



MEMORANDUM

Department of Transportation

DATE: July 2015
 TO: Consultants with current or future DOT contracts
 FROM: Ellen Barth Alster, RLA, LEED AP, Senior Landscape Architect
 SUBJECT: Update Appendix 4D of the Environmentally Sensitive Roadway Design Guidelines, Pima County DOT Roadway Design Manual.

This memo is an update to Appendix 4D of the Environmentally Sensitive Roadway Design Guidelines. It shall substitute for the existing Appendix 4D. It also includes an additional section concerning Regulated Riparian Habitat (RRH) mitigation.

Introduction

Landscaping on Pima County roadways is designed and maintained to preserve the natural character and vegetation density of an area and provide habitat for specific species. The objective is to leave the landscape as natural appearing as possible. Every effort should be made to re-vegetate with plant species that were removed and/or are commonly found in the project environment, matching density, relative location patterns (e.g. small cactus under shrubs), and slope and soil preferences. This process involves inventorying and measuring existing vegetation. The next step is calculating mitigation requirements based on the inventory. These inventories shall be used as a basis for recreating the existing plant communities in new roadway landscaping, including the restoration of washes and riparian areas occurring within the overall project area. The inventories are intended to provide a full representation of the vegetative communities present on the project site, so that these communities can be recreated to the best extent possible.

The two types of required Vegetation Measurement are listed below. The first inventory is of all saguaros and Pima County Protected Trees over 3” in caliper (the only exception to the 3” requirement is acacias - only acacias over 8” caliper are required to be inventoried). This inventory is done for the entire project area to be disturbed by construction. The second type of inventory is a sampling which is used to determine densities and types of shrubs, cacti, succulents, and seed mixes.

Inventory Type	What to Inventory	Inventory Area	Inventory Purpose
Saguaros and Pima County Protected Trees	<input type="radio"/> All Saguaros <input type="radio"/> All Pima County Protected Trees > 3” caliper (see list under Step 1 below)	Entire right-of-way area within project limits	<input type="radio"/> To determine number and sizes of saguaros that should be replaced <input type="radio"/> To determine replacements for Pima County protected tree species
All Other Plants	All plants in determined sampling area. Shall include each specific type of plant community in the project area.	Circular sampling areas (relevés). These vary in size and quantity according to the project.	<input type="radio"/> To determine seed mix <input type="radio"/> To determine replanting density of Pima county protected cactus and shrub species. This value shall be used as a guide in replanting the remainder of the species.

STEP 1: INVENTORY OF PROTECTED PLANT SPECIES

A. Determine ESR Multiplier by the following method:

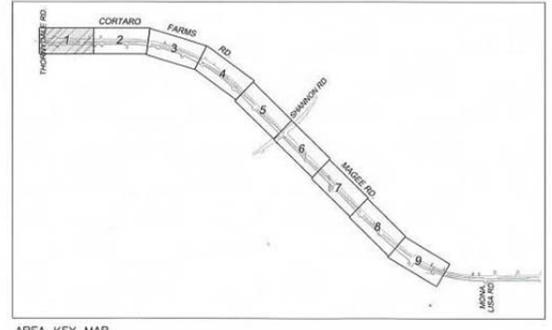
- Calculate disturbed area of project. Disturbed area of project is defined as 10' offset from the project cut and fill limits, including all drainage and utility improvements associated with the project. If the 10' offset falls beyond right of way limits, this area is not to be included, unless the area falls within an easement designated as part of the project limits.
- Calculate the plantable area. Plantable area is defined as the disturbed project area that can be planted with trees. It excludes the following:
 - Road
 - Unpaved area between and curb and sidewalk
 - Medians
 - 10' offset from pavement edge if no curb
 - Sight Visibility Triangle (SVT)
 - Drainage structures
 - Utility offsets for trees (shown below)

Utility	Offset
Wastewater	16' from manholes Maintain clear area from manhole to street 10' from sewer line
Gas	8' from gas line
Electric	25' from pole Trees planted under power lines shall be no taller than 15' at mature height within 15' of power lines
Water	10' from water line
Communications	4' from cable line

NOTE: All utilities should be contacted for any policy updates since the date of this memo.

- ESR multiplier = plantable area / disturbed project area
- ESR may fluctuate throughout the project as drainage, slope and construction easements are refined throughout subsequent design phases. Utility disturbance areas may not be determined until late in the design process, requiring landscape and irrigation adjustments up until the end of the design phase. Consultant is to be aware of these changes and be prepared to update the plans after all utility disturbance is determined.
- Submit a diagram showing the plantable area for the entire project area as shown in the example on page 3.

STEP 1: INVENTORY OF PROTECTED PLANT SPECIES



SAMPLE SHEET SHOWING PLANTABLE AREA (AREA THAT CAN BE PLANTED WITH TREES)

STEP 1: INVENTORY OF PROTECTED PLANT SPECIES

B. Complete a full inventory of the entire disturbed project area for saguaros and Pima County protected tree species. These plants include:

Scientific Name	Common Name	Minimum Size
Acacia constricta	Whitethorn Acacia	8" Caliper
Acacia greggii	Catclaw Acacia	8" Caliper
Carnegiea gigantea	Saguaro	All
Chilopsis linearis	Desert Willow	3" Caliper
Celtis reticulata	Canyon Hackberry	3" Caliper
Olneya tesota	Ironwood	3" Caliper
Parkinsonia floridum	Blue Palo Verde	3" Caliper
Parkinsonia microphyllum	Foothills Palo Verde	3" Caliper
Prosopis velutina	Velvet Mesquite	3" Caliper
Prosopis pubescens	Screwbean Mesquite	3" Caliper

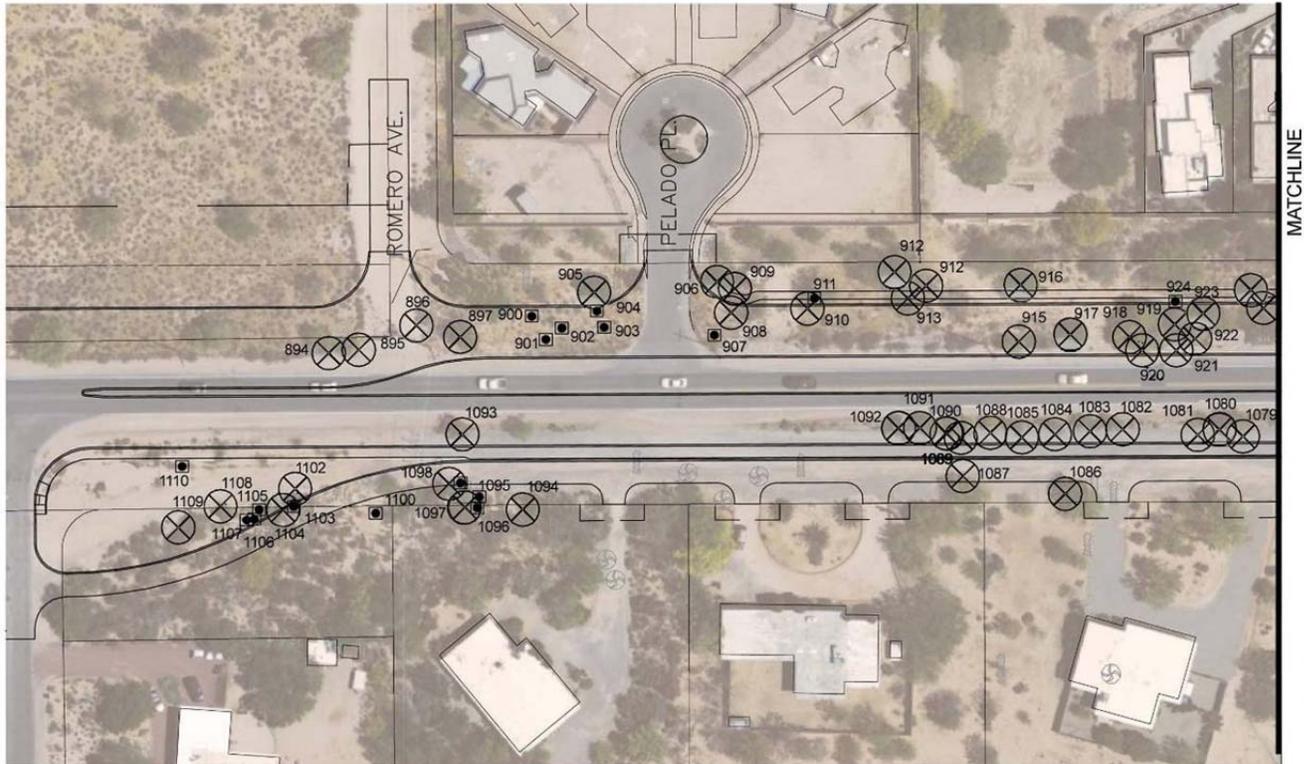
Notes:

- Only the species listed above are required to be inventoried and only the disturbed area needs to be inventoried.
- If the entire site happened to be inventoried including non-disturbed areas, the trees in the non-disturbed areas should not be included in the total caliper inches.

Assess and document the following for each tree:

1. Caliper
 - Measure 24" above ground with forestry caliper
 - For multi-trunked species, the largest 3 trunks are measured. The species is included if the sum of the trunks is greater than or equal to 3"
2. Location
 - Record GPS coordinate points for each tree and saguaro inventoried.
 - Locate trees and saguaros on air photo as shown in page 5.

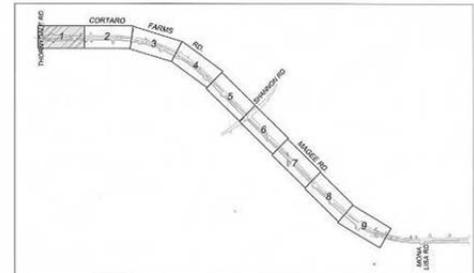
STEP 1: INVENTORY OF PROTECTED PLANT SPECIES



LEGEND

-  TREE (Number refers to inventory)
-  SAGUARO (Number refers to inventory)

SAMPLE NATIVE PLANT INVENTORY PLAN SHEET



AREA KEY MAP

ID #	Scientific Name	Common Name	Caliper	Height
119	<i>Parkinsonia microphyllum</i>	Foothills Verde	5	
120	<i>Parkinsonia microphyllum</i>	Foothills Verde	4	
121	<i>Parkinsonia microphyllum</i>	Foothills Verde	13	
123	<i>Carnegiea gigantea</i>	Saguaro		7
125	<i>Carnegiea gigantea</i>	Saguaro		8
128	<i>Chilopsis linearis</i>	Desert Willow	12	
131	<i>Olneya tesota</i>	Ironwood	9	
134	<i>Carnegiea gigantea</i>	Saguaro		6

SAMPLE NATIVE PLANT INVENTORY

- Tree: indicate caliper inches
- Saguaro: indicate heights

STEP 1: INVENTORY OF PROTECTED PLANT SPECIES

C. Calculate mitigation requirements for protected trees and saguaros

Trees:

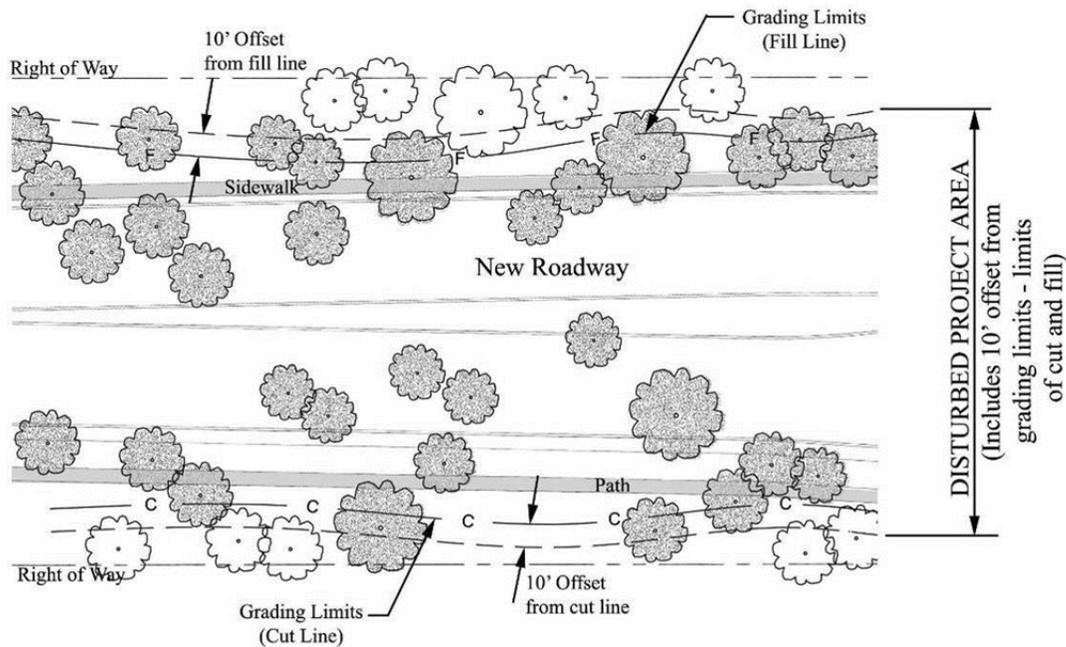
- Add up total caliper inches for each species of tree in the project area that will be disturbed only. Do not include caliper inches for trees in undisturbed areas that will not be impacted by development. (See Diagram Below)
- Mitigation/species = Total Caliper inches x 125% x ESR ratio

Example:

- 100 caliper inch of palo verde in a disturbed site area of 10 acres. (The overall project area r/w to r/w may be larger than these 10 acres, but **only** the caliper inches in the *disturbed area* are counted).
- Only 2.5 acres of the 10 acres are plantable (the rest is roadway, clear zone, drainage, etc.)

Result: 100 cal inch x 125% x ESR multiplier = 31.25 cal inches that must be replaced in the 2.5 acres of disturbed acres

NOTE: ESR Multiplier = Plantable Area/Disturbed Project Area or 2.5 acres/10 acres = 25%



Tree Legend

-  Tree within limits of disturbed project area (caliper of this tree to be counted in total caliper inches)
-  Tree outside of limits of disturbed project area (caliper of this tree is NOT counted)

STEP 1: INVENTORY OF PROTECTED PLANT SPECIES

Saguaro:

- Mitigate saguaros at 1:1
- Saguaros will be replaced with replacement saguaros that are as close in height to the original saguaro being removed up to an 8' maximum height for replacement saguaros.
- Replacement standards will be as follows:

Inventoried Saguaro	Minimum Replacement Size
0-2'	1-2'
2-4'	2-4'
4-6'	4-6'
6-8'	6-8'
Over 8'	8' maximum ht.

Example:

- Site contains 10 saguaros. See the table below for replacement sizes.

Inventoried Saguaros	Height of Inventoried Saguaros	Minimum Replacement Size
1	10'	8'
2	12'	8'
3	6'	4-6'
4	4'	4-6'
5	4'	4-6'
6	8'	6-8'
7	2'	2-4'
8	5'	4-6'
9	7'	6-8'
10	15'	8'

D. Convert Total Caliper Inches for Required Tree Mitigation

The final caliper inch value for protected tree species is to be distributed into appropriately sized trees to the extent possible, based on plant availability. A demonstrated effort must be made to mitigate using a variety of plant sizes.

Example:

For a given project, it is determined that 31.25" of caliper inches for Parkinsonia microphyllum, (Foothills Palo Verde) need to be replaced. The total inventoried plants = 100 caliper inches. They are originally distributed as follows:

STEP 1: INVENTORY OF PROTECTED PLANT SPECIES

ORIGINAL TREE INVENTORY

Tree #	Tree Species	Caliper Inches
1	Parkinsonia microphyllum	18
2	Parkinsonia microphyllum	16
3	Parkinsonia microphyllum	12
4	Parkinsonia microphyllum	9
5	Parkinsonia microphyllum	9
6	Parkinsonia microphyllum	8
7	Parkinsonia microphyllum	7
8	Parkinsonia microphyllum	6
9	Parkinsonia microphyllum	5
10	Parkinsonia microphyllum	4
11	Parkinsonia microphyllum	3
12	Parkinsonia microphyllum	3

Total Caliper Inches = 100

In order to distribute the replacement mitigation trees into a variety of sizes, determine the original distribution of sizes:

DISTRIBUTION OF TREE SIZES IN ORIGINAL INVENTORY

Size ranges	# of Trees	Percentage as Total # of Trees	Total # Required Caliper Inches
> 12"	2	2 trees/12 trees = 17%	17% x 31.25 = 4.8
8-12"	3	3 trees/12 trees = 25%	25% x 31.25= 7.2
6-8"	3	2 trees/12 trees = 25%	25% x 31.25= 7.2
< 6"	5	5 trees/12 trees = 42%	42% x 31.25 = 12.0
Totals		100%	31.3

The next step, once it is determined how many caliper inches are in each size range, is to translate these ratios into sizes of plants that are commercially available. The largest size container available is assumed to be 48" box, with (4) different sizes of plants to be used.

CALCULATING DISTRIBUTION OF TREE SIZES*

Original Caliper Size of Tree	Replacement Container Size	Caliper Inches per Container	Required Caliper Inches/Caliper Inches per Container	Actual # of Trees per each container size
>12"	48" Box	6	4.8/6=.8	1
8-12"	36" Box	4	7.2/4= 1.8	2
6-8"	24" Box	2	7.2/2.5= 2.9	3
<6"	15 Gal. or 24" tree pot	1	12/1= 12.0	12

***The largest caliper tree sizes shall be planted 100' within either side of wash areas**

STEP 1: INVENTORY OF PROTECTED PLANT SPECIES

In the process of distributing the required caliper inches among container grown plants, use the standards specified below:

Container Size Tree	Caliper Inches per Container
15 Gal. or 24" tree pot	1
24" Box	2.5
36" Box	4
48" Box	6

This method assumes a variety of sizes is commercially available. In the event that the required tree species and saguaros cannot be found in the required sizes, the consultant shall proceed by doing the following:

1. Submit a list of nurseries contacted to Pima County's Landscape Architect.
2. Upon reviewing this list, the landscape architect may require additional plant sources be contacted
3. The County Landscape Architect will make a final determination that all possible tree sources have been contacted before allowing smaller tree sizes to be used to meet the ESR requirement or to allow substitution of tree species
4. It is recognized that plant availability may change between the time construction plans are done and the time the project is built. Therefore, if the tree species and sizes specified on the plans are not available at the start of construction, the contractor must verify this by submitting a list of nurseries contacted to the county landscape architect. The county landscape architect may advise one of the following:
 - a) Require additional nurseries to be contacted
 - b) Make an adjustment to the trees required based on caliper sizes available
 - c) Allow alternate species to be used for tree mitigation. Under no circumstance will alternate species be allowed to be used to mitigate for ironwood trees (*Olneya tesota*).

E. Allow for Plant Salvage:

For plants in the right of way that will conflict with new construction, PCDOT is providing the opportunity for them to be salvaged by other government agencies and non-profit native plant organizations. Permits will be required from the Arizona Department of Agriculture for transplanting all plant material protected by the Arizona Native Plant Law. PCDOT Right of Way Use Permits will need to be obtained prior to any work being performed in the right of way.

STEP 2: COMPREHENSIVE PLANT SAMPLING – RELEVE PROCESS

The purpose of this second step is to establish a basis for all other planting (not included in Step 1), used to mitigate the impacts of roadway construction projects through revegetation.

The **Releve Method** is a technique that vegetation ecologists use to sample an area for such variables as species diversity, cover, density, and abundance. It attempts to document the entire biotic plant community in the project area prior to roadway construction, so that the disturbed areas can be restored to as close to original condition as possible post construction. Circular plots (relevés) are used to inventory and record each species present. Information obtained is extrapolated from these representative samples and used throughout the entire project. Releve survey results shall be used to determine the following:

- (1) Tree and shrub species to be planted with tree pots provided by the Pima County Native Plant Nursery
- (2) Cacti and succulents to be planted from containers provided by the Pima County Native Plant Nursery
- (3) Seed mixes

It is critical that the personnel conducting this method are highly skilled in plant identification, including annual species.

Follow these steps:

A. Conduct releve:

1. Determine number of vegetation entities:

Assess visually the number of *vegetation entities* (discrete assemblages of species) represented within a project area.

- Establish one (1) entity in areas with the same assemblage of species represented throughout.
- Establish two (2) or more entities for most roadway projects. Typical projects might include an upland community with a wash running through it, where the wash contains an assemblage of species distinct from the surrounding uplands. The upland community would be one entity, while the wash community is a second entity. Additionally, washes may contain more than one entity.

2. Determine the required number of releve plots:

Locate circular plots (relevés) that are representative of the plant assemblages or communities. The appropriate number and size of these plots will depend upon the size and diversity of the project area.

- Relatively homogenous projects require fewer relevés, while project areas having multiple vegetation entities require a greater number of relevés.
- It is the responsibility of the project manager to meet with the Pima County DOT staff landscape architect to determine the number of relevés required before the project scope is developed.

STEP 2: COMPREHENSIVE PLANT SAMPLING – RELEVE PROCESS

3. Locate releve plots

- Locate plots to be as representative of each vegetation entity as possible. Preliminary assessment of plots may be determined via PimaMaps or other digital tools, but final locations require onsite field visits to be determined.
- Establish 20' radius plots as a general rule. Plot sizes may increase or decrease in size due to site specific circumstances with the approval of the Pima County DOT landscape architect.
- Locate plots in areas adjacent to the project, if limited vegetation is present within the project area due to prior site disturbance. Locate these offsite plots in undisturbed areas with similar topography.
- Define center of plot and plot boundaries with flagging. Document flagged areas with GPS or other means so that they can be re-established if flagging is removed prior to the second releve being done.
- Map releve locations and include this information in the releve submittal to the Pima County staff landscape architect.

MAP OF RELEVE LOCATIONS



STEP 2: COMPREHENSIVE PLANT SAMPLING – RELEVE PROCESS

5. Collect releve data (See Column A in Table 1):

- Identify every species of a plant present within the releve, including annual species.
- Collect unknown plants and bring to the University of Arizona Herbarium or to a qualified botanist for positive identification.
- Include single species of plants that are not represented within the releve but fall within 10' of the releve boundary
- If the releves are not capturing species that appear to be dominant in the landscape, then additional and/or larger releves are required.
- Provide releve inventory data as illustrated in the columns labeled “A” in Table 1. The example shows five releves (five surveyed plots).
- Indicate invasive species as shown in the sample provided in Table 1 (See Column C).

6. Calculate average plant densities per releve (See column B in Table 2):

Example:

Acacia constricta was inventoried in five separate releves. Total these five areas:

$$1 \text{ (Releve 1)} + 0 \text{ (Releve 2)} + 3 \text{ (Releve 3)} + 1 \text{ (Releve 4)} + 3 \text{ (Releve 5)} = 8 \text{ plants}$$

Next, calculate average density:

Total number of plants for each species / number of releves = Average density per releve

$$8 \text{ plants} / 5 \text{ releves} = 1.6 \text{ plants per releve}$$

7. Repeat entire inventory process two separate times:

- Measure the releve twice (spring and fall) to accurately capture the annual flora. On larger PCDOT projects there is typically sufficient design time to allow for two releves to occur.
- It is recognized that it may not always be possible on smaller projects with shorter design timeframes to repeat the process two times.
- It is recognized that there may not be signs of enough vegetative diversity to justify repeating the process twice. If this is the case, the reasoning why the releve was not repeated shall be documented.

STEP 2: COMPREHENSIVE PLANT SAMPLING – RELEVÉ PROCESS

TABLE 1

These five columns indicate the 5 relevé plots. The number of columns will vary depending on the number of relevés

	A					B	C
	Density (plants per 20' radius relevé)					Average Density (per 20' radius relevé)	Invasive (check box if applicable)
	Relevé 1	Relevé 2	Relevé 3	Relevé 4	Relevé 5		
Large Shrubs and Trees							
<i>Acacia constricta</i>	1	0	3	1	3	1.6	
<i>Larrea tridentata</i>	6	2	4	3	5	4	
<i>Parkinsonia microphylla</i>	0	0	2	4	0	1.2	
<i>Prosopis velutina</i>	0	1	2	1	0	0.8	
Cacti/Succulents							
<i>Carnegiea gigantea</i>	0	2	0	1	0	0.6	
<i>Echinocereus fasciculatus</i>	3	2	0	6	1	2.4	
<i>Ferocactus wislizeni</i>	0	1	2	1	1	1	
<i>Fouquieria splendens</i>	1	0	2	0	1	0.8	
<i>Mammillaria grahamii</i>	4	5	8	0	5	4.4	
<i>Opuntia engelmannii</i>	1	2	1	0	1	1	
<i>Opuntia versicolor</i>	0	1	1	0	0	0.4	
Subshrubs, Forbs, and Grasses							
<i>Abutilon incanum</i>	0	1	4	0	3	1.6	
<i>Ambrosia deltoidea</i>	23	15	19	24	4	17	
<i>Bouteloua aristidoides</i>	4	6	9	5	1	5	
<i>Encelia farinosa</i>	9	17	2	8	6	8.4	
<i>Erioneuron pulchellum</i>	55	42	30	24	10	32.2	
<i>Lesquerella gordonii</i>	0	11	4	8	0	4.6	
<i>Muhlenbergia porteri</i>	5	1	7	4	0	3.4	
<i>Pennisetum ciliare</i> (Buffelgrass)	12	2	5	6	0	5	x
<i>Psilostrophe cooperi</i>	2	4	6	4	0	3.2	
<i>Senna covesii</i>	1	6	4	9	0	4	
<i>Zinnia acerosa</i>	16	22	16	30	24	21.6	
					total	104.4	

B. Calculate per acre replanting densities for tree pots and container plants

Per acre replanting densities are shown for the example of *Ferocactus wislizenii* (Barrel Cactus – highlighted in teal in Table 2 next page)

STEP 2: COMPREHENSIVE PLANT SAMPLING – RELEVE PROCESS

Example: Calculate the replanting density for barrel cactus:

a. Convert the square foot (SF) area of the revele plot to acres:

- First, find the square foot (SF) area of the 20' radius revele

$$\text{Area of a circle} = \Pi \times r^2$$

$$3.14 \times 20^2 = 1256 \text{ SF}$$

- Second, convert SF to acres. Area of 1 acre = 43,560 SF

$$1256 \text{ SF} / 43,560 \text{ SF} = .029 \text{ acres}$$

Replanting density for *Ferocactus wislizeni* = 1 plants per revele / .029 acre = 35 plants/acre

Table 2: Calculating Replanting Densities for Tree Pots and Container Plants

	Average (per 20' radius releve, 0.029 acre)	Replanting Density per acre
Trees/shrubs		
<i>Acacia constricta</i>	1.6	55
<i>Parkinsonia microphylla</i>	1.2	42
<i>Prosopis velutina</i>	0.8	28
Cacti/succulents		
<i>Carnegiea gigantea</i>	0.6	21
<i>Echinocereus fasciculatus</i>	2.4	83
<i>Ferocactus wislizeni</i>	1	35
<i>Mammillaria grahamii</i>	4.4	152
<i>Fouquieria splendens</i>	0.8	28
<i>Opuntia engelmannii</i>	1	35
<i>Opuntia versicolor</i>	0.4	14

Notes:

Species highlighted in yellow or green have mitigation requirements satisfied under Step 1. Landscape consultant may chose to add additional 5 gal. plants in these species, depending on the specific situation, but this is not required.

Numbers for replanting densities are recommended guidelines, not mandates. Use of plants depends on specific planting environment

C. Determine Seed Mix

The main goal for re-vegetation is to re-establish the plant community present before disturbance. This can prove challenging as the plant community existing on the site prior to construction may represent a late seral (successional) plant community with long-lived perennials. Disturbance of the soils provides an optimal environment for establishment of ruderals or weedy annual plants. Seed mixes attempting to immediately re-establish perennial grasses and shrubs may have a difficult time establishing in the newly-disturbed soils. These later successional plants may have difficulty competing with annual weedy species and aggressive exotics including buffelgrass and fountain grass.

STEP 2: COMPREHENSIVE PLANT SAMPLING – RELEVE PROCESS

The Natural Resources Conservation Service (NCRS) of the United States Department of Agriculture recommends that seed mixes intended for restoration should try to establish an early to mid-seral community of native annual forbs and grasses that can effectively compete with invasive exotic species and can set the stage for re-establishment of the original native late seral (and more perennial) plant community over time. If the seedbank in the project soil has not been removed or covered over during project grading, the original plant community will regenerate over time. The emphasis in the seed mix should be on native annual forbs and grasses that will germinate quickly and provide cover. Some perennial grasses and tree and shrub species should also be included.

1. Determine relative percentages of plants not included in the container plantings.

The first step in selecting a seed mix is to take each native plant relative to the total number of plant species and determine its percentage relative to the total number of plant species. Do not include plant species represented in the container plantings.

Hypothetical Seed Mix – First Step

	Average (per 20' radius releve, 0.029 acre)	% of Seed Mix	Pure Live Seed per 20 Pounds per Acre	Availability
Trees/Shrubs				
<i>Larrea tridentata</i>	4	3.8	.76	Yes
Subshrubs, Forbs, and				
<i>Abutilon incanum</i>	1.6	1.5	.30	No
<i>Ambrosia deltoidea</i>	17	16.2	3.24	Yes
<i>Encelia farinosa</i>	8.4	8.0	1.6	Yes
<i>Lesquerella gordonii</i>	4.6	4.4	.88	Yes
<i>Psilostrophe cooperi</i>	3.2	3.0	.60	Yes
<i>Senna covesii</i>	4	3.8	.76	Yes
<i>Zinnia acerosa</i>	21.6	20.6	4.12	Yes
Grasses				
<i>Bouteloua aristidoides</i>	5	4.8	.96	Yes
<i>Erioneuron pulchellum</i>	32.2	30.7	6.14	Yes
<i>Muhlenbergia porteri</i>	3.4	3.2	.64	Yes
	104.4	100%	20	

Notes:

Trees and large shrubs are generally not included in the seed mix for roadway projects due to setback restrictions, clear zone issues, and site visibility triangles. In riparian areas where these don't apply, larger shrubs and trees are to be included.

Seed mixes are to be adjusted for seed availability.

2. Select seed mix using first step for general guidance. A seed mix should be developed by the consultant using the following criteria:

- Provide 20 to 25# PLS (pure live seed)/acre depending on project conditions
- Provide up to 50% of seed mix as native grasses depending on project conditions.
- Include species that germinate in both the warm and cool weather

STEP 2: COMPREHENSIVE PLANT SAMPLING – RELEVE PROCESS

Hypothetical Seed Mix – Second Step

	Pure Live Seed per 20 Pounds per Acre	Comment
Trees/Shrubs		
<i>Larrea tridentata</i>	1	
Subshrubs, Forbs, and		
<i>Abutilon incanum</i>	1.0	
<i>Ambrosia deltoidea</i>	0.5	
<i>Encelia farinosa</i>	2.0	
<i>Lesquerella gordonii</i>	0.5	
<i>Psilostrophe cooperi</i>	1.0	
<i>Senna covesii</i>	1.0	
<i>Zinnia acerosa</i>	1.0	
Grasses		
<i>Aristida purpurea</i>	3.0	Added because germinates well and will help re-stabilize slopes
<i>Bouteloua aristidoides</i>	2.0	
<i>Erioneuron pulchellum</i>	6.0	
<i>Muhlenbergia porteri</i>	1.0	
	20.0	

Notes:

Trees and large shrubs are generally not included in the seed mix for roadway projects due to setback restrictions, clear zone issues, and site visibility triangles. In riparian areas where these don't apply, larger shrubs and trees are to be included.

Seed mixes are to be adjusted for seed availability.

Proposed seed mixes shall be submitted to the Pima County landscape architect, along with all the data documenting the consultant's work. The Pima County landscape architect will assist and advise the consultant as to the final composition of the seed mix, based on the additional following considerations:

- Are there steep slopes that will be subject to erosion?
- Is the soil sandy and subject to greater erosion?
- Is there buffelgrass in the area? (If so, the percentage of native grasses to force quick cover should be increased)
- What time of year will the project be seeded? If this is known, what will germinate the quickest?
- Is the seed mix in a riparian mitigation area? If so, RFCD staff may provide additional seed mix recommendations.

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

Wherever Pima County Regulated Riparian Habitat (RRH) occurs on a road project, an additional step is required.

Pima County roadway projects regularly cross Regulated Riparian Habitat (RRH). The Riparian Classification Maps (RCM), which can be viewed on Pima County PimaMaps, show the location of RRH. When RRH occurs on a roadway project, mitigation for impacts is required whenever disturbance exceeds 1/3 acre. Mitigation areas serve as a transition between the constructed roadway and adjoining natural areas, ensuring that roadway projects remain consistent with Pima County's overall goal of conserving and protecting floodplains and riparian corridors.

This section provides a step by step guide to the procedure to be followed when RRH occurs on roadway projects. The steps are:

- A. Calculate RRH Disturbance/Locate mitigation areas/Determine type of mitigation.
 - Confirm accuracy of mapped areas
 - Calculate impacts. If impacts are greater than 1/3 of an acre, the remainder of Step 3 shall be followed.
 - Determine type of mitigation: onsite mitigation and/or in-lieu fee (ILF). Onsite riparian mitigation is encouraged by the RFCD to the maximum extent practicable. If the required mitigation exceeds the amount of space available within the project area, then ILF can be paid for the remaining acreage. See "D" for calculating ILF.
 - If less than 1/3 acre of disturbance, submit exhibit showing the project footprint and mapped riparian area overlaid on an aerial photograph. Calculate disturbance for each type of RRH present and submit to RFCD. No further action is required.
- B. Prepare Planting Plan and Riparian Habitat Summary sheets
- C. Submit planting plans and RRH Summary Sheets to PCDOT and RFCD staff for review and approval.
- D. Calculate in lieu fee (ILF)

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

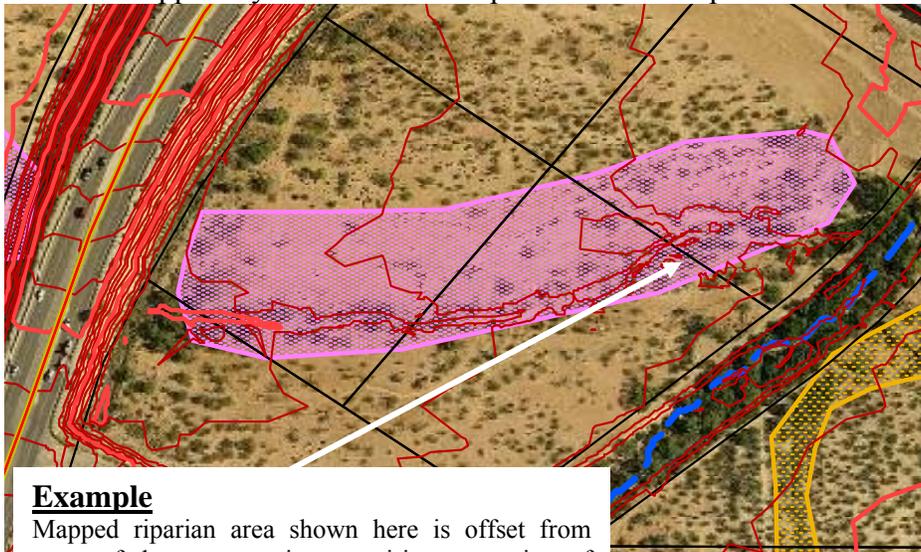
A. Calculate RRH Disturbance, locate mitigation areas, and determine type of mitigation.

1. Confirm the accuracy of the mapped RRH.

- **Turn on riparian layers within Pima County PimaMaps:**

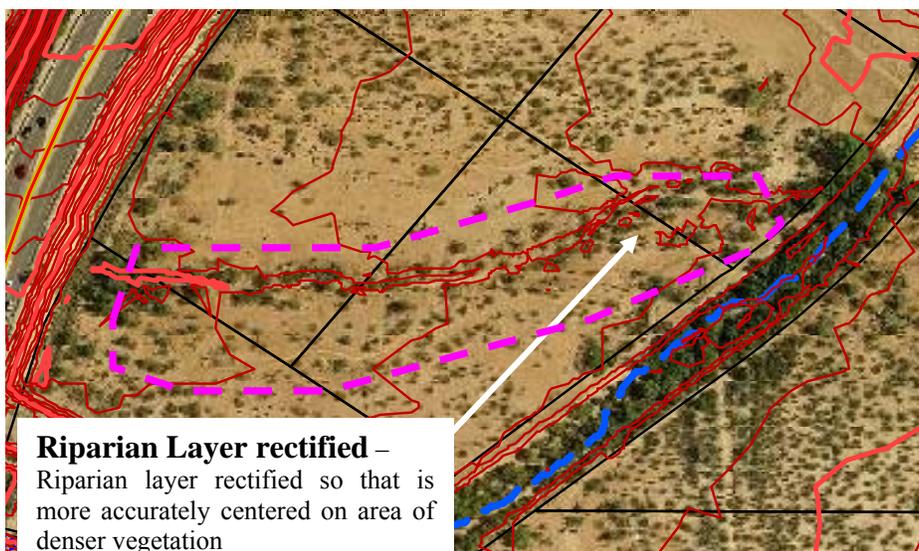
- First turn on “Riparian Habitat - Pima County Ordinance 2005-FC2, Effective 10/20/2005” layer to determine the location of regulated riparian habitat.
- Next turn on “IRA Underlying Classification” layer to determine the underlying class of habitat of Important Riparian Areas (IRA) (if applicable)

- **Confirm the accuracy of the mapped RRH.** Occasionally the mapped RRH layer is incorrectly rectified with the GIS parcel base and aerial photograph. Prior to calculating disturbance of RRH, the consultant shall meet with Pima County Regional Flood Control District (RFCD) staff, if necessary, to rectify the mapped layer with the aerial photo. See example below:



Example

Mapped riparian area shown here is offset from areas of dense vegetation, requiring correction of PimaMaps layer with aerial photo.



Riparian Layer rectified –

Riparian layer rectified so that is more accurately centered on area of denser vegetation

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

2. **Define RRH disturbance within project limits.** See table below:

Type of Disturbance	Definition	Examples
Un-plantable RRH	Permanently modified land that cannot support riparian habitat.	<ul style="list-style-type: none"> • Concrete bridge abutments • Drainage structures • Pavement • Utility Easements • Significantly altered topography that does not support riparian vegetation. • Altered drainage patterns that divert flows away from existing riparian corridors
Plantable RRH	Land that may be altered during the construction process, but where habitat can be restored to pre-existing conditions	<ul style="list-style-type: none"> • Temporary project staging area/materials storage • Temporary construction access
Exempt Disturbances	Disturbances that do not count toward the 1/3 acre threshold	<ul style="list-style-type: none"> * Temporary disturbance of a sandy bottom wash * WUS (Waters of the US) mitigated through the U.S. Army Corps of Engineers permitting process

- Subtract areas within the mapped RRH that were disturbed prior to the effective date of the Riparian Classification Maps (either August 1998 or October 2005). Pre-existing disturbance is determined through review of historic aerial photography, available through Pima County PimaMaps and may include existing pavement and structures where vegetation has been disturbed and remains disturbed. An example is provided on page 20. Please contact RFCD staff for the 1998 RCM. The 2005 RCM can be viewed on PimaMaps.

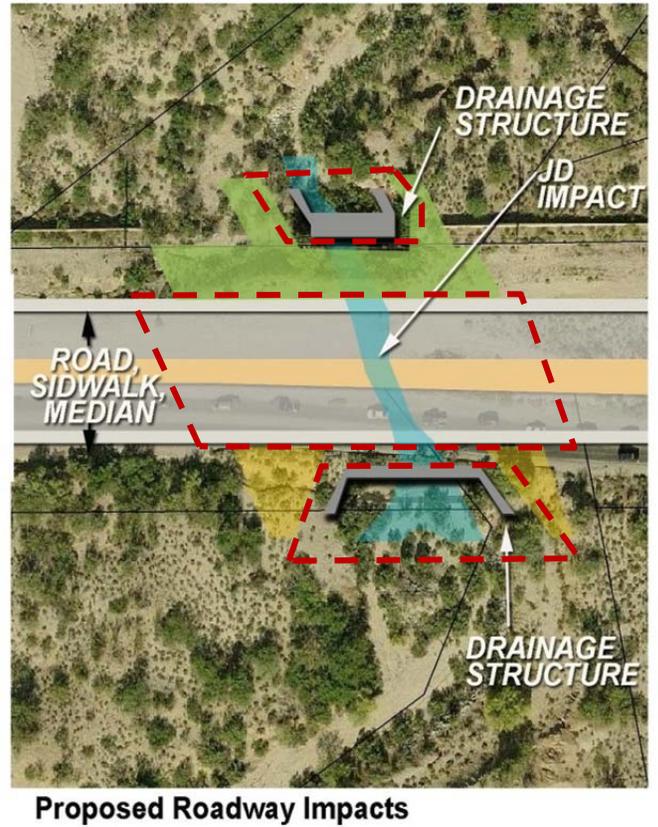
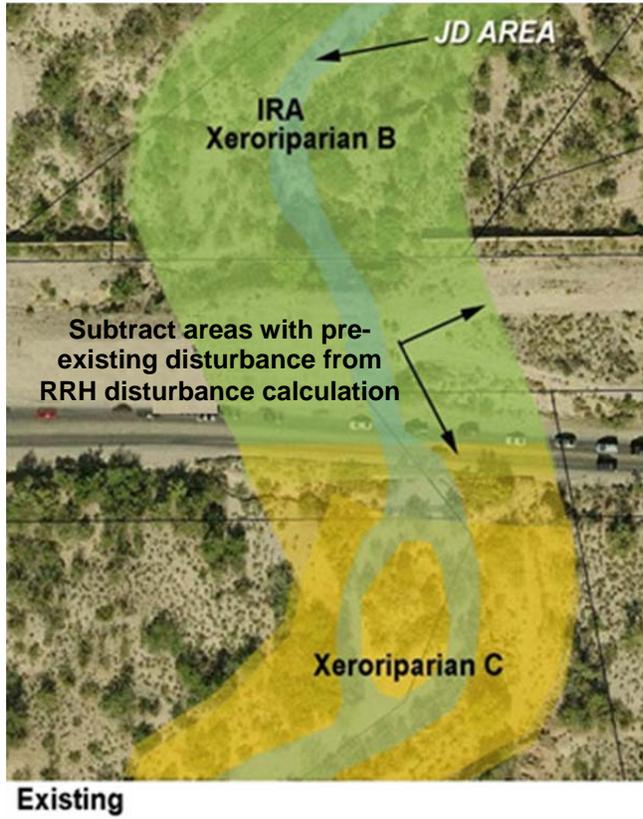
- Subtract Exempt disturbances.

Note:

If determination of the pre-existing disturbance is unclear, please contact RFCD staff to discuss and resolve prior to submitting the RRH Summary Sheets.

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

Example:



STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

3. **Determine mitigation requirement, based on RRH disturbance.** (See pages 25 and 27 for example.) Follow the table below to determine acreage and other requirements:

Classification	Preferred Mitigation Option – Provide mitigation area within project area	Other Requirements – All RRH Disturbance	Alternate Option
RRH – all classes except IRA & Class H Plantable RRH Un-plantable RRH	1:1 replacement; for each acre disturbed, an acre shall be replaced in kind	<ul style="list-style-type: none"> • Use releve data (Step 2) to determine plant species composition and seed mix in mitigation areas. • Choose method for determining plant replacement ratio: plant releve data (step 2, pages 10-16) or table below. • Minimum tree size is 15 gal or 24” tree pot • Minimum shrub size is 5 gal or 15” tree pot. • Mitigation trees determined in Step 1 may be used toward meeting the riparian habitat mitigation requirement. • Mitigation area shall be located within Plantable RRH. Mitigation areas may also be placed adjacent to existing riparian corridors, within areas that can support riparian habitat of a similar density and structure to the habitat that was disturbed. • If mitigation areas are proposed outside of the active floodplain, man-made features such as water harvesting basins shall be used to establish riparian habitat. • When no mitigation area is available adjacent to disturbed RRH within project area, other riparian corridors that are not mapped as RRH may be used for mitigation if they are able to support riparian vegetation (i.e. topography has not been modified) • Riparian mitigation areas shall be maintained using best management practices for invasive species according to PCDOT Special Provisions 201. <p>Monitoring agreement shall be followed (see page 26)</p>	In Lieu Fee (ILF) <ul style="list-style-type: none"> • See #5, page 23 and #7, page 23-24
IRA and Class H Plantable RRH	1:1 replacement; for each acre disturbed, an acre shall be replaced in kind		
IRA and Class H Un-plantable and Plantable RRH that will not be mitigated onsite	1:1.5 replacement; for each acre disturbed, 1.5 acres shall be replaced in kind		

Plant Replacement Ratio (quantity/acre)

Class	Trees/acre	Shrubs/acre
XA	75	90
XB	60	80
XC	45	70
XD	30	Like density
H	90	100

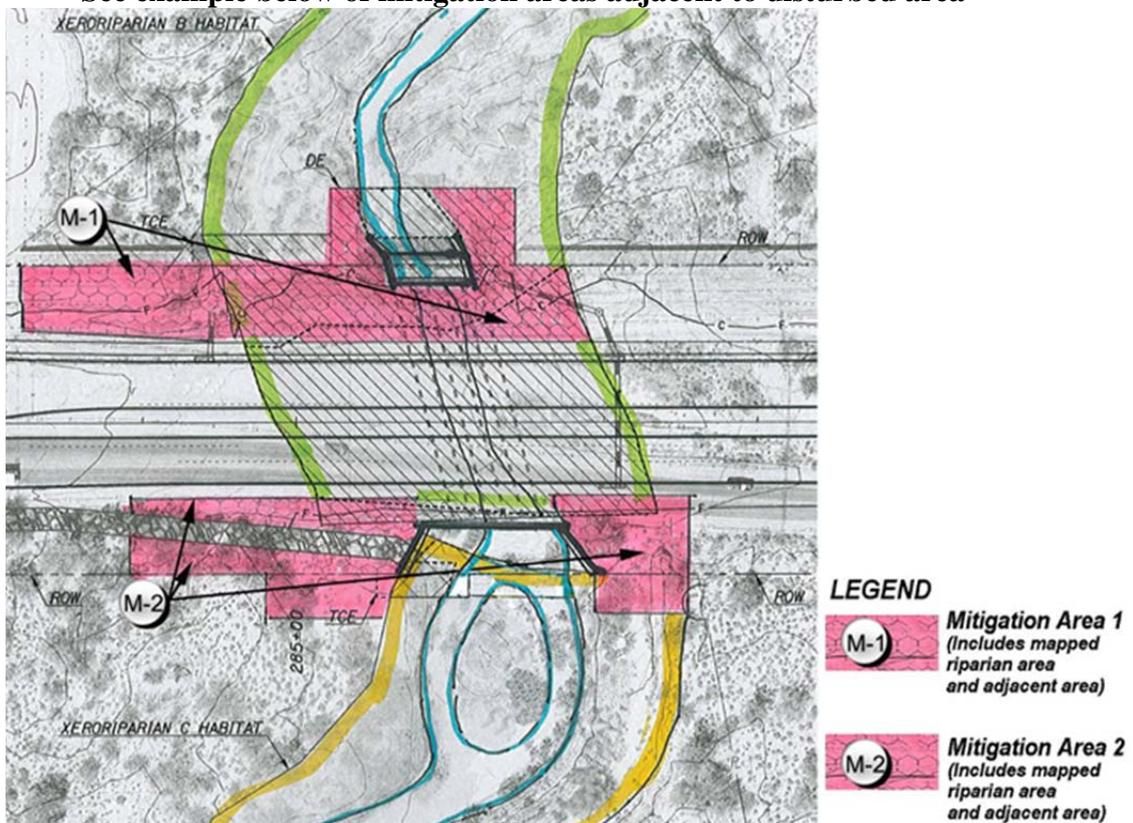
STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

4. **Locate areas for riparian mitigation.** Areas that can support riparian mitigation include:
- Low lying areas adjacent to existing regulated riparian habitat (RRH) or wash corridors
 - Partially disturbed RRH that can support additional plants
 - Un-mapped riparian/wash corridors
 - Banks and overbank areas of washes. Where braided or sheet flow occurs, vegetation can be supported in and near minor flow patterns, as long as flows will not be diverted from the established general drainage pattern.
 - Constructed water harvesting basins adjacent to existing RRH or wash corridors

Areas that are considered un-plantable:

- Where maintenance access is needed
- Areas limited by utility presence. See page 2.
- Directly upstream or downstream of culverts. Provide a 20' buffer around culvert inlets and outlets
- On a hill slope or other elevated topography that will not support riparian vegetation
- Active flow areas of washes

See example below of mitigation areas adjacent to disturbed area



Example of Locating Riparian Mitigation Area

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

5. Determine if payment of in-lieu fee (ILF) is necessary. If insufficient mitigation area is available within or adjoining to the project area, a partial ILF may be paid to RFCDD's mitigation bank for purchase of high value riparian habitat in Pima County. ILF cost estimates shall be prepared in accordance with the *Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County, Appendix F*, and #7, page 22.

6. Prepare summary sheet of riparian impacts (RRH Summary Sheet).

See checklists below for information to be included on the RRH Summary Cover Sheet and RRH Summary Sheets. Examples of these sheets are on page 24 and 26.

Review all work with PCDOT staff landscape architect and RFCDD staff before moving on to planting plan preparation. See page 28-29 for planting plan preparation.

RRH Summary Cover Sheet Checklist (Example on page 25)

Plans shall include the following:

- Location map
- Project number and name
- Project overview, justification for disturbance of RRH
- RRH Monitoring Agreement and General Notes (see page 26 for Monitoring Agreement template)
- Mitigation calculations summary table
- Summary table of plant releve data measured within the RRH (page 13, Table 1)

RRH Summary Sheet Checklist (Example on page 25)

Plans shall include the following:

- Scale and north arrow
- Legend
- Most recent aerial photograph; use as a base for the summary sheets
- RRH limits
- Limits of disturbance. Use hatching to distinguish between types of disturbance listed in the summary table
- Proposed mitigation areas
- Mitigation area reference table. Label and number each mitigation area and reference the corresponding sheet within the landscape plan
-

7. Calculate in-lieu fee (ILF) when applicable. Appendix F of the *Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County, November 2011* shall be used as a guide in calculating ILF, for mitigation areas that cannot be accommodated within the project area:

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

- Refer to the criteria for “Commercial and Subdivision Development” within Appendix F
- Consult with PCDOT for the most current pricing on required items
- Assume that maintenance costs are 45% of total container plant material cost, regardless of habitat type.

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

RRH MONITORING AGREEMENT AND GENERAL NOTES

To be added to all PCDOT plans that include areas of RRH mitigation

Pima County DOT agrees to preserve and protect mitigation areas within Transportations' roadway project area as follows: Pima County DOT agrees to actively maintain the mitigated area until a minimum of 80% of the plants originally planted as 15 gallon or smaller in size are living and actively growing (without significant dieback or loss) after 1 year without supplemental irrigation. Plants larger than 15 gallon in size will be irrigated in accordance with USFWS requirements. Maintenance activities shall include, but not be limited to, the regular operation of the irrigation system, the replacement of dead trees and shrubs, and the removal of noxious and/or invasive plant species.

Additional General Notes:

1. Mitigation area(s) to be left in a natural state. No disturbance shall occur within the mitigation area(s). Such disturbance includes but is not limited to secondary impacts such as fencing, intensive landscaping, etc.

2. Mitigation area shall be seeded with a minimum of 12 species determined from the roadway project ESR Revele Report. Plant species shall be selected from releves completed within riparian habitat areas. Seeding methods include; hydroseeding, drill seeding with crimped straw mulch or broadcast seeding and raking into seedbed with straw or other approved mulch. These species are listed in the Riparian Seed Mix on Sheet xxxxx of the Landscape Plan. Of the 12 species, 4 shall be shrubs, 4 shall be annuals/perennials/vines, and 4 shall be grasses. If plant species listed in the Riparian Seed Mix are unavailable, replacements species from the Revele Report (riparian releves) and/or approved (Class H or Xeroriparian (*select based on habitat type present*)) plant list may be selected based upon availability. Any changes to the seed mix shall be noted on the first monitoring plan submittal.

3. Once plants originally planted as 15 gallon or smaller in size have established (approximately 1 to 3 years after installation), supplemental irrigation will be decreased in accordance with Appendix C of the Guidelines.

4. RHMP implementation shall be completed by the first growing season following completion of construction, which is projected to be (select one season) March-May, 20XX/July-September, 20XX/September-November, 20XX.

5. A monitoring plan, in accordance with the Guidelines, will be submitted annually until a minimum of 80% of the plants originally planted as 15 gallon or smaller in size are living and actively growing (without significant dieback or loss) after 1 year without supplemental irrigation. Any changes from the approved RHMP shall be noted on the monitoring plan submittal." Submittals shall be labeled "Annual Monitoring Report for PCDOT Project #XXXXXX" and sent to the following address:

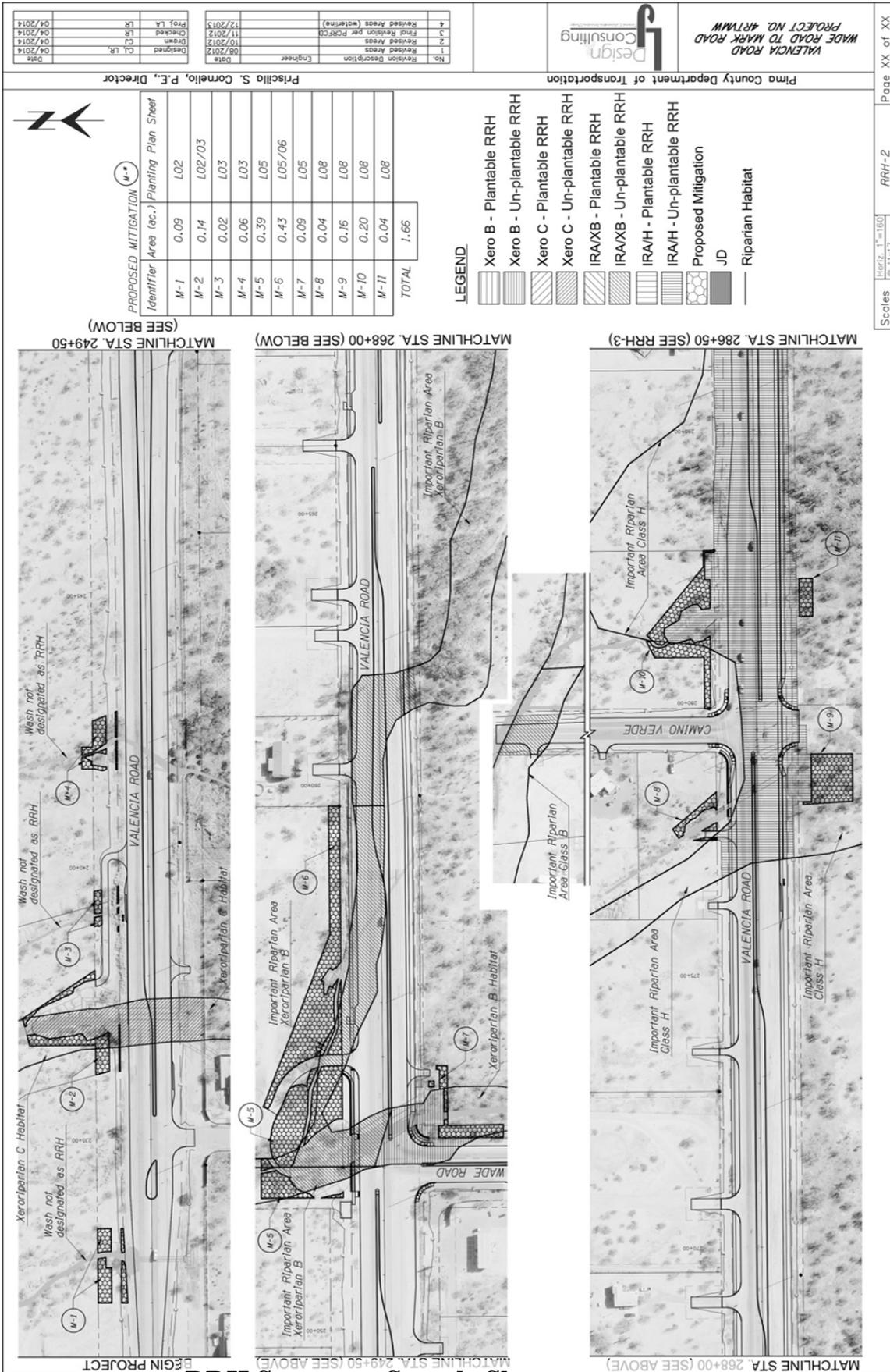
Pima County Regional Flood Control District
ATTN: Water Resources Division Staff
97 E. Congress Street, 2nd floor
Tucson, AZ 85701

(Select one of the following comments below):

The assigned PCDOT monitor for this project is _____ OR
The assigned PCDOT division/section that will monitor this project is _____

6. Riparian habitat to be preserved shall be fenced for protection during construction using minimum 4-foot high orange mesh barricade fencing. Protective fencing must remain in place throughout construction.

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION



RRH Summary Sample Sheet

VALENCIA ROAD WASH PROJECT NO. 4RT1M Design Consulting		Priscilla S. Cornelio, P.E., Director	
No.	Revision Description	Date	Engineer
1	Revised Areas	08/20/2012	
2	Revised Areas per PERFC	10/22/2012	
3	Revised Areas	11/2/2012	
4	Revised Areas (watering)	12/2/2013	
Pinned Checked Designed C.I. LR C.I. LR LR LR		Date 04/20/2014 04/20/2014 04/20/2014 04/20/2014	Date 04/20/2014 04/20/2014 04/20/2014 04/20/2014

PROPOSED MITIGATION		
Identifier	Area (ac.)	Planting Plan Sheet
M-1	0.09	L02
M-2	0.14	L02/03
M-3	0.02	L03
M-4	0.06	L03
M-5	0.39	L05
M-6	0.43	L05/06
M-7	0.09	L05
M-8	0.04	L08
M-9	0.16	L08
M-10	0.20	L08
M-11	0.04	L08
TOTAL	1.66	

- LEGEND**
- Xero B - Plantable RRH
 - Xero B - Un-plantable RRH
 - Xero C - Plantable RRH
 - Xero C - Un-plantable RRH
 - IRA/XB - Plantable RRH
 - IRA/XB - Un-plantable RRH
 - IRA/H - Plantable RRH
 - IRA/H - Un-plantable RRH
 - Proposed Mitigation
 - JD
 - Riparian Habitat

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION

B. Prepare Planting Plan

The plan shall delineate mitigation areas as shown in the example on page 28. The mitigation areas shall be planted using plant densities and species composition provided in the RRH Summary sheets.

- Areas highlighted in yellow show RRH mitigation areas. Also show JD areas, shaded in gray in example on page 28.
- Label mitigation areas with identifier used in the RRH Summary Sheets (example, “M-1”, “M-2”, “M-3”, etc.)
- Identify riparian habitat seed mix on the plan or in the Special Provisions, which is most appropriate for the project.
- Ensure plant species and quantities used within the mitigation areas match plant species and quantities found in the RRH Summary sheets.

Other considerations in planting mitigation areas include:

- Placing larger trees in/near wash crossings per U.S. Fish and Wildlife Service requirements
- Maximizing planting areas on upstream side of road where ponding may occur
- Reducing planting densities on downstream side of road where water flow may be reduced

C. Submit the following items for review by RFCD and PCDOT staff:

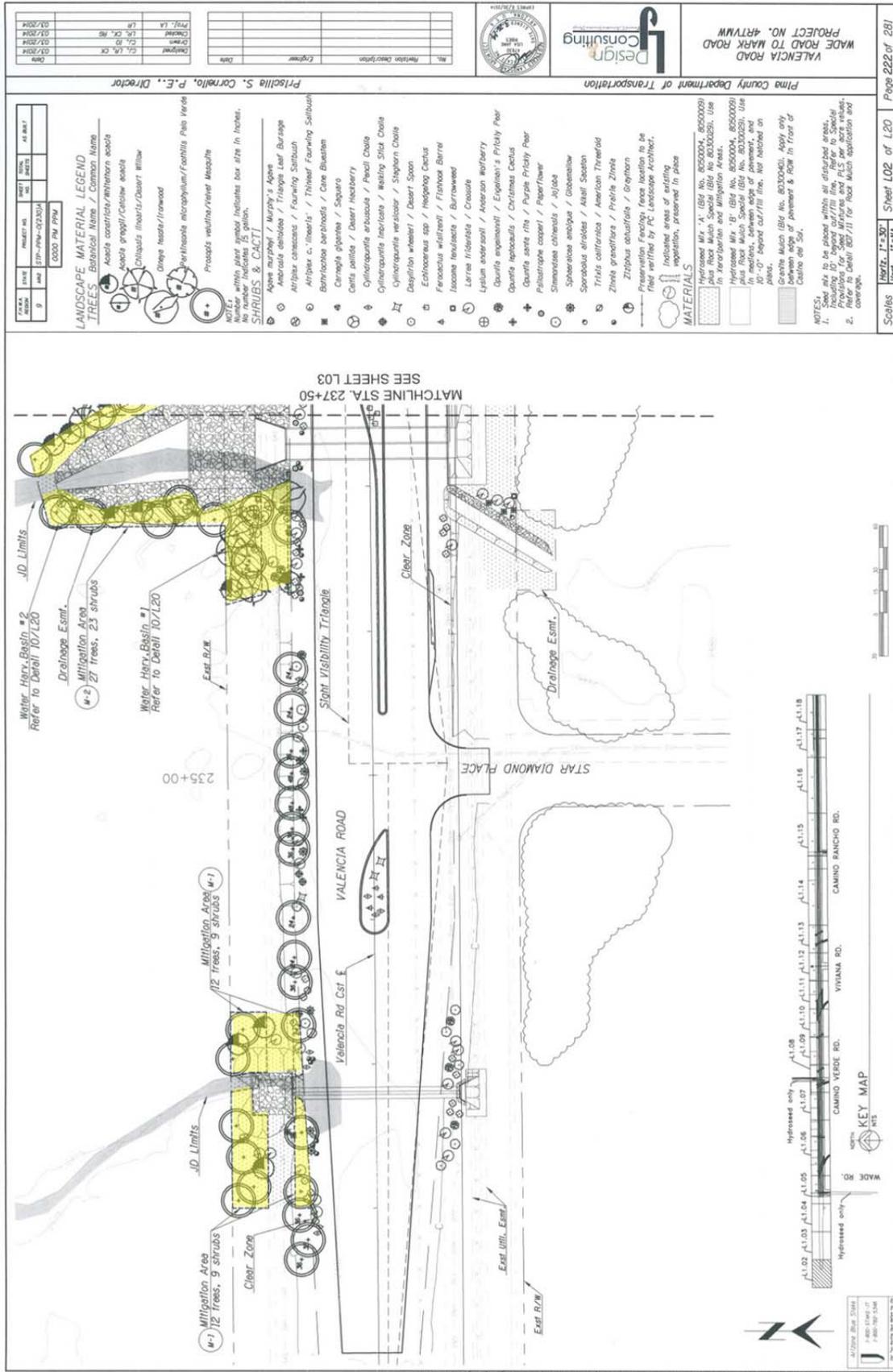
For internal review by PCDOT and RFCD staff only:

- RRH Summary Sheets (requirements found on page 23)
- ILF calculations when applicable. See #7, page 23-24.

For inclusion in roadway construction document set

- Planting Sheets:
RRH Mitigation Areas will be noted on planting plans. Include correct plant quantities, species composition, and seed mix. See Planting Sheet example on page 29.

STEP 3: REGULATED RIPARIAN HABITAT MITIGATION



RRH Sample Planting Plan Sheet