

Investigation of Alternatives

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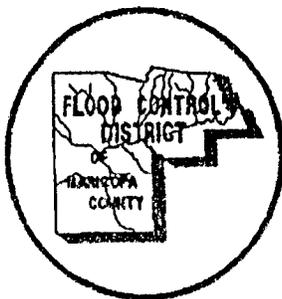
Mitigation Proposal

for the

Property of
Flood Control District of Maricopa County
2801 N. 16th Street
Phoenix, AZ 85009

New River Flood Control Project

Bethany Home Road to Olive Avenue



Prepared by the
**Flood Control District
of Maricopa County**

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Introduction

1.1 Background

Historically a flood hazard has existed in the metropolitan Phoenix area along Cave Creek, Skunk Creek, New River, Agua Fria River, and downstream of the Arizona Canal. As a means to eliminate potential flooding, the U.S. Army Corps of Engineers (Corps), in conjunction with the Flood Control District of Maricopa County (District) and other municipalities, has implemented a comprehensive flood control plan consisting of both structural and non-structural improvements (see Plate 1).

The New River, between Olive Avenue and Bethany Home Road, has been subject to extensive gravel mining activities and unregulated waste disposal for many years. At several locations between Northern Avenue and approximately Bethany Home Road, only remnants of the river's natural banks remain. In addition, three unregulated landfills have been identified and refuse (such as automobiles, tires, scrap concrete, and large electrical appliances) has been illegally discarded along the river. Despite these disturbances, limited wildlife habitat does exist within the New River channel between approximately Olive and Northern Avenues.

As a part of the overall plan, the Arizona Canal Diversion Channel, (ACDC) has been designed to intercept 100-year flows from as far east as Cudia City Wash and convey them to an outlet at Skunk Creek, a tributary to the New River. Under an agreement with the Corps, the District is required to protect the Corps from litigation resulting from these diverted flows. Area property owners, upon hearing that the District was about to pursue the purchase of flowage easements, requested that the District look into other alternatives.

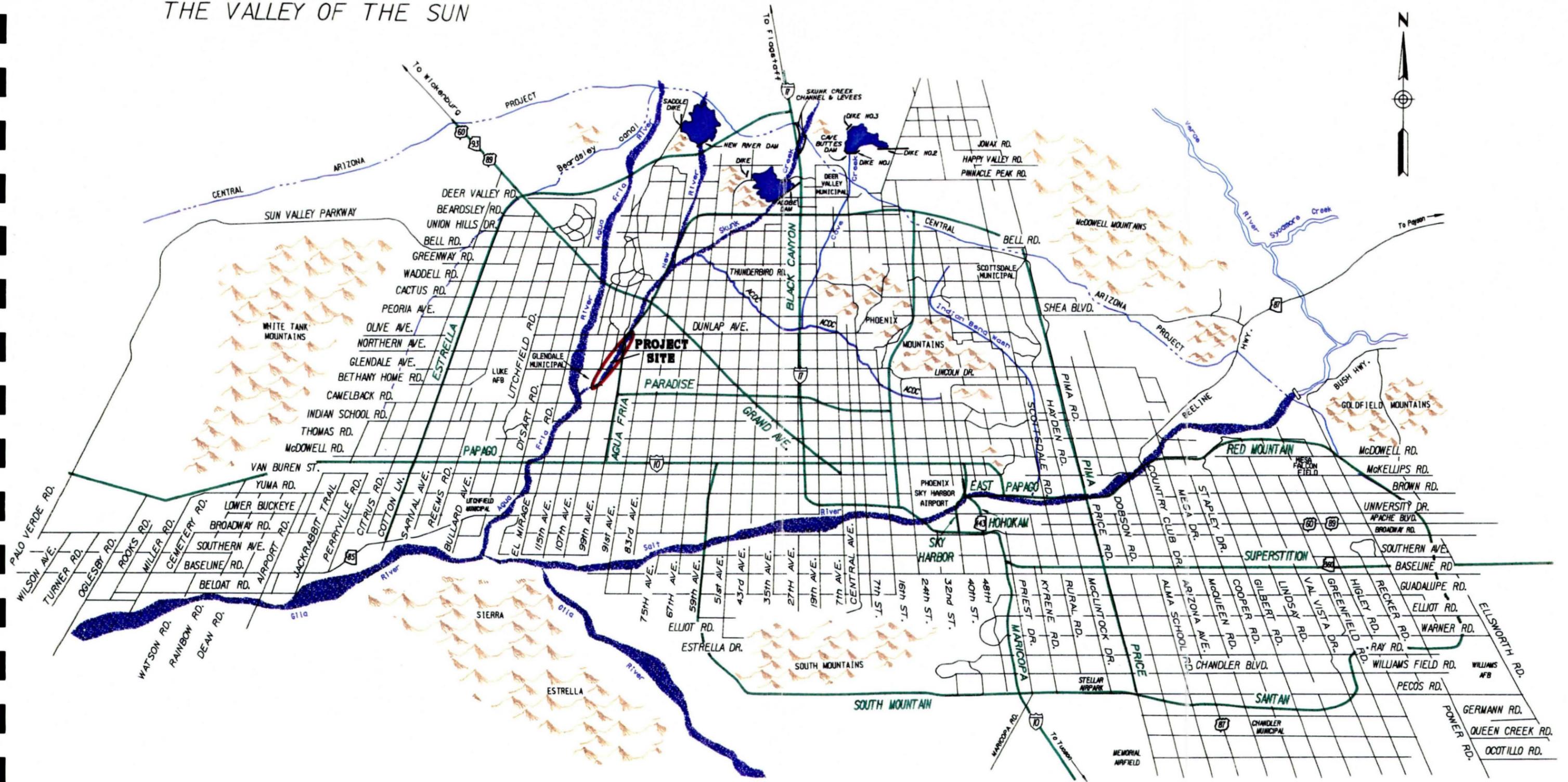
1.2 Project Location

The New River Flood Control Study Area extends south from the Olive Avenue bridge to approximately Bethany Home Road (see Figure 1).

Presently, there are two bridges crossing New River—one at Olive Avenue and the other at Glendale Avenue. In addition, there are unbridged road crossings at 99th and Northern Avenues. Design for bridges at these locations is in progress and will soon be complete. A fifth road, Bethany Home Road, approaches New River, but there are no plans for a future crossing because of the proximity of the Glendale Municipal Airport.

Upstream of the proposed study area, the Corps has designed and is currently constructing channel improvements along the New River from approximately one-half mile north of Grand Avenue, south to Olive Avenue.

THE VALLEY OF THE SUN



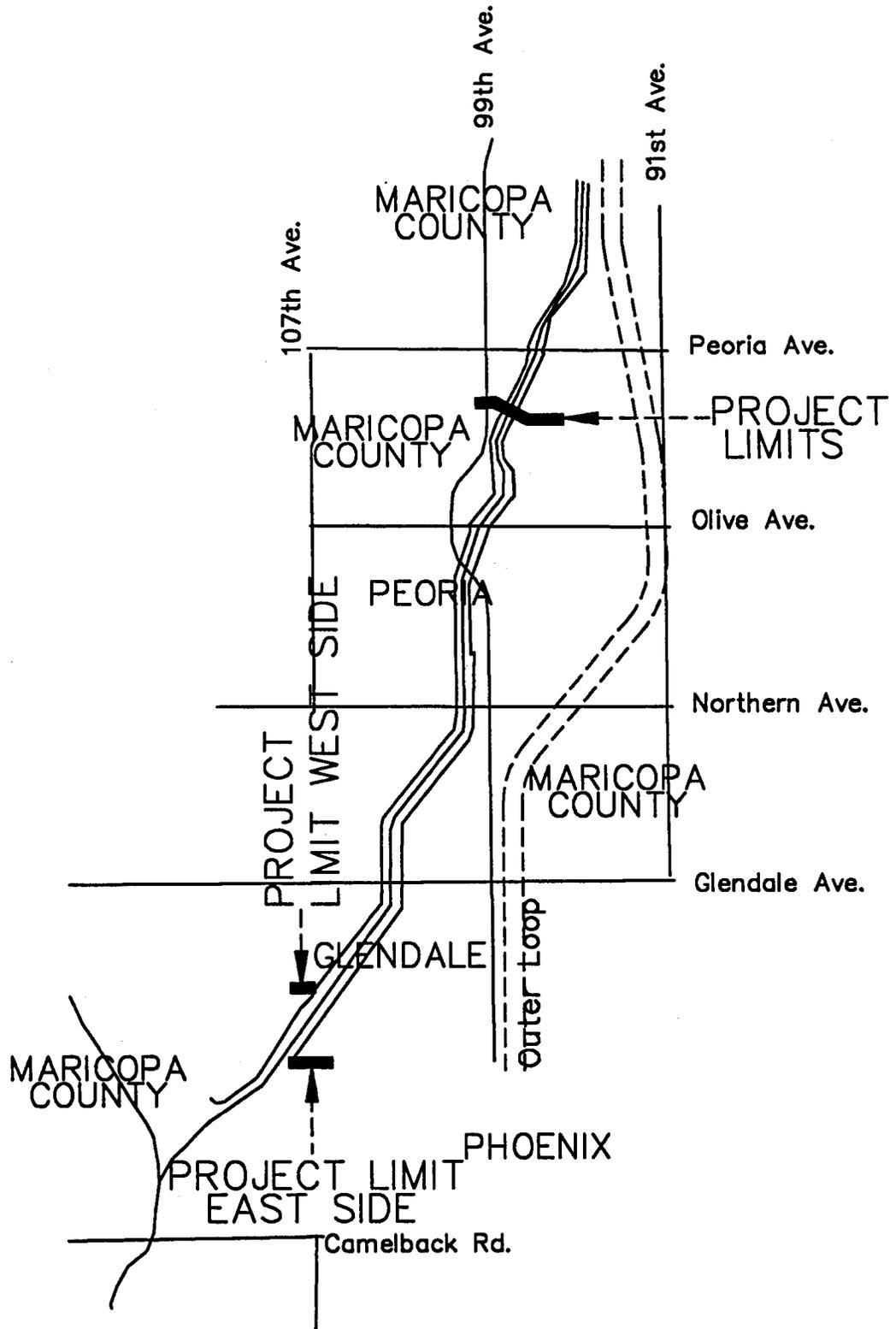


Figure 1
Project Limits

On the downstream end of the proposed study area, at approximately Bethany Home Road, flood control improvements exist along the west bank of New River adjacent to the Glendale Municipal Airport. The east bank of the New River is open agricultural land, but plans are currently underway for a levee system as part of the planned community of Camelback Ranch.

The Outer Loop Freeway (Agua Fria Freeway), which is presently under construction by the Arizona Department of Transportation (ADOT), crosses Olive Avenue approximately one mile east of the New River and presently terminates south of Northern Avenue at 99th Avenue. In the future, the freeway will extend south to the Papago Freeway with an interchange for the Paradise Freeway at Bethany Home Road. A drainage channel constructed in conjunction with the Outer Loop Freeway presently outlets to the New River south of Northern Avenue. An additional drainage channel intended to provide protection for the Paradise Freeway is planned to outlet to the New River near Bethany Home Road.

1.3 Purpose

The New River Flood Control Project will provide flood control protection for the existing 21 homes, 6 businesses, 300 acres of farm land, 2 bridges, roads, utilities, and wildlife habitat in the area, while fulfilling the District's obligation to the Corps. The District has contracted with Coe & Van Loo Consulting Engineers, Inc., to provide engineering services for the New River Flood Control Project.

The parameters of this project are to develop alternatives to provide Standard Project Flood (SPF) protection. One extreme alternative would be to install a channel similar to the one being constructed north of Olive Avenue. This would be the narrowest possible channel to contain the flows. The other extreme would be to place levees at the delineated floodplain.

The alternatives are also to take into consideration that two bridges and a freeway drainage outlet are being proposed in the area. This project shall also include evaluation of bank protection, evaluation of impact on habitat, and overall costs. The alternatives are to have no adverse effect either up- or downstream of the project area.

Alternative Investigation

2.1 Hydraulic Alternatives

The District has considered nine alternatives for this reach of the New River. As discussed below, all of the alternatives have been prepared under the assumption that some excavation would occur under the Olive Avenue bridge and in the river both upstream and downstream of the bridge. The District did, however, make one other study of the area using Alternative D-1 with the assumption that no excavation would occur in the River. This study was prepared to determine if adequate flood protection could be provided without disturbing the habitat.

The results indicated that, without excavation, water would overflow the Olive Avenue bridge by about 6 feet during the SPF event, and by about 1 foot during the 100-year event. Realizing that there is no practical way to recollect water once it has left the river, the District concluded that excavation would need to be done in order to provide adequate flood control protection for the area.

2.1.1 Alternative A

Purchase of easements. A drop structure will be required north of Olive Avenue and the invert at the Olive Avenue Bridge will need to be lowered. A 17-foot excavation of the invert at the Olive Avenue bridge is necessary to safely convey the SPF flows beneath the bridge. At this elevation the invert will be one foot above the toe down of the existing bank protection north of Olive Avenue and at the bridge footings. Therefore, a concrete reinforced lining will be required for the channel invert from the south side of the bridge to about 1300 feet north. The excavation of the river bed will extend from the center of the Olive Avenue bridge, north approximately 2600 feet to a point where it will meet the proposed drop structure, and south approximately 2600 feet to a point where it will meet the existing invert. The result will be the loss of this one-half mile of native habitat. The Glendale Avenue bridge invert will need to be lowered to safely accommodate flows. The bridge invert will require a reinforced concrete lining, placed at the top of the bridge footings and bank protection upstream and down. This work will require a lowering of the invert of the river bed for about a quarter of a mile upstream and down. The result will be a half mile loss of habitat. In order to control the meandering nature of the river, the low flow will require periodic clearing of the larger vegetation and debris (meander control). The net loss of habitat for this alternative is 46 percent. Half of the remaining habitat will be lost when flows reach the level of a 10-year event. This concept will not provide flood protection to any of the businesses, homes, farm lands, roads, or bridge approaches. The downstream area will not be affected by this alternative.

2.1.2 Alternative B-1

Channelization of the New River from upstream of Olive Avenue to approximately Bethany Home Road, within a 550 foot wide right-of-way, to be donated by property owners. Due to width limitations of the donated right-of-way and flow characteristics, soil cement bank protection is the only acceptable alternative. The structural improvements are basically outside the waters of the U.S., but the excavation for them and the channel occur within the waters of the U.S. Implementation of Alternative B-1 will result in a loss of 80 percent of the habitat; however, all other requirements outlined in Section 1.3 will be 100 percent fulfilled.

2.1.3 Alternative B-2

This alternative places the bank protection at the extreme right-of-way lines and only narrows to pass the flows through the existing and proposed bridges. The work proposed for the area upstream of Olive Avenue and at all the bridges would be the same as in Alternative B-1. All structural improvements would occur outside of the waters of the U.S. This alternative uses the same rights-of-way as Alternative B-1, but an additional 11 acres will be needed for ponding easements. This alternative would result in a net loss of 50 percent of the habitat.

2.1.4 Alternative C-1

Channelization of a 550 foot wide bottom with 2:1 side slopes, that would be cut above the natural invert; one side left natural—where possible. This alternative will leave some part of the low water channel intact. It will lower water surface elevations for all natural channel conditions. It will also lower the average velocity for a 10-year event over that of the natural channel conditions south of Northern Avenue (see Appendix III). It will cause destruction of part of the upper vegetation, but would allow the vegetation in the low flow area to be left mostly undisturbed. This alternative would require the drop structure and the same work at the two bridges as Alternative A. Because the river bank is not stabilized throughout and the soils are highly erosive, the District would be required to purchase flowage easements. Because the meandering nature of the river is only partly controlled, the invert of the river will require periodic clearing. The structures for this concept would be placed out of the waters of the U.S. The excavation for the channel would consume about 50 percent of the habitat area. This alternative will result in a net loss of 68 percent of the habitat. Almost half of the remaining habitat will be lost when flows reach the level of a 10-year event. This concept will provide flood protection to 25 percent of the businesses, homes, farm lands, roads, and bridge approaches. The downstream area is not affected by this alternative. Ponding easements will also be required.

2.1.5 Alternative C-2

This alternative is the same as Alternative C-1, except that a 600-foot bottom width will be used. The requirements and results would also be similar to Alternative C-1, except that the water surface would be lower and more of the area would have average velocities for the 10-year flood below 6.0 feet per second.

2.1.6 Alternative C-3

This is the same as alternatives C-1 and C-2, except that the bottom width varies between 500 and 900 feet in an attempt to keep the average velocity for a 10-year

flood below 6.0 feet per second. The requirements and results will be the same as Alternatives C-1 and C-2.

2.1.7 Alternative D-1

Natural channel with diking at the floodway limits. The low water channel will be the same as Alternative A. It will raise the water surface elevations, and in some areas the channel sides might have to be excavated and then replaced in order to properly prepare the toe down for the dike to prevent scour and loss of the dike. This alternative will require a drop structure north of Olive Avenue and about the same work at the two bridges as proposed in Alternative A. Eighty percent of the structural improvements will occur outside the waters of the U.S. This alternative will result in a net loss of 32 percent of the habitat. Half of the remaining habitat will be lost when flows reach the level of a 10-year event. This concept will provide flood protection to all of the businesses, homes, farm lands, roads, and bridge approaches. This alternative will place levees across several existing roads, and will require road ramps at these crossings. The cost of these ramps has not been included in this report. The downstream area will be unaffected by this alternative. Also, ponding easements will be required.

2.1.8 Alternative D-2

Natural channel with diking at 550 feet. This alternative is similar to Alternative D-1 except that the dikes will have to be higher and even greater amount of excavation will be required for dike protection. The Olive Avenue bridge will have to be replaced with a longer one and the upstream soil cement bank protection will have to be removed and replaced to conform to the new bridge in order to pass the SPF flows. The existing low water crossings at 99th and Northern Avenues will be eliminated as the geometrics of the area will not lend itself to bridges.

2.1.9 Alternative D-3

Natural channel with diking at the 100-year floodplain boundaries. This alternative only protects for floods greater than the 100-year event. The drop structure and bridge work described in Alternative A will also be required with the same results. All structural improvements will occur outside of the waters of the U.S. The District will need to purchase ponding easements. This alternative will place levees across several existing roads, requiring road ramps at these crossings. The cost of these ramps has not been included in this report.

2.2 Comparison of the Alternatives

All the alternatives involve channel excavation in the vicinity of the Olive Avenue bridge. These alternatives include structural and drainage improvements to the two existing bridges and to the channel upstream and down.

Alternatives C-1, C-2, and C-3 have bank protection on one side and natural banks on the other. Flowage easements will be required as the flows are not contained within a fully stabilized channel.

Alternatives B-2, C-1, C-2, C-3, D-1, D-2, and D-3 will require ponding easements as the proposed bank protection is a levee and waters will pond outside the channel.

All the alternatives will require a mitigation plan to replace the loss of habitat.

Alternatives A-1, C-1, C-2, and C-3 require the removal of large plants and debris in the low flow area in order to keep the river where it belongs.

In addition, sub-surface exploration and an environmental investigation have identified illegal waste disposal sites on both sides of the existing channel, just south of Olive Avenue (WTI, 1988 and 1989). The tests performed did not identify the presence of hazardous wastes or volatile organic compounds (VOCs); however, the material is not suitable for construction and can be a very serious environmental and health problem if exposed and eroded. Therefore, all the alternatives will require the removal, disposal, and replacement of the material.

Table 1 provides a comparison of the nine alternatives, showing by what percentage the objectives outlined in Section 1.3 is met by each of the alternatives.

| Table 1 Evaluation of Objectives | | | | | | | | | |
|--|--|------------|------------|------------|------------|------------|------------|------------|------------|
| Objectives | Alternatives, % | | | | | | | | |
| | A | B-1 | B-2 | C-1 | C-2 | C-3 | D-1 | D-2 | D-3 |
| Protect Bridges | 75 | 100 | 100 | 75 | 75 | 75 | 100 | 50 | 75 |
| Protect Roads | 0 | 100 | 100 | 0 | 0 | 0 | 100 | 100 | 0 |
| SPF Protection | 25 | 100 | 100 | 75 | 25 | 25 | 100 | 100 | 100 |
| Protect Habitat | 54 | 20 | 50 | 42 | 42 | 42 | 68 | 69 | 66 |
| Total Objectives Obtained (400 possible) | 154 | 320 | 350 | 192 | 142 | 142 | 368 | 319 | 236 |
| Subtotal (Total Objectives Obtained/400) | 38 | 80 | 87 | 48 | 35 | 35 | 92 | 78 | 59 |
| Special Factors | Alternatives A and D-3 provide no protection for the homes, businesses, and farms. Alternatives B, B-2, and D-2, provide full protection for the homes, businesses, and farms. Alternatives C, C-2, and C-3 provide protection for 25 percent of the homes, businesses, and farms. Alternative D provides protection for 75 percent of the homes, businesses, and farms. All the alternatives provide 100 percent protection to utilities; local, ADOT, and SRP drainages; and the up- and downstream areas. | | | | | | | | |
| Total percent of Objectives Obtained after consideration of Special Factors | 58 | 94 | 96 | 65 | 74 | 74 | 92 | 94 | 80 |

2.3 Bank Protection Alternatives

Several bank protection alternatives have been investigated to determine the most cost effective method for protecting the bank of the New River from erosion. Criteria used in the selection process include: strength and durability of the material, cost and feasibility of construction, slope stability, aesthetics, habitat preservation, and maintenance expenses. The alternatives explored are described briefly, below.

2.3.1 Soil Cement

Soil cement would be placed in 6-inch lifts and then compacted with a roller. The final width would be 8.5 to 9 feet. The material would *not* be trimmed on the channel side to a relatively smooth surface. With its massive size and properties, this alternative is expected to be the least expensive in maintenance. Although the width could be reduced, it is anticipated that any savings due to a reduction in material would be offset by increased costs in construction since the standard width for soil cement placement (dictated by the width of the trucks placing the material) is 9 feet. The color and gradation of the soil cement would closely match the surrounding soil conditions. Soil cement bank protection is being used by the Corps upstream of Olive Avenue and has been used to channelize the Agua Fria River. Materials are readily available on site. Cement would have to be imported.

2.3.2 Reinforced Gunite

Ten-inch thick reinforced gunite would be placed over a welded wire fabric material for strength and control of cracking. At the top of this lining, a 3-foot turn-down would be included for stability and protection from undermining. Weep holes throughout the length of the lining would be provided as a means of reducing hydrostatic pressure caused by saturation of the material behind the lining. Maintenance of the lining would require periodic inspection and repair of any spalling or cracking. For aesthetic purposes, the top two inches of the placed material would have an earthtone stain to minimize the visual impact on the environment. All materials would have to be imported.

2.3.3 Grouted Riprap

Grouted riprap bank protection appropriate for this application would require a minimum thickness of 2 feet, a mean stone diameter (i.e., D50) of 12 inches, and a filter fabric. This alternative may call for additional reinforcement or special treatment of the base material, as it is especially susceptible to cracking. Furthermore, this alternative relies heavily on the assumption that adequate material exists in the area. Studies performed by the Corps indicate that use of grouted stone would require at least a 2:1 side slope because of the rounded material available. Cement would have to be imported.

2.3.4 Loose Riprap

Loose riprap bank protection appropriate for this application would require a minimum thickness of 3 feet of angular stones, a mean stone diameter (i.e., D50) of 20 inches, and a filter fabric. Although more natural in appearance, loose riprap requires material which may not be available locally in the required size or volume. Furthermore, because it requires a flatter slope than 1:1, it will require additional right-of-way. Since it is vulnerable to erosion and failure when overtopped, it is not preferred in a levee condition.

2.3.5 Gablons

Gablons, or wire mesh enclosed stones, would provide the necessary flexibility to conform to scour holes which could threaten the stability of the levees. This plan would call for placement of the mattresses on a 2:1 slope. In addition to being more natural looking than a grouted or concrete structure, gablons could exploit the available material in the area. However, the high gravel and rock movements anticipated in the river could damage or destroy the wire mesh mats. Gablons are vulnerable to overtopping and erosion resulting from side drainage; they are not preferred in a levee condition.

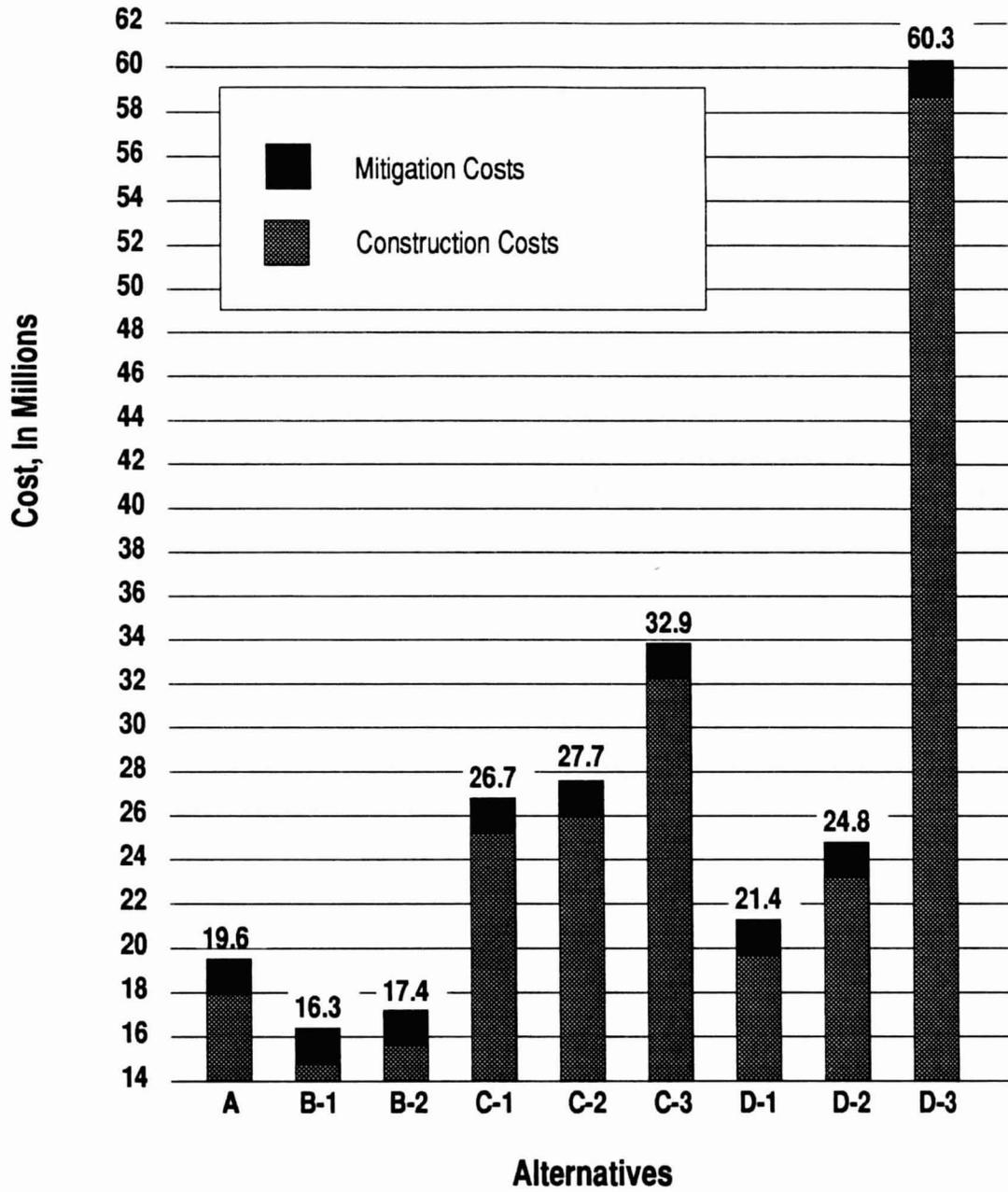
The selection of bank protection is based on cost, stability, and maintenance, as each alternative bank protection has basically the same effect on the area and the slope of the bank protection has little or no effect on the flows. Soil cement was chosen as the bank protection in all of the flood control alternatives previously described because levees are involved, soil cement is more stable, and it has a low maintenance cost.

2.4 Cost Analysis

Conceptual cost estimates have been computed for each alternative flood control plan. The cost estimates for Alternative B-1 is based on the assumption that the flood control improvements can be contained within a 550-foot wide right-of-way. The property owners have agreed to donate the right-of-way if Alternative B-1 is selected. The cost estimates for all the alternatives are summarized in Table 2 and itemized cost estimates are included in Appendix IV. Table 3 graphically depicts the construction and mitigation costs for each of the alternatives.

| Table 2 | |
|---|----------------------|
| New River Flood Control Alternatives | |
| Cost Estimate Summary | |
| Alternative | Cost Estimate |
| A Easements | \$19,600,000 |
| B-1 Channelization | \$16,300,000 |
| B-2 Modifications to Preserve Habitat | \$17,400,000 |
| C-1 Modifications to Preserve Habitat | \$26,700,000 |
| C-2 Modifications to Preserve Habitat | \$27,700,000 |
| C-3 Modifications to Preserve Habitat | \$32,900,000 |
| D-1 Modifications to Preserve Habitat | \$21,400,000 |
| D-2 Modifications to Preserve Habitat | \$24,800,000 |
| D-3 Modifications to Preserve Habitat | \$60,300,000 |

Table 3
Cost Comparison



Conclusions and Recommendations

Bank protection alternatives and alternative flood control plans for the New River between Olive Avenue and Bethany Home Road have been investigated and evaluated. Of the five bank protection alternatives evaluated, soil cement has been found to be the most cost effective and suitable for the hydraulic characteristics of the New River.

Nine alternative flood control plans have been evaluated. All the alternatives involve various structural improvements and channelization. None of the alternatives completely meet the requirements set forth in Section 1.3. All the alternatives result in a loss of habitat. With mitigation for lost habitat, Alternatives B-1, B-2, D-1, and D-2 come the closest to meeting the goals outlined in Section 1.3. Only Alternatives A, B-1, and B-2 have favorable costs.

Alternatives B-1 and B-2 have the following advantages over Alternatives A, D-1, and D-2:

- Alternative D-2 will close two major streets (99th Avenue and Northern Avenue), thereby reducing police and fire protection.
- They provide total protection for existing bridges, roads, utilities, homes, businesses, and farms that are currently susceptible to failure and extensive damage during flow events.
- The costs are well below those of Alternatives A, D-1, and D-2 and they still accomplish a high percentage of the goals set forth in Section 1.3.

3.1 Compliance with the B1 Guidelines

3.1.1 Determination of Practicability

All the alternatives are practicable as they make use of an existing natural floodway system. The New River has historically conveyed floodwater south to the Agua Fria River. The volume of water being conveyed by this project makes it impracticable to be constructed elsewhere.

3.1.2 Availability

Only Alternatives A, B-1, and B-2 are available to the District; the other alternatives far exceed the cost-benefit ratio. Of the available alternatives:

- Alternative A only meets 58 percent of the goals set forth in Section 1.3 (with no provision for human safety), but provides protection for 54 percent of the habitat.
- Alternative B-1 meets 94 percent of the goals but protects only 20 percent of the habitat.
- Alternative B-2 meets 96 percent of the goals and provides protection for 50 percent of the habitat.

3.1.3 Capable of Being Done

The location of the project in the existing river bed is appropriate because diverted flows have been brought to this location. It is a natural outlet for floodwater and is undeveloped, hence causing the least impact. The very nature of the river makes the project capable of being done.

In conclusion, since Alternative A only meets 58 percent and Alternative B-1 only meets 94 percent of the goals set forth in Section 1.3, the District recommends that Alternative B-2, which meets 96 percent of the goals, be implemented for this project. The District recognizes that the cost for Alternative B-2 is 10 percent more than Alternative B-1. Furthermore, the District recommends that a 100-year maintained mitigation plan be added to offset the loss of habitat. Table 4 presents the criteria the District considered before making this recommendation.

| Table 4 Final Alternative Comparison | | | |
|---|----------------------|------------------------|------------------------|
| Comparison Criteria | Alternative A | Alternative B-1 | Alternative B-2 |
| Costs (including Mitigation) | \$19,600,000 | \$16,300,000 | \$17,400,000 |
| Habitat Protection, % | 54 | 20 | 50 |
| On-site Mitigation | Yes | Yes | Yes |
| Acres Needed | 771 | 214 | 225 |
| Section 1.3 Goals Met, % | 58 | 94 | 96 |

References

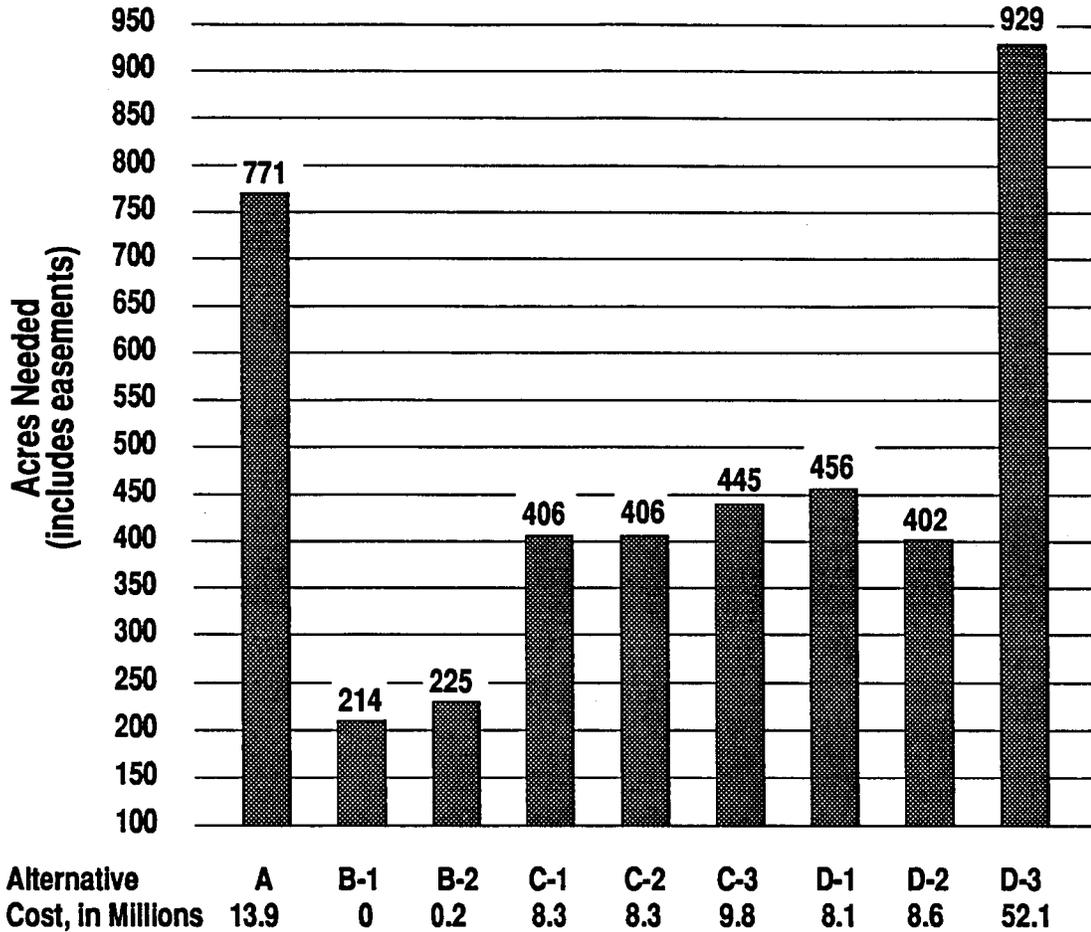
Western Technologies, Inc., "New River Channelization, Bethany Home Road to Olive Avenue," prepared for Coe & Van Loo, Job No. 2128J068, November 9, 1988.

Western Technologies, Inc., "Evaluation of Landfills for the New River Project," prepared for Coe & Van Loo and the Flood Control District of Maricopa County, Job No. 2178J440, February, 1989.

Appendix I

Construction Rights-of-Way Required and Evaluation of Impact on Habitat

**Table 5
Construction Rights of Way Required**



| Alternative | A | B-1 | B-2 | C-1 | C-2 | C-3 | D-1 | D-2 | D-3 |
|-------------------|------|-----|-----|-----|-----|-----|-----|-----|------|
| Cost, in Millions | 13.9 | 0 | 0.2 | 8.3 | 8.3 | 9.8 | 8.1 | 8.6 | 52.1 |

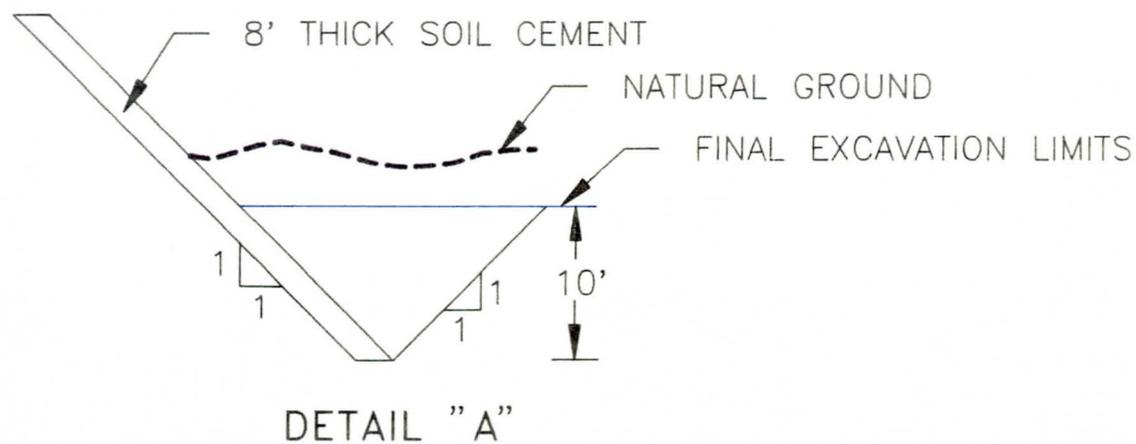
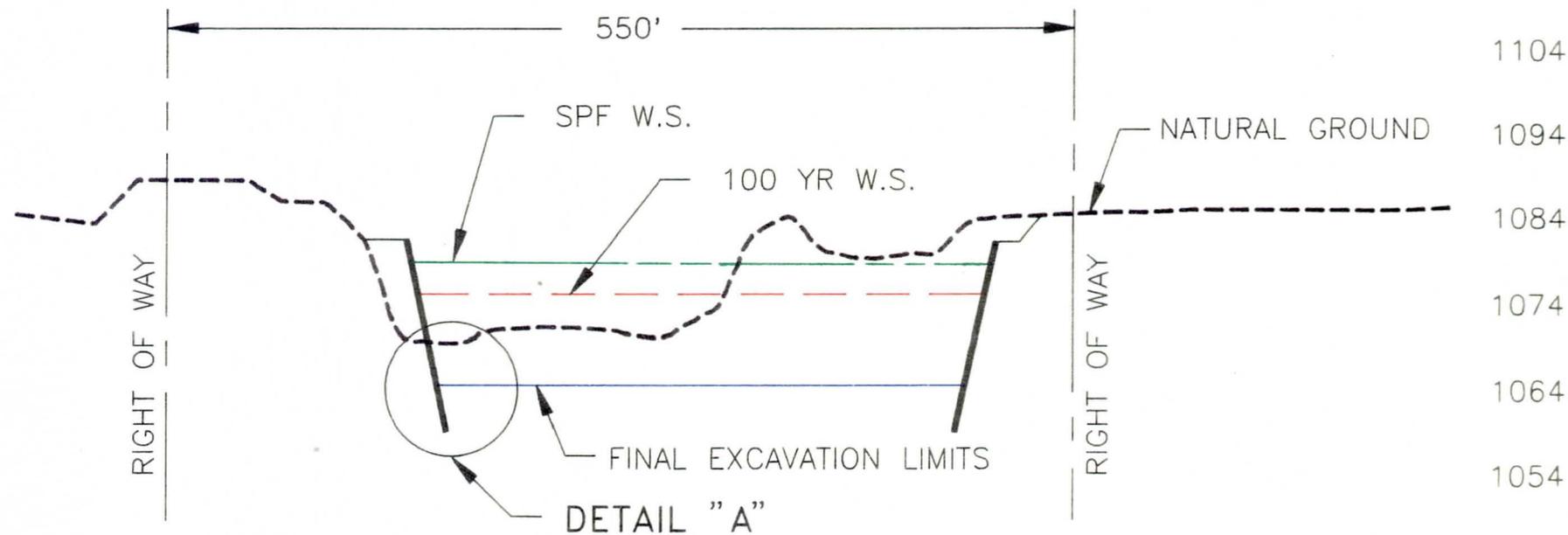
**Table 6
Evaluation of Impact on Habitat**

| Objectives | Alternatives | | | | | | | | |
|---|--------------|-----|-----|-----|-----|-----|-----|-----|-----|
| | A | B-1 | B-2 | C-1 | C-2 | C-3 | D-1 | D-2 | D-3 |
| Acres lost to bank protection | N/A | 22 | N/A |
| Acres undisturbed by construction | 69 | 25 | 64 | 54 | 54 | 54 | 87 | 88 | 85 |
| Acres to be reseeded after construction | 42 | 105 | 68 | 71 | 71 | 71 | 42 | 42 | 42 |
| Acres pruned for growth control | 16 | N/A | N/A | 16 | 16 | 16 | N/A | N/A | N/A |
| Acres available for mitigation | 21 | 26 | 21 | 21 | 21 | 21 | 21 | 21 | 21 |

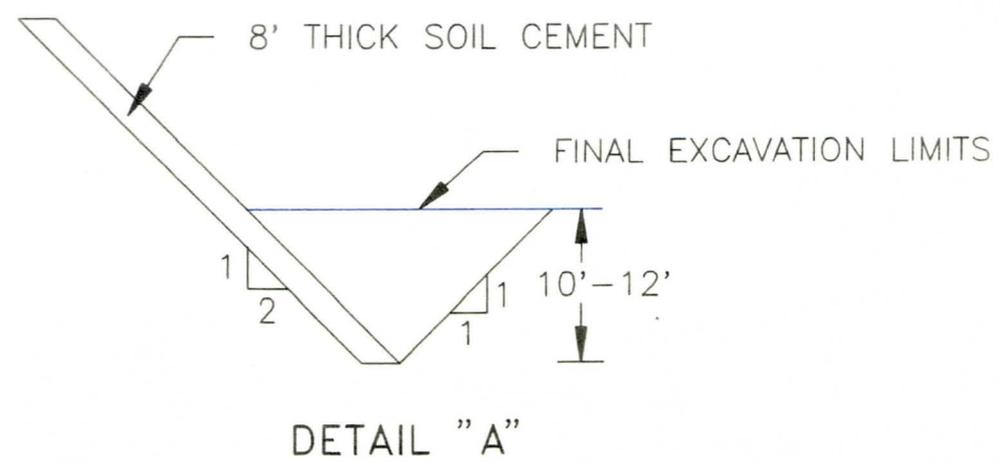
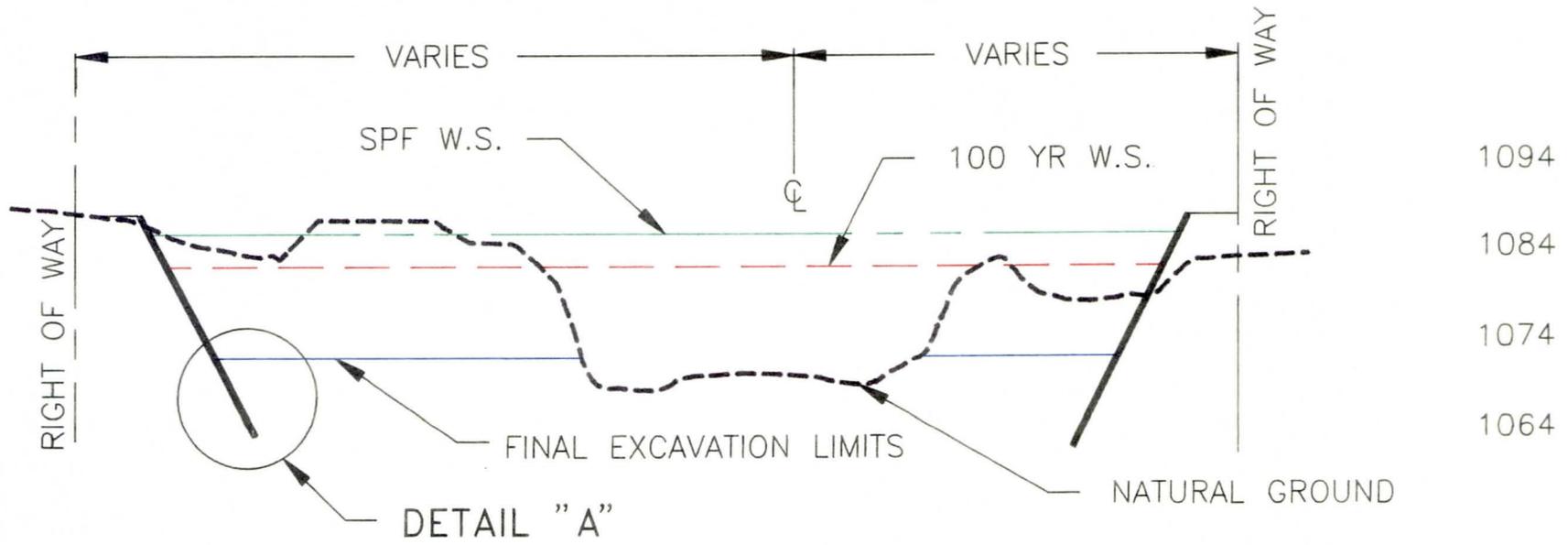
Appendix II

Channel Cross Sections and Plan Views

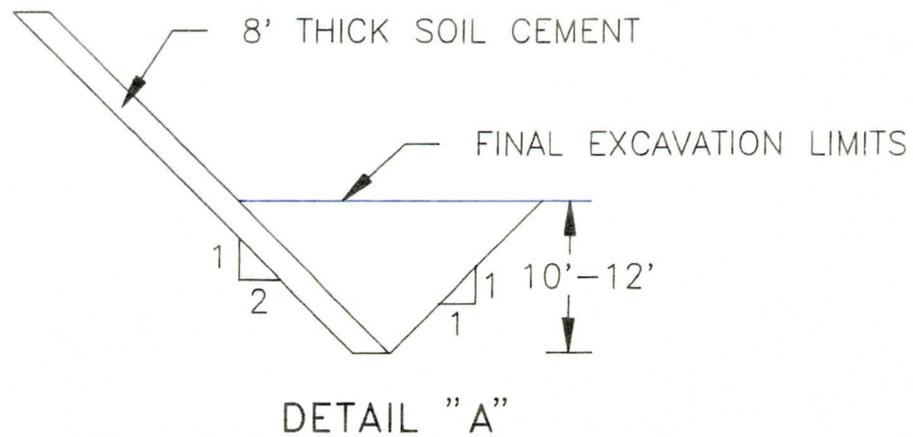
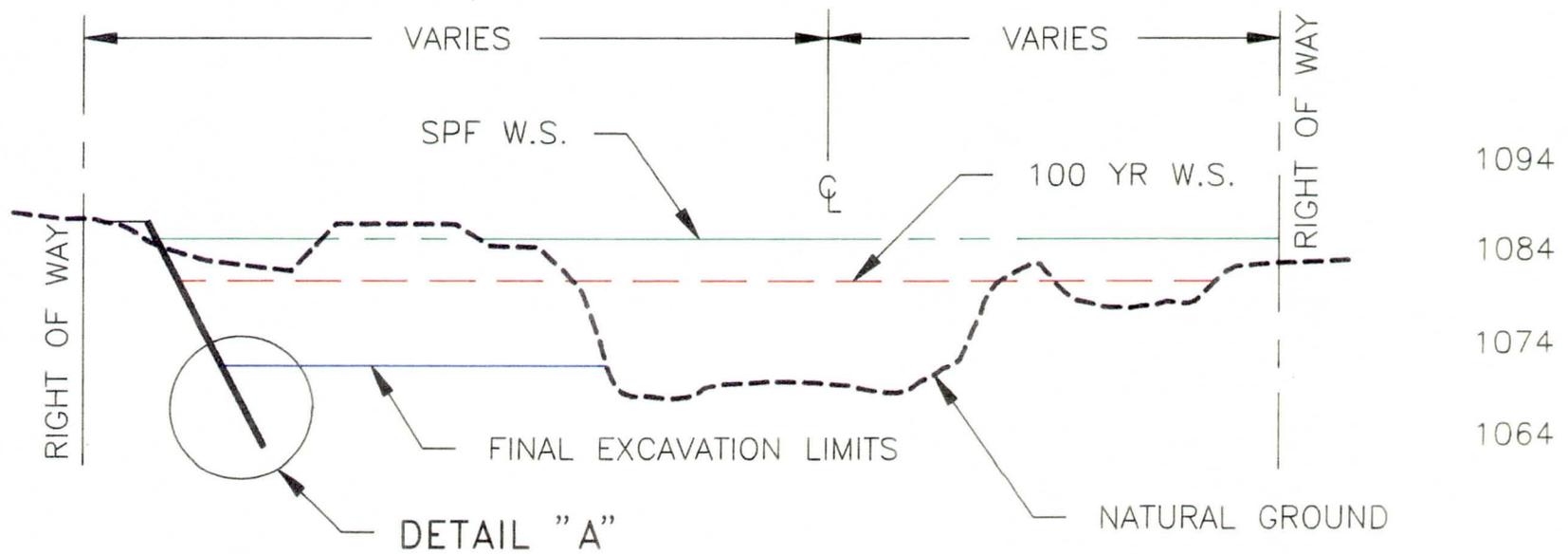
TYPICAL CROSS SECTION FOR ALTERNATIVE "B"



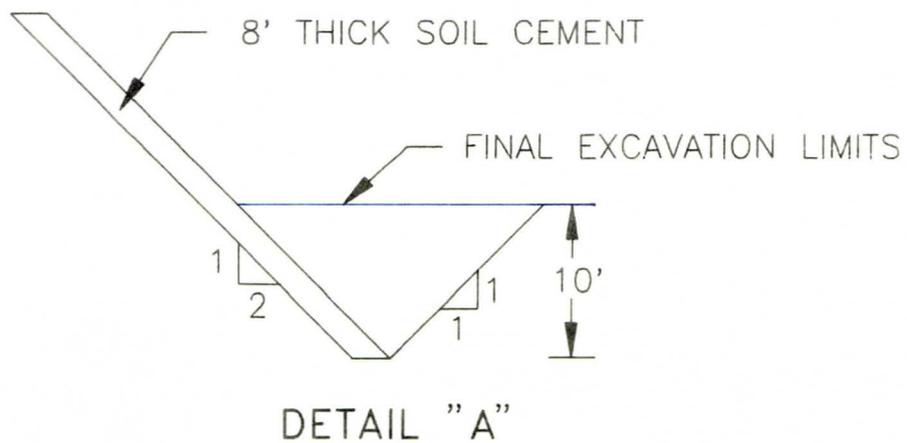
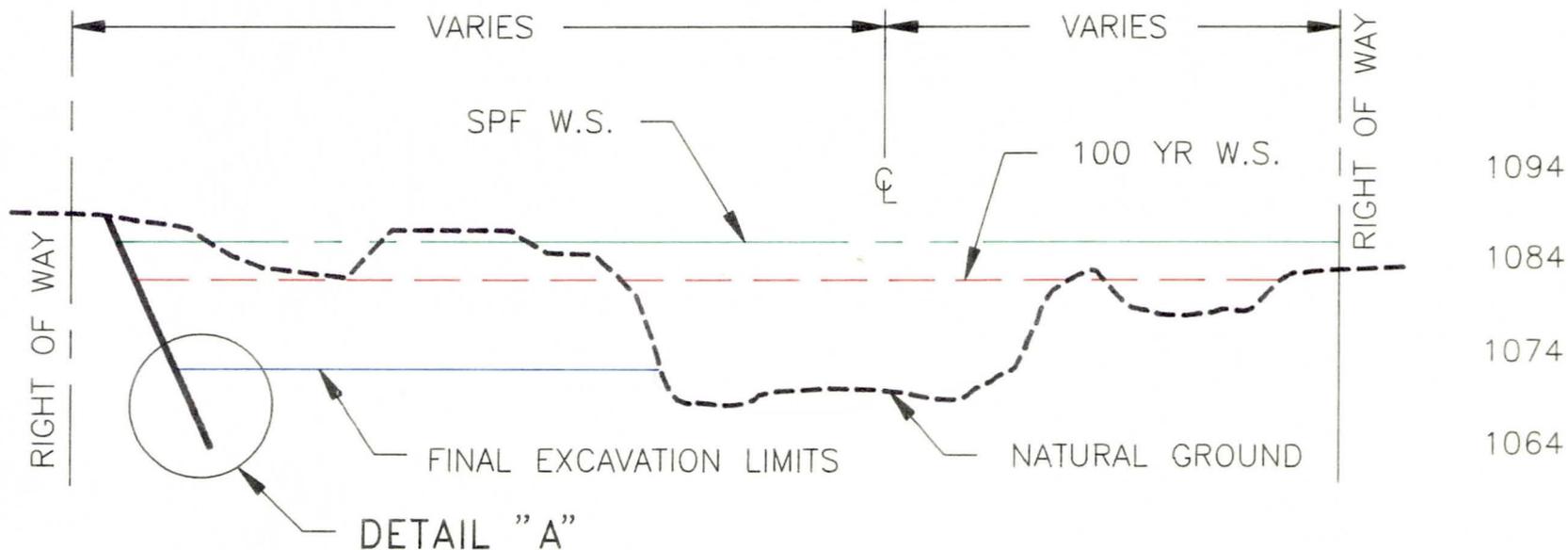
TYPICAL CROSS SECTION FOR ALTERNATIVE "B-2"



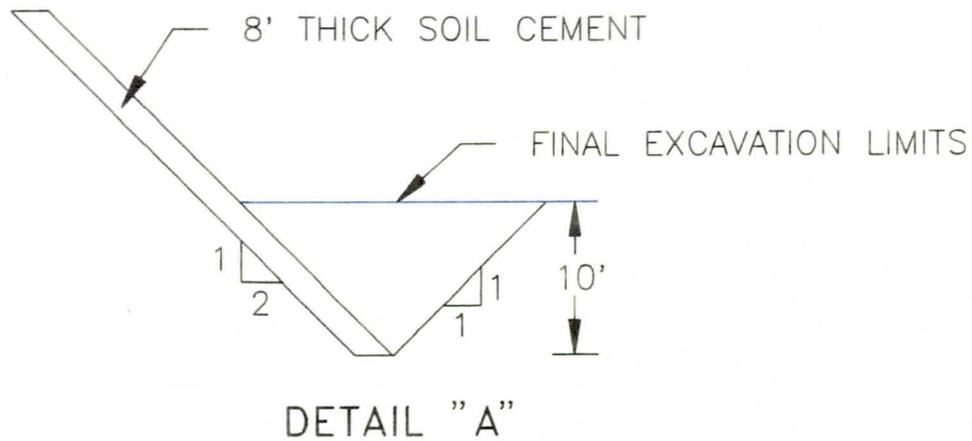
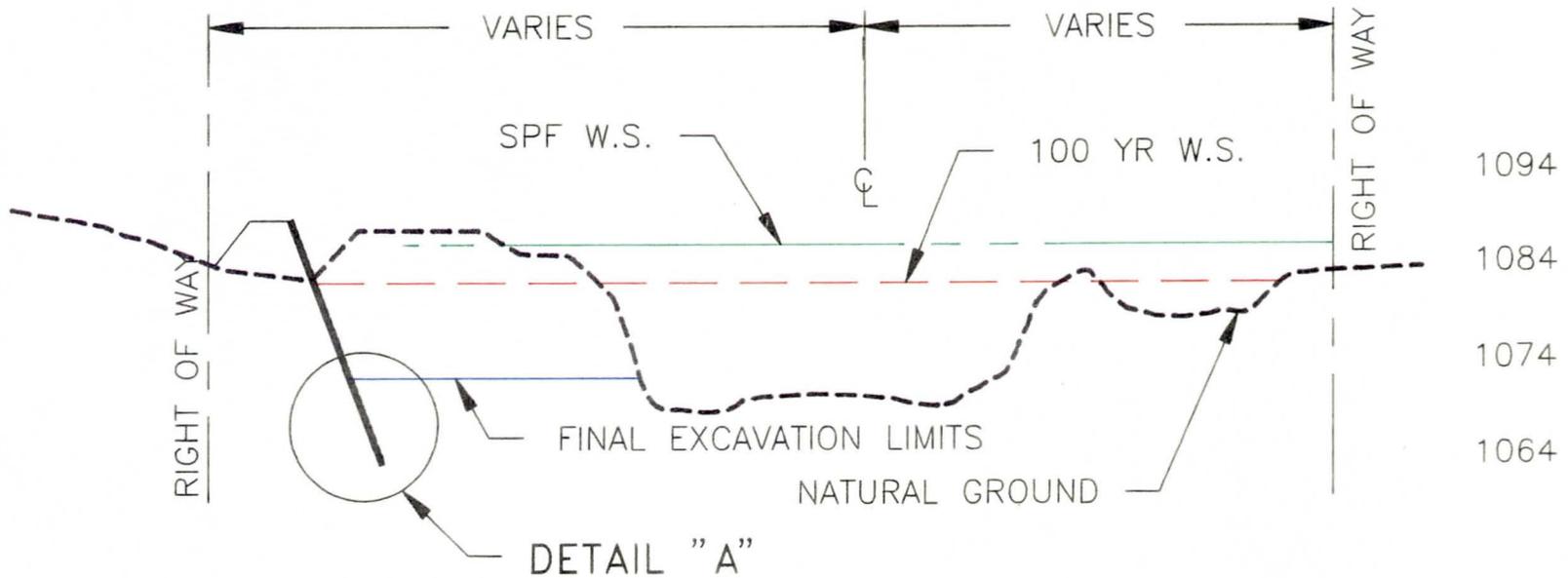
TYPICAL CROSS SECTION FOR ALTERNATIVE "C"



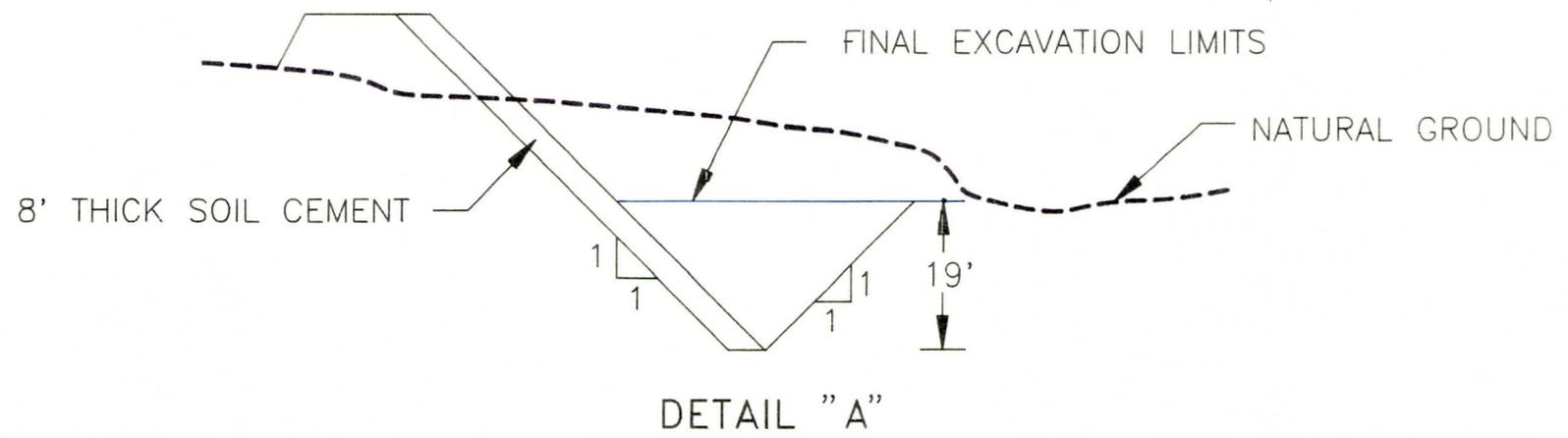
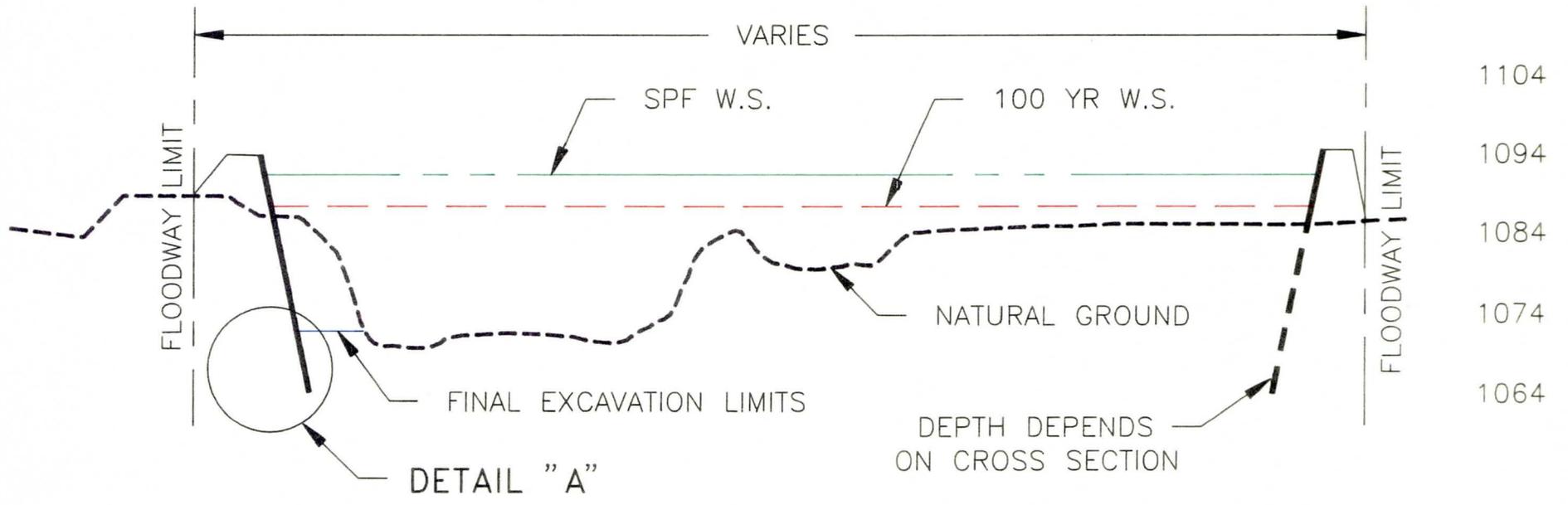
TYPICAL CROSS SECTION FOR ALTERNATIVE "C-2"



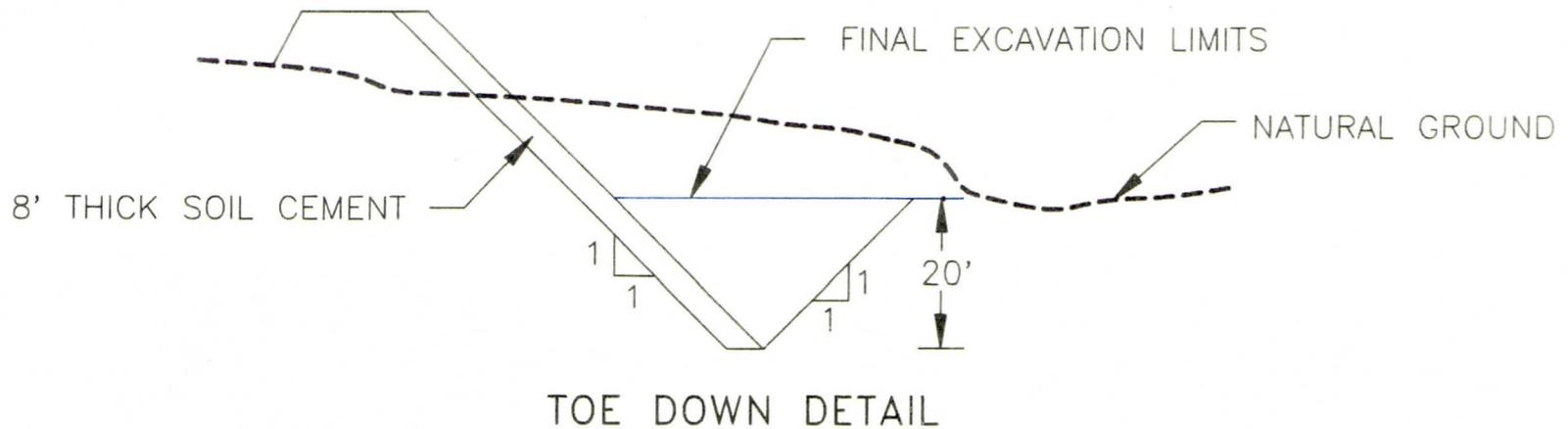
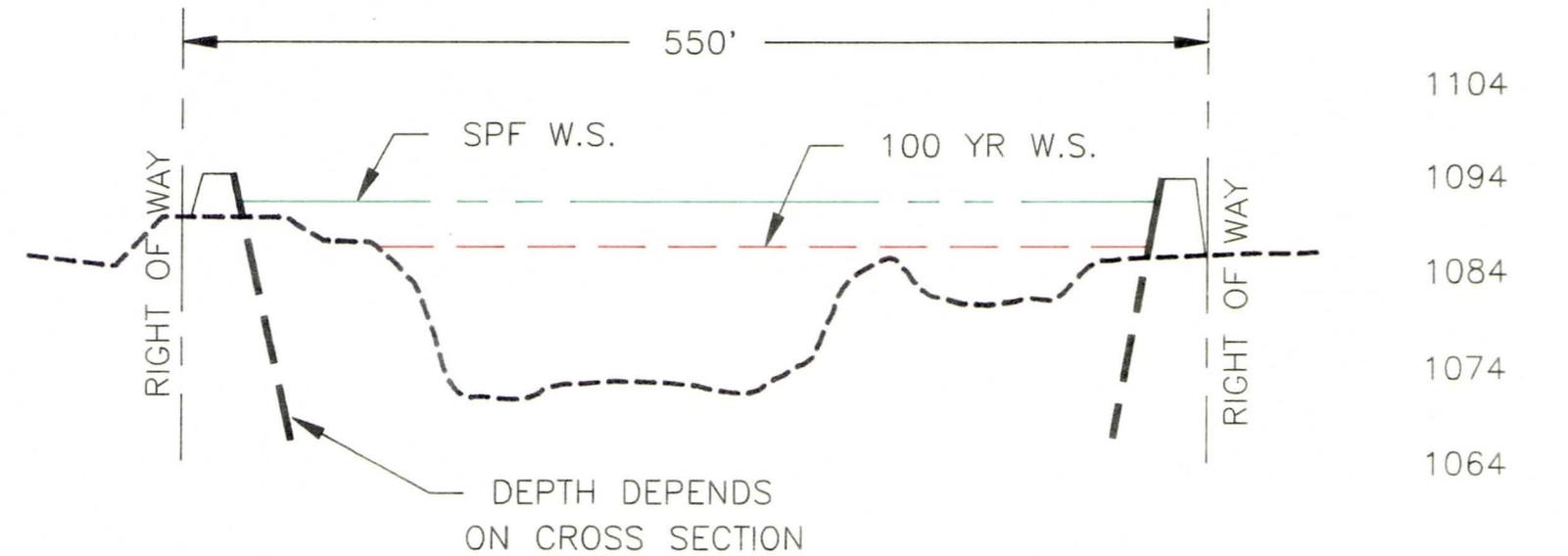
TYPICAL CROSS SECTION FOR ALTERNATIVE "C-3"

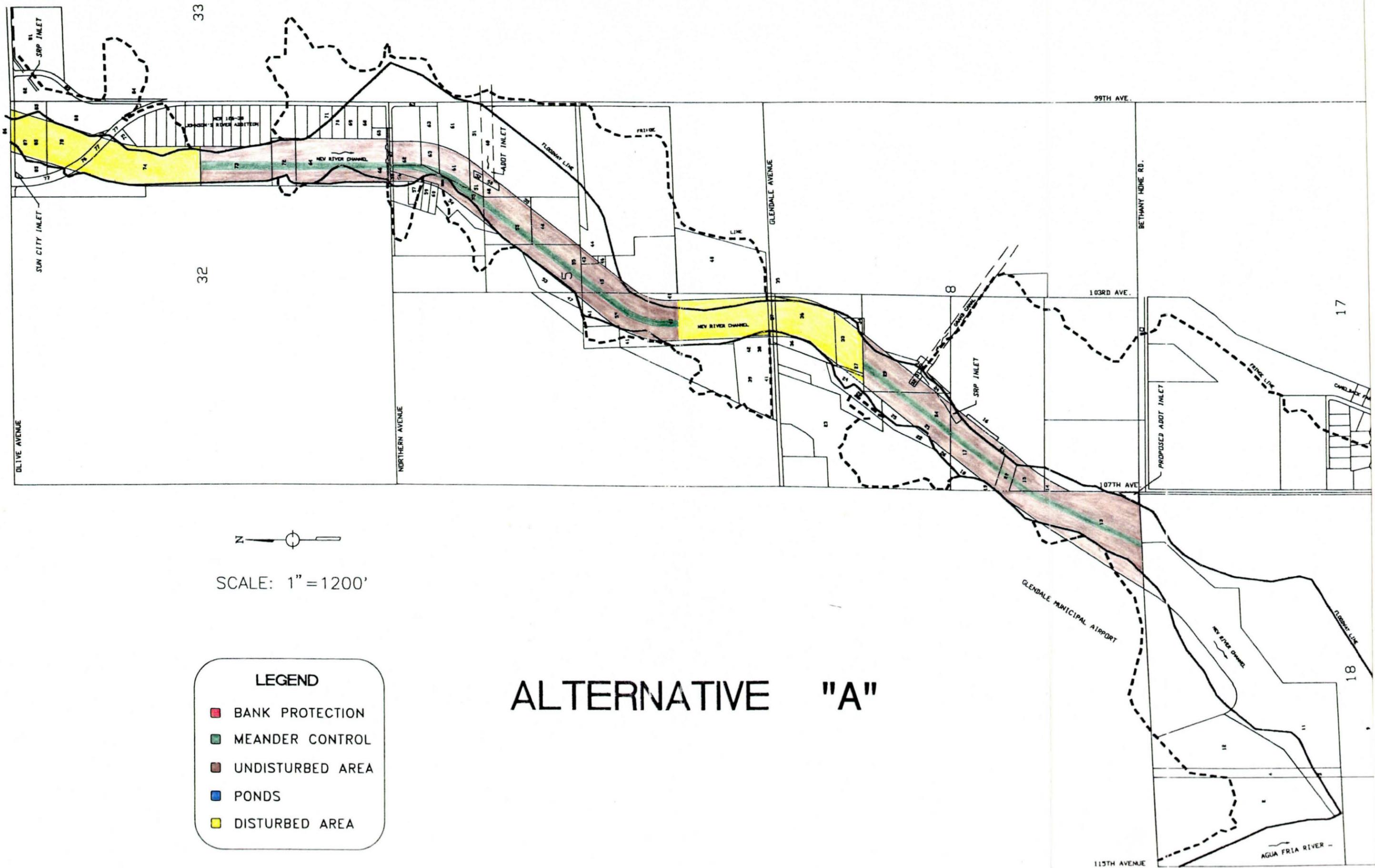


TYPICAL CROSS SECTION FOR ALTERNATIVE "D"



TYPICAL CROSS SECTION FOR ALTERNATIVE "D-2"



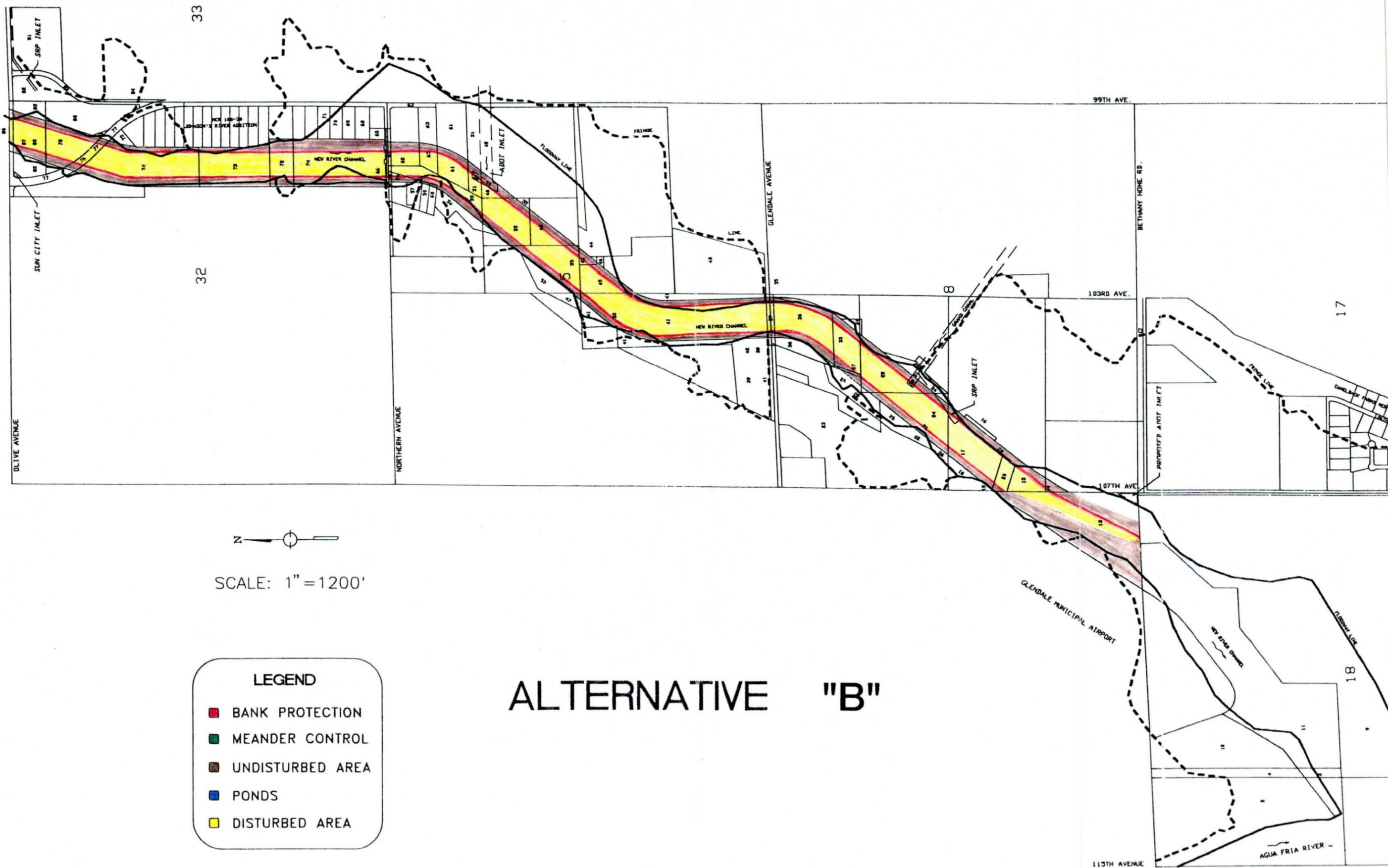


SCALE: 1" = 1200'

LEGEND

- BANK PROTECTION
- MEANDER CONTROL
- UNDISTURBED AREA
- PONDS
- DISTURBED AREA

ALTERNATIVE "A"



33

32

17

18



SCALE: 1" = 1200'

LEGEND

- BANK PROTECTION
- MEANDER CONTROL
- UNDISTURBED AREA
- PONDS
- DISTURBED AREA

ALTERNATIVE "B"

99TH AVE.

103RD AVE.

107TH AVE.

115TH AVE.

OLIVE AVENUE

NORTHERN AVENUE

GLENDALE AVENUE

BETHANY HOME RD.

GLENDALE MUNICIPAL AIRPORT

AGUA FRIA RIVER

SUN CITY INLET

SRP INLET

SRP INLET

SRP INLET

FRINGE

FLOODWAY LINE

LINE

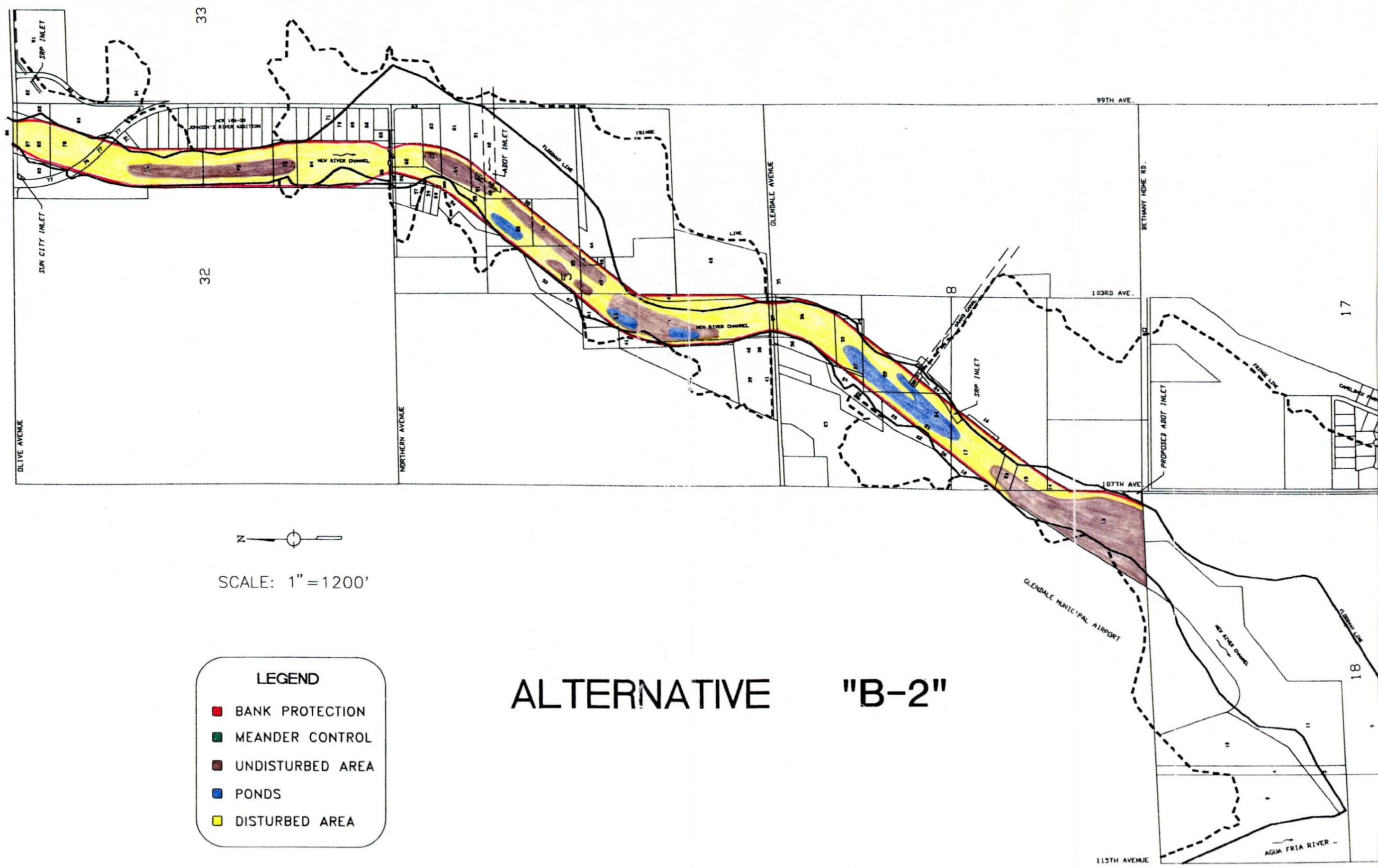
FRINGE

FRINGE LINE

FRINGE LINE

FRINGE LINE

SRP INLET

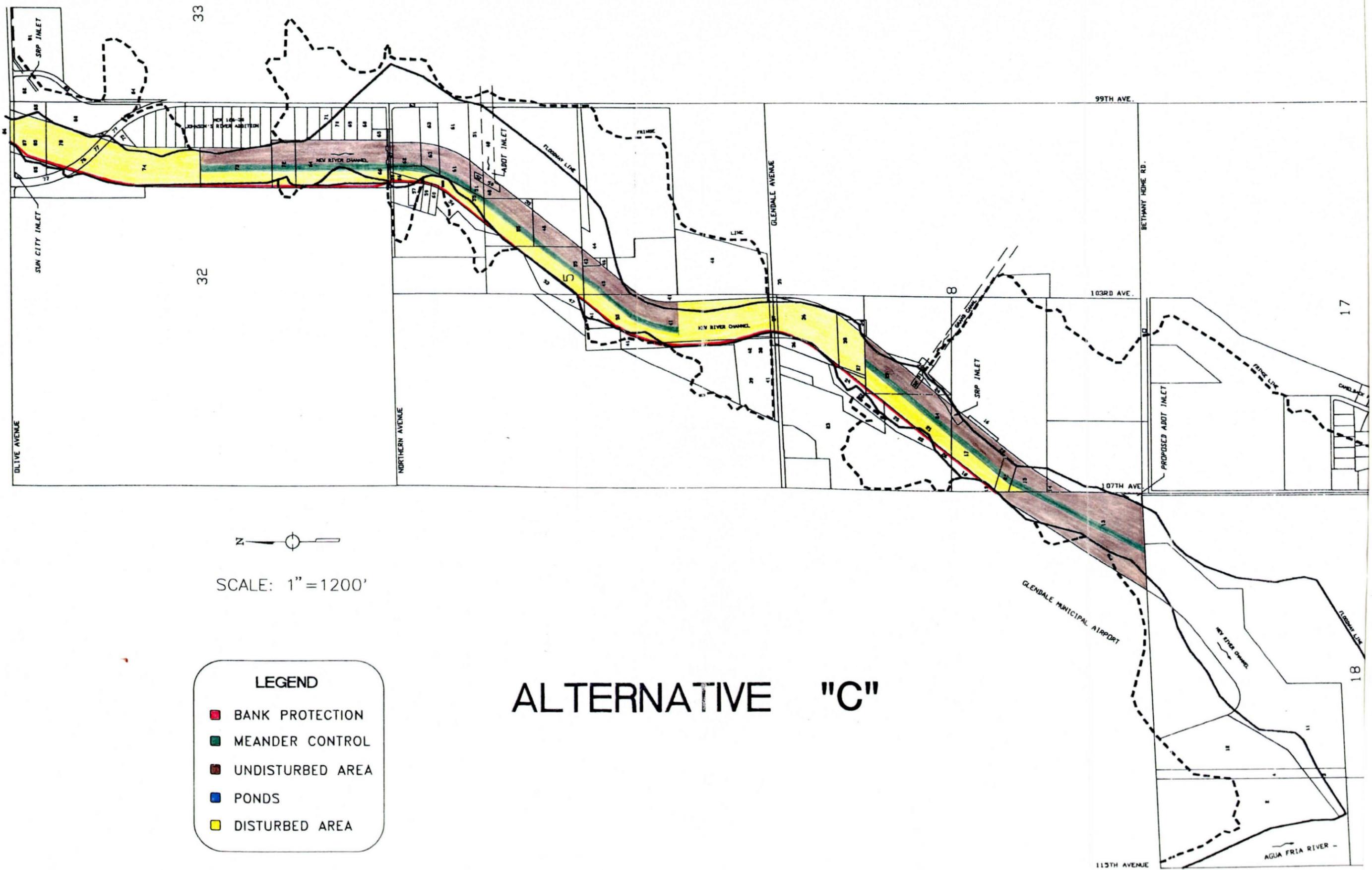


SCALE: 1" = 1200'

LEGEND

- BANK PROTECTION
- MEANDER CONTROL
- UNDISTURBED AREA
- PONDS
- DISTURBED AREA

ALTERNATIVE "B-2"



33

32

17

18



SCALE: 1" = 1200'

LEGEND

- BANK PROTECTION
- MEANDER CONTROL
- UNDISTURBED AREA
- PONDS
- DISTURBED AREA

ALTERNATIVE "C"

99TH AVE.

103RD AVE.

107TH AVE.

113TH AVE.

SUN CITY INLET

OLIVE AVENUE

NORTHERN AVENUE

GLENDALE AVENUE

BETHANY HOME RD.

GLENDALE MUNICIPAL AIRPORT

AGUA FRIA RIVER

SRP INLET

ADDOT INLET

SRP INLET

PROPOSED ADDOT INLET

JOHN'S RIVER ABUTMENT

FLOODWAY LINE

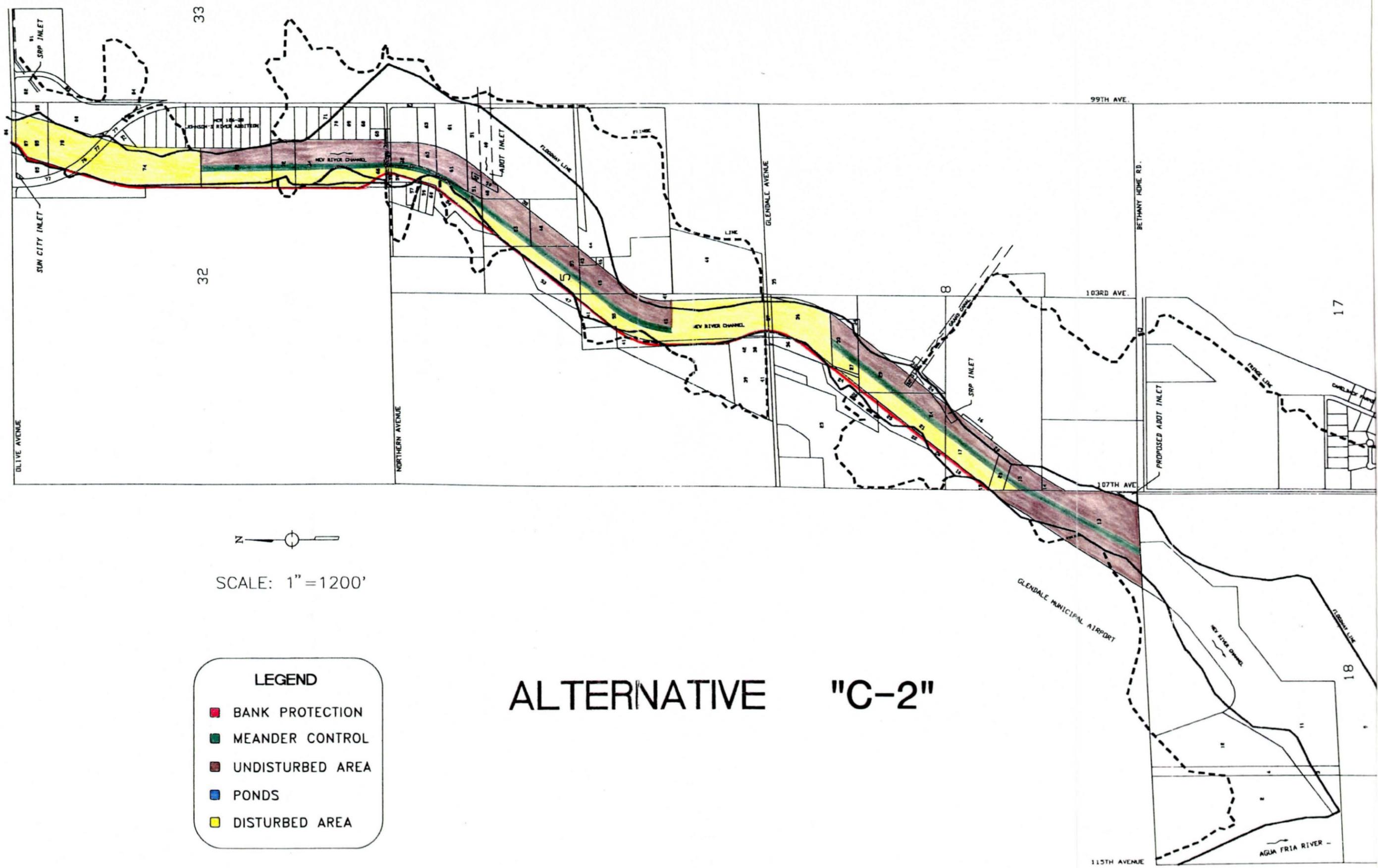
LINE

SRP

SRP RIVER CHANNEL

FLOODWAY LINE

CHANNEL

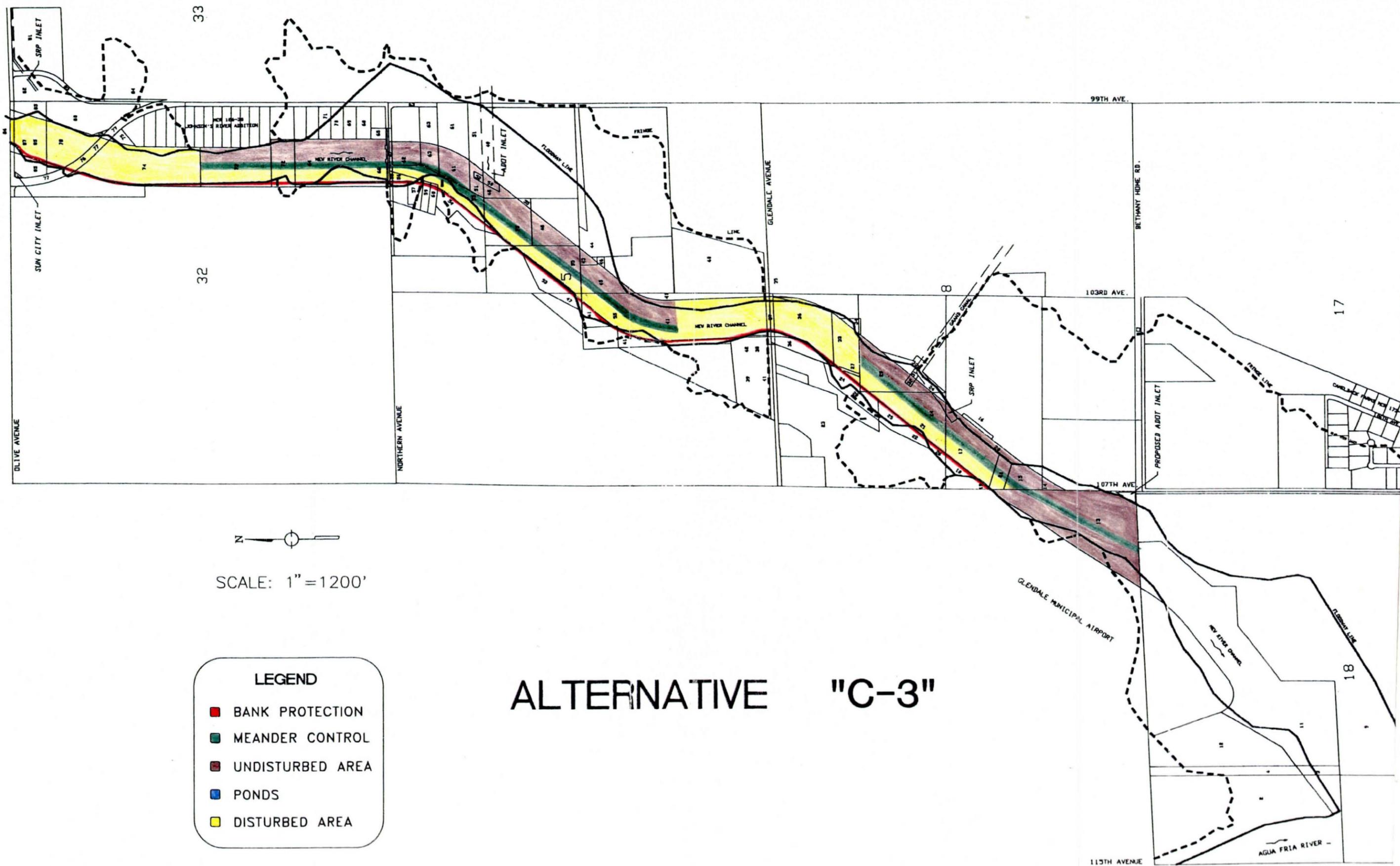


SCALE: 1" = 1200'

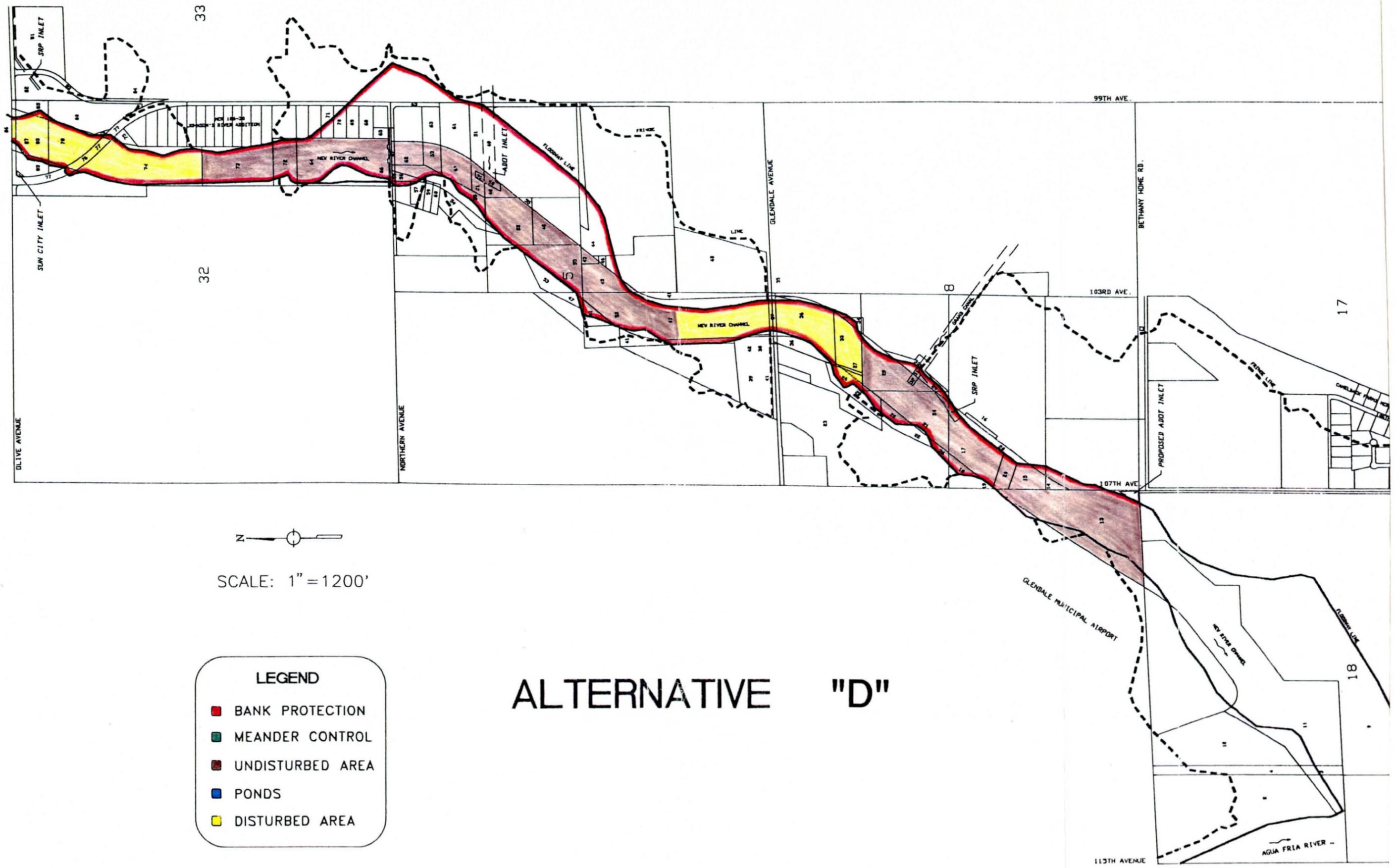
LEGEND

- BANK PROTECTION
- MEANDER CONTROL
- UNDISTURBED AREA
- PONDS
- DISTURBED AREA

ALTERNATIVE "C-2"



ALTERNATIVE "C-3"

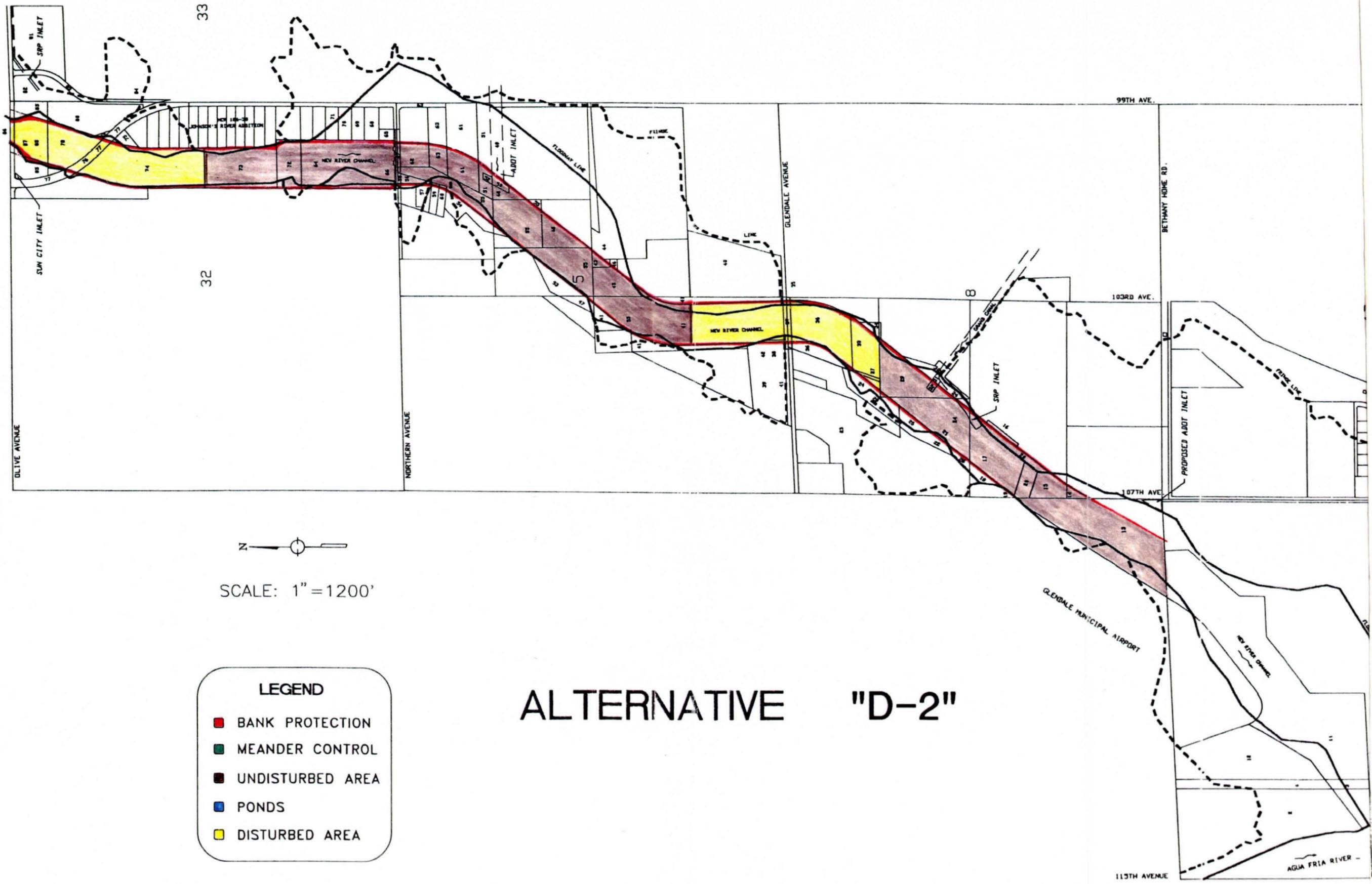


SCALE: 1" = 1200'

LEGEND

- BANK PROTECTION
- MEANDER CONTROL
- UNDISTURBED AREA
- PONDS
- DISTURBED AREA

ALTERNATIVE "D"

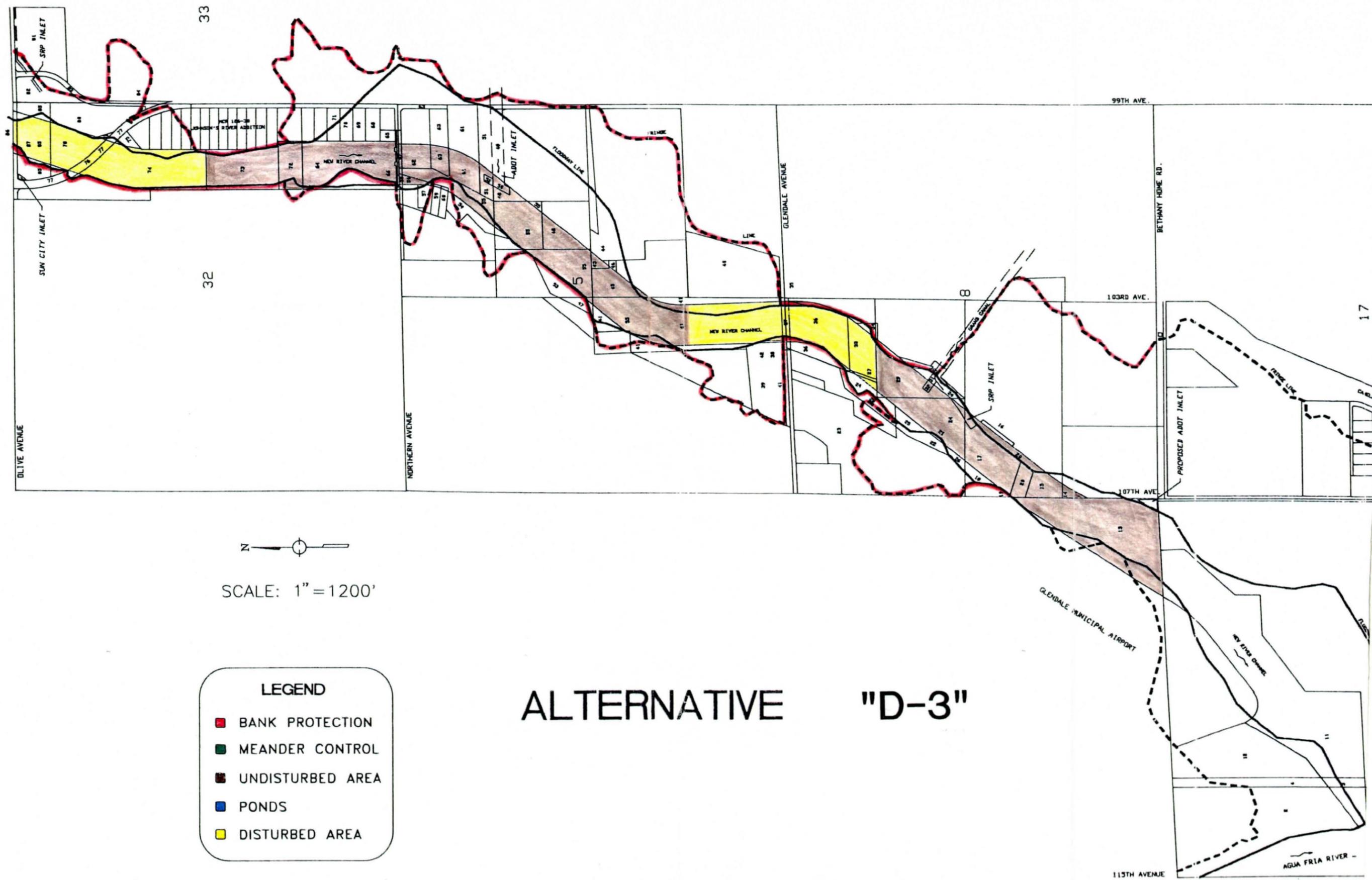


ALTERNATIVE "D-2"

LEGEND

- BANK PROTECTION
- MEANDER CONTROL
- UNDISTURBED AREA
- PONDS
- DISTURBED AREA

SCALE: 1" = 1200'



SCALE: 1" = 1200'

LEGEND

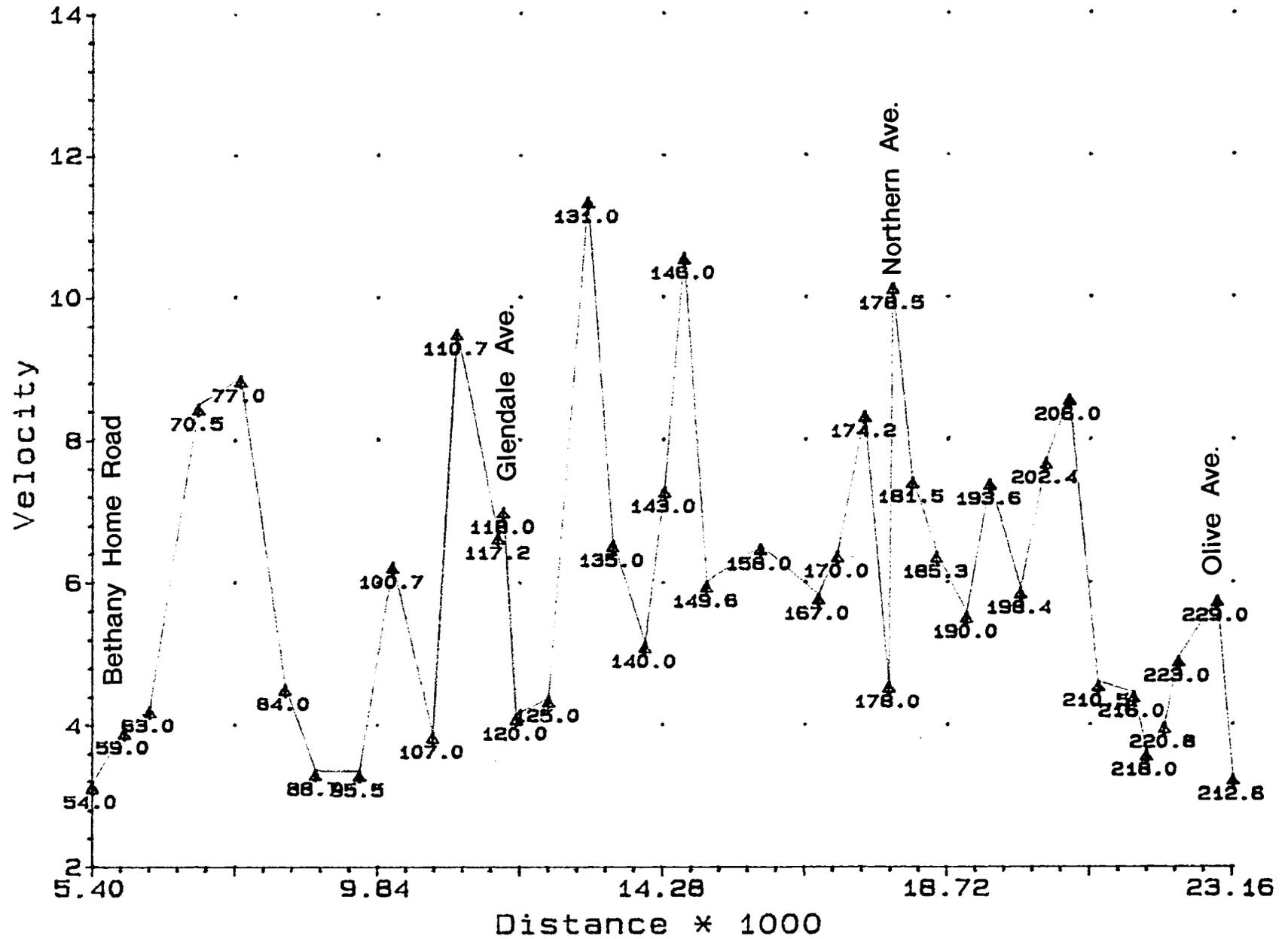
- BANK PROTECTION
- MEANDER CONTROL
- UNDISTURBED AREA
- PONDS
- DISTURBED AREA

ALTERNATIVE "D-3"

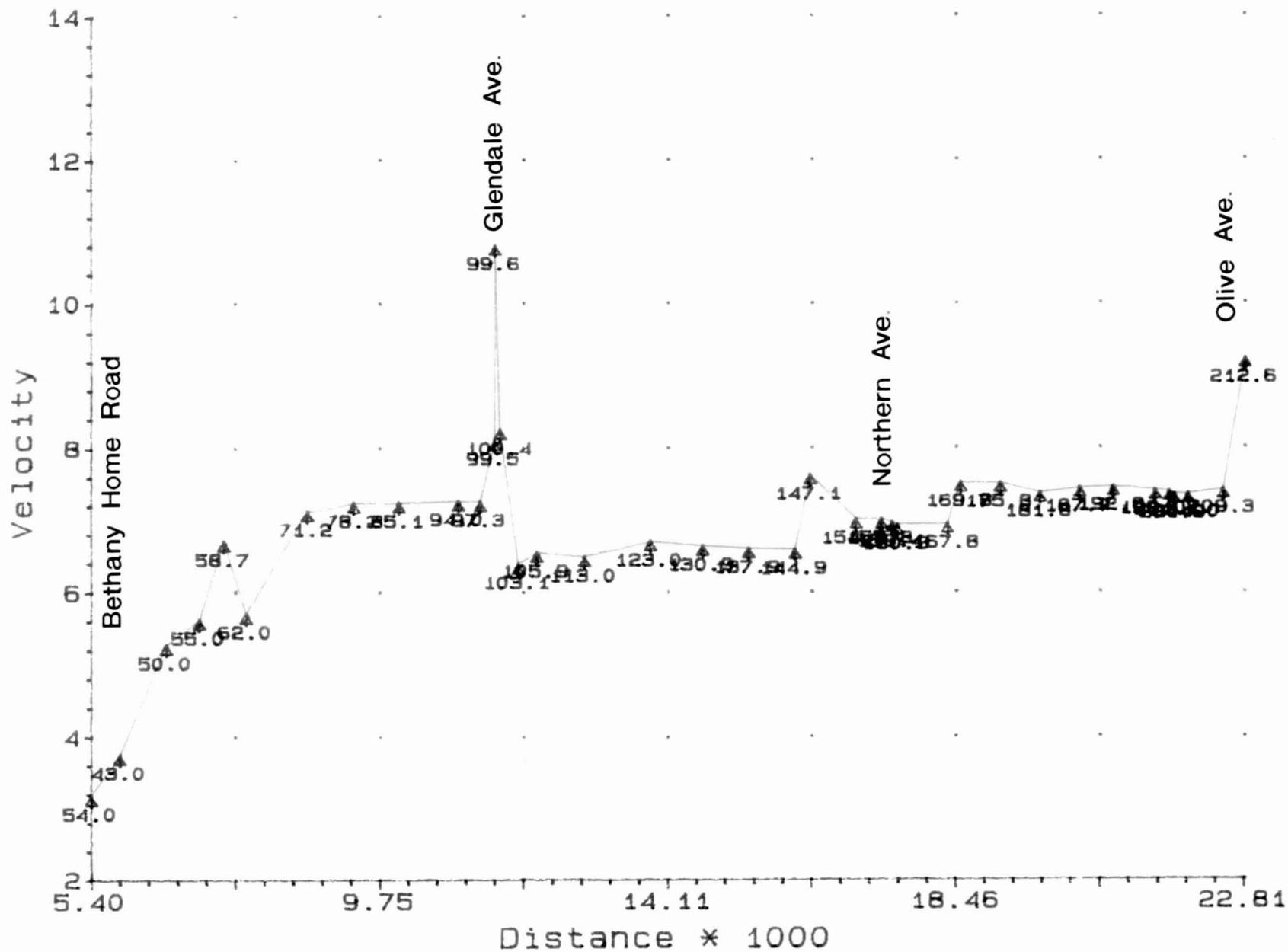
Appendix III

10-Year Velocity Profile and Water Surface Elevation Profiles for Standard Project Flood, 100-, 50-, and 10-Year Events

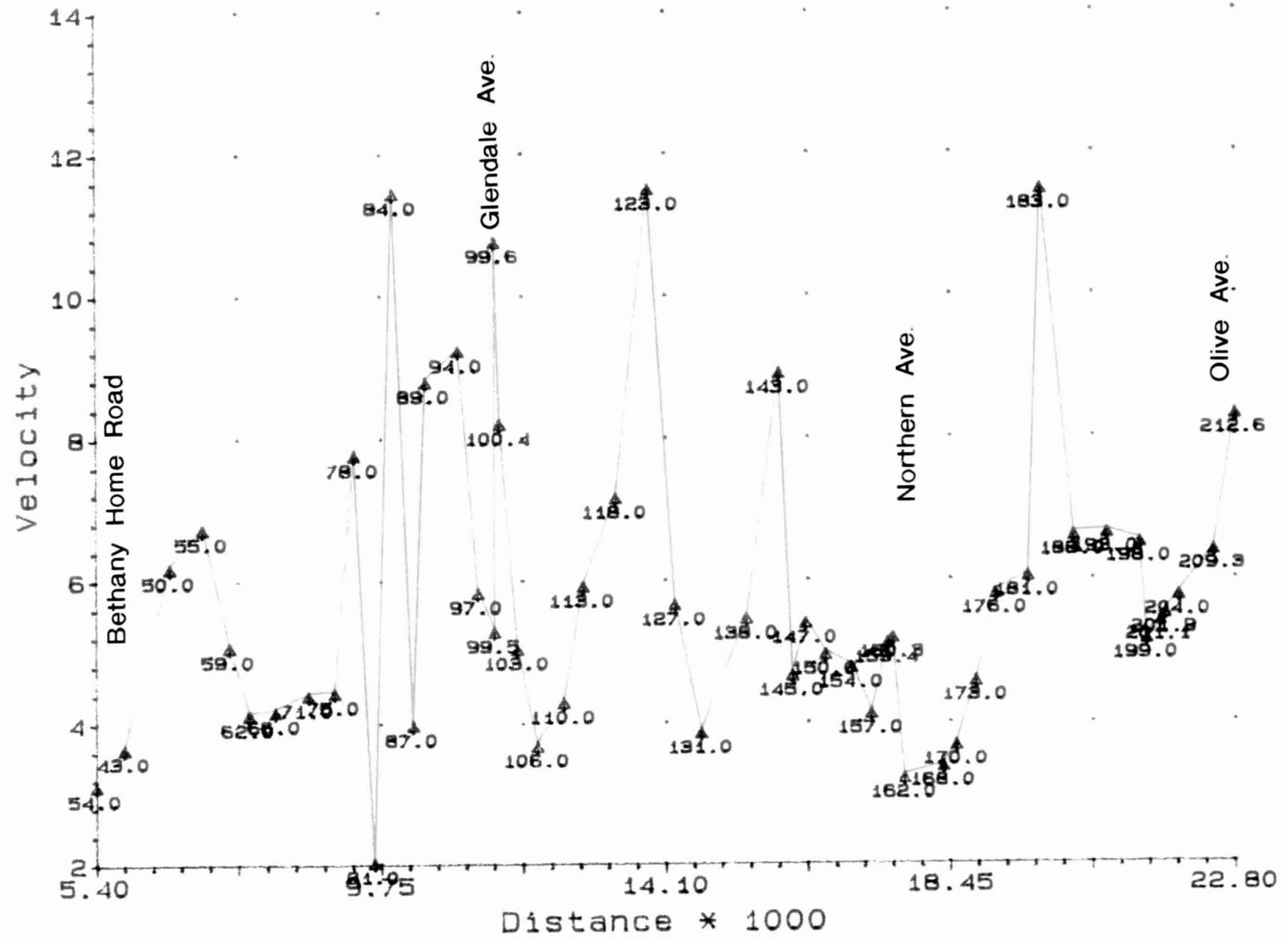
ALTERNATIVE A AVE VEL FOR 10-YEAR Q



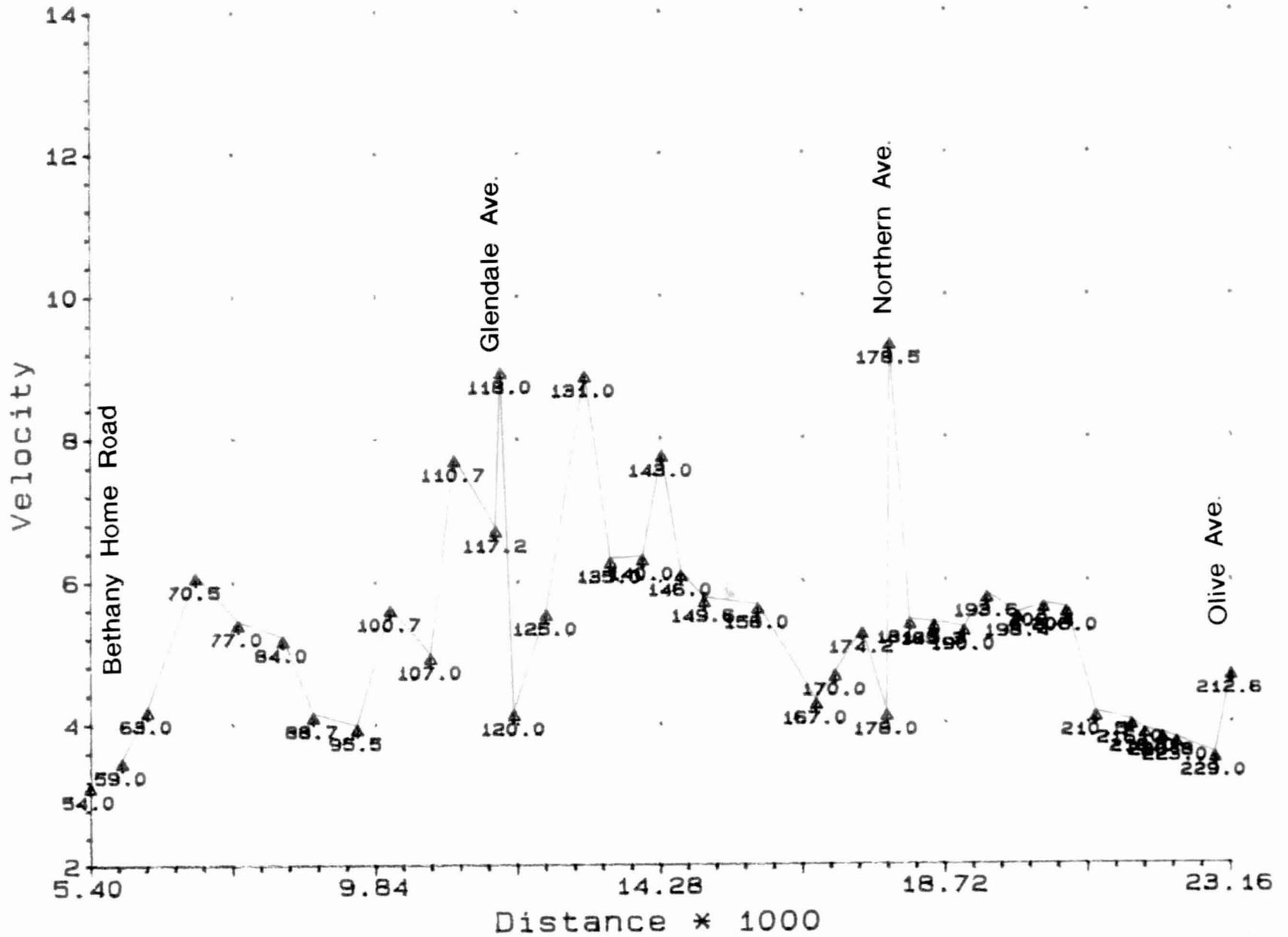
ALTERNATIVE B
 AVE VEL FOR 10-YEAR Q



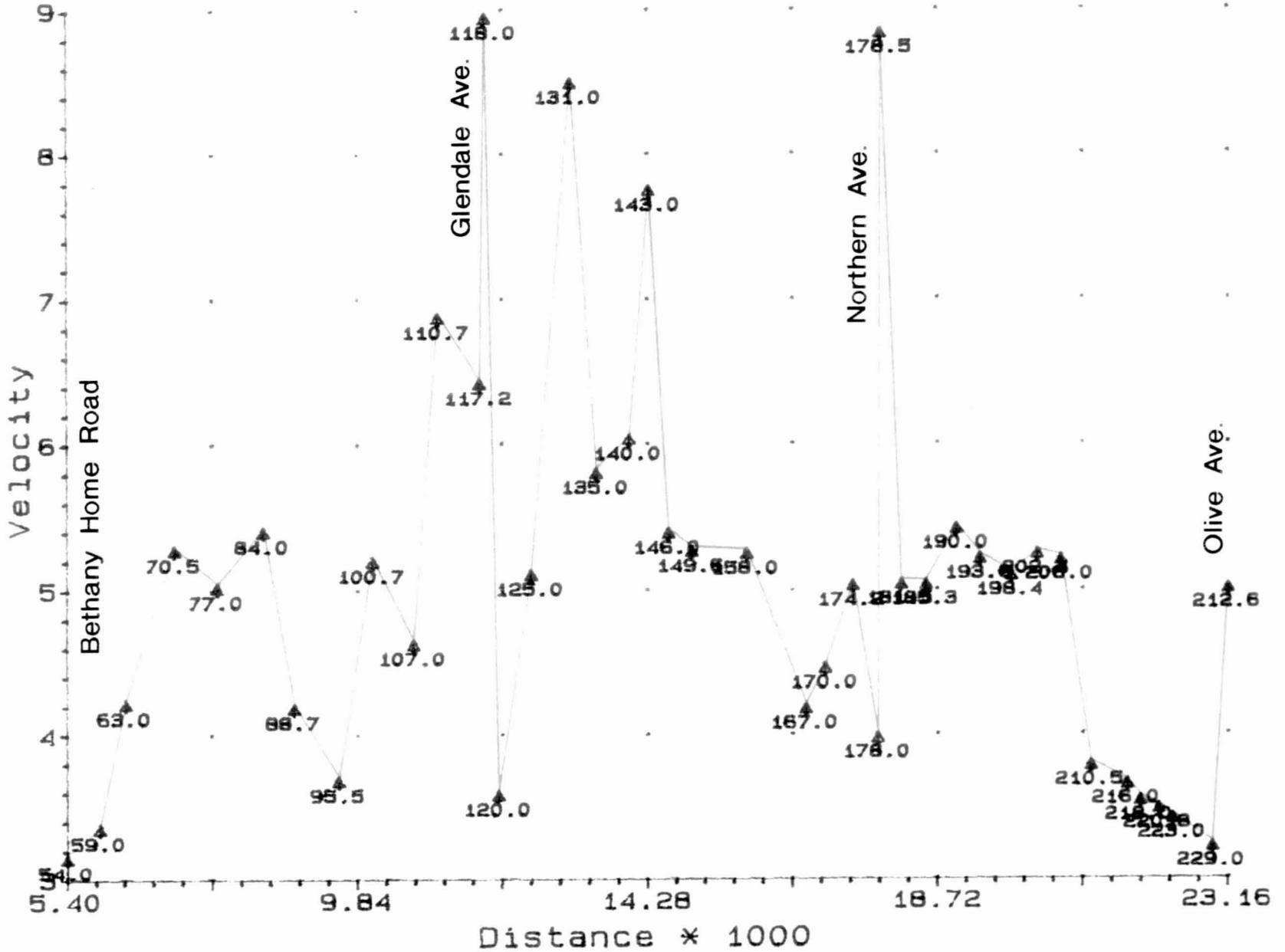
ALTERNATIVE B-2 AVE VEL FOR 10-YEAR Q



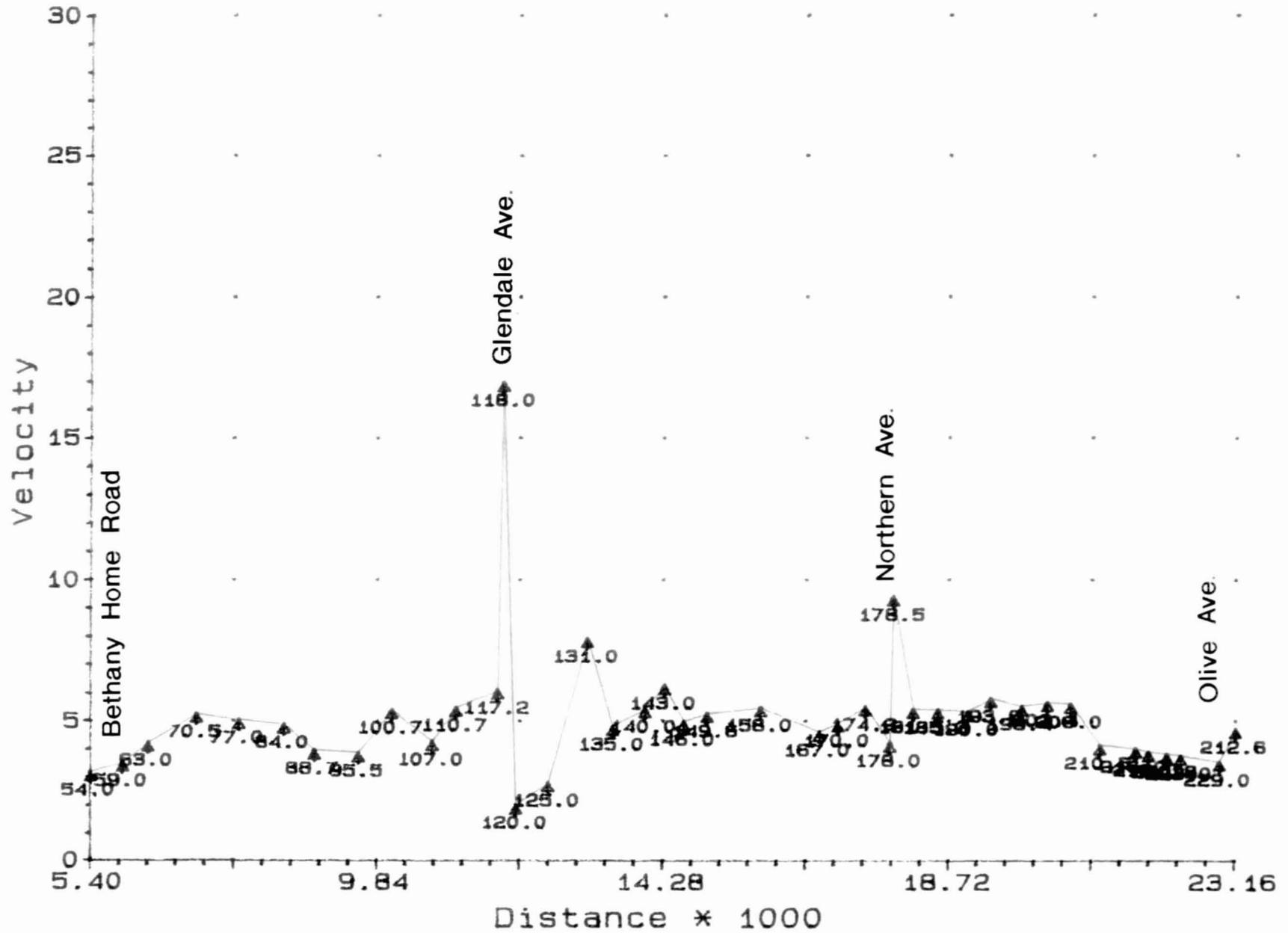
ALTERNATIVE C



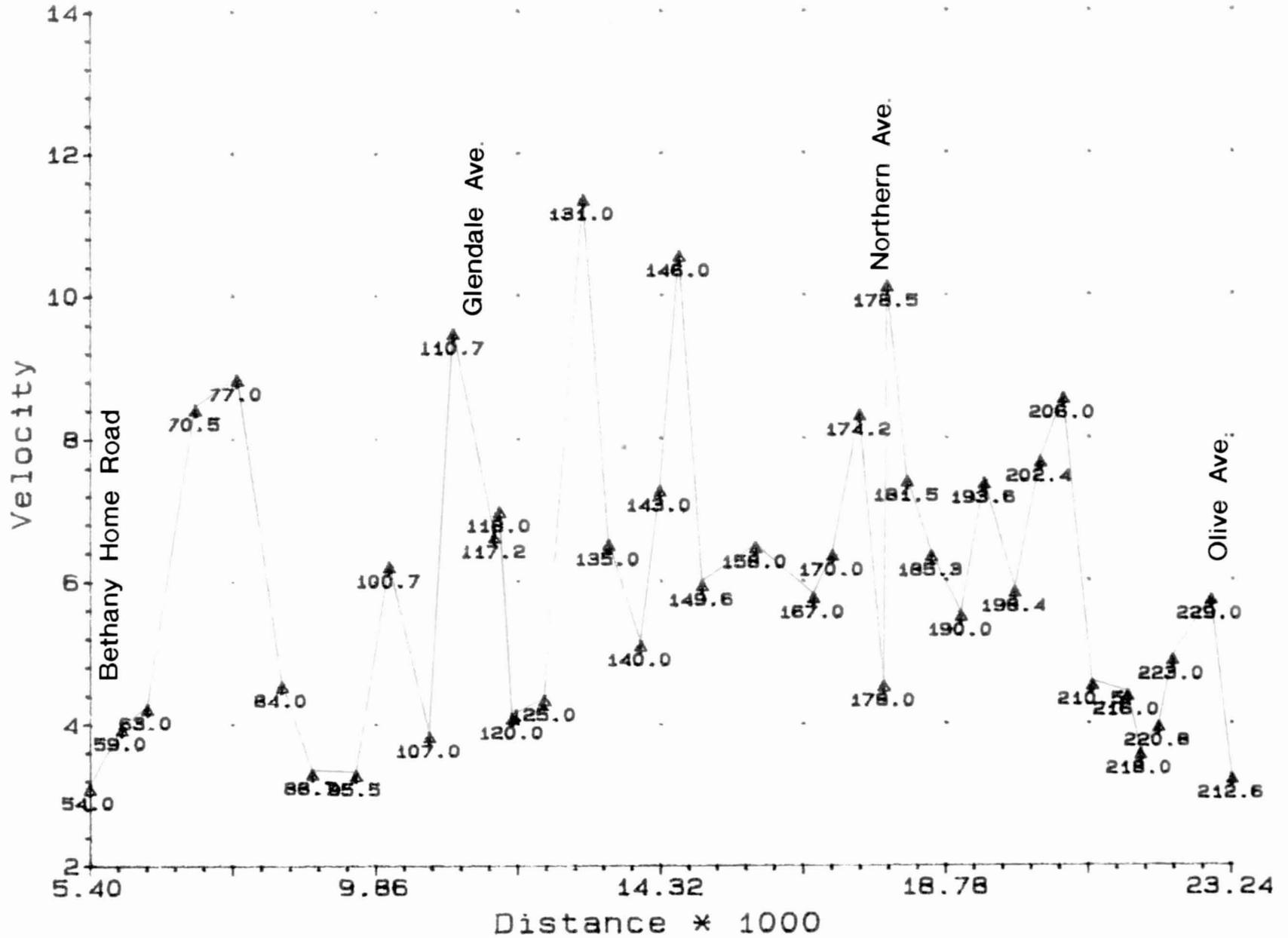
ALTERNATIVE C-2 AVE VEL FOR 10-YEAR Q



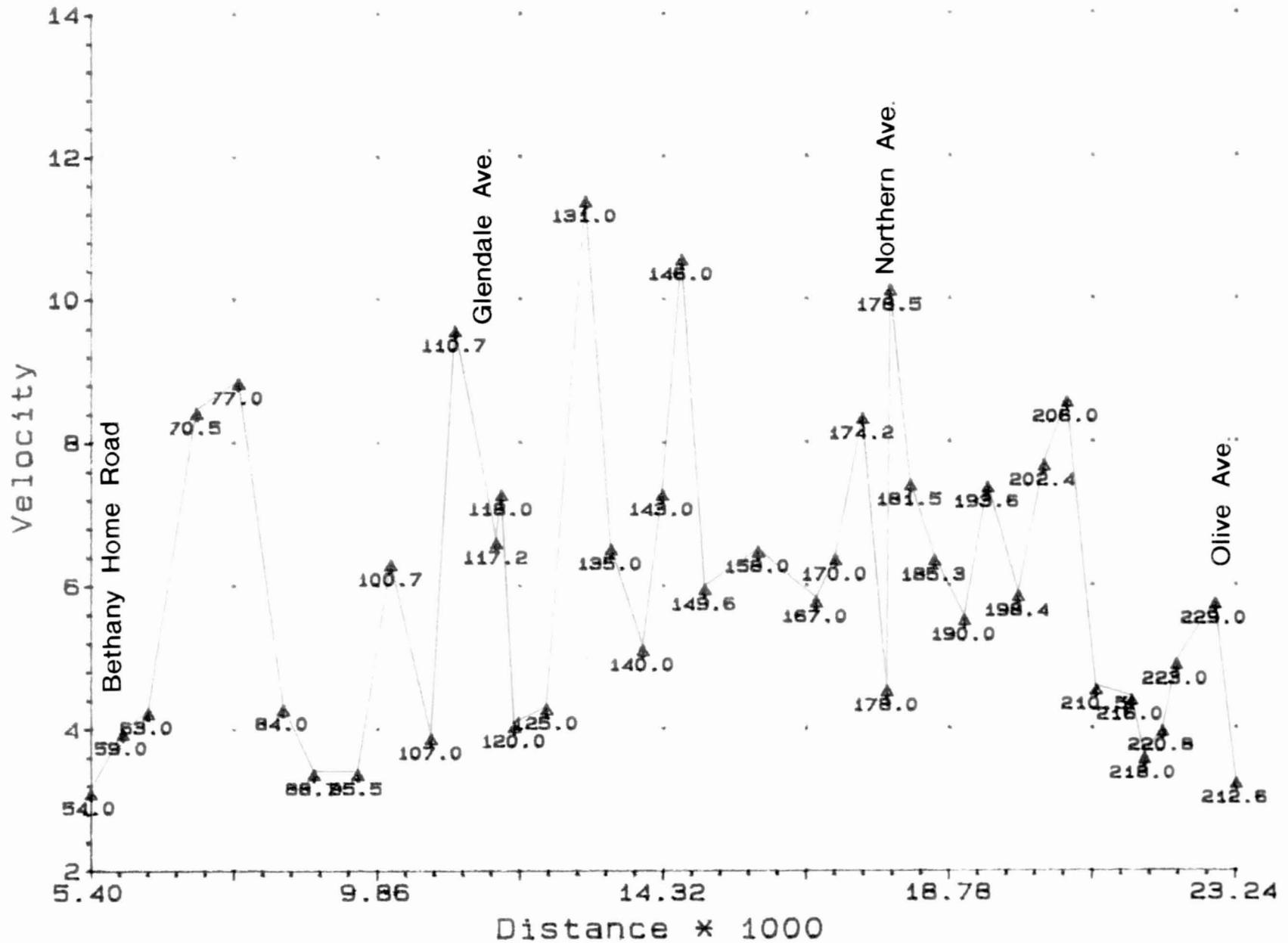
ALTERNATIVE C-3 AVE VEL FOR 10-YEAR Q



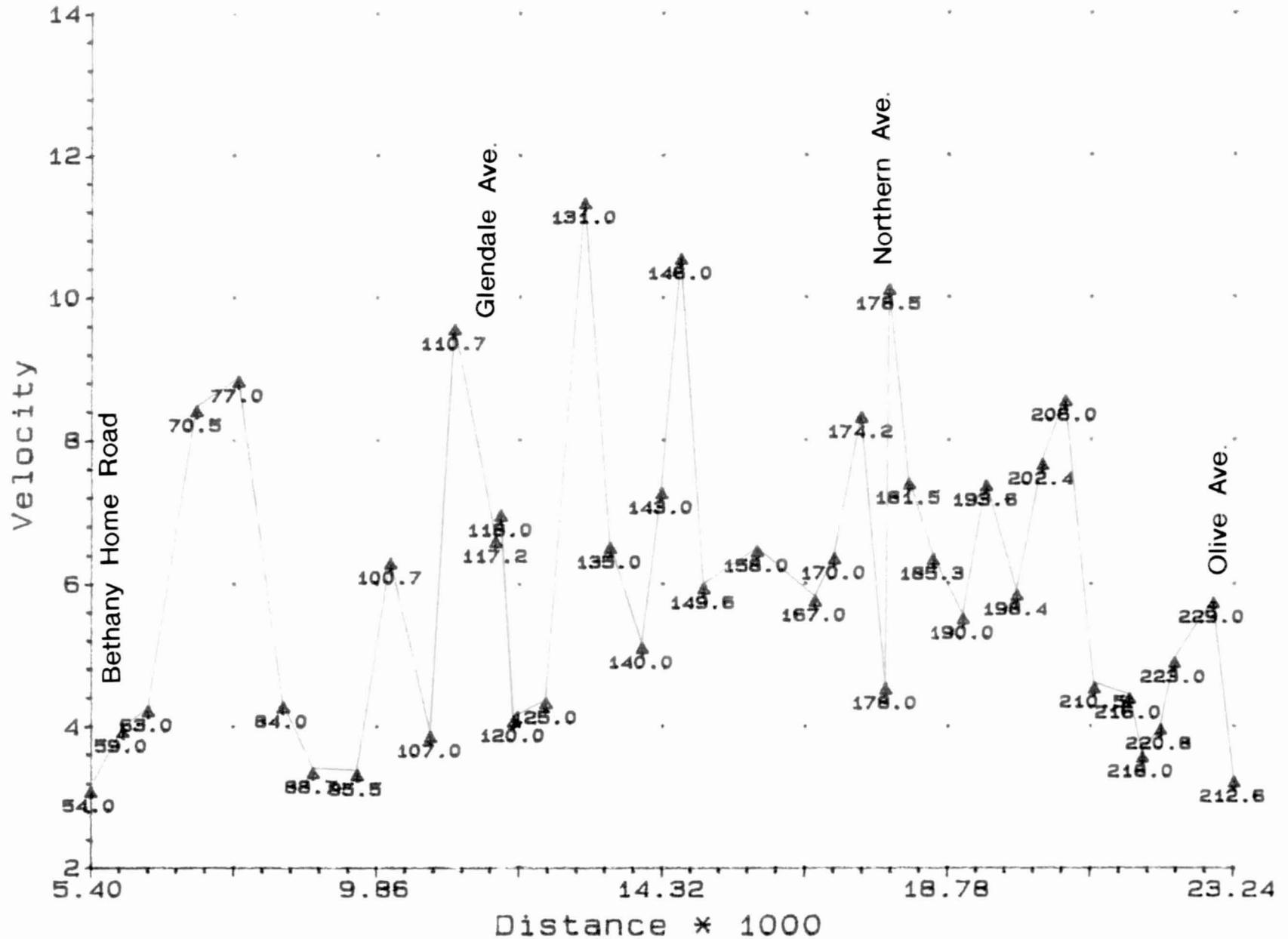
ALTERNATIVE D AVE VEL FOR 10-YEAR Q



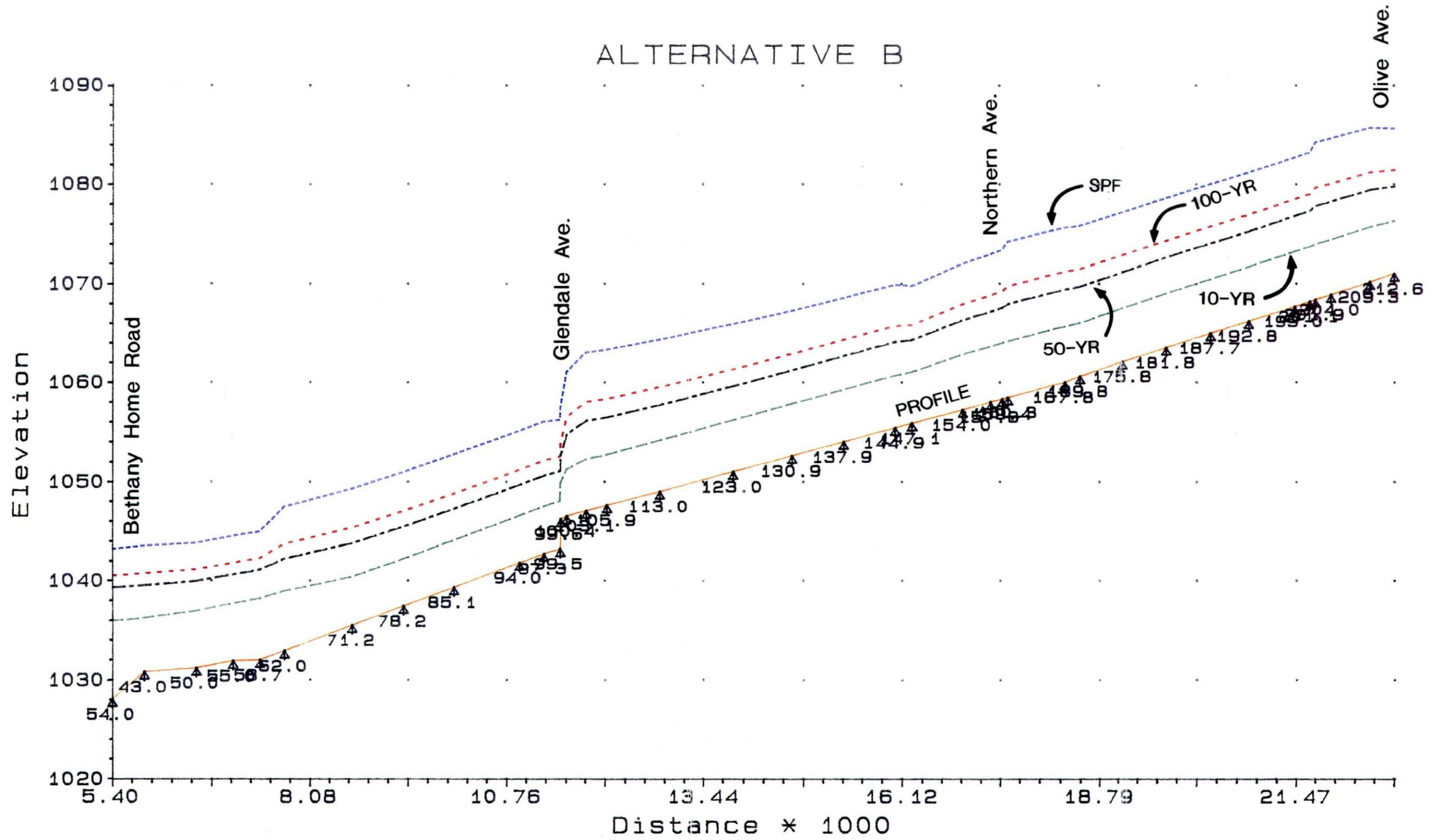
ALTERNATIVE D-2
 AVE VEL FOR 10-YEAR Q



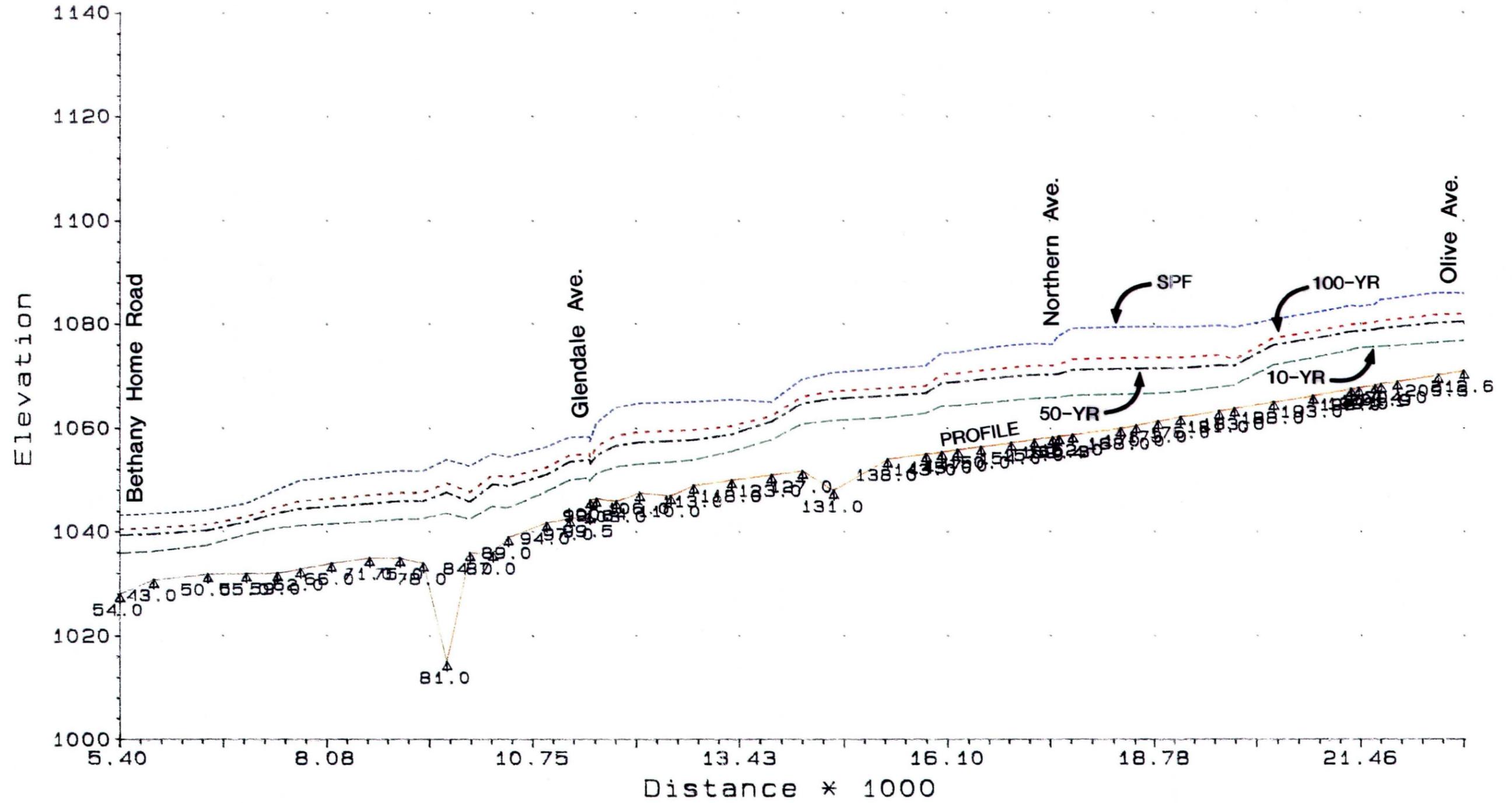
ALTERNATIVE D-3 AVE VEL FOR 10-YEAR Q



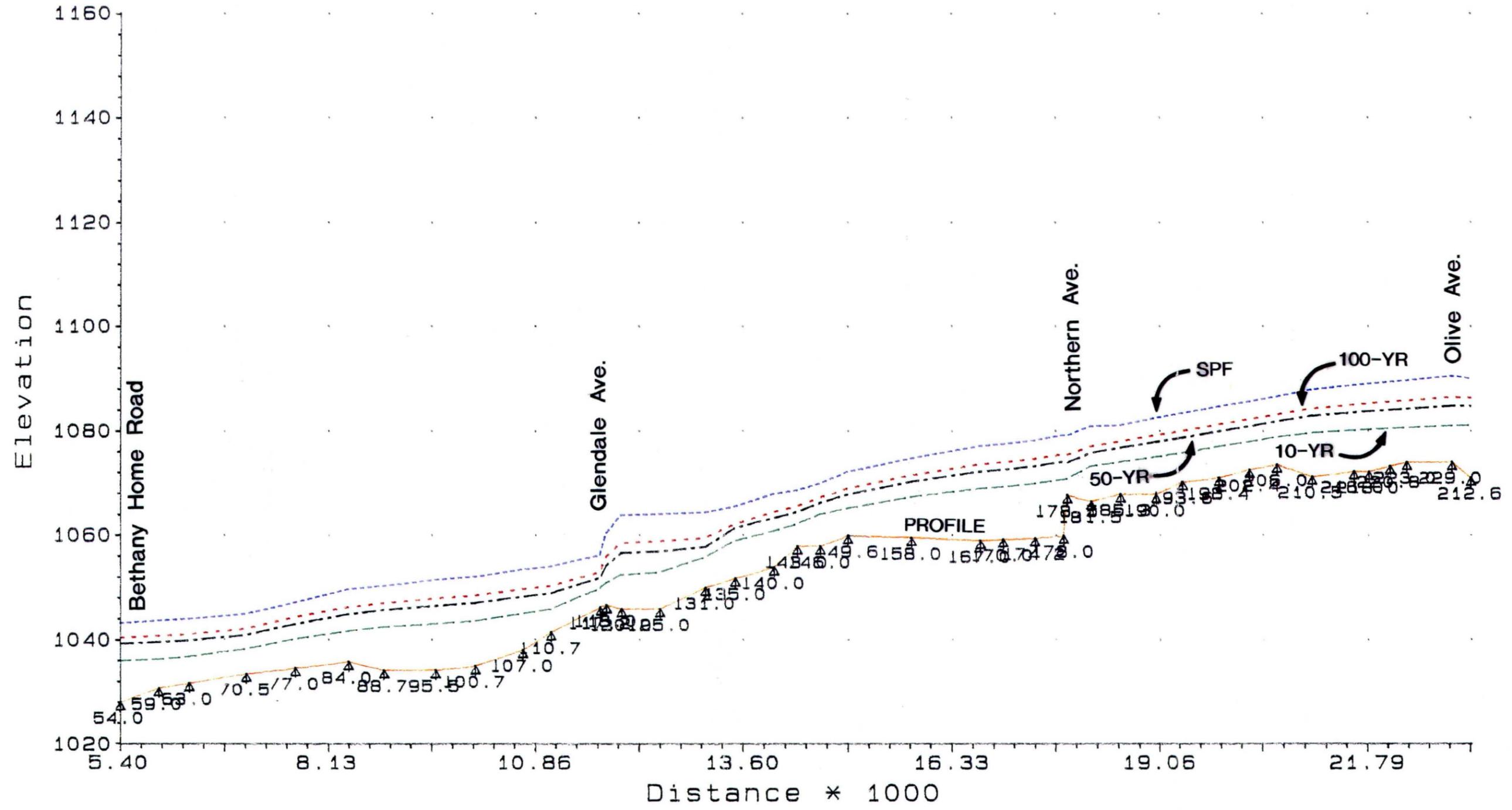
ALTERNATIVE B



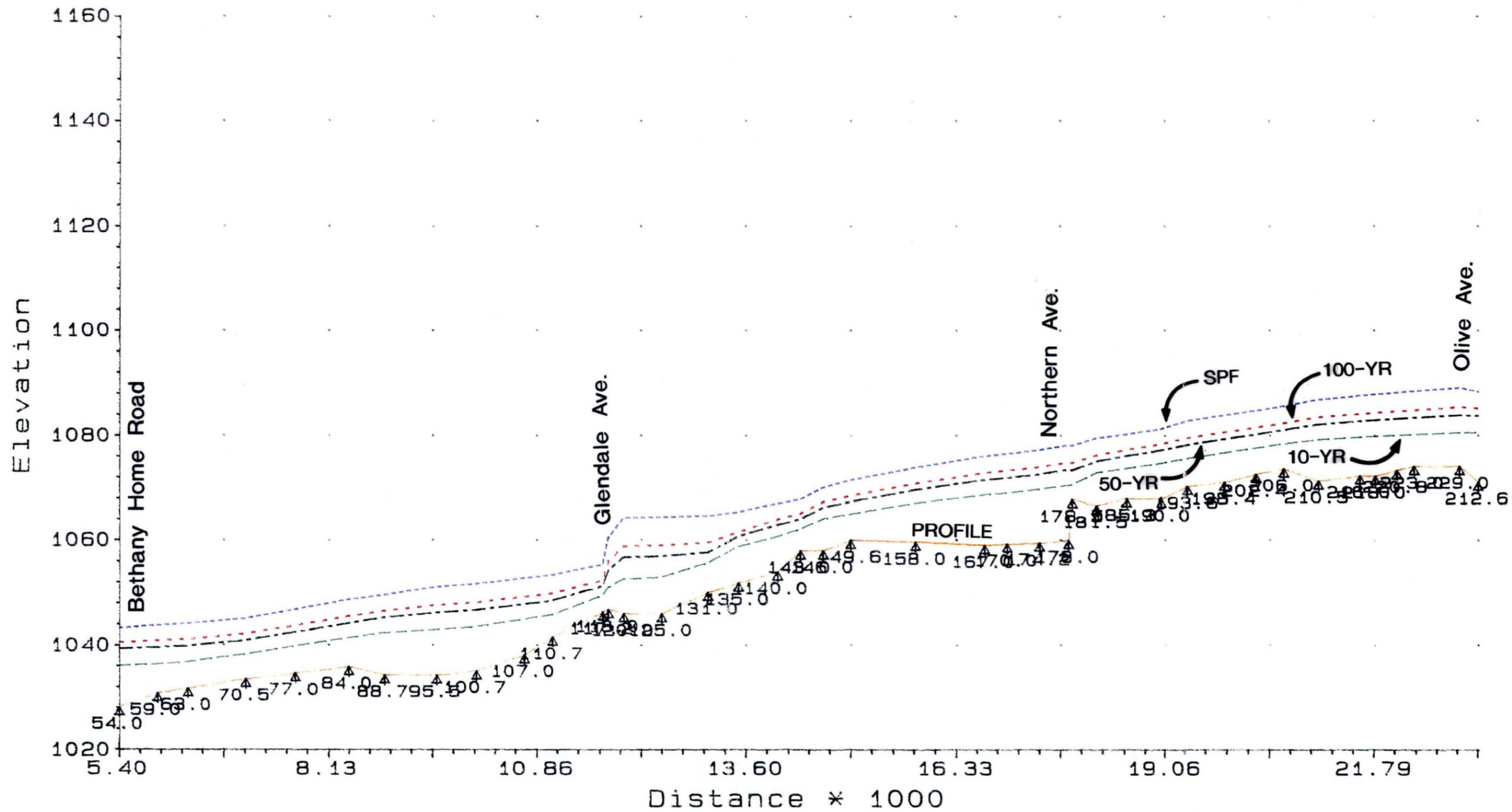
ALTERNATIVE B-2



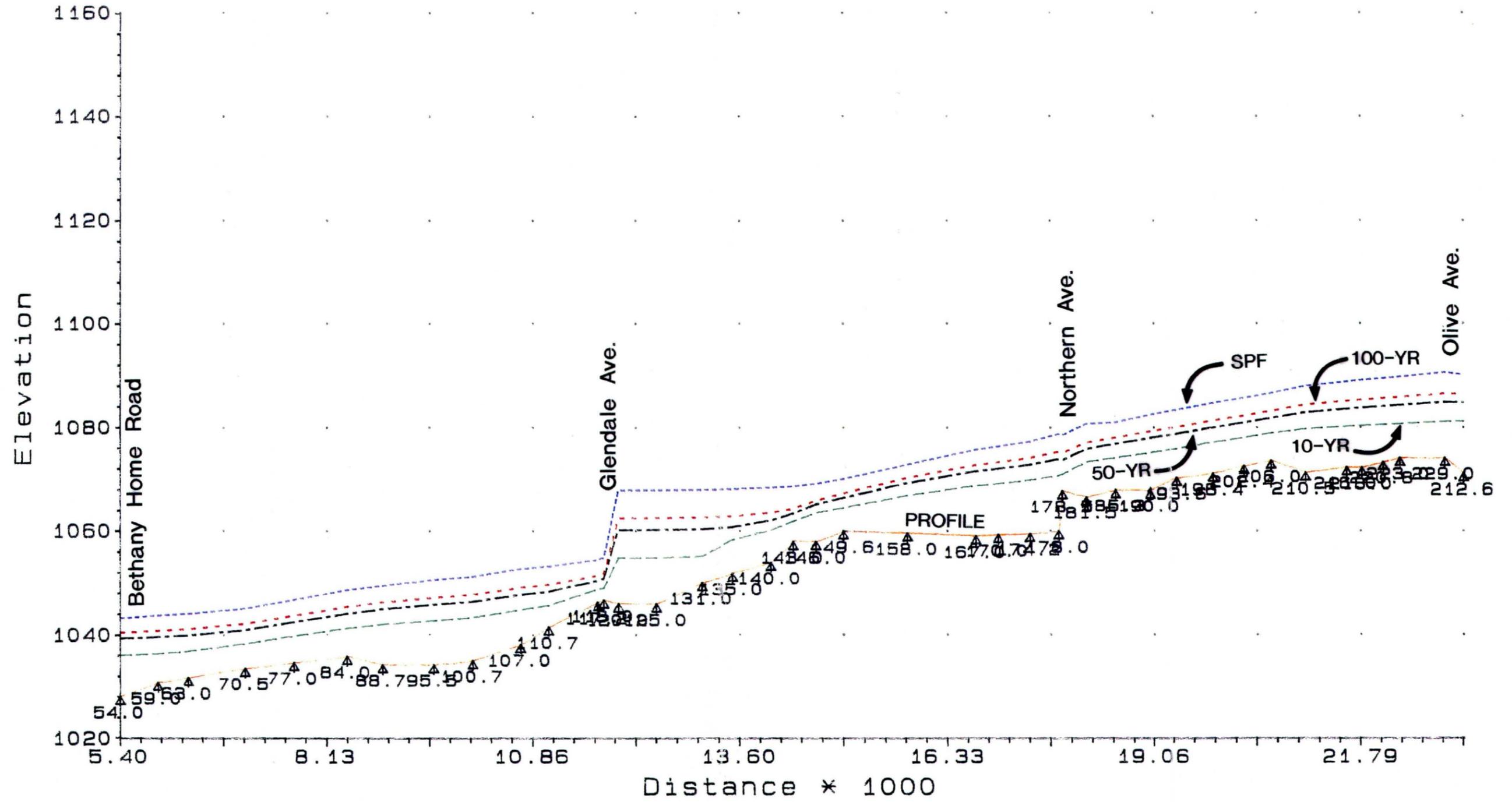
ALTERNATIVE C



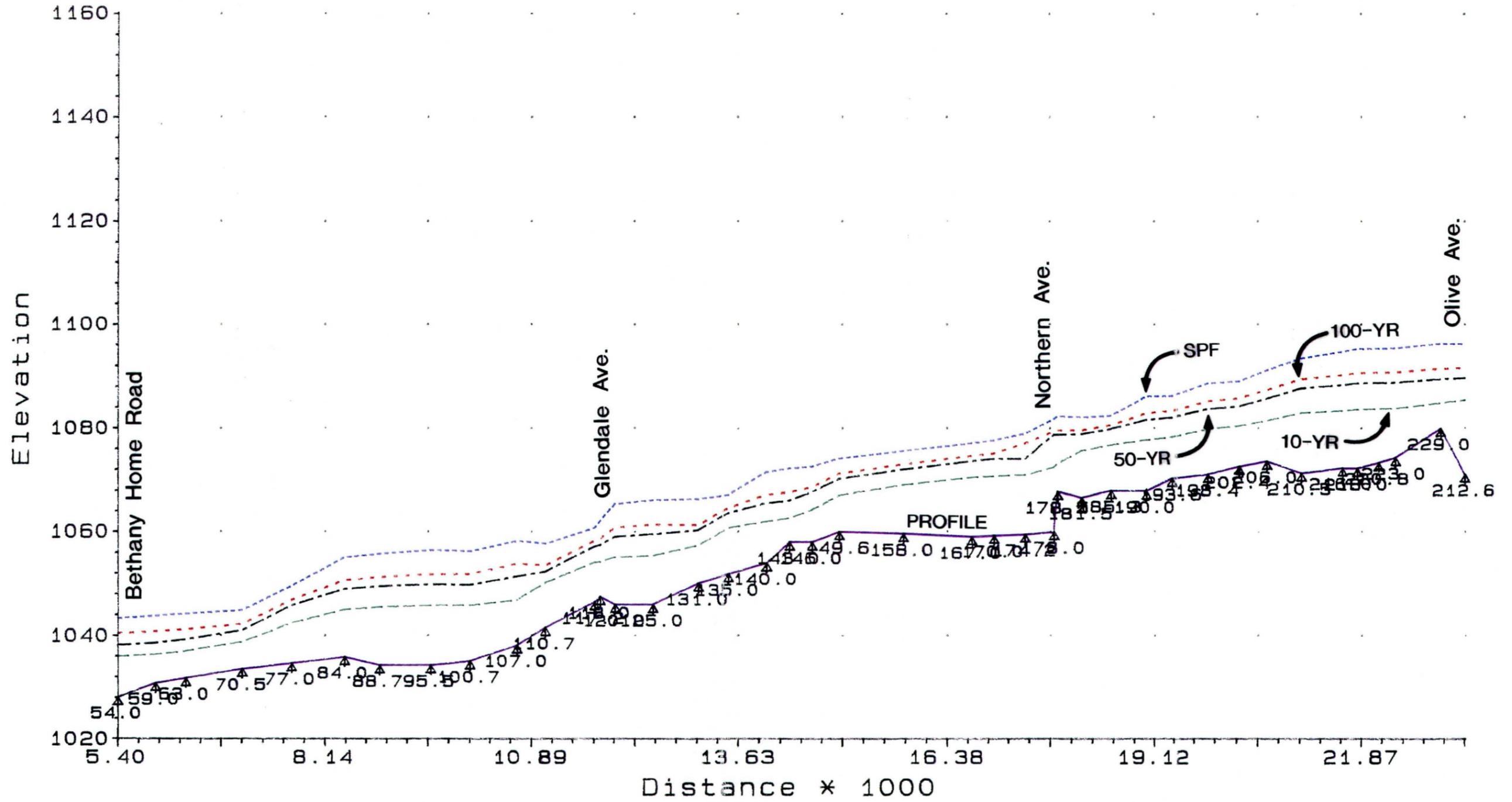
ALTERNATIVE C-2



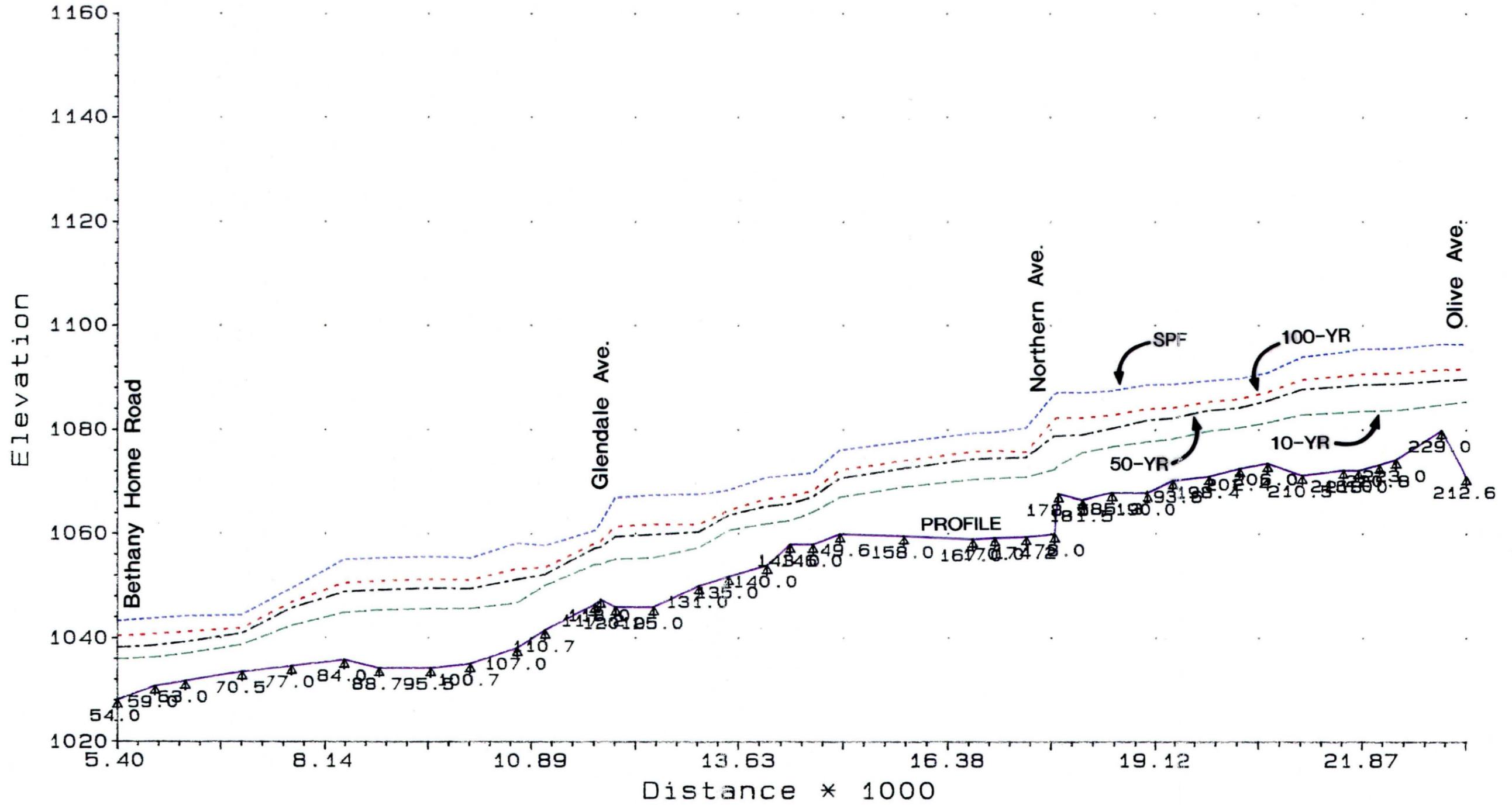
ALTERNATIVE C-3



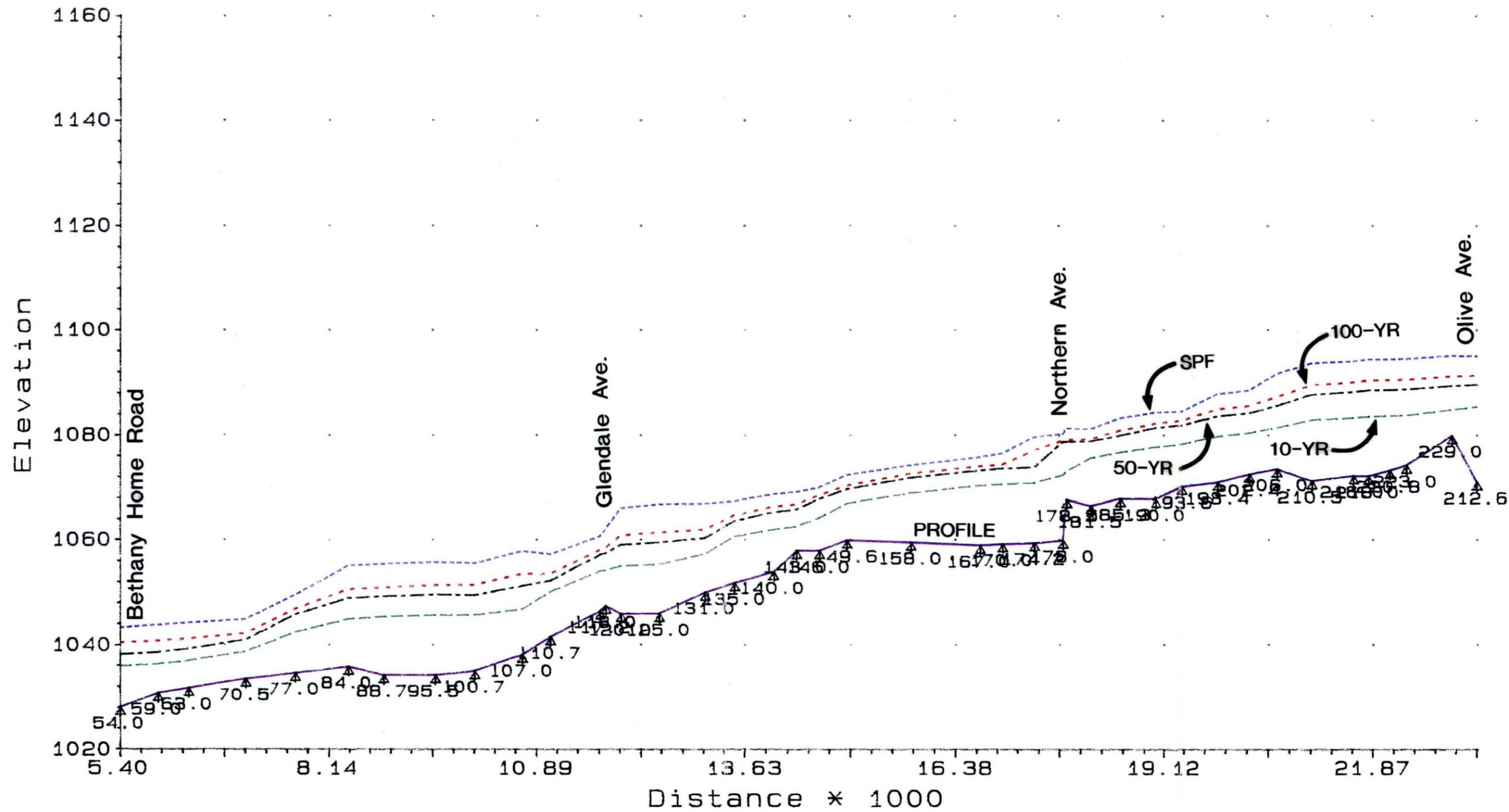
ALTERNATIVE D



ALTERNATIVE D-2



ALTERNATIVE D-3



Appendix IV

Cost Breakdown for Alternatives and Bank Protection Alternatives

**Cost Analysis for the New River Flood Control Project
Olive Avenue to Bethany Home Road,
In Millions**

| | A | B-1 | B-2 | C-1 | C-2 | C-3 | D-1 | D-2 | D-3 |
|---|----------|------------|------------|------------|------------|------------|------------|------------|------------|
| Channel Excavation | 1.9 | 3.5 | 4.4 | 5.0 | 6.0 | 6.2 | 1.9 | 1.9 | 1.9 |
| Soil Cement | — | 8.0 | 8.1 | 8.1 | 8.1 | 10.3 | 5.7 | 6.3 | 4.0 |
| Bank Excavation | — | — | — | 0.7 | 0.7 | 1.5 | 1.2 | 1.3 | 0.2 |
| Bridge Protection | 1.7* | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.3 | 0.7 |
| Side Drainage | — | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Landfill Excavation & Disposal | — | 0.5 | 0.5 | 0.5 | 0.5 | 1.0 | 0.4 | 0.5 | — |
| Miscellaneous | 1.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | — |
| Grade Control Structure | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| New Bridge | — | — | — | — | — | — | — | 2.5 | — |
| Mitigation | 0.8 | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Sub Total | 5.7 | 16.3 | 17.2 | 18.4 | 19.4 | 23.1 | 13.3 | 16.2 | 8.2 |
| Land | | | | | | | | | |
| Floodway | 5.1 | — | — | 3.6 | 3.6 | 3.9 | 5.1 | 3.5 | 5.1 |
| Floodplain | 8.8 | — | — | 0.4 | 0.4 | 0.7 | 0.1 | 0.5 | 44.1 |
| Other Land | — | — | — | 1.3 | 1.3 | 2.2 | — | 1.7 | — |
| Ponding Easements | — | — | 0.2 | 1.4 | 1.4 | 1.4 | 2.9 | 2.9 | 2.9 |
| Fringe Easements | — | — | — | 1.6 | 1.6 | 1.6 | — | — | — |
| Sub Total | 13.9 | — | 0.2 | 8.3 | 8.3 | 9.8 | 8.1 | 8.6 | 52.1 |
| Total | 19.6 | 16.3 | 17.4 | 26.7 | 27.7 | 32.9 | 21.4 | 24.8 | 60.3 |
| * Includes invert lining north of Olive Avenue. | | | | | | | | | |

| Cost Analysis for Alternative A | | | | |
|--|-----------------|--------------|-------------------|-------------------------|
| Items | Quantity | Units | Unit Price | Amount, Millions |
| Channel Excavation | 1.0 million | CY | 1.75 | 1.9 |
| Soil Cement | — | — | — | — |
| Bank Excavation | — | — | — | — |
| Bridge Protection | 2 | LS | 350,000 | 1.7* |
| Side Drainage | — | — | — | — |
| Landfill Excavation & Disposal | — | — | — | — |
| Miscellaneous | 1 | LS | — | 1.0 |
| Grade Control Structure | 1 | LS | — | 0.3 |
| New Bridge | — | — | — | — |
| Mitigation | 1 | LS | — | 0.8 |
| Sub Total | | | | 5.7 |
| * Includes invert lining north of Olive Avenue | | | | |

| Land Type | Acres (Cost/Acre) | Cost For Alternative A, Millions |
|-------------------|--------------------------|---|
| Floodway Acres | 291 (17,500) | 5.1 |
| Floodplain Acres | 480 (18,400) | 8.8 |
| Other Acres | — | — |
| Ponding Easements | — | — |
| Fringe Easements | — | — |
| Sub Total | 771 | 13.9 |

Total Cost for Alternative A: 19.6 Million

| Cost Analysis For Alternative B-1 | | | | |
|--|-----------------|--------------|-------------------|-------------------------|
| Items | Quantity | Units | Unit Price | Amount, Millions |
| Channel Excavation | 2.0 million | CY | 1.75 | 3.5 |
| Soil Cement | 0.3 million | CY | 27.00 | 8.0 |
| Bank Excavation | — | — | — | — |
| Bridge Protection | 2 | LS | 350,000 | 0.7 |
| Side Drainage | 1 | LS | — | 0.4 |
| Landfill Excavation & Disposal | 1 | LS | — | 0.5 |
| Miscellaneous | 1 | LS | — | 2.0 |
| Grade Control Structure | 1 | LS | — | 0.3 |
| New Bridge | — | — | — | — |
| Mitigation | 1 | LS | — | 0.9 |
| Sub Total | | | | 16.3 |

| Land Type | Acres (Cost/Acre) | Cost for Alternative B-1, Millions |
|-------------------|--------------------------|---|
| Floodway Acres | — | — |
| Floodplain Acres | — | — |
| Other Acres | — | — |
| Ponding Easements | — | — |
| Fringe Easements | — | — |
| Sub Total | Donated | 0 |

Total Cost for Alternative B-1: 16.3 Million

| Cost Analysis For Alternative B-2 | | | | |
|--|-----------------|--------------|-------------------|-------------------------|
| Items | Quantity | Units | Unit Price | Amount, Millions |
| Channel Excavation | 2.5 million | CY | 1.75 | 4.4 |
| Soil Cement | 0.3 million | CY | 27.00 | 8.1 |
| Bank Excavation | — | — | — | — |
| Bridge Protection | 2 | LS | 350,000 | 0.7 |
| Side Drainage | 1 | LS | — | 0.4 |
| Landfill Excavation & Disposal | 1 | LS | — | 0.5 |
| Miscellaneous | 1 | LS | — | 2.0 |
| Grade Control Structure | 1 | LS | — | 0.3 |
| New Bridge | — | — | — | — |
| Mitigation | 1 | LS | — | 0.8 |
| Sub Total | | | | 17.2 |

| Land Type | Acres (Cost/Acre) | Cost for Alternative B-2, Millions |
|-------------------|--------------------------|---|
| Floodway Acres | — | — |
| Floodplain Acres | — | — |
| Other Acres | 11 (18,400) | 0.2 |
| Ponding Easements | — | — |
| Fringe Easements | — | — |
| Sub Total | 2.2 + Donated | 0.2 |

Total Cost for Alternative B-2: \$17.4 Million

| Cost Analysis For Alternative C-1 | | | | |
|--|-----------------|--------------|-------------------|-------------------------|
| Items | Quantity | Units | Unit Price | Amount, Millions |
| Channel Excavation | 2.9 million | CY | 1.75 | 5.0 |
| Soil Cement | 0.3 million | CY | 27.00 | 8.1 |
| Bank Excavation | 0.4 million | CY | 1.75 | 0.7 |
| Bridge Protection | 2 | LS | 350,000 | 0.7 |
| Side Drainage | 1 | LS | — | 0.3 |
| Landfill Excavation & Disposal | 1 | LS | — | 0.5 |
| Miscellaneous | 1 | LS | — | 2.0 |
| Grade Control Structure | 1 | LS | — | 0.3 |
| New Bridge | — | — | — | — |
| Mitigation | 1 | LS | — | 0.8 |
| Sub Total | | | | 18.4 |

| Land Type | Acres (Cost/Acre) | Cost for Alternative C-1, Millions |
|-------------------|---------------------------|---|
| Floodway Acres | 204 (17,500) | 3.6 |
| Floodplain Acres | 22 (18,400) | 0.4 |
| Other Acres | 14 (92,000) | 1.3 |
| Ponding Easements | 20 (17,500) + 58 (18,400) | 1.4 |
| Fringe Easements | 88 (18,400) | 1.6 |
| Sub Total | 406 | 8.3 |

Total Cost for Alternative C-1: \$26.7 Million

| Cost Analysis For Alternative C-2 | | | | |
|--|-----------------|--------------|-------------------|-------------------------|
| Items | Quantity | Units | Unit Price | Amount, Millions |
| Channel Excavation | 3.4 million | CY | 1.75 | 6.0 |
| Soil Cement | 0.3 million | CY | 27.00 | 8.1 |
| Bank Excavation | 0.4 million | CY | 1.75 | 0.7 |
| Bridge Protection | 2 | LS | 350,000 | 0.7 |
| Side Drainage | 1 | LS | — | 0.3 |
| Landfill Excavation & Disposal | 1 | LS | — | 0.5 |
| Miscellaneous | 1 | LS | — | 2.0 |
| Grade Control Structure | 1 | LS | — | 0.3 |
| New Bridge | — | — | — | — |
| Mitigation | 1 | LS | — | 0.8 |
| Sub Total | | | | 19.4 |

| Land Type | Acres (Cost/Acre) | Cost for Alternative C-2, Millions |
|-------------------|---------------------------|---|
| Floodway Acres | 204 (17,500) | 3.6 |
| Floodplain Acres | 22 (18,400) | 0.4 |
| Other Acres | 14 (92,000) | 1.3 |
| Ponding Easements | 20 (17,500) + 58 (18,400) | 1.4 |
| Fringe Easements | 88 (18,400) | 1.6 |
| Sub Total | 406 | 8.3 |

Total Cost for Alternative C-2: \$26.7 Million

| Cost Analysis For Alternative C-3 | | | | |
|--|-----------------|--------------|-------------------|-------------------------|
| Items | Quantity | Units | Unit Price | Amount, Millions |
| Channel Excavation | 3.5 million | CY | 1.75 | 6.2 |
| Soil Cement | 0.4 million | CY | 27.00 | 10.3 |
| Bank Excavation | 0.8 million | CY | 1.75 | 1.5 |
| Bridge Protection | 2 | LS | 350,000 | 0.7 |
| Side Drainage | 1 | LS | — | 0.3 |
| Landfill Excavation & Disposal | 1 | LS | — | 1.0 |
| Miscellaneous | 1 | LS | — | 2.0 |
| Grade Control Structure | 1 | LS | — | 0.3 |
| New Bridge | — | — | — | — |
| Mitigation | 1 | LS | — | 0.8 |
| Sub Total | | | | 23.1 |

| Land Type | Acres (Cost/Acre) | Cost for Alternative C-3, Millions |
|-------------------|---------------------------|---|
| Floodway Acres | 220 (17,500) | 3.9 |
| Floodplain Acres | 35 (18,400) | 0.7 |
| Other Acres | 24 (92,000) | 2.2 |
| Ponding Easements | 20 (17,500) + 58 (18,400) | 1.4 |
| Fringe Easements | 88 (18,400) | 1.6 |
| Sub Total | 445 | 9.8 |

Total Cost for Alternative C-3: \$32.9 Million

| Cost Analysis for Alternative D-1 | | | | |
|--|-----------------|--------------|-------------------|-------------------------|
| Items | Quantity | Units | Unit Price | Amount, Millions |
| Channel Excavation | 1.0 million | CY | 1.75 | 1.9 |
| Soil Cement | 0.2 million | CY | 27.00 | 5.7 |
| Bank Excavation | 0.7 million | CY | 1.75 | 1.2 |
| Bridge Protection | 2 | LS | 350,000 | 0.7 |
| Side Drainage | 1 | LS | — | 0.3 |
| Landfill Excavation & Disposal | 1 | LS | — | 0.4 |
| Miscellaneous | 1 | LS | — | 2.0 |
| Grade Control Structure | 1 | LS | — | 0.3 |
| New Bridge | — | — | — | — |
| Mitigation | 1 | LS | — | 0.8 |
| Sub Total | | | | 13.3 |

| Land Type | Acres (Cost/Acre) | Cost for Alternative D-1, Millions |
|-------------------|--------------------------|---|
| Floodway Acres | 294 (17,500) | 5.1 |
| Floodplain Acres | 6 (18,400) | 0.1 |
| Other Acres | — | — |
| Ponding Easements | 156 (18,400) | 2.9 |
| Fringe Easements | — | — |
| Sub Total | 456 | 8.1 |

Total Cost for Alternative D-1: \$21.4 Million

| Cost Analysis For Alternative D-2 | | | | |
|--|-----------------|--------------|-------------------|-------------------------|
| Items | Quantity | Units | Unit Price | Amount, Millions |
| Channel Excavation | 1.0 million | CY | 1.75 | 1.9 |
| Soil Cement | 0.2 million | CY | 27.00 | 6.3 |
| Bank Excavation | 0.7 million | CY | 1.75 | 1.3 |
| Bridge Protection | 1 | LS | 350,000 | 0.3 |
| Side Drainage | 1 | LS | — | 0.3 |
| Landfill Excavation & Disposal | 1 | LS | — | 0.5 |
| Miscellaneous | 1 | LS | — | 2.0 |
| Grade Control Structure | 1 | LS | — | 0.3 |
| New Bridge | 1 | LS | — | 2.5 |
| Mitigation | 1 | LS | — | 0.8 |
| Sub Total | — | — | — | 16.2 |

| Land Type | Acres (Cost/Acre) | Cost for Alternative D-2, Millions |
|-------------------|--------------------------|---|
| Floodway Acres | 199 (17,500) | 3.5 |
| Floodplain Acres | 27 (18,400) | 0.5 |
| Other Acres | 18 (92,000) | 1.7 |
| Ponding Easements | 158 (18,400) | 2.9 |
| Fringe Easements | — | — |
| Sub Total | 402 | 8.6 |

Total Cost for Alternative D-2: \$24.8 Million

| Cost Analysis for Alternative D-3 | | | | |
|--|-----------------|--------------|-------------------|-------------------------|
| Items | Quantity | Units | Unit Price | Amount, Millions |
| Channel Excavation | 1.0 MIL | CY | 1.75 | 1.9 |
| Soil Cement | 0.1 MIL | CY | 27.00 | 4.0 |
| Bank Excavation | 0.1 MIL | CY | 1.75 | 0.2 |
| Bridge Protection | 2 | LS | 350,000 | 0.7 |
| Side Drainage | 1 | LS | — | 0.3 |
| Landfill Excavation & Disposal | — | — | — | — |
| Miscellaneous | — | — | — | — |
| Grade Control Structure | 1 | LS | — | 0.3 |
| New Bridge | — | — | — | — |
| Mitigation | 1 | LS | — | 0.8 |
| Sub Total | | | | 8.2 |

| Land Type | Acres (Cost/Acre) | Cost for Alternative D-3, Millions |
|-------------------|--------------------------|---|
| Floodway Acres | 291 (17,500) | 5.1 |
| Floodplain Acres | 480 (92,000) | 44.1 |
| Other Acres | — | — |
| Ponding Easements | 158 (18,400) | 2.9 |
| Fringe Easements | — | — |
| Sub Total | 929 | 52.1 |

Total Cost for Alternative D-3: \$60.3 Million

Bank Protection Alternatives Analysis

The costs quoted below are based on the volume of material needed multiplied by the in-place unit price, i.e.,:

$$\text{(layer thickness)} \times \text{(b)} \times \text{(a)} \times \text{(cost per cubic yard)} = \text{cost for alternative bank protection.}$$

Soil Cement Cost

$$\begin{aligned} (5.3 \text{ ft} / (3 \text{ ft/yd})) \times (1.4 \text{ ft/ft}) \times (118,788 \text{ yd}^2) &= 293,802 \text{ yd}^3 \\ 293,802 \times \$27/\text{yd}^3 &= \$7,932,654 \end{aligned} \quad \text{\$7.9 million}$$

Reinforced Gunite

$$\begin{aligned} (10 \text{ in.} / (36 \text{ in./yd})) \times (2.7 \text{ ft/ft}) \times (118,788 \text{ yd}^2) &= 89,210 \text{ yd}^3 \\ 89,210 \text{ yd}^3 \times \$150/\text{yd}^3 &= \$13,381,500 \end{aligned} \quad \text{\$13.4 million}$$

Grouted Riprap Cost

$$\begin{aligned} (24 \text{ in.} / (36 \text{ in./yd})) \times (2.7 \text{ ft/ft}) \times (118,788 \text{ yd}^2) &= 213,819 \text{ yd}^3 \\ 213,819 \times \$60/\text{yd}^3 &= \$12,829,140 \end{aligned} \quad \text{\$12.8 million}$$

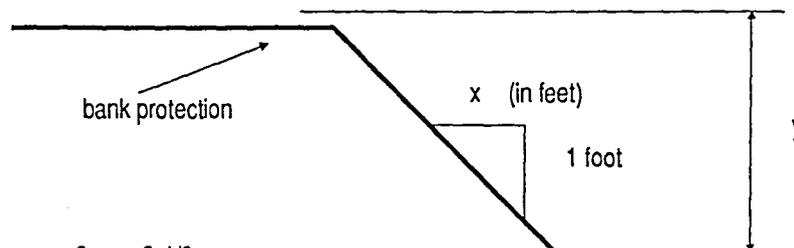
Loose Riprap Cost

$$\begin{aligned} (36 \text{ in.} / (36 \text{ in./yd})) \times (2.7 \text{ ft/ft}) \times (118,788 \text{ yd}^2) &= 320,727 \text{ yd}^3 \\ 320,727 \times \$11/\text{yd}^3 &= \$3,528,000 \end{aligned} \quad \text{\$3.5 million}$$

Gabion (Reno Mattress) Cost

$$\begin{aligned} (14 \text{ in.} / (36 \text{ in./yd})) \times (2.2 \text{ ft/ft}) \times (118,788 \text{ yd}^2) &= 101,630 \text{ yd}^3 \\ 101,630 \times \$80/\text{yd}^3 &= \$8,130,400 \end{aligned} \quad \text{\$8.1 million}$$

| Construction Material | Construction Cost, in millions | Maintenance Cost, million/100 year |
|------------------------|--------------------------------|------------------------------------|
| Soil Cement | \$ 7.9 | \$ 0.2 |
| Reinforced Gunite | \$ 13.4 | \$ 5.1 |
| Grouted Riprap | \$ 12.8 | \$ 0.2 |
| Loose Riprap | \$ 3.5 | \$ 2.7 |
| Gabion (Reno Mattress) | \$ 8.1 | \$ 2.4 |



where: $b = (x^2 + 1^2)^{1/2}$
 $a = y \times \text{length of channel}$

Mitigation Proposal
for the

**New River
Flood Control Project**

Olive Avenue to Bethany Home Road



Prepared by the
Flood Control District
of Maricopa County
May, 1990

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1

Purpose

This mitigation proposal by the Flood Control District of Maricopa County includes various options to compensate for wildlife habitat losses that may incur as a result of alternate construction designs to provide flood protection on New River between Olive Avenue and Bethany Home Road. Figure 1 is an aerial photograph depicting the project area.

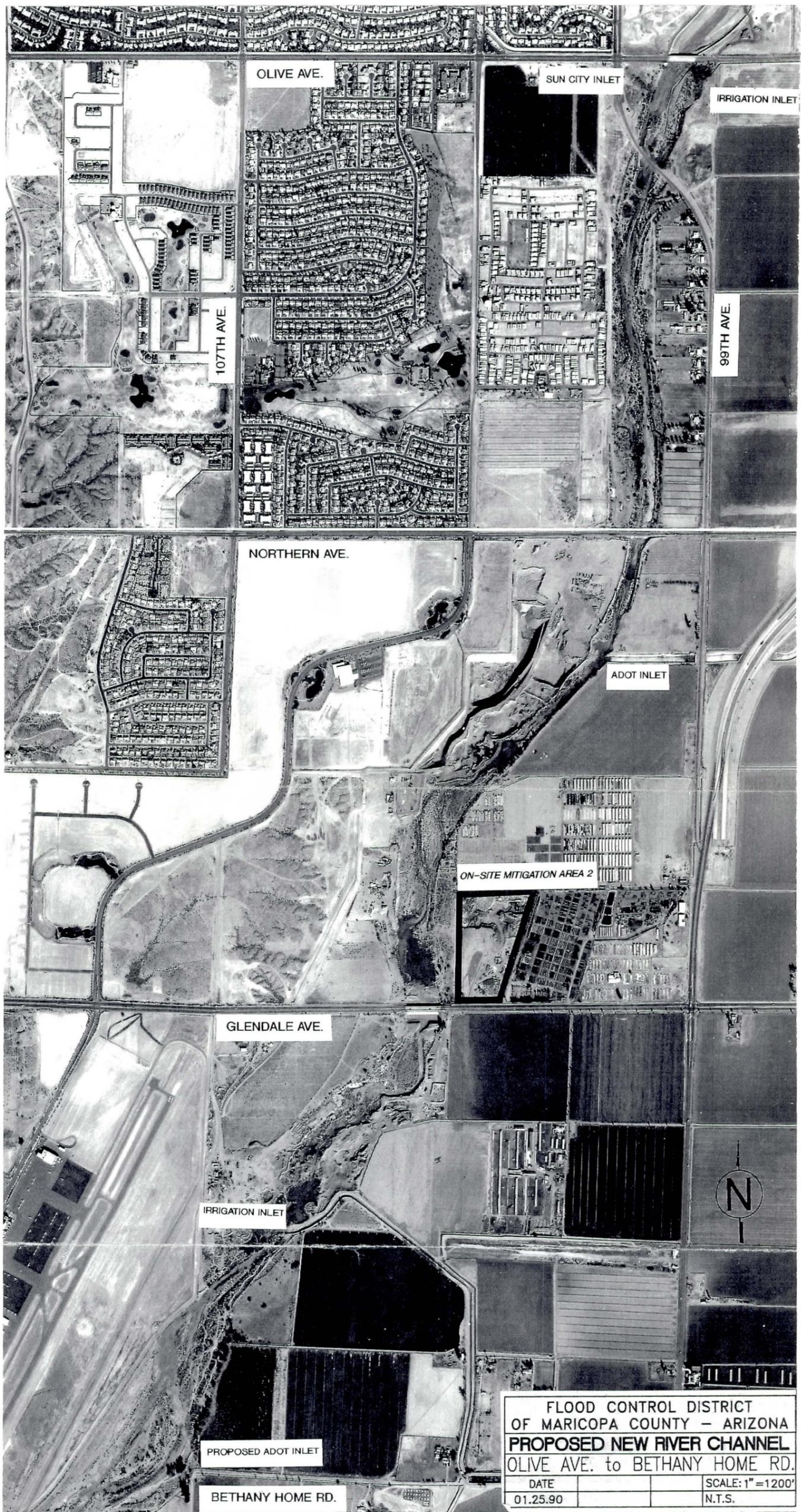


FIGURE 1

Quantification of Existing Habitat

2.1 Procedures

In order to quantify the wildlife habitat within the project limits, a two-part vegetation inventory was conducted in March and April of 1989. Part one consisted of an in-depth inventory for the project area located between Olive and Northern Avenues. Vegetation in this area is more dense and constitutes more valuable wildlife habitat than the remainder of the project area. Vegetation within this area was quantified by dividing the area into half-acre quadrats and inventorying each quadrat for species composition and percent coverage by species.

For the remaining area located between Northern Avenue and Bethany Home Road, a less exhaustive inventory was undertaken. Vegetation within this area is sparse and large open areas occur where gravel mining, off-road vehicle traffic, dumping, and other disturbances have completely removed vegetation or reduced vegetative cover to less than 1 percent. Aerial photographs were used to stratify similar vegetation types and to calculate acreages. In-field surveys were then conducted to determine densities, percent cover, and species composition.

Species encountered during vegetation inventories have been compiled in Table 1 to provide a list of plant species occurring within the project limits.

2.2 Results

The data from the two vegetation inventories were compiled and analyzed. The results are presented in Table 2. Based on cover values, four major vegetative communities were identified and the acreage of grass, shrub, and tree components for each vegetative community were broken out and tallied.

| Table 1 New River Species List February 1990 | |
|--|-----------------------|
| Scientific Name | Common Name |
| Trees | |
| <i>Cercidium floridum</i> | Blue Palo Verde |
| <i>Chilopsis linearis</i> | Desert Willow |
| <i>Parkinsonia aculeata</i> | Jerusalem-Thorn |
| <i>Populus fremontii</i> | Fremont Cottonwood |
| <i>Prosopis juliflora</i> | Mesquite |
| <i>Salix gooddingii</i> | Goodding Willow |
| <i>Tamarix pentandra</i> | Salt Cedar |
| Shrubs | |
| <i>Ambrosia ambrosioides</i> | Canyon Ragweed |
| <i>Atriplex canescens</i> | Four-Wing Salt Bush |
| <i>Atriplex polycarpa</i> | Desert Saltbrush |
| <i>Baccharis salicifolia</i> | Seep Willow |
| <i>Baccharis sarothroides</i> | Desert Broom |
| <i>Bebbia juncea</i> | Bebbia |
| <i>Chrysothamnus nauseosus</i> | Rabbit Brush |
| <i>Haplopappus acradenius</i> | Alaki Goldenbush |
| <i>Hymenoclea monogyra</i> | Burro-brush |
| <i>Hymenoclea salsola</i> | Cheesebush |
| <i>Larrea divaricata</i> | Creosote-bush |
| <i>Lycium spp.</i> | Wolfberry |
| <i>Opuntia spp.</i> | Cholla |
| <i>Tessaria sericea</i> | Arrow-Weed |
| Forbs | |
| <i>Allionia incarnata</i> | Trailing-Four-O'Clock |
| <i>Amaranthus palmeri</i> | Pigweed |
| <i>Datura discolor</i> | Jimson Weed |
| <i>Proboscidea parviflora</i> | Unicorn Plant |
| <i>Erodium cicutarium</i> | Filaree |
| <i>Salsola iberica</i> | Russian Thistle |
| <i>Sisymbrium irio</i> | London Rocket |
| <i>Sphaeralcea ambigua</i> | Globe Mallow |
| <i>Xanthium strumarium</i> | Cockle Bur |
| Grasses | |
| <i>Bouteloua aristidoides</i> | Needlegrass |
| <i>Bromus rubens</i> | Red Brome |
| <i>Cynodon dactylon</i> | Bermuda Grass |
| <i>Hordeum leporinum</i> | Mouse Barley |
| <i>Schismus barbatus</i> | Mediterranean Grass |
| <i>Sorghum halepense</i> | Johnson Grass |

| Table 2 New River Channelization Project Olive Avenue to Bethany Home Road Total Acreage of Habitat | | | | | |
|--|-------------------------|--------------------------|--------------------------------|------------------------------|--------------------|
| Vegetation Community (by dominant species) | Composition | | | | |
| | Grass, acres | Shrubs, acres | Desert Trees, acres | Cottonwood, acres | Total Acres |
| 1. Desert Broom | 2.0 | 19.5 | 3.0 | 1.5 | 26.0 |
| 2. Annual/Perennial Grasses | 42.5 | 12.0 | 4.5 | 1.5 | 60.5 |
| 3. Burro Brush | 4.0 | 29.0 | 1.5 | 1.5 | 36.0 |
| 4. Cottonwood | 0.5 | 1.5 | 0.5 | 1.0 | 3.5 |
| Total | 49.0 | 62.0 | 9.5 | 5.5 | 126.0 |

2.3 Discussion of Vegetation Communities

A discussion of the four major vegetation communities identified within the project follows.

2.3.1 Type 1: Desert Broom (Photo Sheet 1)

This vegetative type is dominated by young and mature Desert Broom. Ground cover was lacking, for the most part, except for an occasional occurrence of Filaree. Within this vegetation type, Desert Broom occurs as a sole dominant or in association with one of two subordinate shrub species: Seep Willow or Burro-brush. Tree species within this vegetation type are infrequent and account for less than 3 percent of the total cover. These species include: Desert Willow, Mesquite, Blue Palo Verde, and Tamarix. An occasional occurrence of Four-wing Saltbush and Prickly Pear was recorded.

2.3.2 Type 2: Annual/Perennial Grasses (Photo Sheet 2)

This vegetative type is dominated by a combination of both annual grasses (Mediterranean Grass, Mouse Barley, Johnson Grass, etc.) and perennial grasses (Bermuda). These grasses are the sole components in 42.5 acres of the inventoried area. Within the remaining 18 acres of this vegetative community, grasses occur in association with two shrub species (Desert Broom and Four-wing Saltbush) and one tree species (Blue Palo Verde).

2.3.3 Type 3: Burro-brush (Photo Sheet 3)

This vegetative type is dominated by Burro-brush. The major subordinate associations within this vegetative type include Desert Broom and annual/perennial grasses. Tree species occurring infrequently within this vegetative type include: Blue Palo Verde, Tamarix, and Mesquite.

2.3.4 Type 4: Cottonwood (Photo Sheet 4)

In the project area, Cottonwood is not considered to be a dominant species. It occurs in small isolated stands, generally consisting of less than 10 individuals. These stands were inventoried separately to document all Cottonwood within the project boundary. The results are presented in Table 3.



Photo Sheet 1: Vegetation Type 1—Desert Broom



Photo Sheet 2: Vegetation Type 2—Annual/Perennial Grasses



Photo Sheet 3: Vegetation Type 3—Burro-Brush



Photo Sheet 4: Vegetation Type 4—Cottonwood

| Table 3 Cottonwood Frequency by Diameter Classes | | | |
|---|---------------------|--------|---------|
| | Diameter, Inches | Number | Percent |
| Juvenile | 0 to 4.0 | 147 | 52 |
| Immature | 4.0 to 8.0 | 105 | 38 |
| Mature | 9.0 to 14.0 | 28 | 10 |
| Total | | 280 | |

A total of 280 Cottonwood were inventoried within the project acre. The majority of these (147) were immature specimens with diameters less than 4 inches (measured 4.5 feet from the base). However, due to the high habitat value associated with these trees, areas of Cottonwood occurrence were treated as a separate vegetative community and the isolated stands were combined to total 5.5 acres. Average cover for Cottonwood is 3.8 percent and average density is less than 51 trees per acre.

Cottonwood was found in association with annual/perennial grasses; two shrub species (Desert Broom and Seep Willow) and one tree species (Goodding Willow). A total of 30 Goodding Willows were tallied during the inventory. Goodding Willow requires a more constant source of water than does Cottonwood for establishment and its occurrence was therefore limited.

2.4 Conclusion

With the exception of the 5.5 acres within the project site which contain Cottonwood, the remaining 121.5 acre habitat is upland shrub. Where encountered, the average density for desert trees was 13.5 trees per acre. The major species that make up this habitat are annual and perennial grasses, Desert Broom, and Burro-brush. The Soil Survey of Maricopa County, Arizona (Central Part) classes vegetation in the project area as very poor for wetland wildlife and poor to fair for rangeland wildlife.

Discussion of Flood Control Alternatives

3.1 Description of the Nine Alternatives

There are four basic flood control alternatives for the New River between Bethany Home Road and Olive Avenue; however variations on the basic alternatives have provided the District with nine flood control considerations. They are identified throughout this report as:

- A The Flowage Easement Alternative
- B-1 Stabilization of Both Channel Banks: Bottom width is 300 feet
- B-2 Stabilization of Both Channel Banks: Bottom width is variable, natural invert is maintained where possible
- C-1 Stabilize One Bank: Bottom width is 550 feet
- C-2 Stabilize One Bank: Bottom width is 600 feet
- C-3 Stabilize One Bank: Bottom width varies from 500 to 900 feet
- D-1 Diking outside the natural banks at Floodway limits
- D-2 Diking at 550 feet
- D-3 Diking at 100-year floodplain

For a more in-depth analysis of these alternatives, refer to the accompanying document *Alternative Investigation for the New River Flood Control Project, Bethany Home Road to Olive Avenue*.

3.2 Environmental Impacts

The Letter Report to the General Design Memorandum No. 3 for Skunk Creek and the New and Agua Fria Rivers (Appendix II) and the Environmental Assessment prepared by the Corps of Engineers (Appendix III) discuss the potential impacts of the proposed project. Except for the vegetation and wildlife impacts, the impacts discussed in these reports will remain the same for all of the alternatives.

Impacts to Habitat under the Alternatives

4.1 Unavoidable Impacts

Table 4 lists the various alternatives discussed in the alternative analysis and the corresponding loss of habitat.

These acreages represent unavoidable damages to the habitat as a result of the construction of the flood control project.

In addition, impacts to Vegetation Type 4, Cottonwood, under the various alternatives were assessed during the inventory. Of the 280 total Cottonwood that occur within the project, Alternatives A, D-1, D-2 and D-3 would impact 135; Alternative B-1 would impact all 280; Alternative B-2 would impact 136; and Alternatives C-1, C-2, and C-3 would impact 227.

4.2 Measures Available under all Alternatives to Reduce Impacts

Channel side slopes will be modified to provide sufficient roughness to allow for wildlife access across the channel slopes. Soil cement side slopes will be installed in 4 to 6 inch lifts, and then compacted. The outer slope surface will be uncompacted and fairly rough. Generally this section would be shaved to create a smooth surface, but in order to facilitate wildlife access, the surface will be left rough. The uncompacted area will eventually weather and the result will be a stair step effect (4 to 6 inches tall, 4 to 6 inches wide) that will permit an animal to climb the sides of the channel. To further accommodate animal passage, rip-rap will be mounded against

| Alternative | Total Acreage Disturbed |
|--|--------------------------------|
| A Flowage Easements | 42 |
| B-1 Soil Cement Banks, 300 ft wide | 126 |
| B-2 Soil Cement Banks, 300 to 500 ft wide | 68 |
| C-1 Soil Cement 1 Bank, 550 ft wide | 71 |
| C-2 Soil Cement 1 Bank, 600 ft wide | 71 |
| C-3 Soil Cement 1 Bank, 500 to 900 ft wide | 71 |
| D-1 Dikes at Floodway | 42 |
| D-2 Dikes at 550 ft | 42 |
| D-3 Dikes at Floodplain | 42 |

the channel banks, forming a 2:1 slope every 500 feet on alternating sides of the channel (Figure 2).

To reduce temporal habitat losses, all off-site mitigation will be completed prior to channel construction. On-site mitigation work will be implemented prior to construction where feasible and immediately following construction where the mitigation sites are within the construction work area.

Construction limits will be strictly enforced to protect large trees growing along the exterior edges of the project. To promote the use of these trees as nesting sites, the channel bottom in the vicinity of remaining trees will be seeded with native grasses, shrubs, and forbs.

Three side inlets have been identified as providing fairly constant drainage. Two of these carry irrigation tailwaters. The last carries stormwater from Arizona Department of Transportation (ADOT) right-of-way. Refer to Figure 1 for the location of these inlets.

In the vicinity of these inlets, Cat-tails (*Typha domingensis*) will be planted from stock harvested from District properties. Because of the aggressive spread characteristic of this species, the harvested area will rapidly regenerate, and the New River low flow area will be colonized where flows are sufficient.

Low growing shrubs and grasses that revegetate naturally within the channel bottom will be encouraged, and the channel bottom seeded in areas of disturbance. However, vegetative growth will need to be periodically thinned to limit growth height within the channel to allow passage of the standard project flood (SPF). (Refer to Appendix 1, *Operations and Maintenance Guidelines for Vegetation within New River Channel*.) Under no condition will Salt Cedar be permitted to colonize within the channel bottom, due to its tendency to choke channel flows and out-compete desirable riparian species.



Rip-Rap Animal Access Ramp

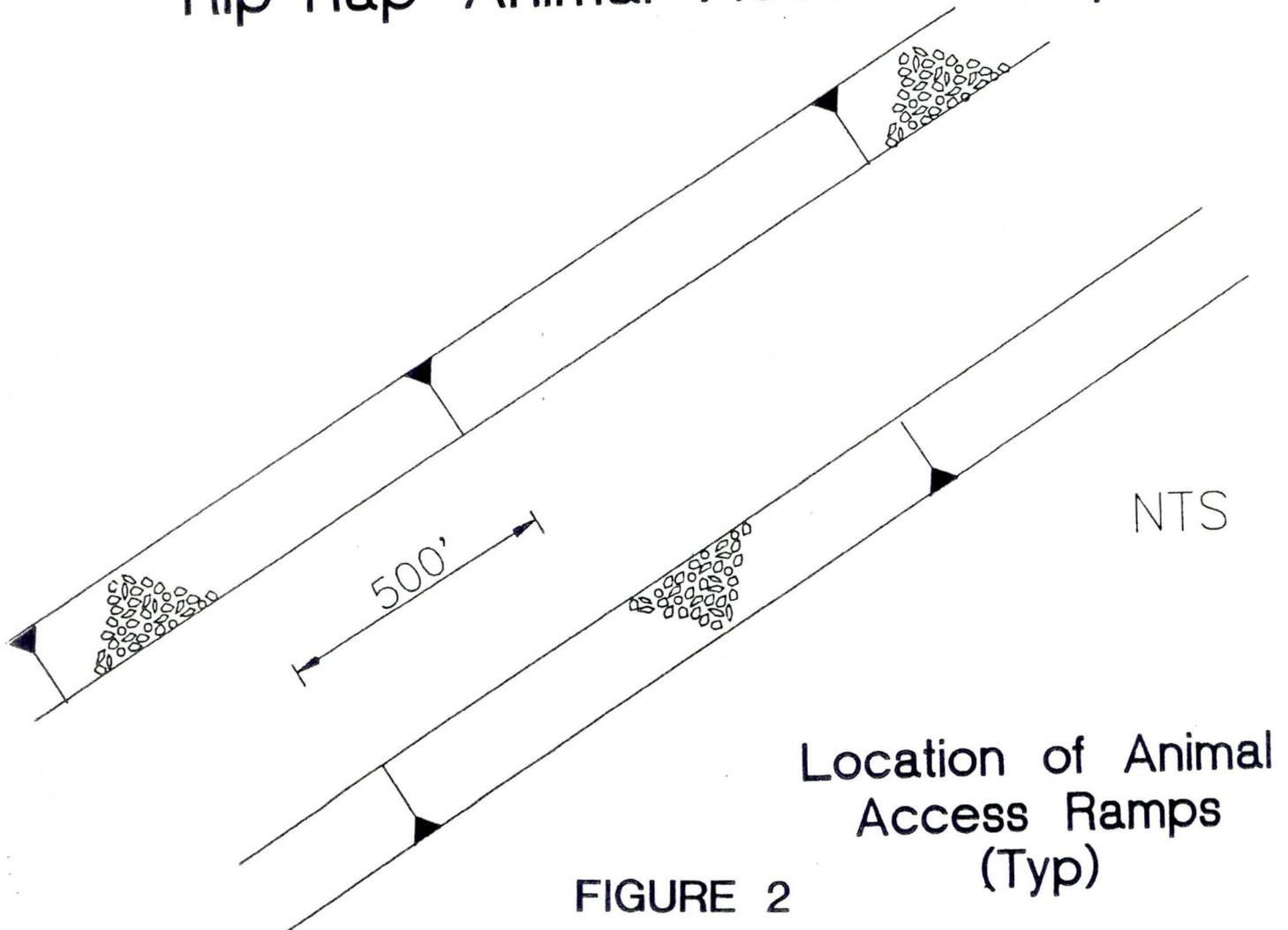


FIGURE 2

Mitigation of Unavoidable Impacts

The mitigation plan for all of the alternatives involves a combination of mitigation sites. These are discussed below.

5.1 On-site Mitigation

5.1.1 Site Analysis

On-site Area 1 (Excess Right-of-Way): Possible mitigation sites within the project right-of-way were inspected and assessed. These sites consist of “excess” parcels which create a linear strip along the edge of the project maintenance roads paralleling the channel on either side. This excess right-of-way is only available under Alternative B-1 and was not considered under the other alternatives.

The linear strip ranges in width from 50 to 100 feet and constitutes approximately 7 acres under Alternative B-1. Existing vegetation within this excess right-of-way is, for the most part, limited due to off-road vehicle use and unrestricted dumping. The vegetation that is present consists of desert shrub community dominated by Palo Verde, Desert Broom, and Saltbush (see Photo Sheet 5). Density estimations range from 3 to 5 trees per acre based on ocular assessment.

Soils in the area are sandy loams and salinity is not a limiting site condition. Ground water depth is greater than 20 feet. Irrigation in these areas will be for establishment only and will be provided by truck watering. The District has over 10 years of experience in dryland revegetation and has successfully established arid-adapted Arizona native trees and shrubs from truck irrigated transplants and dryland seeding.

Undesirable species abound in these disturbed areas and include Bermuda Grass and Tumbleweed. Unique site features include construction debris and indiscriminate dumping.

On-site Area 2 (20-Acre Glendale/New River Parcel): A 20-acre parcel, contiguous with the project right-of-way, located at the New River and Glendale Avenue (see Figure 1) is currently being investigated as a potential mitigation site. The site has been used by the County Highway Department as a construction landfill site. The District is in the process of contracting for an environmental site assessment to determine if any toxic materials have been dumped in the landfill area. If hazardous materials are detected, the District will clean it up or select an alternate site. One possible alternate is located along New River just south of Grand Avenue. This parcel is

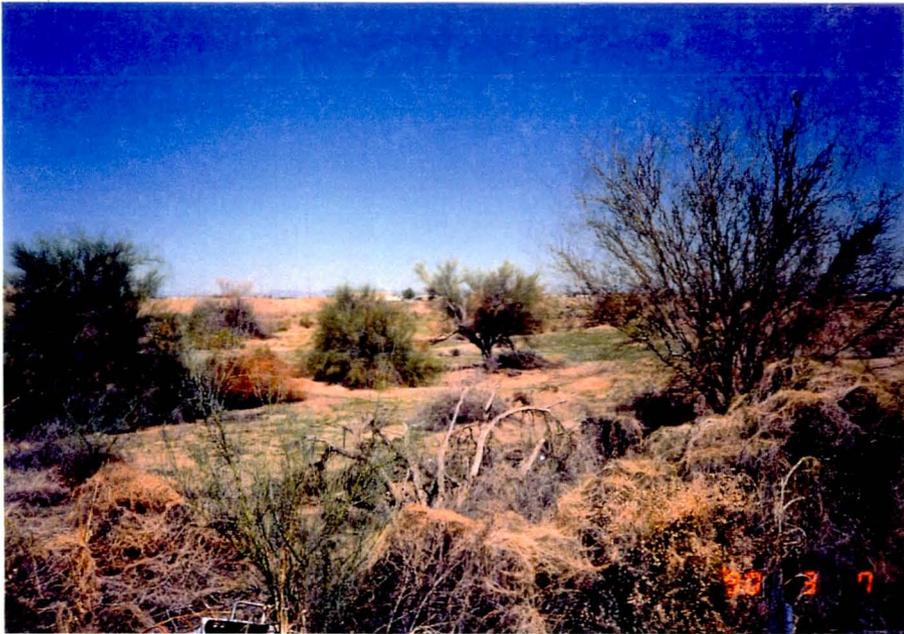


Photo Sheet 5: On-site Mitigation Area 1—Excess Right-of-Way

located along that portion of New River that was channelized by the Corps of Engineers, and totals 25 acres.

The Glendale Avenue site would require clean-up, but has positive potential for development into a Desert Shrub community. Supplemental water would have to be provided by truckwatering during the plant establishment period.

The existing vegetative community consists of annual plants, Desert Broom, Quailbush, Four-wing Saltbush, and Blue Palo Verde. Tree densities are less than 1 tree per acre (see Photo Sheet 6).

The soils on the site have been classified as Gilman Loams, Maripos Sandy Loams, and Brios Loamy Sands. Salinity is not a limiting factor. Groundwater depth is greater than 25 feet. Undesirable plant species include Tumbleweed and Bermuda Grass. The major unique site feature is the location; immediately adjacent to the New River Project right-of-way.

On-Site Area 3 (Earthen Channel Bottom): The earthen bottom of New River will be revegetated where disturbed. The disturbance areas have been previously discussed and are shown in Table 4. Characteristic vegetation within the channel bottom is shown in photo sheets 1-4. The four major vegetation types were discussed under quantification of the existing habitat. Soils have been classed as Carrizo gravelly sandy loams, Gilman loams, and Torripsamments and Torrifluents. Depth to ground water is variable. Several undesirable plant species are present, including Bermuda Grass and Tumbleweed. Three storm and agricultural drains inlet into the river (see Figure 1). These provide frequent flows that could support isolated stands of wetland vegetation. All of the alternatives disturb habitat in the vicinity of at least one drain; Alternative B-2 disturbs habitat near two drains and Alternative B-1 disturbs habitat adjacent to all three of the drains.

5.1.2 Horticultural Design for Areas 1 and 2

The goal of this mitigation planting is to establish a self-perpetuating Desert Shrub habitat along the periphery of the New River Project. Desert tree densities of 15 to 20 trees per acre will be achieved by the end of a 15-year monitoring and establishment period. Height diversity will be accomplished by seeding shrubs, grasses, and forbs and by transplanting tree species.

Seeding Plan: Grass, forbs, and shrub species will be established by broadcast seeding at a rate of 18 pounds of pure live seed per acre (PLS/acre) according to the seedmix listed in Table 5.

All seed is available commercially and will be ordered a minimum of 8 months prior to the fall planting season. Prior to seeding, the mitigation areas will be rough graded to create a variable terrain. Grading will be completed in advance of summer rains to encourage germination of weed seed. These weedy species will be disced immediately after weed emergence to eradicate the undesirable species.

The seedmix will be broadcast seeded and the area will be dragged to cover the seed. Fertilizer will not be used during seeding operations because the increased fertility will encourage growth of weed species.

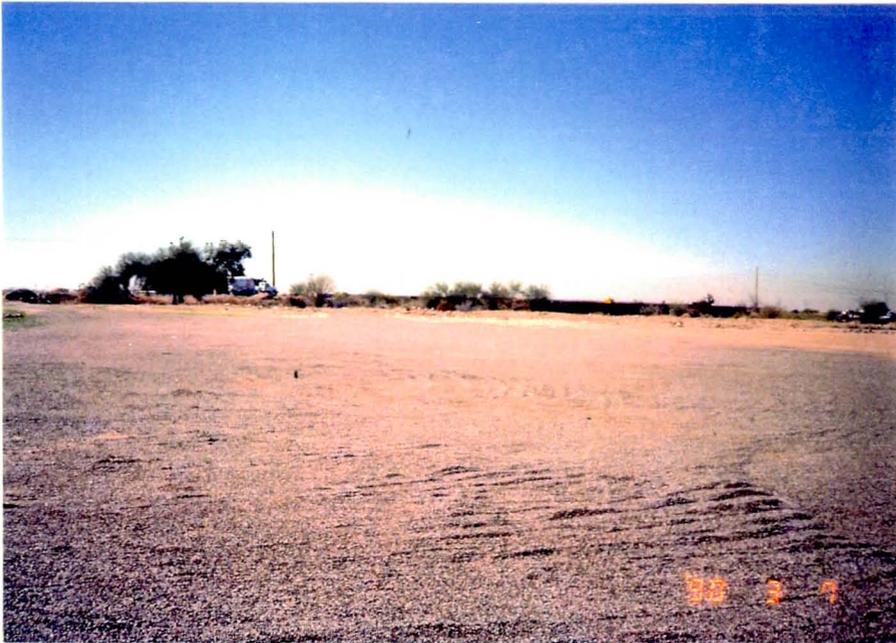


Photo Sheet 6: On-site Mitigation Area 2—Glendale and New River

| Table 5 Seedmix for Desert Shrub Habitat | | |
|---|------------------------|---------------|
| Common Name | Scientific Name | lbs PLS*/Acre |
| Grasses | | |
| Alkali Sacaton | Sporobolus airoides | 0.5 |
| Sand Dropseed | Sporobolus cryptandrus | 0.5 |
| Switchgrass | Panicum virgatum | 0.5 |
| Purple Three-awn | Aristida purpurea | 1.0 |
| Forbs | | |
| Annual Sunflower | Helianthus annuus | 3.0 |
| Desert Lupine | Lupinus sparsiflorus | 2.0 |
| Globe Mallow | Sphaeralcea ambigua | 0.5 |
| Penstemon | Penstemon parryi | 1.0 |
| Indian Wheat | Plantago insularis | 1.0 |
| Shrubs | | |
| Brittlebush | Encelia farinosa | 1.0 |
| Burro-brush | Hymenoclea monogyra | 1.0 |
| Triangle-leaf Bursage | Ambrosia deltoidea | 1.0 |
| Wolfberry | Lycium andersonii | 1.0 |
| Quailbush | Atriplex lentiformis | 1.0 |
| Four-wing Saltbush | Atriplex canescens | 2.0 |
| Desert senna | Cassia covesii | 0.5 |
| Desert Broom | Baccharis sarothroides | 0.5 |
| Total | | 18.0 |

*Pure Live Seed

Following seed application, the entire seeded area will be mulched with straw at a rate of 2,000 pounds per acre and the straw anchored by crimping or tacking.

Transplant Plan: Transplant species will be ordered eight months prior to installation. All species are readily available. Creosote-bush, which does not establish well from seed, will be transplanted.

Trees will be transplanted at a density of 25 trees per acre from 5 gallon size containers. Creosote will be planted at a density of 7.5 per acre.

Trees will be grouped in planting basins to facilitate watering and to create a more natural setting. Within the basins, holes for transplanting will be augured, and the sides roughened by hand to reduce glazing. All holes will be filled to capacity and allowed to drain within 24 hours of planting. This "pre-watering" reduces water stress following transplanting. Backfill will be amended with addition of organic mulch at a rate of one-third of the total volume. Slow release fertilizer (17-7-12) will be incorporated into the backfill at the rate of three and one-half pounds per cubic yard.

Following transplanting, all plant basins will be fenced with galvanized poultry netting to protect new transplants from rodent damage. Poultry netting will be anchored six inches below grade to deter burrowing. These protective fences will remain in place for a minimum of six months. Figure 3 shows the general planting plan for the 50 basins to be installed in the 20-acre parcel located at Glendale Avenue and New River. These basins measure 35 by 45 feet and will be configured as indicated in Figure 4.

Fencing will be installed around the periphery of the mitigation areas and maintained in perpetuity.

Maintenance: Areas measuring more than 25 square-feet and supporting vegetative cover less than 25 percent after the first two years will be reseeded as necessary to meet a guaranteed cover rate of 35 percent for ground cover and 20 percent for shrubs by the end of the fifteen year establishment period.

Outbreaks of weed species, including Bermuda Grass, will be controlled by District field crews during the active growing season for maximum success.

Transplants will be irrigated once a week for the first month, twice a month for the second and third months, and monthly thereafter for a period of six months for a total of 14 waterings. Following this six month period, the trees will be watered once a month during the months of May, June, July, and August—depending on summer rainfall—until they are permanently established.

Transplant basins will be weeded to limit competition during the first year of growth. Transplants will be regularly inspected and corrective measures taken to safeguard plant health and promote growth.

Protective rodent netting will be regularly inspected and replaced as needed within the first six months following planting. The rodent netting will be removed after six months.

5.1.3 Horticultural Design for Area 3

The goal of this planting is to restore vegetative growth to the invert of the New River Channel, while maintaining the capacity to safely conduct the standard project flood.

Seeding Plan: Grass, forbs, and shrubs will be established within the channel bottom by broadcast seeding at a rate of 18.5 PLS/acre according to the seedmix listed in Table 6. Native species were selected for inclusion in the seedmix based on the Operations and Maintenance Guidelines (see Appendix I).

Acres available for seeding under each of the alternatives is identical to the acreages listed under wildlife impacts (Table 4), except for Alternative B-1. Under Alternative B-1, 22 acres will be used in bank protection, therefore, only 104 acres will be available for seeding.

Transplant Plan: Three locations within the channel bottom are suitable for establishment of Cat-tails. These locations have been discussed previously and are where

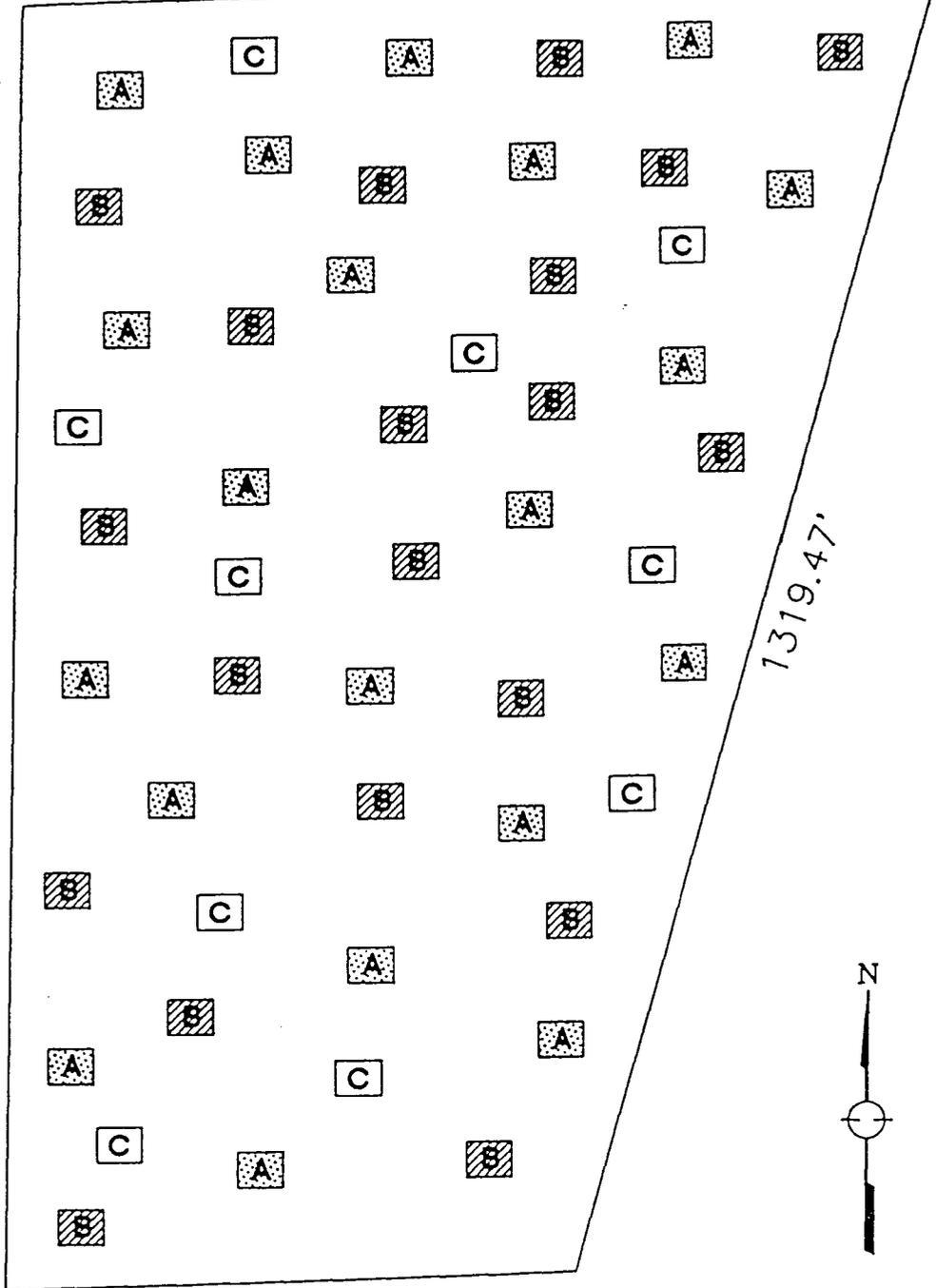
NEW RIVER CHANNEL



909.09'

1170.67'

1319.47'



563.11'
GLENDALE AVENUE



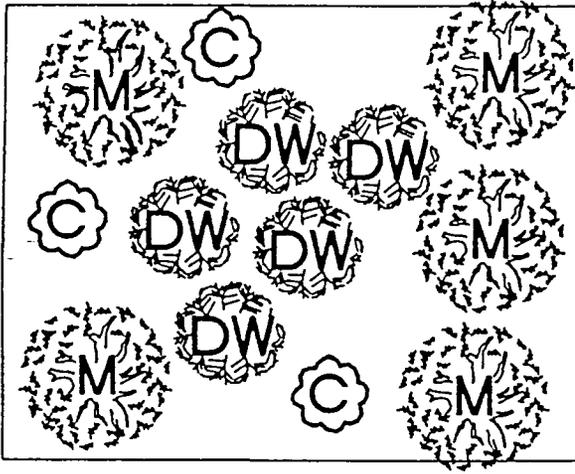
N.T.S.

S4 COR.
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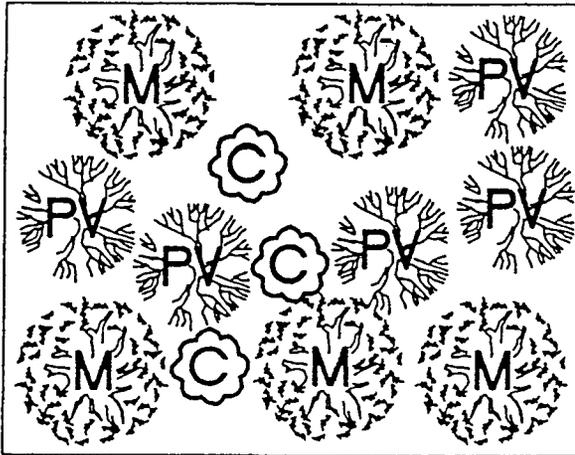
FIGURE 3

| | | | |
|--|--|--------|--|
| FLOOD CONTROL DISTRICT OF MARICOPA COUNTY - ARIZONA | | | |
| NEW RIVER CHANNEL | | | |
| MITIGATION AREA SITE PLAN | | | |
| DATE | | SCALE | |
| 03/26/90 | | N.T.S. | |

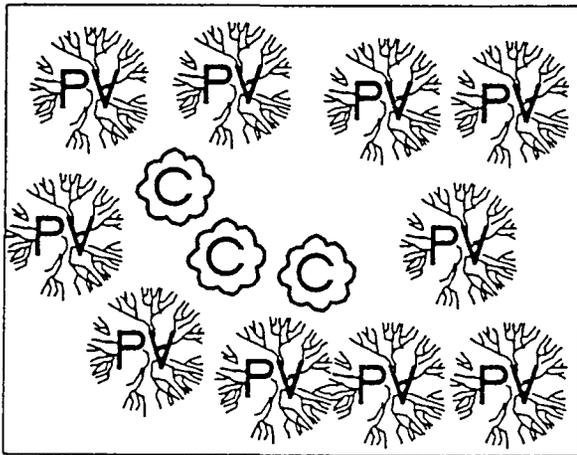
50 BASINS 35' x 45'



- A - 20 Basins:
 5-Desert Willow
 5-Mesquite
 3-Creosote Bush



- B - 20 Basins:
 5-Palo Verde
 5-Mesquite
 3-Creosote Bush



- C - 10 Basins
 10-Palo Verde
 3-Creosote Bush



Mesquite
 Max. Spread @ Maturity
 Desert Conditions:12'



Palo Verde
 Max. Spread @ Maturity
 Desert Conditions:10'



Creosote Bush
 Max. Spread @ Maturity
 Desert Conditions:6'



Desert Willow
 Max. Spread @ Maturity
 Desert Conditions:8'

FIGURE 4

| Table 6 Seedmix for Channel Bottom | | |
|---------------------------------------|--------------------------------|--------------|
| Common Name | Scientific Name | lbs PLS/acre |
| Grasses | | |
| Purple Three-awn | <i>Aristida purpurea</i> | 1.0 |
| Side Oats Grama | <i>Bouteloua curtipendula</i> | 1.5 |
| Alkali Sacaton | <i>Sporobolus airoides</i> | 0.5 |
| Squirrel Tail | <i>Sitanion hystrix</i> | 1.0 |
| Forbs | | |
| Coyote Gourd | <i>Cucurbita</i> sps. | 2.0 |
| Globe Mallow | <i>Sphaeralcea ambigua</i> | 1.5 |
| Annual Sunflower | <i>Helianthus annuus</i> | 3.0 |
| Shrubs | | |
| Canyon Ragweed | <i>Ambrosia ambrosioides</i> | 2.0 |
| Four-wing Saltbush | <i>Atriplex canescens</i> | 1.0 |
| Desert Broom | <i>Baccharis sarothroides</i> | 0.5 |
| Burro-brush | <i>Hymenoclea monogyra</i> | 1.0 |
| Narrow Leaf Goldenweed | <i>Haplopappus larcifolius</i> | 1.5 |
| Graythorn | <i>Condelea obtusifolia</i> | 2.0 |
| Total | | 18.5 |

side inlets provide reliable drainage throughout most of the year. The location of these drains is shown in Figure 1.

Under the various alternatives, Cottonwood and Willow stands can be established from pole plantings in disturbed areas adjacent to the inlets. Under Alternative B-1, stands will be established at each of the three drains. Under Alternative B-2, stands will be established at two of the drains, and under the remaining alternatives, stands will be established at one of the drains.

Given the necessity for the channel to convey SPF flows, the Operations and Maintenance Guidelines (Appendix I) govern the growth of these stands within the channel invert. Stands will not be located within 500 feet of bridged crossings of the channel and will be periodically thinned so the sum of the tree diameters will not exceed 10 feet within any given cross section of the channel. Figure 5 depicts the proposed vegetation plantings for the channel bottom.

Cottonwood and Willows will be planted from dormant poles harvested from abundant stands growing within District property along the Gila River. Stands suitable for harvest will be carefully selected and marked in the field by District Revegetation Ecologists to insure that harvested stands will rapidly recover.

Maintenance Plan: The plantings within the channel bottom will be inspected once every quarter and actions will be taken to insure that the Operations and Maintenance Guidelines are followed.

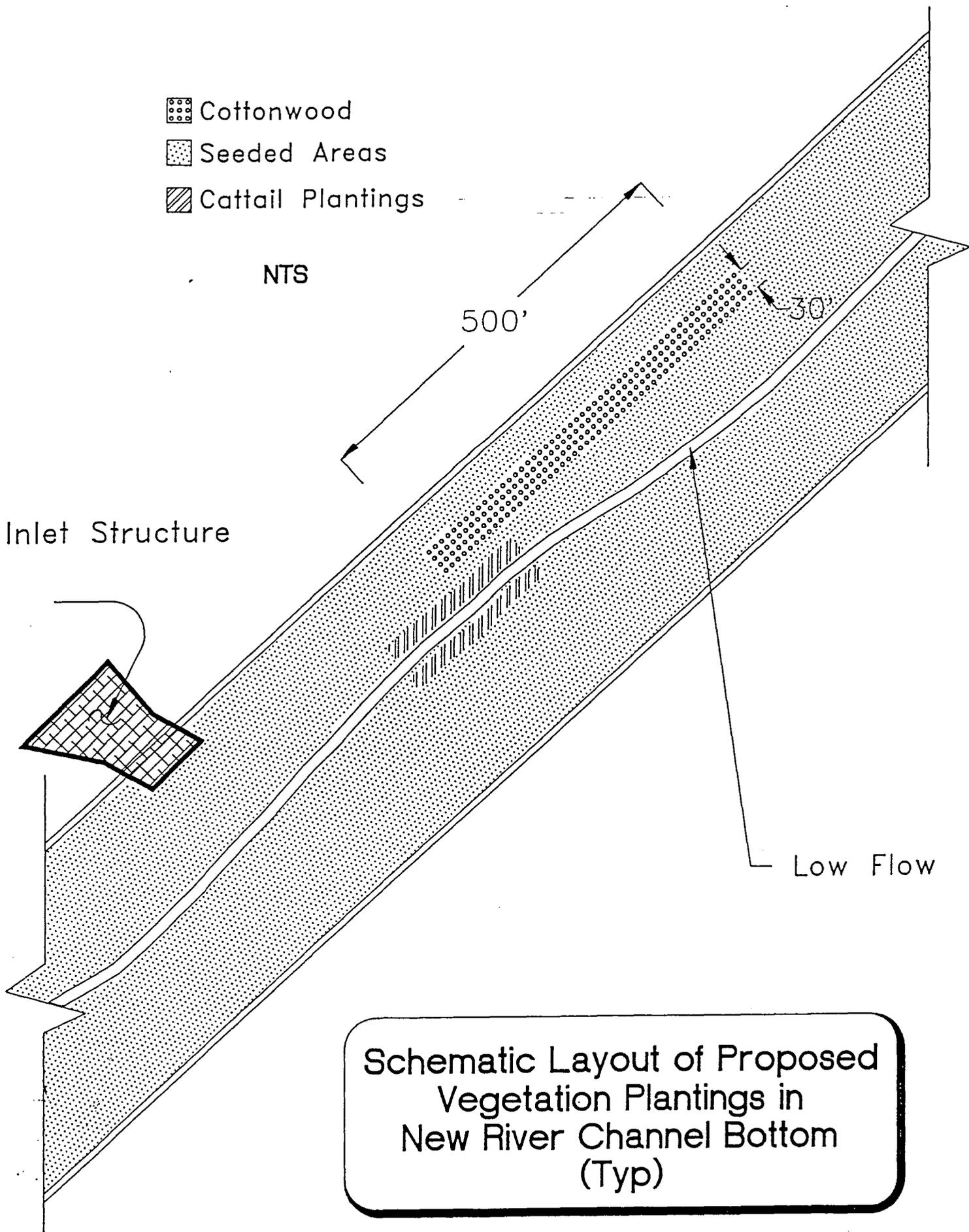


FIGURE 5

5.2 Off-site Mitigation

5.2.1 Site Analysis

The most promising site investigated for off-site mitigation is a recently purchased 32-acre parcel at the confluence of the Gila and Agua Fria Rivers. Figure 6 is an aerial photograph of this proposed site. The parcel had been previously used for pasture and irrigated farmland. Consequently, some Bermuda grass and other undesirable weedy species are present. Soils are Loamy Sand, salinity is slight, and irrigation is available for plant establishment. The concrete-lined irrigation ditches are usable and will be expanded to provide irrigation until plants are established. Irrigation water is available from the Saint John's Irrigation District. If for any reason, the supply of irrigation is interrupted, a well exists on the property that can be used in the interim.

No hardpan is present. The southern perimeter of the property borders riparian habitat supported by the Gila River. Within this habitat, Cottonwood and Willows are present in small numbers and Salt Cedar in abundance (see Photo Sheet 7). Test pits on this parcel indicate that the water table is quite high (5 to 7 inches deep). Unique site features include proximity to the Gila River (contiguous habitat) and the presence of 22 mature Cottonwood trees.

This mitigation site will be planted in three communities, Cottonwood, Mesquite Bosque, and shrub/grassland. Within this 32-acre parcel, trees will be planted to densities equaling 100 trees per acre.

5.2.2 Horticultural Design

The 32-acre site at the confluence of the Agua Fria and Gila Rivers will be developed by the Flood Control District into a self-sustaining wetland wildlife habitat. The habitat created will consist of plantings of Cottonwood, Mesquite, and native grasses, forbs, and shrubs. Together, the range of seeded and transplant species selected will create both vertical and horizontal diversity. Planting and seeding will be accomplished between October 15 and January 15 prior to the completion of the New River Flood Control Project.

The District has investigated placing a "conservation easement" on the mitigation property but has not found a wildlife management agency willing to accept the easement. Until an agency can be located that is willing to take this responsibility, the District will place a "restrictive covenant" on the title which will prevent future use of the property for any purpose other than wildlife mitigation, unless the future use can be agreed to by the Corps of Engineers, Game and Fish, Fish and Wildlife, and the EPA. Flood Control District legal counsel is currently researching the details of this restrictive covenant.

Seeding Plan: Grass, forb, shrub, and tree species will be established by broadcast seeding at a rate of 19.0 lbs PLS/acre according to the seedmix listed in Table 7.

All seed is available commercially and will be ordered a minimum of 8 months prior to the fall planting season. Prior to seeding, the 32-acre site will be rough-graded to create a variable terrain. The site will be pre-irrigated to encourage germination of

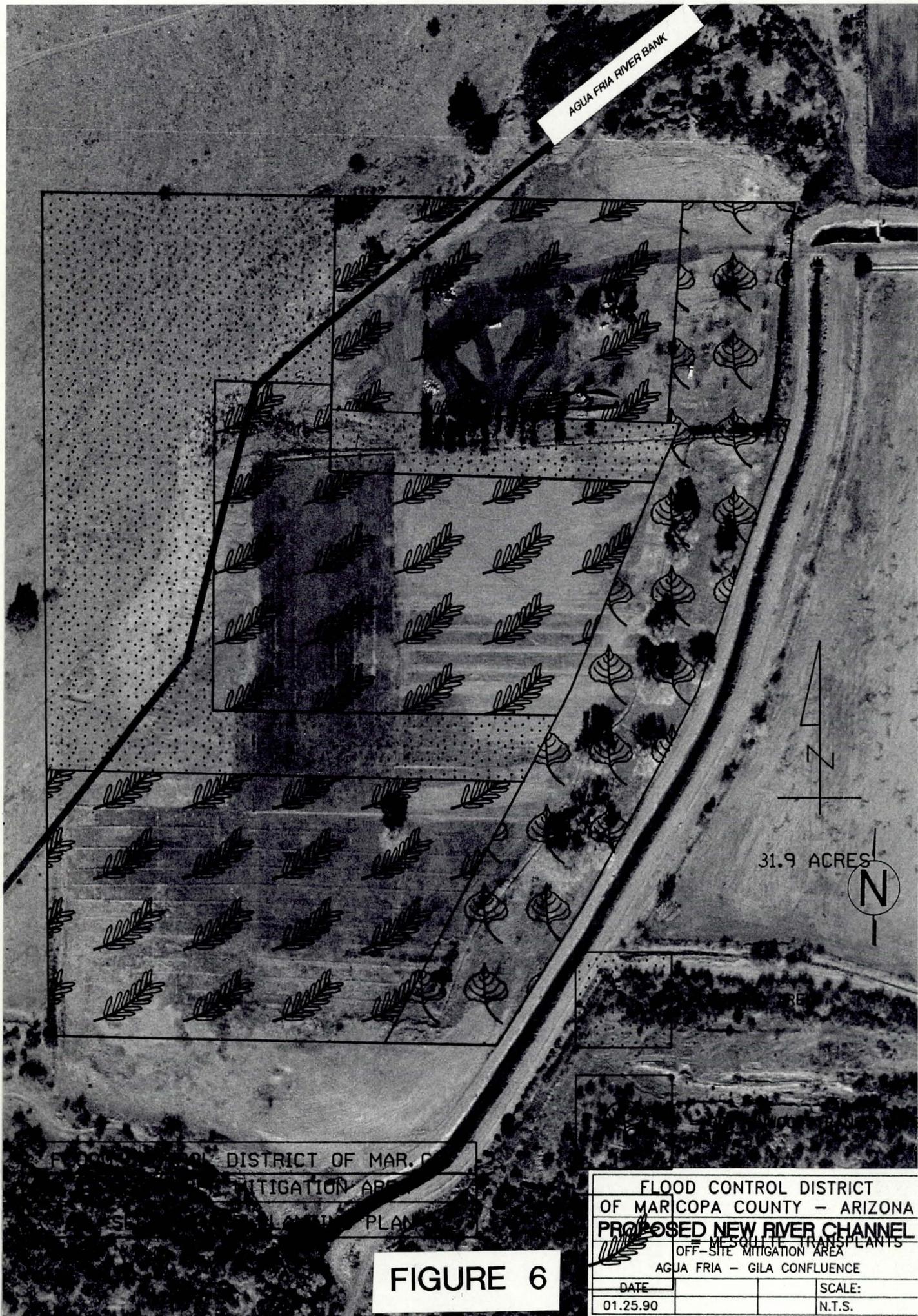


FIGURE 6



Photo Sheet 7: Off-site Mitigation Area—Agua Fria/Gila Confluence

| Table 7 Seedmix for Off-site Mitigation | | |
|--|------------------------|--------------|
| Common Name | Scientific Name | lbs PLS/Acre |
| Grasses | | |
| Sand Dropseed | Sporobolus cryptandrus | 0.5 |
| Switchgrass | Panicum virgatum | 1.0 |
| Annual Canarygrass | Phalaris canariensis | 2.0 |
| Purple Three-awn | Aristida purpurea | 1.0 |
| Forbs | | |
| Annual Sunflower | Helianthus annuus | 2.0 |
| Arroyo Lupine | Lupinus succulentus | 1.0 |
| Shrubs | | |
| Gray-thorn | Condelea obtusiflora | 2.0 |
| Globe Mallow | Spaeralcea ambigua | 0.5 |
| Palmer's Penstemon | Penstemon palmeri | 1.0 |
| Wolfberry | Lycium andersonii | 1.0 |
| Quailbush | Atriplex lentiformis | 1.0 |
| Four-wing Saltbush | Atriplex canescens | 2.0 |
| Desert senna | Cassia covesii | 1.0 |
| Trees | | |
| Mesquite | Prosopis juliflora | 3.0 |
| Total | | 19.0 |

weed seed, and disced immediately after weed emergence to eradicate these undesirable species.

The seedmix will be broadcast seeded and the area will be dragged to cover the seed. Fertilizer will not be used during seeding operations because the increased fertility will encourage growth of weed species.

Transplant Plan: Transplant Species will be ordered eight months prior to installation. Dormant pole plantings will use plentiful stock located on District-owned parcels along the Gila River. Harvested trees will be carefully selected in the field by District Revegetation Ecologists to insure that the existing stands will continue to thrive and flourish. Trees will be harvested 6 feet from the base to allow for regeneration. The District has had six years of experience in pole planting Cottonwood and Willow and will use this hard-earned expertise to insure optimum survivorship of the transplanted poles.

The overlay for Figure 6 shows the planting plan. As shown, the 32-acre parcel will be divided into three habitat zones. The first will be a Cottonwood grove, the second (on slightly higher ground) will be a Mesquite Bosque, and the third will be seeded with Mesquite, shrub, grass, and forb species. The mitigation area will be planted to a density equaling 100 trees per acre. Table 8 shows a breakdown of the tree plantings.

| Species | Type of Planting | Number |
|--------------------------------------|-------------------------|---------------|
| Mesquite, <i>Prosopis juliflora</i> | 5 gallon transplants | 2,700 |
| Cottonwood, <i>Populus fremontii</i> | 5 gallon transplants | 400 |
| Cottonwood, <i>Populus fremontii</i> | Dormant Pole Plantings | 100 |
| Total | | 3,200 |

Following transplanting, all plant basins will be fenced with galvanized poultry netting to protect new transplants from rodent damage. These protective fences will remain in place for a minimum of six months.

Maintenance Plan: Areas supporting vegetative cover less than 25 percent after the first two years and measuring more than 25 square-feet in area will be reseeded as necessary to meet a guaranteed cover rate of 35 percent for ground cover and 20 percent for shrubs at the end of the fifteen-year establishment period.

Outbreaks of weed species, including Bermuda grass, will be controlled during the active growing season for maximum success.

Transplants will be flood-irrigated monthly during the first year of establishment, and thereafter as necessary during the summer months to maintain healthy growth.

Transplant basins will be weeded to limit competition during the first year of growth. Transplants will be regularly inspected and corrective measures taken to safeguard plant health and promote growth.

Transplants will be replaced on an as-needed basis during the October through January planting window to insure 75 percent survival after the fifteen-year establishment period.

Monitoring and Replacement During the Establishment Period

During a fifteen-year establishment period, annual inspections of all mitigation areas will include survivorship data. Based on this data, transplants will be replaced annually, during the October through January planting window, to insure 75 percent survival after the establishment period. Rip-rap animal access ramps will be replaced on an as-needed basis.

The project will be maintained by the District in perpetuity. At the end of the establishment period, the District will guarantee 75 percent survival of transplant species, 35 percent canopy cover by seeded groundcovers and 20 percent canopy cover by seeded shrub species. A fence will be installed along the right-of-way boundaries for the New River Channel and around the periphery of the mitigation site located at the confluence of the Agua Fria and Gila Rivers. This fence will exclude livestock and protect against vandalism, and will be maintained in perpetuity. Flood Control District field crews will provide all labor for maintenance and installation.

During the establishment period, the mitigation areas will be inspected on an annual basis by the Arizona Game and Fish Department, U.S. Fish and Wildlife Service, and other concerned agencies. Permanent photo points will be established during the development of the mitigation site and annual photographs will be taken to document changes to the area. Annual data collection will include: percent survival and diameter at 4.5 feet for the transplant species, and percent cover by species for ground cover, shrubs, and trees. The annual data collected over the fifteen-year establishment period will be included in an annual report. This report will be generated within 60 days of the inspection and copies will be sent to the members of the inspection team.

At the end of the fifteen-year establishment period, the Flood Control District will issue a report which will incorporate the data collected during the establishment period and evaluate the overall success of the mitigation project.

Jointly, the Flood Control District and the Arizona Game and Fish Department will continue annual inspections until such time (if any) that it can be mutually agreed that these inspections are no longer required.

Mitigation Costs

Costs for developing the mitigation plan are presented in Tables 9-14.

| Table 9 Installation Costs 30 Rip-Rap Animal Access Ramps | | |
|---|--------------------------|------------------|
| Item | Quantity | Projected Costs |
| Materials | | |
| River Rock | 1,320 tons | 20,000 |
| Equipment/Labor | | |
| Front End Loader | 80 hours | 1,600 |
| Equipment Trailer | Transport Loader | 1,000 |
| 10 Yard Dump Truck | 8 days | 2,500 |
| Maintenance | one complete replacement | 20,000 |
| Total | | \$ 45,100 |

| Table 10 Installation Costs Three Cattail Patches Adjacent to Three Side Inlets | | |
|--|----------------------------------|-----------------|
| Item | Quantity | Projected Costs |
| Materials | | |
| Cattails | Harvested from District Property | |
| Equipment/Labor | | |
| Backhoe | Harvest/plant Cattails | 2,200 |
| Dumptruck | Transport Cattails | 120 |
| Water Truck | Water-in transplants | 180 |
| Labor | Four days | 3,000 |
| Total | | \$ 5,500 |

| Table 11 Mitigation Costs for On-site Area 1 Excess Right-of-Way (Alternative B-1) | | |
|---|------------------------------|------------------|
| Item | Quantity | Projected Costs |
| Materials | | |
| Transplant Tree Species | 25/acre, 175 total | 1,500 |
| Staking for Netting | 525 poles | 600 |
| Protective Netting | 1100 feet | 500 |
| Seed | 20 PLS/acre, 7 acres | 4,200 |
| Straw Mulch | 2000 lbs/acre | 7 acres |
| Equipment/Labor | | |
| Backhoe with auger | 175 holes | 1,900 |
| Labor | Plant trees, miscellaneous | 700 |
| Tractor | disc, seed, cover seed | 1,350 |
| Dump Truck | transport trees, straw mulch | 500 |
| Mulch Blower | apply mulch | 350 |
| Maintenance | | |
| Water Truck | | 1,400 |
| Annual Maintenance | first 5 years | 5,000 |
| | second 5 years | 3,500 |
| | third 5 years | 1,800 |
| Total | | \$ 24,000 |

| Table 12 Mitigation Costs for On-site Area 2 20-acre Glendale and New River Site | | |
|--|-------------------------------|-------------------|
| Item | Quantity | Projected Costs |
| Clean up of Site | 20 Acres | 200,000 |
| Materials | | |
| District standard fence | 4,000 Linear ft | 6,000 |
| Transplant Species | | |
| Mesquite | 200 Each | 1,500 |
| Palo Verde | 200 Each | 1,500 |
| Creosote | 150 Each | 500 |
| Desert Willow | 100 Each | 700 |
| Staking for Netting | 2,000 Poles | 2,000 |
| Protective Netting | 4,000 ft | 1,800 |
| Seedmix | 20 PLS/acre, 20 acres | 12,000 |
| Straw mulch | 2,000 lbs/acre, 20 acres | 2,000 |
| Equipment/Labor | | |
| Backhoe with auger | 650 holes | 4,500 |
| Labor | Plant trees, miscellaneous | 2,500 |
| Tractor | disc, seed, cover seed, 1,000 | |
| Dumptruck | transport poles, straw mulch | 1,500 |
| Mulch blower | apply mulch | 1,000 |
| Maintenance | | |
| Water truck | | 4,000 |
| Annual Maintenance | first 5 yrs, 15,000/yr | 75,000 |
| | second 5 yrs, 10,000/yr | 50,000 |
| | third 5 yrs, 5,000/yr | 25,000 |
| Total | | \$ 392,500 |

| Table 13 Mitigation Costs for On-site Area 3 Channel Bottom | | |
|---|---|-----------------|
| Item | Quantity | Projected Costs |
| Seeding Costs per acre | | |
| Materials | | |
| Seedmix | 20 PLS/acre, 1 acre | 1,000/acre |
| Equipment/Labor | | |
| Tractor | Broadcast seed/cover seed | 80/acre |
| Labor | | 20/acre |
| Total per acre | | \$ 1,100 |
| Transplanting Costs per inlet | | |
| Materials | | |
| Transplants | | |
| Pole plantings | 200/inlet, harvested from District property | |
| Protective netting | 30 X 500 | 6,750 |
| Equipment/Labor | | |
| Backhoe with auger | auger holes | 1,200 |
| Water truck | prewater holes | 60 |
| Dumptruck | transport poles | 300 |
| Labor | harvest/plant poles/install netting | 130 |
| Total per inlet | | \$ 8,440 |

| Table 14 Mitigation Costs for the Off-site Area Agua Fria/Gila River Confluence | | |
|---|---|------------------|
| Item | Quantity | Projected Costs |
| Materials | | |
| District Standard Fence | 5,000 linear ft | 7,500 |
| Seedmix | 20 PLS/acre, 32 acres | 25,000 |
| Straw Mulch | 2,000 lbs/acre | 7,500 |
| Transplants | 100/acre, 32 acres, 3200 total | 25,000 |
| Protective netting | 6 ft/plant, 19,200 ft | 8,000 |
| Staking for netting | 1"x 2" stakes, 3/plant, 9,600 total | 8,000 |
| Osmocote fertilizer | 200 lbs | 200 |
| Equipment/Labor | | |
| Grader | 32 acres | 13,000 |
| Backhoe with auger | 3,200 holes | 17,000 |
| Tractor | disc/seed/drag/crimp straw | 1,000 |
| Labor | plant trees, install netting, miscellaneous | 10,000 |
| Maintenance | | |
| Irrigation | maximum 3.0 acre-feet/yr | 30,000 |
| Annual Maintenance | \$15,000/yr, first 5 years | 75,000 |
| | \$10,000/yr, second 5 years | 50,000 |
| | 5,000/yr, third 5 years | 25,000 |
| Total | | \$302,200 |

Summary

The total acres impacted under the various alternatives is shown in Table 4. A summary of mitigation features for each alternative is presented in Table 15. Under all of the alternatives, the disturbed acreage within the channel invert will be seeded, rip-rap animal access ramps will be installed every 500 feet on alternating sides of the channel, and Cat-tails will be established along the low-flow in the vicinity of the three side inlets. Cottonwood and Willow pole plantings will be established in disturbed areas adjacent to the side drains. For Alternatives B-1 and B-2, Cottonwood and Willows will be planted adjacent to three and two inlets, respectively. For the remaining alternatives, Cottonwood and Willow pole plantings will be established in the vicinity of the northern-most side inlet.

Additionally, under Alternative B-1, 7 acres of excess right-of-way will be seeded and planted according to the on-site mitigation plan.

Under all of the alternatives, the 20-acre parcel located at Glendale Avenue and New River will be fenced, planted and seeded, and the 32-acre site located off-site at the confluence of the Agua Fria and Gila Rivers will also be fenced, planted, and seeded.

Habitat losses, total mitigation acreage and costs of installation and maintenance of the mitigation areas for 15 years are presented in Table 16.

| Mitigation Feature | Alternative | | | | | | | | |
|--|-------------|-----|-----|-----|-----|-----|-----|-----|-----|
| | A | B-1 | B-2 | C-1 | C-2 | C-3 | D-1 | D-2 | D-3 |
| Seed Disturbed Channel Bottom (number of acres) | 42 | 126 | 68 | 71 | 71 | 71 | 42 | 42 | 42 |
| Rip-rap Animal Access Ramps | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Install Three Cattail Patches | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Pole Plant Cottonwood/Willows (in Channel , number of inlets) | 1 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Plant Excess Right of Way | no | yes | no |
| Plant Glendale/New River Site (20 acres) | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| Plant Agua Fria/Gila River Site (32 acres) | yes | yes | yes | yes | yes | yes | yes | yes | yse |

| Table 16 | | | |
|--|-------------------------|--------------------------|--------------------|
| Mitigation Costs for New River Channel Alternatives | | | |
| Alternative | Acreage Impacted | Acreage Mitigated | Total Costs |
| A Flowage Easements | 42 | 95 | \$799,840 |
| B-1 Soil Cement Banks, 300 ft wide | 126 | 165 | \$933,120 |
| B-2 Soil Cement Banks, 300 to 500 ft wide | 68 | 121 | \$836,880 |
| C-1 Soil Cement 1 Bank, 550 ft wide | 71 | 124 | \$831,740 |
| C-2 Soil Cement 1 Bank, 600 ft wide | 71 | 124 | \$831,740 |
| C-3 Soil Cement 1 Bank, 500 to 900 ft wide | 71 | 124 | \$831,740 |
| D-1 Dikes at Floodway | 42 | 95 | \$799,840 |
| D-2 Dikes at 550 ft | 42 | 95 | \$799,840 |
| D-3 Dikes at Floodplain | 42 | 95 | \$799,840 |

Appendix I

New River Vegetation Operations and Maintenance Guidelines

Purpose:

1. To prevent any encroachment upon an improved channel which would reduce its flood-carrying capacity.
2. To manage the vegetation within New River Channel to maintain a channel capacity of the standard project flood (SPF), 69,000 cubic feet per second (cfs).

Procedure:

The floodway will be revegetated to enhance its appearance, with trees and shrubs native to Arizona and according to the criteria and guidelines stated below. Revegetation efforts will be designed, installed, and maintained in such a manner as to allow the passage of the SPF.

Criteria and Guidelines:

General criteria and guidelines used in the design and maintenance of the floodway are as follows:

- a. Maximum density of trees should be limited to allow the passage of the SPF at a given flow section. Tree patches shall be planted 4 trees wide in 50 parallel rows so the sum total trunk diameter (dbh) at maturity is no greater than 10 feet in any given cross section of flow.
- b. Tree branches should be above the design water surface (16 to 17 feet) within 7 years of planting.
- c. Tree patches within the floodway will be planted in rows and aligned with the flow.
- d. Tree patches will be located no closer than 500 feet downstream of any bridge crossing.
- e. Shrubbery will be restricted to a height of 5 feet.

Appendix II

Appendix II

Excerpts from the Letter Report to the General Design Memorandum No. 3 for Skunk Creek and the New and Agua Fria Rivers

Table 1
Revised 100-Year Floodplain Data

| Stream | Floodway Fringe (Acres) GDM Revised | | Floodway (Acres) GDM Revised | | Total Floodplain (Acres) GDM Revised | |
|--------------|---|-------|------------------------------------|-------|--|-------|
| Skunk Creek | 335 | 0 | 275 | 84 | 610 | 84 |
| New River | 1,225 | 0 | 765 | 705 | 1,990 | 705 |
| Agua Fria R. | 2,865 | 1,065 | 2,550 | 2,550 | 5,415 | 3,615 |
| Total | 4,425 | 1,065 | 3,590 | 3,339 | 8,075 | 4,394 |

permanent parks have been determined to qualitatively have a higher open space value as well as a recreational value of 4 times that of floodway or easement lands on which a number of open space uses (e.g. agriculture, gravel mining, etc.) are permitted. Utilizing this ratio, the total open space equivalent for this reach would be 2,553 acres (1,010 + 1,255 + 156 + 4(10 + 23) = 2,553) as compared to the floodway acreage of 2,550 acres delineated in the phase II GDM.

b. Cave Creek Diversion. - A second deviation from the phase II GDM is the diversion of Cave Creek prior to completion of planned structures and the acquisition of all required flowage easements on Skunk Creek, the New River, and the Agua Fria River.

CHAPTER 5 - ALTERNATIVES CONSIDERED

5.01 Alternatives Considered. - Since this EA presents deviations from the phase II GDM as they will actually be constructed, no further alternatives are being considered as part of this action.

CHAPTER 6 - AFFECTED ENVIRONMENT

6.01 General. - Details of the existing environment may be found in the previous reports noted in Chapter 2, above, for representative areas in the Phoenix vicinity. The significant resources potentially affected by the project modifications described above were determined to be land use, mineral resources, vegetation and wildlife, esthetics, open space, and flooding. Other environmental parameters including soils, air quality, surface water resources, groundwater resources, noise, transportation, recreation, safety, and social resources were examined for this Supplemental Environmental Assessment

(SEA) and it was determined that there was no potential for long term impacts to ~~these resources~~. A cultural records and literature search was conducted. The closest site found was a prehistoric site about 1 mile from the project area. There are no listed historic cultural resources near the project area. The open space mitigation area at the confluence of New River and Skunk Creek was field surveyed for cultural resources by a Corps Archeologist and found to have no cultural resource sites. The determination that project modifications for this project will not involve historic properties listed in or eligible for the National Register of Historic Places was informally coordinated with the State Historic Preservation Officer (SHPO) and the SHPO concurred. The determination was formally coordinated with the SHPO by letter dated November 18, 1988 (Appendix A).

6.02 Land Use. - Land uses within or adjacent to Skunk Creek, the New River, and the Agua Fria River include agriculture, residential, commercial, light industry, sand-and-gravel mining operations, and open space (presently undeveloped land). Residential land use is expected to eventually displace much of the agriculture and open space uses. Sand-and-gravel mining occurs within the New River floodway downstream of Glendale Avenue and within the Agua Fria River floodway. There are no formal recreation facilities within the floodways; however, the floodways are used informally by equestrians, hikers, off-road vehicles, and hunters.

6.03 Mineral Resources. - Sand-and-gravel deposits occurring on the channel bottoms of Skunk Creek, the New River, and the Agua Fria River constitute the only mineral resources within the project area.

6.04 Vegetation and Wildlife. - Vegetation types within the project area consists of desert wash/riparian and outwash or alluvial plain communities whose dominant species are cottonwood (Populus fremontii), black willow (Salix nigra), desert willow (Chilopsis linearis), blue palo verde (Cercidium floridum), mesquite (Prosopis juliflora), creostebush (Larrea divaricata), saltbush (Atriplex cohescens), greasewood (Sarcobatus vermiculatus), broom baccharis (Baccharis sarothroides), catclaw acacia (Acacia greggii), saltcedar (Tamarix aphylla), and athel tamarisk (Tamarix aphylla). Most of the natural biotic communities along the length of these stream segments have been variously disturbed as a result of indiscriminate trash dumping, agricultural development, sand-and-gravel operations, and urbanization.

The riparian and outwash plant communities along Skunk Creek and the New and Agua Fria Rivers provide a diversity of habitats suitable for wildlife. Additionally, different growth forms (e.g., trees, shrubs, and herbs) within these plant communities serve to increase the number of feeding, roosting, and nesting niches available to wildlife. Adjacent agricultural fields provide an additional food source. Wildlife diversity at various locations within the project area include amphibians and reptiles, such as toads, snakes, and lizards; numerous avian species; and mammals, such as rodents, bats, skunks,

jackrabbits, and coyotes. Continued habitat degradation by urbanization, illegal trash dumping, and sand/gravel extraction pose present and future threats to vegetation and wildlife in these reaches.

6.05 Esthetics. - Some areas of Skunk Creek have experienced visual degradation by illegal trash dumping, partial channelization, and removal of some native vegetation. Nevertheless, the remaining native vegetation along lower Skunk Creek's floodway constitutes an important visual element of the area's open space. Along the New River, there has been illegal trash dumping at various dip crossings and locations along channel banks and topographic/visual disruption caused by sand-and-gravel operations; however, the open space remaining still constitutes an esthetically important visual element of the area. Within the project area, the Agua Fria River passes through urbanized, agricultural, and undeveloped areas. This segment of the river is fairly broad, and still supports several areas of extensive riparian vegetation growth, which provides habitat for a number of wildlife species. Sand-and-gravel mining operations, off-road vehicle trails, and illegal trash dumping have somewhat degraded the visual appearance of this area.

6.06 Open Space. - As noted in paragraph 4.01 and table 1, the GDM plan would provide 3,590 acres of open space (275 along Skunk Creek, 765 acres along the New River, and 2,550 acres along the Agua Fria River).

6.07 Flooding. - Under the GDM plan, the flowage easements would be acquired along the entire project length prior to diverting flows from Cave Creek and all residential structures within the floodway would be removed to prevent any possible flood damage and safety hazards.

CHAPTER 7 - ENVIRONMENTAL EFFECTS

7.01 General. - An FEIS was prepared by the Corps in March 1976 to address the environmental impacts associated with construction of the overall Phoenix, Arizona and Vicinity (including New River) Flood Control Project. The impacts associated with modifications to the Skunk Creek and the New and Agua Fria Rivers portion of the project were presented in the final EA and FONSI included in the GDM dated May 1986. This SEA will address only those changes made subsequent to the EA/FONSI. It should be noted that delineation of the floodplains would have effects on land use, mineral resources, vegetation and wildlife, esthetics, and open space. Diversion of Cave Creek flows would have an effect on flooding only.

7.02 Land Use. - Revision of the floodplain and floodplain fringes to reflect channelization by local interests subsequent to the 1986 GDM would allow development to occur on a total of 3,681 acres (251 acres of floodway and 3,360 acres of floodway fringe) of formally floodplain lands. However, under the GDM plan, the floodway fringe could be developed if filled to one foot

above the level of the 100 year flood and is not counted as open space provided by the project. The decrease of 251 acres of floodway and open space would be mitigated by purchase of 176 acres along the New River and 331 acres along the Agua Fria River.

7.03 Mineral Resources. - Development of the 3,681 acres of formally floodplain lands would preclude gravel mining on those lands once developed.

R 7.04 Vegetation and Wildlife. - Vegetation and wildlife currently existing on the 3,681 acres of formally floodplain lands would be lost. However, vegetation and wildlife currently existing on the 3,360 acres of floodway fringe lands would be lost without the project because of the development allowed. Therefore, there would be a net loss of 251 acres of habitat. Vegetation and wildlife currently existing on the 251 acres of floodway lands to be deleted from the project would be lost. However, the habitat on these lands is considered to be of poor quality and loss of the habitat is not considered to be significant. Although mitigation is not required, vegetation and wildlife on the 176 acres along the New River and 331 acres along the Agua Fria River (see paragraph 7.02, above) would be preserved by dedicating those lands to open space, resulting in more habitat being preserved.

7.05 Esthetics. - The use of soil cement bank stabilization and levees along both banks of the river would be less pleasing, visually, than the natural banks. While the reaches channelized would be esthetically degraded, retention of the open space areas by purchase (see paragraph 7.06, below) would ensure the long term natural esthetic character of those areas. Under the terms of the floodway flowage easements, sand-and-gravel mining, agriculture, recreation, and other activities will be permitted to occur in the floodway. These activities have the potential to reduce the esthetic appearance of the floodway area even more.

7.06 Open Space. - Delineation of the floodway would eliminate 251 acres of floodway open space previously delineated. Mitigation for the removal of the open space would be by acquisition 176 acres along New River and 331 acres along the Agua Fria River. These lands would be acquired in fee and permanently dedicated to open space.

7.07 Flooding. - Under the GDM plan, flows from Cave Creek will be diverted, via the Arizona Canal Diversion Channel, into Skunk Creek and thence into the New and Agua Fria Rivers. This interbasin transfer of flows could add to flows already present if a flood event were to occur. Depending upon the magnitude of the flows, flooding could occur on the floodway fringe. If the floodway fringe easements have not been acquired, flooding could occur on those lands which would be owned by others thus creating a potential legal liability problem. While this is not a change in the impact of the project, the impact of the interbasin transfer could occur earlier in time than previously anticipated. However, the Flood Control District is attempting to acquire

flooding easements to those lands that will not be protected by SPF channelization as quickly as possible and should have all of the easements in place by late 1989.

- R 7.08 Environmental Commitments. - Because the proposed alternative has no significant adverse environmental impacts, no environmental commitments have been made as part of this EA.

CHAPTER 8 - COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

8.01 Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements. - Compliance with applicable laws, regulations, and Executive Orders is outlined below.

- a. National Historic Preservation Act of 1966, as Amended. - The project is in compliance. The Phoenix, Arizona and Vicinity (including New River) Flood Control Project area was surveyed by Arizona State University (ASU) in 1974 under contract to the Army Corps of Engineers. The area to be acquired for the new open space was visited by a Corps of Engineers archeologist and found to have no cultural resources. There are no listed cultural resources near the site. The SHPO was informally coordinated with during the preparation of this SEA. The determination that project modifications for this project will not involve historic properties listed in or eligible for the National Register of Historic Places was informally coordinated with the State Historic Preservation Officer (SHPO) and the SHPO concurred. The determination was formally coordinated with the SHPO by letter dated November 18, 1988 (Appendix A). Their response, by letter dated December 9, 1988 (Appendix A), included a "no effect" determination. In addition, they requested that if any archeological remains were encountered during ground disturbing activities, work should cease in the area of the discovery and the SHPO be notified immediately. If any archeological remains are encountered during project ground-disturbing activities, their office will be notified immediately.

- b. Fish and Wildlife Coordination Act. - The project is in compliance. A Fish and Wildlife Coordination Act Report (CAR) for the overall Phoenix, Arizona and Vicinity (including New River) Flood Control Project, dated February 1978, was prepared by the U.S. Fish and Wildlife Service (FWS). The CAR addressed overall project impacts to the fish and wildlife resources. FWS and the Arizona Game and Fish Department (AGAFD) have been informally coordinated with during the preparation of this SEA. The FWS has no concerns as long as the previously agreed-upon mitigation is implemented.

c. Endangered Species Act, as Amended. - The project is in compliance. Informal coordination with the FWS during preparation of this SEA resulted in the conclusion that there are no Federal or State threatened or endangered species present.

d. National Environmental Policy Act. - The project is in compliance. This SEA has been prepared in accordance with the National Environmental Policy Act.

e. Clean Air Act. - The project is in compliance. The contractor will be responsible for complying with all applicable Federal, State, and local laws and regulations concerning air quality.

f. Clean Water Act, as Amended. - The project is in compliance. Delineation of the floodway will not discharge pollutants or place any materials into waters of the United States and, therefore, neither a NPDES permit (section 402) or a 404(b)(1) evaluation is required for this project.

g. Farmland Protection Policy Act. - The project is in compliance. The Soil Conservation Service (SCS) has prepared maps (June 1977) identifying prime farmlands within Maricopa County. According to those maps, the project will not affect any prime and unique farmlands or farmlands of statewide importance. This conclusion was informally coordinated with the SCS, which concurred.

8.02 Environmental Protection Statutes and Other Environmental Requirements Found to be Not Applicable. - The following laws and Executive Orders were found to be not applicable to this project:

Coastal Zone Management Act
Estuary Protection Act
Executive Order 11988, Floodplain Management
Executive Order 11990, Protection of Wetlands
Marine Protection, Research, and Sanctuaries Act
Rivers and Harbors Act
Watershed Protection and Flood Prevention Act
Wild and Scenic Rivers Act

CHAPTER 9 - COORDINATION

9.01 General. - Informal coordination has been ongoing with the FWS and the SHPO during preparation of this SEA.

R Formal coordination with the following agencies has taken place:
Environmental Protection Agency; U. S. Fish and Wildlife Service; Soil Conservation Service; Farmers Home Administration; Arizona State Historic

Appendix III

**Environmental Assessment
prepared by the Corps of Engineers**

9/18/89

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT CORPS OF ENGINEERS

ENVIRONMENTAL ASSESSMENT
- 404(b)(1) EVALUATION -
PUBLIC INTEREST REVIEW

PERMIT APPLICATION NUMBER:
89-001-RD

APPLICANT:
MARICOPA COUNTY FLOOD CONTROL DISTRICT

Prepared by:

ROBERT J. DUMMER
Biologist
Regulatory Branch

Date

Reviewed by:

DAVID J. CASTANON
Chief, Northern Section
Regulatory Branch

Date

Approved by:

CHARLES M. HOLT, P.E.
Chief, Regulatory Branch

Date

This document constitutes my Environmental Assessment, Statement of Findings, and review and compliance determination according to the 404(b)(1) guidelines for the proposed work (applicant's preferred alternative) described in the attached public notice:

I Proposed Project: The location and description of work are described in the attached public notice.

II Environmental and Public Interest Factors Considered:

A. Purpose and Need: In 1976 the U.S. Army Corps of Engineers completed a final environmental impact statement for the New River and Phoenix City Streams project in Maricopa County, Arizona. The purpose of this project is to control floods along Cave Creek, Skunk Creek, Dreamy Draw Wash, Agua Fria River, and New River to flood protect residential, commercial, industrial, and agricultural properties within and adjacent to the cities of Phoenix, Glendale, Peoria, Sun City, and Avondale.

The responsibility for completing some features of the overall plan were given to local, non-federal, authorities. Maricopa County Flood Control District committed to provide 100-year floodplain protection by obtaining flowage easements and some limited flood control structures in the New River from Olive Avenue to the Agua Fria River. However, now when the 13 year old plan is finally being implemented in this reach of the New River Maricopa County Flood Control District has re-assessed the situation and believes that flowage easements are no longer the best alternative to meet their flood control obligations as detailed in the 1976 plan.

Completion of upstream features of the New River and Phoenix City Streams project will greatly increase the flooding potential in the reach of the New River from Olive Avenue to the confluence with the Agua Fria River. The upstream improvements will bring more water over a shorter period of time creating the need to provide protection against these increased flood flows.

B. Alternatives (33 CFR 320.4(b)(4), 40 CFR 230.10)

1. No action: Completion of the Arizona Canal Diversion Channel and other upstream improvements will result in increased flows in the New River from Olive Avenue to the Agua Fria River confluence. The purchase of 100-year floodplain flowage easements to meet the applicant's flood control obligations is considered as the no action alternative. The upstream diversions and channel modifications will direct more water in a shorter period of time into this reach of the New River. Therefore, if the no action alternative is chosen the existing channel will suffer erosion damage during the first major flood event. The flood waters are expected to be increased enough to scour the existing vegetation out of the channel. The increasing urbanization of the surrounding area is also expected to lessen the value of whatever wildlife habitat that would remain in the New River under the no action alternative. It is also reasonable to expect that

since flowage easements do not prohibit or regulate many activities that adversely impact wildlife habitat, such as vegetation clearing, the no action alternative would not prevent the continued loss of wildlife habitat value over time. Furthermore, this alternative would not remove two landfills created without city, county, state, or federal approval from the floodplain of the New River and would not provide for improvements and/or relocation of existing bridges and utility crossings. The applicant is also very concerned about the difficulty and liability that they would encounter in managing the flowage easements.

2. Other project designs (smaller, larger, different site layout, etc.): The applicant submitted an alternatives analysis to the Corps of Engineers in March of 1989 and revised it in May of 1989. Four alternatives were reviewed. Three of the alternatives involved channelization of the New River and the fourth alternative involved purchase of flowage easements without any channelization.

Two of the channelization alternatives included a wider channel between Northern Avenue and Olive Avenue to accommodate existing wildlife habitat. The cost estimate for each of these two alternatives was at least 3.5 million dollars more than the cost estimates of the third channelization alternative or the no action alternative. Therefore, these two channelization alternatives were not considered practicable.

The third channelization alternative costs 14.3 million dollars while the no action alternative costs 15.0 million dollars. The third channelization alternative is described in the public notice. It is the applicant's preferred alternative and would be the most practicable from an economic standpoint, costing approximately 14.3 million dollars. It also includes the removal of the unauthorized waste dumps from the floodplain of the New River, provides for the improvements and/or relocation of existing bridges and utility crossings, and replacement of wildlife values that would be lost. This alternative would result in the immediate loss of the habitat along this reach of the New River. The proposed mitigation, however, would result in no net loss of wildlife values and would provide greater assurance that the wildlife habitat values would not be lost over time. The proposed mitigation would occur on lands owned by either Arizona Game and Fish Department or Maricopa County Flood Control District so that much greater control could be exercised to protect wildlife values. Consequently, the chosen alternative meets the projects goals of protecting structures and property from the standard project flood, minimizing regulation and/or acquisition of private structures and private property, mitigating for wildlife values, and is within budgetary limits.

3. Other sites: Not applicable.

C. Physical/chemical characteristics and anticipated changes (check applicable blocks):

(XX) substrate: The substrate of the channel would change little as a result of the proposed activity. The existing channel is mixture of alluvially deposited materials. Construction of the channel would require removal of between 5 and 15 feet of material to deepen and widen the channel. The new invert would expose alluvial material that is little different from that exposed in the existing channel.

(XX) currents, circulation or drainage patterns: The proposed activity would enlarge the existing channel and allow all flood events up to the standard project flood to be contained within the proposed channel. All overbank flooding would be eliminated.

(XX) suspended particulates; turbidity: The proposed activity would increase the level of suspended particulates. This reach of the New River is normally dry and surface water flows for only for a few hours to a week or so following a major storm event. Because of recent upstream channelization and diversions, much higher flood flows are expected to enter this reach of the New River at Olive Avenue. Therefore, the proposed work which enlarges and stabilizes the channel banks would reduce the potential for bank erosion and consequently turbidity levels. The Arizona Department of Environmental Quality (June 23, 1989) issued a letter that certifies that the proposed activity would comply with standards if the conditions listed in their letter were complied with. The Corps will include their requested conditions as part of any permit issued.

(XX) water quality (temperature, salinity patterns and other parameters): The proposed activity would not adversely impact water quality. Surface water is present only during flood events and it quickly dries after the flow stops. During most of the year this reach of the New River is dry. The Arizona Department of Environmental Quality (June 23, 1989) issued a letter stating that Arizona water quality standards would be met is their list of conditions were complied with by the applicant. The Corps will include their requested conditions as part of any permit issued.

(XX) flood control functions: The proposed activity would increase the level of flood protection from 100-year to the standard project flood. Nearly completed channelization and diversion work upstream on the New River, Skunk Creek, and the Arizona Canal Diversion Channel will increase the flood waters that flow through this reach of the New River. The upstream work is expected to produce additional overbank flooding because of the delivery of more water over a shorter period of time. The proposed channelization would widen, deepen, and bank stabilize a channel from Olive Avenue to Bethany Home Road so that these increased flows would be contained within the new channel. This would eliminate overbank flooding of adjacent residential areas and farm land.

(XX) storm, wave and erosion buffers: Not applicable.

(XX) erosion and accretion patterns: The proposed channel would reduce erosion and accretion problems by widening and deepening the New River Channel so that it would contain the Standard Project Flood. If no action is taken the increased flood flows that would exit the soil cement stabilized channel at Olive Avenue would necessarily erode a larger channel downstream of Olive Avenue and cause erosion and accretion problems in overbank areas.

(XX) aquifer recharge: This reach of the New River does not function as a major area of aquifer recharge. Surface water flows infrequently in this reach of the New River so there is little opportunity for the bed of the channel to act as a recharge area for any underlying aquifer. Furthermore, the proposed activity would not change the amount of water entering this reach of the New River nor would it change the substrate of the channel bed through which any recharge would necessarily occur.

(XX) baseflow: The proposed activity would not impact the amount of water flow in this reach of the New River.

For projects involving the discharge of dredged material;

(XX) mixing zone, in light of the depth of water at the disposal site; current velocity, direction and variability at the disposal site; degree of turbulence; water column stratification; discharge vessel speed and direction; rate of discharge; dredged material characteristics; number of discharges per unit of time; and any other relevant factors affecting rates and patterns of mixing: All discharges of dredged or fill material would take place when the New River was dry, consequently, there would be no adverse effects related to mixing.

D. Biological characteristics and anticipated changes (check applicable blocks):

(XX) special aquatic sites (wetlands, mudflats, coral reefs, pool and riffle areas, vegetated shallows, sanctuaries and refuges, as defined in 40 CFR 230.40-43): Various drainage facilities discharge urban water runoff and agricultural irrigation water into the New River along both the right and left descending banks. Some of these drainage facilities produce enough flow to result in small temporary ponds forming in the bottom of the New River channel. Vegetation around these ponds is generally sparse. The proposed channel would result in the loss of these small ponding areas.

(XX) habitat for fish and other aquatic organisms: No perennial water exists in this reach of the New River to support fish or other aquatic organisms.

(XX) wildlife habitat (breeding, cover, food, travel, general): The New River channel is sparsely vegetated and has been heavily disturbed by human activities downstream of Northern Avenue. These activities

have resulted in the removal of all but a few scattered trees and shrubs and a scattering of residual plant species. Between Northern Avenue and Olive Avenue the New River channel is well defined with occasional cottonwood and willow trees in the bottom of the sandy channel. The banks are well vegetated with honey mesquite trees and a mixture of shrubs species such as desert brown and acacia. This area is one of the few remaining patches of riparian habitat in the northwest part of the Phoenix metropolitan area. The reach of the New River between Olive Avenue and Northern Avenue has been less disturbed and the trees along the bank are used as roost sites by mourning doves, Gambel's quail, and numerous other birds that utilize the shrubby banks.

The applicant surveyed the existing New River channel and there is approximately 100 acres of habitat that would be lost. Broken-down by dominant plant species the area has 50 acres of grass, 30 acres of Sonoran bush, 20 acres of desert broom, 5.0 acres of grass/burno bush mix, and 0.5 acres of cottonwood grass. To replace vegetation and wildlife values the applicant proposed to plant a 30 acre site with 800 trees equally divided between mesquite, hackberry, and aldarberry trees and plant a ground cover of grasses, forbs, and shrubs. Since the mitigation plan uses smaller areas of higher quality habitat to mitigate our larger areas of lower quality habitat it was felt that additional mitigation was required. Therefore, the additional work to replace and improve an irrigation system used to benefit wildlife at Arizona Game and Fish's Black Butte Wildlife Area is believed to be an appropriate mitigation measure. These two measures are believed to be adequate mitigation to fully mitigate for the wildlife habitat values that would be adversely impacted by the proposed activity.

(XX) endangered or threatened species: The proposed project would not impact any species listed as Endangered or Threatened or their Critical Habitat pursuant to the Endangered Species Act of 1973 (87 Stat. 844). Therefore, formal consultation with the U.S. Fish and Wildlife Service pursuant to Section 7 of this Act is not required.

(XX) biological availability of possible contaminants in dredged or fill material, considering hydrography in relation to known or anticipated sources of contaminants; results of previous testing of material from the vicinity of the project; known significant sources of persistent pesticides from land runoff or percolation; spill records for petroleum products or designated (Section 311 of the CWA) hazardous substances; other public records of significant introduction of contaminants from industries, municipalities or other sources: The Corps is not aware of any possible contaminant that the proposed activity would make more biologically available. The sandy nature of the substrate and the high rates of sediment movement downstream are factors that make it unlikely that the area would act as a sink for contaminants. Investigations of the waste dumps that have been located south of Olive Avenue did not identify the presence of any hazardous waste or volatile organic compounds. The proposed activity would still result in the removal of the waste dumps and the safe disposal of the material in a better location.

E. Human use characteristics and impacts (check applicable blocks):

(XX) existing and potential water supplies; water conservation: The proposed activity would not impact existing or potential water supplies.

(XX) recreational or commercial fisheries: No perennial water exists in this reach of the New River to support a commercial or recreational fishery.

(XX) other water related recreation: No other water related recreation occurs in this reach of the New River. The New River is a normally dry channel with surface water present only for brief periods of time following a storm event.

(XX) aesthetics of the aquatic ecosystem: The aesthetics in this area have been heavily degraded. The channel is currently used for unauthorized dumping and other portions of it have been cleared and disturbed as the result of various activities. The proposed channel would be approximately 400 feet wide with an unvegetated earthen bottom and soil cement banks. Future plans include the incorporation of various recreational activities yet to be determined for the channel banks and overbank right-of-way.

(XX) parks, national and historic monuments, national seashores, wild and scenic rivers, wilderness areas, research sites, etc.: No park, national and historic monument, national seashore, wild and scenic river, wilderness area, research site, or other site with a unique characteristic that has been specially set aside would be impacted by the proposed activity.

(XX) traffic/transportation patterns: Traffic patterns would not be changed, however, the bridges across the New River at Olive and Glendale Avenue would be improved so as to pass the standard project flood safely under them.

(XX) energy consumption or generation: The proposed activity would have very little impact on energy consumption. Construction activities would increase energy consumption, however, the impact would be very minor. The proposed activity would have no impact on energy generation.

(XX) navigation: Not applicable.

(XX) safety: The proposed activity would restrict flood waters to a defined channel and improve the bridges at Olive Avenue and Glendale Avenue such that flood hazards in the New River should be reduced.

(XX) air quality: The proposed activity would have minimal direct and indirect adverse impacts on air quality. The minor adverse impacts would result from construction vehicle and equipment emissions. The

project, once constructed, does not include any point source emissions and would not otherwise degrade air quality in anyway.

(XX) noise: The proposed project would cause minor increases in noise levels during construction. After construction is completed, the proposed project would have little or no impact on noise levels.

(XX) historic properties: Cultural resource data indicate that no historic or archeological sites are located within the area of potential effect for the proposed activity. No property listed in or determined eligible for listing in The National Register of Historic Places would be affected.

(XX) land use classification: The preferred channelization alternative increases the likelihood for development on approximately 1.5 square miles of agricultural land by preventing flow events, up to a standard project flood, from inundating them. Neither Maricopa County Flood Control District nor the Corps of Engineers has any floodplain management authority over these land currently or would under any of the proposed project alternatives. These are mostly agricultural fields above the 100-year floodplain but within the standard project floodplain.

Maricopa County Flood Control District estimates that they would have to acquire 285 acres of flowage easements for 100-year floodplain protection and 217 acres if the preferred channel alternative is constructed. Therefore, the channel alternative would remove 68 acres of land, that is currently within the 100-year flood plain, and allow development on it without any need of floodplain review. The channel alternative would also eliminate all sand and gravel operations or other development activities from within the 217 acre right-of-way. However, if flowage easements were obtained all lands within the flowage easements could be utilized or developed to various degrees as long as the activities or work did not obstruct flood flows.

(XX) economics: The proposed activity would likely increase the value of adjacent property and the economic base in this area. The construction of the proposed channel would also benefit the nearby areas by providing construction jobs.

(XX) prime and unique farmland (7 CFR Part 658): No prime or unique farmland would be impacted by the proposed activity.

(XX) food and fiber production: No food or fiber production facilities and no agricultural lands would incur more than minor direct impacts from the proposed activity. However, the channelization project would remove the agricultural fields from the standard project flood and consequently, they would be much more likely to be developed for residential or commercial purposes.

(XX) general water quality: The proposed activity could not adversely impact general water quality. The Corps will require that the applicants comply with the special conditions in Arizona Department of

Water Quality's letter of June 23, 1989 that certifies compliance with state water quality standards.

(XX) mineral needs: The proposed activity would close one aggregate mining operation and not allow any future operations in the New River between Olive Avenue and Bethany Home Road. This impact is minor since there are numerous other sources of aggregate material available from the surrounding area.

(XX) consideration of private property: The proposed impacts to private property have been minimized with the proposed alignment and design. Landowners have agreed to donate the needed right-of-way in return for having the remaining portions of their property protected by the proposed channel and removed from the floodplain.

(XX) other: No other areas of concern were brought to the Corps of Engineers attention through the public notice process.

F. Summary of secondary and cumulative effects: The secondary effect of greatest importance would be the increased likelihood of agricultural lands currently in the standard project floodplain being taken out of the standard project floodplain and become prime real estate for residential or commercial development. This effect, however, would be in concert with what is happening to the surrounding land. Community plans have recognized that the surrounding area will soon be converted from agricultural to residential or commercial developments with the Outer Loop Freeway having been built just to the east of the project area. It was built to service the northwest corner of the Phoenix metropolitan area.

The cumulative effects of the proposed activity have already been addressed in the final environmental impact statement for the New River and Phoenix City Streams project in Maricopa County, Arizona. No significant adverse impacts were identified as remaining unresolved in the original environmental review.

III Findings:

A. Other authorizations:

1. Water quality certification: The applicant has obtained a certificate of compliance with state water quality standards from the Arizona Department of Environmental Quality on June 23, 1989. The Corps of Engineers will include the special conditions requested by the Arizona Department of Environmental Quality in their to the applicant.

2. Coastal zone management consistency determination: Not applicable.

3. State and/or local authorization (if issued): None are known to be required.

B. A complete application was received on November 3, 1988. A public notice describing the project was issued on December 1, 1988 and sent to all interested parties (mailing list) including appropriate state and

Federal agencies. All comments received on this action have been reviewed and are summarized below.

1. Summary of comments received.

a. Federal agencies:

1) The U.S. Environmental Protection Agency (December 29, 1988) requested denial of the proposed activity. They based their request for denial on the applicant's lack of a sufficient practicable alternatives analysis, the lack of special conditions included to mitigate for the adverse impacts, and lack of an analysis of cumulative impacts.

2) The U.S. Fish and Wildlife Service (December 28, 1988) recommended denial of the proposed activity. They believed that the proposed activity does not comply with the 404(b)(1) Guidelines by not providing mitigation for loss of aquatic and terrestrial habitat or an appropriate review of alternatives.

3) The National Marine Fisheries Service (November 29, 1988) has no objection of issuance of permit for the proposed activity.

4) Other: No other federal agencies responded.

b. State and local agencies:

1) The Arizona Department of Environmental Quality (January 19, 1989) requested additional time to complete their 491(a) certification review process.

2) The State Historic Preservation Office (December 15, 1988) requested that the banks of the New River be surveyed by a qualified archeologist to locate and evaluate any existing cultural remains. They also requested that the completed survey be sent to their office for review and comment.

3) The Arizona Game and Fish Department (December 27, 1988) objected to the lack of an alternatives analysis, a piece-meal approach to permit applications filed by the applicant, and a lack of appropriate mitigation measures. Therefore, they requested that the applicant quantify the habitat losses and submit an adequate mitigation plan to replace the identified losses.

c. Organizations:

1) Del E. Webb Communities (December 6, 1988) did not express support or objection to the proposed activity. They only

requested that they be informed of any impacts the proposed activity may have on Sun City.

2) SRS Greenhouses (December 14, 1988) expressed support for the proposed activity expressing the opinion that the proposed activity would improve the general nature of the area.

d. Individuals: No individual responded to this public notice.

2. Evaluation:

I have reviewed and evaluated, in light of the overall public interest, the documents and factors concerning this permit application as well as the stated views of other interested agencies and the concerned public. In doing so, I have considered the possible consequences of this proposed work in accordance with regulations published in 33 CFR Part 320 to 330 and 40 CFR Part 230. The following paragraphs include our evaluation of comments received and of how the project complies with the above cited regulations.

a. Consideration of comments: Eight parties responded with written comments to the Corps of Engineers in response to the public notice. SRS Greenhouses expressed support for the proposed activity and the National Marine Fisheries Service had no objection to the proposed activity. Meanwhile, a third party, Del E. Webb Communities, Inc., expressed neither support nor objection regarding the proposed activity, however, they requested to be kept informed of progress of the proposed activity.

The Arizona Department of Environmental Quality (January 19, 1989) requested additional information. After additional coordination between the applicant and the Arizona Department of Environmental Quality a letter certifying compliance with state water quality standards was issued to the applicant on June 23, 1989.

The Arizona State Historic Preservation Office (December 15, 1988) requested that the banks of the New River be surveyed by a qualified archeologist for cultural remains. The applicant had Archaeological Research Services, Inc. survey existing records and do an actual on-the-ground survey. This survey done in February of 1989 found no "important cultural resources." In addition, the Corps own review of a cultural resource survey completed for the New River and Phoenix City Streams project found that no National Register listed or eligible properties would be impacted by the proposed activity.

The Arizona Game and Fish Department reviewed the May, 1989 alternatives analysis prepared by the applicant and amended their comments of December 27, 1988 by a second letter dated May 31, 1989. Arizona Game and Fish Department stated that they found the applicant's alternatives analysis and mitigation plan to be adequate. The letter expressed some additional concerns that have subsequently been resolved. Specifically, the applicant has agreed

to changes in the use of certain plant species in the revegetation effort and the applicant will fund \$45,000 to \$52,000 in upgrades for the irrigation system used by Arizona Game and Fish Department to maintain 90 acres of grass and 450 cottonwood and honey mesquite trees at the Black Butte Wildlife Area.

The U.S. Fish and Wildlife Service letters of December 28, 1988 and April 4, 1989 expressed the position that the applicant had not adequately met the requirements of the 404(b)(1) Guidelines and that the change from flowage easements to channelization should be reviewed for environmental compliance through an amendment of the New River and Phoenix City Streams project. The Corps of Engineers completed its environmental review in 1976 for the New River and Phoenix City Streams project. This project delegated to Maricopa County Flood Control District the responsibility to resolve the flood control problems on the New River from Olive Avenue downstream to the Agua Fria River confluence through the use of flowage easements. The Corps of Engineers believes that Maricopa County can propose changes in the measures they employ to meet their obligation of providing at least 100-year floodplain control. However, Maricopa County still must be held responsible for obtaining any other required permits and completing any additional environmental documentation that may be required. They must also demonstrate that the proposed changes would not adversely impact any of the commitments, environmental, recreational, or otherwise that were made by the Corps of Engineers in the 1976 environmental document or made in subsequent environmental documentation. Therefore, the Corps has required Maricopa County Flood Control District to make the effort to complete the Section 404 permit process. Planning and Engineering elements within the Corps of Engineers will evaluate the applicant's proposed changes to insure that the changes will satisfy the obligations assumed by the applicant under the 1976 plan and any change would not adversely impact the environmental, recreational, or other commitment made by the Corps. The U.S. Fish and Wildlife Services' contention that this 404 permit process is improper is not correct, the Corps of Engineers believes that we have followed an appropriate course to comply with all applicable federal laws.

Furthermore, the Corps of Engineers believes that the proposed mitigation would result in a long-term benefit to wildlife resources by relocating those values out of the New River, where they could easily be lost to urbanization or flood damage, to areas that can be specifically managed and protected to preserve wildlife values. The proposed project with mitigation would result in no net loss of waters of the United States and no net loss in wildlife habitat value. Consequently, the Corps of Engineers believes that the intent of the 404(b)(1) Guidelines have been satisfied.

The U.S. Environmental Protection Agency requested denial of the permit based on the 404(b)(1) Guidelines. In the May 1989 alternatives analysis provided by the applicant, and the brief discussion of it in the beginning of this document, the Corps of Engineers believes that the applicant has successfully demonstrated that they have chosen the least damaging practicable alternative.

The applicant has also proposed a detailed mitigation plan to replace lost wildlife and habitat values. Furthermore, the cumulative aspects of the flood control improvements along the New River were addressed much earlier in the 1976 Final Environmental Impact statement prepared for the New River and Phoenix City Streams project. Therefore, the Corps of Engineer believes that we have given full and due consideration to comments from the U.S. Environmental Protection Agency and disagree with their objections and intend to issue a permit for the proposed activity.

b. Evaluation of Compliance with 404(b)(1) guidelines (restrictions on discharge, 40 CFR 230.10). (A check in a block denoted by an asterisk indicates that the project does not comply with the guidelines.)

1) Alternatives test:

| | | |
|-----------------|----------------|---|
| <u>*</u> Yes | <u>X</u> No | a) Based on the discussion in II B, are there available, practicable alternatives having less adverse impact on the aquatic ecosystem and without other significant adverse environmental consequences that do not involve discharges into "waters of the United States" or at other locations within these waters? |
|-----------------|----------------|---|

| | | |
|-----------------|----------------|---|
| <u>X</u> Yes | <u>*</u> No | b) Based on II B, if the project is in a special aquatic site and is not water-dependent, has the applicant clearly demonstrated that there are no practicable alternative sites available? |
|-----------------|----------------|---|

2) Special restrictions. Will the discharge:

| | | |
|-----------------|-------------------|---|
| <u>*</u> Yes | <u>X</u> No | a) violate state water quality standards |
| <u>*</u> Yes | <u>X</u> No | b) violate toxic effluent standards (under Section 307 of the Act) |
| <u>*</u> Yes | <u>X</u> No | c) Jeopardize endangered or threatened species or their critical habitat |
| <u>*</u> Yes | <u>X</u> No | d) violate standards set by the Department of Commerce to protect marine sanctuaries |
| <u>Y</u> Yes | <u> </u> No | e) Evaluation of the information in II C and D above indicates that the proposed discharge material meets testing exclusion criteria for the following reason(s). |

() based on the above information, the material is not a carrier of contaminants

(XX) the levels of contamination are substantially similar at the extraction and disposal sites and the discharge is not likely to result in degradation of the disposal site and pollutants will not be transported to less contaminated areas

() acceptable constraints are available and will be implemented to reduce contamination to acceptable levels within the disposal site and prevent contaminants from being transported beyond the boundaries of the disposal site

3) Other restrictions. Will the discharge contribute to significant degradation of "waters of the U.S." through adverse impacts to:

 # X
Yes No

a) human health or welfare, through pollution of municipal water supplies, fish, shellfish, wildlife and special aquatic sites?

 * X
Yes No

b) life states of aquatic life and other wildlife

 # X
Yes No

c) diversity, productivity and stability of the aquatic ecosystem, such as the loss of fish or wildlife habitat, or loss of the capacity of wetland to assimilate nutrients, purify water or reduce wave energy?

 * X
Yes No

d) recreational, aesthetic and economic values?

 X
Yes No

4) Actions to minimize potential adverse impacts (mitigation). Will all appropriate and practicable steps (40 CFR 23.70-77) be taken to minimize the potential adverse impacts of the discharge on the aquatic ecosystem?

(Proposed Special Conditions)

a. That the permittee shall comply with all requirements and conditions in the letter of state water quality certification that the Arizona Department of Environmental Quality sent to the permittee on June 26, 1989. A copy of this letter is attached to this permit.

b. That the permittee shall coordinate with the Corps of Engineers to make certain that any of the commitments, environmental, recreational, or otherwise (e.g. open space) made by the Corps of Engineers in the environmental documentation for the New River and Phoenix City Streams project would not be adversely impacted. If any of the Corps of Engineers commitments are adversely impacted the

permittee would be required to provide appropriate compensation.

c. That the permittee shall provide funding for repair and replacement of the irrigation system at Robbins Butte Wildlife Area managed by Arizona and Fish Department. Costs of this work is estimated at approximately \$45,000 dollars with the permittee obligated to provide at least \$45,000 but not more than \$52,000 for the repair and replacement work.

d. That the permittee shall develop a 32 acre mitigation site at the confluence of the Agua Fria River and Gila River according to the mitigation plan in Appendix II of the Alternative Investigation for the New River Flood Control Project prepared for the permittee in May of 1989.

c. General Evaluation (33 CFR 320.4(a)):

1) The relative extent of the public and private need for the proposed work...A flood control management plan was required in the reach of New River from Olive Avenue to Bethany Home Road by the New River and Phoenix City Streams project. The Corps of Engineers review of alternatives culminated in 1976 with a Final Environmental Impact Statement for New River & Phoenix City Streams. Flood control protection on this reach of the New River was delegated to Maricopa County Flood Control District. In 1976 flowage easements on the New River from Olive Avenue to the Agua Fria River confluence was the method agreed upon to provide for the necessary flood control protection. Since the original decisions 13 years ago Maricopa County Flood Control has had a chance to reevaluate their position in light of current conditions and found that a channelization alternative would be a much more effective way of meeting their flood control responsibilities. Consequently, they applied for a Section 404 permit for the proposed channelization because it was an activity that would discharge dredged or fill material and it was not reviewed for environmental compliance under the environmental review process completed by the Corps of Engineers in 1976. The Corps of Engineers believes that the project as proposed would not result in a net loss of waters of the United State, rather there would be a gain due to a much wider channel, and that wildlife and vegetation values would be adequately mitigated for by the proposed off-site mitigation measures.

2) The practicability of using reasonable alternative locations and methods to accomplish the objective of the proposed structure of work...Available channelization alternatives examined would cost much more, approximately 3.5 million dollars, and would, therefore, not be practicable. The non-structural alternative of flowage easements would also cost

more and would not provide the desired level of flood control protection and would not insure the continued existence of vegetation and wildlife values without further degradation. Furthermore, the non-structural alternative would not prohibit many activities that could further degrade the value of this area for wildlife. The flowage easements would be managed solely for flood control and as long as an activity did not interfere with flood flows it would not be subject to other restrictions. Therefore, activities such as vegetation clearing would be permitted.

3) The extent and permanence of the beneficial and/or detrimental effects that the proposed structures or work may have on the public and private uses to which the area is suited...The changes in this reach of the New River would be permanent. The project would provide flood protection and a stabilized channel for flood events as large as the standard project flood. The loss of the degraded wildlife habitat along the New River from Olive Avenue to Bethany Home Road would be permanent. Plant and wildlife values lost would be mitigated for off-site. The proposed activity would also increase the likelihood of approximately 1.5 square miles of agricultural land being developed for residential or commercial uses by being removed from the standard project floodplain.

3. Determinations:

a. Finding of No Significant Impact (FONSI) (33 CFR Part 325). Having reviewed the information provided by the applicant, all interested parties and our assessment of environmental impacts contained in part II B of this document, I find that this permit action will not have a significant impact on the quality of the human environment. Therefore, an Environmental Impact Statement will not be required.

b. 404(b)(1) Compliance/Non-compliance Review (40 CFR 230.12).

() The discharge complies with the guidelines.

(XX) The discharge complies with the guidelines, with the inclusion of the appropriate and practicable conditions listed in III.B.2.b.4 to minimize pollution or adverse effects to the affected ecosystem.

() The discharge fails to comply with the requirements of these guidelines because:

() There is a practicable alternative to the proposed discharge that would have less adverse effect on the aquatic ecosystem and that alternative does not have other significant adverse environmental consequences.

() The proposed discharge will result in significant degradation of the aquatic ecosystem under 40 CFR 230.10(b) or (c).

() The discharge does not include all appropriate and practicable measures to minimize potential harm to the aquatic ecosystem, namely...

() There is not sufficient information to make a reasonable judgment as to whether the proposed discharge will comply with the guidelines.

c. Public interest determination: I find that issuance of a Department of the Army permit (with special conditions), as prescribed by regulations published in 33 CFR Parts 320 to 330, and 40 CFR Part 230, is not contrary to the public interest.