North Monterey County Amphibian Habitat Enhancement Project

Interim Monitoring Report

August 2019

Central Coast Wetlands Group
at Moss Landing Marine Laboratories

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1. PROJECT DESCRIPTION

Site Location

The North Monterey County Amphibian Habitat Restoration Project seeks to create and enhance upland and wetland habitat for Santa Cruz long-toed salamanders (SCLTS) at the 25-acre piece of land adjacent to the North Monterey County High School (NMCHS) campus located on Castroville Blvd, near Castroville in unincorporated Monterey County. The site is extremely important for the species as it is isolated from other known breeding locations and is under immense pressure from urban activities. This project is considered a priority enhancement location to regulatory biologists as the species is threatened with extirpation in this area.

Restoration and Ground Engineering Work to Date

Ground Engineering

- Installation of 4,900 feet of trail throughout the project site (2017, 2019).
- Extension of the southeast arm of the Central Pond by excavating 1-2 feet over approximately 1/10th of an acre (2017).
- Installation of a 3 feet high and 8 feet wide embankment at the outlet of the East Pond depression to create a deeper and larger wetland area (2017).
- Installation of a French drain across the flowpath in an erosion area near the East Pond, gathering runoff water into a pipeline and sending it to the flat area at the bottom of the gully (2017).
- Gully above East Pond was reshaped to decrease erosion issues and to allow vegetation to grow and naturally secure the soil (2017).

Native Plant Establishment

- Native seed has been spread along the entire length of newly installed trail (2017, 2019).
- Native seed was spread in areas cleared of vegetation during earth work (erosion control areas and Central Pond arm) (2017).
- In total, approximately 11,560 plants have been planted at the project site to date in both wetland and upland areas. Species planted include wetland species such as *Bolboschoenus sp.* and *Juncus patens*; shrubs such as yellow lupine, California blackberry, and dogwood; trees such as cotton wood, arroyo willow, and coast live oak; and grasses such as creeping wild rye and blue wild rye (2017, 2018, 2019).
- Mulch has been added around newly installed native plants (2017, 2018, 2019).

Vegetation Management

- Removal of invasive species (primarily mustard and wild radish and bristly ox-tongue) at the site through methods such as weed whacking, mowing large areas along the trail, and hand pulling around native plants (2018, 2019).
- Removal of invasive locust tree stand (2018).
- Removal of bulrush with the Central Pond to increase open water habitat for salamander breeding (2018).

2. CALIFORNIA RAPID ASSESSMENT METHOD

Purpose

The objective of this study was to characterize the condition of the depressional ponds located at the site over the course of the restoration project using the California Rapid Assessment Method (CRAM). The Central Coast Wetlands Group (CCWG) performed CRAM assessments at four ponds within the restoration project area. Assessments were conducted at each site before restoration in 2017 and after restoration in 2018 and 2019.

Method

The California Rapid Assessment Method for Wetlands (CRAM) was used to assess the habitat condition of ponds at the North Monterey County Amphibian Habitat Enhancement Project. This report reports CRAM scores from the project period of September 2017-May 2019. CRAM is a rapid habitat condition assessment. CRAM is a standardized tool for wetland monitoring, developed with support from EPA. It is based on the concept that the structure and complexity of a wetland is indicative of its capacity to provide a range of functions and services. It is designed for assessing ambient conditions within watersheds, regions, and throughout the State. It can also be used to assess the performance of restoration projects. CRAM requires a team of 2-3 trained practitioners less than 3 hours to assess a representative wetland area. CRAM evaluates wetland condition at specific sites within defined boundaries in what is termed the Assessment Area, or AA. There are specific guidelines for defining the AA for each CRAM module for different wetland types. For depressional wetlands the recommended size is no more than 2 hectares. In this study, each of the four ponds is under 2 hectares.

Each assessment area was evaluated according to the four universal attributes of CRAM (Table 1) using the current CRAM Depressional field book (v 6.1):

- **Buffer and Landscape Context** - measured by assessing the quantity and condition of adjacent aquatic areas as well as extent and quality of the buffering environment adjacent to the AA.
- **Hydrology** - assesses the sources of water, the stream channel stability, and the hydrologic connectivity of rising flood waters in the stream.
- **Physical Structure** - measured by counting the number of patch types found within the AA and the topographic complexity of the marsh plain.
- **Biotic Structure** - assesses the site based on several factors including the number of plant vertical layers, the number of different species that are commonly found in the marsh, the percent of the common species that are invasive, and the horizontal and vertical heterogeneity of the plant communities.

These four attributes are consistent for all wetland modules of CRAM. Each of the four attribute categories is comprised of a number of metrics and submetrics that are evaluated in the field and scored on a scale of D (3) to A (12). Each of the four attribute categories are then converted to a scale of 25 through 100, and the average of these four scores is the final CRAM index score, also ranging on a scale from 25 (lowest possible) to a maximum of 100.

The scale of condition categories presented in Table 1 is appropriate for the purposes of evenly distributing CRAM results into quartiles.

Table 1. CRAM condition categories and associated index scoring ranges.

Condition Category	Total CRAM Index Score Range
Excellent	82-100
Good	63-81
Fair	44-62
Poor	25-43

CCWG conducted CRAM at each of the 4 ponds (Central Pond, East Pond, South Pond, North Pond) in September of 2017, May of 2018, and May of 2019 (Figure 1). The September 2017 CRAM was conducted pre-ground engineering, planting, and vegetation removal. CRAMs conducted in May 2018 and May 2019 represent post-ground engineering and some planting.

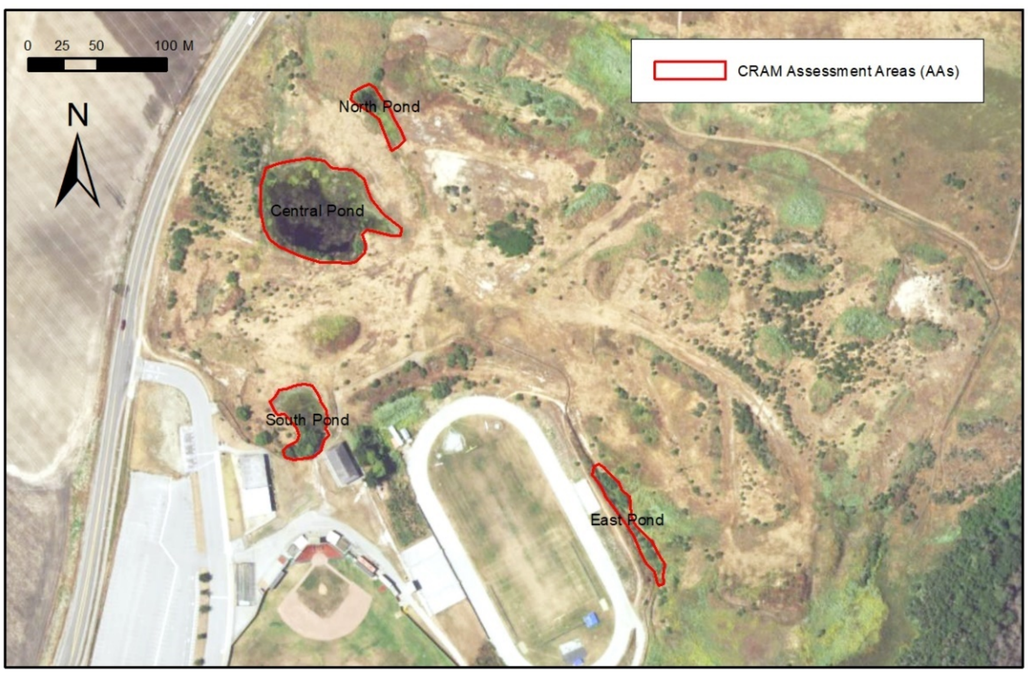


Figure 1. CRAM assessment area (AA) boundaries at the North Monterey County Amphibian Habitat Enhancement Project (conducted October 2017, May 2018, May 2019).

Results from CRAM wetland condition assessments will be uploaded to eCRAM, the Statewide CRAM database. This means that all the scientifically quantifiable outcomes of the project will be available online to any interested groups.

Results and Discussion

Central Pond

During the pre-restoration CRAM, Central Pond received an overall index score of 74. After ground engineering was completed, the pond was assessed in May of 2018 and received an overall index score of 73, and was surveyed again in May of 2019 and received an overall index score of 75. Results of these assessments are presented in Table 2 and Figure 2.

During the May 2019 assessment the *Buffer and Landscape* attribute received a score of 49, which is 7 points higher than the previous CRAMs conducted in 2017 and 2018. This increase is due to the improvement in the *Buffer Condition* metric from a C to a B, due to weed management at the site. The *Hydrology* attribute score stayed the same throughout all 3 years. The *Physical Structure* attribute score increased between the 2018 and 2019 assessments (from an 87.5 to 100), due to receiving an improved score for the *Structural Patch Richness* metric. The *Biotic Structure* attribute score decreased from an 83.3 (October 2017) to a 77.8 (May 2018) to 69.44 (May 2019). This decrease in score is most likely due to both the seasonal timing of the assessment as well as the removal of bulrush from within the pond in 2018. The removal of the bulrush decreased the amount of vertical biotic structure within the pond. The *Percent of Invasive Species* metric decreased (meaning higher percentage of invasive co-dominants) in May 2018 and May 2019. This change in score is most likely because the 2018 and 2019 assessments were conducted during the rainy season, whereas the 2017 CRAM was conducted in Fall when more plants are dormant. During the rainy season the invasive species may be more abundant and be included as co-dominants, while some of the native species that were planted are still not large enough to be counted as co-dominant species.

Central Pond, May 2019

Table 2. Central Pond CRAM metric, attribute and index scores over restoration project period October 2017-May 2019.

CRAM Attribute	CRAM Metrics and Submetrics	October 2018	May 2018	May 2019
Buffer and Landscape Context	Aquatic Area Abundance	3	3	3
	% of AA with Buffer	12	12	12
	Average Buffer Width	6	6	6
	Buffer Condition	6	6	9
	Attribute Score	**42**	**42**	**49**
Hydrology	Water Source	9	9	9
	Hydroperiod	12	12	12
	Hydrologic Connectivity	9	9	9
	Attribute Score	**83.33**	**83.33**	**83.33**
Physical Structure	Structural Patch Richness	9	9	12
	Topographic Complexity	12	12	12
	Attribute Score	**87.5**	**87.5**	**100**
Biotic Structure	PC: No. of plant layers	12	12	12
	PC: No. of co-dominants	6	6	6
	PC: Percent Invasion	9	3	3
	Interspersion	9	9	9
	Vertical Biotic Structure	12	12	9
	Attribute Score	**83.33**	**77.78**	**69.44**
	Index Score	**74**	**73**	**75**

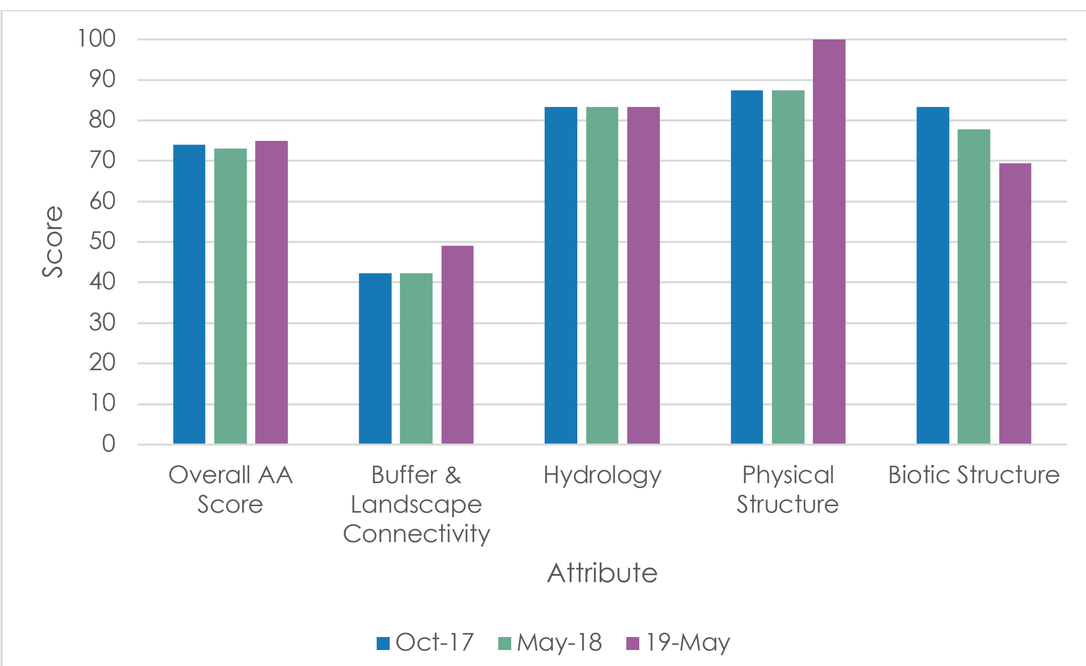


Figure 2. Central Pond CRAM index and attribute scores over restoration project period October 2017-May 2019.

South Pond

During the pre-restoration CRAM, the South Pond received an overall index score of 64. After ground engineering was completed, the pond was assessed in May of 2018 and received an overall index score of 65, and was surveyed again in May of 2019 and received an overall index score of 68. Results of these assessments are presented in Table 3 and Figure 3.

During the May 2019 assessment the *Buffer and Landscape* attribute received a score of 46, which is 5 points higher than the previous CRAMs conducted in 2017 and 2018. Although the *Percent of AA with Buffer* metric decreased from an A in 2017 and 2018 to a B in 2019 due to the installation of a new fence, the *Buffer Condition* metric increased from a C in 2017 and 2018 to a B in 2019, due to weed management at the site. The *Hydrology* attribute score stayed the same throughout all 3 years. The *Physical Structure* attribute score increased between the 2018 and 2019 assessments (from 62.5 to 75), due to receiving an improved score for the *Structural Patch Richness* metric. The *Biotic Structure* attribute score slightly decreased from 69.4 in 2017 to 66.67 in 2019. This decrease in score is most likely due to the seasonal timing of the assessment. The *Percent Invasive Species* metric decreased (meaning higher percentage of invasive co-dominants) in May 2018 and May 2019. This change in score is most likely because the 2018 and 2019 assessments were conducted during the rainy season, whereas the 2017 CRAM was conducted in Fall when more plants are dormant. During the rainy season the invasive species may be more abundant and be included as co-dominants, while some of the native species that were planted are still not large enough to be counted as co-dominant species. However, during the 2018 and 2019 assessments, the pond received an improved *Vertical Biotic Structure* metric score, most likely due to the fact that there is more abundant vegetation (Including invasive species) during the Spring season. The *Horizontal Interspersion* metric score decreased from a B in 2017 and 2018 to a C in 2019, due to interannual variations in vegetation structure.

South Pond, May 2019

Table 3. South Pond CRAM metric, attribute and index scores over restoration project period October 2017-May 2019.

CRAM Attribute	CRAM Metrics and Submetrics	October 2017	May 2018	May 2019
Buffer and Landscape Context	Aquatic Area Abundance	3	3	3
	% of AA with Buffer	12	12	9
	Average Buffer Width	6	6	6
	Buffer Condition	6	6	9
	Attribute Score	**42**	**42**	**46**
Hydrology	Water Source	9	9	9
	Hydroperiod	12	12	12
	Hydrologic Connectivity	9	9	9
	Attribute Score	**83.33**	**83.33**	**83.33**
Physical Structure	Structural Patch Richness	6	6	9
	Topographic Complexity	9	9	9
	Attribute Score	**62.5**	**62.5**	**75**
Biotic Structure	PC: No. of plant layers	12	9	12
	PC: No. of co-dominants	9	9	9
	PC: Percent Invasion	9	6	6
	Interspersion	9	9	6
	Vertical Biotic Structure	6	9	9
	Attribute Score	**69.44**	**72.22**	**66.67**
	Index Score	**64**	**65**	**68**

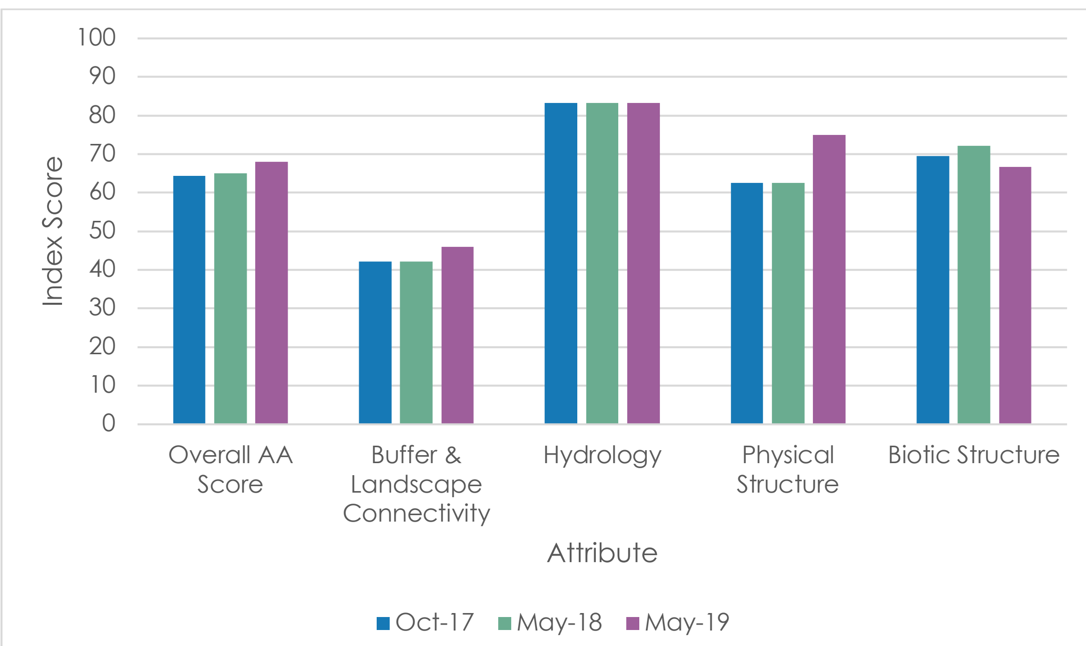
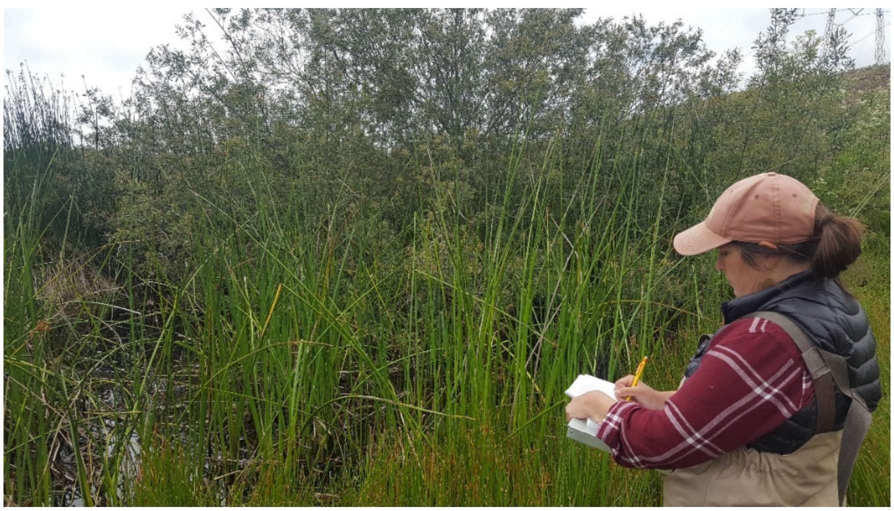


Figure 3. South Pond CRAM index and attribute scores over restoration project period October 2017-May 2019.

North Pond

During the pre-restoration CRAM, the North Pond received an overall index score of 57. After ground engineering was completed, the pond was assessed in May of 2018 and received the same overall index score of 57, and again in May of 2019 and received an overall index score of 69. Results of these assessments are presented in Table 4 and Figure 4. All attributes scores, except for *Hydrology*, increased between October 2017 and May 2019. In the *Buffer and Landscape* attribute, the site received an improved score for the *Buffer Condition* metric (from a C in 2017 and 2018 to a B in 2019), due to weed management actions. In the *Physical Structure* attribute, the pond received an improved score in both the *Structural Patch Richness* metric (from a D in 2017 and 2018 to a B in 2019) and *Topographic Complexity* metric (from a C in 2017 and 2018 to a B in 2019). The *Biotic Structure* attribute score increased slightly from 66.67 in 2017 and 2018 to 69.44 in 2019. However, the metric and sub-metric scores within this attribute fluctuate between the three years the CRAMs were conducted, making it difficult to interpret what may be the driving factors of increases or decreases in individual metric scores. Interannual and seasonal variations in vegetation structure likely led to the slight fluctuations in metric and sub-metric scores.



North Pond, May 2019

Table 4. North Pond CRAM metric, attribute and index scores over restoration project period October 2017-May 2019.

CRAM Attribute	CRAM Metrics and Submetrics	October 2018	May 2018	May 2019
Buffer and Landscape Context	Aquatic Area Abundance	3	3	3
	% of AA with Buffer	12	12	12
	Average Buffer Width	6	6	6
	Buffer Condition	6	6	9
	Attribute Score	**42**	**42**	**49**
Hydrology	Water Source	9	9	9
	Hydroperiod	12	12	12
	Hydrologic Connectivity	9	9	9
	Attribute Score	**83.33**	**83.33**	**83.33**
Physical Structure	Structural Patch Richness	3	3	9
	Topographic Complexity	6	6	9
	Attribute Score	**37.5**	**37.5**	**69.44**
Biotic Structure	PC: No. of plant layers	12	9	12
	PC: No. of co-dominants	6	6	3
	PC: Percent Invasion	9	3	6
	Interspersion	6	9	6
	Vertical Biotic Structure	9	9	12
	Attribute Score	**66.67**	**66.67**	**69.44**
	Index Score	**57**	**57**	**69**

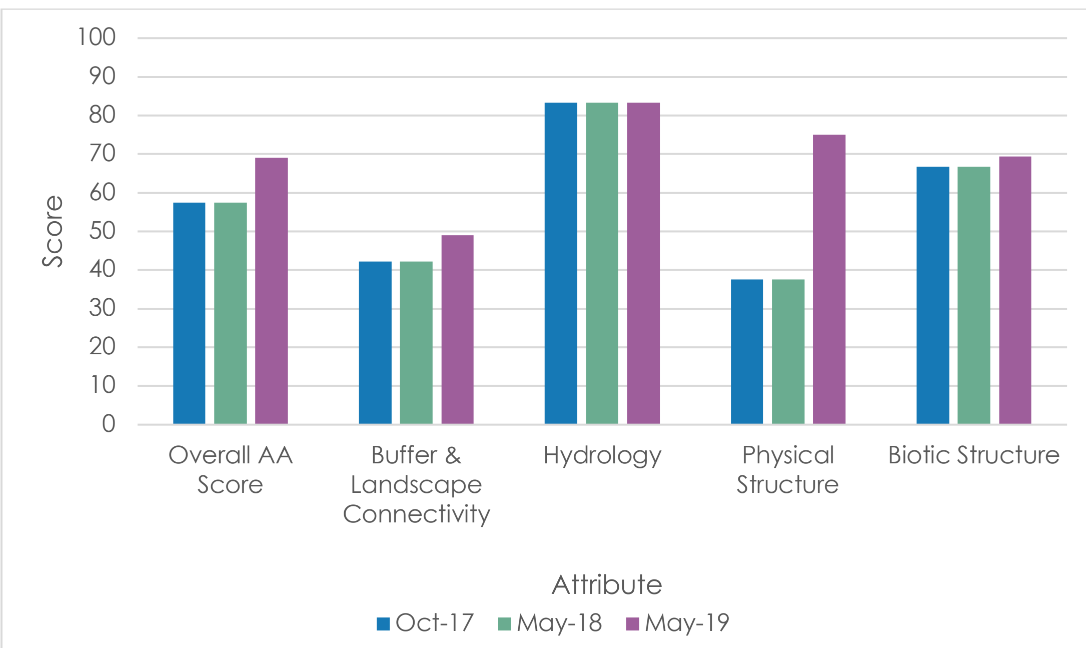


Figure 4. North Pond CRAM index and attribute scores over restoration project period October 2017-May 2019.

East Pond

During the pre-restoration CRAM, the East Pond received an overall index score of 48. After ground engineering was completed, the pond was assessed in May of 2018 and received an index score of 53, and again in May of 2019 and received an overall index score of 52. Results of these assessments are presented in Table 5 and Figure 5. During the May 2019 assessment the *Buffer and Landscape* attribute received a score of 50, which is 8 points higher than the previous CRAMs conducted in 2017 and 2018. Although the *Percent of AA with Buffer* metric decreased from an A in 2017 and 2018 to a B in 2019, due to the installation of a fence around the perimeter of the high school, the *Buffer Condition* metric and the *Buffer Width* metric both increased from a C in 2017 and 2018 to a B in 2019. The *Hydrology* attribute decreased in score between 2017 and 2018 because the *Hydroperiod* metric decreased from an A to a B as a berm was installed in October of 2017 to help hold water in the pond for a longer period of time. No further changes between 2018 and 2019 were identified. The *Physical Structure* attribute score remained the same between all 3 years. The *Biotic Structure* attribute score increased from 33.33 in 2017 to 50 in 2019. However, the metrics and sub metric scores within this attribute fluctuate between the three years the CRAMs were conducted, making it difficult to interpret what may be the driving factors of increases or decreases in individual metric scores.

East Pond, May 2019

Table 5. East Pond CRAM metric, attribute and index scores over restoration project period October 2017-May 2019.

CRAM Attribute	CRAM Metrics and Submetrics	October 2018	May 2018	May 2019
Buffer and Landscape Context	Aquatic Area Abundance	3	3	3
	% of AA with Buffer	12	12	9
	Average Buffer Width	6	6	9
	Buffer Condition	6	6	9
	Attribute Score	**42**	**42**	**50**
Hydrology	Water Source	9	9	9
	Hydroperiod	12	9	9
	Hydrologic Connectivity	3	3	3
	Attribute Score	**66.67**	**58.33**	**58.33**
Physical Structure	Structural Patch Richness	6	6	6
	Topographic Complexity	6	6	6
	Attribute Score	**50**	**50**	**50**
Biotic Structure	PC: No. of plant layers	3	12	9
	PC: No. of co-dominants	3	6	6
	PC: Percent Invasion	12	3	3
	Interspersion	3	6	6
	Vertical Biotic Structure	3	9	6
	Attribute Score	**33.33**	**61.11**	**50**
	Index Score	**48**	**53**	**52**

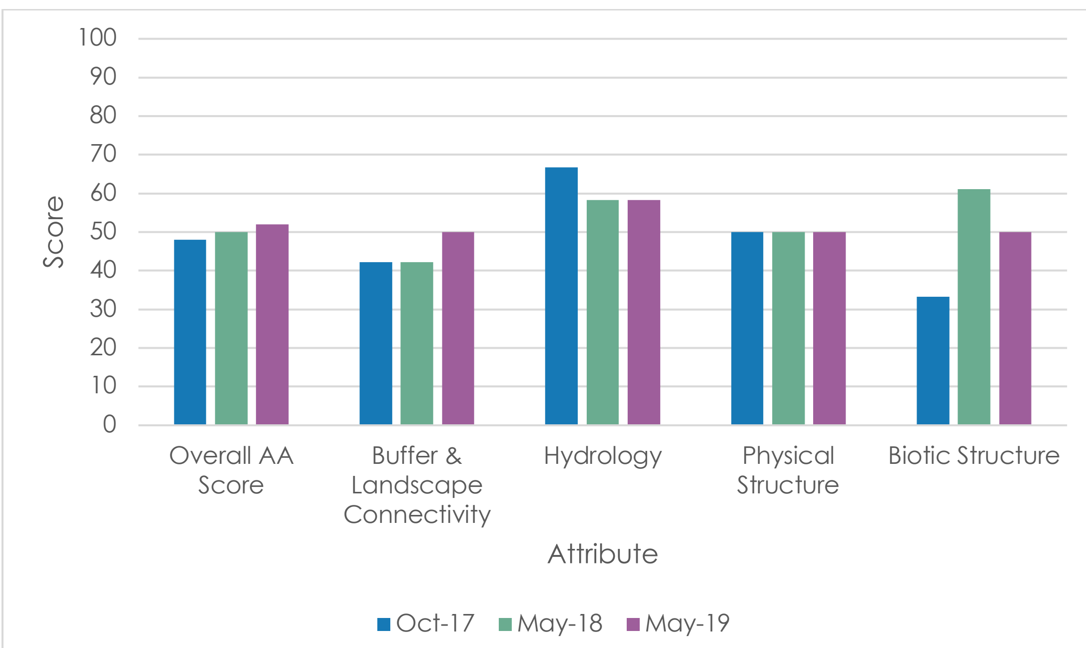


Figure 5. East Pond CRAM index and attribute scores over restoration project period October 2017-May 2019.

Stressors

Several stressors were identified at the sites during the assessments. While not factored into the CRAM scores, stressors can provide more detailed insight about what may be adversely affecting the ecological condition of ponds. Stressors that were consistently observed on the site include:

- Urban residential areas
- Transportation Corridor
- Sports fields
- Vector control
- Passive recreation
- Active recreation
- Intensive row-crop agriculture

Conclusion

CRAM Index scores for each of the four ponds at the North Monterey County Amphibian Habitat Enhancement Project site have increased slightly since pre-restoration. However, the surveys show that the restoration efforts conducted during late fall of 2017 and early 2018 and 2019, which included minimal ground engineering, planting of native plants, and invasive vegetation management, has yet to show a significant increase in CRAM scores. Minimal restoration work is occurring within the pond habitat, except for the Central Pond where vegetation was removed from the ponded area. Therefore, CRAM scores throughout the entire project may only change minimally. This is to be expected. However, we do expect that as the native vegetation becomes more established over the site and invasive species are further managed, the *Biotic Structure* attribute will continue to increase in score. The CRAM results also show that the restoration and invasive management efforts throughout the project site have already helped to improve the buffer condition around each of the ponds, which increases the *Buffer and Landscape* attribute score.

3. VEGETATION SURVEYS

Method

The Point Intercept Method was used to estimate cover of specific species as well as native versus non-native cover through transect sampling at the habitat enhancement site. The method is conducted by placing a 'pin' along the transect at regular intervals and determining the proportion of points that "hit" (or intercept) vegetation. Cover is measured by point intercept based on the number of 'hits' on the species present out of the total number of points measured. Specific methods for this project are detailed below:

1. Vegetation transects were established throughout the project area in 2017 focusing on areas planned for restoration and native planting. In 2018 several more transects were established to capture new areas where planting took place or is planned to take place during the 2018/2019 planting season (Figure 6). Transects vary in length from 25-50 meters.

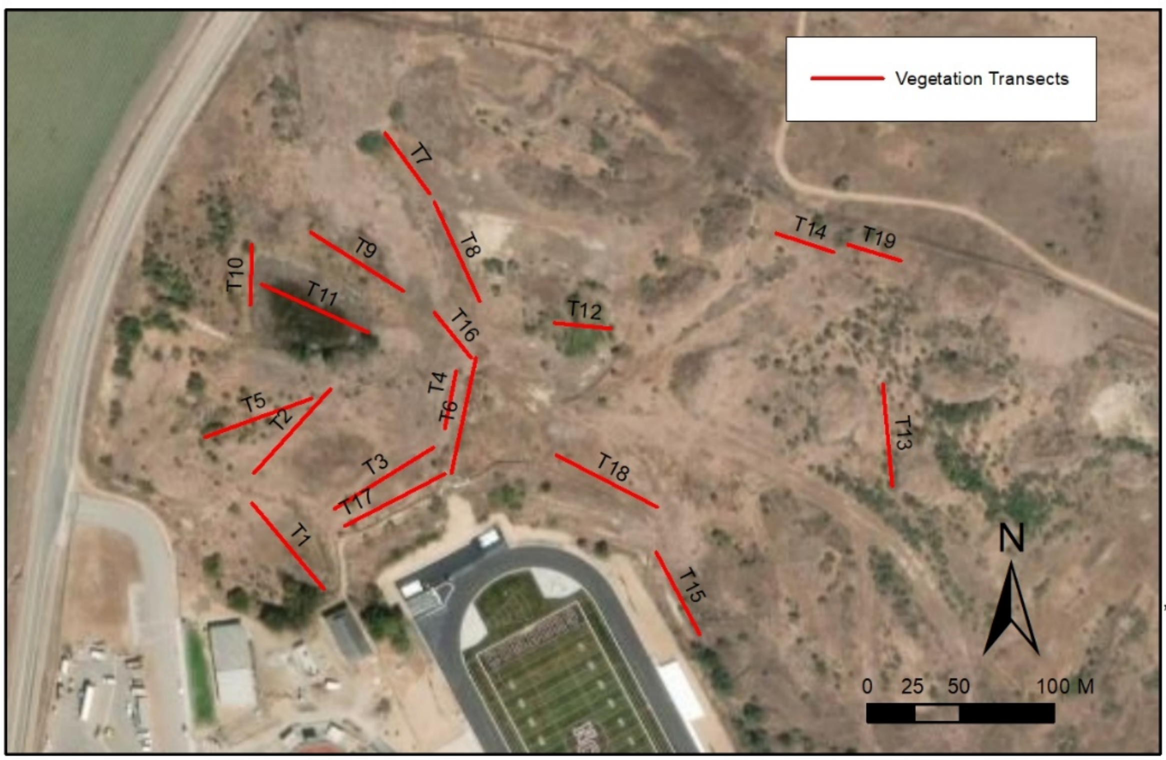


Figure 6. Vegetation transect locations

2. Transects were laid out using a 50 meter transect tape. Coordinates were recorded at the start and end of each transect. Using a compass, the bearing of each transect was recorded. Transects were numbered based on the order in which they were conducted.

3. Point intercept data was recorded at 0.5m intervals along each transect. At each pre-determined interval along the transect (regardless of layout), the point intercept pin was placed on the ground; and the tallest plant species that directly intercepted the pin was recorded.

4. Species were recorded with genus and species name. Non-species such as; bare ground, litter, water, etc. were also recorded.

5. After all data was entered, each species was recorded with type of vegetation (tree, shrub, forb, etc.) and noted as native or non-native. Change in native and non-native cover was analyzed for each transect between Fall 2017 and Spring 2019.

Tarweed (*Madia sativa*) surveyed during vegetation monitoring

Results

The vegetation survey data shows that sitewide, although there is a slight decrease in native plant cover between Fall 2017 and Spring 2019, there was an increase between Spring 2018 and Spring 2019. Similarly, although there is a slight increase in non-native plant cover between Fall 2017 and Spring 2019, there is a decrease between Spring 2018 and Spring 2019. Abiotic cover shows an overall decrease between Fall 2017 and Spring 2019 (Figure 7).

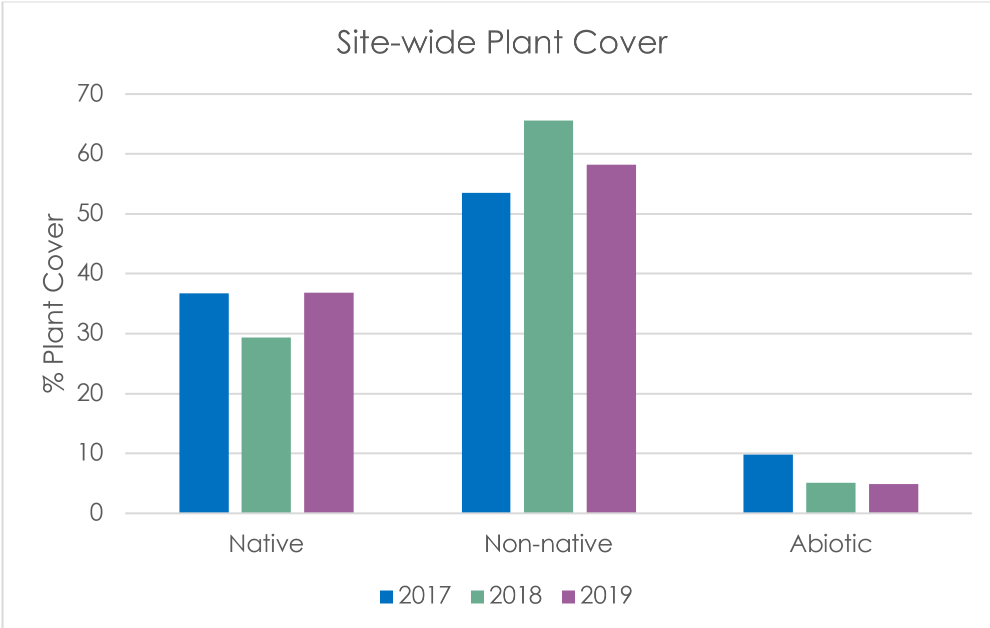


Figure 7. Percent cover of native plants, non-native plants, and abiotic features in 2017, 2018, and 2019

The transects that fall within the corridor zone, which is where the most effort went into native planting, show a significant increase in native cover from 9% in 2017 to 28% in 2019. Non-native vegetation shows a slight decrease in plant cover from 73% in 2017 to 70% in 2019. Abiotic cover decreased from 18% in 2018 to 2% in 2019 (Figure 8).

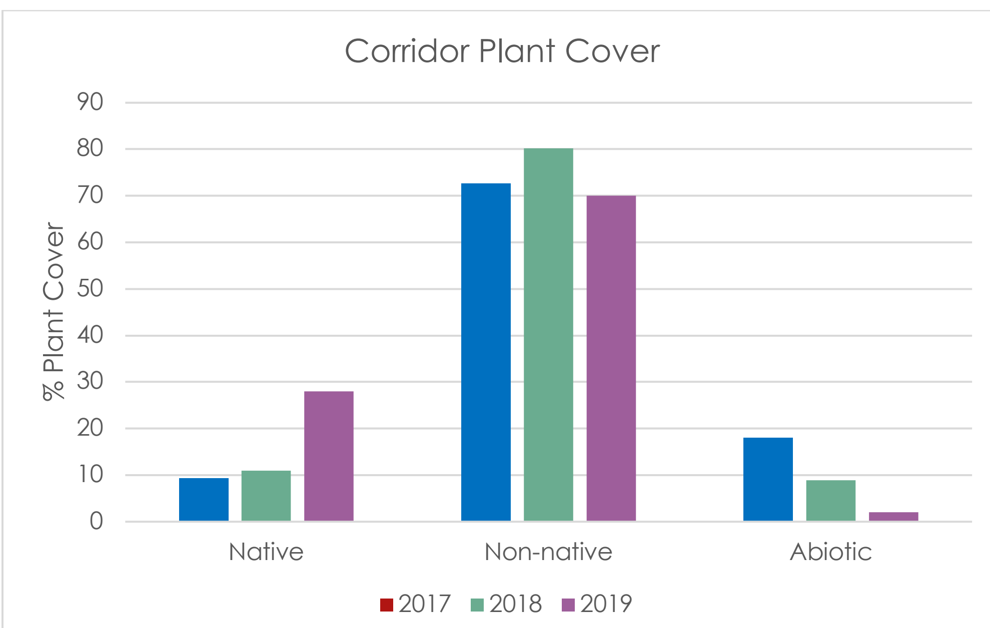


Figure 8. Percent cover of native veg, non-native veg, and abiotic features in 2017, 2018, and 2019 within the corridor planting zone.

Change of native and non-native cover between Fall 2017 and Spring 2019 is shown for each transect in Figure 9. Transects 1, 2, 3, 4, 5, 6, 9, 12, and 15 each show a positive increase in native cover, with transect 2, 4, and 5 showing the largest increases. Transects 7, 8, and 11 show the largest decrease in native cover. Transects 1, 2, 3, 4, 5, 9, 11, and 13 all show a decrease in non-native cover, with transect 2 and 5 showing the largest decrease in cover. Transect 8 shows the largest increase in non-native cover.

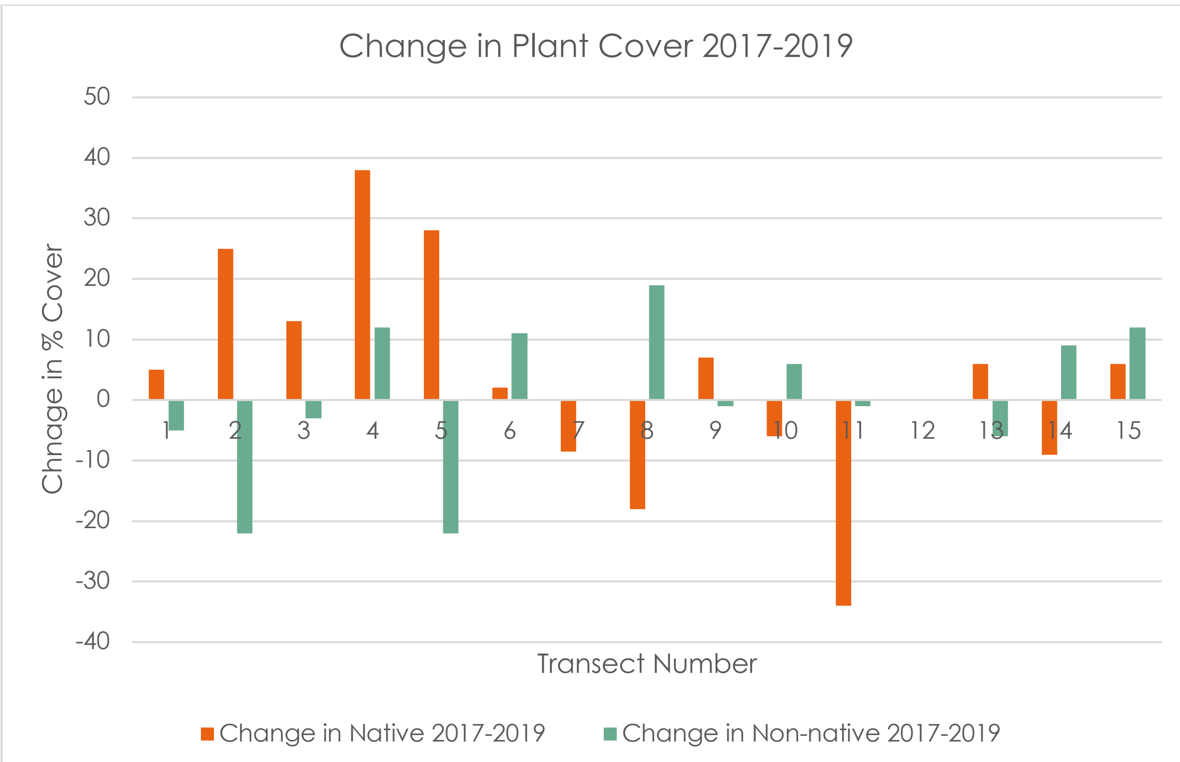


Figure 9. Change in percent cover of native and non-native vegetation between Fall 2017 and Spring 2019. No change data is shown for transects 16-19 as data for these transects were only collected in Spring 2018 and Spring 2019.

Discussion and Conclusion

Although there was a decrease of native plant cover and an increase in non-native plant cover between 2017 and 2018, we are now seeing an increase in native plant cover and decrease in non-native cover between 2018 and 2019. This is typical of restoration projects where after ground-engineering is conducted, non-natives are the first to become established in disturbed areas and newly installed native plants may not be abundant enough to be captured within surveys. Once native plants have more time to become established, we will start to see an increase in native cover.

The greatest increases of native cover are seen within the corridor zone, which is to be expected as this is where the most effort in native planting was conducted. The increase in native cover along the corridor sections is encouraging. Improving movement corridors for seasonal salamander migration is a primary goal of this project, and an increase in native cover facilitates this habitat function.

The greatest decrease in native cover is seen in transect 11. This is the transept that runs through the Central Pond where bulrush was removed to create more open water habitat, which is beneficial for salamander breeding.

Although over 11,000 plants were installed in the winters of 2017-2018 and 2018-2019, the seasonality of the three surveys, as well as data collection occurring in the early phases of the restoration process, most likely plays a role in these results. The first survey was conducted in Fall before any planting occurred, but also when many plants are dormant. Although Fall is not an ideal time to conduct vegetation surveys, we wanted to capture vegetation data prior to any restoration work occurring. The project did not begin until Fall, thus leaving only a small window to conduct plant surveys prior to any restoration efforts beginning. The second and third vegetation surveys were conducted in Spring of 2018 and 2019, which is a more appropriate season for collecting vegetation data. However, the plantings are still getting established, and native plants may not be large enough to be captured in the point intercept method used along the transects. The decrease in non-native vegetation between 2018 and 2019 is most likely due to the invasive vegetation management efforts (weed whacking, mowing and hand pulling) that were conducted in 2018 and 2019.

4. PHOTO MONITORING

Method

Simple photographic monitoring is a practical and cost-effective method of monitoring a restoration project. Photographic monitoring visually documents change in a site as restoration progresses. Photo monitoring of the NMC Amphibian Habitat Enhancement Project was conducted in August 2017, November 2017, June 2018, and May 2019. A photo monitoring map of the restoration area was generated by walking the perimeter with a geographic positioning system (GPS) unit and selecting sites from which the restoration work could be visually covered. Thirteen locations were chosen to use for photo point monitoring (Figure 13). At each point, photos were taken looking in a variety of directions to best capture restoration efforts. Photos from a subset of those points are presented in this report. Google earth imagery pre- and post- earth moving is also presented here to capture the trail system which was installed in October 2017. However, the most recent google earth imagery is from November 2018, so it does not show the most recent segment of trail which was installed during the summer of 2019.

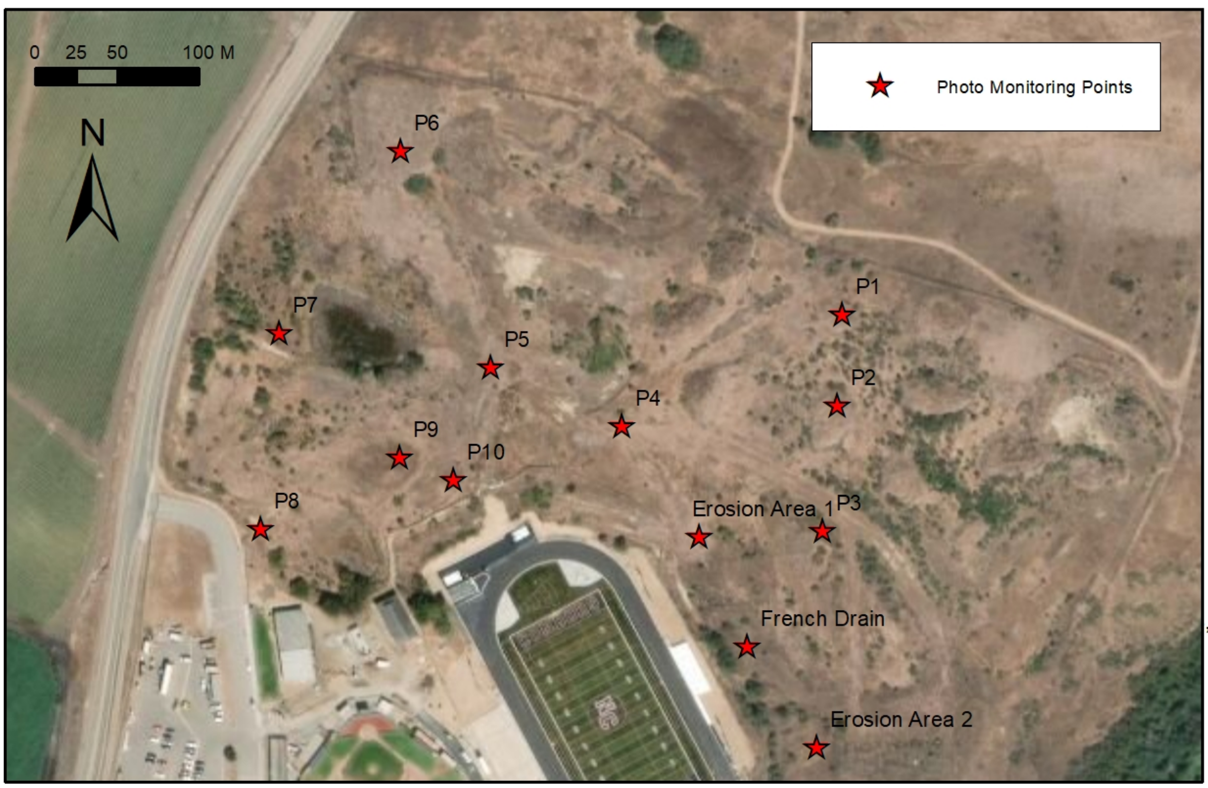


Figure 14. Photo monitoring locations

Results

Aerial Imagery

June 2017 (source: Google Earth)

November 2018 (source: Google Earth)

Point 1

Aug 2017

May 2018

May 2019

Point 4-A

Aug 2017

Nov 2017

May 2018

Point 4-B

Aug 2017

May 2018

Point 5

Aug 2017

May 2018

May 2019

Point 6

Aug 2017

May 2018

May 2019

Point 7

Aug 2017

May 2018

May 2019

Point 8

Aug 2017

May 2018

May 2019

Point 9

Nov 2017

May 2018

May 2019

Point 10

Nov 2017

May 2018

May 2019

Erosion Area 1

Nov 2017

May 2018

May 2019

Erosion Area 2

Nov 2017

May 2018

May 2019

French Drain

Nov 2017

May 2018

May 2019