

Habitat Monitoring Update

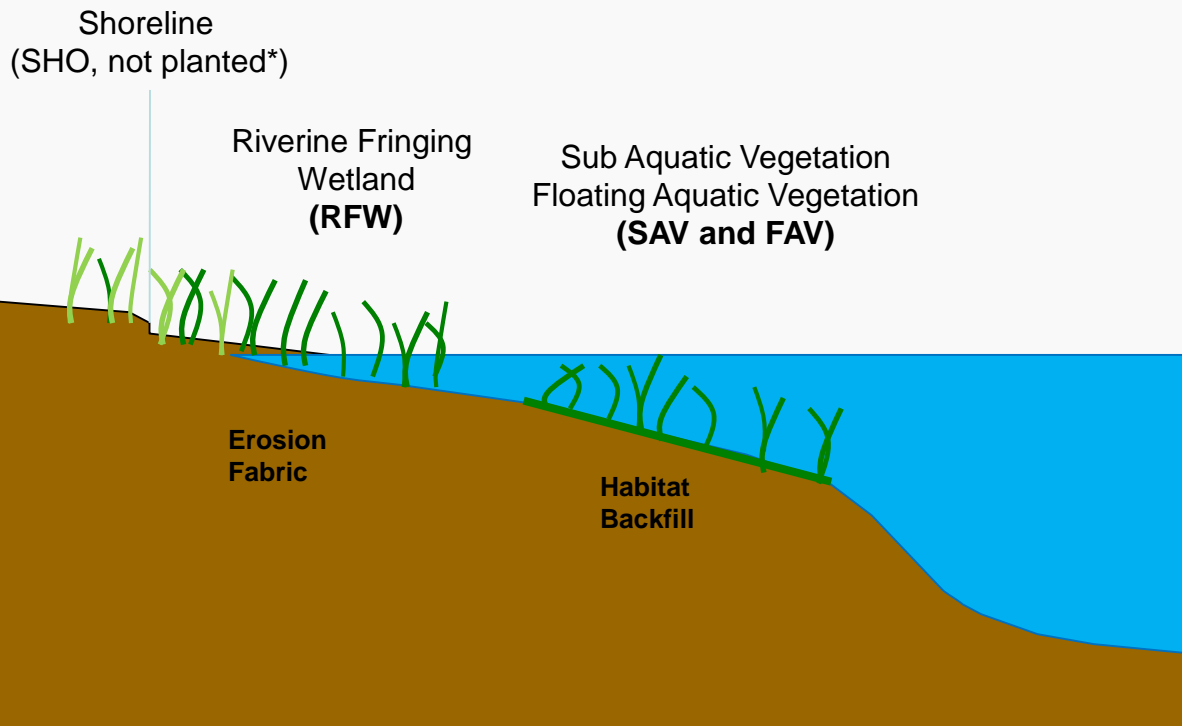
Hudson River CAG November 16, 2017



Habitat Reconstruction Overview: Habitats



A habitat replacement program is being implemented in an Adaptive Management context to reconstruct and stabilize habitats impacted during dredging



- **Shoreline (SHO)**
- **Riverine Fringing Wetland (RFW)**
- **Submerged & Floating Aquatic Vegetation (SAV/FAV)**
 - Planting and Natural Recolonization (NR) Areas
- **Unconsolidated River Bottom (UCB, not vegetated)**

* SHO reconstruction included planting if disturbed above design elevation, depending on energetics.

Habitat Reconstruction Overview: Monitoring and Reporting



Monitoring

- During dredging, backfill placement, and plant installation, reconstruction was tracked (at CU and Reach scales) using a ledger
- Reconstruction areas are currently monitored using a suite of observations identified in the Phase 1 and Phase 2 Adaptive Management (AM) Plans
- Due to the phased nature of the project, some habitat monitoring was implemented in parallel with (but upstream of) dredging activities

Reporting

- Habitat monitoring plans are proposed annually in Operation, Maintenance and Monitoring (OM&M) Plans
- Results are reported annually in Monitoring, Maintenance, and Adaptive Management (MM&AM) Reports
- Potential response actions are proposed in the MM&AM reports and implementation approaches are described in the O&M plans

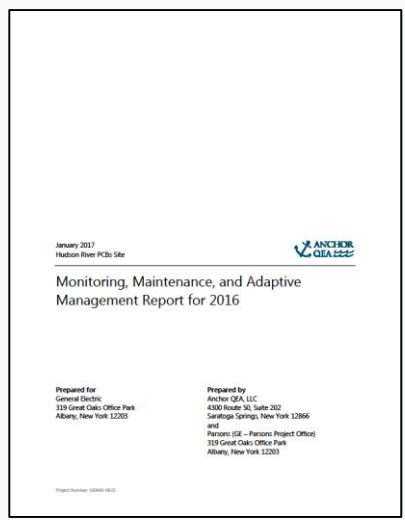
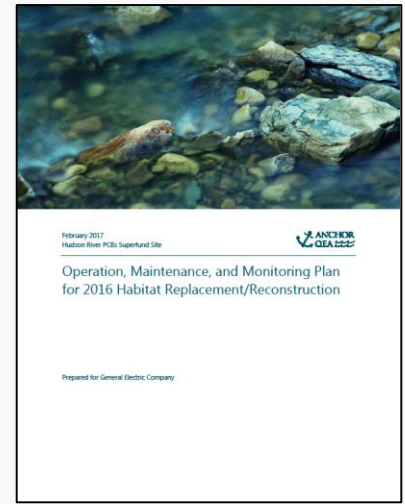
Habitat Reconstruction Overview: Monitoring and Reporting



September 13, 2016. This preliminary ledger is an ongoing work in progress. Acreages will be updated as necessary based on design and construction factors and EPA approval of Form 3 packages. The acreages provided in this version of the ledger are based on Form 2 and Form 3 packages approved by EPA as of September 13, 2016, or currently in draft form, and designs submitted to EPA as of August 4, 2016. Therefore, the acreages are subject to change.

Table 4: RFW Construction Areas

Dredge Year	Certification Unit	FORM 2 AS-BUILT DRAWING		FORM 3 AS-BUILT DRAWING			FINAL DESIGN Before Pre-Planting Survey			FINAL DESIGN After Pre-Planting Survey			FORM 3 RECORD DRAWING			Form 3 - RFD Design	
		RFW Area (acres)	RFW - FAV/SAV Area (acres)	RFW Area (acres)	RFW - FAV/SAV Area (acres)	FORM 2 Notes	RFW Area (acres)	RFW - FAV/SAV Area (acres)	Before Pre-Planting Notes	RFW Area (acres)	RFW - FAV/SAV Area (acres)	After Pre-Planting Notes	RFW Area (acres)	RFW - FAV/SAV Area (acres)	FORM 3 Notes	RFW Area Difference (acres)	RFW - FAV/SAV Area Difference (acres)
TOTAL CUs		22.75	6.47	20.52	7.45	19.00	23.33	5.74	155.00	24.47	5.68	153.00	24.21	5.68	0.00	1.5	-0.8
2009	CU-1			NA	NA		NA	NA								0.0	0.0
	CU-2	0.20		NA	NA		NA	NA		0.20		1	0.20			0.0	0.0
	CU-3			NA	NA		NA	NA					0.00	0.00		0.0	0.0
	CU-4			NA	NA		NA	NA					0.00	0.00		0.0	0.0
	CU-5			NA	NA		NA	NA					0.00	0.00		0.0	0.0
	CU-6	0.00		NA	NA		NA	NA					0.00	0.00		0.0	0.0
	CU-7	0.07		NA	NA		NA	NA		0.05		1	0.05	0.00		0.0	0.0
	CU-8	0.12		NA	NA		NA	NA		0.15		1	0.15	0.00		0.0	0.0
2011	CU-9	0.17		0.24	0.00		0.24		1	0.24		2	0.24	0.00		0.1	0.0
	CU-10	0.08		0.08	0.00		0.08		2	0.08		3	0.08	0.00		0.0	0.0
	CU-11			0.00	0.00											0.0	0.0
	CU-12			0.00	0.00											0.0	0.0
	CU-13			0.00	0.00								0.00	0.00		0.0	0.0
	CU-14			0.00	0.00								0.00	0.00		0.0	0.0
	CU-15			0.00	0.00								0.00	0.00		0.0	0.0
	CU-16			0.00	0.00								0.00	0.00		0.0	0.0
2009	CU-17			NA	NA								0.00	0.00		0.0	0.0
	CU-18			NA	NA								0.00	0.00		0.0	0.0
	CU-19	0.04		0.04	0.00		0.05		1	0.05		2	0.05	0.00		0.0	0.0
	CU-20			0.00	0.00								0.00	0.00		0.0	0.0
	CU-21			0.00	0.00								0.00	0.00		0.0	0.0
	CU-22			0.00	0.00								0.00	0.00		0.0	0.0
	CU-23			0.00	0.00								0.00	0.00		0.0	0.0
	CU-24			0.00	0.00								0.00	0.00		0.0	0.0
2011	CU-25			0.00	0.00								0.00	0.00		0.0	0.0
	CU-26			0.00	0.00								0.00	0.00		0.0	0.0
	CU-27			0.00	0.00								0.00	0.00		0.0	0.0
	CU-28			0.00	0.00								0.00	0.00		0.0	0.0
	CU-29			0.00	0.00								0.00	0.00		0.0	0.0
	CU-30			0.00	0.00								0.00	0.00		0.0	0.0
	CU-31			0.00	0.00								0.00	0.00		0.0	0.0
	CU-32			0.00	0.00								0.00	0.00		0.0	0.0
	CU-33			0.00	0.00								0.00	0.00		0.0	0.0
	CU-34			0.00	0.00								0.00	0.00		0.0	0.0
	CU-35	0.20		0.20	0.00		0.19		2	0.19		4	0.19			0.0	0.0
	CU-36			0.00	0.00								0.00	0.00		0.0	0.0
	CU-37	0.14		0.14	0.00		0.14		3	0.14		4	0.18			0.0	0.0
	CU-38	0.05		0.05	0.00		0.04		3	0.04		4	0.05			0.0	0.0
	CU-39			0.00	0.00								0.00	0.00		0.0	0.0
	CU-40			0.00	0.00								0.00	0.00		0.0	0.0
CU-41			0.00	0.00								0.00	0.00		0.0	0.0	
CU-42			0.00	0.00								0.00	0.00		0.0	0.0	
CU-43			0.00	0.00								0.00	0.00		0.0	0.0	
CU-44			0.00	0.00								0.00	0.00		0.0	0.0	
CU-45			0.00	0.00								0.00	0.00		0.0	0.0	
CU-46			0.00	0.00								0.00	0.00		0.0	0.0	
CU-47	0.00		0.00	0.00		0.15		3	0.15		4	0.14			0.1	0.0	
CU-48			0.00	0.00								0.00	0.00		0.0	0.0	
CU-49			0.00	0.00								0.00	0.00		0.0	0.0	
CU-50	0.51	0.50	0.51	0.00		0.51	0.50	3	0.51	0.50	4	0.49	0.50	2	0.0	0.0	
CU-51	0.77	0.62	0.60	0.00		0.77	0.62	3	0.84	0.62	4, 8	0.94	0.62		0.2	0.0	
CU-52	0.74	0.98	0.52	0.00		0.57	0.98	3	0.57	0.98	4	0.57	0.98		-0.2	0.0	
CU-53	0.59	0.74	0.59	0.00		0.59	0.74	3	0.59	0.68	4, 9	0.59	0.68		0.0	-0.1	
CU-54	0.56	0.45	0.36	0.00		0.60	0.45	3	0.60	0.45	4	0.56	0.45	3	0.0	0.0	
CU-55	0.05	0.05	0.05	0.00		0.31	0.05	3	0.31	0.05	4	0.36	0.05		0.0	0.0	
CU-56	0.22		0.19	0.00		0.31		3	0.31		4	0.35			0.1	0.0	
CU-57			0.36	0.00		0.32		3	0.32		4	0.33			0.1	0.0	
CU-58			0.00	0.00								0.00	0.00		0.0	0.0	
CU-59	0.01		0.00	0.00								0.00	0.00		0.0	0.0	
TOTAL		3.29	5.66	0.00	0.00	6.00	6.64	3.49	46.00	7.21	3.23	60.00	7.31	3.23	1.1	-0.1	



Habitat Reconstruction Overview: Monitoring Observations



We are currently in the post-construction (Benchmark) monitoring phase.
EPA approves transition into the Success Criteria phase.

Habitat	Operation & Monitoring (O&M) Observations
Shoreline (SHO)	Shoreline stabilization inspections.
Wetlands (RFW)	Cover or stem density, plant species composition (including invasive species), stability, hydrology, soils/sediments, acreage, herbivory and other potential impacts.
Submerged Aquatic Vegetation (SAV)	Cover, stem density, or above-ground biomass, plant species composition (including invasive species) by quadrats and video transects, downfall, sediments.
Unconsolidated River Bottom (UCB)	Aquatic invertebrates and substrate, sediments.



Benchmark Phase

- Used to evaluate reconstruction areas to determine if potential response actions might be needed
- Individual areas are compared to reference areas for up to 5 years
- Quantitative, but non-destructive measures applied to individual habitat reconstruction areas
- Purpose is to help areas get on trajectory to success by monitoring their progress and evaluating the need for potential response actions

Success Criteria Phase

- Quantitative comparisons to reference areas
- Application at river-reach scale (e.g., Thompson Island Pool / Reach 8)
- Evaluation against success criteria involves an additional 2-5 years of monitoring
- Total time in monitoring (benchmark + success criteria) will depend on how data indicate the reconstruction areas are performing
- Reaches are not ready for this phase at this time

Benchmark and Success Criteria Monitoring: RFW and SAV Status as of 2017



Reach (RS)	Year(s) RFW / SAV Established	Benchmark Monitoring Start	2017 Benchmark Year(s)
8 (1)	CU60: 2016 CUs 28-59: 2013-14 CUs 9-27: 2012-13 Phase 1: 2011-12	CU60: 2017 CUs 28-59: 2015 CUs 9-27: 2013-14 Phase 1: 2011-12	Phase 1: Years 6+ CU's 9-27: Years 4-5 <u>CUs 28-60: Yrs 1-3</u>
7 (2)	2015	2016	Year 2
6 (2)	2014	2015	Year 3
5 (3)	2014 or 2015	2015 or 2016	Years 2-3
4 (3)	2016	2017	Year 1
3 (3)	2017	2018	Year of Planting
2 (3)	2016	2017	Year 1
1 (3)	2016	2017	Year 1

Adapted from Tables 4-3, 4-4, 4-6, and 4-7 from the 2016 MM&AM Report

Benchmark and Success Criteria Monitoring: Considerations



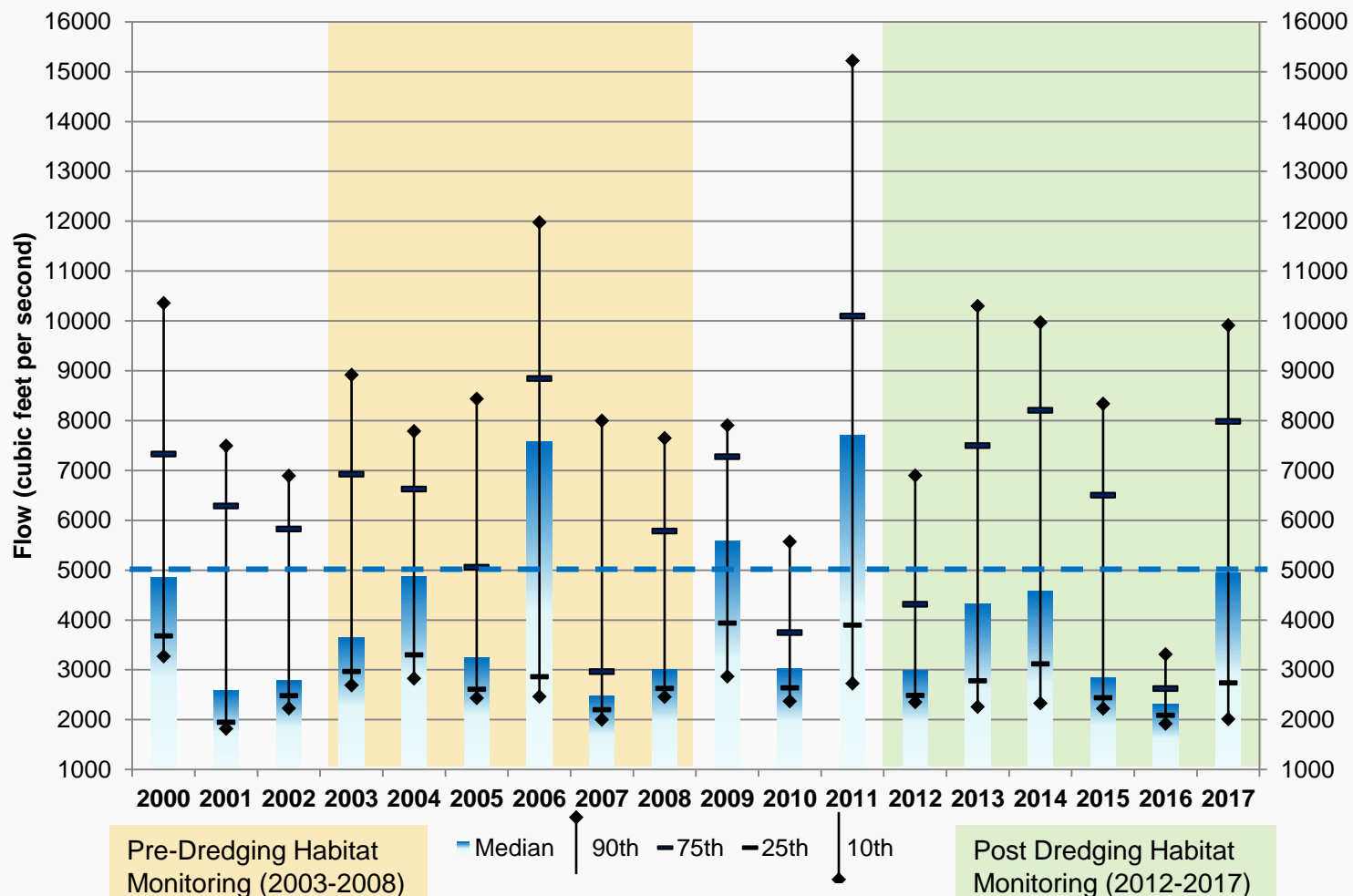
Natural environmental variability poses challenges to establishing reconstructed habitats and monitoring criteria

- Factors that challenge reconstructed habitats include:
 - Amount of sunlight, fluctuating water levels and temperatures
 - Variable River flows (high flow vs. low flow years—droughts and floods)
 - Ice flows, herbivory, and invasive species
 - Boat wakes and other human activity (removing plants)
- Extensive scientific analysis and discussion with NYS/other agencies went into developing the reconstruction approach and monitoring criteria (2005 through 2013).
- Final criteria are science driven, statistically based, reflect environmental variability, and involve comparisons of reconstructed areas to habitat reference areas.
- Overall approach is to establish initial plantings and “jump start” recovery, work with natural recolonization, monitor, and consider potential response actions (if necessary).

Variable River Flows 2000-2017



HR PCB Site Mean Daily Flows During Growing Season May 1 - Sept 30
(Data from USGS Fort Edward Gauge)



RFW Benchmark Monitoring Review



Benchmark Years	Time Since Planting	Benchmarks
1 (First)	Year of Planting	<ul style="list-style-type: none"> • 100% of plants meet acceptance criteria • Invasive species not present
2 (Second)	First full growing season post-planting	<ul style="list-style-type: none"> • 90% species and planting units present • % cover increased from initial planting density • No invasive species
3 (Third)	2 years after planting	<ul style="list-style-type: none"> • % cover \geq 70% of reference area cover • 20% species cover is from native volunteers • No invasive species
4 (Fourth)	3 years after planting	<ul style="list-style-type: none"> • % cover \geq 85% of reference area cover • 40% species cover is from native volunteers • Invasive species % cover \leq reference areas
5 and 6	4 th and 5 th year after planting	<ul style="list-style-type: none"> • % cover \geq 85% of reference area cover • Invasive species % cover \leq reference areas

RFW Benchmark Monitoring Status



28+ ACRES OF THE 29.9 ACRES OF RFW ARE IN YEARS 2-3

Benchmark Years	Time Since Planting	Benchmarks
1 (First)	Year of Planting	<ul style="list-style-type: none"> • 100% of plants meet acceptance criteria • Invasive species not present
2 (Second)	First full growing season post-planting	<ul style="list-style-type: none"> • 90% species and planting units present • % cover increased from initial planting density • No invasive species
3 (Third)	2 years after planting	<ul style="list-style-type: none"> • % cover \geq 70% of reference area cover • 20% species cover is from native volunteers • No invasive species
4 (Fourth)	3 years after planting	<ul style="list-style-type: none"> • % cover \geq 85% of reference area cover • 40% species cover is from native volunteers • Invasive species % cover \leq reference areas
5 and 6	4 th and 5 th year after planting	<ul style="list-style-type: none"> • % cover \geq 85% of reference area cover • Invasive species % cover \leq reference areas

RFW Benchmark Monitoring CU-2 “Bond Creek” Wetland



August 2008, Approx 6,000 cfs

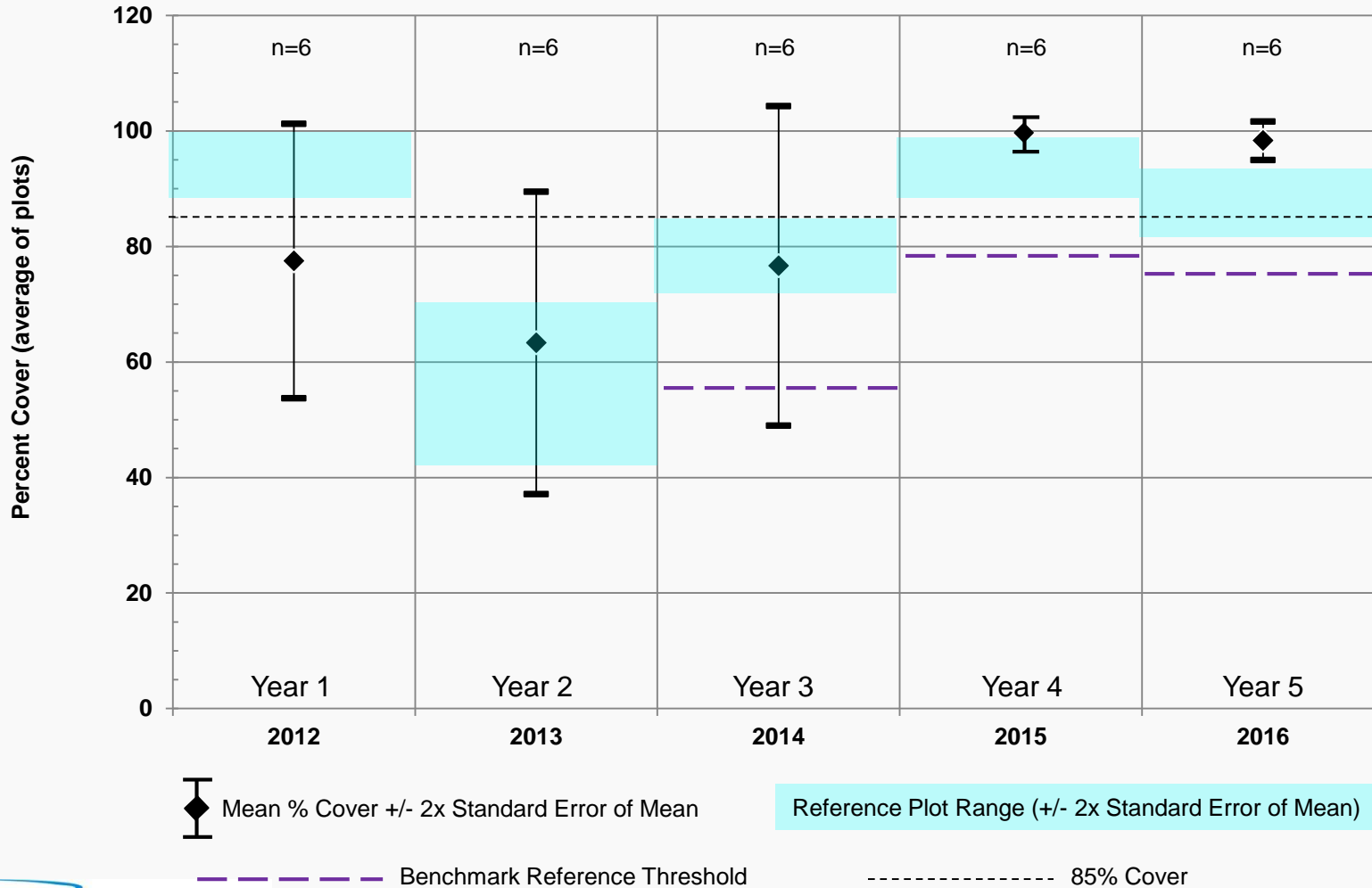


Rice cut grass/spike rush community, 95% Coverage 2007-2008

CU-2 "Bond Creek Wetland" Planted in 2010



RFW Percent Cover (plots) Compared to Reference Area (plots) Percent Cover 2012-2016



CU-2 “Bond Creek Wetland” Post-construction

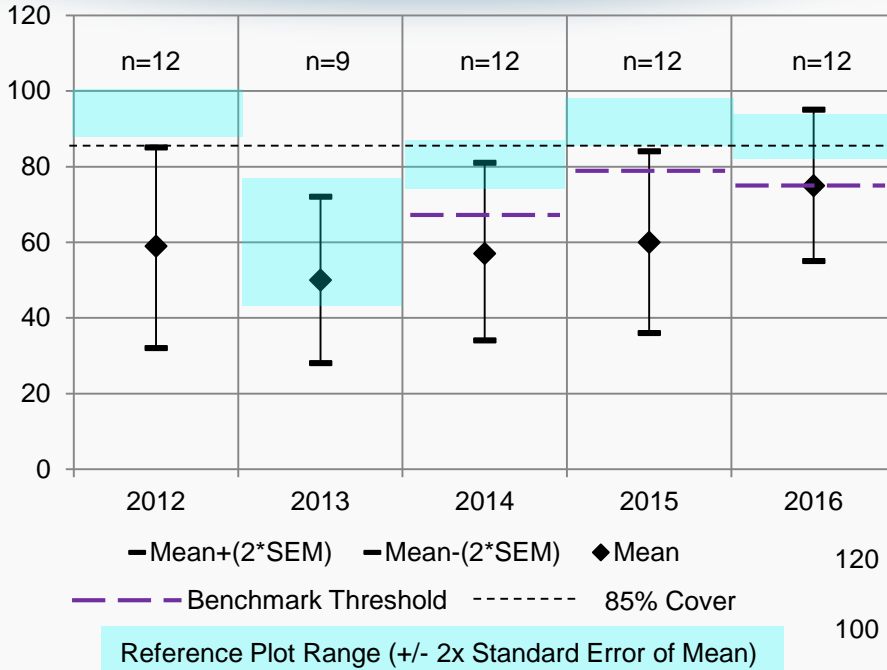


August 2016, Approx 3,000 cfs



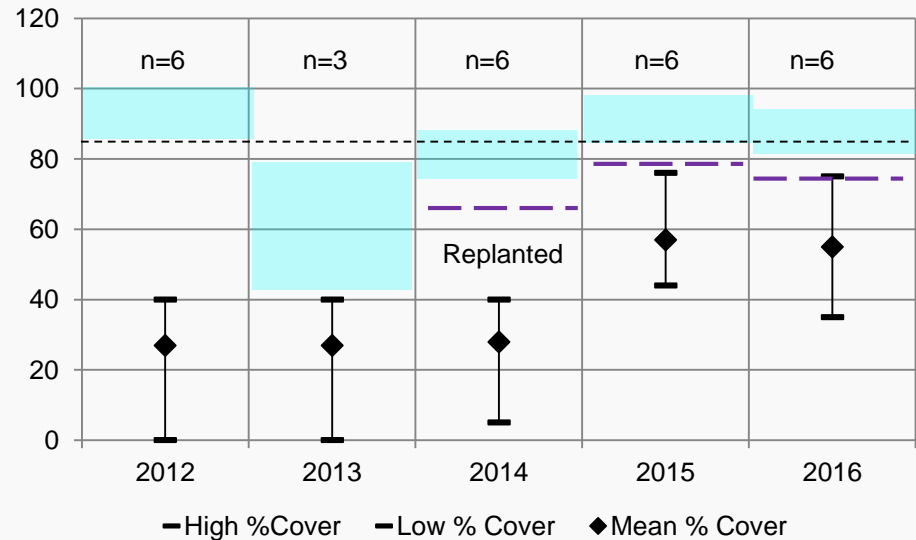
CU-8 RFW Habitat Planted in 2012

CU8-2 Replanted in 2014



CU8 RFW % Cover in **ALL plots** 2012-2016 compared to Reference % Cover range and 85% total cover

CU8-2 RFW plots % Cover 2012-2016 compared to Reference % Cover range and 85% total cover





RFW and SAV Monitoring Locations by Year

Year	RFW Reconstruction Areas*		SAV Locations [^] (Grid Cells)	
	<u>Target</u>	<u>Reference</u>	<u>Target</u>	<u>Reference</u>
2012	5	2	112	112
2013	9	5	133	133
2014	9	5	174	174
2015	30	6	346	346
2016	50	6	408	408
2017	50	6	416	416
2018	TBD		TBD	

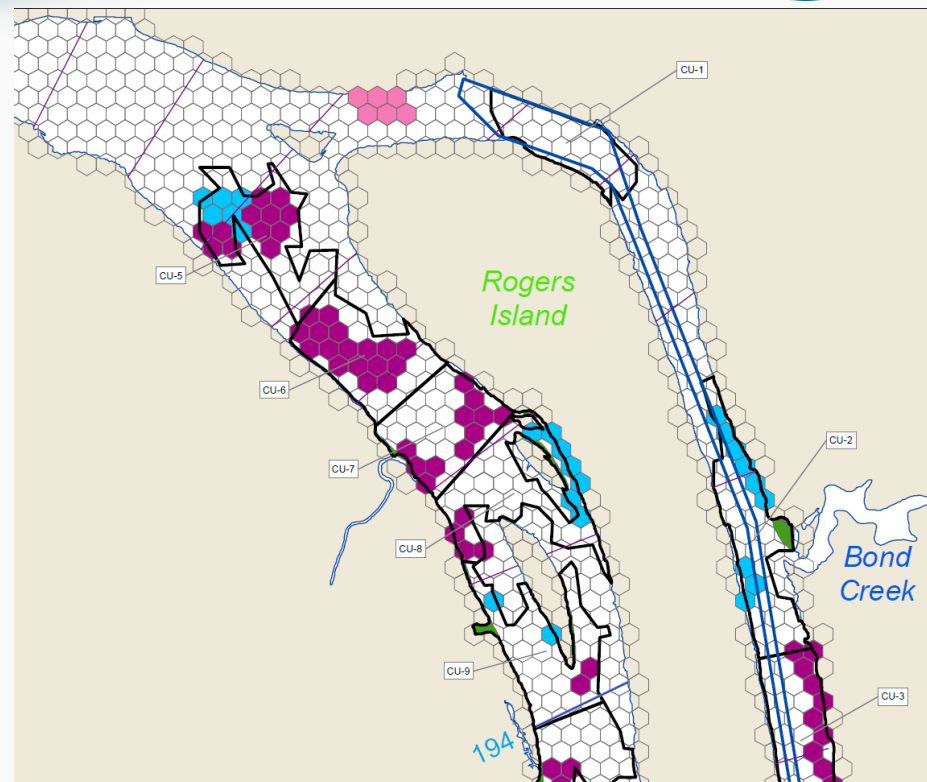
* The number of RFW meter quadrats surveyed is a function of the size of the RFW area being monitored.

[^] SAV “grid cells” represents the number of meter quadrats surveyed.

SAV Monitoring 101



- SAV monitoring differs from RFW in that there is three times more SAV habitat to monitor, we typically don't get to casually observe or photograph it (it's under water), and "standard" monitoring approaches were developed at smaller scales
- For these reasons, the pre-dredge (and typical vegetation monitoring) approaches required adaptation



SAV Planting and Recolonization Benchmarks

Review and Status

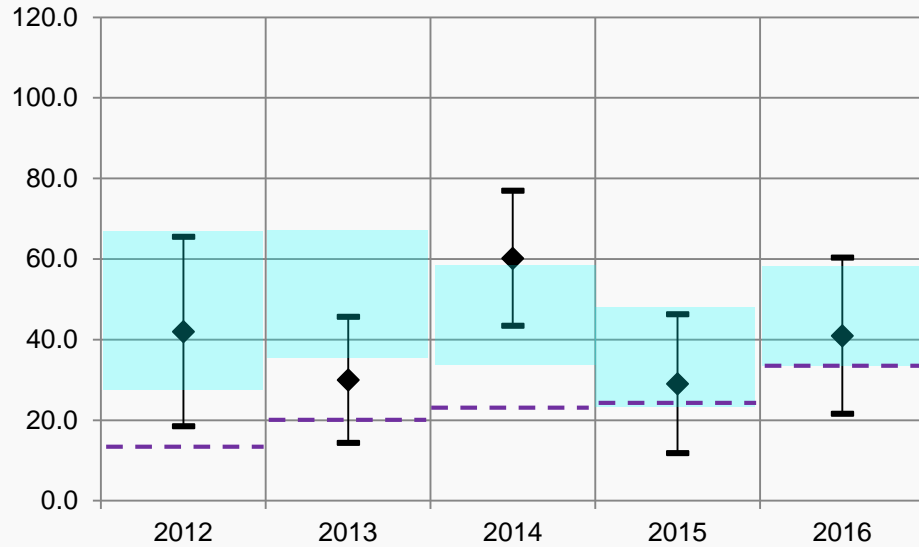


Benchmark Years	SAV Planting Areas Benchmarks	SAV natural Recolonization Areas Benchmarks
Planting Year	100% of plants installed meet acceptance criteria	Invasive species not present
First full season after planting	<ul style="list-style-type: none"> • % cover \geq 20% of the reference area cover • No invasive species 	<ul style="list-style-type: none"> • Native species are colonizing • No invasive species
2 years after planting	<ul style="list-style-type: none"> • % cover \geq 30% of reference area cover • No invasive species 	<ul style="list-style-type: none"> • % cover \geq 5% of reference area cover • Invasive species % cover \leq reference areas
3 rd -4 th years after planting	<ul style="list-style-type: none"> • % cover \geq 40% of reference area cover • Invasive species % cover \leq reference areas 	<ul style="list-style-type: none"> • % cover \geq 10% of reference area cover • Invasive species % cover \leq reference areas
5 th -6 th years after planting	<ul style="list-style-type: none"> • 4th yr \geq 50% of reference area • 5th yr \geq 70% of reference area • Invasive species % cover \leq reference areas 	<ul style="list-style-type: none"> • % cover \geq 40% of reference area cover • Invasive species % cover \leq reference areas

CU-3 and CU-7 SAV Planting Habitat Planted in 2011-12



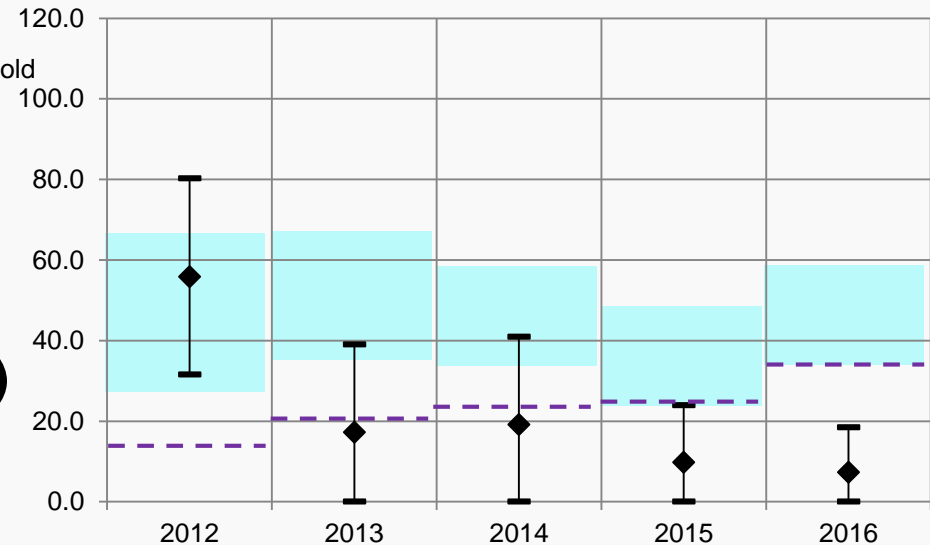
SAV Percent Cover (plots) Compared to Reference Area Percent Cover and Benchmarks 2012-2016



CU-3 (Phase 1, 2012-2016)

Mean % Cover +/- 2 *Standard Error of Mean - - - Benchmark Threshold
 RS1 Reference Plots Range (2*Standard Error of Mean)

CU-7 (Phase 1, 2012-2016)

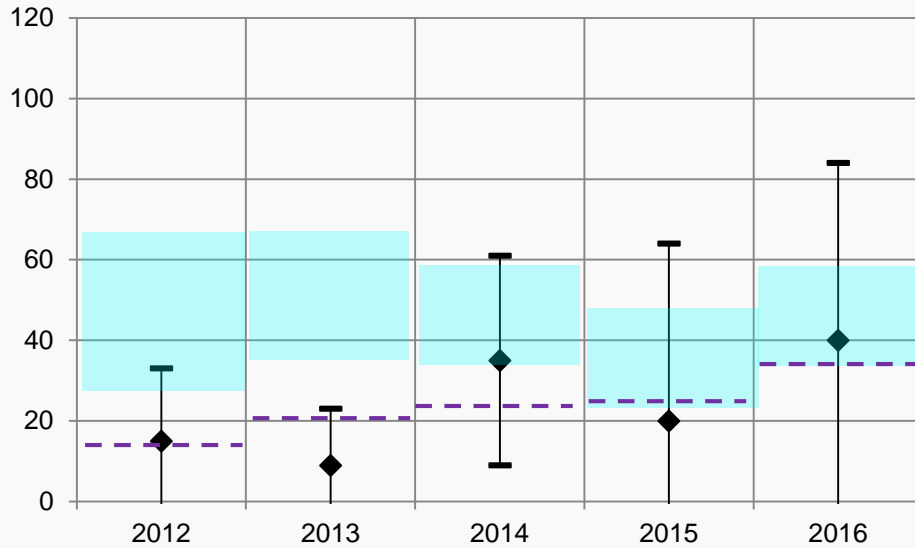


CU-8 SAV Habitat Established in 2010-2011

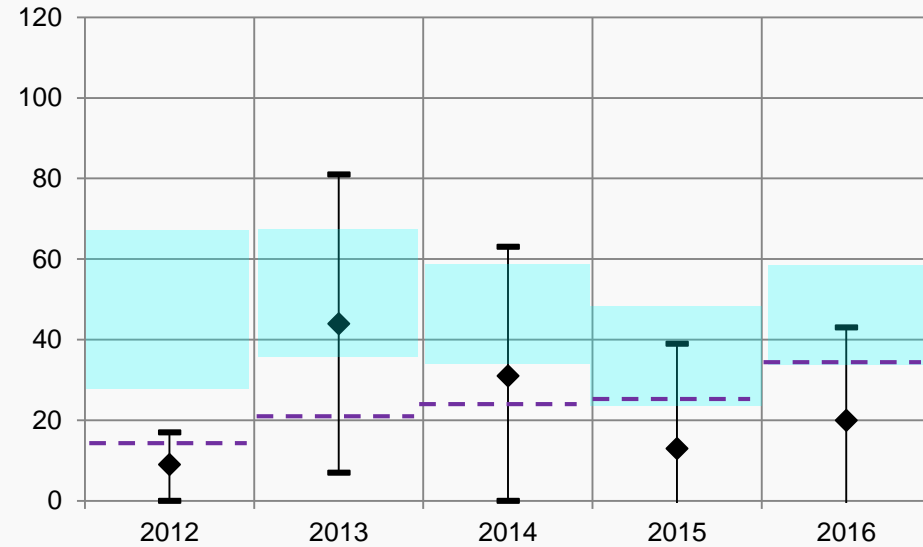


SAV Planting and NR Percent Cover (plots) Compared to Reference Area and Benchmarks 2012-2016

CU8 SAV Planting Areas



CU8 Natural Recolonization Areas



Reference Plot Range (2*Standard Error of Mean)

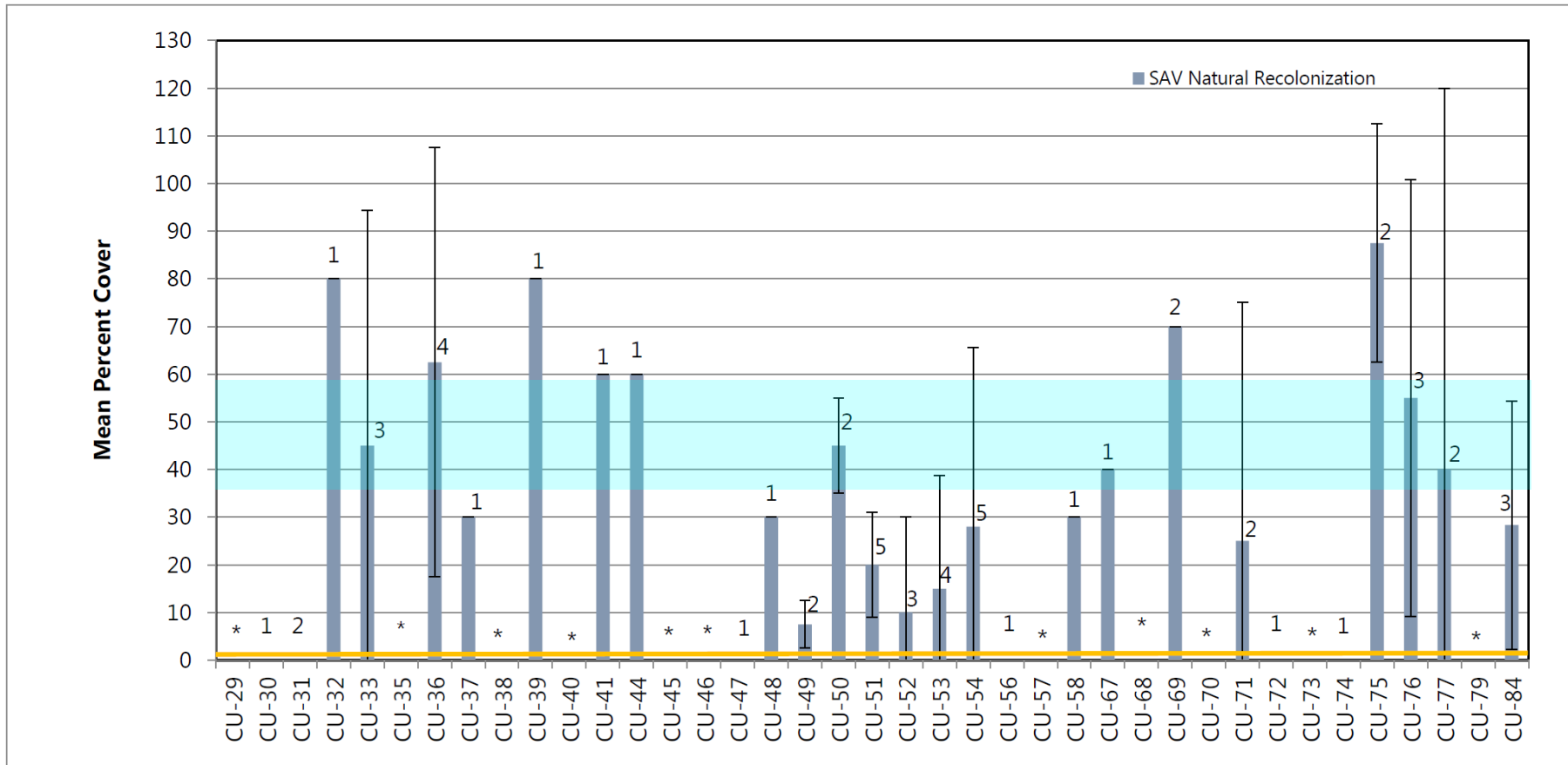
Mean % Cover +/- 2 *Standard Error of Mean

Benchmark Reference Threshold

SAV Natural Recolonization Habitat CUs 29-84 (Established 2014)



SAV Percent Cover (plots) by CU, Compared to Benchmark Threshold 2016



— SAV NR Reference Threshold for 2016

Reference Plots Range (2*Standard Error of Mean)

Habitat Monitoring Response Actions



- CU8 replant (2014)
- Herbivory control adaptations (2013-2016)
- Erosion control fabric repair/removal (2016)



Habitat Monitoring Update: Key Points



- We are still in benchmark monitoring phase
- Total monitoring time could be 7-10 yrs. depending on reach performance
- Only RS1 (Reach 8 / TIP) is close to transitioning to Success Criteria phase, but several areas (CU8, CU51, CU60) were recently (2014-2016) planted or replanted and will be in benchmark monitoring for at least another 2-3 years
- Most RFW and SAV planting areas are meeting or exceeding benchmarks
- SAV natural recolonization areas are indicating mixed results, but most are early in monitoring, and recent data suggest SAV recruitment
- Monitoring continues - EPA will begin evaluating data against success criteria in coming years

Habitat Reconstruction Update



Questions?