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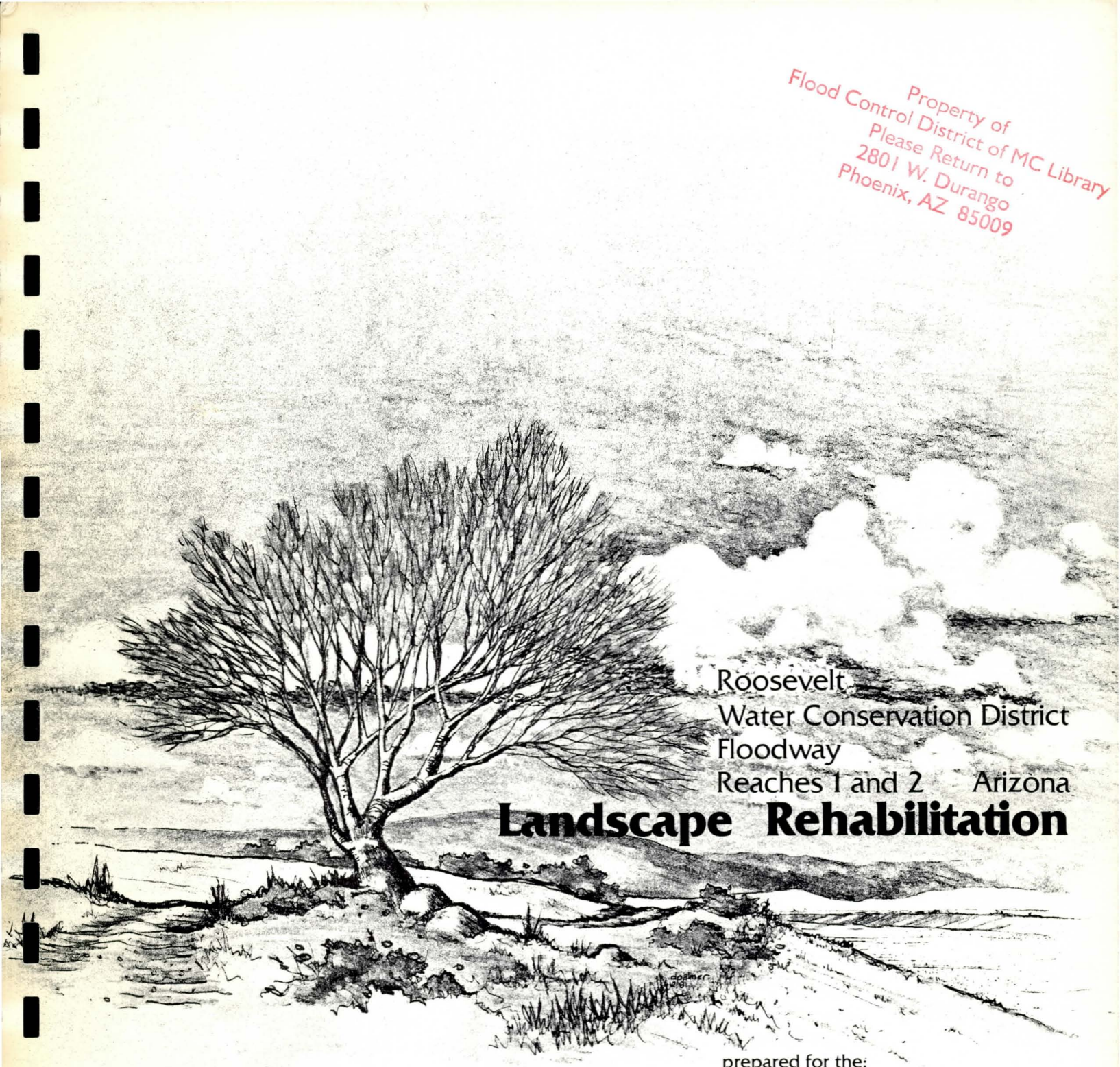

Roosevelt
Water Conservation District
Floodway
Reaches 1 and 2 Arizona

Landscape Rehabilitation

prepared for the:

United States Department of Agriculture
Soil Conservation Service
Phoenix, Arizona

prepared by:

Wirth Associates, Inc.
Phoenix, Arizona

ROOSEVELT WATER CONSERVATION DISTRICT
FLOODWAY
REACHES 1 AND 2
ARIZONA

LANDSCAPE REHABILITATION

Prepared for the:

United States Department of Agriculture
Soil Conservation Service
Phoenix, Arizona

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Phoenix, Arizona

December 1981

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INTRODUCTION

Project Description

The Roosevelt Water Conservation District Floodway (RWCD) Reach 1 and 2 crosses the Gila Indian Reservation between the Gila River, at Gila Butte, north and east to the Pinal County line (Figure 1). Reach 1 and 2 is a 330-foot-wide right-of-way, approximately nine miles long, consisting of trapezoidal earth, concrete and cobble-lined channel. The drainage canal passes through the alluvial fans and desert bajada between the Gila River and the Santan Mountains.

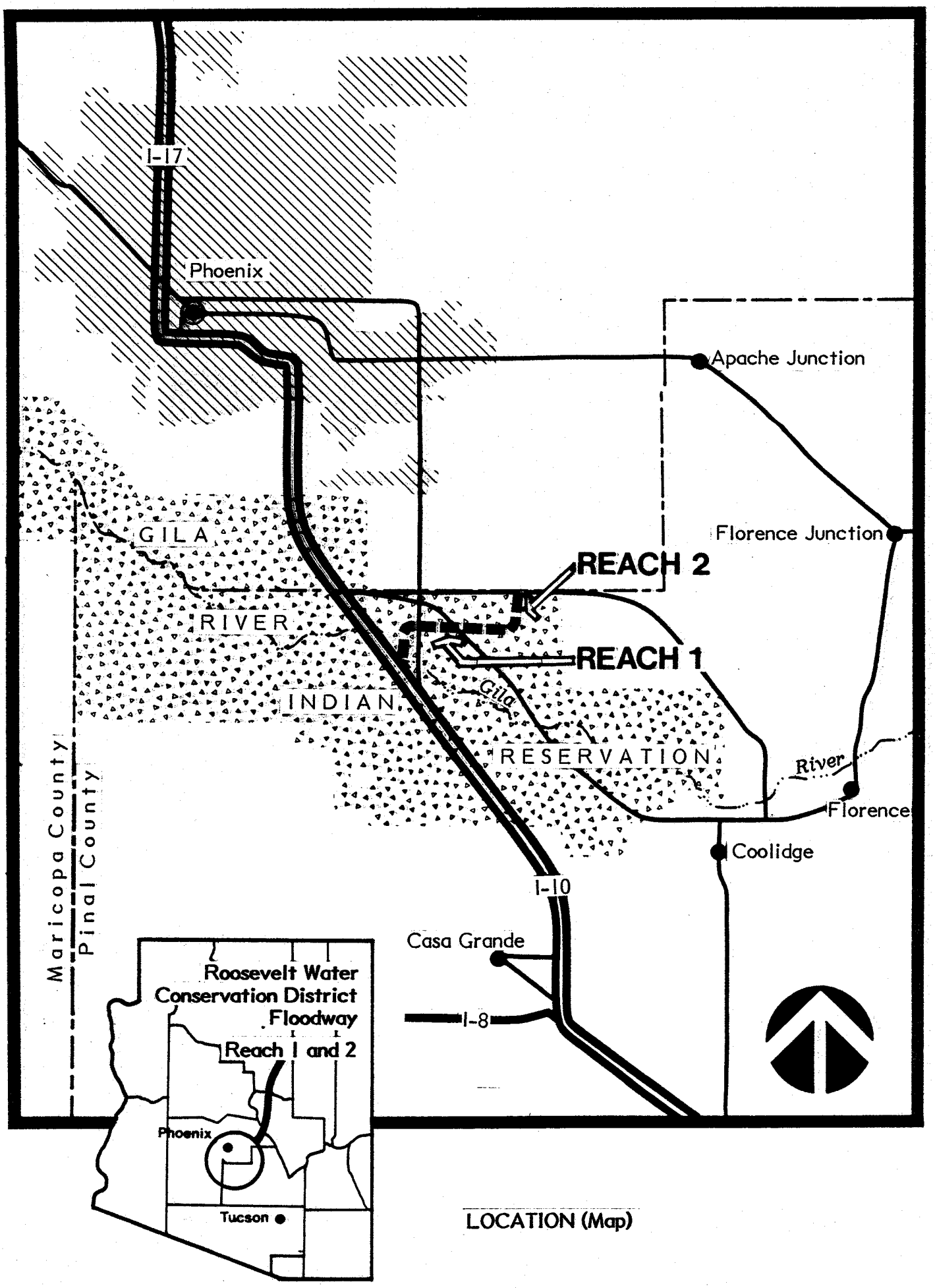
Existing facilities (Reach 1) and the planned facility (Reach 2) are constructed of earthen channel protected where necessary by ungrouted cobble rip-rap (change in channel alignment and at bridge abutments and footings), and concrete lining where water velocities are high. The channel is paralleled on both sides by a maintenance road (except where restricted by narrow right-of-way) elevated on dikes above the existing natural ground. Collector ditches are graded adjacent to the roadway dikes and collected in drop-inlet structures, and then drained under the roadway into the channel. Grouted spillway aprons are provided at the channel exit into the Gila River floodway and the drop inlet outlet pipes on the sides of the channel.

Access to the channel bottom is provided at varying locations along the channel including the roadway and railway bridges and the roadway dip sections. The channel will be fenced to prevent access by off-road vehicles. The spoil material from the channel will be disposed of on site whenever possible to recreate natural appearing earthforms allowing the channel to blend into the surrounding landscape. Riparian and desert vegetation were left undisturbed wherever practical within the limits of construction and spoil disposal.

The purpose of the flood control project is to reduce floodwater damage, particularly the erosion of valuable lands used for agriculture, rangeland, urban development areas and cultural/archaeological features. The project will provide control for the Williams-Chandler watersheds and provide incidental support for the Buckhorn Mesa, Apache Junction-Gilbert and to some extent the upper and lower Queen Creek watersheds.

Study Method

Wirth Associates was retained by the Soil Conservation Service (SCS) to provide a visual analysis of the RWCD Project and suggest methods of landscape rehabilitation of Reach 1 and 2 using landscape architectural solutions. The purpose of landscape rehabilitation is to restore the landscape to a healthy and sound condition or useful capacity and is to be accomplished mainly through the use of vegetation and earthform treatments to include



LOCATION (Map)

FIGURE 1

recreation recommendations where appropriate. Various potential alternatives resulted from the opportunities and constraints presented by rehabilitating the flood control channel.

A combination of field study and secondary source review was used to collect information for the visual analysis, and landscape rehabilitation alternatives and techniques. Public contacts were limited to those necessary to gather routine data including a direct contact with a representative of the Gila and Maricopa Indian tribes. Reports were also provided by SCS concerning other agency input and desires. Further contacts are anticipated as the project progresses into the design phase.

Study Team

The visual analysis, design alternatives and working drawings (to be completed) were accomplished by a team of Wirth Associates' landscape architects with technical support from Wirth Associates' graphics and report production staff. The following presents the study team's responsibilities:

Technical Staff

Principal-in-Charge - Garlyn Bergdale - Registered Landscape Architect
Project Manager - Allen Gross - Registered Landscape Architect
Project Landscape Architect - Ron Landon - Registered Landscape Architect
Project Landscape Architect - Eugene Trobia
Project Landscape Architect - Allison Promin-Buckton
Project Landscape Architect - Pat Morse

Support Staff

Graphics Supervisor - Joyce Gubicya
Sketches - Deborah Palmer
Graphics Staff - Richard Mattson, Ken Ekland, Carol Baker
Report Production Supervisor - Shirley Wiley
Clerical Staff - Kristie James, Cheryl Zrna, Lana Fahrenwald

VISUAL ANALYSIS

Method

The visual analysis was based on the SCS Landscape Architecture System (Technical Release No. 65, October 1978) and presents landscape architecture priorities or levels of treatment for the immediate environs of the RWCD Floodway project. The immediate environs of the project were defined by SCS as a corridor (which would generally coincide with the floodway construction limits) or a right-of-way approximately 330 feet wide. The visual analysis resulted in the identification of potential problems and/or opportunities associated with changes in visual resource quality, landscape use and visibility as a result of construction and maintenance of the project floodway.

The procedure used in establishing landscape architecture priorities involved the identification, rating and mapping of visual resource quality, landscape use and visibility within a one-half-mile-wide corridor. Visual resource quality is a rating of the uniqueness or desirability of landscape elements within the scope of the project environs. Elements considered in determining visual resource quality include landform, vegetation, water, structures (man-made development) and combinations of these singular elements (Figure 2).

Landscape use is a measure of how the use of the landscape affects people's perception and evaluation of each use. Use of the landscape can be either direct (benefits by moving through or being on) or indirect (benefits without actually occupying). Direct uses may include paths and trails, recreation areas or neighborhood play areas, while indirect uses may include visual screens between incompatible land uses, open space or vegetation which provides erosion control. Aspects considered in rating landscape use included intensity of use, availability of that particular use within the project area and the degree to which the use is a valuable environmental control (Figure 3).

Visibility evaluation is an estimate of the number of viewers, their probable expectations and their relative ability to see from their location (viewshed from observation points). Factors investigated in the visibility evaluation included the number, frequency and duration of the views, the expectations of viewers based upon landscape use, and location and orientation of the viewer's position (Figure 4).

The aforementioned landscape elements, visual resource quality, landscape use and visibility, were evaluated and numerical ratings were assigned based on their relative importance within the project area. For example, visual resource quality (VRQ) was broken into three categories: VRQ^3 - distinctive quality, VRQ^2 - average quality and VRQ^1 - minimal quality. Maps of each landscape element were overlayed to identify and assign landscape architecture priorities. Figure 5 illustrates the various combinations or ratings possible. The combined rating is a screening system that identifies the need for further professional landscape architecture input.

FIGURE 2
VISUAL RESOURCE QUALITY

Visual Resource Element	Rating		
	Distinctive VRQ[3]	Average VRQ[2]	Minimal VRQ[1]
Landform	• Visually dominant feature • Topographic patterns provide diversity to homogeneous landscape	• Highly visible feature, not dominant • Expected feature in landscape	• Homogeneous topography • Lacks diverse features
Vegetation	• Vegetative patterns add diversity to homogeneous landscape • Unique/rare plant specimens or communities	• Vegetative patterns add limited diversity to landscape • Expected feature in overall landscape	• Homogeneous vegetative patterns, lacks adverse features
Water	• Presence of water resources in desert landscape adds to overall visual quality	• Ephemeral water resources in desert landscape	• Lacks water resources
Structures (Man-made Development)	• Unique visual identity of structures • Developments showing high concern for appearance	• Typical structure/pattern • Developments showing average concern for appearance	• Visual structure identity "blight" • Lacks concern for appearance
Combinations	• Unique combinations of any visual elements • Proposed/designated scenic areas or locally scenic areas	• Typical/expected combinations of visual elements	• Combinations of visual elements are incongruous, visual intrusions

FIGURE 2

FIGURE 3
LANDSCAPE USE

Type of Use	Rating: Most Important LU3	Rating: Important LU2	Rating: Minimal Importance LU1
Direct	• Unique/locally-important use • Intensive use (volume, frequency)	• Ordinary availability • Normal use	• Abundant availability, one of many • Infrequent use
Indirect	• Highly valuable environmental controls (size, shape, location) • Provides visual/privacy screens between uses	• Valuable environmental controls	• Limited environmental controls
Combinations	• Unique/one-of-a-kind use • Locally-important use • High cultural, scientific or educational value	• Ordinary cultural, scientific or educational value • Typical use	• Limited/lacks cultural, educational or scientific value • One of many

FIGURE 3

FIGURE 4
VISIBILITY

Viewer Factor	Rating		
	High Visibility V^3	Average Visibility V^2	Low Visibility V^1
Number, Frequency and Duration	• Large number of viewers • Very frequent (daily) • Extended viewing time (pedestrian, hiking)	• Frequent (occasionally) • Intermediate viewing time (normal traffic)	• Few viewers • Infrequent viewing (rarely) • Short viewing time
Expected User	• Resident or tourist	• General public	• General public
Location and Viewers Position	• Elevated in landscape 20 feet • View from home, school, church, recreation area, major highways and scenic areas • View to foreground area - 0-1/4 to 1/2 mile	• Elevated 20 feet • View from general community areas, minor highways and roads • View to middleground area - 0-1/2 to 3-5 miles	• Ground level • View from croplands, industrial areas or open desert • View to background area - 3-5 to 15 miles

FIGURE 5
LANDSCAPE ARCHITECTURE PRIORITY MATRIX

	V^3			V^2			V^1		
VRQ^3	H^9	H^8	M^7	H^8	M^7	M^6	M^7	M^6	M^5
VRQ^2	H^8	M^7	M^6	M^7	M^6	M^5	M^6	M^5	L^4
VRQ^1	M^7	M^6	M^5	M^6	M^5	L^4	M^5	L^4	L^3
	LU^3	LU^2	LU^1	LU^3	LU^2	LU^1	LU^3	LU^2	LU^1

VRQ - Visual Resource Quality
LU - Landscape Use
V - Visibility

H - High
M - Medium
L - Low

Generally, high priority areas (8-9 points) require professional landscape architectural planning and design. Medium priority areas (5-7 points) may need professional landscape architectural input for planning and/or design. Special planning attention will be given to medium priority areas that include a VRQ3. Low priority areas (3-4 points) generally do not need professional landscape architectural input.

The following discussion describes the project area in terms of landscape character (visual resource quality), landscape use and visibility within a local frame of reference.

Landscape Description

General Character

Landscape elements within the RWCD Floodway project area are limited in their diversity. The area is dominated by typical Lower Sonoran Desert topography and vegetation. Gila Butte and the foothills of the Santan Mountains provide topographic relief to the otherwise extended, horizontal landscape. Natural vegetation is sparse and, except for patches of riparian vegetation along irrigation canals, desert washes and the Gila River channel, consists of widely-spaced woody and succulent plants that are well adapted to the desert environment. Water resources are ephemeral and limited to the Gila River, numerous desert washes and irrigation canals. Their relative scarcity increases the importance of water resources.

Evidence of man's activities within the project area is significant due to the expansive views associated with the project. Agricultural land use is the driving force behind the developments within the project area. The area is cross-cut with existing irrigation canals and minor roads which provide access to the agricultural lands and associated residences. Also, State Highways 93 and 87 bisect the area.

Natural Landscape Character

Landform

The RWCD study area is typical of the Basin and Range Province, which consists of broad, alluvial valleys bordered by mountain ranges rising up to 2,000 feet above the valley floor. The Santan Mountains, east of the floodway, rise approximately 1,800 feet from the valley floor reaching over 3,000 feet in elevation. Gila Butte is adjacent to the floodway to the west and reaches an elevation of nearly 1,700 feet. Slopes within the project area are generally less than five percent except for those areas bordering the Santan Mountains and Gila Butte. The area is cut by numerous dry washes or arroyos and the Gila River (within the study area) is bordered by steep-cut stream banks.

Vegetation

The vegetation is typical of the Lower Sonoran Desert landscape. Natural vegetation consists of creosotebush communities with scattered cholla and prickly pear cactus. The desert is cut by numerous arroyos lined with paloverde, ironwood, mesquite and saguaro. The Roosevelt Levee which crosses just south of the Pinal/Maricopa County line (Reach 2) is also lined with riparian vegetation including cottonwood, salt cedar, seep willow, etc.

Toward the outlet end of the floodway, the vegetation changes to desert saltbrush communities with scattered hedgehog and saguaro in the higher areas and saltbrush, mesquite and wolfberry bushes in the lower areas. At the outlet, the Gila River is lined with desert riparian vegetation consisting principally of mesquite, salt cedar, desertbroom, seepwillow, quailbush and grasses. Finally, natural vegetation (ironwood, salt cedar) occurs along the majority of canals and levees found within the study area.

Water

Water features within the project area are seasonal in nature and, thus, significant elements in a desert landscape. Precipitation is minimal and averages approximately 10 inches per year. A bi-modal rainfall pattern is evident for this particular climatic regime. Early spring rainfall is typified by cyclonic storms following a northwest-southeast direction of large-scale regional storms. The remainder of precipitation comes in the form of local thunderstorms during the summer months as influenced by tropical air masses.

The Gila River is the most significant water resource within the project area. Irrigation canals and some levees within the study area have water resources that are locally important. Numerous desert washes and arroyos are found on the alluvial fans associated with the Santan Mountains. Finally, other minor washes are found throughout the area.

Man-Made Landscape Character

Visible evidence of man's activities within the viewshed of the floodway is significant due to the expansive views available. Views of the project area would commonly result from area residents and travelers along State Highways 93 and 87. The surrounding landscape is traversed by two major highways, several irrigation canals and numerous minor roads, in addition to the project floodway. Also, agricultural fields and associated residences are found within viewing distance of the project.

Other man-made landscape elements within the project area include the recreation opportunities near Gila Butte, an area of cultural resources (Indian

ruins), an irrigation pumping station (informal swimming hole) and the Southern Pacific Railroad.

Summary of Visual Resource Quality

Two separate areas of high visual resource quality (VRQ^3) were identified within the project area (Figure 6). Gila Butte (Figure 7A) and the riparian vegetation near the Gila River were considered distinctive elements within a desert landscape. The topography and vegetation associated with the features set them apart from the surrounding area. Second, an inactive irrigation canal near the end of Reach 2 has various types of mature riparian vegetation and was considered a distinctive feature of the landscape (see Figure 7B).

Areas identified as having average visual quality (VRQ^2) include agricultural land, riparian vegetation along canals, residences, an archaeological site (ruins) and numerous washes on the alluvial fans associated with the Santan Mountains (see Figure 7C).

The remainder and also the majority of the study area was considered VRQ^1. A typical VRQ^1 area is displayed in Figure 7D.

Landscape Use and Benefits

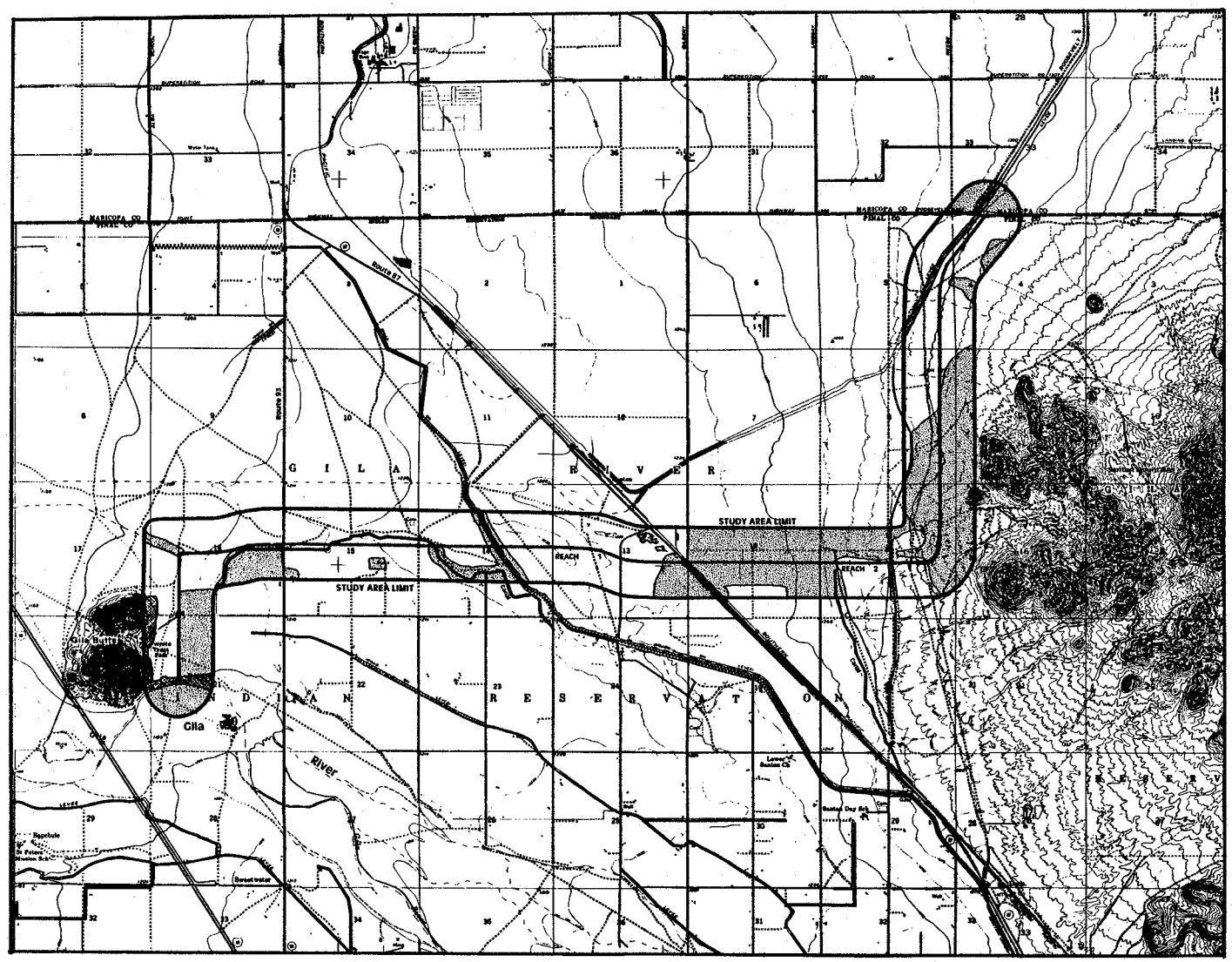
General Use Patterns

A majority of the project area is under the jurisdiction of the Gila River Indian Reservation, with only a small portion of the study corridor on private land. Use of the land is generally restricted to reservation dwellers except for the major travel routes, Highways 93 and 87. Within the project area, single-family dwellings associated with agricultural production and a pedestrian walkway, that provides access to Highway 87, are the major use types.

Recreation opportunities are available near Gila Butte and include ramadas and picnic areas, hiking paths and trails, two fire pits and an informal shooting range. Most of these recreation activities can be expected to take place during the cooler winter months. Along Reach 2, an irrigation pumping station at the eastern edge of the agricultural lands provides an ad-hoc swimming hole for residents of the project area.

User Types

The two user groups are present in the RWCD Floodway project area include year-round residents and transient visitors.



VISUAL RESOURCE QUALITY

- DISTINCTIVE VRQ³
- AVERAGE VRQ²
- MINIMAL VRQ¹

0 ¼ ½ 1 2 3mi.

FIGURE 6

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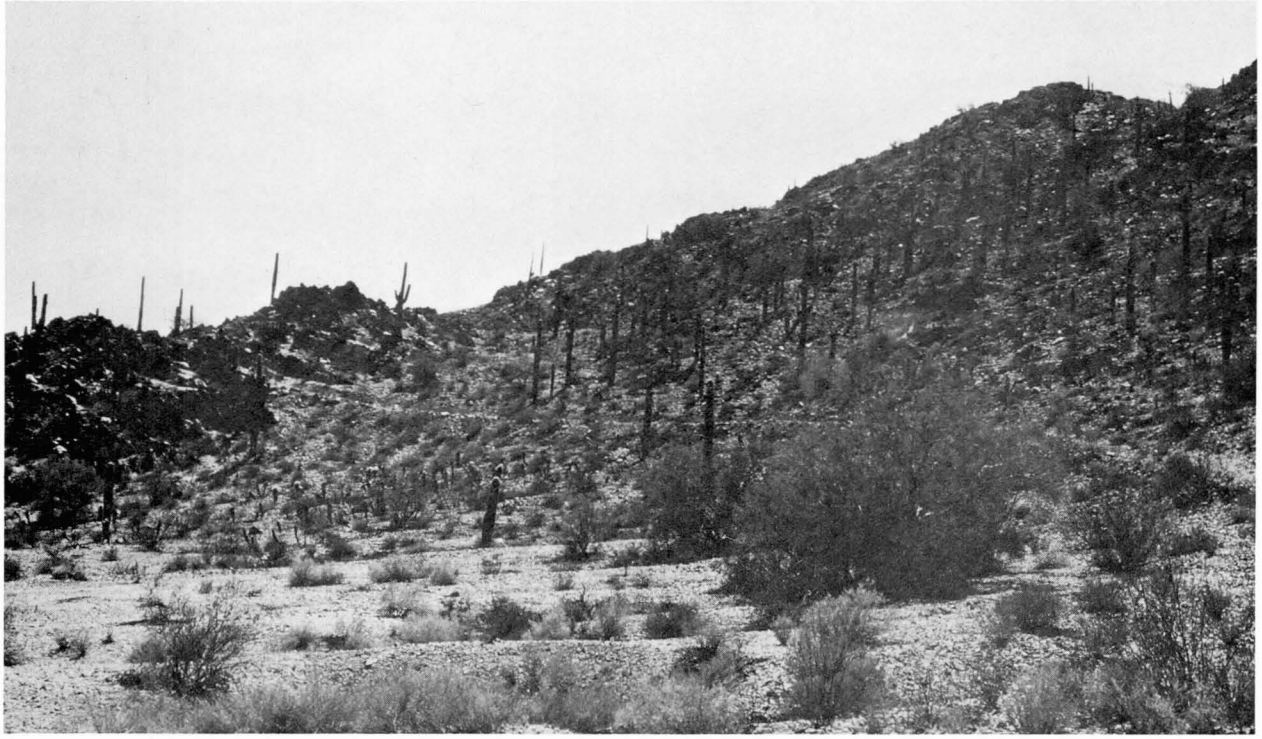
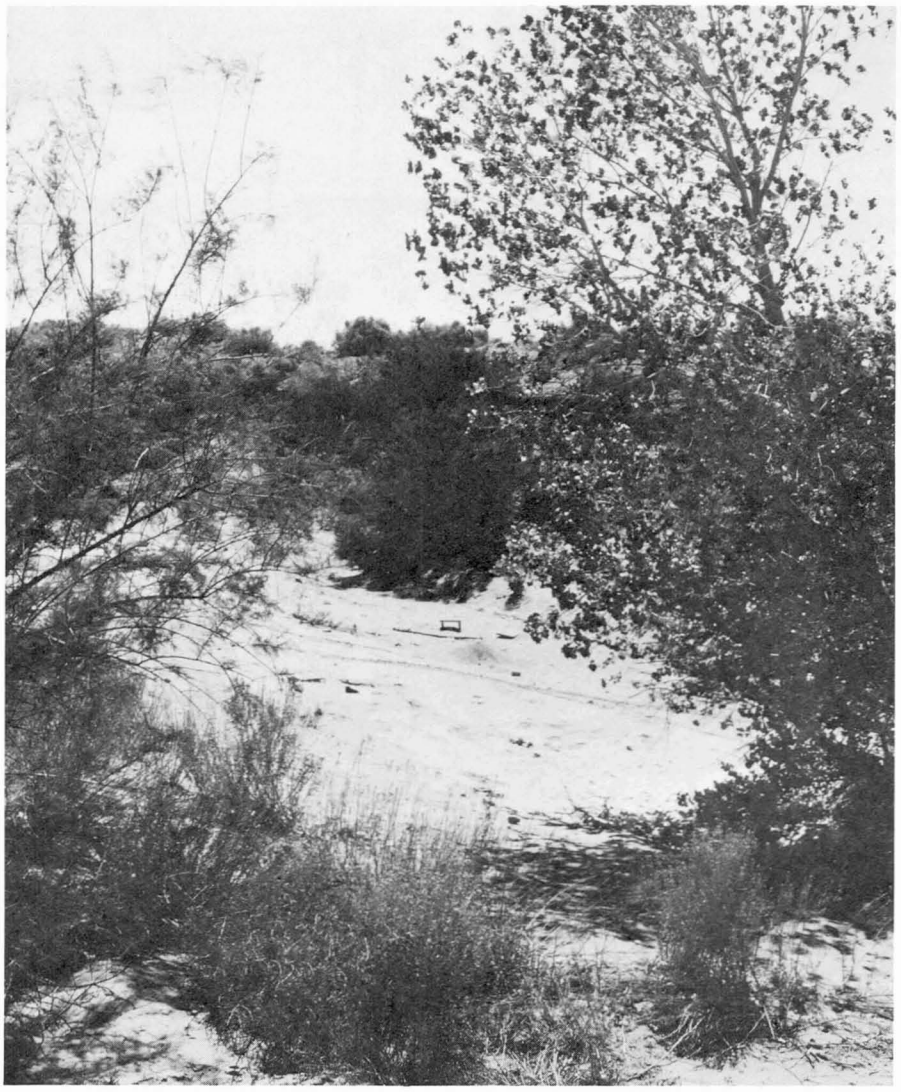
FIGURE 6

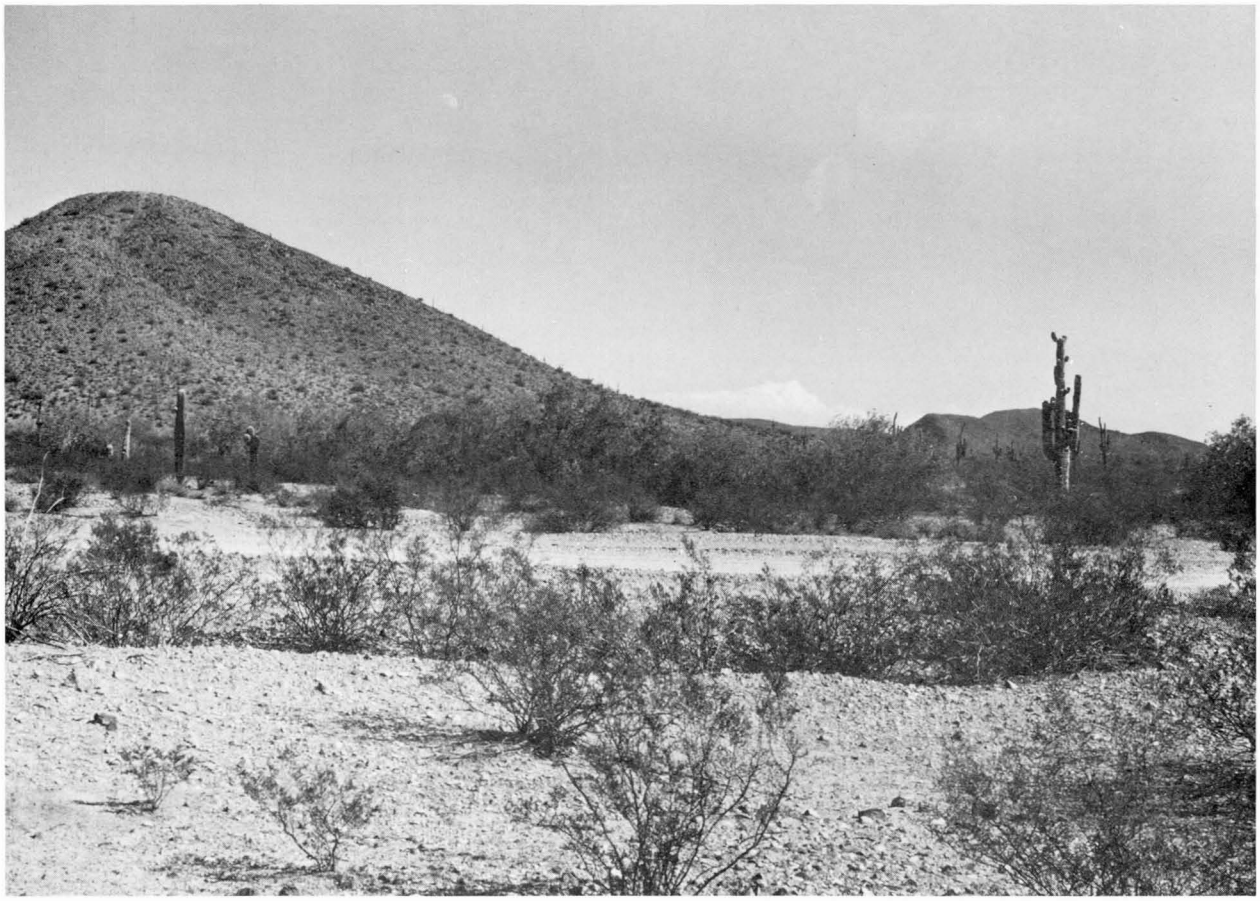


A) VRQ-3



B) VRQ-3

EXAMPLES OF STUDY AREA
VISUAL RESOURCE QUALITY (VRQ)
Figure 7



C) VRQ-2

D) VRQ-1

EXAMPLES OF STUDY AREA
VISUAL RESOURCE QUALITY (VRQ)
Figure 7

Year-round residents include individuals who maintain permanent homes within the project area and those who need to travel the major highways daily or regularly, throughout the year. These potential viewers, each from their own particular viewpoint, would observe the project under all conditions throughout the year. These viewers would have a high degree of exposure to the project.

Transient visitors are in the project area for only a matter of minutes. Included in this group are persons traveling various travel routes in the project area only occasionally.

Summary of Landscape Use

Several areas within the project area have been rated as being "most important" (LU^3) in terms of landscape use (Figure 8). The informal recreation areas on Gila Butte provide local recreation opportunities for residents of the area. The Roosevelt Levee provides a locally unique landscape use. Also, a canal pumping station provides the local residents with a swimming hole during the hot summer months. Other areas receiving an LU^3 rating include the pedestrian walkway to Highway 87 and an archaeological site (see Figure 9A) and cemetery which may have significant cultural importance. It should be noted that Governor Alexander Lewis, Jr. of the Gila River Indian Reservation was contacted (September 14, 1981) to assist in the identification of landscape uses of cultural or religious value. Governor Lewis did not know of anything along Reaches 1 and 2 of cultural or religious importance.

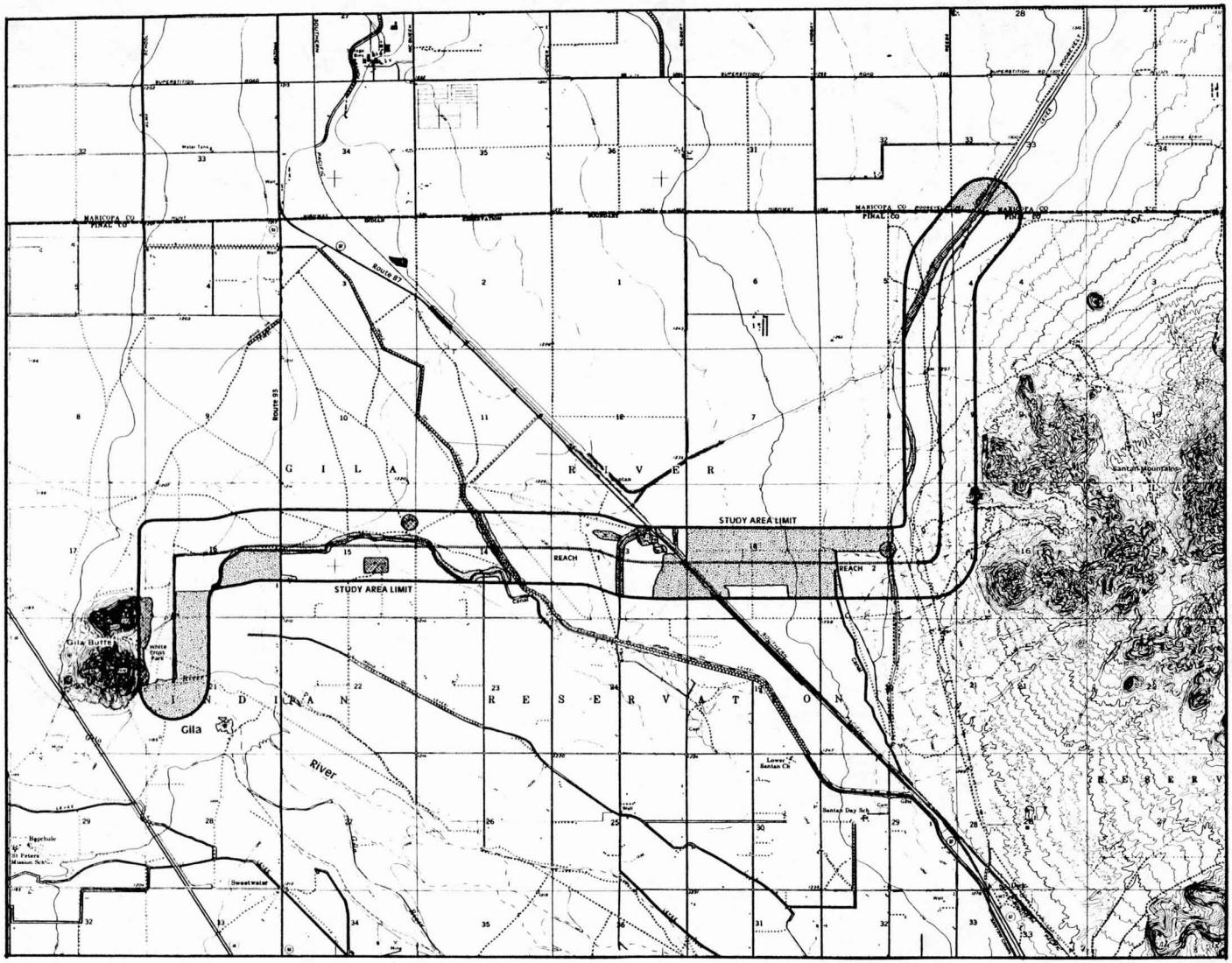
Four areas have been rated "important" (LU^2) landscape uses. Two areas of mature vegetation were identified along levees and irrigation canals (see Figures 8 and 9B), and provide screening of the project floodway. The third is associated with residences approximately one-quarter mile south of the project floodway along Highway 93 (see Figures 8 and 9C). The fourth "important" landscape use is the abandoned gravel pits and agricultural land (see Figure 8).

Landscape uses of "minimal" (LU^2) importance would include the remainder of the study area (see Figure 9D).

Visibility

Viewer

The first step in the determination of project visibility was to identify the location and position of viewers. The view number, frequency and duration and expected viewer was then defined. All major and minor roads were identified using Arizona Department of Transportation - Average Daily Traffic information. Within the study area two major highways (State Routes 87 and 93) were identified as well as numerous secondary roads. Average Daily



LANDSCAPE USE

- MOST IMPORTANT LU[3]
- IMPORTANT LU[2]
- MIN. IMPORTANCE LU[1]

0 ¼ ½ 1 2 3mi.

FIGURE 8

FIGURE 8

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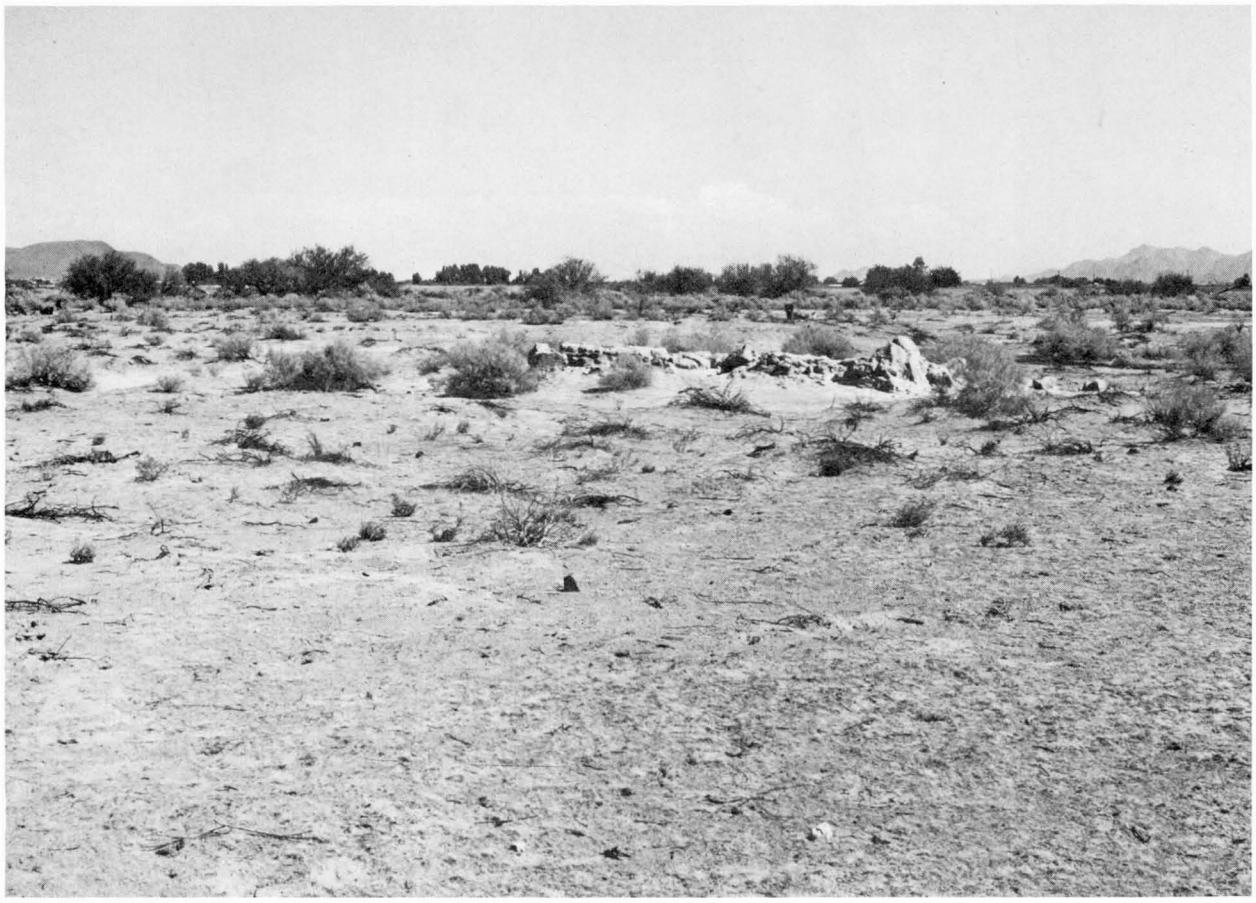


A) LU-3

B) LU-2

LANDSCAPE USES (LU)
Figure 9

C) LU-2

D) LU-1

LANDSCAPE USES (LU)
Figure 9

Traffic for State Route 87 is 1900 and 2600 for State Route 93 (ADOT 1980). Because of the large number of viewers (residents and general public), extended viewing time (duration) and a frequent number of viewers (daily) expected along these two major highways and associated viewshed (see following view position discussion), a "high visibility" (V^3) was assigned along both highways.

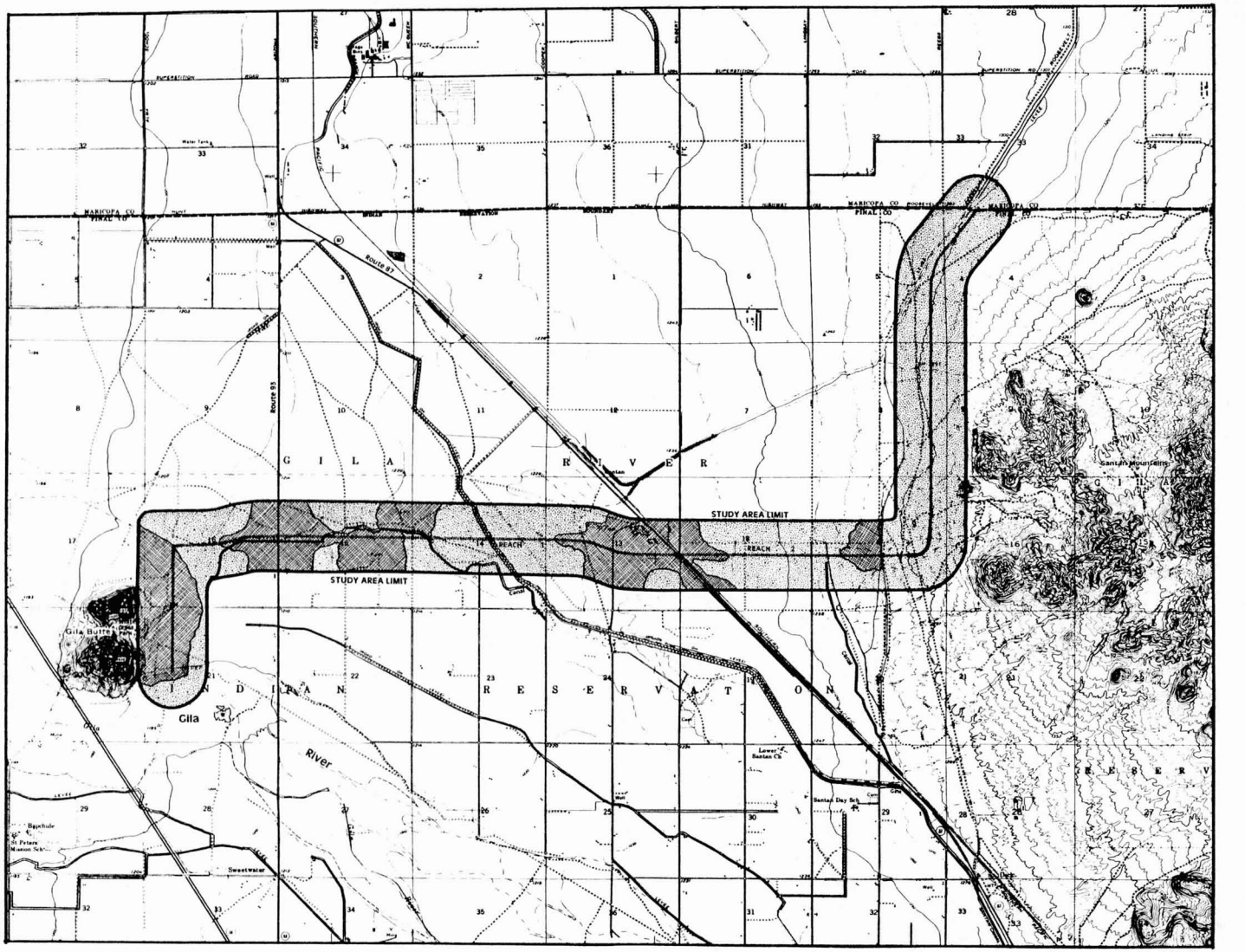
One pedestrian walkway was identified between the community of Santan and State Route 87. Since members of the Gila River Indian Community do a rather large amount of walking and hitchhiking, this route was also given a V^3 ranking. Finally, the recreation site, or key observation point, at Gila Butte, the archaeological ruins and the informal swimming hole (irrigation canal) were considered a V^3 because they are used by the local residents for extended periods. An extended viewing time (duration) was also associated with these observation points. At Gila Butte and to a lesser degree at the archaeological ruins and the informal swimming hole the observation points are slightly elevated resulting in an extended view (up to five miles). Visibility by the general public from observation points in the Santan Mountains, along secondary roads and within the agricultural lands resulted in an "average" (V^2) visibility for the remainder of the study area.

Viewshed

Once viewer positions, locations and expectations were identified, a determination of visibility (viewshed) was completed. Visibility was evaluated for the key observation points according to two categories - foreground and middleground. A background category (from 3-5 to 15 miles) was not identified within the study area. The foreground was judged to be from zero to one-quarter to one-half mile from the observation point and/or where landscape detail was apparent. The study corridor was also defined as one-quarter-mile wide because the Reach I disturbance is not apparent beyond this distance (see Figure 10) unless the viewer is crossing the proposed structure whereby detail (riprap) is still apparent up to one-half mile (field observation in August and September 1981). The middleground included all visible areas up to three-to-five miles from the observation point. Initial mapping of viewsheds were based on topographic map studies (7.5 minute quads) and field verified in September 1981.

Summary of Visibility

In summary, a majority of the study area is visible from some observation point (e.g., Gila Butte and Santan Mountains) and was classified as V^2. Highly visible areas (V^3) were identified for zero to one-half mile away from key observation points (e.g., State Routes 87 and 93, a recreation area, cultural ruins, a cemetery, a pedestrian walkway and an informal swimming hole) as shown in Figure 11A and B.



VISIBILITY

- HIGH V^3
- AVERAGE V^2
- LOW V^1

FIGURE 10

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FIGURE 10

A) V-3

B) V-3

VISIBILITY (V)
Figure 11

Landscape Priorities

High Priority

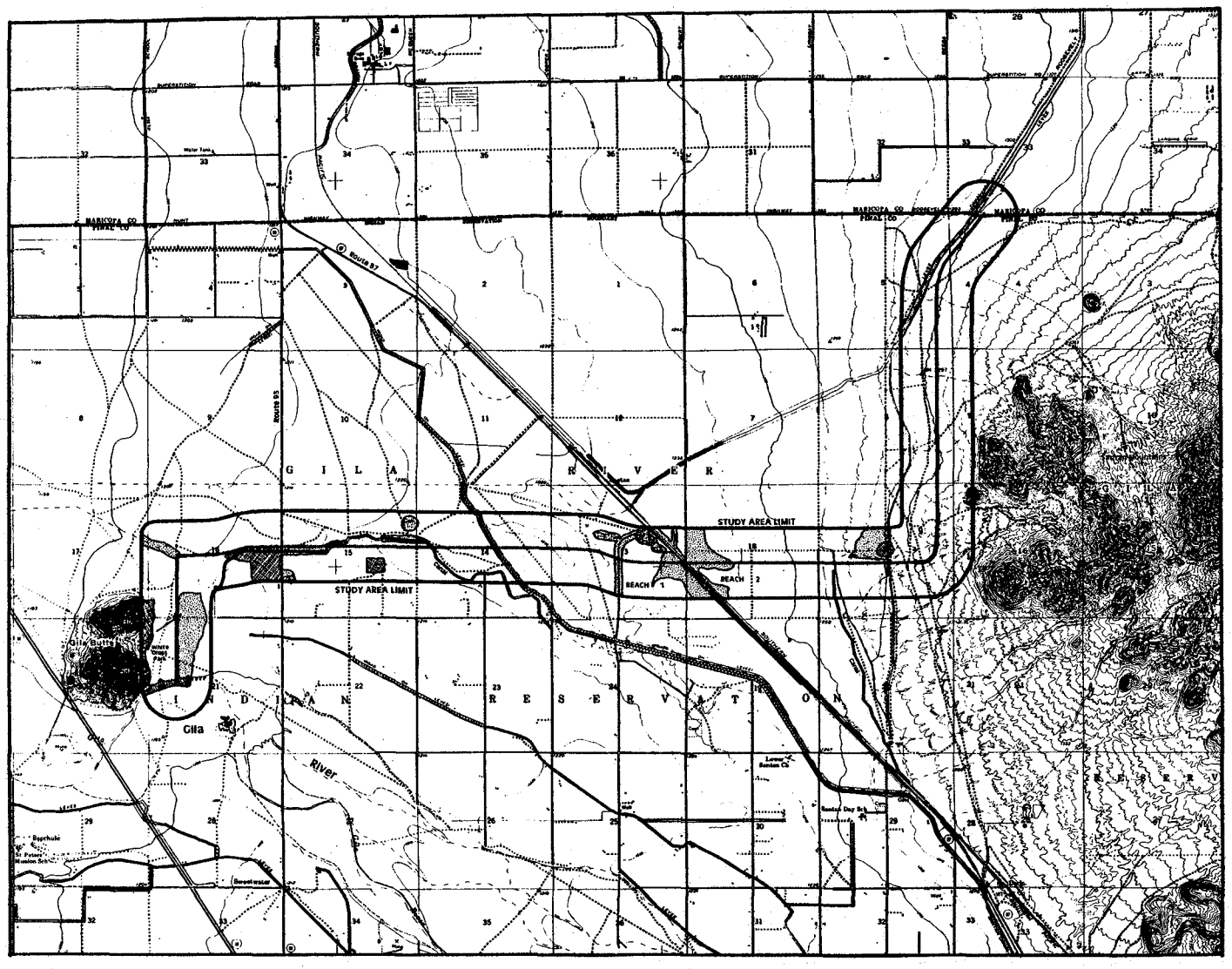
Four areas within the project area were rated as a "high priority" areas. One area includes the portion of Gila Butte and a portion of the Gila River riparian vegetation, near the outlet of the floodway, located within the project area (Figure 12). The second "high priority" area is east of State Route 93's crossing of Reach 1. The last two areas (archaeological ruins located less than one mile from State Route 93 and the informal swimming area where Reach 2 turns north) are outside of the 330-foot right-of-way.

Medium Priority

Several areas were rated as "medium priority" areas. These include levees and canals, pumping station/swimming hole, the pedestrian walkway and the major highways (State Routes 93 and 87), the cemetery, abandoned gravel pits, railroad and the residences along Highway 93 (Figure 12).

Low Priority

The remainder of the project area was classified as "low priority" (Figure 12).



LANDSCAPE ARCHITECTURE PRIORITIES.

- HIGH (8-9)
- MEDIUM (5-7)
- LOW (3-4)

FIGURE 12

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ROOSEVELT WATER CONSERVATION DISTRICT FLOODWAY – REACH 1 AND 2

SHEET TITLE | DRAWN | CHECKED | JOB NO. | DATE | SHEET NO

FIGURE 12

LANDSCAPE OPPORTUNITIES AND CONSTRAINTS

Overview

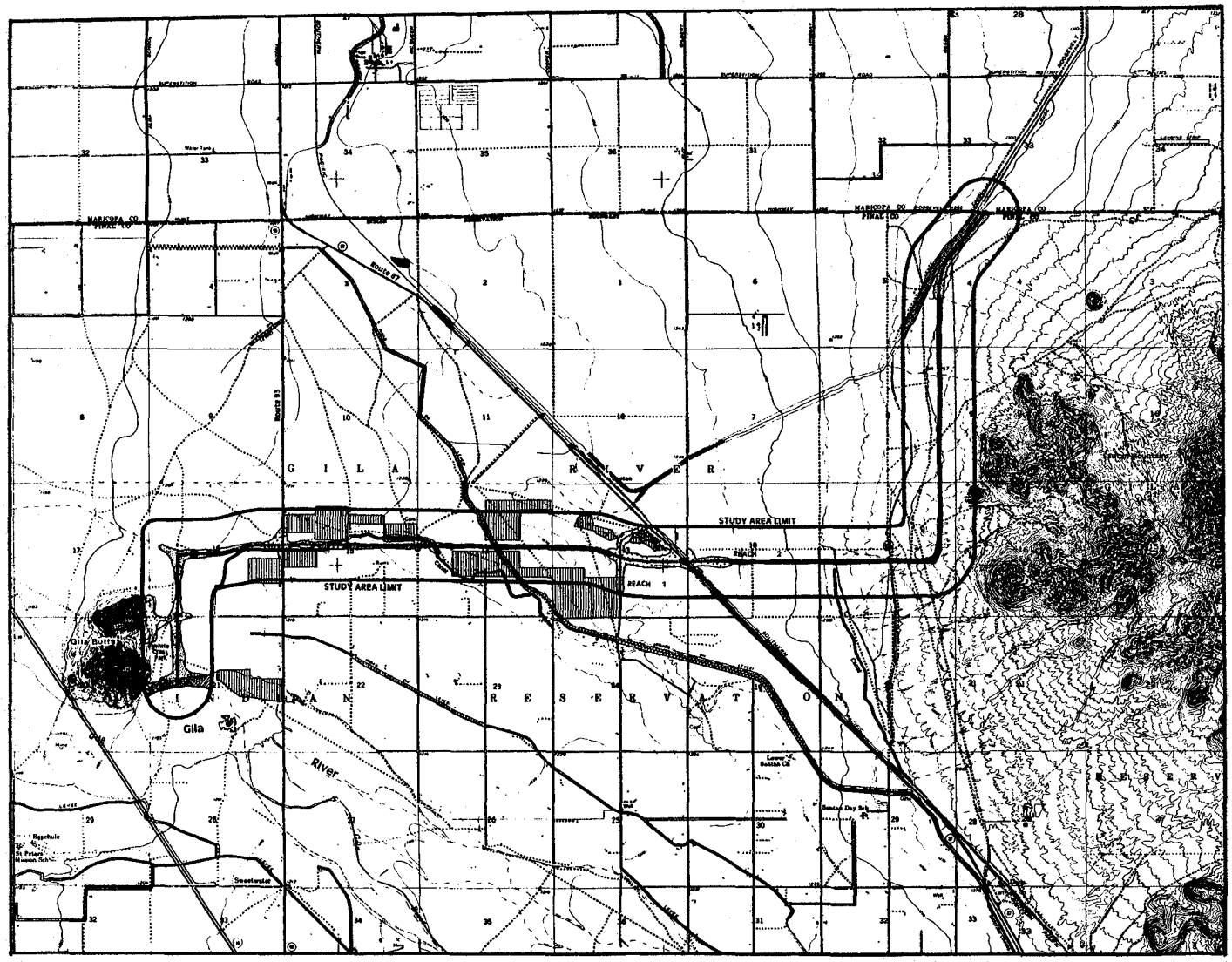
Based on the landscape architecture priorities resulting from the visual analysis of the project, rehabilitation opportunities and constraints within the desired goals for the floodway were identified (Figure 13). The opportunities/constraints map depicts vegetation opportunities including maintaining existing vegetation and revegetation (desert, desert transition and riparian), as explained in the following section on vegetation. Following the identification of vegetation opportunities, a series of alternative actions were developed for consideration within the areas identified in Figure 13, excluding the alternative of no action and the opposite extreme of excessive vegetation manipulation. In addition, alternative actions for consideration along Reaches 3 and 4 are addressed.

In meeting this objective, the available data were gathered, aggregated, analyzed and interpreted into the following reasonable alternatives, including the anticipated outputs and consequences, where predictable. The alternatives serve as design templates for various treatments. The results are general in nature and could be applied almost anywhere (within reasonable limitation of temperature, season, development density and so on). The generic alternatives are applicable to rural and urban areas, remaining basically the same when applied to varying project components. Therefore, this section of the report concentrates on design options (the actual physical manipulation), rather than theory and research.

The alternative development and rehabilitation schemes considered as a part of the opportunities and constraints of this project are as follows: (1) vegetation, (2) earth channels, (3) residences, (4) spillways, (5) pump station, (6) spoil material, (7) road crossings, (8) rip-rap and concrete areas, (9) recreation sites, (10) wildlife habitat improvement, (11) fencing, (12) cultural areas and (13) miscellaneous. The following section discusses each alternative scheme and provides graphic examples.

Vegetation

The arid environment crossed by the RWCD Reach 1 and 2 project has resulted primarily because of a water deficit for the plants. This condition occurs when the replenishment of moisture lags behind the moisture lost through evaporation and transpiration. The plant materials that have adapted are involved in a complex ecosystem due to the climatic extremes of the desert environment. The visual analysis suggests the need to provide revegetation in the disturbed areas to complement existing vegetation in a manner which appears natural. This means that the form, color and texture of the added material should blend, visually, with the native material to appear natural or existing (prior to the project).



OPPORTUNITIES & CONSTRAINTS

- RECLAIMED SPOILS AREA
- RIPARIAN VEGETATION
- DESERT TRANSITIONAL VEG.
- DESERT VEGETATION
- MAINTAIN EXISTING VEG.

0 ¼ ½ 1 2 3mi.

FIGURE 13

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FIGURE 13

The plant list developed for the rehabilitation of the project must reflect arid-region and native plant material in all cases. The distinction between riparian plants, transitional desert shrubs, and the sparse desert floor vegetation is important and was carefully observed to serve as a guide in selecting plants for revegetation purposes.

The vegetation types involved in determining rehabilitation opportunities and constraints (Figure 13) were separated into four basic categories:

1. Existing vegetation to be maintained whenever possible and either left in natural state, trimmed and pruned for the health of the plant material, or supplemented with additional complementary vegetation to improve that particular area in response to identification as a priority visual or environmental community.

2. Riparian vegetation existing along the Gila River and at various side drainages into the canal and at seeps in irrigation ditches and canals involved with the agricultural uses adjacent to the project. The riparian vegetation is to be drawn up to the edge and along the banks of the flood channel to delineate the entrance of the channel into the Gila River and the major side drainages into the channel. Riparian material will be used in limited areas directly relating to the existing riparian growth and of close proximity to the existing community. This type of revegetation is suggested because of the dependence of riparian vegetation on a water table within reach of the root zone or a periodic supply of moisture such as a drainage or levee backup.

3. Desert transition vegetation is a plant community which is less dependent upon a water source but more complex in form, texture and color than the open desert community plants existing on the flat areas around the site. These plants create a desert-wash-type of ambiance along the channel while giving a transitional appearance in size, color and texture between the riparian growth in the floodways and the sparse desert grasses and cacti in the drier flat areas.

4. Desert vegetation receives little moisture and no prolonged wet periods because of instant runoff to the lower drainage areas incised through the flat desert floor. The vegetation is very sparse having little soil protection except from root structure. This is evident from the mounding effect around the base of the plants caused by the sheet erosion of water flowing over the baked soil. Desert vegetation in the area includes perennial grasses and a limited variety of cacti, as well as many species of drought-tolerant weeds.

Important to the proposed planting of various materials will be plant survival without irrigation (Figure 14A). The final installation grading should allow for tree and shrub placement in low areas and subtle basins to collect runoff and with mulched surface (stone or gravelly soil) to hold moisture around the root

zone. Condensation traps may be established for large trees to provide temporary moisture provision until over transplanting stock (Figure 14B).

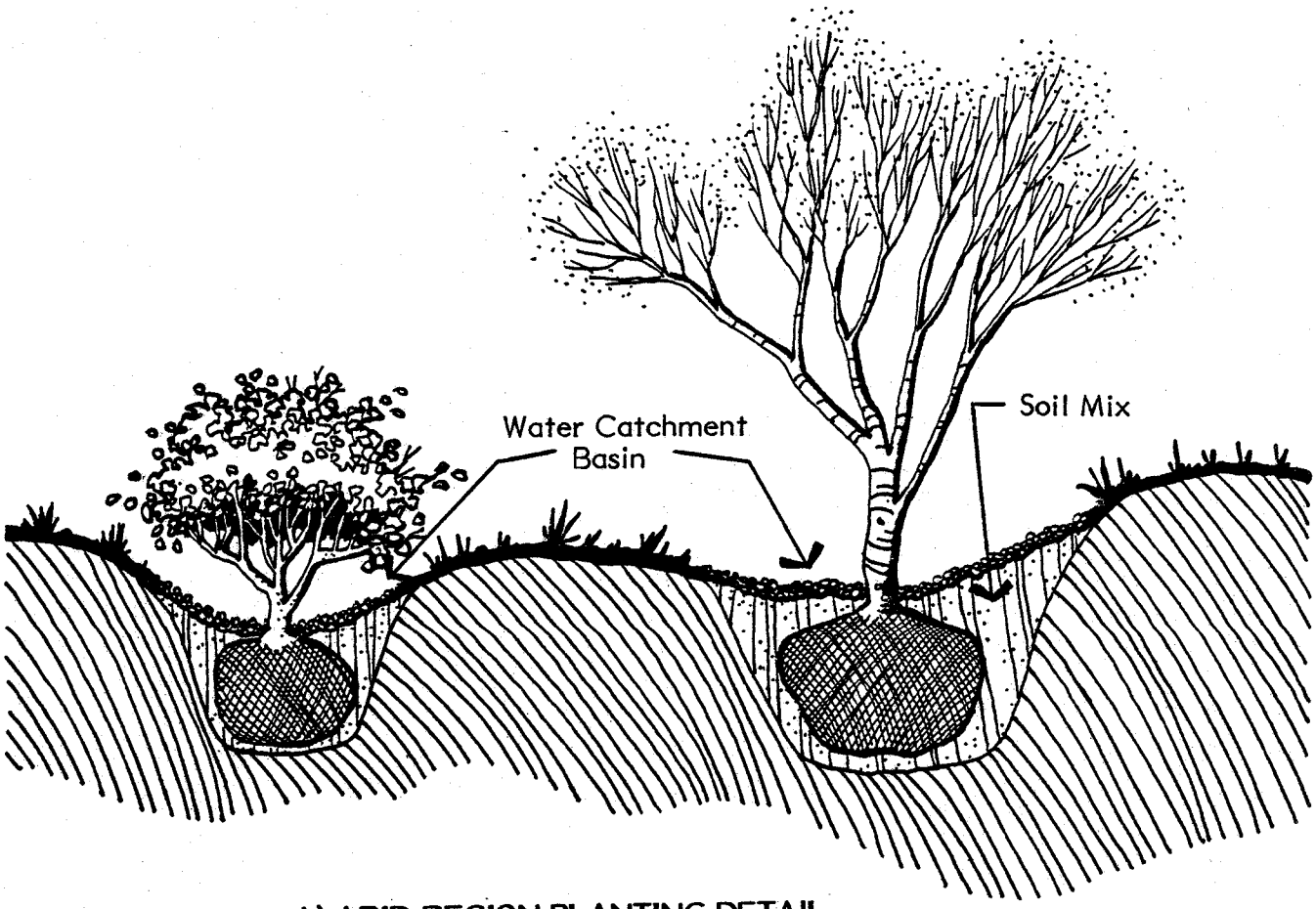
Vegetation will be used not only for aesthetic enhancement but for circulation barriers, screening, soil stabilization, shade, and spatial definition (such as road alignment coming out of the channel, Figure 15A and B) of areas now used by the local inhabitants and visitors. This approach involves groundcover, understory planting and trees. The use of vegetation will also define and accent traffic corridors (Figure 16) and existing recreation sites.

The planting of various materials in relation to the natural method of occurrence is imperative. The riparian community may be extended out of the channel area and into side washes, where appropriate (Figure 17). Another alternative would be to extend the transitional desert community from the wash into adjacent areas where it would occur naturally, such as along roadways and low areas surrounding the Gila Butte picnic area (Figure 18).

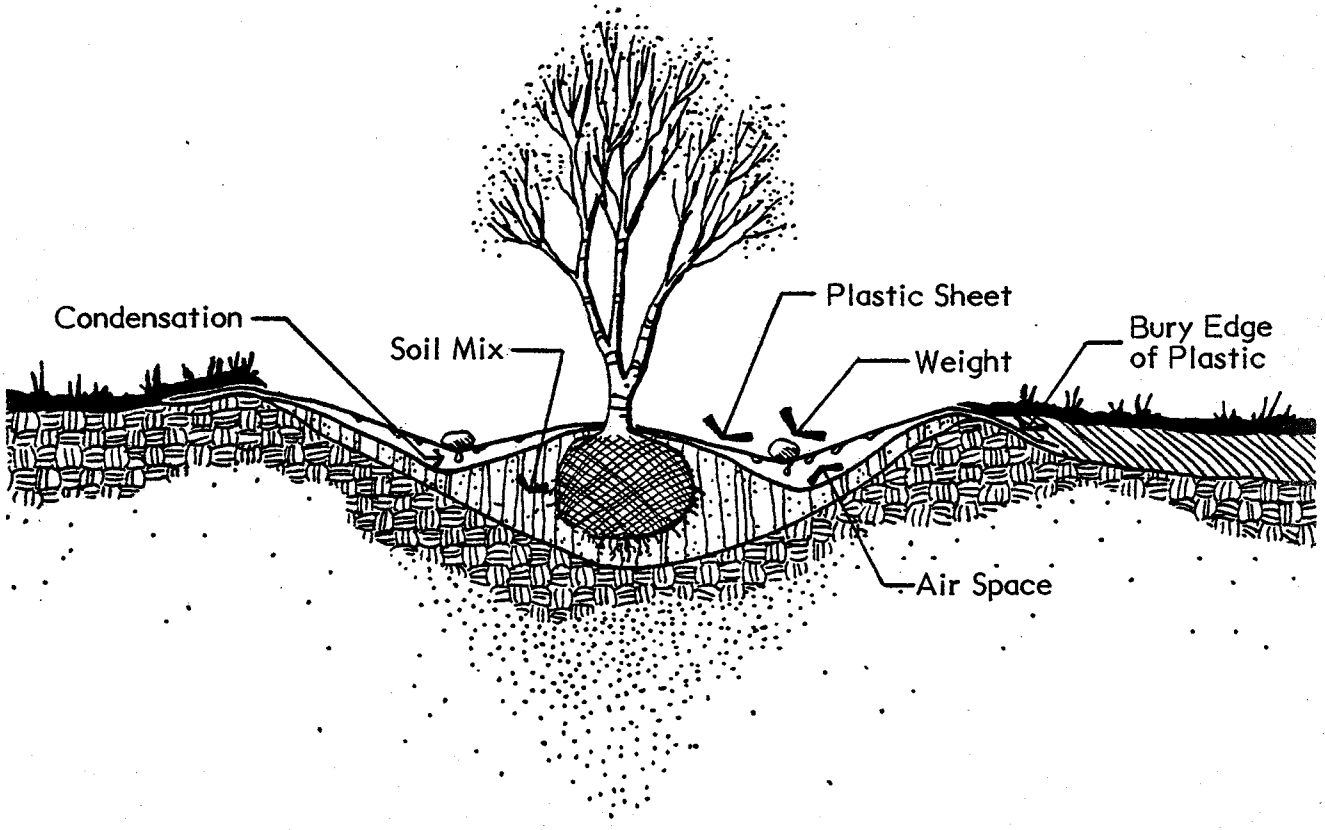
A potential constraint of planting the banks, outside the channel, is the establishment of an unnatural corridor, causing the channel and its surroundings to become more visible and potentially intrusive in the desert than if it were not rehabilitated at all. Therefore, planted areas should respond only to the visual intrusion of the project as seen by the potential user. Road crossings would be planted for varying distances back from the roadway to soften the visual intrusion of the crossing. Less dense planting and lower material could then provide a visual transition away from the road, further into desert areas adjacent to the channel having only natural grasses and desert paving. In any situation, rural or urban, it is important that the choice of plant materials should resemble existing plant development patterns found in similar contour and drainage situations. The plant material should also be compatible with plant species in terms of maintenance and water requirements, general form, color and texture.

Channels

The main channel of the RWCD is a constraint in terms of physical requirements and spoils disposal; however, it provides a reasonable opportunity to improve existing recreation areas, inhabitated areas, wildlife habitat, and to provide for additional recreational features appropriate to the project, such as trails and rest areas (Figures 19 and 20). The mechanical aspects of the channel can be countered by softening the engineered edges and alignments through the creative use of spoil material and the introduction of selected vegetation (Figure 21). The necessary channel right-of-way can be used for development of various schemes of rehabilitation, spoil disposal and recreation. The maintenance roads have circulation potential for hikers and bicycle riders while much of the channel and surrounding corridor can be used for equestrian trails.

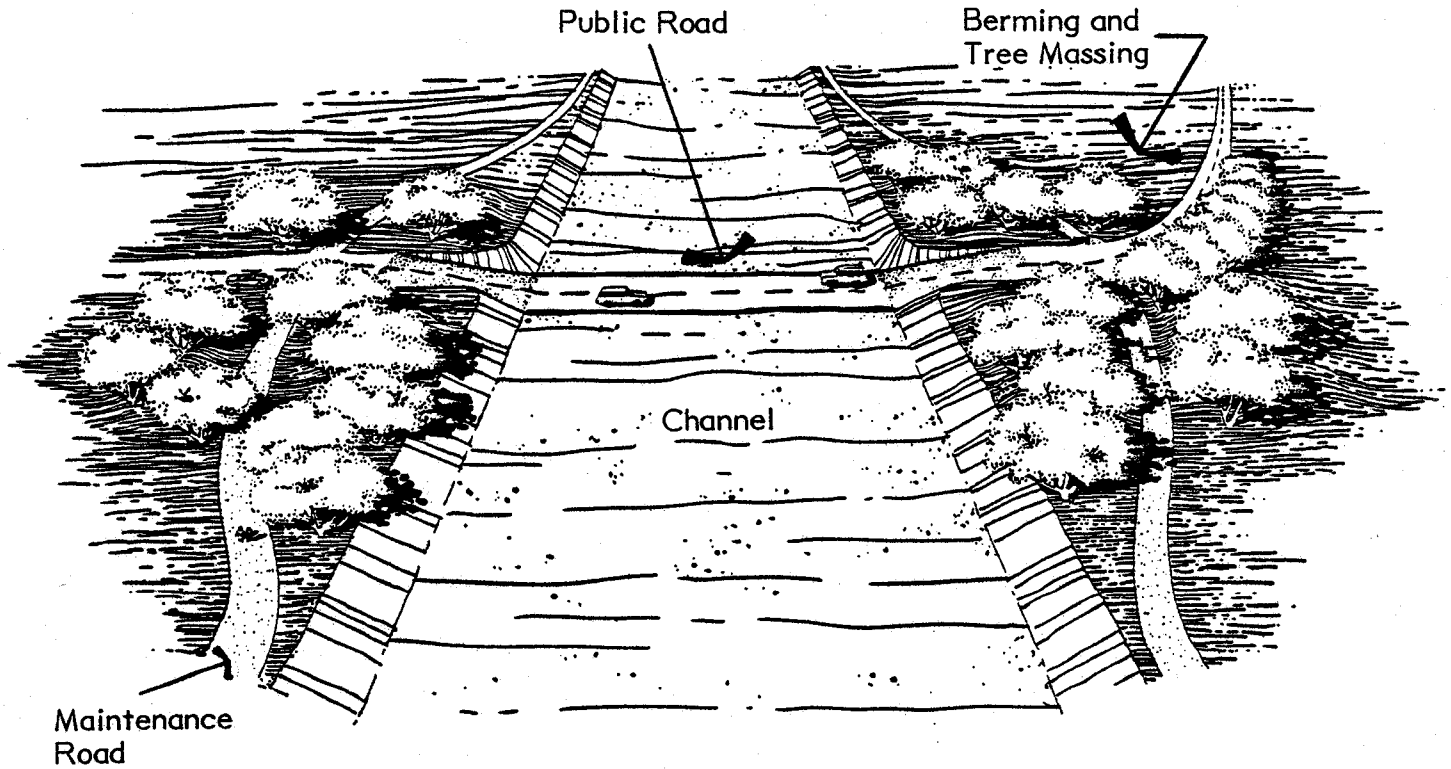


A) ARID REGION PLANTING DETAIL

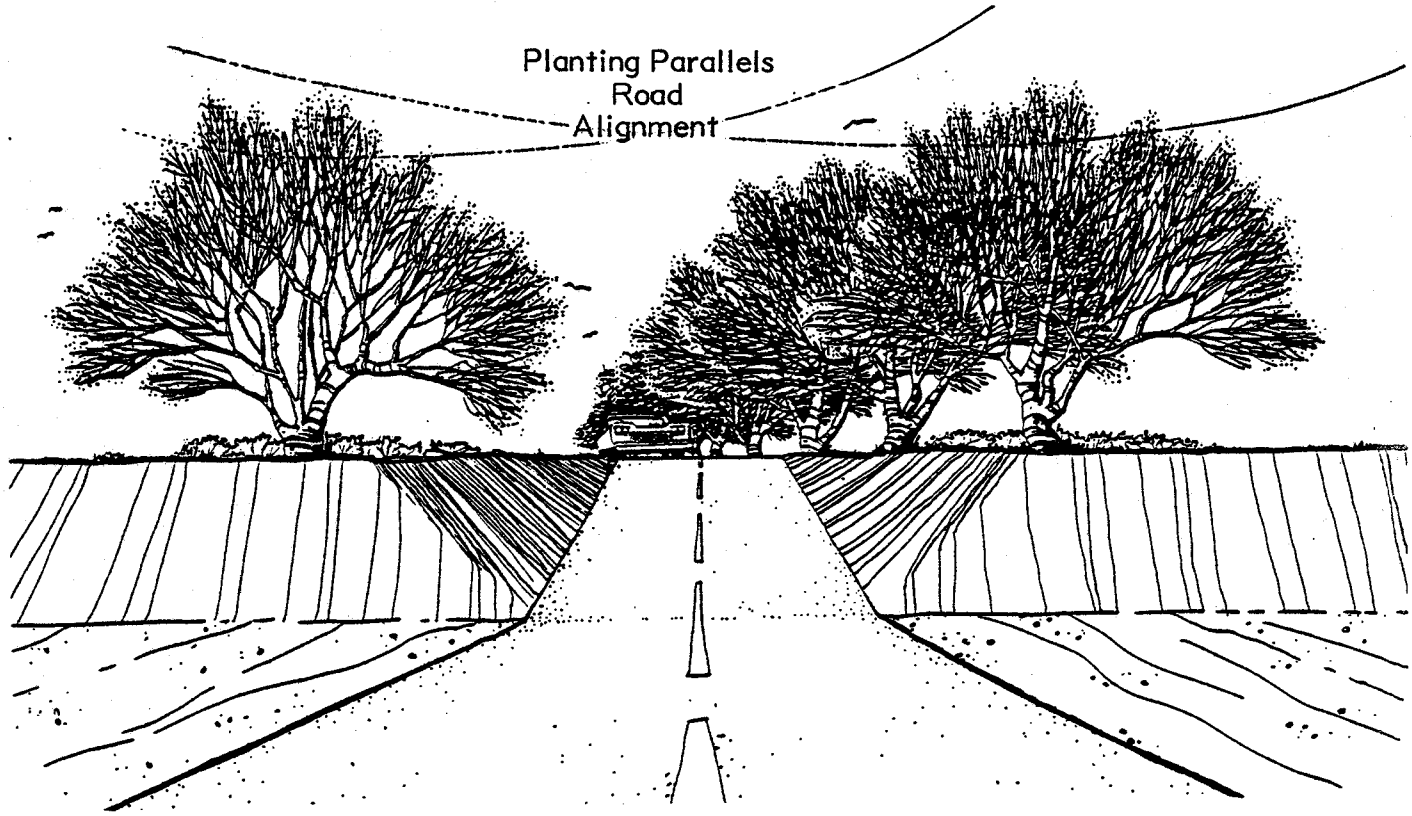


B) CONDENSATION TRAP

FIGURE 14

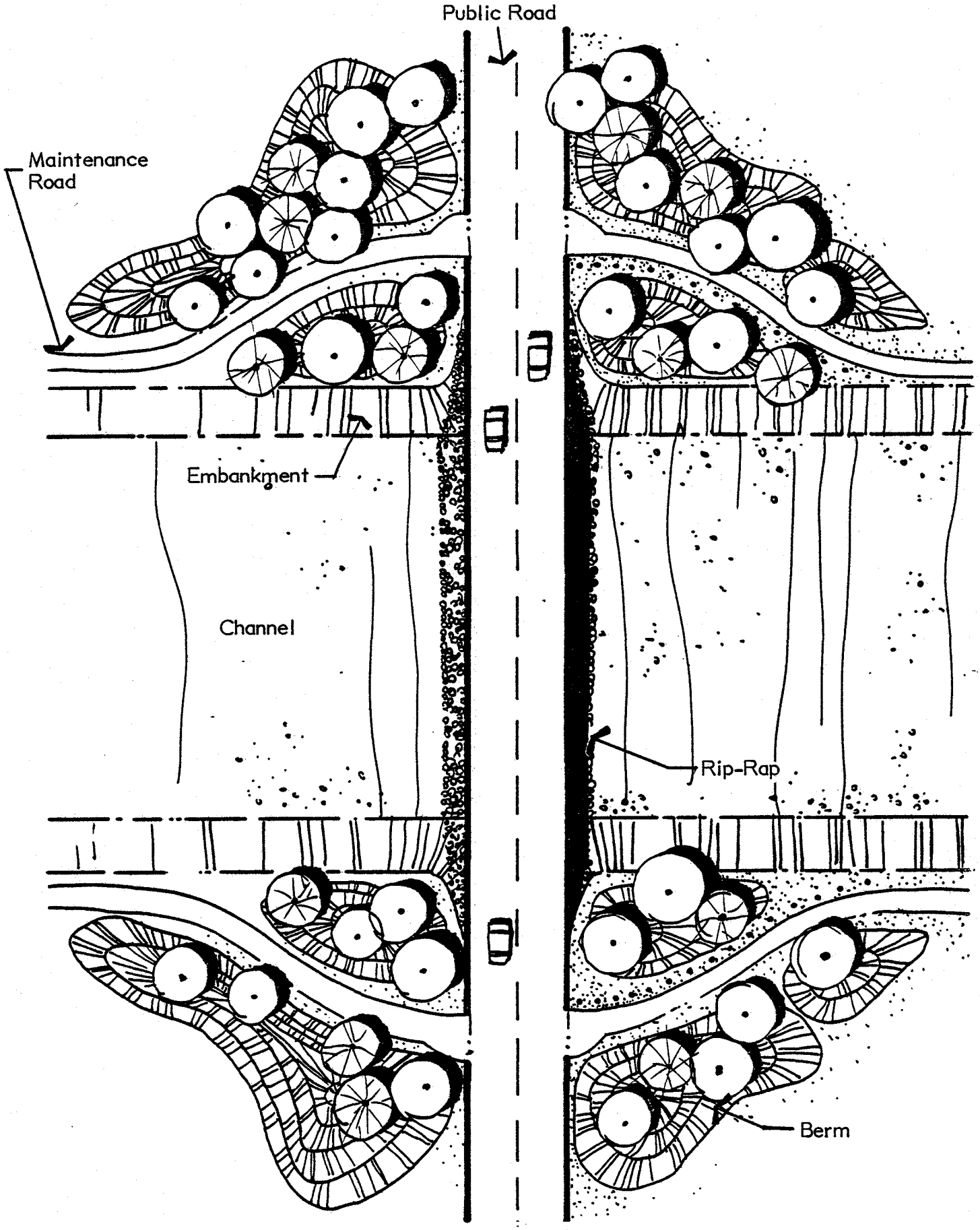


A) TYPICAL DIP CROSSING (Aerial View)



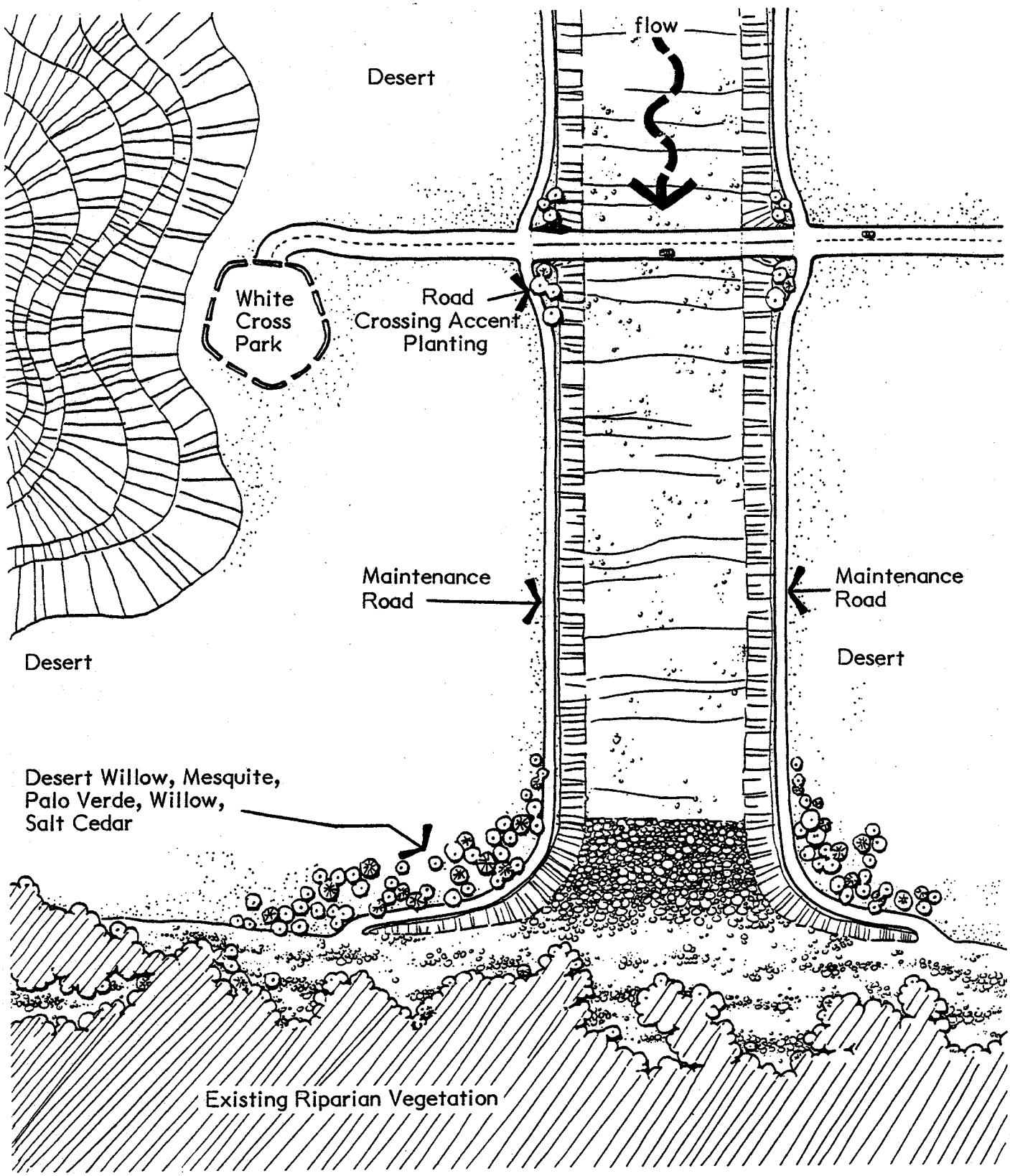
B) TYPICAL DIP CROSSING (Drivers View)

FIGURE 15



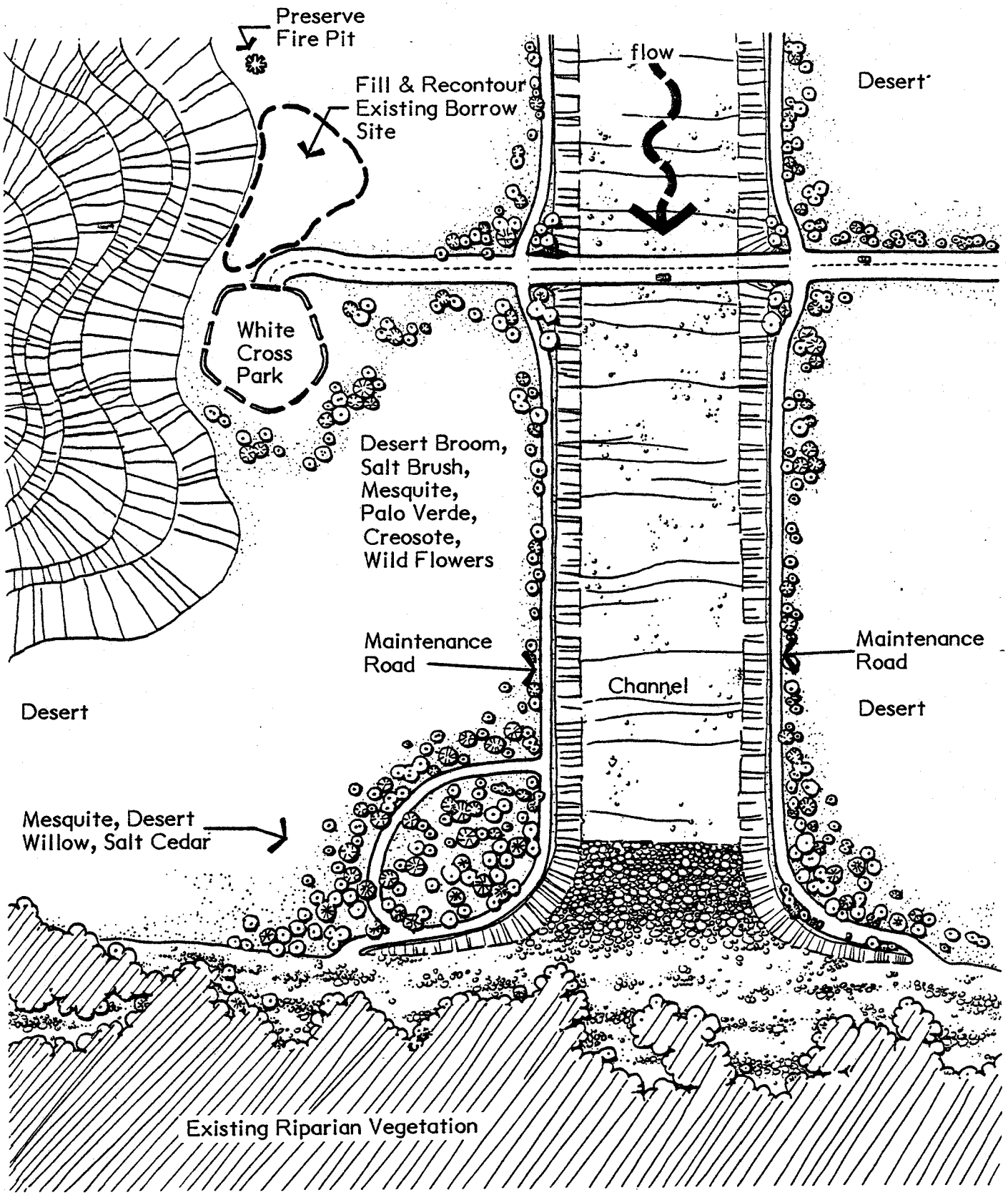
USE OF VEGETATION TO DEFINE TRAFFIC CORRIDORS

FIGURE 16



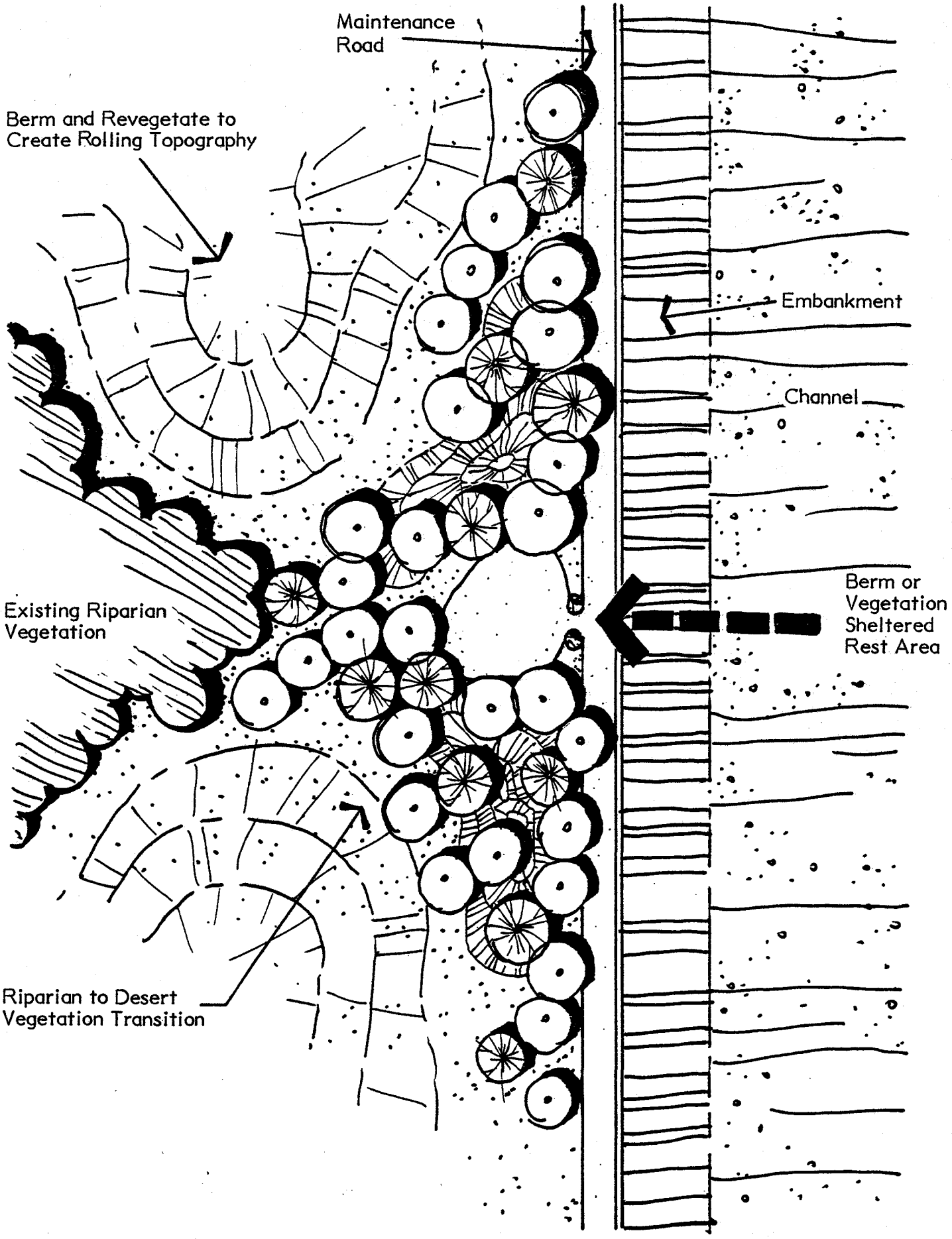
GILA BUTTE AREA - RIPARIAN PLANTING

FIGURE 17



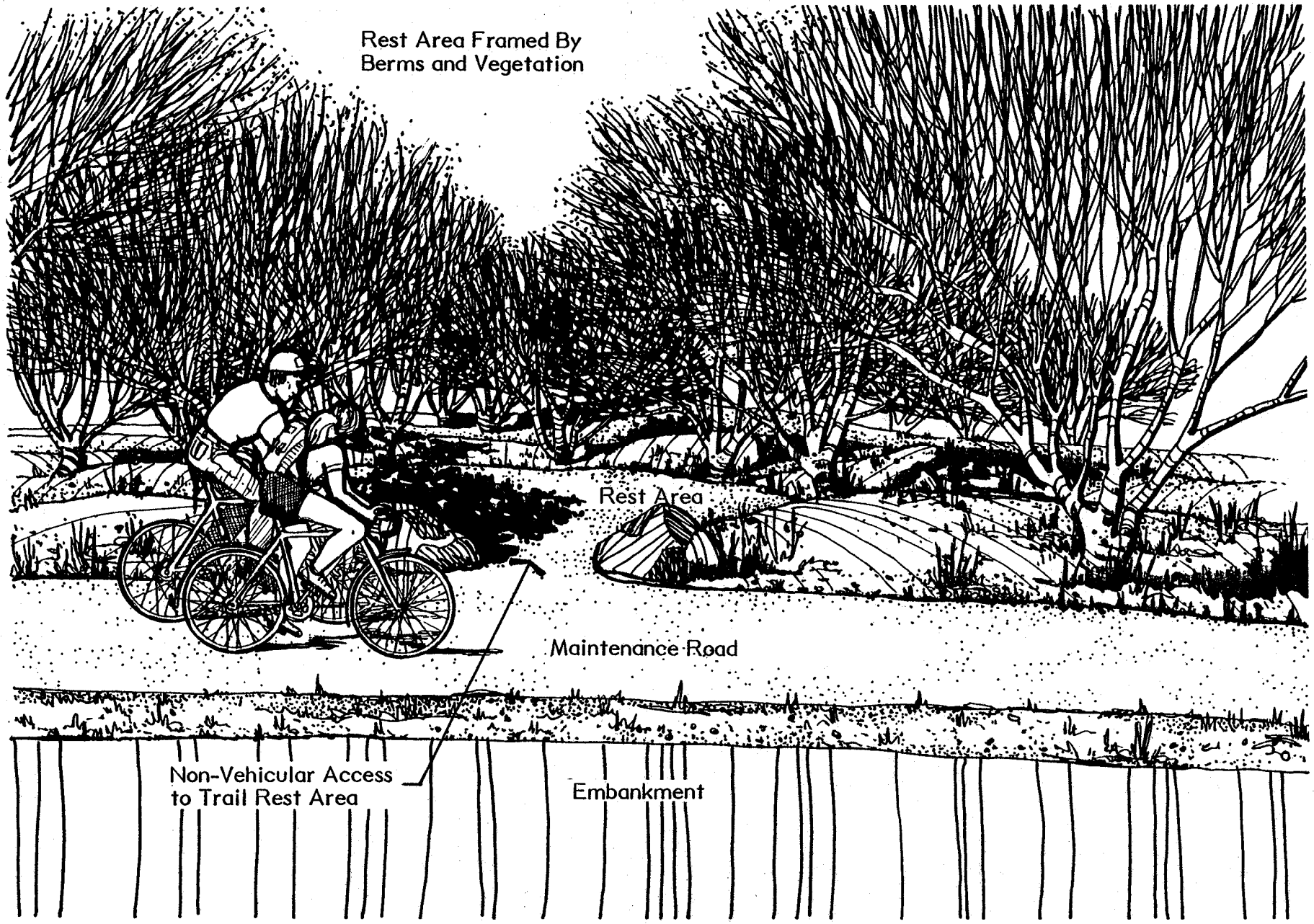
GILA BUTTE AREA - RIPARIAN AND DESERT PLANTING

FIGURE 18



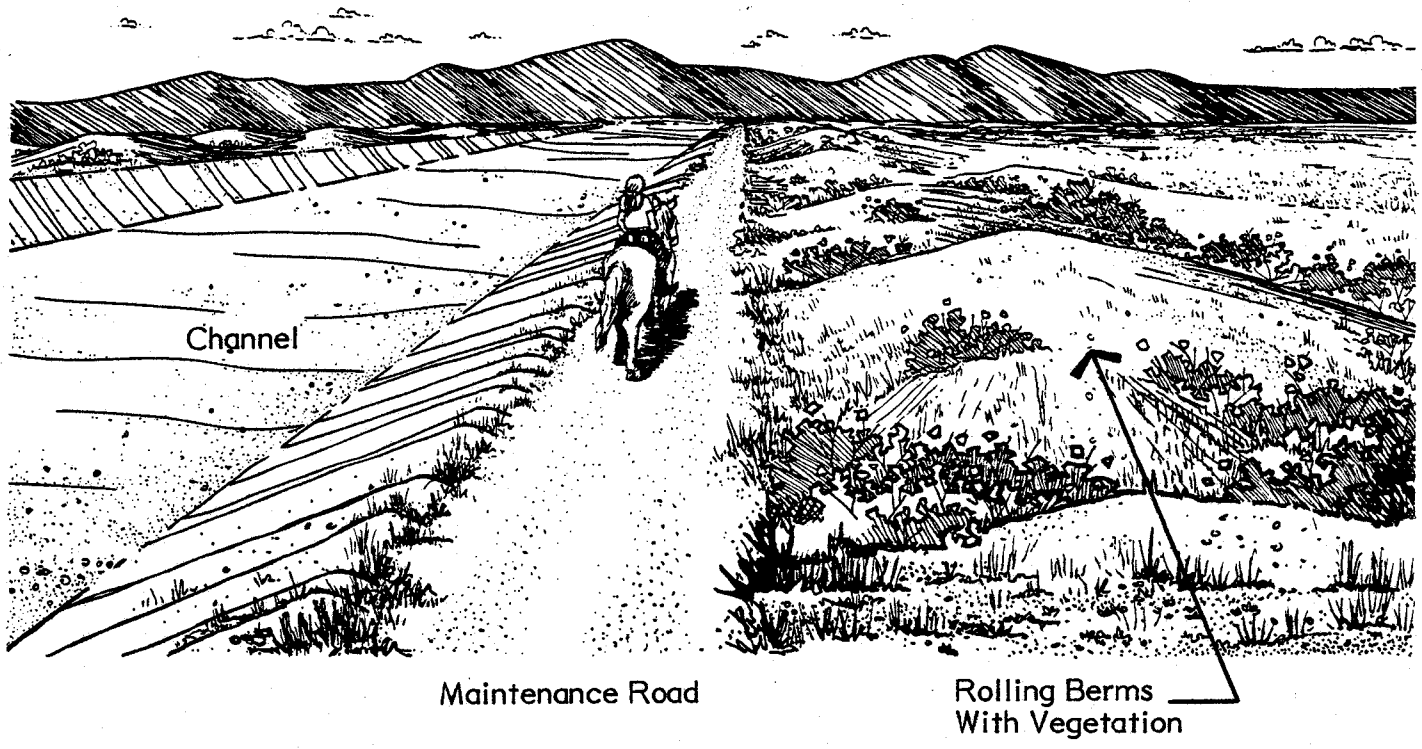
TYPICAL TRAIL REST AREA (Plan View)

FIGURE 19



TYPICAL TRAIL REST AREA (Perspective)

FIGURE 20



A) Perspective

B) Typical Section

C) Typical Section

D) Typical Section

ADDITION OF SPOIL TO BLEND CHANNEL INTO SURROUNDINGS

FIGURE 21

Residences

As noted in the visual analysis, Reaches 1 and 2 have minimal visibility from existing residences. However, along Reaches 3 and 4, residences adjacent to the channel may be visually screened from channel construction and the spoil disposal. At the same time, the residential areas may benefit from the project by improved definition of the inhabitated area, improvement of access and recreation opportunities. The key to successful rehabilitation in relation to inhabited areas is to blend the channel into the background (where possible), block views to the channel with vegetative screening, berms, fencing or walls (depending upon space available), and to create aesthetic-appearing channel corridors (where the channel is visible) (Figure 22).

Spillways

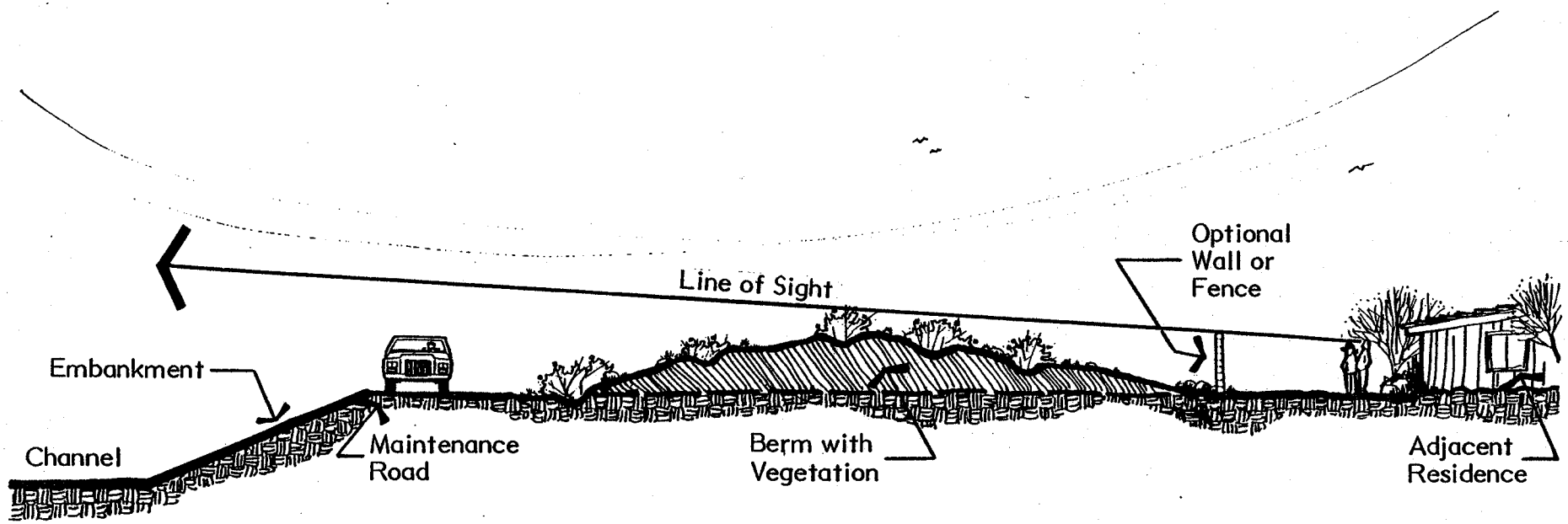
The spillways involved are the main spillway into the Gila River (grouted cobble) and several smaller embankment-protection devices where side streams and drip inlets enter the channel. The spillways represent opportunities where riparian growth may deviate from the main channel alignment. The physical presence of the spillway has no effect on the overall channel visually and may be an advantage where the concrete and rock can be chemically altered to blend into a desert varnish. The spillways will be absorbed into the planting scheme in most cases since the spillway entrance or exit location is the area of heavier planting along the side of the channel (Figures 17 and 18).

Pump Station

One existing groundwater pumping station is currently being used for recreation by the local inhabitants. Keeping this recreation opportunity and improving it in an unsophisticated way (no signing, lighting or other urban park amenities) would be an alternative to consider (Figure 23). Some controlled parking and additional definition of the site through planting and earthform would allow for greater use by the local people. It is unlikely, however, that most irrigation companies would allow use of pump areas because of increased water loss through evaporation and potential liability as an attractive nuisance. This type of development would be strictly rural in nature and would require a different solution if in an urban setting.

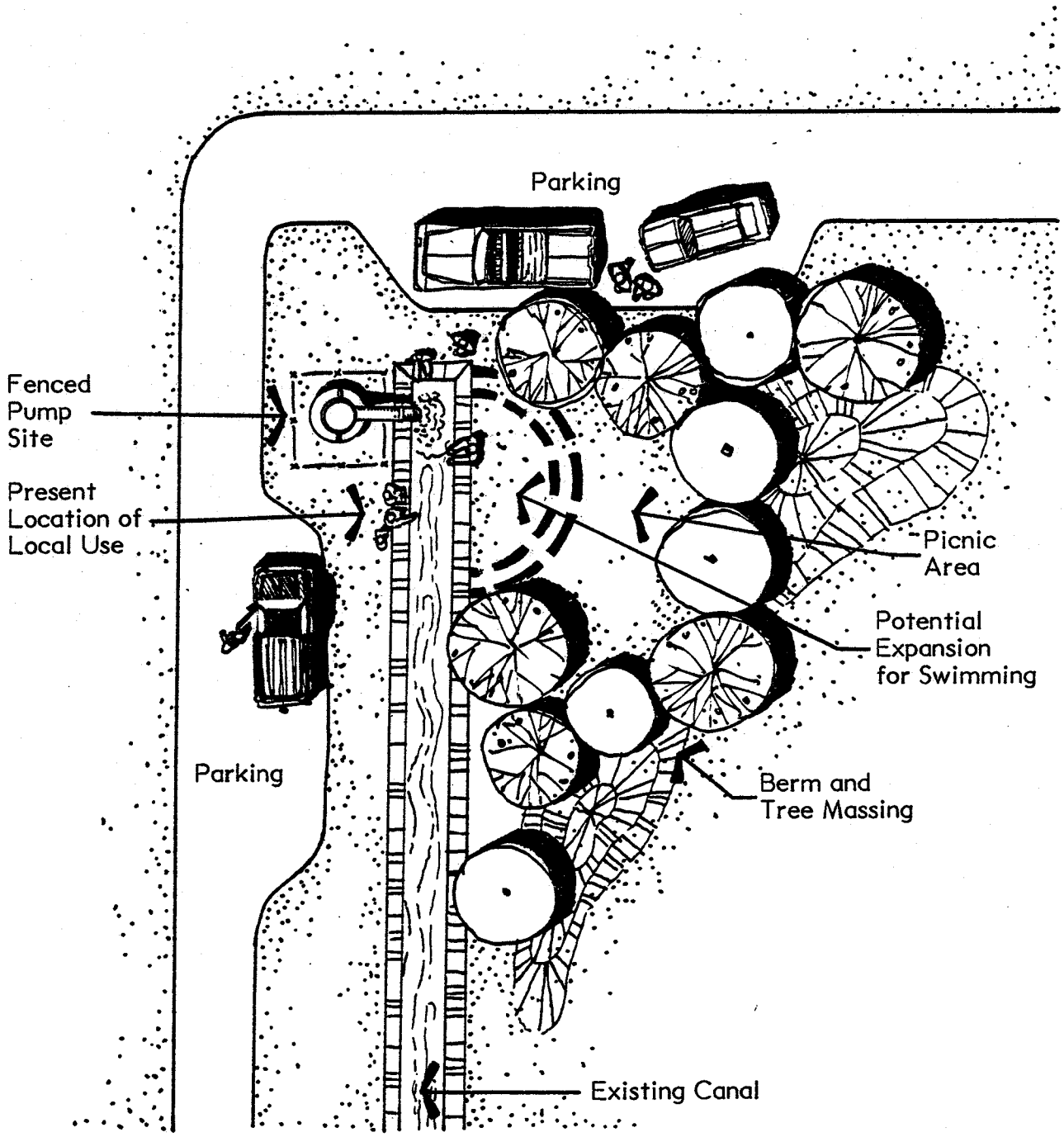
Spoil Material

Disposal of spoil is a key problem throughout the project. The advantage is that considerable material is available to create new landform in areas suitable for disposal of waste soils. Spoil areas extending beyond the one-half mile study boundary were addressed in the report since reclamation procedures must be used to rehabilitate the disturbed soil surface. Reclamation of all



SCREENING OF CHANNEL FROM ADJACENT INHABITED AREAS

FIGURE 22



PUMP AND IRRIGATION CANAL HEAD USED FOR RECREATION

FIGURE 23

scarred areas is advisable, even if an area was not highly recommended for reclamation in the visual or environmental analysis. Spoil piles in any situation should be feathered to existing ground (daylighted) to produce a uniform contour and blend into the area (Figure 24).

In the disposal process, returning to Reach 1 and feathering edges of angularly cut existing piles would be desirable, as would varying the height of the disposal areas and creating some contouring to provide interest to the area. Compaction is not considered since no structural use is anticipated other than maintenance on roads crossing the spoil piles.

Avoiding the destruction of mature vegetation in disposal areas where a plant community has developed is also important; especially backfilling against levees or areas where water gathers during runoff periods. Pockets and drainage catchments could be formed to allow existing vegetation to continue to survive in areas being inundated by spoil material.

Off-site disposal is also a consideration since the total yardage available (estimated at two million cubic yards) may be more than can be realistically disposed of within the right-of-way for the canal. The spoil material could be mulched over large areas of agricultural land, similar to Reach 1 Reclaimed Spoils Areas (Figure 13), especially if soil improvement was provided prior to disposal. The use of the material to form water catchment pits and direct-sheet runoff should be considered. The soil could be used to backfill against road dikes (Figure 25), alleviating a maintenance concern (debris collected in dike embankments) and softening the canal edge. In addition, plant material could also root more easily in that area because of the lesser slope and reduced erosion potential.

The use of spoil to enhance circulation patterns (such as the entrance to the Indian village from State Route 87) and establishment of a visual screen (between viewers, and the channel and associated fence) should be approached in the same manner in rural or urban areas. The limitation is usually that the urban area will be of lesser overall area and, therefore, the earthform will be either more pronounced in side-slope contour or smaller in total size. At the same time, the proximity and number of residences will be greater.

Although the use of the spoils for urban park play form does not appear practical for Reach 1 and 2, opportunities may arise in an urban environment. In addition, excavated material may be used for levelling irrigable farmland, road fill and bank protection and flood-protection berms and dikes, and by developers for fill and housing pads. The main drawback to many disposal schemes is the cost of transportation from the project site to the disposal site.

Agriculture

Several areas of spoil in the Reach 1 vicinity are in a situation suitable for use as agricultural land. Large areas could be levelled and, by addition of soils

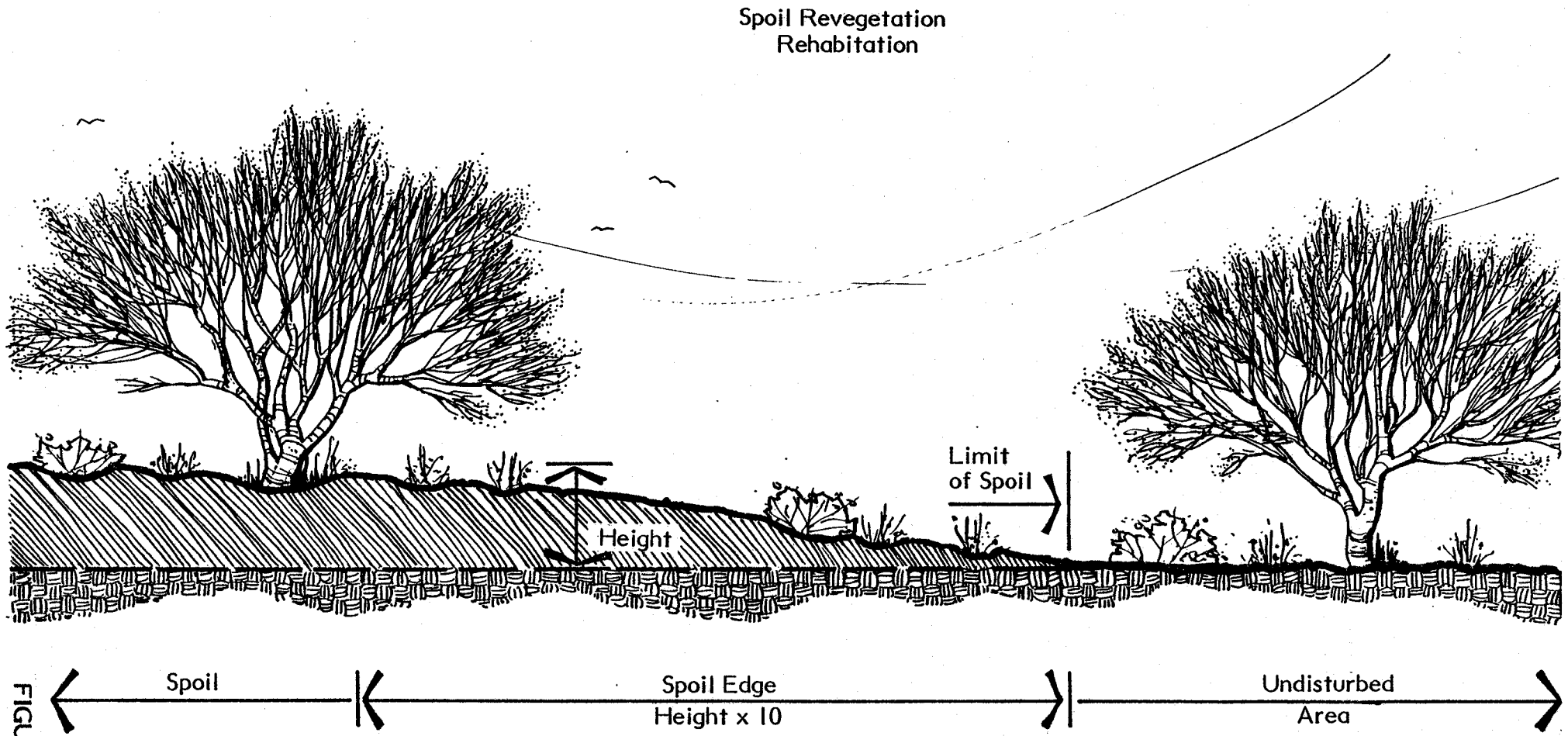
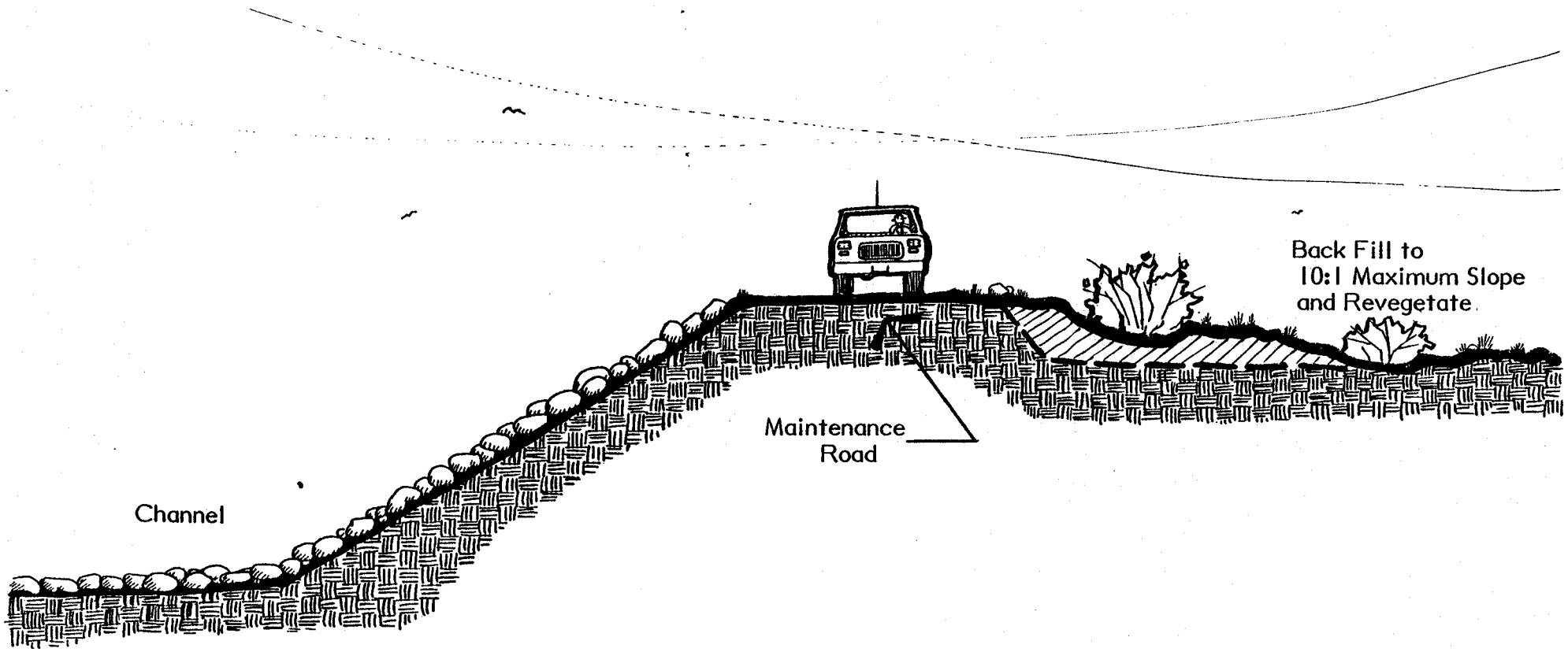


FIGURE 24

BLENDING OF SPOILS INTO NATURAL TERRAIN



BACKFILLING AGAINST ROADWAY CUTS

FIGURE 25

additives and fertilizer, turned into producing cropland. The cost-efficiency of providing cropland in this manner is borderline if the owner of the land must move the soil; however, if it is in the area of disposal for the Project and adjacent to existing irrigation facilities, the provision of levelled arable land may be an excellent opportunity to use the spoil material for topsoil mix.

Spoil disposal may be used to create additional agricultural areas, providing water is available, such as tree farm development. The production of arid-region trees and shrubs may be profitable considering the increase in market demand for arid-region plant material. Experimental farms might be established to grow various new types of arid vegetation through the universities or the agricultural extension service.

Berms

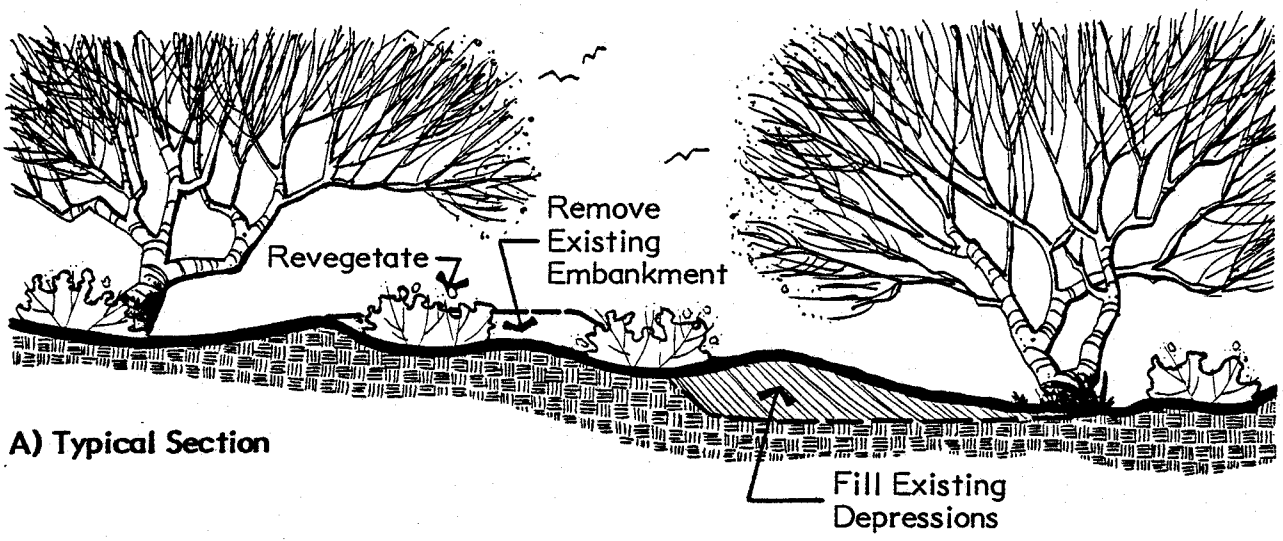
The use of spoil for berms and mounds will create a more interesting landscape by joining vertical movement to the channel corridor. The earthforms can also accent roadway entrances, park areas, trails and road crossings. Berms may increase traffic safety by offering visible clues to changes in direction of roads and trails and by establishing circulation corridors (Figure 16).

The use of berms also supplements the vegetation scheme, giving greater height to certain areas of plant material and allowing a greater reduction in visual and noise intrusions (Figure 22). Characteristics of desert vegetation growing on natural mounds, resulting from sheet flow, may be supported by the varied topography formulated by the spoil use throughout the key visual areas of the channel.

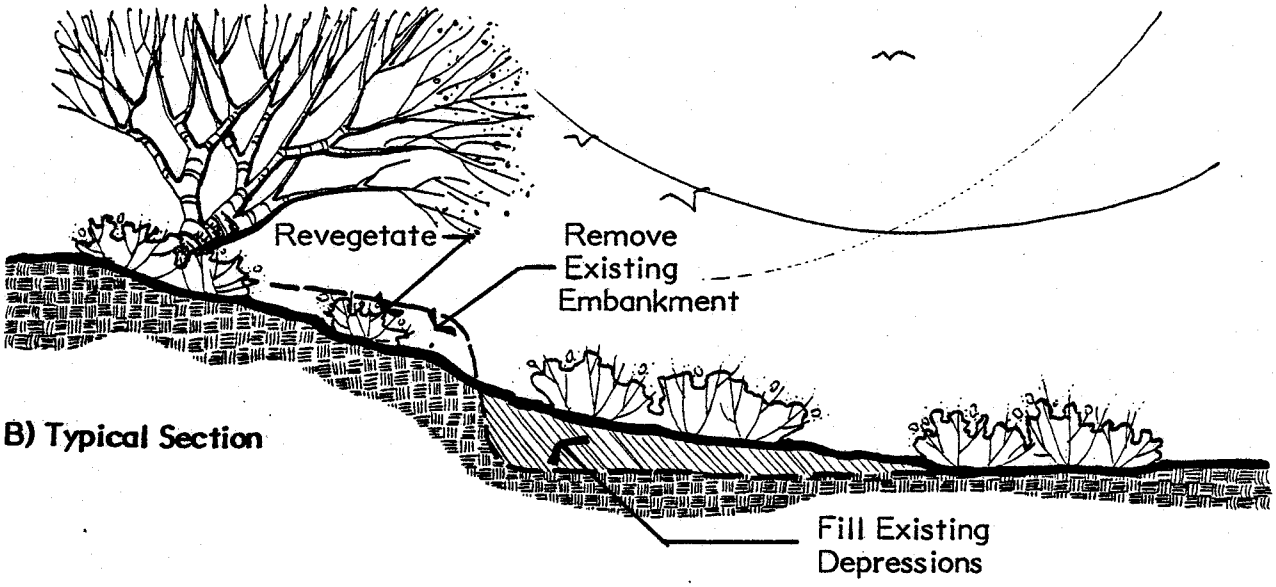
Scar Reclamation

The most visible earth scar resulting from the project is the graded pits or borrow areas. These areas, the earthen surface (soil), are often left at a grade incompatible with the establishment of plant material covers. Three alternatives for use of spoil material and/or grading to fill and shape slopes are shown on Figure 26A, B and C. This is the preferred method to recontour, sculpture and blend disturbed areas. Some regrading of the disturbed area to reduce bank height and feather edges steeper than desirable (3:1) for landscaping may be necessary. Chemical treatment (of the soils) for color change is not efficient since the soil absorbs great amounts of the liquid and the erosion process constantly exposes new surface of untreated color. There are soil adhesive chemicals available to stabilize the larger cuts and banks but the compatibility with coloring agents is unknown.

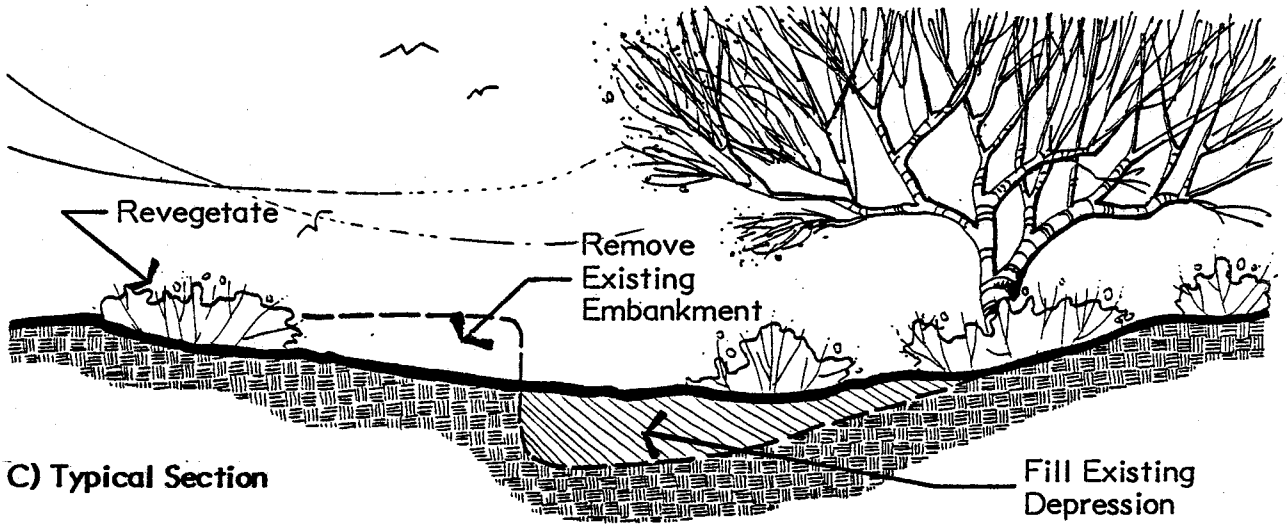
Disposal of spoil material in abandoned mine shafts may be a supplemental land scar reclamation technique available to the project. Also, blending of



A) Typical Section



B) Typical Section



C) Typical Section

RECONTOURING TO FILL AND SHAPE SLOPES

FIGURE 26

tailings and overburden areas around abandoned mines may be a valuable use of spoil.

Retention Ponds and Sheet Wash Breaks

Excess spoil material could be used for the establishment of retention basins and sheet wash breaks in the areas adjacent to the project. Benefits of retention basins would be the availability of additional moisture to plant material around the basins. A scheme for holding small amounts of runoff adjacent to the channel, perhaps in large spoil disposal areas, would benefit the periphery vegetation in the landscape schemes.

Landing Strips

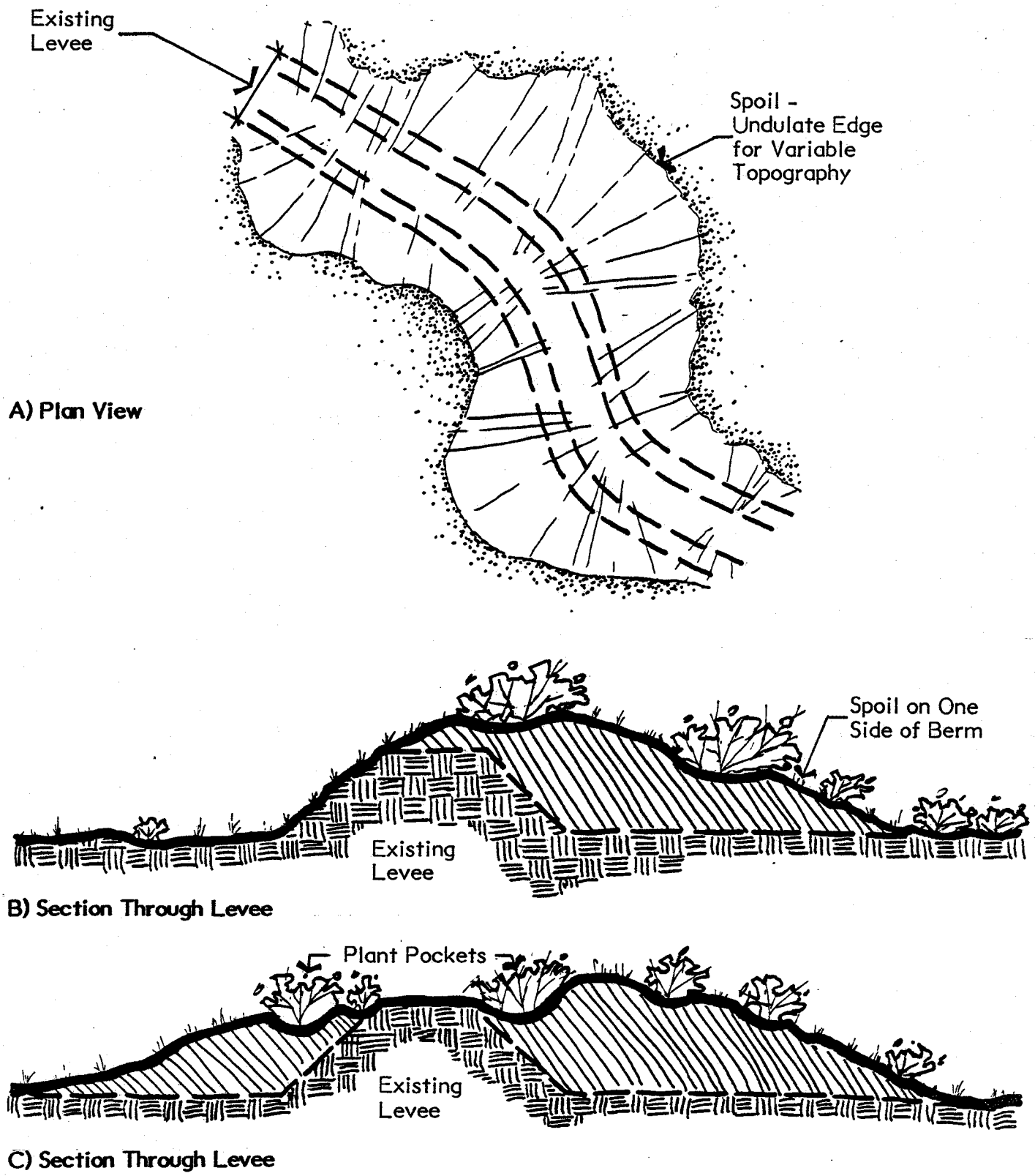
Spoil material and disturbed areas could be used to create a landing strip (dirt) as a supplement for Estrella Airport or other service that would be desired of an ancillary training facility. The spoil could also be used for reconstruction of runways at Sky Harbor in Phoenix or lengthening of runways at Williams Air Force Base. Other private/municipal airports may be in need of fill material to improve facilities. An operations base for powered hand-gliders, gliders and balloons could be desirable.

Levees

The levees adjacent to the project and within the general area can be recontoured and revegetated to produce a distinctive improvement of the existing landscape. The use of spoil material from the project can be added to the levees in horizontal and vertical directions as well as filling back from the levee face to meet existing desert grade (Figure 27A, B and C). The freeboard required by the engineered levee structure could be maintained while the levee itself became more like a natural series of hills and berms occurring in the desert. The visual intrusion can be further reduced by the addition of selected plant materials placed in a natural manner emulating the existing vegetative cover. Wildlife habitat improvement would also result from the additional plant material that would volunteer into the new soil section created, specifically on the upstream side where moisture will be more plentiful for a slightly longer period. Refer to Figure 12 for the section of an existing levee that should be protected and not filled.

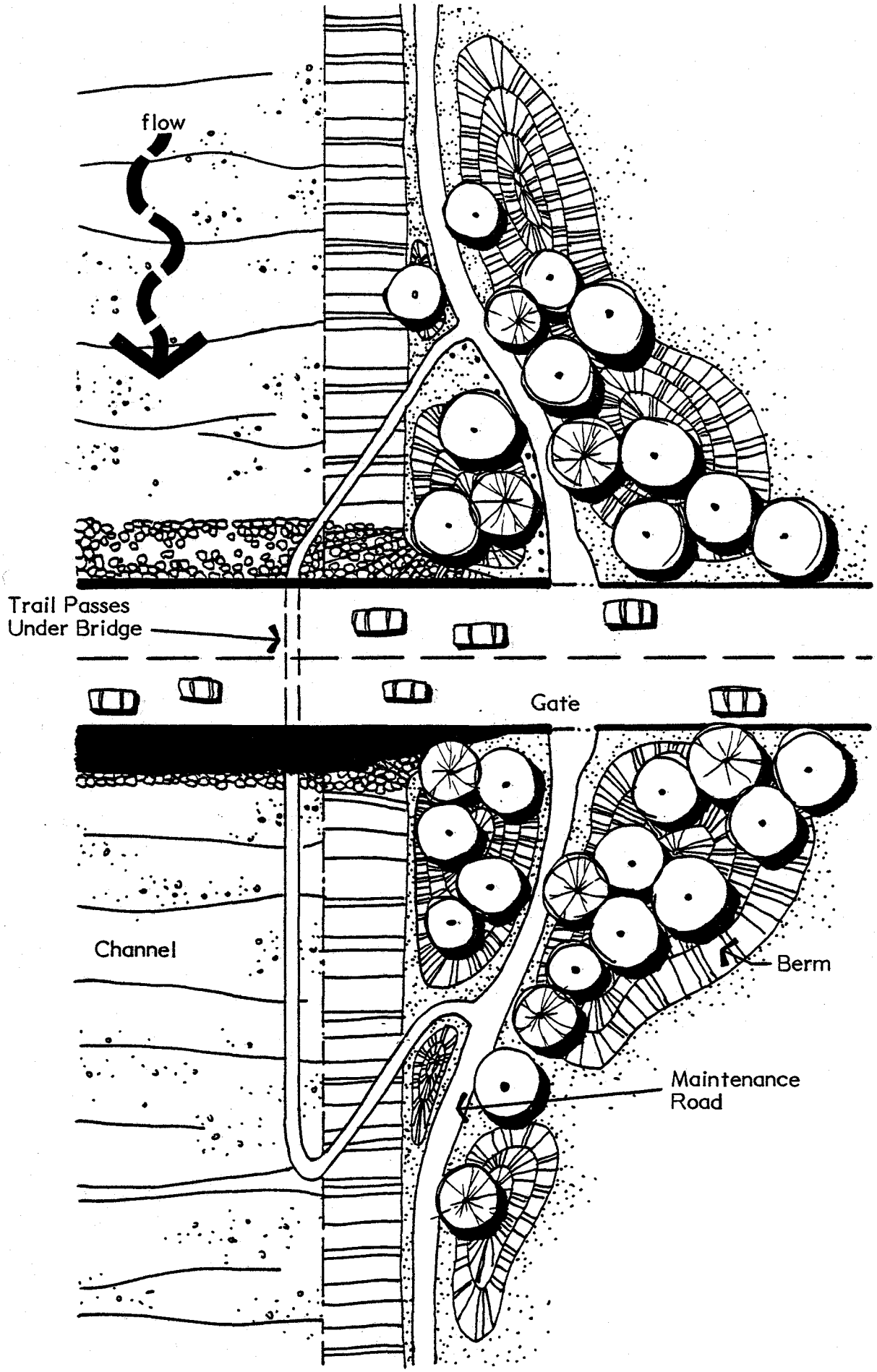
Road Crossings

Road crossings of the channel are one of the major points of project visibility. The method of treatment will be planting, mounding or berm design (Figure 28). The realignment of the maintenance roads could provide a



ADDITION OF SPOIL MATERIAL ON LEVEES TO REDUCE VISUAL INTRUSION

FIGURE 27



TYPICAL ROADWAY CROSSING AND TRAIL APPROACH (Plan View)

FIGURE 28

contiguous trails system in the future and reduce the potential safety hazard of a sharp turn at the end of a long, straight roadway (Figures 28 and 29A and B). The realignment of the source road/trail approaches creates "island" areas where the trail is engulfed in the vegetation and separated from the channel. It also serves as notice that a functional change is approaching--the roadway crossing. Gates and ballards could be placed at crossings to alert nonvehicular traffic to the roadway and potential hazard from vehicles (Figure 29).

Vegetation (riparian transitioning to desert shrub and grasses) will be drawn along the outside edges of the channel on both sides of the roadway to enhance the view of the motorist or pedestrian crossing the bridge or paved dip section (Figure 16). The vegetation will be placed up and down channel, a minimum of 300 feet from the road crossing (further if practical) to connect adjoining areas, increase the recreational users experience on the trails (maintenance road), or provide a link to side washes where riparian vegetation could deviate from the channel alignment and penetrate the surrounding desert. This would also be an acceptable treatment for intersecting roadways and areas, such as the Indian Village access, where an entrance-exit would benefit from better delineation resulting from vegetation and earthforms (Figure 30).

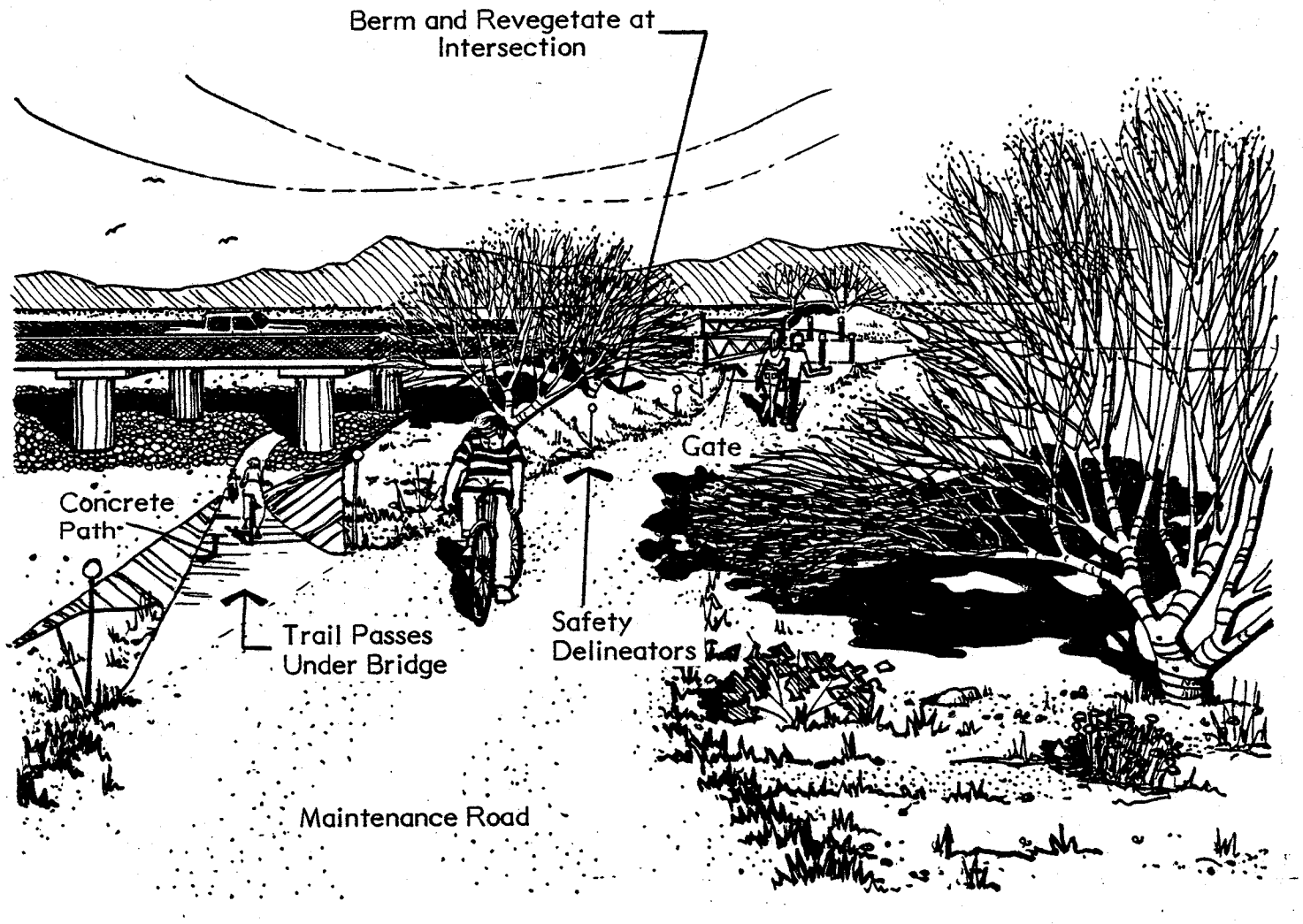
Dip sections will use the edge of a planting arrangement as visual guides for roadway direction when emerging from the bottom of the channel (Figure 15B). This safety feature will correspond with the drawing of desert transitional material away from the wash and along the roadways when a higher moisture content would be present adjacent to the paved section or graded area.

Bridge crossings result in a higher visibility of the channel because of the additional height of the viewer; therefore, the distance to be landscaped may be further down the channel away from the viewing point. Along Reach 1 and 2, the bridges are in proximity to other roadways and drainages that necessitate additional landscape measures on the channel corridor. The proposed landscaped area would be sufficient in these cases to successfully mitigate the linear view along the channel from the bridge (Figure 16).

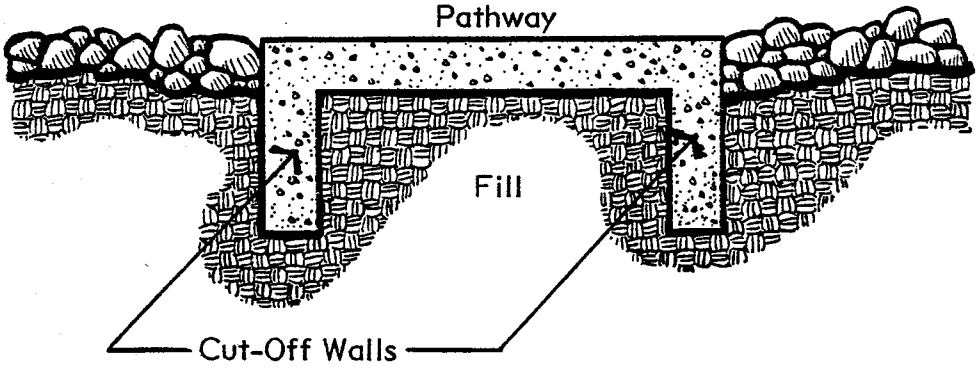
Rip-rap Areas

The potential visual intrusion of ungrouted stone cobble rip-rap along certain areas of the channel can be reduced in two ways: (1) chemical coloring to match desert varnish and paving through the use of Eonite or a similar process; or (2) soil backfill to form a channel armour expendable at peak flows and higher velocities.

The Eonite process involves two steps. First, custom formulated oxidizing chemicals are applied to rock surfaces accelerating the aging process at the stone surface resulting in a highly stable (100 years plus) color

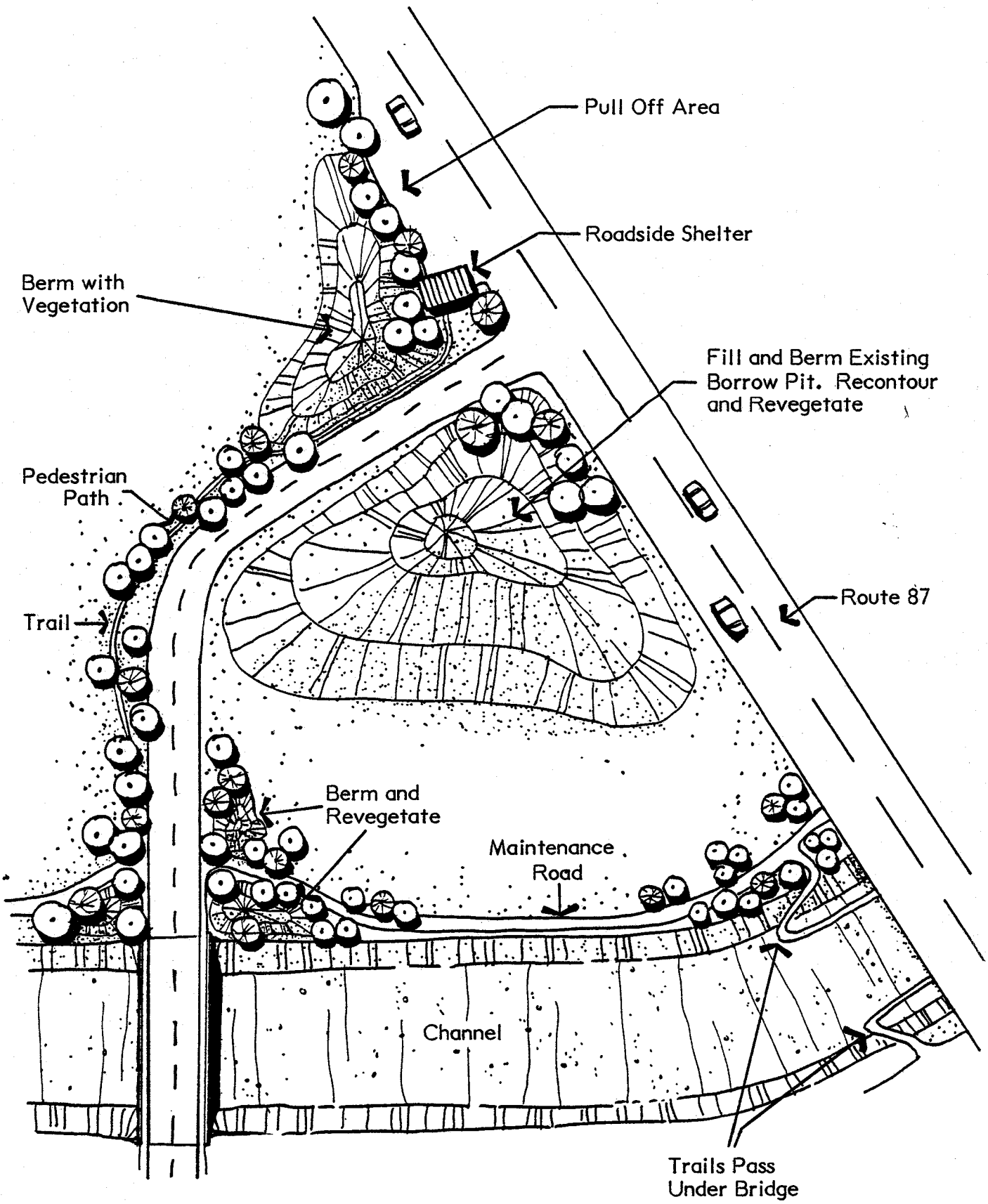


A) TYPICAL ROADWAY CROSSING AND TRAIL APPROACH (Perspective)



B) TYPICAL CHANNEL TRAIL SECTION

FIGURE 29



INDIAN VILLAGE ACCESS

FIGURE 30

coating. The oxidizing process is then neutralized when the rock surface has attained the desired degree of varnish and coloration. Nitrogen and trace quantities of metalic ions are given off as residuals, which provide a natural fertilizer for plant growth.

The overfill of the rip-rap is not desirable in the existing channel since volumes have been computed on the existing channel profile. The second reach could be adjusted to use this method; however, the soil cover would be expendable at a given frequency of flood and would require frequent repair under these conditions. The visual intrusion of the rip-rap results from the uniform nonconforming color contrasting with the adjacent soil and desert pavement (it should be noted that some additional visual interest is also provided). The chemical coloring of the rip-rap would reduce visual intrusion and is less expensive with no maintenance involved.

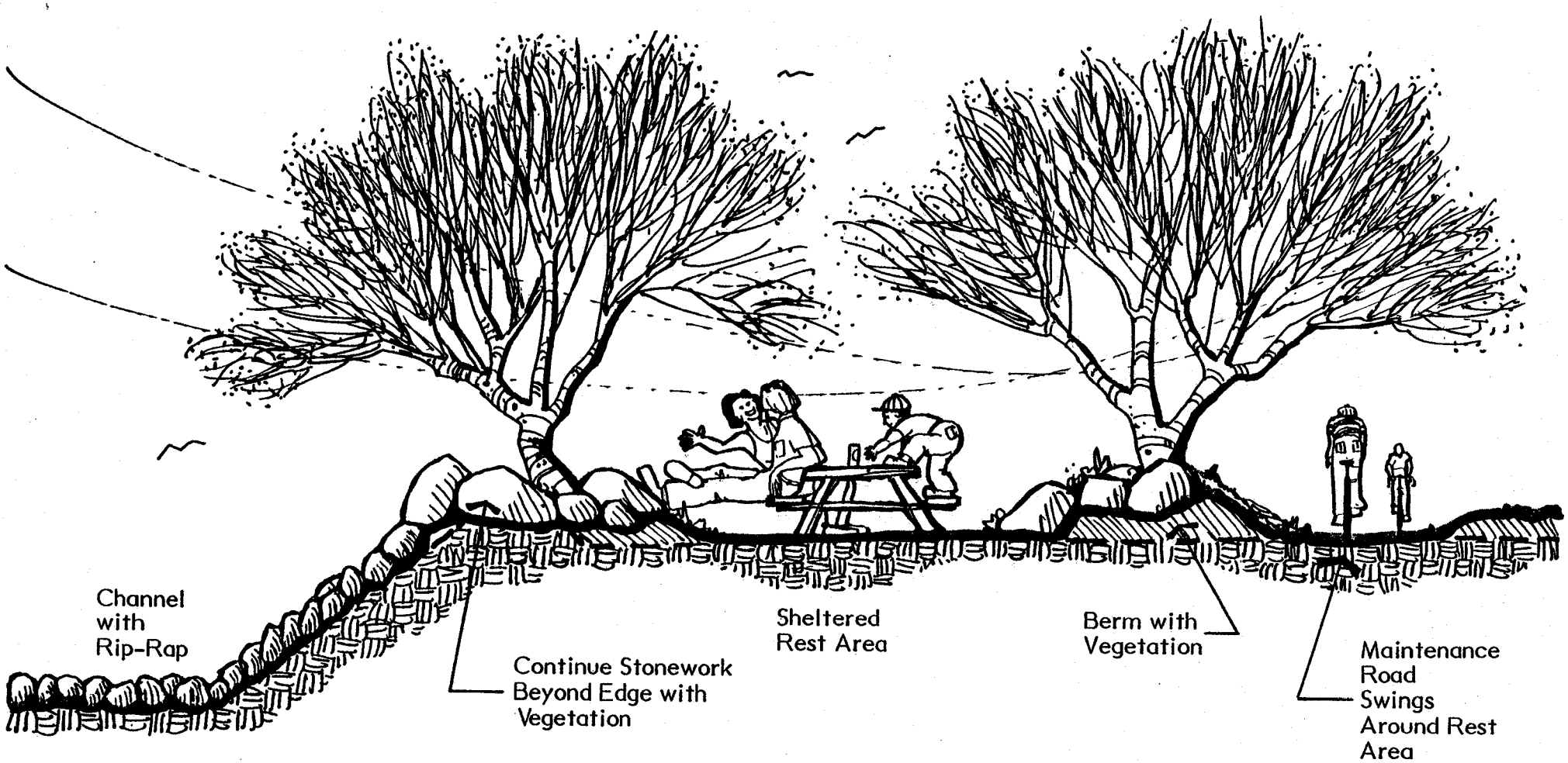
Chemically-treated rip-rap areas could be extended over the bank into recreation areas to provide additional interest to the area and have the appearance of a natural occurrence (Figure 31). This could be further enhanced by the addition of large boulders in the rip-rap area, interspersed plant material and feathering the out-of-channel rip-rap into the landforms and desert pavement as a part of the landscape. The pocket created in this method could be used as a trail stop, picnic area or visual barrier to adjacent uses.

Concrete-Lined Channel

Concrete-lined sections of the channel may be aesthetically treated as follows: (1) accent the channel with graphics on the concrete walls; (2) blend the concrete into the landscape by tinting the concrete a similar color; (3) texture the surface of the concrete to resemble the surrounding ground cover; or (4) use vegetation and berms to visually screen the channel from observers.

A concrete-lined channel presents a high structure contrast to the natural character of the earth-lined channel. The use of graphics on the concrete sidewalls of the channel would allow the channel to become a backdrop for an aesthetic display. This alternative is most appropriate in an urban area with a large use-volume of observers. The graphics could include a lineal display for the entire channel with higher-use areas accented by special signage and graphics (Figure 32). The surrounding landforms, vegetation, trails and overlooks would be located to best display, complement and accent the channel and its accompanying graphics (Figure 33).

In Reach 2, the concrete-lined section of channel is within the Gila River Indian Reservation where local Native American symbols may be used to create additional interest for the observers. An existing pump station, used as a swimming hole by local residents, could be linked to a passive recreation site



RIP-RAP EXTENSION INTO RECREATION AREA

FIGURE 31

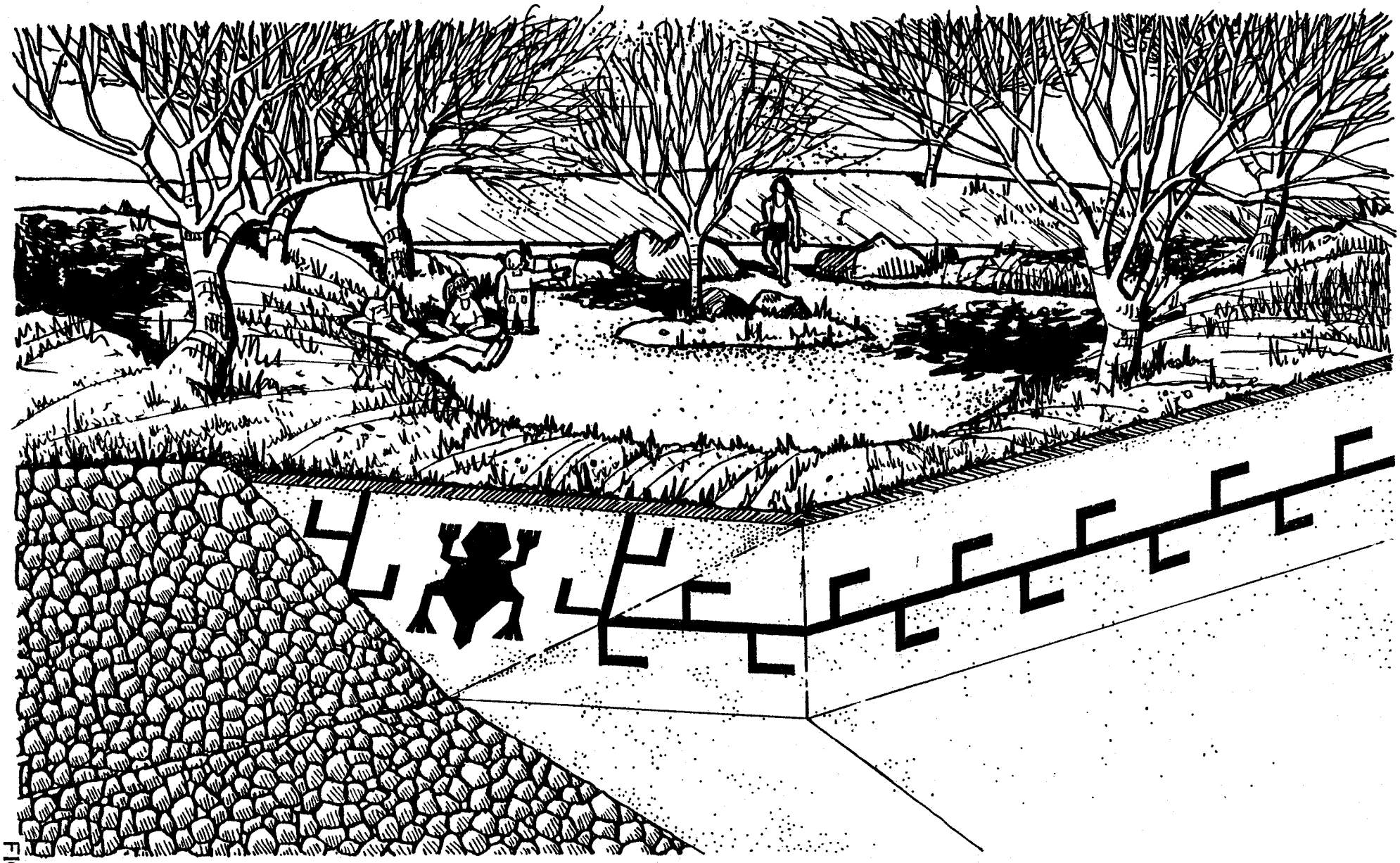
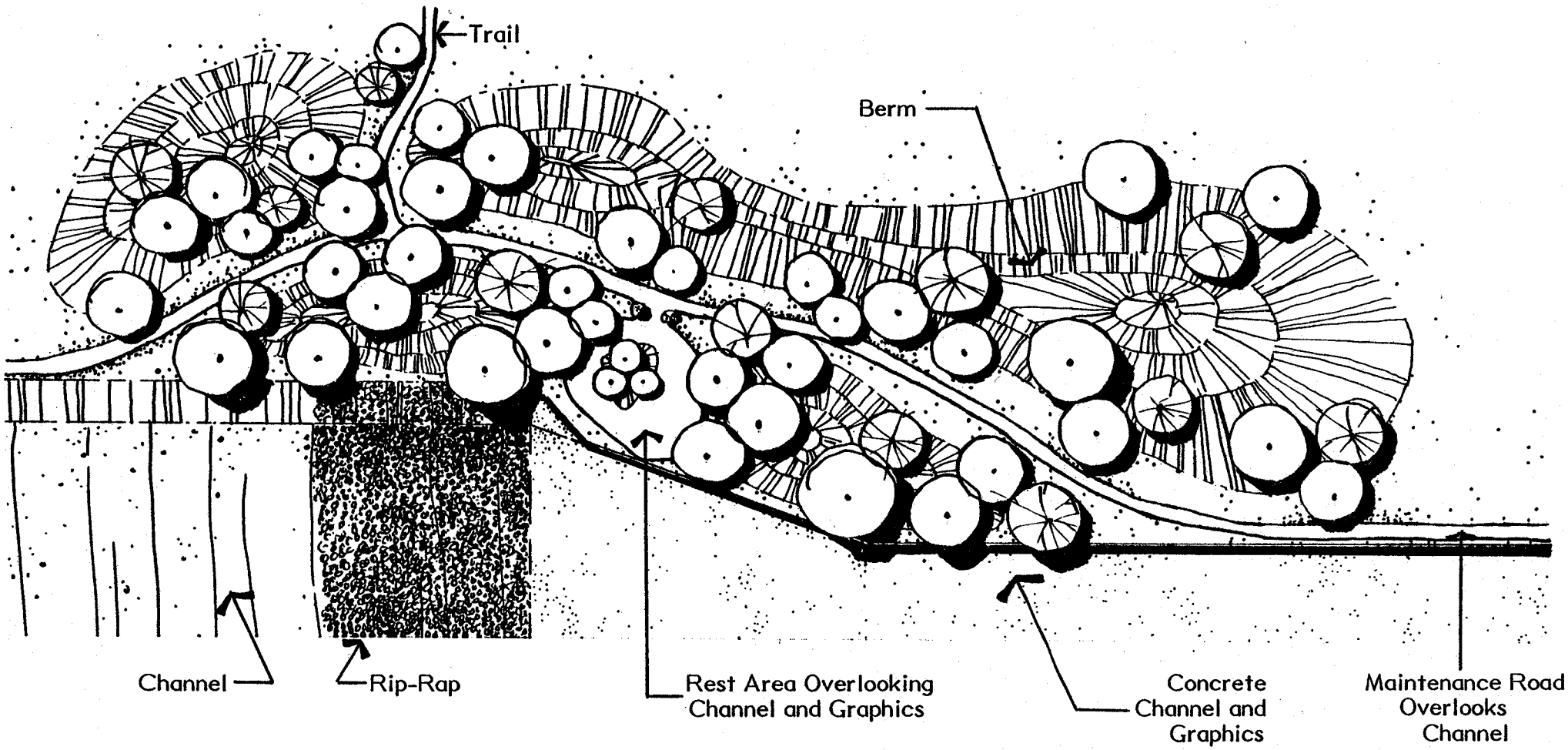


FIGURE 32

TYPICAL GRAPHIC CONCEPT FOR CONCRETE-LINED CHANNEL



TRAIL AND REST AREA WITH VIEW OF CHANNEL GRAPHICS

FIGURE 33

beside the channel where a vista point could be located to view wall graphics, further enhancing the viewer's experience.

Concrete walls of the channel may contrast less with the landscape if they are colored and textured to resemble the surrounding landscape. By minimizing the color and texture differences of the channel to the surrounding landscape, the visual contrast of the channel would be reduced. The surrounding earthforms may also be used to further soften and absorb the concrete forms. This approach may be most appropriate where the area is not to be emphasized, but viewed similarly to the unlined sections of channel (Figure 34).

Views of the concrete-lined channel may also be blocked to observers through the use of berms and vegetation as visual screens (Figure 35). By locating hiking trails away from the concrete portions of the channel, the intervening landscape may be used to introduce softer, natural forms, colors, lines and texture while eliminating inappropriate views to the channel.

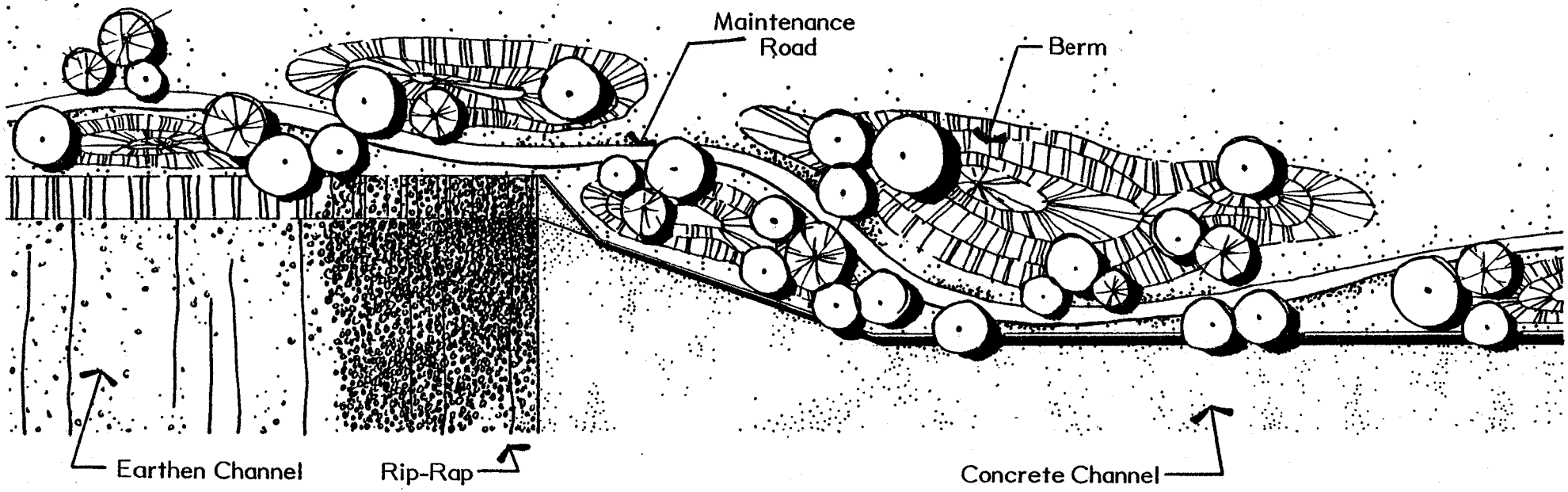
Recreation Sites

Various levels of recreation sites could be furnished along the channel. The linear nature of the corridor limits the types of recreation (soccer fields would not have sufficient room) to passive activities other than trail hiking and riding. The activities could be a small park (Figure 17), picnicking sites (Figure 19), roadside shelters (Figure 30), or swimming holes where water is available (Figure 23).

In more urban areas, additional property may be acquired to provide recreation fields and ball diamonds where applicable and also provide additional areas for spoil disposal. The channel could be placed underground and playing fields constructed over the top. The existing 330-foot right-of-way for Reach 1 and 2 could then support active recreation.

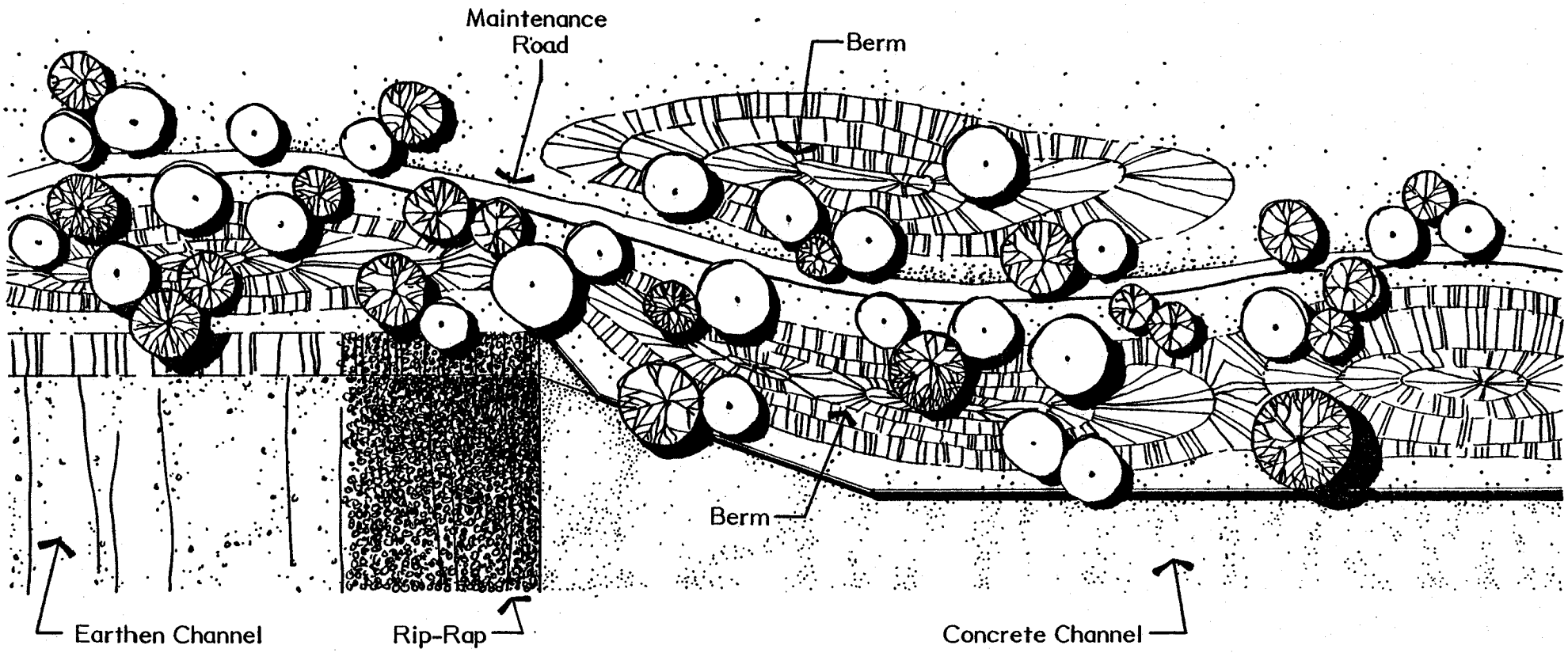
The creation of recreation areas and rest areas along the channel at reasonable intervals (approximately one mile) help to draw users to the potential trails system along the canal as well as give further impetus to additional landscaping along the canal corridor. The recreation areas could be placed in conjunction with side drainage areas, giving further support to the more dense vegetation and more active earth manipulation taking place there.

A trails system is a logical use of the canal corridor. Although this part of the Project (Reach 1 and 2) is not ideally located for heavy use, a multi-use trail (hiking, biking and equestrian) could be established along the maintenance roads already present. The trails system at the location is a long-range endeavor looking forward to a tie with the Maricopa County trails system, the metropolitan Phoenix and valley systems and further north to the Central Arizona Project (CAP) trails system. Two major trails systems currently extend north-south between CAP and the proposed Rio Salado (Cave Creek and



TRAIL BLENDING WITH CHANNEL

FIGURE 34



TRAIL SCREENED FROM THE CHANNEL

FIGURE 35

Indian Bend Wash) and the ultimate destination of the RWCD canal in Apache Junction. This is an excellent opportunity to proceed south with a trails system to Casa Grande, perhaps ultimately tieing into CAP again at Picacho Peak State Park.

Other recreational opportunities which would increase by the rehabilitation of the channel corridor could be related to the proposed wildlife habitat improvement. Bird watching, photography, wildlife art and hunting (on the periphery of the reservation) could experience increased participation due to the greater numbers of animal life resulting from an improved food chain.

Additional recreational uses to be considered for the flood channel and its environs could be a recreational vehicle park (spoil material could be used to level and fill an area sufficient for parks and buildings), a golf course and/or driving range, an archery range, horse facilities such as practice polo fields and rodeo arenas, rifle and pistol ranges, skeetshooting, moto-cross tracks for bicycle or motorcycle use, par-course (in densely developed areas), radio-controlled aircraft or vehicles, ballooning, and urban camping (a campground experience within an urban setting separated by earthform and vegetation).

Wildlife Habitat Improvement

The continuation of the riparian growth from the Gila River and the enlarging of vegetation areas on side streams as well as addition of grasses and other groundcover should create additional habitat for birds and small game (Figures 13 and 17 and 18). The amount created should more than replace that lost by construction of the channel.

The introduction of new arid-region food plants and the continuation of proven plants such as Atriplex and mesquite will serve to create the desired desert-oriented landscape along the channel as well as provide additional forage and habitat for various animal species.

Fencing

The Flood Control District of Maricopa County (FCDMC) has required that the entire RWCD right-of-way be fenced. Various fencing types and treatments may be used along the channel (right-of-way, following SCS guidelines) depending upon the function of the fencing and location of the area to be fenced. Where the channel crosses rural landscapes (most of Reaches 1 and 2), the primary purpose of the fencing is to keep off-road vehicles out of the channel. Security fencing, in these areas, could consist of five-strand cattle fencing strung on T-posts. There are relatively few observers along the desert and agricultural reaches of the floodway. There are some areas, road and pedestrian crossings, as well as more urbanized areas, where an increase in the number of observers viewing a location and their sensitivity to the landscape

may necessitate another type of fencing treatment to be used. In these areas the function of the fencing may be to control vehicular and pedestrian circulation and provide a compatible landscape setting where the channel and fencing are more visible to observers. In these places, specific treatments such as bollards, gates, bare galvanized, or beige vinyl-coated chain link fencing may be the best design application. In visually sensitive areas, part of the channel right-of-way may be used to screen the fencing with berms and vegetation, or vining-vegetation may be planted to grow over and through the fence for additional visual screening of the channel.

The act of fencing the channel will create a visual intrusion. The line effect created by fencing the channel will appear as a linear feature crossing the desert and will add to the visual contrast of the channel in flat, sparsely vegetated landscapes. This may not be an issue along some sections of the channel surrounded by agricultural areas containing few observers. However, in more sensitive areas, the linear aspects of the fencing may need to be visually screened or absorbed through the use of earthforms, vegetation, and the location and type of fencing chosen.

Cultural Areas

Nearby archaeological sites will be considered for the level of importance and potential for interpretation as a part of the canal recreation system. Other approaches to the archaeology would be the backfilling of the sites with spoil material for protection or delineation of the area by mounds and berms, giving it an isolated atmosphere in support of a potential interpretive program.

Cultural areas such as the cemetery adjacent to the channel can be visually removed from the corridor by berm and vegetation manipulation, or tied into by the same manner, if desirable.

Miscellaneous

The conservation of distinctive landscapes, such as Gila Butte or the plant growth that has developed around the levee should be a high priority (Figure 12). Methods of spoil disposal, planting technique and circulation patterns should work towards the continuation and improvement of the views and materials now in place.

The maintenance (protection) of existing vegetation is very important. The vegetation in place on the project is limited and it will be expensive to replace it. The existing vegetation has developed a community with the topographical features aiding in water retention, erosion protection and a limited topsoil layer. The wildlife has established a relationship with existing food and shelter plants which should be further encouraged by improvement of vegetation habitats.

REHABILITATION OPPORTUNITIES FOR RWCD

Reclamation of desert land has changed considerably in scope from once meaning that the land was first irrigated and then turned into a crop-producing area to the present definition of a treatment of disturbed lands to restore the natural occurring vegetation and landform. Within the limitations identified in the alternatives section and the opportunities and constraints map (Figure 13), the landscape rehabilitation of the RWCD Project will follow five steps: (1) reshaping of the earthforms disturbed by the channel construction and disposal of the spoil material; (2) restoration of the topsoil section and soil improvement, if considered advantageous relative to the desired revegetation cross-section; (3) reclamation of existing extraction pits, fill areas and spoil disposal piles; (4) reestablishment of natural groundcovers; and (5) the introduction and reestablishment of arid and native shrubs and trees.

Each of these steps take a specific time schedule and have an established linear progression in order to function properly. Landform must be completed prior to establishing groundcover, for example, and technique of reclamation of a borrow pit or eroded area may be by either vegetation introduction or landform manipulation, or both. In all cases, a specific period of maintenance must be established during which moisture supplement is furnished to the plant material to assure its proper establishment. This additional moisture requirement will vary in relation to the plant material and the time of year the installation takes place. Proper timing of the revegetation to coincide with the rainy season for the RWCD project area will significantly reduce the need for supplemental water.

To complete a regeneration/reclamation of the disturbed area resulting from the project construction, consideration must include: (1) the revegetation of native species to return the area to its near original condition of plant material cover; (2) the improvement of specific areas (see Figure 17 and 18) to allow for increased recreation and wildlife habitat; (3) creation of visual barriers, and/or general upgrading of areas receiving use by residents and visitors. The following is a brief review, in generic terms, of the five landscape architectural steps envisioned.

Reshaping

Reshaping of earthforms disturbed by channel construction should be completed initially and could utilize the disposal of spoil material from the construction site. Mounds and berms may be desirable in areas to provide visual, aural and circulation barriers as well as additional vertical height for vegetation. The creation of a landscape that undulates vertically as well as horizontally (Figure 27) will result in a more natural appearance, providing visual interest as well as barriers by the changes in earthform height and width. The use of spoil material for earthform is desirable, although the overall character of the site limits the height of berms and mounds to avoid

appearing out of place in the relatively flat topography that currently exists. Variation in width is not so critical a factor.

The shaping of earthform can provide additional drainage, erosion prevention and circulation control, as well as safety (blocking vehicular access to the channel), especially on curves in the maintenance road and public crossing approaches (see Figures 28, 29, 36 and 37). Additional visual interest can be added by winding the maintenance road (trail) through varying height mounds and berms, thus avoiding the boredom of a long, straight, level stretch. Picnicking areas and small park/rest areas can be isolated from the surrounding desert and channel area giving an oasis feeling to the resulting "pocket." This "pocket," with the addition of plant material, could become a very pleasant rest stop or mini-park providing shade and visual interest to users of the trail system along the channel.

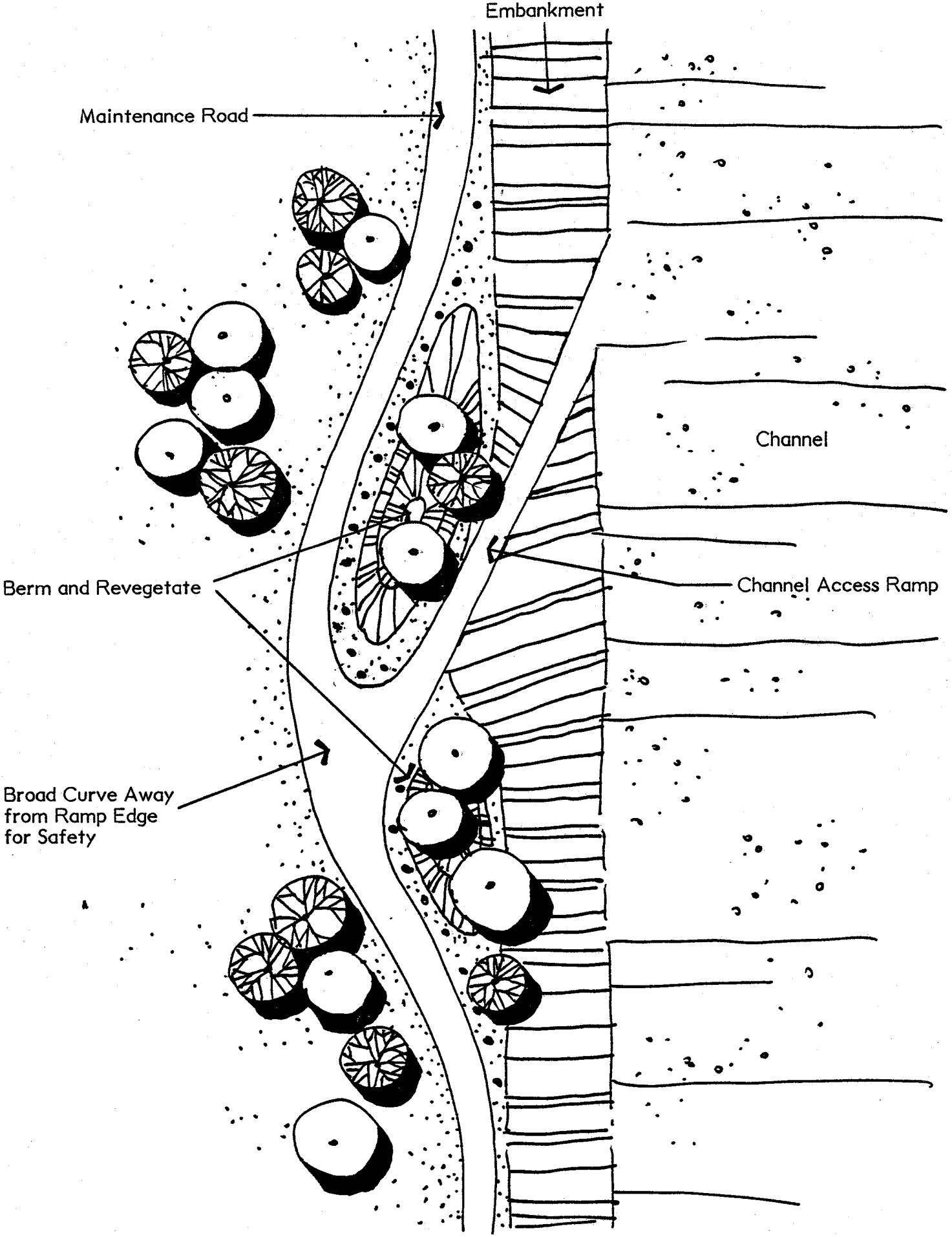
Restoration

Restoration of the topsoil section and soil improvement, if advantageous in relation to desired revegetation cross-sections, would be completed. The existing land surrounding the channel has a topsoil section present although apparently insignificant in its ability to provide nutrient and moisture for vegetation. The stripping and stockpiling of topsoil should be considered during the Reach 2 construction. In addition, reconstruction of a topsoil layer is desirable in Reach 1. It is necessary to be very cautious in soil improvement, however, to avoid a soil mix so superior that extreme growth along the channel would create an undesirable visual accent relative to the surrounding desert.

Stabilized areas (graded areas and slopes) will have topsoil reestablished in one of two methods: (1) the land surface will be cleaned and scarified and a topsoil section applied directly if available (such as spoils from Reach 2 to Reach 1); or (2) a satisfactory section can be constructed by the addition and intermixing of various materials such as sand, organic material, soil conditioners and natural mulches. It is possible that, where topsoil and subsoil are mixed, certain chemical changes may occur invalidating earlier soil tests concerning nutrients and desired additives.

Soil properties generally considered important to a reclamation effort would be: (1) the free salt in the soil; (2) exchangeable sodium ions in the soil; (3) free lime in the soil; (4) water erosion susceptibility; (5) percent base saturation (basic indicator of soil fertility); (6) pH factor; (7) saturation percentage (water holding capacity); (8) sodium absorption ratio; (9) soil texture (sand, silt, clay mixture); and (10) wind erodibility.

Various methods of further enriching the topsoil layer may be the application of sewage effluent, composted manure and a straw mulch. A silva-fiber mulch



TYPICAL CHANNEL ENTRANCE APPROACH

FIGURE 36

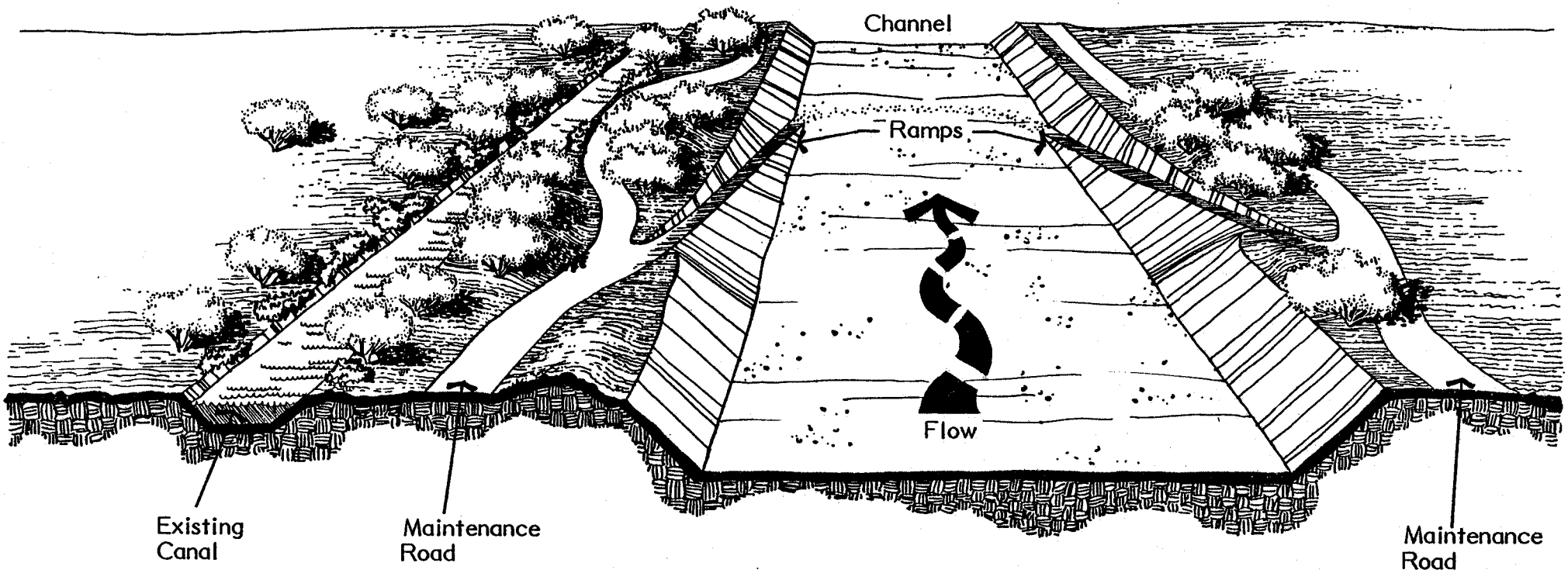


FIGURE 37

TYPICAL APPROACH TO CHANNEL ENTRANCE AND CROSSING

designed to retain a high percentage of moisture would be beneficial to hydroseeding efforts over large disturbed areas such as spoil disposal areas.

Reclamation

Reclamation and continued earth contouring of existing extraction pits, borrow areas, and fill areas would provide a disposal area for spoil produced by the continuing channel construction. Addition of spoil to existing levees and spoil piles could soften the visual intrusion and, consequently, be visually more compatible with the surrounding environment. The use of existing or future spoil material to produce a physically stable area (creation of desirable gradients) is imperative to a successful revegetation effort. It also takes advantage of the various opportunities for earthform manipulation that provide user interest and aesthetic amenities.

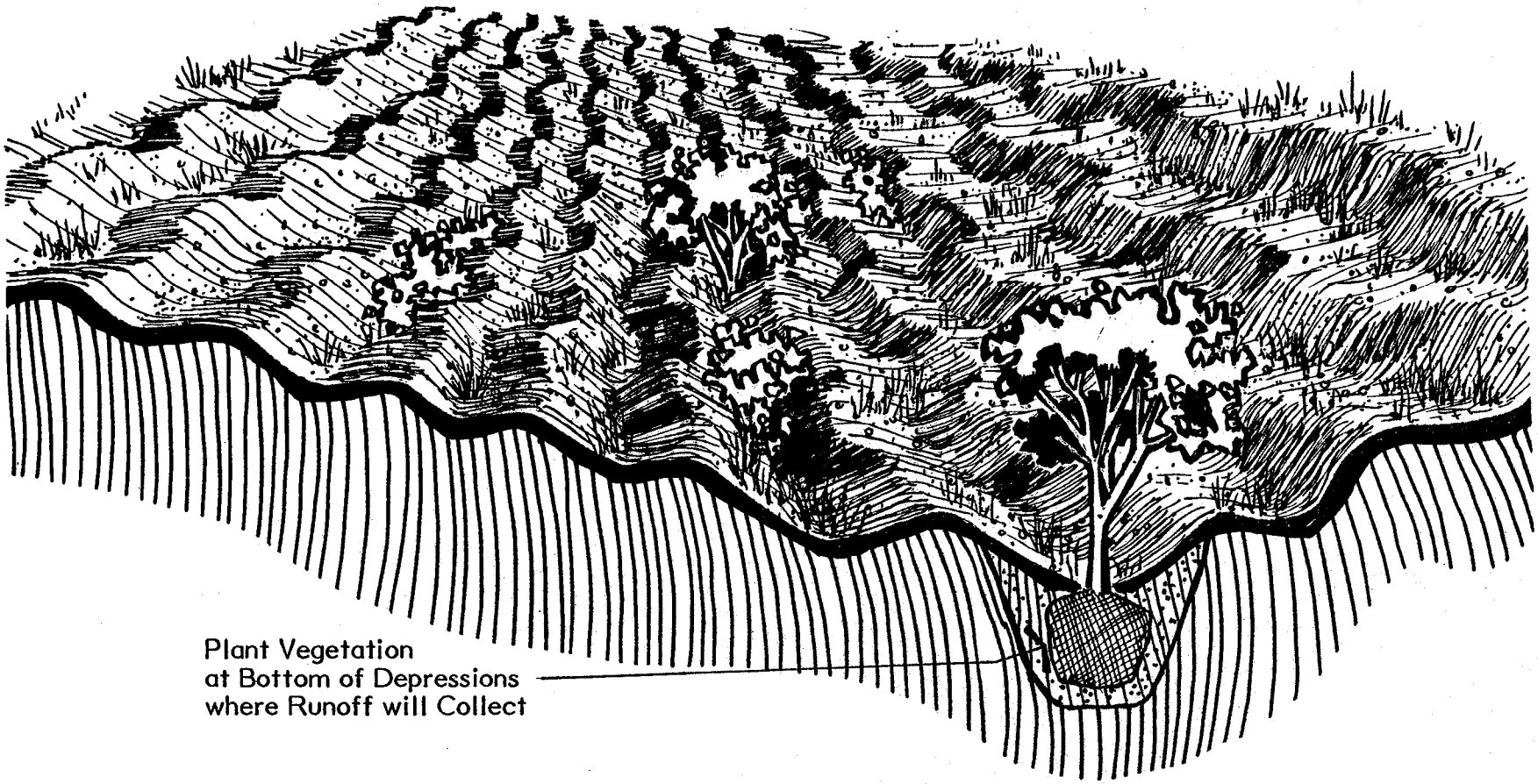
Groundcover Reestablishment

Reestablishment of natural groundcover prior to the planting of larger shrubs and trees provides a stabilized ground section that prevents erosion of scarified soils and other mechanical surface manipulations such as listering (Figure 38), gouging, chiseling and Dozer Basin (Figure 39). The groundcover also impedes runoff and increases infiltration.

The groundcover lowers soil temperature, minimizes raindrop splash and reduces surface puddling and sealing. The plant layer traps and holds additional seeds and forbes, either deliberately applied or volunteers. There is a symbiotic relationship present in many desert grasses and shrubs, usually a symbiotic fungal relationship at the rootzone which results in a heightening of the soils ability to trap and store various nutrients needed by the plant material. Soil innoculated with Mycorrhizal establishes an endomycorrhizal association which is, for instance, especially advantageous to the establishment and growth of four wing saltbush (Atriplix). Developing this type of soil conditioning prior to planting trees and shrubs should reduce the mortality rate and decrease the effort necessary to assure proper plant establishment.

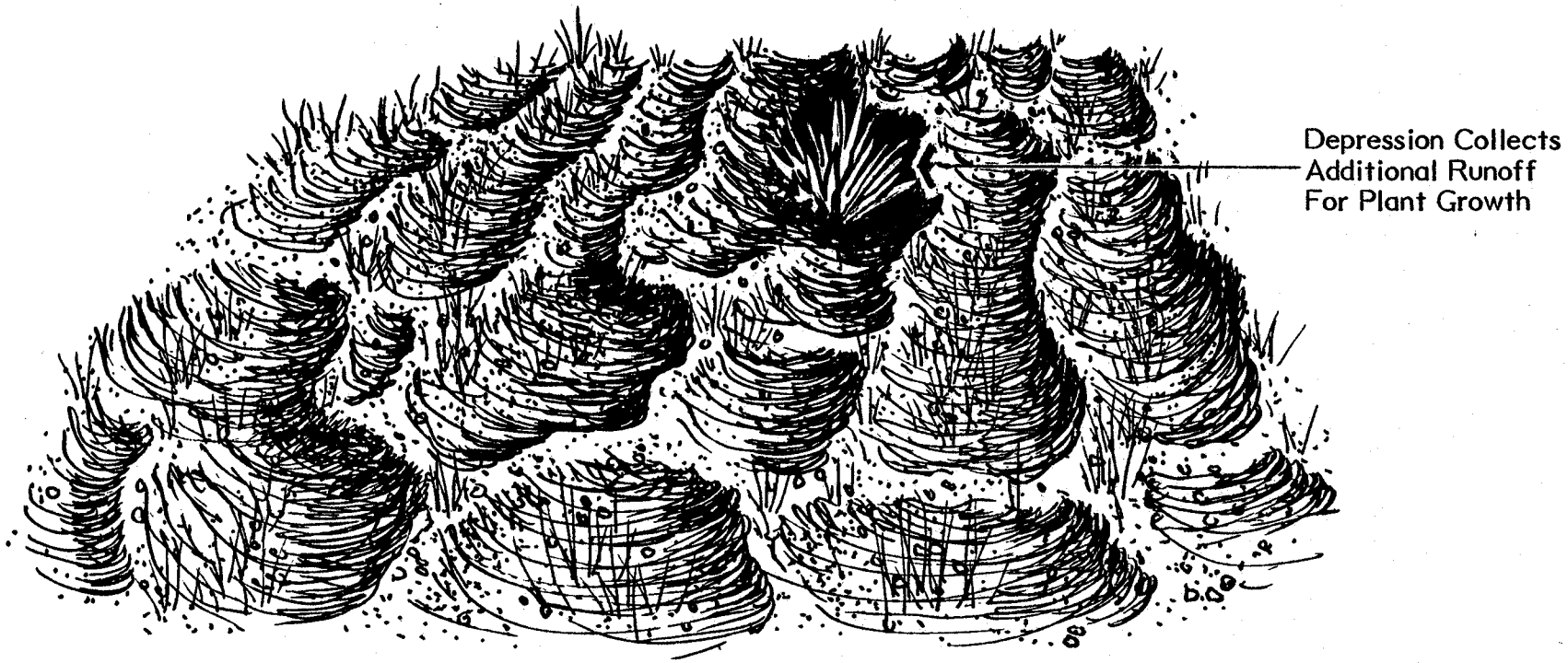
Materials involved in the groundcover establishment could be native grass seed, introduced grass seed, native grass plugs, introduced grass plugs, native forbes and lagumes seed, introduced forbes and legumes seed, selected native shrub seed, selected introduced shrub seed, selected native shrub seedlings (from containers or collected) and selected introduced shrub seedlings (from containers or collected).

Two other methods of plant material introduction would be topsoil with plants or roll mats, both of which are dependent on additional moisture being furnished during establishment period.



LISTERING OF SOIL SURFACE FOR REVEGETATION

FIGURE 38



GOUGING, CHISELING AND DOZER BASIN OF SOIL SURFACE FOR REVEGETATION

FIGURE 39

1. Topsoil with plants involves the shredding of living plant material into fragments, essentially sprigs, which are mixed with the topsoil prior to spreading. The material must be handled quickly and not stockpiled, and a moisture-holding mulch such as silcon-fiber must be added.

2. Roll mats are especially effective on slopes. The mat is a sandwich of the selected vegetation seed stock in a fertile medium and moisture-holding mulch. It is secured in position with pins, allowing the vegetation to root into the slope area. The mat disintegrates over a period of time leaving the established plant material to continue growth.

Aerial application of seeds, mulch and moisture could also be considered. The initial plant material application and its subsequent watering by slurry bomber could be a cost-effective method of revegetation. Condensation traps (Figure 14B) may be considered on larger important plantings that may take a longer period to guarantee establishment. Tublings, or the drilling and planting of soil stock in deeper soil where a higher moisture level may be present should also be considered.

Introduction and Reestablishment of Shrubs and Trees

The final step within the rehabilitation scheme is the introduction and reestablishment of arid and native shrubs and trees. Methods of this introduction may be through the use of native shrub seed, introduced shrub seed, native shrub seedlings (contourized or collected), introduced shrub seedlings (containerized or collected), native tree seed, introduced tree seed, native tree seedlings (containerized or collected), introduced tree seedlings (containerized or collected), larger native tree stock (containerized, boxed, bare root or collected by mechanical means such as tree-spade), and larger introduced tree stock (containerized, boxed, bare root or collected by mechanical means such as tree-spade).

The introduction of plant material could include transplanting cacti to form a fast plant cover. Cacti, however, are very sparse and by themselves not sufficient to revegetate the disturbed area. On disturbed areas, plant cover may invade naturally over many years once the soils are stable. Revegetation shortcuts this process, especially when dealing with the larger riparian materials and other arid adapted trees and shrubs along the project.

The establishment period and maintenance of the larger trees will be more involved than with the grasses, groundcover and shrubs, and smaller trees. Large stock (specimen) materials should only be introduced where a cost-effective and an immediate result is desirable. This would be especially applicable to urban areas where immediate screening and blending of the project is desired.

In all cases of native or introduced plant material, the final selection will be based on its hardiness, ability to be transplanted, survival records in similar situations, local availability in sufficient number, mobilization cost of crews and equipment for proper installation, cost of the material on an installed basis (inclusive of individual fertilizer requirements, soil mix and other special requirements), availability of acclimatized, locally grown stock, access to collectable material and specimen trees, and compatibility as a homogeneous plant community providing soil protection and wildlife habitat. The desirable end product is a functional landscape that provides recreation opportunity, where possible, and appears as a native vegetation unit, blending with the surrounding plant material and landforms.

Recommendations

As a result of Wirth Associates' visual analysis and landscape rehabilitation study of RWCD Reaches 1 and 2 for the SCS, many alternative opportunities and constraints have been presented and explored. Various sources of information, including fieldwork, agency and private business contacts, and secondary sources were used to form the basis for landscape architectural recommendations. In addition, the SCS contributed valuable assistance and guidance during the course of this study, with many of the alternatives presented resulting from the direct input by the SCS.

Based upon the visual study findings, using the SCS Landscape Architecture System, most of the landscape traversed by RWCD Reaches 1 and 2 consists of irrigated agricultural lands or natural desert with a fairly low population density. In order to lessen the impacts of the channel, its construction, maintenance roads and fencing, most of the area will be contoured so as to best blend into the existing landscape and to provide a favorable environment for the reestablishment of native vegetation. This may be accomplished by seeding most of the length of the channel right-of-way with native seed not requiring supplemental irrigation.

There are some key areas along RWCD Reaches 1 and 2 recommended for additional treatment. These locations include areas where more people interact with the channel, such as vehicular and pedestrian crossings. Also included are existing wildlife habitat areas, which have been disturbed, where the channel empties into the Gila River and at canal crossings with riparian vegetation along the two channel reaches. These areas could be reestablished in order to replace the lost habitat. Another area that may require further treatment occurs along the concrete-lined portion of Reach 2 because of additional channel right-of-way available for spoil redistribution. Within the concrete-lined channel area, where fast flows are expected during flood events, there may be additional need for landscaping to keep people safely away from the channel.

The areas which are recommended for additional vegetation and landscape treatment may be hydro-seeded in the same manner as recommended for the rest of the channel right-of-way, but the seeds may be of different species.

The areas recommended for additional vegetation and landscape treatment may require additional application of seed, use of containerized plants for a more immediate effect and the necessity for supplemental irrigation to provide water necessary to establish the vegetation.

Another recommendation would be for the SCS to initiate a community involvement program with the communities which will be affected by the RWCD Project. Due to higher population densities and the increased land use mix in and around urban areas, the SCS should update project information and initiate communications with the appropriate local authorities. With the inflow of new people into the area, there is a need to update community awareness and discuss potential benefits and opportunities associated with the project. For instance, communities may be able to share in the acquisition of additional right-of-way along the channel to provide possible recreation and trail amenities. Local developers may be offered options of using development money for landscaping or other trade-offs instead of providing water-retention along the channel. There may also be opportunities for communities to provide support for future channel park and trail amenities which could be master planned based upon present project construction.

COST ESTIMATE

The costing of landscape rehabilitation, resulting from project construction, at this stage of planning and preliminary design development is very general because of the inability to develop a unit pricing index. Until further decision is made concerning the desired direction of rehabilitation to be pursued and the detail to which such ancillary values as recreation are to be established, more detailed pricing is not feasible. Therefore, the costs are established in basic units such as riparian revegetation per channel unit (Table 1). The basis for the estimates are local contractors, SCS and Wirth Associates' recent experience with similar projects, Kerr cost analysis for landscape construction (national publication), Dodge cost analysis for construction (national publication), local material costs from suppliers and review of other similar recent projects by state and county governmental agencies. A project review will also be developed with estimators and planners of related government agencies having experience with this type of construction.

Four general treatment alternatives were developed for the channel and incidental areas. All development alternatives have recreation included in the form of a trails system using the existing maintenance roads. This minimal recreation program is considered in all cases since the maintenance roads are existing and very little additional effort would be needed to establish a road. The four alternatives are as follows:

1. A basic vegetative rehabilitation and simple trails system would be comprised of minimal planting of stock material, little or no mounding and contouring, and the seeding of all disturbed areas without special surface preparation of the spoils areas. Vegetation manipulation for reclaiming the graded and filled areas would prevent wind and water erosion, and reestablish wildlife shelter and food areas. Aesthetics are not a priority consideration in this alternative.

2. A complex vegetative rehabilitation, simple landform manipulation and minimal trails and recreation sites would consist of a denser planting of canned stock of larger size including some specimen materials in each of the three categories of vegetation, riparian, transitional and desert. Spoils areas and graded areas will be specially prepared for seeding (Figures 38 and 39) and a prepared mix will be applied to assure revegetation of all disturbed areas. Berms and mounds will be included to add interest to the existing landform. Use of new landform will be in conjunction with trails, roadways, recreation areas, reclamation of borrow areas and softening of existing landform. Landform use will be minimal and only in areas listed as highly visible (Figure 6).

3. A complex vegetation, complex landform, trails and minimal recreation would be comprised of vegetation manipulation as discussed in Alternative 2. Landform use will relate to the trails system by enhancing roadway approaches (Figure 28) movement in and out of the channel

TABLE I
GENERAL COSTS PER TYPE OF REHABILITATION EFFORT

	UNIT	SIMPLE	COMPLEX
VEGETATION			
Riparian	acre	2,500	3,000
Transitional	acre	1,800	2,200
Desert	acre	1,200	1,600
Seeding	acre	1,000	1,200
LANDFORM			
Grading/Fill	acre	2,000	2,200
TRAILS (INCL. FENCING/SIGNING)			
Dirt/Gravel	mile	5,000	5,500
Soil Cement	mile		
Under. Bridge	each	40,000	45,000
SPOIL AREAS			
Contouring	acre	1,000	1,200
PARK AREAS			
White Cross	each	8,000	10,000
Village Access	each	25,000	30,000
Swimming Hole	each	5,000	8,000
TRAIL RESTS			
Trailside	each	8,000	10,000
Off-trail	each	8,500	12,000

(Figure 29), and for aesthetic treatment such as the main village entrance and its channel crossing (Figure 30). Landform use in the minimal recreation areas will be complex in nature even though the recreation areas will be relatively simple (Figure 19).

4. A complex vegetation, complex landform, trails system and complex recreation program (optimum recreation development considering the visual priorities and existing use of the areas adjacent to the channel). The vegetation effort level is the same as Alternatives 2 and 3, and the landform manipulation effort is the same as Alternative 3. Trails will be more complex in that a soil-cement surface will be used for the bicycle trail portion to provide a more usable surface. The recreation will also be more developed, included trail rest areas every mile or as appropriate and developed recreation areas coinciding with existing use and areas of priority.

In the cost-effectiveness matrix (Table II) the area is examined by section, delineated in Figure 40. Within each section is a division by basic vegetative community for that section: (1) riparian, relating to the washes and side drainages; (2) transitional, relating to the material which forms a transition between the thicker riparian and the sparse desert growth, usually smaller in habit and less dense when compared to riparian; and (3) desert vegetation, made up mostly of grasses, drought-resistant weeds, shrubs and bushes and cacti. The regions of the reach relating to these zones are delineated in Figure 40.

The matrix then compares each portion of the reach (Figure 40) in its individual desired vegetation rehabilitation and ranks these modules against the visual effect and the recreation potential. The recreation potential is rated good, fair or poor in relation to its potential use, existing use, supplemental ability to relieve identified visual intrusion and its potential to add a beneficial service to the projected users, both adjacent inhabitants and visitors.

A cost range is provided for the implementation of the alternatives and a recommendation for further design consideration. This menu approach allows the comparison and mixture of different levels of rehabilitation within the same project. Areas of the reach or modules within those areas may receive different treatment depending upon the ranking established by the matrix.

TABLE II
COST/EFFECTIVENESS MATRIX

Area	Visual Effect	Recreation Potential	Cost Range	Recommend For Design Consideration
AR1	poor	poor	15,000	no
2	good	good		yes
3	fair	fair		no
4	fair	fair	25,000	no
AT1	poor	poor	145,000	no
2	fair	poor		no
3	good	good		yes
4	good	good	180,000	yes
BT1	poor	poor	56,000	no
2	poor	poor		no
3	poor	poor		no
4	poor	poor	70,000	no
BD1	fair	poor	40,000	no
2	good	fair		yes
3	poor	poor		no
4	poor	poor	52,000	no(1)
CT1	good	poor	30,500	yes(2)
2	fair	poor		no
3	poor	poor		no
4	poor	poor	38,500	no
CD1	fair	poor	21,000	no
2	good	fair		yes
3	good	fair		yes
4	fair	fair	28,000	no
DD1	fair	poor	42,000	no
2	good	poor		yes
3	fair	poor		no
4	poor	poor	56,000	no
ET1	fair	poor	88,000	no
2	fair	poor		no
3	good	fair		yes
4	good	good	107,000	yes

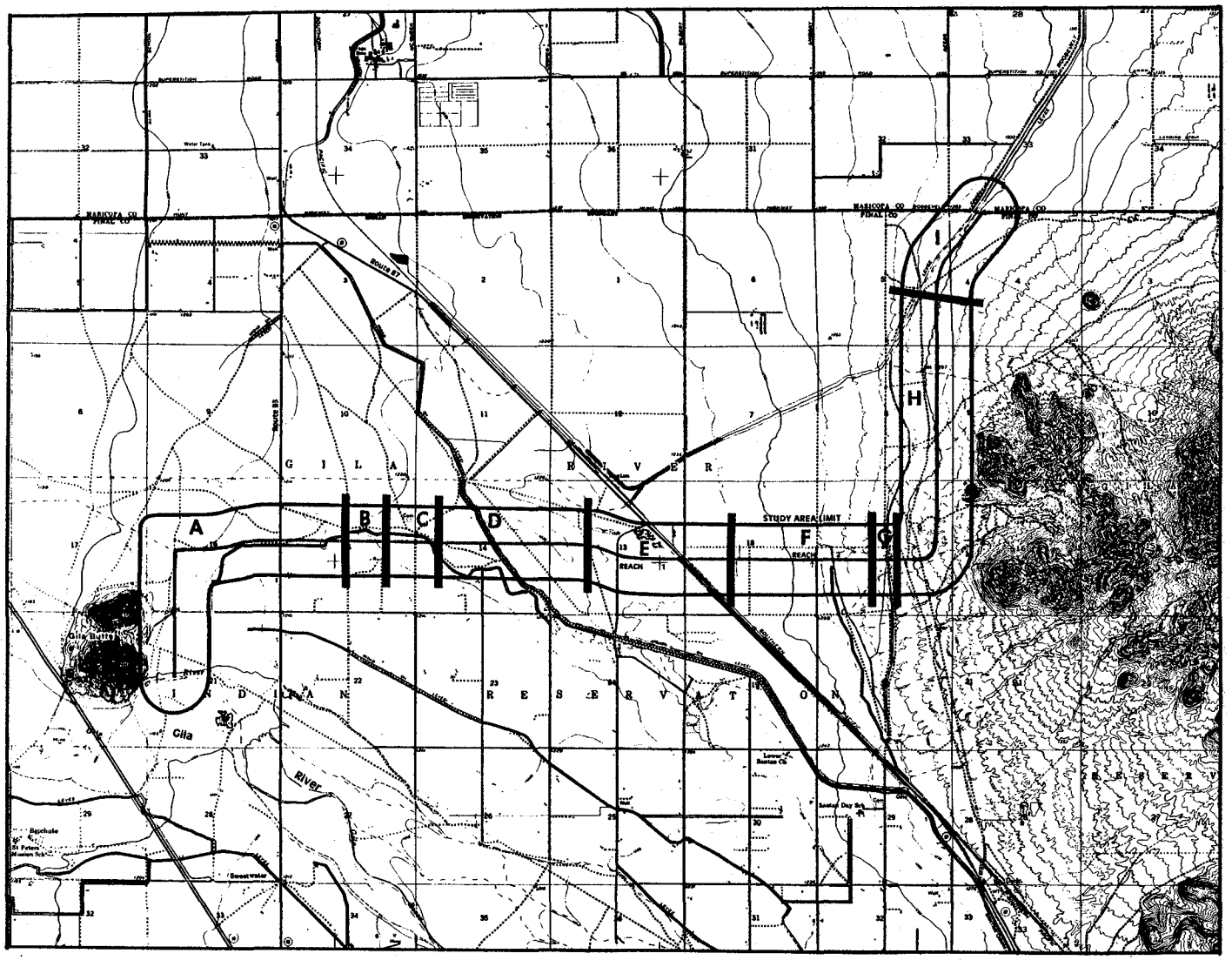
(1) Unless it is determined that the ruins will be interpreted.
(2) Along existing canal only.

Table II (continued)
Cost/Effectiveness Matrix (continued)

Area	Visual Effect	Recreation Potential	Cost Range	Recommend For Design Consideration
FT1	poor	poor	65,000	no
2	poor	poor		no
3	poor	poor		no
4	poor	poor	82,000	no
FD1	fair	poor	44,000	no
2	good	fair		yes
3	fair	poor		no
4	poor	poor	62,000	no
GT1	poor	poor	28,000	no
2	poor	fair		no
3	poor	poor		no
4	poor	poor	36,000	no
GD1	fair	poor	14,400	no
2	good	poor		yes
3	fair	poor		no
4	poor	poor	19,200	no
HD1	fair	poor	95,000	yes
2	good	poor		yes
3	poor	poor		no
4	poor	poor	130,000	no
IR1	fair	fair	90,500	no
2	good	fair		yes
3	good	fair		yes
4	fair	fair	115,000	no
IT1	poor	poor	63,000	no
2	fair	poor		no
3	fair	good		yes
4	fair	fair	77,000	no

TOTAL OF SUGGESTED ALTERNATES: 805,000/885,000

R: Riparian
T: Transition
D: Desert



COST EFFECTIVENESS MATRIX MAP

0 ¼ ½ 1 2 3mi.

FIGURE 40

wirth associates LANDSCAPE ARCHITECTS · ARCHITECTS · PLANNING AND DESIGN
2701 East Camelback Rd · Suite 391, Phoenix, Arizona 85016 602-956-9830

ROOSEVELT WATER CONSERVATION DISTRICT FLOODWAY – REACH 1 AND 2

SHEET TITLE

DRAWN
CHECKED
JOB NO
DATE

SHEET NO

FIGURE 40

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ROOSEVELT WATER CONSERVATION DISTRICT
FLOODWAY
REACHES 1 AND 2
ARIZONA

PRELIMINARY PLAN REPORT

Prepared for the:

United States Department of Agriculture
Soil Conservation Service
Phoenix, Arizona

Prepared by:

Wirth Associates, Inc.
Phoenix, Arizona

December 1981

PRELIMINARY PLAN REPORT

Overview

This Preliminary Plan Report deals specifically with Roosevelt Water Conservation District (RWCD) Reaches 1 and 2, which constitutes part of a study being conducted by Wirth Associates, Inc. for the Soil Conservation Service (SCS). The Phase I Landscape Rehabilitation Report for this project previously submitted to SCS, also included a majority of the information requested for the Phase II portion of this project.

For example, Phase II items covered in the Landscape Rehabilitation report include a summary of the data used as a basis for the Preliminary Planting Plan. The information contained in the Landscape Rehabilitation report documented the landscape description of RWCD right-of-way and surroundings. It was comprised of the general character, natural landscape character, landform, elevation, type of vegetation, precipitation expectations and man-made characteristics of the floodway area (pp. 4 and 5).

In addition, the criteria used for landscape design considerations of RWCD was based upon SCS's "Procedures to Establish Priorities in Landscape Architecture" TR-65 (pp. 5-9). The design criteria used for the project was further summarized in the Landscape Rehabilitation report on pages 10 through 25. The criteria consists of the physical and cultural opportunities and constraints associated with the RWCD floodway. The discussion of opportunities and constraints also included a presentation of various design alternatives (pp. 10-25). These alternatives were graphically represented and explained in the text. Alternative landscape treatments at different locations were discussed and summarized under recommendations at the end of the report (pp. 26 and 27). The specific design alternatives which were not presented for Reaches 1 and 2 in the Landscape Rehabilitation report have been included in the Preliminary Planting Plan, submitted to SCS by Wirth Associates as part of Phase II of the RWCD project.

Planting Treatment Alternatives

There are basically two methods of increasing the re-establishment time of plants within areas disturbed by the construction of the RWCD floodway channel. The first method is to prepare the soil, dig a hole and plant container vegetation within the hole. There are pros and cons concerning the use of containerized plants, mainly the increased costs to dig each hole and plant each plant individually. Depending upon the size, containerized plants may vary in cost from $1.50 per plant for one gallon plants, to $115 per plant for a 24" box (see Appendix A). It is important to note that costs are for material only and do not include cost of installation. To establish container plants, supplemental irrigation will be needed for a period of two to four years depending upon the size of the plant ultimately desired for a location. Irrigation options include: (1) placing irrigation lines alongside the channel and using impact sprayer heads to water fairly large areas being revegetated; (2) haul water to the site by a water truck and then sprayed on to the plants; or (3) water may be flown in by slurry bomber and released over the plants needing irrigation. In any case, there will be the maintenance costs of establishing an irrigation maintenance regime. Another additional cost of using containerized plants would be the need to fence each individual plant from predators. This is usually accomplished by using redwood stakes to anchor galvenized wire fencing with 1" mesh, which is at least 24" high, around each plant. This is because the new, tender vegetation set out in containers will be more tempting food source than the drier, tougher, established vegetation for animals whose diets include the planted vegetation. The main advantage of using container plants is the immediate landscape effect, however, considering the cost of such an alternative, perhaps it would be best to use this option in locations with more viewers that are highly sensitive to the specific area.

The other alternative for establishing vegetation would be by broadcasting desirable seed mixes on areas disturbed by channel construction. The advantages of this seed broadcasting (hydro-seeding and hydro-mulching)

alternative planting technique are multiple. Plants established by hydro-seeding are sprayed over an area and do not need to be planted on an individual basis. If the seeding application is timed properly (e.g., during, or just after, late summer rains) the seed will sprout without the need for supplemental irrigation. If the proper species of plant is selected, then the existing average rainfall should be enough to germinate and establish broadcast seed. Hydro-seeded plants germinating from the rains would start to grow with other naturalized seeds in the area. This means that animals would have a large variety of plants to browse upon rather than just the relatively few, new, tender containerized plants. This would increase the chances of individual plant survival and eliminate the need to screen each plant from predators. Plants which are sown directly in the ground at the location where they are to mature have proved to be more vigorous and faster growing than their containerized counterparts. The drawback to using hydro-seeding is the time lag from the seed broadcasting treatment until the plants start growing and become established. If there is a need for a more immediate landscape effect, the areas of concern may be irrigated to speed the germination and growth of seedlings, or container plants may be used to suppliment the design of a hydro-seeded area. However, this would involve the extra maintenance already discussed concerning using containerized plants.

Hydro-Seeding and Hydro-Mulching

It is the recommendation of this report that all the areas to be revegetated along RWCD Reaches 1 and 2 be treated by hydro-seeding and hydro-mulching. This appears to be the least expensive, lowest maintenance revegetation alternative.

The Landscape Rehabilitation report discusses various methods of mechanical surface manipulations to impede surface runoff and increase soil infiltration rates of water. The rougher the land surface can be made by gouging, listering and chiseling, the more runoff will be collected in depressions to be utilized by

vegetation. Therefore, it is suggested that no soil top dressing be applied to the areas to be seeded and that land surfaces to be seeded be left in as rough a condition as possible to improve seedling germination and establishment.

There does seem to be a question concerning the adequacy of right-of-way provided for landscape rehabilitation. At the locations where the RWCD channel crosses roads, the acquisition of additional right-of-way is not presently considered necessary. The nature of the planting treatment will be to return the intersections to the condition they were in prior to channel construction. This treatment may be supplimented by the creation of berms as a circulation barrier for undesirable vehicles desiring access via the channel maintenance roads, and by the introduction of wildflowers and other colorfully-flowered plants to make the area more attractive to passerbys. Along much of Reach 2, the physical requirements of the channel and maintenance road has caused the construction area to extend beyond the channel right-of-way. In these areas an assumption was made to seed to the edge of the disturbed area. The data obtained from this assumption will be used until which time the right-of-way problem is further clarified by the SCS. One area where the acquisition of additional right-of-way is recommended is the area directly north and south of the RWCD channel and Santan Highway intersection. This is located between the village, south of the intersection, and Highway 93. Acquiring additional right-of-way for landscape treatment was discussed in the Landscape Rehabilitation report (Figure 30 following page 17) and could be used to better define areas for use and circulation patterns.

The method of broadcasting seed may vary from hand broadcasting to hydro-seeding and hydro-mulching. Indeed, where some side channels and desert washes intersect the RWCD right-of-way, a more accurate determination of the location and species of vegetation is called for (Phase III construction documents) so that these areas may be seeded by hand to re-establish the vegetation and simulate conditions occurring before channel construction. Most of Reaches I and 2 should be seeded by hydro-seeding and hydro-mulching. The suggested hydro-mulch treatment may include a two-step

operation. The first step combines seed, fertilizer and 10 pounds to the acre of TI-TAC. The mixture is hydro-seeded on to the roughened soil surface. In the second step, 2000 pounds to the acre of sawdust or wood residue mulch is combined with 70 pounds to the acre of M-TAC and this mixture is hydro-mulched over the area seeded and fertilized in step one. More exact hydro-seeding/hydro-mulch specifications will follow in Phase III depending upon the contractor chosen to do this work.

The following (Table 1) is an estimate of the extent of the areas to be hydro-seeded, the suggested species and amount of seed to be used for Reaches 1 and 2. The recommended unit cost of the seed and estimated cost of seed will follow as soon as the information is obtained.

A number of seed producers and nurserymen were contacted both from Arizona and other states. The plant and seed lists and other suggestions are contained in Appendix B. Of the companies contacted, the most familiar with the RWCD Reaches 1 and 2 area seemed to be Hubb's Brothers Seed and Mountain States Wholesale Nursery. It is Wirth Associates' recommendation that these companies be used as needed. The knowledge and experience of these firms concerning the growing of native vegetation in Arizona should prove highly valuable to the project. Hubb's Brothers Seed is a local Phoenix, Arizona firm. They collect native seed from central Arizona including the RWCD Reaches 1 and 2. Mountain States Wholesale Nursery specializes in native and indigenous plants which are grown in containers just outside of Phoenix, Arizona and have been grown and therefore adapted to this region.

Berms

Berms may be utilized as a means of disposing of some of the channel spoils. There are several areas which warrant consideration for the addition of berms. As the highway matches grade with the floodway channel bottom (Landscape Rehabilitation report, Figure 16), berms could be used as barriers between the

TABLE I
LANDSCAPE REHABILITATION
RWCD FLOODWAY

Seed Mix List

	Pure Live Seed (PLS) lbs seed/acre
Seed Mix 1: ±73 acres	
Common Mallow - Sphaeralcea ambigua	1
Australian Saltbush - Atriplex semibaccta	5
Dyssodia - Dyssodia concinna	1
Indian Wheat - Plantago insularis	5
Mediterranium Brass - Schismus barbatus	1
Three Awn - Aristida wrightii	1
Filaree - Erodium cicutarium	2
Brittlebush - Encelia farinosa	3
Desert Saltbush - Atriplex polycarpa	3
Desert Broom - Baccharis sarathroides	1
Cochise Lovegrass	1
Seed Mix 2: ±0.5 acres	
Desert Senna - Cassia covesii	3
Purple Lupine - Lupinus sparsiflorus	3
Desert Marigold - Baileya multiradiata	2
Mexican Poppy - Eschschlozia mexicana	3
Desert Broom - Baccharis sarathroides	1
Creosote Bush - Larrea tridentata	3
Brittlebush - Encelia farinosa	3
Foothill Palo Verde - Cercidium microphyllum	1
Penstemon Bandara - 'Bandara' Penstemon	1
Cochise Lovegrass	

Table 1 (continued)
Seed Mix List

	Pure Live Seed (PLS) lbs seed/acre
Seed Mix 3: ±2 acres	
Creosote Bush - Larrea tridentata	3
Desert Saltbush - Atriplex polycarpa	2
Desert Broom - Baccharis sarathroides	2
Triangle Bursage - Franseria deltoides	3
Brittlebush - Encelia farinosa	2
Mediterranium Brass - Schismus barbatus	1
Indian Wheat - Plantago insularis	5
Filaree - Erodium cicutarium	1
Common Mallow - Sphaeralcea ambigua	1
Cochise Lovegrass	
Seed Mix 4: ±2 acres	
Common Mesquite - Prosopis juliflora	1
Blue Palo Verde - Cercidium floridum	2
Sweet Acacia - Acacia smallii	1.5
Desert Willow - Chilopsis linearis	2
Seep Willow - Salix gooddingii	1
Indian Wheat - Plantago insularis	5
Mediterranium Brass - Schismus barbatus	1
Common Mallow - Sphaeralcea ambigua	1
Desert Senna - Cassia covesii	2
Arizona Poppy - Kallstroemia grandiflora	1.5
Cochise Lovegrass	1
Verbesena - Verbesena encelioides	1.5

maintenance roads and the banks of the highway road. These dipped intersections are called out for alternative design considerations in the Preliminary Planting Plan. Another area worth considering for berm treatment should be the old borrow pit area located north of the RWCD right-of-way adjacent to the west side of Highway 93. This area could be used to deposit a considerable amount of channel spoil. By building berms over this fairly large area, even more spoil material could be disposed of. Berms could then be shaped which would allow the spoil material to blend into the landscape in a natural appearring manner. In addition, the use of berms is recommended along the concrete-lined channel section of Reach 2. The opportunity of an increased area within the RWCD right-of-way for spoil deposition should be capitalized upon. In each of the situations mentioned above, the spoil material should be removed from that portion of the channel closest to where a berm is desired resulting in lower overall costs. Higher cost would result if SCS was to transport the spoil material to disposal sites farther away. In the case of the concrete-lined channel portion of Reach 2, a good opportunity exists for disposal of spoil material on both sides of the channel. This material may be used to create berms which would blend into the desert setting (see Preliminary Planting Plan).

In all cases, it is expected that the berms will be hydro-seeded. Therefore, the surface of all berms should remain as rough as possible to increase the collection of runoff, and aid in the germination and establishment of drought-hardy seed.

A preliminary estimate of the volume (between ±60,500 to ±111,200 cubic yard depending upon the alternatives chosen) and cost of earthwork involved in various areas of Reaches 1 and 2 being considered for berm treatment will follow as the information can be obtained from contacted contractors.

Eonite

As previously mentioned in the Landscape Rehabilitation report, the whitish color of the cobble-lined rip-rap portions of the RWCD floodway channel do not blend well with the contextual colors of the landscape. It is suggested that the rip-rap areas be treated chemically so that they may become compatible with natural desert coloration. A unit cost breakdown from Mountain Repair Service for spraying approximately 32 acres of rip-rap areas with Eonite will follow as soon as the information is available.

Fencing

The primary purpose of fencing along RWCD Reaches 1 and 2 will be to keep off-road vehicles out of the floodway channel. As stated in the Landscape Rehabilitation report on page 20, the Flood Control District of Maricopa County (FCDMC) has required the entire RWCD right-of-way to be fenced. Considering the rural nature of Reaches 1 and 2, it is recommended that four-strand cattle fencing strung on t-posts be used. The following cost estimates (Table 4) were determined for this type of fencing along Reaches 1 and 2.

Break-away fencing has been suggested, as a barrier for vehicle access, across the bottom of the channel at road crossings. It is Wirth Associates' recommendation that there be a double fence post located at the top of the channel bank and at the bottom of the channel bank to anchor the break-away fencing. This is so a smaller flood event, affecting only the bottom of the channel, would only break away the channel bottom portion of fencing, leaving the break-away fencing located on the channel banks untouched. In the event of a large flood conveyance within the channel, the whole fence would be designed to break away and not hamper the flow of flood waters. More detailed information concerning fencing is forthcoming from SCS and will be incorporated into the Phase III construction drawings.

APPENDIX A

MOUNTAIN STATES WHOLESALE NURSERY

OST OFFICE BOX 33982 PHOENIX, ARIZONA 85067 PHONE 602-247-8509

March 12, 1981

Dear Friends,

Attached is our current price list - which also happens to be our last year's price list. It's a good bet you have seen enough inflation to last a lifetime and we have too. It is our intent to try to hold back a price increase until we are forced to react in self defense. The mood of Congress in implementing budget cuts is all important to our decisions and it will be the signal for notification of any impending price increase.

As always we are most interested in supplying native and arid land plants. The price list is for container grown plants which are adapted to desert conditions, particularly that segment of the Lower Sonoran Desert extending into southern Arizona.

Species which are adapted to colder deserts in other regions are also grown and some are listed. Other species of plants are grown on special order or in such small quantities that they are not included on this price list.

Prices are F.O.B. Glendale, Arizona. All material is subject to prior sale and to stock on hand.

Sincerely,

THE STAFF AT MOUNTAIN STATES

MOUNTAIN STATES
WHOLESALE NURSERY

Mailing address: P.O. Box 33982
Phoenix, Arizona 85067

location: 10020 W. Glendale Ave.
Glendale, Ariz.

Phone: (602) 247 8509

	1 gal.	5 gal.	15 gal.	24" box
Acacia abyssinica	$1.50	$6.25	$28.00	
aneura	1.60	6.25	28.00	
cavenia	1.60	6.25	28.00	$115.00
constricta	1.50	6.25	28.00	
crasspedocarpa	1.60	6.25		
farnesiana	1.50	6.25		
redolens	1.60			
rigens	1.60	6.25		
salicina	1.60	6.25	28.00	115.00
shaffneri	1.60	6.25	28.00	115.00
stenophylla	1.60	6.25	28.00	115.00
willardiana	1.60	6.25		
Atriplex canescens	1.50			
hymenelytra	1.60			
lentiformis	1.50			
lentiformis var. breweri	1.50			
nummularia	1.50			
polycarpa	1.50			
semibaccata	1.50			
torryi	1.50			
rhagodioides	1.50			
mulleri	1.50			
Aloysia lycioides	1.50			
Anisacanthus thurberi	1.50			
Antigonon leptopus	1.50			
Asclepias subulata	1.50	6.25		
Baccharis sarothroides (seedling)	1.50			
(male)	1.60	6.25		
Beloperone californica	1.50			
Caesalpinia gilliesii	1.50	5.75		
pulcherrima	1.50	5.75		
pumila	1.50	5.75		
Calliandra eriophylla	1.60	6.25		
Cassia artemisioides	1.50	5.75		
biflora	1.50	5.75		
candoleana	1.50	5.75		
covesii	1.50			
nemophila	1.50	5.75		
sturtii	1.50	5.75		
wislizenii	1.50	5.75		
Celtis pallida	1.50	6.25		
reticulata	1.50	6.25		
Cercidium floridum	1.50	6.25	28.00	115.00
microphyllum	1.50	6.25	28.00	
praecox	1.50	6.25	28.00	
Chilopsis linearis	1.50	6.25	28.00	115.00

	1 gal.	5 gal.	15 gal.	24" box
Clianthus formosus	$1.50			
Dalea bicolor var. argyreae	1.50			
greggii	1.50			
wislizenii	1.50			
Dasylirion wheeleri	1.60			
Dodonaea viscosa var. augustata	1.50	$5.75		
Dyssodia pentachaeta	1.50			
Encelia farinosa	1.50			
Franseria deltoidea	1.50			
dumosa	1.50			
Hesperaloe funifera	1.50	6.25		
parviflora	1.50			
Jacobinia spicigera	1.50			
ovata	1.50			
Juglans major	1.60	6.25		
Larrea tridentata	2.00	6.75		
Leucophyllum frutescens	1.50	5.75		
laevigatum	1.50	5.75		
Lycium andersonii	1.50			
fremontii	1.50			
Lysiloma candida		6.25		
thornberi	1.50	6.25		
Melampodium leucanthum	1.60			
Maytenus phyllanthoides	1.60			
Nicotiana glauca				
Nolina Bigelovii	1.60			
microcarpa	1.60			
Oenothera speciosa	1.30			
Olneya tesota		6.25		
Prosopis alba		6.25	28.00	115.00
chilensis		6.25	28.00	115.00
juliflora	1.50	6.25		
Pithecellobium flexicaule		6.25		
Parkinsonia aculeata	1.50	6.25	28.00	
Pennisetum setaceum (green)	1.30			
(ruby)	1.50			
Penstemon barbatus	1.50			
eatoni	1.50			
microphyllus	1.50			
palmeri	1.50			
parryi	1.50			
spectabilis	1.50			
strictus var. bandera	1.50			
thurberi	1.50			
Pittosporum phillyraeoides		6.25		
Randia obcordata		6.25		
pringlei		6.25		
Robinia fertilis	1.50			
neomexicana	1.50			

	1 gal.	5 gal.	15 gal.	24" box
Ruellia californica	$1.50	$5.75		
peninsularis	1.50	5.75		
Salvia greggii	1.50			
mojavensis				
Sambucus mexicana	1.50	6.25		
Sesuvium verrucosum	1.50			
Simmondsia chinensis	1.60	6.50		
Sphaeralcea spp.	1.50			
Tamarix aphylla	1.50	6.25		
Tecoma stans var. angustata	1.50	5.75		
Vauquelinia californica	1.60	6.25		
Verbena ciliata	1.50			
gooddingii	1.50			
Yucca angustissima	1.60	6.25		
decipiens	1.60	6.25		
elata	1.60	6.25		
schottii	1.60	6.25		
whipplei	1.60	6.25		
Zauschneria latifolia	1.50			
Zinnia acerosa	1.50			
grandiflora	1.50			

APPENDIX B

CLYDE ROBIN SEED CO
INCORPORATED

COLLECTORS AND PRODUCERS OF QUALITY WILDFLOWER SEEDS
P.O. Box 2855 • Castro Valley, California 94546
Telephone (415) 581-3467 • Telex 336 428

ARIZONA WILDFLOWER SEED MIXTURE

NAME	TYPE	COLOR	HEIGHT
Achillea millefolium, Yarrow	Perennial	White	20"
Centaura cyanus, Bachelor Button	Annual	Blue	18"
Coreopsis tinctoria, Plains Coreopsis	Annual	Yellow	36"
Echinacea purpurea, Purpel Prarie Coneflower	Perennial	Purple	20"
Eschscholzia california, Califronia Poppy	Annual	Orange	12"
Gaillardia pulchella, Indian Blanket	Annual	Orange	12"
Linum lewisii, Blue Flax	Perennial	Blue	18"
Linanthus grandiflora, Mountain Phlox	Annual	Pink	12"
Lupinus densiflorus Gedling, Gedling Lupine	Annual	Yellow	14"
Oenotheria argillicola, Primrose	Annual	Yellow	24"
Oenotheria missouriensis, Missouri Primrose	Perennial	Yellow	8"
Penstemon "Bandera", Bandera Penstemon	Perennial	Blue	14"
Ratibida columnaris, Upright Coneflower	Perennial	Yellow	20"
Rudbeckia hirta, Black-Eyed Susan	Perennial	Yellow	36"
Sisyrinchium montanium, Blue Eyed Grass	Perennial	Blue	12"

There are approximately 870,000 seeds/lb.

Planting Rate: 5 lbs. acre (43,560 ft^2)
1 lb. per 9,000 ft^2
1 oz. per 500 ft^2

Planting Instructions

Prepare the soil by removing all top growth of weed and related material. If possible, disc or till the soil and level with a harrow or garden rake. Break up any clods remaining. Distribute the seeds evenly on the surface of the soil. Lightly rake the seeds in to the top $\frac{1}{4}$-$\frac{1}{2}$ inch of soil and lightly sprinkle with an even spray of water. This watering will cover the remaining seeds with washed soil. Keep the seed-bed moist for 10 to 14 days or until germination occurs. If the seeds are planted in the Fall, watering is not necessary once they are covered. Let the Fall and Winter rains bring the seeds up.

S & S SEEDS
910 ALPHONSE
SANTA BARBARA, CA 93103
(805) 965-5243

Plants for the Gila River Indian Reservation

	List Price/lb
Aplopappus heterophyllus	$24.00
Atriplex canescens (dewinged)	$ 6.00
Atriplex polycarpa	$ 6.50
Baccharis sarothioides	$18.00
Baileya multiradiata	$50.00
Cassia covesii	$36.00
Cercidium floridum	$30.00
Cercidium microphyllum	$30.00
Encelia farinosa	$18.00
Larrea tridentata	$18.00
Olneya tesota	$30.00
Prosopis juliflora	$30.00
Sphaeralcea ambigua	$24.00

HUBBS BROS. SEED

Collectors of Seed Native to Arizona
1015 NORTH 35th STREET • PHOENIX, ARIZONA 85008

FALL 1981 PRICE LIST

Prices given are per pound, F.O.B. Phoenix, AZ. and do not include State Sales Tax. Orders less than $65.00 are subject to a $10.00 handling charge. Terms are net cash upon receipt of invoice unless prior arrangements have been made. Special quotations on quantity orders are available. All prices are subject to change without notice.

SHRUB SEED

Atriplex canescens	3.50
Atriplex conterfolia	8.50
Atriplex lentiformis	5.00
Atriplex polycarpa	5.50
Baccharis sarthroides	28.00
Calliandra eriophylla	55.00
Cercocarpus montana	30.00
Chrysothennia nauseasus	5.50
Cowania mexicana	42.00
Dodenea viscosa	22.00
Encelia farinosa	10.50
Eurotia lanata	9.50
Franseria deltoidea	12.00
Franseria dumosa	14.00
Fallugria paradoxa	40.00
Larrea divaracata	11.00
Rhus ovata-dried berries	20.00
Rhus trilobata	22.00
Simmondsia chinensis	12.00

TREE SEED

Acacia constricta	20.00
Acacia farnesiana	15.00
Acacia greggii	18.00
Cercidium floridian	24.00
Cercidium microphyllum	24.00
Chilopsis linearis	26.00
Cupressus arizonica	ASK
Juniperus deppeana	ASK
Juniperus monosperme	ASK
Lysiloma thornberri	25.00
Olneya tesota	30.00
Parkinsonia aculeata	22.00
Prosopis juliflora	45.00
Prosopis pubescans	100.00
Robinia neomexicana	18.00

GROUNDCOVERS & FLOWERS

Atriplex semibaccata	23.00
Aristida wrightik-three awn	ASK
Baileya multiradiata	40.00
Cassia covesii-sesert senna	27.00
Castilleja-indian paintbrush	150.00
Iris arizonica	ASK
Erodium cicutarium-filaree	25.00
Eschscholzia californica	18.00
Eschscholzia mexicana	40.00
Kallstroemia-Arizona poppy	
Lupinus arizonica	35.00
Lupinus sparsiflorus	40.00
Oenothera caespitosa	6.50
Orthocarpus purpurascens	38.00

We have a wide variety of grasses available. We price these by quote, please call for availability and price.

Grasses:

Alkali sacaton
Blue grama
Galleta
Indian ricegrass
Lehmans lovegrass
Sand dropseed
Side oats grama
Madrid sweet clover
Russian wildrye
Wheatgrasses

HUBBS BROS. SEED

Collectors of Seed Native to Arizona
1015 NORTH 35th STREET • PHOENIX, ARIZONA 85008 (602) 267-8132

1. Wirth + Associates — Gene Trobia
COMPANY NAME ADDRESS PHONE DATE

2. 2701 East Camelback Suite 391 Phx. Ariz. 85016
PROJECT

3. Phone # 956-9839

4. SEED AVAILABILITY LIST

5. Phase II Soil CONSERVATION SERVICE

6.

Riparean

TOTAL LBS. % of ACRES		LBS. Per Acre	% Purity Per Acre	% Germ. Per Acre	SPECIES TREES	PRICE Per LB.	PRICE Per AC.
					Foothill Palo Verde		
					Cercidium microphyllum		
					Common Mesquite		
					Prosopis Juliflora		
					Desert Willow		
					Chilopsis linearis		
					Blue Palo Verde		
					Cercidium Floridum		
					Sweet Acacia		
					Acacia Smallii		

7.

8. L. Hubbs — Partner 12/9/81
SIGNATURE & CONFIRMATION DATE

SEED COMPONENTS

Crossings

TOTAL LBS. % of ACRES		LBS. Per Acre	% Purity Per Acre	% Germ. Per Acre	SPECIES SHRUBS	PRICE Per LB.	PRICE Per AC.
					Brittlebush		
					Encelia farinosa		
					Cresote bush		
					LARREA DIVARICATA		
					DESERT SALTBUSH		
					Atriplex polycarpa		
					Desert Broom		
					Baccharis sarothroides		
					TRIANGLE BURSAGE		
					FRANSERIA DELTOIDES		

7. SQ. FT./LOAD _____ NO. LOADS/AC _____ LBS./SACK _____

8. _____
SIGNATURE & CONFIRMATION OF ABOVE QUOTATION DATE

SEED COMPONENTS

most of stretch

TOTAL LBS. % of ACRES		LBS. Per Acre	% Purity Per Acre	% Germ. Per Acre	SPECIES GRASSES	PRICE Per LB.	PRICE Per AC.
					INDIAN WHEAT		
					PLANTAGO INSULARIS		
					MEDITERRANIUM brass		
					Schismus barbatus		
					THREE AWN		
					Aristita Wrightii		
					Filaree		
					Erodium cicutarium		

7. SQ. FT./LOAD _____ NO. LOADS/AC _____ LBS./SACK _____

8. _____
SIGNATURE & CONFIRMATION OF ABOVE QUOTATION DATE

SEED COMPONENTS

most of stretch

TOTAL LBS. % of ACRES		LBS. Per Acre	% Purity Per Acre	% Germ. Per Acre	SPECIES (GROUND COVERS	PRICE Per LB.	PRICE Per A
					not native		
					Australian Saltbush		
					Atriplex Semibaccta		
					not around area		
					Dyssodia		
					Dyssodia CONCINNA		
					Common Mallow		
					SPHAERALCEA AMBIGUA		

7. SQ. FT./LOAD _____ NO. LOADS/AC. _____ LBS./SACK _____

8. _____
SIGNATURE & CONFIRMATION OF ABOVE QUOTATION DATE

Crosswings

SEED COMPONENTS

TOTAL LBS. % of ACRES		LBS. Per Acre	% Purity Per Acre	% Germ. Per Acre	SPECIES COLOR	PRICE Per LB.	PRICE Per AC.
					MEXICAN POPPY		
					Eschscholzia MEXICANA		
					PURPLE LUPINE		
					Lupinus sparsiflorus		
					DESERT SENNA		
					CASSIA COUESII		
					DESERT MARIGOLD		
					BAILEYA Multiradiata		
					ARIZONA POPPY		
					KALLSTROEMIA GRANDIFLORA		

7. SQ. FT./LOAD _____ NO. LOADS/AC _____ LBS./SACK _____

8. _____
SIGNATURE & CONFIRMATION OF ABOVE QUOTATION DATE