City of Austin WATERSHED PROTECTION

City of Austin Riparian Zone Restoration Site Prioritization

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Abstract

Riparian zone restoration is a commonly applied management strategy designed to improve the water quality and quantity in the City of Austin. In order to maximize ecological benefits at the least economical cost it becomes imperative to accurately prioritize sites in need of restoration. By combining the current literature with field investigation/ verification, the Watershed Protection Department has developed a riparian restoration site selection framework. Results suggest that combining regional water quality and biological data with site specific evaluations of existing soil and vegetation composition is an appropriate method for allocating restoration resources. Due to the small budget, large size, and public land application of most WPD riparian restoration projects, stakeholder support has also been identified as a key component in guiding site selection. Without the ability to pragmatically select sites to receive riparian restoration there is a risk of losing public support.

Introduction

The City of Austin Watershed Protection Department Environmental Resource Management Division has recently shifted some of its focus to include more proactive solutions that address concerns over reduced water quantity and quality. Building on definitions from Meehan (1977), Swanson (1982), and Gregory (1991), Kaufmann *et al.* (1997) describes the riparian zone as a three dimensional interaction between the physical, chemical, and biological constructs of the aquatic and terrestrial environment that play a vital role in providing essential ecosystem services that our city relies upon. Healthy riparian buffers function to store and filter our water, minimize erosion, reduce flooding, provide wildlife habitat, and provide an aesthetic amenity to the community. With proper pre-site evaluation and monitoring the City of Austin will be able to promote maximum ecosystem function at the least economic cost.

Site Selection

When selecting sites to receive riparian restoration it is critical to adopt a systematic, transparent approach that is both fair to the community and a sensible use of city resources. Our approach combines regional water quality data with site specific evaluations and stakeholder participation. The specific steps involved in selecting a site are as follows:

1. Environmental Integrity Index (EII) problem score data is used to identify watershed reaches that are in high need of riparian restoration. A high need reach is determined as having poor water quality, sediment stability, and riparian vegetation scores. These three scores are compiled to obtain an overall site score ranging between 0-300 (Table 1). A score of 300 would be considered highest priority for riparian restoration.

2. Once high priority reaches have been selected a GIS exercise is performed to select potential city owned properties within the identified reach that may be suitable for restoration (Table 1). Available land area and existing riparian vegetation is used to select appropriate sites.
3. Once locations have been mapped Riparian Site Evaluations are performed to identify if restoration is warranted and feasible. Onsite evaluations combine regional water quality info with channel measurements (entrenchment ratios), soil compaction and moisture, riparian zone width, and vegetation structure, composition, and hydrologic associations (Table 2). These variables are then compiled to obtain an onsite score ranging between 0-30. Sites that receive a score of 15 or below are considered a high priority for riparian restoration.
4. Finally we consider if any stakeholder support has been expressed, or there are organized groups who would be interested in riparian restoration. Stakeholder support is vital for the success of our restoration projects. Steps to build partnerships with existing groups or encouraging new members to take an interest should be taken before any restoration activities are scheduled. Priority will be given to sites that have established and organized groups able to provide volunteer hours to the restoration effort. With the small budget and large impact area of these projects, volunteer effort and support is critical.

Table 1: Initial restoration site evaluation score. Calculation based on most recent City of Austin Environmental Integrity index (EII) data. Combines EII reach riparian, stability, and water quality (WQ) scores to identify regional restoration priorities.

Site Name	EII Reach	No mow Acres	Rip Veg	Stability	WQ	Overall Score	WQ CIP Priority
Bartholomew Park	TAN3	5.55	94	91	100	**285**	Very High
Dottie Jordan	LWA1	0.91	44	95	69	**208**	High
Gillis Park	EBO2	0.23	97	52	58	**207**	Very High
Blunn @ Terrace	BLU2	2.32	80	49	59	**188**	Moderate
Tarrytown Park	JOH1	0.17	90	56	37	**183**	High
Boggy @ 10th	BOG1	1.2	82	59	39	**180**	Moderate
Commonsford Park	CMF	6.56	70	57	52	**179**	Moderate
Givens Park	TAN1	3.82	52	65	56	**173**	Very High
Battle Bend	WMS2	0.38	79	52	36	**167**	Low
Shoal @ Shoal Edge	SHL3	3.5	52	52	62	**166**	Moderate
Buttermilk Greenbelt	BMK2	0.43	100	54	7	**161**	Very High
Reed Park	TYS1	0.95	36	43	45	**124**	Low
Dittmar Park	SBG2	2.38	19	65	30	**114**	Moderate
Northstar Green Belt	WLN4	1.72	44	36	32	**112**	Low
Robert E. Lee Trib	BAR1	1.52	46	11	39	**96**	Low
Bull District Park	BUL2	2.58	0	0	35	**35**	Low

Restoration Methods

Completion of the Site Evaluation field sheet (Appendix 1) will assist in determining the type of restoration that should be implemented. Being able to accurately diagnose a potential restoration site prior to implementation can increases chances of success and lower project costs (Holl and Aide 2010). Establishment of passive grow zones is recommended for sites where a rare natural disturbance event (extreme flood, drought, excessive rain, disease, etc…) has occurred or where a temporary (e.g. construction) or easily modified (e.g. mowing) human disturbance has taken place (Duncan 2012). Often altering or removing a management disturbance may set an ecosystem on a successional trajectory towards improved ecosystem function (Kauffman *et al.* 1997). Active restoration (e.g. revegetation) is recommended for degraded sites where the primary disturbance is naturally reoccurring or a human alteration that the community is unable or unwilling to remedy (Duncan 2012).

a. Grow Zones – This method can work as a complete technique or a precursor to a more active approach. Simple and cost effective, it involves changing the maintenance practice to exclude mowing in an area adjacent to a stream. This enables the natural process of restoration to occur. The result will be limited to the plants that are already established and whatever seed stock is naturally available.
    i. This option is ideal when there are few resources available and the ability of the riparian zone to support plantings is low.

b. Riparian Revegetation – When conditions dictate that a more active approach to revegetation is required, containerized plants (transplants) and seeding with a temporary irrigation system will be installed.
    i. This option is desirable when the hydrology, hydraulics and geomorphology are all functional or incapable of being altered. There also need to be resources and infrastructure available to keep transplants alive. It also helps to have an active community with an interest in seeing the plant community prosper in this location.
    ii. The planting plan is based on the eco-region of the stream reach and limitations may be imposed by flood restrictions or neighborhood desires. When possible a three tiered plant scheme is assembled including native grasses, wildflowers, understory trees and shrubs and canopy trees.

c. Channel alteration – In some situations where there appears to be sufficient baseflow year round it is possible to expect good results from a stream bank and bottom alteration. This method would include adding grade control structures, meanders, riffle/run/pool units, multiple flood stages, and vegetation to the reach.
    i. This option fits where stream channel erosion has stabilized but left the banks steep and incised, hydrology to the stream reach includes a source of baseflow and the disturbance will not significantly set back the natural successional process of the established vegetation.
    ii. Stream channel alterations are based on hydrology and hydraulics within the reach.

Environmental impacts associated with the above restoration methods are as follows:

- Thicker, taller, healthier vegetation
    - Increases groundwater infiltration
    - Reduces suspended solids
    - Reduces water temperature
    - Reduces erosion
    - Improves biotic conditions
    - Creates wildlife habitat
- Woody debris in channel
    - Creates pools for water storage
    - Construct stream functional units (riffle, run, pool)
- Bank modification
    - Create multiple stage channel
    - Increase hydrostatic pressure in soil
    - Improve benthic substrate/instream habitat
- Maintenance Modification

    - Reduction in amount of mowing
    - Change to more specialized landscaping methods (edge mowing, manual weed control, mulching etc)
- Improved Hydraulics
- Denitrification
- Reduction in atmospheric carbon
- Lowered heat island effect

Cost Estimate

Costs will vary based on the type of restoration performed. Passive restoration such as the Grow Zones that have been implemented in the parks has very little cost associated with it. This approach is often coupled with a little bit of active planting in the form of native grass and wildflower seeding which can be done for $300-$800 per acre.

When a full planting occurs that includes an irrigation system and longer-term maintenance, the cost is estimated at $40,000 per acre. If there are going to be infrastructure changes or channel work then the costs will go up based on detail of work.

Outreach

We supply a variety of technical support and material outreach to all identified stakeholders. These groups include neighborhood associations, PARD, WPD Field Operations, KAB, Austin Parks Foundation, Austin Trails Foundation, PODER, surrounding businesses, community groups, University of Texas classes, Capitol Area Master Naturalists and pretty much anyone interested that requests information. Often the outreach involves multiple meetings with stakeholders, which is all recorded in an outreach calendar managed by the ERM education group.

Locations

We are only able to do work on City of Austin owned land. Our focus is primarily on WPD and PARD property.

Results

A total of 1,330 City of Austin Parcels, consisting of 45,850 acres, located within 50 ft. from a stream channel were analyzed using Geographic Information System (GIS) software. Each parcel was scored using City of Austin Environmental Integrity Index (EII) problem score data (water quality, sediment stability, and riparian vegetation scores) and then analyzed for existing riparian vegetation. Adjacent parcels were combined to form sites and a GIS assessment of vegetation cover and land availability was performed. Sites consisting of reduced vegetation cover (≤ 40% canopy cover) that had minimal bordering infrastructure (houses, roads, utility easements, etc…) and appropriate land area to perform restoration (≥ 25 ft. from bank of stream) were selected as potential riparian restoration locations. A total of 82 sites fit the above mentioned criteria. Sixteen of the 82 selected riparian locations were agreed upon between the Watershed Protection and Parks and Recreation Departments to receive riparian zone restoration (Table 1). These 16 locations then received on site evaluations of entrenchment ratios, soil compaction and moisture, riparian zone width, and vegetation structure, composition, and hydrologic associations. These onsite values were combined with EII regional water quality and diatom data and scored (Table 2). Overall scores ranging between 0-7 received a ranking of poor, 8-15 receive a marginal ranking, 16-22 receive a suboptimal ranking, and scores ≥ 23 receive a ranking of optimal. The majority of our current sites (12 out of 16) scored within the marginal ranking and is thus considered a restoration priority. Tarrytown, Commonsford, Northstar, and Bull District Parks ranked in the suboptimal category and should be considered a lower priority for riparian restoration. However, due to stakeholder interest, education and outreach opportunities, and ERM research investigations, these park systems should remain in the Riparian Zone Restoration Program. The site evaluation protocol will likely be routinely updated as additional data and site evaluation information is gathered.

Table 2: Site Evaluations for current City of Austin Environmental Resource Management Division riparian restoration sites. WQ = EII water quality score, DI = EII diatom Index, E = entrenchment ratio, C = soil compaction, M = soil moisture, RW = riparian zone width, VC = vegetation cover, DT = dominant tree, IC = invasive cover, HP = hydrophytic plants.

	WQ	DI	E	C	M	RW	VC	DT	IC	HP	Overall
Gillis Park	1	2	0	0	0	0	2	2	2	2	**11**
Robert E. Lee Trib	2	3	3	0	0	0	0	0	3	0	**11**
Dottie Jordan	2	3	0	0	2	0	1	1	1	2	**12**
Buttermilk Greenbelt	2	3	2	1	1	0	0	0	3	0	**12**
Dittmar Park	2	2	1	0	2	0	2	1	0	2	**12**
Boggy @ 10th	2	3	0	0	1	0	2	1	3	1	**13**
Shoal @ Shoal Edge	2	2	1	0	0	0	2	2	1	3	**13**
Bartholomew Park	2	3	1	0	1	0	1	1	3	2	**14**
Givens Park	2	3	2	0	1	0	1	3	1	1	**14**
Blunn @ Terrace	2	3	0	0	1	0	2	2	2	2	**14**
Reed Park	2	2	2	0	0	0	2	0	3	3	**14**
Battle Bend	3	3	3	0	0	0	1	1	2	2	**15**
Tarrytown Park	1	2	3	0	2	0	2	1	3	2	**16**
Commonsford Park	3	3	3	1	2	0	1	2	3	2	**20**
Northstar Green Belt	2	3	3	0	3	0	1	3	3	2	**20**
Bull District Park	2	3	3	3	3	0	2	1	3	2	**22**

Conclusions

The Environmental Resource Management division has developed a systematic, transparent approach for prioritizing riparian zone restoration projects throughout the City of Austin. By combining regional Environmental Integrity Index data with local site evaluations and stakeholder interest ERM is able to select appropriate sites to perform restoration. This approach is designed to maximize improvements to ecosystem function at the least economic cost by focusing restoration resources on the most environmentally degraded locations.

Recommendations

1. Incorporate the above methodology for ranking all future riparian zone restoration projects.
2. Routinely update the site evaluation data sheet as additional data and evaluation information become available.
3. Develop a more quantifiable approach to ranking stakeholder interest.

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Appendix A.

CITY OF AUSTIN RAPID RIPARIAN FUNCTIONAL ASSESSMENT

SITE EVALUATION

Site Location:	Date:	Time:	Staff:
Photos:			
Stakeholder Interest: Yes/ No	Info/ affiliation:		
Additional site info:			

1. Water Quality– Record the most recent City of Austin Environmental Integrity Index (EII) Water Quality score for the associated reach on the Scoresheet.

Reach:_____________________________ **Water Quality Score:**____________________________________

2. Diatom Index- Record the most recent City of Austin Environmental Integrity Index (EII) Diatom Index score for the associated reach on the Scoresheet.

Reach:_____________________________ **Diatom Index Score:**____________________________________

3. Entrenchment- Throughout the entire stream reach measure channel entrenchment; once in the upper, middle, and lower section of the reach. The entrenchment ratio is determined by dividing the width of the flood prone area (F) by the bankfull width (B). The flood prone area is defined by measuring the width of the channel at twice bankfull depth. Depth should be taken at the stream thalwag (T) (deepest section of the channel). Bankfull corresponds to the start of the floodplain and is indicated by a break in slope from the channel, a change in vegetation from bare surfaces or annual wetland species to perennial water-tolerant or upland species, and from a change in the size distribution of surface sediments.

Upper	Middle	Lower	Site Average
B_______T_______F_______	B_______T_______F_______	B_______T_______F_______	________

4. Soil Compaction– In the center of each vegetation sampling plot (see #7) take three soil compaction measurements. Measurements should be taken approximately 15 ft from the stream bank using a soil penetrameter. Apply even downward pressure on both handles of the penetrameter to keep the shaft and tip penetrating the soil at a slow even pace. The tester shaft is marked at three inch intervals for easy depth measurement. As the tester's shaft penetrates the soil, the gauge reading at the 3 inch depth should be recorded (be sure to use the correct scale for the size tip that you are using as indicated on the dial).

Upper	Middle	Lower	Site Average
#1______ #2______ #3______	#1______ #2______ #3______	#1______ #2______ #3______	________psi

5. Soil Moisture– In the center of each vegetation sampling plot (see #7) take three soil moisture measurements. Measurements should be taken approximately 15 ft from the stream bank using a soil moisture probe. The soil probe tester plates must be chemically cleaned prior to use by rubbing with conditioning film. Soften soil in spot to be tested, break up pieces if it's hardened, and remove grass, leaves, pebbles and other debris. Insert soil tester so metal plates are fully covered and press the soil tightly around the tester so that the metal plates are in close contact with the soil. Press the button until value stabilizes to read soil moisture.

Upper	Middle	Lower	Site Average
#1______ #2______ #3______	#1______ #2______ #3______	#1______ #2______ #3______	________%

6. Riparian Zone Width– Measure the riparian zone width in the upper middle and lower section of the stream reach.. Consider the riparian zone to begin at the stream bank and the edge is often dictated by a human structure (e.g. house, road) or management activity (e.g. mowing) that inhibits natural plant growth.

Upper	Middle	Lower	Site Average
________ft	________ft	________ft	________ft

7.Vegetation Cover - Once in the upper, middle, and lower portion of the stream reach; estimate the percent cover (the shadow cast by a particular layer) provided by the groundcover (gc), understory (us), and canopy (cp) vegetation layers in the riparian zone. Select a representative area and visualize a 33 by 33 foot plot beginning from the edge of the stream bank extending perpendicular into the riparian zone. The canopy layer is >15ft high, the understory is 1.5 to 15ft high, and the ground cover is <1.5ft high. Average all three layers together to obtain an overall site average. The surveyors should walk the plot focusing on 1 vegetation category at a time and then agree on one value to record. Running a measuring tape to better define the study plot or dividing transect into smaller units can help to obtain a more accurate estimation.

Upper	Middle	Lower	Site Average
cp_____% us_____% gc_____%	cp_____% us_____% gc_____%	cp_____% us_____% gc_____%	_________%

8. Dominant Tree- Throughout the entire stream reach determine the presence or absence of multiple age classes of the dominant native tree (most overall site canopy cover).

Dominant Species_______________________: **Circle age classes present:** seedling, sapling, mature, snag.

9. Invasive Cover- Throughout the entire stream reach estimate the percentage of overall vegetation cover occupied by non-native invasive plant species.

Species:____

10. Hydrophytic Plants- Record the presence or absence of hydrophytic vegetation in the upper, middle and lower portions of the study transect. Circle sections occupied and record species name.

Circle transect sections containing hydrophytic vegetation: Upper, Middle, Lower

Species:____

SCORESHEET

	Optimal	Suboptimal	Marginal	Poor
1. Water Quality	Score >75	Score 75-51	Score 50-25	Score >25
	3	2	1	0
2. Diatom Index	Score >75	Score 75-51	Score 50-25	Score >25
	3	2	1	0
3. Entrenchment	Ratio > 2.20	Ratio 2.20-1.85	Ratio 1.84-1.40	Ratio < 1.40
	3	2	1	0
4. Soil Compaction	0-100 psi	101– 200 psi	201-300 psi	> 300 psi
	3	2	1	0
5. Soil Moisture	>75%	75-61	60-45	< 45%
	3	2	1	0
6. Riparian Width	Width >100 ft	Width 100-61 ft	Width 60-26 ft	Width < 25 ft
	3	2	1	0
7. Vegetation Cover	>50% plant cover	50-38% plant cover	37-25% plant cover	<25% plant cover
	3	2	1	0
8. Dominant Tree	All age classes	3 age classes	2 age classes	0-1 age class
	3	2	1	0
9. Invasive Cover	< 5% cover	5-20% cover	21-40% cover	> 40% cover
	3	2	1	0
10.Hydrophytic Plants	all sections have hydrophytic plants	2 sections have hydrophytic plants	1 section has hydrophytic plants	No hydrophytic plants
	3	2	1	0
Overall Site Score*	**Optimal ≥ 23**	**Suboptimal 16-22**	**Marginal 8-15**	**Poor 0-7**

***Sites with an overall score in the Marginal and Poor categories should be considered high priority for riparian restoration.**