

**SELECTED ALTERNATIVE REPORT
BULLARD WASH OUTFALL CHANNEL
IMPROVEMENTS**

FCD #95-39

WOOD/PATEL

**SELECTED ALTERNATIVE REPORT
BULLARD WASH OUTFALL CHANNEL
IMPROVEMENTS**

FCD #95-39

Prepared for:

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and

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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FLOOD CONTROL DISTRICT RECEIVED		
MAY 07 1998		
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ADMIN		LMGT
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C & M		
ENGR		
REMARKS		



April 16, 1998
WP #96464

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1.0 INTRODUCTION

The Flood Control District of Maricopa County (District) has contracted (FCD #95-39) with Sverdrup Civil, Inc. (Sverdrup) to complete final design plans and construction documents for the channelization of Bullard Wash between the Gila River and Lower Buckeye Road. Wood, Patel & Associates, Inc., as a sub-consultant, has been assisting Sverdrup on several tasks, more specifically hydraulics, sediment transport, and scour analysis for the proposed design.

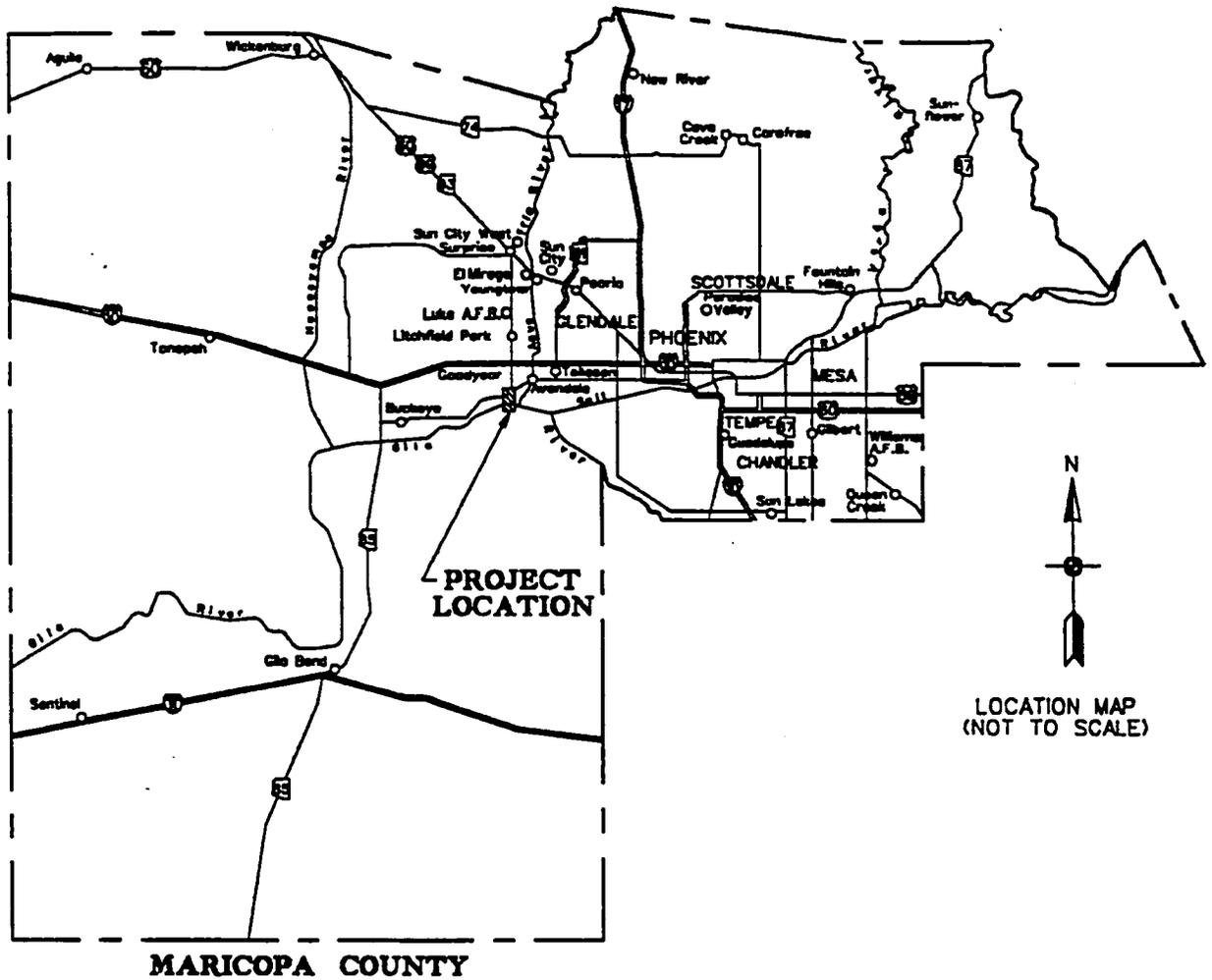
The flooding potential of the area has been previously studied in the *White Tanks/Agua Fria Area Drainage Master Study (ADMS)* prepared by the WLB Group and submitted to the District in October, 1992. In addition, the *Bullard Wash Outfall Feasibility Study, Final Design Concept Report for Recommended Alternative* was prepared for the District by Stanley Consultants, Inc. (Stanley) and submitted in September 1995. That Report documented a recommended alternative for the Bullard Wash Outfall Channel. Subsequent to the Stanley Report, the District has selected a horizontal alignment of the channel and type of channel lining, including typical cross-sections, with input from the City of Goodyear, Maricopa County Department of Transportation (MCDOT), and Sverdrup. This Report will document the selected alternative.

Bullard Wash is approximately eight miles long, and originates just south of Luke Air Force Base near Bethany Home Road. The wash continues south between Estrella Parkway (formerly Reems Road) and Bullard Avenue. The outfall of Bullard Wash has been encroached upon, and in some locations almost completely obliterated due to farming activities over the years. The Bullard Wash Channel ends near the Maricopa County Highway Route 85 (MC 85) - Estrella Parkway intersection, with only a minor roadside ditch and 42" cmp outfall pipe to convey low flows to the Gila River. Due to various encroachments and the elimination of a positive outfall, the area is subject to substantial flooding, as documented in the White Tanks/Agua Fria ADMS.

The project area lies entirely within the incorporated limits of the City of Goodyear between Sarival Road on the west, Bullard Avenue on the east, Yuma Road on the north, and the Gila River on the south. The Bullard Wash Floodplain upstream from Yuma Road is relatively free from encroachment, diversions, and obstruction and was, therefore, not included in this project.

There are major transportation facilities located within the study area involving the jurisdictions of MCDOT (MC 85), the City of Phoenix (Phoenix - Goodyear Municipal Airport), the Union Pacific Railroad (UPRR, formerly Southern Pacific Railroad), as well as the local roadways within the City of Goodyear right-of-way. The study area also includes jurisdictions of the Buckeye Irrigation District (BID) and the Roosevelt Irrigation District (RID). There are also numerous major utilities within the study area. Figures 1 and 2 indicate the location and vicinity of this project.

BULLARD WASH OUTFALL FEASIBILITY STUDY FLOOD CONTROL DISTRICT OF MARICOPA COUNTY (FCD 94-06)



MARICOPA COUNTY
LOCATION MAP

FIGURE 1

BULLARD WASH OUTFALL FEASIBILITY STUDY FLOOD CONTROL DISTRICT OF MARICOPA COUNTY (FCD 94-06)

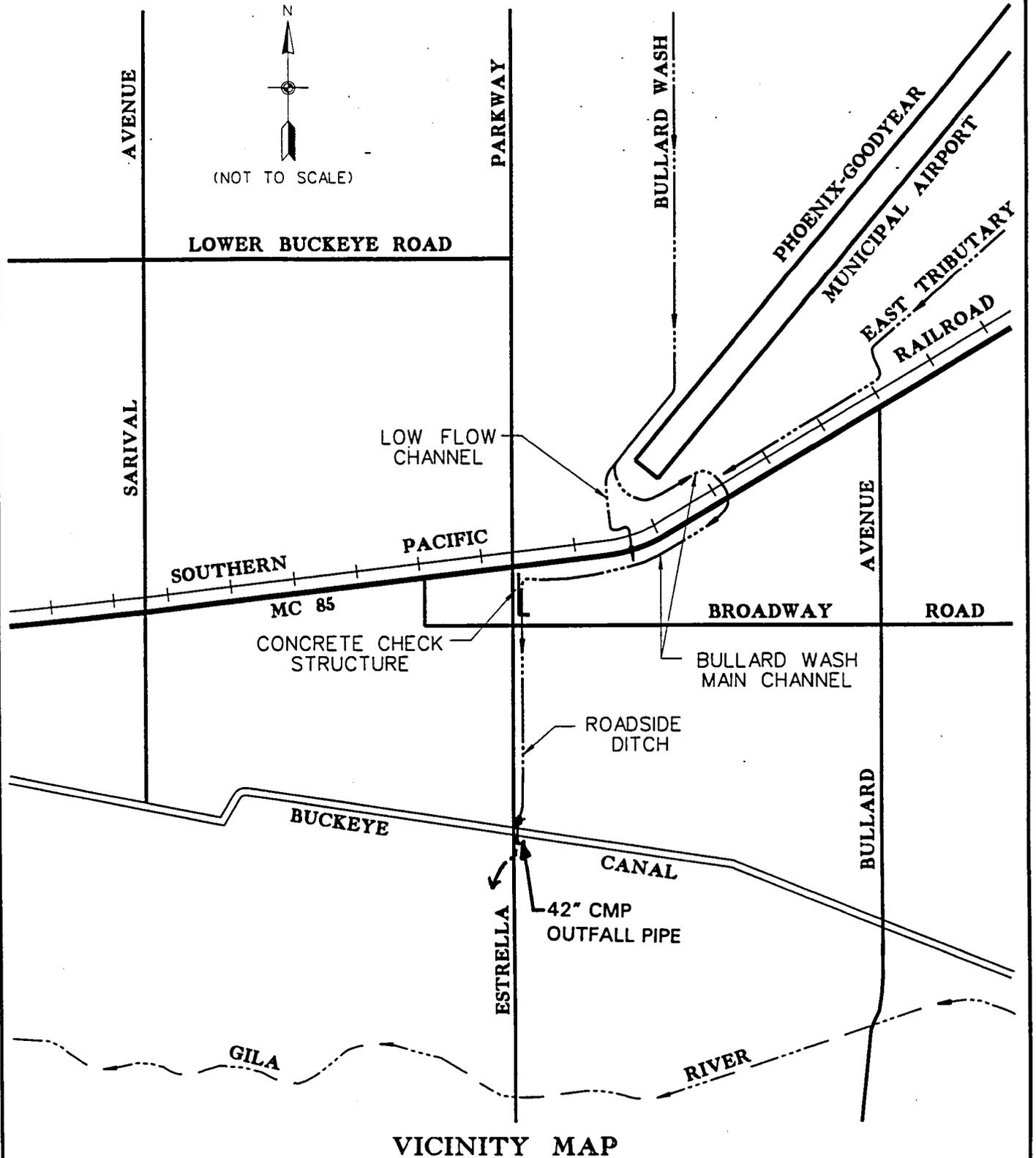


FIGURE 2

2.0 PURPOSE AND SCOPE

During the initial design phase of this project, Sverdrup, together with the District, the City of Goodyear, and MCDOT, agreed upon a revised channelization concept. The concept addressed the City's requirements on the aesthetics, recreational, and equestrian needs, as well as maintenance issues. As a result, a workable channel cross-section, style of bank protection, and drop structure scheme have been mutually agreed upon for this channelization project.

The purpose of this Report is to document the selected alternative, including key channel features such as typical bank protection and type of drops used. In addition, it documents design constraints such as highway, railroad, canal, irrigation, and utility conflicts as well as environmental constraints, floodplain issues, and recreational facilities. This Report is intended to be a brief document which will not include detailed design calculations, detailed hydraulic analysis, or cost estimates.

3.2 Recommended Alternative (Stanley, September 1995)

The following is a summary of the recommended alternative as presented in the *Bullard Wash Outfall Feasibility Study, Final Design Concept Report for Recommended Alternative*. Refer to Figure 3 for an illustration of the recommended alternative.

Segment 1

Segment 1, from Lower Buckeye Road to the end of the Phoenix-Goodyear Airport runway, was recommended to be a composite cross-section with an earth bottom and concrete banks. The channel bottom width varied from 85 feet to 55 feet, and the longitudinal slope was 0.0017 ft/ft. At the upstream end of the project, the banks were to be feathered out to match the existing ground.

A drop structure was required at the upstream end of the project where the natural ground transitions into the incised channel. The drop structure served as a hard point to prevent upstream headcutting of the channel and to dissipate energy as the flow in Bullard Wash falls as it enters the channel. It also provided upstream property owners the opportunity to extend the channelization in the future.

The hard bank toedown depth for Segment 1 was calculated as six feet for the majority of this segment. However, due to channel curvature and lateral inflows, the toedown may increase up to 12 feet in isolated locations.

Another consideration in the design of the channel in Segment 1 was the conveyance of irrigation tailwater flows from upstream and adjacent fields. Presently, these flows are carried by a small ditch. It was therefore recommended that tailwater flows be carried by a typical concrete lined low flow ditch within the Bullard Wash Channel at the toe of the west bank. This low flow channel was to be sized to carry the same quantity of flow as the existing irrigation ditches. The tailwater flows were to be carried into Segment 2 and ultimately diverted out of the channel, as discussed in the following section. Maintenance access into the channel in Segment 1 would need to be provided by down-ramps.

**BULLARD WASH OUTFALL
FEASIBILITY STUDY**
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
(FDC 94-06)



- NOTES**
- CHANNEL ALIGNMENTS ARE ILLUSTRATIVE AND DO NOT REPRESENT ACTUAL WIDTH.
 - DESIGN DISCHARGES ARE BASED ON WHITE TANKS/AGUA FRIA ADMS REC-1 MODEL BY THE WLS GROUP REVISED BY STANLEY CONSULTANTS TO REFLECT FUTURE DRYART DRAIN AND WHITE TANKS FLOOD CONTROL PROJECTS.

- LEGEND**
- RECOMMENDED CHANNEL ALIGNMENT LOCATION
 - ▭ CULVERT OR BRIDGE
 - 850 cfs DESIGN DISCHARGE AND FLOW DIRECTION
 - SEGMENT LIMITS
 - OVERHEAD ELECTRIC (WITH SELECTED POLES/TOWERS)
 - FIBER OPTIC CABLE (U.S. SPRINT)
 - UTILITY UTILITY OWNER
 - CORPS 404 WATERS OF THE U.S. JURISDICTIONAL LIMIT
 - BULLARD WASH OR LOCALIZED FLOODPLAIN LIMIT
 - BULLARD WASH FLOODWAY LIMIT

N

SCALE 1" = 400'
CONTOUR INTERVAL - 2'

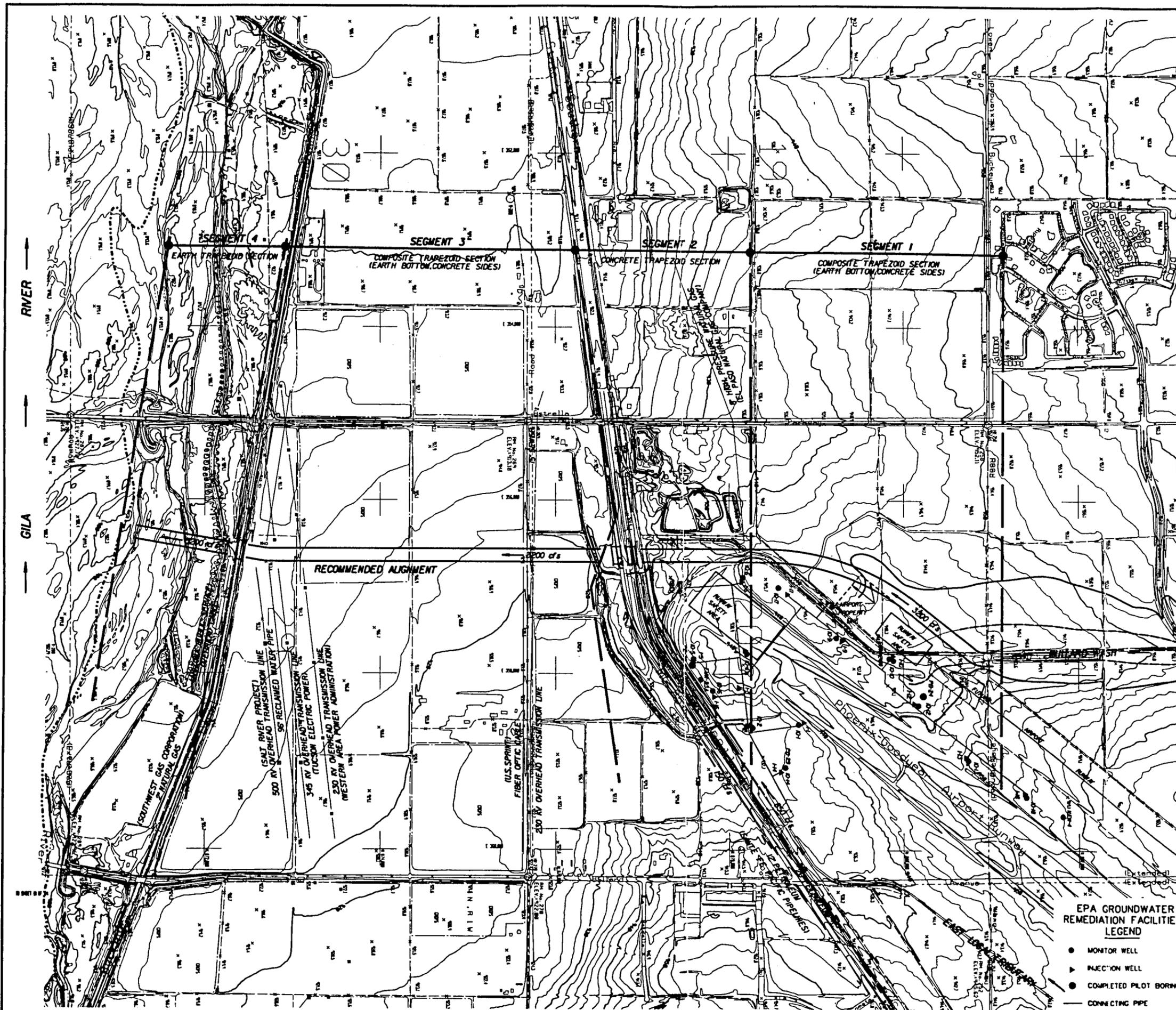
BASE MAP: WHITE TANKS/AGUA FRIA ADMS
FCD 89-70

MAPPING COMPANY: COOPER AERIAL OF PHOENIX INC. FLIGHT DATE 12-22-89

BULLARD WASH OUTFALL
FEASIBILITY STUDY
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
FCD 94-06

**FIGURE 3
RECOMMENDED
ALTERNATIVE
PLAN VIEW**

DES. S.W. CHD. G.S.A.	DATE 8-26-88
DRG. P.J.P. APP.	SHEET 1 OF 2
FOR EAST COULDER ROAD, DATE 03	DRWG.
PHOENIX, ARIZONA 85004 • 602 944-2600	PROJ. NO. 92778



- EPA GROUNDWATER
REMEDATION FACILITIES
LEGEND**
- MONITOR WELL
 - ▲ INJECTION WELL
 - COMPLETED PILOT BORING
 - CONNECTING PIPE

Segment 2

Segment 2 is mainly characterized by a steep natural ground gradient just north of the UPRR tracks. In order to maintain a sub-critical flow regime in the channel, drop structures were proposed within this reach. Between the drop structures, the channel was proposed to have a slope of 0.0017 ft/ft, a bottom width of 55 feet (widening to 65 feet just north of the UPRR tracks), and concrete lining.

The three drop structure option was recommended for Segment 2 of Bullard Wash. These concrete drop structures were proposed to be the "sloping drop" type of structure, with concrete stilling basins to induce a hydraulic jump and minimize scour. Although flow was sub-critical between the drop structures, full concrete lining was recommended for this entire reach to prevent scour and undermining of the drop structures.

A low flow diversion structure would be required for irrigation tailwater. It was to consist of a vertical dam within the low flow channel, with a 36-inch pipeline inlet into which the low flows would enter. The 36-inch pipeline carries the irrigation tailwater flow to a proposed open ditch just west of the Bullard Wash Channel and ultimately south across the UPRR and MC 85 to outfall into an existing tailwater ditch.

Just north of the UPRR tracks, a collector channel with a capacity of 850 cfs was to enter the Bullard Wash Channel from the East Local Tributary. This proposed channel was concrete lined and carried runoff from the Phoenix-Goodyear Airport, as well as from land east of the airport and north of the railroad tracks. The channel extended approximately 2400 feet from the main channel to the existing Bullard Wash crossing of the UPRR tracks.

The east bank of the proposed Bullard Wash Channel was notched to accommodate the collector channel inflow. The collector channel flow line at the notch was approximately three feet above the main channel flow line, providing a small drop for the lateral inflows. Another drop structure was proposed at the upstream end of the lateral channel where overland flows transition into the incised channel. This drop was six feet in height and was a sloping drop similar to the others along the main channel. Upstream of the proposed drop structure, the channel bottom was unlined and feathered to match natural ground approximately 200 feet upstream of the drop. Tailwater

flows would continue to be discharged south at the upstream end of the existing UPRR bridge over Bullard Wash for use by downstream farmers.

Guide dikes or berms were proposed to direct overland flows upstream of this drop structure into the collector channel. These guide dikes extended from the top of the drop structure for a distance of approximately 200 feet and were approximately three feet in height. The recommended alignment of the north dike was a curved, quarter-ellipse shape per Arizona Department of Transportation spur dike standards. The recommended alignment of the south dike was parallel to the UPRR tracks. The upstream end of the dike tied into the railroad embankment to ensure that all flow along the embankment were directed into the channel.

A 6-barrel 10' x 6' box culvert was recommended to provide a 100-year crossing of the UPRR, with approximately 3.5 feet of freeboard to the top of the proposed channel lining.

A box culvert was recommended for the MC 85 crossing of Bullard Wash. The proposed box culvert was a 6-barrel 10' x 6' box culvert, which allowed approximately one foot of freeboard at the roadway and matches the 65-foot upstream channel bottom width. The 6-foot high box was selected because it produced no impact to the existing MC 85 roadway profile.

Due to the use of drop structures, maintenance access into the channels in Segment 2 was to be provided by down-ramps from the adjoining maintenance roads. Access was to be provided to the proposed irrigation low flow channel and adjacent airport property.

Segment 3

The profile of Segment 3 of the Bullard Wash Outfall Channel was largely determined by utility constraints. Specifically, two underground pipe utilities cross the channel alignment within Segment 3. One is the City of Goodyear 15-inch diameter sewer line, and the other a 96-inch diameter reclaimed water pipeline operated by Arizona Public Service (APS) for the Palo Verde Nuclear Power Generating Station. The presence of these pipelines sets a minimum elevation for the channel flow line at both locations. A cover depth of 1.5 feet was allowed over the top of pipe in both cases. The 96-inch water line is

approximately 250 feet north of the BID Canal, and the 15-inch line is located in the Broadway Road alignment.

In addition to these constraints, the box culvert at MC 85 imposed a maximum channel flow line elevation, since a major goal in setting the channel profile was to minimize the impact to the MC 85 roadway. The UPRR crossing, on the other hand, did not impose a restriction on the channel profile, as the railroad track elevation is 3.5 feet higher than the MC 85 pavement elevation. As a result of these constraints, the channel longitudinal slope was proposed to be 0.0017 ft/ft.

A composite channel lining was recommended, consisting of an 85-foot width earth bottom with 2:1 concrete sides. The depth of the channel ranges from 5 to 6 feet. Additional protection was necessary just upstream of the BID canal where overland flows from the east will enter the channel. A minimum hard bank toedown depth of six feet was recommended for Segment 3 based on examination of low flow channel incisement and bed form scour.

Just north of the BID canal local inflow from the east will need to enter the channel. Placement of fill along the east bank at this location was recommended to provide additional freeboard as long as a notch was provided to allow lateral flows to enter the channel. Continuous fill along the west bank to provide one foot of freeboard within this reach of the channel was recommended.

At the BID Canal, a slab bridge was recommended because the lack of piers allows canal flows to pass underneath with less risk of debris clogging. This option may be the more costly, but was chosen due to its increased hydraulic performance. As a measure to reduce the cost of the canal crossing, it was attempted to minimize the width of the bridge slab crossing structure to 65 feet. A concrete transition was to begin upstream of the Palo Verde pipeline, also providing scour protection for the pipeline.

Immediately downstream of the BID canal crossing, a 3-foot vertical drop structure was proposed both as a hard point to prevent headcutting into the BID canal and to lower the channel flow line as the channel daylighted in the Gila River floodplain. An 8-foot cutoff wall depth was recommended at the downstream end of this drop structure based on scour depth.

Segment 4

Segment 4 consisted of a mostly incised channel from the BID canal to the point where the channel daylighted in the Gila River. As the channel passed through low points in the natural ground along its alignment, some fill was necessary to build up the channel banks to the 100-year Bullard Wash Channel water surface elevation.

Downstream near the Gila River, the 10-year water surface elevation of the Gila River exceeds the banks of the incised channel, meaning that some reconstruction of these fill embankments may be necessary following flow events in the Gila River.

Segment 4 of the proposed channel system will be susceptible to scour/deposition from the Gila River. This segment will require annual maintenance to limit the growth of vegetation (salt cedar), and may require significant debris clearance following major flows in the Gila River. Periodic monitoring and maintenance of the channel, including clearing out any such growth, is necessary to ensure that it performs as designed. Due to the relatively high potential of flood damage, capital expenses were minimized in the concept design of Segment 4.

The recommended alternative for Segment 4 involved a composite section in the north approximately one half of the segment, and an earth section in the south approximately one half of the segment. The composite section was to use wire enclosed rock or "gabion mattress" lining on the channel sides at a 4:1 slope, and a 65-foot earthen bottom. This lining would stabilize the Segment 4 channel and prevent lateral migration. The gabion mattress lining is more flexible than concrete lining, and better able to withstand potential overflows from the Gila River without significant damage. The channel longitudinal slope was to be 0.0017 ft/ft.

Near the south end of the channel, existing ground elevations in the Gila River drop significantly, and the Gila River low flow channels are encountered. If lining was extended into this area, it would be subject to greater failure risk. Therefore, no lining was recommended and the channel would be earth sides and bottom, with essentially the same cross section and slope as the composite channel.

Summary of Stanley's Recommended Alternative

The following is a summary of the recommended designs for each segment:

Segment 1:

lining: composite (earth bottom, concrete sides)
bottom width: 55 to 85 feet
sideslopes: 2:1
longitudinal slope: 0.0017 ft/ft
drop structures: 1 sloping drop, 7.9 feet high
reach length: 3200 feet
approx R.O.W. width: 150 feet

Segment 2:

lining: concrete sides and bottom
bottom width: 55 to 65 feet
sideslopes: 2:1
longitudinal slope: 0.0017 ft/ft
drop structures: 3 sloping drops, 5.2 feet high each
SPRR crossing: 6-barrel 10' x 6' concrete box culvert
MC 85 crossing: 6-barrel 10' x 6' concrete box culvert
reach length: 1800 feet
approx. R.O.W. width: 130 feet

East Local Tributary Collector Channel:

lining: concrete sides and bottom
bottom width: 8 feet
sideslopes: 2:1
longitudinal slope: 0.0028 ft/ft
drop structures: 2 sloping drops; 1-6 foot high @ upstream end, 1-3 foot high @ downstream end (main channel)
reach length: 2400 feet
approx R.O.W. width: 70 feet

Segment 3:

lining: composite (earth bottom, concrete sides)
bottom width: 85 feet, narrowing to 65 feet north of BID canal
sideslopes: 2:1
longitudinal slopes: 0.0017 ft/ft

drop structures: 1 vertical drop, 3 feet high south of BID canal
BID canal crossing: Clear span slab bridge
reach length: 4200 feet
approx R.O.W. width: 150 feet

Segment 4:

lining: upstream \pm 500 feet-composite (earth bottom, gabion mattress sides)
downstream \pm 600 feet-earth (no lining)
bottom width: 65 feet
sideslopes: 4:1
longitudinal slope 0.0017 ft/ft
drop structures: none
reach length: 1100 feet
approx R.O.W. width: 150 feet

4.0 AGENCY'S INITIAL DESIGN FEEDBACK

The initial design phase of this project included extensive coordination between the District, MCDOT, the City of Goodyear, and Sverdrup. The purpose of this coordination was to obtain feedback pertaining to the needs of the entities, which included input regarding aesthetic, recreational, access, maintenance, and safety aspects of the project. As a result, the following channel linings were agreed upon.

The above-mentioned agencies reviewed the recommended alternative by Stanley and made recommendations on how the project could better serve their interests. Several meetings have been held with the City of Goodyear to agree upon the design criteria and features that were to be imposed on the project. These meetings include: City Staff Meeting (November 10, 1997); Public Meeting (December 4, 1997); City Council Meeting (December 9, 1997); City Staff Meeting (January 20, 1998); and the City Staff Meeting to review 30% plans (February 26, 1998). The Minutes of these meetings that are available are included in the Appendix. This information was then utilized to select a design alternative as described in Section 5.0.

Segment 1

- Slope-blanket or stepped gabions will be used in the 200-foot long inlet area to the north of Lower Buckeye Road. Work in this area will be considered temporary until the future channel section is designed and constructed (by others).
- Slope-blanket gabions with a natural bottom are to be used from the north end of the channel at Lower Buckeye Road to the drop structure upstream of the UPRR. The bank protection on the east side of the channel will be sloped at a 2:1, and vary between 2:1 and 3:1 on the west side.

Segment 2

- Full-section concrete lined channel is to be used from the grade control structures north of the UPRR, through the UPRR bridge, and the MC 85 bridge. The channel sideslopes will be 1:1 through the UPRR bridge and the MC 85 bridge. Colored concrete and form liners will be used to improve the aesthetics at the channel section, and planters will be used to enhance the grouted riprap channel section.
- The railroad will construct a new bridge under traffic in lieu of a box culvert which would require a shoo-fly detour.

- A flat slab bridge was specifically required by MCDOT at the MC 85 crossing over a box culvert to provide better hydraulic characteristics and a more open environment for recreational use of the channel.

Segment 3

- Stepped, rock filled gabions (1:1 or 1.5:1 sideslopes) with natural stream bed is to be used from just south of MC 85 to the APS reclaimed water 96-inch pipeline.
- Full-section concrete lining from north of the APS 96-inch reclaimed water pipeline across the BID Canal and BID maintenance road box culvert. The bank sideslopes will transition from vertical walls at the overchute to 1:1 or 1.5:1 sideslopes just north of the structure. The full-section lining with 1:1 or 1.5:1 sideslopes would continue north and match the top of the proposed APS pipeline encasement.

Segment 4

- Exposed stepped gabions (1:1 sideslope) with a natural stream bed will be allowed in the segment from the BID Canal maintenance road for the 500' south.

In the initial phase, the City of Goodyear requested several aesthetic and recreational elements, including the desire for pedestrian, bicycle, equestrian paths within and adjacent to the channel, and maintenance ramps. The City required that these elements be designed to meet the American Disabilities Act. It was recommended by the agencies that the pedestrian and bicycle path could be a meandering path predominantly on top of the channel banks. Periodic wide spots could provide rest areas or shade trees. An equestrian path is desired in the bottom of the channel. The access ramps should be placed where cyclists, equestrians, and pedestrians would all derive benefit. These ramps should have a maximum of an 8 percent slope with periodic level landings to provide rest areas. The recreational use of the channel would begin at the Gila River (the south end of the project) and extend north along the entire length of the channel. Due to a 9-foot clearance under the UPRR bridge, it was recommended that a 1-foot shallow depression in the channel bottom be constructed, allowing a 10-foot clearance for an equestrian path under the bridge. For aesthetic reasons, gabion type bank protection was preferred over concrete bank protection where possible. For concrete sections, it is desirable that "form liner" style

concrete (with a pattern) is used in locations where vertical concrete banks are required. In addition, it is requested that the concrete lining be textured and colored to match the predominant soil type. Hand rails will be placed along the channel bank as directed by the City of Goodyear.

The City of Goodyear will maintain the channel after construction is completed.

It is recommended that farm access be provided at Broadway Road in the form of a "dip" crossing with a hardened ford to prevent roadway undermining. When the area is later developed, the dip crossing can be removed and a bridge or box culvert constructed.

5.0 SELECTED ALTERNATIVE

The previously discussed information in Section 4.0 was utilized in the selection of the horizontal and vertical alignment of the channels, as well as the cross-section characteristics. The design criteria and constraints discussed in Section 3.0 (Stanley) were generally utilized for the selected alternative. The major selected design elements are listed in the following subsections. Refer to Figure 4 for the selected alternative alignment. See the plan, profile, and cross sections in the Appendix for more detail.

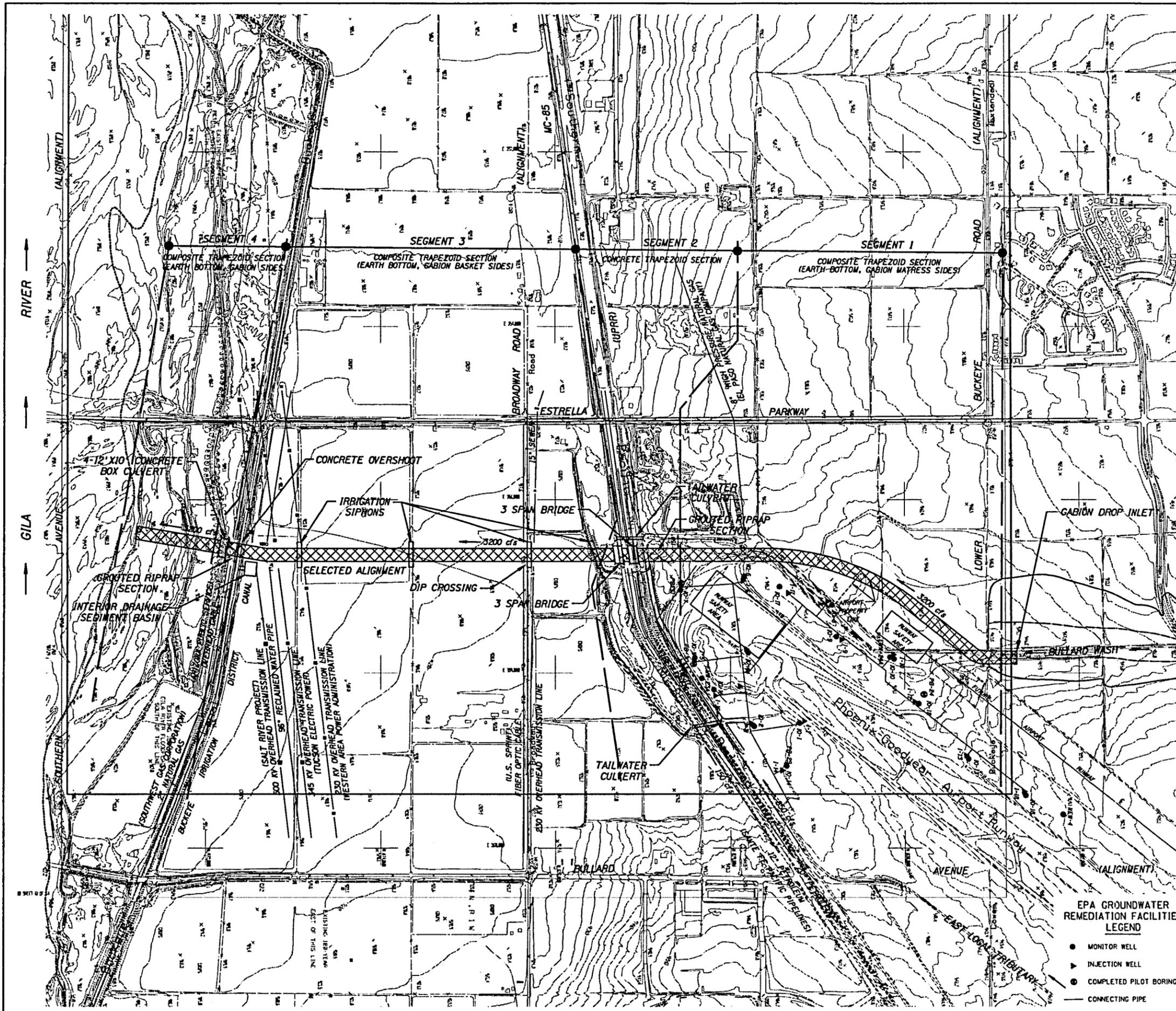
5.1 Channel Design

Segment 1

The Bullard Wash Collection System will begin approximately 1300 feet north of the Lower Buckeye Road Alignment. The vegetation and berms associated with abandoned tailwater ponds are to be cleared to allow the wide floodplain to migrate toward the Channel. Preliminary estimates indicate the channel should begin approximately 250 feet north of Lower Buckeye Road to intercept and collect the flow. This distance may be adjusted based on final hydraulic analysis. The channel is to be a trapezoidal section with a bottom width of 80 feet and 1:1 sideslopes. The overall channel depth is approximately 9 feet, and is contained within a 150-foot right-of-way. Gabion baskets will be used to line the sides, and the bottom will be gabion mattresses. The longitudinal slope will be 0.0012 ft/ft. Refer to the plan and profile and Section H-H in the Appendix.

Lower Buckeye Road located west of the channel will be raised to function as a guide berm to assist in directing flood waters into the proposed channel inlet.

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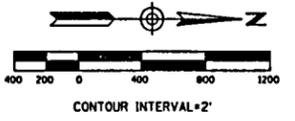
BULLARD WASH OUTFALL CHANNEL IMPROVEMENTS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD #95-39



- NOTES:**
- CHANNEL ALIGNMENTS ARE ILLUSTRATIVE AND DO NOT REPRESENT ACTUAL WIDTH.
 - DESIGN DISCHARGES ARE BASED ON WHITE TANKS/AGUA FRIA ADMS HEC-1 MODEL BY THE WLB GROUP REVISED BY STANLEY CONSULTANTS TO REFLECT FUTURE DYSART DRAIN AND WHITE TANKS FLOOD CONTROL PROJECTS.

- LEGEND**
- SELECTED CHANNEL ALIGNMENT LOCATION
 - CULVERT OR BRIDGE
 - DESIGN DISCHARGE AND FLOW DIRECTION
 - SEGMENT LIMITS
 - OVERHEAD ELECTRIC (WITH SELECTED POLES/TOWERS)
 - FIBER OPTIC CABLE (U.S. SPRINT)
 - UTILITY
 - UTILITY OWNER
 - CORPS OF ENGINEERS WATERS OF THE U.S. JURISDICTIONAL LIMIT
 - BULLARD WASH OR LOCALIZED FLOODPLAIN LIMIT
 - BULLARD WASH FLOODWAY LIMIT



BASE MAP: WHITE TANKS/AGUA FRIA ADMS AND BULLARD WASH OUTFALL FEASIBILITY STUDY
MAPPING COMPANY: COOPER AERIAL OF PHOENIX INC. FLIGHT DATE 12-22-89

FIGURE 4
SELECTED ALTERNATIVE
PLAN VIEW

EPA GROUNDWATER REMEDIATION FACILITIES LEGEND

- MONITOR WELL
- INJECTION WELL
- COMPLETED PILOT BORING
- CONNECTING PIPE

DES. J.M. CHD. A.C.P.
DRAWN T.Y. APP.
DATE 6-26-95
SHEET 1 OF 1
DWG.
PROJ. NO. 95464

WOOD, PATEL & ASSOCIATES, INC.
1550 EAST MISSOURI, SUITE 203
PHOENIX, ARIZONA 85021 234-1344

From the Lower Buckeye Road Alignment south to approximately 600 feet upstream of the Union Pacific Railroad, a composite section is proposed. This section is to be a composite trapezoid, with a concrete low flow channel for irrigation tailwater and nuisance water on the east side. The bottom width is 80 feet, including the concrete nuisance water channel. The remainder of the channel bottom is to be earthen. The east bank is to be lined with gabion blankets sloped at 2:1. The west bank is also to be lined with gabion blankets, however, they will be at a variable 2:1 to 3:1 slope. Discussion was held with the City of Goodyear regarding the placement of a 12" soil layer over the gabion materials. The City decided that it was not desirable. The longitudinal slope of the channel is to be 0.0012 ft/ft. The overall channel depth averages approximately 9 feet, including 2 feet of freeboard. The entire channel can be contained within the 175-foot right-of-way. Refer to the plan and profile and Sections E-E and F-F in the Appendix.

Segment 2

Approximately 600 feet upstream of the Union Pacific Railroad, the full grouted riprap lined trapezoidal section begins. This section has a bottom width of 80 feet with 1:1 sideslopes. From approximately 600 feet upstream of the railroad to 175 feet upstream of the railroad, the longitudinal slope of the channel will be 0.0430 ft/ft to quickly lower the channel elevation. A 15 foot wide concrete maintenance path will be constructed through the grouted riprap lined section. Refer to the plan and profile and Section G-G in the Appendix.

A full concrete lined trapezoidal section begins approximately 175 feet upstream of the Union Pacific Railroad. The trapezoidal section has an 80-foot bottom width as it passes under the UPRR. A three-span concrete box girder bridge is proposed for the UPRR crossing. The channel continues under Maricopa County Highway 85, where a three span continuous slab bridge is proposed. The longitudinal slope of the channel in this portion is 0.0011 ft/ft, and the entire section utilizes a 175 foot right-of-way. An at grade crossing of the UPRR is proposed for a maintenance roadway located on the west side of the channel. Refer to the plan and profile and Section D-D in the Appendix.

Segment 3

A trapezoidal channel section with an 80-foot wide earthen bottom is utilized between MC 85 and the BID Canal. Stepped gabion baskets at a 1:1 side slope are used for bank linings. The majority of this segment is in a partial levee condition due to vertical constraints from utilities. A 15-foot wide maintenance road is located on the top of the levee on each side. The levee ranges from one foot to five feet above natural ground. The majority of the levee height above natural ground is to accommodate the 3-foot freeboard requirements, per FEMA's levee guidelines. Additional FEMA levee guidelines and requirements will be followed during the design and construction phases of the project. The back side of the levee will return to natural ground using a 3:1 earthen slope or stepped gabion baskets at a 1:1 slope. This section is maintained in a 150-foot wide right-of-way. The overall depth of the channel is approximately 9 feet to 10 feet, including three feet of freeboard. The channel slope ranges from 0.0011 ft/ft to 0.0015 ft/ft in this area. Refer to the plan and profile and Section C-C in the Appendix.

Approximately 300 feet north of the BID Canal, the channel transitions using a concrete trapezoidal section to a concrete rectangular section to form an overshoot for the BID Canal crossing. This section has a bottom width of 50 feet and is six feet deep. A grouted riprap channel on a 0.0451ft/ft slope conveys the flow from the overshoot while dropping approximately six feet through a four-barrel 12 feet wide by 10 feet high reinforced concrete box culvert. The box culvert will convey the wash under the south canal maintenance road. Refer to the plan and profile and Section B-B, M1-M1, and M2-M2 in the Appendix.

Segment 4

Stepped gabion baskets at 1:1 sideslope are used for bank linings following a rectangular section at the box culverts for approximately 350 feet. This entire segment is within the Gila River's 100-year floodplain. A trapezoidal section with soil sideslopes is utilized for the remainder of the channel (700 feet) to the Gila River conveyance area. This section has an 80-foot bottom width, 3:1 sideslopes, and 0.0020 feet per foot longitudinal slope. The Bullard Wash Channel daylights prior to reaching the Gila River low flow channel. This area utilizes a 150-foot wide right-of-way, however, the downstream floodplain property has been purchased, which avoids a flowage easement as

the channel daylight into the Gila River floodplain. Refer to the plan and profile and Sections A-A and I-I in the Appendix.

Summary of Selected Alternative

The following is a summary of the recommended designs for each segment:

Segment 1:

lining: gabion baskets @ inlet structure, composite (earth bottom, gabion mattress sides)

bottom width: 80 feet

sideslopes: 1:1 @ inlet; 2:1 east side varies 2:1 - 3:1 west side

longitudinal slope: 0.005 ft/ft @ inlet; 0.0012 ft/ft

drop structures: 1 sloping drop, 8 feet high

reach length: 4270 feet

approx R.O.W. width: varies 150' to 175' north of IMSALCO property line, then 305 feet

Segment 2:

lining: grouted riprap north of UPRR, then concrete sides and bottom

bottom width: 80 feet

sideslopes: 1:1

longitudinal slope: 0.0430 ft/ft north of UPRR, 0.0011 ft/ft under bridges

UPRR crossing: Bridge, opening = 99 feet, span = 33 feet with 20 inch wide piers

MC 85 Crossing: Bridge, opening = 101 feet, middle span = 39 feet, 2 outer spans at 31 feet each, with 24 inch wide piers

Reach length: 820 feet

approx R.O.W. width: 305 feet at north end, 205 feet at UPRR crossing, 175 feet south of MC 85.

East Tributary Channel:

lining: riprap apron with 30 inch RGRCP sump at inlet, concrete sides and bottom

bottom width: 16 feet

sideslopes: 1.5:1

longitudinal slope: 0.0017 ft/ft at inlet to first drop, then 0.0025 ft/ft to second drop, then 0.0030 ft/ft to drop at confluence with Bullard Wash

drop structures: 3 sloping drops (2 in the tributary and 1 at the confluence to Bullard Wash), 3 feet high each

reach length: 2210 feet

approx R.O.W. width: 70 feet

Segment 3:

lining: composite (earth bottom, gabion basket sides), concrete lined sides and bottom north of BID Canal overshoot. Grouted riprap south of BID Canal overshoot.

bottom width: 80 feet, narrowing to 70 feet north of BID Canal overshoot, and 50 feet at the overshoot, expanding back to 80 feet south of overshoot

sideslopes: 1:1

longitudinal slopes: 0.0011 ft/ft to grade break, then 0.0015 ft/ft, then 0.0040 ft/ft north of BID Canal overshoot. 0.0451 ft/ft south of overshoot, then 0.0020 ft/ft

grade break: Broadway Road dip crossing utilizing a ford crossing with a concrete encased sewer line in Broadway Road.

BID Canal crossing: Overshoot is concrete slab bridge of rectangular section, base width is 50 feet

Maint. road crossing: 4-barrel, 12 feet wide by 10 feet high reinforced concrete box culvert

reach length: 4800 feet

approx R.O.W. width: 150 feet, 460 feet at Broadway Road, and 425 feet at BID

Segment 4:

lining: earth bottom and sides

bottom width: 80 feet

sideslopes: 3:1

longitudinal slope 0.0020 ft/ft

reach length: 700 feet

approx R.O.W. width: 150 feet

5.2 Road and Railroad Crossings

The only major transportation crossings of the Bullard Wash Channel are for the MC 85 and the UPRR. These two crossings are within 150 feet of each other. As previously mentioned, a three-span continuous slab bridge is to be used for the MC 85 crossing. A three-span concrete box girder bridge is to be used for the railroad crossing based on the UPRR design standards. Two additional minor road crossings occur south of MC 85. A "dip" crossing will be used at the Broadway Road alignment for farm access. A hardened ford will be used to prevent undermining of the roadway. The second minor crossing is an access road adjacent to the BID Canal. A four barrel box culvert, 12 feet wide by 10 feet high is used for this crossing.

5.3 Canal and Irrigation Crossings

The Bullard Wash Channel crosses the BID Canal in a concrete overshoot. The Canal is allowed to pass under in an open channel flow condition.

A concrete irrigation tailwater channel is incorporated into the channel design from Lower Buckeye Road to just upstream of the grouted riprap section near the railroad. At that point, the tailwater and nuisance flow is collected and piped out of the channel back into an existing tailwater ditch.

Irrigation tailwater flows also enter the study area via the East Local Tributary. These flows currently cross the railroad and MC 85 at the existing major bridge structures and enters an existing tailwater sump south of MC 85. These flows will be maintained and controlled in a manner similar to the main channel irrigation flows.

There are seven existing irrigation ditches that cross the proposed alignment south of MC 85. Among them are four existing tailwater ditches and three concrete-lined supply ditches.

The tailwater ditches are earth cut and relatively shallow. Irrigation practices in this area basically flood the fields and, ideally, there would be no tailwater runoff to dispose of. The occasional tailwater runoff will be conveyed to the BID Canal via an existing tailwater collector channel located along the north side of the BID Canal and the east side of the proposed Bullard Wash Channel. Excess tailwater and storm runoff from the local farm fields that exceed the capacity of the collector channel will enter BID Canal by pipe

culverts. A small sediment basin will be constructed upstream of the BID Canal to remove sediment from the interior drainage runoff prior to entering the canal. The supply ditches south of MC 85 provide water for the irrigation of multiple fields throughout the area and cannot be removed. There are three supply ditches which will require inverted siphons to convey the water under the proposed Bullard Wash Channel and connect to the west. The inverted siphons will be maintained by local farmers. Irrigation practices may change throughout the seasons and years. For the final design of this project, coordination with the current land user will be required. Refer to Figure 5 for existing irrigation facilities.

5.4 Utilities

The relocation and/or protection of utilities comprises a significant portion of the effort for this project. All the major utilities listed previously have been investigated, and approximate procedures for relocating or protecting them have been obtained directly from the utility companies in writing and in the utility coordination meeting held February 17, 1998. The discussion on utility relocation and/or protection is preliminary and conceptual in nature. Field confirmation of top of pipe elevation for the 96-inch diameter Palo Verde water re-use line and Goodyear 15-inch sewer line have been done. The major utilities which require a significant effort or cost to relocate and/or protect are described below. Those utilities not included below are easily relocated at relatively low cost.

The 12-inch and 20-inch Santa Fe Pacific petroleum pipelines are major utility relocations and are relatively difficult to relocate. It will be necessary to relocate the lines, but the associated costs are high. The 12-inch line is not currently in use and is filled with a stationary substitute fluid. The 20-inch line is in use and will require expensive procedures for the line to be interrupted and relocated. Angled bends must be used to go under the proposed channel as the depth of relocation is too great to under-excavate and relax the pipe. The proposed main channel alignment and configuration requires the petroleum lines to be relocated for approximately 200 feet. The East Local Tributary Collector Channel does not cross the lines.

**BULLARD WASH OUTFALL
FEASIBILITY STUDY**

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
(FDC 94-06)

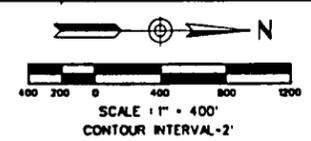


NOTES

- ① ALL IRRIGATION FACILITIES ARE ILLUSTRATIVE AND DO NOT REPRESENT ACTUAL LOCATIONS. IRRIGATION SYSTEM/PLAN SHOWN IS APPROXIMATE BASED ON FIELD OBSERVATION. VARIOUS ASPECTS MAY BE MISLOCATED, INCORRECT OR MISSING. HEADWALLS, BOX STRUCTURES AND OTHER IRRIGATION CONTROLS ARE NOT SHOWN.
- ② IRRIGATION FLOW DIRECTIONS ARE BASED ON EXISTING LAND USE AND IRRIGATION PRACTICES. SOME FIELDS AND IRRIGATION DITCHES HAVE NO SLOPE ALLOWING FLOWS IN BOTH DIRECTIONS.

LEGEND

- CONCRETE LINED IRRIGATION DITCH AND DIRECTION
- - - EARTHEN IRRIGATION DITCH AND DIRECTION
- - - - - STORM WATER FLOW PATHS
- - - - - FIELD DIVIDE
- PIPE CULVERT OR INVERTED SIPHON
- ◊ AGRICULTURAL FIELD IRRIGATION DIRECTION
- WELL AND PUMP



BASE MAP: WHITE TANKS/AGUA FRIA ADMS
(PCD 89-78)

MAPPING COMPANY: COOPER AERIAL OF
PHOENIX INC. FLIGHT DATE 11-22-89

BULLARD WASH OUTFALL
FEASIBILITY STUDY

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
(FDC 94-06)

**FIGURE 5
EXISTING IRRIGATION**

DES. S.W. CHD. C.S.B.	DATE 1-25-95
DRN. P.A.P. APP.	SHEET 1 OF 1
STANLEY CONSULTANTS, INC.	DWC
FOR BEST RESULTS, REFER TO PROJECT NUMBER 94-06 - 001 OF 001	PROJ. NO. 9278

The City of Goodyear gravity sewer along Broadway Road will be encased with concrete. The proposed channel flow line is approximately 1.5 feet above the top of pipe. The top of pipe elevation was obtained to verify as-built information. The manholes are avoided by the proposed channel alignment. The extent of the encasement of the sewer will be completed in the final design phase of this project and approved by the City of Goodyear.

The 8-inch El Paso natural gas high pressure line crosses both the main Bullard Wash Channel and the East Local Tributary Collector Channel. There is also a potential conflict with the horizontal location of the natural gas line with respect to the collector channel. The natural gas line runs parallel to and just north of the collector channel. Based on the utility maps, it appears that the collector channel can be constructed without a lateral relocation of the natural gas line. The procedure for vertical relocation of the natural gas line is relatively simple and inexpensive. Standard 45° and 90° bends can be installed to accommodate necessary vertical clearance. The length of the relocation is dependent on the existing depth of the natural gas line and the crossing locations of the channels.

The 96-inch diameter Palo Verde water re-use line will be encased with reinforced concrete. Based on the information provided by APS, the proposed channel flow line is set approximately 1.5 feet above the top of pipe. This will allow for an 18-inch encasement with the channel bottom lined from the pipe encasement upstream and downstream. Toe-downs designed at the upstream edge of the lined section will prevent scour from impacting the pipe. The proposed flow line and top of pipe will be reviewed by APS. Encasement of the 96-inch line is scheduled for March 1998. Refer to Figure 6 for existing major utility locations.

**BULLARD WASH OUTFALL
FEASIBILITY STUDY**
FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
(FDC 94-06)



- NOTES**
- ① ALL UTILITY LOCATIONS SHOWN ARE APPROXIMATE ONLY MAJOR UTILITIES HAVING A POTENTIAL CONFLICT WITH THE PROPOSED PROJECT HAVE BEEN INVESTIGATED OTHER LOCAL UTILITIES SUCH AS TELEPHONE, ELECTRIC, NATURAL GAS AND CABLE TELEVISION MAY BE PRESENT WITHIN THE PROJECT AREA.
 - ② ALL WATER AND SEWER UTILITIES SHOWN ARE CITY OF GOODYEAR.
 - ③ THIS EXHIBIT DOES NOT ATTEMPT TO REFLECT THE NUMEROUS AGRICULTURAL IRRIGATION DELIVERY AND TAILWATER DITCHES, PIPE AND CONTROL FACILITIES PRESENT IN THE PROJECT AREA.

LEGEND

- OVERHEAD ELECTRIC (WITH SELECTED POLES/TOWERS)
- FIBER OPTIC CABLE (U.S. SPRINT)
- UTILITY
- UTILITY OWNER

North arrow pointing up.

Scale bar: 0, 200, 400, 600, 800, 1000 feet.

SCALE 1" = 400'
CONTOUR INTERVAL - 2'

BASE MAP: WHITE TANKS/AGUA FRIA ADMS
PCD 89-70

MAPPING COMPANY: COOPER AERIAL OF PHOENIX INC. FLIGHT DATE 12-25-89

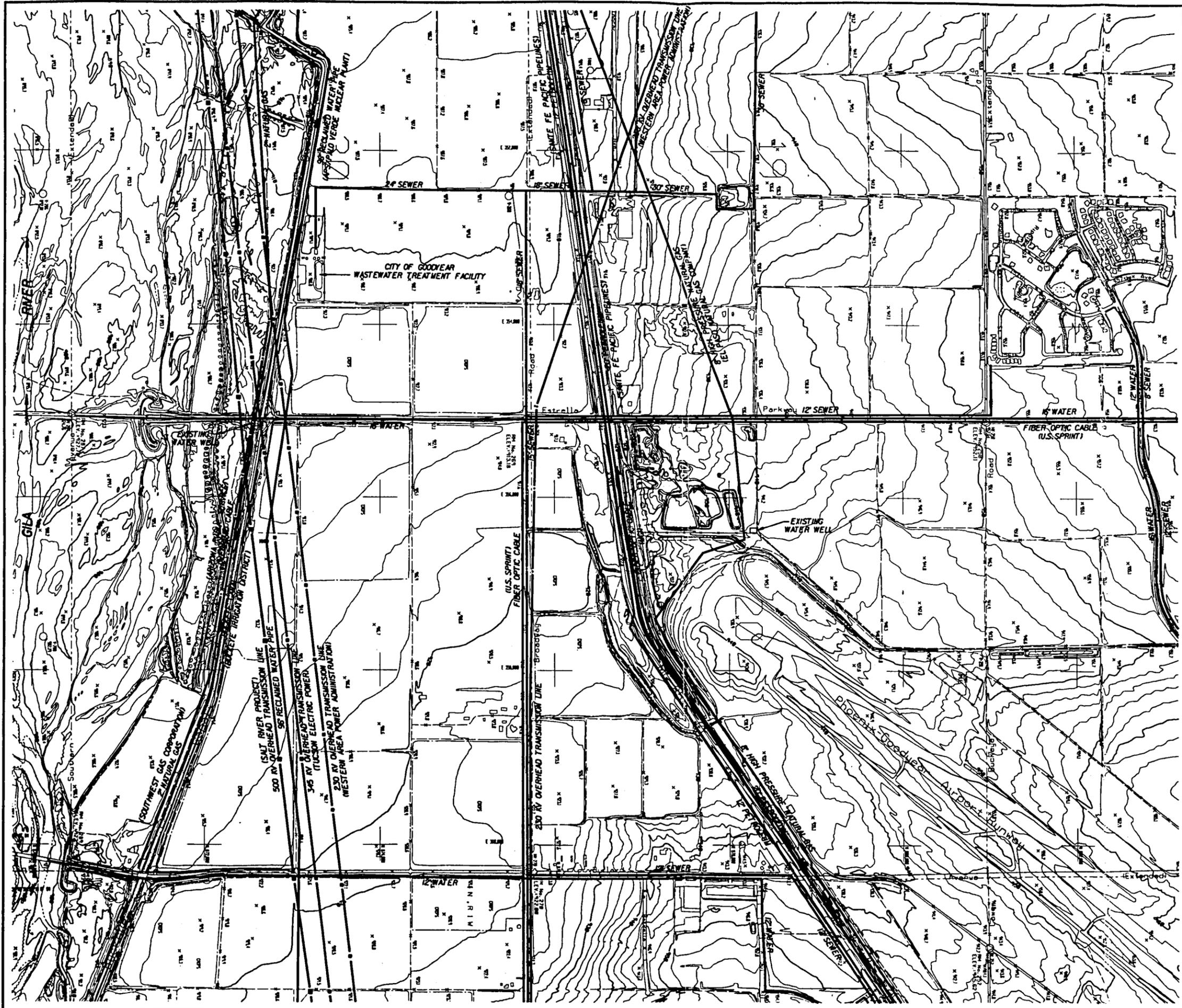
BULLARD WASH OUTFALL
FEASIBILITY STUDY

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
(PCD 94-06)

**FIGURE 6
EXISTING MAJOR
UTILITIES**

DES. S.W. CHD. G.S.B.
CHK. P.J.P. APP.
DATE 1-25-95
SHEET 1 OF 1
PROJ. NO. 12278

STANLEY CONSULTANTS, INC.
100 EAST CHANDLER ROAD, SUITE 200
PHOENIX, ARIZONA 85024 • 602-998-8800



5.5 Environmental Compliance

Located within the Phoenix-Goodyear Airport (PGA) property is an existing EPA Superfund groundwater remediation site. Although the project is located within the Superfund Site area, the project will not impact or be impacted by the Superfund Site. The groundwater within the PGA Superfund Site is contaminated with trichloroethane (TCE) and aviation fuel. The contaminated groundwater is being remediated. The treatment system includes a series of extraction wells, an air stripper, injection wells, monitoring wells, and associated piping. The selected alternative will be reviewed by the Superfund engineers, Bartholomew Engineering and Sharpe & Associates, the City of Phoenix, or the Environmental Protection Agency.

The U.S. Army Corps of Engineers (COE) has jurisdiction over the Gila River stream bed. Because the channel design has stopped short of the COE jurisdictional area, a 404 Permit is not required.

5.6 Recreational Facilities

The recreational facilities that will be installed by the City of Goodyear at a later date includes a bicycle/pedestrian path on top of the channel bank and an equestrian path along the bottom of the channel. Access ramps will provide connections between the two paths. Bridge and culverts are being designed to accommodate bicycle, pedestrian, and equestrian traffic. Landscaping of the areas around the paths will be the responsibility of the City of Goodyear.

5.7 Federal Emergency Management Agency

The northern portion of Bullard Wash is currently delineated as a floodplain Zone "AE" by the Federal Emergency Management Agency (FEMA). The southern portion is delineated as a floodplain Zone "A" by FEMA. These floodplains are delineated on the Flood Insurance Rate Maps (FIRM) Number 04013C2070F dated September 30, 1995.

The Gila River is also shown on this map as being in Zone "AE", however, the floodplain delineation and Base Flood Elevations are currently being revised in a re-study by Baker Engineering for the District. The current flood base 100-year water surface elevation in the Gila River is 910.35. The restudy by Baker Engineering does not include an evaluation of the 10-year flow or water surface elevation. Therefore, the currently effective FEMA information from the Flood Insurance Study, Maricopa County, Arizona

(September 30, 1995) has been utilized for the 10-year hydraulic information in the Gila River. This is consistent with the Stanley Report. A starting water surface elevation of 906.3 (based on the 10-year flow in the Gila River, 95,000 cfs) was used in the HEC-RAS model provided in the Appendix.

Refer to Figure 7 for the proposed channel alignment super-imposed on the current FIRM.

A Conditional Letter of Map Revision (CLOMR) will be applied for from FEMA when the design plans are nearly complete.

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY,
ARIZONA AND
INCORPORATED AREAS

PANEL 2070 OF 4350

CONTAINS:

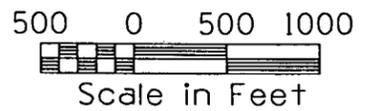
COMMUNITY	NUMBER	PANEL	SUFFIX
GOODYEAR, TOWN OF	040046	2070	F
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	2070	F

MAP NUMBER
04013C2070 F

MAP REVISED:
SEPTEMBER 30, 1995

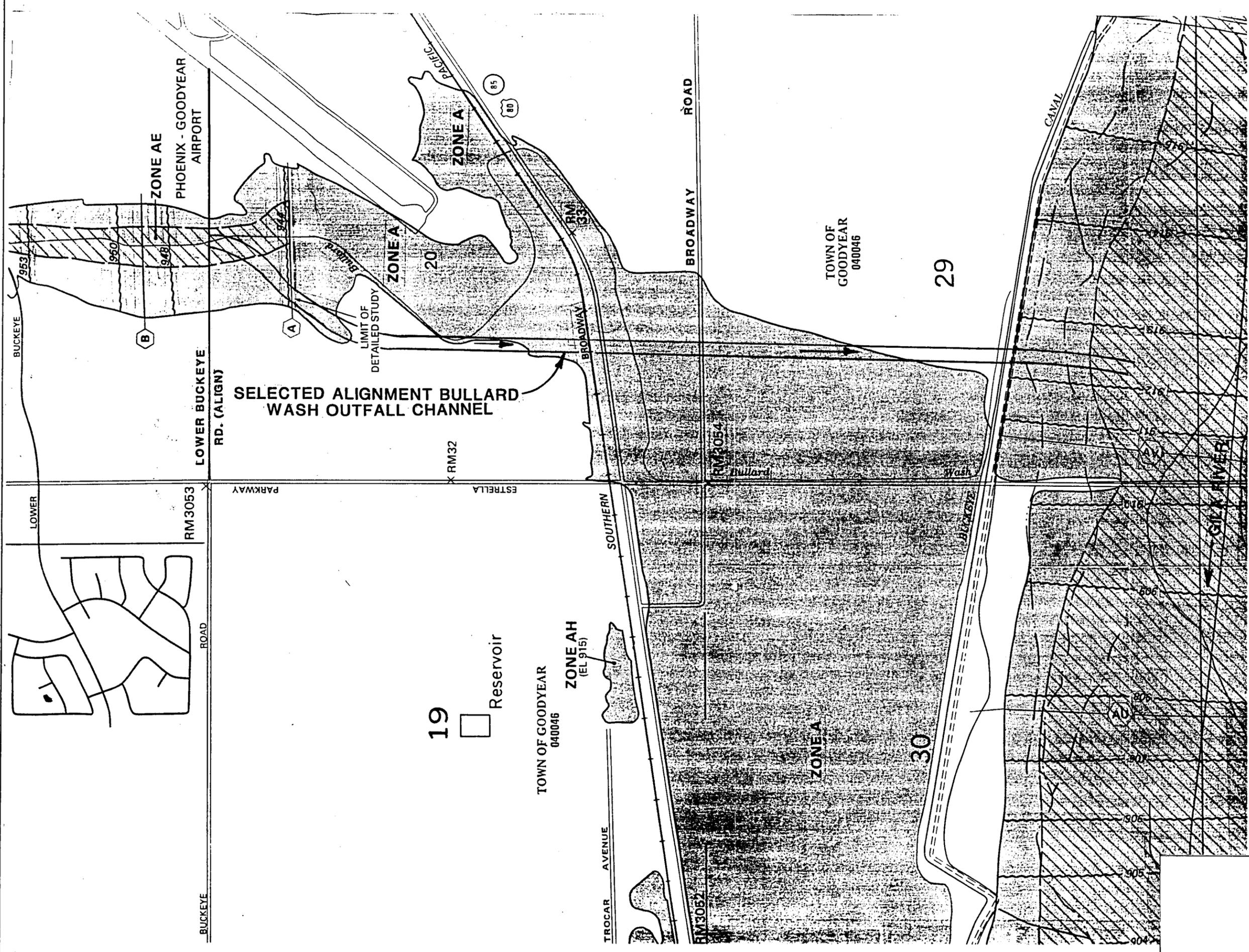


Federal Emergency Management Agency



FLOOD INSURANCE RATE MAP
FIGURE 7

WOOD/PATEL ASSOCIATES Civil Engineers Hydrologists Land Surveyors (602) 234-1344	SCALE	SHEET
	1" = 1000'	1 OF 1
	DATE	JOB NO.
	1/12/98	96464
	DESIGN: JRM	CHECK: ACP
	DRAWN: AEL	FILE: 123-98



6.0 CONCLUSIONS AND RECOMMENDATIONS

A significant selection process has taken place to arrive at this selected alternative. The process included an extensive feasibility study with an alternative analysis and a recommended alternative. This was documented in the Report *Final Design Concept Report for Recommended Alternative* prepared by Stanley Consultants, Inc., in association with Wood, Patel & Associates, Inc. That was followed by pre-design coordination between Sverdrup Civil, Inc., the City of Goodyear, MCDOT, and the FCDMC. All of this information and coordination has resulted in the selected alternative presented within this Report. It is recommended that design plans be prepared which will incorporate all features selected and documented in this report.

Design issues and technical documentation, including toedown, local scour, detailed hydraulic information, freeboard requirements, interior drainage, and levee requirements will be compiled and documented in a design data report.

APPENDIX

Coordination Meeting Minutes

Selected Alternative Concept Plan and Profile

Selected Alternative Cross Sections

HEC-RAS Output and Profile

COORDINATION MEETING MINUTES

MEETING MINUTES

Sverdrup Civil, Inc.

Date: November 25, 1997

LOCATION **City of Goodyear**
AND DATE: **November 10, 1997**

PARTICIPANTS: Steve Cleveland - City of Goodyear
 Larry Martinez - City of Goodyear
 Douglas Sanders - City of Goodyear
 Joe Evans - Yost and Gardener Engineers
 Don Rerick - FCDMC
 Laura Fritschi - MCDOT
 Brad Olbert - Sverdrup Civil Inc.
 Dan Stough - Sverdrup Civil Inc.

SUBJECT: **Contract FCD 95-39**
 Flood Control District of Maricopa County
 Bullard Wash Channel Improvements - Final Design
 Channel Aesthetics Coordination Meeting

SUMMARY:

Mr. Martinez opened the meeting with a general overview of the Bullard Wash project. The City of Goodyear will allow certain sections of the Bullard Wash channel to be lined with hard lining (concrete or shotcrete) if the following key features are incorporated into the channel segments:

- The City of Goodyear desires a bicycle / pedestrian path on top of the channel bank. The path would be set back approximately 2 feet from the top line of gabions or bank lining to avoid damage to the lining. Mr. Cleveland stated that the City desires a meandering path that allows the use of both the channel bottom and top of bank. Ramps would be required to join the levels.
- Discussion ensued regarding the City's desired locations for the ramps. It was agreed that the ramps should be placed where cyclists, equestrians, and pedestrians would all derive some benefit, and that the initial ramp locations will be shown on the 30% plan set (for review by City staff).
- Mr. Olbert suggested the design incorporate the ramp standard from the "Skunk Creek Master Drainage Plan"; a target maximum ramp slope of 8 percent (12:1) on the inclines with periodic level landings to provide rest areas (per ADA requirements). The overall slope would be approximately 5 percent (20:1).

Mr. Cleveland stated that wide spots should be provided periodically along the top of bank, to provide rest areas and shade trees. To achieve this effect, the path could meander away from the channel lining, or the lining could be steepened (narrower top width) in those locations. City of Goodyear will be responsible for the rest area development and all landscaping.

Mr. Olbert noted that a pedestrian rail should be used behind the bank lining when the bank protection is steeper than 2 to 1 or stepped gabions are used that are higher than 3 feet. The FCDMC standard handrail will be used which has a top and mid rail made of galvanized pipe stock.

The City planners have specified that the Bullard Wash corridor will be equestrian accessible. Mr. Cleveland stated that the City of Goodyear must strive to provide a continuous equestrian corridor within the Bullard Wash corridor. Although equestrians will be allowed access to the trail at the top of the bank, they will most likely choose to travel in the channel bottom, separated from pedestrian and bicycle traffic.

Mr. Olbert explained the following constraints to equestrian access along the channel corridor:

- the BID canal overchute has a significant grade control structure located south of the BID canal.
- the standard Union Pacific Railroad (UPRR) bridge has a low vertical clearance (approximately 7 feet) that will be passable only by pedestrians. Even dismounted horseback riders will have difficulty getting a horse to pass under the low chord of the bridge.
- UPRR does not allow equestrians within their right-of-way, nor will they allow a designated equestrian at-grade crossing of the tracks.
- three grade control structures located just north of the railroad bridge will be too steep and tall to be negotiated on horseback.

The following equestrian crossing alternatives were discussed by the group:

Design the grade control structure at the BID canal overchute to be usable by equestrians. The drop can possibly be reduced in height by steepening the slope of the overchute and then use a 12 to 1 ramp for the drop.

Mr. Olbert suggested that ramps leading out of the channel, on both sides of the channel, could direct equestrians onto the north bank of the BID canal. From there, they could be routed west to the Estrella Parkway crossing of the canal or to a separate bridge crossing of the BID canal. He also agreed that Sverdrup will check on what is needed to make the BID overchute safe for equestrian use.

To avoid the UPRR bridge, an equestrian path could be developed along the Elwood Street alignment to the west, that would turn south and follow Estrella Parkway. Equestrians would cross over the railroad tracks at the railroad at-grade crossing. Additional right-of-way could be obtained on the east side of Estrella Parkway to provide additional width (10 feet) for a path behind the sidewalk.

The at-grade crossing of the railroad was unacceptable to the City of Goodyear. Mr. Cleveland explained that the City must uphold an "equestrian friendly" requirement for this project. Failure to do so would give future land developers sufficient reason to evade the requirement, as well.

A concrete box culvert (10-foot height) could be constructed parallel to and separate from the Bullard Wash channel. A designated equestrian path would diverge from the Bullard Wash channel leading to the new CBC. A sump pump would keep the depressed CBC free of nuisance water. The CBC would also need lighting and phone equipment.

The City of Goodyear would have to negotiate the separate CBC crossing (at a later date) with UPRR and the affected utilities. The new crossing project would be built independent of the Bullard Wash Final Design project. The City of Goodyear would bear all costs, including construction, relocation of utilities (including UPRR shoo-fly), and O&M of the structure.

Mr. Cleveland suggested that the CBC design of the UPRR crossing (whatever form it may take) should occur during the design of the Bullard Wash channel, for the sake of design consistency. The intergovernmental agreement (IGA) would be renegotiated, such that the City of Goodyear would pay for additional CBC design costs.

Mr. Rerick reviewed the channel lining types that were visited by City of Goodyear officials the previous week. Mr. Rerick also noted that for the channel design to proceed, this meeting must reach a decision pertaining to which channel bank linings are acceptable to the City.

Mr. Cleveland stated that exposed stepped-gabions, soil-covered slope-blanket gabions, shotcrete banks with natural bottom, and full-concrete lining were each appropriate in certain locations. He elaborated that the channel lining types could be varied along the length of the channel. He also stated that mixed bank-lining treatments could be used, if needed. The City recognized the need to use concrete for sideslopes in the bridge and drop structures just north of the UPRR bridge.

Mr. Cleveland specified that the "form liner" style concrete (with a pattern) is desirable in locations where vertical concrete banks are used. He also requested that shotcrete lining be textured and colored to match the predominant soil type in the reach.

Mr. Rerick stated that the FCDMC have the personnel and equipment to hydroseed the banks on any soil-covered gabion segment(s) if they are desired.

Mr. Olbert explained that the channel profile grade line between the BID canal and the railroad is constrained by the APS pipeline crossing, the City of Goodyear sanitary sewer, and the proposed UPRR bridge. Between the BID canal and Broadway Road, the 100-year water surface is above the existing ground using a typical section with gabion bank protection that is covered with soil. The resulting channel banks must be 3 feet above the design 100-year water surface to meet FEMA requirements. The resulting channel/maintenance road footprint results in a 210-foot wide

(minimum) width right-of-way. He stated that the land owner (Sun Chase) was not agreeable with the possible FCDMC acquisition of sixty or more additional feet of property to meet this need. Mr. Olbert suggested a stepped-gabion lining with a 1:1 or 1.5 to 1 sideslope through this area. The slope of the sideslope can be selected based on the right-of-way. Gabion baskets can be used on the backslope of the dike to reduce right-of-way needs.

The meeting attendees reached an agreement on the bank linings to be used in the following locations:

PHASE I LININGS (Gila River to north of the UPRR Bridge)

- Exposed slope-blanket gabions (3:1 sideslope) with a natural stream bed will be allowed in the segment from the Gila River to the BID canal overchute.
- Full-section concrete lining from the BID maintenance road box culvert, through the grade control structure just downstream from the BID canal crossing, north to the APS (Arizona Public Service 96-inch reclaimed water) pipeline. The bank sideslopes will transition from vertical walls at the overchute to 1:1 or 1.5:1 sideslopes just north of the structure. The full-section lining with 1:1 or 1.5:1 sideslopes would continue north and match the top of the proposed APS pipeline encasement.
- Stepped, rock filled gabions (1:1 or 1.5:1 sideslopes) with natural stream bed from the 96-inch pipeline to just south of MC 85.
- Full-section concrete lined channel from just downstream of the MC 85, through the Union Pacific Railroad (UPRR) bridge and grade control structures north of UPRR. The channel sideslopes will transition to vertical walls through the MC 85 bridge, and transition to 1:1 sideslopes between the MC 85 bridge and the UPRR bridge. The channel sideslopes will transition back to vertical walls through the UPRR bridge and then transition to 1:1 sideslopes through the drop structures.

PHASE II LININGS (North of the Drop Structures to Lower Buckeye Road)

- Slope-blanket gabions from the drop structures to the north end of the channel at Lower Buckeye Road. The bank protection on the east side of the channel will be sloped at a 1.5:1 rate and vary between 2:1 and 3:1 on the west side.
- Slope-blanket or stepped gabions will be used in the 200-foot long inlet area to the north of Lower Buckeye Road. Work in this area will be considered temporary until the future channel section is designed and constructed (by others).

BROADWAY ROAD CROSSING

Mr. Olbert stated that farm access will initially be recommended at Broadway Road in the form of an interim "dip" crossing. A hardened ford will be used to prevent undermining of the roadway. The

crossing roadway will have an approach grade of 10:1.

Discussion ensued about locations for access points for channel maintenance. Mr. Martinez agreed to discuss the matter with City of Goodyear Operations and Maintenance personnel. The FCDMC and Sverdrup have had discussions with the BID and local land owners to determine other locations. Current locations include north of the BID canal, north of Broadway Road, north of the UPRR bridge, north of the drop structures, and south of Lower Buckeye Road. The access ramps will double as ramps for equestrian access to the channel bottom. Sverdrup will then identify access locations in the 30-percent plans.

DISCUSSION OF FUTURE PUBLIC MEETING

The group reached a consensus on the date for the public information meeting: *December 4, 1997*. Mr. Rerick stated that FCDMC will mail meeting notices to land owners (within one half mile of Bullard Wash or Estrella Parkway). He suggested an "open house" format for the upcoming public information meeting. He added that the Estrella Parkway/MC 85 and the Bullard Wash Channel final designs will be on the meeting agenda. Mr. Cleveland and Mr. Martinez agreed to this style of meeting.

Mr. Olbert explained that Sverdrup, FCDMC, and MCDOT personnel will mingle with the public, explaining the key points of the design concept, listen to specific comments, and address questions that arise. Informational handouts will be produced and distributed by FCDMC that include a fact sheet with the key project features, an overall project map with improvements delineated, and a questionnaire.

Mr. Martinez suggested that additional notices be posted along Estrella Parkway and MC-85 and in the local Goodyear newspaper. He also suggested that SunCorp be included on the mailing list (because of their significant role in land development in the area).

Ms. Fritschi agreed to create a County location board for display at the entrance to the meeting. Mr. Martinez agreed to arrange for the City Hall or the Community Center to be used for the meeting place. Mr. Olbert agreed to create the following exhibits by December 1, for use at the public meeting:

- Bullet charts showing the key design features of the channel design (emphasis placed on aesthetics, multi-use access, equestrian access).
- Bullet charts showing the key design features of the roadway design.
- Roadway typical sections.
- Channel typical sections (stepped gabions, slope-blanket gabions, shotcrete, concrete lined).
- Mounted 8" x 10" photos of recommended linings.

- 12-foot long aerial photo with proposed channel right-of-way limits (Gila River to Lower Buckeye Road).
- A 1"=100' scale strip drawing showing the edge of pavement, existing and new rights-of-way, property lines and owner names. The drawings will be displayed flat, rolled out on 8-foot long tables. Use markers to write down public comments at the appropriate locations on the strip maps.
- 1" = 20' scale illustrations of intersections at MC 85, Elwood Street, Lower Buckeye Road, Lower Buckeye Parkway and Yuma Road.

CITY OF GOODYEAR TOWN COUNCIL MEETINGS

Mr. Cleveland agreed to arrange a City of Goodyear Town Council work session (briefing) on *December 9, 1997*. Mr. Rerick stated that FCDMC will provide flyers for that meeting (and 25 will be given to the council).

A regular Town Council business meeting will follow on *December 16th*, at which time the council will vote on the recommended action items.

Please contact me at (602) 231-8999 if you have additions to or comments on these meeting minutes.

Signed:



Bradford D. Olbert, P.E.

Distribution:

Attendees
RWM
013884-2B

MEETING MINUTES

Sverdrup Civil, Inc.

Date: February 2, 1998

LOCATION City of Goodyear, Old Fire Station Conference Room
AND DATE: January 20, 1998; 1:30 pm

PARTICIPANTS: Don Rerick, Flood Control District of Maricopa County (FCDMC)
Timothy Edwards, City of Goodyear
Larry Martinez, City of Goodyear
Chris Stevens, Yost and Gardner Engineers
Jackie Meck, Buckeye Irrigation District
John Christensen, SunChase
Barbara Rust, Coe & Van Loo
Claire Able, SunChase
Ron Rayner, A-Tumbling-T Ranches
Tim Smith, Local Farmer
Dan Stough, Sverdrup Civil, Inc.
Brad Olbert, Sverdrup Civil, Inc.

SUBJECT: Contract FCD 95-39
Flood Control District of Maricopa County
Bullard Wash Channel Improvements - Final Design
Agency / Property Owner Coordination Meeting

SUMMARY:

The above participants met to review the progress in the Bullard Wash Channel Design and to provide additional input and comments prior to the 30% construction plan submittal. Mr. Olbert presented an overview of the project to the participants utilizing an blue line aerial and a preliminary right-of-way map developed for the project. Also, a handout was given to the meeting participants which illustrated the typical sections of the proposed channel and includes schematics of critical locations along the project, such as the inlets to the Bullard Wash and East Local Tributary, the drop structures located north of the railroad and south of the BID canal, and the BID canal area.

Mr. Christensen said that SunChase does not own the property to the north and east of the Bullard Wash inlet area. He will relay information about removing the tailwater sump ponds and extending the project north to the property manager of the parcel, and provide Sverdrup a contact name and telephone number. Mr. Christensen would also like to see a copy of the HEC-2 runs to verify the lowering of the water surface profile north of Lower Buckeye Road. Mr. Olbert said the HEC-2 runs will be forwarded for review after they are prepared.

Mr. Christensen asked if a LOMR will be prepared for this project. Mr. Rerick said one will be prepared as standard policy with the Flood Control District. The LOMR will revise the floodplain from Lower Buckeye Road to the Gila River.

Ms. Able asked if tailwater will be passing through the dip crossing located at the Broadway Road alignment. Mr. Olbert said no tailwater will cross the dip crossing because the Bullard Wash tailwater will exit from the channel just north of the drop structure that is located to the north of the Union Pacific Railroad.

Mr. Rayner expressed concern that his large trucks (40-foot trailer/semi rig) will not be able to pass through the dip crossing and over the raised berms. Mr. Rerick said that in other FCD projects where a dip crossing was utilized, there have been no problems with large trucks crossing the wash.

Mr. Rayner said that the TCE's to construct the farm roads will remove additional acreage from production.

Mr. Meck preferred that local drainage, that collects along the east side of the proposed Bullard Channel and north of the BID canal, be discharged into the BID canal and not the Bullard Channel. He did not want to see any opportunity for flow from the Gila River to back up into the channel, pass up through sidedrains for the local drainage, and then flow into the canal. He understood that the local drainage is primarily from agricultural land and will decrease with time as development occurs within the local drainage basin area. Mr. Meck suggested additional sediment basins and discharge pipes be installed along the north bank of the BID canal in lieu of one discharge point located on the east side of the channel. Mr. Rayner pointed out that not much overland flow reaches the tailwater ditch located on the north side of the BID canal. It was agreed that the location shown for the sediment basin/discharge point was in the best location.

Mr. Meck didn't want public access to the BID maintenance road along the north bank of the canal. The Buckeye Irrigation District already has a significant problem with the number of private vehicles that are driven into the canal without encouraging public access to the maintenance roads. Mr. Meck wanted fencing and gates where the channel crosses the canal.

Mr. Olbert reviewed the types of drop structures submitted to the City of Goodyear for comment. The first drop structure is located north of the railroad, and the second is located south of the BID canal. Mr. Stevens said that the City preferred the grouted riprap design for both drop structures. The grouted riprap design meets all of the City of Goodyear's needs. Mr. Stevens will prepare a letter response approving the grouted riprap drop structures.

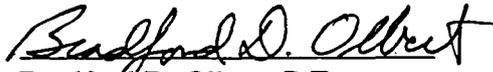
Mr. Olbert reviewed a cost estimate to add a trail located in the side bank of the main channel with Mr. Stevens. To provide the trail from MC 85 to the BID canal, the added cost is approximately \$180,000 plus an additional six foot of R/W from SunChase. Mr. Stevens will review costs with City staff and respond back to Sverdrup if the City wants the additional side bank trail.

Mr. Olbert reviewed with Mr. Rayner the inlet structure proposed for the East Local Tributary, and the outlet pipe proposed to discharge tailwater to the A-Tumbling-T Ranch. The proposed inlet will collect tailwater in a sump and convey the tailwater south in a 30-inch diameter pipe. Mr. Rayner said the 30-inch pipe is adequate for his needs and will help to restrict storm flows to his property that have

damaged his fields in the past. Mr. Rerick said the FCD will need to clarify with the Roosevelt Irrigation District (RID) where the RID's maintenance responsibilities stop on the East Local Tributary.

Mr. Stough reviewed with Mr. Smith the raising of Lower Buckeye Road within the existing R/W. A concept was developed with Mr. Smith on how to collect and convey tailwater to the channel, and provide access to the farm roads that serve the fields north and south of Lower Buckeye Road. Mr. Smith preferred that when Lower Buckeye Road is raised that the fill slopes not disturb the agricultural field to the south. When details of the Lower Buckeye Road improvements are developed, a copy of the area can be Faxed to Mr. Smith at 936-1417. The 30% plans will be submitted to Mr. Wood, who will route the plan set to Mr. Smith.

Signed:


Bradford D. Olbert, P.E.

Distribution:

013884-2B
Participants

MEETING MINUTES

Sverdrup Civil, Inc.

Date: March 11, 1998

LOCATION Flood Control District
AND DATE: February 17, 1998; 8:30 pm

PARTICIPANTS: Don Rerick, Flood Control District of Maricopa County (FCDMC)
Olin Sutton, FCDMC
Scott Yogel, FCDMC
Jim Neibergall, MCDOT Utility Coordinator
Laura Fritschi, MCDOT
John McNelly, El Paso Natural Gas
Bill Ward, El Paso Natural Gas
Robert Sprague, Southwest Gas Company
Dan Tarango, Santa Fe Pacific Pipelines
Stan Ashby, Roosevelt Irrigation District
Tony Tapia, Roosevelt Irrigation District
Bob Friess, US West
Bob Bott, APS
Sarianne Rittenhouse, APS-PVNGS
Pat Kavanaugh, MCI
Larry Martinez, City of Goodyear
Dan Stough, Sverdrup Civil, Inc.
Brad Olbert, Sverdrup Civil, Inc.

SUBJECT: **Contract FCD 95-39**
Flood Control District of Maricopa County
Bullard Wash Channel Improvements - Final Design
30% Plans Review / Utility Coordination Meeting

SUMMARY:

Mr. Rerick opened the meeting with a brief overview of the project which included the project location and the proposed flood control facilities. Mr. Rerick stated emphatically that all utilities must be relocated **NO LATER THAN September 1, 1998**. All relocation plans, estimates, and prior rights information needs to be submitted to Mr. Sutton for review and approval. All utilities not in attendance will be notified by Mr. Sutton for a follow up meeting to identify their conflicts or to respond with a letter stating that they have no conflicts. Utilities should identify any additional R/W requirements needed for their relocation effort as soon as possible.

Roosevelt Irrigation District - They had no conflict with the plans as detailed so far. They plan to be in attendance at the March 17th meeting with UPRR.

Arizona Public Service (APS)- Two power poles need to be relocated near the BID canal. One power pole is located on the south side of the BID canal and the other pole, a service drop pole, is located on the north side of the BID canal. The overhead power line (12 kV) on the south side of the BID canal and the service line to the service drop pole will need to be raised to provide a minimum of 25 feet of overhead clearance for construction purposes. The underground service line from the service drop pole to the PVNGS manhole will need to be relocated. Two power poles located on the south side of Broadway Road will need to be relocated outside the channel limits and raised to provide a minimum of 25 feet of overhead clearance for construction purposes. Sverdrup will provide APS with updated plots to highlight the pole locations. Half size plans are adequate. Send information to Bob Bott.

Southwest Gas (SWG)- SWG has a 1¼ inch steel gas line located on the south side of the BID canal that will need to be lowered. Limits of the lowering will include the construction limits of the new BID south bank maintenance road. SWG will provide adequate cover to handle the construction loads. A steel line was uncovered last summer located under the north BID maintenance road. SWG had no record of an abandoned gas line located under the maintenance road.

Salt River Project (SRP) - Not in attendance. Mr. Sutton to contact and obtain written comments.

Tucson Electric Power Company (TEP) - Not in attendance. Mr. Sutton to contact and obtain written comments.

Western Area Power Administration (WAPA) - Not in attendance. Written comments have been received. They have no conflicts with the proposed channel construction.

US Sprint - Not in attendance. Mr. Sutton will contact Sprint to identify their relocation needs along Broadway Road. Mr. Stough said the US Sprint line is mislabeled as MCI in the profile, sheet 5.

US West (USW) - USW has two fiber optic lines in Broadway Road that need to be relocated. They currently plan to jog to the south of the sewer line with a new conduit encased in concrete with a minimum of 4 feet of cover. Three hundred feet of cable needs to be relocated, but 2000 feet of cable will need to be pulled and spliced at one or both ends. Mr. Rerick suggested combining relocation efforts with US Sprint at this location. Mr. Sutton (506-8437) will coordinate effort to use a joint trench.

Santa Fe Pacific Pipelines (SFPP) - SFPP has provided an estimate for their relocation work to the FCD (\$244,000 for both lines). They can relocate by Labor Day. Relocation work to be reviewed by Mr. Sutton, Mr. Rerick and Sverdrup. SFPP have their own easement with UPRR. **Mr. Rerick requested that all of the utilities be sure to get a no cost license to work in the R/W from the FCD. It takes one week to receive. Coordinate with Mr. Sutton to pick up the license.**

Qwest - Not in attendance. Mr. Sutton will contact Qwest to request as-builts for the new conduit placed last fall parallel with the railroad. The plans are needed ASAP to plot the conduit on the plan and profile sheets to identify any conflicts.

UPRR - Not in attendance. Field meeting has been set up for March 17th, to discuss their overhead signal lines located just south of the UPRR tracks. Two poles need to be relocated out of the channel. The overhead lines also need to be raised to provide 25 feet of clearance for construction purposes.

MCI - MCI has a 42 count fiber optic cable within the UPRR R/W that needs to be lowered. Their conduit is concrete encased at the Estrella Parkway crossing. They will need a minimum of 36 inches of cover over their line. Sverdrup to send an additional set of plans to Gary Nelson in Texas. Mr. Nelson will prepare the relocation plans for MCI.

El Paso Natural Gas (EPNG) - EPNG will lower about 350 feet of their 8 inch line that crosses the Bullard Wash Channel alignment. They will need to lower the line in place without cutting or splicing. The line must remain in operation while the lowering work is being completed. EPNG will check their records on the location of the line. Mr. McNelly's recollection is that the line was placed back in the 1940s with little as-built information. EPNG and Sverdrup to coordinate the potholing of the line and to determine limits of conflicts with the East Local Tributary Channel.

MCDOT - Mr. Neibergall said that there will be a utility meeting in mid March concerning the Estrella Parkway 40% Construction Plan Set. Locations of possible conflicts should be identified as well as providing prior rights information. Mr. Olbert said that the utilities within Estrella Parkway will be potholed during the month of March. Several utilities reported they have not received plan sets from MCDOT yet. Mr. Neibergall stated that there are two 40% construction plan sets that will be discussed at the roadway utility coordination meeting. The first set was sent out last November, the second set went out just recently.

City of Goodyear - Provide encasement of sewer line at the Broadway Road crossing per MAG standards.

Please review these meeting minutes and call me or Dan Stough (231-8999) if you have comments or questions. Unless comments or questions are received on these minutes within 1 week of distribution, the statements above will be considered true for design purposes.

Signed:


Bradford D. Olbert, P.E.

Distribution:

013884-2B
Meeting Attendees

MEETING MINUTES

Sverdrup Civil, Inc.

Date: March 16, 1998

LOCATION Flood Control District
AND DATE: February 26, 1998; 1:00 pm

PARTICIPANTS: Don Rerick, Flood Control District of Maricopa County (FCDMC)
John Christensen, SunChase
Todd Tupper, SunChase
Barbara Rust, Coe and Van Loo
Tim Smith, Wood Family Enterprises
Ron Rayner, A-Tumbling-T Ranches
Tom Koenekamp, Stantech, representing Buckeye Irrigation District (BID)
Larry Martinez, City of Goodyear (COG)
Joe Evans, City of Goodyear
Dan Stough, Sverdrup Civil, Inc.
Brad Olbert, Sverdrup Civil, Inc.

SUBJECT: **Contract FCD 95-39**
Flood Control District of Maricopa County
Bullard Wash Channel Improvements - Final Design
30% Plans Review Landowner Meeting

SUMMARY:

The above participants met to submit their comments regarding the 30% construction plan submittal for the Bullard Wash Channel Improvements. Mr. Rerick presented the agenda for the meeting and asked for comments from each of the landowners or representatives present at the meeting.

BUCKEYE IRRIGATION DISTRICT

Mr. Rerick briefly described the outfall grading, outlet channel and lining, concrete structures around the BID canal overchute site, BID access road bypass and box culvert, and the sedimentation basin located just north of the canal. Mr. Rerick stipulated that the overchute structure will close off the lower north channel bank from any maintenance traffic. He added that the maintenance road on the upper north bank of the canal will have access control gates to the Operation and Maintenance (O&M) roads that will parallel the Bullard Wash channel. Mr. Rerick suggested that the infield areas between the south bank bypass road, the canal, and the channel will be backfilled to improve safety, aesthetics, and local drainage.

BULLARD WASH CHANNEL - 30% PLAN LANDOWNER REVIEW MEETING

Mr. Koenekamp stated that he had not had much opportunity to review the 30% plans, however, Jackie Meck (BID) provided several comments or questions for the meeting:

- How much of the 96-inch APS water reuse pipeline was going to be encased. Mr. Rerick identified the limits of encasement as a minimum of 65 feet each side of the channel centerline. The encasement may extend a little further depending on where the 96-inch pipe joints are located.
- Is the channel downstream of the BID to be lined? Mr. Rerick explained that the channel would be unlined from station 18+00 to 25+00, and step-gabion bank lining with natural bottom from station 25+00 to 29+10.
- Where will the hydraulic jump occur? Mr. Olbert explained that at high flows the hydraulic jump will be "washed out" by the backwater formed upstream of the bypass road box culvert.
- Mr. Koenekamp stated they preferred that the bleed off pipes (out of the sediment basin) should be no larger than 24-inches in diameter, that multiple pipes can be used, and the outlet inverts of the pipes must be positioned at least 1 foot above the normal high water of the canal.
- Several items on the sediment basin were discussed. The proposed basin is not a detention basin (typically used for peak flow reduction). The basin is positioned to allow sediment to collect for easy removal and reduce the amount of sediment discharged into the canal. Operation and maintenance (O&M) of the basin will be the responsibility of the City of Goodyear as a part of the channel project. To reduce maintenance of the basin, the tailwater ditch will be lined as it enters the basin and continued within the basin to the basin tailwater outlet pipe. A suggestion was made to make the sediment basin longer and narrower to facilitate O&M. This caused concerns regarding modifications to the required Permanent Construction Easement (PCE) limits. The consensus was to leave the pond size as it is.

A-TUMBLING-T RANCHES

- Ms. Rust stated that the sediment basin PCE description (and the Broadway Road "bulge") be worded to allow the ownership and control of the property to revert back to Sun Chase (or future land owner) in the event that the basin is no longer needed with the approval of the City of Goodyear and the FCD.
- Mr. Rayner requested that the sediment basin pond depth be deeper than the tailwater ditch so that silting and water depths in the basin do not interfere with the operation of the tailwater ditch.
- MAG wooden barricades were suggested to be placed at the intersection of the canal banks and the channel berms in line with the north and south canal maintenance roads. This will help warn drivers along the roadways at night of the changed conditions.
- Mr. Rayner requested that 50-foot radius curves be placed at the intersections of the new farm roads (parallel to the Bullard Wash channel) and the existing farm roads. The TCEs will need to be expanded to accommodate the request. Sverdrup to provide new TCE limits to FCD as soon as possible.

BULLARD WASH CHANNEL - 30% PLAN LANDOWNER REVIEW MEETING

- Mr. Rayner agreed that a width of 14-foot for the new farm roads is adequate. He requested that the profiles of the roads be set approximately 1-foot above the adjacent fields.
- Mr. Rayner noted that the irrigation siphons will have to be placed outside of the inside radius of the new farm road returns. He stated that the peak irrigation flows are 3,500 gallons per minute (7.8 cfs). He requested 30" diameter pipes for two siphons (Station 36+65 and 49+90).
- Mr. Rayner stated that the irrigation tailwater culvert at Broadway Road immediately east of the channel is not required. He also noted that he would prefer that tailwater not be mixed with delivery ditch water at the two siphon locations described above. He requested that the tailwater be diverted southward in an unlined V-ditch that would ultimately be discharge into the Sediment Basin. Sverdrup will review the existing ditch and siphon profiles and attempt to accommodate the request.
- Mr. Rayner stated that following the channel construction, the property north of Broadway Road and west of the Bullard Wash channel will not be utilized unless the land is excavated to an elevation below Broadway Road.
- Mr. Koenekamp noted that Salt River Project uses a standardized rectangular irrigation structure that is readily adaptable to a siphon application. He recommended calling SRP to obtain the standard details for incorporation into the 60% plans submittal. The siphon details for the four siphon crossings will be provided to Ms. Rust and Mr. Rayner for their review and comment prior to final design. This includes the use of a second clean out port in the channel bottom.
- The connection of the new north/south farm roads to the existing Broadway Road farm road alignment needs to be revised to incorporate the 50-ft turning radius. The relationship between the farm road and the channel O&M road needs to be revisited to determine how best to connect with existing Broadway Road. **This will require further reviews by Ms. Rust and Mr. Rayner.**

BROADWAY ROAD DIP CROSSING and SEWER ENCASEMENT

- Mr. Evans and Mr. Martinez asked if the ABC covered roadway will survive the design channel flows? Mr. Olbert said the AB surface will provide adequate resistance against the 100-year flow. The 100-year flow velocity in the main channel is approximately 5 to 6 fps at this location. The concrete "ford" cutoff walls were designed to approximately the 10-year water surface elevation. The low portion of the dip crossing will have a concrete surface. The remaining roadway surface beyond the concrete surface will be 6-inches of AB. The ABC surface is located outside of the main current where the velocities will be much lower. The city requested that the concrete roadway section be 8-inches thick and reinforced with steel.
- Mr. Olbert stated that the Gabion bank protection from the channel section will wrap around the returns at the dip crossing but not much further. Areas that are not protected with the bank protection will be covered with a gravel mulch.

BULLARD WASH CHANNEL - 30% PLAN LANDOWNER REVIEW MEETING

- COG requested that 16-inch diam. ductile iron pipe (DIP) be substituted for the 14-inch diam. DIP. The DIP should be placed the entire distance between manholes.
- The COG requested encasement of the new sewer pipe under the concrete roadway surface be designed per MAG Standard details. Where the two concrete sections intersect (roadway surface and encasement), they should be poured as a monolithic section.
- The City requested that the existing 15-inch sewer pipe will be removed and replaced with the DIP pipe to retain the existing alignment. The contractor will need to determine the best way to manage the sewerage flows. The COG will provide Sverdrup with sewer flow data including peak flows, peak flow times, and a contact name and number for the contractor to coordinate the shutting down the old line and replacing it. The information will be incorporated into the special provisions (SP's) and supplemental general conditions (SGC's) to require the Contractor to contact the City of Goodyear prior to replacement of the pipe. The Contractor will be allowed to choose the method to bypass flows, pending City of Goodyear approval.
- Mr. Rayner expressed concern that the crest curves might be too sharp for his "belly-dump" type truck-trailer rigs to pass over. The dip crossing profile will meet AASHTO criteria for a 20 mph design speed. The design speed criteria will be shown on the 60% submittal using notes on the dip crossing sheet.
- It was suggested that the dip crossing be signed and posted for warnings of no crossing while flooded, and a speed caution for the restricted sight distance. The existing farm road does not have any roadway rights of way for public usage. The COG and the FCD risk management to provide input on signage needs.
- Mr. Rayner asked if the abandoned portion of the low flow channel located south of MC 85 and east of the new channel could be backfilled as part of the construction. The work can be done by directing the contractor in the Special Provisions to contact Mr. Rayner for disposal of waste soil. A TCE may be required.

SUNCHASE PROPERTY (North of Lower Buckeye Road)

- The area north of Lower Buckeye Road was discussed with Mr. Tupper and Mr. Smith. Both were in agreement with the general concept of the future location of the channel and the proposed removal of the existing pond dikes above the elevation of the adjacent ground. The soil can be disposed of at a nearby location. Mr. Tupper said they were interested in the soil from the pond dike removal. **Mr. Tupper said he would have Ms. Rust look to identify a spoil site in the area between the airport and the ponds.**
- It was concluded that as many names and numbers as possible will be provided in the SP's Section 215 for property owners interested in the excess soil from the channel. This will include Mr. Smith, Mr. Rayner, SunChase, and the airport.

BULLARD WASH CHANNEL - 30% PLAN LANDOWNER REVIEW MEETING

WOOD FAMILY (Represented by Tim Smith)

- Mr. Smith asked if the contractor can rebuild portions of the old concrete lined ditch (CLD) beyond the limits of the proposed work area. The contractor can do the additional work, but the work would need to be arraigned between the contractor and Mr. Smith. The contractor's name and number can be provided to Mr. Smith and it will be up to the two parties to work out the specific arrangements.
- It was agreed to leave the new farm road and irrigation ditch along Lower Buckeye Road within the existing 66 ft R/W and allow the City of Goodyear to deal with the encroachment in the future.
- Mr. Smith requested that he rebuild the tailwater ditches along Lower Buckeye Road and the west side of Bullard Wash. In addition, Mr. Smith would like a tailwater discharge culvert near station 108+00. Coordination between the contractor and the farmer will be needed in the SP's for the tailwater ditches.
- Mr. Smith suggested 12-inch diameter irrigation tailwater culverts under the new farm roads (1 foot of minimum cover).
- Mr. Rerick suggested that grouted riprap or shotcrete lined ditches be added (station 103+50, and 108+00) to convey irrigation tailwater flows from each 12-inch irrigation cross culverts to the low-flow channel.
- Mr. Smith requested that the farm road be at the same elevation as the top of the concrete lined ditch from station 93+00 to 98+00.
- Mr. Smith requested a standard irrigation (box-type) headwall at each tailwater culvert inlet, to facilitate diversion of flows.

CITY OF GOODYEAR, NORTH OF UPRR

Mr. Rerick suggested the following adjustments for Sheet 7 of the Bullard Wash plan/profile sheets:

- The irrigation low-flow pipe from the Bullard Wash channel to the existing dirt irrigation ditch be angled at 45 degrees to lessen the bend angles at the inlet and outlet.
- Fill in the existing low-flow ditch north of the new low-flow pipe outlet to the new channel alignment.
- Construct a 3-foot high, 10-foot top width berm parallel to and immediately east of the IMSAMET fence. This berm will assist the City with the future construction of a landscaped berm to be shaped by the City.

Mr. Rerick made note of several items that require an immediate COG written response. These items have been requested several times by Sverdrup and the FCDMC. Mr. Evans said he will follow-up on this request to make sure a letter is written to outline the City's preference.

- The need for handrail at 1:1 and 2:1 slopes along the top of channel sideslopes.
- Use of a 15 ft wide roadway for O&M purposes.
- Use of a 3-strand plain wire access control fence along the Wood Family R/W, around the upstream drop structure north of Lower Buckeye, chain link along the airport

BULLARD WASH CHANNEL - 30% PLAN LANDOWNER REVIEW MEETING

property, and no R/W fence south of MC 85. Additional fencing will be needed at the BID Canal and MC 85 to preclude access by the public at these locations.

- Use of a 12-inch soil covering over channel locations with a 3:1 gabion mat bank protection. The positives include protection for the gabion baskets, more aesthetic treatment of channel including vegetation, and it reduces tripping hazard of wire. The negatives include additional O&M, soil needs to be replaced after major storm events, more difficult to check gabion baskets for corrosion, vegetation on soil requires additional maintenance to maintain channel roughness factor, and variation in channel treatment will always raise a question as to why the difference.
- Is the bench path located near the midpoint of the sideslope to be included in the channel design.
- Use of cathodic protection or special coatings to control corrosion. Current state of the art uses special coatings (PVC and al-zinc alloy) to retard corrosion of the steel wire. Mr. Olbert recommended the use of the coatings with yearly spot checks of the gabions (exposed and buried) to ensure the condition of the channel and long life of the product.
- The roughness coefficient (n-value) to use for the channel design. The "n" value used for the initial 30% design was 0.032. This is a conservative value allowing for some moderate vegetation growth along the bottom of the channel between maintenance cycles. A newly constructed channel will have an approximate "n" value of 0.025. A poorly maintained channel will have an "n" value 0.035 to 0.040. A poorly maintained channel will provide little or no freeboard during the 100-year flood and may overtop the channel banks. **Sverdrup will follow-up with a letter outlining limitations in the roughness factor and the need for channel maintenance.**
- Use of AC on the maintenance ramps versus use of a crushed granite. The difference being less maintenance required on the ramps for the near future. The AC will gradually crumble with little or no usage. The COG can place AC on the ramps and in the channel at a later date when recreation use of the channel will be encouraged and the AC will experience some traffic. Public use of channel at this time should be discouraged until the Broadway Road crossing is constructed and residential / commercial properties are developed along the channel. The channel would have signs posted stating "NO TRESPASSING" and fence at MC 85 and the BID maintenance roads.
- Approval of the use of the riprap channel concept south of the BID Canal and north of the UPRR bridge. The riprap channel north of the UPRR bridge can be upgraded by setting 48-inch diameter pipes as tree wells within the channel lining and constructing a concrete maintenance roadway through the area.
- The City Council will be encouraged to select a color for the concrete channel lining. Mr. Rerick will provide paint charts for the COG Council members to select a concrete paint color. Mr. Olbert will get ADOT paint specifications and typical costs (per sq yd). Mr. Rerick will also locate a concrete add-mixture color chart for the grouted riprap.

BULLARD WASH CHANNEL - 30% PLAN LANDOWNER REVIEW MEETING

- The COG was given a choice on the location of the maintenance road adjacent to the channel through cut sections (i.e. north of MC 85). The maintenance road can be located at the lining hinge point with the exposed cut section outside the roadway, or the exposed cut can be located above the lining with the roadway placed near the ground elevation. Mr. Evans said the City will study the request and comment later.
- Mr. Rerick said that gravel mulch will be placed on all graded side slopes that are not protected by channel lining. The gravel mulch will be used to control rilling of the surface. The material was shown to the City's staff on a field visit to other FCD projects.

Mr. Martinez said that he would get responses on these matters from the City Council at the next meeting.

The FCD and City of Goodyear will meet on 3-17-98 with UPRR to discuss the UPRR bridge crossing, R/W access control, restrictions during construction, and other matters.

Please review these meeting minutes and call me or Dan Stough (231-8999) if you have comments. Unless comments are received on these minutes within 1 week of distribution, the statements above will be considered true for design purposes.

Signed:


Bradford D. Olbert, P.E.

Distribution:

013884-2B
Meeting Attendees
Jackie Meck - BID

**SELECTED ALTERNATIVE CONCEPT PLAN
AND PROFILE**

NOTE: These plans are preliminary and should not be considered final design.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	00000		10	

REMOVAL/RELOCATE

- 1 Relocate 2" Gas (Buried) S.W. Gas
- 2 Relocate Service Pole & Overhead Service Line (APS)
- 3 Relocate UG Service Line (APS)

CONSTRUCTION

- 1 New Burled Concrete Apron See
- 2 New 24" RCP with Hdwl. See
- 3 New Grouted Riprap Grade Control Structure, See
- 4 New (4) 12"x10" CBC, See
- 5 New 20" BID Bypass Road, See
- 6 New Concrete Lined Overchute Structure, See
- 7 New 24" RCP, 120 Lf, Drop Inlet, See
- 8 New Concrete Lined Transition #1. See
- 9 New retention basin #1. See
- 10 New 6" PVC Sleeve
- 11 New Wood Service Pole and Meter (APS)
- 12 New Concrete Pipe Encasement (By Others) See
- 13 50' Trans Sec B-B to Sec C-C
- 14 New Maintenance Ramp, See
- 15 New Maintenance Ramp, See
- 16 New Access Gate, See

NO.	REVISION	BY	DATE

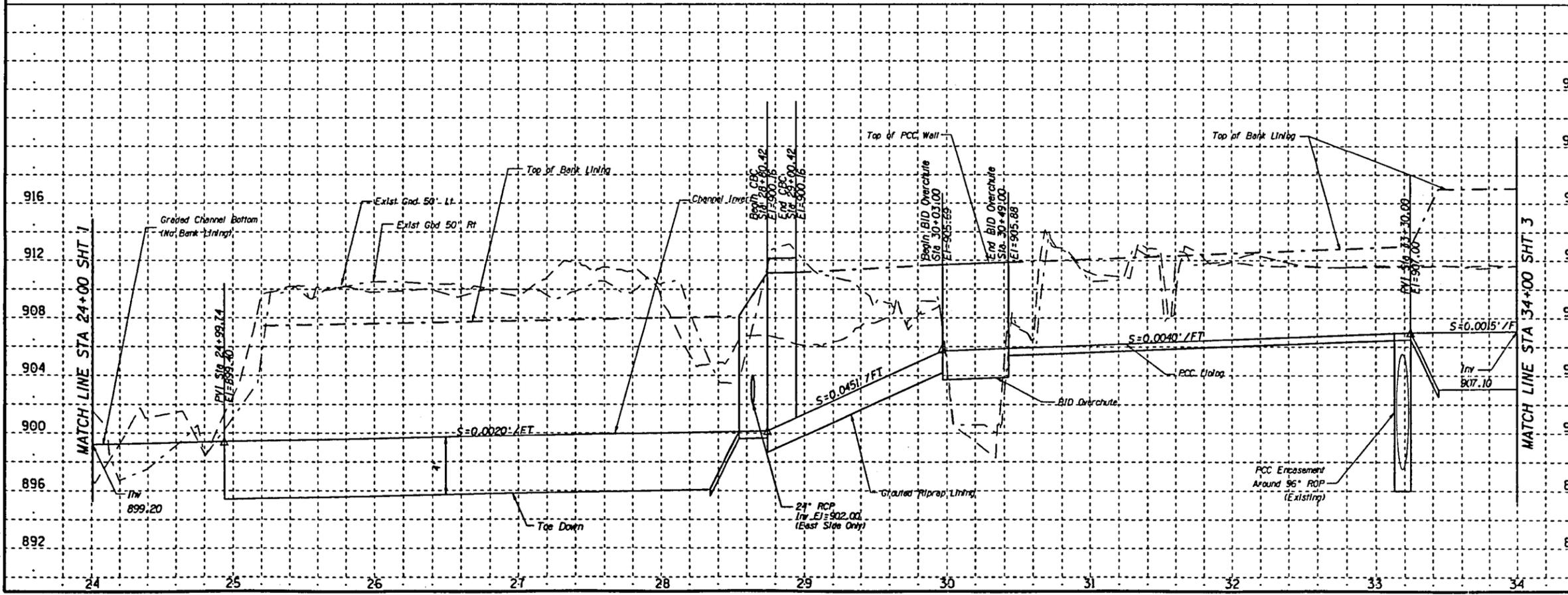
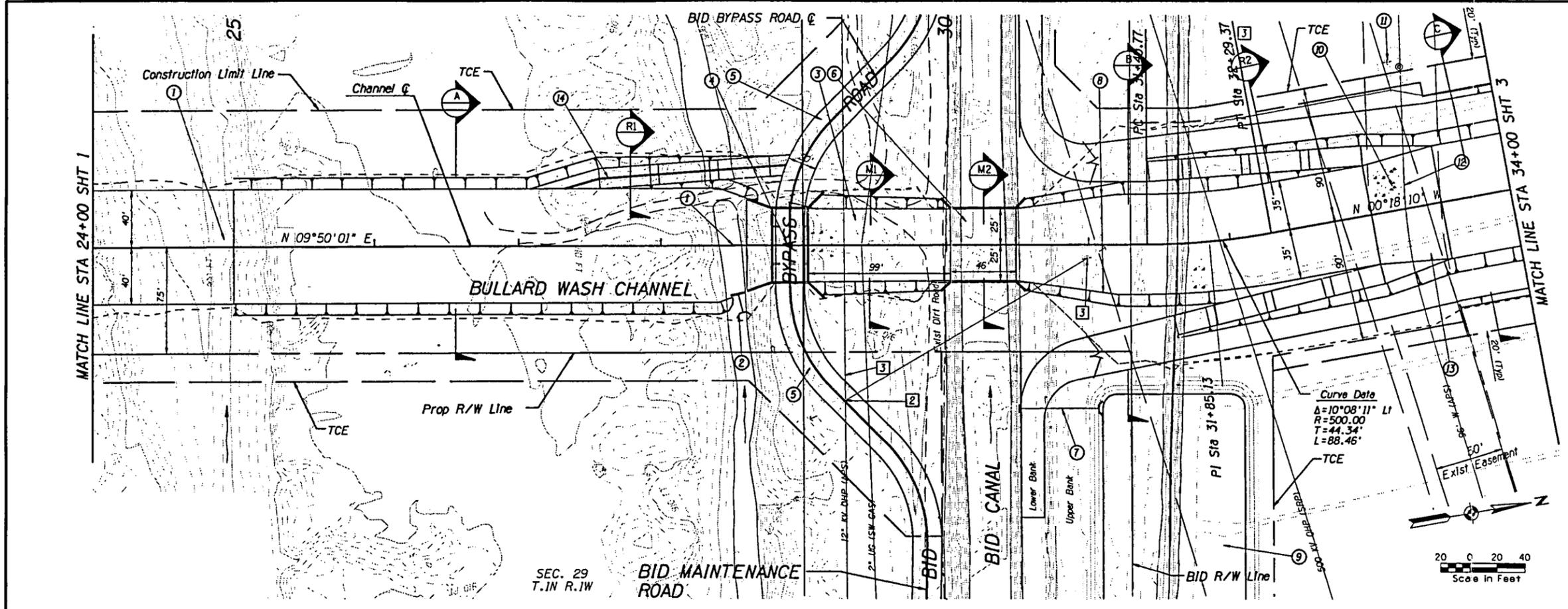
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY ENGINEERING DIVISION

BULLARD WASH CHANNEL FINAL DESIGN - PHASE 1 AND 2 PROJECT NO. 470070

PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	D. STOUGH	02/05/98
	DRAWN	B. EDGAR	
	CHECKED		

Sverdrup CORPORATION

PLAN AND PROFILE STA 24+00.00 TO STA 34+00.00 SHEET 2

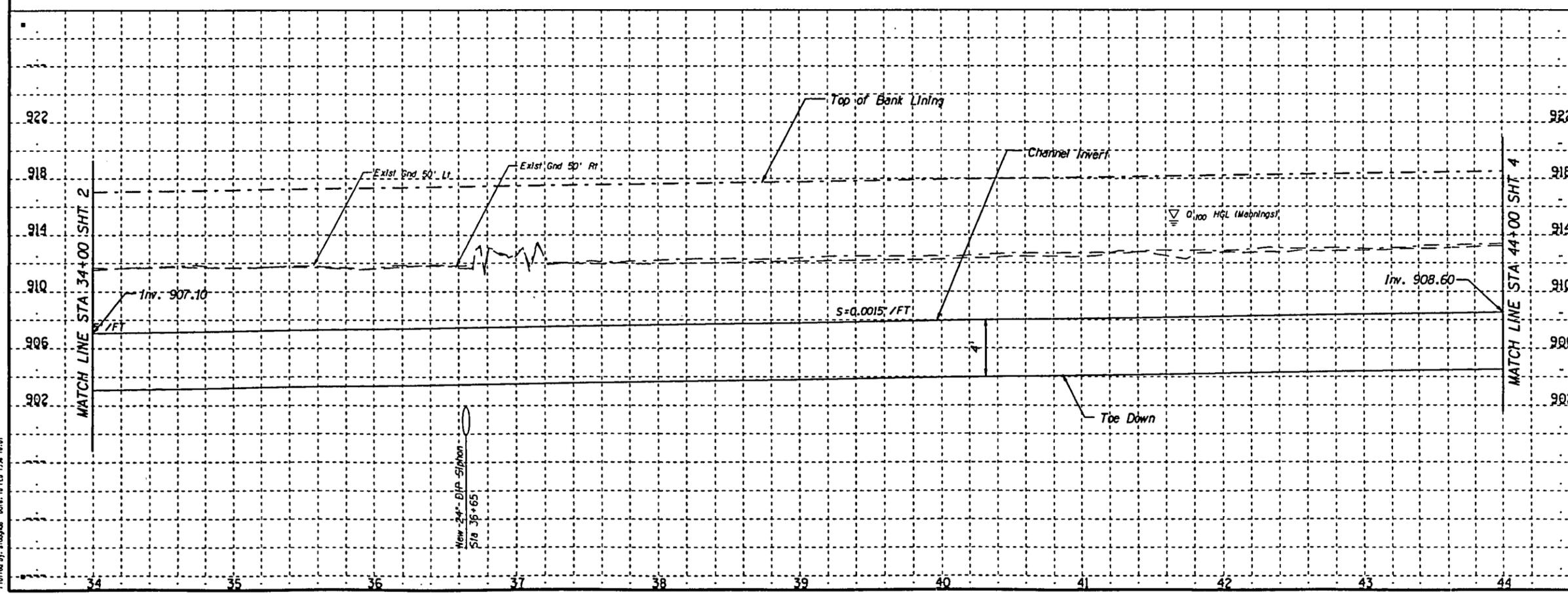
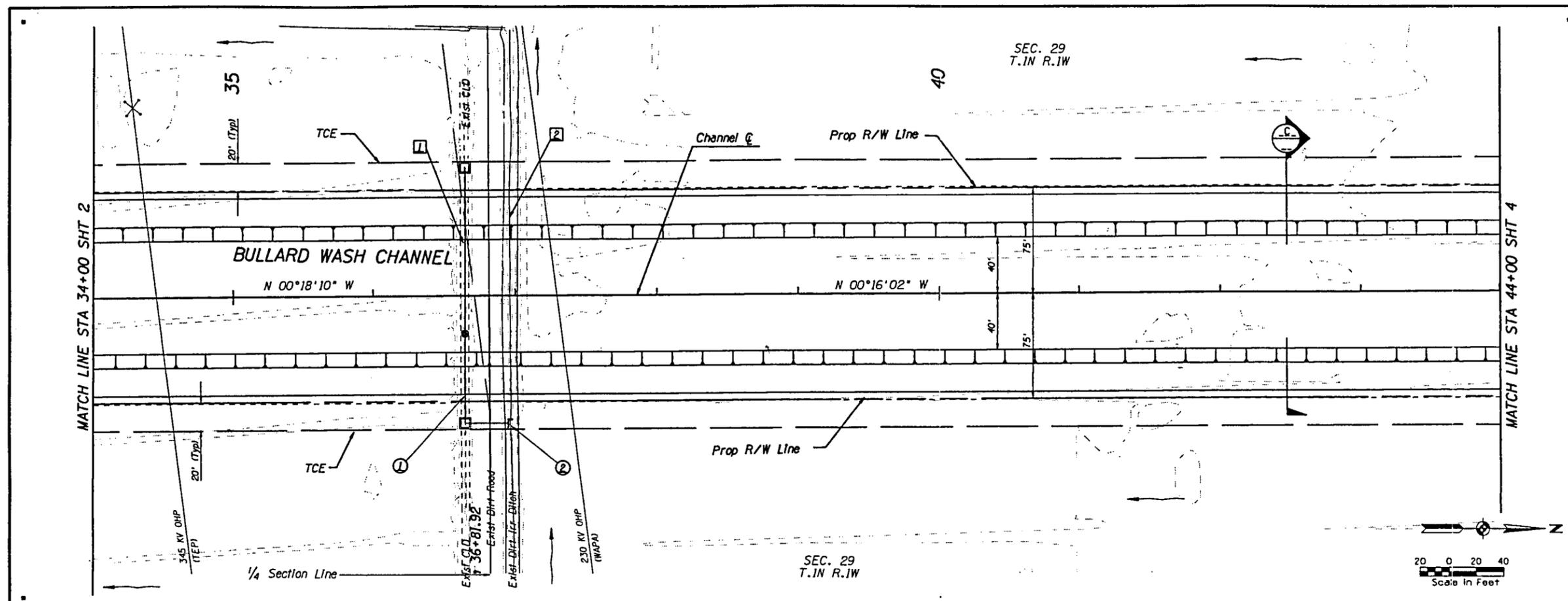


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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	00000	10	10	

- REMOVAL/RELOCATE
- ① Remove Exist CLD
- ② Fill & Compact Exist Dirt Ditch

- CONSTRUCTION
- ① New 24" DIP Siphon & Hdws See ---
- ② New 24" RGRCP & Hdwl See ---



NO.	REVISION	BY	DATE

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

BULLARD WASH CHANNEL
FINAL DESIGN - PHASE 1 AND 2
PROJECT NO. 470070

PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	D. STOUGH	02/05/98
	DRAWN	B. EDGAR	02/05/98
	CHECKED	-	02/05/98

Sverdrup
CORPORATION

PLAN AND PROFILE
STA 34 +00.00 TO STA 44 +00.00

SHEET
3

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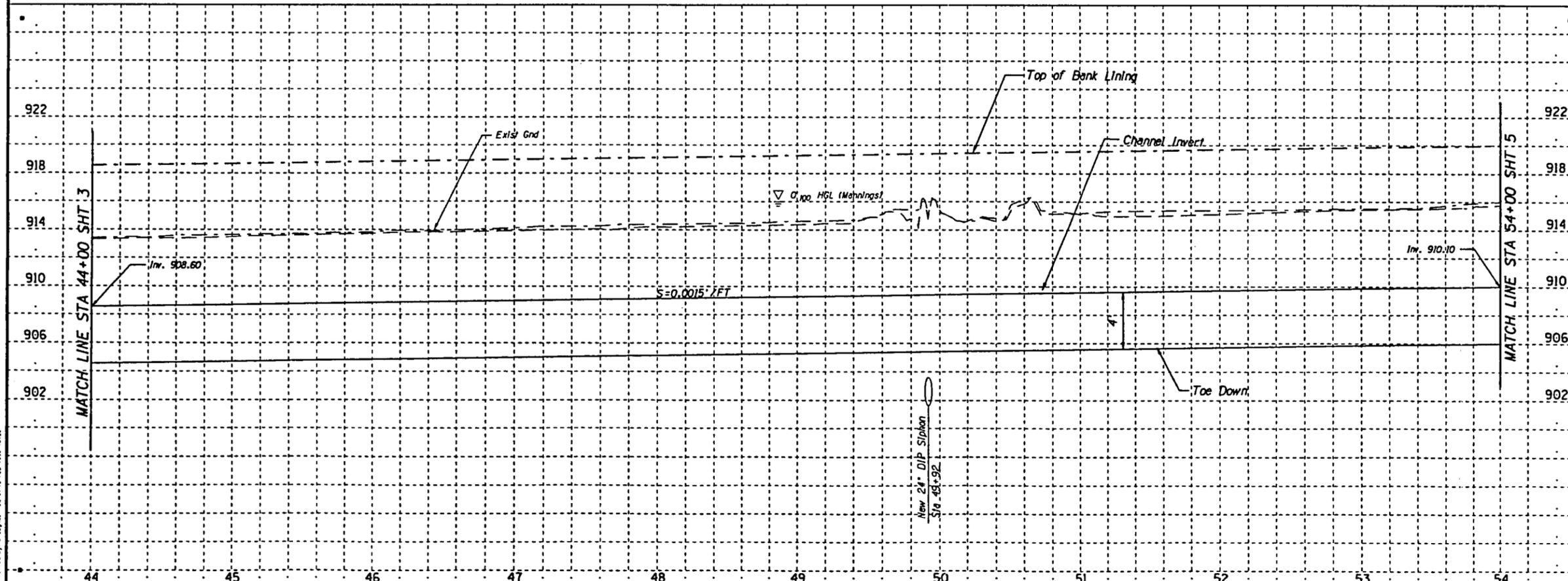
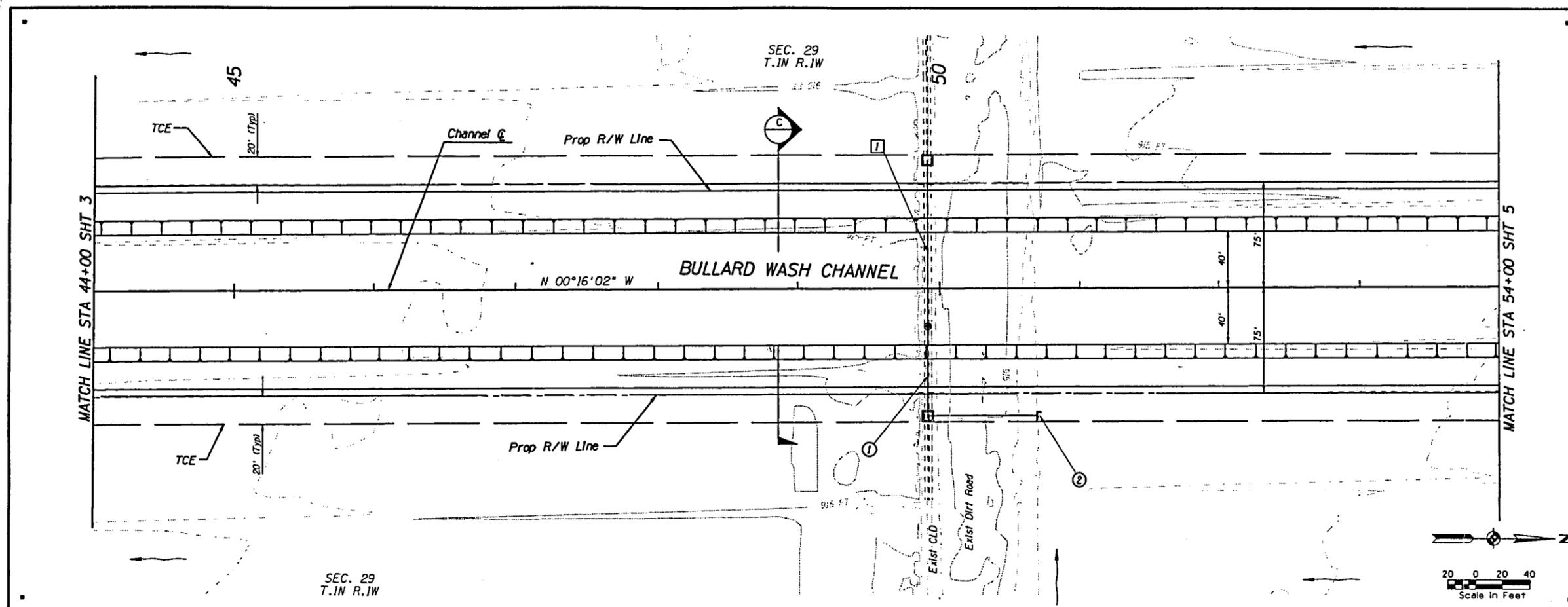
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	00000	0	10	

REMOVAL/RELOCATE

- Remove Exist CLD

CONSTRUCTION

- ① New 30" DIP Siphon & Hdwl See
- ② New 24" RCRCP & Hdwl See



NO.	REVISION	BY	DATE

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION

BULLARD WASH CHANNEL
FINAL DESIGN - PHASE 1 AND 2
PROJECT NO. 470070

	BY	DATE
DESIGNED	D. STOUGH	02/05/98
DRAWN	B. EDGAR	02/05/98
CHECKED		02/05/98

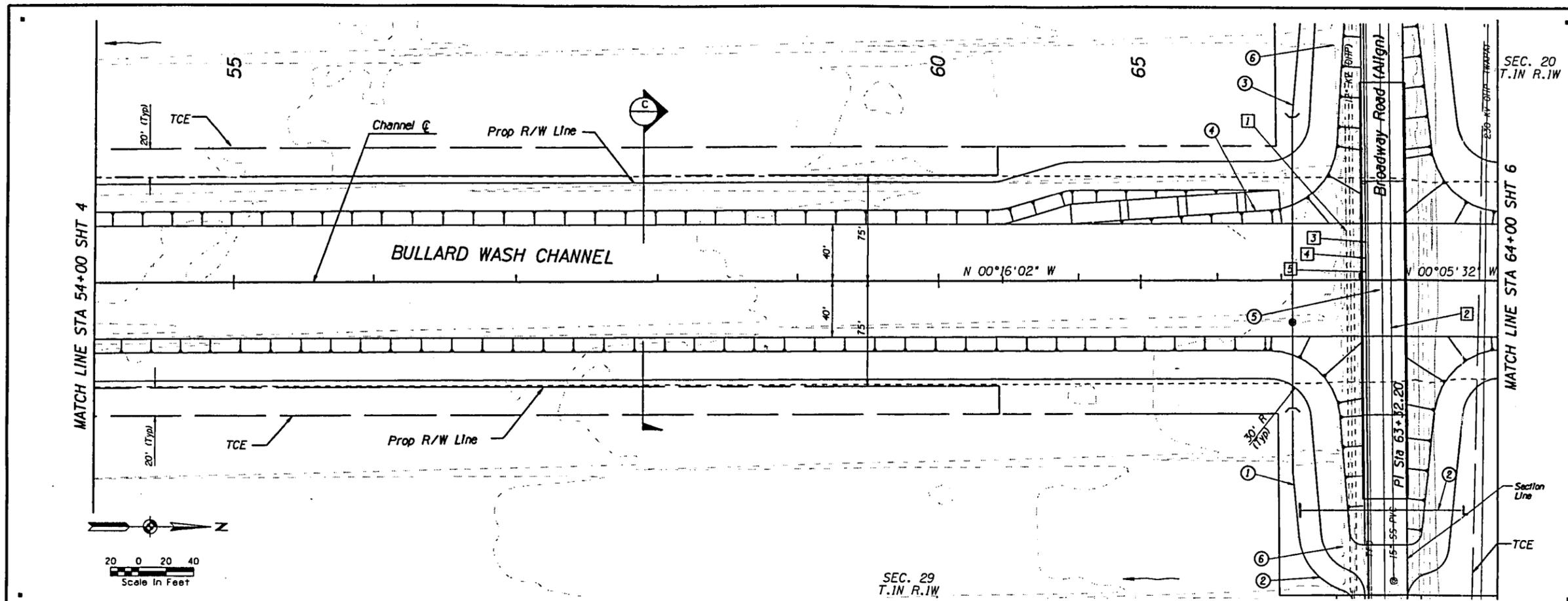
PRELIMINARY
NOT FOR
CONSTRUCTION

Sverdrup
CORPORATION

PLAN AND PROFILE
STA 44+00.00 TO STA 55+00.00

SHEET
4

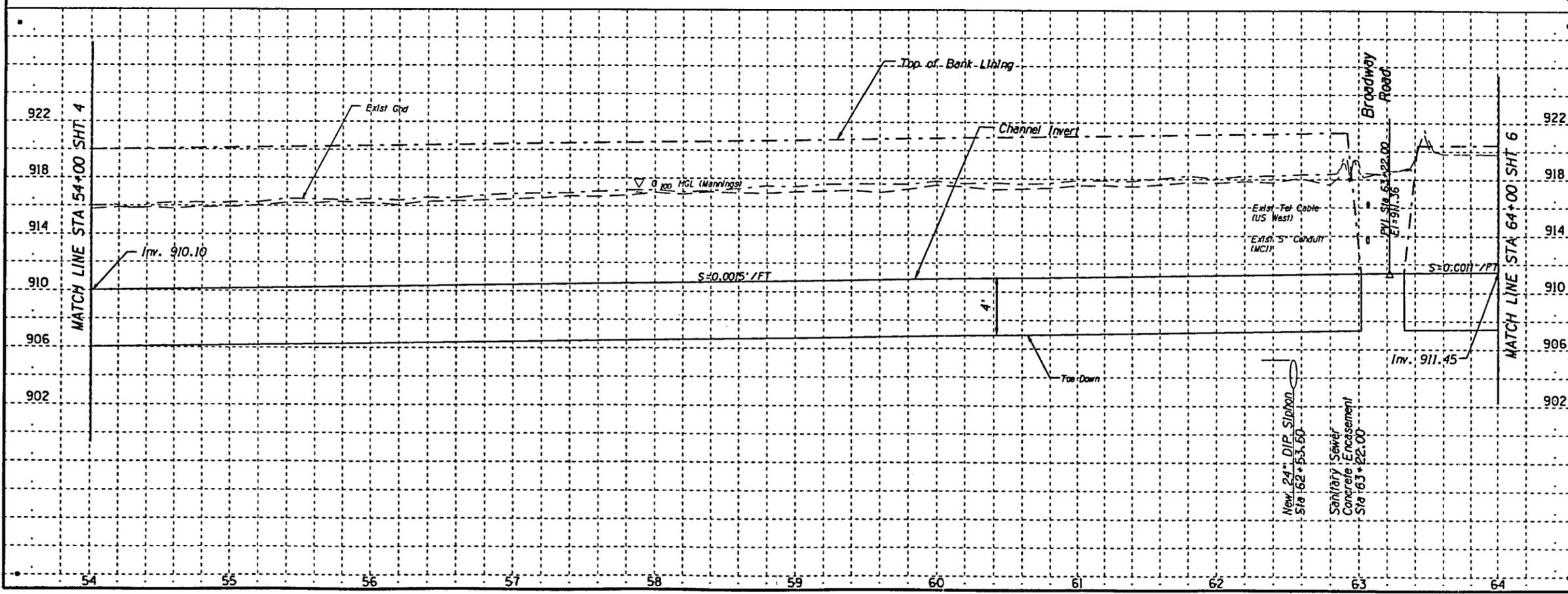
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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	00800	-	10	

- REMOVAL/RELOCATE
- 1 Remove Exist CLD
 - 2 Sanitary Sewer Encasement See
 - 3 Relocate 12 Kv OHP (APS)
 - 4 Relocate Tel Cable (US West)
 - 5 Relocate FO Cable (MCI)
- Note:
See Detail Sheet DIP Crossing/
SS Encasement for Location of
Utilities in this area.

- CONSTRUCTION
- 1 New 24" DIP Siphon & Hdws See
 - 2 New 24" RGRCP & Hdwl See
 - 3 New CLD by Others
 - 4 New Maintenance Ramp, See
 - 5 New ABC Dip Crossing, See
 - 6 New 20' Maintenance Road Access



NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION**

**BULLARD WASH CHANNEL
FINAL DESIGN - PHASE 1 AND 2
PROJECT NO. 470070**

PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	B. STOUGH	02/05/98
	DRAWN	B. EDGAR	02/05/98
	CHECKED		02/05/98

**Sverdrup
CORPORATION**

PLAN AND PROFILE
STA 54+00.00 TO STA 64+00.00

SHEET
-5-

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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	0000		10	

- REMOVAL/RELOCATE
- 1 Relocate 12" HP Petroleum Pipeline (SFPP)
 - 2 Relocate 20" HP Petroleum Pipeline (SFPP)
 - 3 Relocate Tel FO Cable (MCI)
 - 4 Relocate Railroad Switching OH Lines (UPRR)
 - 5 Fill In Dirt Irr Ditch
 - 6 Relocate 8 3/4" HP Gas Pipeline (El Paso NG)

- CONSTRUCTION
- 1 New Access Gate, See
 - 2 New CLD, See
 - 3 New 30" RCP (Jack under RR) with Hdws, See
 - 4 New Std UPRR Precast Bridge By Others
 - 5 New Conc. Lined E. Trib. Chl, See
 - 6 New Maintenance Ramp, See
 - 7 New 24" RGCRP w/ Drop Inlet, See

NO.	REVISION	BY	DATE

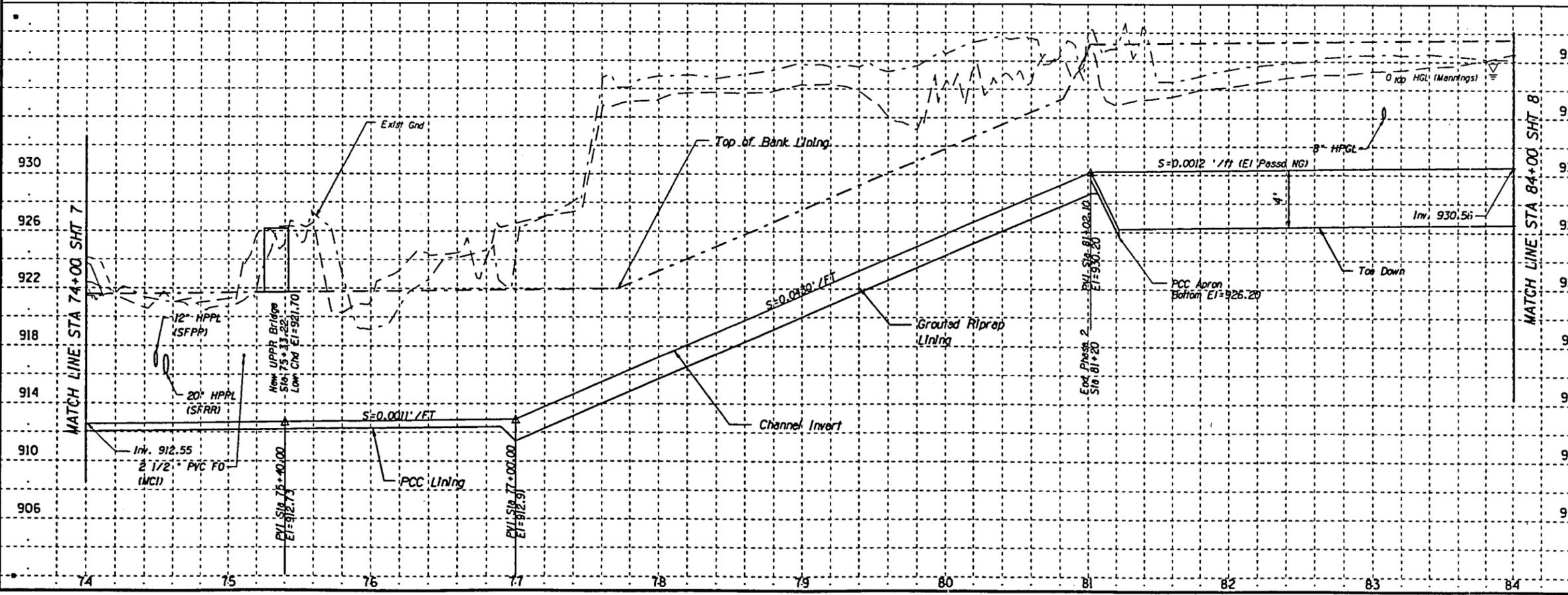
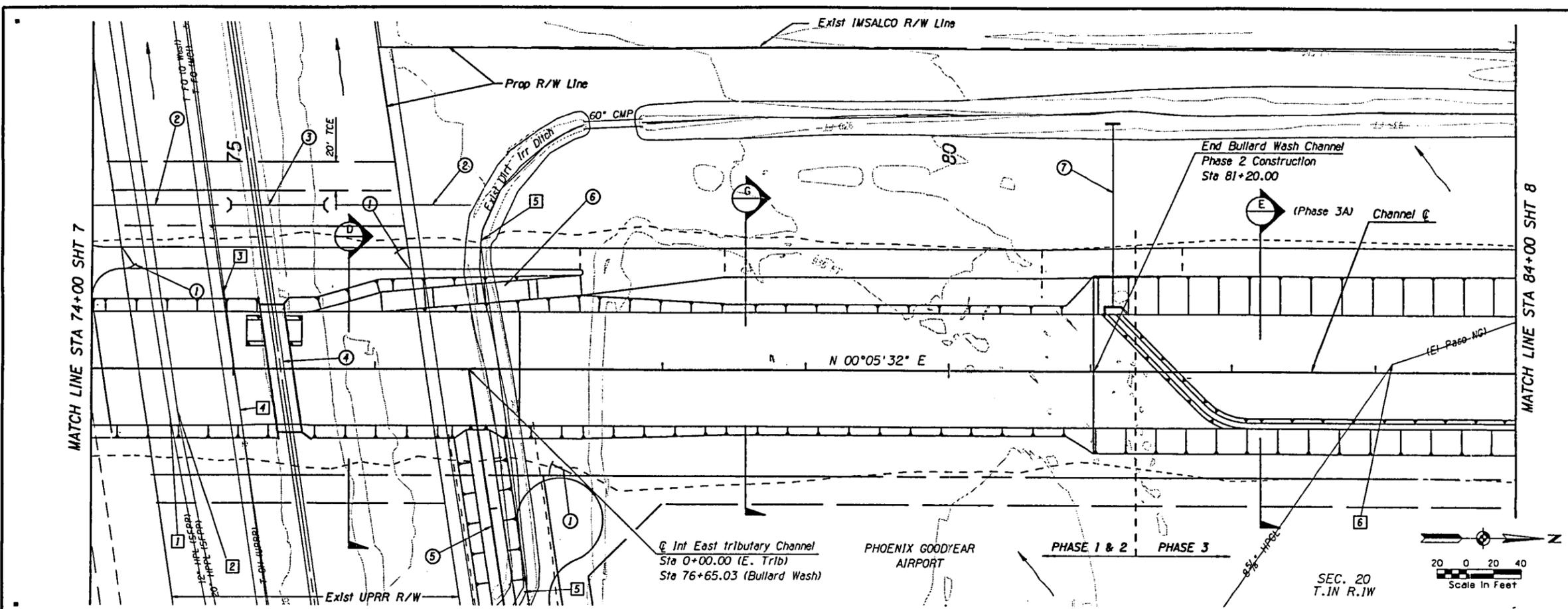
**FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION**

**BULLARD WASH CHANNEL
FINAL DESIGN - PHASE 1, 2 AND 3
PROJECT NO. 470070**

PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	D. STOUGH	02/05/98
	DRAWN	B. EDGAR	02/05/98
	CHECKED		02/05/98



PLAN AND PROFILE
STA 74+00.00 TO STA 84+00.00 SHEET .7



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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	00800	0	10	

REMOVAL/RELOCATE

- 1 Remove Exist 24" CP
- 2 Fill in Exist Dirt Irr Ditch
- 3 Relocate Exist HPGL (See Phase IA)

CONSTRUCTION

- 1 New Chain Link Fence
- 2 New 100' Channel Transition
- 3 New Access Gate, Chain Link Fence
- 4 New Dirt Irr Ditch by Others
- 5 New Pedestrian Ramp
- 6 Fill Overbank area Level with Top of Bank Lining.

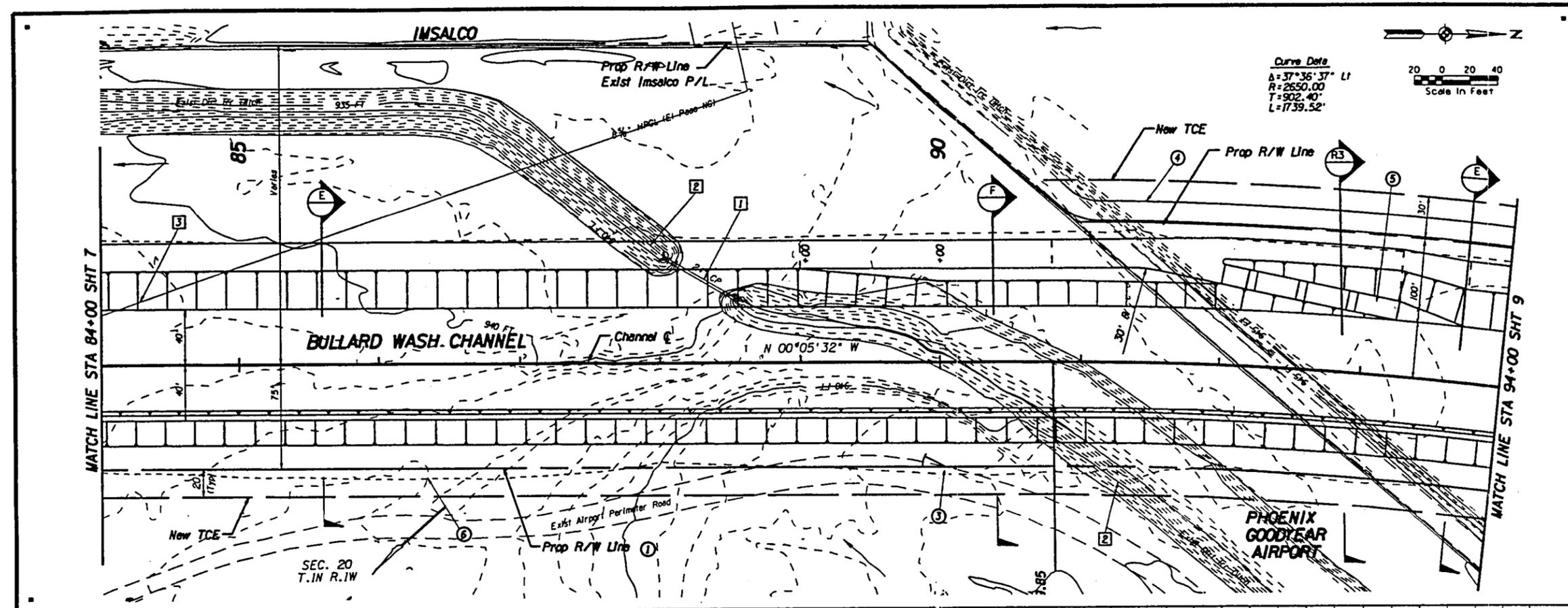
NO.	REVISION	BY	DATE

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY
ENGINEERING DIVISION
BULLARD WASH CHANNEL
FINAL DESIGN - PHASE 3
PROJECT NO. 470070

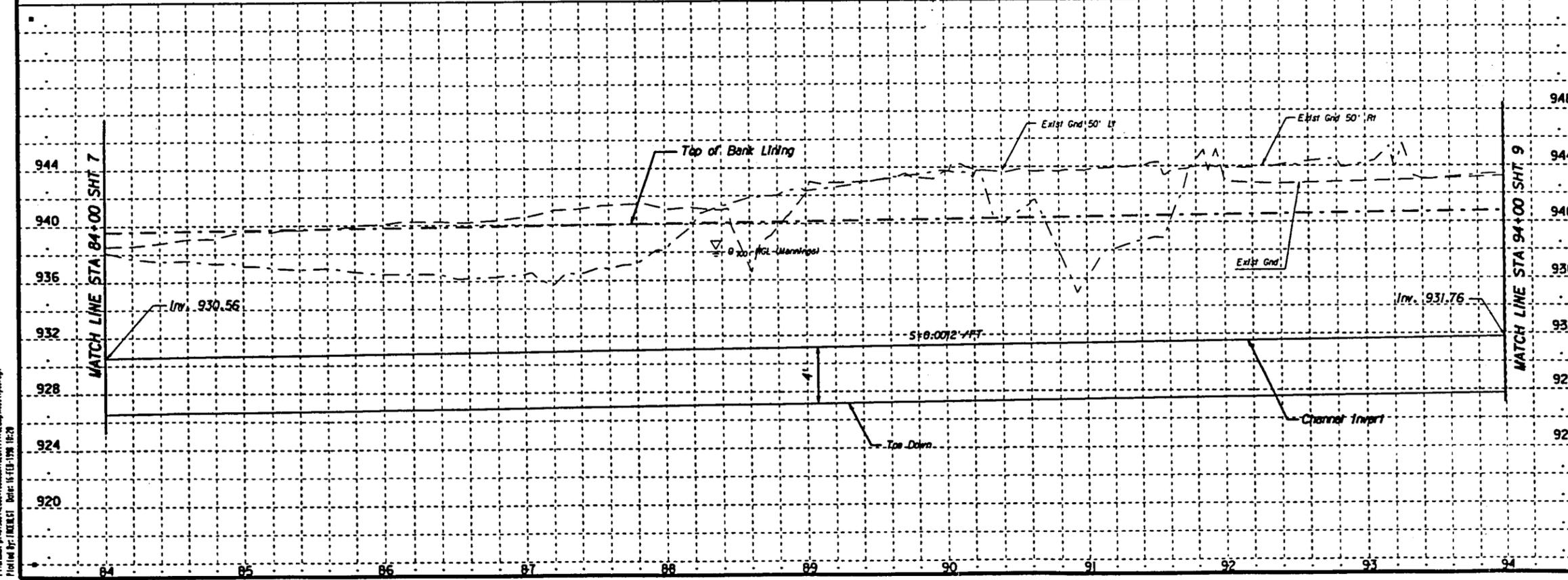
PRELIMINARY NOT FOR CONSTRUCTION	BY	DATE
DESIGNED	D. STOUGH	02/05/98
DRAWN	B. EDGAR	02/05/98
CHECKED		02/05/98

Sverdrup
CORPORATION

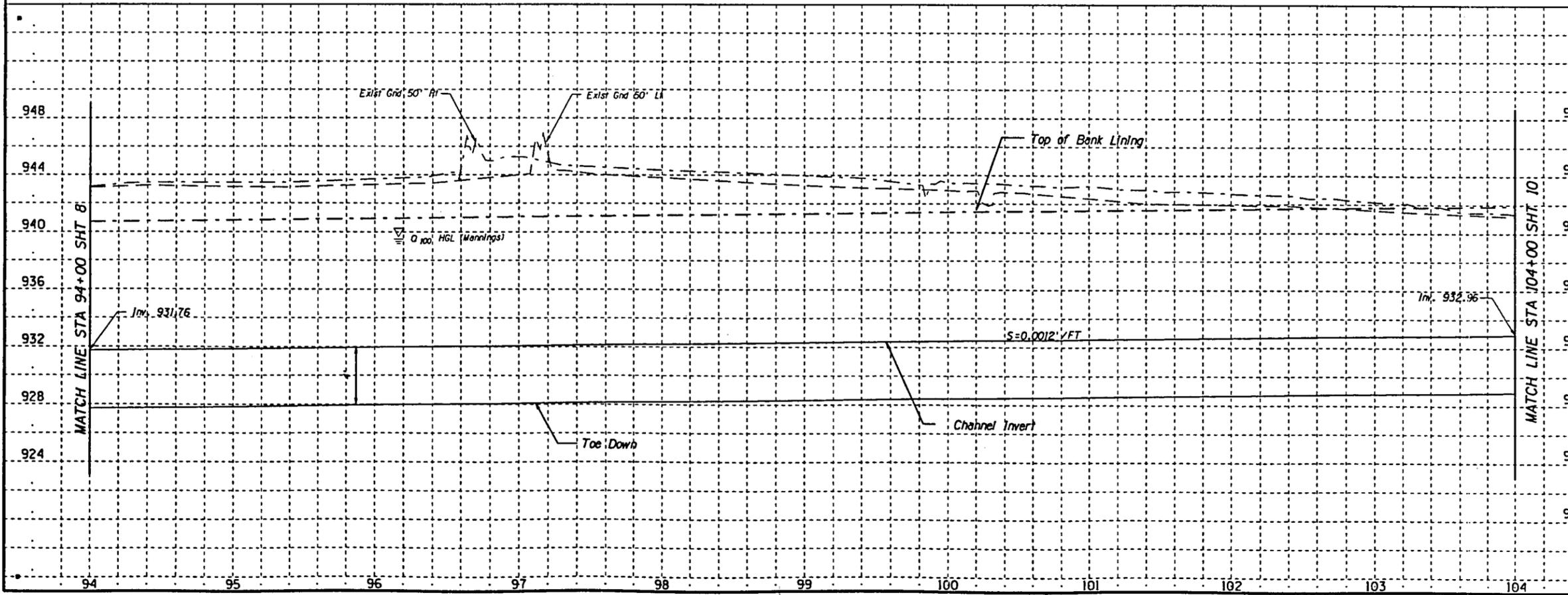
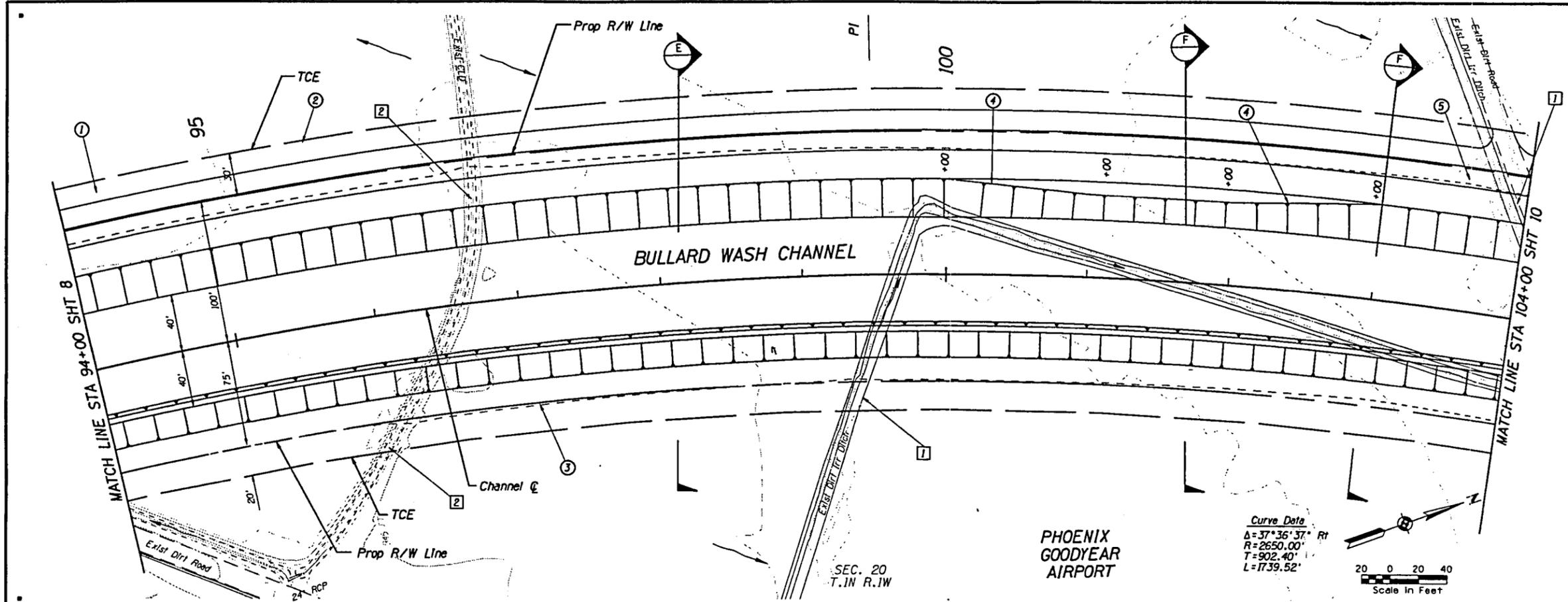
PLAN AND PROFILE
STA 84+00.00 TO STA 94+00.00 SHEET 8



Curve Data
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 $T = 902.40'$
 $L = 1739.52'$



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F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	00800	0 10	0 10	

- REMOVAL/RELOCATE
- 1 Fill In and Compact Exist Dirt Ditch.
- 2 Remove Existing CLD.

- CONSTRUCTION
- 1 New 14' Wide Dirt Road
 - 2 New CLD
 - 3 New Chain Link Fence
 - 4 New 100' Channel Transition
 - 5 New 24" RGRCP & Hdwl See

Curve Data
 $\Delta = 37^{\circ}36'37''$ Rt
 $R = 2650.00'$
 $T = 902.40'$
 $L = 1739.52'$



NO.	REVISION	BY	DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
 ENGINEERING DIVISION
 BULLARD WASH CHANNEL
 FINAL DESIGN - PHASE 3
 PROJECT NO. 470070

DESIGNED	D. STOUGH	02/05/98
DRAWN	B. EDGAR	02/05/98
CHECKED		02/05/98

Sverdrup
CORPORATION

PLAN AND PROFILE
 STA 94+00.00 TO STA 104+00.00

PRELIMINARY NOT FOR CONSTRUCTION

SHEET .9

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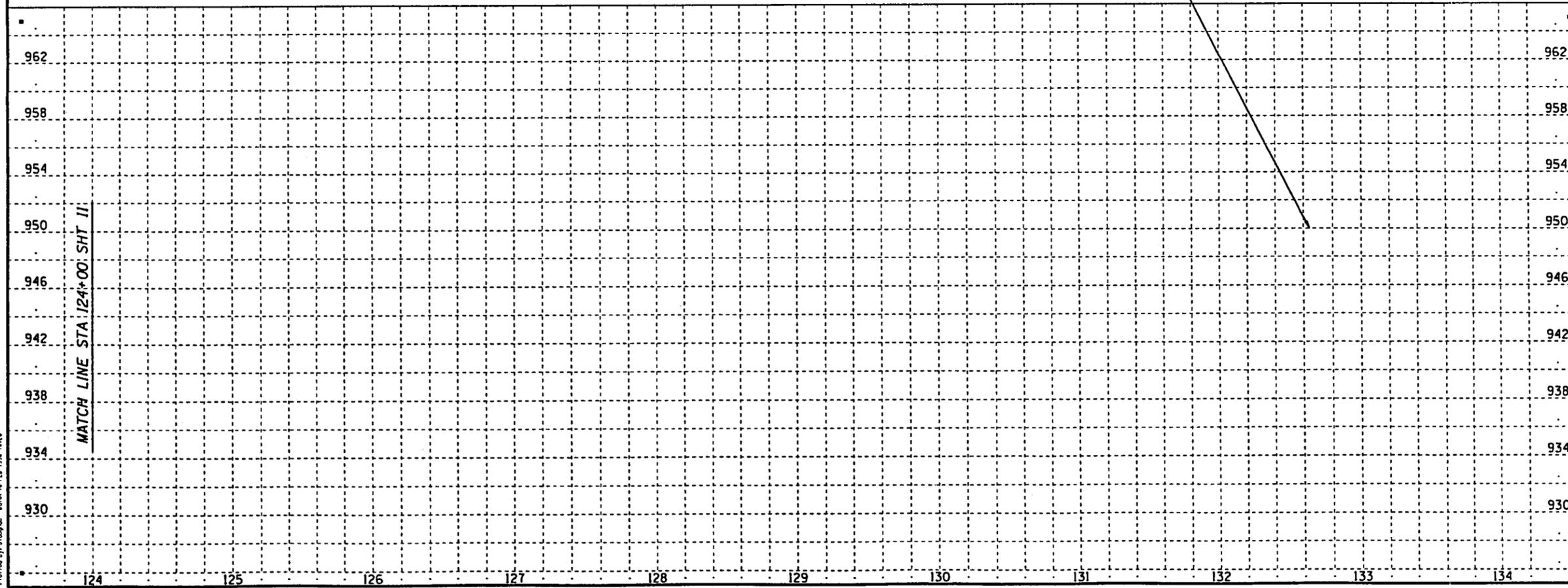
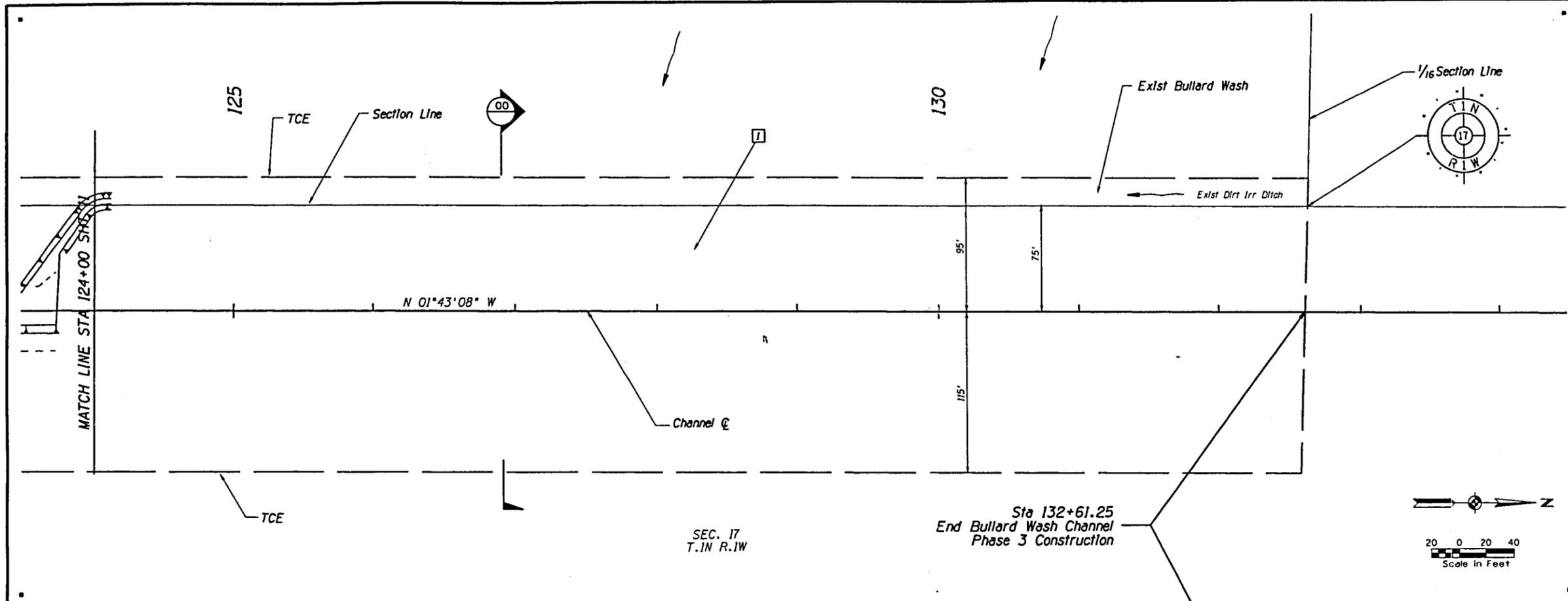
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	00000	010	010	

REMOVAL/RELOCATE

1 Excavate Exist Pond Dikes to Match Adjacent Fields.

2 Remove Exist Concrete Rubble.

CONSTRUCTION
 ① New Hdwl



NO.	REVISION	BY	DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY ENGINEERING DIVISION

BULLARD WASH CHANNEL FINAL DESIGN - PHASE 3 PROJECT NO. 470070

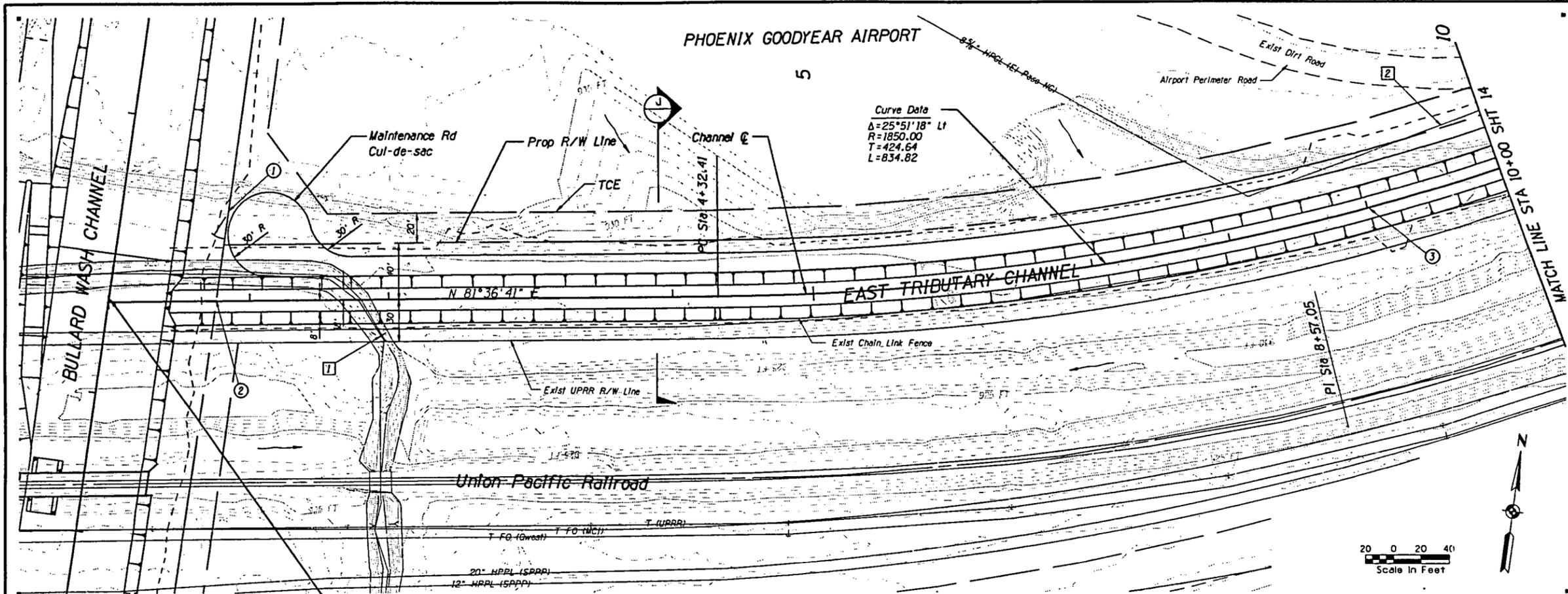
	BY	DATE
DESIGNED	D. STOUGH	02/05/98
DRAWN	B. EDGAR	02/05/98
CHECKED		02/05/98

PRELIMINARY NOT FOR CONSTRUCTION

Sverdrup
CORPORATION

PLAN AND PROFILE STA 124+00.00 TO STA 134+00.00 SHEET 12

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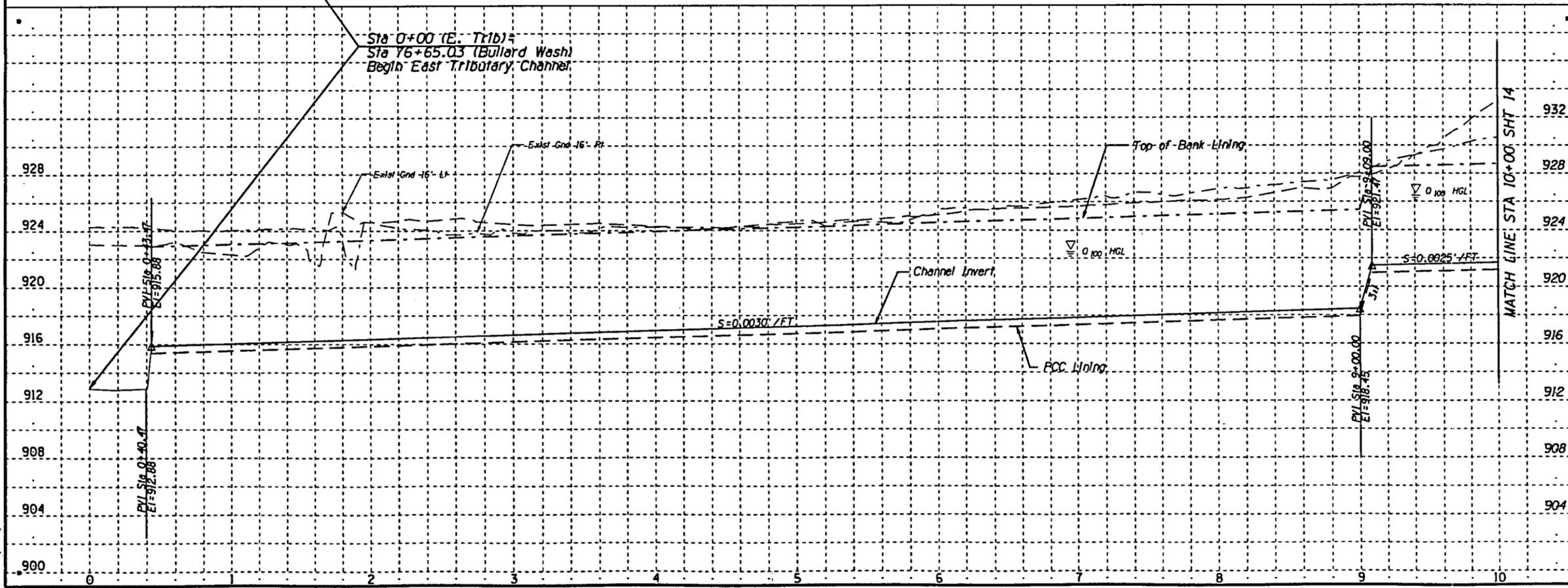
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	470070	0	10	

REMOVAL/RELOCATE

- ① Fill in Exist Dirt Irr Ditch
- ② Relocate 8" HP Gas Pipeline (EI Paso NG) as Required.

CONSTRUCTION

- ① New Access Gate, See
- ② New Breakaway Chain Link Fence Crossing, See
- ③ New Grade Control Structure, See



NO.	REVISION	BY	DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY ENGINEERING DIVISION

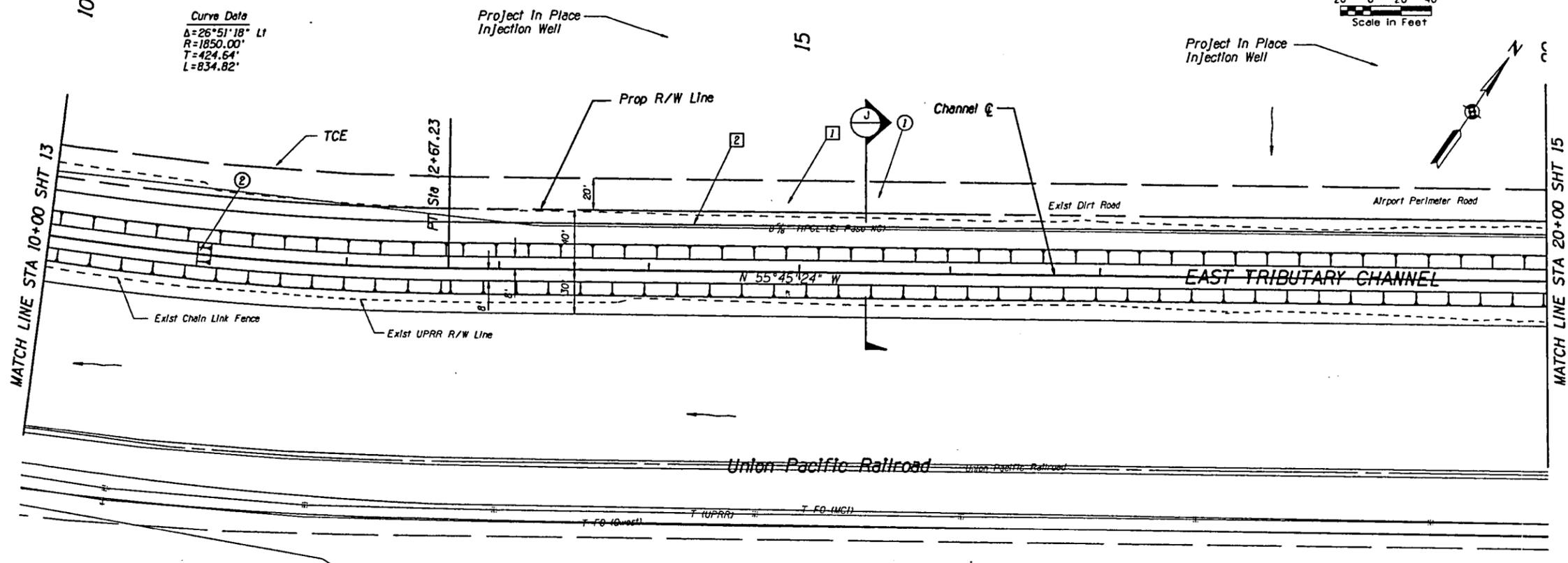
BULLARD WASH CHANNEL FINAL DESIGN - PHASE 3 PROJECT NO. 470070

PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	D. STOUGH	02/05/98
	DRAWN	B. EDGAR	02/05/98
	CHECKED	-	02/05/98

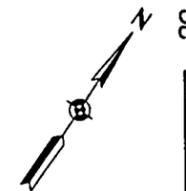
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 PLAN AND PROFILE: (EAST TRIBUTARY) STA 0+00.00 TO STA 10+00.00 SHEET 13

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PHOENIX GOODYEAR AIRPORT

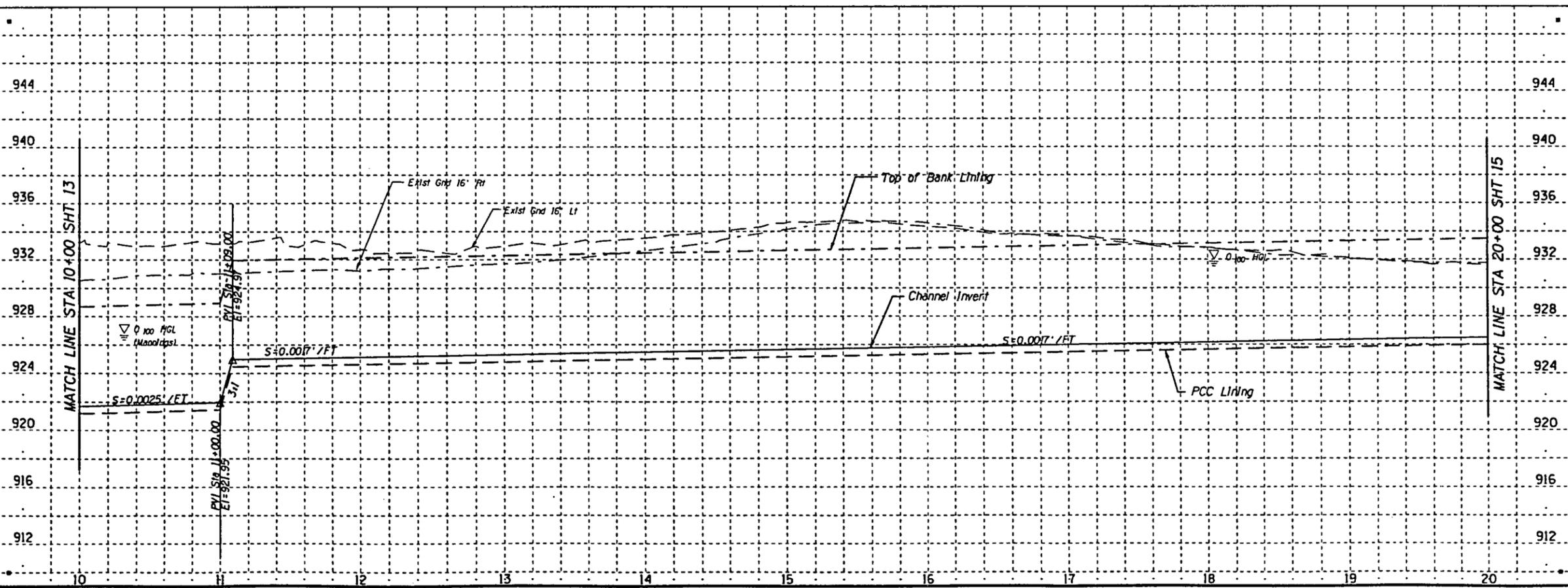


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 $L = 834.82'$



F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	470070	0	10	

- REMOVAL/RELOCATE
- 1 Remove AC Pavement
 - 2 Relocate 8" Hp Gas Pipeline (El Paso NG) as Required
- CONSTRUCTION
- 1 Widen Dirt Perimeter Road as Required to Maintain 16' Width.
 - 2 New Grade Control Structure, See



NO.	REVISION	BY	DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
 ENGINEERING DIVISION

BULLARD WASH CHANNEL
 FINAL DESIGN - PHASE 3
 PROJECT NO. 470070

PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	D. STOUGH	02/05/98
	DRAWN	B. EDGAR	02/05/98
	CHECKED		02/05/98

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 CORPORATION

PLAN AND PROFILE: (EAST TRIBUTARY)
 STA 10+00.00 TO STA 20+00.00

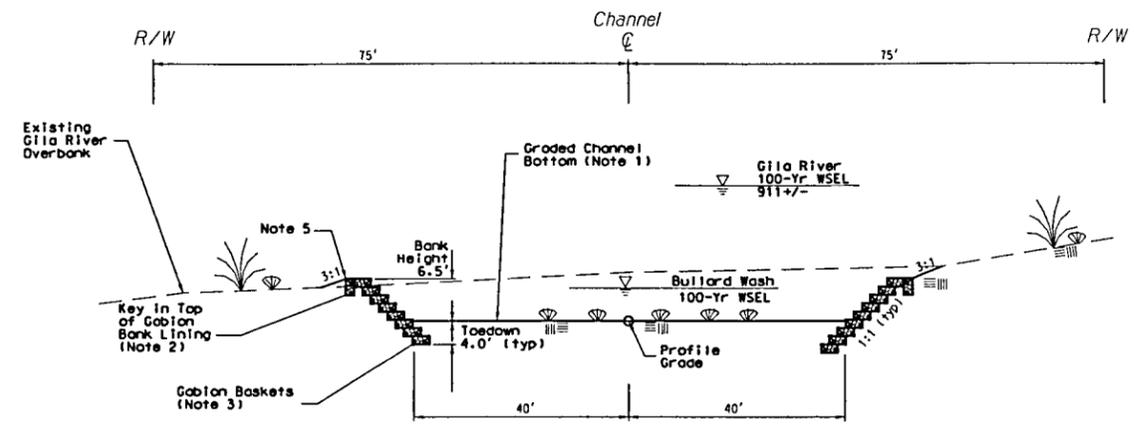
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SELECTED ALTERNATIVE CROSS SECTIONS

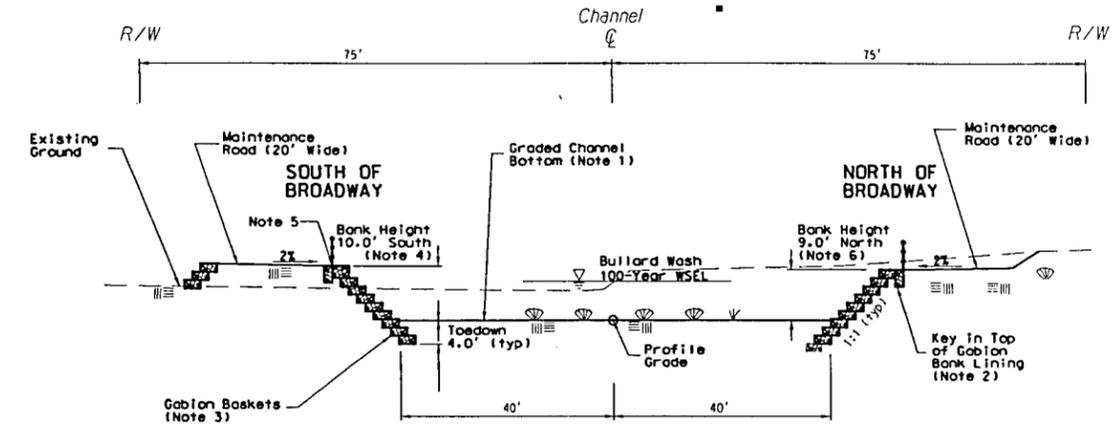
NOTE: These plans are preliminary and should not be considered final design.

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	470070	-	-	-



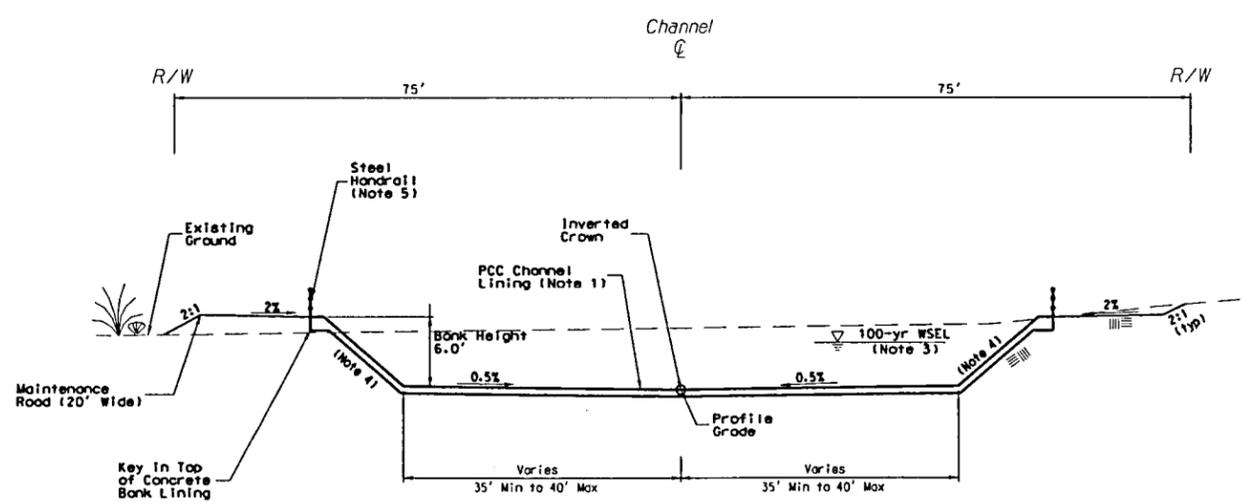
TRAPEZOIDAL CHANNEL SECTION
 STEPPED GABION BANK LINING
 Sta 25+00 to 29+10
SECTION A-A
 N.T.S.

- NOTES (Sec AA)**
- 1) Recurring vegetation in channel bottom will require vegetation management.
 - 2) Key in top of bank per FCDMC, or City of Goodyear, as required.
 - 3) Riprap filled gabion baskets, stacked with 50-percent overlap, 18" x 36" x 12" basket size, on geotextile fabric.
 - 4) Channel bank height is flow depth for normal depth flow.
 - 5) Berm height shall not exceed 1.0 foot. Downstream low areas shall be backfilled for a maximum distance of 20 feet when required.



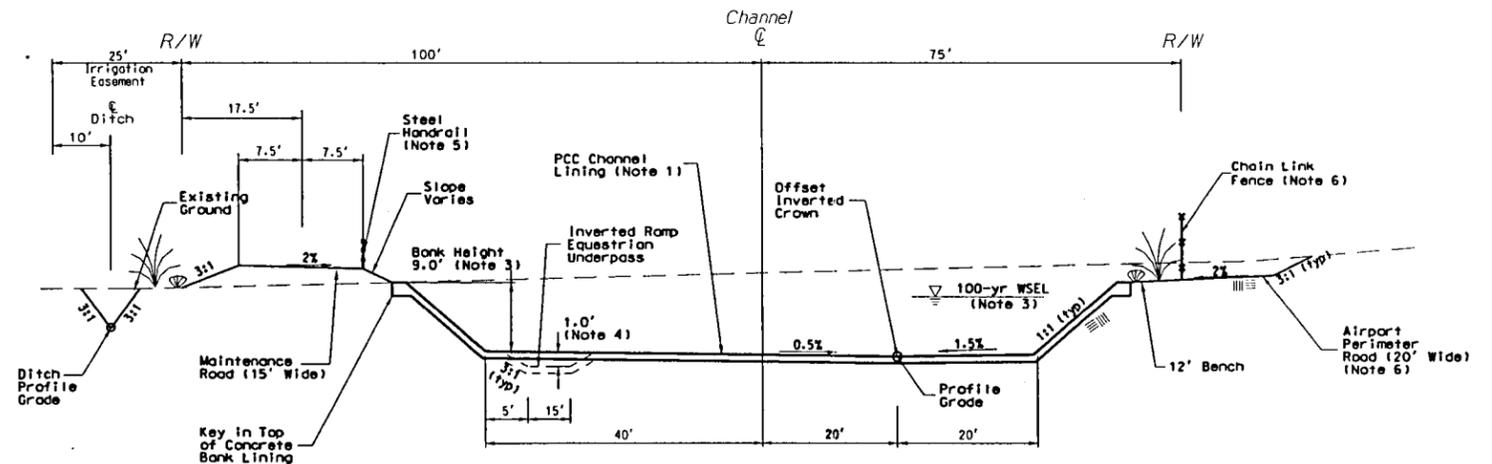
TRAPEZOIDAL CHANNEL SECTION
 STEPPED GABION BANK LINING
 Sta 33+20 to 63+20 (South)
 Sta 63+20 to 73+00 (North)
SECTION C-C
 N.T.S.

- NOTES (Sec CC)**
- 1) Recurring vegetation in channel bottom will require vegetation management.
 - 2) Key in Top & Gabion Bank Lining per FCDMC or City of Goodyear, as required.
 - 3) Riprap filled gabion baskets, stacked with 50-percent overlap, 18" x 36" x 12" basket size, on geotextile fabric.
 - 4) South of Broadway Road, freeboard is 3 feet (controlled by WSEL relative to surrounding ground). Top gabion lift will use a 24" x 36" x 12" basket size.
 - 5) Steel handrail will be installed immediately behind channel lining. See Detail.
 - 6) North of Broadway Road freeboard is 1.9 feet (normal depth & velocity criteria). Top gabion lift will use a 18" x 36" x 12" basket size.



TRAPEZOIDAL CHANNEL SECTION
 FULL CONCRETE LINING
 Sta 30+60 to 33+40
SECTION B-B
 N.T.S.

- NOTES (Sec BB)**
- 1) Channel bottom shall be roughened, colored PCC concrete, cast in place, 6-inch minimum thickness.
 - 2) Key in top of bank and install weep holes per FCDMC or City of Goodyear standards, as required.
 - 3) Channel bank height is flow depth 3.3 feet plus 1.7 feet of freeboard, 100-year WSEL is below surrounding ground.
 - 4) Channel sideslopes transition from vertical at the BID overchute to 1:1 slope at Sta 31+10.
 - 5) Steel handrail will be installed immediately behind channel lining. See Detail.



TRAPEZOIDAL CHANNEL SECTION
 FULL CONCRETE LINING
 Sta 73+00 to 77+00
SECTION D-D
 N.T.S.

- NOTES (Sec D-D)**
- 1) Channel bottom shall be roughened, colored PCC concrete, cast in place, 6-inch minimum thickness.
 - 2) Key in top of bank and install weep holes per FCDMC or City of Goodyear standards, as required.
 - 3) Water surface at Sta 73+00 to 77+00 is controlled by downstream channel roughness. Bank height is downstream normal depth plus freeboard of 2.0 feet.
 - 4) Equestrian path is lowered beneath channel bottom only under new UPRR bridge.
 - 5) Section D-D, steel handrail will be installed at top of bank adjacent maintenance road where shown on plans. See Detail.
 - 6) Chain link fence (MAG Std 160) is to be installed along airport R/W only. Dirt airport perimeter road to be built as required by Phoenix Goodyear Airport.

NO.	REVISION	BY	DATE

**FLOOD CONTROL DISTRICT
 OF MARICOPA COUNTY
 ENGINEERING DIVISION**

**BULLARD WASH
 CHANNEL IMPROVEMENTS
 PROJECT NO. 470070**

PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	D. STOUGH	02/05/98
	DRAWN	B. EDGAR	02/05/98
	CHECKED		02/05/98

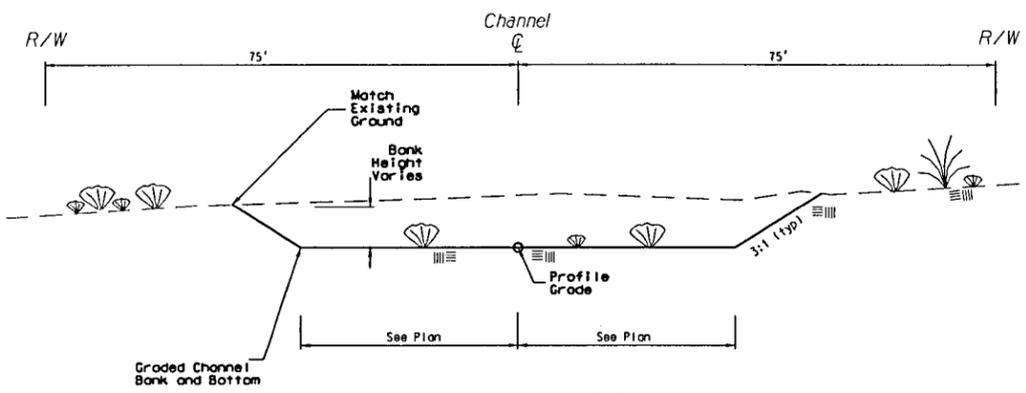
Sverdrup
CORPORATION

CHANNEL TYPICAL SECTIONS
 A-A, B-B, C-C and D-D

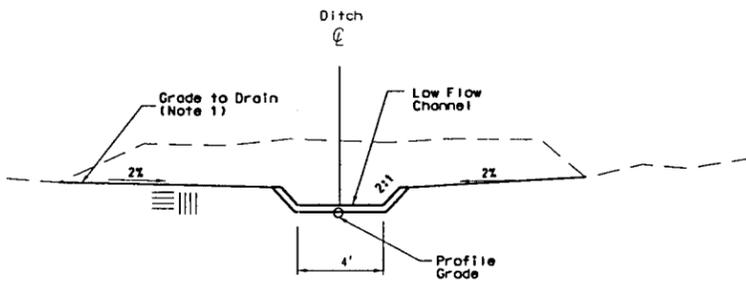
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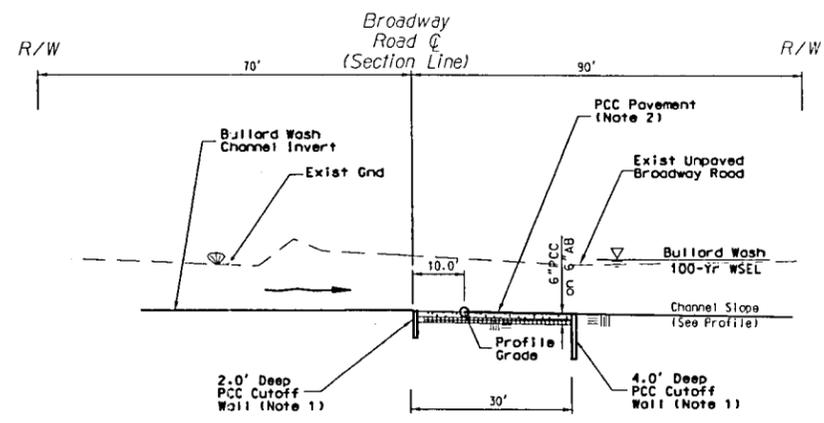
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9	AZ.	470070	.	.	.



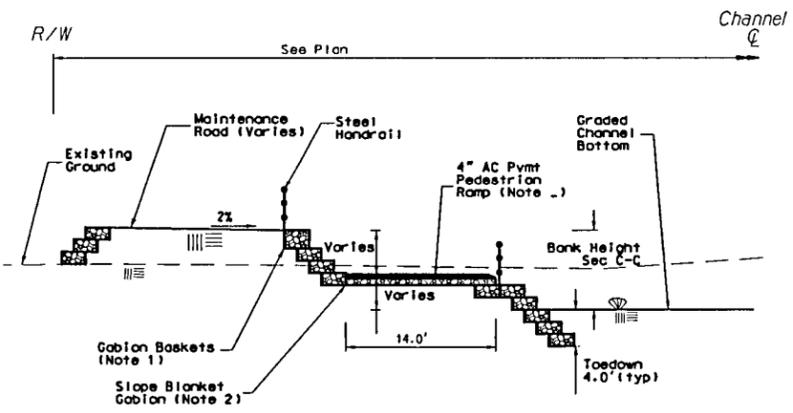
GRADED CHANNEL SECTION (UNLINED CHANNEL)
Sta 18+10 to 25+00
Sta 121+00 to 123+80
SECTION I-I
N.T.S.



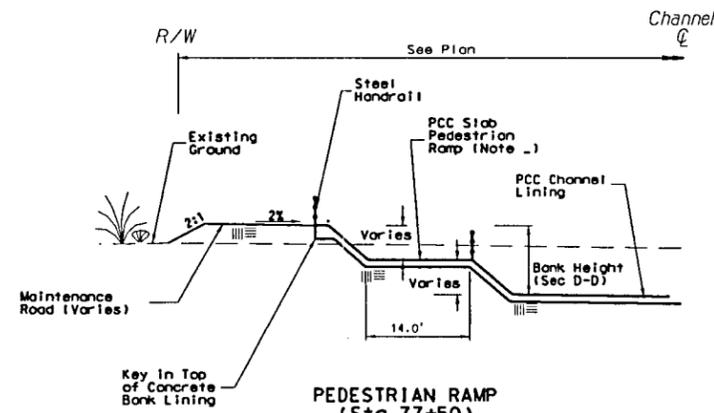
LOW FLOW CHANNEL
Sta 123+00 to Exist Bullard Wash
SECTION K-K
N.T.S.
NOTES (Sec KK)
1) Grade as necessary to join back of channel lining to surrounding ground.



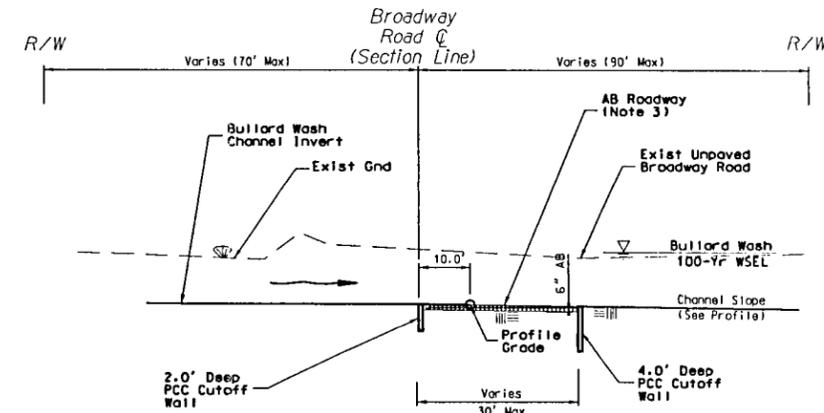
PCC SURFACE FORD CROSSING
Sta 41+75 to 43+15 Broadway Road
SECTION L1
N.T.S.



MAINTENANCE RAMP
(Sta 62+50 and 64+50)
SECTION R1
N.T.S.

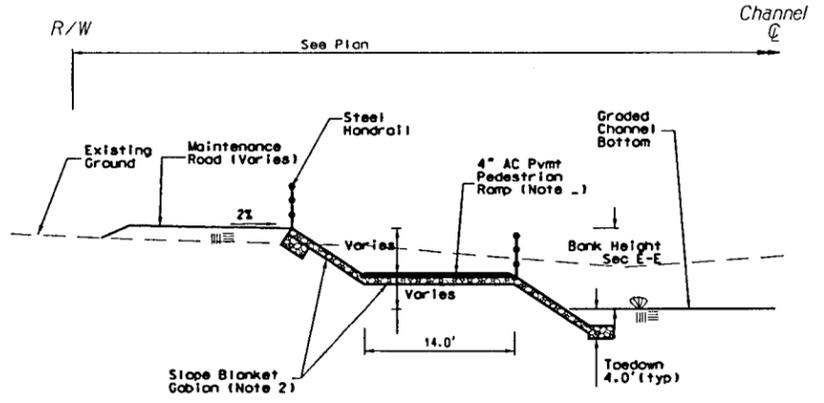


PEDESTRIAN RAMP
(Sta 77+50)
SECTION R2
N.T.S.

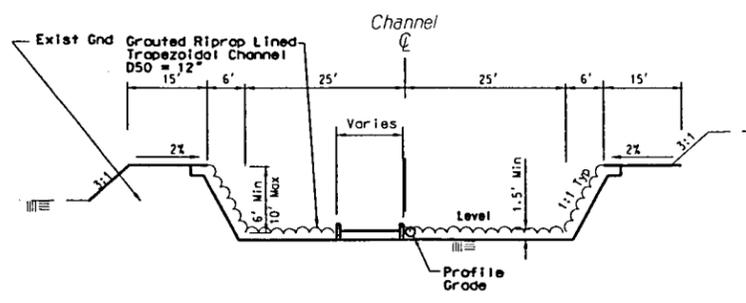


NOTES (Sec L1 and L2)
1) PCC cutoff walls per MAG Sta 552.
2) PCC roadway surface, 6 inch thick over 6 inches AB.
3) AB roadway surface, 6 inch thick

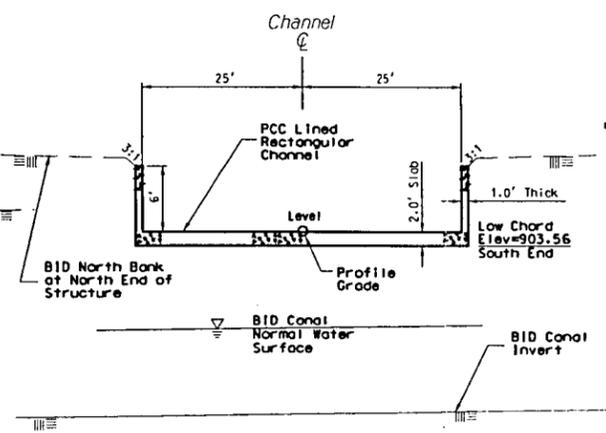
AGGREGATE BASE COURSE FORD CROSSING
Sta 41+05 to 41+75 and
Sta 43+15 to 43+75 Broadway Road
SECTION L2
N.T.S.



MAINTENANCE RAMP
(Sta 91+50 and 118+00)
SECTION R3
N.T.S.



GRADE CONTROL STRUCTURE 1
(Sta 29+30 to 29+90)
SECTION M1
N.T.S.

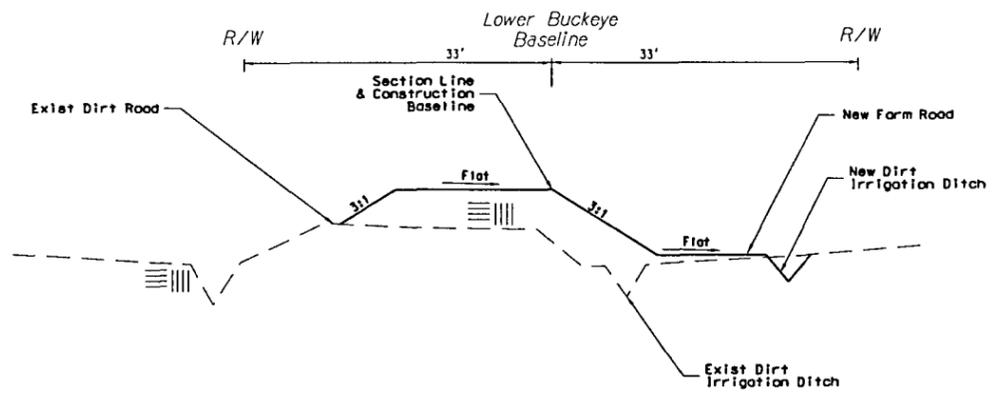


BID CANAL OVERCHUTE STRUCTURE
(Sta 29+90 to 30+60)
SECTION M2
N.T.S.

REVISION		BY	DATE
NO.			
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY ENGINEERING DIVISION			
BULLARD WASH CHANNEL IMPROVEMENTS PROJECT NO. 470070			
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	D. STOUGH	01/14/98
	DRAWN	B. EDGAR	01/20/98
	CHECKED		01/27/98
Sverdrup CORPORATION		BY	DATE
CHANNEL TYPICAL SECTIONS I-I, K-K, R1, R2, and R3			SHEET OF 0 A

File name: P:\01\BID\470070\Drawings\11\1120\chp\470070.dwg
 Plotted by: stough Date: 10-11-1998 08:23

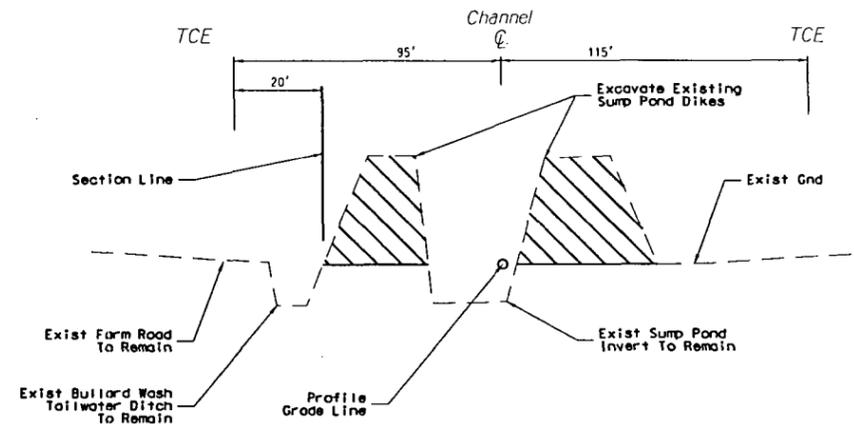
F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.	470070	.	.	.



LOWER BUCKEYE ROAD
FILL SECTION
Sta
SECTION N-N
N.T.S.

NOTES (Sec NN)

- 1) Construct roadway from 6-inch AB on roadway fill.
- 2) Farm road and dirt irrigation ditch shall be constructed prior to construction of new roadway fill.



DIKE REMOVAL
BULLARD WASH
Sta 123+40 to 132+60
SECTION O-O
N.T.S.

NO.	REVISION	BY	DATE
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY ENGINEERING DIVISION			
BULLARD WASH CHANNEL IMPROVEMENTS PROJECT NO. 470070			
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	D. STOUGH	01/14/98
	DRAWN	B. EDGAR	01/20/98
	CHECKED	.	01/ /98
CHANNEL TYPICAL SECTIONS N-N and O-O			SHEET OF 0 A

File name: p:\470070\0001\0001\0001.dwg
 Plotted by: srauph Date: 11/13/98 09:30

HEC-RAS OUTPUT AND PROFILE

NOTE: These plans are preliminary and should not be considered final design.

**SELECTED ALTERNATIVE - Bullard Wash Outfall Channel Improvements
Final (30%) Hydraulic Profile (100-yr Q) for sub & super critical flow conditions
Bullard Wash from Gila River to Lower Buckeye Road**

Profile Output Table - Standard Table 1

HEC-RAS Plan: 2-5-98 Plans River: Bullard Wash Out Reach: Bullard Wash

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Bullard Wash	13700	3200.00	948.50	951.79	951.27	952.04	0.007063	7.10	1023.04	701.83	0.80
Bullard Wash	13120	3200.00	947.30	949.74	949.09	949.95	0.002958	4.26	1118.06	786.37	0.51
Bullard Wash	13000.*	3200.00	946.78	949.37	948.77	949.59	0.003037	4.47	1149.67	832.77	0.52
Bullard Wash	12880.*	3200.00	946.25	948.99	948.45	949.22	0.003113	4.68	1205.26	898.30	0.53
Bullard Wash	12760.*	3200.00	945.72	948.63	948.07	948.84	0.003039	4.77	1297.88	950.29	0.53
Bullard Wash	12640	3200.00	945.20	947.65	947.65	948.20	0.010281	7.51	842.23	810.17	0.93
Bullard Wash	12420	3200.00	943.40	946.97	945.85	947.09	0.001388	2.81	1139.41	549.71	0.34
Bullard Wash	12296.2*	3200.00	943.25	946.85	945.51	946.94	0.000955	2.54	1413.42	995.51	0.30
Bullard Wash	12172.42	3200.00	943.10	945.98	945.98	946.64	0.006764	8.14	712.97	565.43	0.85
Bullard Wash	12164.42	3200.00	935.10	936.96	938.92	945.67	0.121810	23.69	135.10	83.06	3.27
Bullard Wash	12063.7*	3200.00	934.98	941.43	938.80	941.98	0.001479	5.95	537.94	92.63	0.43
Bullard Wash	11963	3200.00	934.86	941.27	938.68	941.83	0.001511	5.99	534.29	92.52	0.44
Bullard Wash	11943	3200.00	934.84	941.32	938.39	941.76	0.001291	5.30	603.25	106.05	0.39
Bullard Wash	11882.84	3200.00	934.76	941.25	938.32	941.68	0.001293	5.31	602.64	105.83	0.39
Bullard Wash	11735.25	3200.00	934.58	941.05	938.13	941.49	0.001301	5.32	601.40	105.83	0.39
Bullard Wash	11550	3200.00	934.36	940.84	937.89	941.25	0.001238	5.14	622.72	112.25	0.38
Bullard Wash	11425.*	3200.00	934.20	940.68	937.73	941.09	0.001232	5.13	623.89	112.42	0.38
Bullard Wash	11300	3200.00	934.04	940.53	937.57	940.94	0.001226	5.12	625.15	112.60	0.38
Bullard Wash	11200	3200.00	933.92	940.36	937.48	940.81	0.001320	5.34	598.76	105.83	0.40
Bullard Wash	11100	3200.00	933.80	940.23	937.35	940.68	0.001331	5.36	597.02	105.72	0.40
Bullard Wash	11000	3200.00	933.68	940.12	937.21	940.54	0.001262	5.17	618.77	112.13	0.39
Bullard Wash	10819.37	3200.00	933.46	939.89	936.99	940.31	0.001271	5.18	617.30	112.01	0.39
Bullard Wash	10689.5*	3200.00	933.31	939.72	936.84	940.14	0.001282	5.20	615.58	111.99	0.39
Bullard Wash	10559.6*	3200.00	933.15	939.56	936.68	939.98	0.001286	5.20	615.05	112.03	0.39
Bullard Wash	10429.8*	3200.00	932.99	939.39	936.52	939.81	0.001291	5.21	614.46	112.06	0.39
Bullard Wash	10300	3200.00	932.84	939.22	936.37	939.64	0.001305	5.23	612.36	112.03	0.39
Bullard Wash	10200	3200.00	932.72	939.04	936.28	939.50	0.001414	5.47	585.47	105.33	0.41
Bullard Wash	10100	3200.00	932.60	938.89	936.15	939.36	0.001435	5.49	582.54	105.17	0.41
Bullard Wash	10000	3200.00	932.48	938.77	936.01	939.21	0.001370	5.31	602.20	111.39	0.40
Bullard Wash	9868.57*	3200.00	932.32	938.59	935.85	939.03	0.001389	5.34	599.46	111.27	0.41

**SELECTED ALTERNATIVE - Bullard Wash Outfall Channel Improvements
Final (30%) Hydraulic Profile (100-yr Q) for sub & super critical flow conditions
Bullard Wash from Gila River to Lower Buckeye Road**

Profile Output Table - Standard Table 1

HEC-RAS Plan: 2-5-98 Plans River: Bullard Wash Out Reach: Bullard Wash

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Bullard Wash	9737.14*	3200.00	932.16	938.40	935.69	938.85	0.001411	5.37	596.25	111.10	0.41
Bullard Wash	9605.71*	3200.00	932.00	938.21	935.53	938.66	0.001438	5.40	592.54	110.93	0.41
Bullard Wash	9474.28*	3200.00	931.85	938.01	935.38	938.47	0.001480	5.45	586.97	110.71	0.42
Bullard Wash	9342.85*	3200.00	931.69	937.80	935.22	938.27	0.001520	5.50	581.87	110.48	0.42
Bullard Wash	9211.42*	3200.00	931.53	937.59	935.06	938.07	0.001568	5.56	575.84	110.18	0.43
Bullard Wash	9080	3200.00	931.37	937.36	934.90	937.85	0.001626	5.62	568.94	109.87	0.44
Bullard Wash	8942.85*	3200.00	931.20	937.12	934.73	937.63	0.001698	5.71	560.88	109.50	0.44
Bullard Wash	8805.71*	3200.00	931.04	936.86	934.57	937.38	0.001805	5.82	549.75	109.02	0.46
Bullard Wash	8668.57*	3200.00	930.87	936.57	934.40	937.12	0.001932	5.95	537.48	108.46	0.47
Bullard Wash	8531.42*	3200.00	930.70	936.26	934.23	936.84	0.002111	6.13	522.09	107.77	0.49
Bullard Wash	8394.28*	3200.00	930.53	935.90	934.06	936.53	0.002385	6.38	501.57	106.82	0.52
Bullard Wash	8257.14*	3200.00	930.37	935.44	933.90	936.16	0.002905	6.81	470.20	105.37	0.57
Bullard Wash	8120	3200.00	930.20	933.73	933.73	935.35	0.012471	10.22	313.25	97.63	1.01
Bullard Wash	8080	3200.00	929.25	932.46	932.86	934.69	0.018365	11.97	267.29	86.37	1.20
Bullard Wash	7953.33*	3200.00	923.80	926.67	927.95	930.91	0.048235	16.52	193.65	81.43	1.89
Bullard Wash	7826.66*	3200.00	918.36	921.47	922.56	925.14	0.040929	15.36	208.32	85.87	1.74
Bullard Wash	7700	3200.00	912.91	919.63	916.67	920.12	0.000312	5.63	567.90	93.15	0.40
Bullard Wash	7553	3200.00	912.74	919.61	916.47	920.07	0.000284	5.46	586.16	93.70	0.38
Bullard Wash	7543	Bridge (UPRR Bridge Low chord = 921.7, Freeboard = 2.1 ft)									
Bullard Wash	7533	3200.00	912.73	919.53	916.46	920.00	0.000295	5.52	579.28	93.54	0.39
Bullard Wash	7500	3200.00	912.69	919.51	916.46	919.99	0.000296	5.53	578.17	93.63	0.39
Bullard Wash	7460	3200.00	912.64	919.50	916.40	919.97	0.000290	5.50	581.89	93.64	0.39
Bullard Wash	7430	3200.00	912.60	919.50	916.36	919.96	0.000285	5.47	584.94	93.65	0.39
Bullard Wash	7357	Bridge (MC85 Bridge Low chord = 922.5, Freeboard = 3.0 ft)									
Bullard Wash	7300	3200.00	912.43	919.16	916.21	919.65	0.000310	5.62	569.75	93.36	0.40
Bullard Wash	7270	3200.00	912.40	919.15	916.01	919.61	0.001266	5.47	585.52	93.50	0.38
Bullard Wash	7134.57*	3200.00	912.25	918.97	915.86	919.44	0.001282	5.49	583.13	93.45	0.39
Bullard Wash	6999.14*	3200.00	912.10	918.79	915.71	919.27	0.001302	5.51	580.33	93.39	0.39
Bullard Wash	6863.71*	3200.00	911.95	918.61	915.56	919.09	0.001324	5.54	577.21	93.32	0.39
Bullard Wash	6728.28*	3200.00	911.81	918.42	915.42	918.91	0.001358	5.59	572.54	93.22	0.40

SELECTED ALTERNATIVE - Bullard Wash Outfall Channel Improvements
Final (30%) Hydraulic Profile (100-yr Q) for sub & super critical flow conditions
Bullard Wash from Gila River to Lower Buckeye Road

Profile Output Table - Standard Table 1

HEC-RAS Plan: 2-5-98 Plans River: Bullard Wash Out Reach: Bullard Wash

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Bullard Wash	6592.85*	3200.00	911.66	918.23	915.27	918.72	0.001388	5.63	568.48	93.13	0.40
Bullard Wash	6457.42*	3200.00	911.51	918.03	915.12	918.53	0.001424	5.67	563.90	93.04	0.41
Bullard Wash	6322	3200.00	911.36	917.82	914.97	918.33	0.001465	5.73	558.70	92.92	0.41
Bullard Wash	6173.4*	3200.00	911.14	917.60	914.75	918.11	0.001463	5.73	558.94	92.93	0.41
Bullard Wash	6024.8*	3200.00	910.93	917.39	914.54	917.90	0.001469	5.73	558.21	92.93	0.41
Bullard Wash	5876.2*	3200.00	910.71	917.17	914.32	917.68	0.001468	5.73	558.32	92.92	0.41
Bullard Wash	5727.6*	3200.00	910.49	916.95	914.10	917.46	0.001467	5.73	558.52	92.92	0.41
Bullard Wash	5579.*	3200.00	910.28	916.73	913.89	917.24	0.001473	5.74	557.73	92.91	0.41
Bullard Wash	5430.4*	3200.00	910.06	916.51	913.67	917.02	0.001473	5.74	557.84	92.92	0.41
Bullard Wash	5281.8*	3200.00	909.84	916.29	913.45	916.80	0.001472	5.74	557.96	92.92	0.41
Bullard Wash	5133.2*	3200.00	909.63	916.07	913.24	916.59	0.001479	5.74	557.05	92.90	0.41
Bullard Wash	4984.6*	3200.00	909.41	915.85	913.02	916.37	0.001479	5.74	557.08	92.90	0.41
Bullard Wash	4836.*	3200.00	909.20	915.63	912.81	916.15	0.001488	5.76	556.01	92.89	0.41
Bullard Wash	4687.4*	3200.00	908.98	915.41	912.59	915.93	0.001489	5.76	555.89	92.89	0.41
Bullard Wash	4538.8*	3200.00	908.76	915.19	912.37	915.70	0.001490	5.76	555.76	92.89	0.41
Bullard Wash	4390.2*	3200.00	908.55	914.97	912.16	915.48	0.001501	5.77	554.44	92.86	0.42
Bullard Wash	4241.6*	3200.00	908.33	914.74	911.94	915.26	0.001504	5.77	554.12	92.85	0.42
Bullard Wash	4093.*	3200.00	908.11	914.52	911.72	915.04	0.001507	5.78	553.76	92.84	0.42
Bullard Wash	3944.4*	3200.00	907.90	914.29	911.51	914.81	0.001520	5.80	552.19	92.82	0.42
Bullard Wash	3795.8*	3200.00	907.68	914.06	911.29	914.59	0.001526	5.80	551.57	92.81	0.42
Bullard Wash	3647.2*	3200.00	907.46	913.84	911.07	914.36	0.001532	5.81	550.81	92.78	0.42
Bullard Wash	3498.6*	3200.00	907.25	913.60	910.86	914.13	0.001550	5.83	548.79	92.75	0.42
Bullard Wash	3350	3200.00	907.03	913.42	910.64	913.94	0.001022	5.79	552.50	92.83	0.42
Bullard Wash	3330	3200.00	907.00	913.31	910.83	913.92	0.000415	6.26	510.82	88.00	0.46
Bullard Wash	3300	3200.00	906.88	913.19	910.91	913.90	0.000489	6.76	473.40	82.00	0.50
Bullard Wash	3130	3200.00	906.20	913.16	910.22	913.73	0.001209	6.07	527.58	82.00	0.42
Bullard Wash	3049	3200.00	905.87	910.90	910.90	913.41	0.002438	12.71	251.69	50.17	1.00
Bullard Wash	3003	3200.00	905.69	910.40	910.72	913.26	0.002989	13.57	235.76	50.15	1.10
Bullard Wash	2980	3200.00	904.65	908.04	909.50	912.89	0.039272	17.66	181.18	56.74	1.74
Bullard Wash	2920	3200.00	901.95	905.25	906.79	910.36	0.042984	18.15	176.32	56.91	1.82

SELECTED ALTERNATIVE - Bullard Wash Outfall Channel Improvements
Final (30%) Hydraulic Profile (100-yr Q) for sub & super critical flow conditions
Bullard Wash from Gila River to Lower Buckeye Road

Profile Output Table - Standard Table 1

HEC-RAS Plan: 2-5-98 Plans River: Bullard Wash Out Reach: Bullard Wash

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Bullard Wash	2900.42	3200.00	900.25	908.05	905.19	909.05	0.000602	8.01	399.54	51.20	0.51
Bullard Wash	2890.42	Culvert									
Bullard Wash	2880.42	3200.00	900.16	906.20	905.10	907.86	0.001314	10.34	309.40	51.20	0.74
Bullard Wash	2840	3200.00	900.10	906.74	903.71	907.22	0.001321	5.53	578.71	94.00	0.39
Bullard Wash	2733.33*	3200.00	899.88	906.61	903.49	907.07	0.001261	5.45	587.20	94.00	0.38
Bullard Wash	2626.66*	3200.00	899.66	906.49	903.27	906.94	0.001201	5.37	596.33	94.00	0.38
Bullard Wash	2520	3200.00	899.44	906.38	903.04	906.81	0.001140	5.28	606.07	94.00	0.37
Bullard Wash	2499.74	3200.00	899.40	906.45	902.90	906.75	0.000747	4.65	757.01	135.58	0.31
Bullard Wash	2400	3200.00	899.20	906.45	902.67	906.66	0.000545	3.97	936.54	197.32	0.26
Bullard Wash	2265.*	3200.00	898.93	906.36	902.46	906.59	0.000545	3.99	913.11	190.95	0.26
Bullard Wash	2130.*	3200.00	898.66	906.28	902.16	906.51	0.000536	3.96	895.87	184.13	0.26
Bullard Wash	1995.*	3200.00	898.39	906.21	901.89	906.44	0.000521	3.90	885.08	176.53	0.26
Bullard Wash	1860	3200.00	898.12	906.15	901.62	906.37	0.000500	3.80	881.05	167.59	0.25
Bullard Wash	1800	3200.00	898.00	906.30	901.45	906.30	0.000012	0.66	8189.77	2346.00	0.04 ^b

Notes:

* Denotes HEC-RAS interpolated cross section.

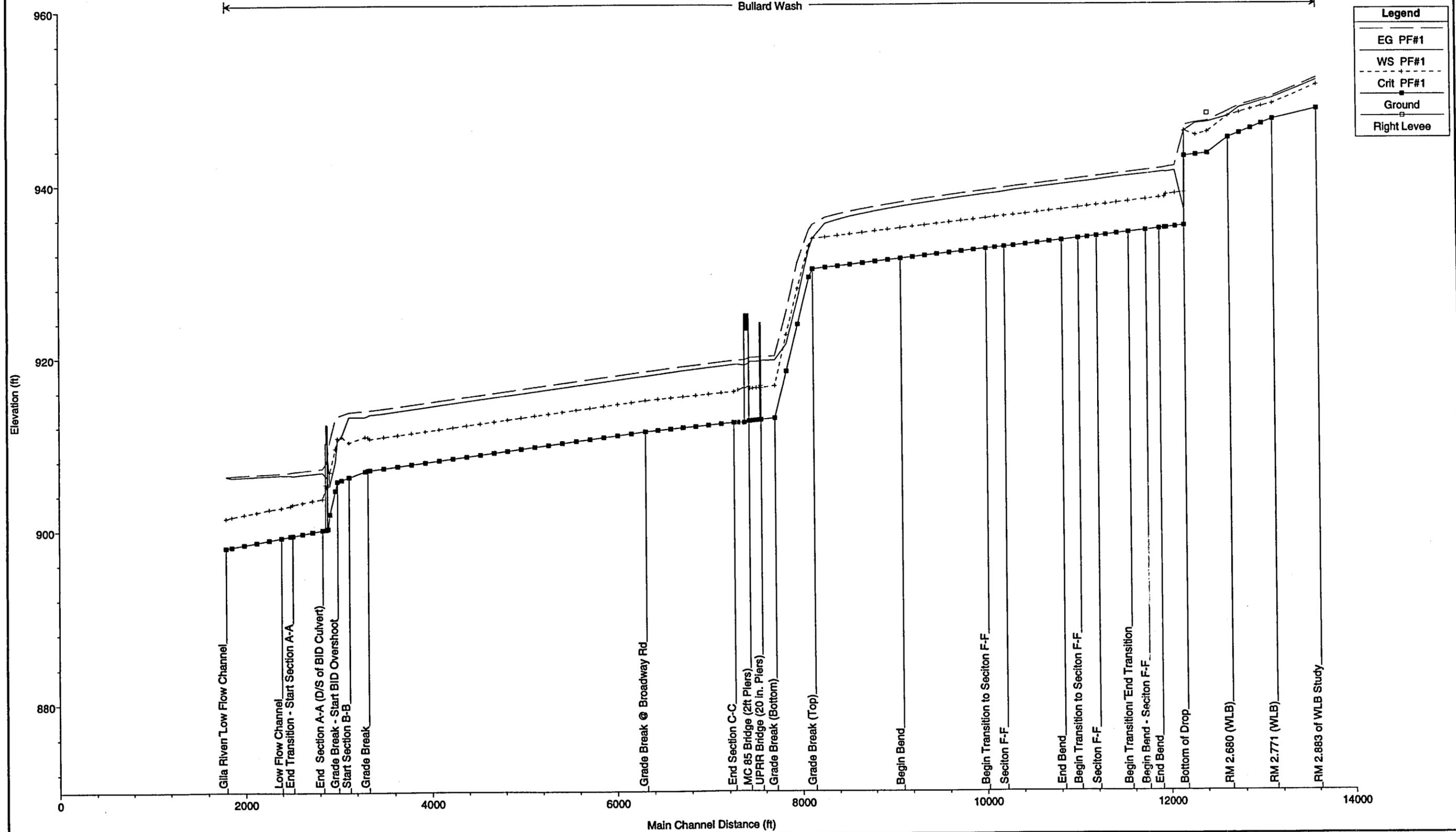
a Starting WSEL using normal depth with channel slope = 0.0046 ft/ft.

b Starting WSEL = 906.3 ft, per FEMA study of record by Dames & More.

Bullard Wash Improvements PH 1,2 & 3 (5FEB98 plans) w/ int. sect. 4/16/98

Bullard Wash (30% Final)

Bullard Wash



Legend	
—●—	EG PF#1
- - - + - - -	WS PF#1
- · - · - · - · -	Crit PF#1
—■—	Ground
—○—	Right Levee

