Technical Report, Sacramento.

San Joaquin River Reach 1A

Subreach 1_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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Subject to revision

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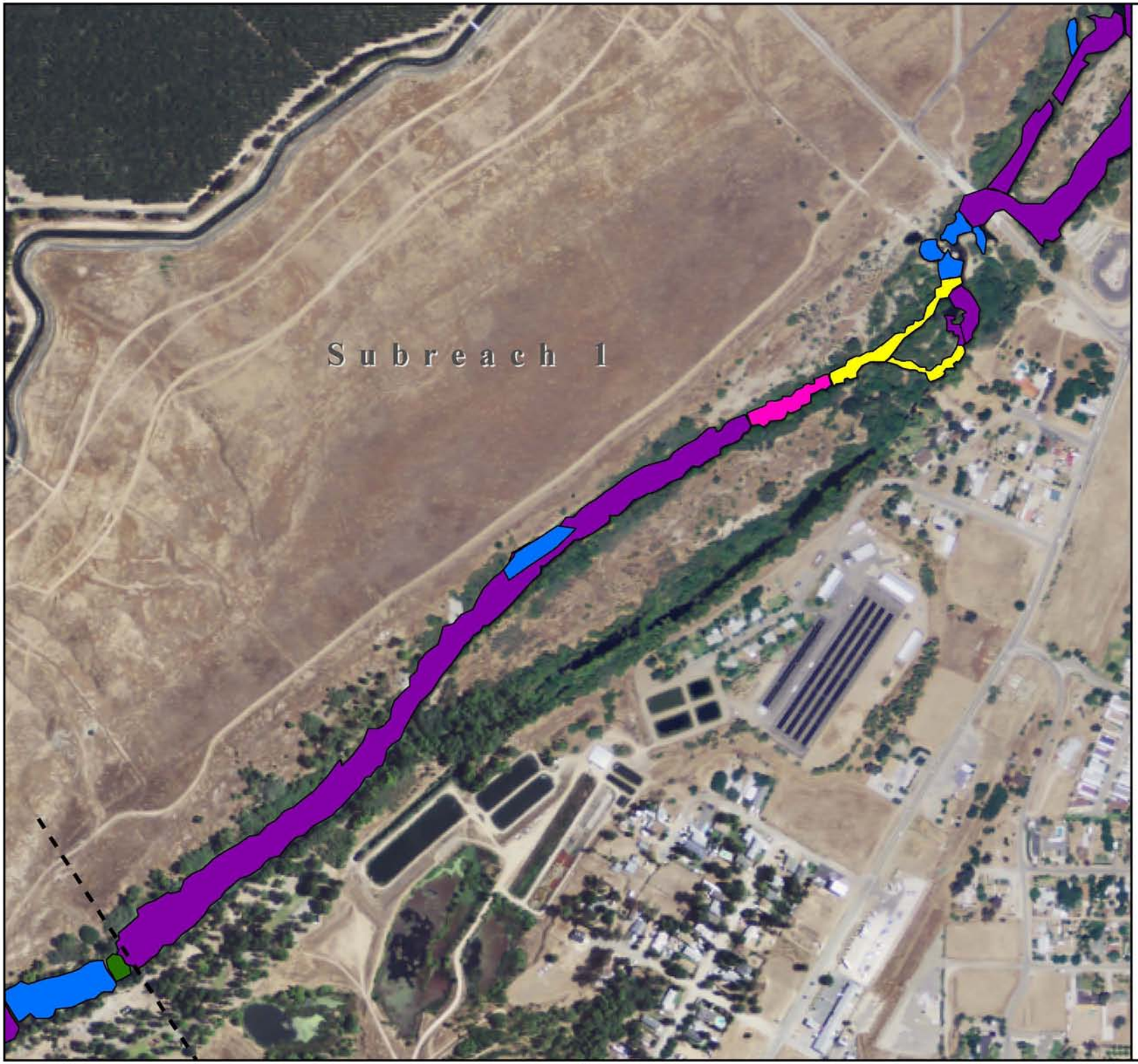

San Joaquin River Reach 1A

Subreach 1_2

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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Subject to revision

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San Joaquin River
Reach 1A
Subreach 2_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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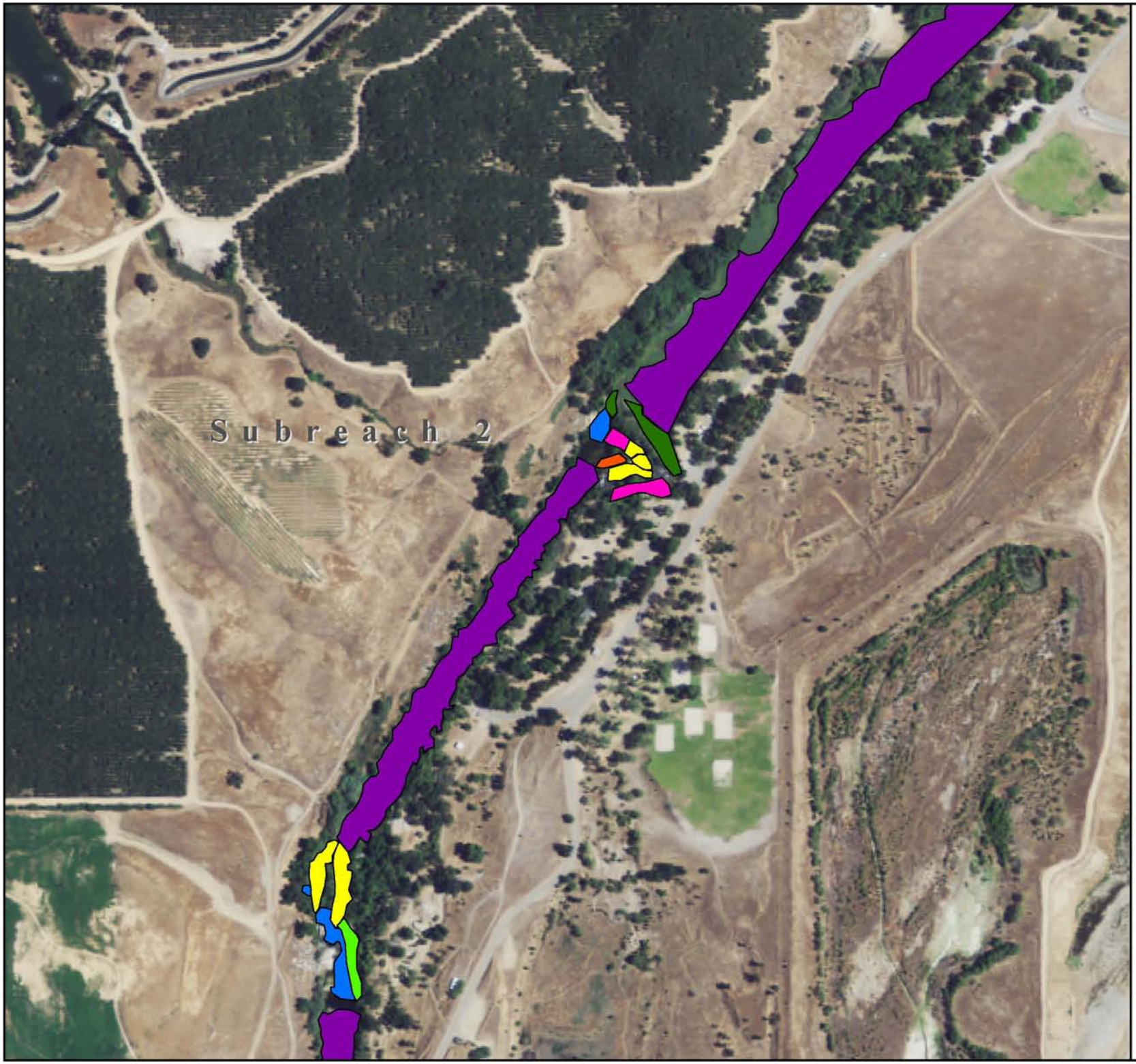

San Joaquin River
Reach 1A
Subreach 2_2

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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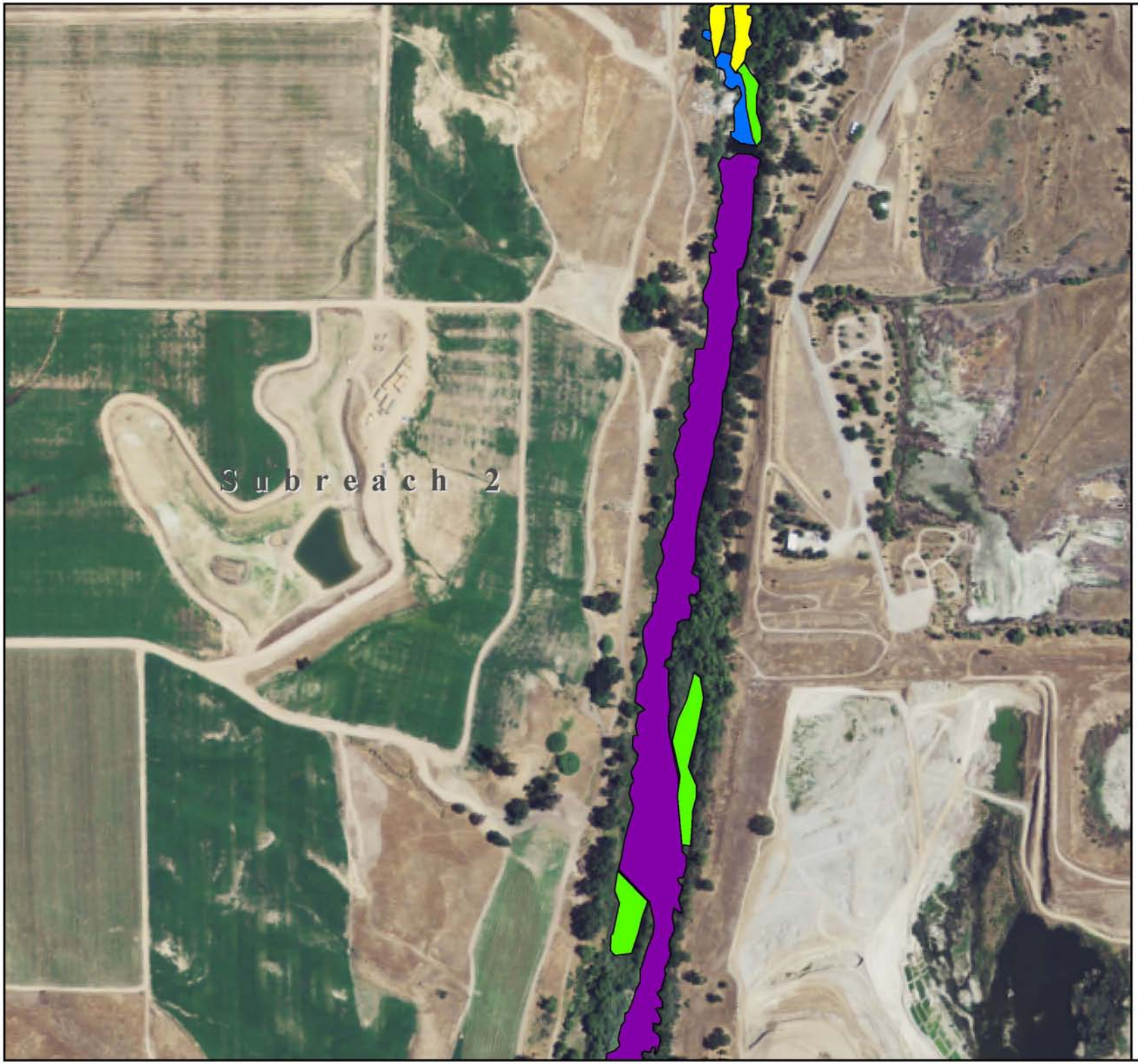

San Joaquin River
Reach 1A

Subreach 2_3

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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San Joaquin River
Reach 1A
Subreach 2_4

Subreach 2

Subreach 3

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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Subject to revision

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San Joaquin River
Reach 1A
Subreach 3_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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Subject to revision

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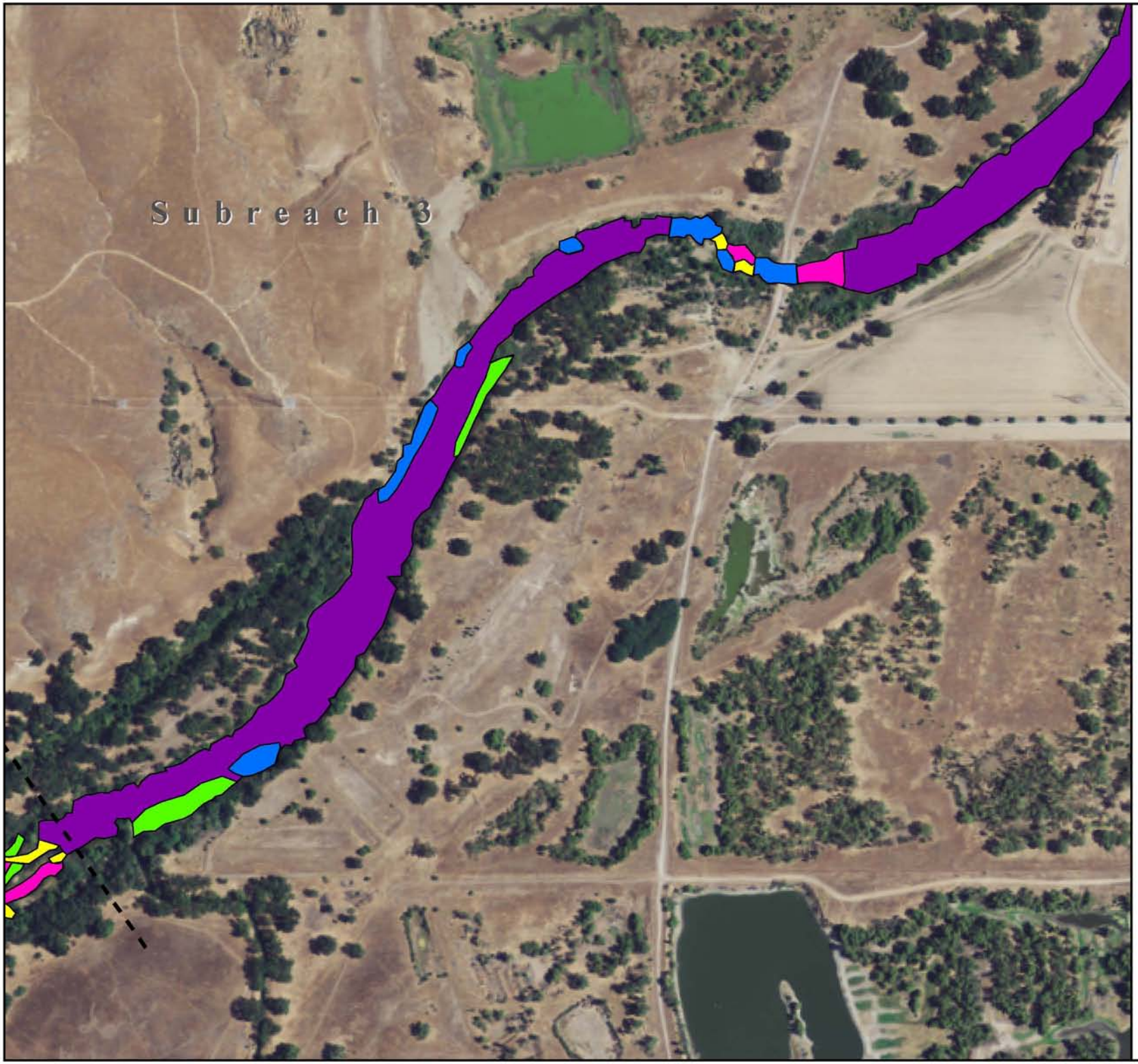

San Joaquin River Reach 1A

Subreach 3_2

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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San Joaquin River Reach 1A

Subreach 4_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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Subject to revision

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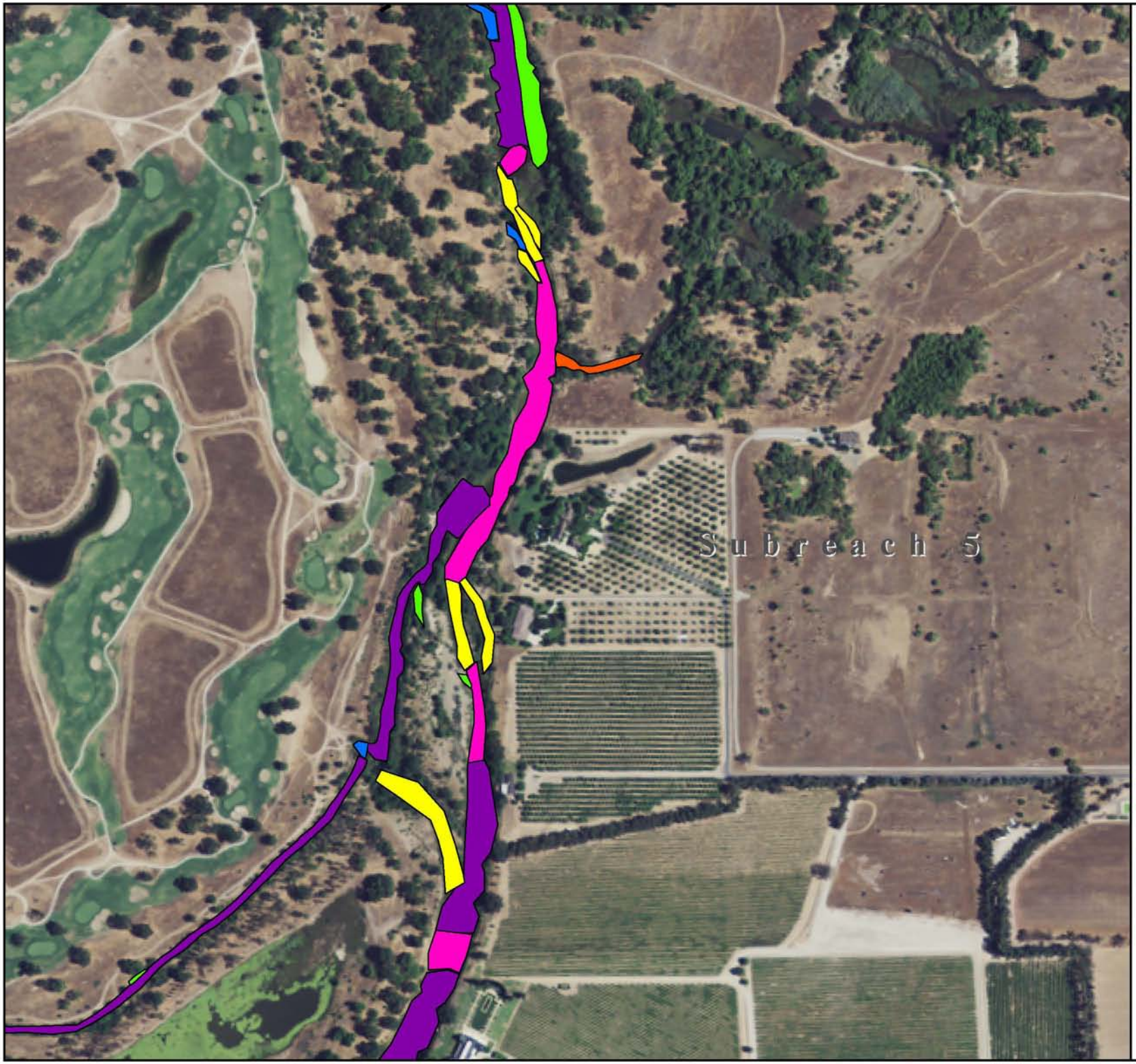

San Joaquin River Reach 1A

Subreach 5_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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Subject to revision

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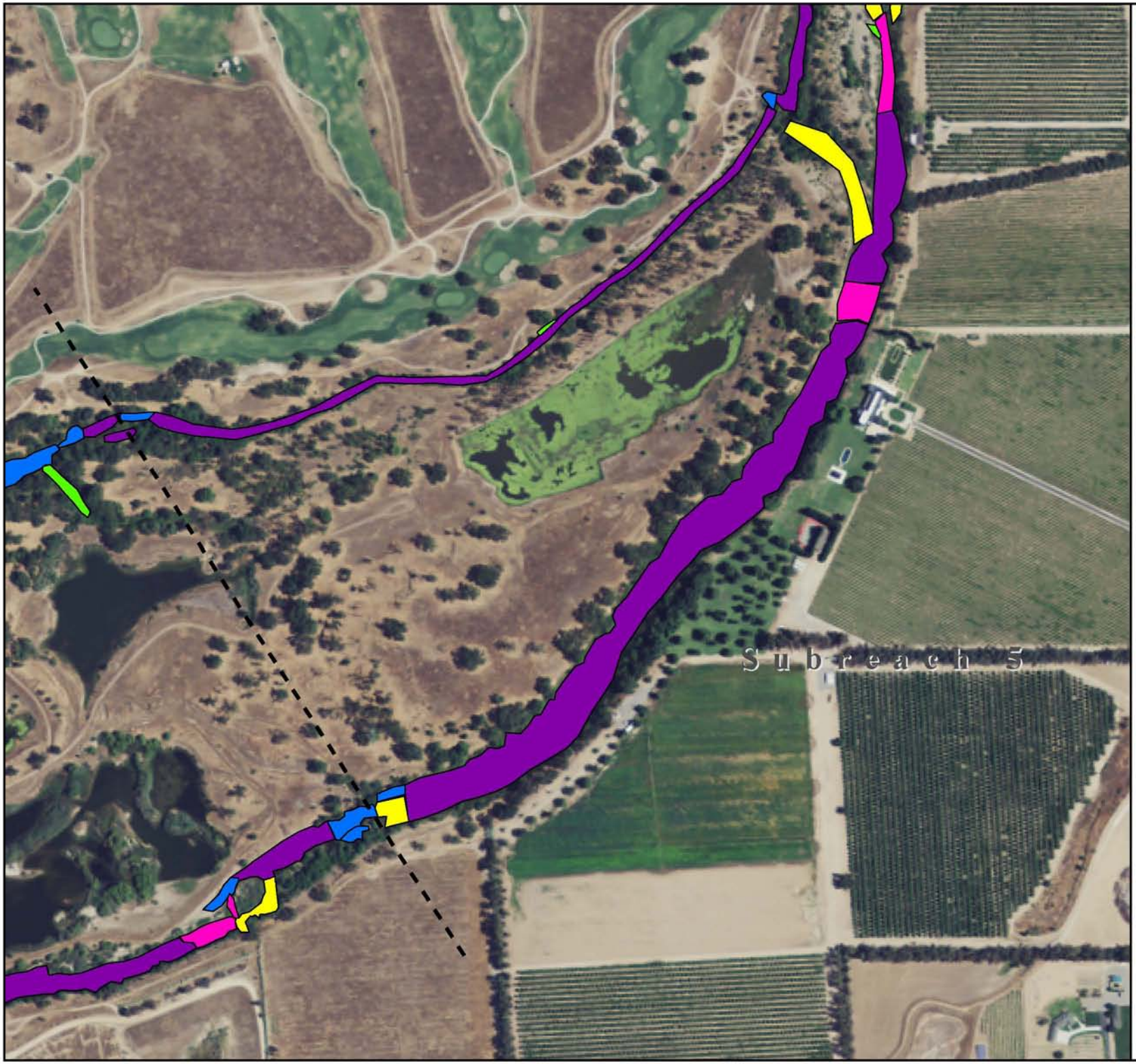

San Joaquin River
Reach 1A
Subreach 5_2

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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Subject to revision

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San Joaquin River
Reach 1A
Subreach 6_1

Subreach 6

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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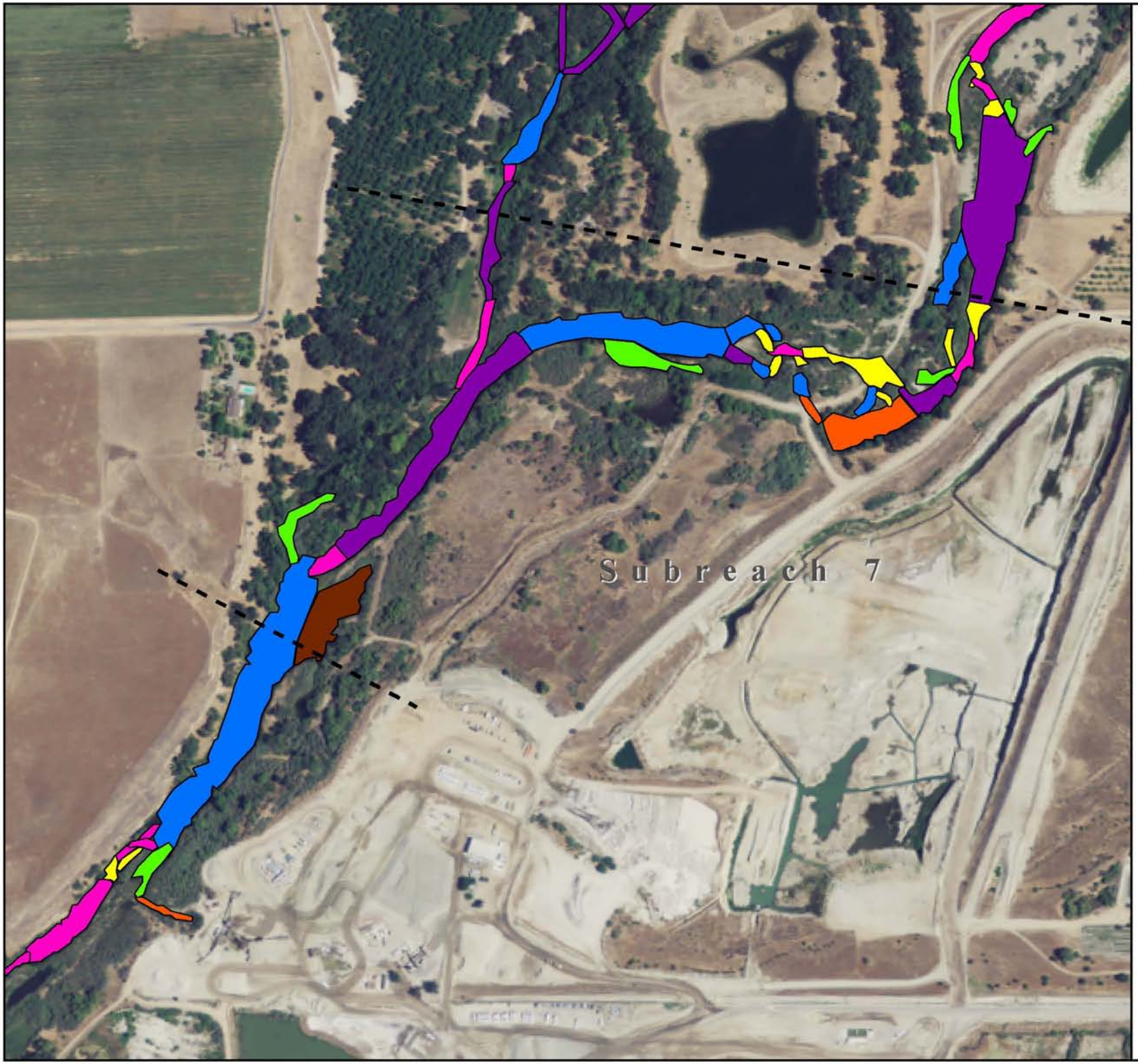

San Joaquin River
Reach 1A
Subreach 7_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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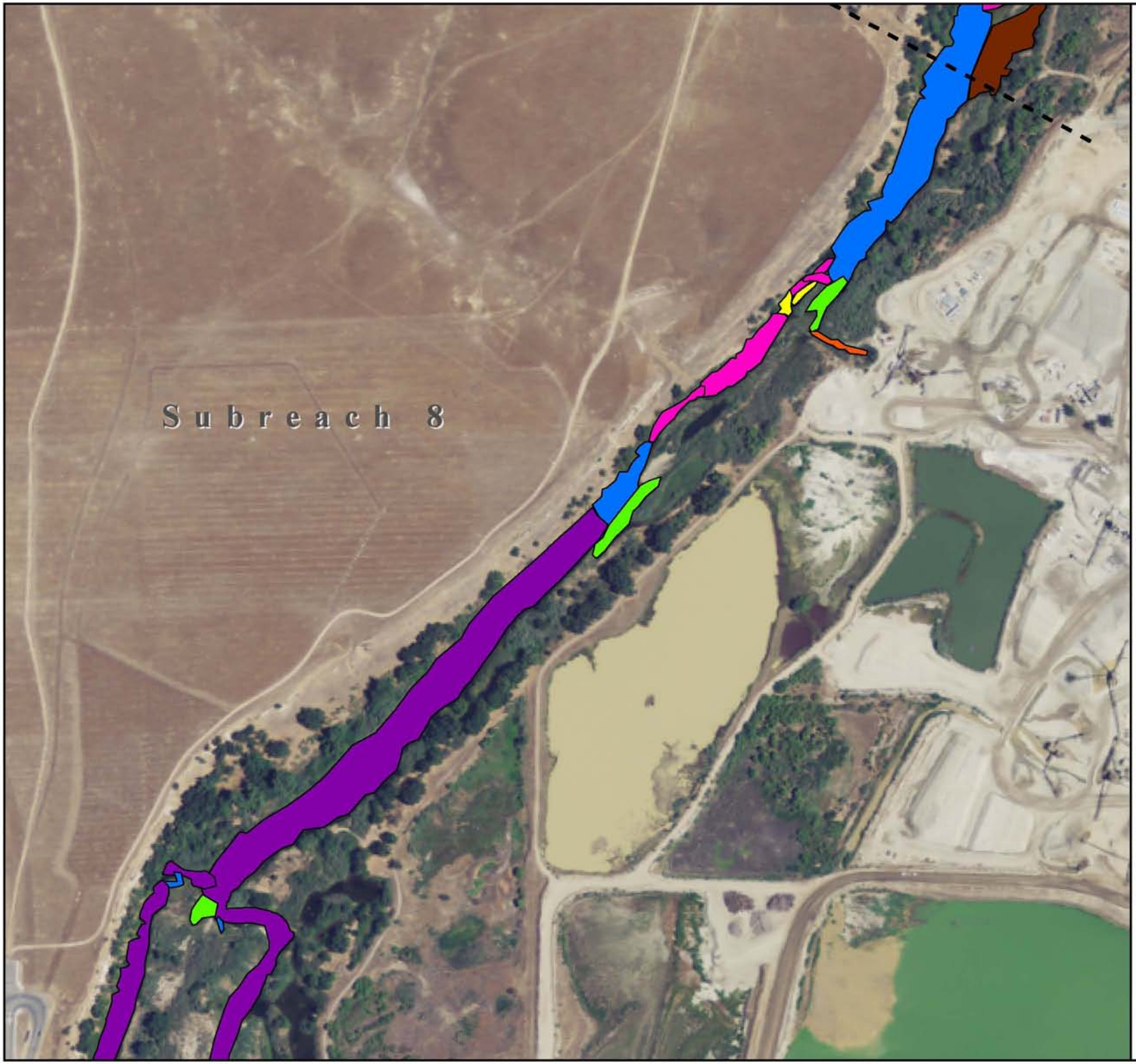

San Joaquin River
Reach 1A
Subreach 8_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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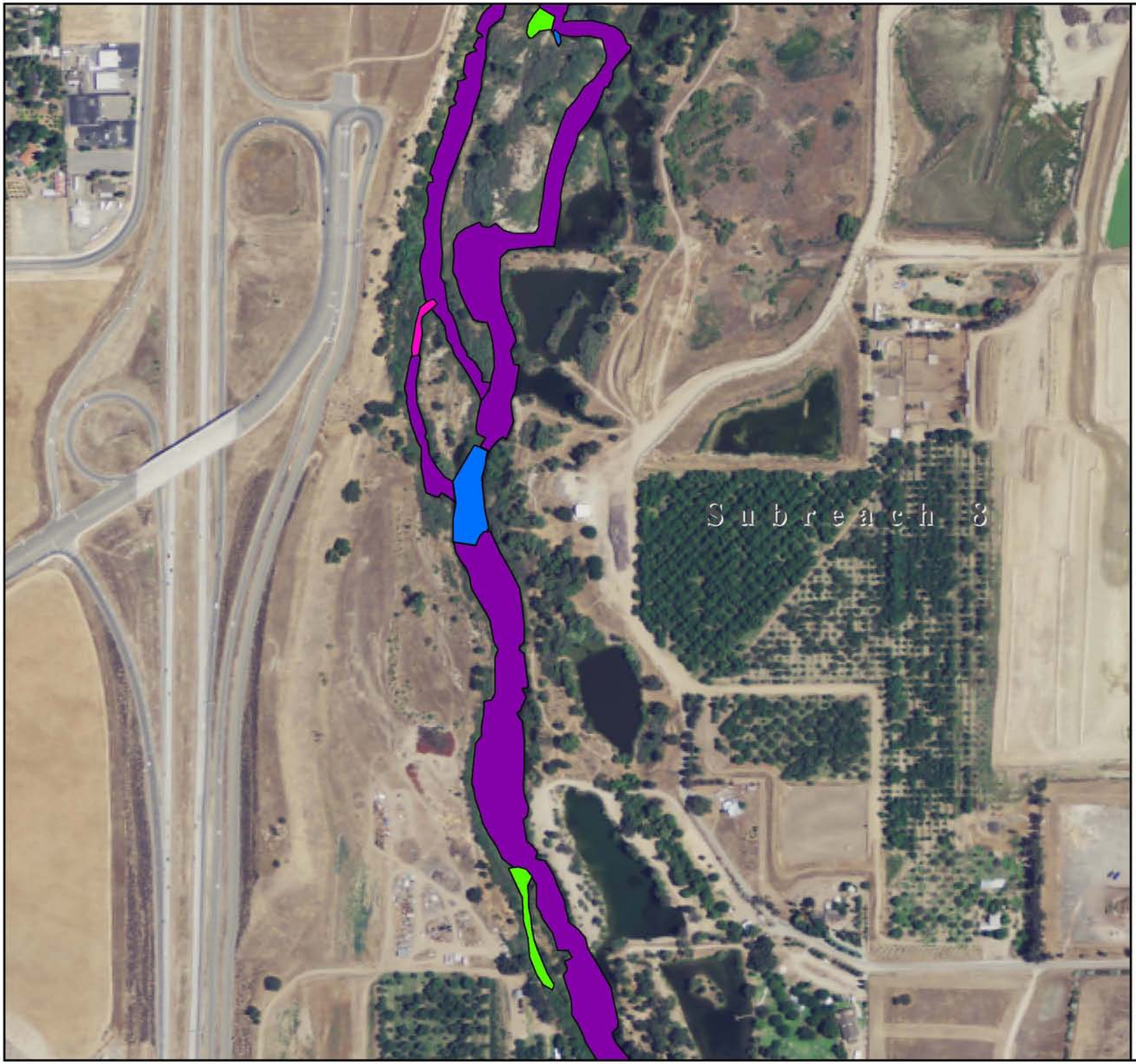

San Joaquin River Reach 1A

Subreach 8_2

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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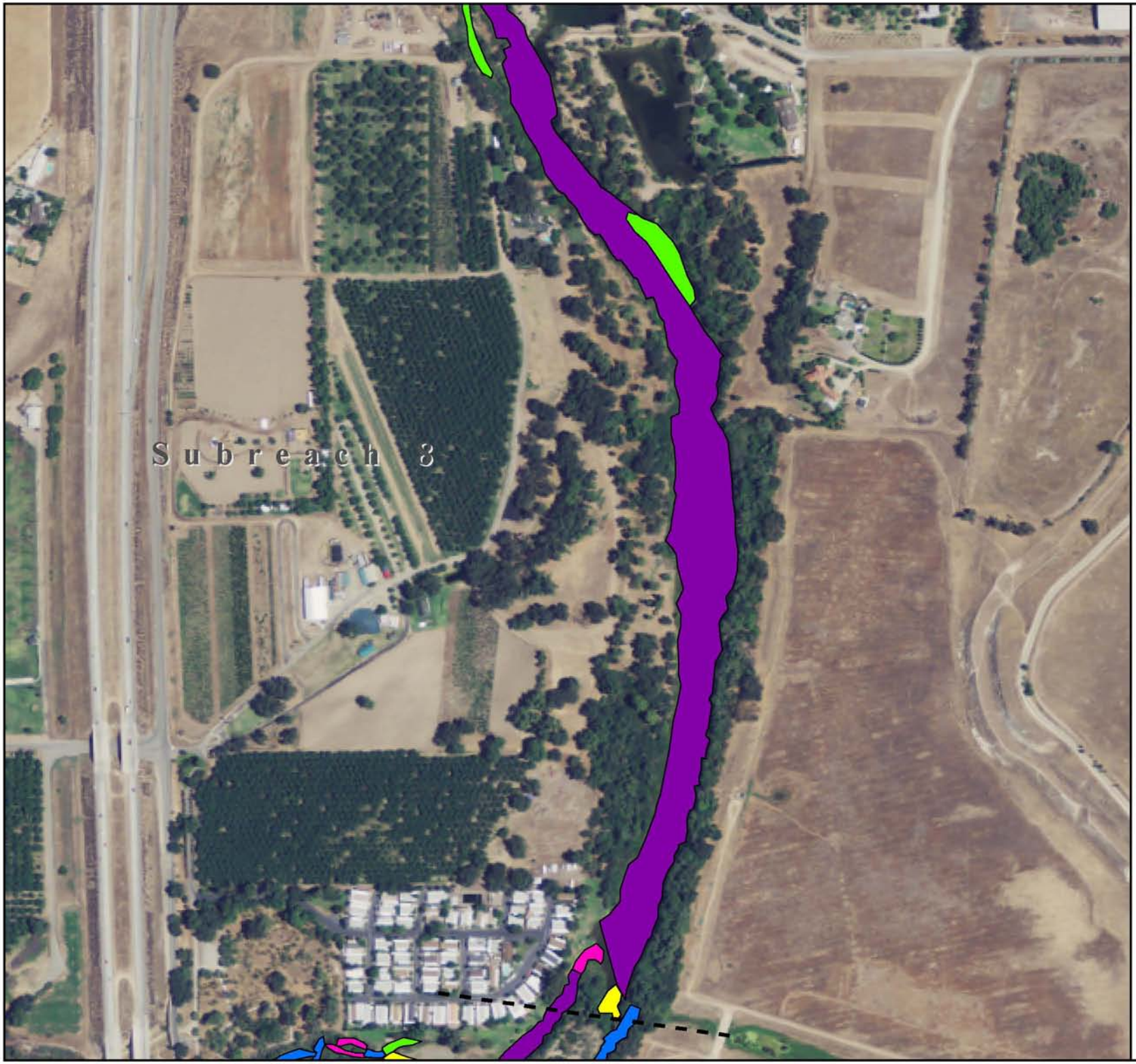

San Joaquin River
Reach 1A

Subreach 8_3

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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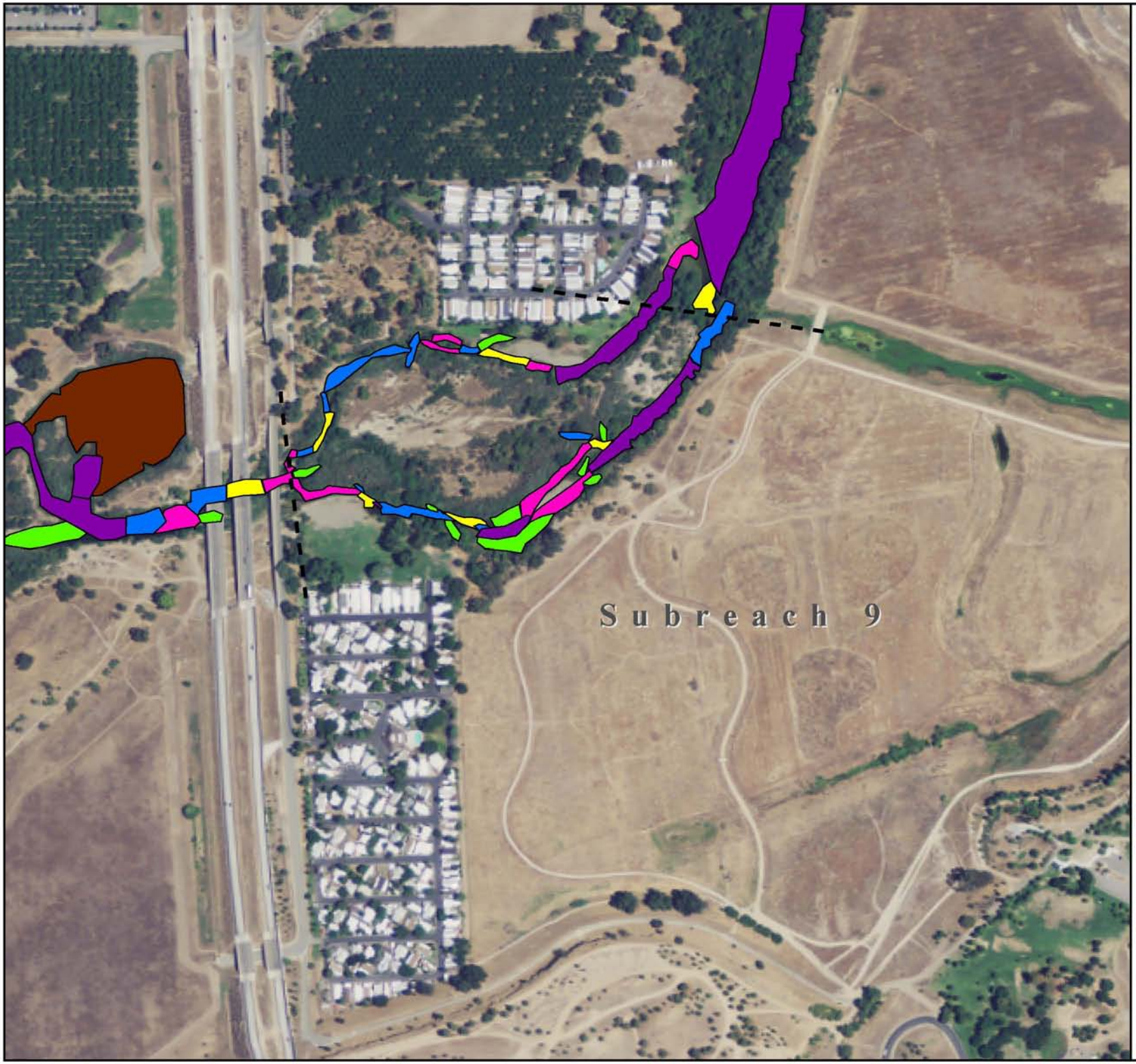

San Joaquin River
Reach 1A
Subreach 9_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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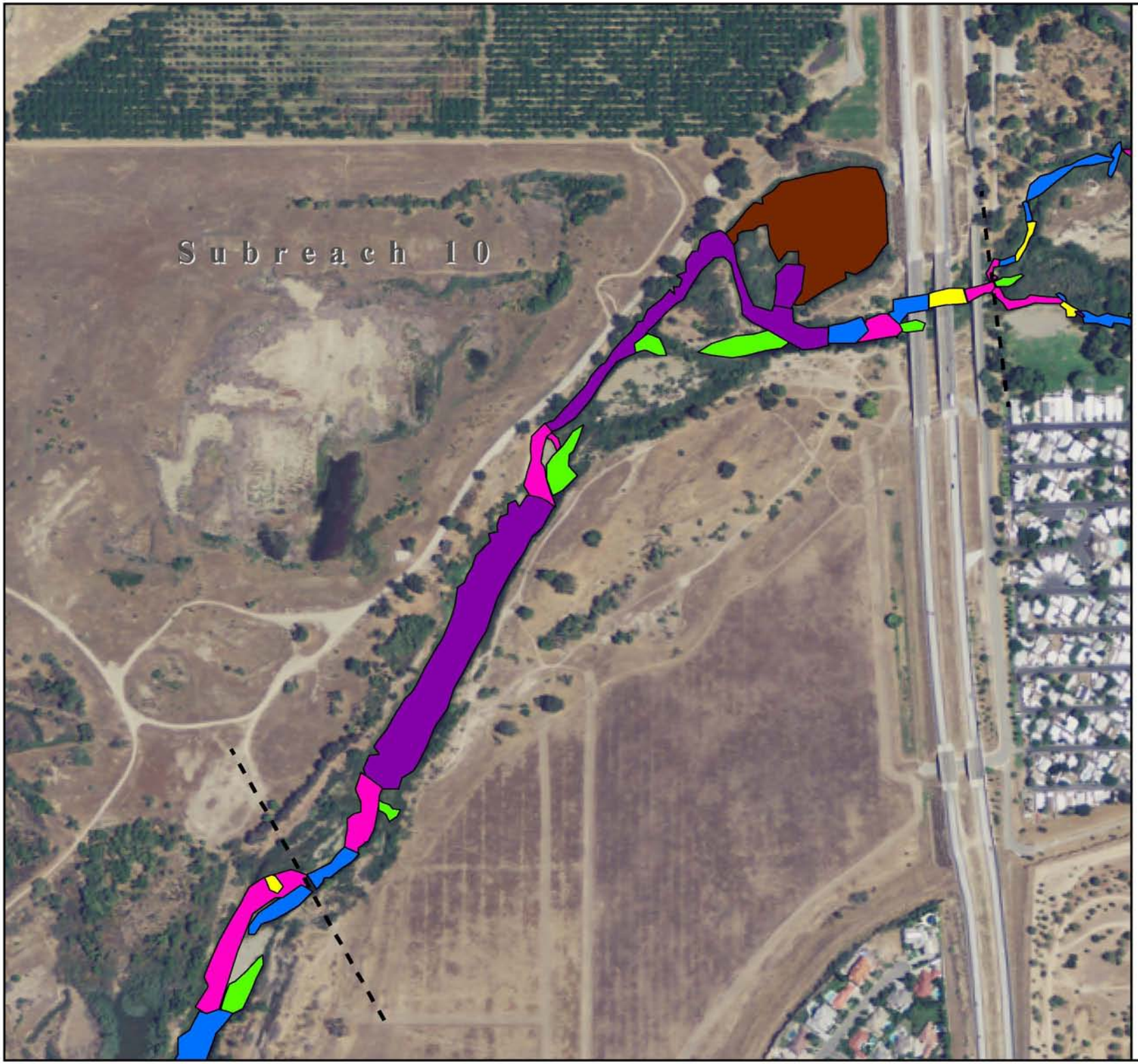

San Joaquin River
Reach 1A
Subreach 10_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

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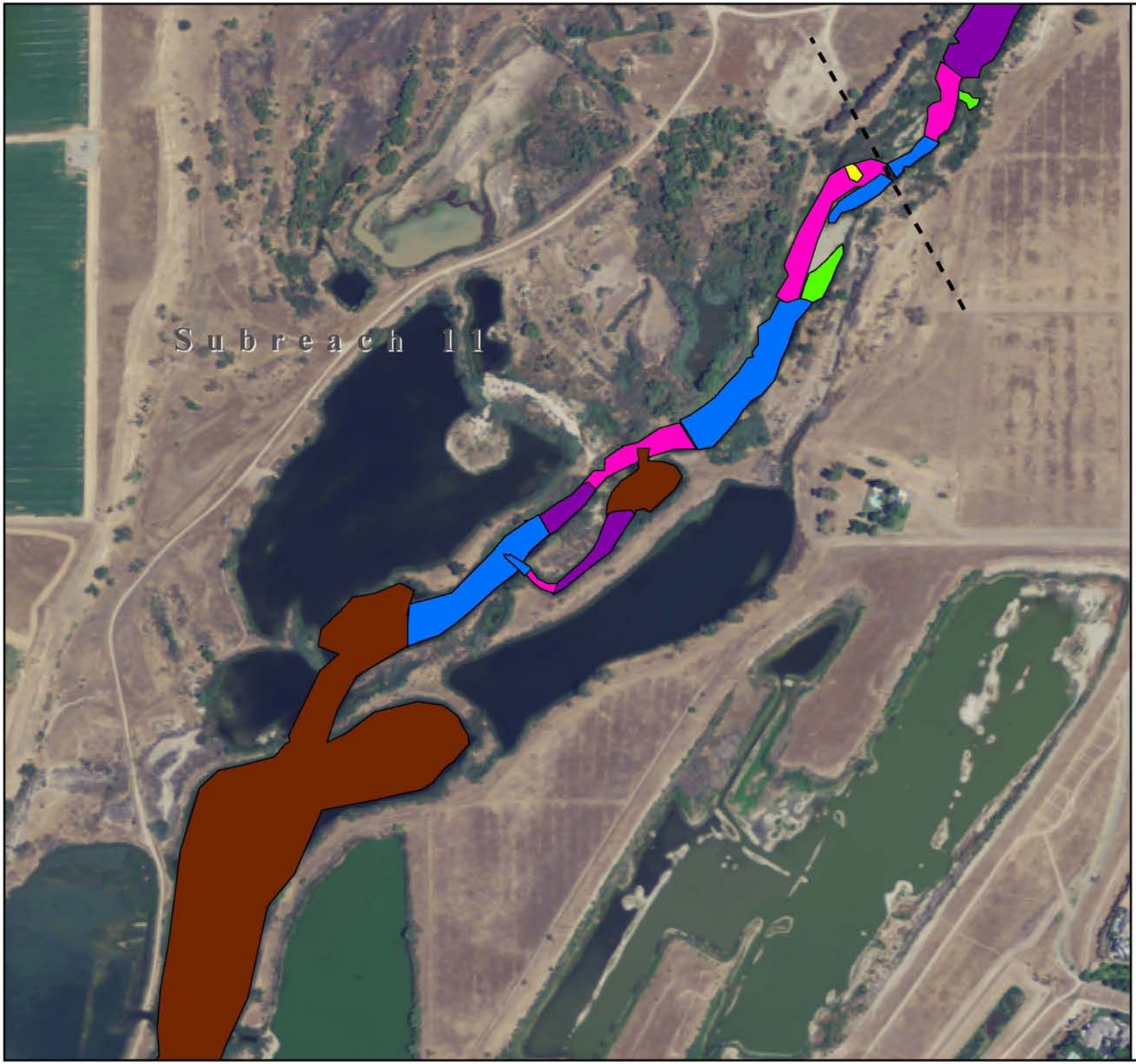

San Joaquin River
Reach 1A
Subreach 11_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

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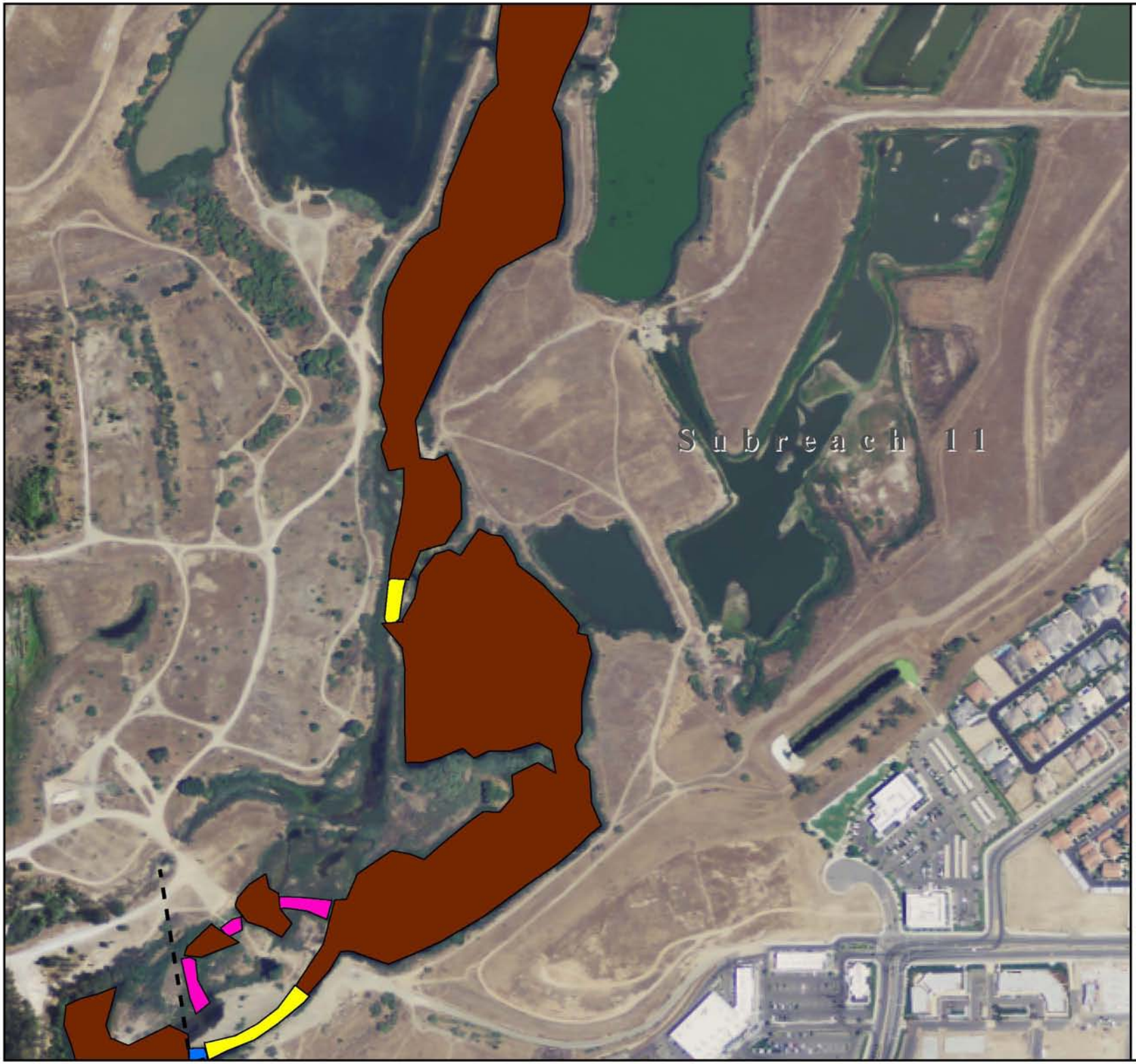

San Joaquin River
Reach 1A
Subreach 11_2

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

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Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)

San Joaquin River
Reach 1A
Subreach 12_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
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San Joaquin River
Reach 1A
Subreach 13_1

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)

San Joaquin River
Reach 1A
Subreach 13_2

Map Key

- Subreach Division

Habitat

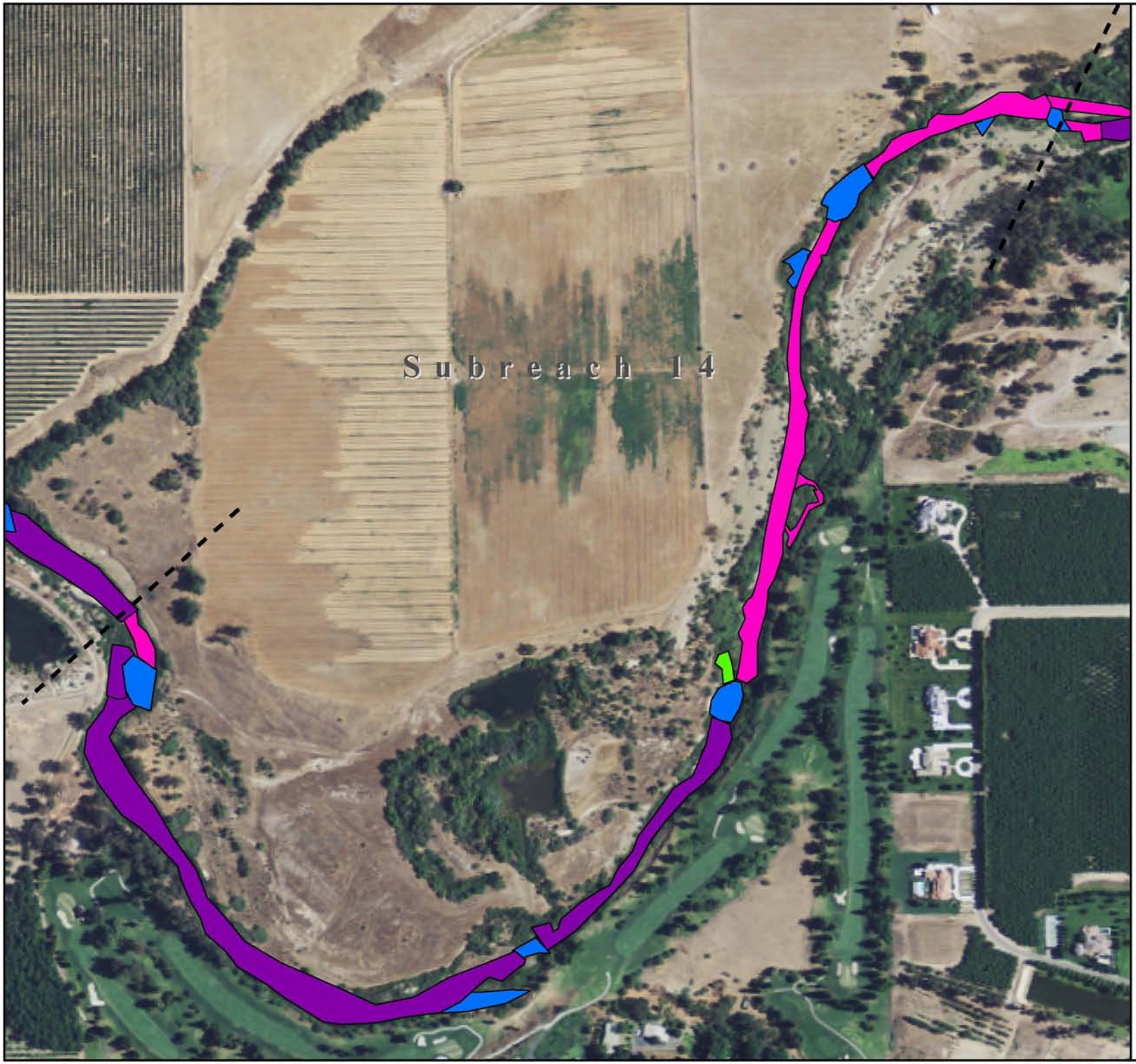
- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)



San Joaquin River Reach 1A

Subreach 14_1

Map Key

- Subreach Division

Habitat

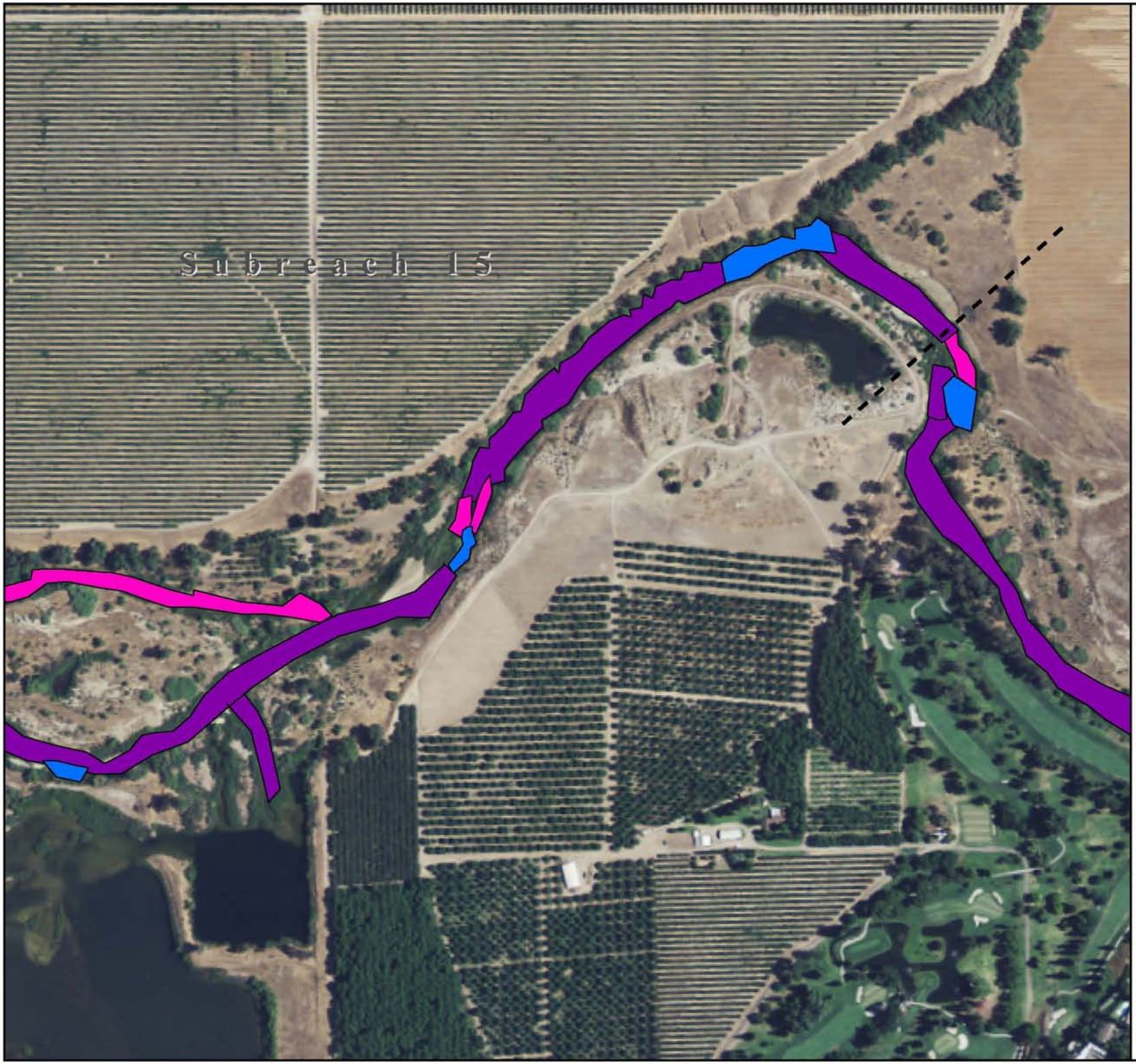
- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)



San Joaquin River
Reach 1A
Subreach 15_1

Map Key

- Subreach Division

Habitat

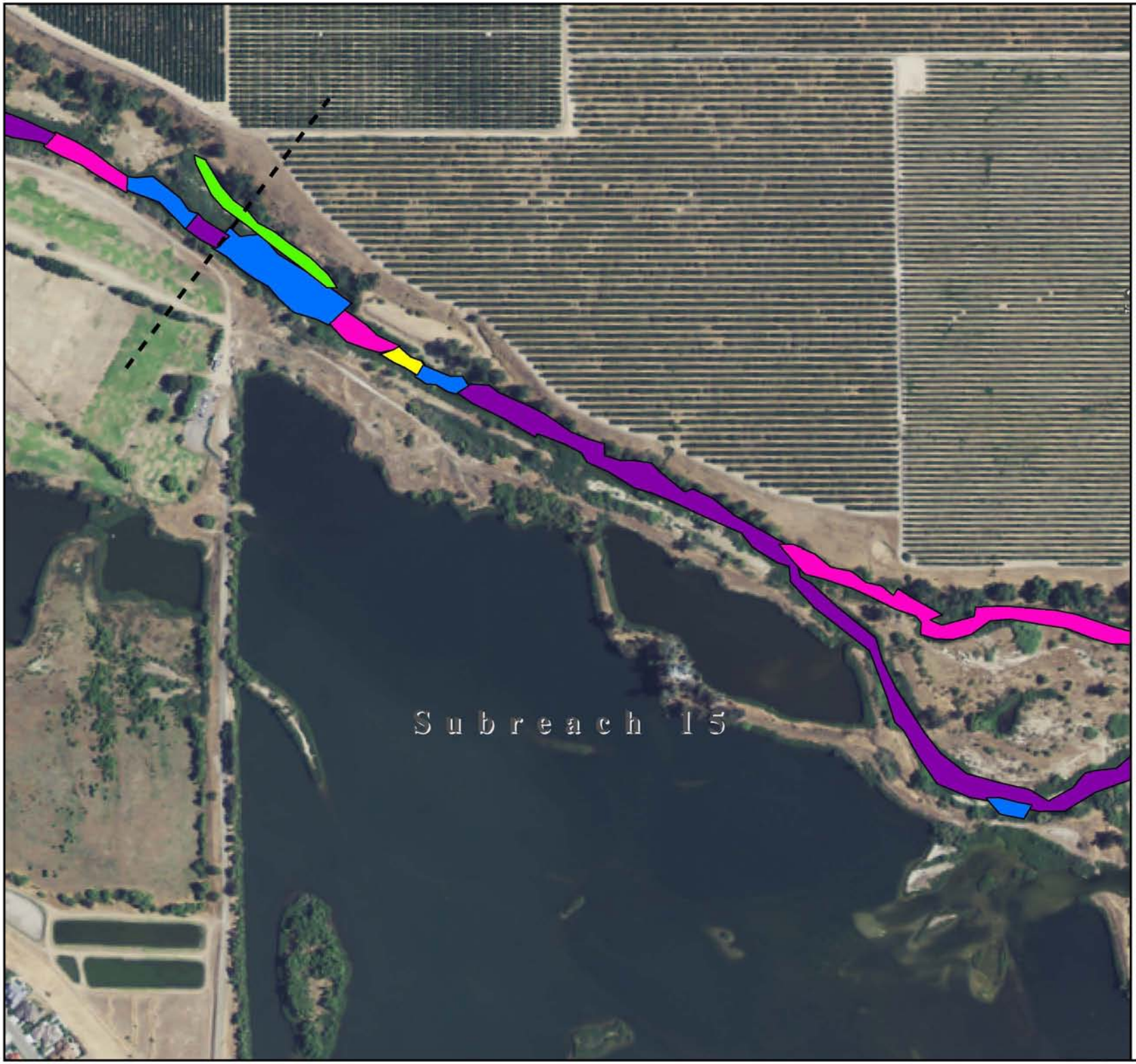
- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)



San Joaquin River
Reach 1A
Subreach 15_2

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)

San Joaquin River
Reach 1A
Subreach 16_1

Map Key

- Subreach Division

Habitat

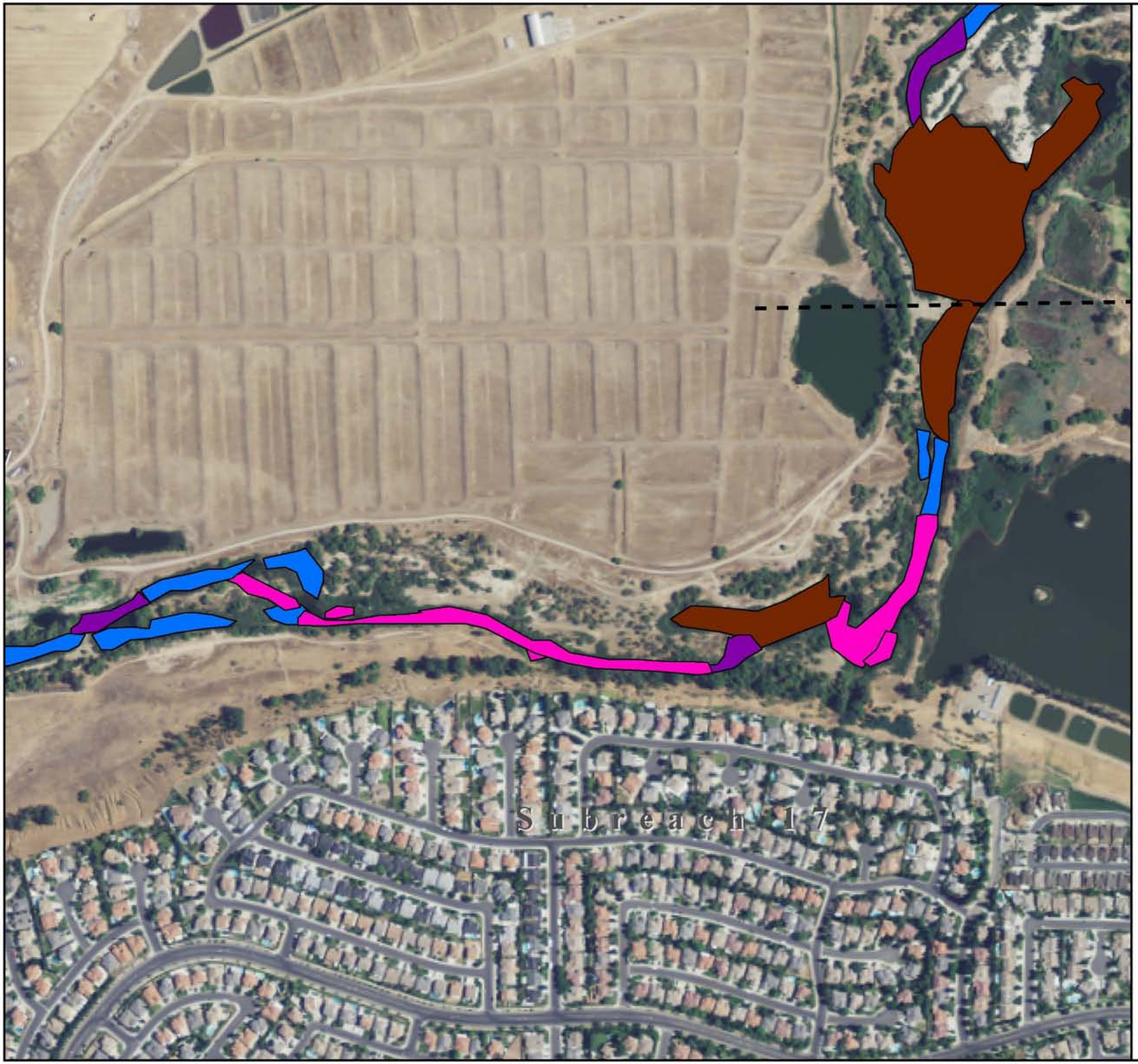
- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)



San Joaquin River
Reach 1A
Subreach 17_1

Map Key

- Subreach Division

Habitat

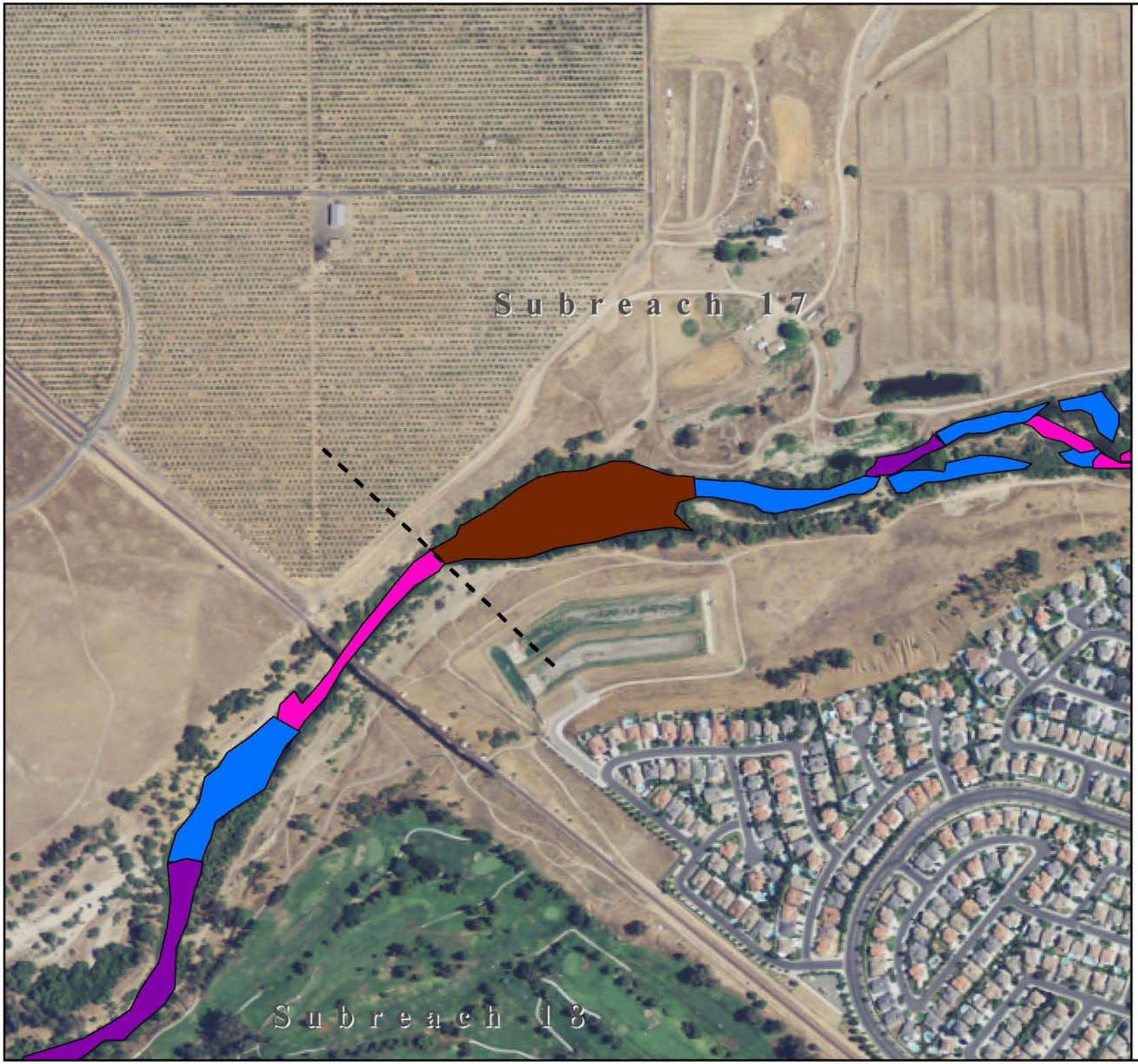
- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)



San Joaquin River
Reach 1A

Subreach 17_2

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

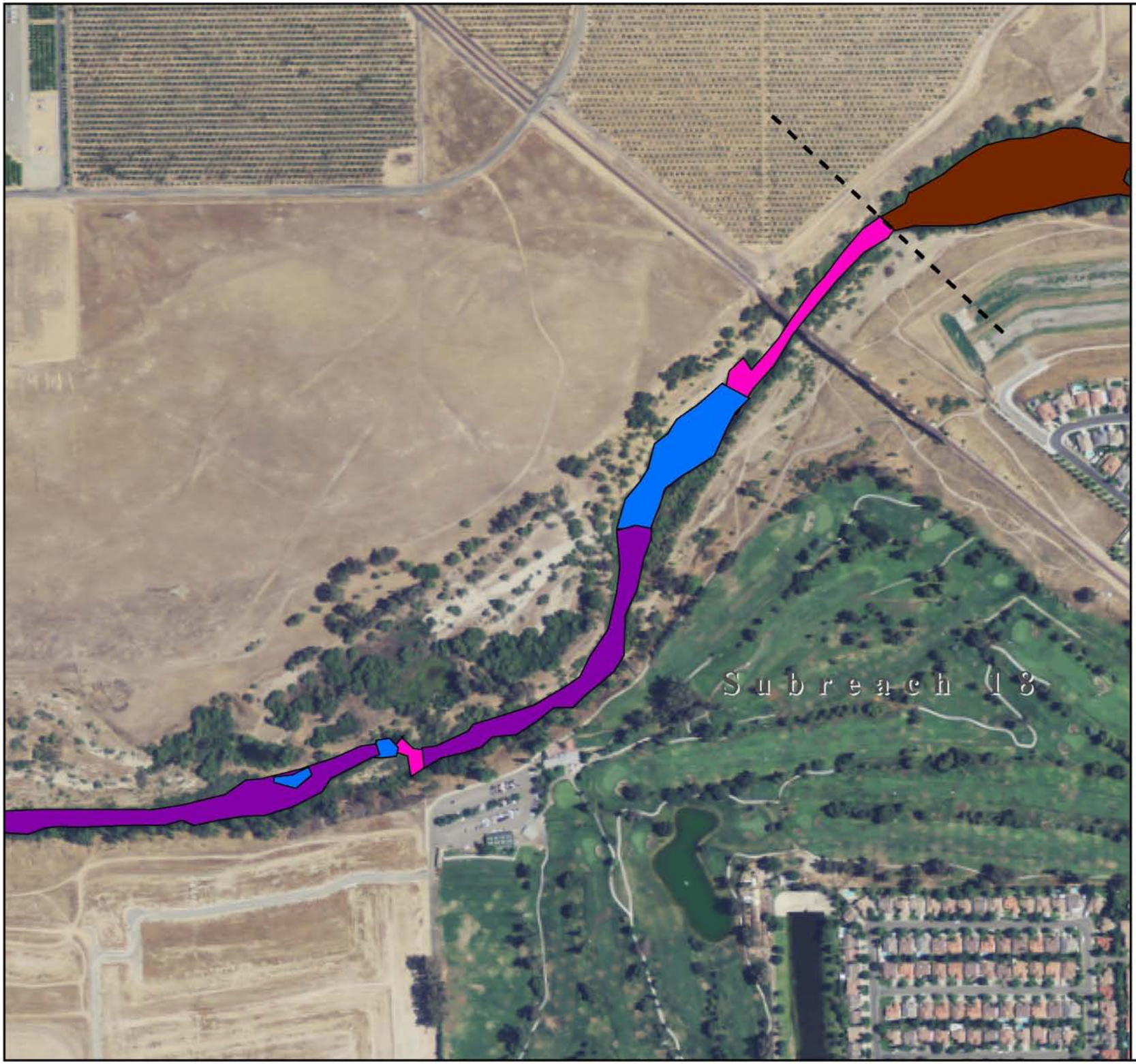
Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)

San Joaquin River
Reach 1A
Subreach 18_1



Map Key

- Subreach Division

Habitat

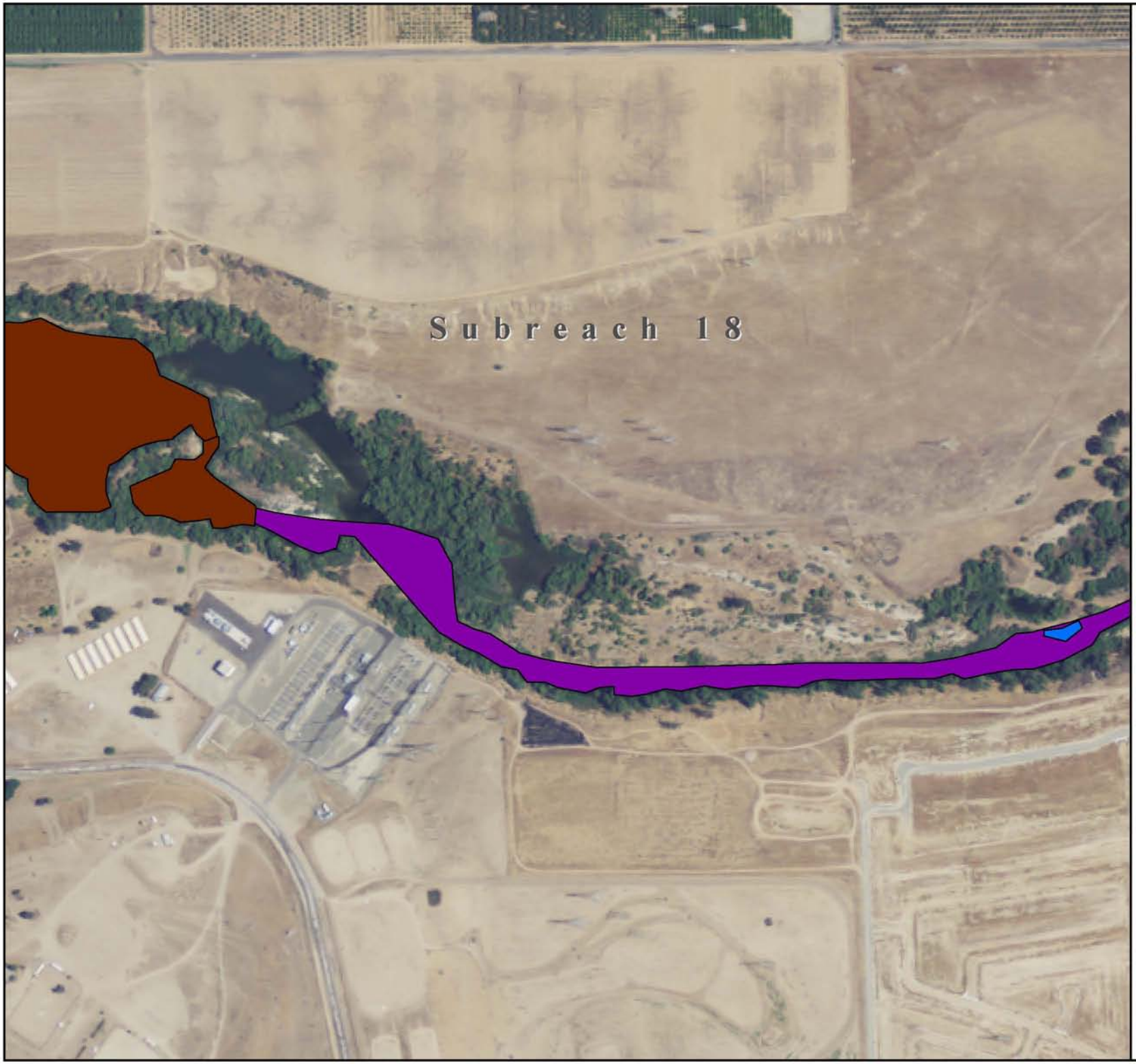
- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)



San Joaquin River
Reach 1A
Subreach 18_2

Map Key

- Subreach Division

Habitat

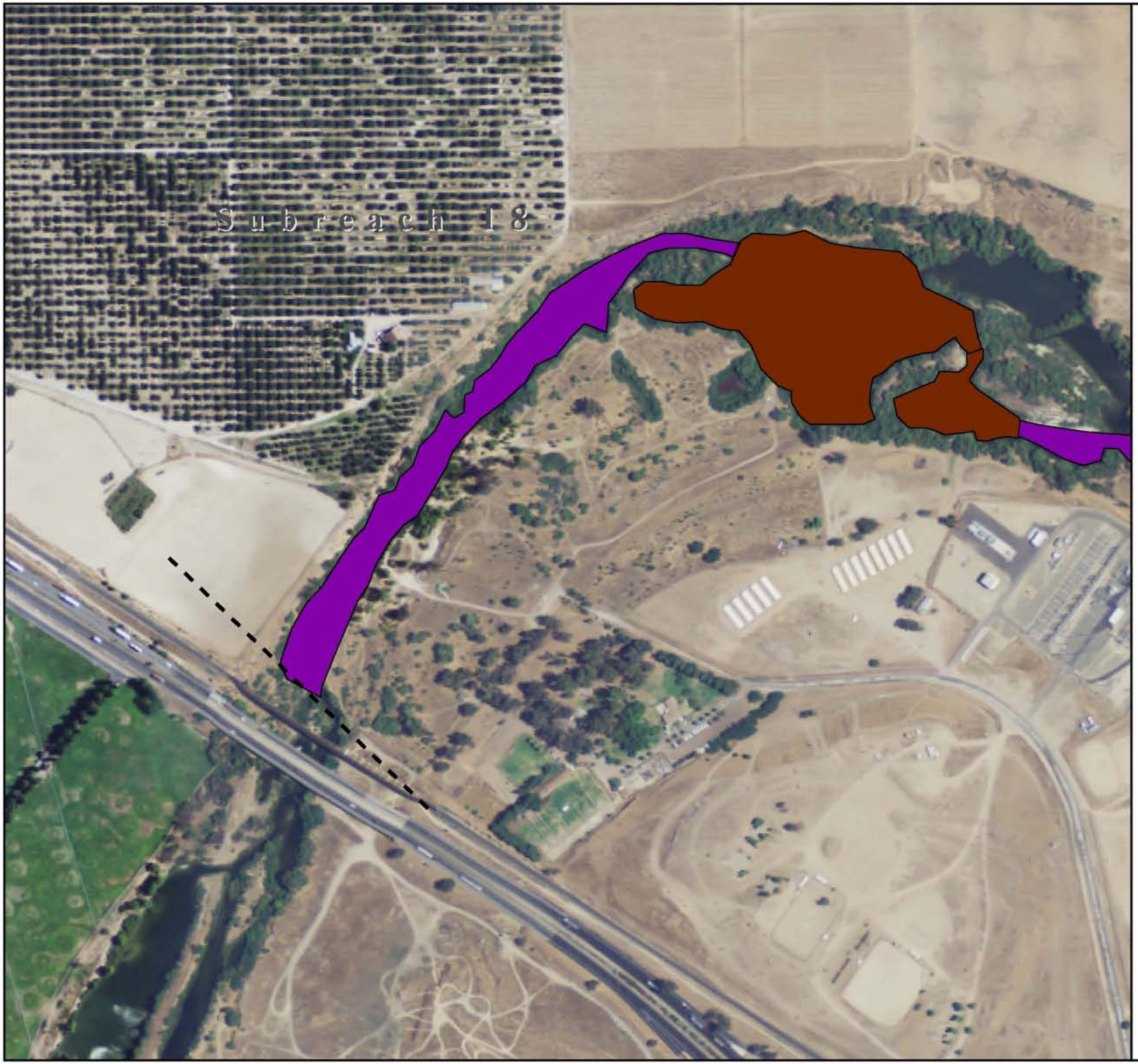
- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)



San Joaquin River
Reach 1A
Subreach 18_3

Map Key

- Subreach Division

Habitat

- Cascade
- Edgewater
- Glide
- Mine pit
- Pool
- Riffle
- Run
- Other

Sampling flows 350 cfs
Aerial photo flows 150-250 cfs

0 50 100 200 Meters

DRAFT
Subject to revision

File: sjr_habitat_maps.mxd
Source: Habitat GPS'd by DFG staff, Aerial (NAIP, 2009)