Riparian Evaluation for Baffin Bay Tributaries

Final Report

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Riparian Evaluation Report: Tributaries of Baffin Bay
August 30, 2019

Point between Cayo de Hinoso and the Cayo del Mazon

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Riparian Evaluation Report:
The Tributaries of Baffin Bay

Water Body: Baffin Bay 2492 Tributaries

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TABLE OF CONTENTS

Executive Summary

A riparian area is the part of the landscape that borders a creek or river. A properly functioning riparian area positively influences water quality. Riparian areas are known to recover their functional condition naturally once the activities or conditions that may be hindering recovery are altered or removed.

This report offers a baseline description of riparian conditions along Baffin Bay tributaries as observed June 18-19, 2019. These descriptions may be useful in measuring riparian health and recovery over time as management changes are implemented that address the identified hindrances.

This riparian evaluation report aims to provide a foundation for further decision-making and guidance for implementing riparian practices to address hindrances. The report identities opportunities for riparian improvements within each reach that could benefit water quality in Baffin Bay. The report may be used to:
1) guide watershed planning efforts, 2) help focus resources and interest on opportunities to improve water quality through riparian management, and 3) help build riparian understanding among stakeholders.

One of the most cost-effective ways to protect and improve water quality is to protect and improve riparian function along creeks and drains. Several stormwater ditches are included in this report as they basically operate as tributaries to larger waterways and hold special opportunities for enhanced function to benefit water quality. As identified here, riparian function along the tributary streams to Baffin Bay varies greatly with some areas of very high function, while others show significant dysfunction.

A total of 385 riparian stream miles were identified, and 184 miles were evaluated by helicopter in June 2019 using the Bull's-Eye Riparian Evaluation method, fully explained in Background & Methodology section below.

It is estimated that about half of the evaluated stream miles are flanked mostly by high-functioning riparian areas, and the other half are in marginal to dysfunctional condition. It is estimated that about 80 percent of the unevaluated stream miles are high functioning with about 20 percent having impaired function. Those unevaluated tributaries that appear to offer opportunity for improvement are noted within this report along with a recommendation for full evaluation in the future.

Based on the estimated potential riparian area widths, the total identified riparian potential along tributaries to Baffin Bay is estimated to include about 37,979 acres. The evaluated areas are estimated to include 21,454 acres, and the unevaluated potential riparian areas are estimated to include 16,525 riparian acres. These metrics are detailed in the following table:

Riparian Summary Estimates for Baffin Bay Tributaries

	Measured Stream Length on Google Earth tm		Calculated Area Based on Estimated Potential Riparian Width		Estimated Riparian Enhancement Opportunity		
Total Identified Tributaries	385	miles	37,979	acres	37%	14,032	acres
Tributaries Evaluated 6-2019	184	miles	21,454	acres	50%	10,727	acres
Unevaluated Tributaries	202	miles	16,525	acres	20%*	3,305	acres

* placeholder estimate only, 20% estimate is based on two factors – 1) a 50% enhancement opportunity was estimated by the 6/2019 evaluation of select tributaries and 2) the Google Earth tm observations of tributaries that were no evaluated on 6/2019 because of their observed natural conditions.

Figure 1 *Area metrics summary for riparian evaluations of Baffin Bay tributaries.*

Riparian areas generally recover their function when the activity that is hindering recovery is halted. Hindrances to riparian recovery identified along Baffin Bay tributaries include:

- farming or mowing too close to the creek bank
- artificial manipulation of banks, channels or stream sediment
- physical alteration of floodplain
- poorly designed steam crossings
- poor grazing management

Other Observations

During the aerial evaluation of tributary riparian function other water quality observations were noted. The presence of apparent algal blooms and dramatic changes in water clarity were noted in the proximity of several communities. It is possible that wastewater discharge is affecting water quality at those locations. A program that engages communities in addressing and protecting water quality in Baffin Bay could result in the funding and development of off-channel wetland/riparian tertiary treatment for wastewater discharges to ensure water quality entering Baffin Bay tributaries is compatible with the quality of the receiving water.

A notable quantity of tires was seen dumped along the banks of tributaries, buried in streambeds and floating in water bodies. The number and wide-spread distribution of tire waste seems to indicate a long-term and possibly strategic and intentional placement. An outreach campaign aimed at tire waste recovery could be valuable in engaging citizens and in improving water quality.

Possible Next Steps:

1) This report can be made available to the Baffin Bay Watershed Working Group for their consideration along with other studies and assessments that have been completed within the Baffin Bay watershed.
2) Evaluation of the riparian conditions along the recommended reaches and streams that were not included in this evaluation, should be considered as funding is identified.
3) A program should be considered that incentivizes riparian landowners and decision-makers to:
    a) remove hindrances, allowing poor functioning areas to improve, and
    b) protect high functioning areas from degradation.
4) Aerial photo point locations have been recommended. A periodic retake of the same photos could serve to document changes in functional condition with the address of identified hindrances.
5) Improving riparian conditions along a stream or ditch requires the cultivation of common understanding about riparian function and an awareness of activities that hinder riparian recovery. Riparian function is not well understood. Key riparian concepts are often misunderstood, leading to management strategies that do not necessarily favor riparian function or water quality. With available funding, riparian education can help to raise awareness and cultivate common understanding about how riparian areas work, what types of activities can hinder their function, and how that condition may contribute to water quality in Baffin Bay.
6) A plastic relief model of the watershed would be a very valuable outreach/education tool. These types of models have proven successful to illustrate watershed geography and how water moves through a landscape. A model for the Baffin Bay watershed might be produced for $20,000 to $25,000.
7) Community-based engagement could be an important first step toward addressing the opportunity to improve water quality through tertiary treatment of wastewater and tire removal.

Background & Methodology

The objective of this project is to conduct a riparian evaluation for main Baffin Bay tributaries and their contributing streams. This project examines overall riparian conditions, identifies strong functioning, weak functioning, and non-functioning areas. Apparent riparian hindrances, along with opportunities for improvement and possible constraints, are identified. Aerial photo point sites are established to help document benchmark riparian conditions in areas with identified opportunity for enhancement.

An aerial (helicopter) evaluation of the riparian functional conditions along tributaries to Baffin Bay was conducted on June 18-19, 2019 in accord with the Quality Assurance Protection Plan (QAPP) approved by the Texas Commission on Environmental Quality (TCEQ) for this project. The area evaluated includes approximately 183 miles and encompasses about 21,454 acres of riparian area mostly flanking Los Olmos, San Fernando and Petronila creeks and their primarily tributary streams. (See Fig 2)

Figure 2 *Google Earth™ image of the Baffin Bay tributaries highlighted with the classified water bodies numbered in yellow.*

During the evaluation no suitable and accessible on-the-ground photo point sites for long-term evaluations could be identified. However, one riparian area on each of the main creek drainages was identified for long-term evaluation, and an aerial photo point site was established within each. The chosen photo point sites are intended as examples of areas where hindrances are clearly identifiable, where the opportunity for enhanced riparian function is most obvious, and therefore where the opportunity to document remarkable riparian recovery over a relatively short time, is predictable. The potential photo point sites are presented on page 35, page 41 and page 74 of this report.

This riparian evaluation report may ultimately help determine priority areas for riparian/wetland restoration and conservation efforts, and in this case, the aerial photo points could be valuable benchmarks for pre-implementation conditions. Presented in Figs. 4 A, B and C below are the reaches for the three primary tributary creeks to Baffin Bay and their primary tributary streams. Reaches were previously established and amended based on field conditions. Some reaches were not evaluated at this time, primarily because they are believed to be undisturbed and highly functional.

Baffin Bay and associated bays of Alazan, Cayo del Grullo, and Laguna Salada are together considered waterbody 2492 and are commonly referred to together as Baffin Bay. These bays are critical habitat for recreationally important fish, and an inlet of the Laguna Madre (2491). Baffin Bay (2492) has experienced documented nutrient exceedances resulting in algal blooms and degraded fish habitat. Two of the three main tributaries to Baffin Bay have documented water quality problems. The riparian areas along the tributary creeks to the bay have not been evaluated for their functional condition.

Petronila Creek (segments 2204 and 2203) is the primary tributary of the Alazan Bay section of the Baffin Bay. It runs through mostly ranch and farmland of Kleberg and Nueces counties. It is classified as a 44-mile freshwater stream with chloride, sulfate, and total dissolved solids documented in excess of standards since 2000. Measures have been taken to reduce oilfield related contamination, but the functional condition of riparian areas has not been a focus.

San Fernando Creek (segment 2492A) is the primary tributary of the Gayo del Grullo Bay section of the Baffin Bay. It is about 42 miles long and since 2006 has had a record of bacterial impairment for contact recreation, as well as excessive levels of nitrates, chlorophyll-a, and total phosphorus. The creek primarily flows through rural areas, but also through the cities of Alice and Kingsville where it receives discharge from municipal wastewater treatment plants.

Los Olmos Creek is a primary tributary in the Laguna Salada section of the of Baffin Bay drainage. Los Olmos is an unclassified stream about 67 miles long. It is not routinely monitored for water quality and little is known about its contribution to Baffin Bay. The drainage areas for all three major creeks and their many smaller tributaries are composed of mostly private land offering opportunity for enhanced riparian function and off-channel wetland treatment to improve water quality through private land stewardship.

A healthy and functioning riparian/wetland area filters and slows run-off and floodwaters and allows for sediment trapping and groundwater infiltration. The water quality benefits of a healthy riparian area are well documented and have been shown to improve water quality by removing nutrients, improving dissolved oxygen, storing sediments, regulating temperatures, and buffering flood energies. They have been shown effective in reducing pathogens such as coliform and cryptosporidium. The loss of riparian function equates to a loss in water quality treatment capability and this can contribute directly to a decline in water quality.

Evaluation Method

The Bull's-Eye Riparian evaluation method prescribed by the QAPP considers ten factors. The Bull's-Eye evaluation method is qualitative by nature, not quantitative, and is designed to help identify hindrances to recovery that indicate opportunity for enhanced function.

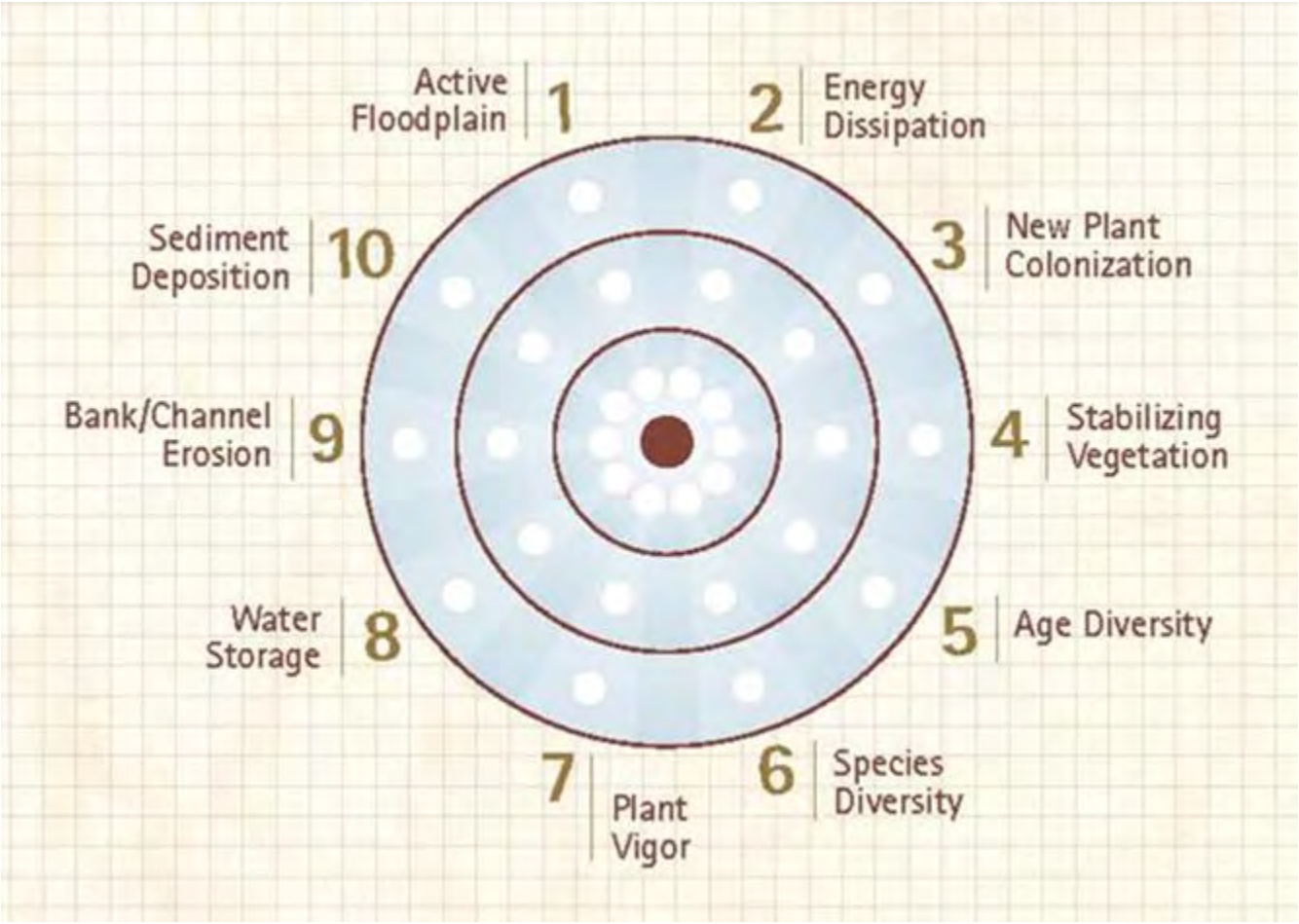

Figure 3 *Bull's-Eye evaluation target*

Not all of the parameters will be appropriate for all channel types. Leaving some portions of the target blank does not detract from the evaluation. Some of the parameters may not apply to ephemeral streams, and likewise, some of the indicators will be difficult to evaluate on tidal-influenced segments of coastal streams. Most of the ten parameters are associated with plants and can be evaluated using the plant information contained within the *Remarkable Riparian Field Guide* to riparian vegetation across most of Texas.

In the field guide, a stability rating (SR) is assigned to riparian plants according to the plants observed ability to withstand the erosive forces of water. The rating scale is 1 through 10, with SR 1 being equivalent to bare ground and SR10 being like anchored rock. A riparian plant community with an SR rating of 6/7 is acceptable to withstand typical forces of erosion. The vegetation growing within a riparian area can indicate the presence or absence of water storage, a key component of riparian health.

Wetland indicator categories have been assigned to most riparian plants. Obligate wetland plants (OBL) are those that require wet conditions, and facultative wetland plants (FACW) are found in areas that are usually wet. Facultative (FAC) plants can be found in equally in wet and dry conditions, and facultative upland (FACU) are usually found in drier upland areas. An abundance of OBL and FACW plants indicates that the riparian area is storing water and maintaining a water table connection for much of the year. This condition is sometimes referred to as the "riparian sponge"

The bull's-eye area in the center of the target represents optimal function, and the outermost ring of the target represents dysfunction. The middle ring of the target represents an at-risk condition, a kind of riparian health danger zone. Using the bull's-eye target to evaluate riparian function over time can provide a visual measure of change.

Following are indicators of riparian function considered in the Bull's-Eye evaluation:

1. **Active Floodplain**. Does floodwater have access to a floodplain? Floodplain access gives floodwater a place to spread out and slow down. Sediment deposition associated with the slowdown offers increased water storage. Areas with good floodplain access will have debris or silt deposits where the vegetation is thick in the floodplain.
2. **Energy Dissipation**. Is there enough "stuff" in channels, on banks, and in the floodplain to dissipate flood energy? Signs include vegetation, rocks, or dead wood in the flood plain to help slow down floodwaters. Slowing down floodwaters is essential for healthy functioning riparian areas.
3. **New Plant Colonization**. Is trapped sediment being successfully colonized by new plants? Look for growth in newly deposited sediment. New plants stabilize the floodplain and allow for more water storage.
4. **Stabilizing Vegetation**. Are banks covered with strong stabilizing plants? Strong-rooted plants are needed to withstand the energy of floodwaters. Plants are rated for their ability to withstand floods with a stability rating (SR). SR1 is bare ground and SR10 is equivalent to the strength to anchored rock. SR6/7 is considered the minimum SR necessary for adequate bank stability. These ratings are based on the information published in *USDA TR47: Monitoring Vegetation Resources in Riparian Areas*, A. Winward, 2000, and have been adjusted by Steve Nelle based on his observations across Texas. A majority of plants with an average of SR6/7, and/or the presence of large wood or boulders, will result in a favorable Bull's-Eye score.
5. **Age Diversity**. Are young, middle-aged, and mature riparian plants present? Age diversity of riparian plants is an indicator of health. Different-aged plants offer stability during fluctuations in flow and climactic conditions. A range of young to old plants is indicative of a Bull's-Eye score.
6. **Species Diversity**. Are several key native riparian plant species present? Diversity contributes to system stability and resilience. Various species of native trees, sedges, and grasses can be identified using the Remarkable Riparian Field Guide, Third Edition, published by the Nueces River Authority, April 2016.
7. **Plant Vigor.** Are riparian plants vigorous and healthy? Plants that are continuously browsed, mowed, or grazed can have compromised root systems and may be unable to dissipate flood energy and stabilize banks. Plants with leaves intact and plants that are not stunted or scarred can indicate Bull's-Eye conditions.
8. **Water Storage**. Are the banks and floodplain storing water? Use the wetland indicator status based on the U. S. Fish and Wildlife Service's Wetland Plant List (1988), for Obligate (OBL) and Facultative Wetland (FACW) plants to indicate water storage capacity.
9. **Bank and Channel Erosion**. Is bank and channel erosion balanced with deposition on point bars? Creation and maintenance of meander banks help dissipate energy and compensate for erosion through deposition. Meander bends where point bars are being formed with the eroded material downstream of cut banks can indicate balance. Out-of-balance bank and channel erosion will show down-cut channels or incised channels that resemble drainage ditches.
10. **Sediment Deposition**. Is sediment being deposited in a balanced way? If there is not enough water to process large amounts of sediment being moved downstream, sediment can build up in mid-channel and in other illogical places. Heaps and piles of sediment in the channel, or mounds of sediment trapped behind a structure with unnatural erosion below, show out-of-balance conditions.

Hindrance and Opportunity Identification

Evaluation activities included visual appraisal of existing functional conditions indicated by the factors previously listed, identification of hindrances, and notation of opportunities for enhanced function. A hindrance is any activity or situation that interferes with natural riparian recovery and healthy function and is usually the result of human or animal activity. Hindrances can often be identified through close observation of the riparian vegetation.

Opportunities for improved riparian function, and thereby improved water quality, are focused on the identification and removal of hindrances.

Following are common hindrances observed in Texas riparian areas:

- Farming, mowing, or spraying weeds or brush too close to the bank
- Logging and related timber harvest activities adjacent to the creek
- Manicured or altered residential or park landscapes next to the creek
- Prolonged grazing concentrations in creek areas
- Excessive populations of deer, exotics, or feral hogs in creek areas
- Burning in riparian area
- Removal of large dead wood and downed trees
- Artificial manipulation of banks, channels or sediment (bulldozing)
- Physical alteration of floodplain
- Excessive vehicle traffic in creek area
- Excessive recreational activity or foot traffic in creek area
- Excessive alluvial pumping or other withdrawals
- Excessive growth of invasive species that inhibit the ability of native riparian plants to do their job
- Low water dams and large reservoirs
- Poorly designed road crossings and bridges

Baffin Bay Tributaries Identified

The riparian areas evaluated were previously established for varying sizes of tributary and measured using Google Earth tm. The established sizes were as follows: An average of 600 feet on each side of the major tributaries near their mouth, and an average of 300 feet on each side of main tributary streams upstream, then 300 - 150 – 100 - 50 feet on each side of smaller tributaries. Based on field observations, the average widths of some riparian areas were amended to reflect observed conditions. The following chart presents the most up-to-date estimates for riparian area width and summarizes and totals those areas for each section of the Baffin Bay watershed.

Cayo Del Grullo Section	Description of Area	Stream Length	Evaluation Area	Est. ave width	Means of Evaluation
San Fernando Creek					
Lower Reach San Fernando Creek	Cayo Del Grullo to US 77	10.8 miles	2618 acres	1000 feet	by helicopter 6-18-19
Carreta Creek	Confluence with San Fernando to tank west of Bishop	7.7 miles	1120 acres	600 feet	by helicopter 6-18-19
Bishop Trib A2	Confluence with Carreta Creek to North Ave. C. in Bishop	3.7 miles	266 acres	300 feet	by helicopter 6-18-19
Tranquitas Creek	Confluence with San Fernando to Tranquitas Lake	6.7 miles	487 acres	300 feet	by helicopter 6-18-19
Upper Reach San Fernando Creek	US 77 to FM 1355	8.1 miles	1178 acres	600 feet	by helicopter 6-18-19
Alice Reach San Fernando Creek	FM 1355 to above Lake Alice Findley	24.4 miles	3549 acres	600 feet	RECOMMENDED FOR FUTURE EVALUATION
Santa Gertrudis Creek	Confluence with Cayo Del Grullot upstream of SH 141	19.4 miles	2822 acres	600 feet	RECOMMENDED FOR FUTURE EVALUATION
Escondido Creek	Confluence with Santa Gertrudis upstream about 6 miles	6.3 miles	458 acres	300 feet	RECOMMENDED FOR FUTURE EVALUATION
Jaboncillos Creek AND TRIB A	FM 1118 to US 77 Plus tributary lying to the south	6.0 miles	433 acres	300 feet	by helicopter 6-18-19
Trib A to Jaboncillos		2.1 miles	51 acres	100 feet	by helicopter 6-18-19
Radicha Creek Including 3 tributaries	FM 2215 to head pool near US 77	5.3 miles	382 acres	300 feet	by helicopter 6-18-19
Trib A to Radicha Creek	Lying to south of 2220	1.4 miles	105 acres	300 feet	by helicopter 6-18-19
Trib B to Radicha Creek	above FM 1075	1.0 miles	12 acres	50 feet	by helicopter 6-18-19
Trib B2 to Radicha Creek	Lying south of 2220	0.8 miles	9 acres	50 feet	by helicopter 6-18-19
Vattman Creek	FM 1546 to Rosita Lake	4.5 miles	325 acres	300 feet	by helicopter 6-18-19
	Totals	**108 miles**	**13,815 acres**		

Figure 4 *A* -Cayo Del Grullo drainage including San Fernando Creek and others

Alazan Bay Section	Description of Area	Stream Length		Evaluation Area		Est. ave width		Means of Evaluation
Petronila Creek								
Lower/Chapman Ranch Reach Petronila Creek	Laureles Ranch Road to Landfill Ditch	8.6	miles	2085	acres	1000	feet	by helicopter 6-19-19
Landfill Drain Ditch	Lying to the east, from the confluence with Petronila Creek to north side of landfill.	5.6	miles	204	acres	150	feet	by helicopter 6-19-19
Petronila Ditch	Confluence with Petronila Creek to CR 67	8.7	miles	316	acres	150	feet	RECOMMENDED FOR FUTURE EVALUATION
Lost Creek Ditch	Lying to the east, from the confluence with Petronila Creek to near Hwy 40, near Raab.	8.1	miles	196	acres	100	feet	by helicopter 6-19-19
Lubby Lake/Driscoll Reach Petronila Creek	SH 70 to US 77	18.8	miles	1367	acres	300	feet	by helicopter 6-19-19
Concordia Trib	Confluence with Petronila Creek to above US 77	10.0	miles	242	acres	100	feet	RECOMMENDED FOR FUTURE EVALUATION
Banquete Reach Petronila Creek	US 77 to confluence of Banquete and Agua Dulce Creeks below SH 44	11.3	miles	822	acres	300	feet	by helicopter 6-19-19
Banquete Creek	Confluence with Petronila Creek to headwater above CR 93 (Mantor Briggs Rd)	7.4	miles	541	acres	300	feet	by helicopter 6-19-19
Agua Dulce Creek Lower Reach	Confluence with Petronila Creek to FM359	23.2	miles	1687	acres	300	feet	by helicopter 6-19-19
Quintas Creek	Confluence with Petronila Creek to FM306	12.2	miles	296	acres	100	feet	POSSIBLE PRIORITY FOR FUTURE EVALUATION
Leon Creek	Confluence with Quintas to FM624	6.9	miles	167	acres	100	feet	LOW PRIORITY FOR FUTURE EVALUATION
Rosita Creek	Confluence with Agua Dulce 1to Hwy 359	7.3	miles	177	acres	100	feet	LOW PRIORITY FOR FUTURE EVALUATION
Palo Hueco Creek	Confluence with Agua Dulce 1to Hwy 281	11.2	miles	272	acres	100	feet	LOW PRIORITY FOR FUTURE EVALUATION
Tecolote/Ruces Creek	Confluence with Palo Hueco to headwater	4.7	miles	114	acres	100	feet	LOW PRIORITY FOR FUTURE EVALUATION
El Caro Creek	Confluence with Palo Hueco to headwater	5.4	miles	131	acres	100	feet	LOW PRIORITY FOR FUTURE EVALUATION
Agua Dulce Creek Upper Reach	FM359 to US 281	10.0	miles	727	acres	300	feet	LOW PRIORITY FOR FUTURE EVALUATION
Pintas Creek	Confluence with Petronila to confluence with San Fernando creek near Alice	19.7	miles	2865	acres	600	feet	by helicopter 6-19-19
Los Tunas Creek	Cayo del Mazon to ditch south of county line	12.0	miles	2909	acres	1000	feet	by helicopter 6-19-19
Chiltipin Creek	Confluence with Los Tunas to ditch at end of CR 6	11.3	miles	1644	acres	600	feet	by helicopter 6-19-19
	Totals	**202**	**miles**	**16,763**	**acres**			

Figure 4 B Alazan Bay section drainage including Petronila and Los Tunas creeks and their tributaries

Laguna Salada Section	Description of Area	Stream Length		Evaluation Area		Est. ave width		Means of Evaluation
Los Olmos Creek								
Lower Reach Los Olmos Creek	US 77 to Salado Creek Confluence	1.0	miles	145	acres	600	feet	by helicopter 6-18-19
King Ranch Reach Los Olmos Creek	Salado Creek to SH 285 near Falfurrias	25.8	miles	3753	acres	600	feet	LOW PRIORITY FOR FUTURE EVALUATION
Upper Reach Los Olmos Creek	SH 285 to above SH 349	46.4	miles	3375	acres	300	feet	LOW PRIORITY FOR FUTURE EVALUATION
Salado Creek	Confluence with Los Olmos following its easterly branch to Rivera	1.8	miles	128	acres	300	feet	by helicopter 6-18-19
	Totals	**75**	**miles**	**7,401**	**acres**			
	GRAND TOTALS	**385**	**miles**	**37,979**	**acres**			
	EVALUATED 6.19	**184**	**miles**	**21,454**	**acres**			
	UNEVALUATED	**202**	**miles**	**16,525**	**acres**			

Figure 4 C Laguna Salada section drainage including Los Olmos and Salado creek

Riparian Evaluations by Reach

Cayo Del Grullo Section

San Fernando Creek

Lower Reach of San Fernando Creek

Figure 5 *GoogleEarth™ image of the lower reach of San Fernando Creek shows riparian evaluation area highlighted in yellow. The reach begins at its mouth in Cayo del Grullo Bay and ends at US Hwy 77.*

Observations

The riparian area of the lower reach of San Fernando Creek is about 10.8 miles in length and is estimated at 1,000 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 2,618 acres of land. Beginning at its mouth at Cayo Del Grullo Bay, it runs mostly alongside the Naval Air Station on the eastern edge of Kingsville. The creek's riparian area is well buffered with wide flanks of well- vegetated highly functional riparian areas throughout the reach. Overall, the lower reach of San Fernando Creek is a benchmark for high function.

Figure 6 *Image shows wide functional marsh-like riparian area flanking San Fernando Creek near its mouth at Cayo del Grullo. Farming activities are set back from the creek, and the wide floodplain is well vegetated.*

Figure 7 *These images show highly functional riparian areas along San Fernando Creek around the Naval Air Station. Image on the left shows braided channels with banks vegetated in Spiny aster. Image on the right shows a riparian area (river right) more than 1,000 feet wide covered in Cordgrass with pockets of standing water. Retama and Mesquite ring the channels with occasional Willow and Ash trees present.*

Figure 8 *Near the top of the reach the creek narrows and becomes a heavily wooded meandering stream, retaining a highly functional condition.*

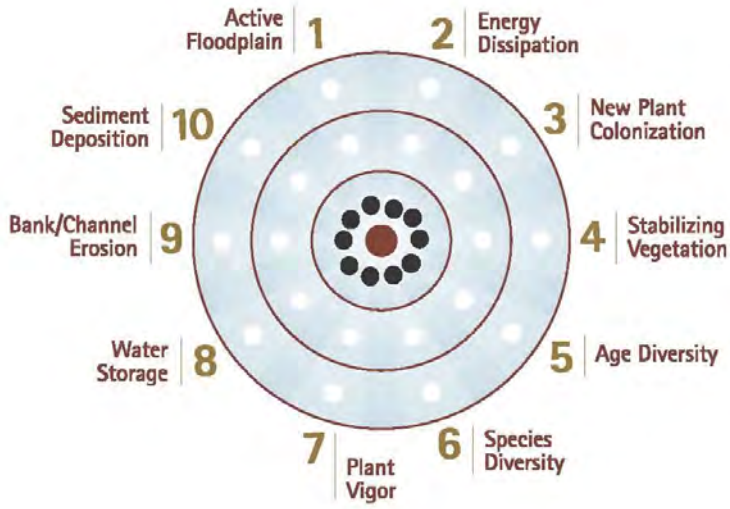

Figure 9 *Bull's-Eye evaluation target for the lower reach of San Fernando Creek.*

Riparian Evaluation (Lower Reach of San Fernando Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain throughout the reach.
2. **Energy dissipation**. The channel, banks and floodplain host an abundance of energy-dissipating features throughout the reach.
3. **New plant colonization**. New plants were observed colonizing fresh sediments throughout.
4. **Stabilizing vegetation**. Banks are covered with stabilizing vegetation. (Spiny aster SR8, Marshhay/Gulf cordgrass SR9, Retama SR6)
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed.
6. **Species diversity of riparian vegetation.** More than five species of native riparian plants were observed.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing.
8. **Water storage**. Several OBL and FACW plant species were observed both at the water's edge and on the floodplain. (Spiny aster FACW, Marshhay/Gulf cordgrass FACW/OBL, Buttercup FACW, Sea-oxeye daisy FACW, Saltgrass FACW, Shoregrass OBL, Retama FACW, Dwarf palmetto FACW)
9. **Bank and channel erosion**. Erosion and deposition appear balanced and channel size and shape appear of size and depth to manage sediment.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed within this reach.

Riparian Hindrances

None observed.

Riparian Enhancement Opportunities

Work with landowners to reward the current stewardship; protect and document the highly functional riparian condition along the lower reach of San Fernando Creek. Without creating new hindrances, find ways to utilize this reach to demonstrate capability for riparian recovery and its influence on water quality.

Carreta Creek (tributary to lower reach of San Fernando Creek)

Figure 10 *GoogleEarth™ image of the Carreta Creek highlighted in yellow. The reach begins at the confluence with San Fernando Creek near the Naval Air Station and ends at a tank west of Bishop.*

Observations

Carreta Creek is about 7.7 miles in length and its riparian area is estimated at 600 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 1,120 acres of land. Beginning at the confluence with San Fernando and looking upstream to Bishop, the creek runs near the Naval Air Station and then through farmland. Carreta Creek is highly functional, resembling the lower reach of San Fernando Creek in its plant community and channel character. Even as it runs through the town of Bishop, riparian function is

retained. The creek has been allowed a wide vegetated floodplain and does not appear to have been channelized recently.

Near the creek's crossing with U.S. Hwy 77, discharge from Bishop's wastewater treatment plant (WWTP) enters the creek, and water clarity and color noticeably changes. An algal bloom was observed in this area, and downstream of the discharge dense groups of fish were observed hitting the surface, possibly stressed for oxygen.

Overall, Carreta Creek is high functioning and similar to the benchmark condition observed on the lower reach of San Fernando Creek. Carreta's creek channel alternates between single thread and braid two or three times over its length that could be indicative of a past sediment transport issue. However, given the extensive vegetation present, it appears that the channel condition is becoming balanced and normal. None of the hindrances typically associated with increased sediment delivery were observed.

Figure 11 *Carreta Creek's channel is braided and laced with Cordgrass. The overall width of channel and riparian area is estimated at about 1,000 feet in this area.*

Figure 12 *Further upstream the creek's channel becomes straight and single thread, but the riparian area remains wide and well vegetated.*

Figure 13 *At the discharge location for the Bishop WWTP there is a distinct change in the water's color and clarity. An algal bloom was observed beginning at this location.*

Figure 14 *The creek's riparian area remains remarkably functional and well vegetated as it runs through the town of Bishop. The channel braiding could be indicative of excessive sediment runoff in the past, but the creek seems to be managing its sediment now — most braids have well-vegetated perimeters*

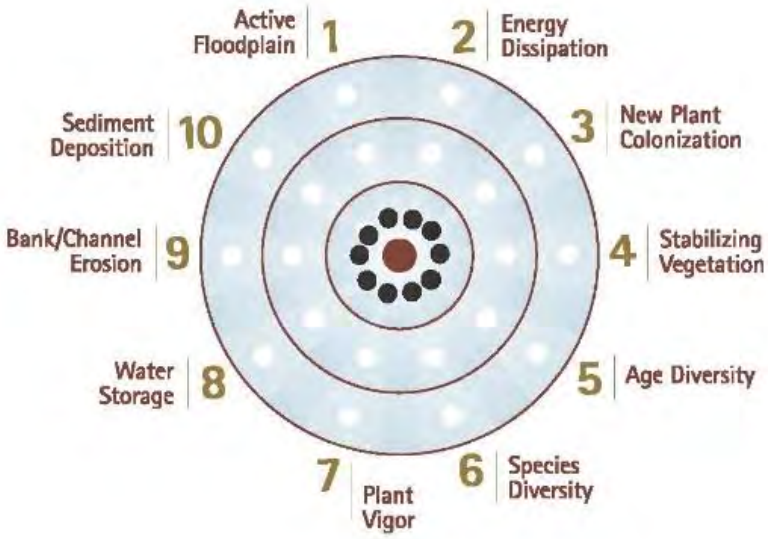

Figure 15 *Bull's-Eye evaluation target for Carreta Creek.*

Riparian Evaluation (Carreta Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain.
2. **Energy dissipation**. The channel, banks and floodplain host an abundance of energy-dissipating features throughout the reach.
3. **New plant colonization**. New plants were observed colonizing fresh sediments.
4. **Stabilizing vegetation**. Banks are covered with stabilizing vegetation. (Spiny aster SR8, Marshhay/Gulf cordgrass SR9)
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed.
6. **Species diversity of riparian vegetation.** More than five species of native riparian plants were observed.

7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing.
8. **Water storage**. Several OBL and FACW plant species were observed both at the water's edge and on the floodplain. (Spiny aster FACW, Marshhay/Gulf cordgrass FACW/OBL, Buttercup FACW, Sea-oxeye daisy FACW, Saltgrass FACW, Shoregrass OBL)
9. **Bank and channel erosion**. Erosion and deposition appear balanced and channel size and shape appear of size and depth to manage sediment.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed. The presence of alternating braid and single-thread channel may be indicative of previous sediment transport issues.

Riparian Hindrances
None observed.

Riparian Enhancement Opportunities for Carreta Creek

1) Work with landowners to reward the current stewardship; protect and document the highly functional riparian condition along the lower reach of San Fernando Creek. Without creating new hindrances, find ways to utilize this reach to demonstrate capacity for riparian recovery and its influence on water quality.
2) Engage the town of Bishop in ways to improve the quality of wastewater discharged to creek. Off-channel wetlands or other tertiary treatment should be considered to protect water quality in this otherwise clear healthy creek.

Bishop Trib A2 (tributary to Carreta Creek)

Figure 16 *GoogleEarth™ image of the Bishop Trib A2 highlighted in yellow. The reach begins at confluence with Carreta Creek (highlighted in yellow with red channel line) and ends in the town of Bishop.*

Observations

The riparian area of the upper reach of Bishop Trib A2 is about 3.7 miles in length and is estimated at 300 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 266 acres of land. Beginning at the confluence with Carreta Creek and looking upstream to Ave. C in Bishop, the creek runs through farmland and appears to have been used as a community or industry dump ground in several locations. At its confluence with Carreta Creek, this tributary is much like Carreta with a wide functional riparian area, but moving upstream it quickly becomes fully dysfunctional with mostly non-riparian vegetation that is being mowed, farming too close, and alteration of the floodplain. The creek banks and channel are littered with trash/debris dumpsites, and the creek ends in a highly manicured floodway within the town of Bishop. Gullies are apparent as drains enter the creek from adjacent farmlands. Overall, Bishop Trib A2 is dysfunctional and holds much opportunity for enhancement and community engagement.

Figure 17 *Pictured here are one of several large tire and debris dumps located on the creek. Banks are vegetated here, but not with riparian plants that can provide functional attributes.*

Figure 18 *Farming too close, channelizing and mowing riparian areas to enhance field drainage serves to hinder riparian function along a creek. Pictured here, the creek is well vegetated primarily with non-riparian grasses. One exception in the image on the left are the obligate plants growing within the channel that appear to be trapping some fresh sediment and creating tiny meanders to process it.*

Figure 19 *As the creek runs through Bishop it become a wide, grassy drain way primarily vegetated with non-riparian grasses that are mowed to enhance drainage.*

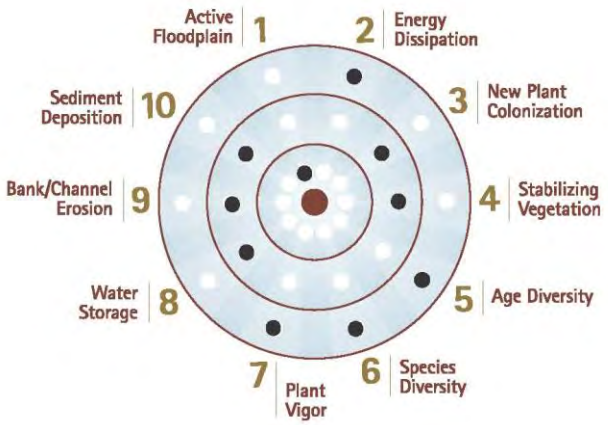

Figure 20 *Bull's-Eye evaluation target for Bishop Trib A2.*

Riparian Evaluation (Bishop Trib A2)

1. **Floodplain access**. The creek appears to have access to a floodplain, but it is highly altered to serve as a drain way.
2. **Energy dissipation**. There are not many energy dissipating features in the channel, banks and floodplain.
3. **New plant colonization**. Some fresh sediment is being colonized within the channel on tiny emergent "point bars" within the channelized limits.
4. **Stabilizing vegetation**. Banks are covered, but not with stabilizing riparian vegetation. Guinea grass appears to be the dominant vegetation, possibly planted as part of a previous drainage, channelization and/or soil conservation project.
5. **Age diversity and reproduction of riparian vegetation**. No age diversity is present. Plants appear to be of one age group.
6. **Species diversity of riparian vegetation.** Low diversity of native riparian plants was observed.
7. **Plant vigor**. Riparian plants are mostly absent, and upland plants growing in the riparian area appear mowed.
8. **Water storage**. The only OBL and FACW plant species observed were at the water's edge —possibly Spike rush and Star sedge.
9. **Bank and channel erosion**. Numerous gullied areas present,; erosion and deposition do not appear to be balanced; and channel size and shape appear to have been altered.
10. **Sediment deposition**. Sediment is being caught and colonized within the channel, but not within the riparian area. The sediment balance appears to have been altered in this creek.

Riparian Hindrances

Mowing too close to the bank, physical alteration of the floodplain, artificial manipulation of banks and channel.

Riparian Enhancement Opportunities

1) Work with landowners and engage community leaders to address the dumping and learn about riparian function.
2) Encourage a cessation or setback of mowing in the riparian area where acceptable for accommodating drainage.

Tranquitas Creek (tributary to lower reach of San Fernando Creek)

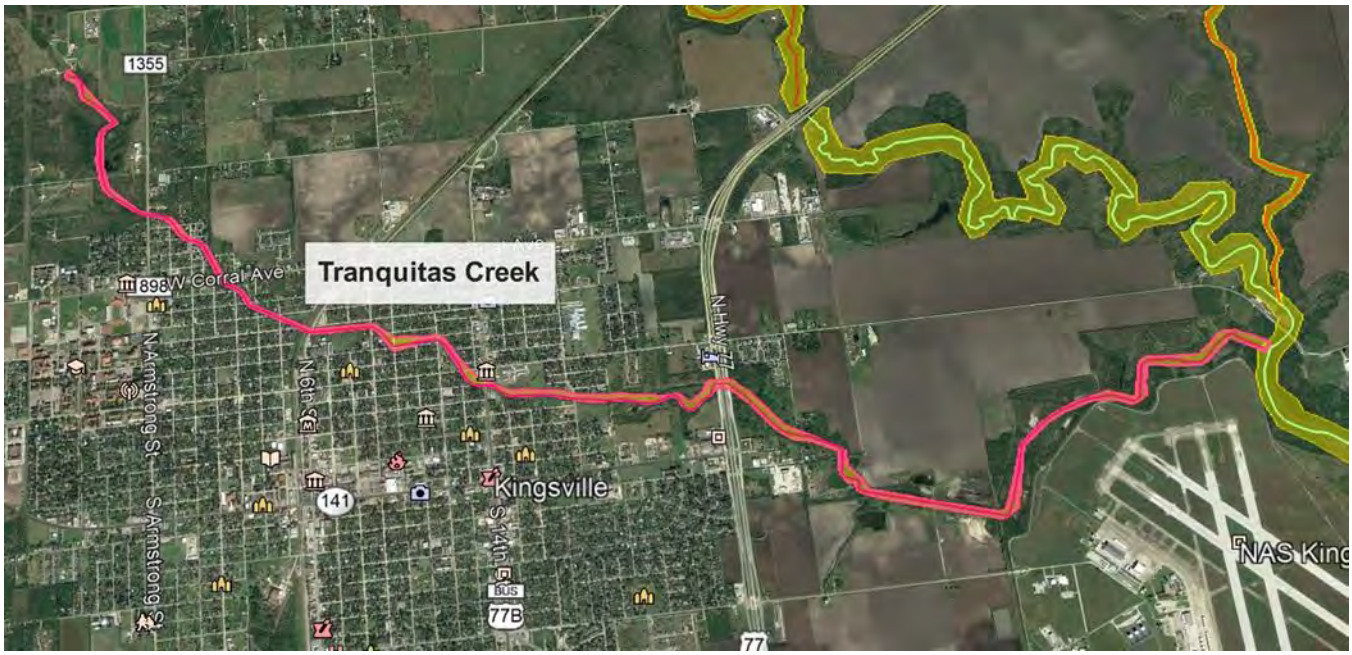

Figure 21 *GoogleEarth™ image of the Tranquitas Creek highlighted in pink. The creek begins at the confluence with San Fernando (yellow) near the Naval Air Station and ends at Tranquitas Lake on the northeast side of Kingsville.*

Observations

Tranquitas Creek is about 6.7 miles in length and its riparian area is estimated at 300 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 487 acres of land. Beginning at the confluence with San Fernando Creek and looking upstream through Kingsville, the creek runs near the Naval Air Station and then through urban lands. Tranquitas Creek is highly functional, resembling the wooded portions of the lower reach of San Fernando Creek in its plant community and channel character until it enters Kingsville near U.S. Hwy 77. As it runs through town for about 2.3 miles, the creek is a channelized drainage way with a hardened cement bed. Overall, the lower portion of Tranquitas Creek, or about 65 percent of its length, is similar to the benchmark condition observed on the lower reach of San Fernando, except where it runs through Kingsville.

Figure 22 *Tranquitas Creek below U.S. 77 is a highly functional wooded creek. Farming and mining activities are mostly set back from the banks and do not appear to be hindering riparian function.*

Figure 23 *As the creek enters Kingsville, passing under U.S. 77, it becomes a manicured and manipulated floodway with hardened cement bed.*

Figure 24 *As the creek leaves Kingsville it once again becomes highly functional ending at Tranquitas Lake above FM 1355.*

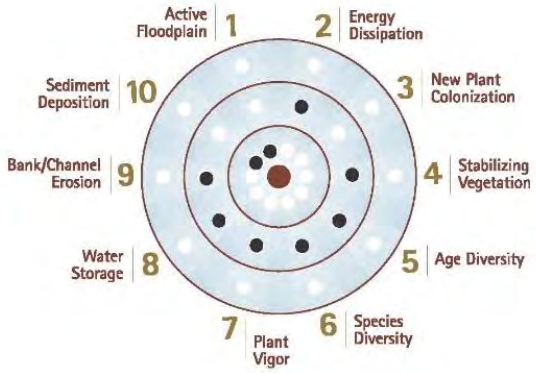

Figure 25 *Bull's-Eye evaluation target for Tranquitas Creek.*

Riparian Evaluation (Tranquitas Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain even through Kingsville, albeit an engineered flood management floodplain.
2. **Energy dissipation**. For the most part, the channel, banks and floodplain host an abundance of energy dissipating features. Except through Kingsville, the creek is heavily wooded and undisturbed. Not many energy dissipating features are present through town.
3. **New plant colonization**. NA. Fresh sediment was not observed.
4. **Stabilizing vegetation**. Banks below U.S. Hwy 77 and above FM1355 are covered with woody stabilizing vegetation. (Retama SR6, Ash SR6, Palmeto SR7)
5. **Age diversity and reproduction of riparian vegetation**. Except through Kingsville, all age groups were observed.
6. **Species diversity of riparian vegetation.** More than five species of native riparian trees were observed, except through Kingsville.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing, except through Kingsville.
8. **Water storage**. Several FACW tree species were observed both at the water's edge and on the floodplain, except through Kingsville. (Retama FACW, Ash FAC/FACW, Palmeto FACW)
9. **Bank and channel erosion**. Erosion and deposition appear balanced and channel size and shape appear of size and depth to manage sediment throughout the woody reaches, below U.S. Hwy 77 and above FM 1355. Within Kingsville, the creek is managed as a floodway without regard to the erosion/deposition balance.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed.

Riparian Hindrances

Mowing, artificial manipulation of bank and channel, physical alteration of floodplain through Kingsville (about 2.3 mile section of the creek).

Riparian Enhancement Opportunities

1) Engage Kingsville community leaders and stakeholders to recognize the potential value of a healthy functional (wooded) stream running through their town. A functional stream can also preform floodway/drainage services while offering recreation and aesthetic value to residents and visitors.
2) Work with landowners to reward the current stewardship; protect and document the highly functional riparian condition along Tranquitas Creek below U.S. Hwy 77. Without creating new hindrances, find ways to utilize the high functioning portion of the creek to inform stakeholders of the potential for recovery of a wooded stream amenity within Kingsville.

Upper Reach of San Fernando Creek

Figure 26 *GoogleEarth™ image of the upper reach of San Fernando Creek with the average riparian evaluation area highlighted in yellow. The reach begins at US Hwy 77 and ends at FM 1355.*

Observations

The riparian area of the upper reach of San Fernando Creek is about 8.1 miles in length and is estimated at 600 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 1,178 acres of land. Beginning at U.S. Hwy 77 and looking upstream to FM 1355, the creek runs through farmland and pastureland. The Celenese chemical plant and a community park are located near the bottom of the reach.

With the exception of channelization and manicuring in the vicinity of the plant and the park, the creek's riparian area is well buffered with woody vegetation and mostly functional riparian areas. Overall, the upper reach of San Fernando Creek is highly functional with exception of the park/plant area where mowing to creek edge is inhibiting riparian vegetation recovery and the floodplain appears to have been altered to accommodate stormwater runoff. Of the 8.1 miles included in the upper reach, hindered function was observed on about .4 of a mile.

Figure 27 *Stormwater runoff ditches entering the creek.*

Figure 28 *GoogleEarth™ image of the park/plant area along Upper Reach of San Fernando Creek where the creek banks are manicured and channel/floodplain appear altered.*

Figure 29 *Community park with manicured grounds and off-channel pond.*

Figure 30 *Heavily wooded meandering channel of the upper reach of San Fernando Creek.*

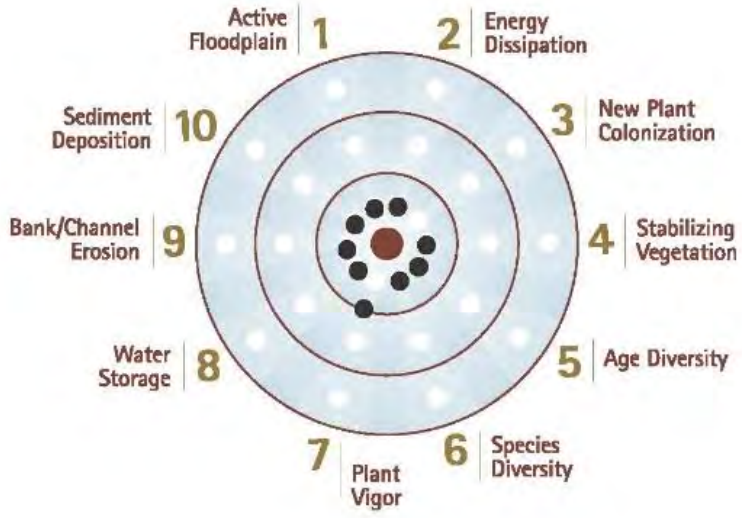

Figure 31 *Bull's-Eye evaluation target for the upper reach of San Fernando Creek.*

Riparian Evaluation (upper reach of San Fernando Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain throughout the reach.
2. **Energy dissipation**. The channel, banks and floodplain host an abundance of energy-dissipating features throughout the reach, with the exception of the manicured park.
3. **New plant colonization**. Not applicable, no fresh sediments were observed.
4. **Stabilizing vegetation**. Banks are covered with stabilizing vegetation. (Retama SR6, Oak trees SR6, Elm trees SR6, Dwarf palmetto SR7, Ash trees SR6)
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed.
6. **Species diversity of riparian vegetation.** More than five species of native riparian plants were observed.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing with exception of about .4 mile through the park/plant area.
8. **Water storage**. Several OBL and FACW plant species were observed both at the water's edge and on the floodplain. (Retama FACW, Dwarf palmetto FACW)
9. **Bank and channel erosion**. Erosion and deposition appear balanced and channel size and shape appear of size and depth to manage sediment.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed within this reach.

Riparian Hindrances

None observed, except for mowing too close to the bank and alteration of the floodplain in the park/plant area.

Riparian Enhancement Opportunities

Work with landowners to address the identified hindrances within the park/plant area which could include setting mowing/manicuring away from the creek bank to allow riparian plant recovery.

Alice Reach of San Fernando Creek

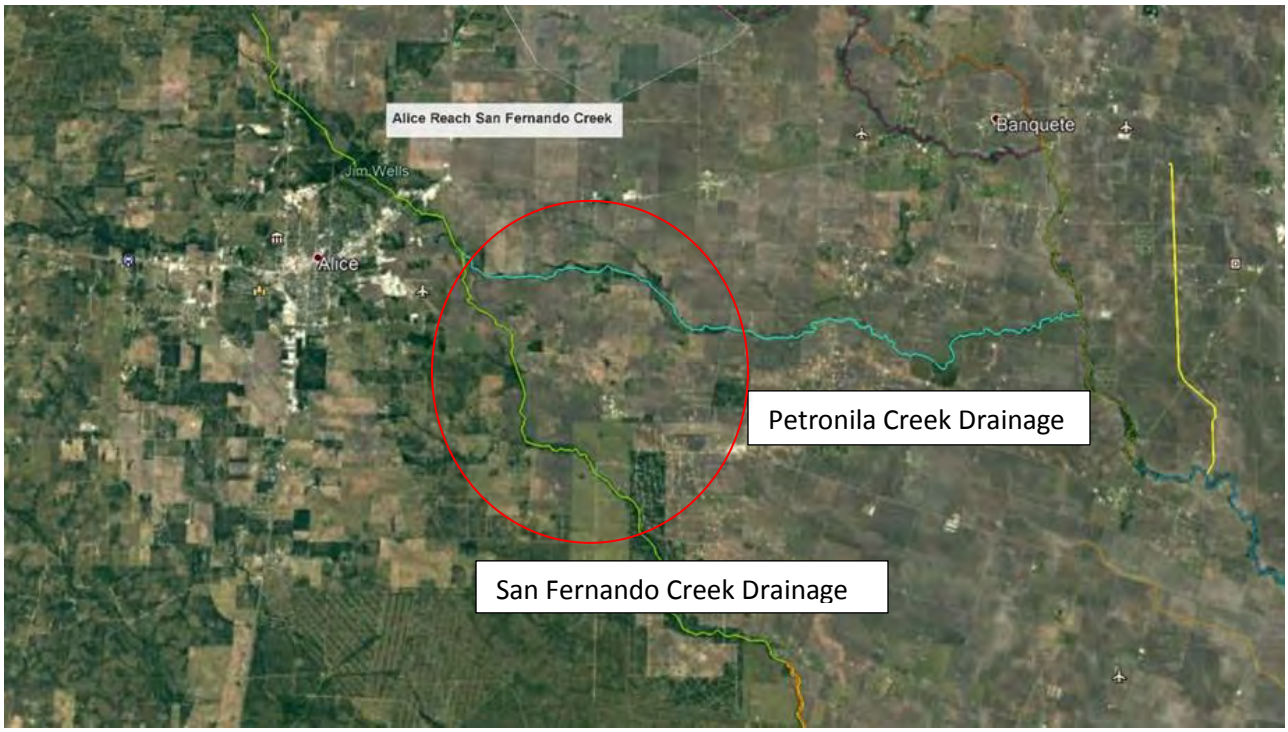

Figure 32 *GoogleEarth™ image of the Alice reach of San Fernando Creek with the average riparian evaluation area highlighted in green. The reach begins at FM 1355 and ends above Lake Alice Findley.*

Observations
The riparian area of the Alice reach of San Fernando creek is about 24.4 miles in length and is estimated at 600 feet on each side of the established channel. Based on this estimated width, the potential riparian area includes about 3,549 acres of land. It is interesting to note that the Petronila Creek and San Fernando Creek drainages are connected by an apparently altered channel/ditch at the top of this reach. The Alice reach of San Fernando was not evaluated as part of this project; it is recommended for evaluation as part of a future project.

Santa Gertrudis and Escondido Creek (tributary to Santa Gertrudis)

Figure 33 *GoogleEarth™ image of the Santa Gertrudis Creek marked with the narrow red line and its tributary, Escondido Creek, marked with the narrow yellow line. Santa Gertrudis has its mouth in the Cayo Del Grullo and its head above Lake Alice Findley near SH 141.*

Observations
The riparian area of the Santa Gertrudis Creek is about 19.4 miles in length and is estimated at 600 feet on each side of the established channel. Based on this estimated width, the potential riparian area includes about 2,822 acres of land. Escondido Creek is a tributary to Santa Gertrudis Creek about 6.3 miles in length. At an estimated 300 feet on each side its potential riparian area is estimated at 458 acres. Santa Gertrudis and Escondido Creeks were not evaluated as part of this project. They are recommended for evaluation as part of a future project.

Jaboncillos Creek and Trib A

Figure 34 *GoogleEarth™ image of Jaboncillos Creek and a tributary stream highlighted in blue. Jaboncillos was evaluated from FM 1118 to US 77, along with its tributary lying to the south.*

Observations

The riparian area of Jaboncillos Creek is about six miles in length and is estimated at 300 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 433 acres of land. A small tributary stream about 2.1 miles in length enters the creek from the south, and based on an estimated width of 100 feet on each side of the channel, the evaluated area includes about 51 acres. A number of washed out crossings and dumpsites were observed with deep gullies and erosion along most of the length of both the main creek and its tributary. One reach along the tributary appears to be high functioning and managed with a riparian conservation buffer. Overall, riparian conditions of the Jaboncillos and its tributary were observed to be “at risk”.

Figure 35 *Image illustrates the most common hindrance on the creek and gully formation.*

Figure 36 *Confluence of Janboncillos (right) and the tributary (left).*

Figure 37 *This image shows a poorly designed crossing on Jaboncillos Creek. It appears that the creek has down cut around the crossing and left its conduits high and dry. Piles of cement debris can be seen dumped along the channel around the crossing in an apparent attempt to dissipate stream energy. Stream crossings should always be located on a straight section of channel to avoid excessive stream energy being directed at the crossing.*

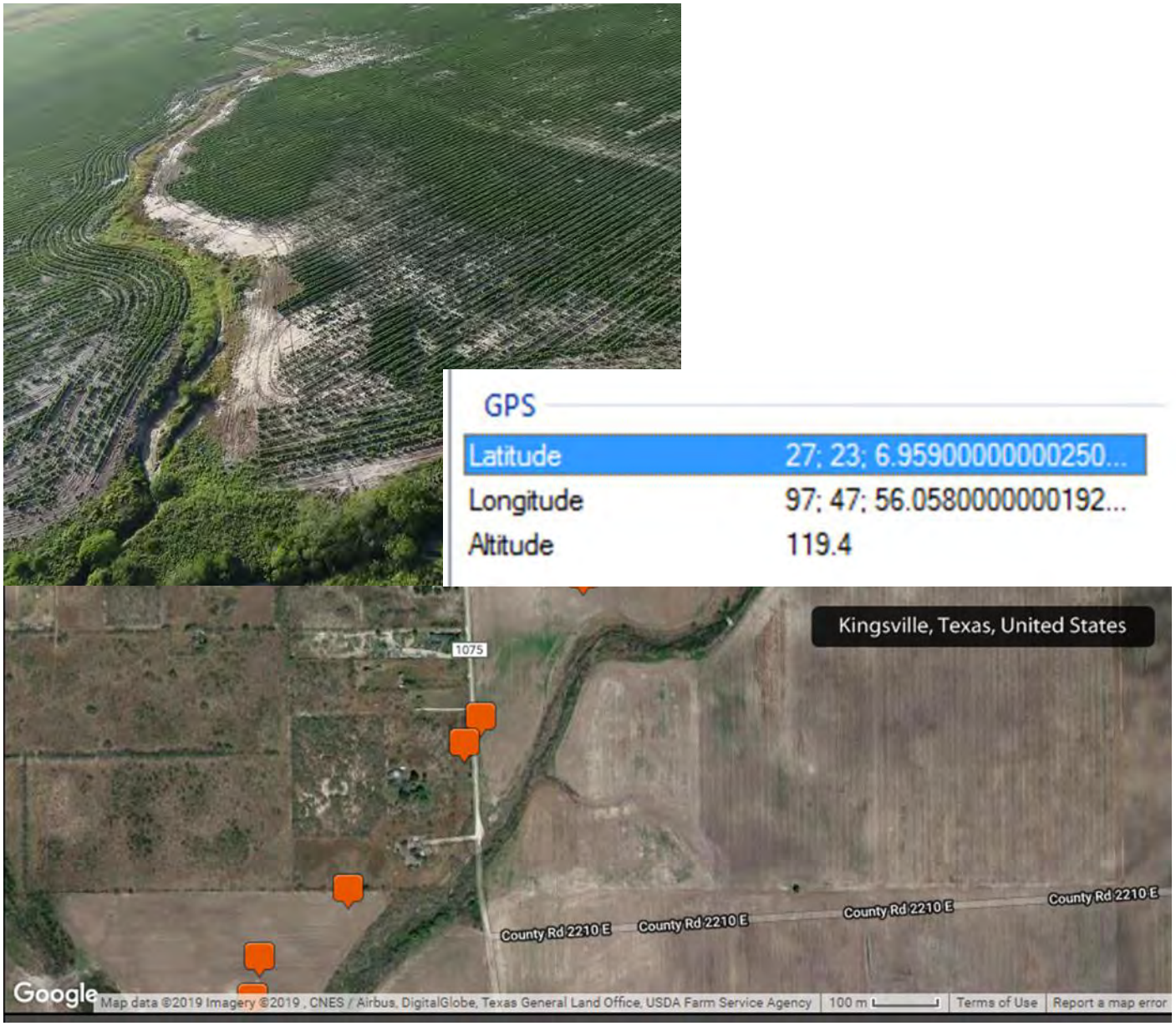

Figure 38 *Looking east at the confluence of a small drain way and Jaboncillos Creek tributary. This image illustrates the hindrance of farming to close to a drain way and the opportunity for enhanced function with a setback of disturbance. This image is an aerial photo point choice.*

Figure 39 *Image shows discarded tires doting the channel of Jaboncillos creek. Tires can be seen in large numbers, floating, strewn and in dump piles along many Baffin Bay tributaries.*

Figure 40 *Image shows channel slightly incised and grazing concentrations in the creek area that appears to be hindering vegetation recovery.*

Figure 41 *Image shows an exceptionally well-buffered segment of the tributary.*

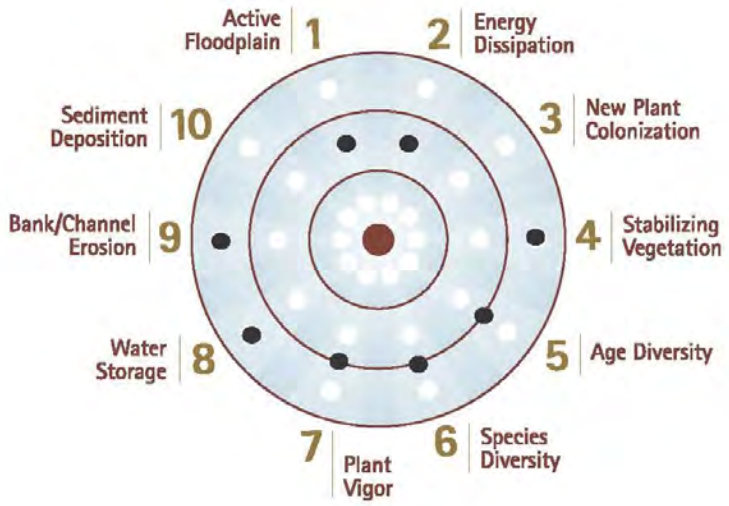

Figure 42 *Bull's-Eye evaluation target for Jaboncillos Creek and tributary.*

Riparian Evaluation (Jaboncillos Creek and a tributary)

1. **Floodplain access**. The creeks appear to have down cut in a number of locations and lost easy access to its floodplain.
2. **Energy dissipation**. With some exceptions, the channel, banks and floodplain are lacking in energy dissipating features.
3. **New plant colonization**. Not applicable, no fresh sediment was observed.
4. **Stabilizing vegetation**. With limited exception not much of the creek and tributary banks are covered with stabilizing riparian vegetation. Trees are mostly upland species offering some root stability but not near what can be provided by riparian plants.
5. **Age diversity and reproduction of riparian vegetation**. Most of the riparian areas appear to have been cleared in the past. Few to no older trees were observed.
6. **Species diversity of riparian vegetation.** Low diversity with limited exception.
7. **Plant vigor**. With some exception, plants show signs of heavy grazing, mowing, trampling or browsing.
8. **Water storage**. Few to no OBL and FACW plant species were observed.
9. **Bank and channel erosion**. Erosion is widespread, and channel is incised in many places.
10. **Sediment deposition**. Sediment deposition was not observed.

Riparian Hindrances

- Observed hindrances include: grazing management, farming too close, and poorly designed crossings, plus dumping and abundant tires.
- Poorly designed road crossing.

Riparian Enhancement Opportunities

1) Work with landowners to address identified hindrances.
2) Remove, repair or replace the poorly designed crossing.

Radicha Creek and Tribs A, B & B2

Figure 43 *GoogleEarth™ image of Radicha Creek and a tributary stream highlighted in purple with its tributaries in red.*

Observations

The riparian area of Radicha Creek is about 5.3 miles in length and is estimated at 300 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 382 acres of land. Three small tributary streams, together 3.2 miles in length, enter the creek, and based on an estimated width of 50 to 300 feet on each side of the channel, the evaluated tributary areas include about 126 acres. A number of gullies were observed as well as erosion along most of the length of both the main creek and its tributary. One reach along the creek appears to be high functioning and managed with a riparian conservation buffer. Overall, the Radica Creek and its tributaries are in poor functional condition and offer opportunity for enhancing function with changes in land practices that appear to be hindering riparian recovery.

Figure 44 *Image illustrates the riparian condition along most of Radicha Creek and its tributaries.*

Figure 45 *Image illustrates the riparian condition along most of Radicha Creek and its tributaries in contrast with the heavily wooded tract in the foreground.*

Figure 46 *Looking west at Trib A to Radica Creek south of FM 2220. This image illustrates the hindrance of farming too close to a drain way and the opportunity for enhanced function with a setback of disturbance.*

Figure 47 *The location of the image is shown on the Google Earth tm map and is an aerial photo point choice at the* GPS Coordinates of 27°21'50.518" N 97°46'29.992" W.

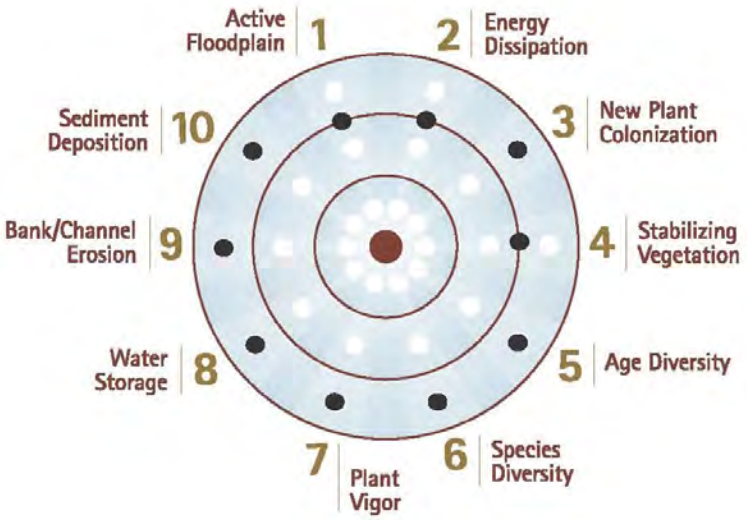

Figure 48 *Bull's-Eye evaluation target for Radicha Creek and three tributaries.*

Riparian Evaluation (Radicha Creek and 3 tributaries)

1. **Floodplain access**. The creeks appear to have down cut in a number of locations and lost easy access to its floodplain.
2. **Energy dissipation**. With some exceptions, the channel, banks and floodplain are lacking in energy dissipating features.
3. **New plant colonization**. None observed on fresh sediments.
4. **Stabilizing vegetation**. With limited exception, not much of the creek and tributary banks are covered with stabilizing riparian vegetation.

5. **Age diversity and reproduction of riparian vegetation**. Most of the riparian areas appear to have been cleared in the past. No age diversity was observed.
6. **Species diversity of riparian vegetation.** Low diversity.
7. **Plant vigor**. With some exception, plants show signs of tilling, heavy grazing, mowing, trampling or browsing.
8. **Water storage**. Few to no OBL and FACW plant species were observed.
9. **Bank and channel erosion**. Erosion is widespread and channel is incised in many places.
10. **Sediment deposition**. Sediment deposition does not appear balanced. Mid-channel bars were observed.

Riparian Hindrances
Observed hindrances include: grazing management and farming too close to the bank.

Riparian Enhancement Opportunities
Work with landowners to address identified hindrances and improve water quality.

Vattman Creek

Figure 49 *GoogleEarth™ image of Vattman Creek in pink.*

Observations
The riparian area of Vattman Creek is about 4.5 miles in length and is estimated at 300 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 325 acres of land. A number of gullies were observed as well as erosion along most of the length of both the main creek and its tributary. The lower sections of the creek appear to be fairly high functioning. Moving upstream across farmland, the riparian condition degrades. Overall, Vattman Creek is in moderate "at-risk" condition and offers opportunity for enhanced function with changes in practices that appear to be hindering riparian recovery.

Figure 50 *Looking upstream from the mouth of Vattman Creek. The creek veers to the right in this image.*

Figure 51 *Looking upstream at the FM 628 crossing of Vattman Creek, the riparian areas is functional and well vegetated below and immediately above this location.*

Figure 52 *This image shows a fairly well vegetated riparian area with Cordgrass and Spiny aster despite the farming infringement on the riparian area and the gully formation. This small area of functional condition seems to indicate the creek's readiness for recovery.*

Figure 53 *In this image the riparian area is hindered by farming/grazing too close. Further upstream, near the top of the image, the channel has been manipulated and straightened.*

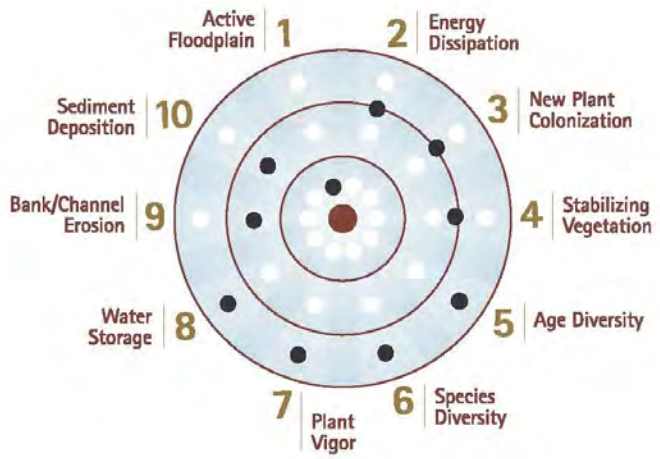

Figure 54 *Bull's-Eye evaluation target for Vattman Creek.*

Riparian Evaluation (Vattman Creek)

1. **Floodplain access**. The creek appears to have access to its floodplain.
2. **Energy dissipation**. Some energy dissipating features were observed in the channel and on the banks in the lower section of the creek, but upstream very little energy dissipation is present.
3. **New plant colonization**. Some colonization observed in the lower sections.
4. **Stabilizing vegetation**. Lower section of the creek has some stabilizing riparian vegetation (Spiny aster SR8, Cordgrass SR9) but the upper sections appear to be lined with upland plants.
5. **Age diversity and reproduction of riparian vegetation**. Most of the riparian area appears to have been cleared in the past. No age diversity was observed.
6. **Species diversity of riparian vegetation.** Low diversity.
7. **Plant vigor**. Plants show signs of tilling, heavy grazing, mowing, trampling or browsing.
8. **Water storage**. Few to no OBL and FACW plant species were observed.
9. **Bank and channel erosion**. Erosion is observed, but channel is not incised.
10. **Sediment deposition**. Sediment deposition does not appear completely balanced. Mid-channel deposition was observed.

Riparian Hindrances

- Grazing management and farming too close.
- Physical alteration of floodplain and channel.

Riparian Enhancement Opportunities

Work with landowners to address identified hinderances.

Alazan Bay Section

Petronila Creek

Lower/Chapman Ranch Reach of Petronila Creek

Figure 55 *GoogleEarth™ image of the Lower/Chapman Ranch Reach of Petronila Creek highlighted in red. The reach begins at the crossing of Laureles Ranch Road and ends at Texas Hwy 70.*

Observations

The riparian area of the lower reach of Petronila Creek is about 8.6 miles in length and is estimated an average of 1,000 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 2,085 acres of land. Beginning at the crossing of Laureles Ranch Road, the creek runs through mostly grazing and farming lands. The creek's riparian area is well buffered with wide flanks of well-vegetated, functional riparian areas throughout most of the reach. Overall, the lower reach of Petronila Creek's riparian area is high functioning but lacking in species diversity as its width narrows toward the top end of the reach.

Figure 56 *Image shows wide functional riparian area flanking Petronila Creek at the Laureles Ranch Road bridge. Farming activities are set back from the creek, and the wide floodplain is well vegetated.*

Figure 57 *Images show highly functional riparian areas along the Lower/Chapman Ranch Reach of Petronila Creek near the top of the reach. Banks are well vegetated in what appears to be Cordgrass with Retama and Mesquite. A fringe of algae is visible along the channel edge. At this point, the riparian area is narrower than the downstream areas of the reach.*

Figure 58 *Pictured here is part of a 200+/- acre farm where an installed wetland is being contemplated to improve water quality in Petronila Creek before it reaches the bay.*

Figure 59 *Near the top of the reach, the creek and its riparian area narrow and become meandering. This image shows the confluence of the Landfill Ditch stormwater drain to Petronila Creek.*

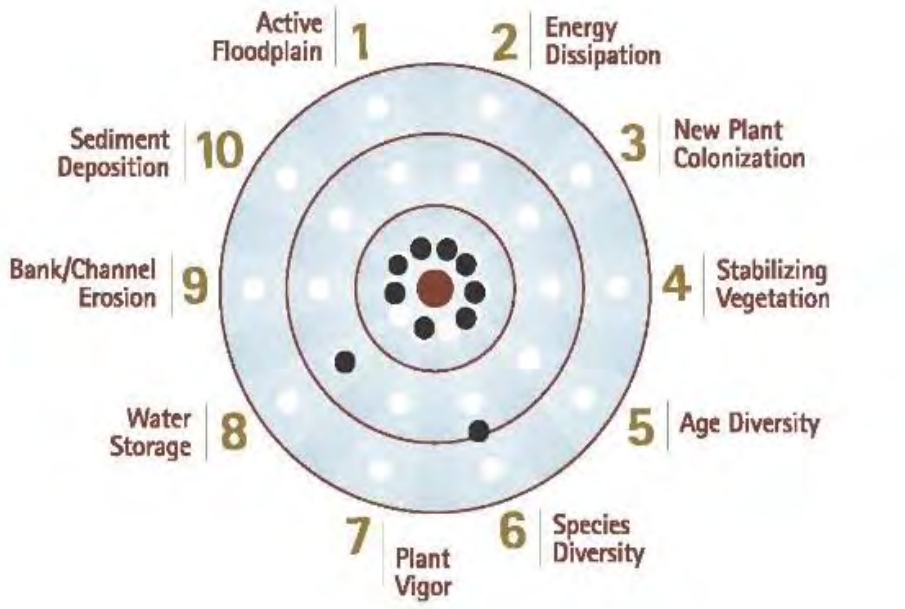

Figure 60 *Bull's-Eye evaluation target for Lower/Chapman Ranch Reach of Petronila Creek*

Riparian Evaluation (Lower/Chapman Ranch Reach of Petronila Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain throughout the reach.
2. **Energy dissipation**. The channel, banks and floodplain host an abundance of energy-dissipating features that become sparser near the top of the reach.
3. **New plant colonization**. New plants were observed colonizing fresh sediments in places.
4. **Stabilizing vegetation**. Banks are covered with stabilizing vegetation. (Marshhay/Gulf cordgrass SR9, Retama SR6)
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed.
6. **Species diversity of riparian vegetation.** Only two native riparian plants were identified, however it is likely that 1 to 2 more are present. Overall, species diversity is low to moderate.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing.
8. **Water storage**. A few OBL and FACW plant species were observed both at the water's edge and on the floodplain. (Marshhay/Gulf cordgrass FACW/OBL, Retama FACW)
9. **Bank and channel erosion**. Erosion and deposition appear balanced, and channel size and shape appear of size and depth to manage sediment.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed within this reach.

Riparian Hindrances

None observed

Riparian Enhancement Opportunities

1) Work with landowners to reward the current stewardship; protect and document the functional riparian condition along the lower reach of Petronila Creek.
2) Work with willing landowners to convert farmland to functional wetlands for the purpose of improving water quality in the creek before it reaches the bay.

Landfill Drain Ditch (storm drain to the lower reach of Petronila Creek)

Figure 61 *GoogleEarth™ image of the Landfill Drain Ditch stormwater drain to the lower reach of Petronila Creek highlighted in white. The reach begins at the confluence with Petronila and ends at the landfill site.*

Observations

The Landfill Drain Ditch (stormwater drain) is about 5.6 miles in length, and its riparian area is estimated at 150 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 204 acres of land. Beginning at the confluence with Petronilla's Lower/Chapman Ranch Reach, the ditch runs through farmland and wind-farm land ending on the north side of the landfill. The ditch's riparian area is mostly non-functional and holds opportunity for enhancing function through inexpensive passive restoration activities. Very near its top end, the riparian area has been offered room and appears to have enough flow to support obligate (OBL) vegetation. For a few hundred yards it is mostly functional, but as it runs through farmlands on its way to the creek, the ditch is straight, channelized and appears to be kept clear of vegetation by mechanical or chemical controls. A cessation of mowing or spraying, planting of riparian plants, and inviting the channel to enhance its meander where feasible and acceptable could generate enhanced function and water quality benefit.

Figure 62 *This image shows the Landfill Ditch stormwater drain to the Lower Reach of Petronila Creek incised and its banks either bare or kept mowed. There appears to be a setback, perhaps an easement that restricts row crops to within 80-150 feet of the channel edge.*

Figure 63 *The Landfill Ditch stormwater drain to the Lower Reach of Petronila Creek is overly straight for a natural drain. In this image we identified a water hole that may be a remnant of the old meandering channel of a natural drain before channelization. This feature could be included in a re-meander project to enhance riparian function for the benefit of water quality.*

Figure 64 *Near the landfill the drain becomes more functional, vegetated with obligates and slightly meandering.*

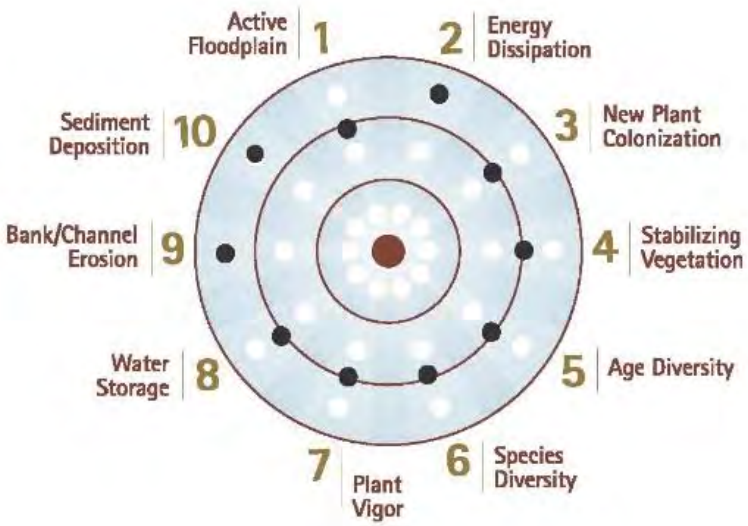

Figure 65 *Bull's-Eye evaluation target for Landfill Ditch stormwater drain to lower reach of Petronila Creek.*

Riparian Evaluation (Landfill Ditch stormwater drain to the lower reach of Petronila Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain near its top (1.6 miles), but it appears to be entrenched near the bottom (4 miles).
2. **Energy dissipation**. The channel, banks and floodplain have few energy-dissipating features, with the exception of the top of the ditch near the landfill.
3. **New plant colonization**. Some new plants colonizing fresh sediments were observed near the landfill only.
4. **Stabilizing vegetation**. Banks are mostly bare. In the area around the landfill banks are covered with what appears to be some stabilizing riparian/wetland vegetation, but identification of only one was possible. (Cattail SR9)
5. **Age diversity and reproduction of riparian vegetation**. Mowing and maintenance of the ditch is keeping age group from forming, except near the landfill where it is apparently too wet to mow.
6. **Species diversity of riparian vegetation.** Only 2 to 3 species of native riparian plants were observed, all sedges and grasses near the landfill.
7. **Plant vigor**. Riparian plants appear healthy and vigorous only near the landfill; lower sections of the ditch appear to be mowed.
8. **Water storage**. OBL and FACW plant species were observed near the landfill both at the water's edge and on the floodplain. (only identifiable plant was Cattail OBL)
9. **Bank and channel erosion**. Erosion can be observed increasing toward the confluence of the Ditch and creek. Deposition is apparent near the landfill. Deposition and erosion do not appear to be balanced. Channel is not capable of managing flow and sediment.
10. **Sediment deposition**. The channel is altered, and normal, balanced sediment deposition cannot be expected.

Riparian Hindrances

1) Farming, mowing and spraying too close
2) Artificial manipulation of banks, channels or sediment
3) Physical alteration of the floodplain

Riparian Enhancement Opportunities

1) Work with landowners the landfill operators to allow vegetation to grow along the entire length of the ditch with the landfill border as a benchmark.
2) Plant riparian vegetation where needed.
3) Allow or encourage the ditch to meander, possible by expanding its floodplain, lowering its banks and even incorporating what appear to be portions of natural channel.
4) Where appropriate and acceptable, work with willing landowners to convert farmland to functional wetlands for the purpose of improving water quality in the creek before it reaches the bay.

Petronila Ditch (storm drain to the lower reach of Petronila Creek) NOT EVALUATED

Figure 66 *GoogleEarth™ image of the Petronila Ditch, storm drain to Lower Petronila Creek highlighted in red.*

Observations

The reach begins at the confluence with Petronila Creek and ends at CR 67 near the town of Petronilla. The drain is about 8.7 miles in length and the riparian area is estimated at 150 feet average on each side of the established channel. Based on this estimated width the potential riparian area includes about 316 acres of land. The ditch is creek-like near its confluences and becomes a straight drainage ditch through farmland. The Petronila Ditch was not evaluated as part of this project. It is recommended for evaluation as part of a future project due to the likelihood of increased development within the drainage.

Lost Creek Ditch (storm drain to the lower reach of Petronila Creek)

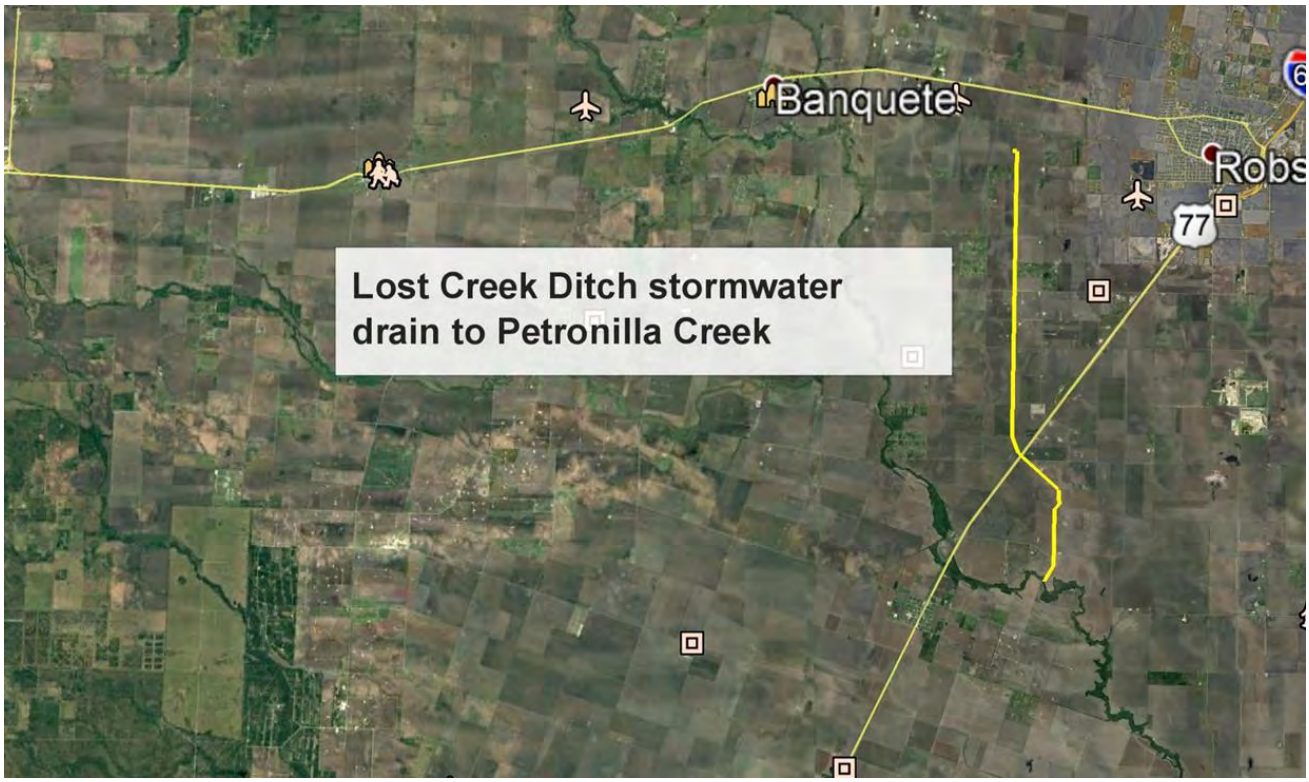

Figure 67 *GoogleEarth™ image of the Lost Creek Ditch, storm drain to lower Petronila Creek highlighted in yellow. The ditch begins at the confluence with Petronila Creek and ends across Hwy 77 to near Hwy 40, near the community of Raab.*

Observations

The riparian area of the Lost Creek Ditch is about 8.1 miles in length and is estimated at 100 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 196 acres of land. The creek runs through farmland and small neighborhoods, an area of future residential growth. Lost Creek's riparian condition is mostly dysfunctional and covered mostly with non-riparian vegetation. The area is being mowed and farmed too close, resulting in alteration of the floodplain. Gullies are apparent as drains enter the creek from adjacent farmlands. The creek holds much opportunity for enhancement and community engagement. As this area may be in the path of residential development in the near future, aesthetically appealing alternatives to the traditional straight drainage ditches may be appealing to developers and community planners while also improving water quality.

Figure 68 *In this image you can see the Lost Creek Ditch as it runs through farmland. The creek appears to be attempting to recover by growing vegetation, trapping sediments, and holding water, but may be hindered by attempts to curtail vegetation. In the image, vegetation on the right appears to have been sprayed with herbicide.*

Figure 69 *This image shows gullies forming where runoff drains from adjacent farmland into the ditch. Allowing the drain to develop energy dissipating vegetation could slow the runoff and help slow the gully formation.*

Figure 70 *In this image the banks of Lost Creek Ditch appear well vegetated, but only a portion of the vegetation is believed to be native riparian plants, like Spiny aster. Herbaceous buffers for creeks draining farmland were often planted in Guinea grass, a strong colonizer of disturbed soils. It is a non-native, weak-rooted, ground-covering plant that does not advance riparian function.*

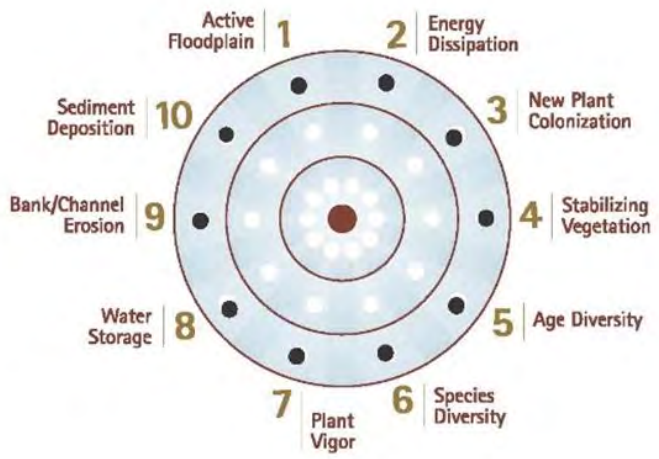

Figure 71 *Bull's-Eye evaluation target for Lost Creek Ditch stormwater drain to the lower reach of Petronila Creek.*

Riparian Evaluation (Lost Creek Ditch stormwater drain to the Lower Reach of Petronila Creek)

1. **Floodplain access**. The creek appears to be entrenched over much of its length.
2. **Energy dissipation**. The channel, banks and floodplain have some energy-dissipating features, riparian and upland plants.
3. **New plant colonization**. Some new plants appear to be colonizing fresh sediments, but they are being hindered from expansion by ditch maintenance.
4. **Stabilizing vegetation**. Banks are mostly vegetated, but only a portion is believed to be native riparian plants. Only Spiny aster SR 8 was identified, however other riparian plants are likely present.
5. **Age diversity and reproduction of riparian vegetation**. Mowing, spraying and maintenance of the ditch may be keeping age groups from forming, except where it is too wet to mow.
6. **Species diversity of riparian vegetation.** Only 1to 2 species of native riparian plants were observed.
7. **Plant vigor**. Riparian plants appear to be hindered in places by mowing and spraying, i.e. standard stormwater ditch maintenance practices.
8. **Water storage**. OBL sedges were observed at the water's edge only, and not on the banks or floodplains.
9. **Bank and channel erosion**. Erosion can be observed with gullies being formed where drains enter the creek. Deposition is apparent in the channel. Deposition and erosion do not appear to be balanced. Channel is not capable of managing flow and sediment.
10. **Sediment deposition**. The channel is altered, and normal, balanced sediment deposition cannot be expected.

Riparian Hindrances

- Farming, mowing and spraying too close
- Artificial manipulation of banks, channels or sediment
- Physical alteration of the floodplain

Riparian Enhancement Opportunities

1) Work with landowners the landfill operators to allow vegetation to grow along the entire length of the ditch with the landfill border as a benchmark.
2) Plant riparian vegetation where needed.
3) Allow or encourage the ditch to meander, possible by expanding its floodplain, lowering its banks and even incorporating what appears to be portions of natural channel.
4) Where appropriate and acceptable, work with willing landowners to convert farmland to functional wetlands for the purpose of improving water quality in the creek before it reaches the bay.

Gertrude Lubby Lake/Driscoll Reach of Petronila Creek

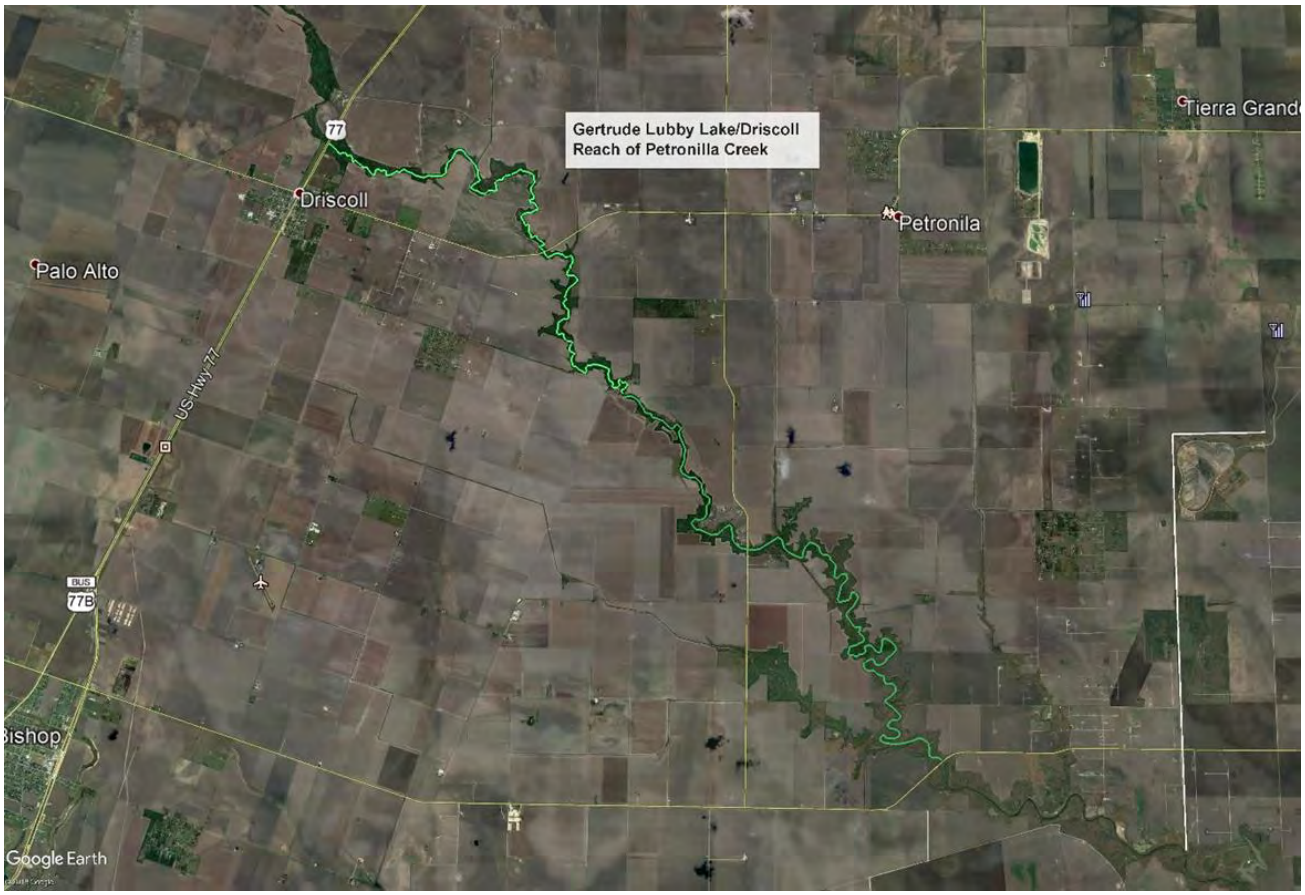

Figure 72 GoogleEarth™ image of the Gertrude Lubby Lake/Driscoll Reach of Petronila Creek highlighted in green. The reach begins at State Hwy 70 and ends at the crossing of U.S. Hwy 77 near Driscoll.

Observations

The riparian area of the upper Lubby/Driscoll Reach of Petronila Creek is about 18.8 miles in length and is estimated at 300 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 1,367 acres of land. Beginning at the crossing of State Hwy 70 and looking upstream to the U.S. Hwy 77 crossing. Through this reach the creek runs through farmland and wind-farm land. The banks are heavily wooded, and the channel is narrow and meandering, possibly slightly incised but with an accessible and functional floodplain in most places.

Figure 73 *Pictured here is the Lubby/Driscoll Reach of Petronila Creek with its well-vegetated banks and floodplain. Visible in this image is a healthy stand of what appears to be Cordgrass on the right bank and an abundance of large trees: Oak, Ash, Mesquite, Retama and others. Guinea grass and Arundo donax were also observed.*

Figure 74 *Wind-farm development too close to the creek can also hinder riparian recovery by increasing and focusing runoff. This image shows the bank erosion apparently as a result of enhanced runoff from a tower cited too close to the creek bank without an adequate buffer.*

Figure 75 *Both a new and older, dismantled waste water treatment plant (WWTP) were observed near Driscoll on the bank of Petronila Creek. The discharge location for newer WWTP was not distinctly visible in the creek, however a pond and a seep (pictured here) are located adjacent to the creek near the site of the dismantled plant and appear to be experiencing an algal bloom.*

Figure 76 *Near FM 892, a drain enters the creek from the north. It was not identified for evaluation as part of this project. This GoogleEarth™ image shows the location of this drain and with orange flags, where the images in Figure 76 were taken.*

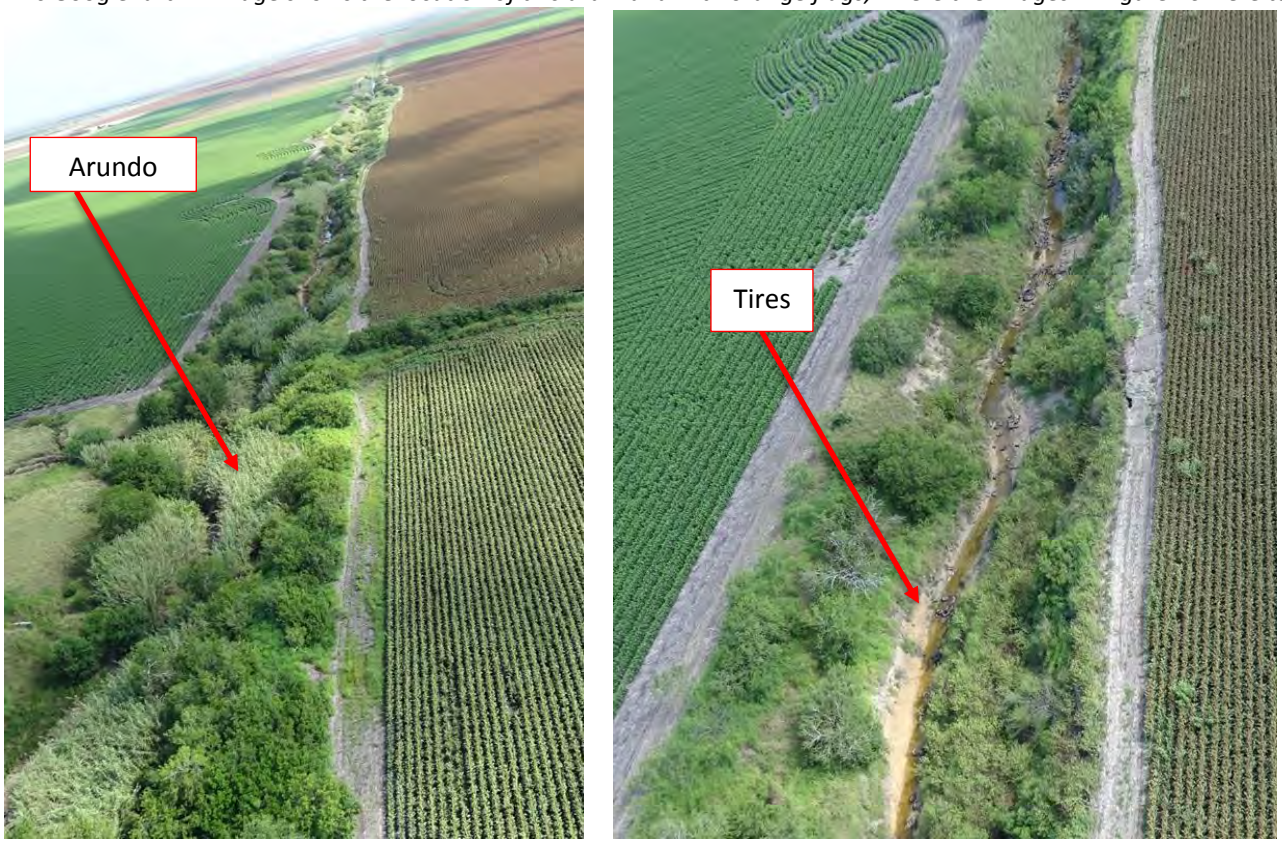

Figure 77 *This image shows the small drain entering Petronila is littered with large quantity of dumped tires and covered with the highly invasive plant, Arundo donax.*

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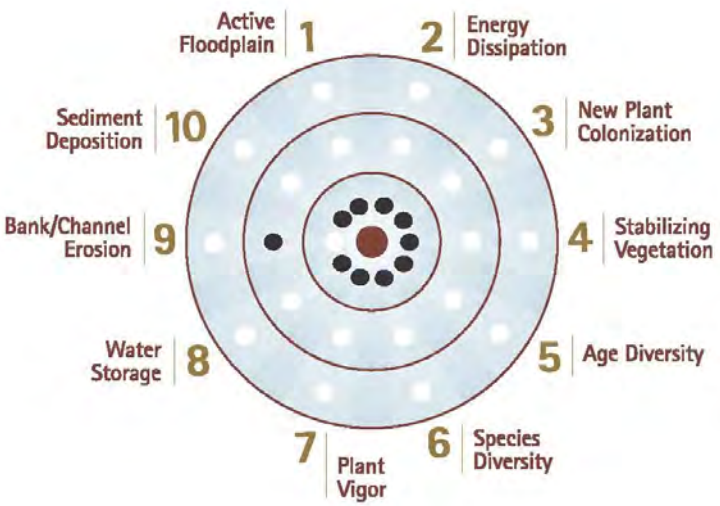

Figure 78 *Bull's-Eye evaluation target for Gertrude Lubby Lake/Driscoll Reach of Petronila Creek.*

Riparian Evaluation (Gertrude Lubby Lake/Driscoll Reach of Petronila Creek)

1. **Floodplain access**. The creek appears to slightly incised in some areas but has access to a floodplain.
2. **Energy dissipation**. There are many energy-dissipating features in the channel, banks and floodplain.
3. **New plant colonization**. Fresh sediment is being colonized within the channel's emergent point bars.
4. **Stabilizing vegetation**. Banks are mostly covered with stabilizing riparian vegetation (Retama SR6, Ash SR6, Oak SR6, Cordgrass SR 9, Spiny aster SR 8). Guinea grass and Arundo donax are also present.
5. **Age diversity and reproduction of riparian vegetation**. Age diversity is present.
6. **Species diversity of riparian vegetation.** At least five different species of native riparian plants were observed.
7. **Plant vigor**. Riparian plants are vigorous and healthy throughout the reach.
8. **Water storage**. OBL and FACW plant species were observed in the floodplain. (Retama FACW, Spiny aster FACW, Marshhay/Gulf cordgrass OBL/FACW)
9. **Bank and channel erosion**. Numerous gullies are present through the wind-farm lands where energy dissipation and buffering vegetation is lacking. Erosion and deposition appear to be balanced, and channel size and shape appear to have been altered.
10. **Sediment deposition**. Sediment is being caught and colonized within the channel and the floodplain. The sediment balance appears to be normal and balanced.

Riparian Hindrances

- Farming and wind farming too close to the bank.
- Excessive growth of invasive plants that inhibit native riparian vegetation.

Riparian Enhancement Opportunities

~~3)~~1) Work with landowners to ensure proper setback for wind towers and furrow agriculture, and maintain a strong vegetated buffer between the farms and the creek bank.

~~4)~~2) Engage the town of Driscoll in ways to evaluate the pond and seep and their possible relationship with the creek. Off-channel wetlands or other tertiary treatment options have been demonstrated to protect water quality in receiving waters.

Concordia Tributary (tributary to Gertrude Lubby/Driscoll Reach of Petronila Creek) NOT EVALUATED

Figure 79 *GoogleEarth™ image of the Concordia Tributary outlined in red.*

Observations

The tributary begins at the confluence with Petronila and ends above U.S. Hwy 77. Its riparian area is 10 miles in length and is estimated at 100 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 242 acres of land. The creek appears to hold opportunity for enhanced function and is recommended for evaluation in the future.

Banquete Reach of Petronila Creek

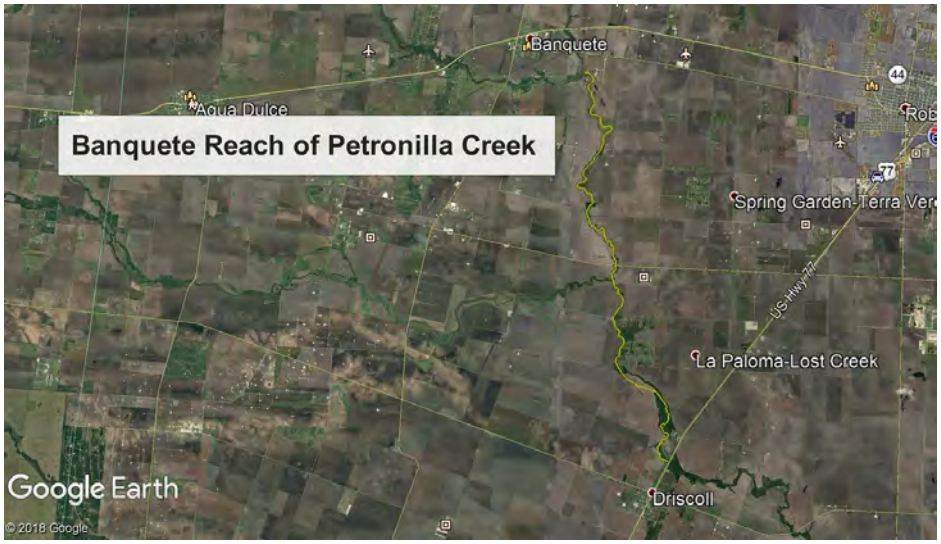

Figure 80 *GoogleEarth™ image of the Banquete reach of Petronila Creek highlighted in yellow. The reach begins at US Hwy 77 and ends at confluence of Banquete and Agua Dulce Creeks.*

Observations

The riparian area of the Banquete reach of Petronila creek is about 11.3 miles in length and is estimated at 300 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 822 acres of land. Beginning at U.S. Hwy 77 and looking upstream to the confluence of Banquete Creek and Aqua Dulce Creek, this upper reach of Petronila Creek runs through farmland, pasture land, and near two rural neighborhoods and a detention facility. With the exception of some channel alterations and an extensive manicured area in the vicinity of Banquete, the creek's riparian area is well buffered with woody vegetation in mostly functional riparian areas. Overall, the riparian area of the upper reach of Petronila Creek is highly functional with the exception of manicured/grazed pastureland and the areas of farmland where the creek has been rechanneled or is being farmed too close. In this reach, the water's appearance changes noticeably from a brown-tinted color to a muddy milky turbid appearance. A large area of Duck week cover was also observed in this reach.

Figure 81 *This image shows the heavily wooded and functional condition of the riparian area along most of the Banquete reach of Petronila Creek.*

Figure 82 *Towards the top of the reach, a thick cover of Duck weed covers the creek's surface.*

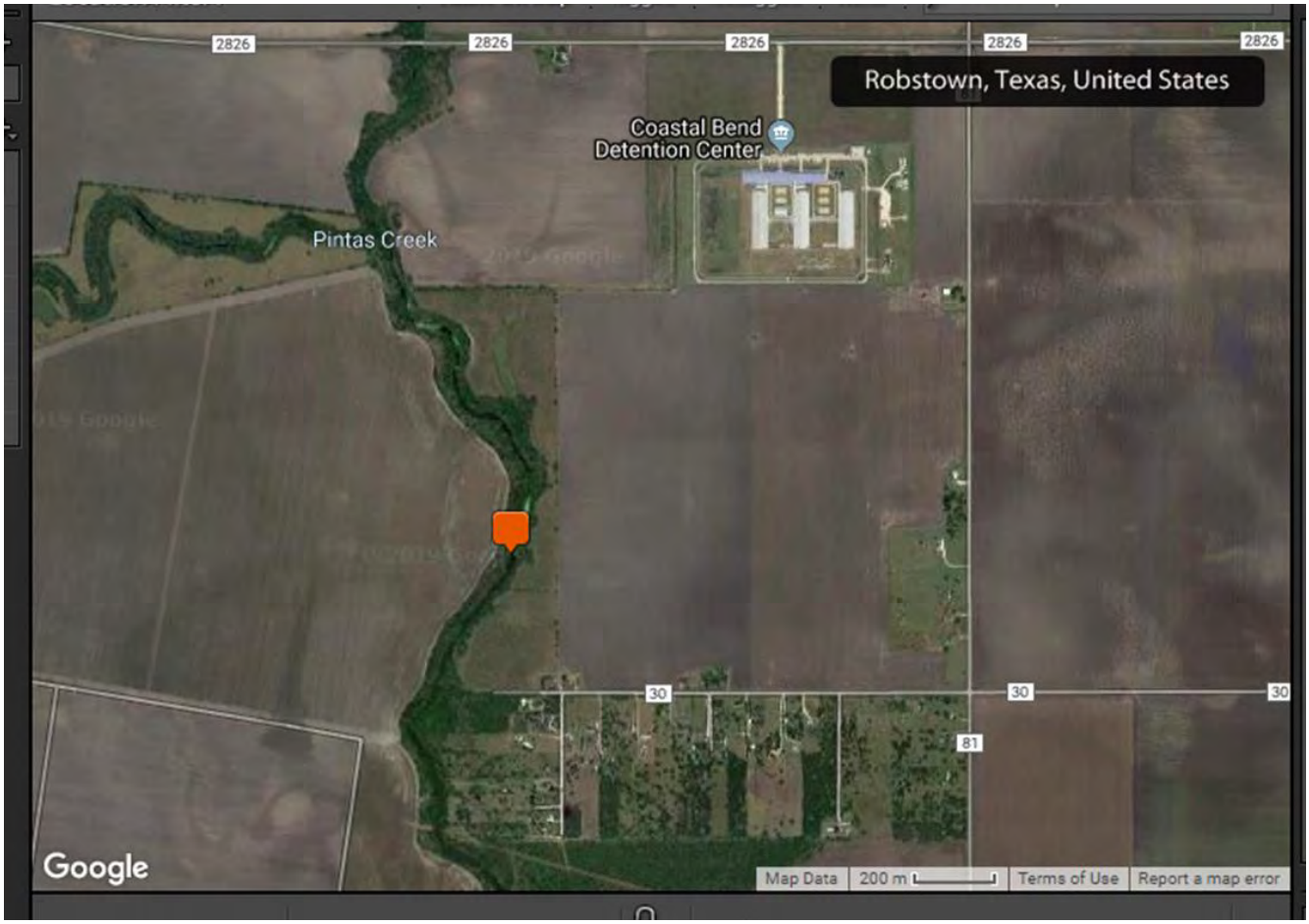

Figure 83 *GoogleEarth™ image of the location where the image in Figure 81 was taken.*

Figure 84 *Manicured and grazed riparian area at the top of the reach. The water's color at this location has become turbid and milky brown.*

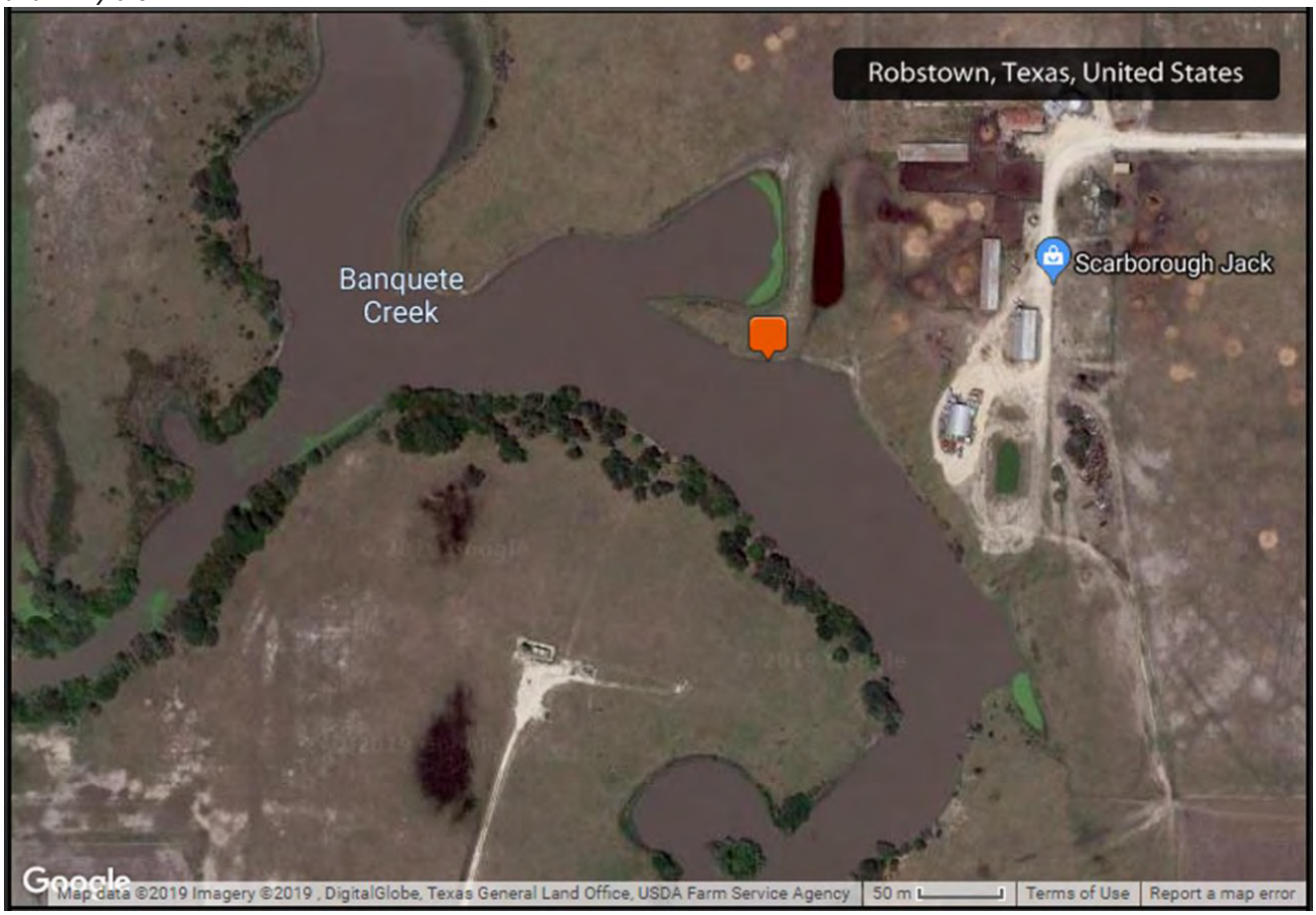

Figure 85 *GoogleEarth™ image of the location where the image in Figure 83 was taken. Google has the location listed as a meat processor.*

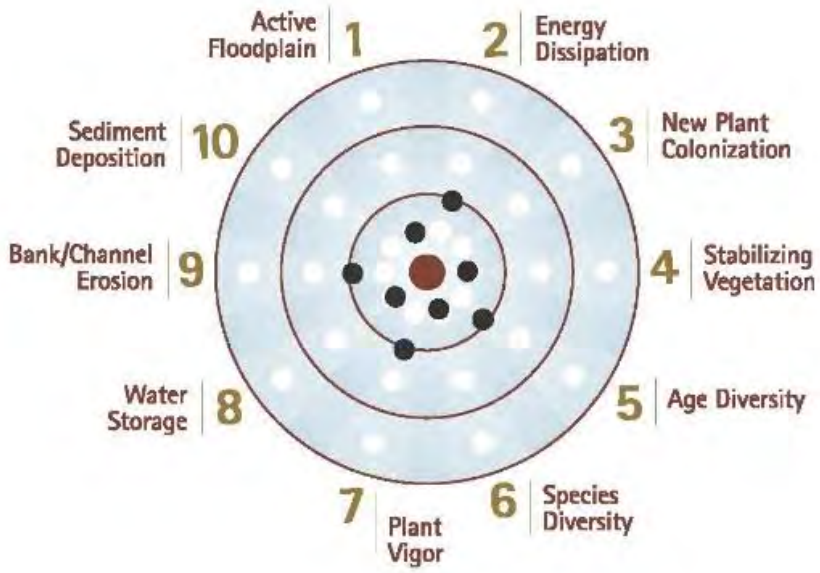

Figure 86 *Bull's-Eye evaluation target for Banquete reach of Petronila Creek.*

Riparian Evaluation (Banquete reach of Petronila Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain throughout the reach.
2. **Energy dissipation**. The channel, banks and floodplain host an abundance of energy-dissipating features throughout the reach, with the exception of the manicured grazing lands at confluence of Banquete and Aqua Dulce creeks.
3. **New plant colonization**. Not applicable, no fresh sediments was observed.
4. **Stabilizing vegetation**. Banks are covered with stabilizing vegetation. (Retama SR6, Oak trees SR6, Elm trees SR6, Dwarf palmetto SR7, Ash trees SR6)
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed except near the top of the reach where only large oak trees have been left.
6. **Species diversity of riparian vegetation.** More than five species of native riparian plants were observed.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing with exception of top of the reach.
8. **Water storage**. Several OBL and FACW plant species were observed both at the water's edge and on the floodplain. (Retama FACW, Dwarf palmetto FACW)
9. **Bank and channel erosion**. Erosion and deposition appear balanced, and channel size and shape appear of size and depth to manage sediment.
10. **Sediment deposition**. None observed.

Riparian Hindrances

Excessive grazing and clearing in riparian area at the top of the reach.

Riparian Enhancement Opportunities

1) Work with landowners to address identified hindrances that could include a setback of pasture manicuring and an initially rest from grazing pressure on the creek banks to allow riparian plants to recover.
2) Without creating additional hindrances, engage the communities within the neighborhoods and the detention center in water quality and riparian issues surrounding the creek in their area.

Banquete Creek

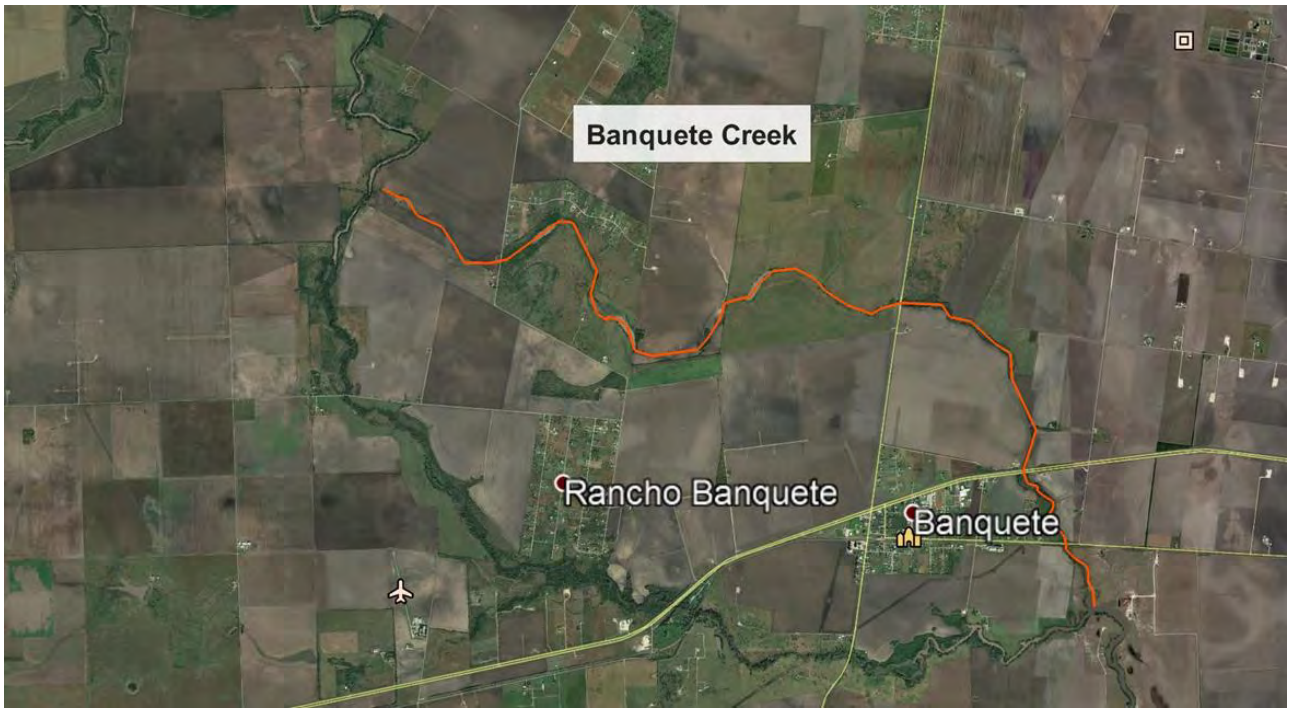

Figure 87 *GoogleEarth™ image of Banquete Creek highlighted in orange. The reach begins with its confluence with Aqua Dulce Creek to form Petronila Creek just below State Hwy 40 and ends above at its headwater above CR 93 (Mantor Briggs Rd).*

Observations

The riparian area of Banquete Creek is about 7.4 miles in length and is estimated at 300 feet on each side of the established channel. Based on this estimated width, the potential riparian area includes about 541 acres of land. However, most of the creek's riparian area and channel is farmed or dug-out into tanks. Its current condition offers much opportunity for improved function. Small areas of Banquete Creek measuring about 1.6 miles in length remain wooded and highly functional, and another small piece shows signs of wetland function. The later may be the site of the town's wastewater effluent discharge and is also the recipient of additional sediment from a utility and highway crossing.

With the exception of about 1.6 miles of its length, Banquete Creek's riparian condition is dysfunctional. An aerial photo point is suggested here as opportunity for enhanced function by addressing recovery hindering activities is thought to be great.

Figure 88 Image illustrates the wetland-like conditions observed at the mouth of Banquete Creek about .1 mile below TX Hwy 40.

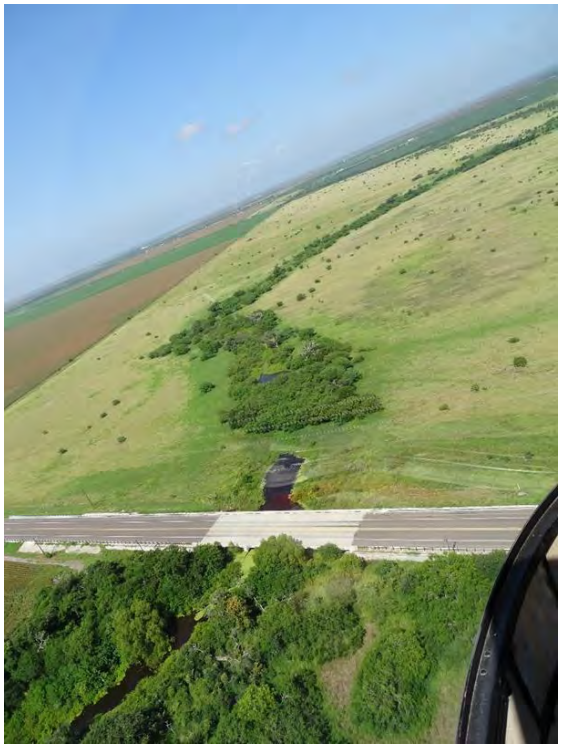

Figure 89 Heavily wooded riparian area and water color within this functional area are pictured here. About 1.5 miles of wooded functional riparian area was observed over the 7.4 mile-long Banquete Creek.

Figure 90 This image illustrates the riparian recovery hindered by farming too close to the creek.

Figure 91 This image is a possible aerial photo point. It shows a meander bend of the creek included in a field. Visible in the distance is the tree lined Aqua Dulce Creek. If the identified hindrance, i.e. farming too close, was addressed here, riparian recovery could be expected along with water quality benefits.

Figure 92 *Bull's- Eye evaluation target for Banquete Creek.*

Riparian Evaluation (Banquete Creek)

1. **Floodplain access**. The creek appears to have easy access to its floodplain.
2. **Energy dissipation**. With small exception, the channel, banks and floodplain are lacking in energy-dissipating features.
3. **New plant colonization**. Not applicable, no fresh sediment was observed. One exception is the wetland-like area at the mouth of the creek where some fresh sediment is being captured and incorporated within the channel by obligate vegetation.
4. **Stabilizing vegetation**. With limited exception not much of the creek and tributary banks is covered with stabilizing riparian vegetation. A little over one mile of the creek is lined with a thick buffer of riparian trees species.
5. **Age diversity and reproduction of riparian vegetation**. Most of the riparian areas appear to have been cleared in the past. Within the wooded section there are trees of all ages represented.
6. **Species diversity of riparian vegetation.** Low diversity with limited exception.
7. **Plant vigor**. With some exception plants show signs of disturbance.
8. **Water storage**. Few to no OBL and FACW plant species were observed, except within the woody sections.
9. **Bank and channel erosion**. Channel is not well defined in most sections.
10. **Sediment deposition**. NA Sediment deposition was not observed, except at the creek's mouth and only in mid-channel.

Riparian Hindrances

Observed hindrances include; farming too close and artificial manipulation of the creek bed and banks.

Riparian Enhancement Opportunities

Work with landowners to provide incentives to address identified hindrances. Clean water could be a valuable "crop" for producers. Farmers could be paid to plant and maintain riparian vegetation for water quality benefits in downstream creeks and bays.

Aqua Dulce Creek Lower Reach

Figure 93 *GoogleEarth™ image of the lower reach of Aqua Dulce Creek shown with the narrow purple line. Aqua Dulce and Banquete Creeks come together to form Petronila Creek. That confluence marks the mouth of Aqua Dulce, located just south of Texas Hwy 44 near the town of Banquete.*

Observations

The riparian area of Aqua Dulce Lower Reach is about 23.2 miles in length and is estimated at 300 feet average on each side of the established channel. Based on this estimated width, the area evaluated includes about 1,687 acres of land. Beginning at its mouth, the confluence with Banquete Creek, which forms the head of Petronila Creek, and looking upstream to the crossing of FM359, Aqua Dulce lower reach runs through mostly ranch lands with a wide forested highly functional riparian area. The creek's riparian area is well buffered with wide flanks of well-vegetated functional riparian areas throughout most of the reach. Overall, the lower section of Aqua Dulce Creek's riparian area is high functioning and offers a great example of potential for riparian areas nearby. A number of identified tributaries join the creek within this lower section. They are presented in this report below, but were not fully evaluated at this time, nor are they recommended for evaluation as part of a future project.

Figure 94 *This image shows the wide, forested and functional riparian area along lower reach of Aqua Dulce Creek.*

Figure 95 *Further upstream on the lower reach of Aqua Dulce Creek, Duck weed covers the water's surface. Duck weed is quick to respond to nutrients in a stream and could indicate some nutrient addition. It is actually an aquatic plant and can*

serve to cool water and provide a food supply for waterfowl. A hazard of Duck weed proliferation can be unhealthy vacillations in dissolved oxygen content in the stream, which can affect fish and other aquatic life.

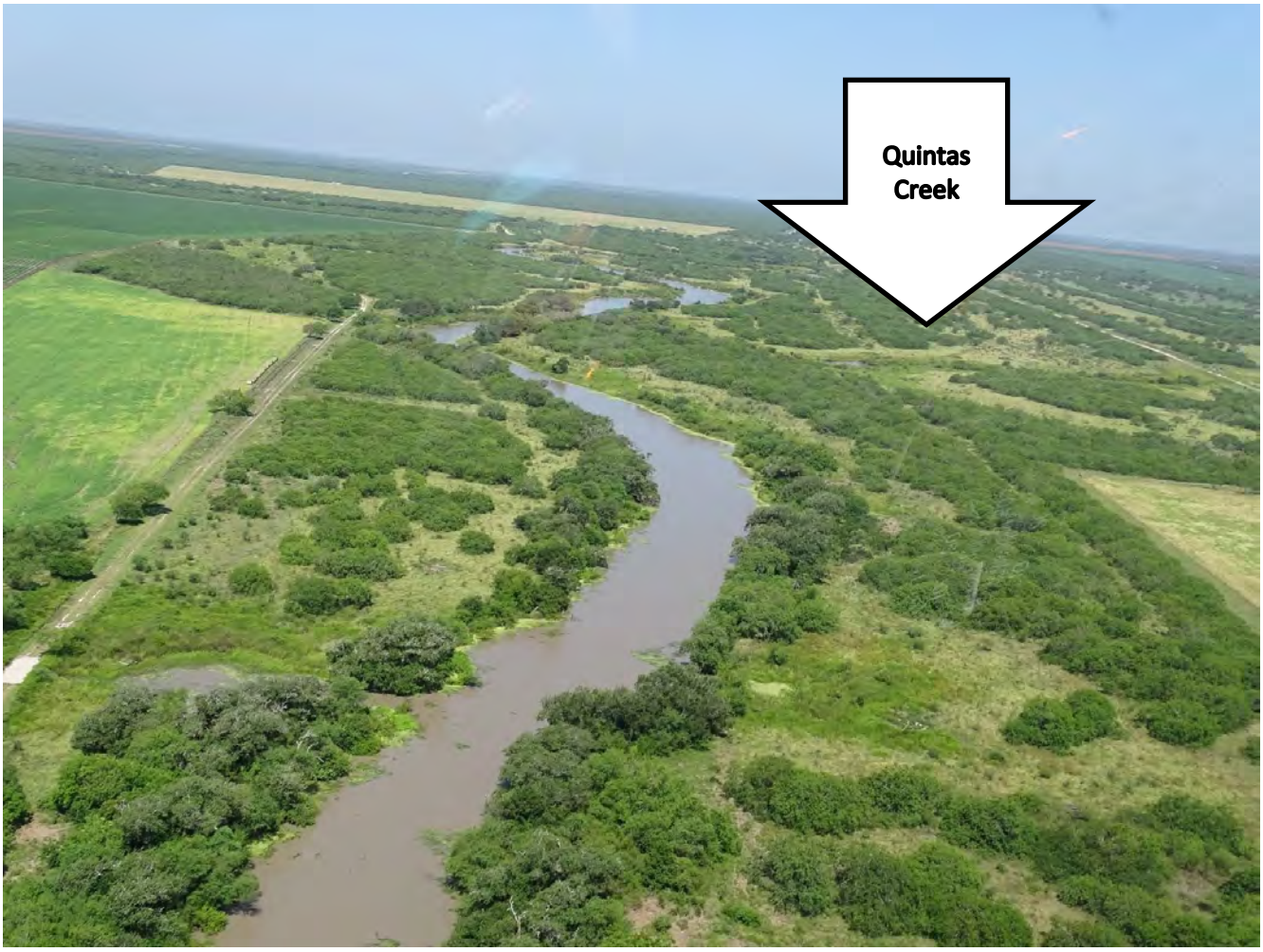

Figure 96 *Further upstream on Aqua Dulce Creek, shown in this image, the water becomes brown and cloudy and Duck weed can be seen colonizing the surface. This photo was taken near the confluence with Quintas Creek, a tributary that may deliver treated effluent from the town of Orange Grove.*

Figure 97 *Near the head of Aqua Dulce lower reach, the stream is completely shrouded in large woody plants. The creek water is not visible from the air.*

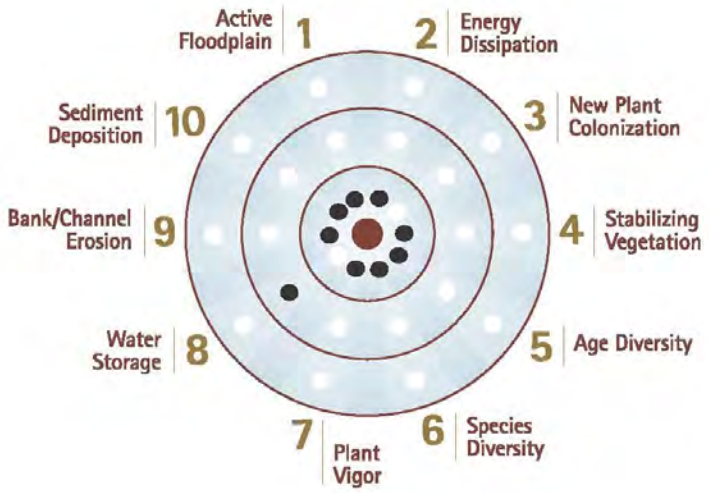

Figure 98 *Bull's-Eye evaluation target for Aqua Dulce Creek Lower Reach.*

Riparian Evaluation (Aqua Dulce Creek Lower Reach)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain throughout the reach.
2. **Energy dissipation**. The channel, banks and floodplain host an abundance of energy-dissipating features.
3. **New plant colonization**. New sediments were not observed.
4. **Stabilizing vegetation**. Banks are covered with stabilizing vegetation. (Retama SR6, Oak trees SR6, Elm trees SR6, Ash trees SR6)
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed.
6. **Species diversity of riparian vegetation.** More than five native riparian plants were observed.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing.
8. **Water storage**. A few OBL and FACW plant species are present, mostly along the streams edge. (Retama FACW)
9. **Bank and channel erosion**. Erosion and deposition appear balanced, and channel size and shape appear of size and depth to manage sediment.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed within this reach.

Riparian Hindrances

Water quality seems to be influenced by Las Quintas Creek where muddy turbid and nutrient-enriched conditions were observed.

Riparian Enhancement Opportunities

1) Work with landowners to reward the current stewardship; protect and document the functional riparian condition along Aqua Dulce Creek.
2) Work with willing landowners to convert farmland to functional wetlands/riparian areas to help improve water quality in the vicinity of the confluence with Las Quintas Creek.

Quintas, Leon, Rosita, Palo Hueco, Tecolote, Ruces and El Caro Creeks (Tributaries to Aqua Dulce Lower Reach)

Figure 99 *GoogleEarth™ image of the general location of several tributary watersheds (shaded in white) to the lower section of Aqua Dulce Creek (shown in purple). These creeks were not evaluated as part of this project but may justify evaluation in the future. Their lengths were measured and are presented below:*

Quintas Creek	Confluence with Petronila Creek to FM306	12.2	miles
Leon Creek	Confluence with Quintas to FM624	6.9	miles
Rosita Creek	Confluence with Agua Dulce 1 to Hwy 359	7.3	miles
Palo Hueco Creek	Confluence with Agua Dulce 1 to Hwy 281	11.2	miles
Tecolote/Ruces Creek	Confluence with Palo Hueco to headwater	4.7	miles
El Caro Creek	Confluence with Palo Hueco to headwater	5.4	miles

Aqua Dulce Upper Reach

Figure 100 *GoogleEarth™ image of the upper reach of Aqua Dulce Creek highlighted in blue. It runs from FM 359 to U.S. Hwy 281, approx. 10 miles and its riparian area has an average width of 300 feet on each side of the channel and may contain about 727 acres of land. The creek was not evaluated as part of this project and is not recommended for evaluation in the near future because it appears to run through relatively undisturbed ranchlands.*

Pintas Creek (Tributary to Petronila Creek within the Banquete Reach)

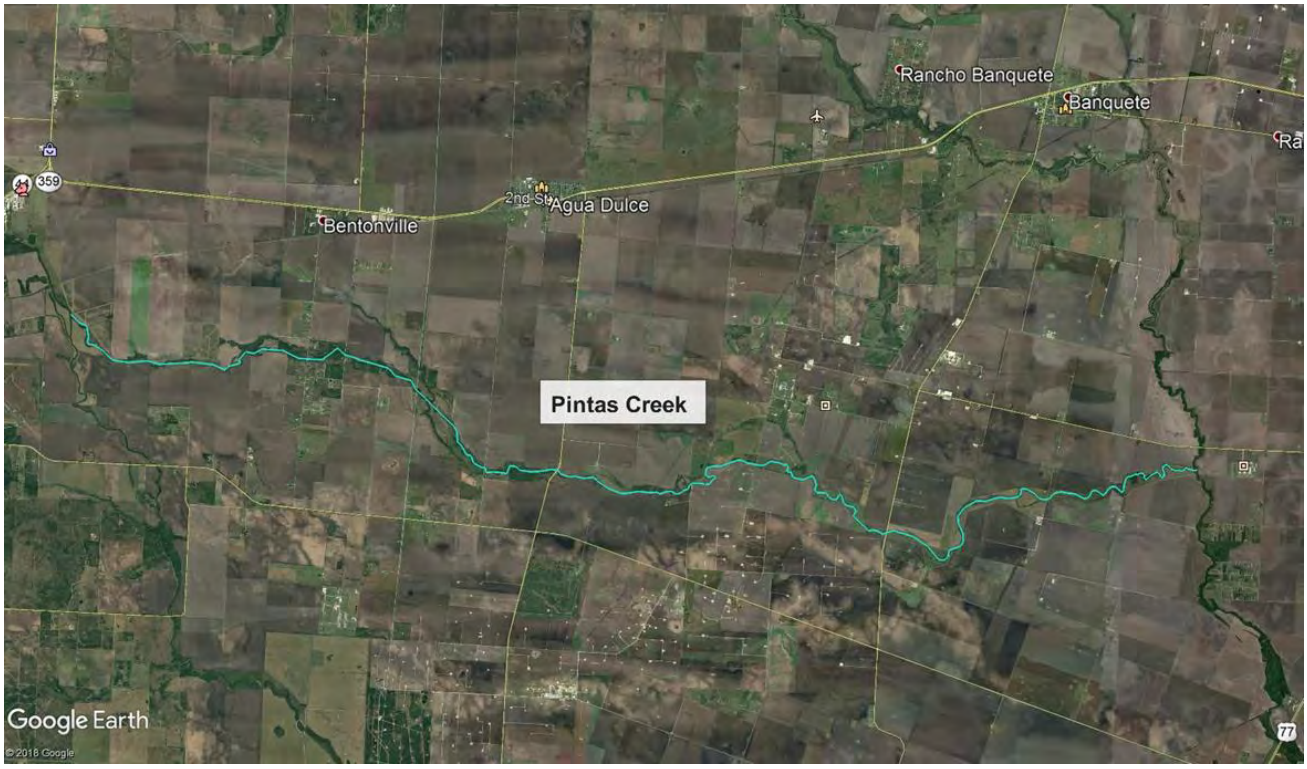

Figure 101 *GoogleEarth™ image of Pintas Creek identified in blue. It is interesting to note that the Petronila Creek and San Fernando Creek drainages are connected by an apparently altered channel/ditch at the top of Pintas Creek.*

Observations

The riparian area of Pintas Creek is about 19.7 miles in length and is estimated at 600 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 2,865 acres of land. The creek runs from its confluence with Petronila Creek within the lower section of the Banquete reach to its confluence with San Fernando Creek near Alice. The creek is wooded and appears to be high functioning and managed with a riparian conservation buffer in mind as it runs through mostly farm and range lands. Overall, the Pintas Creek and its tributaries are in functional condition and the opportunity for enhanced function, from changes in practices, exist mostly on the many small drain ways entering the creek.

Figure 102 *Image shows the riparian condition on Pintas Creek at Texas Hwy 85 crossing. The creek is heavily wooded and riparian area highly functional.*

Figure 103 *Image illustrates the riparian condition along most of Pintas Creek.*

Figure 104 *This image illustrates the management of the riparian area along Pintas Creek to keep grazing livestock from hindering the riparian function along the creek.*

Figure 105 *This image shows an abandoned or secondary over-flow channel of Pintas Creek. Overflow channels with high functioning riparian areas can provide water quality benefits by capturing and incorporating sediments from floodwaters. The over-flow channel pictured here does not offer much riparian benefit.*

Figure 106 *Near the top of Pintas Creek the riparian area retains its woody functional condition.*

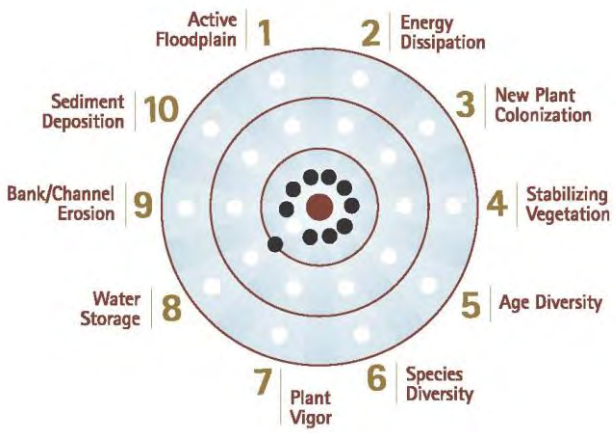

Figure 107 *Bull's-Eye evaluation target for Pintas Creek.*

Riparian Evaluation (Pintas Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain throughout the reach.
2. **Energy dissipation**. The channel, banks and floodplain host an abundance of energy-dissipating features.
3. **New plant colonization**. New plants were observed colonizing fresh sediments in places.
4. **Stabilizing vegetation**. Banks are covered with stabilizing vegetation. (Retama SR6, Oak trees SR6, Elm trees SR6, Ash trees SR6)
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed.
6. **Species diversity of riparian vegetation.** More than five native riparian plants were observed.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing.
8. **Water storage**. A few OBL and FACW plant species are present, mostly along the streams edge. (Retama FACW)
9. **Bank and channel erosion**. Erosion and deposition appear balanced, and channel size and shape appear of size and depth to manage sediment.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed within this reach.

Riparian Hindrances

Farming too close and through over-flow channels with riparian potential.

Riparian Enhancement Opportunities

1) Work with landowners to reward the current stewardship; protect and document the functional riparian condition along Pintas Creek.
2) Work with willing landowners to convert farmland to functional wetlands/riparian areas where abandoned or alternative flow paths cross existing fields.

Los Tunas Creek

Figure 108 *GoogleEarth™ image of Los Tunas Creek in shown in red. It was evaluated from its mouth in Cayo del Mazon upstream to a ditch south of the Kleberg County line.*

Observations

The riparian area of Los Tunas Creek is about 12 miles in length and is estimated at an average of 1,000 feet on each side of the established channel. Based on this estimated width the area evaluated includes about 2,909 acres of land. The upper six miles of the creek are channelized and ditch-like with reduced function and an average width of 500 feet on each side of the channel. In contrast, the lower six miles of the creek are flanked by highly functional riparian areas with wide well-vegetated floodplains estimated at well over 2,000 feet wide on each side of the channel.

Figure 109 *Image shows wide functional riparian area flanking Los Tunas Creek at its mouth in the Cayo del Mazon. Farming activities are set back from the creek, and the wide floodplain is well vegetated.*

Figure 110 *Image shows wide functional riparian area flanking Los Tunas Creek at the confluence of Chiltipin Creek. Farming activities are set back from the creek, and the wide floodplain is well vegetated.*

Figure 111 *Image shows wide functional riparian area flanking Los Tunas Creek further upstream. Cordgrass and other native riparian plants form a thick water-holding, sediment-trapping matt across a more than 2,000-foot-wide riparian area. Farming activities are set back from the creek and its floodplain.*

Figure 112 *Upstream the creek has been channelized and is more ditch like, straight and narrow. Still the riparian area is marginally functional and well vegetated. Farming activities are beginning to encroach on the creek and its floodplain. The poorly designed crossing pictured here is acting as a gradient control structure and is a source of erosive energy evidenced by a scour pool and head cut.*

Figure 113 *Despite channelization, the creek retains some of its riparian function with floodplain access and stabilizing vegetation covering the banks.*

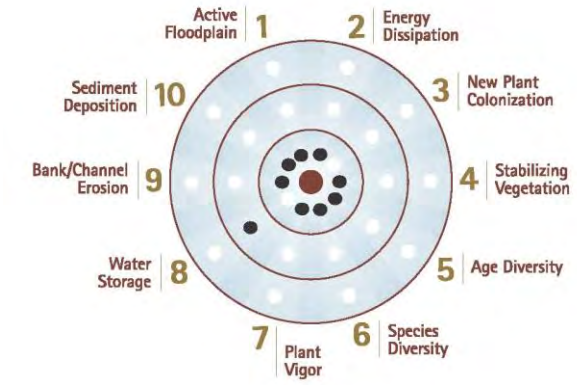

Figure 114 *Bull's-Eye evaluation target for Los Tunas Creek.*

Riparian Evaluation (Los Tunas Creek)

1. **Floodplain access**. The creek appears to have access to its floodplain.
2. **Energy dissipation**. An abundance of energy-dissipating features were observed in the channel and on the banks in the lower section of the creek, but upstream energy dissipation is reduced.
3. **New plant colonization**. New sediments were not observed.
4. **Stabilizing vegetation**. The creek has an abundance of stabilizing riparian vegetation (Spiny aster SR8, Cordgrass SR9), but woody plants are missing from the upper channelized reaches.
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed.
6. **Species diversity of riparian vegetation.** More than five native riparian plants were observed.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing.
8. **Water storage**. OBL and FACW plant species are present, mostly along the stream's edge.
9. **Bank and channel erosion**. Erosion and deposition appear balanced, and channel size and shape appear of size and depth to manage sediment, except in the vicinity of the poorly designed crossing.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed within this reach.

Riparian Hindrances

- Channelization of creek into a ditch-like drain way
- Poorly designed crossing that acts as gradient control structure, creating erosive energy with inadequate energy dissipation

Riparian Enhancement Opportunities:

1) Work with landowners to reward the current stewardship; protect and document the functional riparian condition along Los Tunas Creek.
2) Work with willing landowners to expand the setback along the upper six miles of the creek to allow for the development of meander.
3) Work with landowners to replace/restore road crossings to allow for energy dissipation, gradient equalization, and the free transport of sediment.

Chiltipin Creek (tributary to Los Tunas Creek)

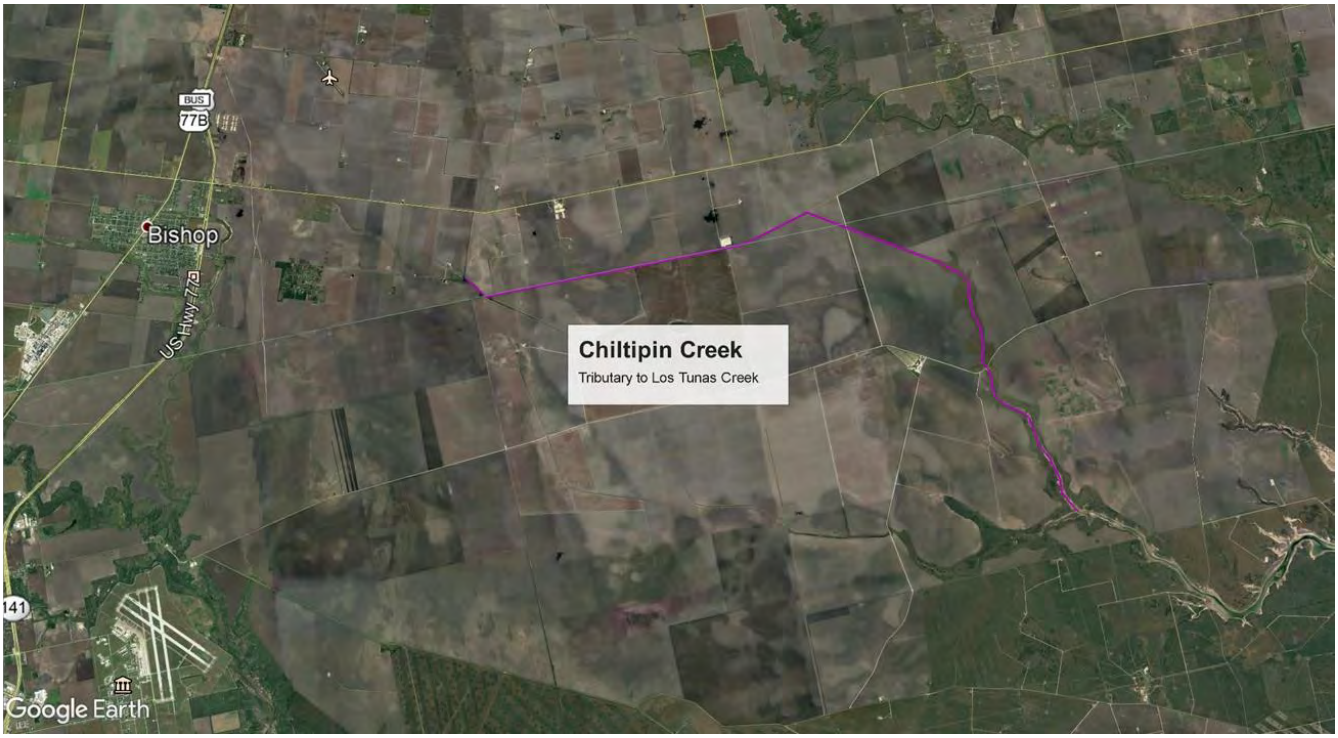

Figure 115 *GoogleEarth™ image of Chiltipin Creek in shown in purple. It was evaluated from its confluence with Los Tunas Creek upstream to County Road 6.*

Observations

The riparian area of Chiltipin Creek is about 11.3 miles in length and is estimated at an average of 600 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 1,644 acres of land. The upper six miles of the creek are channelized and ditch-like with reduced function and an average width of 300 feet on each side of the channel. In contrast, the lower five miles of the creek are flanked by highly functional riparian areas with wide well-vegetated floodplains estimated at well over 2,000 feet wide on each side of the channel.

Figure 116 *Image shows wide functional riparian area flanking Chiltipin Creek near its confluence with Los Tunas Creek. Farming activities are set back from the creek, and the wide floodplain is well vegetated.*

Figure 117 *Further upstream the riparian area becomes narrower. Farming activities are closer to the creek but the floodplain remains well vegetated.*

Figure 118 *The poorly designed crossing pictured in the foreground is acting as a gradient control structure and is a source of erosive energy evidenced by scoured banks and gully formation. In contrast, the crossing pictured in the background is well designed to allow passage of sediment and water without enhancing the streams erosive energy.*

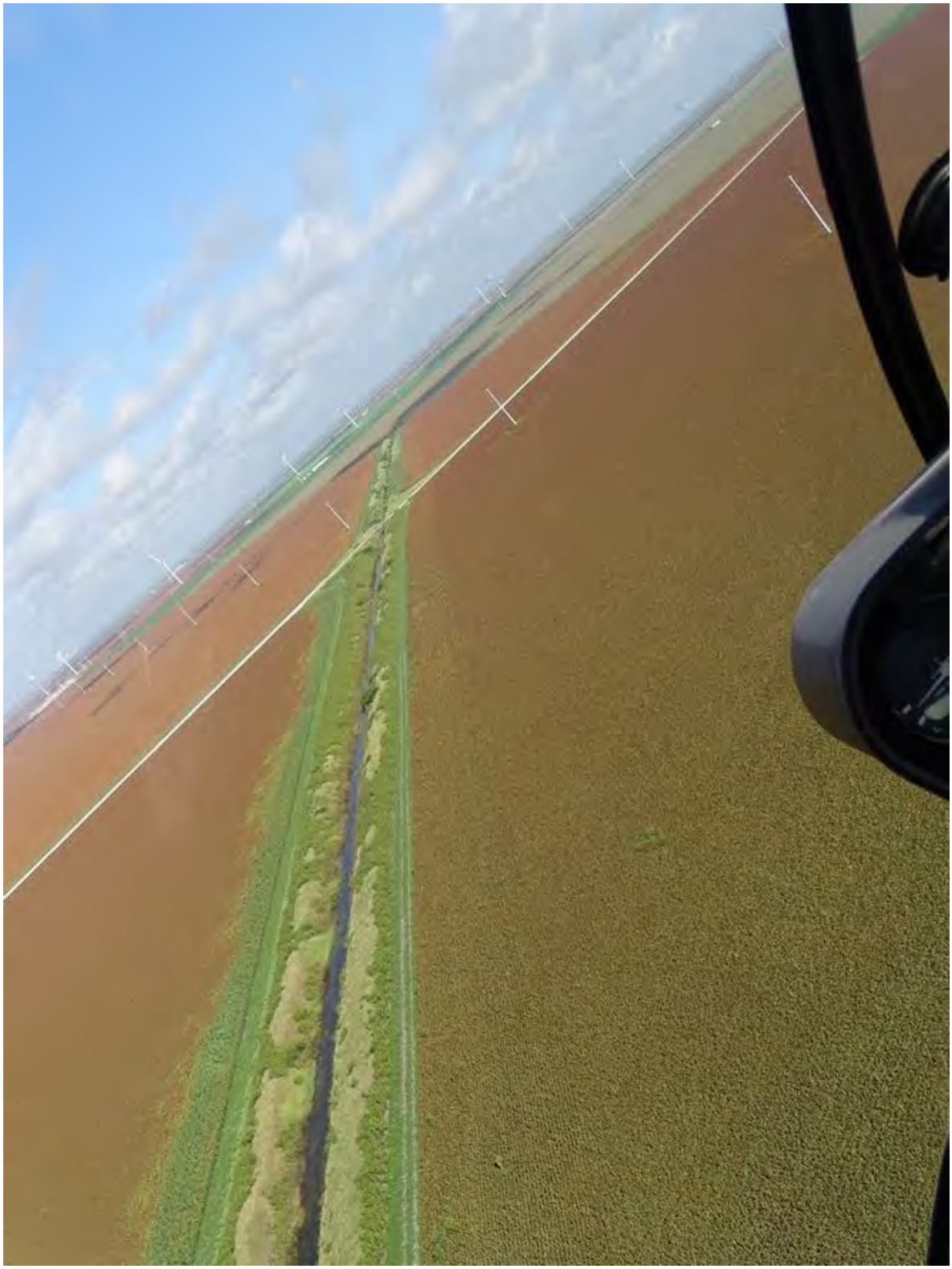

Figure 119 *Upstream, the creek has been channelized and is more ditch-like, straight and narrow. Still the riparian area is marginally functional and well vegetated. Farming activities are beginning to encroach on the creek and its floodplain.*

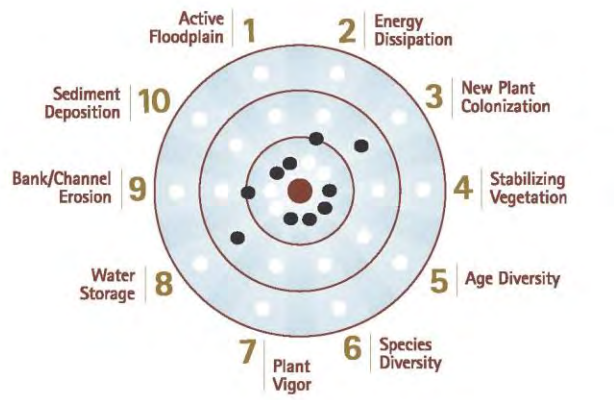

Figure 120 *Bull's-Eye evaluation target for Chiltipin Creek.*

Riparian Evaluation (Chiltipin Creek)

1. **Floodplain access**. The creek appears to have access to its floodplain.
2. **Energy dissipation**. An abundance of energy-dissipating features were observed in the channel and on the banks in the lower section of the creek, but upstream energy dissipation is reduced.
3. **New plant colonization**. In some areas new sediments are present and are being colonized.
4. **Stabilizing vegetation**. The creek has an abundance of stabilizing riparian vegetation (Spiny aster SR8, Cordgrass SR9), but woody plants are missing from the upper channelized reaches.
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed.
6. **Species diversity of riparian vegetation.** More than five native riparian plants were observed.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing.
8. **Water storage**. OBL and FACW plant species are present, mostly along the streams edge.
9. **Bank and channel erosion**. Erosion and deposition appear balanced, and channel size and shape appear of size and depth to manage sediment, except in the vicinity of the poorly designed crossing.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed within this reach.

Riparian Hindrances

- Channelization of creek into a ditch-like drain way
- Poorly designed crossing that acts as gradient control structures creating erosive energy with adequate energy dissipation

Riparian Enhancement Opportunities

1) Work with landowners to reward the current stewardship; protect and document the functional riparian condition along Chiltipin Creek.
2) Work with willing landowners to expand the setback along the upper six miles of the creek to allow for the development of meander.
3) Work with landowners to replace/restore road crossing to allow for energy dissipation, gradient equalization, and the free transport of sediment.

Laguna Salada Section

Los Olmos Creek

Lower Reach Los Olmos Creek

Figure 121 *GoogleEarth™ image of the lower reach of Los Olmos Creek highlighted in red. The reach begins at the crossing of U.S. Hwy 77 and ends at the confluence of Salado Creek.*

Observations

The riparian area of the lower reach of Los Olmos Creek is about 1 mile in length and is estimated at 600 feet average on each side of the established channel. Based on this estimated width, the area evaluated includes about 145 acres of land. Beginning at the crossing of U.S. Hwy 77 it runs through mostly grazing lands. The creek's riparian area is well buffered with wide flanks of well-vegetated functional riparian areas throughout most of the reach. Overall, the lower reach of Los Olmos Creek's riparian area is high functioning and a good example of potential for coastal riparian zones at the tidal margin.

Figure 122 *Image shows wide functional riparian area flanking the lower reach of Los Olmos Creek at the U.S. Hwy 77. Livestock grazing activities are set back from the creek, and the wide floodplain is well vegetated.*

Figure 123 *Image show highly functional riparian areas along the lower reach of Los Olmos Creek at the confluence of Salado Creek. Banks are well vegetated in what appears to be Cordgrass with Retama and Mesquite. A fringe of algae is visible along the channel edge.*

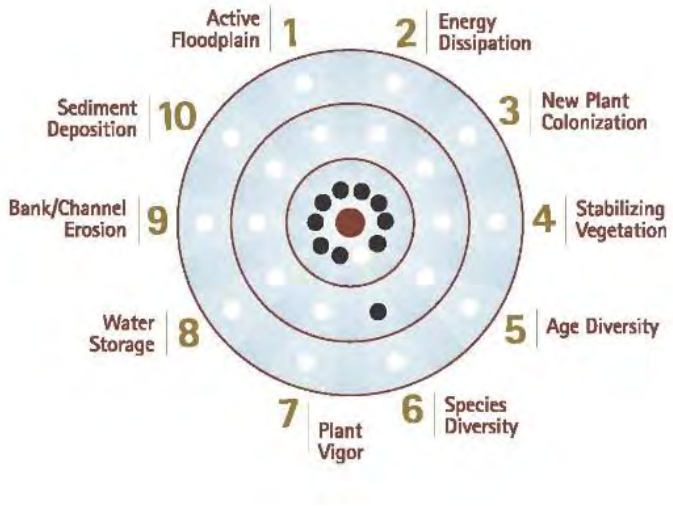

Figure 124 *Bull's-Eye evaluation target for lower reach of Los Olmos Creek.*

Riparian Evaluation (Lower Reach of Los Olmos Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain throughout the reach.
2. **Energy dissipation**. The channel, banks and floodplain host an abundance of energy-dissipating features.
3. **New plant colonization**. New plants were observed colonizing fresh sediments at the channel margins.
4. **Stabilizing vegetation**. Banks are covered with stabilizing vegetation. (Marshhay/Gulf cordgrass SR9, Retama SR6)
5. **Age diversity and reproduction of riparian vegetation**. All age groups were observed.
6. **Species diversity of riparian vegetation.** Only two native riparian plants were identified, however it is likely that 1 to 2 more are present. Overall, species diversity is moderate.
7. **Plant vigor**. Riparian plants appear healthy and vigorous with no signs of heavy grazing, mowing, trampling or browsing.
8. **Water storage**. A few OBL and FACW plant species were observed both at the water's edge and on the floodplain. (Marshhay/Gulf cordgrass FACW/OBL, Retama FACW)
9. **Bank and channel erosion**. Erosion and deposition appear balanced, and channel size and shape appear of size and depth to manage sediment.
10. **Sediment deposition**. Normal and balanced sediment deposition were observed within this reach.

Riparian Hindrances

None observed

Riparian Enhancement Opportunities

Work with landowners to reward the current stewardship; protect and document the functional riparian condition along the lower reach of Los Olmos Creek.

Salado Creek (tributary to Lower Reach Los Olmos Creek)

Figure 125 *GoogleEarth™ image of the eastern prong of Salado Creek, tributary to the lower reach of Los Olmos Creek highlighted in yellow. Salado begins at the confluence with Los Olmos and the east prong ends near the Rivera wastewater treatment plant (WWTP). Another prong of the creek veers west for a short distance.*

Observations

The riparian area of the Salado Creek, and its east prong is about 1.98 miles in length and is estimated at 300 feet on each side of the established channel. Based on this estimated width, the area evaluated includes about 128 acres of land. The creek runs through rangeland but appears to have had its channel altered, straightened, flattened and cleared. Salado Creek's riparian condition is mostly at risk with moderate function due to the alteration of its floodplain and grazing management that does not limit creek access. The Rivera WWTP appears to discharge into a pond that is located either off-channel or within an old channel of the creek. The riparian condition of this area appears to hold opportunity for enhanced function with the address of identified hindrances and the possible addition of wetland tertiary treatment for the WWTP discharge. The creek holds much opportunity for enhancement as well as community engagement.

Figure 126 *In this image you can see the Salado Creek near its confluence with Los Olmos. The creek appears to be attempting to recover by growing vegetation, trapping sediments, and holding water but may be hindered by livestock and/or wildlife grazing. In the image, animal trails on the lower right corner and the condition of plant vigor are clues to the presence of a hindrance.*

Figure 127 *Further upstream, the creek appears to have the good riparian vegetation present (Cordgrass, Spiny aster were identifiable), but the plant vigor appears to be hampering its contribution.*

Figure 128 *In this image the WWTP and a pond are shown. It is difficult to tell the relationship of the pond to Salado Creek as the creek's floodplain and channel appear to have been highly altered. Installed wetlands and riparian enhancement offer potential for improved water quality in Salado Creek prior to its confluence with Los Olmos Creek.*

Figure 129 *The pond shown in this image is appears to be nutrient-rich and may be in communication with Salado Creek.*

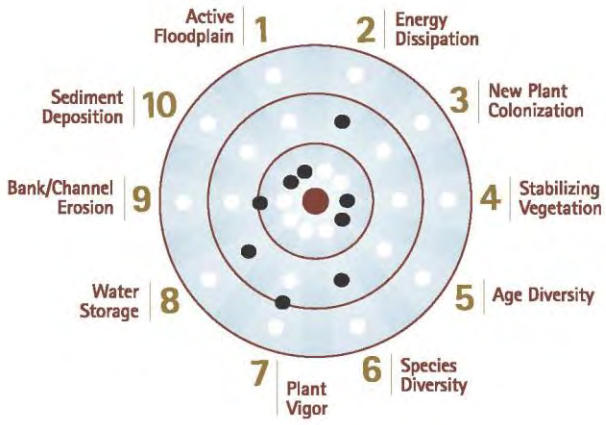

Figure 130 *Bull's-Eye evaluation target for Salado Creek.*

Riparian Evaluation (Salado Creek, tributary to the lower reach of Los Olmos Creek)

1. **Floodplain access**. The creek appears to have unimpeded access to its floodplain throughout the reach.
2. **Energy dissipation**. The channel, banks and floodplain host an abundance of energy-dissipating features, but their energy-dissipating ability has been impaired by reduced vigor.
3. **New plant colonization**. NA No sediment deposition was observed.

4. **Stabilizing vegetation**. Banks are covered with stabilizing vegetation. (Marshhay/Gulf cordgrass SR9, Spiny aster SR8)
5. **Age diversity and reproduction of riparian vegetation**. The riparian grasses noted may be remnants of older populations. Young cordgrass and even aster can be palatable.
6. **Species diversity of riparian vegetation.** Only two native riparian plants were identified, however it is likely that 1to 2 more are present. Overall, species diversity is moderate.
7. **Plant vigor**. Riparian plants appear trampled with some signs of heavy grazing and browsing in the area.
8. **Water storage**. A few OBL and FACW plant species were observed both at the water's edge and on the floodplain. (Marshhay/Gulf cordgrass FACW/OBL, Spiny aster FACW, Retama FACW)
9. **Bank and channel erosion**. Erosion and deposition appear balanced, and channel size and shape appear of size and depth to manage sediment.
10. **Sediment deposition**. The channel and floodplain appear to have been altered, and normal balanced sediment deposition cannot be expected.

Riparian Hindrances

- Artificial manipulation of banks, channels or sediment
- Physical alteration of the floodplain
- Plant vigor, i.e. grazing management

Riparian Enhancement Opportunities

1) Work with landowners to control grazing in the riparian areas along Salado Creek and allow vegetation to grow along the entire length of the creek.
2) Work with the community of Rivera to focus on the WWTP discharge as a valuable resource to be utilized for wildlife and water quality benefit. Consider possible off-channel wetlands for tertiary treatment for the purpose of improving water quality in the creek before it reaches the bay.

King Ranch Reach Los Olmos Creek NOT EVALUATED

Figure 131 *GoogleEarth™ image of the King Ranch reach of Los Olmos Creek. The reach begins at the confluence with Salado Creek and ends at State Hwy 285. The riparian area of the King Ranch reach of Los Olmos Creek is about 25.8 miles in length and is estimated at 600 feet on each side of the established channel. Based on this estimated width, the potential riparian area includes about 3,753 acres of land. The King Ranch reach was not evaluated as part of this project; it is not recommended for evaluation as part of a future project.*

Upper Reach Los Olmos Creek NOT EVALUATED

Figure 132 *GoogleEarth™ image of the upper reach of Los Olmos Creek highlighted in blue. The reach begins at State Hwy 285 and ends west of Benavides. The reach is about 46.4 miles in length, and the riparian area is estimated at 300 feet average on each side of the established channel. Based on this estimated width, the potential riparian area includes about 3,375 acres of land. The upper reach of Los Olmos was not evaluated as part of this project; it is not recommended for evaluation as part of a future project.*